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Proceedings of 3rd International Wildlife Symposium

October 18-20, 2016

"Conserving Sumatran Wildlife Heritage for Sustainable Livelihood"

Institute for Research and Community Service
University of Lampung

3rd INTERNATIONAL WILDLIFE SYMPOSIUM

"Conserving Sumatran Wildlife Heritage for Sustainable Livelihood"

PROCEEDING

ISBN: 978-602-0860-13-8

Organized by:

RESEARCH AND DEVELOPMENT CENTER OF ENVIRONMENT
INSTITUTE FOR RESEARCH AND COMMUNITY SERVICE
UNIVERSITY OF LAMPUNG
2016

PROCEEDING IWS 2016

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WELCOMING SPEECH FROM CHAIR PERSON OF THE ORGANIZING COMMITTEE

Distinguished guests,

- Minister of Environment and Forestry Republic of Indonesia, Dr. Siti Nurbaya or representing,
- Rector University of Lampung, Prof. Dr. Ir. Hasriadi Mat Akin, M.P.
- Honorable Keynote Speaker, Invited Speakers, participants, sponshorships, ladies and gentlemen

Assalamu'alaikum warohmatullohi wabarokatuh.
May God bless all of us.
Tabik pun.

It gives me great pleasure to extend to you all a very warm welcome to the 3rd International Wildlife Symposium (IWS 2016), here in Bandar Lampung.

Ladies and gentlemen, it is gratifying to note that symposium is designed to improve awareness on wildlife conservation and sustainability in order to improve the welfare of society. To increase the consciousness and understanding on the potenstial, economic value, and sustainable management of tropical wildlife through bioengineering application and to strengthen international scientific network of biological and related scientiests to share and exchange progress in various fields of wildlife research.

No matter how much we can do by ourselves on the institutional and national level, it is never enough. International level of collaboration work would be the best answer. Therefore I wish that this event which is attended by distinguished speaker and attendants from Malaysia, India, US, and Indonesia, would be a great opportunity for us to establish scientific collaboration between scientist internationally.

Hereby, on the behalf of Organizing Committee I acknowledge Dr. Siti Nurbaya, Minister of Environment and Forestry Republic of Indonesia or representing, and also to Mrs. Siti Nur Hidayati, Ph.D. (Middle Tennessee State University), as a keynote speaker, and also to the following invited speakers, Dr. Ashley Brooks (WWF Tigers Alive Initiativ), Dr. Barney Long (Global Wildlife Conservation), and drh. Dedi Candra (Way Kambas National Park) for willingness to share their valuable knowledge and scientific information.

To make this symposium happen, I would like to gratefully acknowledge to the valuable contributions from personal and institutional sponshorships including University of Lampung, Doctor Coffee, Aska Jaya, PT. Nestle Indonesia, Levi's Indonesia, and Rumah Kolaborasi (Ru-Ko). In particular, thanks a lot to the World Wide Fund (WWF) for supporting the financing of this symposium.

I would like also to take this opportunity to express my sincere thanks to the Head and Secretary of Research Institution and Community Service University of Lampung, for giving us opportunity and support to organize this symposium. Heartfelt thank is delivered to

steering committee, academic reviewers, organizing committee, for all participation and hard works. All of them have been working since the begining of the planning stage and they are still here today for all of us.

Despite our best efforts, it is inevitable that there is a lack in organizing this symposium and I proudly apologize to all invited speakers, oral and poster presenters, attendants, donators, and committee members.

Finally, I would like to offer my best wishes for a highly enjoyable, succesful, productive and fruitful symposium.

Thank you so much.

Dr. Erdi Suroso
Chair Person of the Organizing Committee

OPENING REMARKS FROM THE HEAD OF RESEARCH INSTITUTION AND COMMUNITY SERVICE, UNIVERSITY OF LAMPUNG

Distinguished guests

- Minister of Environment and Forestry Republic of Indonesia, Dr. Siti Nurbaya or representing,
- Rector University of Lampung, Prof. Dr. Ir. Hasriadi Mat Akin, M.P.
- Honorable Keynote Speaker, Invited Speakers, participants, sponshorships, ladies and gentlemen

Assalamu'alaikum warohmatullohi wabarokatuh.
May God give us health and happiness.
Tabik pun.

It is my great pleasure to welcome all speakers and participants to the 3rd International Wildlife Symposium 2016 (IWS-2016) held in Meeting Room 2nd floor Rektorat University of Lampung, Bandar Lampung, Indonesia. I recognize that this symposium is principally designed to enhance and strengthen the contribution of researchers to the wildlife conservation. The theme of this event is "*Conserving Sumatran Wildlife Heritage for Sustainable Livelihood*". Therefore, I wish that this event will be a great opportunity and wonderfull venue to lay down a cooperative framework and to internationally establish scientific collaboration among scientiests.

Hereby, I appreciatively acknowledge Dr. Siti Nurbaya, Minister of Environment and Forestry Republic of Indonesia, and also to Mrs. Siti Nur Hidayati, Ph.D. (Middle Tennessee State University), as a keynote speaker, and also to the following invited speakers, Dr. Ashley Brooks (WWF Tigers Alive Initiativ), Dr. Barney Long (Global Wildlife Conservation), and drh. Dedi Candra (Way Kambas National Park) for delivering their valuable scientific information.

My appreciation also goes to the Steering Committee, Academic Reviewers, and the Organizing Committee that spend almost their valuable time to review, manage and organize this symposium effectively. I also would like to gretefully acknowledge to the valuable contributions from personal and institutional sponshorship and funding to make this program happen.

Finally, I wish you all best wishes to have meaningfull and useful symposium. Thank you.

Wassalamu'alaikum warohmatullohi wabarokatuh.

Warsono, Ph.D.
Head of Research Institutions and Community Service

KEYNOTE SPEAKER
MINISTER OF ENVIRONMENT AND FORESTRY
REPUBLIC OF INDONESIA

AT 3rd INTERNATIONAL WILDLIFE SYMPOSIUM
Bandar Lampung, 18 October 2016

Distinguished Participants,
Ladies and Gentlemen

Assalamu'alaikum wr.wb
Good morning and May God bless us.

It is my great honor and pleasure to attend to this event and deliver my speak. Let me express my appreciation to University of Lampung in collaboration with WWF Indonesia for organizing this symposium. Hopefully from this symposium which brings together scientific community and field experts, where we share knowledge, experience and concern, can enhance and synergize our efforts to cope issues in various aspects.

Ladies and gentlemen,

Indonesia should be proud to be a country which has rich biodiversity, reported it reaches 47.910 species, that makes Indonesia is well known as mega biodiversity country. At the same time, Indonesia is responsible to promote sustainable use of biodiversity to improve society and country's well-being.

This responsibility will be challenging for Indonesia, considering our country as one of the hot spot of biodiversity loss. The threat mainly coming from habitat loss caused by encroachment, forest fragmentation and forest fires as well as coming from illegal logging, and trade.

Plants and wildlife are one of supporting elements for human life, which their existence hold important and irreplaceable roles. Having that said, I would like to take this opportunity to encourage all of us to protect and conserve the sustainability of wildlife and plants as heritage for the next generation and sustainable livelihood.

Ladies and gentlemen,

Strategy and policy of Indonesian Government to secure the biodiversity are directed into three focuses namely protection, preservation and sustainable use of ecosystem, species and genetic resources. National regulation has been enacted, to mention some, including UU 5/ 1990, UU 41/ 1999, UU 32/ 2009, PP 7/ 1999, PP 8/ 1999 as well as strategic and action plan of several endangered and umbrella species such as sumatran tiger, orangutan, rhino, sumatran elephant, javan eagle, tapir, proboscis monkey (*bekantan*), maleo, banteng and babyrousa.

Our global commitment on biodiversity conservation also reflected on ratification of several conventions such as Convention on Biodiversity (CBD) through UU 5/1994, Ramsar through Keppres No 48/1991, UNFCCC through UU No. 6/1994 and protocols such as Kyoto Protocol through UU No. 17/ 2004, Nagoya Protocol through UU 11/ 2013 and Cartagena Protocol through UU 2/ 2014.

We also aware that in this global era, efforts on the conservation of biodiversity always in the spotlight of international attention. Threats on the biodiversity, for example illegal killing of endangered species have and will always be connected with the issues of deforestation and habitat destruction and these will be the entry points for discrediting and black-campaigning against Indonesia, that in turn can be impacted to Indonesia's products in the global market. Thus saving the biodiversity requires active participation from all stakeholders including private sector.

Biodiversity including ecosystem and genetic resources can and should be utilized in a sustainable manner for human welfare such as for source of food, clothes, medicine, water, energy, and oxygen, for controlling climate and disease, ecosystem balance as well as for leisure.

Sustainable use of biodiversity, for example as I mention before for source of food has been a main discussion in many forums. With the growth of human population, it is a must to conduct study and formulate strategy to maintain our natural resources that can be utilized not only for our generation but also for our kids' generation and further. With this regard, Indonesia as mega-biodiversity country plays an important role as source of germplasm which may contain useful substance for human health or important for bioprospecting to increase country's revenue.

To illustrate, global trade on medicinal herbs reach approximately US$ 60 billion/year. While protection of coral to support genetic resources for research on medicine can provide revenue US$ 55-1.110 per ha/year in South East Asia (source: CBD). Indonesia revenue on export from traditional medicine (jamu) reach US$ 113 million, while for domestic reach US$ 100 million (source: BPOM 2007).

Ladies and gentlemen,

Despite having all of potency and opportunity, there are also threats and challenges facing our existing biodiversity:

Globally, these includes pressure from human population growth which require demand for land, food, energy and clean water; climate change; and increasing demand of genetic resources for food and energy.

Nationally, these includes illegal logging, forest fire, encroachment, illegal trade, declining of wildlife population, loss of habitat, invasive alien species, as well as low resources capacity and quantity (human and fund) and lack of integrated database.

Hence enormous efforts have been taken by Government Indonesia namely:

a. public awareness and campaign by involving religious leader and other groups for promoting religious and local wisdoms as well as local engagement.
b. to restore and protect the population at local level in their habitat to prevent further damage to the population.
c. Strengthen coordination among government institutions and networking with CSO's.

Currently Ministry of Environment and Forestry Indonesia with relevant law enforcement institutions (Police, General Attorney, Financial Transaction Reports and Analysis Center, and Financial Services Authority) have commitment to support "multi door law enforcement". By implementing multi door law enforcement initiative including applying of

corruption and money laundry act in line with environmental, conservation and forestry act is expected that it could strengthen deterrent effects.

Ladies and gentlemen,

As we are all aware, illegal activity related to environmental and forestry including wildlife illegal trafficking is now even more sophisticated, organized and transnational crime, which involves a large network of actors that make up its own chain. We cannot stop it alone. Therefore collaborative among relevant actor/ stakeholder is badly needed to tackle these issues in effectively.

We believe that global collaboration through bilateral, regional and multilateral cooperation can increase the effectiveness in combating illegal activities such as wildlife trafficking. Hence, Indonesia has involved in global collaboration such as:

a. Bilateral cooperation with Vietnam and USA
b. Regional cooperation in the framework of the ASEAN-WEN (Wildlife Enforcement Network)
c. London Conference, Kasane Conference, The Hague Conference on wildlife
d. Multilteral Cooperation: Interpol, CITES, Global Wildlife Programme
e. We also have cooperation with International and National NGO concern in combating wildlife crime, such WWF, WCS, etc.

In this moment, I would also inform that we are in the progress renewing our conservation act in order to increase effectiveness of conservation efforts including wildlife law enforcement.

Distinguish ladies and gentlemen,

To develop strategy on biodiversity conservation and sustainable use require strong research and scientific evidence which will be needed to convince government agency and related stakeholder to be aware and act on the right approach. Thus, active participation of scientific community in communicating their knowledge should be appreciated and facilitated such as through this event.

To conclude, the efforts for the conservation of biodiversity required the involvement of us all, not just the governmental institutions only, but also private sectors, NGOs, civil societies and scientific community. I sincerely hope that this symposium can provide a media for us all to share knowledge, experience and concern, and to synergize all efforts.

Wasalamualaikum Warahmatullohi Wabarohkatuh

Bandar Lampung, 18 October 2016

Minister of Environment and Forestry,

Dr. Siti Nurbaya

INVITED SPEAKERS

SAFE SYSTEMS

HWC Safe Systems approach and the HWC Rapid Assessment tool

Ashley Brooks, Ph.D. - WWF Tigers Alive

1. What is the Safe Systems approach?

Current approaches to HWC globally insufficient to tackle the dynamic, emotive and complex challenge of minimizing and managing HWC.
Current approaches suffer from three critical weaknesses:
1) they have an isolated focus on the symptoms of conflict;
2) they lack coherent long term direction;
3) there is no basis to measure progress and impact.

1) They have an isolated focus on the symptoms of conflict;

- Current approaches do not integrate the six conflict elements.
- Result is that actions:
- Only address symptoms
- Require constant fundraising;
- Do not address drivers of conflict;
- Limited ability to impact on human progress and wildlife conservation in that area

2) they lack coherent long term direction;

- Does not coalesce around desired long term goals
- Result is that actions are:
  - having little impact on the drivers of conflict;
  - are often demonstrating false success by displacing the conflict

3) there is no basis to measure progress and impact.

- The focus on symptoms of conflict and the 'current state' means that HWC actions only measure against the progress of that action itself. E.g. the number of straying tigers.
- There is no ability to measure progress toward a 'desired state' of coexistence nor to demonstrate wise investment.
- Result is:
  - No need to capture a baseline and therefore nothing to measure progress and impact against;
  - A lack of foundation for a long term commitment;
  - A lack of ability to report at completion on the impact of the interventions; and
  - Ultimately a weak ability to argue for stronger regulatory and policy foundations in government to mainstream HWC.

What is the Safe Systems approach?

- Has a single long term goal: to make the area safer.
- Has a baseline for safety
- Ensures that all six conflict elements are addressed
- Can be applied to any conflict context or species
- Accounts for the drivers of conflict – e.g. habitat loss.
- Aligns HWC management decisions with existing development plans and processes that contribute to economic, human, and environmental goals.

2. The 6 Elements of HWC

a) Policy and legislation
b) Prevention
c) Monitoring
d) Mitigation
e) Response
f) Understanding the conflict

A site must have high coverage of each element. Elements must be integrated and reinforce each other.

3. The 6 Elements of HWC – clearing up definitions

POLICY: Protocols, principles, provisions and measures undertaken by authorities which are stipulated in legislation and governmental plans

- International law
- National law
- Wildlife and forest crime
- National strategy
- Translocation and respons
- International collaboration

PREVENTION: Stopping or preventing HWC before an event occurs

- Education
- Livestock and crop management
- Zero poaching
- Deterrents
- Barriers (eg electric fencing)
- Habitat management
- Land use planning
- Early warning systems

MITIGATION: Reducing the impacts of HWC after ian event occurs

- Insurance schemes
- Compensation programs
- Interim relief schemes
- Alternative livelihoods

RESPONSE: Measures taken to alleviate a specific or ongoing HWC event

- Response teams

UNDERSTANDING THE CONFLICT: Research into all aspects of the conflict profile

- Hotspot mapping
- Spatial and temporal characteristics
- Social characteristics
- Severity and impact
- Capturing conflict information

MONITORING: - Measuring the performance and effectiveness of HWC
- management interventions over time HWC
- management interventions over time

- Monitoring
- The Safe base Line-What does it means?

Safe Outcome	Strategic Intent
Safe Person	• Does not hunt wildlife; practices wildlife friendly grazing; participates in wildlife education events; has access to "Innovation Fund" to develop own preventative measures; reports any HWC events; complies with rule of law relating to wildlife; has more than one income stream; has a safe working environment; is supported with alternative livelihoods as required.
Safe Wildlife	• Is protected under law; has designated space to roam and reproduce; does not have access to livestock; is separated from people via barriers and land use plans; is supported by Response Teams; makes a positive contribution to local livelihoods.
Safe Assets	• …
Safe Habitat	• …

4. Conducting a HWC Rapid Assessment at a site

The purpose of the RA Tool is:

- to determine a baseline for how safe each part of the system (people, their assets, wildlife and habitat) is.
- to determine the scale and gaps of current HWC interventions.
- to determine the effectiveness and gaps of current HWC interventions.

1. Compile HWC information: Capture conflict trends and baselines (hotspots, impact, attitudes)
2. Rapid Assessment: Capture SAFE Baseline
3. Develop SAFE Strategy
4. Implement Strategy
5. Monitor [and repeat process]

Hotspot mapping

- Number & location of wildlife killed in retaliation to conflict event
- Number & location of wildlife crime cases recorded (involving snaring, trapping, poisoning, electrocution, hunting etc.)
- Human population and settlement locations
- Human population density

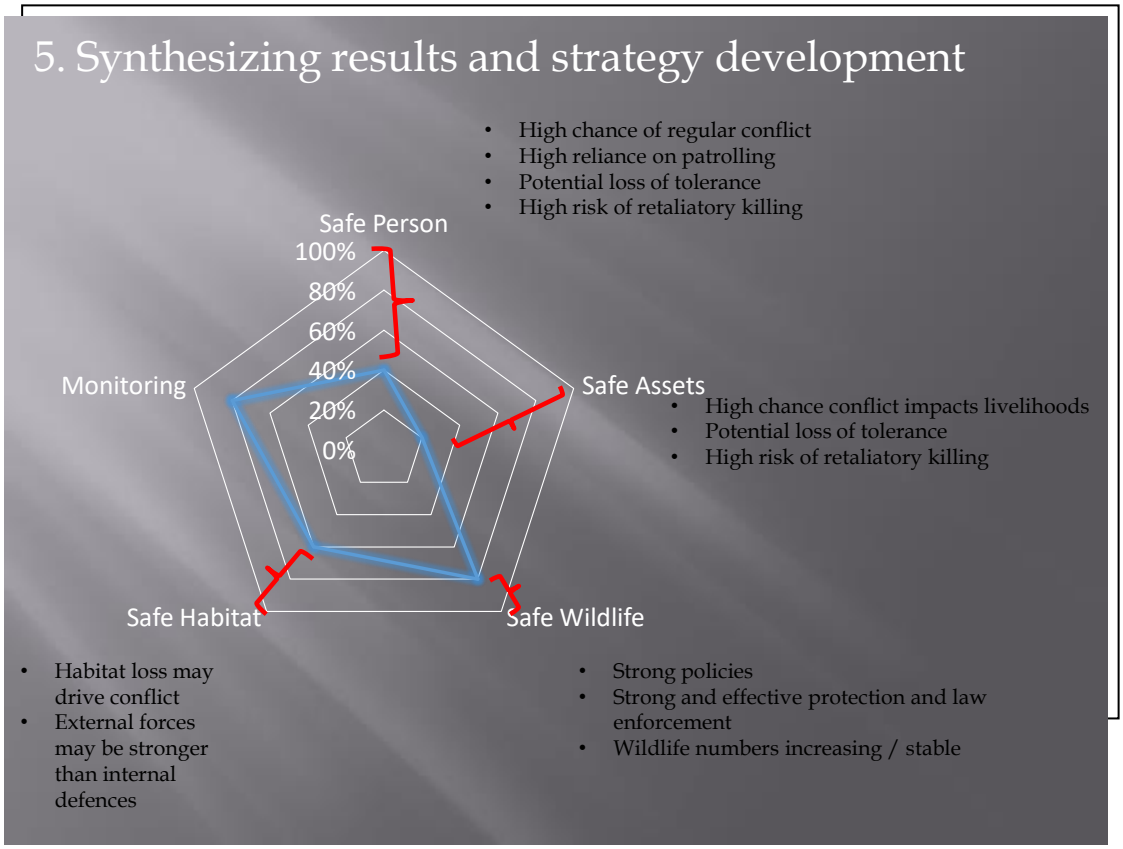
Impact and severity monitoring

- Number, location and cost of livestock killed or injured p/month; p/year
- Number, location and cost of incidents of crop raiding p/month; p/year
- Number, location and cost of incidents of structures damaged / destroyed p/month; p/year
- Statistics of crop loss
- Frequency of crop raiding times/month
- Severity of crop raiding cost $/month

Delivering the RA

- Through one-on-one surveys, desk analysis of existing data and reports, a multi-stakeholder workshop, or a combination of all.
- The criteria should be backed by available data, information and verifiable evidence.
- Given that many of the RA criteria rely on quantitative information, the RA can ultimately be automated.

5. Synthesizing results and strategy development



PROMOTING MULTI-STAKEHOLDER INTERNATIONAL COLLABORATIONS FOR ENDANGERED SPECIES RECOVERY

Barney Long

Director, Species Conservation
Global Reserve Conservatio

Endangered Species Recovery

Red List Status is about risk of extinction
"Success" is improvement in a species' status
As far as "Least Concern"

What is Fully Conserved

Successful species conservation is much more than avoiding extinction. It is conservation of a species with ecologically significant numbers, interacting fully with the full suite of other native species and processes. An integral part of a thriving ecosystem! "A species is fully conserved if it is viable, and ecologically functional, in each part of its indigenous range."

Saltwater crocodile:

- "Least Concern" on IUCN Red List – stable or increasing population of up to 150,000 adults in northern Australia.
- But extinct across much of Southeast Asia, and ecologically extinct in most of the rest of the region. Hence, far from being "Fully Conserved". "Least Concern".

Planning for Recovery

The One Plan approach to species conservation is the development of management strategies and conservation actions by all responsible parties for all populations of a species, whether inside or outside their natural range. Field biologists, wildlife managers, and conservationists monitor wild populations and develop conservation strategies and actions to conserve threatened species. The zoo and aquarium community develops long-term goals for sustaining *ex situ* populations

Saola - One Plan Approach

The Saola Working Group works collaboratively to conserve Saola in nature, and to leverage Saola as a flagship for conservation of the bio-cultural diversity of the Annamite Mountains as a whole.

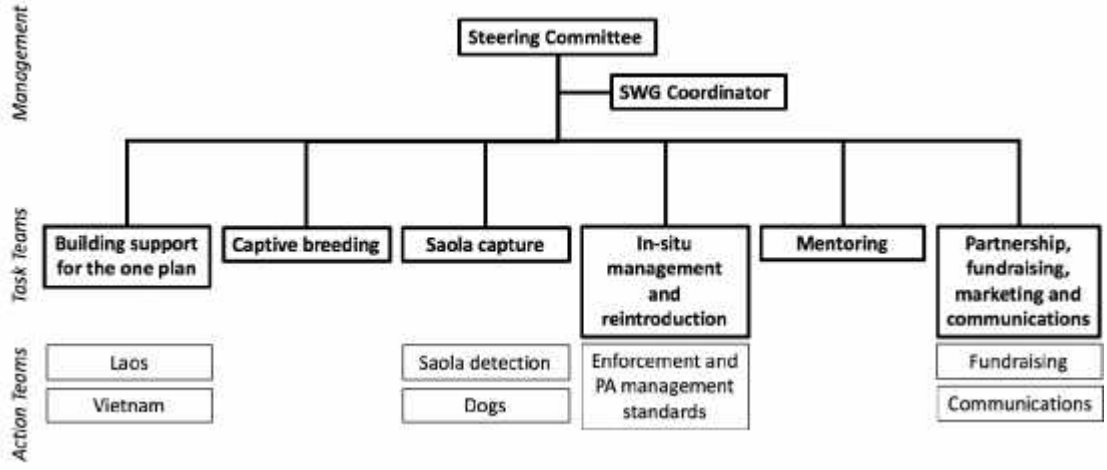
Saola - One Plan Approach

- Park management
- Snare removal
- Zero Poaching Research
- Monitoring
- Readying for reintroduction

Saola - One Plan Approach

- Conservation breeding.
- Rescue
- Research
- Education
- Capture

Saola Working Group



- IUCN Asian Wild Cattle Specialist group
- Vinh University
- Smithsonian Conservation Biology Institute
- WWF-Greater Mekong
- WCS
- Institute of Ecology and Biological Resources Department of Forest Resources Management White Oak Conservation Center
- GWC
- Leibniz Institute for Zoo and Wildlife Research
- Zoological Society of London
- Lao Wildlife Conservation Association
- IUCN
- Cambridge University
- Wroclaw Zoo
- Royal Zoological Society of Scotland
- ZooParc de Beauval San Diego Safari Park Project Anoulak
- Center for Conservation of Tropical Ungulates
- Africa Alive!
- Viet Nature
- King Mongkut's University of Technology-Thonburi

A coalition to address the extinction risk among the most threatened non-marine vertebrates of Southeast Asia

Catalyse urgent actions to reduce immediate threats causing the decline of ASAP species by filling knowledge gaps, initiating new initiatives for species recovery.

Strengthen ongoing conservation action by facilitating partnerships, raising profiles and increasing financial support.

Convene and support dialogue among stakeholders by helping coordinate and streamline action.

Improve efficiency and impact of conservation action by promoting conservation best practice for species planning and impact monitoring.

Amphibian Ark **Amphibian Survival Alliance**	**Haribon Foundation** **International Rhino Foundation**	**Save Asian Vultures from Extinction** **Save Vietnam's Wildlife**
Bali Safari &	IUCN – Species Survival	SEABCRU
Begawan	Commission IUCN –	Selamatkan Yaki
BirdLife International	Office Global Wildlife	Sumatran Orangutan Conservation Project Synchronicity Earth
Cat Ba Langur	Katala Foundation	TRAFFIC
Chester Zoo	Mabuwaya Foundation	Turtle Survival Alliance
Conservation	Noe Conservation	Viet Nature
Cikananga Wildlife	Orangutan Tropical	Wildlife Conservation Society
Durrell Wildlife	Philippine Eagle	Wildlife Reserves Singapore
East Asian-Australasian Flyway Partnership	Planet Indonesia Project Anoulak	Wildfowl and Wetlands Trust World Wildlife Fund Greater Mekong
Fauna & Flora International	Little Fireface Project Saola Working Group	Zoologische Gesellschaft für Arten und Populationsschutz
	Satucita Foundation	

Lessons

Conservation is difficult
Conservation is expensive Standardization helps everyone
Species are not recovered by any single organization

Big challenges need many:
Brains Years Policies Wallets
Collaboration is CRITICAL
Together we CAN make a chang

INTEGRATING PLANTS INTO WILDLIFE CONSERVATION PROGRAMS

Siti Nur Hidayati, Ph.D.

University of Tennesse, USA

Wildlife ?

Wildlife refers to living organisms (flora and fauna) in their natural habitats. But cultivated plants and domesticated animals are not included in wildlife.

Benefits of Wildlife

Wildlife is an essential component of various food chains, food webs, biogeochemical cycles and energy flow through various trophic levels. Preserves vitality and health of environment and provides stability to various ecosystems.

Threat to wildlife

Habitat loss
Population growth, industrialisation, and modernisation
Pollution urbanisation

1. Air, water, soil, noise
2. Activities
   - the use of synthetic materials,
   - waste of various toxicity
3. Indiscriminate hunting
4. Killing and poachi

Animal Preference on Vegetation

1. Landscape
2. Habitat within the landscape
3. Plant species within habitats

Landscape Ecology

1. Matrix
2. Patches
3. Corridor
   (Barnes, TG, 2000)

Habitat Fragmentation

Fragmentation begins with a small gap in the matrix. Over time the gaps may get larger.
Shift in the matrix. (Barnes, TG, 2000)

Habitat corridors

A strip of favorable habitat located between two large patches of habitat that facilitates dispersal (e.g., a narrow band of trees that connects forests).

Key Design Considerations

1. Design corridors at several spatial and temporal scales.
2. Provide quality habitat in a corridor whenever possible.
3. Locate corridors along dispersal and migration routes.

4. Corridors, should not be limited to a single topographic setting.
5. Similarity in vegetation between corridors and patches is beneficial.
6. Restore historical connections and generally avoid linking areas not historically connected.

Habitat restoration

Why Native Plants

Native plants:

1. Fewer pest and disease problems than exotic (non native plants).
2. Adapted to local temperature and rainfall patterns.
3. Provide better nutritional requirements for native animals, and are the basis for delicately balanced food webs

What is the goal of the restorations?

Restoring a plant community or Restoring habitat? For which species?
Species characteristics

- food requirements
- shelter/breeding requirements
- mobility/dispersal ability
- response to environmental variability (temporal & spatial)
- interactions with other species

Can the species colonies? Will population be viable?

Landscape characteristics

- size/shape of patch
- distance to source
- connectivity/corridors
- matrix characteristics

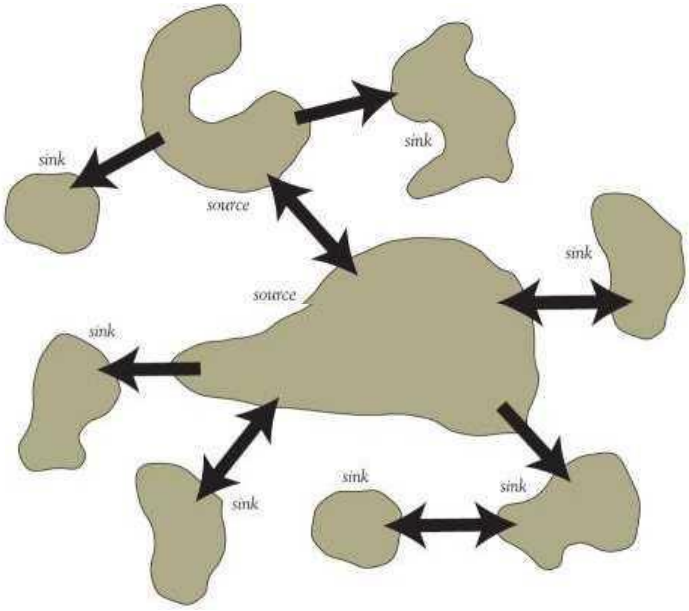
Restoring habitats for animal

Need to consider:

1. Quality of the habitat
2. Difficulty in reaching the habitat
3. Distance to the habitat
4. Difficulty in crossing the area between habitat

Conceptual Models of Spatial structure

1. Basic metapopulation model
2. Source-sink metapopulation model
3. Landscape metapopulation model



Models of Spatial Structure

Landscape metapopulation model a population model that considers both differences in the quality of the suitable patches and the quality surrounding matrix (e.g., habitat corridors). Represents the populations most realistic and most complex spatial structure of population.

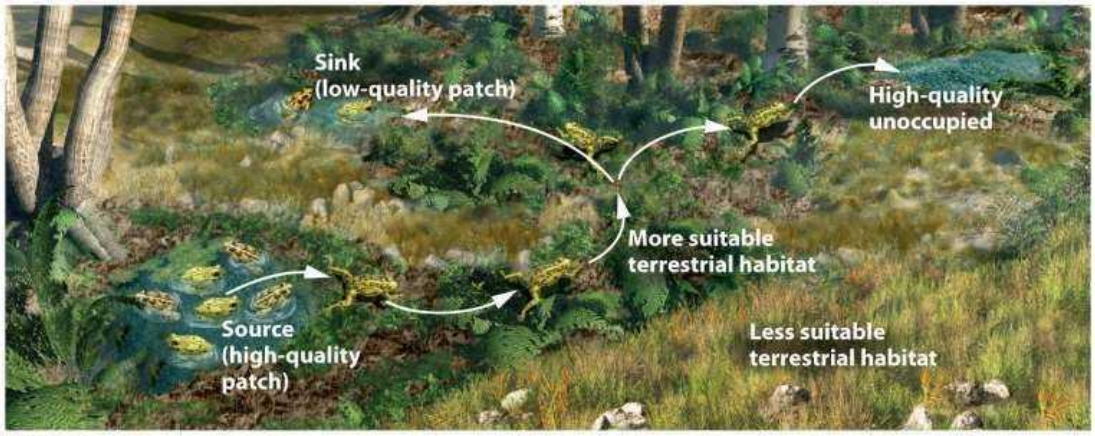


Figure 11.19
Ecology: The Economy of Nature, Seventh Edition

BREEDING PROGRAM FOR SUMATRAN RHINOCEROS (*Dicerorhinus Sumatrensis*) CONSERVATION: PAST, PRESENT, AND FUTURE

drh. Dedi Candra

Way Kambas National Park, Lampung Indonesia

INTRODUCTION

The Sumatran rhinoceros or Two-horned hairy rhinos *(Dicerorhinus sumatrensis)* is now the most endangered and the most threatened rhino among the five surviving rhino species in the world. Estimates indicate that the numbers of wild Sumatran rhino was reducing very rapidly over the last 2 decades and now there remain less than 100 individuals in the whole world. Numbers are now so low that we may see the rhino finally vanish in the coming decade, if we do not act fast and massively now. In the 200 years since the Sumatran rhinoceros was first scientifically described (Fisher 1814), the range of the species has contracted from a broad region in Southeast Asia to three areas on the island of Sumatra and one in Kalimantan, Indonesia.

Characteristics of Sumatran Rhino:

- Males are primarily solitary except for mating pairs activity and mothers with baby under 2 years old
- Life span is shot, just 35-40 years, long gestation length of approximately 15-16 months, and age at sexual maturity estimated at 6-7 years for females and 10 years for males
- Home range: Males up to 5,000 ha with often overlapping with female home range and females more small, just about 1,000 -1,500 ha.
- Daily movements between feeding sites and wallows site are probably only a few kilometers per day. Longer treks are made when males and females go to saltlicks (5-10 km) and by males exploring their large ranges.
- Water is never very far away in the habitats occupied by the Sumatran rhino.

THE SUMATRAN RHINO STORY

Sumatran Rhino in Captivity:

1985-1992 Sumatran rhino capture program. PHKA working together with HPLF (Howletts and Port Lympne Foundation) from England and SRT (Sumatran Rhino Trust) from America were captured 40 rhinos from areas being converted to plantations in Riau and Bengkulu province (18 rhinos), for the captive breeding program. In same period in Malaysia were success captured 22 rhino from Peninsular and Sabah. So the Sumatran rhino were distributed to few places such as Indonesia, England, US and Malaysia. Unfortunately 13 Sumatran rhino was died until 1993 because of various causes, in particular because of problems with food and digestion, poor husbandry and health care, and fatal fighting because of limited space and no reproduction did occur. So, we can say captive breeding program was failed, even thought the first rhino expert too confident about captive breeding success.

- Howlett and Port Lympne England Zoo- failed
- US (Bronx zoo, San Diego Zoo, LA zoo and Cincinnati zoo – Breeding 2001, 2004, 2007) – overall failed
- Sungai Dusun and Zoo Malaysia - failed
- Sepilok and Borneo Rhino Alliance Tabin Sabah Malaysia - failed
- Safari park Indonesia - failed
- Ragunan and Surabaya Zoo Indonesia - failed
- Sumatran Rhino Sanctuary Indonesia (breeding 2012) – still survive and running to date.
- On 2016 just Bina, one Sumatran rhino survive in the captivity with 39 Sumatran rhinos was died.

SUMATRA RHINO EXTINCT IN MALAYSIA

Malaysian population 52-75 on 1980, including 20 to 25 individuals in the Endau-Rompin area in Johor and 15 to 30 in Sabah. Population continuing to decreased and separated in few small populations. The tragic death of all six rhinos at Sungai Dusun Rhino Conservation Centre in Selangor

between April and November 2003 put a finish to the captive breeding effort. Sumateran rhino extinct in Peninsular (Taman Negara, Endau Rompin National Park and Royal Belum State Park) on 2007 and close to extinct Sabah, just 3 sumatran rhino (*Dicerorhinus sumatrensis harrissoni*)left in the rhino Sanctuary, they are Tam (2008), Puntung (2011) and Iman (2014) - Tabin Wildlife Reserve). 200 cameras running in Danum Valley on 2012, there is just one rhino lest and captured on 2014. The Sumatran rhino is now considered to be extinct in Malaysia (Hance, 2015), and the current conservation strategy there is to propagate the remaining rhinos in a captive breeding program (Payne, 2012). The Borneo Rhino Alliance (BORA) directs this program, and currently it seems there is no chance to re-introduce any rhinos back into the wild (Ahmad *et al., 2013*). Main conservation program is patrol, protection and intensive monitoring.

The Sumatran Rhino Population Problem in Indonesia right now is same with Malaysian condition 20 years ago:

- Sumatran rhino population distributed in small population <15/habitat
- Male and female rhino is very difficult to meet because small and distributed.
- High Inbreeding potential
- Just few rhino calves was born

The captive propagation plan largely failed through a fatal combination of diverse factors including dealing with a solitary species which is inherently difficult to breed, inadequate knowledge of rhino breeding biology and dietary requirements, cautious decision-making, poor hygiene in some facilities, weak collaboration, emphasis on capture of "doomed" rhinos rather than fertile rhinos, and a willingness to keep on doing the same thing and waiting in vain for a better result. Three calves were produced by one rhino pair in Cincinnati Zoo in 2001, 2004 and 2007 and 2 calves was produced by one pair in SRS in 2012 and 2016.

CURRENT POPULATION - ESTIMATES OF SUMATRAN RHINOS LEFT IN THE WILD

Strategy and Action Plan for the Conservation of Rhinos in Indonesia (2007-2012) in situ Conservation: overall failed

- Expand the wild population in Gunung Leuser, Bukit Barisan Selatan and Way Kambas National Parks by at least 30%
- Secure adequate habitat for viable wild populations in Kerinci Seblat National Park (500,000 ha), Bukit Barisan Selatan National Park (100,000 ha), Gunung Leuser National Park (700,000 ha) and in Kalimantan (500,000 ha).
- Translocation of animals from the southern parts of Bukit Barisan Selatan National Park (which has a relatively dense rhino population), to its relatively empty northern sections. The movement of rhinos will occur when security is assured in the northern areas

2012

- WKNP 35 Sumatran rhinos in 2012 (Talukdar *et al.,* 2012), indicating a strong recovery after being declared extinct in the Park in 1961 but rediscovered in the 1980s (Reilly *et al.,* 1997)
- BBSNP during 2007-2008 estimated there were 21 ± 7.1 rhinoceroses in the Park (Pusparini and Wibisono, 2013). Based on patrol data, the distribution of rhinoceros signs had decreased by 70% during 2007-2012 (Talukdar *et al.,* 2012)
- Leuser Ecosystem 17 individuals were confirmed in a 250 km2 area in 2012 (Leuser International Foundation, 2012

2013-2014

Base on Sumatran rhino crisis summit (2013) and rhino range state meeting (2014), the Sumatran rhinos were protected in the three main Sumatran rhino regions in Sumatera and From the 14 sites that recorded the presence of wild Sumatran rhinos in 1995, only five still have incontrovertible evidence of the species in 2012 and they are now restricted to the island of Sumatra, Indonesia (Bukit Barisan Selatan, Gunung Leuser and Way Kambas National Parks) and Malaysian Borneo (Danum Valley Conservation Area and possibly Tabin Wildlife Reserve).The 1984-2016 strategy of trying to protect them in the wild has not resulted in increasing their numbers in each sites.

The 2016 best population of Sumatran rhino numbers is less than 100, down from an estimated 413 - 563 in 1995 and declining is in very serious trouble. Sumatran rhino numbers have declined more than 70% over the last two decades due to poaching for its horn as well as increasing destruction of its habitat.

Now, the populations are primarily threatened by small population size, habitat enroachment, the potential for catastrophic events, and invasive plant species, as well as poaching.

2015-2016

Kalimantan 4-15, Way Kambas 31-36, Leuser 26-36, BBS 16-35.
Summary of Sumatra rhino PVA meeting in Bogor 2015:

- Four location distribution Sumatran rhino in Way Kambas, BBS, Leuser, Kutai Barat, each site needed special solution and different challenge.
- Build national level support for Sumatran rhinoceros conservation
- Conservation effort is zero poaching, increasing individual, control of species invasive.
- Action points: build Intensive Protection Zone and Intensive Management Zone in each population and manage individual as metapopulasi
  - Establish IPZs and ensure that all Sumatran rhinoceros are protected from poaching, deforestation, encroachment and habitat degradation
  - Manage all Sumatran rhinoceroses from Indonesia and Malaysia as one meta-population and establish Intensive Management Zones (IMZs) at each site in Indonesia
- Conduct critical research and monitoring to measure effectiveness and inform and evaluate conservation management including - Monitor diseases within the surrounding livestock population.
- Engage local communities, government authorities and the private sector in the conservation of Sumatran rhinoceros and their habitats.
- Captive must be support to wild population.

Interesting fact about condition of Sumatran rhino to date:

1. Summary of TFCA rhino expert Meeting in Jakarta August 2016 (just ~72 Sumatran rhino left in *in-situ* habitat)
2. Camera/video trap in BBSNP during 3 years project just capture 6 photos of Sumatran rhino (~2/3 different individual rhino (unpublished WWF Indonesia). Population 17- 24 Rhinos (Footprint, Occupancy & CT), Footprint 30-40 rhinos (RPU) – confuse with Tapir footprint? Nobody know what the real number of sumatran rhino in the field.
3. Camera/video traps in WKNP and RPU activities ~ 25 rhinos (TERMA). Footprint 31-36 rhinos (RPU)
4. Leuser ~ 12 rhino from (2-15) 6 different area (KEL)
5. Sumatran Rhino Population in the area which have intensive protection and monitoring (RPU 1995-now) continuing to decreased or stagnant (TNBBS and TNWK) - no overall indication of recovery of the wild populations
6. Rhino zero poaching (TNBBS and TNWK) - no recorded poaching events – real or nor? Protection and habitat restoration are no longer sufficient to ensure the Sumatran rhino's survival.
7. Camera trap and Fecal DNA – low result
8. No info about rhino death in BBS 2001, TNWK (1 or 2) on 2006
9. Just 3-10 Sumatran (Kalimantan) rhino survival, capture and translocation protocol to rescue the sumatran wild rhinos (Najaq) from remote hill forests in Kutai Barat. The capture of isolated Sumatran rhinos is indeed inherently risky, but leaving isolated animals in a place where they cannot find a breed and snare on the leg has far greater risks. Although Najaq's death is tragic, we have learning much from this experiences to continue its rescue efforts

Problem has been occurring such as:

- The rhino population densities in 1990s were probably already too low for them to recover without intensive management intervention.
- With the deaths of the many captive sumatran rhinos, the breeding project became unpopular and the focusing on saving rhinos in the wild rather than bringing them into santuary.

- No evaluation and comprehensive scientific assessment from Sumatran rhino monitoring and protection project by expert.
- No info about reproductive status individual of rhino in Leuser, BBS and WK.
- No info about Genetic Plasticity and Heterositas Genetic status of population in Leuser, BBS and WK. The small size of Sumatran rhino populations make them vulnerable to inbreeding.
- Sumatran rhino population drastic decline about 90% during period 1984-2015. Distribution habitat of Sumatran rhino in 5 sites (1984) and now just in 3 sites left (Leuser, BBSNP and WKNP). The wild populations in Sumatera mostly have stagnated, declined or gone extinct.
- Very small individual into population just 2-10 rhino, separated without access for transferred new blood (genetic exchange) between sub population
- The essence of the problem now is only one breeding female's success in captive (Ratu). A conservation program now needs to put in place measures that significantly boost rhino birth rate in captive conditions.
- Strategy and Action Plan for the Conservation of Rhinos in Indonesia 2007-2017 was failed – need Emergency Plan

Even thought the Sumatran rhino decreased in Indonesia but if we compare with other country in the south East Asia, Indonesia still is the best to save Sumatran rhino.

SUMATRAN RHINO CONSERVATION IN WKNP - CENTER OF EXCELLENT

Rhino Protection Unit

Protection Securing the rhinoceros and their habitat through operating Rhino Protection Units (RPU) and intelligence and law enforcement unit (ILEU). the activity of teh rpu are Intensive patrolling of areas to detect and destroy traps, interdict intruders and arrest suspected poachers, take actions against unauthorized utilization of natural resources in addition of rhino protection, conduct intensive and extensive surveys and monitoring of the rhino population, and Provide intelligence to assist in the apprehension of poachers.

Sumatran Rhino Sanctuary

The Sumatran Rhino Sanctuary (SRS) is a unique breeding center for Sumatran Rhinoceros in the native habitat of the species. The sanctuary was build within the Way Kambas National Park in an effort to provide a natural environment to keep and propagate Sumatran rhinos. The captive conditions in the SRS are different from those in zoos, as the SRS provides 10-20 ha of secondary forest habitat for each rhino within the 100 ha complex, with minimized human interference. The SRS has separate enclosures for each rhino, because in the wild Sumatran rhinos are solitary animals that live alone most of the time. The female and male Sumatran rhinos are kept separate until a willingness to mate is shown in their behavior in correlation with their sexual cycle. The mature secondary tropical rain forest of Way Kambas National Park provides natural habitat for the Sumatran rhino.

The aim of Sumatran Rhino Sanctuary is produce many offspring as safely possible, safely mean save/secure genetic and environments.

Program Management:

- 1996 SRS starting to build
- 1997 big fire in WKNP
- 1998 establish with one manager
- 2000 SRS foundation
- 2008 Yayasan Badak Indonesia (YABI) with two manager (Animal and facility)
- 12 June 2012 Andatu was Born
- 12 May 2016 Delilah was Born
- 2014 back with one manager

Key: Principle of Sumatran rhino Breeding Success are combining natural breeding and technology of reproductive.

Breeding Sumatran rhinoceroses has proven challenging because the animals can become very aggressive (fighting) when they are paired and the female is not receptive to the male. We need to make sure; when female have peak of estrous cycle if we need to run breeding program. Actually, not so difficult to breeding this endangered animal, two important activities are daily behavior monitoring and Ultrasound examination (Follicle development, Ovulation, Early pregnancy, Embryo development and Pathology condition). After we know the estrous cycle and then introduce them, if good response each other pair male and female in one place. During the female cycle just 4 days female receptive to the male and just about 12 hours good time to breeding success. The other important this is the rhinos must be health with good nutrition.

Miscarriage – Loss Pregnancy

There was no vaginal discharge, no change in her behavior, nothing that gave us a hint she had lost the embryo. She is very healthy. The embryos can be absorbed fairly quickly early on. We did track the uterine horns from cervix to both ovaries and not see any fluid in there. Ratu was lost pregnancy, that is sometimes happens and is not related to how the rhinos are being cared for or managed. Nobody is to feel responsible for the loss. It is simply the way nature works sometimes.

Breeding Success Story

- The last record of a Sumatran rhino calf produced by a pair of captive animals dates back to 1889, in Calcutta, India [Rookmaaker, 1998].
- Captive Breeding Success in America. Ipuh and Emi successes produce three calves on 2001, 004 and 2007.
- Captive Breeding Success in Indonesia. The Sumatran rhino global propagation and management board (GMPB) consisting of representatives of rhino range states, rhino breeding facilities and donors, has been meeting since 2005. One of GMPB successful is brought Andalas into captivity in Way Kambas and breeding program has succeeded with two captive births but all of them related. The only unrelated male is held separately in Sabah. The pace is too slow to save the species. Fresh ideas and perspectives are needed to help decide what to do next.
- Rare Sumatran Rhino Birth in Way Kambas National Park Lampung, Indonesia on June 23, 2012 early Saturday morning. The birth is the first in 124 years in a breeding center in Asia and is a significant advance in Indonesia's conservation efforts for one of Earth's most threatened species. One rhino calve is very important because he has one percent of the world's sumatran rhino population.

Sumatran rhino prediction age in Indonesia and Malaysia captivity (estimation of Sumatran rhino productive age is under 30) – life span about 35-40 years old.

No	SRS	BORA	Sex	Age	Productivity
1	Bina		Female	32	1 calf, prolonged cycle
2	Ratu		Female	16	4-5 calf
3	Rosa		Female	15	4-5 calf, cyst and myoma?
4	Andalas		Male	15	
5	Harapan		Male	11	
6	Andatu		Male	4	
7	Delilah		Female	1	
8		Tam	Male	25	Low spermatozoa
9		Puntung	Female		Cyst
10		Iman	Female		Myoma

Based on table, Sumatran rhinos at the SRS looks related especially male (low genetic variation) and Sabah female is not potential to produce calve because have pathology status of reproductive tract. If do not have new blood to put into both sites, the rhino will be extinction.

In the other site, in situ Sumatran rhino conservation, high risk also occurred such as: allee effect, high in-breeding index, low heterositas genetic population, pathology case on reproductive organ, potential for recessive lethal gen or abnormal, population stagnant or decline and bring species to exstint.

If the Sumatran rhino population just fewer than 100, what can we do? What needs to be done? What the best strategy for conserving the Sumatran rhinoceros? Good question but difficult to answer or the answer should be obvious. Without specific actions to bring Sumatran rhinoceroses together to boost production it is likely that the species will go extinct even if protection of suitable habitat increases. Need extreme or revolution action for Sumatran rhino conservation now!!! If Not, Sumatran rhino will be Gone.....!!!!

Saving Sumatran rhinos in the wild? or Saving Sumatran rhino in the captivity?

GOOD EXPERIENCES TO SAVE ENDANGERED ANIMALS

The inspiration and lessons learned in bringing back species on the edge such Californian condor, black footed ferret, crested Ibis, red wolf, Indian rhino and white rhino, and to stop us from making the same mistakes that were made that led to the extinction of the Yangtze river dolphin, the Javan rhino in Vietnam, and the northern white rhino.

Solution needed

1. Review the situation and our existing strategies. Identify key issues on which action has to be taken.
2. Global strategy to manage the global population (both wild and captive) as a single metapopulation across national and international borders. The best example of success of a single metapopulation strategy is that of the greater one-horned rhinoceros *Rhinoceros unicornis* in Nepal and India (Talukdar, 2006; Martin et al., 2013).
3. The second agreed action is the continued deployment of Rhino Protection Units at sites with remaining breeding populations.
4. The third proposed action is the creation of intensive management zones, with increased protection and monitoring in areas where the Sumatran rhinoceros breeds naturally.
5. The fourth action of the conservation strategy is captive breeding. The development of advanced reproductive technology for captive breeding.
6. Strong governmental commitment and support to save Sumatran Rhino.

Action:

1. **Review** Strategy and Action Plan for the Conservation of Rhinos in Indonesia (2007- 2012) and **change** with Emergency plan for Sumatran rhino (need a comprehensive budget).
2. **Rhino Protection Unit**. Strict anti poaching operations, protection rhino population and habitat, intensive monitoring, apply ILEU each sites is important for Sumatran rhino conservation, BUT Sumatran rhino conservation program with small population must be use scientific assessment for:
    - Make sure real viable rhino population viable. Find rhino and translocation of isolated wild rhino with population < 5 into existing semi *in-situ* captive breeding. Act now to add animals to the population.
    - Securing priority areas (Leuser, BBS and WK).
    - Reproductive status including pathological status of reproductive organ
    - Index in-breeding and genetic variation(heterocyst) into population - create a real genetic reservoir to support the wild population
    - IPZ, IMZ, Sanctuary - Advance Reproductive Technology
    - Diseases surveillance surrounding 3 different sites
    - Act now to truly manage captive Sumatran rhino population as one global population, with exchange of animals and gametes.

3. Sumatran Rhino Sanctuary in Lampung

a. Way Kambas is the most undisturbed and secure Sumatran rhino habitats in Indonesia. Way Kambas also have good access and adequate ecological factors for the development of a natural breeding center for Sumatran rhino. In addition, Way Kambas has potential to support

endangered animal conservation as part of the sustainable development of Lampung province.

b. SRS must be developed as a breeding centre for Sumatran rhino – framework SRS – change brands image SRS not only Sanctuary but real breeding centre. Semi in-situ BREEDING CENTRE – Natural breeding combine with reproductive technology. Framework SRS – change brands image SRS not Sanctuary anymore but real breeding centre: Human resource – upgrading staff, Equipment & Laboratory.
c. Reproductive technology: hormone modification for female, ultrasounds, EEJ (Artificial insemination has resulted in the births of five white rhinoceros calves in European zoos and three greater one-horned rhinoceros calves (Terri Roth, pers. comm.), AI, Embryo transfer, etc.
d. SRS must be Insurance (Future security) for Sumatran rhino and need more analyses to support this program.
e. SRS in-situ and ex-situ closely link to add SRS potency for viable. Actually *in-situ* population has decreased.
f. Future SRS need government support.
g. Few options to obtain male sperm quality is:
h. Continue Natural Breeding
i. Sperm collection with Electro Ejaculator (EEJ) from Andalas and Andatu and Tam
j. Collaboration with Sabah (Tam's Sperm for SRS's female rhino), IVF to Bina or Rosa
k. Government policy and Mou need to be clarified
l. Genetic issue need to be finished – the need of a join analysis for assessment
m. Loan New Male from wild (doom rhino): Survey and identification dome rhino in Sumatera, Government policy, Capture – translocation, Adaptation at the SRS, Breeding program, Evaluation and KSDAE Policy: release rhino to the wild or just stay at the SRS (need release program issue).

4. Sumatran Rhino Sanctuary in Kutai Barat Kalimantan Timur

a. Find and capture all Sumatran rhino in Kalimantan and bring to sanctuary to captive breeding program
b. Government policy and Mou need to be clarified

REFERENCES

Abdul Kadir, H. 2009. Current status and threats of Sumatran rhinoceros (Dicerorhinus sumatrensis) in Peninsular Malaysia. In Report on the Meeting for Conservation of Sumatran and Javan Rhinos in South-East Asia (eds B.K. Talukdar, K. Crosbie, S. Ellis, W.S. Ramono, A.C. Williams & Sectionov), p. 8. Asian Rhino Specialist Group, Guwahati, India.

Ahmad AH, Payne J, Zainuddin ZZ. 2013. Debate Forum: Preventing the extinction of the

Sumatran rhinoceros. Journal of Indonesian Natural History; 1(2): 11–22.

Agil, M., Riyanto, M.A.C.T., Sumampau, T., Hodges,K.&Van Strien, N.J. 2002. A program of managed breeding for the Sumatran rhinoceros at the Sumatran rhino sanctuary, Way Kambas National Park, Indonesia. In Proceedings of the International Elephant and Rhino Research Symposium (eds H.M. Schwammer, T.J. Foose, M. Fouraker & D. Olson), p. 303. Vienna, Austria.

ARRS (Asian Rhino Range state) meeting, 2014. BORA (Borneo Rhino Alliance). 2010. Http://www.borneorhinoalliance.org. [accessed 24 September 2016].

Hance J. 2015. Officials: Sumatran rhino is extinct in the wild in Sabah. Mongabay.

http://news.mongabay.com/2015/0423-hance-sumatran-rhino-sabah- extinct.html. [accessed 2 September 2016].

IRF (International Rhino Foundation). 2010. Rare Rhino Pregnancy Gives Hope to Species: Andalas-Ratu Love Story Proves Conservation Efforts Can Work. Http://www.rhinos-irf.org/andalasloves-ratu [accessed 14 Agustus 2016].

Isnan, W.M., Subrata, D.D. & Van Strien, N.J. 2006. Annual Report: Indonesian Rhino Conservation Program, Bogor, Indonesia.

IUCN (2010) IUCN Red List of Threatened Species v. 2010. IUCN, Gland, Switzerland.

Http://www.iucnredlist.org [accessed 12 September 2016].

GMPB (Global Management and Propagation Boar) for Sumatran rhino, 2012. Konservasi Sumber Daya Alam Dan Ekosistem – KLHK, 2016

Miller, P.S., Lees, C., Ramono, W., Purwoto, A., Rubianto, A., Sectionov, Talukdar, B., and Ellis, S. (Eds.) 2015. Population Viability Analysis for the Sumatran Rhino in Indonesia. Apple Valley, MN: IUCN/SSC Conservation Breeding Specialist Group.

MoF (Ministry of Forestry). 2007. Stretgy and action plan for the conservation of rhinos in Indonesia. MoF, Republic of Indonesia.

Payne J, Ahmad AH. A comment on 'sex and the single Rhinoceros' by Henry Nichols. 2012.

Available:http://www.borneorhinoalliance.org/featured/a-comment-on-sex-and-the- single-rhinoceros-by-henrynicholls/.[accessed 2 August 2016].

Pusparini W, Sievert PR, Fuller TK, Randhir TO, Andayani N. 2015. Rhinos in the Parks: An Island-Wide Survey of the Last Wild Population of the Sumatran Rhinoceros. PLoS ONE 10(9): e0136643. doi:10.1371/ journal.pone.0136643

Pusparini W, Wibisono HT. 2013. A landscape-level assessment of Sumatran rhinoceros distribution in Bukit Barisan Selatan national park, Sumatra. Pachyderm; 53: 59–65.

Schaffer, N.E., Agil,M. And Bosi,E. 2001. Utero-ovarian pathological complex of the Sumatran rhinoceros (*Dicerorhinus sumatrensis*). In Abstracts of the International Elephant and Rhino Research Symposium (eds H.M. Schwammer, T.J. Foose, M. Fouraker & D. Olson), pp. 322. Vienna, Austria.

SRS (Sumatran rhino sanctuary) report, 2000-2015

SRCS (Sumatran rhino crisis summit), 2013

Talukdar, B.K., Crosbie, K., Ellis, S., Ramono, W.S., Williams, A.C. & Sectionov. 2009. Report on the Meeting for Conservation of Sumatran and Javan Rhino in South–East Asia. Asian Rhino Specialist Group, Guwahati, Assam, India.

Talukdar, B.K., Sectionov And Campbell,C. 2012. Report on the Meeting for Conservation of Sumatran and Javan Rhino in South East Asia. Asian Rhino Specialist Group, Guwahati, Assam, India.Reilly J, Spedding GH, Apriawan. Preliminary observations on the Sumatran rhino in Way Kambas National Park, Indonesia. Oryx,

1997; 31(2): 143–150.

TFCA rhino expert meeting, 2016

WKNP (Way Kambas National Park report), 2000-2015

YABI (Yayasan Badak Indonesia). 2009. Annual Report: Yayasan Badak

Indonesia, Bogor, Indonesia.

Zafir AWA, Mohamed A, Lau CF, Sharma DSK, Payne J, Alfred R, et al. 2011. Now or never: What will it take to save the Sumatran rhinoceros Dicerorhinus sumatrensis from extinction? Oryx; 45: 225–233.

LIST OF CONTENTS

PREVENTION MODELS TOWARDS HUMAN - TIGER CONFLICT (HTC) IN BUKIT BARISAN SELATAN NATIONAL PARK (BBSNP), LAMPUNG

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ABSTRACT

The population of Sumatran tigers *(Panthera tigis sumatrae* Pocock, 1929*)* is having fairly high pressure because of the forest habitat reduction. Human-tiger conflict (HTC) and its management in Sumatra have become a challenge in the means of tiger conservation because they generate material loss and deaths, that eventually reduce community tolerance towards its conservation attempt. Attack and predation towards cattle by tigers have made local community in some suburb villages of Taman Nasional Bukit Barisan Selatan (TNBBS / Bukit Barisan Selatan National Park) to develop some non-lethal control conventional approaches in order to protect their cattle and to prevent higher conflict to occur. Seven research location villages around TNBBS give important information in HTC prevention used by community in Bukit Barisan Selatan landscape. Questionnaire survey and structured interview have been done on 154 respondents. Some general local prevention models are anti-tiger attack cage or Tiger Enclosure Proof (TPE), fireplace around the cage, lighting or lamp in the cage, high platform cage, and night patrol and guard. From the questionnaire done, TPE model is evaluated effective in preventing tigers to enter the cage by local community. From 48 respondents stating that they have built TPE, there are 4 TPE respondents (8.3 %, n=48) having disruption and predation after TPE is built. The analysis result of Generalized Linear Model (GLM) shows that TPE model is the best modeling that reducing the number of conflicts with delta value of Akaike's Information Criterion'(AIC = 28,638), which is the smallest criterion value. Modeling interpretation defines that more TPEs built by a village of conflict area will decrease the number of occurring conflict frequencies.

Keywords: sumatran tiger, human, conflict, TPE, GLM

1. INTRODUCTION

Sumatran tiger *(Panthera tigis sumatrae*Pocock, 1929*)* is one of species key remaining on Sumatra Island. The threat of losing it existence is due to anthropogenic factors. This subspecies tigers very depend on the existence of forest [19] and they are having quite high pressure because of the reduction of forest habitat in Sumatra as the result of land use conversion and the increasing human population, so there is a conflict because of human activities around and inside forest [17]. "Critically Endangered" status is embedded on this species[12], considering of its population in Sumatra that is less than 250 individuals left from the newest assessment [21].

Human-Tiger Conflict (HTC) and its management in Sumatra become a challenge in tiger conservation means because they create material loss and deaths that eventually reduce community tolerance towards its preservation means. This conflict is also a factor triggering community to catch and even kill tigers[17]. HTC is divided into three types based on the effects appearing, the first type is that tigers are visible around the habitation, although they do not cause any deaths, they create fear among people. The second type is that tigers prey on cattle. In this type, the risk over tigers is increasing along with the existence of possible vengeance from the community. The third type is that tigers attack human, where the risk towards their existence is much higher to be relocated or even to be killed by people [5;6].

Bukit Barisan Selatan National Park (BBSNP) in the province of Lampung is one of landscapes for tiger conservation (TCL / Tiger Conservation Landscape) that is stated in Strategy dan Rencana Aksi Konservasi Harimau Sumatera (STRAKOHAS/ Strategy and Plan of Sumatran Tiger Conservation Action)(Soehartono *et al.*, 2007), that cannot be separated from the challenge of HTC management. There are 85 incidents of HTC recorded in BBSNP between years of 1998 – 2011, but there were no attacks or deaths.

Initiation of treatment through HTC mitigation in Bukit Barisan Selatan National Park (BBSNP) has been done in the areas of Talang Sebelas and Talang Kalinda (a cluster in the area of Desa Rajabasa, District of Bengkunat, Lampung Barat Regency) since 2005 by conservation agency of Wildlife Conservation Society – Indonesia Program (WCS-IP). Human and tiger conflict occurs with high frequency intensity, firstly recorded on 16th of December 2005, with the missing of goats from their cage [1]. The search based on data of WCS-IP camera trap shows that their predators are Sumatran tigers. Up to 2007, they are recorded that 14 goats and a dog were the victims of tiger predation in Talang Sebelas, Desa Rajabasa, Bengkunat, Pesisir Barat [18].

The attack and predation on cattle by tigers have make local community in some suburb areas of BBSNP developing some conventional approaches that are non-lethal control for protecting their cattle and preventing higher level of conflict to occur. Moreover, WCS-IP has also developed a design of cattle cage that is tiger proof enclosure / TPE with a prototype that has been tested since 2005 in one of HTC hotspots surrounding BBSNP which are Desa Sukamaju and Rajabasa, Pesisir Barat Regency. The cage with this special design uses barbed wire to prevent tigers from entering, climbing, and jumping over the cage. Cage plank installation is done by nailing from inside to avoid the damage of plank by tigers. Some cattle predation cases show that tigers are able to pull planks installed from outside of the cage.

Conservation intervention is needed to build understanding and tolerant attitude of community on the existence of tigers, so they are not always considered as a threat for human life in suburb area surrounding BBSNP. The understanding on the relationship of the risk living side by side with the forest and conditions that will prevent and reduce the conflict risks between two entities, as well as the tolerant attitude towards wildlife existence such as tigers that certainly need forest as their life support is expected can create low conflict risk and the presence of tigers that is still maintained. The aim of this study is to set an effective model of human-Sumatran tiger conflict prevention based on non-lethal control approach that has been done by community during this time in villages that are affected by conflict surrounding BBSNP.

1. MATERIALS AND METHODS

2.1 Study area

Bukit Barisan Selatan National Park (BBSNP) was first established as a wildlife sanctuary because thisarea is home for several protected wildlife species (see Biological Conditions). During the third World National Park Congress on October 14, 1982 in Bali, the area was formally gazetted as national park based on Decree of the Minister of Agriculture No.736/Mentan/X/1982 (BBSNP 1999).BBSNP is a chain of the southern Barisan ranges located in southern Bengkulu and extending to southern Lampung.BBSNP is part of West Lampung, West Coast, and Tanggamus Regencies, Lampung Province and Kaur Regency (Bengkulu Province). Geographically, the park lies between the coordinates 4°29’ - 5°57’ S and 103°24’ - 104°44’ E. BBSNP covers an area of approximately 356,800 ha.

Study activity is done in seven villages listed in conflict data of time series WCS-IP Wildlife Response Unit since 2008 – 2015 as HTC locations in suburb of BBSNP which are Desa Sukamaju, Rajabasa, Way Sindi, Pagar Agung, Enclave Way Haru, Enclave Kubu Perahu, and Tampang (Figure 1). The selection of those seven villages is based on the highest HTC frequency in suburb area of BBSNP since 2008 up to now.

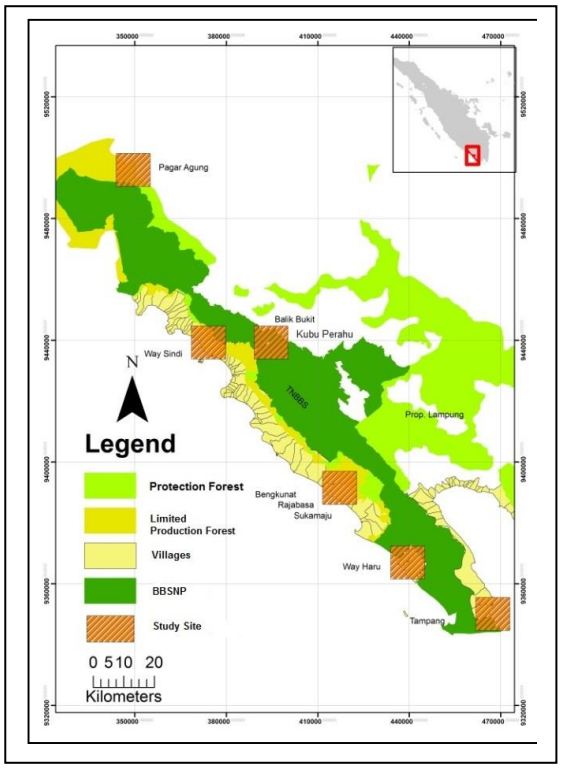

Fig 1. BBSNP landscape with the location of study site.

2.2 Methods

There are two approaches conducted to investigate which prevention model that has been done by community in study site. The first is by using supporting data (secondary) on conflict record in suburb area of BBSNP since 2008 obtained from conservation agency of Wildlife Conservation Society - Indonesia Program (WCS-IP) and which village that has built Tiger Proof Enclosure (TPE) as part of the means of conflict prevention, while primary data are extracted directly by using survey questionnaire and direct interview with local community about local prevention model that they have applied and its effectiveness level in preventing or reducing cattle predation risk by tigers. Respondent sample referred is local community affected by HTC, both in the first conflict level (directly see, hear, find sign of tiger presence, and others) and the second conflict level(having attack or predation toward their cattle). Time of study is done in January – March 2016.

1.3. Data Analysis

Questionnaire form completed will be decoded and put in to software application Minitab 17.0 to be processed as descriptive statistic data. Pearson Correlation Test, as well as using Generalized Linear Model (GLM) on data variable grouping is done including key topic of prevention model on conflict frequency occurring during this time in the village or conflict location. Data and information obtained will be tabulated, summarized, and presented in the form of table and graph. The result obtained will be recommendation for cattle owner in the village having conflict with Sumatran tigers.

1.4. *Generalized Linear Model* (GLM).

Generalized linear model (GLM) is a method used in quantification of relationship between response variable and predictor variable in a model. The use of GLM can be a model to explain the changing process between values from predictor variable towards response variable. Conflict event or specifically predation even on cattle has varied contributing causative factors that are. The best model selection in GLM is done to investigate which predictor variable that will be preventing factor in the conflict through the smallest AIC delta value.

Predictor Linear Model:

$$\eta_i = \alpha + \beta_1 x_{1i} + \ldots + \beta_j x_{ji}$$

η = Response Variable
α = Intercept Value
β =Coefficient Value
χ = Predictor Variable (categorical, nominal, discrete, continuous)

1.5. AIC Method in GLM

AIC method is a method used in selecting the best correlation model found by Akaike [7]. This method is based on maximum likelihood estimation (MLE).
To count AIC value, the formulation used is as the following:

$$AIC = \frac{2k}{n} + \ln\left(\frac{\sum_{i=1}^{n} \hat{u}_i^2}{n}\right)$$

k= the number of parameter estimated in correlation model
n= the number of observations
e= 2,718
u = Residual

According to AIC method, the best regression model is the model that has **the smallest** value of AIC [3].

2. RESULT AND DISCUSSION

3.1. Local Wisdom in Preventing Human – Tiger Conflict.

Seven villages of study site give important information in preventing human and tiger conflict used by community is Bukit Barisan landscape. Questionnaire survey and structured interview have been done on 154 respondents. Some general local prevention models are Tiger Proof Enclosure (TPE), fireplace around the cage (Perun), lighting or lamps in the cage, high platform cage, and night patrol or guard. There are 48 active TPEs and 28 high platform cages that have been built by community in seven study sites since 2006. Generally, the condition of the habitat surrounding the cage is still in the form of coffee plantation and shrub cover that have not been cropped for a long time, so it potentially becomes crawling and hiding place for tigers.

In management of human and tiger conflict, prevention is an important part in order to reduce conflict. [17] stated that the principle of specific area describing conflict prevention method in an area cannot always be used in other areas. [4] added that for a long time human has been responded to wildlife disturbance by building varied methods for a long period of time.

In India, [8] reported that a fence and a field guard dog can reduce plant loss as the result of wildlife release such as elephants from the forest, but did not show significant result for reducing loss on cattle predation. Meanwhile,[13] also explained that fences surrounding the village are quite good for preventing the entering of cattle predators such as leopards*(Panthera pardus)*.

TPE is a barbed wire fence model designed by WCS-IP since 2005 in Sumatra [18]. Modification of TPE is adjusted to local natural condition and the existence predators. For goat cage, it is standardized with the height of the cage (2.5 m) that is surrounded by barbed wire on the wall, base of the cage, top gaps, and other gaps. For cow and buffalo cage (Fig 2), barbed wire is installed as outer fence up to the height of 2.5 m so that tigers are not able to jump over it [11]. Outer fence pole

wrapped around barbed wire can be made of a log with diameter > 10 cm in order to have resistance when wildlife such as tigers and bears are not easily able to push or ruin it. Generally people use cottonwood log (*Ceiba pentandra*) that can be hedges and can be used as cage shade at the same time.

According to[17], environment surrounding TPE must also be more open and brighter, the presence of bushes around TPE can be crawling place for tigers. As comparison in India, [13] stated that habitat modification includes weeding, such as lantana (*Lantana camara*), is effective to prevent the entry of cattle predators such as leopards *(Panthera pardus).*[21] reported that TPE that is also introduced by WCS-IP in Southern Aceh, Gunung Leuser National Park (GLNP), and combined along with awareness activity, is proven reducing the number of cattle predation by tigers, and increasing local support in conservation of Sumatran tigers. [11]also evaluated that TPE has effectiveness in cattle protection at night time so that farmers are able to do activities conveniently at day time.

TPE cage making that is in accordance with standard design developed from initial prototype will protect cattle from tiger enclosure. From the questionnaire survey done, TPE model is evaluated effective in preventing the entry of tigers into cage by village community. From 48 respondents stating that they have built TPE, there are 4 TPE respondents (8.3 %, n=48) (Fig 3.) having disturbance and predation on their cattle after TPE is built. It is because barbed wire is not maximally installed, wire is not installed in rooftop gaps, and gaps underneath the cage is not dense, so it can be reached by tigers by breaking the plank from the bottom of the cage and pulling the cattle inside. Other effectiveness evident is that tiger tracks around TPE cage are frequently found by residents in the morning. It can be predicted that tigers try to enter the cage at night from all sides, but cannot pass through because they are blocked by barbed wire. [21] also informed that in Southern Aceh in 2007 – 2010, the number of conflicts that must be handled is reduced up to 60%, even though there were still some conflicts, at least only encounter indicating the presence of tigers.

TPE is initially modified from high platform cage, without protecting wire, and is other choice for community in suburb area of Bukit Barisan Selatan landscape for preventing tigers to prey their goats. Cost limitation makes some residents are able to make only low cage without platform, that is sometimes not an ideal cage (Figure 2), so tigers are frequently able to prey their cattle, and some of them eventually decide to sell all of their cattle because they feel there are no solutions on conflict problems happen.

The challenge in conflict management is the awareness to community of the importance of cage condition that is good and fulfills standard criteria of TPE design. It relates to support in compensation program over cattle that becomes the casualty of tiger predation. [14] explained that to et full compensation over cattle casualties, it must be ensured the criteria of cattle in the cage that is well maintained in order to be protected especially at night time.

A B C

Fig 2.(A)TPE with outer fence model in Desa Pagaragung, (B) high platform cage type, (C) conventional cage in Enclave Kubu Perahu.

Other prevention model done by community is lighting in the cage in the form of electrical lamps, kerosene or oil lamps, or fireplace nearby the cage. [16] reported that in Jangkat and Birun, Kerinci Seblat National Park (KSNP), the use of confounding stimulation coming from the light can prevent the arrival of tigers to the cattle cage and human habitations, even though it is not permanent.

Moreover, [2] informed that the use of light, especially Light Emitting Diode (LED), has effect on behavior change of predator on its prey. The use of light has not been a choice that can be used by all community members. It is calculated from 7 villages in study site, only 3 villages having electrical power facilities which are Desa Sukamaju, Rajabasa, and Kubu Perahu, while 4 other villages still use traditional lighting of kerosene or oil lamps with limited fuel.

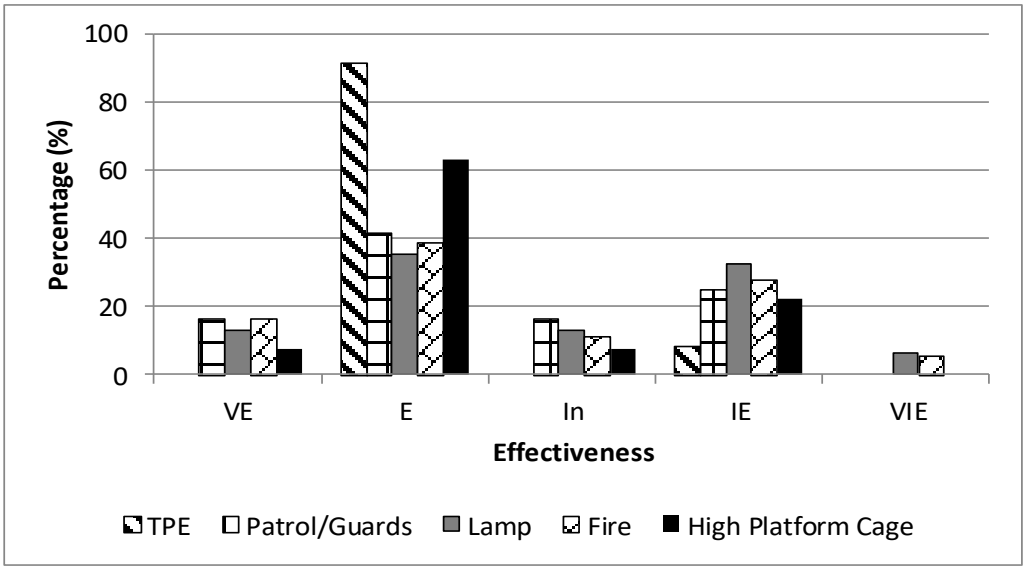

Fig 3. Perception of Respondent Community towards Local Prevention Model
Note: VE = Very Effective, E = Effective, In = Indifferent, IE = Ineffective, VIE = Very Ineffective

The fireplace is made by burning garbage or dried grass from cleaning the cage, the smell from the combustion is believed by local people will be keep wildlife away, even though it has not been known it effectiveness level. The use of chemistry material as prevention (chemical repellent) of wildlife presence, both synthetic and natural, is also used in other areas in the case of non-lethal conflict management application. Among others are pepper *(Piper nigrum)*and Lithium Clorida (LiCl), they are used in Kerinci Seblat National Park (KSNP) to prevent tiger predation on cattle, but other innovations must be done before wildlife predator getting used to those stimulants [16]. The type of predator also becomes differentiating factor for stimulant effectiveness. [15]reported that the use of LiCl is evaluated effective to reduce the conflict level on fox predator in America, but it is not used in Africa.

Active prevention management in human and wildlife conflict is by involving human resources. [17] stated the importance of a conflict prevention team to deal with wildlife conflict. [8] also stated that night patrols done in conflict villages in three national park landscapes in India (Ranthambore, Kanha, and Nagarahole) have positive correlation to reduce wildlife conflict.

Quick response team is formed in conflict hotspot in Sundarband, Bangladesh, that is a new approach to reduce human-tiger conflict in Sundarband. They recruited volunteers from the village to be Tiger Conflict Response Team and train them to overcome tiger entering the village [10]. Initiation of conflict response team and patrol formationactually was firstly introduced in Bukit Barisan Selatan Landscape through Wildlife Response Unit (WRU) built by WCS – IPalong with Balai Taman National Bukit Barisan Selatan / Bukit Barisan Selatan National Park Office and Balai Konservasi Sumber Daya Alam Propinsi Lampung / Natural Resources Conservation Office of Lampung Province since 2006. The role of this wildlife response team is quite significant in conducting conflict mitigation or reducing the loss effect caused by human and tiger conflict surrounding Bukit Barisan Selatan Landscape by conducting protection along with community when the conflict is detected.

3.2. Predicting Factor of Conflict Prevention

Pearson Correlation Test is done to see variable having relationship towards the number of conflicts in each study site. Variable total conflict (predictor) is related to some variables (covariate) of

prevention which are independent variables (number of TPEs, number of cattle, patrol response intensity, number of cage lighting users, number of cages using fireplace, number of platform cages, type of habitations, type of plantation habitat, type of bush habitat in each study site).

Initial analysis using Pearson correlation shows that variable number of TPE has the strongest negative correlation and is significantly different (*r*s = - 0.930, P < 0.01) (Fig 4; Table 1.). It means that there is relationship (although not cause and effect) which is more number of TPEs will relate to the number of human-tiger conflict occurring in a village. The presence of TPE does not absolutely reduce the number of conflict because there were 4 incidents of cattle predations recorded still occurring in the cage designed by using TPE. However, the number of cattle loss is reduced because the cage usually is protected with barbed wire that cannot be entered by tigers. The presence of tiger's tracks is still found around the TPE indicating that the conflict prevention has success value and still keeps the existence of tigers. [16,9] stated that "lethal control" or conflict controlling by killing wildlife is a matter must be avoided in conflict management, and is only the last choice because it will not solve the problems. [17] explain that the lethal control make them lose an important entity in the ecosystem, namely the existence of the sumatran tiger as a natural balance.

High platform cage is also a variable that has strong negative correlation and is significantly different (*r*s = - 0.88, P < 0.01) (Fig 4). The number of platform cagedoes not have significant value in reducing conflicts because gaps in the cage still can be passed through by tigers to prey the cattle inside.

The number of conflict response and patrol that can be done in each village has strong negative correlation value, and is significantly different (*r*s = - 0.80, P< 0.05) (Fig 4; Table 1.), because night patrol and guard responses are done collectively and rotating among community groups when there is any conflict information in a village, and when conducive situation is perceived, the patrol is not done.

Analysis using Generalized Linear Model (GLM) is done to see wider relationship between response variable, which is conflict and other covariates that are predicting factor (Table 2). All of variable obtained from questionnaire surevy, with additional data from WCS patrol for conflict respon during 2008 – 2015. Settlement area, paddy field, field (dominated by coffe and cocoa), and shrubs considered as environmental covariat that influences and also affect the incidence of conflict. Analysis result shows that TPE presence factor is to most influencing factor on the number of conflict frequency among other factors (number of cattle, platform cage, fireplace, cage lighting, and guarding patrol).

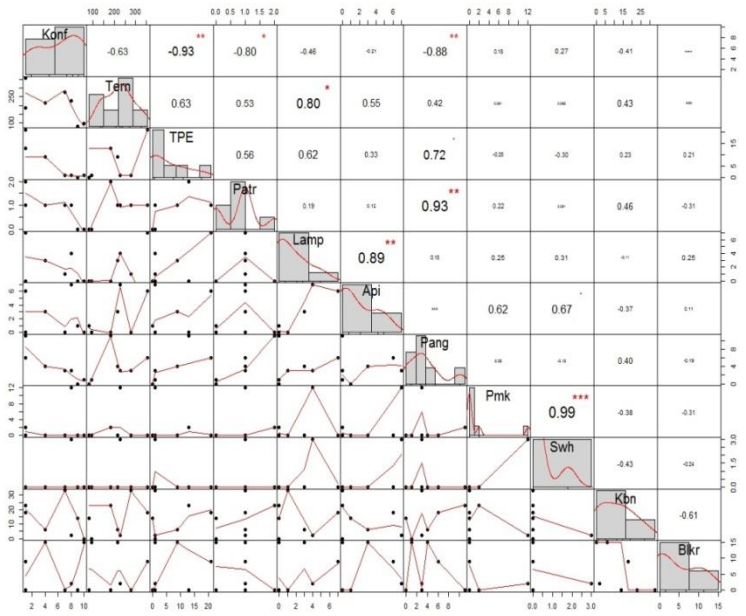

Fig 4. Pearson correlation test for all variables in GLMsSignif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05

Tabel 2. Variables in Generalized Linear Model (GLM)

Variable	Tipe Data	Sumber
Conflict Freq.	Integer	Questionnaire
Number of cattle	Integer	Questionnaire
TPE	Integer	Questionnaire
Patrol	Integer	Questionnaire, WCS Data
Lighting	Integer	Questionnaire
Fireplace	Integer	Questionnaire
High cage platform	Integer	Questionnaire
Settlement	Nominal	Questionnaire
Paddy field	Nominal	Questionnaire
Field	Nominal	Questionnaire
Shrubs	Nominal	Questionnaire

Tabel 3. Model Selection of GLM among Variables

Model	Predictor	AIC	Delta AIC	ModelLik	ModelWt
Model 2 bbs	**TPE**	**28.638**	**0**	**1**	**0.709**
Model 6 bbs	High Cage	30.643	2.005	0.367	0.26
Model 3 bbs	Patrol	35.406	6.767	0.034	0.024
Model 1 bbs	Number of cattle	39.023	10.385	0.006	0.004
Model 4 bbs	Lighting	41.532	12.894	0.002	0.001
Model 9 bbs	Field	42.412	13.774	0.001	0.001
Model 0 bbs	Null Model	42.991	14.352	0.001	0.001
Model 8 bbs	Paddy field	44.023	15.384	0	0
Model 5 bbs	Fireplace	44.319	15.681	0	0
Model 7 bbs	Settlement	44.547	15.909	0	0
Model 10 bbs	Shrubs	44.99	16.352	0	0

Note : Bold font: TPE selected as the best model fits with the smallest *Akaike's Information Criterion*' (AIC) delta criteria[3].

Tabel 4. The best three models by GLM's

Coefficients :	Estimate	Std Error	Z value	Pr(>|z|)
(Intercept)	2.23077	0.18105	12.321	< 2e-16 ***
TPE	-0.11932	0.03714	-3.213	0.00131 **
Model 2: Conflict = 2.23077 + (-0.11932.TPE)				
(Intercept)	2.3034	0.2161	10.66	< 2e-16 ***
Patrol	-0.8011	0.2679	-2.99	0.00279 **
Model 3: Conflict = 2.3034 + (-0.8011. Patrol)				
(Intercept)	2.4312	0.2218	10.961	< 2e-16 ***
High plat. cage	-0.2313	0.0707	-3.272	0.00107 **
Model 6: Conflict = 2.4312 + (-0.2313.High platform cage)				

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Analysis result of GLM shows TPE model as the best modeling (Table 3) that reducing the number of conflicts (AIC = 28.638 and Delta AIC = 0), which is the smallest criterion value among others. Modeling interpretation interprets that more TPEs made in a conflict area, the number of conflict

frequency occurring is reduced. This statistic value give illustrate that the relationship among the various models are more complicated than the correlation.TPE which was built with standard design provide safeguards system. There is no gap enclosure that can be entered by tiger.The best model selection can be formulated as **model 2: conflict frequency~ *2.23077 + (-0.11932.TPE)***(Table 4.).TPE combined with livestock management and socialization of personal safety were successful enough to decrease the incidence of conflict, there are no tigers or humans are killed, death of livestock can be reduced[20].

3. CONCLUSION

Pearson correlation test result shows that TPE has the strongest negative correlation and significantly very different (rs = - 0.93, P < 0.01) toward the reduction of conflict frequency,the result based on GLM analysis also makes conclusion that prevention model considered the best to prevent or to reduce the number of conflict is by using Tiger Proof Enclosure (TPE) cage, themore TPEs made in a conflict area, the number of conflict frequency occurring is reduced.

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REFERENCES

[1] Adhiasto,D.N. 2008. Mitigasi Konflik Harimau Sumatera di Talang Sebelas. *WRU- WCS-IP Brief Report 2008.*. Unpublished Report.

[2] Blumstein. DT, Berger-Tal O. 2015. Understanding sensory mechanisms to develop effective conservation and management tools. Current opinion of Behavioral Science. *Science Direct*. California. USA

[3] *Burnham, K. P.; Anderson, D. R.; Huyvaert, K. P. (2011), "AIC model selection and multimodel inference in behavioral ecology"* , Behavioral Ecology and Sociobiology *65: 23–35*, doi:10.1007/s00265-010-1029-6.

[4] Connover, M. 2002. Resolving Human-Wildlife Conflicts: *The Science of Wildlife Damage Management*. Boca Raton, 418 pp.

[5] DEPHUT. 2008. Peraturan Menteri Kehutanan No.P.48/ Menhut-II/2008. Pedoman Penanggulangan Konflik Antara Manusia dan Satwa Liar. Departemen Kehutanan. Jakarta.

[6] Goodrich, J.M. 2010. Human – tiger conflict: A review and call for comprehensive plans. *Integrative Zoology*; 5: 300-312. doi: 10.1111/j.1749-4877.2010.00218.x

[7] Grassa, A. A. 1989. *Econometric Model Selection*:*A New Approach*, Kluwer Academic Press. Boston.

[8] Karanth KK, Naughton-Treves L, DeFries RS, Gopalaswamy AM. 2013. Living with wildlife and mitigating conflicts around threeIndian protected areas. *Environ Manag* 52:1320–1332. DOI 10.1007/s00267-013-0162-1.

[9] Karanth, K.U, Gopal. R. 2005. An ecology-based policy framework for human–tiger coexistence in India. In: Woodruffe R, Thirgood S, Rabinowitz A, eds. People and Wildlife*: Conflict or Co-Existence*? Cambridge University Press, Cambridge, UK, pp. 373–87.

[10] Law. YH. 2015. A Hotspot for Humat – Tiger Conflict Transformed With Stick and Teamwork. http://www.earthtouchnews.com/conservation/human-impact . Diakses pada 12 Desember 2015.

[11] Lestari, W.P. 2015. *Dukungan Istri Terhadap Perilaku Suami Merawat Tiger Proof Enclosure*. Tesis Master. Fakultas Psikologi. Program Studi Psikologi Terapan. Pasca Sarjana Universitas Indonesia.

[12] Linkie, M., Wibisono, H. T., Martyr, D. J., Sunarto, S. (2008)."Panthera tigris ssp. sumatrae". *IUCN Red List of Threatened Species. Version 2015.2*. International Union for Conservation of Nature.

[13] Malviya, M., Ramesh. K. 2015. Human - Felids Conflict In Coridor Habitat, Implication For Tiger And Leopard Conservation In Terai Arc Landscape, India. *Human–Wildlife Interactions* 9(1):48–57, Spring.

[14] Murphy J. 2010. *Do Compensation Schemes Work?* . African Lion and Envrionmental Research Trust. **African Lion & Environmental ResearchTrust** (Alert). UK.

[15] Muruthi, P. 2005. *Human Wildlife Conflict : Lessons Learned From AWF's African Heartlands*. AWF Working Papers. Washingthon D.C. USA.

[16] Nugraha RT., J. Sugardjito. 2009. Assessment and management options of human–tiger conflicts in Kerinci Seblat National Park, Sumatra, Indonesia. *Mammal Study* 34, 141–54.

[17] Priatna, D., W. Novarino, H.T. Wibisono, Sunarto, H.A. Wahyudi, L. D'Arcy, J. Goodrich, N.B. Wawandono, A.S.B. Sutito. 2012. *Penyelamatan Harimau Sumatera: Pedoman Praktis Pencegahan dan penanggulangan Konflik Antara Manusia dengan Harimau*. Ditjen PHKA/Direktorat KKH, Kementerian Kehutanan: ix + 80 hlm.

[18] Saroso, H.N.O. Mencegah Konflik Harimau Sumatera dengan Manusia : Pelajaran dari Desa Talang Sebelas. http://www.teraslampung.com/2014/10/mencegah-konflik-harimau-sumatera.html.. Diakses pada 7 Desember 2015.

[19] Sunarto S, Kelly MJ, Parakkasi K, Klenzendorf S, Septayuda E, Kurniawan H. 2012. Tigers Need Cover: Multi-Scale Occupancy Study of the Big Cat in Sumatran Forest and Plantation Landscapes. *PLoS ONE* 7(1): e30859. doi:10.1371/journal.pone.0030859

[20] WCS. 2014. *Sumatran Tiger*.. WCS Indonesia: http://indonesia.wcs.org/Wildlife/SumatranTiger.aspx. Diakses pada 17 April 2016

[21] Wibisono, H.T. & Pusparini,W. 2010. Sumatran Tiger (*Panthera tigris sumatrae*): A Review of Conservation Status. *Integrative Zoology*, 5:309–318.

IMPACT OF ANIMAL HOUSING TOWARDS WORMS INFECTION IN LOCAL BEEF CATTLE FARMS IN DUKUHBADAG VILLAGE, CIBINGBING, KUNINGAN, WEST JAVA, INDONESIA: AN ANALYSIS

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ABSTRACT

Traditional beef cattle farming isa system still commonly practiced by many local farmers in Indonesia. Unfortunately, in this system, animal housing management as one of the most important production factors, is not given enough attention by the farmers. Therefore, this research intends to obtain information from farmers regarding theiranimal housing management, animal-health efforts, and the types of worms which commonly infect their cattle.

The research methodology used in this research is descriptive method with sample tests in the Center for Testing and Investigation of Animal Disease and Veterinary Public Health's laboratory, including data analysis, interviews, surveys, Focus Group Discussion (FGD), and secondary data. The result of the research shows: 1) the conditions of cattle housing do not meet the standard, additionally, there is no sanitation system, causing the enclosure to be damp and muddy - the perfect place for the proliferation of worms' eggs 2) Every cattle which being kept traditionally is mildly infected with worms' eggs (*Strongyle sp*, *strongyloldes Sp*, *Moniezia Sp*, *Fasciola sp*, *Paramphistomun sp* and*Coccidia Sp*). The recommendation given is to improve the sanitation in the animal housing, and to give helminthiasis medication regularly to increase the production of beef cattle.

Keywords: beef cattle, animal housing, worm types, helminthiasis

1. INTRODUCTION

Beef cattle farming in Indonesia is mostly dominated by local farmers. More efforts should be done to fulfill the demands of beef and improve the welfare of local farmers. The efforts to develop farms include 1)management 2)feeding and 3)breeding.

In this research, management means animal housing management, finance, and marketing. Animal housing management is about choosing location, construction, and sanitation for the sheds, which serves as animals' protection against rain, heat of the sun, wild animals, thieves, and also to maintain their health. The housing has several important functions for beef cattle business 1) protecting cattle from unfriendly weather 2) place where the cattle can rest comfortably 3) controlling cattle so that they don't ruin the plants around the farm 4) place to concentrate their excrements 5) protecting cattle from wild animals 6) making it easier to maintain, especially in feeding, drinking, and health surveillance (Abidin, 2002), quoted from Nainggolan (2013).

Helminthiasis (plural *helminthiases*), also known as **worm infection**, is any macroparasitic disease of humans and other animals in which a part of the body is infected with parasitic worms, known as helminths. There are numerous species of these parasites, which are broadly classified into tapeworms, flukes, and roundworms. They often live in the gastrointestinal tract of their hosts, but they may also burrow into other organs, where they induce physiological damage.Soil-transmitted helminthiasis and schistosomiasis are the most important helminthiases, and are among the neglected tropical diseases. This group of helmianthiases have been targeted under the joint action of the world's leading pharmaceutical companies and non-governmental organizations through a project launched in 2012 called the London Declaration on Neglected Tropical Diseases, which aims to control or

eradicate certain neglected tropical diseases by 2020. Helminthiasis has been found to result in poor birth outcome, poor cognitive development, poor school and work performance, poor socioeconomic development, and poverty. Chronic illness, malnutrition, and anemia are further examples of secondary effects.Soil-transmitted helminthiases are responsible for parasitic infections in as much as a quarter of the human population worldwide. Helminthiasis also infected in traditional beef cattlle.

Animal housing management is one of the production factors which has yet to be given enough attention from local beef cattle farmers. Therefore, this research intends to obtain information from local farmers about their animal housing management and animal-health efforts. The data is confirmed by directly observing the housing's construction, feeding management, and the cattle's health (by detecting helminthiasis in the cattle).

2. MATERIAL AND METHODS

2.1. Subject

The subject of this research is beef cattle from three locations: Karangsari (242 beef cattle), RW 02 (270 beef cattle), and Maja (800 beef cattle). For control, dairy cows which have been given medications every two months are used. In every group, a sample of three cows are taken to identify the worms' eggs.

2.2. Methodology

Descriptive method and sample test in the Center for Testing and Investigation of Animal Disease and Veterinary Public Health's laboratory, including data analysis, in-depth interview, survey, transect, Focus Group Discussion (FGD), and secondary data.

2.3. Socialization

Socialization is done through FGD to collect the problems faced by local farmers in Dukuhbadag village, Cibingbin, Kuningan. The common problems are: feeding, animal housing, and health, which is mostly about helminthiasis.

2.4. Sampling

From each group, three beef cattle's feces are extracted at random and examined in the laboratory. Below is the identification of the worm types.

Table 1. Population and sample

Group	Population	Sample
	----------per head----------	
A (Karangsari)	242	3
B (RW 02)	270	3
C (Maja)	800	3
K (Control)		3

2.5. Laboratory examination

Endoparasyte identification with Mc Master method:
1. Take three grams of sample and pulverize with mortal.
2. Add 60 ml of saturated sugar and stir until homogenous.
3. Filter and put into beker glass.
4. With pipette, put into the whitlock until full.
5. Check under the microscople with 4 x 10 magnification.
6. Match the worms' eggs with the pictures.

3. RESULT AND DISCUSSION

3.1. Animal Housing Management

Animal housing management includes choosing location, construction, and sanitation of the housing.

3.1.1. Location of the housing

The location of this beef cattle housing is about ten meters from people's housing and is next beside two rivers, Cilogodor and Cipicung. The ownership of the land used for animal housing is private and some of them are rented from the village. The animal housing area is rented by paying 30 kilograms of agricultural products (rice or corns) to Dukuhbadag village. According to Rasyid and Hartati (2007), quoted by Nainggolan (2013), the minimal distance from sheds and housing is ten meters.

Fig. 1. Location of the animal housing

Animal housing colony system 1) guarantee the health of the citizens because the animal housing is located quite far from people's houses 2) improve the cooperation between villagers and local farmers because of the joint security effort to protect the animals 3) improve the distribution of information and support. The animal housing in Dukuhbadag village all use the colony system, in total there are three colonies: Karangsari village 3, village 2 RW 02, and Maja village RW 01.

3.1.2. Animal housing construction

Materials used by local farmers to build animal housing are mostly wood, bamboo, and roof tiles, which are very easy to obtain around the village. The beef cattle shed owned by a respondent has yet to fulfill the standard of a good animal housing. This is mainly caused by the lack of information on how to build a good housing and the lack of capital. Modest animal housing has quite negative impact towards production and the health of the beef cattle as there's no place for manure disposal, as seen in this image:

Fig. 2. Traditional cow sheds

3.1.3. Animal housing sanitation

Local farmers do not have construction especially built for animal housing's sanitation, therefore, the manure is disposed directly behind the cattle. The floor is just made slightly higher, with flat surface and a disposal duct. The condition of the shed is worser in the rainy season, because the location of the shed will be muddy. It invites a lot of flies and worms in the shed. According to Widyani (2013), the animal housing's sanitation is very important for the health of the beef catle and its productivity. The animal housing needs to be disinfected periodically, and plants and wild grass around the housing also need to be cleaned.

3.1.4. Feeding Management

The feed given to the beef cattle from respondents are mostly green feeding, concentrated feed are not given because they believe if cattle are given concentrated feed, they will be infertile. This belief is mainly caused because of several factors: 1) the lack of knowledge on what concentrated feed are 2) funds 3) tofu and tempe home industries are located far from the farm.

(a) (b)

(c) (d)

Fig. 3. Cattle feed: 1) bulrush 2) wild grass 3) corn leaves and stalks 4) hay

The majority of respondents do not measure the amount of feed given to the cattle. Mostly the amount fed is just in accordance of the farmer's instinct. Some local farmers give brans as additional feed for their cattle. To anticipate for the dry season they preserve the food by drying the hay used for feeding. Only a small number of local farmers preserve food through silage.

During the dry season, the cattle are fed hay or corn straw and they are also herded to the places where there are still fresh grass. The places are usually located three to five kilometers from their village. This herding system is seen as innefective time-wise, since most of the farmer's time are spent to herd the cattle, even though it's done alternately so that they can still use the time for other productive activities.

Fig. 4. The pasture

During the rainy season, they cattles are fed with fresh grass, which mostly are obtained from their own land and in the pasture. Respondents mostly are oblivious to the fact that fresh grass obtained during the rainy seasonmay result in bloating and diarrhea.

3.1.5. Cattle health

Beef cattle farming in Dukuhbadag village uses a semi-intensive system, which means the cattle are herded from early morning until afternoon. It resulted to common cattle disease such as bloating, diarrhea, scabies, and flu. Local farmers don't give helminthiasis medication periodically every month. Only when the cattle is experiencing a decrease in appetite do they give them Vermix medicine brand.

Respondents admitted that for disease with mild symptoms they can still handle it themselves using traditional methods, however, as forrelatively heavy disease which cannot be treated traditionally, they have to call veteranians. The cost that they have to pay is around Rp 10.000 to Rp 70.000.

3.1.6. Endoparacyte identification result

The average *Strongyle sp*which infected the beef cattle in Karangsari group are 13,3 EPG, *Fasciola sp* 0,3 EPG and *Pramphistomun sp* 2 EPG. In Maja group, *Strongyle sp* is 86,67 EPG, *Strongyloldes sp* 6,67 EPG, *Moniezia ip* 40 EPG, and *Fasciola sp* 0,3 EPG. In Village 2 group, *Strongyle sp* is 140 EPG and *Paramphistomun sp* 1,33 EPG. The result of this research falls into mild worm infection. This is supported by Novalyta et. al. (2016), if the average of beef cattle is infected by 78 EPG of *Strongyle sp*, 2 EPG of *Stronglyoides* 2 EPG, *Moniezia sp* 13 EPG, *Fasciola sp* 0,3 EPG, and *Paramphiostomun* 1 EPG, it falls into mild worm infection.

Table 2. Endoparacyte identification result

No	**Spechman code**	**Nematoda**		**Protozoa**		**Trematoda**	
		Strongyle sp	***Strongyloldes sp***	***Coccidia sp***	***Moniezia sp***	***Fasciola sp***	***Paramphlstornum sp***
		egg per gram (EPG)					
	Control						
1	**K1**	0	0	0	0	0	0
2	**K2**	0	0	0	0	0	0
3	**K3**	0	0	0	0	0	0
	Average	0	0	0	0	0	0
	Karangsari						
4	**A1**	0	0	0	0	0	4
5	**A2**	0	0	0	0	0	0
6	**A3**	40	0	0	0	1	2
	Average	13,3	0	0	0	0,3	2
	Maja						
7	**B1**	160	0	Positif	120	0	0
8	**B2**	0	0	0	0	1	0
9	**B3**	160	20	0	0	0	0
	Average	86,67	6,67		40	0,3	0
	RW 02						
10	**C1**	0	0	0	0	0	0
11	**C2**	220	0	0	0	0	0
12	**C3**	200	0	Positif	0	0	4
	Average	140	0		0	0	1,33

Center for Testing and Investigation of Animal Disease and Veterinary Public Health Laboratory, 2016

The beef cattle kept in Maja and Village 2 housing have the same manure characteristics: black and watery, which shows that it's infected with *Coccidia sp*. According to Widyani (2013), cattle infected by *Coccidia sp* will produce softer manure than cattle infected by Ookista. Animal housing construction with good wall ventilation and dry flooring can prevent the spread of Ookista. For the cattle infected by Eimeria, there will be no Ookista symptoms during the feces examination, but the eficiency of feeding will decrease.

4. CONCLUSION AND RECCOMMENDATION

4.1. Conclusion

The farming system in Dukuhbadag village is semi-intensive. The animal housing construction is still non-permanent and clearly not feasible as animal housing due to the lack of sanitation system. Rainy season makes the surfacewet and muddy, which is perfect for the worm's eggs to live in. The result of endoparasyte shows that the cattle is infected by mild helminthiasis.

4.2. Recommendation

The researchers recommend the socialization of animal housing management, especially how to build proper animal housing sanitation system to control and handle the life cycle of worms, which needs commitment from local farmers to create a healthy environment, and to have further research to give helmintiashis medications using local produce that can be applied by farmers as an effort to improve the productivity of beef cattle in traditional farms.

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REFERENCES

Del Rosso, Joy Miller and Tonia Marek (1996). Class Action: Improving School Performance in the Developing World through Better Health and Nutrition. The World Bank, Directions in Development

https://en.wikipedia.org/wiki/Helminthiasis

London Declaration (30 January 2012). "London Declaration on Neglected Tropical Diseases" (PDF). Retrieved 26 March 2013

Luh. Gede Sri Astiti. 2010. Manajemen Pencegahan dan Pengendalian Penyakit Pada Ternak Sapi. Balai Pengkajian Teknologi Pertanian NTB.

Muhammad Roufiq Nezar. 2014. Jenis cacing pada feses sapi di TPA Jatibarang dan KTT

Nainggolan, Yunita Dewi Afiati. 2013. Studi eksploratif upaya kesehatan sapi potong peranakan ongole (po) oleh Peternak Di Kecamatan Halongonan Kabupaten Padang Lawas Utara Sumatera Utara. Fakultas Kedokteran Hewan. Institut Pertanian Bogor.

"Neglected Tropical Diseases". cdc.gov. 6 June 2011. Retrieved 28 November 2014.

Novalyta Nugraheni, Euis Tanti Marlina dan Yuli Astuti Hidayati. 2016. Identification of endoparasites helminth in beef cattle feces at before and after biogas processing in fixes dome digester. [Essay] [Bandung (Indonesia)] :Fakultas Peternakan. Universitas Padjadjaran.

Report of a WHO Expert Committee (1987). Prevention and Control of Intestinal Parasitic Infections. World Health Organization, Technical Report Series 749

Retno Widyani. 2013. Kesehatan Hewan. Penerbit Swagati Press.

_____. 2013. Ilmu Lingkungan Ternak. Penerbit Swagati Press.

Sidomulyo Desa Nongkosawit Semarang. [Skripsi] [Semarang (Indonesia)] : Fakultas Matematika dan IPA. Universitas Negeri Semarang.

"Soil-transmitted helminth infections". Fact sheet N°366. May 2015. Retrieved 30 June 2015.

Suhedi, E, Retno Widyani, Rudi Permana. 2009. Pengaruh pemberian pakan karuk dan dedak padi halus terhadap peningkatan bobot badan domba peranakan ekor tipis jantan. J Kandang. Vol 1, No 2 : 103-114.

Tekad Mandiri Citra. 2016. Bahaya Coccidiosis pada ternak. [Internet]. [Cited 29 Maret 2016]. Available from : http://www.temanc.com/detail_artikel.php?kode_obat=51

Thomas Herdt. 2002. Digestion: The Fermentative Processes. In: James G. Cunningham, DVM, PhD, editors.Texbook of Veterinary Physiology. United States of America (USA): WS Sounder Company. p. 280-303.

WHO (2012). "Research priorities for helminth infections". World Health Organization Technical Report Series. ***972*** *(972): 1–174.*

ESTABLISHING BASELINE DATA ON FISHERMAN AND FISH CAUGHT ON THE SERKAP RIVER, KAMPAR PENINSULA, RIAU

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ABSTRACT

Communities that live around Riau Ecosystem Restoration area made their living by fishing at Serkap river. The fishing communities spend 14-60 days for fishing in one trip. Intensity and number of fisherman in Serkap River can be a threat for fish sustainability as the result of over-harvesting. Observations to identify number of fish catch and fisherman in Serkap River for January-June 2016 were made to establish baseline data for future monitoring and management practices that will continue on a monthly basis. Each fisherman pass through forest ranger guard pos is interviewed on number of catch. Additional direct interviews with fishermen on were conducted to get in-depth information e.g. fishing duration, trend of harvest etc. From these data the number of fisherman and quantity of fish caught can be observed on a monthly basis. Seventeen (17) fishermen caught 2,113 kg wet fish during this 6-month period, approximately 124 kgs/person. Average catch per person for six groups of fisherman was as follows: 1-person: 333 kg; 2-persons: 67 kg; 4-persons: 58.5 kg; 5-persons: 29.8 kg; 8-persons: 78 kg; 10-persons: 63.9 kg. Based on these results, it can be observed that average catch per person generally declines as group size increases. This is dependent upon many variables such as number of days spent fishing, location, and type of equipment.

Keywords **:** fish, total catch, sustainable use, Serkap River, Kampar Peninsula

1. INTRODUCTION

Peatlands are unique ecosystems that formed from the remains of animals and plants. The process decay very slowly so soil peat has organic matter. Peatlands function is as carbon sink (C) and has a high water holding capacity thus supporting the hydrology of the area around them and also function as fastening *(sequester)* carbon , thereby reducing greenhouse effect (Parish et al, 2007). Generally, peat water has a pH of acidic to neutral, ie 3.5 to 7. With medium brightness (Whitten et al, 1987). That conditions affect the diversity and richness of fish species that inhabit in the waters of peatland and kind of species that is resistant to water quality. Utomo and Asyari (1999) states that the waters are acidic (peat) will be found a unique fish community. Base on the size and condition, there are many kind of fish that occupy peatland area. For freshwater fish species, Achmad and Dahril (1992) found there are 86 species of fish in some waters in Riau region. Research that is conducted in the waters along Rangau River found 70 species of fish (Yustina, 2001). Tjakrawidjaja and Haryono (2001) reported that peat in the mining area in Perawang had been collected 38 species. Generally, species diversity has been decreased, in Kampar Kiri River found only 86 species (Simanjuntak et al), Kampar Kanan River are 58 species (Fitra and Siregar), Koto Panjang Reservoir are 26 species (Warsa et al, 2009) and Siak River are 36 Species (Iskandar and Dahiyat).

Riau Ecosystem Restoration (RER) is one of IUPHHK-RE in Indonesia that has main activity to protect and restore peatland forest in Kampar Peninsula. It located in Teluk Meranti District, Pelalawan Regency, Riau. With that main activity, RER focuse on planting open area, canal blocking, and fire patrol to prevent forest fire so the forest can be restored. As restoration area, RER area become rare wild habitat such as Sumatran Tiger *(Panthera tigris),* Sun Bear *(Helarctos malayanus),* White-winged wood duck *(Cairina scutulata).* It shows that peatland forest in Kampar Peninsula as wildlife habitat must be protected from destruction because of human or fire.

RER area has four rivers that has dark water because located in peatland forest i.e. Sangar river, Serkap river, Turip river and Kutub river. The rivers has many peatland characteristic fishes, such as

Channa spp, *Hemobagrus nemurus* and *Krypyopterus* spp (Wahyudewantoro, 2010). Serkap river is the widest river among four rivers in RER area. In dry season, Serkap river has the biggest water discharge. Meanwhile, the other river is receding when dry season so it is hard to pass with boat. Communities use Serkap River as their source of livelihood because of easiness and availability of access. As source of livelihood for communities around RER area, Serkap River is always visited by fisherman to catch the fish, to be sold or eat by themself.

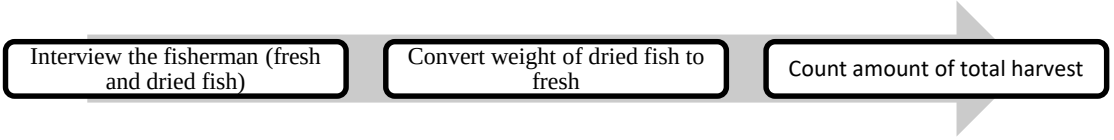
Small-scale fisheries support the livelihood and food security of millions people worldwide and if well managed can make significant contributions to human and socio-economic development (Bene et al, 2010 in Cohen et al 2011). However, the resources that support small scale fisheries are in decline (McClanahan, 2002; Worm et al., 2009 in Cohen et al, 2011). Intensity and number of fisherman in serkap can be a threat for fish sustainability as the result of over-harvesting. Almost every month, the fisherman always catch fish in Serkap River that can be affected to number of fish. To realize sustainable management, catching the fish must be managed. Before applying sustainable management, must be exist baseline data of fisherman catch in Serkap River. Baseline data consist of montly number of fisherman and fish catch. From that data, can be decided and applied sustainable management practice. This observation is conducted to get that baseline data.

2. MATERIAL AND METHODS

This observation is conducted for six months on January - June 2016 in Serkap River, Kampar Peninsula, Riau Province. Observation methods is interview to get more information about number of fish catch per person so it can be grouped by month. Interview was conducted in Forest Ranger Pos and fisherman hut in Serkap River. Fish catch that was brought by fisherman is fresh and dried fish. Thus, weight of dried fish must be converted to weight of fresh fish so can be counted amount of fish catch per fisherman per month. Additional directly interview were conducted to get in-depth information about fisherman, i.e. fishing duration, equipment, range area of fishing.

To convert weight of dried fish to weight fresh fish, must be multiplied with number 6,6 (water content dried fish 15 %). Sahyudi et al (2015) reported that water content of Mystus smoked fish are made from fresh fish is respectively 15 % higher than wter content of smoked fish are made frozen fish, which is 14,66 %. Meanwhile Suryanto et al (2014) reported that water content of selais smoked fish has range between 8 – 10 %.

To analize the data, number of fisherman and amount of fish catch were grouped per person and month so it can be determined average fish catch per person and per month as baseline data for future monitoring and sustainable management. The result describes trend of fish catch per person and month that shows actual condition in Serkap River about fisherman and fish catch by fisherman.



3. RESULT AND DISCUSSION

Based on observation that was conducted in Serkap River can be found 17 fishermen catching fish for six months on January – June 2016. The communities as fisherman is from village around RER area such us Teluk Meranti, Pulau Muda and Teluk Binjai. Data number of fisherman shown in table below.

Fishermen fish catch on study periods is 2113 kg for 17 fishermen. Same fishermen visit Serkap river several times during the study periods. Among 17 fishermen, Nuna/Inun get highest fish catch for six months on January – June 2016 totally 491 kg. They catch fish in Serkap River four times on January, March, April, and May. Seven fishermen catch fish once in the study area, i.e. Niak, Ijap, Nasri, Amad, Eman, Hendra, and Jono. Fisherman that catch fish once because they have the other livelihood such as palm oil farm, swiftlet nest so fishing is not the main livelihood

Table 1. Total Fish Catch per Fisherman

No.	Name/Month	January	February	March	April	May	June	Total
1	Nuna/Inun	333		104	30	24		491
2	Niak		67					67
3	Ijap		67					67
4	Untat			10	43		66	119
5	Herman			23	157		38	218
6	Backtiar			97	10			107
7	Bima/Bakar				133	100		233
8	Dani				67		38	105
9	Nasri				33			33
10	Amad				23			23
11	Eman				10			10
12	Idrus				133		133	266
13	Hendra					15		15
14	Kamar					10	10	20
15	Pendi						133	133
No.	**Name/Month**	**January**	**February**	**March**	**April**	**May**	**June**	**Total**
16	Kasim						193	193
17	Jono						13	13
Total		333	134	234	639	149	624	2113

Fisherman catch fish using traditional equipment, fish trap or locally known as “pengilar”, fishnet, line “tajur” and hooks. That equipment was made in the village and was brought to Serkap River when fisherman started cathing the fish. Equipment material was searched in the village so fisherman keep protecting natural source in the forest. Moreover, fisherman used died tree that fall down in the river. One fisherman can use more than one kind of fishing equipment, they use different tool in different location. In location with shallow water they use “pengilar” and line, while in deep water use fishnet and hooks. Moreover, fisherman use kind of equipment depends on kind of fish. Line is used to catching predator fish like *Channa micropeltes, Wallago attu.*

There are several reasons why certain fishermen here recorded with more catch. They get more catch is not only caused the day spend for fishing but also amount and type of equipment fishing and location catching the fish. Some fishermen stay for two months in the study area. The reason behind this is distance from their own home that takes a full day trip.

Number of Fish Catch

Observation for six months can be obtained data about amount and average fish catch per month. The result is shown in Table 2. The table below showed that highest catch occurred on April amounted 639 kg and February recorded the lowest for six months periode from January – June 2016. April was the month with highest presence of fishermen i.e. ten fishermen. While January is recorded the lowest fisherman activity followed by February. Based on interview with fisherman, they rarely do not catch the fish due to flooded river. In rainy season, the fish is more dispersed and many species is belived to move into the flooded forest. January and February are beninning of rainy season in Riau (BMKG, 2016). so the river water is flooded with high rainfall

Table 2. Amount and Average Fish Catch

Month	Amount of Fish Catch (kg)	Average of Fish Catch (x 10^1) (kg)	Fisherman (Person)
January	333	33,3	1
February	134	6,7	2
March	234	5,85	4
April	639	6,39	10
May	149	2,98	5
June	624	7,8	8

According to observation, can be counted average of fish catch from amount of fish catch and number of fisherman every month so can be determined trend of average fish catch in Serkap River for six months. The highest catch average is January with 333 kg, followed by June, February, April, March, and May. Although amount fish catch in April is the highest but the highest fish catch average is on January. On January there is one fisherman catch the highest fish i.e. 333 kg. Fisherman on January get the highest catch can be caused the day spending to fish and how many equipment that is used. Moreover, location with many fishermen in one area usually has competition cathing the fish so the amount is not as much as in location with little fishermen. Some fishermen also use more than one type of fish catch equipment and locate it in many location in Serkap River. They can set many equipments with wider range freely.

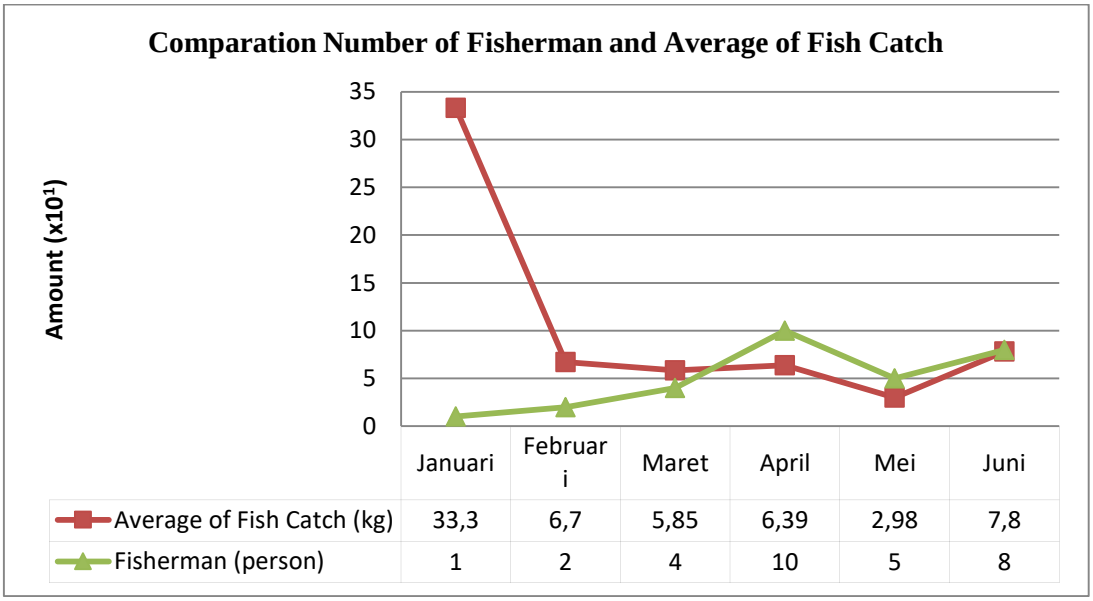


Fig. 1 Graphic Comparation Number of Fisherman and Average of Fish Catch

The trend between number of fisherman and average of fish catch can be seen in graphic above. There is relation that average of fish catch declines as increase of fisherman group. Although average of fish catch on April and June is increase but generally the trend is decline. That can be caused the pressure of fish stock is high. Almost along the year fisherman always catch the fish in Serkap River so probability of over-harvesting is high. To keep fish stock must be did sustainable fish harvesting management. The graphic is shown that amount of fisherman has effect to decline of average fish catch. The trend can be used as baseline data for monitoring fisherman catch. Fish caught by fisherman need to be managed to realize fish sustainable management in Serkap so the amount of fish can be kept.

Factors causing the decline in the number of fish populations by Moyle and Leidy (1992), can be caused by : a) Habitat degradation, b) pollution, c) introduction of foreign fish, d) commercial

exploitation. The population of demersal fishes tends to be decline in the last few decades. The decline was due to the increased of intensive catches, fishing effort and illegal fishing practices (Yonvitner and Fahmi, 2010).

Communities as fisherman around RER area use Serkap River as source of livelihood almost along the year due to easeness of access and fish abundance. Almost every month they get the fish that shown from observation result. In study periods, seventeen fishermen got fish with amount minimal weight 10 kg. Some fisherman stay in Serkap River for 2 months especially fisherman that catch fish in Tasik Besar. They stay in long time due to distance from village to fishing location. Fisherman needs two days to go Tasik Besar Serkap from the village so fisherman bring more logistics for two months. Most of communities are fisherman as main livelihood thus fishermen have high dependence in Serkap River as source of fish near the village. Because of that dependence, fisherman always visit Serkap River to catch fish along the year.

Sustainability in Fisheries

Fisheries management theory on the whole is traditionally based on a rather biocentric philosophical viewpoint (Garcia and Grainger 1997) and focusing on physical output and aim to sustain fish stocks and harvests (Charles 2001). Modern perspectives on fishery management focus on whole systems and aim to produce healthy ecosystems and human systems (Charles 2001). Healthy aquatic ecosystems are able to produce high social and economic benefits while remaining ecologically sustainable at the same time (Arlinghaus et al. 2002). This kind of sustainability is called strong sustainability. It assumes that the various forms of capital (biological, ecological, economical, social) are not equivalent but complementary, and should each be conserved in their own right (Costanza and Daly 1992). In contrast, anthropocentric weak sustainability implies that natural, man-made, human and social forms of capital are perfect substitutes for each other (Arlinghaus et al. 2002). Under these conditions, for instance, if economic values are high enough it is acceptable that rates of exploitation may surpass the ecologically sustainable limits of the resources concerned so does source river in RER area. To realize sustainable fish catch management in RER area, need to observe estimation fish stock because river in RER area become main livelihood for communities around RER area. Therefore communities around RER area have high dependence to river in area.

How fisheries are managed

Fisheries management can be defined as the use of all types of information (ecological, economic, political and socio-cultural) in decision-making to achieve goals related to the use of fish resources (Krueger and Decker 1999). The use of all this information in the activities of specific fisheries involves developing suitable tactics and operational plans to guide fisheries in keeping with overall strategic fishery objectives and policy directions (Charles 2001).

Fisheries management consists of the following elements (cf. Caddy 1999, De la Mare 1998, Charles 2001 in Juha and Timo):

1. Assessment (i.e. determining stock sizes, the extent of fishing efforts and fishing catches and recognising alternative management objectives);
2. Decision-making (i.e. choice of strategic objectives);
3. Selection of harvest strategies and tactics;
4. Implementation of a chosen set of management tactics and measures; and
5. Controls over implementation.

4. CONCLUSION

a) The number of Fisherman for January-June 2016 is 17 persons, some fisherman catch fish more than once. Total of fish catch during this observation is 2113 kg
b) Average catch per person for during six month periode was as follows:
    1. 1-person: 333 kg;
    2. 2-persons: 67 kg;
    3. 4-persons: 58.5 kg;
    4. 5-persons: 29.8 kg;

5. 8-persons: 78 kg;
6. 10-persons: 63.9 kg

c) The trend between number of fisherman and fish catch is decrease as the increase of fisherman in Serkap River

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REFERENCES

Achmad, M. dan Dahril, T. 1992. Conservation of Wetlands Adjacent to Large Rivers in Riau Province, Indonesia Ed. Ke-9. Pusat Penelitian Universitas Riau. Pekanbaru.

Arlinghaus, R., Mehner, T. & Cowx, G.I. 2002. Reconciling traditional inland fisheries management and sustainability in industrialized countries, with emphasis on Europe. Fish and Fisheries 3: 261-316.

Bene, C., Hersoug, B., Allison, E.H., 2010. Not by Rent Alone: Analyzing The Pro-Poor Functions of Small Scale Fisheries in Developing Countries. Development Policy Review 28, 325-358

Charles, A. 2001. Sustainable fishery systems. Blackwell Science, Oxord, 370 pp.

Cohen, P.J., Joshua, E.C., Simon, F., 2011. Fishing Dynamics Associated with Periodically Harvested Marine Closure. Global Environmental Change 23 (2013), 1702-1713.

Costanza, R. & Daly, H.E. 1992. Natural capital and sustainable development. Conservation Biology 6: 37-46.

Fithra RY, Siregar YI. Fishes biodiversity of Kampar River an inventory from Kampar Kanan River. Journal of Environmental Science 2010; 2(4):139-147.

Garcia, S.M. & Grainger, R. 1997. Fisheries management and sustainability: a new perspective of an old problem?. In: Developing and sustaining world fisheries resources: the state of science and management (eds. D.A. Hancock, D.C. Smith, A. Grant & J.P. Beumer). CSIRO, Collingwooe. p. 631-654.

Haerunnisa, et al. 2012. Management Model of Sustainability Fisheries at Lake Tempe, South Sulawesi, Indonesian. Fisheries and Marine Faculty. Hasanuddin University. International Journal of Science and Research (IJSR) Vol 4 Issue 6 June 2015 : 1939-1944

Iskandar J, Dahiyat Y. The diversity of fish in the Siak River Riau. Bionatura- Journal of Biological Sciences and Physical 2012; 1(14):51-58.

Juha Karjalainen, Timo J. Marjomäki. Sustainability in fisheries management. Department of Biological and Environmental Science. University of Jyväskylä. Finland

Krueger, C.C. & Decker, D.J. 1999. The process of fisheries management. In: Inland fisheries management in North America (eds. C.C. Kohler

McClanahan, T.R.,2002. The near Future of Coral Reefs. Environmental Conservation 29. 460-483

Worm, B., Hilborn, R., Baum, J.K., Branch, T.A., Collie, J.S., Costello, C., Fogarty, M.J., Fulton, E.A., Hutchings, J.A., Jennings, S., Jensen, O.P., Lotze, H.K., Mace, P.M., Mcclanahan, T.R., Minto, C., Palumbi, S.R., Parma, A.M., Richard, D., Rosenberg, A.A., Watson, R., Zeller, D., 2009. Rebulding Global Fisheries. Science 325, 578-585.

Parish, F., Sirin, A., Charman, D., Joosten, H.,Minayeva, T., Silvius, M., and Stringer, L.(Eds.). 2007. Assessment on Peatlands, Biodiversity and Climate Change: Main Report. Global Environment Centre, Kuala Lumpur and Wetlands International. Wageningen.

Sahyudi, Bustari, H., Desmelati, 2015. Evaluasi Mutu Sensoris dan Kimia Ikan Asap Baung (Mysyus nemurus) yang Dibuat dari Ikan Segar dan Beku. Jurnal Onlime Mahasiswa Volume 2, No 1 (2015). Fakultas Perikanan dan Ilmu Kelautan, Universitas Riau.

Simanjuntak CPH, Rahardjo MF, Sukimin S. Ichthyofauna in Floodplain of Kampar Kiri River. Jurnal of Ikhtiologi Indonesia 2006; 6(2):99-109.

Suryanto, A., Mirna, I., Desmelati., 2014. Quality Assesment of Smoked Selais (Cryptopterus bicirrhis) Result Using Laban Wood Smoke with Different Methods for The Storage Room Temperatur. Jurnal Online Mahasiswa Vol 1 No 1 (2014). Fakultas Perikanan. Universitas Riau.

Tjakrawidjaja, A.H. & Haryono. 2001. Keanekaragaman Jenis Ikan di Areal Penambangan Gambut erawang dan Sekitarnya, Kabupaten Bengkalis-Riau. P: 55-59. Sjafei *et al*. (Eds .) . Prosiding Seminar Nasional Keanekaragaman Hayati Ikan. Bogor 6 Juni 2000.

Utomo, A.D. & Asyari. 1999. Peranan Ekosistem Hutan Rawa Bagi Kelestarian Sumberdaya Perikanan di Sungai Kapuas, Kalimantan Barat. Jurnal Penelitian Perikanan Indonesia, 5(3): 1-14.

Wahyudewantoro, Gema. 2010. Kajian Potensi Ikan di Lahan Gambut Tasik Betung, Riau. Bidang Zoologi, Puslit Biologi-LIPI. Bionatura-Jurnal Ilmu-ilmu Hayati dan Fisik Vol 12. No 2, Juli 2010 : 57 – 62

Warsa A, Nastiti AS, Krismono, Nurfiarini. A Fisheries resources in Koto Panjang Reservoir. Bawal 2009; 2(3):93-97.

Whitten, A.J., Damanik, S.J., Anwar, J. and Hisyam,N. 1987. The Ecology of Sumatera. Gadjah Mada University Press. Yogyakarta. 53 p.

Yustina. 2001. Keanekaragaman Jenis Ikan Di Sepanjang Perairan Sungai Rangau, Riau Sumatera. Jurnal Natur Indonesia, 4 (1) : 1-14.

Yonvitner and Fahmi, 2010, Population dynamics of Dominant demersel Fishes Caught in Tambelan Islands Water, Riau Archipelago Province. Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science. Bogor Agriculture University. Diodiversitas Jurnal Volume 13 Number 4, October 2010 : 200-204

WALKING THROUGH CONVERSION: A MONITORING OF ELEPHANT MOVEMENT IN DEGRADED FOREST OF TESSO NILO LANDSCAPE

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ABSTRACT

The critically endangered Sumatran elephant is a subspecies of Asian elephant which has large home-range. A monitoring of elephant movement based on GPS collaring was conducted in degraded forest of TessoNilo Landscape (including national park area and other land use areas)in2015. As the result, received 587 coordinate locations with the largest monthly MCP (Minimum Convext Polygon) was in August around 324 km^{2}with also the longest distance movement was 12.852 km2 in the same month. Forest fire influencing the elephant movement was also captured during summer dry seasonwith 845 hotspots in TessoNilo landscape during peak of dry season April to October 2015. The monitored elephant was avoiding forestfires that proved by MCPs outside the forestfire areas. Information of elephant movement is useful for habitat management and protection, especially in TessoNilo, the information can be used for mitigating human – elephant conflict by raising awareness of people, concessionaries, and stakeholder. Also, in term of poaching, it is helpful for protection team to reduce elephant killing by retaliatory poaching and professional poaching.

Keywords**:** Better Management Practices, intensive patrol, conflict management, spatial distribution, forest fire.

1. INTRODUCTION

The Sumatran elephant is an endangered species by Red-list IUCN A2c ver 3.1 (Gopala, et al., 2011). This species is an island elephant species where separated to the Asian mainland elephant. Since the 1990s, the wild population of Sumatran elephants (*Elephasmaximussumatranus*) has declined by approximately 35%, to an estimated 2,400–2,800 individuals (Soehartono et al. 2007; Sitompul et al. 2013). This animal is umbrella species to other species due to large home range in covering species habitat. This elephant sub-species is social animal that has group for female as well as calve, young male and female elephants. However, adult male has separated to his group into solitary elephant. Reportedly, a female of the Sumatran elephant has home range size about 97.4 km^2(Sitompul et al. 2013). In related to Indonesia's legal policies have been introduced into Indonesian law. Act 5/1990 for the Conservation of Living Resources and Their Ecosystems, Act 23/1997 for the Basic Provision for the Management of Living Environment, Act 41/1999 for Forestry Management, Government Regulation No. 7/1999 for Preservation of Fauna and Flora, and Government Regulation No. 8/1999 for Utilization of Fauna and Flora were created (Azmi & Gunaryadi, 2011).

The Sumatran elephant in Riau province has distributed to 9 elephant pouches such as Mahato, Koto Tengah, Balai Raja, GiamSiak Kecil, Tapung, Tesso Utara, Tesso Tenggara, Serangge, and Pamayungan. These pouches are formerly reported as natural forest areas that in general have been degraded and fragmented to human uses such as settlement, plantation, mining, and infrastructure. Although those areas have been degraded and fragmented, those pouches are still home to wild elephants. Tragically the elephant population in several pouches is extremely declining due to land conversion, elephant killing caused by human – elephant conflict or poaching. Land conversion is becoming a contributing factor in causing elephant population declinesbesides poaching for the tusk.
We are intensively monitoring of elephants by using GPS collar in the most populated elephant pouch in Riau namely TessoNilo landscape (TNL) consist of TessoNilo National Park and surrounding areas

with the size is 627,451.95 km^2 (WWF – Indonesia, unpublished data). This landscape is being dominated by low-land forest and shallow peat-land forest so that it is becoming the highest population of elephants in central Sumatra. This landscape is also becoming the biggest conservation area for elephants in Riau (Desai &Samsuardi, 2009).Threats are thriving in this landscape because of good season crossed by equator line and because of accessible of the terrain. By using coordinate information, we can determine the actual suitable habitat and preference habitat of elephant.This study aims to generate elephant movement areas which is useful for elephant and habitat management including conflict mitigation and protection.

2. MATERIAL AND METHODS

Sumatran elephants are large home range animal so that we should know deeply their movement to describe the specific of elephant conservation areas, however, is difficult because there is no information on the movements and home range of elephants on Sumatra (Sitompul et al. 2013). Especially in TessoNilo Landscape which is our focus area for elephant monitoring, we do not have any sufficient data of it. Using GPS collar to know the elephant distribution size is a solution. GPS collar is modern tool that can send the coordinate information to satellite automatically, thus we can use the coordinate information to monitor wildlife in the wild. We use GPS collar from AWE Telemetry System (https://www.awetelemetry.com/animal-tracking/) that provides GPS coordinate information by downloading the transmitted GPS coordinate to our server provided.This tool can be automatically operated by sending the GPS coordinate to satellite and to user. We have fitted two GPS collars to two adult female elephants in TessoNilo in 2013, however, tragically one individual was killed in 2014. We are downloading the collar coordinates every month.The information from satellite encompasses GPS coordinate, temperature (deg C) and altitude (meter) of the elephant movement area, and distance of elephant movement (kilometer).

GPS and maps

This study was based on spatially study which is consisting spatial data and analysis. We use ArcGIS 10.1 to manage and analyze the GIS layer data (ESRI 2012) at fire layers were provided by NASA (https://earthdata.nasa.gov/earth-observation-data/near-real-time/firms/active-fire-data) and land cover layer was provided by NOAA (http://asmc.asean.org/) and Aqua-terra satellite (http://terra.nasa.gov/about/terra-instruments/modis). MCP (minimum convex polygon) size calculated by connecting dots of elephant movement area. We compared information of GPS coordinate, temperature (degree C) and altitude (meter) of the elephant movement area, and distance of elephant movement (kilometer) with MCP and fire hotspot number. By comparing those information above, we can understand impact of the habitat to elephant movement without complex statistic.

3. RESULT AND DISCUSSION

We were observing elephant movement and behavior in two seasons of 2015 with received 587 coordinate locations. Our study wasfocusing to monitor an elephant with ID 324 which has been fitted with a GPS collar on her neck. Based on the result,the largest MCP was in August with the size is 314 km^2 which is far larger than other study 97.4 km^2 by Sitompul et al (2013). The main daily distance movements (Table 1), from the lowest to the highest, are zero or near zero kilometer every month for the lowest movement and 12.852 km^2 in August for the longest movement. TN generally has two seasons; monsoon wet and dry with no different between two seasons so that there is no significantly influence elephant movement both seasons. Also, TN has high humidity (>80%) and precipitation ranging from 2,000 to 3,000 mm annually (Sunarto et al. 2015). We have assumed that elephants in TN were following food distribution and avoiding threats. Also proved by Rood et al (2010) that elephant presence was positively related to forest cover and vegetation productivity.

Elephants in TN have large home-range in southern and northern of the landscape, however, tragically almost entire their ranges have been degraded habitats because of illegally encroachment, plantation (Acacia, Eucalyptus, oil palm, and rubber) and other human use areas with accessible roads. Since 1990, deforestation in Sumatra has contributed to a loss of 7.45 million hectares in an area of primary forest measured 75,000 km2 (Margono et al 2012; Yulianti et al 2013). Primary intact forest loss in Riau accounted for nearly 68% of all primary intact forest loss in Sumatra (Margono et al 2012).Some

elephants found dead in the area which were mostly killed by conflict retaliation and even poaching that driven by conflict or professional poaching. Based on other study Sitompul et al (2013), the use of roads by elephants may also increase their risk to poachers.

Table 1. Elephant movement and habitat information during the dry season April to October 2015

Month (in 2015)	Elephant Movement				
	Temp (deg C)	Alt (m)	Distance (km)	MCP Size (km2)	Fire hotspot
January	26-33	37.1-67.0	0-3.459	11.06	12
February	26.5-31.5	0.7-78.1	0-5.797	12.01	13
March	25.5-34	0.3-97.2	0-3.731	25.47	2
April	26.5 - 34	11.1 - 79.9	0 - 4.098	69	13
May	26 - 34.5	10.3 -67.8	0 - 4.354	89	21
June	26 - 35	10.9 - 78.3	0 - 3.376	45	118
July	25 - 34.5	10.5 - 70.4	0 - 9.263	51	323
August	27 - 34	13.7 - 110	0 - 12.852	314	94
September	25.5 - 36	18.1 - 214	0 - 3.682	47	272
October	25.5 - 35	22.4 - 147	0 - 11.432	213	4
November	26-35.5	37.1-104	0.036 - 7.224	42.8	2
December	25.5-35.5	0.4-76.6	0.022 - 2.684	32.23	0

Elephant and forest fires

Sumatra Island faces annual forest fire disaster that is notable that the frequent fire occurrence in Sumatracoincides with the rapid rate of deforestation and It is also evident that most fires are re-lated to agriculture activity, and this is consistent with Sumatra being home to the largest industrial plantations in Indonesia (15,280 km2) (Joosten et al 2012; Yulianti et al 2013).Based on our analysis, elephants were scattered moving during forest fires in summer dry season. We presume that forest fires were influencing the elephant movement and behavior. Dry season is also a fragile season of forest fire phenomenon in the island.

Especially in TessoNilo Landscape where our study wasfocused on, based on our hotspot information that provided by the Aqua-terra satellite, we have captured 845 hotspots in Tesso Nilo landscape during peak of dry season April to October 2015. Forest fire was also become a factor to influence how large elephant movements during that time. We found that because of forest fires, elephants have been moving wider than the season with rarely fires. Based on our data, during June – September, elephants were moving wider than several months before those months. We assumed that elephants wereavoiding the fires. The largest movement encountered was around 12.852 km in one day. It was also influencing the MCP (Minimum Convex Polygon) size that was used to compare how large they can move on their actual home ranges (Fig. 1). Based on our analysis that they have the widest movement in October when the beginning of rainy season starts with the MCPs were not in the hotspots.

Based on GPS collar information, we assumed that elephant movement was related to the hotspots (Fig 1). The elephant movement was depending on hotspot distribution. Also, during our monitoring since January until October 2015, we found that elephant avoided the hotspots. Forest fire also had influenced to MCP size that based on the maps above. Forest fires become seriously deadly catastrophe in Sumatra Island.

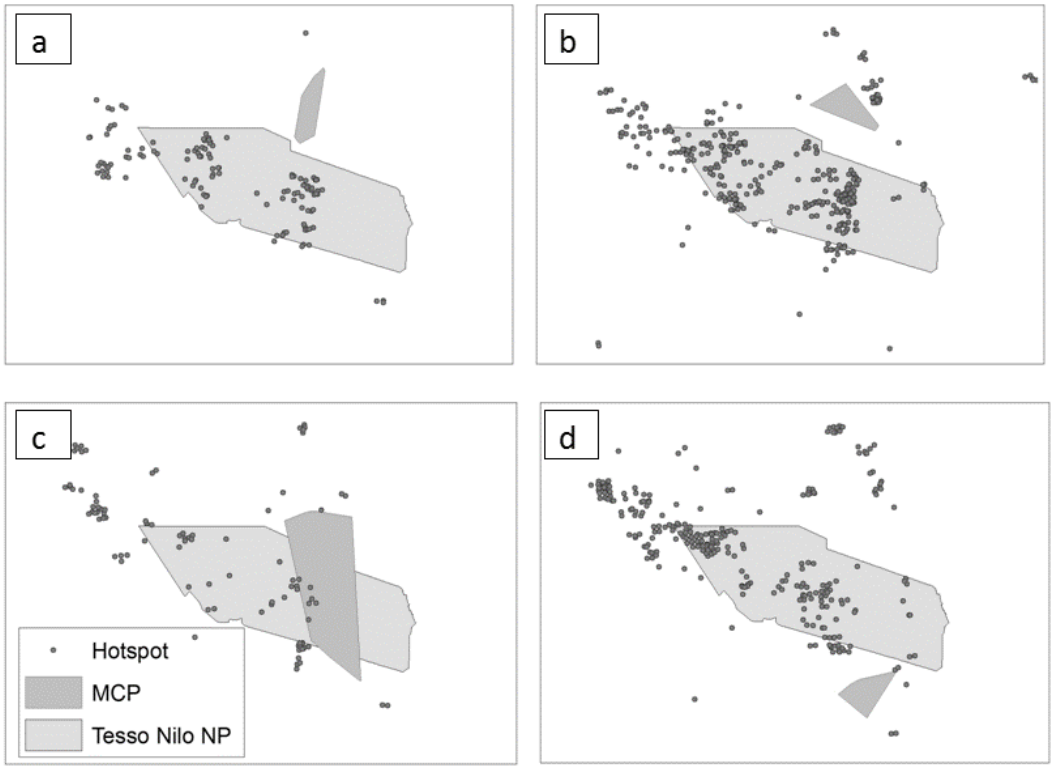

Fig. 1. Map of elephant movement and forest fires in TessoNilo Landscape during huge forest fire moments June to September 2015. From above: (a) elephant movement in June; (b) elephant movement in July; (c) elephant movement in August; (d) elephant movement in September.

Implication for elephant habitat management and protection

This report is showing the actual information of elephant movement which was occurred in TessoNilo Landscape in 2015.This study is useful for mostly elephants and its habitat management as well as protection. Based on findings of the study, we have produced plenty of useful recommendation and have been taking action in the field so that for some reasons, continuing of GPS collar study is pivotal in the future. Study says that within actual and potential elephant home-range, we should do several activities such as raising awareness to local community, multi-level of government and their agencies and private sector to concern about this issue and elephant conservation works.Actual elephant movement can be shown by GPS collar to help stakeholder for mitigating human – elephant conflict such as engaging concessionaries and other parties in and around TessoNilo Landscape, however, we need supportfrom government in collaborating about elephant conservation program especially inside the national park.In outside the park, concessionaries can implement Better Management Practices (BMP) for elephants which use their concession for habitat and movement area.In the end, management includes monitoring and protection by involving stakeholder is useful for habitat management and protection.

4. CONCLUSION

Based on study we recorded the largest MCP of elephants is around 314 km^2 in August and elephant movement is not only inside the national park but also throughout the landscape with landuse divides. People are occupaying inside and outside landscape of TessoNilo so that in and around elephant homerange, to minimize conflict impacts and elephant killing for poaching, we should conduct conflict mitigation and protection by doing intensive patrols.

REFERENCES

Azmi, W., & Gunaryadi, D. (2011). Current status of Asian elephants in Indonesia. *Gajah 35(2011)*, 55-61.

Chong, D. K., & Dayang, N. A. (2005). Gudelines on the better management practices for the mitigation and management of human-elephant conflict in around oil-palm plantations in Indonesia and Malaysia, Versiaon 1. *WWF - Malaysia, Petaling Jaya, Malaysia*.

Desai, A. A. (2002). Design of human-elephant conflict mitigation strategy for the proposed TessoNiloProtected Area, and possible expansion of such strategy into the TessoNilo Conservation Landscape, and the Province of Riau. *WWF - Indonesia, Jakarta, Indonesia*.

Desai, A. A., & Samsuardi. (2009). Status of elephants in Riau Province, Sumatra. *WWF - Indonesia, Jakarta, Indonesia*.

ESRI. (2012). ArcGIS 10.1. . *Environmental Systems Research Institute, Redlands, California, USA*.

Gopala, A., Hadian, O., Sunarto, Sitompul , A., Williams, A., Leimgruber, P., . . . Gunaryadi, D. (2011). Elephas maximus ssp. sumatranus. . *The IUCN red list of threatened species. Version 2014.3. <www.iucnredlist.org>*, Downloaded on 10 March 2015.

Joonsten, H., Tapio-Biström, M., & Tol, S. (2012). Peatlands—Guid- ance for climate change mitigation through conservation, rehabilita- tion and sustainable use. Rome: The Food and Agriculture Organiza-tion of the United Nations and Wetlands International.

Margono, B. A., Turubanova, S., Zhuravleva, I., Potapov, P., Tyukavina, A., Baccini, A., . . . Hansen, M. C. (2012). Mapping and monitoring deforestation and forest degradation in Sumatra (Indonesia) using Landsat time series data sets from 1990 to 2010. *Environt. Res. Lett 7 (2012).*

Rood, E., Ganie, A. A., & Nijman, V. (2010). Using presence-only modelling to predict Asian elephant habitat use in a tropical forest landscape: implications for conservation. *Diversity and Distribution (Diversity Distrib) (2010) 16*, 975-984.

Sitompul , A. F., Griffin, C. R., & Fuller, T. K. (2013). Sumatran elephant ranging behavior in a fragmented rainforest landscape. *International Journal of Biodiversity and Conservatin Vol. 5(2).*, 66-72.

Sitompul, A. F., Griffin, C. R., Rayl, N. D., & Fuller, T. K. (2013). Spatial and temporal habitat use of an Asian elephant in Sumatra. *Animals 2013, 3*, 670-679.

Soehartono, T., Susilo, H. D., Sitompul , A. F., Gunaryadi, D., Purastuti, E. M., Azmi, W., . . . Stremme, C. (2007). The strategic and action plan for Sumatran and Kalimantan elephant. *Departemen Kehutanan (Ministry of Forestry): Jakarta, Indonesia*.

Sunarto, S., Kelly, M. J., Parakkasi, K., & Hutajulu, M. B. (2015). Cat coexistence in central Sumatra: ecological characteristics, spatial and temporal overlap, and implications for management. *Journal of Zoology, 296: 104-115. doi:10.111/jzo.12218*.

Yulianti, N., Hayasaka, H., & Sepriando, A. (2013). Recent trends of fire occurence in Sumatra (analysis using MODIS hotspot data): a comparison with fire occurence in Kalimantan. *Open Journal of Forestry 2013 Vol. 3, No. 4*, 129-137.

EVALUATING THE INTERVENTION METHODS TO REDUCE HUMAN-ELEPHANT CONFLICT AROUND WAY KAMBAS NATIONAL PARK

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ABSTRACT

Since 2001, WCS-IP with local communitieshas been developing various intervention methods to reduce human-elephant conflict around Way Kambas National Park. Evaluation on the implementation of these methods is crucial to assess the effectiveness of each techniques to preventcrop raiding by elephants.In this article, we examine nine intervention methods whichhavebeen implemented around WKNP, including: 1) tin-can fences, 2) tripwire-triggered fences, 3) trenches, 4) barbed-wire fences, 5) beehive fences, 6) chili fences and dung fires, 7) rolling drums, 8) community-based guarding, 9) microfinance scheme. The description, implementation, advantages and disadvantages of these methods are discussed here. We also provided the recommendation for future implementation to reduce human elephant conflict in WKNP.

Keywords: evaluation, human-elephant conflict, intervention methods, Sumatran elephants,Way Kambas National Park

1. INTRODUCTION

Evidence-based conservation is vital in the management of conservation programs (Davies et al. 2011). Various conservation programs have been implemented by many parties in and around Way Kambas National Park (WKNP), especially focusing on Sumatran elephants, including population analysis (Hedges et al. 2005; WCS-IP 2014), identification on the needs and challenges of Sumatran elephant conservation (Hedges et al. 2005; Hedges 2012), and human-elephant conflict management (Nyhus et al. 2000; Sitompul 2004; Hedges & Gunaryadi 2010). Evaluation on thoseprograms is indispensable to assess if the programs weresucceeded in conserving the elephants and whether additional improvement needed.

This is also applied for the human-elephant management programs. Hedges et al. (2005) reported beside hunting and habitat loss, human-elephant conflict (HEC) is the main cause of elephant population decline in Sumatra. Human-elephant conflict has become a complex conservation challenge because it involves multi factors, from the ecology and behavior of the species to the socioeconomic and political aspects of stakeholders dealing with it (Sitompul 2004). As the second priority sites for Sumatran elephant conservation(Santiapillai & Jackson 1990), WKNP has a long history and high frequency of HEC. In 2015, 437 incidents of HEC have been reported in 17 villages around WKNP (WCS-IP 2016). It is an increasing number, compared to 2014 whilst only 291 incidents recorded.

Wildlife Conservation Society-Indonesia Program (WCS-IP) since 2002 hasbeen actively involved in managing HEC by preventing the elephant intrusion to the crop area. Together with community and WKNP Authority, WCS-IP have been developing methods to reduce crop raiding by elephants, such as community-based crop guarding, early warning detection system, building physical barriers, and microfinance scheme. Yet, there have been few rigorous assessments on the effectiveness of these methods. Evaluation on intervention methods is crucial to assess which method or combination methods is the most effective in reducing elephant crop raiding (Nelson et al. 2003; Hedges & Gunaryadi 2010; Davies et al. 2011).

This study aims to evaluate the effectiveness of nine methods applied on elephants' crop raiding intervention around WKNP. We discuss the description, implementation, advantages and disadvantages of the methods and provide some recommendations for future implementations.

2. MATERIAL AND METHODS

Human-elephant conflict (HEC) datawascollected by WCS-IP Wildlife Response Unit team (WRU), who has been conducting HEC mitigation activities since 2002. We defined HEC as the case when the elephants come out from WKNP forest area and try to enter community crop or settlement areas. We developed a communication scheme of local informants who notified WRU team when HEC occurred. After received the notification, WRU team moved towards the conflict locations to assist protecting the crops with local villagers and collected the HEC data. Data collected including date and time of the conflict, detail of conflict elephants (age, individual numbers), intervention methods applied in the conflict location, and the result of intervention.

Crop raiding intervention methods discussed in this article are methods which have been developed by WCS-IP, local community, and WKNP Authority since 2002.We categorized the methods into three types of intervention: 1) early detector, 2) passive deterrents, 3) active deterrents, and 4) compensation scheme. We analyzed the effectiveness of intervention methods using scoring methodbased onseven categories: 1) implementation cost, 2) maintenance, 3) area scale, 4) endurance, 5) effectiveness to reduce crop damage, 6) risk to elephants, and 7) implementation problems. Each category was given score 1-3, with total score of overall effectivity is 21.

Only two methods which their effectiveness had been systematically evaluated: chili-based crop protection and rolling drum. Forabove-mentioned methods, we used the evaluation reports to assess their effectiveness. For the other seven intervention methods, we mainly usedHEC data and annual reports to assess the effectiveness. In addition, we conducted interview with WRU team and local villagers to verify the evaluation results.

3. RESULT AND DISCUSSION

Early detection tools

Tin-can fences

Tin-can fences are traditional fences consisted of barbed wire or ropestung across elephant active routes. Tin-cans and stones attached to the fences will produce loud noises when elephants tried pass the fences and alert the guards. Tin-can fences have been used by local villagers since 1980s and succeeded in detecting the approaching elephants.

Simply purposed as early detector, tin-can fences do not requirehigh cost materials, and it is easy to make. The fences can be installedin different types of area, from trenches wall side, paddy fields, to swamps. It is also applicable for large area, i.e. one tin-can fence can be extended up to 50 meters. Tin-can fences could also deter other pest animals such as birds and pigs. Conversely, extensive use of these fences can induce habituation on the elephants. Tin-can fences also prone to get broken while being crashed by theherd of passing elephants.

Tripwire-triggered fences

Tripwire-triggered fences are consisted of tripwire attached between two fences in elephant active routes. These fences will trigger electronic sirens to alert the guards when elephants tried to pass the fences. Tripwire-fences have been frequently used in 2005-2007 and occasionally used in the following years.

The advantage of tripwire fences ison its dual function feature, as early detector and also act as deterrent. In period of February-April 2016, we found that tripwire fences set in one elephant active route were successfully scare away the approaching elephant three times,because of the sirens loud noises. Another advantage isits large scale protection, like tin-can fences. The disadvantages of this

method are the possibility of elephant's habituation, the risk of vandalism from the elephants or people, and a lot of maintenance.

Passive deterrents

Trenches

Trenches were built in some part of the area, along national park boundary, to prevent the movement of elephants to the crop areas. The trenches, with wide and depth of 3-5 m, currently extend to the length of 27 km and separated 14 villages with national park. Based on local villagers, the construction of trenches was greatly reduced the conflict frequency especially when it was first built in 1994. However in these recent years, the main problem of the established trenches is the lack of maintenance which caused erosion of the side walls. The erosion fills up the trench thus providing access for the elephants to pass the trenches. To maintain the effectiveness of canal, local community and WCS-IP built stone and concrete walls to stabilize the side of trenches, but this also increases the cost significantly.

Barbed wire fences

Barbed wire fences are consisted of barbed wire setacross elephant active routes. The barbed wire will act as deterrent to approaching elephants. The pain from pushing or pulling the barbed wire will make the elephants back away to avoid the fences. Like traditional tin-can fences, the cost to build barbed wire fences is relatively low. These fences also can be set in many types of area and cover large area. Currently, barbed wire fences are not used anymore because they had little effects on preventing the elephants' movement since they are prone to get broken while being crashed by the elephants.

Beehive fences

Beehive fences are passive deterrent method adapted from Africa to deterthe elephants using honey bees *Apiscerana*. There are two types of beehive, the box beehive attached to the ground and hanging beehive using coconut trunk as medium. Both beehives were attached to rope strung across elephant active routes and when elephants crossed, it will pull the rope, shake the beehive, and trigger the bees to attack the elephants. Another advantage of these fences is the beehives will produce honey and provides extra income to the farmers that might reduce the losscaused by elephant crop raiding.
Beehive fences were tested in 2004 in two villages around WKNP. Ten locations in elephant active routes were selected and fences were set. In the trial stage, beehive fences were found not effective because of disturbance from humans, ants, and sun bears; the bees moved away; and the elephants created new routes, 5-10 meters next totheir initial routes to avoid the beehives.

Chili fences and chili-dung fires

Chili-based crop protection methods were being testedby WCS-IP duringOctober 2006-April 2007. The aim of the test is to assess their effectiveness in detering the elephants. Two additional methods were combined with chili methods to form three layers of protection: 1) tripwire fences as early detector set in the front line, 2) chili fences and chili-dung fires as passive deterrents, and 3) crop guarding as active deterrent set at the back line. Detail of two methods: tripwire fences and crop guarding are explained in each method sections.

Dried hot local chili powder (*cabairawit*) mixed with old engine grease (ratio 1:1) to form chili-grease was applied to rope and cloth spacers stung between fences. The chili-grease then was reapplied frequently especially when raining seasons because the grease washed off by the rain. Chili dung fires are made by mixing chili-grease with fresh elephant or cow dung. The mixture then dried the mixture to make briquettes that burnt to make a noxious smoke. In Africa chili protection methods are proven effective to deter elephants from crop areas.

The result found that community-crop guarding played big roles in chasing away the elephants instead of chili methods. Chili fences did not add significant deterrent effects and required a lot of efforts for maintenance to reapply the chili-grease.Chili dung fire also impractical as the wind direction was drifting the smoke to the crop areas rather than forest area where the elephants came from. After the evaluation, chili-based crop protection methods were not used in Way Kambas anymore.

Rolling drums

Rolling drums are barriers built from drums with sharp edges on the surface attached to the pole between two concrete pillars.As the elephant usually use their trunk to examine the object in front of them, the sharp edges of the drums will cause pain sensation when get touched by the trunk, and deter the elephant to pass the drums. The big dimension of the drums also makes it harder for the elephants to push or to pull it using their trunks.

Rolling drums arethe first method initiated by local community around WKNP. In 2015, WCS-IP helped local villagers to build 13 rolling drum and installedit in 10 elephant active routes in three villages, mostly in the narrow and steep routes on the edge of canals. Rolling drums were found prevent the elephants to enter the crop areas, especially when the first three-months of trials. In the following months, the elephant showed learning signs where the elephants kicked and pulled the concrete pillars to deactivatethe drums.

Active deterrents

Community-based guarding

Crop protection by local villagers has been implemented since early 1980 when the human-elephant conflict started to occur. In 2007, local villagers were voluntary adopted community-based guarding scheme developed by WCS-IP until now. The guarding involved the use of supplementary tools such as sirens, spotlight, and fireworks. WCS-IP also helped local villagers building some watch towers to monitor the elephants' movement. Currently, local villagers have developed guarding shifts in their own villages and intensified the use of mobile phones for immediate response and coordinating guarding between villages.

Community-based guarding has encouraged participation from local villagers to guard their crops from elephants(Hedges & Gunaryadi 2010; Graham et al. 2012). This method is effective at keeping elephants out of the crop areas because of immediate response and coordinated guarding. Although effective, the guarding requires dedication and commitment especially when conflict peak seasons and the team have to guard their crops from dusk to dawn for months.

Compensation scheme

Microfinance scheme

In 2010, WCS-IP developed microfinance scheme to promote greater community participation in resolving human-elephant conflict around WKNP through the development of local organic farming, fish farming, duck rearing for eggs and vegetables farming. By developing these activities along the border between forest and crop areas, it is hoped to increase motivation to invest in the area and to guard it properly from the elephants. The scheme has also intended to generate alternative incomes and improve the community resilience to elephants' crop raiding. Three villages were chosen as model villages to promote this microfinance scheme.

Although having good concept, the implementation found two main problems: 1) the swampy areas in the demonstration plot were highly flooded during the first quarter of 2010 and affected the crops and livestock production. 2) monthly basis finance system which didn't accommodate theactual needs in the field, especially when the team facing crop or livestock failures and need immediate recovery fund. This microfinance scheme was not continued after the trial in 2010.

Evaluating the intervention methods

Currently, five out of nine intervention methods (tin-can fences, tripwire fences, trenches, rolling drums, and community-based guarding) are still used to reduce HEC around WKNP. The other four methods were not used because they were unlikely effective in reducing the conflicts. Beehive fencesand chili crop protection methods for example, both were not implemented after trials in 2004 and 2006-2007 respectively because both had little effects on deterring the approaching elephants although implementation of chili crop protection (Osborn 2002; Parker & Osborn 2006; Hoare 2012)

and beehive fences (King et al. 2011). Different type of chilies and bees used in trials, climate, and vegetation community (for beehive fences) may affect the effectiveness of these methods around WKNP.

Evaluation on crop raiding intervention methods will provide some lessons learned and best practices to develop the betterconflict management strategies in the future ((Nelson et al. 2003; Osborn & Parker 2003; Davies et al. 2011; Hoare 2012). Assessment on current methods showed trenches and community-based guarding as two most effective methods to prevent elephants' intrusions (Table 1). We identified community-based guarding as key success in preventing elephants' crop raiding. These community groups have proved in playing important roles and, in a certain way, contribute to the community development itself to manage HEC. We also consider the issue of exhausting activities, psychological fatigue, and the amount of social cost in the implementation of community based guarding. In the future, the community needs to be assisted to organize themselves, consolidate their resources, and find the most effective way in implementing community-based guarding.

Trenches also have proved as the effective passive deterrent method to limit the elephants' intrusion to crop and settlement areas. The issue of passive deterrent methods is the lack of maintenance which eroded the methods' effectiveness. In trenches case, the lack of maintenance has caused wall erosionwhich provides access for the elephants to pass.Thus, we highlighted the need of routine maintenance to preserve passive deterrent methods effectiveness.

Conflict management can not only depend on one intervention method but need to be combined with other methods as we are dealing with elephants, intelligent animals who can learn to overcome the protection methods(Osborn & Parker 2003). The optimal combination of intervention methods consist of three layers of protection: 1) early detectors, 2) passive deterrents, and 3) active deterrents. These combined methods are important to deal with the elephants. In Way Kambas, using trip-wire fences as early detectors, trenches combined with physical barriers such as rolling drums, and community-based guarding as active deterrents will provide maximum effects on deterring the elephants.

4. CONCLUSION

Out of nine crop raiding intervention methods implemented around WKNP, trenches and community-based guarding are highly effective at preventing crop damage by elephants. For better effectiveness, we recommended the use of combination methods of early detector, passive deterrents, and active deterrents. Furthermore, we emphasized the needs of routine maintenances and community involvement to overcome the issues faced in the methods' implementation.

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Table 1. Effectiveness of nine intervention methods to reduce elephants' crop raiding around WKNP.

No	Method	Method type	Cost	Mainte-nance	Area scale	Endurance	Effectiveness to reduce crop damage	Risk to elephants	Implementation problems	Overall effectivity
1	Tin-can fences	Early detector, passive deterrent	Low (3)	Low (3)	Medium (2)	Prone to get broken (1)	Low (1)	Low (1)	Medium (2)	**13**
2	Tripwire-triggered fences	Early detector, passive deterrent	Low (3)	High (1)	Medium (2)	Prone to get broken and stolen (1)	Medium (2)	Low (1)	Medium (2)	**12**
3	Trenches	Passive deterrent	High (1)	High (1)	Large (3)	Strong, except at the erosion locations (3)	High (3)	Low (1)	Few (3)	**15**
4	Barbed wire fences	Passive deterrent	Low (3)	Low (3)	Medium (2)	Prone to get broken (1)	Low (1)	Low (1)	Medium (2)	**13**
5	Beehive fences	Passive deterrent	Low (3)	High (1)	Small (1)	Prone to get broken (1)	Low (1)	Low (1)	Many (1)	**9**
6	Chili crop protection methods	Early detector, passive deterrent, active deterrent	Medium (2)	High (1)	Medium (2)	Prone to get broken (chili dan tripwire fences) (1)	Low (1)	Low (1)	Medium (2)	**9**
7	Rolling drum	Passive deterrent	Low (3)	Medium (2)	Small (1)	Strong, with notes on the needs of modification in the rolling drum design (2)	Medium (2)	Medium (2)	Medium (2)	**14**
8	Community-based guarding	Early detector, active deterrent	Low (3)	None (3)	Large (3)	None (3)	High (3)	Low (1)	Few (3)	**19**
9	Microfinance scheme	Economic scheme	High (1)	High (1)	Medium (2)	Prone to get raid by elephants (crop) and flood (crop and livestock) (1)	Unknown	Low (1)	Many (1)	**7**

REFERENCES

Davies, T.E. et al., 2011. Effectiveness of intervention methods against crop-raiding elephants. *Conservation Letters*, 4(5), pp.346–354.

Graham, M.D., Adams, W.M. & Kahiro, G.N., 2012. Mobile phone communication in effective human elephant–conflict management in Laikipia County, Kenya. *Oryx*, 46(01), pp.137–144.

Hedges, S. et al., 2005. Distribution, status, and conservation needs of Asian elephants (Elephas maximus) in Lampung Province, Sumatra, Indonesia. *Biological Conservation*, 124(1), pp.35–48.

Hedges, S., 2012. Monitoring Elephant Populations and Assessing Threats. , (March), p.345.

Hedges, S. & Gunaryadi, D., 2010. Reducing human–elephant conflict: do chillies help deter elephants from entering crop fields? *Oryx*, 44(01), p.139.

Hoare, R., 2012. Lessons from 15 years of human elephant conflict mitigation: Management considerations involving biological, physical and governance issues in Africa. *Pachyderm*, 51(1), pp.60–74.

King, L.E., Douglas-Hamilton, I. & Vollrath, F., 2011. Beehive fences as effective deterrents for crop-raiding elephants: Field trials in northern Kenya. *African Journal of Ecology*, 49(4), pp.431–439.

Nelson, A., Bidwell, P. & Sillero-zubiri, C., 2003. A review of human-elephant conflict management strategies. *Wildlife Conservation*, (January), p.27. Available at: www.peopleandwildlife.org.uk/crmanuals/HumanElephantConflictP&WManual.

Nyhus, P.J., Tilson, R. & Sumianto, 2000. Crop-raiding elephants and conservation implications at Way Kambas National Park, Sumatra, Indonesia. *Oryx*, 34(4), pp.262–274.

Osborn, F.V., 2002. Capsicum Oleoresin as an Elephant Repellent : Field Trials in the Communal Lands of Zimbabwe. *The Journal of Wildlife Management*, 66(3), pp.674–677.

Osborn, F.V. & Parker, G.E., 2003. Towards an integrated approach for reducing the conflict between elephants an people: a review of current research. *Oryx*, 37(1), pp.1–6.

Parker, G.E. & Osborn, F. V., 2006. Investigating the potential for chilli Capsicum spp. to reduce human-wildlife conflict in Zimbabwe. *Oryx*, 40(03), p.343.

Santiapillai, C. & Jackson, P., 1990. The Asian elephant: an action plan for its conservation.

Sitompul, A., 2004. *Conservation implications of human-elephant interactions in two national parks in Sumatra*. The University of Georgia.

WCS-IP, 2016. *Laporan tahunan program WCS-IP di Taman Nasional Way Kambas Provinsi Lampung tahun 2015*, Bogor, Jawa Barat: Wildlife Conservation Society-Indonesia Program.

WCS-IP, 2014. *Pengembangan kapasitas Indonesia dalam analisis DNA gajah dan satwa terancam punah lainnya berdasarkan teknik sampling non-invasiv*, Bogor, Jawa Barat: Wildlife Conservation Society-Indonesia Program.

JAVAN RHINO (*RHINOCEROS SONDAICUS*),BANTENG (*BOS JAVANICUS*)& OTHER MAMMALS COEXISTENCE IN UJUNG KULON NATIONAL PARK: SPATIAL AND TEMPORAL OVERLAP

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ABSTRACT

Ujung Kulon National Park (UKNP) is home to some threatened and iconic species including Javan rhinoceros (*Rhinoceros sondaicus*,) and banteng(*Bos javanicus*). Based on anecdotal observations, some conservationists suggest that these species are competing over space in the relatively small area of the Park.There is a growing concern that managing the habitat that benefit one species may reduce habitat availability for the other. This study investigates the use of space and time byJavan rhinos and banteng that may suggest coexistence of competitions between the two species. We used photographic samples from camera trap deployed in 2013 to monitor rhinos in UKNP. We used single-season occupancy model to determine important habitat variables for both species. Spatial co-occurrence of these species were investigated using conditional two-species occupancy model. Temporal overlap between two species was analysed using kernel density estimation (KDE) on circular time data. We found that both species are likely to be independent in using space and time. Probability of banteng occupancy when rhinoceros was present (PsiBA) higher(0.84) than occupancy of banteng when rhinoceros was not detected (0.81). Species interaction factor (SIF) for both species was1.039, indicating that both species werelikely to be independent and no indication of avoidance. Temporal coefficient of overlap for both species based on kernel density estimation was 0.79,which indicate that both species were active at around the same time. The results suggest that there wasno evidence of avoidance for both species as the indicator of competition. This impliesthat even both species have the potency to compete each other on food resources, this study could not find evidence for such a hypothesis. As the comparison, the same procedure in analysing temporal overlap done for other mammals pair of potential competitor (Muntjak and wild pig) and potential predator (wild dog). Mutjak and wild pig have time overlap with Javan rhinoceros of 0.51 and 0.47 indicates a very different time uses. Time overlap coefficient for wild dog and Javan rhinoceros is 0.49 indicates that wild dog preferred to hunt other mammals with more time overlap (mutjak (0.76) and wild dog (0.82)).

Keywords: Banteng (*Bos javanicus*), conditional two-species occupancy, inter-specific competition, Javan rhinoceros (*Rhinoceros sondaicus*),niche partitioning, Ujung Kulon National Park, world heritage.

1. INTRODUCTION

Ujung Kulon National Park (UKNP) is home to several endangered species, including Javan rhinoceros (*Rhinoceros sondaicus*, Desmarest 1822) and Banteng (*Bos javanicus*, d'Alton 1823). Javan rhinoceros is listed as Critically Endangered (IUCN 1996) and included on the Appendix I of CITES (Cites, 2016) due to the fact that,across the entire world, currently only a single population of 63 individuals in UKNP exists. (UKNP 2016). Meanwhile, bantengis Endangered under IUCN criteria. Both are, therefore, priority conservation target of UKNP. Banteng population size in UKNP is still remain unknown due to lack of population monitoring activity in UKNP for this species. Some rumours said that there still hundreds individual still remain in UKNP even the scientific based calculation is still hardly to be found.

As both Javan rhinos and banteng are large herbivores having some overlaps in their diets, many believe that these species are competing for food, space, and other resources. Javan rhinoceros browse on tip of leaves, small branches, treebark and lianas (Hoogerwerf, 1970). Banteng mainly graze (Hoogerwerf, 1970). However, some researchers found indications of competition between these two species in obtainingfood items due to the overlap on food plant preferences (Dharmakalih 1977, Mulyati, 1998 and Muntasib, 2000). About 57% (62 out of 109) types of rhinoceros food plants are also consumed by banteng (YMR, 2002). Similarly, Muntasib (2000) found that 75 types of food plants consumed both by javan rhinoceros and banteng. Javan rhinoceros and Banteng have similarities on shelter preference and water dependent as well as food preference (Suhono, 2001). Alikodra has indicated the change of banteng behaviour from grazer to become a browser (Alikodra, 1985). Those study suggest that javan rhinoceros and Banteng are likely to compete each other in the form of indirect competition as known as exploitative competition.

Previous studies conclusions of competition between Javan rhinoceros and Banteng was the conclusion of potential competition that might happened due to similarities of resources needs between two species. In this study, we used camera trapping data deployed to monitor Javan rhino population in 2013 to investigate possible competitions between the two species as indicated by overlaps in the use of space and time between the two species. UKNP has been using camera trap as a tool to monitor the dynamics ofJavanrhinoceros population since 2011. Since then, twenty three species of animal including javan rhino and banteng has successfully recorded in almost Eighty thousand video clip (UKNP, 2015).

2. MATERIALS AND METHODS

Study Area

This study was conducted in Ujung Kulon National Park, the westernmost tip of Java island in Indonesia, wherethe only world population of Javan rhinoceros inhabits ~30.000 hectares of the area. Mount Payung in the western part of this area was excluded as we believe that it is not habitable by both of these species due to steep terrain. Elevationof the study area variesfrom0 to 150 meters above sea level (USGS DEM) with land cover compositions include lowland primary forest (46.27%), low land secondary forest (20.7%), bushes and grassland (26.7%), as well as mangrove and coastal forest (4.57%). Land cover data were obtained from supervised classification on Landsat 8 imagery ofJune 2015 (WWF 2015).

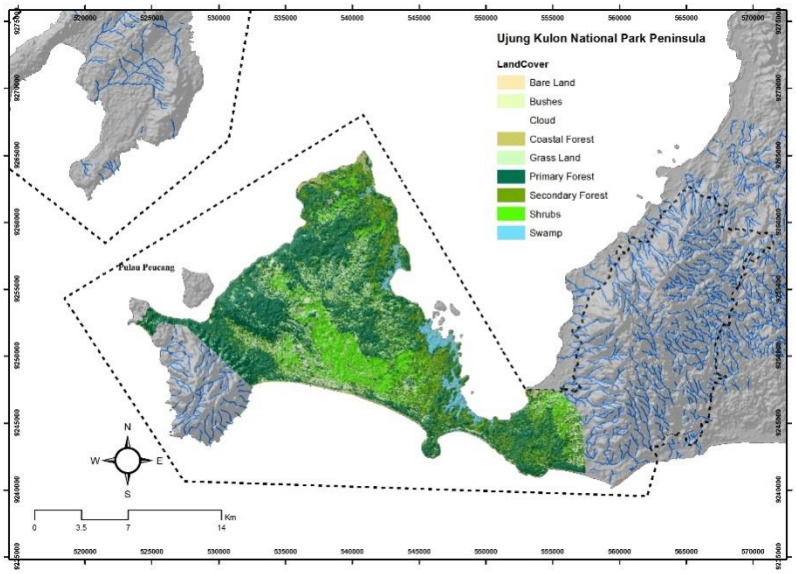

Figure 1. Map of the study area in Ujung Kulon Peninsula. Land cover information obtained from supervised classification on Landsat 8 imagery acquired in July 2014 (WWF 2015).

Camera trap and site covariates sampling

UKNP management has been using camera traps as a tool for wildlife monitoring since 2011 with Javan rhinoceros as the primary target. Camera trap is able to record photographic samples of the primary target as well as other species that pass through the range of its sensor (Sunarto et al, 2013). Data from camera trap of UKNP peninsula from 2013 survey were used for this study. The types of cameras used were Bushnell Trophy Cam®119406/119416.Twenty three species including javan rhinoceros and banteng, were recorded (UKNP, 2016). At least one camera was systematically deployed in every two by two kilometres grid cell, and covered all area known as potential habitat ofJavan rhinoceros and banteng.Tomaximise detection probability,up to three cameras were installed in different one by one kilometre square subcell within two by two kilometres cells based on the level of abundance of Javan rhinoceros sign from previous survey. In total, 36,104 clips were recorded, that include 1660 (5%) clipsof Javan rhinoand 3062 (8%) clips of Banteng. In this study, 176 sites were used for data analysis (Fig 2).

Information of variables assumed to be impacting species activities were carefully documentedin 50 metres range from every the camera trap station. They include elevation (meter ASL), topography (varies from flat to very steep, recorded as a scale from 0 (very flat) to 5 (very steep), vegetation's densities,scaled from 0 (open area) to 5 (very dense) and human disturbance level scaled from 0 (very low) to 5 (very high). Rumpang is log of distance to site from javan rhinoceros feeding ground were calculated based on rhinoceros feeding ground point locations (based on existing data from previous survey) to the camera stationusing geographic information system (GIS) techniques. Land cover types of each site were determined based on the land cover layer produced from the supervised classification on 2015 Landsat 8 imagery. Trapping rate data of Javan rhinoceros, banteng, muntjak (*Muntiacus muntjak*), wild pig (*Sus scrofa*), and wild dog (*Cuon alpinus*) were used as site covariates for the species assumed to be influencingeach other.

Land cover data extraction

Land cover information in this study extracted from Landsat 8 imagery acquired date of June 18, 2015 with resolution of 30 metre. Panchromatic sharpening technique is used to improve the spatial resolution into 15 metres. Three bands used to build the composite imagery are band 5, 6 and 7. Band 5 measures the near infrared, or NIR. This part of the spectrum is especially important for ecology because healthy plants reflect it – the water in their leaves scatters the wave lengths back into the sky. Bands 6 and 7 cover different slices of the shortwave infrared, or SWIR. They are particularly useful for telling wet earth from dry earth, and for geology (USGS, 2013). This composite of bands (657) will produce "false green" composite that sensitive enough to differentiate almost all surface feature on earth.

The composite imagery then classified using the supervised classification technique using maximum likelihood method and manually corrected by interpreter based on the field experiences of Ujung Kulon Peninsula condition. The groundchecking is needed to determine the accuracy level of this land cover data.

Habitat use modelling

Detection histories weredeveloped using detection - non detection of each species in the camera traps.Single-season occupancy model (MacKennzie et al, 2006)implemented in R package WIQID (Meredith, 2014) was usedto determine the factors impacting habitat used by Javan rhinoceros and banteng. We developed model to calculate single covariate effect in every model and compare each other based on model weight and Akaike Information Criteria/AIC (Brunham & Anderson, 1998) to determine the covariate affecting the species most. Two covariates influencing most for each species then selected to be used as covariate in conditional two-species occupancy model.

Analysis

Species interaction

Spatial co-occurrence

Overlap in the use of space between Javan rhinoceros and Banteng was investigated using conditional two-species occupancy model (Richmond et al, 2010) developed based on the likelihood-based two-occupancy model (Mackenzie et al, 2004, 2006) on detection history constructed from camera trapping photographic samples. Mackenzie builtthe likelihood-based two-species occupancy model that accounts for imperfect detection for analysing species co-occurrence pattern from repeated presence-absence survey data. The model directly estimates a "Species Interaction Factor" (SIF) that is a ratio of how likely the two species to co-occur compared to what would be expected under the hypothesis of independence. However, the limitation of the two-species model occupancy by Mackenzie et al (2004, 2006) is the failure to converge when covariatesare included and SIF is directly estimated (Richmond et al, 2010). The model developed by Richmond successfully incorporates the covariates in the analysis. Parameters estimated in the analysis are outlined in Table 1, where species A was assumed to be the dominant species while species B was assumed to be the subordinate species in the conditional two-species occupancy model.

Table 1. Description of the parameters used in the conditional two-species occupancy model

Parameter	Description
psiA	probability of occupancy of species A
psiBa	probability of occupancy of B if A is absent
psiBA	probability of occupancy of B if A is present
pA	probability of detection of species A if B is absent
rA	probability of detection of species A if both are present
pB	probability of detection of species B if A is absent
rBa	probability of detection of species B if both are present but A was not detected
rBA	probability of detection of species B if both are present and A was detected

Note: Javan rhinoceros assumed to be superior species (Species A) and Banteng assumed to be subordinate species (Species B).

The formula below was used to calculate SIF in the conditional two-species occupancy model:

$$SIF = \frac{Psi^{A}Psi^{BA}}{Psi^{A}(Psi^{A}Psi^{BA} + (1 - Psi^{A})Psi^{Ba})}$$

If two species occur independently, the SIF is equal to one. An SIF less than one indicates that species B is less likely to co-occur with species A (avoidance) under the hypothesis of independence, whereas value greater than one indicates that species B is more likely to co-occur with species A (co-existence) than expected under the hypothesis of independence.

The data were then pulled into seven days unit as occasion unit from the camera trap detection histories data due to the occurrenceof errors when using daily unit as occasion unit, which indicated that the daily detection probability was too small to be calculated in the model.

Temporal co-occurrence

Temporal co-occurrence between Javan rhinoceros and banteng was investigated based on their daily activity patterns. As a comparison, the temporal co-occurrence between pairs among Javan rhinoceros, banteng, muntjak, wild pig, and wild dog using kernel density estimation (KDE) on their activity circular data (Ridout & Linkie, 2009)were used to characterize activity pattern for each species and to calculate the coefficient of overlap (Δ) between their equation of 3.1 with a smoothing parameter (c) of 1.25.

3. RESULTS

Effort & General Results

Javan rhino monitoring with 120 units of camera trap in 2013 has successfully recorded 36,104 clips of 23 species including javan rhino and banteng. The effort varies between 50 to 286 active days for every sites and summarized in one by one kilometre square cell unit as shown in figure 2.Capture rate varies between 0.1 to 6.2 clips perday.

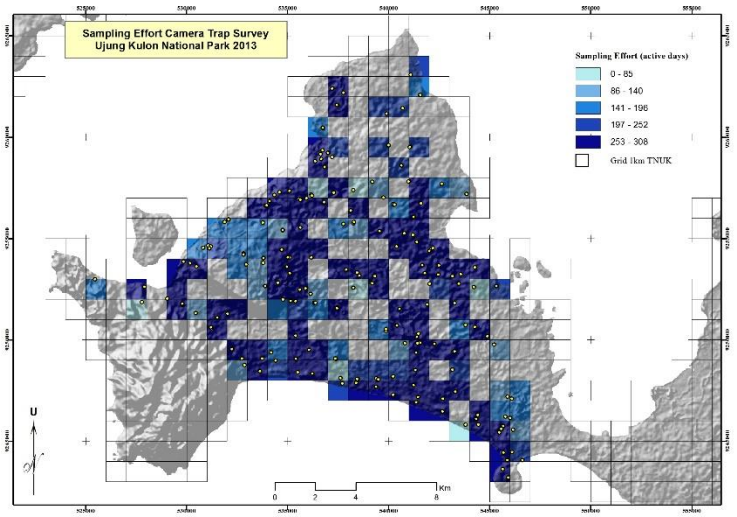

Fig 2. Camera trap active day information from every 1x1 km square area study

Habitat Model

Table 2. Single season occupancy model for Javan rhinoceros with Psi based on 'habitat' univariates

Models	Nparameter	AIC	DeltaAIC	ModelWt
RoccSSpsiRumpang	3	3378.177	0	0.485
RoccSSpsi_bos	3	3380.962	2.785	0.121
RoccSSpsi_constant	2	3382.121	3.944	0.068
RoccSSpsi_elev	3	3382.341	4.163	0.061
RoccSSpsi_Top	3	3383.1	4.923	0.041
RoccSSpsi_cuon	3	3383.938	5.76	0.027
RoccSSpsi_VegDens	3	3383.962	5.785	0.027
RoccSSpsi_panpar	3	3383.963	5.785	0.027
RoccSSpsi_LC	4	3384.03	5.853	0.026
RoccSSpsi_Disturbance	3	3384.092	5.915	0.025
RoccSSpsi_munmun	3	3384.121	5.943	0.025

The best model for single season occupancy model of Javan rhinoceros is the one that calculates Psi depending on the Rumpang (Javan rhinoceros feeding ground). Delta AIC difference ofmore than 2 points and model weight more than twice larger in comparison to the second best model means that this model was"significantly" better than the other models (Burnham & Anderson, 1998). The Javan rhinoceros was less likely to occur as the value of Rumpang become greater (Table 3) meaning that the Javan rhinoceros preferred to get closer to their feeding ground.

Table2a. Single season occupancy model for Javan rhinoceros where Psi depends on Rumpang covariate in beta value.

Model	est	SE	lowCI	uppCI
Psi~(Intercept)	0.6759526	0.17968662	0.3237733	1.0281319
Psi~logRumpang	-0.8883552	0.38579499	-1.6444994	-0.1322109

Tabel 3. Single season occupancy model for BantengwherePsi depends on covariates

AICtablen	Nparameter	AIC	DeltaAIC	ModelWt
nBoccSSpsi_Rhi	3	4130.559	0	0.567
nBoccSSpsi_cuon	3	4132.729	2.17	0.191
nBoccSSpsi_panpar	3	4133.64	3.081	0.121
nBoccSSpsi_constant	2	4137.272	6.713	0.02
nBoccSSpsi_elev	3	4137.564	7.005	0.017
nBoccSSpsiRumpang	3	4137.905	7.346	0.014
nBoccSSpsi_VegDens	3	4138.059	7.501	0.013
nBoccSSpsi_LC	4	4138.33	7.772	0.012
nBoccSSpsi_Disturbance	3	4138.934	8.375	0.009
nBoccSSpsi_munmun	3	4138.984	8.425	0.008
nBoccSSpsi_Top	3	4139.134	8.575	0.008

The best model for Banteng was the one where Banteng occupancy depends on Javan rhinoceros trapping rate as the covariate. This means that Javan rhinoceros trapping rate was the covariate that most influencing Banteng occupancy positively (table 5). The higher Javan rhinoceros trapping rate indicates the higher Banteng occupancy value. Delta AIC difference of more than 2 points from the second best model and other models meanno model competing. It is still unsure how the Javan rhinoceros trapping rates give positive impact to Banteng. This might be due to Javan rhinoceros feeding ground distance that equal to its trapping rate which makesthe Banteng easier to find food resource because 57% of Banteng food would be found in Javan rhinoceros feeding ground. Other factor such as the role of Javan rhinoceros asprotectors from predator consideredasthe biggest animal in UKNP could also be considered. Further analysis would be needed to investigate these findings more thoroughly.

Tabel 3a. Single season occupancy model for banteng where Psi depends on Javan rhinoceros trapping rate covariate in beta value.

Model	st	E	owCI	ppCI
Psi~(Intercept)	2.319184	0.706466	0.934535	3.703832
Psi~raterhison	5.984706	3.900624	-1.66038	13.62979

Spatial and Temporal Co-occurrence

Spatial Overlap

Conditional two-occupancy models were run to examine and conclude the type of interaction between Javan rhinoceros and Banteng. Questions to be answered including the likelihood of these two species to occur independently, the possibility of Banteng being less likely to co-occur (avoidance) which indicates the presence of competition, and the possibility of Banteng being more likely to co-occur (aggregation) which indicates a mutualism. The model exhibiting maximum interaction was the best out of 95 models run, where AIC difference was more than two indicating there was no model

competing. Conditional two-species occupancy model was used with maximum interaction to describe the type of interaction between Javan rhinoceros and Banteng spatially.

Tabel 4. The 20 top-performing conditional two-species occupancy models examining interaction between Javan rhinoceros and Banteng.

no	Model Name	Para-meter	AIC	Delta	Model Weight
1	RB_psiAr_rAbos_psiBArhi_psiBarhi_rBacuon	13	7330.33	0	0.179
2	RB_psiAr_rAbos_psiBArhi_rBARHi	12	7330.704	0.374	0.149
3	RB_psiAr_rAbos_psiBArhi	11	7330.888	0.558	0.136
4	RB_psiAr_rAbos_psiBArhi_rBacuon	12	7331.129	0.799	0.12
5	RB_psiAr_rAbos_psiBArhi_rBaRHi	12	7332.533	2.203	0.06
6	RB_psiAr_rAbos_psiBArhi_rBAcuon	12	7332.701	2.371	0.055
7	RB_psiAbos_rAbos_psiBArhi_psiBarhi_rBArhi	13	7333.167	2.837	0.043
8	RB_rAbos_psiBArhi_psiBaRHi	11	7333.205	2.875	0.043
9	RB_rAbos_psiBArhi_rBARHi	11	7333.907	3.577	0.03
10	RB_psiAbos_rAbos_psiBArhi_rBARHi	12	7333.928	3.598	0.03
11	RB_rAbos_psiBArhi	10	7334.09	3.759	0.027
12	RB_psiAbos_rAbos_psiBArhi	11	7334.107	3.777	0.027
13	RB_psiAbos_rAbos_psiBArhi_rBacuon	12	7334.32	3.99	0.024
14	RB_rAbos_psiBArhi_rBacuon	11	7334.323	3.993	0.024
15	RB_rAbos_psiBArhi_rBaRHi	11	7335.729	5.399	0.012
16	RB_psiAbos_rAbos_psiBArhi_rBaRHi	12	7335.768	5.438	0.012
17	RB_psiAbos_rAbos_psiBArhi_rBAcuon	12	7335.911	5.58	0.011
18	RB_rAbos_psiBArhi_rBAcuon	11	7335.912	5.582	0.011
19	RB_rAbos_psiBArhi_psiBarhi_rBarhi_rBAcuon	13	7336.675	6.345	0.008
20	RB_psiAr_rAbos_psiBAcuon_rBArhi	12	7350.912	20.582	0

The best model with maximum interaction indicated that Javan rhinoceros occupancy (PsiA) with the assumption of no interaction was lower (not significant) than Javan rhinoceros occupancy (PsiA) with interaction happened between Javan rhinoceros and Banteng.The probability of occupancy of Banteng in the absence of Javan rhinoceros (PsiBa) was shown to be lower (not significant) than the probability of occupancy of Banteng as independent species. Meanwhile, the probability of occupancy of Banteng in the presence of Javan rhinoceros was shown to be higher (not significant) than the probability of occupancy of Banteng as independent species. The result reveals that Javan rhinoceros and Banteng were likely to be independent in their way to occupy a certain space. There was an indication of positive impact of the Javan rhinoceros presence although not statistically significant.

Detection probability of Javan rhinoceros in the absence of Banteng (pA) was shown to be significantly lower than the detection probability of Javan rhinoceros as independent species (no interaction). On the other hand, detection probability of Banteng in the absence of Javan rhinoceros (pB) was shown to be significantly lower than the detection probability of Banteng as independent species (no interaction). Detection probability of Javan rhinoceros if both javan rhinoceros and Bantengwerepresent (rA) was shown to be higher (not significant) than the detection probability of Javan rhinoceros as independent species. Detection probability of Banteng when both Javan rhinoceros and Banteng were present but Javan rhinoceros was not detected (rBa) was lower (not significant) than detection probability of Banteng as independent species. The detection probability of Banteng if both javan rhinoceros and Banteng were present and detected (rBA) was significantly higher than detection probability of Banteng as independent species. Banteng seemed to be influenced positively with the presence of Javan rhinoceros according to the result of maximum interaction model for conditional two-species occupancy in this study.

We calculate SIF for Javan rhinoceros and Banteng based on the best model (maximum interaction) result. SIF for Javan rhinoceros and Bantengwas 1.039 meaning that both were likely to be independent of each other considering the SIF value was close to one. The result of this study implies that even though Javan rhinoceros and Banteng are potentially competing with each other due to food plant resource overlaps, however this indication of competition was not detected in 2013 survey data.

Table 7. Conditional two-species occupancy model result for Javan rhinoceros and Banteng

No interaction				**Maximum interaction**			
	est	**lowCI**	**uppCI**		**est**	**lowCI**	**uppCI**
psiA	0.6506	0.5720	0.7219	**psiA**	0.6818	0.5858	0.7645
psiBa	0.8249	0.7530	0.8792	**psiBa**	0.8149	0.5606	0.9382
pA	0.1787	0.1659	0.1924	**psiBA**	0.8442	0.7264	0.9171
pB	0.1897	0.1777	0.2023	**pA**	0.0531	0.0254	0.1077
				pB	0.1321	0.1087	0.1597
				rA	0.1889	0.1752	0.2034
				rBa	0.1812	0.1658	0.1976
				rBA	0.3193	0.2825	0.3584

Temporal Overlap

Kernel density estimation analysis on Javan rhinoceros, Banteng, mutjak, wild pig, and wild dog's circular data of their daily activity pattern (Table 8) shows that Javan rhinoceros and Banteng had similar activity pattern [Δ=0.798]. Activity pattern of mouse deer was similar with activity pattern of wild pig [Δ=0.806]. Wild dog which is a predator suspected to be the main threat for Javan rhinoceros had a very different activity pattern when compared to Javan rhinoceros [Δ=0.493] or its other potential prey species. Wild dog is considered to be top predator of Javan rhinoceros after the Javan tiger was reported to be extinct. Wild dog was most likely to co-occur based on activity pattern with wild pig [Δ=0.821], mouse deer [Δ=0.761], and Banteng [Δ=0.624] consecutively. When the activity pattern similarity between predator and potential prey was used as indicator of prey preference for predator, then it could be concluded that wild dog's most preferred prey in consecutive order was wild pig, mouse deer, and Banteng. Javan rhinoceros would be the last species expected to be hunted by wild dogs.

Based on the analysis of spatial and temporal overlap in this study, no indication of competition between Javan rhinoceros and Banteng was found. Javan rhinoceros and Banteng were likely to occur independently.

Table 8. Overlap coefficient of activity pattern based on Kernel density estimation on circular data

Species	**Javan rhinoceros**	**Banteng**	**Muntjak**	**Wild pig**	**Wild dog**
Javan rhinoceros	1				
Banteng	0.7987704	1			
Muntjak	0.5100416	0.6602768	1		
Wild pig	0.4725833	0.6018588	0.806473	1	
Wild dog	0.4938083	0.6249953	0.7617438	0.8219245	1

0 indicates no overlap in activity time and 1 indicates complete overlap in

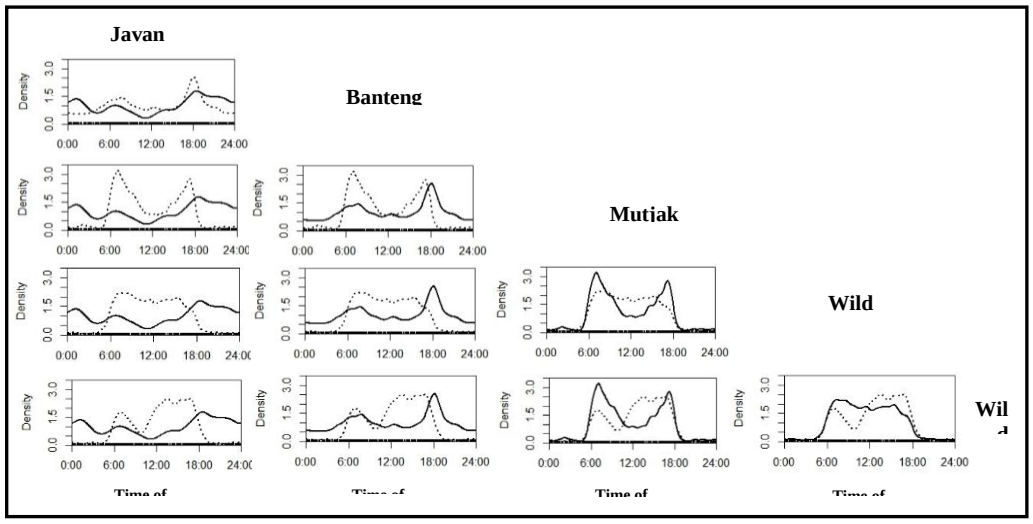

Figure 3. Overlap of activity patterns based on Kernel density estimation on circular data. Solid linesrepresent species in each column; dotted lines represent species in the row.

4. DISCUSSION

Habitat model

Habitat variables used in the model to determine habitat variable important most for javan rhinoceros and banteng are habitat variables recorded during the camera trap survey in 2013 and habitat variable that important for javan rhinoceros and banteng based on the previous study (YMR 2000 and Muntasib, 2002) which is rumpang. Rumpang assumed to be the hotspot for both species in seeking of food and rumpang is the place where most of food plant types for javan rhinoceros can be found (Rahmaningsih, 2013). Rumpang is the place where interaction between javan rhinoceros and banteng would be higher than other habitat types. Sign of selected species (javan rhinoceros, banteng, muntjak, wild pig and wild dog) were observed during the survey in purpose to be used in the species analysis. In this study, trapping rate of selected species are used rather than the finding rate of sings of selected species observed during the survey due to time range of camera trap active days are longer than the time range of sign's observation. This makes the data of trapping rate are more complete and represent the same time range with the detection non-detection data of javan rhinoceros and banteng than the rate of signs observed during the survey. Other habitat variables assumed to be important for both species – Wallow for javan rhinoceros (Rahmat, 2012), salinity and mineral sources for example - may be used in the future study to find more complete understanding of javan rhinoceros and banteng needs in the habitat.

The model built in this study to determine habitat variable important for javan rhinoceros and banteng was only compared single variable in every model influencing the occupancy value (psi). Single variable influencing the probability of detection and combined variables influencing both occupancy and probability of detection may be compared in the future study to get better estimation according to the AIC and model weight value.

Species interaction

Spatial co-occurrence and time overlap

Co-occurrence analysis between javan rhinoceros and banteng is using detection non-detection data from camera trap survey on javan rhinoceros monitoring in 2013. The data pulled into seven day unit as occasion unit due to the very small probability of detection when using daily unit as occasion unit and the convergence was not reached in the model. The model cannot generate AIC value using R program in WIQID (Meredith, 2014) package and generate unrealistic standard error value (SE are hundred or even thousand times the estimate value) in the PRESENCE program (Hines, 2010) when using daily unit as occasion unit. That unrealistic results are due to the very small probability of

detection when using the daily unit as occasion unit. Seven day unit (weekly unit) as the closest unit that most people will familiar with is chosen to be used as occasion unit. Convergence was reached in the model using weekly unit as occasion unit. But using weekly unit as occasion unit made co-occurrence assumption become weak if the assumption of co-occurrence is the direct encounter of javan rhinoceros and banteng. Javan rhinoceros could be occurred on Monday and banteng could be occurred on another day yet the data of detection non-detection will still tell that both javan rhinoceros and banteng were detected in the same occasion. The longer occasion unit used the smaller probability of direct encounter will happen. Time overlap analysis from both species (javan rhinoceros and banteng) is used as the comparison with spatial overlap analysis in this study. If time overlap analysis conclude the same result as spatial overlap analysis, then the conclusion of this study could become stronger and if the time overlap analysis conclude the opposite result with the spatial overlap analysis, then further analysis is needed to get the proper result. Survey designed to get data with occasion unit that will gives highest probability of encounter for javan rhinoceros and banteng and able to give the data with higher probability of detection is highly needed in the future study as same as building the method that able to calculate a very small probability of detection and still able to give the plausible result.

The conclusion of time overlap between pairs of species in this study analysed based on camera trap data of javan rhinoceros monitoring survey in 2013. No independent clip interval were set to the camera trap data in this study because more than 90% site of camera trap were in animal trail. Animal only passing through this type of site and the chance to get clips recorded the same animal with a long duration of time will be very small. The thirty second duration of recording and ten second interval between one capture to another capture setting of the camera trap will record different individual of animals in the trail type of site. Independent clip interval setting to this kind of data will make the possibility of losing some independent clip of certain animal will be higher while not setting independent clip interval will make certain animals with "trap happy" (anilmal with high curiosity of new things) character have higher density of detection than reality which both setting give unequal data for all species. Independent clip interval would be needed based on the type of site and the character of species is needed in the future study to give the closest similarity with the real condition.

Interaction analysis between two species ideally is done based on the data observed from area of interest for both species where both species depend on the same resource. For example, interaction analysis for larger Virginia rail (*Rallus limicola*, Vieillot, 1819) and smaller California Black Rail (*Laterallus jamaicensis coturniculus*, Gmelin, 1789) done based on data observed from marsh area which is the area where both species depend their self in finding food (Richmond, 2010). If the resource is rich enough for both species then the dominant species will likely let the subordinate species to find the resource when dominant species is occur. And the dominant species will chase away the subordinate species or the subordinate species will likely avoid the dominant species if the resource is limited for both species. Rumpang is assumed to be the area of interest for javan rhinoceros and banteng while there are very few site types of rumpang in this study. Alternatively sites distance to rumpang is used in this study as covariate to how the model prediction on interaction varies with the distance of rumpang to the sites.Identification of the most important variable habitat for javan rhinoceros and banteng to be area of observation will make a better prediction on how likely javan rhinoceros and banteng to co-occur for future study.

Javan rhinoceros and Banteng are priority species for conservation action, globally and national level. The commitment at national level has been implemented based on Ministry of Forestry regulation No. P.57/Menhut-II/2008. Ujung Kulon National Park is home to both of these species.Previous studies indicate the presence ofcompetition between them. Reliable analysis is important to build an effective strategy on habitat and population management on both species. This study provides an insight into the condition of species interaction through plausible data analysis and conclude that no evidence found on javan rhinoceros and Banteng competition is happening based on spatial and temporal overlap analysis.

Single season occupancy analysis on some covariates for Javan rhinoceros indicates that "distance to feeding ground" to be the most important factor affecting Javan rhinoceros occupancy. Previous study indicated that distance to wallow is the factor most affecting Javan rhinoceros movement (Rahmat,

2002). Feeding ground and wallow are usually found to be closed to each other in UKNP. Browsing and wallowing are part of Javan rhinoceros daily activities.

Feeding ground is described as an area dominated by understory vegetation level with very low density of canopy cover. Feeding ground has a vast range of Javan rhinoceros food plant preferences (Rahmanigsih, 2013). With 57% javan rhinoceros food plant consumed by Banteng, this makes feeding ground an important habitat component for Banteng as well as Javan rhinoceros. Muntasib (2000) found Banteng signs on feeding ground where Javan rhinoceros signs were also found.

This study and Javan rhinoceros monitoring by UKNP found that Javan rhinoceros and Banteng are likely to co-occur temporally (BTNUK, 2006). Single season occupancy model for Banteng suggested that javan rhinoceros trapping rate is the most affecting factor for Banteng occupancy. It could be due to the same area for both species to find food resource (feeding ground) as Muntasib (2000) documented 75 types of vegetation are consumed by Javan rhinoceros as well as the Banteng. Species interaction factor for Javan rhinoceros and detection probability of Banteng in the presence or absence ofJavan rhinoceros indicated that higher likelihood for Banteng to co-occur with Javan rhinoceros. It could be due to Banteng avoidance from predator and Javan rhinoceros can be assumed to be a protector considered as the biggest mammals in the area. Even thoughthe indication of competition was not found in this study, the population monitoring of Banteng would be essential in order to capture the evidence of competition between both species for especially considering they have same food resource. There is also a possibility of mutual symbiosis between Javan rhinoceros and Banteng based on the spatial temporal co-occurrence analysis, however further study is needed to comprehensively describe this phenomenon. Strategy to optimize habitat carrying capacity for both species is needed as well as the plan on population management.

Assumption of wild dog as a threat for Javan rhinoceros is found to be less precise based on this study result. Activity pattern of wild dog overlaps mostly with the wild pig. If the value of activity pattern overlap of predator and potential prey species indicates prey preference for predator then wild dog would prefer to hunt wild pig and mouse deer than Banteng or javan rhinoceros. However, wild dog has apotency to hunt a prey with size much bigger than themselves because they hunt it in a group. Hunting in group enables them to build distraction strategy to separate the easier targetlike calves from their parent. Therefore, monitoring on wild dog and its prey population in UKNP is also important to catch early indication of wild dog over population as well as prey decreasing population that potentially become a serious threat for priority species in Ujung Kulon National Park such as the Javan rhinoceros and Banteng.

5. CONCLUSION

1. Rumpang (feeding ground) is the most important habitat variable for javan rhinoceros while banteng depend on javan rhinoceros occurrence in unknown reason based on this study.
2. Javan rhinoceros and Banteng are likely to co-occur independently, spatially (SIP=1.01) or temporarily [Δ=0.798] and indicate no competition happening. But even now indication of competition has not been found in this study, Banteng population monitoring is essential to capture indication of competition between both species for both species highly demand for the same food resource.
3. Monitoring on wild dog and its prey population in UKNP is important to catch early indication of wild dog over population that potentially become a serious threat for priority species in Ujung Kulon National Park such as javan rhinoceros and Banteng.

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REFERENCES

Alikodra, H. S., 1985. Ekologi Banteng (*Bos javanicus*, d'Alton 1823) di Taman Nasional Ujung Kulon, [Disertasion], IPB (Agriculture Institute of Bogor), Bogor, Indonesia

Burnham, K. P., and D. R. Anderson. 2002. Model selection and multimodel inference: A practical information-theoretic approach. Second edition. Springer-Verlag, New York, New York, USA.

(BTNUK) Balai Taman Nasional Ujung Kulon. 2016. Laporan Monitoring Populasi Badak Jawa(*Rhinoceros Sondaicus*Desmarest, 1822) Tahun 2015 Di Taman Nasional Ujung Kulon.[Laporan], Labuan, Banten, Indonesia.

Dharmakalih, G. 1977. Analisis Habitat Banteng (*Bos javanicus* d'Alton 1832) di Resort Pulau Peucang, Taman Nasional Ujung Kulon, Jawa Barat.[Skripsi]. Bogor, Indonesia.

Hines, J. E. 2006. PRESENCE2. Software to estimate patch occupancy and related parameters. USGS-WRC.http://www.mbr-pwrc.usgs.gov/software/presence.html, June 2016.

Hoogerwerf. 1970. Udjung Kulon the land of the last Javan Rhinoceros. Leiden.E.J. Brill.

http://landsat.usgs.gov/documents/Landsat8DataUsersHandbook.pdf, August 2016.

Timmins, R.J., Duckworth, J.W., Hedges, S., Steinmetz, R. & Pattanavibool, A. 2008. Bos javanicus. The IUCN Red List of Threatened Species 2008: e.T2888A9490684.http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T2888A9490684.en. Do wnloaded on **19 August 2016**.

http://www.iucnredlist.org/details/22692479/0,BirdLife International. 2012. Rallus limicola. The IUCN Red List of Threatened Species 2012: e.T22692479A38371800. http://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T22692479A38371800.en. Downloaded on **19 August 2016**.

http://www.iucnredlist.org/details/22692353/0, BirdLife International. 2012. *Laterallus jamaicensis*. The IUCN Red List of Threatened Species 2012: e.T22692353A38171382. http://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T22692353A38171382.en. Downloaded on **19 August 2016**.

https://cites.org/eng/app/appendices.php, August 2016

MacKenzie, D. I., J. D. Nichols, J. A. Royle, K. H. Pollock, L. L. Bailey, and J. E. Hines. 2006. Occupancy estimation and modeling: inferring patterns and dynamics of species occurrence. Elsevier, Burlington, Massachusetts, USA

Muntasib, H.E.K.S., D. Rinaldi, Haryanto. Dan Masúd. 2000. Pilot Project Pengelolaan Habitat Badak Jawa (*Rhinoceros sondaicus*) Di Taman Nasional Ujung Kulon. Bogor.

Mulyati, S. 1998. Studi Pendugaan Persaingan Pakan Antara Badak Jawa (*Rhinoceros sondaicus* Desmarest 1822) dengan Banteng (*Bos javanicus* d'Alton 1832) di Resort Cidaun-Cibunar, Taman Nasional Ujung Kulon, Jawa Barat. Bogor.

Orien M. W. Richmond, James E. Hines, Steven R. Beissinger, 2010, Two-species occupancy models: a new parameterization applied to co-occurance of secretive rails, Ecological Society of America.

Rahmaningsih, MD. 2013. Penyususnan Desain Wisata Minat Khusus Berdasarkan Pola Pergerakan Badak Jawa di Taman Nasional Ujung Kulon. Bogor.

Rahmat U.Mamat., Santosa, Yanto, Prasetyo, Lilik Budi., Kartono, Agus Priyono. 2012. Habitat Suitability Modeling of Javan Rhino (*Rhinoceros sondaicus* Desmarest 1822) in Ujung Kulon national Park. Jurnal Manajemen Hutan Tropika Vol. XVIII, (2):129-137 Agustus 2012.

Ridout, M.S. & Linkie, M. (2009). Estimating overlap of daily activity patterns from camera trap data. *J. Agric. Biol. Environ. Stat.* **14**, 322–337.

Suhono S and Muntasib H (2001). The Use of water, Food and Cover by Javan rhino (*Rhinoceros sondaicus*, Desmarest 1822) and Banteng (*Bos javanicus*, d'Alton 1832) at Cikeusik and Citadahan, Media Konservasi Vol III no. 2. June 2001, 69-74.

Sunarto, S., Kelly, M.J., Klenzendorf, S., Vaughan, M.R., Zulfahmi, Z., Hutajulu, M.B. & Parakkasi, K. (2013). Threatened predator on the equator: multi-point abundance estimates of the tiger *Panthera tigris* in central Sumatra. *Oryx* **47**, 211–220.

van Strien, N.J., Steinmetz, R., Manullang, B., Sectionov, Han, K.H., Isnan, W., Rookmaaker, K., Sumardja, E., Khan, M.K.M. & Ellis, S. 2008. *Rhinoceros sondaicus*. The IUCN Red List of Threatened Species 2008: e.T19495A8925965. August 2016.

(YMR) Yayasan Mitra Rhino, 2002, Laporan Akhir Studi Persaingan Ekologi Badak Jawa (*Rhinoceros sondaicus*) Dan Banteng (*Bos javanicus*) Di Taman Nasional Ujung Kulon

FILLING THE KNOWLEDGE GAP ON THE ENDANGERED ASIAN TAPIRS IN SOUTHERN PART OF TROPICAL RAINFOREST HERITAGE OF SUMATRA

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ABSTRACT

As the largest protected area in southern part of Sumatra, Bukit Barisan Selatan National Park (BBSNP) is believed to harbor one of the highest populations of Endangered Asian tapirs. However, despite becoming animportant area for tapir conservation, there is a paucity of information on this large mammalspecies'spopulation status and ecology in BBSNP. Thus, to fill the knowledge gap, we analyzed the Asian tapir data collected from a camera trapping study targeting tigers in BBSNP. With a trap effort of 1.580 trap days/100 km^2 covering effective trapping area size of 969.5 km^2, a total of 512 tapir photographs were recorded resulting in 162 independent tapir detections. Tapir relative abundance was 2.08 events/100 camera-trap days. Tapir site occupancy was mostly affected by slope with *Psi* = 0.72 (0.54—0.85 95% CI). Tapirs were found mostly active at night-time (56.96%) and using low elevation hills to submontane areas (x^2 = 1.4189, P = 0.4919). This study thus provides much needed information on tapir population and ecology in BBSNP and highlights the extent application of camera trapping to study other cryptic mammals beside target species.

Keywords: Asian tapir (*Tapirusindicus*), camera trapping, population, distribution, activity patterns, BBSNP

1. INTRODUCTION

Widely knownas the largest of four living tapir species and the only Old World tapir species, Asian tapirs (*Tapirusindicus*) are among the least studied large mammals in the Southeast Asia's tropical forests (Holden et al. 2003; Lynam et al. 2012; Linkie et al. 2013). Tapirs occur in three relatively distinct populations: mainland Southeast Asia (Thailand and Myanmar), Southern Thailand and Malaysia, and the island of Sumatra, Indonesia (Traeholt et al. 2016). In Sumatra, this remarkable mammals are found in at least seven of eight provinces, excluding Aceh and most North Sumatra province (Meijaard 1998).

Asian tapirs only received few attention compared to the other large mammals in Sumatra such as Sumatran tigers, Sumatran elephants, and Sumatran rhinos. To date, Traeholt et al. (2016) reported there are no reliable Asian tapir population estimates for Sumatra, but it is predicted below 400-500 individuals. Tapirs in Sumatra aremostly threatened by rampant deforestation, accidental and deliberate trapping, and removal of animals for zoos in Indonesia (Holden et al. 2003; Kinnaird et al. 2003; Novarino 2005; Traeholt et al. 2016).

Camera trapping technique is effective method to study elusive and nocturnal animals such as Asian tapirs. Studies on tapirs in Sumatra using camera trapping have been conducted since 2000s to investigate the ecological aspect of tapirs, covering the island-wide tapir occurrence(Linkie et al. 2013) and tapir abundance (O'Brien et al. 2003; Holden et al. 2003; Novarino et al. 2005; Novarino 2005). However, recent information on Asian tapirsin Sumatra is severely limited, as all of these studies were conducted in the previous decade. Thus, the lack of updatedinformation hampers the conservation planning for Asian tapir.

As the largest protected area in southern part of Sumatra, Bukit Barisan Selatan National Park (BBSNP) is a potential stronghold for Asian tapir population. Linkie et al. (2013) found tapir occupancy in BBSNP was 0.30 (0.07) but this was based on a camera trap data set from 2004-2006

and part of a regional not site-specific analysis. Thus, more recent information on tapir ecology and population status in BBSNP is lacking. In this study, we demonstrate that camera-trapping is useful method to study Asia tapirs in BBSNP. We provide information on tapir abundance, distribution, and activity patterns to fill the knowledge gap for future tapir conservation planning in Sumatra.

2. MATERIAL AND METHODS

Study area

BBSNP located in the provinces of Lampung, Bengkulu, and South Sumatra with elevation ranges from 0 to 1,964 m asl forming a dense tropical rainforest, which is surrounded by coffee and cocoa small holder farms. About 17% of BBSNP area, mainly in the Sekincau region located in the mid-eastern section, is inhabited by farmlands with human population up to 16,522 families (TFCA 2010). The mid and southern part of the park contains some of the last intact areas of lowland rainforest in Sumatra and supports highly threated species such as Sumatran rhinos, Sumatran tigers, Sumatran elephants, Asian tapirs, clouded leopards, Asian dholes, seven hornbill species and giant pittas (O'Brien and Kinnaird, 1996). BBSNP elongated shape makes it highly accessible to wildlife poachers, collectors of non-timber forest products (NTFP), and illegal loggers or encroachers (Gaveau, Epting, et al. 2009).

Since 2004, BBSNP, Kerinci Seblat National Park and Gunung Leuser National Park are declared as Tropical Rainforest Heritage of Sumatra (TRHS) site by UNESCO. These three national parks were chosen because they represent significant area of tropical forests on the island of Sumatra that harbor outstanding biodiversity and ecosystem services. In 2015, due to the occurrence of Critically Endangered Sumatran rhino population (Pusparini et al., 2015), the central section of BBSNP was formally established as an 'Intensive Protection Zone' (IPZ) (PHKA 2015). The IPZ represents a new concept for protected area management in Indonesia. It also overlaps with core tiger and elephant habitat and therefore offers great potential as a replicable model for securing populations of threatened wildlife, including Asian tapirs, in other Indonesian protected areas. Our survey was focused on the middle section of BBSNP, which overlapped with approximately 51% of the IPZ.

Data collection

A camera trap survey targeting Sumatran tigers was predominantly conducted inside the IPZ of BBSNP from May to November 2015. The cameras (Panthera V.3 and V.4 models) were set across 65 grids with a 3 x 3 km dimension, an optimum grid dimension for tiger survey, to ensure a target trap spacing of 2-3 km(Pickles et al. 2014). Four grids were located in the protection forest (HutanLindung) and the remaining 61 were located inside BBSNP. Pairedcamera traps set in two grids were stolen, resulting 63 active trap grids. These cameras were set ~45 cm above ground level with average distance of 2.2 m from the target forest trail. In most grids, paired camera traps were positioned on opposite sides of an animal trail where tiger principal prey species (red muntjac*Muntiacusmuntjak*, sambar*Rusa unicolor*, wild boar *Susscrofa*, and southern pig-tailed macaque *Macacanemestrina*)are usually found. The trails are also used by other large mammals including Asian tapir which make us certain thatour camera trap placement would be likely to capture as many tapir photographs as possible.

Data analysis

Tapir relative abundance

We collected tapir photographs and used independent photographs as an index of abundance and calculated Relative-Abundance Indices (RAI) based on Kinnaird et al. 2003 and O'Brien et al. 2003. Independent photographs were defined following O'Brien et al. 2003, as:different species, consecutive photographs of different individuals of the same species; consecutive photographs of the same species individuals taken more than 0.5 hours apart, or nonconsecutive photographs of the same species individuals.RAI was the number of independent photographs acquired per day and increased as density increased, making it an easily interpreted index.RAI in this study was scaled to independent photographs per 100 trap-days.

Tapir occupancy

We calculated tapir probability of occupancy (psi) and detection (p) using a modeling framework that accounts for imperfect species detection (Mackenzie et al. 2002) performed by wiqid package in R version 3.2.3 statistical software. We used 24-h trapping period as an independent sampling occasion. We included nine covariates to be fitted in the model: 1) canopy opening, 2) understory layer cover, 3) distance to forest edge, 4) distance to road,5) distance to river, 6) slope, 7) elevation, 8) human RAI, and 9) trap efforts. These covariates were then incorporated as explanatory variables for occupancy models, starting with one covariate, and then we added more covariates until reached the best fitting model. Candidate models were compared using the Akaike Information Criterion corrected for small sample sizes (AICc).

Tapir activity patterns

Information on the date and the time are available for each picture. Temporal activity of tapirs was calculated by percentage of independent photographs in each of three time-day periods following Azlan & Sharma (2006): night-time (19:00-05.00 h), day-time (07.00-17.00 h), and dawn/dusk (05.00-07.00 h/17.00-19.00 h). Tapir activity was further defined as: strongly nocturnal (>85% independent photographs in night-time), nocturnal (50-85% in night-time), dawn/dusk (up to 50% in dawn-time and dusk-time), diurnal (50-85% in day-time), and strongly diurnal (>85% in day-time)(Pusparini et al. 2014).

We then compared the RAI of tapirs in three altitudinal zonation in BBSNP based on Laumonier (1997): low elevation hills (150-500 m), medium elevation hills (500-900 m), and submontane (900-1400 m).Altitudinal zonation was used to predict general informationon species habitat use as each zonation represents different habitat type (Pusparini et al. 2014). We used chi square independency test to assess the difference of tapirs temporal and altitudinal utilization in BBSNP.

3. RESULT AND DISCUSSION

From 21 May to 20 November 2015, we completed camera trap survey in 63 out of 65 target grids. From total 130 cameras placed, 23 were stolen in the field and one camera was trampled by an elephant. Our survey covered effective trapping area of $\pm$969.5 km^2. Mean distance between camera traps was 2.2 km. Total trapping effort was 1.580 trap-days/100 km^2, with each grid had mean trapping effort of 119.6 trap-days (ranging from 63—150 trap-days).

Tapir relative abundance

We recorded 512 Asian tapir photographs resulting in 162 independent photographs.We used Relative-Abundance Indices (RAI) as an index for tapir relative abundance. Our survey found tapir RAIwas2.08/100 trap-days, the highest compared to RAI of other large mammals such as tigers (0.96), elephants (0.67), and rhinos (0), and the sixth highest RAI compared to overall species.The current tapir RAI was higher than previous survey where O'Brien et al. (2003) reported the tapir RAI in BBSNP was 1.25/100 trap-days (0.14-4.99). The higher RAI value may be affected by the survey area which focusing on the IPZ of BBSNP, the well-protected area believed as the hotspot for large bodied mammals including tapirs,while O'Brien et al. (2003) conducted park-wide survey which covered all areas of BBSNP.

Tapir occupancy

Tapirs were recorded in 43 out of 63 camera trapping locations, resulting in naïve occupancy of 0.68. Tapir site occupancy was mostly affected by slope with psi 0.72 (0.54—0.85 95% CI) and tapir detection were affected by time quadrat with p 0.02 (0.02—0.03). The increasing slope degrees or the steeper the area will reduce the tapir occupancy probability. Our result was different from previous study in Thailand where tapirs were positively influenced by annual rainfall and proximity to the edge (Lynam et al. 2012) and in wide-scale study in Southeast Asia where tapir were negatively correlated

Tabel 1. Asian tapiroccupancy models in BBSNP

	Models	K	AICc	ΔAICc	ModelLik	W_i
1.1	p.time2.psi.slope	5	1404.407	0	1	0.329
1.2	psi.slope	3	1404.916	0.509	0.775	0.255
1.3	p.time2	4	1407.284	2.877	0.237	0.078
1.4	p.psi.	2	1407.876	3.469	0.177	0.058
1.5	psi.forest	3	1408.115	3.708	0.157	0.052
1.6	p.time	3	1408.260	3.853	0.146	0.048
1.7	psi.under	3	1408.428	4.021	0.134	0.044
1.8	psi.river	3	1409.134	4.727	0.094	0.031
1.9	psi.human	3	1409.483	5.075	0.079	0.026
1.10	psi.can	3	1410.017	5.610	0.061	0.020
1.11	psi.road	3	1410.022	5.615	0.060	0.020
1.12	psi.edge	3	1410.050	5.642	0.060	0.020
1.13	psi.elev	3	1410.083	5.675	0.059	0.019
1.14	psi.global	11	1420.490	16.082	0.000	0.000

Notes: K = number of parameters.

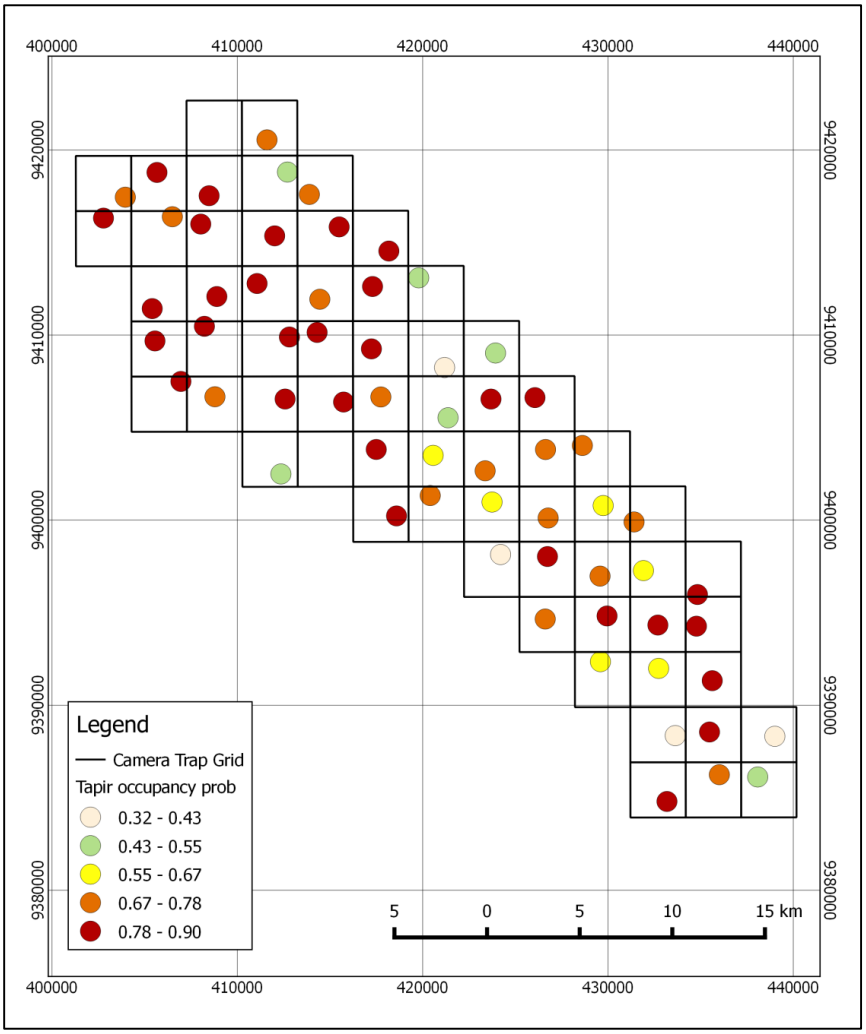

Figure 1. Asian tapir site occupancy map derived from the top-rankedmodel.

with human disturbances (Linkie et al. 2013). We suspect the difference in the result because of the difference in study area where Lynam et al. (2012) focused on the Thailand landscape and Linkie et al. (2013) study covered South East Asia landscape while our study focused on site-specific of Bukit Barisan Selatan National Park.

Previous study by Kinnaird et al. (2003) and O'Brien et al. (2003) found tapirs in BBSNP were photographed at approximately equal rates near and far from the forest edge, indicating this infrequently hunted species were not affected by human disturbances as Linkie et al. (2013) suggested. Our occupancy mapping showed similar patterns with tapir occupancy probability were high in both forest edge and forest interior.

Slope, the best variable to explain tapir occupancy in our study, may not directly affect the tapir distribution. Furthermore, this variable may act as proxy for other environmental variables which were not included in our model.Sternberg & Shoshany (2001) and Bennie et al. (2006) reported the influence of slope angle and orientation (facing south or north) to the composition, structure and density of the plant communities. Slope alters solar radiation and water availability thus affecting temperature, soil moisture, and nutrients which affect the vegetation(Bennie et al. 2006). Tapirs as selective browsers prefer plentiful foliage and soft twigs of seedlings, saplings, and shrubs, and fallen fruits (Williams 1980; Novarino et al. 2004)which may not frequent in steeper areas than flatter areas. Another explanation, tapirs may avoid steeper areas to minimizing the energy cost. This was consistent with other studies by Novarino et al. (2005) and Shwe & Lynam (2012) where they found Asian tapirs prefer flat areas, salt licks, and existing animal trails for their activity.

Tapir activity patterns

Tapirs were found mostly active at night-time (56.96%), indicating that tapirs are primarily nocturnal (x^2=28.591, p-value=6.188e-07) (Figure 2).Previous studies also shown tapirs mostly active in night time although in rare occasions they were found active in day time (Holden et al. 2003; Novarino 2005; Shwe & Lynam 2012). The nocturnal activity of tapirs may explain their resilience to human disturbance as most of human activities are occurred in day time thus minimizing the interaction between humans and tapirs (Kinnaird et al. 2003; Lynam et al. 2012). Predatory threat is also relatively low as the only potential tapir predator, Sumatran tigers, are crepuscular animals which active in dusk and dawn, thus nocturnal tapirs are less likely to be encounter which makes them less important prey(Hayward et al. 2012).

Tapirs RAIs were similar between three altitudinal zonation (x^2=0.0512, p-value = 0.9747), indicating tapirs may use all of these zonation.Our finding wassame with previous study where tapirs weredetected in many altitudinal range of from sea level to 1931m asl(Linkie et al. 2013). The utilization of different type of forests showed tapirs as widespread animals which can be found from submontane forests to degraded fragments of remaining lowland forests (Holden et al. 2003; Clements et al. 2012).

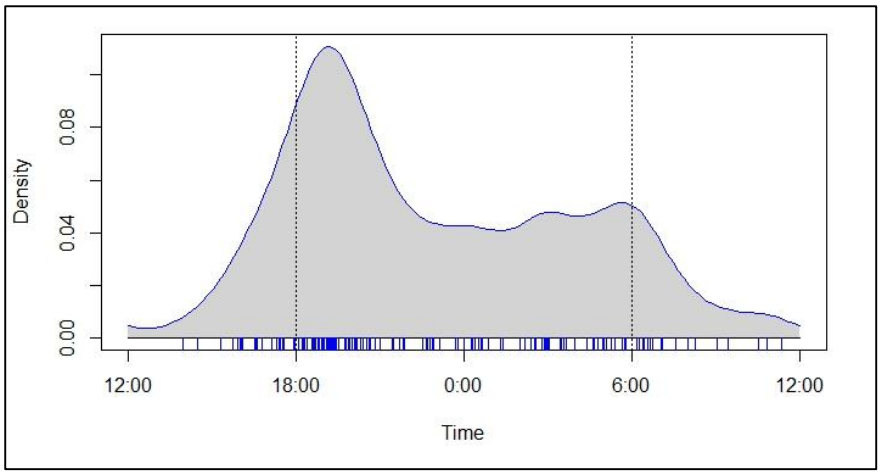

Figure 2.The density estimate of Asian tapirdaily activity patterns in BBSNP.

Table 2. Tapir RAI in three altitudinal zonation.

Altitudinal zonation	Relative-Abundance Indices (RAI)
Low elevation hills (150-400m)	2.37
Medium elevation hills (400-800m)	1.91
Submontane (800-1300m)	2.19

Threats for tapirs in BBSNP

Asian tapirs in BBSNP currently are facing main threats from illegal encroachment resulting in habitat destruction. Purwanto (2016) reported from three TRHS sites, BBSNP had second largest encroachment area behind KerinciSeblat National Park, at size of 74.988 Ha (30.3% of the total) with encroachment rate of 1.240 Ha/year (average rate from 1990-2014 data). Over four decades, agricultural expansion for coffee production has been dominating the forest-cover change in and around BBSNP (Gaveau et al. 2007; Gaveau, Linkie, et al. 2009). The forest loss will reduce the habitat of Asian tapir thus decreasing the population and their survival as most of surviving animals will spend higher percentage of their time in an unfriendly habitat matrix (Kinnaird et al. 2003). Although tapirs are found in degraded forests, monoculture coffee cultivated area do not accommodate the growth of tapirs' diet plants therefore do not act as tapir habitat.

Accidental trapping on Asian tapirs is also occurred in BBSNP. We found one tapir which photographed carried scars from snares on its right forelimb. Trapping using snares still occurs inside BBSNP. In 2015, patrol team consisted of BBSNP and WCS-IP rangers eliminate a total of 12 snares targeting prey species (sambar deer, red muntjac, and wild boar) but strong enough to trap large mammals such as Asian tapirs and Sumatran tigers (WCS-IP unpublished data). As the snares may not directly kill Asian tapirs, the trapped tapirs will be dead because of thirst, hunger, and further injury. Even though tapirs are able to escape,Rochlitz et al. (2010) reported most animals that escape may subsequently die from their injuries, or from exertional myopathy, over a period of days or weeks. Similar cases happened in Kalimantan, where the Critically Endangered Sumatran rhino which found after 40 years has died after it was suspected suffering severe infection caused by snares from earlier poaching attempt (Guardian 2016).

Conserving the Asian tapirs

Law enforcement inside BBSNP is crucial to conserve one of the last remaining Sumatran tropical forest landscape and its biodiversity. BBSNP provides encouraging examples of the conservation efforts being implemented through the establishment of IPZ and the operation of adaptive management (SMART) patrol system. Despite there still a long way to tackling deforestation and hunting, the increasing spatial coverage and frequency of ranger patrols, especially on IPZ, along with strict law enforcement will significantly reducing the number of illegal activities inside national park, thus help protecting the endangered wildlife. We then recommend collaboration of national park authority, government stakeholders, NGOs, and local community to search solutions for the illegal encroachment and hunting practices inside BBSNP.

As recent survey reported the increasing population trends of Sumatran tigers (WCS-IP unpublished data), we also found BBSNP is an important area for regionally endemic Asian tapirs. The continuing existence of tapirs' healthy population strengthens its function as protected areas for Sumatran large mammals and hence its protection as a part of Tropical Rainforest Heritage of Sumatra is paramount.

4. CONCLUSION

Our study highlights the extent application of camera trapping targeting tigers to study less-known large mammals of Sumatra, Asian tapir. Information extracted from single camera trapping survey are enough to provides crucial information on recent tapirs' relative abundance, distribution, and activity patterns in BBSNP which are vital for tapir conservation management in BBSNP. For the future study, as BBSNP tiger population monitoring are conducted by WCS-IP every three years, it is possible to monitor long term Asian tapirs population dynamics which will provide us a better understanding on this endangered Sumatran megafauna.

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REFERENCES

Azlan, M. & Sharma, D.S.K., 2006. The diversity and activity patterns of wild felids in a sec- ondary forest in Peninsular Malaysia. *Oryx*, 40, pp.36–41.

Bennie, J. et al., 2006. Influence of slope and aspect on long-term vegetation change in British chalk grasslands. *Journal of Ecology*, 94(2), pp.355–368.

Clements, G.R. et al., 2012. Predicting the distribution of the Asian tapir in Peninsular Malaysia using maximum entropy modeling. *Integrative zoology*, 7, pp.400–406.

Gaveau, D.L.A., Epting, J., et al., 2009. Evaluating whether protected areas reduce tropical deforestation in Sumatra. *Journal of Biogeography*, 36, pp.2165–2175.

Gaveau, D.L.A., Linkie, M., et al., 2009. Three decades of deforestation in southwest Sumatra: Effects of coffee prices, law enforcement and rural poverty. *Biological Conservation*, 142(3), pp.597–605.

Gaveau, D.L.A., Wandono, H. & Setiabudi, F., 2007. Three decades of deforestation in southwest Sumatra: Have protected areas halted forest loss and logging, and promoted re-growth? *Biological Conservation*, 134(4), pp.495–504.

Guardian, T., 2016. First Sumatran rhino found in Borneo in 40 years has died. *2016*. Available at: https://www.theguardian.com/environment/2016/apr/06/first-sumatran-rhino-found-in-borneo-in-40-years-has-died [Accessed September 3, 2016].

Hayward, M.W., Jedrzejewski, W. & Jedrzejewska, B., 2012. Prey preferences of the tiger Panthera tigris. *Journal of Zoology*, 286, pp.221–231.

Holden, J., Yanuar, A. & Martyr, D.J., 2003. The Asian Tapir in Kerinci Seblat National Park, Sumatra: evidence collected through photo-trapping. *Oryx*, 37(01), pp.34–40.

Kinnaird, M.F. et al., 2003. Deforestation trends in a tropical landscape and implications for endangered large mammals. *Conservation Biology*, 17(1), pp.245–257.

Laumonier, Y., 1997. *The Vegetation and Physio- graphy of Sumatra*, Dordrecht, The Netherlands: Kluwer Academic Pub.

Linkie, M. et al., 2013. Cryptic mammals caught on camera: Assessing the utility of range wide camera trap data for conserving the endangered Asian tapir. *Biological Conservation*, 162, pp.107–115. Available at: http://dx.doi.org/10.1016/j.biocon.2013.03.028.

Lynam, A.J. et al., 2012. Comparative sensitivity to environmental variation and human disturbance of Asian tapirs (Tapirus indicus) and other wild ungulates in Thailand. *Integrative Zoology*, 7(4), pp.389–399.

Mackenzie, D.I. et al., 2002. Estimating site occupancy rates when detection probabilities are less than one. *Ecology*, 83(8), pp.2248–2255.

Meijaard, E., 1998. The Asian tapir in Central Sumatra. *Tapir Conservation*, 8, p.17.

Novarino, W. et al., 2005. Habitat Use and Density of the Malayan Tapir (Tapirus indicus) in the Taratak Forest Reserve, Sumatra, Indonesia. *Tapir Conservation*, 14(2), pp.28–30. Available at: http://tapirs.org/Downloads/newsletters/tapircons2_02.pdf#page=2.

Novarino, W. et al., 2004. Habitat Use by Malay Tapir (Tapirus indicus) in West Sumatra, Indonesia. *Tapir Conse*, 13(2), pp.14–18.

Novarino, W., 2005. *Population monitoring and study of daily activities of Malayan tapir (Tapirus indicus)*, Padang.

O'Brien, T.G., Kinnaird, M.F. & Wibisono, H.T., 2003. Crouching tigers, hidden prey: Sumatran tiger and prey populations in a tropical forest landscape. *Animal Conservation*, 6(2), pp.131–139. Available at: http://doi.wiley.com/10.1017/S1367943003003172.

PHKA, D., 2015. *Kebijakan. Pembangunan area perlindungan intensif (Intensive Protection Zone) di Taman Nasional Bukit Barisan Selatan sebagai upaya peningkatan populasi badak sumatera.*,

Pickles, R., Smith, J. & Goodrich, J., 2014. Panthera Field Manual Series: PFM03-Running a Camera Trap Grid.

Purwanto, E., 2016. *An Anti-encroachment Strategy for the Tropical Rainforest Heritage of Sumatra: Towards New Paradigms*, Bogor, Indonesia: Tropenbos International Indonesia and UNESCO.

Pusparini, W. et al., 2014. Small and medium sized cats in Gunung Leuser National Park, Sumatra, Indonesia. *CATnews*, 8, pp.4–9.

Rochlitz, I., Pearce, G.P. & Broom, D.M., 2010. *The Impact of Snares on Animal Welfare*, Cambridge.

Shwe, Nay Myo; Lynam, A.J., 2012. A preliminary investigation of the status and threats to Malayan tapir Tapirus indicus in the Taninthayi Nature Reserve, Myanmar. *Tapir Conservation*, 21(29), pp.18–23.

Sternberg, M. & Shoshany, M., 2001. Influence of slope aspect on Mediterranean woody formations: Comparison of a semiarid and an arid site in Israel. *Ecological Research*, 16(2), pp.335–345.

TFCA, 2010. Bukit Barisan Selatan. , p.1.

Traeholt, C. et al., 2016. Tapirus indicus . The IUCN Red List of Threatened Species 2016: e.T21472A45173636. *2016 International Union for Conservation of Nature and Natural Resources Reproduction*. Available at: http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T21472A45173636.en.

Williams, K.D., 1980. Browse Use, Feeding Behavior, and Management of the Malaysian Tapir. *Journal of Wildlife Management*, 44(2), pp.489–494. Available at: http://dx.doi.org/10.2307/3807985.

PEKON MUARA TEMBULIH, NGAMBUR, PESISIR BARAT: PRELIMINARY STUDY ON THE CHARACTERISTICS OF TURTLE HABITAT

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ABSTRACT

Regional marine conservation areas (KKLD) of the West Coast is an area of deployment and the nesting naturally. Ngambur the natural habitat of Olive Ridley turtles, green turtles, leatherback and hawksbill. Turtle habitat is located in the coastal area of vegetated and rescue area at the beach Ngambur, the turtle habitat environmental changes around the beach Ngambur thought to trigger the decline of turtle species. The purpose of this study is to determine the characteristics of the species diversity of turtles and turtle nesting habitat types in Muara Pekon Tembulih, Ngambur, West Coast. This research was conducted in February to May 2016 using a concentrated area and method of Rapid Assessment Procedures. Based on the research of sea turtle species found in Ngambur namely the green turtle (Chelonia mydas) (n = 3) and hawksbill (Eretmochelys imbricata) (n = 2) identification by outer shells were found. Characteristics of nesting habitat in Ngambur has a length of 941.23 meters beach, intertidal beach width ranging between 11.52 to 14.76 meters, the width of the beach supratidal ranged from 5.04 to 10.96 meters, temperature in the range of 26.5 to 33.750 C, the water content of 0.07%, the texture of the sand was 84.22% and 13.98% of fine sand texture, the flatness of the beach Ngambur including ramps category with an average of ± 2.43%. Vegetation is dominated nesting sites are the type of pandan sea (Pandanus tectorius) and animals that potentially predatory turtles and turtle eggs are paederinae (Paederus littoralis), ghost crabs (Ocypode ceratophthalma), eagle (haliaetus leucogaster), long-tailed macaque (Macaca fascicularis), snakes (Bungarus Candidus), dogs (Canis lupus familiaris) and lizard (Varanus salvator). The existence of turtles in Ngambur still be maintained, with good habitat conditions will help the survival of turtles in captivity turtle in Ngambur.

Keywords: Turtle nesting habitat characteristics, Ngambur, Turtle.

1. INTRODUCTION

Turtle is a species that lived on earth millions of years ago, and is able to perform the annual migration, in the thousands of kilometers between areas where to eat and a place to lay eggs. Turtle belongs to the class Reptilia were able to escape and live up to now.

Under the provisions of CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna), all kinds of sea turtles have been included in Appendix I, which means turtle international trade for commercial purposes is prohibited. World conservation body IUCN (International Union for Conservation of Nature and Natural Resources) insert hawksbill to the list of critical species (critically endangered). While the green turtle, olive ridley turtles and loggerhead sea turtles are classified into endangered species (endangered).

Region turtle conservation in Muara Pekon Tembulih Ngambur District of the West Coast District is a turtle nesting area as well as a turtle breeding area. The region includes KKLD (Marine Conservation Areas) whose activity since 2007 by community groups Sukamaju. Research the diversity and characteristics of sea turtle nesting habitat is done in Ngambur aims to obtain data and information on sea turtle nesting activity as well as the presence of habitats that may affect breeding success. Efforts to support sea turtle conservation in the region, it needs a good management system to collect data on the biological aspects, habitat and the factors that threaten the existence of sea turtles, so the policy of marine conservation areas in the region will be better Ngambur.

2. MATERIAL AND METHODS

The research was conducted from February to May 2016 Pekon Muara Tembulih, District Ngambur, West Coastal District, Lampung Province. Data is collected using a concentrated area, turtles are found in place to identify species based on morphological characteristics. The discovery of turtles taken point using GPS coordinates, and then note the condition of the existing vegetation around the site turtle invention. While the observations using Rapid Assessment Procedures method involves taking a point using GPS coordinates when there is the lowest and highest tides, the flatness of the beach, while collecting data about coastal vegetation and wildlife potential as natural predators of turtles done by direct observation in the study site.

Analysis of the nesting habitat characteristics is based on vegetation data and parameter data discovery environment turtles. Environmental parameters were analyzed descriptively, covers the length and width of the beach, beach vegetation type, texture and temperature of the sand beach, size of the hole, turtle predators and human activity.

3. RESULT AND DISCUSSION

3.1. Diversity Turtle

a. Turtle identification

Turtles were found on 22 April 2016 at 19:48 am at the observation station 1 is located at coordinates (x, y) (50 45 '73.97 "and a 1040 12' 03,61") is a type of green turtle (*Chelonia mydas*), this information tailored to the characteristics possessed. The characteristics possessed like the green turtle (*Chelonia mydas)*, namely the shape of the plastron and a head that resembles a green turtle (Figure 1 and 2), forms a small head, beak blunt and this turtle can't enter his head into the shell (Agus 2007).

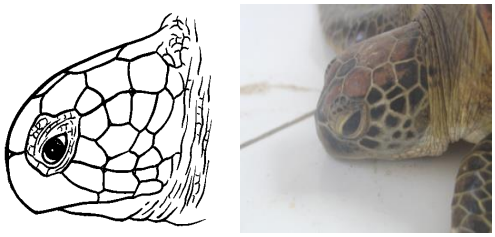


Figure 1. The shape of the head of a green turtle that was found in the observation station 1 Ngambur nesting beaches, (Wyneken, 2001).

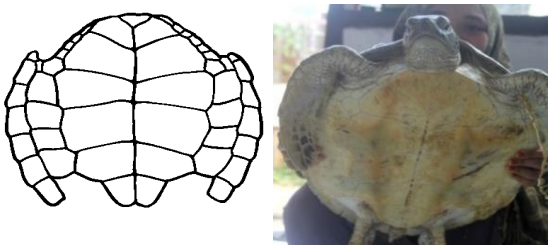


Figure 2. The shape of the plastron green turtles are found in the observation station 1 Ngambur nesting beaches, (Wyneken, 2001).

Direct encounter with the green turtle, when the implementation of a night patrol at 19:48 pm. Turtles are found weighs about 28.5 kg and 27 years old are conducting preparatory activities for the spawn. According to Agus (2007), the age of the turtle to reach sexual maturity ie if the turtle had lived for many years at sea, which is not less than 25 to 30 years. Before release turtle back to the sea, turtle morphology measurements (Table 1).

Table 1. The morphology of the green turtle (*Chelonia mydas*), which is found in the observation station 1 turtle nesting beaches in Ngambur on 22 April 2016

Date and Time encounter with wildlife	Morphology Green Turtle	Unit (cm)
22 April 2016	1. Curved carapace length	45,0
	2. carapace width	41,5
	3. Right upper limb length	25,0
	4. Left upper limb length	25,0
	5. The width of the right upper limb	12,5
	6. The width of the left upper limb	12,5
	7. The length of the lower leg right	12,0
	8. The length of the left lower leg	12,0
	9. The width of the right lower limb	7,0
	10. The width of the left lower leg	7,0
	11. Long neck - head	13,0
	12. The width of the head	6,6
	13. long tail	2,0
Total length		60 cm
Weight		28,5 kg

Before the turtle in release into the sea, after cleaning carapace of parasites that attack barnacles and moss that grows on the body (Figure 3).

Figure 3. Cleaning parasites (Barnacle) and the moss on the carapace.

Parasite that grows in the form of turtle shells of shellfish called barnacles. Barnacle has a white color with soft parts in it, which over time can erode the carapace so hollow. This type of parasite attacking the turtle's body such as the head and flipper turtles. Cleansing parasites and moss should be done with caution due to the barnacles of life converge on the turtle's body and if done abruptly, it can hurt the body of the turtle.

3.2. Physical Habitat Nesting

a. Length and Width Beach

Long beach turtle breeding Ngambur is 941.23 meters. Conditions beach long enough will facilitate in the selection of the mother turtle nesting sites. For the measurement of the width of the beach turtle breeding area is divided into two regions namely intertidal and sub supratidalnya (Table 2).

Long beach turtle breeding is 941.23 meters, while the width of the intertidal beach 11.52 m - 14.76 m wide beach supratidal 5.04 m - 10.96 m, it can help the turtle to land and lay eggs at the start the highest tide tide because the sea will bring the turtle to the limit of vegetation with ease. This

statement is consistent with the statement Hirth (1971), that a general state of green turtle nesting beaches is the beach with supratidal wide area.

Table 2. Measurement of the length and width of the beach nesting habitat Ngambur

No.	Observation Station	Long Beach	Wide Width Intertidal Beach	Wide Width Supratidal Beach
1.	Station 1	313.743 meter	11.52 meter	7.42 meter
2.	Station 2	313.743 meter	14.76 meter	10. 96 meter
3.	Station 3	313.743 meter	12.68 meter	5.04 meter
Total		941.23 meter	27.28 ± 9.09	23.42 ± 7.80

b. The size of the nest and laying

There is a relic hatchlings nest has hatched and found the size of the surface of the nest diameter is 42 cm, base diameter is 60 cm nests and nest depth was 68 cm (Figure 4).

Figure 4. Measurement nest of turtle eggs.

According to Agus (2007), green sea turtles lay eggs for approximately 2 hours with the number of eggs in a nest ranged between 80-195 grains. Nests are generally diameter between 23-45 cm with a depth of about 55-70 cm. The size of the nest to save turtle eggs depends on the species nesting turtle, turtle the size and number of eggs released by each species.

c. Planting nest Turtle Eggs

Nest egg implantation is used to assist the process of hatching eggs, turtle eggs whose existence is threatened human theft or disturbed by predators can be exhumed and transferred to artificial nests safer. The size of the turtle nests plantings adapted to the type of turtle eggs, generally green turtle nests in diameter from 23 to 45 cm with a depth of 55 to 70 cm (Agus, 2007). Green turtle eggs that have been granted by the residents around the turtle breeding on 10 April 2016 amounted to 98 grains. Planting nest egg located at coordinates (x, y) (50 45 '87.01 "and a 1040 12' 56.88") in diameter nest observation station 1. measuring 30 cm by 57 cm depth (Figure 5).

Figure 5. The artificial nest planting of green turtle eggs in one observation station, the beach Ngambur nesting.

d. Vegetation Beaches

Found diverse coastal vegetation type, sea pandanus (Pandanus tectorius) is a plant that spreads overall on turtle nesting area in Ngambur. Type of beach vegetation at each observation station has a different composition (Table 3).

Table 3. The type of vegetation found on any observation station in Turtle Conservation Area in Ngambur

Observation Station	Vegetation Type	**Scientific Name**	**Remarks**
Observation Station 1	Tapak kuda	*Ipomea pescaprae*	Perdu
	Pandan laut	*Pandanus tectorius*	Perdu
	Ketapang	*Terminalia catappa*	Tree levels
	Kelapa	*Cocos nucifera*	Tree levels
Observation Station 2	Jati pasir	*Guettarda speciosa*	Tree levels
	Nyamplung	*Callophylum inophylum*	Tree levels
	Tapak kuda	*Ipomea pescaprae*	Perdu
	Pandan laut	*Pandanus tectorius*	Perdu
	Ketapang	*Terminalia catappa*	Tree levels
Observation Station 3	Jati pasir	*Guettarda speciosa*	Tree levels
	Nyamplung	*Callophylum inophylum*	Tree levels
	Tapak kuda	*Ipomea pescaprae*	Perdu
	Pandan laut	*Pandanus tectorius*	Perdu
	Waru laut	*Hibiscus tiliaceus*	Tree levels
	Ketapang	*Terminalia catappa*	Tree levels

e. Layout and Position Location Observation Station

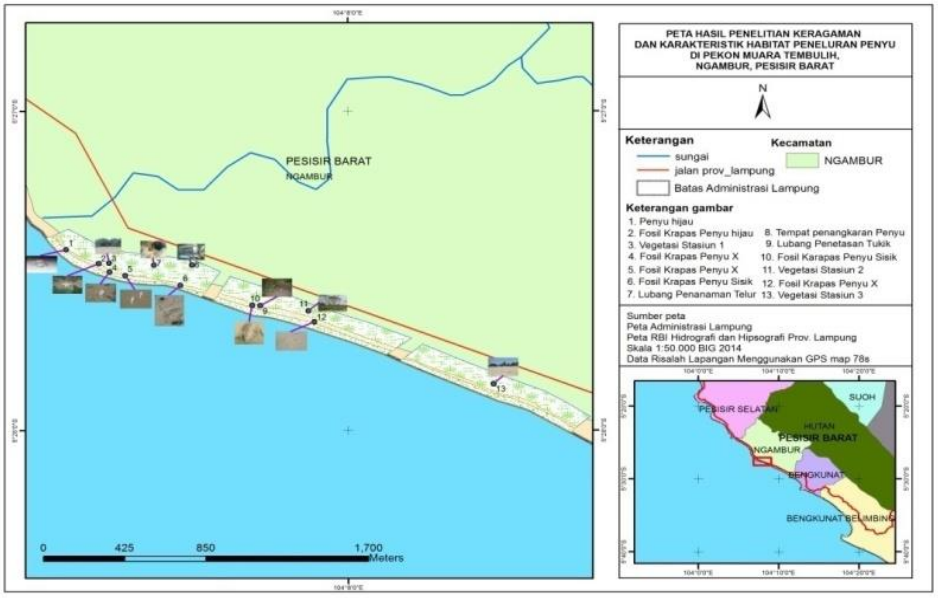


Figure 6. Lay out the location and position of observation stations in the region captivity Ngambur turtle (Bramsah, 2016).

Determination of coordinates at each point of observation stations use the GPS map 78s. The method used is the method of Rapid Assessment Procedures by tracing the beach and retrieve data in the form of point coordinates at the time of the encounter with turtles live and when they found signs of turtle like the discovery of shells, hawksbill turtle, trace and nest nesting, the tide sea in the intertidal and supratidal the coordinates vegetated areas and facilities in the turtle breeding locations (Figure 6).

Decision point coordinates using GPS map 78s, to produce information that could explain the location and position of the time found the turtle and the signs of its existence (Table 4).

Table 4. The location and the position is found turtles and signs of its presence in the nesting beaches Ngambur

No	Description	Latitude	Longitude	Observation Station
1	Green Turtle	-5,457397	104,120361	Station 1
2	Green turtle shells	-5,458147	104,121887	Station 1
3	Vegetation	-5,457924	104,122048	Station 1
4	Karapas not identified	-5,458419	104,121909	Station 1
5	Karapas not identified	-5,458608	104,123617	Station 1
6	Hawksbill turtle shells	-5,459265	104,125374	Station 1
7	Green Turtle Nest Egg Planting	-5,458701	104,125688	Station 1
8	Location Turtle Breeding Station In Ngambur	-5,45802	104,125959	Station 1
9	Hatchlings Hatching Hole	-5,460081	104,129269	Station 2
10	Hawksbill turtle shells	-5,460479	104,128606	Station 2
11	Vegetation	-5,461	104,131782	Station 2
12	Karapas not identified	-5,461002	104,131742	Station 2
13	Vegetation	-5,463782	104,13834	Station 3

f. The Flatness Of The Beach

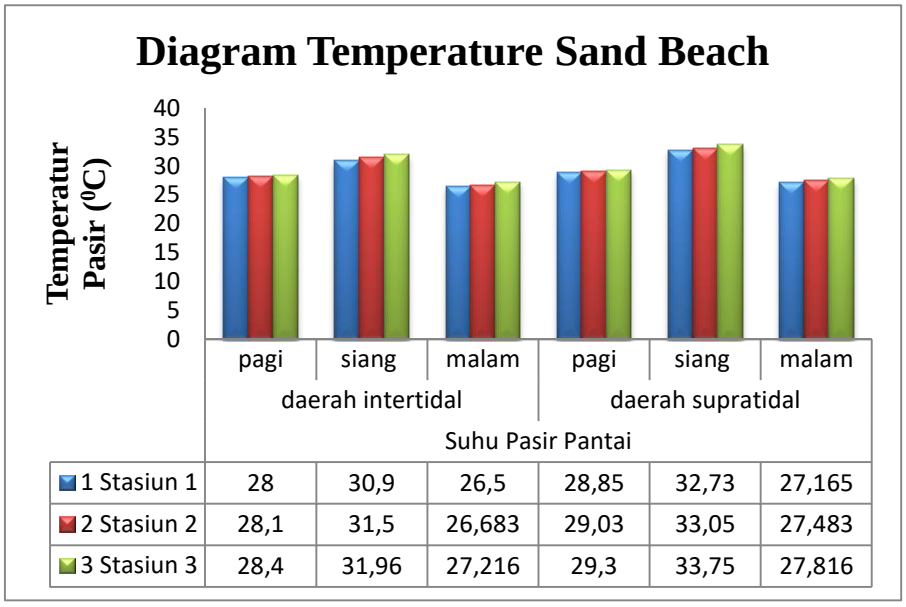
The flatness of the beach is measured by the distance between vegetation representing inland boundary to the shoreline as the ocean boundary. Measurement of the flatness of the beach in Ngambur done by measuring the height and distance of the beach flat (Table 5).
Table 5. Measurement of the flatness of the beach at three observation stations in Ngambur

Observation Station	**Local Meaurement Beach**	**Width Beach (m)**	**Difference Height (m)**	**Distance Flat (m)**	**α**	**Tg α**	**α (^{O})**	**%**
		07.00 wib	**07.00 wib**	**07.00 wib**				
Observation Station 1	Supratidal	7,42	0,28	7,39	0,037	6,45	2,11	3,79
	Intertidal	11,52	0,37	11,41	0,032	5,58	1,83	3,24
Observation Station 2	Supratidal	10,96	0,11	10,89	0,010	1,74	0,57	1,01
	Intertidal	14,76	0,64	14,68	0,043	7,50	2,46	4,35
Observation Station 3	Supratidal	5,04	0,10	5,01	0,019	3,31	1,08	0,01
	Intertidal	12,68	0,28	12,61	0,022	3,83	1,26	2,22
Average		62,38 **±10,40**	1,78 **±0,30**	61,99 **±10,33**	0,163 **±0,027**	28,41 **±4,73**	9,31 **±1,55**	14,62 **±2,43**

The slope of the beach in Ngambur between 0.570 to 2.460. the slope of the highest in the observation station 2, namely in the area of intertidal 2,460 and the lowest was in the area supratidal 0.570. Nesting sites in the turtle breeding area Ngambur relatively flat and wide, and the area is quite spacious supratidalnya. According Nuitja (1992), in general, to the nesting area covers only ranges from 2-12 meters above the highest tide. While the flatness of the beach is relatively flat and flat, is a habitat for green turtles and hawksbill (Priyono, 2004).

g. Temperature and Texture Sand Beach

Sand temperature measurement performed on intertidal areas and regions supratidal use a thermometer. Measurements done 3 times a day at (06:00, 12:00 and 21:00) in the intertidal area and supratidal that exist at each observation station. Temperature fluctuations in the beach sand is presented (Figure 7).



1 Stasiun 1	28	30,9	26,5	28,85	32,73	27,165
2 Stasiun 2	28,1	31,5	26,683	29,03	33,05	27,483
3 Stasiun 3	28,4	31,96	27,216	29,3	33,75	27,816

Figure 7. Fluctuations in temperature sand beach at 3 observation stations.

Increasing the maximum temperature occurs during the daytime ie 33.75 0C at station 3, the high temperature caused by the heat produced by the sun at 12:00 to 13:00 pm and a lack of vegetation cover in the vicinity of the station 3. The temperature at the surface of the sand is too high , can cause the level of turtle encounters at that location the less.

Testing of the texture and moisture content in the sand beach at Ngambur done using oven systems and methods of sieving (sieve) using the tools storey sand filter. Tests conducted at the Laboratory of Analysis Polinela, the water content is generated by the testing was 0.07%, the water content in the sand has a function which is to maintain the temperature in the sand, so that the temperature of the sand is relatively stable.

Texture sand nesting beaches in Ngambur dominated by sand texture moderate (mm 0:19 - 0:45 mm) amounted to 84.22% and the texture of fine sand (mm 0:09 - 0:19 mm) amounted to 13.98% (Table 6). Green and hawksbill turtles lay their eggs in the sand predominantly fine to medium sand. Nuitja (1992), states that the composition of the sand texture of sand to the nesting area of not less than 90% with a diameter between 0.18 to 0.21 mm and the remaining dust or clay with a grain diameter of fine form and medium.

h. Type - Type Other Animals

Animals that potentially predatory turtles and turtle eggs in the turtle breeding area in Ngambur there are 7 species (Table 7).

Table 7. Type - Type Animals As Predator turtles and eggs

No.	Animal type	Latin Name	Description
1.	Ant Semai	*Paederus littoralis*	Predators
2.	Ghost Crab	*Ocypode ceratophthalma*	Predators
3.	Eagles	*Haliaetus leucogaster*	Predators
4.	Long-tailed monkeys	*Macaca fascicularis*	Predators
5.	Snake	*Bungarus candidus*	Predators
6.	Dog	*Canis lupus familiaris*	Predators
7.	Lizard	*Varanus salvator*	Predators

4. CONCLUSION

Based on the research results can be summarized as follows.

1. Type of turtle found in the turtle breeding Ngambur is the green turtle (*Chelonia mydas*) (n=4) and hawksbill (*Eretmochelys imbricata*) (n=2).
2. Characteristics of nesting site for turtles in captivity turtle Ngambur has a length of 941.23 meters with a width shore intertidal beach 11.52 m - 14.76 m while the width of the beach supratidal 5.04 m - 10.96 m, sand temperatures in the range 26 5-33,750C, the water content of 0.07%, the texture of the sand was 84.22% and 13.98% of fine sand texture, the flatness of the beach Ngambur including ramps category with an average of ± 2.43%. Vegetation is dominated nesting sites are the type of pandan sea (*Pandanus tectorius*) and animals that potentially predatory turtles and turtle eggs are paederinae (*Paederus littoralis*), ghost crabs (*Ocypode ceratophthalma*), eagle (*haliaetus leucogaster*), long-tailed macaque (*Macaca fascicularis*), snakes (*Bungarus Candidus*), dogs (*Canis lupus familiaris)* and lizard (*Varanus salvator*).

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REFERENCES

Agus. 2007. *Penangkaran Penyu*. Angkasa. Bandung.

Hirth, H.F. 1971. *Synopsis of Biological Data on the Green Turtle. FAO Fisheris synopsis*. No. 85. Rome Research. Jhon Willey and sons Inc. USA.

Nuitja. I.N.S. 1992. *Biologi Dan Ekologi Pelestarian Penyu Laut*. IPB Press. Bogor.

Priyono, A. 2004. Pengelolaan Habitat Dan Satwa Penyu Laut. *Media Konservasi Volume II*.

Wyneken, Jeanette. 2001. *The Anatomy of Sea Turtles.* U.S. Department of Commerce NOAA Technical Memorandum NMFS-SEFSC-470, 1-172 pp.

SUMATRAN ELEPHANT (*ELEPHAS MAXIMUS SUMATRANUS* T) FOOD COMPOSITION AND ITS PREFERENCE IN TESSO NILO NATIONAL PARK

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ABSTRACT

Tesso Nilo is one of national park that has human elephant conflict over time. The conflict caused by the use of same habitat between man and elephant. The research about food preference of Sumatran elephant have conducted in Tesso Nilo National Park in Riau Province in June to August 2016. The aim of this research was to identified elephant food species vegetation and its preference in elephant habitat. This research used direct observation method in 4 transect, 2 transect at forest and 2 transect at shrubsand used grab method to identified elephant food preference. That,found 24 species at the forest and 5 eaten by Sumatran elephant and found 4 species at the shrubs and 1 eaten by elephant at Tesso Nilo National Park. Species important value from the forest 44,14% at *Artocarpus elasticus*/Moraceae dan 45,18% at *Nephelium cuspidatum*/Sapindaceae. The food preference consist of *Cyperus rotundus*/Cyperaceae (341 grabs), *Paspalum conjugatum*/Poaceae (265 grabs), *Panicum repens*/Poaceae (99 grabs), *Artocarpus elasticus*/Moraceae (72) and *Ficus alba*/Moraceae (27 grabs)

Keywords: Food preference, Sumatran elephant, vegetation composition, Tesso Nilo National Park, vegetation analysis

1. INTRODUCTION

Elephant population has decreased drastically 700 to 800 in 1999 and 354 to 431 in 2003 (WWF and BBKSDA Riau, 2006). Declining populations due to declining habitat quality and also the conflict between human and the elephant. On one side of the elephant is protected under the Act No. 5 of 1990 on Conservation of Natural Resources and CITES Appendix 1. On the other hand elephants are considered pests by palm farmers.

Reduction of elephant habitat is evident due to the change of the elephant habitat into monoculture plantations (palm and rubber) are destroying the habitat of Sumatran elephants. This resulted elephant trapped in small blocks of forest that is not enough to support life in the long term. It became a trigger for conflict between humans and elephants (Jogasara, 2011).

The highest conflict are found in spaces shared by humans and elephants. Many cases occur on lands that have been converted from forest to oil palm plantation (Yoza, 2009). As a result of forest conversion causes a fragmentation of habitat for the animals (Yoza, 1995).

Sumatran elephant (Elephas maximus sumatranus, Temminck, 1847) is an endangered species that spread to almost all parts of Sumatra island from Aceh until Lampung Province, but its main habitats are lowland island of Sumatra. This endangered species can be found in some forest areas of production, among others in the group TessoNilo that most of the region has changed her status to TessoNilo National Park.

TessoNilo National Park still offers the lowland forests is one of the remaining regions in Sumatra. This area is very possible for the population of Sumatran elephants due to their topography is relatively flat and water sources are available throughout the year. Besides the abundant availability of food is an important factor in determining the survival of Sumatran elephants.

The large number of elephant populations inside TessoNilo National Park area is very dependent on the carrying capacity of the habitat and food available. Based on this it is necessary to feed the elephants inventory to adjust the carrying capacity of its habitat and the purpose of providing feed

elephants in the field. The purpose of this research is to identify the types of feed elephants contained in TessoNilo National Park and identify the palatability of feed elephants in TessoNilo National Park

2. MATERIAL AND METHOD

2.1. Location

Research was conducted during 2 months in May-June 2016. Research located in Gondai village, LubukKembangBungaand TessoNilo National Park

2.2. Procedures

2.2.1. Elephant Position

Elephantsposition can be determined by using direct and indirect methods. Direct methods such as elephant observation, while the indirect method may include the discovery of traces (former fault elephant, feces and footprints of elephants) and interviews. Interviews were conducted with local people who know the existence of elephants. If found traces of elephants or elephant, then use GPS to save the point.

2.2.2. Elephants Food Palatability

The types of elephant food plants known from bites, the rest being eaten elephant and mahout information. Parameter potential vegetation elephant feed studied cover the diversity of vegetation types of feed, spread types, the palatability of feed and feed production. Data collected vegetation types feed concurrent with vegetation analysis (in the sample plot vegetation analysis) to determine the quantitative density and dominance in the structure and composition of vegetation in the habitat of elephants. In addition, data collection elephant feed types also performed in other transects to seek information other diets plant species as well as the edible part. To quantify the elephants feed production is done by cutting the plant species feed on seedlings, saplings, lower plants (including grass), shrubs, lianas, epiphytes, palms and pandanus; then weighed to obtain the wet weight. The size of the sample plot observations for the types of grasses (including weeds) is 1m x 1m, while for the nursery, lower plants (other than grasses) shrubs / herbs, ferns, with a sample plot size of 2m x 2m. Laying the sample plots were selected based on observations of the location of a food source, with a number of sample plots adapted to field conditions.We use mount of grab to know elephant food palatability around the field.

2.2.3. Plot Sample Location of Elephants Food

Vegetation composition is done by using the plots are made on location into elephant habitat feed using a line transect using purposive sampling method (selected sample). Transect Line is a method of observation of wildlife populations through sampling with unit form samples of transect.Based on secondary data and interviews obtained from the manager and the public stated that the number of elephants in groups of as many as three elephants Gondai village and in the village of LubukKembangBunga there are seven elephants. Therefore, observations in the form of lines, then the number of samples required track is two transect with a broad sample of 2 hectares. Each transect has a width of 20 m and a length of 500 m.

2.3. Data analysis

Vegetation composition analyzed by importan value index with density index, frequency index, dominance index. The amount of TIP for growth on trees and poles maximum level is 300%, while the growth rate of saplings and seedlings / herb maximum is 200% (Soerianegara and Indrawan, 1978).To obtain quantitative data of vegetation inorder the vegetation analysis to determine the potentialelephant food in Tesso Nilo national Park,it is necessary to count the value of vegetation following parameters:Absolute frequency (FM), Relative Frequency (FR),Absolute density (KM), Relative Density (KR),Absolute Dominance (DM), relative dominance (DR), ValueImportant (NP), and species diversity index(H).To find natural food species of elephantswhich has an important value

is high, then the wholestations merged into one, so that it candemonstrated species dominatearea studied. So that significant value can beinterpreted, then the value is classified onthree groups: low, high, and very high(Barbour et al., 1987).

Preferences feed elephants Sumatra was determined by observation directly in the field to the number anddiets plant species. Determining the location sampling and plant species feedby traces (fault or plant remainsfeed) abandoned elephants. laying downplot carried out along the daily path of elephantsby purposive sampling of 10 plotswith a size of 1x1 meters.

3. RESULT AND DISCUSSION

3.1. Composition of Elephants Feed

Identify the composition of tree species found in natural forests carried of Tesso Nilo National Park (TNNP) by using the path along 500 meters and a width of 20 meters. Information about the composition of plant species found in the region can be seen in Table 1 and important values can be seen in Table 2.

Table 1.Types of Trees in Elephant Tracks

No	Name Trees	Latin Name	Family
1	Petatal	*Ochanosthacys amentaceae*	Olacaceae
2	Terap	*Artocarpus elasticus*	Moraceae
3	Saga	*Adenanthera pavonina*	Fabaceae
4	Bintangur	*Callophyllum sp.*	Callophylaceae
5	Keranji	*Dialium platysepalum Baker.*	Fabaceae
6	Kedondong	*Dacryodes costata*	Burseraceae
7	Tambal	unidentified	unidentified
8	Dara-dara	*knema hookeriana*	Myriticaeceae
9	Rambutan Hutan	*Nephelium cuspidatum*	Sapindaceae
10	kelat	*Syzygium sp.*	Myrtaceae
11	Kelat merah	*Eugenia ridleyi*	Myrtaceae
12	Kelat putih	*Eugenia odorata*	Myrtaceae
13	Empelur	*Dillenia reticulata*	dilleniaceae
14	Samak	*Syzygium spicata*	Myrtaceae
15	Pisang-pisang	*Mezzettia parvifolia Becc*	Annonaceae
16	Ludai	*Sapium bicolor*	Euphorbiceae
17	Medang kangkung	*Litsea sp*	Lauraceae
18	Meranti kunyit	*Shorea sp.*	Dipterocarpaceae
19	Rengas	*Swintonia sp*	Anacardiaceae
20	Putat	*Barringtonia pendula*	Lecytidaceae
21	Meranti Kanuar	*Shorea sp.*	Dipterocarpaceae
22	Tempunik	*Artocarpus rigidus*	Moraceae
23	Tembalun	*Parashorea aptera*	Dipterocarpaceae
24	Kandis	*Garcinia farvifolia*	Guttifer ae

From the results in Table 1 obtained 24 species of trees found in the path of an elephant. Of the 24 types of the most common types of rambutan hutan and terap with importan value respectively 44.14% and 45.18%. importan value most determined of the high relative frequency, relative dominance and relative abundance of a species. Of the 24 species found in secondary forest, 5 types of which are the food of elephants are terap (*Artocarpus elasticus*), pisang-pisang (*Mezzettia parvifolia*), ludai (*Sapium bicolor*), Rengas (*Swintonia sp*) and tempunik (*Artocarpus rigidus*). Of the five types of the two of them came from the family Moraceae namely terap (*Artocarpus elasticus*) and tempunik (*Artocarpus rigidus*).

Table 2.Importan Values Type Trees in the Forest Nature around TNNP

No.	Local name	Latin name	Family	K	KR	F	FR	D	DR	INP
1	Petatal	*Ochanosthacys amentaceae*	olacaceae	0.00	5.63	0.12	4.55	0.29	3.76	13.94
2	Terap	*Artocarpus elasticus*	Moraceae	0.00	15.49	0.36	13.64	1.18	15.01	44.14
3	Saga	*Adenanthera pavonina*	Fabaceae	0.00	5.63	0.16	6.06	0.44	5.61	17,31
4	Bintangur	*Callophyllum sp.*	Clusi aceae	0.00	2.82	0.08	3,03	0.13	1.69	7.54
5	Keranji	*Dialium platysepalum Baker.*	Fabaceae	0.00	4.23	0.08	3,03	0.26	3.34	10.60
6	Kedondong	*Dacryodes costata*	Burseraceae	0.00	8.45	0.24	9.09	0.67	8.60	26.14
7	Tambal	Unidentified	Unidentified	0.00	1.41	0.04	1.52	0.03	0.44	3.37
8	Dara-dara	*knema hookeriana*	Myri sticaceae	0.00	4.23	0.12	4.55	0.32	4.08	12.85
9	Rambutan Hutan	*Nephelium cuspidatum*	Sapindaceae	0.00	14.08	0.32	12.12	1.54	19.68	45.88
10	kelat	*Syzygium sp.*	Myrtaceae	0.00	4.23	0.12	4.55	0.12	1.55	10.32
11	Kelat merah	*Eugenia ridleyi*	Myrtaceae	0.00	2.82	0.08	3,03	0.13	1.60	7.45
12	Kelat putih	*Eugenia operculata*	Myrtaceae	0.00	1.41	0.04	1.52	0.04	0.49	3.41
13	Empelur	*Dillenia reticulata*	dilleniaceae	0.00	8.45	0.20	7.58	0.78	10,00	26.03
14	Samak	*Syzygium spicata*	Myrtaceae	0.00	7.04	0.20	7.58	0.47	5.97	20.59
15	Pisang-pisang	*Mezzettia parvifolia Becc*	Annonaceae	0.00	1.41	0.04	1.52	0.04	0.49	3.41
16	Ludai	*Sapium bicolor*	Euphorbiceae	0.00	1.41	0.04	1.52	0.09	1.09	4.02
17	Medang kangkung	*Litsea sp*	Lauraceae	0.00	1.41	0.04	1.52	0.11	1.45	4.37
18	Meranti kunyit	*Shorea sp.*	Dipterocarpaceae	0.00	1.41	0.04	1.52	0.14	1.77	4.69
19	Rengas	*Swintonia sp*	Anacardiaceae	0.00	1.41	0.04	1.52	0.14	1.77	4.69
20	Putat	*Barringtonia pendula*	Lecytidaceae	0.00	1.41	0.04	1.52	0.11	1.45	4.37
21	Meranti Kanuar	*Shorea sp.*	Dipterocarpaceae	0.00	1.41	0.04	1.52	0.08	1.03	3.95
22	Tempunik	*Artocarpus rigidus*	Moraceae	0.00	1.41	0.04	1.52	0.10	1.30	4.22
23	Tembalun	*Parashorea aptera*	Dipterocarpaceae	0.00	1.41	0.04	1.52	0.08	0.96	3.89
24	Kandis	*Garcinia farvifolia*	Guttifer ae	0.00	1.41	0.04	1.52	0.04	0.53	3.45
		Amount		0.01	100.00	2.64	100.00	7.83	99.97	299.97

Relative density is highest on terap (*Artocarpus elasticus*) and rambutan hutan (*Nephelium cuspidatum*) amounted to 15.49% and 14.08%. According to Arief (1994) high relative abundance of a species indicates that type have the ability to adapt better to the environment than other types. While the low relative density indicates that the number of individuals of a species that is not able to adapt to the environment.

The highest frequency is also found in terap (*Artocarpus elasticus*) and rambutan hutan (*Nephelium cuspidatum*) of 0.36 and 0.32. According Soerianegara (1998) shows the frequency of a particular type of deployment types in an area. Types that are distributed over a large frequency has a value, otherwise the species has a small frequency value having a small distribution area. This can be caused by a lack of factors that can help its spread, so that the power distribution is reduced.

The highest importan value was found in the rambutan hutan (*Nephelium cuspidatum*) and types of terap (*Artocarpus elasticus*) respectively by 45.88% and 44.14%. Described by Soerianegara and Indrawan (1978) in Andriyani (2006), that a plant species with the highest important value in a vegetation, meaning that type is the dominant species. Where these types have advantages over other types of competing and adapt to the existing environment.

In addition to natural forests, vegetation analysis was also performed on shrubs. In shrub found four tree species from four families. The following types of trees found in the scrub around TNNP (Table 3)

Table 3. Trees Type in Shrublands around TNNP

No	Local Name	Latin Name	Family	Diameter (cm)	High (m)
1	Petatal	*Ochanosthacys amentaceae*	Olacaceae	40	16
2	Terap	*Artocarpus elasticus*	Moraceae	34	14
3	Saga	*Adenantera parvifolia*	Fabaceae	42	17
4	Bintangur	*Callophylum sp.*	Clusia ceae	32	14

Based on Table 3 it can be seen that there are 4 species of 4 families that are around shrubs in TNNP. These species grow among the shrubs that are all around TNNP. Of the four species found in thickets, one species is food that is kind of the applicability of elephants (*Artocarpus elasticus*).

Both natural forests and shrubs used by elephants as well as a source of feed passage in addition to other functions as a bed or shelter from the sun. The results of the identification of plants contained in the trajectory path of elephants totaling 24 species consist of 16 *family*. The composition of plant species in natural forests as many as 24 species of trees with a growth rate of seedlings. Plants that are found to herbaceous level of Poaceae and Asteraceae while seedling plants from syzygium (Myrtaceae), nangka-nangkaan (Moraceae), and Euphorbiaceae. Sumatran elephant allegedly like species of Poaceae because in addition to having a soft texture morphology, stature such as shrubs or bushes so it's easier to reach than the leaves on tall trees in the forest are difficult to reach (Yansyah, 2005).

In general, species that were found in the arearesearch has an important value is low. Symptom so common in the type of vegetation leads to the climactic conditions and stable (Djufri,1995). It thus also relevant to a conclusion Mueller-Dombois and Ellenberg (1974) that the composition of forest vegetation is disturbedin the long term will show physiognomy, phenology and regeneration relativefast, so that the dynamics in the communitytakes place quickly and easily observe the pacechange of the composition of a constituent. More real toif the area at any time experience disruption for their grazing (grazing) conducted by an elephant, so that the regeneration species is rapid, and usually can not becompleting the cycle of life as it should be.

3.2. Preferences Feed Elephants

3.2.1. Based wrench

Overall found the observed type of feed it directly to the three elephants grazing for 3 days. Observations preference elephant feed to the first adult male elephants (38 th), 1 adult female elephants (36 th) and 1 juvenile male elephants (8 th) in the *Flying Squad* village Gondai Base. Here are the types of feed eaten by elephants during two days of observation for each elephant

Table 4. Types of Animal Feed and Eating Behavior Observation Elephant

No.	Elephants sample	Food type	Observation					
			Day 1			Day 2		
			Morning (grab)	Evening (grab)	Amount	Morning (grab)	Evening (grab)	Amount
1	Jambo	Rumput teki	17	63	90			
		Rumput jarum	6	2	8			
		Rumput sianik	1	0	1			
		Akar	0	2	2			
		Terap				72		72
		Akar Kunyit					7	7
		Beringin					13	13
		Semantung					27	27
		Rumput teki	17	143	160	11	68	79
		Rumput sianik	10	0	10			
		Ilalang	2	2	4			
2	Novi	Lampuyangan	29	0	29	38	32	70
		Papaitan	51	2	53	33	4	37
		Pakis	2	0	2			
		Akar				1	0	1
3	Dono	Rumput teki	13	7	20			
		Papaitan	80	95	175			

Sources: Observations, 2016

Table 5. Grab amount for 3 Elephants in 3 Days

No.	Local name	Scientific name	Family	Grab amount
1	Rumput Teki	*Cyperus rotundus*	Cyperaceae	341
2	Rumput jarum			8
3	Rumput sianik	*Cyperus aromaticum*	Cyperaceae	11
4	Akar			3
5	Ilalang	*Imperata cylindrica*	Poaceae	4
6	Rumput lampuyangan	*Panicum repens L*	Poaceae	99
7	Papaitan	*Paspalum conjugatum*	Poaceae	265
8	Pakis	*Nepholepis biserrata SCHOTT.*	Polypodiaceae	2
9	Terap	*Artocarpus elasticus*	Moraceae	72
10	Akar Kunyit	*Coscinium blumeanum Merr.*	Menispermaceae	7
11	Beringin	*Ficus benjamina*	Moraceae	13
12	Semantung	*Ficus alba*	Moraceae	27

Sources: Observations, 2016

According to Table 4 rumput teki and papaitan favored by a third elephant to pull the highest number found on rumput teki for two elephants and papaitan for one elephant. This is in accordance with Fadillah (2013) which states that the elephant like papaitan of the family Poaceae. Information on the number of grab for 3 days and feed a family of elephants can be seen in Table 5.

The observation and identification of plants that belong to feed the elephants numbering 12 species consist of five *family*. Elephant food plants at the seedling stage as much as 3 types and 9 types of

herbs. Plants that are found to herbaceous level of tribe Poaceae and Cyperaceae while seedling plants from the tribe found jackfruit-nangkaan (Moraceae). Plants are most taken by elephants for 3 days, namely: rumput teki (*Cyperus rotundus)* as much as 341 times, Papaitan *(Paspalum conjugatum)* as much as 265 times grabs, lampuyangan *(Panicum repens L)* as much as 99 times, sianik *(Ciperus aromaticum)* as 11 times and only occasionally eat grass needles, roots, ferns. The Sumatran elephant allegedly liked species of Cyperaceae and Poaceae because in addition to having a soft texture morphology, stature such as bushes or shrubs making it easier to reach them, other than that the plant also does not contain a very sharp odor and not slimy. To more clearly the amount of pull feed the elephants for 30 minutes in the morning and 30 minutes late for 3 days against 3 observations Sumatran elephants can be found in Appendix 1. The parts are eaten by elephants can be seen in Table 6.

Table 6. Edible Plants Section Elephant

No.	Local Name	Latin Name	Family	Parts
1	Rumput Teki	*Cyperus rotundus*	Cyperaceae	All parts
2	Rumput Jarum	*Eleusine indica*	Poaceae	All parts
3	Rumput Sianik	*Cy perus aromaticum*	Cyperaceae	All parts
4	Akar			All parts
5	Ilalang	*Imperata cylindrica*	Poaceae	Leaf
6	Lampuyangan	*Panicum repens L*	Poaceae	All parts
7	Papaitan	*Paspalum conjugatum*	Poaceae	All parts
8	Pakis	*Nepholepis biserrata*	Polypodiaceae	Stems and leaves
9	Terap	*Artocarpus elasticus*	Moraceae	All parts
10	Akar Kunyit	*Coscinium blumeanum*	Menispermaceae	All parts
11	Beringin	*Ficus beyamina*	Moraceae	The leaves and bark
12	Semantung	*Ficus alba*	Moraceae	all parts

Sources: Observations, 2016

Based on Table 6 it can be seen that for these kinds of herbs and seedlings, elephants usually ate all the plants. On the types of trees, elephants eat the leaves and bark. Elephants are homoiterm animals that can not be to graze in the open. Part of plant that elephant ate show at Figure 1.

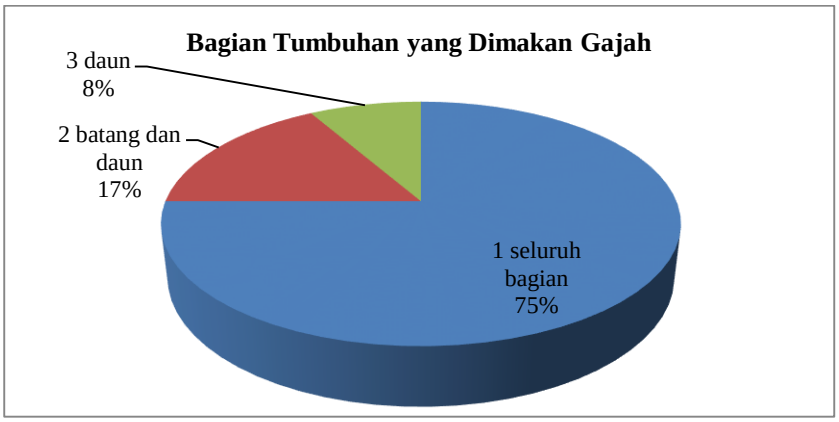

Fig 1. Proporsion of Plant Partthat elephant ate

In doing variouselephant feeding activity usingtrunk to grab or graspeating plants, ivory to openbark on the trunk asthe food, the front legs are used forhelps suppress in choosing the typefeed plants and mouth to chew(Zulkarnaini, 1993: 24). needs elephantthe fresh herbs in a number ofmany require elephant eating vegetationsecondary forest, undergrowth and lianaswhich generally prefers elephantthe types of plants grow fast (fastgrowing species).

Grazing is done in the area of shrubby vegetation dominated by *pioneer* . Among the plants that exist around grazing can be seen in Table 6.

Table 6. Pioner plants around Areal Grazing Elephant

No.	Plant names	Scientific name	Family	Habitus
1	Akar ribu-ribu	*Lycodium flexuosum*	schizaeaceae	herb
2	Mahang*	*Macaranga* sp.	Euphorbiacea	Tree
3	Tenggek burung*	*Euodia lucida* Miq.	Rutaceae	Tree
4	Anggrung	*Trema orientalis*	ulmaceae	Semai / Tree
5	Laban	*Vitex pubescens*	Verbenaceae	Tree
6	Rumput setawar	*Boreria alata*	Rubiaceae	herb
7	Akar kait*	*Uncaria sp.*	Rubiaceae	herb
8	Rumput pait*	*Axonopus compressus*	Poaceae	herb
9	Marapuyan	*Rhodamnia cenerea*	Myrtaceae	Tree
10	Dalok	*Fordea splendidissima* L.	faba ceae	Tree
11	Kelat	Syzygium sp.	Myrtaceae	Tree
12	Sikeduduk	*Melastoma malabathricum*	Melastomaceae	Terna
13	Resam*	*Gleichenia linearis*	gleicheniaceae	herb
14	Kacang-kacangan*	*Centrosema pubescens*	Fabaceae	herb
15	Maniran	*Phyllanthus urinary*	Euphorbiaceae	herb
16	Mahang tapak gajah*	*Macaranga gigantean*	Euphorbiaceae	Tree
17	Gletang	*Tridax procumbens*	Asteraceae	herb
18	Bandotan	*ageratum conyzoides*	Asteraceae	herb
19	Krinyuh	*Eupathorium odoratum*	Asteraceae	herb
20	Putri malu	*Mimosa pudica*	Fabaceae	herb
21	Akasia*	*Acacia mangium*	Fabaceae	Tree
22	Balik angin*	*Mallotus paniculata*	Euphorbiaceae	Tree
23	Merambung	*Vernonia Arborea* Buch.	Co mpositae	Tree
24	Layau	*Adinandra dumosa* jack.	Theaceae	Tree
25	Kantong semar	*Nepenthes* sp.	Nepenthaceae	herb
26	Pulai	*Alstonia pneumatophora* Bach.	Apocynaceae	Tree

Description: * feed elephants

Table 7. Number of Family and habitus Plant Food Elephants

No.	Family	Amount	habitus
1	Schizaeaceae	1	Herb
2	Euphorbiaceae	3	Tree
		1	Herb
3	Rutaceae	1	Tree
4	ulmaceae	1	Tree
5	Verbenaceae	1	Tree
6	Rubiaceae	2	Herb
7	Poaceae	1	Herb
8	Myrtaceae	2	Tree
9	Fabaceae	2	Tree
		2	Herb
10	Melastomaceae	1	Terna
11	gleicheniaceae	1	Herb
12	Asteraceae	3	Herb
13	Compositae	1	Tree
14	Theaceae	1	Tree
15	Nepenthaceae	1	Herb
16	Apocynaceae	1	Tree
	Amount	26	

The identification results overall observation of plants in the area of grazing elephants, total 26 species. Of the 26 species, 9 of them are food elephants. Plants belonging to feed the elephants (can be

seen in Table 5) and the remaining 17 species are not favored by the elephants. Based on the observations, most plants around grazing is not favored by elephants due to taste, smell or liquid contained in the plants. Elephants only break and used to repel insects that attach to the surface of the body. Here is the number of families and habitus of plants being the food of elephants.

Based on Table 7 it can be seen that the types of trees are eaten by elephants about 13 species, as many as 12 kinds of herbs and herb as much as 1 type. Family of the most widely eaten elephants of the family Fabaceae and Euphorbiaceae each as much as 4 types. The composition of elephant feed most commonly found in tree habitus followed by herbs and herb. The types of herbs and trees are found in the area of the edge of the forest. Composition and habitus of elephant food shown at Fig 2 and Fig 3.

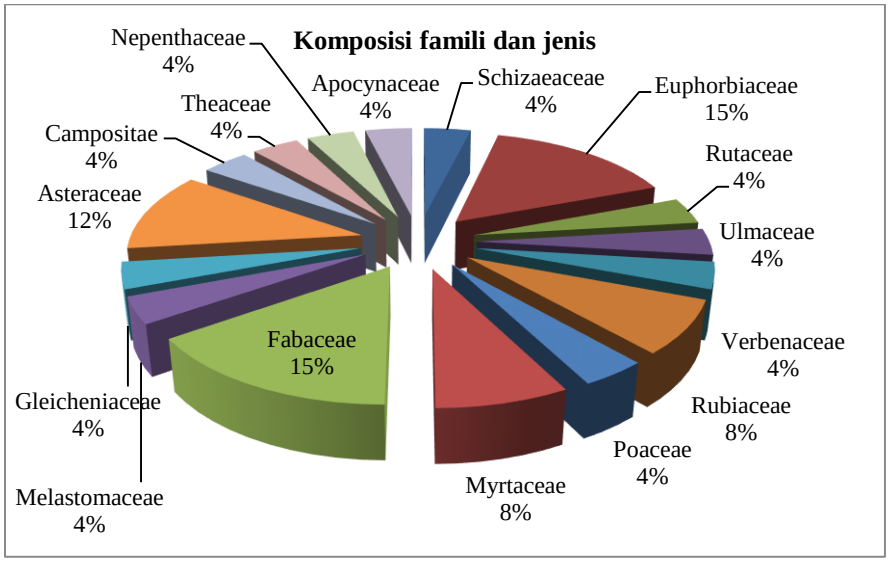

Fig 2. Composition and Family of Elephant Food

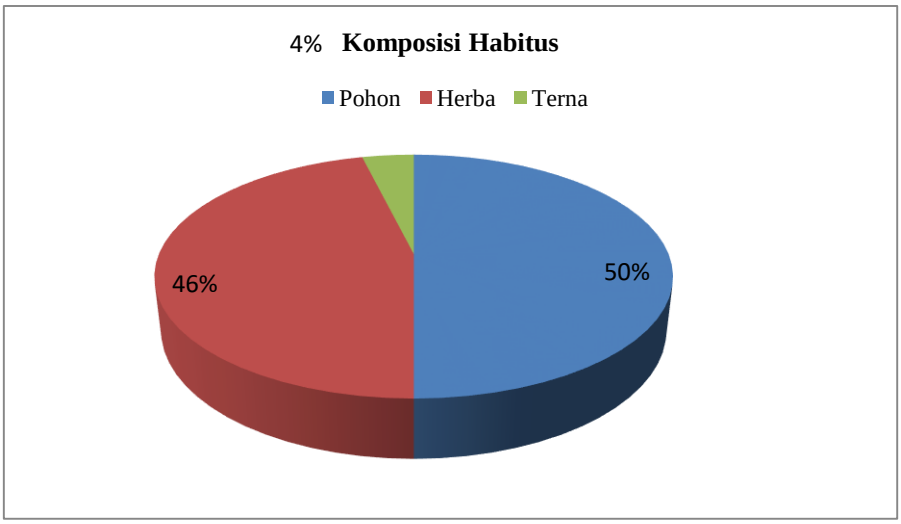

Fig 3. Habitus composition of Elephant Food

3.2.2. Based Feeding Test

Additional food is also given to the elephants to see if a plant species eaten or not by elephants. From feeding can be determined a certain plant species are feeding an elephant or not. Here is a test of elephants feeding in the field.

Table 8. Feeding trials against Elephants

No.	Local Name	Latin name	Family	Condition
1	Pagar-Pagar	*Ixonanthes icisandra*	linaceae	not edible
2	Dara-Dara	*knema hookeriana*	Myriticaeceae	not edible
3	Dalok	*Fordea splendidissima L.*	Papilionaceae	not edible
4	Medang	*Litsea sp*	Lauraceae	not edible
5	Semantung	*Ficus alba*	Moraceae	Twigs and leaves
6	Karet	*Hevea braziliensis*	Euphorbiaceae	Twigs and leaves
7	Petatal	*Ochanosthacys amentaceae*	olacaceae	not edible
8	Terap	*Artocarpus elasticus*	Moraceae	Twigs and leaves
9	Kelat Jambu	*Syzygium cuprea*	Myrtacea	not edible
10	Lengkuas Hutan	*Alpinia aquatica*	Zingiberaceae	not edible
11	Nasi-nasi	*Syzygium sp.*	Myrtacea	not edible
12	Kandis	*Garcinia sygyfolia*	guttiferae	not edible
13	Keranji	*Dialium platysephalum*	Leguminosae	not edible
14	Ludai	*Sapium baccatum*	Euphorbiacea	not edible
15	Kedondong Hutan	*Dacryodes costata*	Burseraceae	not edible
16	Nangka	*Artocarpus heterophylus*	Moraceae	Ranting and da un
17	Laban	*Vitex pubescens*	Verbenaceae	not edible
18	Mahang	*Macaranga gigantifolia*	Euphorbiacea	not edible
19	Beringin	*Ficus benjamina*	Moraceae	Twigs and leaves

Based on Table 8 it can be seen from 19 species of plants are given to the elephants, which are eaten are 15 kinds. In general the types of family Moraceae favored by elephants. This family is characterized by abundant white latex. Additionally one kind of family Euphorbiaceae also favored by elephants. According to Allen, *et al* (1997) in Andriyani (2006) says that in the rainy season elephants prefer to feed on flowers and in the dry season elephants prefer bark, bark, and twigs.

Elephants have the nature of *browsing* and *grazing* (Allen, *et al* ., 1997 in Andriyani, 2006). The nature of *browsing* is the nature of the elephant in the selection of plant parts are preferred, namely the roots, twigs, leaves, bark and sap. The nature of *grazing* is the nature of the elephant in the selection of the preferred vegetation type is a primary or secondary forest and shrubs. From the research results can be presumed that the wild elephants that live in Tesso Nilo National Park have the nature of *grazing* , where the elephants were like shrub vegetation for foraging and secondary forests used for shelter and rest.

Knowing the fondness feed the elephants do with taking some of the plants found in nature. Observation is done by providing a direct one by one of the plant species as many as 19 types of plants are taken directly from nature to an elephant. Generally giving the plant to determine the level of joy elephant be identified types of jackfruit tree-nangkaan of famyli Moraceae lot like elephants. Famyli Moraceae generally has a sweet taste and stature are not hard to make an elephant like this plant. The results showed that the elephant was like rubber from Famyli Euphorbiaceae, but only rubber are eaten by elephants. Stature and eskudat (fluid) from the rubber tree is different from trees that also belong to the Euphorbiaceae Famyli. Have the white latex rubber, not smelly and slimy like an elephant

Preferences eat an elephant is not only influenced by plant species ineating, availability of the number of plants feed and seasons also greatly affectplant taken by elephants sufficient feed her every day,therefore, elephants often doall year long journey surrounds its forest habitat(Home range). According to Mulya (1978) in Abdullah et al (2006) mentions that the source of feed elephants primary forest, secondary forest even the types of agricultural crops such as rubber and palm tree leaves sawit.dari groups of grasses, kind of wild sugarcane (*Sacharumspontanium*) is the most favoured by elephant grabbed her food by way of the browser or by crop damage. Logs (Cambium) are also eaten to meet especially calcium mineral to strengthen bones, teeth and ivory continues to grow.According Soeriaatmadja (1982: 34), "for the life of an elephant should eat at least 300-350 kg

plants a day because it is a part of life elephant, time is only used foreating and chewing. And almost everything of plants eaten, although theresome species of choice and his favorite".

4. CONCLUSION

Based on the results of the study can be summarized as follows

1. The survey results get 24 species of trees found in the trajectory path of elephants and of the 24 types of the most common types of forest rambutan and arranging with important value respectively 44.14% and 45.18%.
2. Plants are most taken by elephants for 3 days ie: rumput teki (*Cyperus rotundus)* as much as 341 times, Papaitan *(Paspalum conjugatum)* as much as 265 times the pull, grass lampuyangan *(Panicum repens L)* as much as 99 times, grass sianik *(Ciperus aromaticum)* 11 times and only occasionally eat grass needles, roots, ferns. Allegedly Sumatran elephants like plants from the tribe Cyperaceae and Poaceae because in addition to having the texture morphology soft, stature such as bushes or shrubs making it easier to reach them, besides these plants also does not contain a very sharp odor and not slimy
3. Pemberian plants to determine the level of joy elephant be identified types of nangka-nangkaan of famyli Moraceae lot like elephants. Family Moraceae generally has a sweet taste and stature are not hard to make an elephant like this plant.

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REFERENCES

Abdullah, Dahlian dan Mukhlisin. 2006. Preferensi Makan Gajah Sumatera (*Elephas maximus sumatranus*) di Kawasan Hutan Cagar Alam Jantho. Jurusan Pendidikan Biologi FKIP Unsyiah Banda Aceh

Alikodra, HS. 1990. *Pengelolaan Satwaliar Jilid 1*. Pusat Antar Universitas Ilmu Hayat. Bogor : Institut Pertanian Bogor.

Andriyani. 2006. *Potensi Herba Sebagai Pakan Alami Gajah Sumatera (Elephas Maximus Sumatranus) Di Tahura Sultan Syarif Hasyim*. [Skripsi] Fakultas Matematika dan Ilmu Pengetahuan Alam. Pekanbaru : Universitas Riau.

BalaiBesar Konservasi Sumber Daya Alam (BKSDA) Riau dan Yayasan WWF Indonesia. 2006. Protokol Pengurangan Konflik Gajah Sumatera di Riau. Pekanbaru

Barbour, G.M., J.K. Burk and W.D. Pitts. 1987. *Terrestrial PlantEcology*. New York: The Benyamin/Cummings Publishing Company, Inc.

Djufri. 1995. *Inventarisasi Flora Sepanjang Proyek Krueng Aceh untuk Menunjang Perkuliahan Ekologi dan Taksonomi Tumbuhan.* Banda Aceh: Pusat Penelitian Unsyiah Darussalam.

Jogasara, F.A. 2011. Analisis Faktor-Faktor Yang Mempengaruhi Intensitas Konflik Antara Gajah dengan Manusia di Kecamatan Mandau dan Kecamatan Pinggir Kabupaten Bengkalis.Thesis Program Pascasarjana. Fakultas Pertanian Universitas Riau. Pekanbaru (Tidak Dipublikasikan)

Mueller-Dombois, D. and H.H. Ellenberg. 1974. *Aim and Methods of Vegetation Ecology*. New York: John Wiley and Sons.

Soerianegara, I dan Indrawan. 1978. *Ekologi Hutan Indonesia*. Laboratorium Ekologi Hutan. Bogor : Fakultas Kehutanan. IPB.

Yoza. D. 1995. Dampak Perkebunan Kelapa Sawit terhadap Keanekaragaman Jenis Burung di PT. Ramajaya Pramukti Kabupaten Kampar. Skripsi.Fakultas Kehutanan Universitas Gajah Mada. Yogyakarta (Tidak Dipublikasikan)

Yoza. D., 2009.Pemetaan Sebaran Gajah di Areal Konsesi PT. Chevron Pacific Indonesia. Laporan Penelitian Bekerjasama dengan PT. Chevron Pacific Indonesia. Pekanbaru

Zulkarnain,(1993). Kajian Tentang Aktivitas Gajah Sumatera (*Elephas maximus sumatranus Temminck*,1947) dalam Pengembaraannya di Kabupaten Aceh Utara**.** Banda Aceh: SekolahTinggi Ilmu Kehutanan Perguruan Tinggi Islam

DIVERSITY AND ABUNDANCE OF AVIAN COMMUNITY AT COASTAL LAGOONS IN BUKIT BARISAN SELATAN NATIONAL PARK, INDONESIA: WHY WATERBIRD IS LACKING?

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ABSTRACT

Coastal lagoons have been known to have high waterbird diversity and abundance. This objective of this study was to assess the bird diversity and abundance at two coastal lagoons (Sei Leman and Menjukut Lagoons) in southern tip of Sumatra, and to find out whether the pattern of high diversity and abundance of waterbirds was also occurred in the study sites. The birds were surveyed by combination of concentration method combined with look and see approach, by boat and by walking along the perimeter of the lagoons. A total of 55 bird species was recorded at both lagoons (48 bird species at Sei Leman, 29 species at Menjukut), of which 83.6% were terrestrial species, 9.1% waterbirds, and 7.3% shorebirds. There were only five waterbird species in both lagoons, all belong to the Ardeidae family. This was contradictory with other studies elsewhere, which found many waterbirds species in lagoon. The low number of waterbird in the study site is most likely due to the strong wind. The strong wind also influenced number of bird species observed every hour, causing no peak in bird diversity and abundance during early morning and late afternoon in the most windy site of Menjukut Lagoon.

Keywords: birdwatching, bird diversity, Bukit Barisan Selatan, coastal lagoon, waterbirds

1. INTRODUCTION

Sumatra is an island in Indonesia that has a vast area of wetlands, mostly along the eastern coast (Whitten et al.1987), but very few is categorized as coastal lagoons. Coastal lagoons has been defined by Kjervfe (1994) as a shallow coastal water body separated from the ocean by barrier, connected at least intermittently to the ocean by one or more restricted inlets, and usually oriented shore-parallel. The coastal lagoons plays important roles for various waterbird species as foraging areas (Hattori and Mae 2001), breeding sites (Goutner 1997), refuge area (Hattori & Mae 2001; Gbogbo 2007), as well as resting places during migration (Ntiamoa-Baidu 2000; Gbogbo 2007; Ma et al.2008).

In Sumatra many studies related to diversity and abundance of waterbirds have been conducted in various wetland types, particularly in the tidal lowlands and floodplains along the eastern coast (e.g. Verheugt et al. 1993;Crossland et al. 2006; Shepherd and Giyanto 2009;Iqbal et al. 2010; Iqbal et al. 2011;Crossland et al. 2012;Jumilawaty 2012, Putra et al. 2015). Coastal lagoons, however, rarely studied in Sumatra, probably due to the less availability of this habitat type.

The aim of the study was to reveal the diversity and abundance of avian diversity in two coastal lagoon of Sumatra, and to find out whether the pattern of high diversity and high waterbird abundance was also occurred in both study sites. The lagoons are part of Kerinci Seblat National Park in Lampung, southern Sumatra. Based on Ramsar Convention wetland type, both lagoons are categorized as wetland type J, i.e. “coastal brackish/saline lagoons(brackish to saline lagoons with at least one relatively narrow connection to the sea)”.Both lagoons have mosaic habitat arrangement, and might suggest having high avian diversity. However, the field study suggested otherwise.The main scientific question, therefore,was why both lagoons have poor waterbird species, although habitat for the waterbird seems highly suitable. Waterbirdsin this paper refers to wading birds, shorebirds and waterfowl. Kingfishers and allies, as well as rails, were excluded although the membersof this group are also highly associated with water.

2. Study Area and Methods

Field research was conducted at Sei Leman Lakeand Menjukut Lake, at the southern tip of Bukit Barisan Selatan National Park (**Fig. 1**). Although the formal name of the sites are 'lakes', both lakes are essentially lagoons and hereafter referred to as Sei Leman and Menjukut Lagoons. The two lagoon-type wetlands have been developed by PT Adhiniaga Kreasinusa as an ecotourism area, known as Tambling Wildlife Nature Conservation (TWNC).

Sei Leman Lagoon (also locally pronounced as 'Sleman' Lagoon; approx. 195 ha) is surrounded by a relatively undisturbed rainforest in the east, north, and west direction. To the south, it bounders with the Sunda Strait and located very close to the Indian Ocean. The lagoon is separated from the sea by narrow sand strand. The inlets are several small rivers originated from Bukit Barisan Selatan mountain range at the northern part. The outlet is a small river going to the Sunda Strait at the southern part.

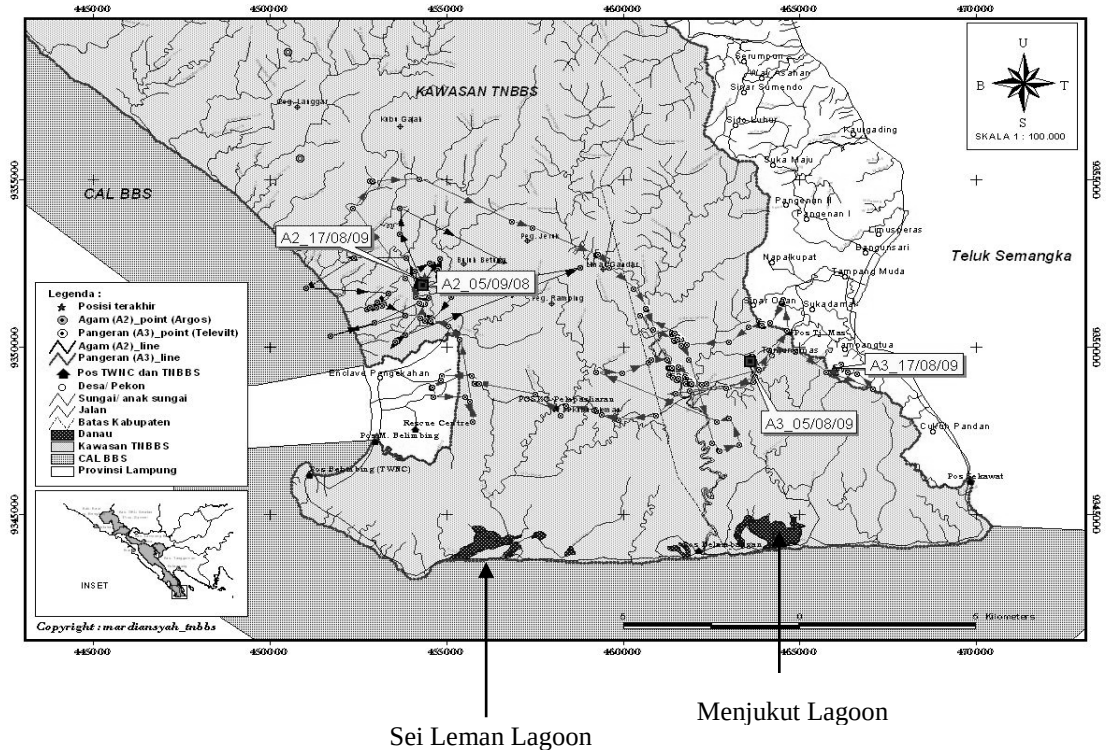

Fig. 1. Map of Sei Leman Lagoon and Menjukut Lagoon, Bukit Barisan Selatan National Park, Sumatra, Indonesia

The Sei Leman Lagoon has an irregular shape and relatively shallow in most areas (less than 1.5 m), exposing its bottom mud during the dry season or low tide. In some area, the lagoon is used as a bathing site by herds of Water Buffalo *Bubalus bubalis* from the grazing areas nearby. The dominantvegetation type surrounding the lagoone are*Nypa fruticans*which occurs at the muddy substrate in more inward location, and *Pandanus tectorius*at the sandy shores along the southern side.

Menjukut Lagoon (approx. 150 ha) is also have a similar geographical situation.The different features of Menjukut Lagoon compare to Sei Leman Lagoon are the depth of the lagoon and the surrounding vegetation type. Menjukut Lagoon is deeper (approximately 4-5m) and therefore has less exposed mudflat. The vegetation surrounding the lagoonis mostly trees associated with brackish water. Based on category of Sumatran forest by Whitten et al.(1987), the forest surrounding Menjukut Lagoon can be categorized as brackishwater forest.

Sei Leman Lagoon is closer (3 km) from the office and lodging facilities of TWNC. Menjukut Lagoon is further away, about 4 km from Sei Leman Lagoon, or 7 km from TWNC office. There was

a relatively good road access (by car) from the TWNC office to the Sei Leman Lagoon. Menjukut Lagoon, in contrast, was difficult to reach as there was no road access. Besides these two lagoons, there is no other lagoon or lake nearby or along the same coastal area.

Following a pre-survey in October 2008, actual field survey was conducted from August to September 2009by using concentration method combined with look and see approach (Bibby et al.1998). To intensify the effort, survey was also done by boat and by walking along the perimeter of the lagoons. Data taken during the field survey was species name, number, and time of encounter. Most birds were identified by visual contact, and very few identified solely by song.

Spatial distribution of the birds was observed by examining the location where the birds were encountered. The use of space by birds were divided into six sub-habitats: lagoons (areas inundated by water of more than 20cm deep), edges (areas at the edges of lagoons, still inundated by shallow water, shrub or palm-like vegetation), mudflat (exposed lagoons showing muddy habitat), forest (dominated by trees, dry or partially inundated), sandy shores (sandy areas between lagoons and the sea), and aerial spaces (areas above lagoons and forests).

In order to reveal the species fluctuation during the day, the species and number of birds were identified and counted starting from 5:00am until 6:00pm, but data used for analysis is only until 5:00pm, considering that between 5:00pm and 6:00pm were increasingly dark and might subject to bias. The total effective observation time for both lagoons was 154 hours (7 consecutive days for each lagoon). Additional information of the species occurrence was obtained from interviews with staff of TWNC who regularly patrolling both lagoons.

Proportions of various parameters were computed by using simple percentages. Average number of bird individuals was calculated by taking the means of 7-day field research for each lagoons. Number of bird by species was counted for every hour (5am to 5pm) for both lagoons and plotted on a simple graph to examine the trend of temporal distribution. Bird guilds were categorized following Gbogbo (2007) as follows: Guild 1 - ducks and cormorants; Guild 2 - visual surface foraging waders; Guild 3 - tactile surface foraging waders Guild 4 - pelagic foraging waders; Guild 5 - stalking herons; Guild 6 - fishing pelicans, and Guild 7 - fishing terns.

3. RESULTS AND DISCUSSION

3.1. Species Diversity and Abundance

A total of 55bird species was recorded at both lagoons during the study period, belonging to 25families (**Table 1**). There were 48 bird species birds found at Sei Leman Lagoon and 29 bird speciesfoundat Menjukut Lagoon. Twenty two bird species were shared by both lagoons.Both sites combined, a big proportion (83.6%) of the bird species were categorized as terrestrial species, and only very few species was categorized as waterbirds (9.1%) and shorebirds (7.3%). Alcedinidae (Kingfishers and allies) were grouped as terrestrial species, although this family has a strong affiliation with water bodies.

The families with the largest number of species for both lagoons combined were Columbidae (seven species), followed by Ardeidae, Alcedidinae, and Pycnonotidae (five species each). Of these bird species, bird family categorized as waterbirds was Ardeidae. The five species of Ardeidae family belong to two genera, namely Ardea (herons) and Egretta (egrets).

The abundance of bird species at two lagoons were surprisingly low, averaging only 1.91 individuals for a certain bird species per day for Menjukut Lagoon and 1.92 individuals for Sei Leman Lagoon. Members of Columbidae (pigeons and doves) were diverse and abundant in Sei Leman Lagoon. The bird species of this family with a high number at both lagoons was Pied Imperial-Pigeon *Ducula bicolor*, with an average observation of more than 20 individuals per day at both lagoons. This species flied in big flocks up to 52 individuals.

Table 1. List of species, average daily number, and sub-habitat usage of bird community at Sei Leman Lagoon (SL) and Menjukut Lagoon (ML), Bukit Barisan Selatan National Park. Sequence and nomenclature follows MacKinnon et al.(1998)

No	English Name	Latin Name	Family	Sub-Habitat*	Average Daily Number	
					SL	ML
1	Great-billed Heron	*Ardea sumatrana*	Ardeidae	E,M	0.6	0.0
2	Grey Heron	*Ardea cinerea*	Ardeidae	E,M	1.9	1.4
3	Purple Heron	*Ardea purpurea*	Ardeidae	E,M	2.7	1.1
4	Pacific Reef-egret	*Egretta sacra*	Ardeidae	E,M	1.9	0.4
5	Little Egret	*Egretta garzetta*	Ardeidae	E,M	0.1	0.0
6	Grey-headed Fish-eagle	*Ichthyophaga ichthyaetus*	Acciptridae	E,F	1.0	0.0
7	White-bellied Fish-eagle	*Haliaeetus leucogaster*	Acciptridae	E,F	0.9	2.0
8	Red Junglefowl	*Gallus gallus*	Phasianidae	E,S	0.7	0.1
9	Little Ringed Plover	*Charadrius dubius*	Charadriidae	M,S	1.6	0.9
10	Common Redshank	*Tringa totanus*	Scolopacidae	M,S	2.0	0.0
11	Common Sandpiper	*Tringa hypoleucos*	Scolopacidae	M,S	4.9	5.7
12	Beach Stone-curlew	*Burhinus giganteus*	Burhanidae	S	0.0	0.1
13	Pink-necked Green-Pigeon	*Treron vernans*	Columbidae	E,F	6.6	0.0
14	Green Imperia-Pigeon	*Ducula aenea*	Columbidae	A	0.9	0.0
15	Pied Imperial-Pigeon	*Ducula bicolor*	Columbidae	A	24.1	20.4
16	Metallic Pigeon**	*Columba vitiensis*	Columbidae	F	0.0	0.3
17	Barred Cuckoo-Dove	*Macropygia unchal*	Columbidae	F	0.3	0.0
18	Spotted-Dove	*Streptopelia chinensis*	Columbidae	A,F,E	0.4	0.0
19	Emerald Dove	*Chalacophaps indica*	Columbidae	E,S	1.6	0.0
20	Green-billed Malkoha	*Phaenicophaeus tristis*	Cuculidae	E,F	0.3	0.0
21	Lesser Coucal	*Centropus bengallensis*	Cuculidae	E	0.1	0.0
22	Large-tailed Nightjar	*Caprimulgus macrurus*	Caprimulgidae	E	0.0	0.1
23	Edible-nest Swiftlet	*Collocalia fuciphaga*	Apodidae	A	4.1	0.0
24	Cave-Swiftlet	*Collocalia linchi*	Apodidae	A	6.6	0.0
25	Glossy Swiftlet	*Collocalia esculenta*	Apodidae	A	0.0	10
26	Little Swift	*Apus affinis*	Apodidae	A	0.3	2.4
27	Blue-eared Kingfisher	*Alcedo meninting*	Alcedinidae	E,S	0.3	0.4
28	Stork-billed Kingfisher	*Pelargopsis capensis*	Alcedinidae	L	0.9	0.0
29	Ruddy Kingfisher	*Halcyon coromanda*	Alcedinidae	L,M	0.1	0.0
30	White-throated Kingfisher	*Halcyon smyrnensis*	Alcedinidae	L	0.7	0.4
31	Collared Kingfisher	*Todirhamphus chloris*	Alcedinidae	F,M,L,E,S	5.1	2.3
32	Blue-tailled Bee-eater	*Merops philippinus*	Meropidae	E,S	0.9	0.0
33	Blue-throated Bee-eater	*Merops viridis*	Meropidae	E,S	0.4	0.3
34	Oriental Pied Hornbill	*Anthracoceros albirostris*	Bucerotidae	E,F	0.4	1.3
35	Golden-naped Barbet	*Megalaima australis*	Capitonidae	F	0.6	0.0
36	Sunda Woodpecker	*Dendrocopus molucensis*	Picidae	F,E	1.1	0.4
37	Orange-backed Woodpecker	*Reinwardtipicus validus*	Picidae	E	0.1	0.0
38	Pacific Swallow	*Hirundo tahitica*	Hirundinidae	A	3.6	0.0
39	Common Iora	*Aegithina tiphia*	Chlorosopseidae	F	0.0	0.1
40	Sooty-headed Bulbul	*Pycnonotus aurigaster*	Pycnonotidae	F,E,S	5.4	2.9
41	Yellow-vented Bulbul	*Pycnonotus goiavier*	Pycnonotidae	E,S	1.4	0.0
42	Cream-vented Bulbul	*Pycnonotus simplex*	Pycnonotidae	E	1.0	0.0
43	Red-eyed Bulbul	*Pycnonotus brunneus*	Pycnonotidae	E,S	0.9	0.0
44	Spectacled Bulbul	*Pycnonotus erythrophthalmos*	Pycnonotidae	E,S	0.0	0.3
45	Black Drongo	*Dicrurus macrocercus*	Dicruridae	F	0.1	0.1
46	Hair-crested Drongo	*Dicrurus hottentottus*	Dicruridae	F	0.3	0.0
47	Greater Racket-tailed Drongo	*Dicrurus paradiseus*	Dicruridae	F	0.1	0.0
48	Black-naped Oriole	*Oriolus chinensis*	Dicruridae	F,E	0.0	0.1
49	Slender-billed Crow	*Corvus enca*	Corvidae	F	0.4	0.0
50	Magpie Robin	*Copsychus saularis*	Turdidae	F,S	1.0	0.3
51	Dark-necked Tailorbird	*Orthotomus atrogularis*	Silviidae	E,S	0.1	0.6
52	Ashy Tailorbird	*Orthotomus ruficeps*	Silviidae	E,S	0.3	0.3
53	White-breasted Wood-swallow	*Artamus leucorhynchus*	Artamidae	A,E,S	1.9	0.3

54	Scarlet-backed Flowerpecker	*Dicaeum cruentatum*	Dicacidae	E,S	0.4	0.0
55	Eurasian Tree Sparrow	*Passer montanus*	Ploceidae	S,E	0.9	0.4

* Note for Sub-Habitats - L: on lagoons, E: edge, M: mudflat, F: forest, S: sandy shore, A: aerial space.

** natural distribution is in Kalimantan; it is either new record for Sumatra of escapee/feral species

Kingfishers (Alcedinidae) were also easily observed at both lagoons, especially at Sei Leman Lagoon. Collared Kingfisher *Todirhamphus chloris* were also common at both lagoons. As for the Pycnonotidae family, Sotty-headed Bulbul *Pycnonotus aurigaster* was easily spotted at Sei Leman Lagoon.

Situated very close to the sea shore, these two lagoons were also inhabited by shorebirds from the family of Scolopacidae (two species), Charadriidae (one spesies), and Burhinidae (one species). However, bird families that normally use lakes and lagoons as their habitat and might be present in habitat similar to both lagoons - for example Anatidae (ducks), Phalacorocacidae (cormorants), Rallidae (rails) - were absent at both lagoons.

In accordance to the waterbird guild classification used by Gbogbo (2007), Sei Leman and Menjukut Lagoon was inhabited by birds of Guild 5 (stalking herons), i.e. genera of Ardea and Egretta, and Guild 2 (visual surface foraging waders), i.e., Charadrius, Tringa, Burhinus. Other guilds, namely Guild 1 (ducks and cormorants), Guild 3 (tactile surface foraging waders), Guild 4 (pelagic foraging waders), Guild 6 (fishing pelicans), and Guild 7 (fishing terns) were absent.

Waterbirds that occupy Guild 1 was absent on both lagoons. According to the information of the TWNC staff, during rainy season of September to December, both lagoons have been regularly visited by many individuals of Whistling-Duck *Dendrocygna arcuata*. Clearly this species is a visitor to the lagoons, and probably a regular migrant.

The occurrence of many forest birds, such as Columbidae and various families belonging to Passeriformes, clearly indicated that the avian communities at both lagoons were more a forest-type community than a lagoon-type. At Sei Leman Lagoon, there were six species of Columbidae, of which most of them known as canopy top birds.

3.2. Factors Contribute to the Species Diversity and Abundance

In term of size, both lagoons had relatively good sizes. However, the number of species found in the lagoons was considerably low (i.e. 55 species for both lagoons, 16.4% were waterbirds and shorebirds).Unfortunately, similar data from Indonesian lagoon has been very lacking. In comparison with similar medium-size tropical Asian lagoon, Kallar Kahar brackish lake in Pakistan (133.5 ha) had 86 species, of which 33.72% were waterbirds (Rais et al.2011).

Species richness and abundance of waterbirds on lakes and lagoons in general is influenced by many factors, including lagoon size, trophic status, aquatic marcophytes (Hoyer and Canfield 1994; Hattori and Mae 2001), water/mud depth (Hattori and Mae 2001), season (Tavares and Siciliano 2014), and the recurrence of minor disturbance to the habitat (Nichols and Thompson 1985).

Although many other habitat factors were not surveyed, visual observation indicated that both lagoons contained abundance of waterbird food. In Menjukut Lagoon, for instance, Marsh Clam *Polymesoda expansa* (Corbiculidae), a big size bivalve, was still easily can be found, indicating a rich nutrient in its muddy substrate. Judging from these factors, both lagoons should have had good number of waterbird species. However, the fact that these lagoons had low waterbirds species lead to other reason.

There were also reports that climatic condition also plays important role in waterbird diversity and abundance. Strong wind has a high impact on the nest site selection of waterbirds nesting on Pulau Rambut Wildlife Sanctuary in Jakarta Bay area, Indonesia, as well as species diversity (Mardiastuti

1992). In Lousiana, United States, the abundance of waterbird colony use was negatively associated with the maximum wind speed (Leberg et al. 2007).

Strong wind could play a very crucial factor that affecting the waterbird diversity and abundance in Sei Leman and Menjukut Lagoon. Wind along the coastal area, including at both lagoons, are very strong, especially during the period of west wind (September to December).

Menjukut Lagoon had a stronger wind than Sei Leman Lagoon because the sea current and wind from Indian Ocean and Java Sea meet near this lagoon. Furthermore, bathimetric study revealed that there is a deep sea trench (-1,050m) near Menjukut Lagoon, causing a constant sea current turbulence near Menjukut Lagoon. Sei Leman Lagoon is slightly hidden from the strong wind due to its location behind a small cape.

3.3. Spatial and Temporal Distribution

The species that used the lagoon itself, rather than the margin, were herons and kingfishers. Herons utilized the shallow water for foraging, while kingfishers plunged for fishes in deeper water. Many bird species (56.4%) use the lagoon edges for foraging. Mudflats were used for foraging by various birds (waterbirds, shorebirds, kingfishers) preyed on fish and macro-invertebrates. Sandy shores were used as well, although most species utilize the vegetation on the sandy shores rather than the exposed sand. Aerial spaces, specifically spaces close to the water surface,were used by swifts and swallows to forage for aerial insects. Large birds of prey also soaring above the lagoons to search for their fish of small mammals prey.

The number of bird species used forest for their habitat is higher than the those utilize the lagoons and parts of the lagoons, suggesting that forest habitat plays higher roles as the bird habitat in both sites. Forest habitat surely is able to provide refuge for birds, especially during strong wind blown from the sea.

The temporal distribution of the waterbirds at Menjukut Lagoon showed little variation all day long (**Fig. 2**). This condition is rather unusual for a waterbird community. In other areas (e.g. Mardiastuti 1992, Ntiamoa-Baidu et al. 1998)the temporal distribution of the birds during the day showed a significant jump in the morning and again in the late afternoon, as also shown at Sei Leman Lagoon.

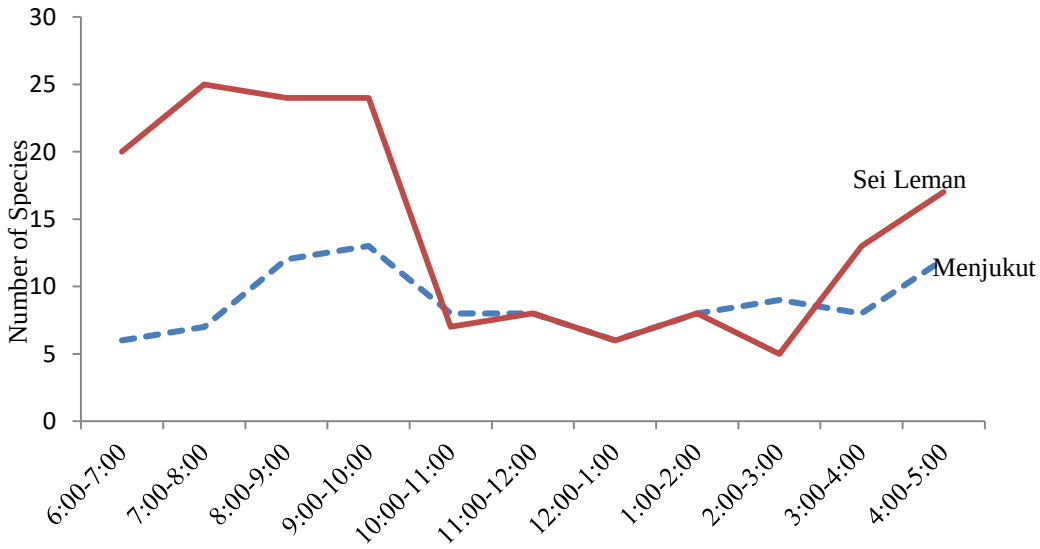

Fig. 2.Number of bird species observed between 6am to 5pm at Sei Leman and Menjukut Lagoon, Bukit Barisan Selatan National Park

The low use of habitat during early morning and late afternoon in Menjukut Lagoon apparently was heavily influenced by the strong wind. As mentioned in the previous section, Menjukut Lagoon

received stronger wind than Sei Leman Lagoon. Unlike in Menjukut Lagoon, it seemed that in Sei Leman Lagoon the birds were still able to utilize more intensively in early morning and late afternoon.

3.4. Management Implication

The areas surrounding both lagoons have been used for ecotourism activities. Wildlife watching, especially Sambar Deer *Cervus unicolor*and Water Buffalo watching, have been the main attraction of the area. As both lagoons also have been designated for ecotourism, the impact of the visitors to birds in lagoons needs to be assessed as well. Klein et al.(1995) has proven that in general ecotourism has a negative affect to the migratory birds and shorebirds. The impact of visitors to both study areas, however, was considerably negligible. Although both lagoons have been developed as ecotourism areas, visitor number has been very low, less than 100 persons per year, mostly light picnic and boating.

Menjukut Lagoonis not recommended for birdwatching due to its low bird diversity, long distance from the lodging facilities, and strong wind. As for Sei Leman Lagoon, which located closer to the lodging facilities, it is recommended for birdwatching and the recommended time is between 6am and 10am. Strong wind still need to be considered in birdwatching, especially during west wind between September and December.

4. CONCLUSION

Coastal lagoons elsewhere have been reported to harbor many waterbird species. Waterbird species at two lagoons in this research, however, showed different pattern compare to other lagoons: (a) had a low number (9.1%) of waterbird species, (b) had no peak in bird diversity and abundance during early morning and late afternoon in the most windy site. This anomaly most likely is due to the strong wind from the Indian Ocean.

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REFERENCES

Bibby C, Jones M, Marsden S. 1998. Expedition field techniques: Bird surveys. Expedition Advisory Centre Royal Geographical Society. 1 Kensington Gore, London SW7 2AR.

Crossland AC, Sinambela SA, Sitorus AS, Sitorus AW. 2006. An overview of the status and abundance of migratory waders in Sumatra, Indonesia. Stilt 50: 90–95.

Crossland AC, Lubis L, Sinambela SA, Sitorus AS, Sitorus AW, Muis A. 2012. Observations of shorebirds along the Deli-Serdang coast, North Sumatra Province, Indonesia: 1995–2006. Stilt 61: 37–44.

Gbogbo F. 2007. The importance of unmanaged coastal wetlands towaterbirds at coastal Ghana. Afr. J. Ecol. 45:599–606.

Goutner V. 1997. Use of the drana lagoon (Evros Delta, Greece) by threatened colonially nesting waterbirds and its possible restoration.Biological Conservation 8: 113-120.

Hattori A, Mae S. 2001. Habitat use and diversity of waterbirds in a coastal lagoon around Lake Biwa, Japan. Ecological Research 16: 543–553.

Hoyer MV, Canfield DE. 1994. Bird abundance and species reichness on Florida lakes: Imfluence of trophic status, lake morphology, and aquatic macrophytes. Hydrobiologia 279/280: 107-119.

Iqbal M, Giyanto, Abdillah H. 2010. Wintering shorebirds migrate during January 2009 along the east coast of North Sumatra province, Indonesia. Stilt 58: 18–23.

Iqbal M, Ridwan A, Herman. 2011. Notes on the wintering waders in November 2009 along the east coast of Lampung province, southernmost Sumatra, Indonesia. Stilt 59: 58–60.

Jumilawaty E. 2012. Kesesuaian habitat dan distribusi burung air di Percut Sei Tuan, Sumatera Utara. [Dissertation]. Institut Pertanian, Bogor. [Indonesian].

Kjervfe B. 1994. Coastal lagoons. In: Coastal lagoon process Kjervfe B (ed). Elsevier Oceanography Series 60.Elsevier Science Publishers BV.

Klein M, Humphrey SR,Percivalí HF.1995.Effects of ecotourism on distribution of waterbirdsin a wildlife refuge. Conservation Biology 9(6): 1454-1465.

Leberg PL, Green MC, Adams BA, Purcell KM, Luent MC. 2007.Response of waterbird colonies in southern Louisiana to recent drought and hurricanes. Animal Conservation 10: 502–508.

MacKinnon J, Phillipps K, van Balen B. 2010. Burung-Burung di Sumatera, Jawa, Bali dan Kalimantan. Burung Indonesia. Bogor.

Ma Z, Wang Y, Gan X, Li B, Cai Y, Chen J. 2008. Waterbird population changes in the wetlands at Chongming

Dongtan in the Yangtze River estuary, China. Environmental Management (2009) 43:1187–1200.

Mardiastuti, A. 1992. Habitat and nest-site characteristics of waterbirds in Pulau Rambut Nature Reserve, Jakarta Bay, Indonesia. [Dissertation]. Michigan State University, Michigan, USA.

Nichols FH, Thompson JK. 1985.Persistence of an introduced mudflat communityin South San FranciscoBay, California.Marine Ecology - Progress Series 24: 83-97.

Ntiamoa-Baidu Y, Nyame SK, Nuoh AA. 2000. Trends in the use of a small coastal lagoon by waterbirds: Muni Lagoon (Ghana). Biodiversity and Conservation 9: 527–539.

Ntiamoa-Baidu Y, Piersma T, Wiersma P, Poot M, Battley P, Gordon C. 1998. Water depth selection, daily feeding routines and diets of waterbirds in coastal lagoons in Ghana. Ibis 140: 89-103.

PutraCA, Hikmatullah D, Prawiradilaga DM, Harris BJ. 2015 Surveys at Bagan Percut, Sumatra, reveal its international importance to migratory shorebirds and breeding herons.Kukila 18(2):46-59.

Rais M, Anwar M, Mehmood T, Hussain I. 2011. Bird diversity and conservation at Kallar Kahar Lake with special reference to water birds. Pakistan J. Zool 43(4): 673-681.

Shepherd, CR, Giyanto. 2009. Observations of Milky Storks *Mycteria cinerea* in Percut, NorthSumatra, Indonesia. Birding Asia 11:70–72.

Tavares DC, Siciliano S. 2014. The bird community in a threatened coastal lagoon in southeastern Brazil. Open Journal of Ecology 4: 98-112.

Verheugt WJM, Skov H, Danielsen F, Suwarman U, Kadarisman R, Purwoko A. 1993. Notes on the birds of the tidal lowlands and floodplains of South Sumatra Province, Indonesia. Kukila6: 53–84.

Whitten T, Damanik SJ, Anwar J, Hisyam N. 1987. The ecology of Sumatra. Gadjah Mada University Press. Yogyakarta, Indonesia.

HUMAN ELEPHANT CONFLICT STUDY BASED ON THE COMMUNITY INFORMATION IN RIAU - INDONESIA

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ABSTRACT

Human Elephant Conflict (HEC) study was conducted in three locations are important habitat for elephants (Tesso Nilo, Balai Raja and Giam Siak - Riau Province). Study was conducted by distributing the questionnaire to the people in the region. Total area of study was 7,800 km2 in 312 grids (5x5 km2) with 244 people as respondents. In total area of study, 105 grids (33,65%) of all grid cells still had elephants (2,625 km^2). The other 66,35% (5,175 km^2) had no elephants. Elephant were present in 45,9% of the all respondents and 34,4 % of them stated the elephant still present until now. In the conflict, 77,1% inflicted crop demage, 7,5% house breaking and others 12,85%.95-100% (in Tesso Nilo, Balai Raja and Giam Siak) the community rejected the existence of the elephant, however, the people known that the elephant was protected (96-100%).

Keywords: Human Elephant Conflict (HEC), Community Information, Riau

1. INTRODUCTION

In the world, Sumatran elephants are categorized separately sub-species from Asian Elephant *Elephas maximus* due to isolated population among Sumatra island and Asian mainland. The population now are considered small and decline and based on IUCN red data book was entered on the most of critical endangered species or most species conservation priority based on the Indonesia government strategy. From the estimates of elephant conservation Forum Indonesia (FKGI), the current population of Sumatran elephants ranged only between 2,400 and up to 2,800 people and in the province of Riau was estimated about 330-360 individuals (WWF Indonesia 2010 unpublished). This amount is reduced since the death of elephants in Riau province until 2014.

In general, there are currently 9-10 pouches or clan of elephants in Riau province. Some clans have been analyzed in the context of elephants home range in the area and its populations using standard methods such as the faecal DNA analysis for the population and GPS Collar to check the Sumatran elephant ranges; 2 pouches of Sumatran elephants in Tesso Nilo, 2 pouch in Balai Raja and Serangge – Pemayungan in Riau – Jambi border. In the illustration from 2005, Number of pouches decreased from 12 to 9 pouches. The missing pouches identified in the border region of Riau - North Sumatra and 2 others in the region of Rimbang Baling – Bukit Bungkuk. All three pouches of extinction because of the arrest of elephants was held by the government in 2000 to 2006 and human - elephant conflict (Desai & Samsuardi 2009).

Current reality

The biggest problem to preserve the Sumatran elephant and its habitat was land conversion, the human - elephant conflict and poaching for ivory. In generally, 70-80% of the Sumatran elephant habitat is gone and replaced by human settlements, plantation (communities and companies), and other real uses. The decline in land habitat is the toughest issue for the Sumatran elephant population. Declaining in forest land issue has led to increasing human-elephant conflict. Note of 2001 – 2012, 126 elephants died due to the conflict or poaching motives. Poaching lately increased since the 2012 due to 90% of elephant death losed their tusks, the same record occurred in 2013 and the last record elephant deaths in 2014 in the region of HTI Arara Abadi concession or in Giam Siak pouches.

As a step to improve elephant mortality reduction is to reduce the number of human-elephant conflict, give people an understanding of conflict mitigation and concern about the lives of elephants and a decrease in the number of poaching. In 2015, the death rate of elephants declined, reaching 7 elephant dead and in 2016, is expected to decline at only one dead until April 2016 as well. Some steps were held for the purpose of elephant mortality reduction such as identifying human - elephant conflict in

Riau and fostering the community to be able to do human elephant conflict mitigation with various techniques, especially the use of carbide cannon or alcohol cannon, put the monitoring team to day to day monitor the movement of elephants, especially in locations that elephant mortality was high as Tesso Nilo, Balai Raja and Giam Siak and strengthening law enforcement for anti-poaching and trafficking.

In 2014, ESG (Elephant Society Group) developed an study to obtain information on human elephant conflict and the target activity is to identify the presence of the elephant evidences from year to year based on the community information. The study also provided human elephant conflict information from them.

2. METHOD

These activities focus on three important location for human elephant conflict - namely Tesso Nilo (3 pouches of elephant), Balai Raja and Giam Siak. Grid cell 5 x 5 km2 was used in the landscape, where in the grid cell, the researchers identified 3 people (per grid cell) that lives in that location. Identifying the community respondents was held and each respondent was given a list of questions to be answered by the respondents. Total grid cell in Tesso Nilo are 184 grid cells, Balai Raja are 52 grid cells and the Giam Siak are 64 Grid cells.

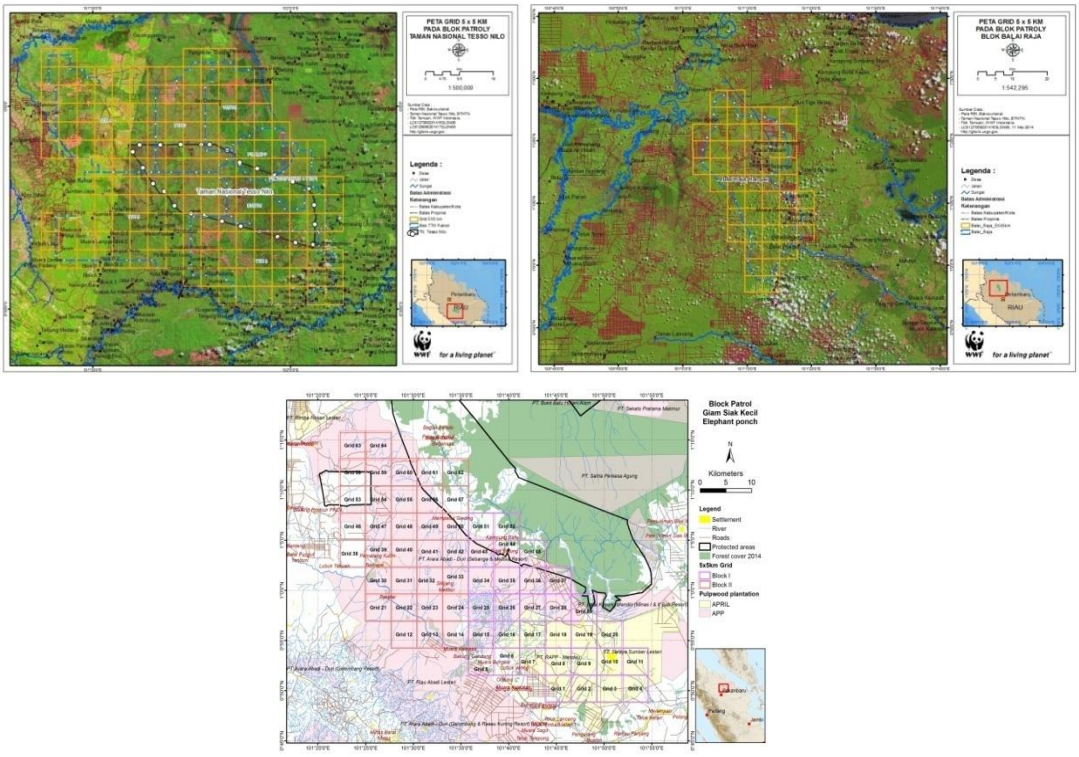


Figure 1. The map of 5 x 5 km2 grid cell

3. RESULT AND DISCUSSION

Elephant Distribution

From December 2014 – October 2015, we surveyed 312 grids (Tesso Nilo are 184 grids, Balai Raja are 52 grids and the Giam Siak are 76 Grids) in covering an area of 7,800 km2. In the area, 830,68 km2 is the national park, 180 km2 is wildlife reserve and at least 4,240 km2 is the company concession (Asian Pulp and Paper and Riau Andalan Pulp and Paper) and the local community areas. Grid cell 5 x 5 km2 was used in the landscape as part as the method.

In the area surveyed 105 grids (33,65%) of all grid cells still had elephants (2,625 km^2). The other 66,35% (5,175 km^2) had no elephants, including the entirely forested grids and company concessions areas.

HEC conditions

Identifying the people in the field as survey sampling was held the the survey area in three region; Tesso Nilo, Balai Raja and Giam Siak, Riau Province (Sumatra island) – Indonesia and three surveyors involved to interview to them.

Total sampling are 244 people (73 people in Balai Raja, 95 people in Tesso Nilo and 76 people in Giam Siak), 93,4% of them being men and 6,6% women. They were living in that area on average since 1 - > 30 years.

Elephant were present in 45,9% of the all respondents (Balai Raja, Tesso Nilo and Giak Siak) and 34,4 % of them stated the elephant still present until now and the other did not saw them in among since 1 - 8 years ago. In all elephant come to the areas, 27,2 % was loner (in particular for the bull), 29,8% <5 individuals and 17,2 % group with young. The community stated that 63,84% human elephant conflict was still evidence in their sites until now, mostly for the minor scale conflict (46,7%), none (42,1%) and moderate (11,2%). In the conflict, 77,1% inflicted crop demage (75,9% in Tesso Nilo, Balai Raja (69,8%) and Giam Siak (90,9%)), 7,5% house breaking and others 12,85%.). In the past five years, in Tesso Nilo and Balai Raja, the human death average is 1 individuals and Giam Siak Kecil, the human elephant conflict caused average 2,5 people death. The elephant death in Tesso Nilo is average 1,7 individuals, only one in Balai Raja and zerro in Giam Siak.

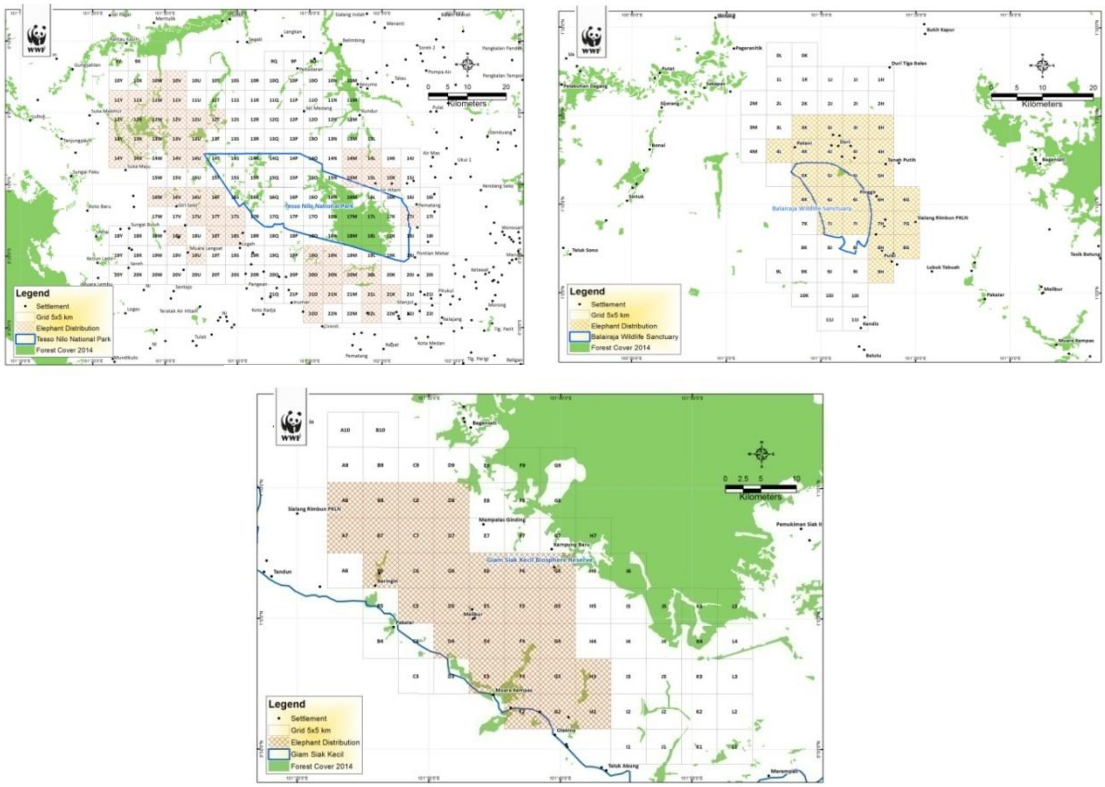


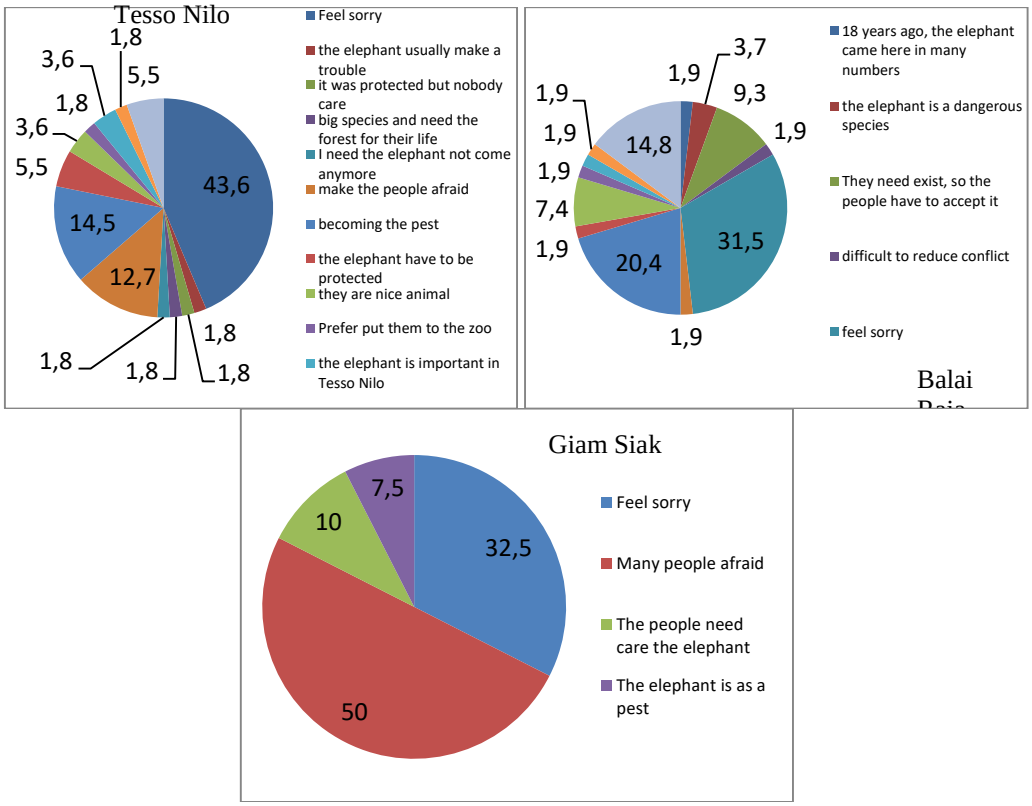
Figure 2. The map of elephant evidences in Tesso Nilo, Balai Raja and Giam Siak based on HEC study

About the HEC condition, 43,2 % the people stated decrease, 13,2% are stable and 4,6% stated increase. The other stated unknown. Among many reasons, the highest persentage the people stated 37,3% based on elephant come was rare or not coming anymore, 10,4% stated the people still planted

the trees or palm oil still young so that the elephant still come here and the other stated the human elephant conflict mitigation has been working by using flying squad or safe guard the elephant in traditionally aspect. For the crop raiding occur, the people said that the crop reading tend occured on February – July in Tesso Nilo (41,5%) or 18% irregularly, February – May in Balai Raja (45,3%) and March – April (27,9%) or all the year (41,2%) in Giam Siak. In the people to mitigate the conflict, 68,5% driving out the elephant in any method and equipments such as using carbid or alcohol canon, fire or fireworks. Sometimes the people also used electric fencing in small scale. In Tesso Nilo, 12,1% people coordinated with Elephant Protection Unit – WWF Indonesia to carry out human elephant conflict mitigation with the team.

The community perceptions

95-100% (in Tesso Nilo, Balai Raja and Giam Siak) the community rejected the existence of the elephant because it makes people afraid, to make people hurt, damage gardens or as pests. Public perception of the elephant is to feel sorry for the lives of the elephants, they wanted the elephants were not in their sites, but they also want the elephant to be protected and given a decent life. A dominant people known that elephants are protected (96 – 100%) and the elephant protection information, they can get from television, NGOs such as WWF, newspapers and on the information from the local community itself.



4. CONCLUSIONS

Tesso Nilo, Balai Raja and Giam Siak is an important habitat of elephants in Riau. The main problem of this region is the loss of natural habitat of elephants. The natural habitat of elephants has turned into a concession company for the timber industry (acacia or eucalyptus trees) and palm oil. Sukmantoro et. al. 2013 record 70-90% of elephant habitat is the forest of acacia or openings community in Tesso Nilo. In Balai Raja, the target area of the habitat of elephants dominated by the society today.

In this context, the conflict elephant - human beings can not be avoided. From HEC study shows that the elephants roaming space is getting cramped from the public information about the distribution of

elephants from time to time. Conflict has decreased which is generally caused by movement of an elephant or a decline in population, but the presence of conflict mitigation team that is flying squad contributed to the decline in the conflict in a restricted location. HEC study stated that the flying squad has usefulness in mitigating human-elephant conflict.

Public opinion against the elephant is denying the existence of the elephant. This is because the conflict can not be dealt with and they felt a loss due to the conflict. They know elephants are protected but because the plantation was broken and causes fear for some people and do not have the ability to mitigate conflicts, turned into a negative public perception.

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REFERENCES

AREAS Riau Project. 2001. Logging activities and forest conversion in the Tesso Nilo forest complex, Riau, Sumatra, Indonesia (December 2001). AREAS, WWF Indonesia Riau Program.

Desai, A.A. and Samsuardi. 2009. Status of elephants in Riau Province, Sumatra. WWF Indonesia report.

Sitompul, A.F. . 2011. Ecology and Conservation of Sumatran Elephants (Elephas maximus sumatranus) in Sumatra, Indonesia Doctor of Philosophy (February 2011), Environmental Conservation . University of Massachusetts – Amherst.

Sukmantoro W., E. Purastuti, Samsuardi, A. Sudibyo And Nurchalis Fadli. 2013. Installation and study on the use of GPS Collar on Sumatran Elephant Elephas maximus sumatranus in Tesso Nilo National Park, Riau Province (2007-2009). WWF Indonesia – AREAS report.

STUDY ONHEALTH CARE MANAGEMENT SYSTEM OF CAPTIVE SUMATRAN ELEPHANT (*Elephas maximus sumateranus*) IN Prof. Dr. Ir. M. RUBINI ATMAWIDJAJA ELEPHANT HOSPITAL, WAY KAMBAS NATIONAL PARK

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ABSTRACT

Preliminary study on health care system of captive sumatran elephant, *Elephas maximus sumateranus*, was conducted in Prof. Dr. Ir. Rubini Atmawidjaja Elephant Hospital, Way Kambas National Park by one month direct observation based on individual, sex and age characteristics. Three heatlh cares were observed. There are treatment differences based on their sex and age. Health examination of untrained young elephant under 10 years old needs more effort by and adult elephant accompaniment. Adult male elephant needsspecialcare for its agressiveness. Food provision such as banana was used to serve oral medicine.

Keywords: Sumatran elephant, health care,Prof. Dr. Ir.M. Rubini Atmawidjaja Elephant Hospital, Way Kambas National Park.

1. INTRODUCTION

Indonesia has a high biodiversity, including endangered species such as the Sumatran elephant (Elephas maximus sumatranus). Sumatran elephant (Elephas maximus sumatranus), is part of the family Proboscidea. Since 1951 these animals have been protected under the Ordinance Protection of Wild Animals No. 134 and 226 and included in Appendix I, CITES (Convention on International Trade in Engdangered Species of Wild Flora and Fauna) (2010), wildlife should not be traded internationally well ivory or any part of his body.

Sumatran elephant population has decreased in its natural habitat, caused by habitat fragmentation, poaching, human-elephant conflict, as well as diseases that cause animal health declined. To meet their needs, elephant wildlife populations require an area abundunt food, sufficiut for canopy shelter and water sources. Their endemic in Way Kambas National Park (Syarifuddin 2008).

Way Kambas National Park is lowland forest ecosystem which has an area of 125,621.3 ha (BTNWK 2011). In the Sumatran elephant conservation efforts, the manager built Way Kambas National Park Elephant Conservation Centre or also known as the Elephant Training Center with an area of 400 ha operated starting on August 27, 1985 (Mukhtar 2004). The PLG establishment aims to foster and increase the elephant population of . Conservation efforts continue to be do made to build ,Prof. Dr. Ir. H Rubini Atmawidjaja hospital elephant. Activities undertaken for the preservation of elephants include, elephant health, reproduction, security patrols and the treatment of the elephants.

Prof. Dr. Ir. H Rubini Atmawidjaja Elephant Hospital is the first in Indonesia that has been officially on November 5, 2015. In this hospital, carried out of checking the health of elephant in captivity. With the aim of controlling health Elephant Hospital Sumatran elephants in captivity. therefore system and examination of elephants in captivity need to be known.

Elephant medical examination humans and other animals. Although elephants in Elephant Training Center Way Kambas domesticated, wild animals Sumatran elephants remain, therefore some elephants can only be controlled by certain people only. to provide health-related information elephants need to do the literature study and practice evaluation of health care system in the Sumatran elephant Elephant Hospital Prof. Dr. Ir. Rubini Atmawidjaja, Way Kambas National Park.

2. MATERIAL AND METHODS

This study was conducted in July-August 2016 Gajah Hospital Prof. Dr. Ir. H. Rubini Atmawidjaja, Way Kambas National Park, using the method of direct observation of the medical team who caring for elephants and interviews medical teams and mahout of the elephant history.

3. RESULT AND DISCUSSION

Elephant health condition in Elephant Training Center was informed by its mahout. Treatments given to the elephant are defferent individually based on their indiviual behavior. From July to August there were 3 medical treatments in Prof. Dr. Ir. M Rubini Atmawidjaja Elephant Hospital, for Ling-ling adult female elephant, salmon adult male elephant, and Eri infant female.

Ling-ling is the oldest elephant in Elephant Training Center. She is around 50 years old. She is diagnosed with malnutrition, eosiiphilia and hipoprotein. It lowered her physical cndition. Special treatment is done by 20 bottles. Intravenus treatment twice a day **(Fig. 1).** Varied food was given .

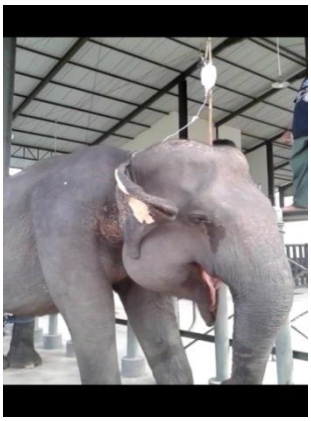

Fig 1. Treatment of Ling-ling Elephant in Prof. Dr. Ir. M Rubini Atmawidjaja

Ling-ling also had infection/ wound due to her body of rubbing to the tree or object. There was an abscess on her forehead and left leg. It lowered her stamina, surgery with local anaesthesia was conducted **(Fig. 2).** Surgery was done by handling her leg and neck to minimize her response mahout was by her side, additional food was provioded.Daily treatment and check up were done.

\

A **B**

Fig 2. A. The process of anesthesia in elephants abscess Ling-ling.
B. Operation process abscess surgically made hole in the abscess.

Salmon, the adult male, 27 years old had wound treatment on its right leg. Treatment on adult male is more difficult due to its agressiveness. During the treatment, the individual was placed in specialy

space “kandang jepit”, to ease the handling with mahout on him. Additional food was provided. Twice a day treatment was given.

Eri, the infant elephant was abadone by his group. He is found in Susukan Baru in bad condition, loosing his front trunk. Intravena auricularis treatment was done young elephant needs spcialy treatment as it is untrained. Adult male individual assisted to bring Eri to the treatment room. Binding his legs and neck to reduce its behavior reponse

4. CONCLUSION

Health treatment is conducted differently for different sex and age in captive elephant. Mahot companiment, food provision and binding treatment were among the options.

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REFERENCES

[BTNWK] Balai Taman Nasional Way Kambas.2011. *Profile Taman Nasional Way Kambas*. Taman Nasional Way kambas. Lampung.

Convention on International Trade in Engdangered Species of Wild Flora and Fauna.2010.Appendix I, as adopted by the coference of the parties. http://www.cites.org/eng/append/I-II.shtml. diakses pada tanggal 12 Agustus 2016

Syarifuddin, H. 2008. *Analisis daya dukung habitat dan permodelan dinamika populasi gajah sumatera (Elephas maximus sumatranus) studi kasus di kawasan Seblat KabupatenBengkulu Utara*. *Disertasi*. Institut Pertanian Bogor. Bogor.

Mukhtar. 2004. Taman Nasional Way Kambas Daya Tarik Kepariwisataan Lampung. http://repository.usu.ac.id/bitstream/pariwisata-muchtar.pdf. diakses 10 September 2016

A PRELIMINARY STUDY ON POPULATION ESTIMATION TECHNIQUE OF SIAMANG (*Sympalangus syndactilus)* in WAY CANGUK RESEARCH STATION, BUKIT BARISAN SELATAN NATIONAL PARK

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ABSTRACT

In collaboration with WCS-IP,visual, audio and audiovisual line transects were carried out during the month of July – August 2016 in Way Canguk Research Station, Bukit Barisan Selatan National Park to estimate population of siamang (Sympalangus syndactilus), an endangered primate in Indonesia. A 2.5 x 2.5 km^2 plot was set up in its natural habitat. Siamang were observed from 07AM- 11.PM, individuals and group were recorded using visual, audio or both audiovisual technique. Audio technique was not applicable for young or infant individuals as vocal communication was recorded gor adult siamang. Visual and audiovisual were applicable, but audiovisual seems better suited technique as it gives information about location and the number of individuals. Visual technique looks more effective for smaller area.

Keywords: siamang, visual, audio, population estimation, Way Canguk

1. INTRODUCTION

Siamang (*Sympalangus syndactylus*) is known as one of endemic gibbon in Indonesia, and Malaysia. In Indonesia, siamang can be found in Sumatran tropical rainforest, including in Bukit Barisan Selatan National Park.*S. syndactylus* is protected by Indonesian government and was categorized in Appendix I by Convention on International Trade in Endangered Species of Wild Fauna and Flora(CITES) (O'Brien *et al.*, 2003). Director Generalof Forest Protection and Nature Conservation (1995) described that since the Dutch colonial era, siamangs are protected and listed as one of the endangered primate. In 2009, International Union for Conservation of Nature (IUCN)Red List classified siamang as an endangered animal (Nijman & Geissman, 2008). Siamang remains in the conservation and protected areas. Researcher and conservationist pay a lot of attention and concern on decliningnumber of siamang population in their natural habitat. Natural siamang habitat have been threatened by human activities such as deforestations, forest degradation (Kwatrina *et al.*, 2013), illegal trading and poaching. Therefore, strict surveillance of siamang should be carried out in accordance with government regulation.

In-situ conservation of siamang will prevent declining number of siamang population in their natural habitat. An important tool in the conservation of wildlife in nature is the information about the siamang population density (Kwatrina et al., 2013). However, The Indonesian Gibbon Workshop in 2008 stated that total population size of siamang in Sumatra is less than 200.000 (MacKinnon, 1987). More information about the actual status of this species could lead IUCN Red List to reevaluate siamang as critically endangered (Geissman, 2007).

Wildlife Conservation Society (WCS) is a conservation organization from the United States.Their main goal is to save the wildlife around the world through research, environmental action, education and community approach. In Indonesia, the Wildlife Conservation Society-Indonesia Program (WCS-IP) was established in 1965 to improve conservation and saving biodiversity. In 1997, WCS-IP built Way Canguk Conservation and Research Station in Bukit Barisan Selatan National Park .This station was built for research and conservation training (WCS-IP, 2001).

Siamangs can be found around Way Canguk Research Station, Bukit Barisan Selatan National Park, Lampung.Siamang population should be monitored frequently to give a chance for its conservation in the wild.

The purpose of this study is to learn and compare the techniques of estimating siamang population in Way Canguk Research Station that located in Bukit Barisan Selatan National Park. In this study, we collaborated with WCS-IP and Bukit Barisan National Park.

2. MATERIALS AND METHODS

This study was carried out during July-August 2016 in Way Canguk Research Station, Bukit Barisan Selatan National Park, where the groups of siamang arefound. Geographically, Way Canguk Research Station located on 05° 39' 325" south latitude and 104° 24' 21" east longitude, and at the elevation 0-100 meter. This station has two research plots: south plot and north plot.

The methods of this study consist of two stages: preliminary survey and data collection. The aim of preliminary survey is to determine the research location of the siamang population in Way Canguk Research Station. Line transect method is used to collect data. In this method, observers walked about 1 kilometer along the straight line(transect) and observations are made 200 meters to the left and right of this line. Siamang was observed from 07 AM -11.AM.

Visual, audio and audiovisual technique were used and compared for this research. In visual technique, observers noted the number of siamangs that were seen along the transect line. Using audio technique, observers noted the number of siamangs that were heard when they were vocalizing. In audiovisual technique, observers came to the location of the source of the voice and record the number of visible siamangs.

Data collected consisted of discovery technique, the number of individuals, age and sex of siamangs, discover time, distance from transects, and the discovery site.

Preliminary Survey

Preliminary survey conducted to determine the research plots and transects to find groups of siamang.South plot of the camp was used for observation.Line 'C', 'I','O,'U' was walked by the observers.Visual and audio data technique was applied at the same time, while the audiovisual technique was applied separately.Each technique was repeated twice.

Data Collection

Line transect is a survey method used to collect data in the field of wildlife.In this method, the observer walked straight along path that form a straight line and then record the data of individual animals. Range finder was used to determine the distance measured from the transect line to the visible animal.

3. RESULT AND DISCUSSION

During the 16 days of observation, six groups of siamangs (Sony, Una, Freddie, Yadi, G800 and C200 group) were discovered in 11 location points (Figure 1) with different composition of individual numbers, age, and sex in each group (Table 1).Total individuals of siamang were 18.

Table 1. Observation data of discovered siamang group

Groups	**Age/Sex**					
	Adult	**Sub-adult**	**Juvenile**	**Sub-juvenile**	**Infant**	**Discovery technique**
Sony	1 F, 2 M			1 M	1/unidentified sex	Visual
Una	1M, 1 F			1 M		Visual
Yadi	1 M, 1 F					Visual
Freddie	1 M					Visual
G800*	2 M, 1 F					Audio
C200	1 M, 1 F	1 F	1 F			Visual, Audiovisual

* Exactly 5 individuals in one group: 2 adult males; 1 adult female; 1 sub-juvenile (unidentified sex); and 1 infant (unidentified sex)

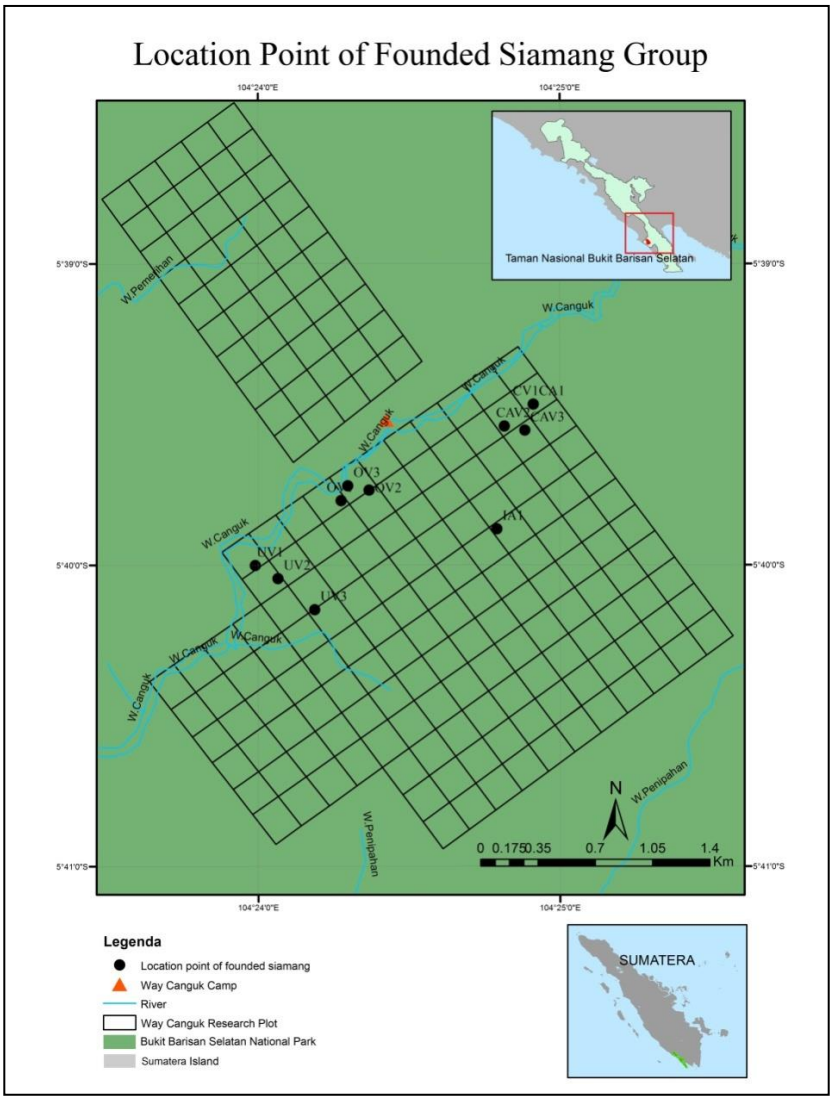

Fig 1. Location point of discovered siamang groups

Visual technique

Siamangs are arboreal animal and their brachiatingmovementin primary forest can be relatively fast (Chivers, 1972). Moreover, it takes time for the siamang to get used to the human presence. Group Sony, Una, Yadi were already acclimated to human so direct visual and identification were relatively easy. However, group Yadi was visually spotted for the first time and some individuals ran away during the observation, making visual identificationincomplete. Hence, 5 individuals were observed but only two individuals were identified; 1 male, 1 female. Group Freddie was also visually observed and revealed only 1 individual. The reason for this group to be composed of 1 individual was not known at the moment.

As explained above, visual technique relies on direct observation. However, in primary forest, the vision can be severely reduced. Therefore, visual technique can only be applied in small area and trained eye is required.

Audio technique

Adult and sub-adult siamangs are capable to produce alarm call for mating and maintaining their territories (Chivers, 1976, Olgerdinger, 1997, Palombit, 1996), which can be subsequently recorded. On the other hand, young and infant individuals are not capable of vocalizing. Using audio technique, the number of individuals which vocalize simultaneously can be obtained as well as the difference between male and female among those recorded individuals.

Walking along 'C','O,'U' transect did not produce any recordable vocalize from siamang. Walking along 'I' transect, vocalization was recorded and identified G800 group. Three out of five individualswere recorded and differentiation was also possible, giving 2 males and 1 females. However, this group composed of 5 individuals, with 1 sub-juvenile and 1 infant siamangs.

However, rainy or cloudy weather can affect the result from audio technique. Hence, siamangs rest during these type of weather (Rosyid, 2007) andless producing any recordable vocalization. Therefore, the limitations for the audio technique are followed: not applicable for young and infant; and less applicable during rainy of cloudy weather.

Audiovisual technique

This method is commonly used forsiamang census as in the observers know the exact location of the siamangs and their individual numbers.When walking along 'C' transect, sounds from a siamang group was heard. Searching the origin of these sounds, give the exact location for group C200: visual observation was carried out, revealing a total of 4 individuals: 1 adult male, 1adult female, 1 sub-adult female and 1 juvenile female (Table 1).

4. CONCLUSIONS

The audio technique was and less applicable during rainy of cloudy weather and not applicable for young and infant individuals as vocal communication was recorded by adult siamangs only. Visual technique looks more effective for smaller areaand trained eye is required.Audiovisual technique were applicable. This techniqueseems gives information about location and the number of individuals.

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REFERENCES

Chivers DJ. 1972. The siamang and the gibbon in the Malay peninsula. Gibb Siam 1:103-35.

Chivers DJ. 1976. Communication within and between family groups of siamang (*Symphalangus syndactylus*). Behaviour 57:116-35.

Geissman, T. 2007. *Status reassessment of the gibbons: Results of the Asian Primate Red List Workshop 2006*. *Gibbon Journal 3*: 5-15.

Kwatrina, *et al*. 2013. *Sebaran dan Kepadatan Populasi Siamang (Sympalangus syndactylus* Raffles, 1821) *di Cagar Alam Dolok Sipirok dan Sekitarnya, Sumatera Utara*. *Jurnal Penelitian Hutan dan Konservasi Alam*. 10(1): 81-91.

MacKinnon K. 1987. Conservation status of primates in Malesia, with special reference to Indonesia. Prim Conserv 8: 175-83.

Nijman, V. dan Geissman, T. 2008. *Symphalangus syndactylusIn* IUCN Red List of Threatened Species Version 2009. Diakses tanggal 7 Mei 2016 dari http://www.iucnredlist.org/.

O'Brien, T., Kinnaird, M., Nurcahyo, A., Prasetyaningrum, M. and Iqbal, M. 2003. Fire, demography and the persistence of siamang (Symphalangus syndactylus: Hylobatidae) in a Sumatran rainforest. Animal Conservation 6: 115 - 121.

Olgerdinger, M. 1997. *Protective and Territorial Behavior in Captive Siamangs (Hylobates syndactylus*). Zoo Biology. 16:309-325

Rosyid, A. 2007. *Perilaku Makan Siamang Dewasa (Hylobates syndactylus* Raffles, 1821*) yang Hidup di Hutan Terganggu dan Tidak Terganggu*. Agroland 14 (3): 237-240

Wildlife Conservation Society – Indonesia Program. 2001. *Taman Nasional Bukit Barisan Selatan Dalam ruang danWaktu. Laporan Hasil Penelitian 2000 –2001*. PHKA/WCS-IP. Bogor.

HELMINTHES PARASITIC (*PARAMPHISTOMUM SP*) INFECTION ON THE SUMATRAN ELEPHANTS IN ELEPHANT TRAINING CENTER WAY KAMBAS NATIONAL PARK LAMPUNG

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ABSTRACT

This study was conducted to identification the presence and type of helminthes parasitic in the Sumatran elephant (*Elephas maximus sumatranus*) in Elephant Training Center Way Kambas National Park. A total of 56 (22 December 20150 and 43 (15 June 2016) elephant's fecal samples were collected. Samples were examined with qualitative methods (native, sedimentation and flotation) and quantitative using McMaster method. The helminthes parasitic founded in this study is *Pharamphistomum sp* of trematodes. From 56 samples, found 45 samples were positive and from 43 samples, was founded 39 samples were positive for helminthes eggs *Pharamphistomum sp*. Quantitative examination shows that the infection varies from moderate to severe. This suggests that the presence of this type of worm is threatening the health of the Sumatran elephant because very difficulty of getting antelminthic (deworming) which effectively to kills *Pharamphistomum sp*. Grazing fields contamination by feces containing worm eggs can accelerate the process of transmission and improve worm infection.

Keywords: fecal, Parasitic, *Paramphistomum sp*, Sumatran elephant, Way Kambas

1. INTRODUCTION

Way Kambas National Park (WKNP) located in Lampung province is a forest habitat of primary importance for conservation of the large mammals in Indonesia. This area is nature habitat to rare and endangered wildlife species in the world including the Sumatran elephant (*Elephas maximus sumatranus*). Base on IUCN (2013) Sumatran elephant is endangered species and at risk of becoming extinct (CITES APPENDIX I) and are protected. Elephant that reside in wild nature also have a special place (semi captive) where efforts to save animals in the Elephant Conservation Centre (ECC). Sumatran elephant conservation is an important part of conservation of Indonesia's rich natural heritage. Deforestation of rainforest habitat and hunting has resulted in significant population declines of Sumatran elephant. Another important factor is disease, especially parasitism especially parasited from contact with domestic animals such as buffalo and cattle.

Endoparasite is a parasite living inside the host body. *Paramphistomum* spp. are Platyhelminth (flat-worm) parasites (Platyhelminthes: Trematoda: Digenea) responsible for Paramphistomosis i.e. gas-trointestinal parasitic disease (Ozdal et al., 2010) with distribution is worldwide (Ayaz, 2013), but the highest prevalence has been accounted in tropical and subtropical regions, particularly in Africa, Asia, Australia, and Eastern Europe (Ozdal et al., 2010; Melaku and Addis, 2012)

The prevalence of gastrointestinal helminthes is related to the agro climatic conditions like quantity and quality of pasture, temperature, humidity, and grazing behavior of the host (Pal and Qayyum 1993) and management (Littlewood and Bray, 2001). Cases example happened in ECC; an elephant died because of severe infection helminthes parasitic Trematoda (*Paramphistomum sp*) on 2007, 2004, 2005 and 2006. At the same time this parasite was identified in others Sumatran elephant in the ECC since 2006 until to date. *Paramphistomum sp* is parasitic flukes also often found in livestock surrounding WKNP.

Some research about the relation of disease in wildlife and livestock has been done especially in border areas. This research aimed to determine the identification of gastrointestinal helminthiasis in

ECC to better understand the existence. This information will provide important knowledge about disease incidence and drug of choice for parasit preventive and tretment.

2. MATERIAL AND METHOD

Study Area: the study was conducted in ECC WKNP.

Materials: Collection of Fecal Samples
Elephant fecal were collected from ECC area. Fresh feces were collected from 54 (22 December 2015) and 43 (15 Juni 2016).

Equipment: Plastic sample, label, McMaster, reaction tube, Refrigerator, centrifuge, scale, Pipette, Rack, Tissue / towel, filter, Microscope and digital camera.

Laboratory Examination: The samples were put in the ice box filled and and taken to the Balai veteriner Lampung laboratory for microscopic examination for identification with sedimentation and floation method and number of egg per gram feces was calculated by McMaster method. Identification will be based on morphology, structure and measurements from observation adapted from the literature.

Data Analysis: Analysis of data will include both descriptive results from identification and quantitative results from parasite counts.

3. RESULT AND DISCUSSION

A total of 56 domesticated elephant fecal were examined on 2015. 45 were infected with gastrointestinal helminthes as *Paramphistomum sp* and 1 sample infected by *Strongyloides sp* 1 and 1 sample infected by *Cooperia sp*. A total of 43 domesticated elephant fecal were examined on 2016. 39 were infected with gastrointestinal helminthes as *Paramphistomum sp*.

Paramphistomum sp is found dominan parasit in this study and grouped in the Trematode class. This worm is very danger for Sumatran elephant because live in the gastrointestinal tracts and could cause severe body condition loss and malnutrition condition in most elephant in the ECC. Periodic inspection in the Sumatran elephant housed at the ECC has identified parasitic trematode found in elephant fecal including organisms of *Paramphistomum sp*. Existence of public buffalo herds in the area of WKNP also indicates that there is a high risk of parasite transfers from domestic animals to wildlife because the habitat overlaps with the wildlife in area WKNP. These results are consistent with findings of different researchers in WKNP (Andriansyah , 2008; Muryani, 2008; ECC WKNP, 2015). Keberadaan keong dan siput sangat penting dalam penularan parasit ini karena as intermediate host sedangkan mammalian (elephant) as definitive host (Soulsby, 1974 and Gonzalez-Warleta et al., 2013).

Parasitic infections do not kill animals suddendly but through a long process (chronic) and cause less animal nutrition resulting malnutrition conditions and few elephants was showed decline of body weight. When the immune system is reduced in the body, the other diseases can easily to attack infection. The existence of *Paramphistomum sp* parasites in the body of elephant for a long time predispose to other illnesses.

The high case of Paramphistomum sp in ECC is caused by poor sanitation, grazing area have been rare in rotation, bathroom pool was dirty, elephants often pastored in the swamps which have connecting to village bordering where many buffaloes and cattle are also grazed in the same place and most important is the limited effective drug for trematode Paramphistomum types. So far deworming medicine that effectively to kills *Paramphistomum sp* on elephants is oxyclosanide but very difficult to find in Indonesia.

Routine fecal examination, deworming with drug ofchoice and rotation grazing land will be effective in controlling disease. Animals should be restricted to special areas of land provided by the ECC for grazing

4. CONCLUSION

In conclusion, dominan gastrointestinal parasites (*Paramphistomum sp*) have been found in domesticated elephant in the ECC. Epidemiological facts suggest that high standard of sanitation in modern animal husbandry will prevent exposure of livestock to graze in deteriorated and environmentally polluted range lands will be effective in controlling disease.

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REFERENCES

Andriansyah, Candra D, Agil M, Handayani SU, Tiuria R. 2008. Diseases Surveillance around Way Kambas National Park to support sumatran rhino conservation and health. Proceedings of Asian Zoo Wildlife Medicine and Conservation, Bogor, Indonesia 19-22 August 2008. p128-129

Ayaz MM, Raza MA, Murtaza S and Akhtar S. 2013. Epidemiological survey of helminths of goats in southern Punjab, Pakistan. Trop. Biomed., 30(1): 62-71.

Fikru R, Teshale S, Reta D, and Yosef K. 2006. "Epidemiology of gastrointestinal parasites of ruminants in western Oromia, Ethiopia," International Journal of Applied Research in Veterinary Medicine, vol. 4, pp. 51–57.

Littlewood DTJ and Bray RA. 2001. Interrelationship of the Platyhelminthes, vol. 60, Taylor & Francis, London, UK

[IUCN] International Union for Conservation of Nature. 2013. IUCN Red List of Threatened Species. Version 2013.2. [Download: Juni 20, 2015]

Melaku S and Addis M. 2012. Prevalence and intensity of Paramphistomum in ruminants slaughtered at Debre Zeit industrial abattoir, Ethiopia. Glob. Vet., 8(3): 315-319

Muryani A, Tiuria R, Andriansyah, Agil M. 2008. Helminthes parasite at feces of Sumatran rhinoceros (Dicerorhinus sumatrensis) dan Sumatran Elephant (Elephas maximus sumatranus) in Way Kambas National Park Lampung (semi in-situ). Proceedings of Asian Zoo Wildlife Medicine and Conservation, Bogor, Indonesia 19-22 August 2008. p142

Ozdal N, Gul A, Ilhan F and Deger S. 2010. Prevalence of Paramphistomum infection in cattle and sheep in Van Province, Turkey. Helminthologia, 47: 20-24.

Pal RA and Qayyum M. 1993. "Prevalence of gastrointestinal nematodes of sheep and goats in upper Punjab," Pakistan Veterinary Journal, vol. 13, pp. 138–141

Soulsby EJ. 1974. Helminths, Arthropods and Protozoa of Domestic Animals. Williams & Wilkins, Baltimore. Gonzalez-Warleta M, Lladosa S, Castro-Hermida JA, Martinez-Ibeas AM, Conesa D, Munoz F., Lopez, Quilez A, Manga-Gonzalez Y and Mezo M. 2013. Bovine paramphistomosis in Galicia (Spain): Prevalence, intensity, aetiology and geospatial distribution of the infection. Vet. Parasitol., 191(3-4): 252-263

[WKNP] Way Kambas National Park Report. 2015. Lampung. p4-9

TRAPPING FRUIT EATING BATS IN WAY CANGUK RESEARCH STATION, BUKIT BARISAN SELATAN NATIONAL PARK: MIST NET VS HARP TRAP

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ABSTRACT

Bat is one of unique mammals which can be found in Bukit Barisan National Park. Preliminary study on bat trapping techniques was conducted in Way Canguk Research Station, Bukit Barisan National Park in collaboration with WCS-IP. Mist net and harp trap were applied in four different plots during the month of July-August 2016. Mist net gave a better chance on trapping fruit eating bats due to their flying height.

Keywords: mist net, harp trap, fruit feeding bats, way canguk

1. INTRODUCTION

Bats are the only flying nocturnal mammals. There are two kinds of bats: inset: feeding bats and fruit feeding bats. The role of insect eating bats is as a biological control in nature. They could eat more than hundred mosquitos every single night (Kingston, 2009). Fruit eating bats could help some plants that only rise at the night for pollination (Domount, et. Al, 2004). Beside, bats also help plant dispersion seed and could make a guano (Suyatno, 2001). Bats fill a wide range of small ammals feeding ninche and according Wilson (1973) there are seven kind of bat tropical role these include: aerial insectivores (feeding on insect in the air); frugivores (feeding on fruit); foliage gleaner (feeding on insect on foliage, wall, cliff and the ground); nectarivores (feeding on flower, nectar and pollen); piscivores (feeding on fish); carnivores (feeding on other mammals, birds, reptiles, and amphibians); and sanguinivores (feeding on blood) which confined to 3 genera of Neotropical vampire bats (Kingston, 2009).

Bukit Barisan Selatan is one of Indonesia National Park and one of world heritage UNESCO. It is the biggest national park in Sumatra and it has an important role for conservation for both flora and fauna. Geographicly, Way Canguk is 05° 39’ 325” LS and 104° 24’ 21” BT. According to Wiantoro (2005), 36 species were identified in Way Canguk, Bukit Barisan Selatan National Park,

Two different technique were used to capture both insect and fruit eating bats, namely mit net and harp trap (Kunz,1988). According to Kunz (1988) mist net is easier and lighter. However harp trap can catch more bats than mist net (Francis,1989). Another main different cited by (Palmeirim and Rodriges, 1993) is that mist net need to be checked a soon as possible. Whereas, harp trap can be left alone for a longer period of time.

However, until now no conclusive evidence were given to establish which trapping technique can offer better fruit and insect eating bat. In order to optimize the capture of fruit bats in Bukit Barisan Selatan those two technique swere applied.

2. MATERIAL AND METHODS

This research was conducted in way canguk research station bukit barisan selatan national park during july until august 2016. Materials that used in this research are mist net and harp trap and those was applied in the same place and were repeated twice. Mist net was consisted of a pairs of pole and a net that was made from polyester. Mist net was tied at a pairs of pole it was 6 meters height. It was placed at 05:30 PM then will be finished at 09.30 PM .

Harp trap consist a string (fishing line), two pairs of pole and a bag. Bats are caught in the string and gradually fallen down into the bag at the bottom of harp trap. It was placed at 04:00 PM then will be checked first at 07:00 PM then 07:00 AM the next morning. Four different location were used by two method and each method were repeated twice (Fig 1).

4 location X 2 methods X 2 repeated = 16 trials

Fig 1. Trials of applied

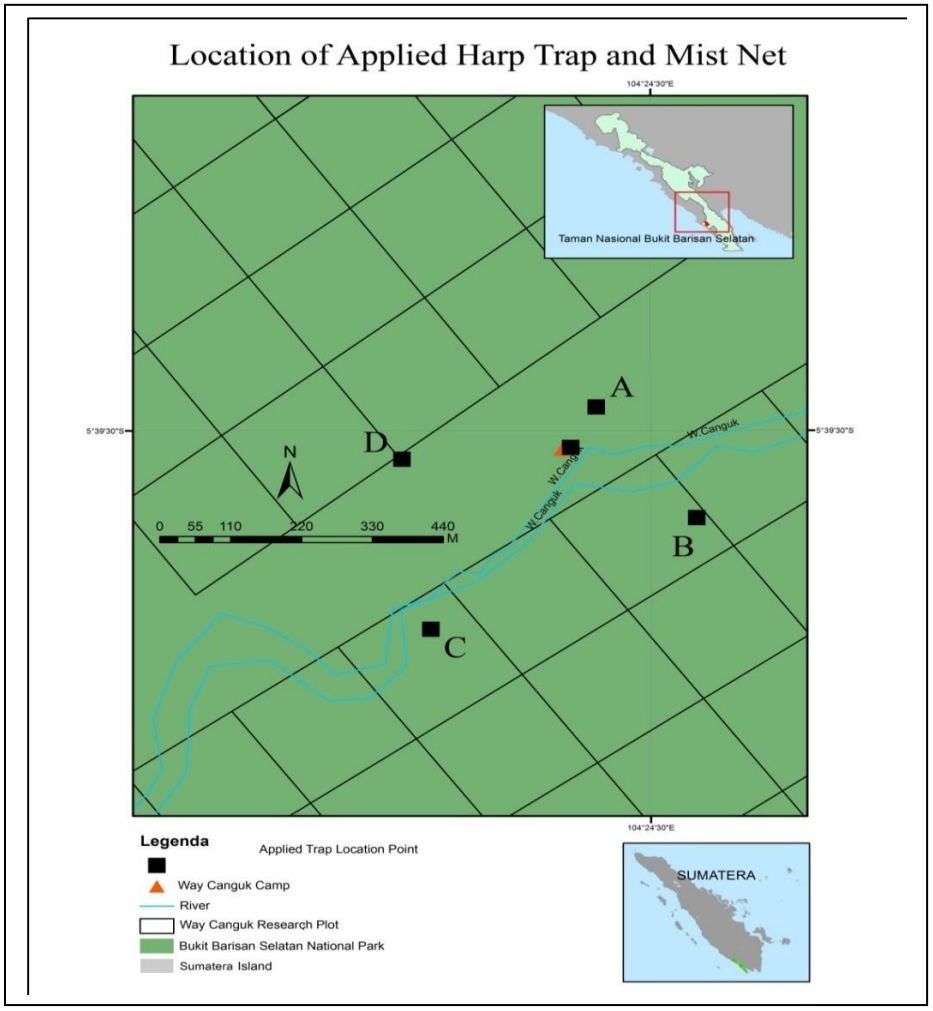

Fig.2 Location of Applied Traps

3. RESULT AND DISCUSSION

Four different locations (A, B, C and D) in primary forest were used for this research (Figure 2). Study area was a primary forest and has a huge canopy.

Of 150 bats consisted 14 species, 12 species of insect bats and 2 species of fruit bats (Table 1). Two fruit bat species that were caught in bukit barisan selatan national park are *Cynopterus branchiotis* and *Chironax melancepaus*. *Cynopterus branchiotis* as known as black capped – fruit bat or kelelawar kepala hitam in Indonesia. This habitat is in forest, especially higher elevation, hill and lowland. C. *branchyotis* are commonly in tent roots in harem groups for protection from rain and predators. It also to attract female from male (Kingston, 2009). This species is an important seed dispersers. According

to Tan, et al, (1997) C. *branchyotis* diet include the fruit at least 54 plant species, the leaves of 14 species and flower parts of a further four species.

Chironax melancepalus as known as lesser short – nosed fruit bat or kelelawar pisang in Indonesia. Its the most common and abundant of the cynopterus species and in this place this species is a forest lineages.C melanocephalus rootsusually in rock shelter and it can be found in caves in forest (Kingston, 2009). Diet of this species includes fruit of *Polyalthia oblique, Disopyros umatrana, Ficus sp.,Pellacaclyx saccardianus* and Adinandra Sarosanthera (Hodkison, 2001).

Fig 3. *Cynopterus branchiotis* (left) and *Chironax melancepaus* (right)

Table 1. List of captured bats in Way Canguk Bukit Barisan Selatan National Park

Genus	Species	Total
Hipposideros	*larvatus*	96
	cervinus	9
Rhinolophus	*Affinis*	23
	Lepidus	4
	acuminatus	4
	boreenis	1
Kerivoula	*papillosa*	2
	intermedia	1
Murina	*Cyclotis*	2
	Suilla	1
Megaderma	*Spasma*	1
Nycteris	*Tragata*	1
Cynopterus	***branchyotis***	**4**
Chironax	***melanocephalus***	**1**

Of 16 trials, this research caught 150 bats consisted 102 insect eating bats and 48 fruit eating bats. According to francis in 1989 the result capturing bats by harp trap is more than mist net (Palmeirim and Rodriges, 1993). However all 102 bats that captured by harp trap is an insect bats while mist net only caught 48 bats it is consisted 43 insect bat and 5 fruit bats. It makes the percentage of capturing fruit bats in primary forest by mist net is only 10,4% and by harp trap is 0% (Table. 2).

Table 2. percentage success mist net and harp trap in primary forest

	Bats	insect bat	fruit bat	percentage of capture fruit bat
Harp Trap	102	102	-	0%
Mist Net	48	43	5	10.40%

The chance of capture fruit bats is small because according to kunz (1989) rossting of fruit bats usually located near the canopy it makes fruit bats fly hinger than insect bats.

4.CONCLUSION

Comparison for two trapping technique was carried out in way canguk in order to establish the best trapping technique for fruit bats. After 16 trials this research caught 150 bats consisted 12 insect bat species and 2 fruit bat species. The change of capture fruit bat in primary forest is small because rossting of fruit bats usually located near the canopy, it makes fruit bats fly higher than insect bats. Last mist net gave a beter trapping succe for frit bats because it has 6 meters height it makes the chance of capture fruit bat is bigger than mist net.

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REFERENCES

Kigston, T., Lim B. Liat., Z. Akbar. 2009. Bats of Krau Wildlife Reserve. Universiti Kebangsaan Malaysia. Malaysia.

Dumont, ER., GD Weiblen & JR Winkelmann. 2004. Prefe-rences of fig wasps and fruit bats for figs of functionally dioecious Ficus pungens. J.Trop. Eco. 20:233–238.

Suyanto., A. 2001. Kelelawar di Indonesia (LIPI – Seri Panduan Lapangan). Pusat Penelitian dan Pengembangan Biologi., LIPI. Bogor.

Kunz TH. 1988. Ecological and Behavioral Study of Bats. Smithsonian Institution Press. Washington.

Palmeirim JA & Rodrigues L. 1993. The 2-Minutes Harp Trap for Bats. Bats Research News Vol 34 No 2&3.

Tan, K. H., A. Zubaid and T. H. Kunz. 1997. Tent costruction and social organization in *Cynopterus brachyotis* (Muller) (Chiroptera: Pteropodidae) in Penisular Malaysia. *Journal of Natural History* 31 : 1605 – 1621.

Hodgkison, R. 2001. The Ecology of fruit bats (Chiroptera: Pteropodidae) in a Malaysian lowland dipterocarp forest, with particular reference to the spoted - winged fruit bat (Balionycteris maculate, Thomas). Phd. Diss., University of Aberdeen.

RESCUE SUMATRAN ELEPHANT BABY WITHOUT TRUNK IN WAY KAMBAS NATIONAL PARK LAMPUNG

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ABSTRACT

A wild female's baby elephant with 3 years old and 250 kg of body weight. Named "Eri Buntung", was rescued from swamp in the border of WKNP Susukan baru. Villager and WKNP staff called rescue team to evacuation this elephant because her condition looks poor with broke trunk (Trunky). Elephant Conservation center with Elephant response Unit team, WCS and villager worked together to rescued the elephant. When first time founded Eri Buntung, her condition was bad, dehydration and malnutrition. Clinical signs such as decreased her appetite including drink, and loss of skin elasticity. Also Fecal bad condition (smell, watery black color and founded many species of worm). Physically examination founded head wound and the trunk look completely healed process after cut by poacher snare. In the elephant hospital, the veterinary team began emergency therapies including wound care, fluids therapy, anti-inflammation including amino acid therapy and multivitamin every 2 days in the first week and continuing every week after that and the planning to treatment her is about 4-5 months. After several days in the elephant hospital, she look much better and condition become normal but still slow progress. Supporting therapy and food supplement are very important in this critical time.

Keywords: rescue, Sumatran elephant, treatment, trunky, Way Kambas

1. INTRODUCTION

Way Kambas National Park (WKNP) is located in south- eastern island of Sumatra - Lampung, Indonesia. WKNP is comprises about 1,300 square km2 of important lowland rain forest and fresh-water swamp forest. WKNP with secondary lowlands forest is ranked as the second highest priority area for Sumatran elephant conservation activity (Santiapillai and Jackson, 1990). The national park supports populations of critically endangered - APPENDIX I CITES (IUCN, 2013) including Sumatran elephant (*Elephas maximus sumatranus*). From a 2010 survey base on fecal DNA, Sumatran elephant populations in the park are estimated 240 individuals.

Elephant Conservation Centre

In the early 1980s, elephant training program was initiated in an attempt to provide some solution to elephant conservation in Lampung and south Sumatra province because in this time has been deforestation for transmigration (migrant people from Java) and plantations. This involved capturing elephants without home and drives them to WKNP then training them become to domesticated elephant. The program is popular with The "Tata Liman, Bina Liman and Guna Liman" methods. Elephant Conservation Centre (ECC) has been established in the August 27, 1985, this resulted in the broad scale capture of wild elephants. ECC is area of approximately 2000 ha and is located on the southern border of WKNP. The elephants in the ECC have been domesticated with following training method from Thai's mahout and ECC provided elephant hospital on November 5, 2015 to improved health care of veterinary attention, preventative medication, and emergency care has been supported by Australian Zoo and Taman Safari. The ECC's short term aim is to manage and ensures health of elephant with animal welfare approach. The long-term vision for ECC is to sustainable sanctuary for the captive elephant population to support wild population (*in-situ*). The captive elephants at the ECC have been trained as either patrol elephants to prevent further conflict with local communities, rescue wild animal, education, research and for tourism entertainment purposes. Rescued, injured or trapped baby elephants are also taken into semi *in-situ* captivity at ECC, where they are veterinary care back to health, and if possible, released back into the wild habitat and reunited with their original family groups. When this is not possible, they remain in captivity and are trained as domesticated elephant.

2. MATERIAL AND METHOD

A wild female's baby elephant with 3 years old and 250 kg of body weight. Named "Erin Buntung", was rescued from swamp in the border of WKNP Arjo swamp Way Ipis- Susukan baru on June 23, 2016. Villager and WKNP staff called rescue team to evacuation this elephant because her condition looks poor with cut of trunk (Trunky). ECC team with Elephant response Unit (ERU) team, WCS and villager worked together closely to rescued the elephant using elephant's patrol.

When the first time founded Erin, her condition was illness, weakness, skinny, dehydration and malnutrition. Clinical signs such as decreased her appetite including drink, and loss of skin elasticity. She is more calm and keep alert when people trying to approach. Also Fecal is worse condition (smell, watery with black color and founded many species of parasites). Physically examination founded head wound and one interesting is the trunk look completely healed process after cut by poacher snare. Difficult to feeding, she used trunk and one of leg to take the grass or leave and often she drop to knees to eat and drink. She's disability elephants without trunks.

After about 5 hours evacuation processes including drive her to ECC facility. In the ECC's elephant hospital, the veterinary team began emergency therapies including wound care, fluids therapy, anti-inflammation including amino acid and multivitamin every 2 days in the first week and continuing every week after that and the planning to treatment her is about 4-5 months procedures. Supporting therapy and food supplement are very important in this critical time.

3. RESULT AND DISCUSSION

After several days in the elephant hospital, she look much better and condition become normal but still slow healing progress. ECC has prepared mahout for 24 hours care. In all day, she drive to grassing land surrounding elephant hospital and prepared about 20 kg variety of extra food such as grass, leaves, banana fruit, etc. in the night situation, she also prepared about 10 kg extra foods and ad libitum water for play and drink. She looks good progress with improving adapted with her condition. The last blood sample also showed she getting better without abnormality, just need to improve her dehydration and malnutrition condition and ECC was planning to intensive veterinary care until 4-5 months.

Elephant Trunk

Erin is elephant loses trunk in snare trap but she has been manages to survive. The team make a prediction, she has been trap by snare since a year ago because the ERU team was observed this animal since last year but still difficult to find and approaching because still together with big wild group.

The elephant's trunk is an extended nose that is fused with their top lip and highly dynamic. They have opposable "fingers" at the end for grasping small objects. The trunk Asian Elephant has only one finger with sensitive tissue and no skeletal structure present. These fingers are very strong and precise, allowing the elephant to pick up tiny items. One of the main functions of the elephant's trunk is for feeding and drinking and makes it useful by independently searching and retrieving more food. The long trunk alleviates this by allowing the elephant to graze the ground or trees for food without so much as moving their head at all. They can also suck up and squirt almost 14 liters of water into their mouths. The young baby will within time comprehend that it is to be used as an extra hand to pick up items, to scratch with, to drink with, and much more. It is the close contact and relationship between adult elephant and baby that allows knowledge to be acquired and processed. Given that they have the largest nose in the world; it is perhaps not surprising that elephants are thought to have the best sense of smell of all animals. Something, the trunk as a chemical receptor allows them to obtain information about other elephants. The others useful think of trunk is playing, transfer a layer of dust or mud to their bodies, an essential tool for social behavior interaction, used in more confrontational situations both aggressive and defensive (Elehost, 2016 and Eleaid, 2016).

Every day “ERIN” getting better and has been adapted with her condition and one other important thing she has more confident to relationship with other elephant in the ECC and we are optimistic ERIN will be survive with care by people surrounding. ERIN is icon for save the Sumatran elephant.

4. CONCLUSION

The elephant’s trunk is unique important part of elephant body and absolutely vital for an elephant’s survival. Elephant without trunk “ERIN” will be survive with care by people.

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REFERENCES

Dephut. 2006. Taman Nasional Way Kambas. *http://www.dephut.go.id/uploads/INFORMASI/ TN%20INDO-ENGLISH/ tn_waykambas. html*. Download: August 25, 2016.

Elehost. 2016. Elephant trunk. http://elephant.elehost.com/About_Elephants/Life_Cycles/ Baby/baby.html. (Download: September 10, 2016).

Eleaid. 2016. Elephant trunk. http://www.eleaid.com/elephant-information/elephant-trunks/. (Download: September 5, 2016)

[IUCN] *International Union for Conservation of Nature*. 2013. IUCN *Red List of Threatened Species*. Version 2013.2. (Download: Juni 20, 2015).

Santiapillai, C. & Jackson, P. 1990. The Asian elephant: an action plan for its conservation. IUCN/SSC Asian Elephant Specialist Group, Gland

THE TABANID FLY BIODIVERSITY AND ITS POTENCY AS TRANSMISSION VECTOR OF TRYPANOSOMIASIS TO THE JAVAN RHINO POPULATION WITHIN THE UJUNG KULON NATIONAL PARK

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ABSTRACT

Javan rhinos are struggling to survive with only 63 individuals remaining in their last habitat in the world, Ujung Kulon National Park. Infectious disease has been one of the presumably challenges that faced in the Javan rhino conservation due to the unknown cause of Javan rhino die-offs without their horns detached from the body that ruled out the probability of poaching. This study is conducted to investigate the Tabanid fly within the NP as the potential vector for trypanosomiasis on Javan rhino, as they are known as the common trypanosome vector on water buffaloes and cattles.The diversity and the high amount of total Tabanid fly collected showed a high potency of cross infection between the inhabitant's livestock to ungulate sympatric animal in the NP (Javan rhino and banteng). *Tabanus megalops* holds a prominent dominance from the amount of total collected Tabanid fly from this sampling period.

Keywords: Javan rhino, biodiversity, Tabanid fly, vector, trypanosome, Ujung Kulon National Park

1. INTRODUCTION

Javan rhinoceros is one of the rarest terrestrial mammals in the world. Javan rhinos are struggling to survive with only 63 individuals remaining in their last habitat in the world, Ujung Kulon National Park. Javan rhino used to have a second home in Vietnam, however in 2011, Vietnam lost their last Javan rhinoceros and leaving the Javan rhino's Indonesia group population as the species' last resort of existence. The attempt on actualizing the Javan rhino conservation efforts are facing many complicated challenges; from the geographical location of the Park that prone to natural disaster since it lies nearby the active Mount Krakatoa, the species' small population problem, the species' feeding competition with other ungulate sympatric animal in the Park, and the unknown cause of species deaths reported.

Ujung Kulon National Park consists of two regions; the peninsula region, which is the core habitat of the Javan rhino and the Honje Mountain region that intersect directly with 19 buffer villages. The direct intersection between the NP and the inhabitant's residence cause a concern since the inhabitants are free to entering their water buffaloes in the NP. The inhabitant's main livelihoods lie on the water buffaloes as their livestock. The direct intersect of their villages to the NP allows them to rely solely and freely to shepherd their water buffaloes into the NP. This cause a big concern since the unknown cause of death within the Javan rhino population without any horns detached as a remark, has been one of the challenges that faced the Javan rhino conservation efforts. Disease surveillance study was conducted in 2014 based on this concern towards the water buffaloes' livestock of the 19 UKNP buffer villages. The surveillance study showed that two of the UKNP buffer villages; Rancapinang village (the south border of the NP) and Ujung Jaya village (the north border of the NP) shared the prevalence number of 90% to trypanosomiasis within their water buffaloes livestock (Khairani 2014).

Trypanosomiasis is a vector-borne disease that disrupting blood circulation and causing anemia that will decrease the host's body immune system. *Trypanosoma evansi* is the causative protozoan pathogen of trypanosomiasis. Trypanosomiasis is transmitted by blood sucking insects as its mechanical vector. Tabanid fly is the most common blood sucking insects that transmitted the trypanosomiasis. Trypanosomiasis attacked cattles, water buffaloes, fatal on horses, and other ungulate sympatric animals like elephants, and camels (Desquesnes 2013). *Tabanus* is known to play a significant role in transmitting infectious disease to the cattles through sucking the blood of the host (Chandra *et al.* 2005). It is also reported throughout October-November 2003, there has been case of Sumatran rhino die-offs caused by trypanosomiasis in Peninsular Malaysia (Vellayan *et al.* 2004). Aside from transmitting infectious disease to the host animals, it also caused a persistent irritation to the host's skin due to the blood sucking activity by the Tabanid fly. The infected area can also trigger the occurrence of secondary infection from other pathogens. Since *Trypanosoma evansi* circulating in the blood vessels, its main agenda is by causing anemia so that it will decrease the host's body immune system.

Infectious disease has been one of the presumably challenges that faced in the Javan rhino conservation due to the unknown cause of Javan rhino die-offs without their horns detached from the body that ruled out the probability of poaching. Water buffaloes are known as the reservoir host of the trypanosomiasis. Based on the surveillance report by Khairani (2014) on the high prevalence of the disease occurrence in two buffer villages, the study on the Tabanid fly is imperative to acknowledge the amount of mechanical vectors of the disease in both buffer villages that intersect directly to the NP. The high number of amount Tabanid fly collected in both area presumably leads to a higher risk of the cross infection between the infected water buffaloes to the other ungulate sympatric animals (Javan rhino and banteng) within the NP. This study is conducted to investigate the Tabanid fly within the NP as the potential vector for trypanosomiasis on Javan rhino, as they are known as the common trypanosome vector on water buffaloes and cattles.

2. MATERIALS AND METHODS

Materials

Materials that used in this study are NZI trap, black-painted ball, black funnel, pan, hygrometer and thermometer, clocks, centrifuge tube, labels, pencils, markers, electron microscope, petri dish, collection bottles, and silica gels.

Sampling Methods

We conduct the sampling with the help of Rhino Health Unit (RHU) team from the UKNP. We adopted the methods on the *Sleeping Sickness* caused by *Trypanosoma gambiense* with Tsetse fly as vector, which is conducted in Africa. We use NZI trap as the sampling media. We set the NZI trap in the open area without any shades from the canopy to gather the much amount of light to lure the Tabanid fly into the NZI trap. NZI trap was set using bamboos or wooden sticks approximately 50 cm from the ground to camouflage NZI trap as the water buffaloes' body to the Tabanid fly. Black-painted funnel is also placed on top of the NZI trap to attract the Tabanid fly into the collection bottle. We set the trap on the ecotone site, which is the intersection between two different environments, such as between the savanna and the forest, to create a optical contrast of the trap that increasing the appeal of the trap for the Tabanid fly. We also ornament the trap with several items, such as black-painted ball hung below the trap, pan full of water to amplify the amount of light into the trap. We collected everyday from 24 hour sampling period.

Time and Place

We set the trap within the NP (Cidaon and Cibunar) in three sampling period: July, December 2015, and August-September 2016. The three sampling period is considered enough to represents two distinct season; wet and dry season, respectively. We conduct the sampling within the NP for 3-4 days each period. We collected the samples with dry preservation methods using silica gel as the media. All Tabanid fly collected in a centrifuge tube filled with silica gel and tissue to separate the gel and the Tabanid fly. We labeled the sample by time and date of trap setting, time and date of collection, and other variable information such as temperature, humidity, and weather. Identification process is

conducted in the home stay at Polos, Cimanggu Subdistrict, Pandeglang District, Banten Province and at the Entomology Laboratory, Department of Animal Disease Science and Veterinary Public Health, Faculty of Veterinary Medicine, IPB-Bogor.

Identification Process

We identify the Tabanid fly using the electron microscope based on taxonomy key guide from Schuurmann and Stekhoven (1926). The identified Tabanid fly is collected per species identified, collection date, and collection site in one centrifuge tube preserved later in the freezer. The identified samples also labeled by the species name, the amount of the species, collection site, time and date of setting and collection, and other variable information.

We sometimes collected samples that in bad condition, such as too dry to be identified. For samples that we have a hard time to identify it, we bring the samples to Entomology Laboratory, Department of Animal Disease Science and Veterinary Public Health, Faculty of Veterinary Medicine, IPB-Bogor, to have a discussion with the lecturer staff regarding the samples' identification process.

Data Analysis

The collected Tabanid fly is analyzed descriptively using frequency distribution table. We use the relative abundance value (kn), collected frequency value (ft), and dominance value (dom). We calculate each values by using formulas as followed:

$$\text{Relative Abundance Value} = \frac{\text{Total of specific species collected}}{\text{Total of all species collected}} \text{ x } 100$$

$$\text{Collected Frequency Value} = \frac{\text{Frequency of specific species collected in each collection}}{\text{Total Collection}}$$

Dominance Value = Relative Abundance x Collected Frequency Value

3. RESULTS AND DISCUSSION

Based on the Tabanid fly identification collected within the NP, we collected 1266 Tabanid fly from 20 Tabanid fly species. From those 20 tabanid fly species, *Tabanus megalops* holds the prime dominant with the dominance of 39.09952607. *Tabanus striatus* followed it with the dominance of 18.16745656. *Haematopota javana* represents other genus aside Tabanus in the Tabanidae subfamily came in third with the dominance of 8.478146393, followed by *Tabanus atripunctatus* with the dominance of 6.556082148, and *Tabanus rufiventris* with the dominance of 5.687203791. *Tabanus megalops* is shown have a collected frequency value of 1 along with *Tabanus striatus, Tabanus atripunctatus,* and *Tabanus rufiventris.* This means that during the whole sampling period, these species are constantly collected. Based on the data, we obtain the Margalef richness index (R1): 2.659716835 and the Menhinick's richness index (R2) of 711.617875. We also obtain the Simpson's diversity index of 0.215922672. The richness index showed the species quantity in one community. The more species quantity collected from the sampling display the rich quantity species abundance. Based on the Margalef richness index, we obtain a low value of richness due to the constant number of total species collected in the three sampling periods.

Out of 20 species identified from the collected samples, we collected three genus form two subfamilies of Tabanid fly: Chrysops genus (*Chrysops fixissima*) from the Chrysopsinae subfamily, Tabanus and Haematopota (*Haematopota javana, Haematopota fumigata, Haematopota cingulata, Haematopota irregularis*) genus from Tabaninae subfamily. Chrysopsinae subfamily has a distinct feature from the Tabaninae subfamily regarding their relatively small size body. Chrysopsinae subfamily has the body size range of 6-10 mm, whilst Tabaninae has the body size range more than 10 mm. However, despite its small size, Chrysopsinae subfamily recorded as the vector-borne zoonotic disease, such as tularemia and loiasis, whilst Tabaninae subfamily recorded as the vector-borne nonzoonotic disease, such as animal trypanosomiasis or surra and anaplasmosis.

Species Group Classification I from Stekhoven (1926) classification appeared as the most collected species member from the sampling, which placed 5 for its member on the identified species: *Tabanus megalops, T. striatus, T. rufiventris, T. rubidus,* and *T. effilatus.* Species Group Classification I is

classified for their common abdominal markings of three lateral median stripes and their black-brown, brown, blackish, and grayish body color. This species group is distributed all over Indonesia (Stekhoven 1926). *Tabanus megalops* and *T. rubidus* is also reported as the vector for trypanosomiasis in Indonesia (Hadi 2010). Table 1 showed the diversity of identified Tabanid fly species collected within the NP.

The diversity of Tabanid fly collected occurs due to the sampling site is set within the NP. NP consists of primary forest, which naturally contains the multispecies biodiversity. This high amount of total Tabanid fly collected within the NP showed the potency of cross infection of vector-borne transmitted disease from the water buffaloes to the other ungulate sympatric animals (banteng and Javan rhino) within the NP.

Table 1 Compile Sampling Data from Three Sampling Periods (July, December 2015, and August-September 2016)

No	SPECIES	TOTAL TABANID FLY COLLECTED PER SPECIES IN UKNP	RELATIVE ABUNDANCE	Frequency		Dominance
				∑Species Collected	Frequency	
1	T. megalops	495	39.09952607	3	1	39.09952607
2	T. striatus	230	18.16745656	3	1	18.16745656
3	T. rufiventris	72	5.687203791	3	1	5.687203791
4	T. ceylonicus	66	5.213270142	3	1	5.213270142
5	T. rubidus	4	0.315955766	2	0.66666667	0.210637177
6	T. albopunctatus	68	5.371248025	3	1	5.371248025
7	T. breviusculus	4	0.315955766	1	0.33333333	0.105318589
8	T. basalis	1	0.078988942	1	0.33333333	0.026329647
9	T. tristis	9	0.710900474	2	0.66666667	0.473933649
10	T. ilustris	1	0.078988942	1	0.33333333	0.026329647
11	T. aurifer	5	0.394944708	1	0.33333333	0.131648236
12	T. atripunctatus	83	6.556082148	3	1	6.556082148
13	T. canipus	1	0.078988942	1	0.33333333	0.026329647
14	T. immanis	1	0.078988942	1	0.33333333	0.026329647
15	T. effilatus	6	0.473933649	1	0.33333333	0.157977883
16	H. javana	161	12.71721959	2	0.66666667	8.478146393
17	H. cingulata	43	3.396524487	1	0.33333333	1.132174829
18	H. fumigata	11	0.868878357	1	0.33333333	0.289626119
19	H. irregularis	1	0.078988942	1	0.33333333	0.026329647
20	C. fixissima	4	0.315955766	1	0.33333333	0.105318589
TOTAL		1266	100	3		

4. CONCLUSION

The diversity and the high amount of total Tabanid fly collected showed a high potency of cross infection between the inhabitant's livestock to ungulate sympatric animal in the NP (Javan rhino and banteng). *Tabanus megalops* holds a prominent dominance from the amount of total collected Tabanid fly from this sampling period.

Suggestion

More sampling period is needed to investigate the richness and diversity data of the Tabanid fly collected within the NP. We also need to conduct a series of molecular biology for further investigation to confirm the correlation of the Tabanid fly as trypanosomiasis vector within the NP.

REFERENCE

Chandra K, Halder S, Raha A, Parui p, Banerjee D. 2015. *Tabanid Flies (Insecta: Diptera) from Chhattisgarh, India*. Journal of Threatened Taxa Vol. 7 (10)

Desquesnes M, Holzmuller P, Lai DH, Dargantes A, Lun ZR, Jittaplaplong S. *Trypanosoma evansi and Surra: A Review and Perspectives on Origin, History, Distribution, Taxonomy, Morphology, Hosts, and Pathogenic Effects.* BioMed Research International Volume 2013

Hadi UK, Soviana S. 2010. *Ektoparasit: Pengenalan, Identifikasi, dan Pengendaliannya*. IPB Press: Bogor

Khairani KO, Nydam D, Felippe MJ, McDonough P, Barry J, Mahmud R, Haryono M and RW Radcliffe. 2014-under review. Surveillance for hemorrhagic septicemia in buffalo (*Bubalus bubalis*) as an aid to range expansion of the Javan rhinoceros (*Rhinoceros sondaicus*) in Ujung Kulon National Park, Indonesia. J. Wildl. Dis.

Vellayan S, Mohamad A, Radcliffe RW, Lowenstein LJ, Epstein J, Reid SA, Paglia DE, Radcliffe RM, Roth TL, Foose TJ, Khan M. 2004. *Trypanosomiasis (Surra) in the Captive Sumatran Rhinoceros (Dicerorhinus sumatrensis sumatrensis) in Peninsular Malaysia.* Proceeedings: The 11th International Conference of the Association of Institutions for Tropical Veterinary Medicine and 16th Veterinary Association Malaysia Congress: Animal Health, A Breakpoint in Economic Development?

Stekhoven JHS. 1926. *The Tabanids of the Dutch East Indian Archipelago.* Treubia: Utrecht

ELEPHANT ENDOTHELIOTROPIC HERPESVIRUS (EEHV) MANAGEMENT IN ELEPHANT CONSERVATION CENTER WAY KAMBAS NATIONAL PARK LAMPUNG

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ABSTRACT

Elephant Endotheliotropic Herpes virus (EEHV) is an important disease in elephant conservation center (ECC) Way Kambas National Park (WKNP). EEHV case was occurred in the October 2014 - February 2015 in ECC, which four young elephants were dead, while the adult elephant as a carrier and onset of infection is very fast with a very high mortality (sudden death). Although it has made several treatment protocols for EEHV but so far does have good method to eliminate herpes virus. Therefore, management of EEHV in ECC is necessary for minimized the transmission of this virus. EEHV Management in the ECC are as follows: 1. Separate the elephant adults enclosure (mother with calves and calves under 10 years old); 2. Changing the drinking patterns of elephants drinking at the pool to be drinking in the tub that had prepare in the night stall and hospital with fresh water sources from artesian well; 3. Examination of blood and stool samples are routinely; 4. Apply early warning system for a calves elephant with intensive monitoring and intensive treatment; 5. Medics are available 24 hours a day so that when it was discovered symptoms of the disease in elephant calves immediate treatment can be done as soon as possible; 6. Provision of herpes virus drug (acyclovir) for 14 days every 1-2 months lag depends on monitoring calves health status and 7. Minimize parasitic disease cases by examination and routine treatment for parasites because parasitic as predisposition to herpes virus infection in elephants.

Keywords: Acyclovir, Diseases, EEHV, Management, Sumatran elephant

1. INTRODUCTION

Elephant conservation center (ECC) with about 2.000 ha area in the Way Kambas National Park (WKNP) is one important facility for domesticated Sumatran elephant. ECC was established on August 27, 1985 by Indonesian government together with Indonesian military and Taman Safari Indonesia Bogor. Wild elephant which was loss home in south Sumatra (Palembang and Lampung) drive successfully to WKNP on 1980s.

Elephant endotheliotropic herpes virus (EEHV) first detected in African elephants in 1970 and the first case of the Asian elephant at the zoo Washington USA 1995. In Asia EEHV suspected cases in 1997 and was first detected in 2006 in Cambodia elephant sanctuary (EEHV). Furthermore EEHV found in other countries such as Thailand, India, Nepal, Myanmar and Indonesia (Asia), Canada and the UK. All cases EEHV elephant attacking a young age under 10 years old, with most cases in the age range of 1-3 years. EEHV can cause fatal hemorrhagic disease in Asian elephants (*Elephas maximus*) and African elephants (*Loxodonta africana*) so considered to bring a serious threat to endangered wildlife conservation status (Jeffrey et al., 2005).

EEHV is an important disease in ECC WKNP. EEHV case was occurred in the October 2014 - February 2015 in ECC, which four young elephants were dead, while the adult elephant as a carrier and onset of infection is very fast with a very high mortality (sudden death). Clinical signs are Lameness, lethargy, anorexia, cyanosis, edema, mild colic, dullness and hypothermia. Necropsy result are mucous cyanosis, Hepatomegaly, bloat, lymphoid nodules 3-30 mm, hemorrhagic and ulcer, hyperemia.

2. MATERIAL AND METHODS

These studies were conducted during October 2014 until now in the ECC WKNP. Sixty elephants in captive situations were included in the study. The age range of the group was 1 month to 45 years old. The cohort includes elephants that lived in the elephant response unit (ERU) and interacted extensively with free-ranging elephants, such as the Margahayu, Tegal Yoso and Bungur camp. All the elephants included in this study were routinely under human care.

3. RESULT AND DISCUSSION

In Indonesia, EEHV case was first confirmed in two babies of domesticated Sumatran elephant with two years old who was born in an Elephant Conservation Unit in Medan, North Sumatra in 2012. Visual inspection when the post mortem procedure was showed swelling of the head and the tongue looks blue (cyanosis) accompanied by signs of hemorrhage. Macroscopic examination of the internal organs showed worse hemorrhage. Organs affected are trunk mucosal, parenchyma lungs, the entire lining of the heart, the mucosa of the entire gastrointestinal tract, spleen, kidneys, and related limfo glandules.

The second case occurred in the ECC WKNP during the end of 2014 to early of 2015. At that time, four elephant's baby with 3-8 years old was died with clinical symptoms and post-mortem examination results are similar to cases in Sumatra North. PCR with primers specific for EEHV-1 is done on a trial basis at the Laboratory Animal Medical Satwa, Bogor and showed positive results in samples taken from cases 2 elephant's baby in North Sumatra and 4 elephant's baby ECC WKNP in Lampung. EEHV suspected case recently took place in mid of 2015 in CRU Tangkahan North Sumatra and Tesso Nilo Riau.

In the case in ECC the elephant with clinical symptoms suspect EEHV have been tried medical treatment by providing: Fluids therapy infusion (saline, lactate ringer, glucose and Amino acid), Antibiotic LA, Multi Vitamins (B complex, Vitamin C), Anti bloat, Anti-Inflammatory and Acyclovir but often failed. There is some evidence suggesting deterioration in conditions such as lack of nutrition, lack of hygiene, and the presence of gastro intestinal parasites with discovery of botfly larvae in the stomach and trematode worms (*Pharampistomum sp*) in the stomach and intestines. Parasites have a contribution to decreased the body condition for general and parasites as predisposition in this case. Difficulties in diagnosis of disease are: EEHV virus very difficult to detect except when the virus really is at the acute stage or viremia. EEHV's examination with the trunk wash methos is never detected in ECC. EEHV cases in ECC and just attack domesticated elephant and no infection to wild elephant because in this moment two wild baby elephant was captured and together treatment with elephant suspect EHHV but wild elephants potentially to infection because there is no barrier between ECC and the natural habitat of wild elephants.

While transmission of the disease is difficult to determine but there are some indications the modes of transmission such as direct contact between an elephant (trunk, saliva and other body fluids), adult elephants latent or carrier, water (drinking and bathing), wounds, air, mahout and others. Naturally, EEHV already exists in elephant body and is highly dependent on the immune system. EEHV is not transmissible to humans (not zoonosis) and specifically attack only the elephant. EEHV mortality is 80-90% since clinical symptoms (Latimer *et al.,* 2011). Treatment with anti-herpes virus (famcyclovir) 8 out of 12 cases during 1995-2005 in the United States experienced the death (only 5 were successfully treated).

The big challenge for EEHV case is difficult to diagnose when animal still life and when animal showed clinical signs of EEHV often too late to give medical care and sure drugs of choice for treatment needed. Base on case for three years, EEHV seems to be a new challenge for the Sumatran elephant's conservation in Indonesia.

Collaboration among all stakeholders (institutions in the field, the relevant national authorities, and others) is required to conduct ongoing investigations, manage, and prevent the further spread of this infectious disease.

Strategic for EEHV preventive in ECC WKNP

Diagnosis before infection (viremia) is very difficult (Javier *et al.*, 2015), routine blood tests including antibody titer can be done, although not always help. Until now, there has been no single most effective method to handling or eliminate EEHV and do not believe in the one opinion. Management of EEHV in ECC is necessary for minimized the transmission of this virus (EEHV, 2015). The last protocol for Asian Elephant EEHV by Houston Zoo (2015).

EEHV Management in the ECC is as follows:

1. Separate the adult's elephant enclosure (mother with baby and baby under 10 years old);
2. Changing the drinking patterns of elephants drinking at the pool to be drinking in the tub that had prepare in the night stall and hospital with fresh water sources from artesian well;
3. Examinations of blood and stool samples are routinely;
4. Apply early warning system for a baby elephant with daily intensive monitoring by mahout (Visual and physical inspection) and intensive treatment by medic team;
5. Medics are available 24 hours a day so that when it was discovered symptoms of the disease in elephant calves immediate treatment can be done as soon as possible; Intensive Care of the EEHV Patient: Antiviral medications – Famcyclovir 15 mg/kg/bb or Acyclovir 10 mg/kg/bb twice daily, Sedatives, Rectal Fluid Therapy, Hypothermia therapy, Intravenous Fluid Therapy, Plasma Transfusion, Blood Transfusion, Oxygen Therapy, Antibiotics and Analgesia.
6. Provision of herpes virus drug (acyclovir) for 14 days every 1-2 months lag depends on monitoring calves health status and
7. Minimize parasitic disease cases by examination and routine treatment for parasites because parasitic as predisposition to herpes virus infection in elephants.

Since last case on February 2015 until now, no EEHV case in the ECC and we hope elephant husbandry management countinuing to improve.

4. CONCLUSION

Although EEHV is very dangerous and have not found a suitable treatment for the elephants but with improved management will be minimize the risk of spreading the disease.

ACKNOWLEDGEMENT

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REFERENCE

EEHV. 2015. http://eehvinfo.org/wp-content/uploads/2016/07/10th-EEHV-workshop-Proceedings-2015-FINAL. pdf. (Download September 20, 2016)

Javier L, Andrew MK, Akbar D. 2015. An Alternative Blood Sampling Technique in Elephants For EEHV PCR Testing. EEHV 2015 Workshop Proceedings, Houston, Texas

Jeffrey JS, Sally AN, Arun Z, Kalaivannan N, and Paul DL. 2014. Detection of Elephant Endotheliotropic Herpesvirus Infection Among Healthy Asian Elephants (*Elephas Max/Mus*) In South India. Journal of Wildlife Diseases, 50(2) pp. 279-287

Latimer E, Zong JC, Heaggans SY, Richman LK & Hayward GS. (2011) Detection and evaluation of novel herpes viruses in routine and pathological samples from Asian and African elephants: identification of two new proboscis viruses (EEHV5 and EEHV6) and two new gamma herpes viruses (EGHV3B and EGHV5). Veterinary Microbiology 147 (1-2), 28-41

AN EXPERT SYSTEM TO DIAGNOSE CHICKEN DISEASES WITH CERTAINTY FACTOR BASED ON ANDROID

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ABSTRACT

Theresearch was conducted to create an expert system that is able to diagnosechicken diseases based on the experts / specialists knowledge. This study uses a calculation method called Certainty Factor (CF) to calculate the level of expertise. The expert system created on Android mobile device platform.The research data consist of symptoms data, chicken diseases data, and data rules. Chicken disease data is limited to diseases caused by bacteria (bacterial), totaling 19 types of diseases with 78 kinds of symptoms and 184 types of rules.Inference method that used is forward chaining by searching for rules based on user answers in the form of check mark (√).Users answers are processed according to the rules and calculated using certainty factor method. The test results showed that : (1) Functional testing using Black Box Equivalence Partitioning (EP) get results as expected as the test scenarios in each test class.(2) Diagnosis testing by comparing the results of manual calculations and systems calculations showed 99 percent was appropriate and well-run.(3) Questionnaire testing with 31 respondents were divided into three groups of respondents indicated; first respondents group consisting of specialists of chicken diseases gets 63.33 percent of an average value (categorized good), the second respondents group consisting of breeder and students of majoring in animal husbandrygets77.71 percent of an average value (categorized good), and the third respondents group consisting of students of majoring computer science gets82 percent of an average value (categorized very good).

Keywords**:** *Android, Certainty Factor, CF method, Chicken Disease, Expert System.*

1. INTRODUCTION

According to data from Directorate General of Livestock and Animal Health Ministry of Agriculture in 2015, the type of free-range chicken, chicken laying and broiler are the most populated livestock that managed by entrepreneurs or breeders in Indonesia. In the history of poultry in Indonesia, raising chickens in the dry season, rainy season, and transition season are very exhausting for breeders. Because of that seasons, the possibility of a disease will attack the chickens will be higher.

In Lampung, the presence of veterinarians still very low when compared to the high population of poultry. Head of Department of Animal Husbandry and Animal Health Lampung Province, Dessy Desmaniar Romas said in 2014 they only had 40 veterinarians. From that amout, 12 people already have the status as civil servant (PNS). While 28 other people are still listed as 'Tenaga Harian Lepas' (THL).

The process of diagnosing a disease on livestock should be done by an expert in that field. However, the limited number and difficulty interacting with experts such as veterinarians, make most of breeders handle their own health problems and diseases of livestock. Lack of knowledge about how to handle the disease on livestock, may result breeders make mistakes in diagnosis and give medicine to animals that are sick. Therefore, it takes an expert system that is able to diagnose the disease in poultry with the knowledge that comes directly from the experts.

Application of expert systems can represent an expert to solve the problems. With these applications, knowledge of expert can be stored indefinitely. In addition, the expert system can also increase productivity, save time in resolving the problem, simplification solutions for complex and repetitive cases. Implementation of expert system can be constructed in various forms, such as based on web or mobile.

In this era, the development of technology is developing very rapidly, such as the development of the Operation System (OS) Android on the phone. According to data from Waiwai Marketing, the number of Android users in Indonesia reached 94 percent while users of other OS such as iOS (iPhone OS) is only about 6 percent. This indicates that Android platform is the most widely used in Indonesian society. In addition, Android can be utilized in the process of implementation of an expert system application because of Android is an open platform for developers to create many applications.

2. LITERATURE REVIEW

Expert System

An expert system is a branch of Artificial Intelligence (AI) that was developed in the mid 1960. The expert system is derived from the term knowledge-based expert system, a system that uses human knowledge where knowledge is inserted into the computer and then used to solve the problems that usually requires the expertise or human expertise [1].

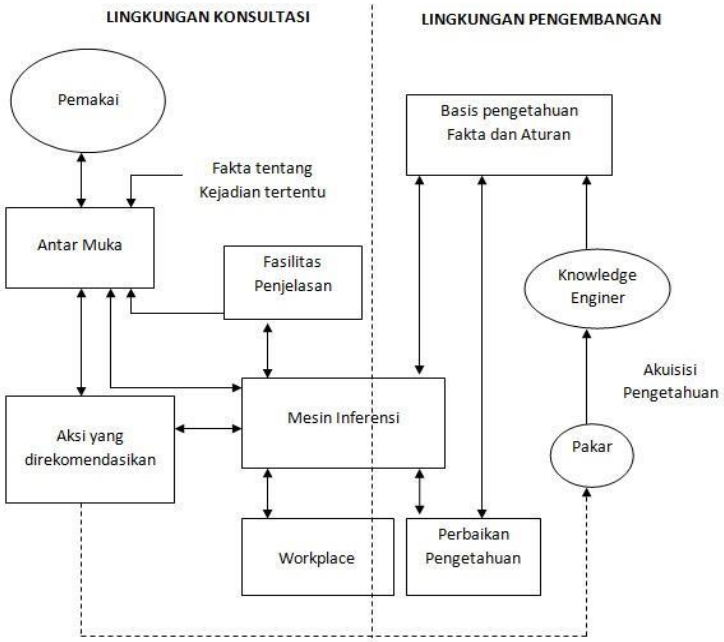

Figure 1 Expert System Architecture

Expert systems composed by two main parts, development environment and consultation environment. The development environment is used by manufacturers to build an expert system components and introducing knowledge into the knowledge base. The consultation environment is used by the user to consult so that users get the knowledge and advice of an expert system like a consultation with an expert [2]. The components of the expert system can be seen in Figure 1.

Diseases in Chicken

In general, the disease in poultry may be brought about by two causes [4], namely:

1. Causes of living (Living agent), such as: Microorganisms (microbes) such as bacteria, viruses, fungi, rickettsial, protozoan one-celled animals. Worms such as round worms, flat, and tapeworms and the species of insects such as ticks, flies, and others.
2. The cause is not alive (Nonliving agent), such as high or low temperature stress, chemical poisoning or vegetable, food deficiency and excess food element.

According Tabbu (2015) [3], in general there are 10 types of disease in chickens caused by bacteria, as shown in Table 1.

Table 1 Data Chicken Diseases Causing Bacteria

No	Name of Diseases	Type of Diseases	Name of Bacteria
1	*Infectious coryza* (snot)		*Haemophilus paragallinarum*
2	*Fowl cholera* (kolera unggas)		*Pasteurella multocida*
3	*Kolibasilosis*	Kematian embrio, infeksi *Yolk Sac*, dan *Omfalitis*	*Escherichia coli*
		Koliseptisemia	
4	*Salmonelosis*	*Pulorum*	*Salmonella*
		Fowl typhoid	
		Infeksi *paratifoid*	
		Arizonosis	
5	*Klostridial*	*Enteritis ulseratifa*	*Clostridium sp.*
		Enteritis nekrotikan	
		Dermatitis gangrenosa	
		Botulisme	
6	*Stafilokokosis*		*Staphylococcus aureus*
7	*Streptokokosis*		*Streptococcus sp.*
8	*Tuberculosis*		*Mycobacterium avium*
9	Infeksi *pseudomonas*		*Pseudomonas aeruginosa*
10	*Mikoplasmosis*	Infeksi*Mycoplasma gallisepticum* (CRD)	*Mycoplasma*
		Infeksi *Mycoplasma synoviae* (bentuk sinovitis)	
		Infeksi *Mycoplasma synoviae* (bentuk pernapasan)	

Certainty Factor

Certainty Factor (CF) theory proposed by Shortliffe and Buchanan in 1975 to accommodate the uncertainty of thought (inexact reasoning) from an expert. To accommodate this used to describe the level of confidence of experts on the matter at hand [1]. In expressing some degree of belief, certainty theory using a value called certainty factor to assume a degree of belief of an expert to the data. This concept was formulated in the basic formula in Equation (1) as follows.

$$\mathrm{CF}_{\mathrm{combine}}(\mathrm{CF}_1,\mathrm{CF}_2) = \begin{cases} CF1 + CF2(1 - CF1) & \text{Both } > 0 \\ \dfrac{CF1+CF2}{1-\min(|CF1|,|CF1|)} & \text{One of } < 0 \\ CF1 + CF2(1 + CF1) & \text{Both } > 0 \end{cases}$$

According Kusrini (2008) [4], there are two kinds of certainty factors, namely:

1. Certainty factor populated by experts with the rules.
2. Certainty factor provided by the user.

a. Getting the results of interviews with experts
That is by getting the results of interviews with experts concerned. Value of CF is obtained from interpretation of the "term" of experts to be value an MD / MB particular as shown in Table 2.

Table 2 Certain Term CF

Certain Term	MD/MB
Unknown	0.00 - 0.29
Maybe	0.30 - 0.49
Probably	0.50 - 0.69
Almost certainly	0.70 - 0.89
Definitely	0.90 - 1.00

b. Using the calculation method*'Net Belief*'
Certainty Factor indicates the size of belief to the fact of the rules.Certainty Factor notation shown in Equation (2), (3) and (4) as follows.

$$CF(H,E) = MB(H,E) - MD(H,E) \quad (2)$$

$$MB(H,E) = \begin{cases} 1 & P(H) = 1 \\ \dfrac{max\,(P[(H|E),P(H)]-P(H)}{\max[1,0]-P(H)} & \text{others} \end{cases} \quad (3)$$

$$MD(H,E) = \begin{cases} 1 & P(H) = 1 \\ \dfrac{min\,(P[(H|E),P(H)]-P(H)}{\min[1,0]-P(H)} & \text{others} \end{cases} \quad (4)$$

CF(H,E) = Certainty factorof the hypothesis H influenced by symptoms *(evidence)* E. The amount of CF ranges from 0 to 1
MB(H,E) = Measure of increased belief of the hypothesis H that are affected by the symptoms of E
MD(H,E) = Measure ofincreased disbelief of the hypothesis H that are affected by the symptoms of E
P(H) = The probability of the truth of the hypothesis H
P(H|E) = The probability that H is true because facts of E
H = Hypothesis (alleged)
E = Evidence (events or facts)

Android Operating System

Android is an operating system for *mobile devices* that was developed by Android Inc.This company purchased by Google in 2005. To develop Android formed a group called *Open Handset Alliance* (OHA), which is a combination of 34 companies hardware, software, and telecommunications, including Google, HTC, Intel, Motorola, Qualcomm, Tmobile, and Nvidia.Android is built using a modified Linux kernel 2.6.Android applications written in Java using *Java Core Libraries.*Android applications run on a VM called *Dalvik Virtual Machine.*Android provides an open *platform* for developers to create their own applications that can be used by a variety of propulsion devices [5]

3. METHODS

Time and Place of Research

This research was conducted at the Department of Computer Science Faculty of Mathematics and Natural Sciences and the Department of Animal Husbandry, Faculty of Agriculture, University of Lampung.The research was implemented during the second semester of the 2015/2016 Academic Year.

Support Tools

Support tools that used in this study are as follows:

A. Hardware
- ACER Aspire E1-431 laptopwith specifications*Processor Intel* (R) *Celeron* (R)CPU B820 @ 1.70 GHz, *Harddisk* 350 GB, RAM 2.00 GB.
- *Smartphone* Android (Lenovo A316i *Jelly Bean 4.2.2 version*).

B. Software
- Operating system Windows 7 32-bit.
- *Eclipse Luna* SDK, is used as framework of making an application.
- *Java Develoment Kid* (JDK),tools of Java programming language.
- *Android SDK (Software Development Kid,* tools of the development android programming.
- *Android Development Tool (ADT),* Plug-insare used to integrateinto the development environmenteclipseandroid.
- *SQLite Manager,* a software to create and access databases.
- *Microsoft Excel 2007*, is used to do calculation process with certainty factor method.
- *Photoshop CS4*, is used to design user interface system and to editpicture atributte.

Stage of Research

Stages of research are the steps that will be conducted by researchers in conducting research.The steps in this research include the identification of problems, problem formulation, data collection, system development, system testing and analysis of results.Stages of this research can be seen in Figure 2.

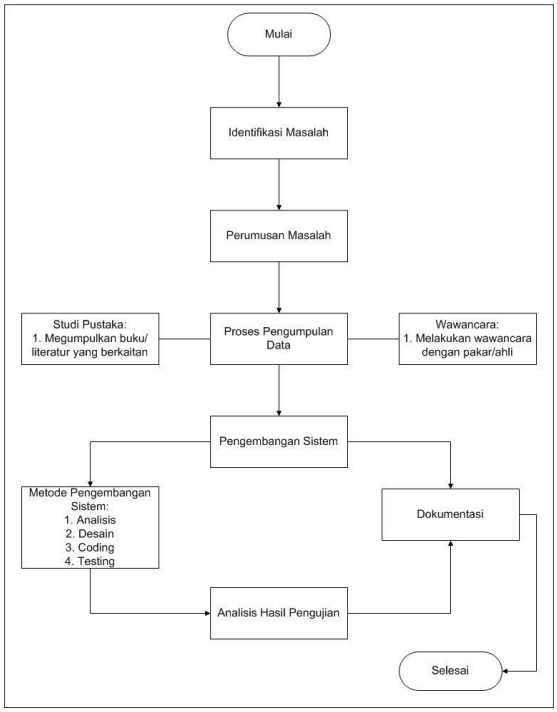

Figure 2 Stage of Research

Stage of Problem Formulation

This stage is the process of formulating and limiting the problem to be investigated.Formulation and restrictions of problem is needed in order to better guide the researchers in making the system so that the project is done not out of predetermined limits.

Stage of Data Collection

Stages of data collection is used by two methods: through literature and interviews.

a. Literature Review
   At this stage the data is collected through a variety of literature such as books, journals or documents relating to the research theme.
b. Interview
   In this method the process of interviewis done with experts / specialists.It aims to get the data that is not found in literature study method.Furthermore, the data that has been collected compiled into the rule base to be used in an expert system.

Stage of Systems Development

In this stage uses waterfallmethod consists of four stages as follows.

a. Software Requirements Analysis

In this process,do searchingsystem requirements.In building applications expert system based on android has been designed a use case model diagram to interpret the functions of the user interface. Design of use case diagram is shown in Figure 3.

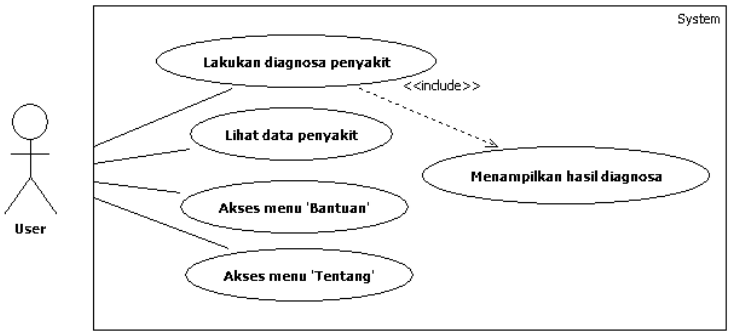

Figure 3 *Usecase Diagram*

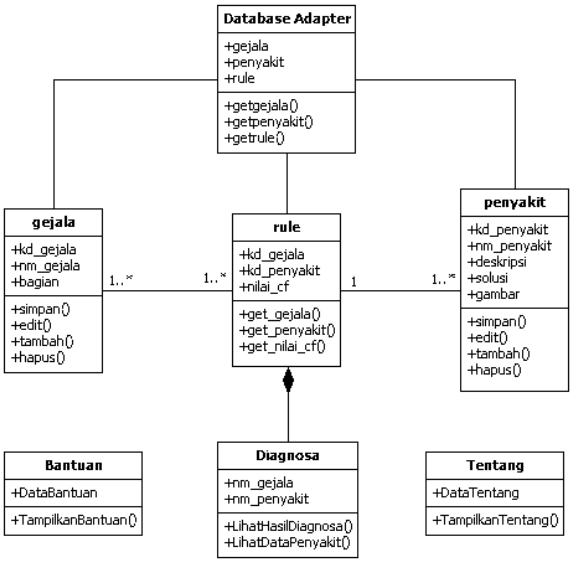

Figure 4 *Class Diagram*

In this process, system design where design is created to be able to implement the requirements mentioned in the previous stage.The design of system is made using UML (Unified Modeling Language).Design in this study used four models, namely flowcharts,class diagrams, sequence diagrams and activity diagrams.Model class diagram is shown in Figure 4.

b. Coding

The process of translating a design that has been designed into a language understood by the computer.In order to be understood by the machine, in this case is a computer, the design must be transformed into a programming language such as C, C ++, PHP, Java, or others.In this study, the system is built using android programming language which consists of the Java language and XML using the Eclipse framework.

c. Testing

After the coding process is completed, then is conducted the testing process using black box method.Black box testing is a test of the fundamental aspects of the system regardless of the internal logic structure of software.This process is done to make sure the system was created has worked in accordance with the specified conditions.

4. RESULT AND DISCUSSION

Analysis of Data Requirement

Data requirement on this expert system includes symptoms data and disease in chickens data caused by bacteria (bacterial). Information on symptoms and disease as well as treatment and prevention of chicken comes from the book“Penyakit Ayam dan Penanggulangannya” (Rangga Tabbu, 2015).In the literature there are 78 types of symptoms and 19 types of chicken diseases caused by bacteria.The name of the symptoms and diseases name on this expert system is coded as "G" for the symptoms data and "P" for the disease data.

Analysis Calculation of Precentage of Disease

Calculation of percentage of the expert system is built based on Certainty Factor (CF) using the formula in Equation (1).CF value in the equation obtained from an expert chicken diseases.
For example, a user selects some of the following symptoms:

1. Exudate becomes thick and malodorous (G3)
2. Eyelid redness (G5)
3. Eyes closed (G6)
4. Diarrhea (G10)

Table 3 The symptoms weight that selected by user

No	Possibility of Diseases	The Symptoms	Weight (CF Value)
1	Salmonelosis Pulorum shape (P5)	Diarrhea (G10)	0.95
2	Kolibasilosis Embryo shape (P3)	Diarrhea (G10)	0.9
3	Salmonelosis Infectious Paratifoid shape (P7)	Eyes closed (G6)	0.8
		Diarrhea (G10)	0.9
4	Infectious Coryza (P1)	Exudate becomes thick and malodorous (G3)	0.9
		Eyelid redness (G5)	0.7
		Eyes closed (G6)	0.7
		Diarrhea (G10)	0.6

1. Salmonelosis Pulorum shape (P5)

- Diarrhea (G10)
  Precentage = CF Value × 100%
  = 0.95×100% = 95%

2. Kolibasilosis Embryo shape(P3)

- Diarrhea (G10)
  Precentage = CF Value × 100%
  = 0.9×100% = 90%

3. Salmonelosis bentuk Infeksi Paratifoid (P7)

- Eyes closed (G6)
- Diarrhea (G10)

CF (P7,G6|G10) = CF(P7,G6) + (CF(P7,G10) × (1 – CF(P7,G6)))
= 0.8 + (0.9 × (1-0.8))
= 0.8 + (0.9 × 0.2) = 0.8 + 0.18 = 0.98
Precentage = CF Value × 100%
= 0.98×100% = 98%

4. Infectious Coryza (P1)

- Exudate becomes thick and malodorous (G3)
- Eyelid redness (G5)
- Eyes closed (G6)
- Diarrhea (G10)

CF (P1,G3|G5) = CF(P1,G3) + (CF (P1,G5) × (1 – CF(P1,G3)))
CF (A) = 0.9 + (0.7 × (1-0.9))
CF (A) = 0.9 + (0.7 × 0.1) = 0.9 + 0.07 = 0.97

CF (P1,A|G6) = CF(P1,A) + (CF(P1,G6) × (1 – CF(P1,A)))
CF (B) = 0.97 + (0.7 × (1-0.97))
CF (B) = 0.97 + (0.7 × 0.03) = 0.97 + 0.021 = 0.991

CF (P1,B|10) = CF(P1,B) + (CF(P1,G10) × (1 – CF(P1,B)))
CF (C) = 0.991 + (0.6 × (1-0.991))
CF (C) = 0.991 + (0.6 × 0.009) = 0.991 + 0.0054 = 0.9964

Precentage = CF Value × 100%
= 0.9964×100% = 99.64%

Based on above calculation example, get the conclusion that the *Infectious Coryza* diseases have the largest percentage is 99.64 per cent. According to *certain terms* in Table 2, it can be concluded that *Infectious Coryza* diseases have a level of belief "Definitely" and become the result of a diagnosis based on a choice of four symptoms.

Designing of Expert System For Diagnosing Chicken Diseases

There are some screenshots of expert system diagnosing chicken disease based on android which can be seen ini Figure 5.

Testing

This research uses two types of testing, namely internal testing and external testing.Internal testing conducted by researchers for functional test systems and test diagnosis of expert system based on the facts provided.

Functional Testing

Functional testing is used to find errors in the system that has been built.Functional testing in this study using Black Box Equivalence Partitioning (EP).This method is done by dividing the input domain (input) into classes so that the test casecan be obtained.The tests on this research is done by dividing class tests such as android version testing, screen resolution and density of the screen, user interface testing, and testing functions and the application menu.The process of functional testing is to get results as expected on the test scenarios in each test class.

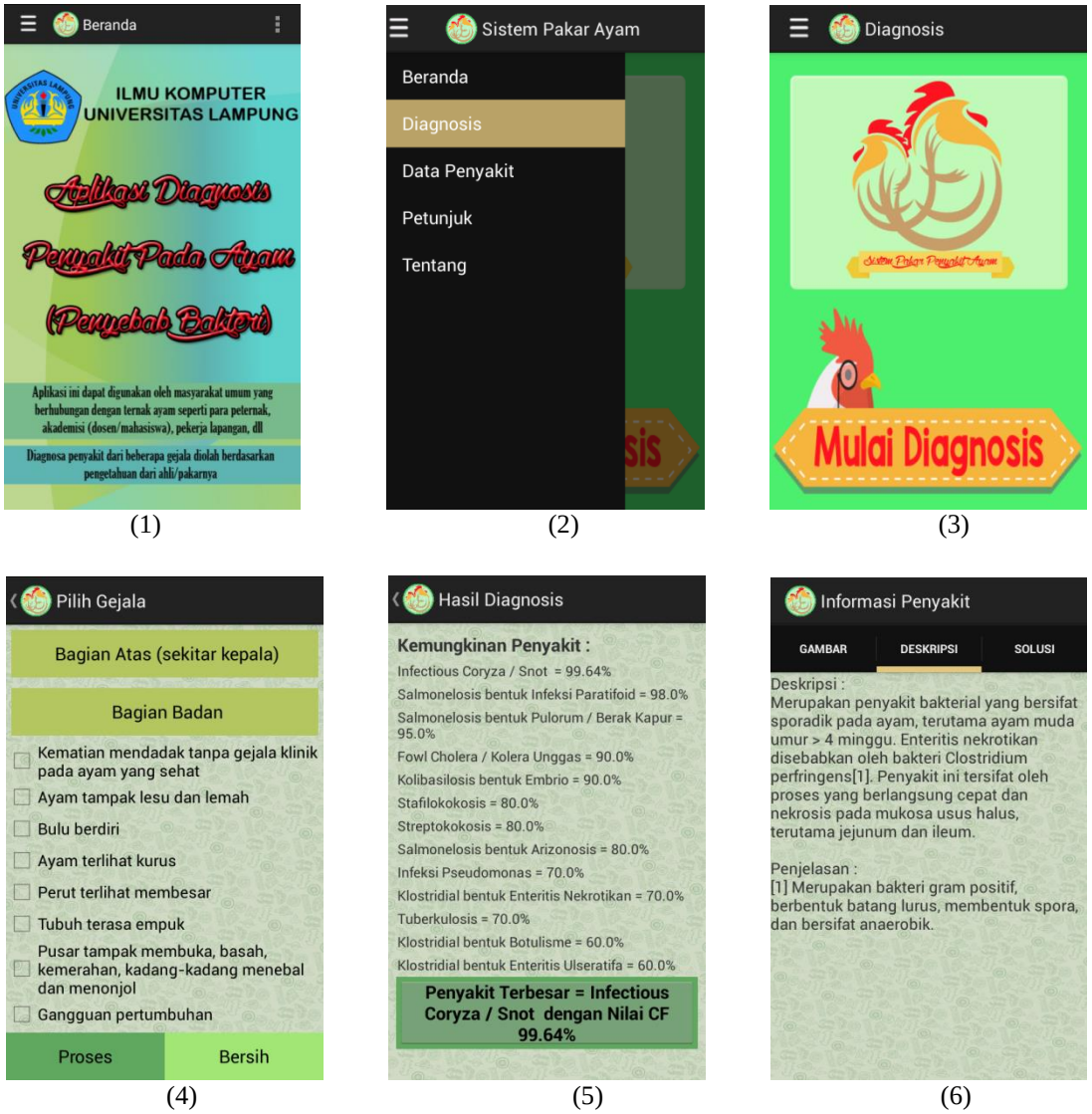

Figure 5 (1), (2), (3), (4), (5), (6)Screenshot of User Interface (UI) Expert System For Diagnosing Chicken Diseases

Diagnostic Testing

The test aims to see the diagnosis expert system capability in this application in diagnosing chicken disease cause by bacterial based on the facts that is given.The fact of this system in the form of selection of symptoms with a check mark. The tests conducted with 10 times of testing.The test results showed that the belief level of diseases diagnosing, either manually or on system get 99 per cent was appropriate and well-run.

External Testing

External testing is done by collecting questionnaires filled out by respondents were selected at random.Overall, the test was conducted by involving 31 respondents.In details 6 respondents of chicken disease experts consisting of veterinarians, professors, and civil servants.Five respondents are farmers/entrepreneurs of chickens livestock.Twenty respondents came from 10 students of Department of Animal Husbandry and 10 students from the Department of Computer Science.

From 31 respondents were divided into three groups of respondents;the first respondent group (chicken diseases expert), the second respondents group (breeders and students of Animal Husbandry), and the third respondent group (students of Computer Science).The purpose of grouping

these respondents is to compare assessment result of respondents between who understand about chicken diseases such as an experts (veterinary), who related directly to chicken diseases such as breeders and students of Animal Husbandry, and whodo not understand and related about chicken diseases such as Computer Science students.

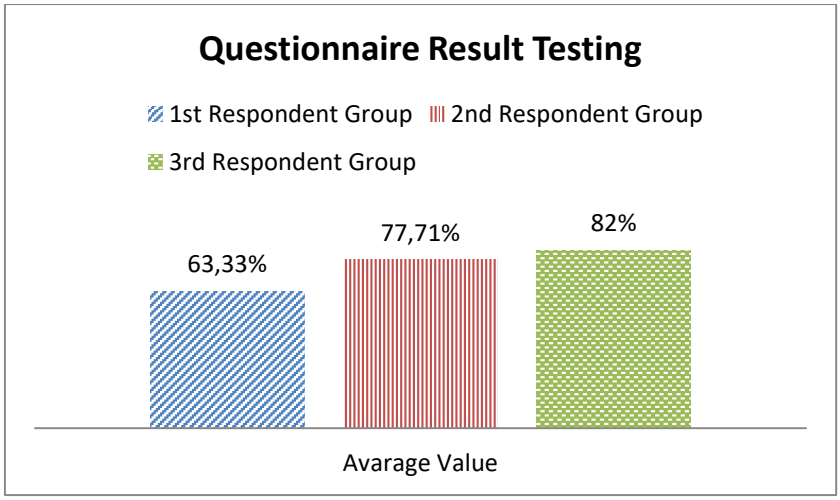

Figure 6 Average Value of Questionnaire Result Testing

Based on test results that have been calculated by the likert scale, is concluded that from 31 respondents, 6 peopleof the first respondent group gets 63.33 percent of average value.This shows that the assessment of the application by the respondents were aware of the chicken disease classified as 'Good'.

Fifteen people of the second respondent group gets 77.71 percent of average value.This shows that the assessment of the application by respondents relate directly to diseases of chicken are 'Good'.10 people of the third respondent group gets 82 percent of average value.This shows that the assessment of the application by respondents who do not understand and are not related to the disease chicken is 'Very Good'.

5. CONCLUSION

Based on research that has been done, it can be concluded:

1. Have successfully built the application'Pakar Ayam' based on Androidthat can help breeders, entrepreneurs or academics that associated with poultry in diagnosing disease problems chickens.
2. Expert systems are built can provide a percentage of the diagnosis of disease based on facts and knowledge that has been given.
3. Percentage of diagnostic results by using the calculation processCertainty Factor(CF) is very influenced on the value of CF that is given by experts.

REFERENCES

Sutojo, T., Edy M., dan Vincent S. 2011. *Kecerdasan Buatan*. Semarang: ANDI Yogyakarta.

Siswanto, 2010. *Kecerdasan Tiruan Edisi 2*. Yogyakarta: Graha Ilmu.

Rangga Tabbu, Charles. 2015. *Penyakit Ayam dan Penanggulangannya.* Yogyakarta: PT Kanisius.

Kusrini. 2008. *Sistem Pakar Teori dan Aplikasi*. Yogyakarta: Penerbit ANDI.

Komputer, Wahana. 2012. *Langkah Praktis Membangun Aplikasi Sederhana Platlayout Android*. Jakarta: PT Elex Media Komputindo.

COMPARISON EFFECTIVENESS OF ANTIOXIDANT ACTIVITY EXTRACT HERBAL MIXTURE OF SOURSOP LEAF *(Annona muricata)*, BAY LEAF *(Syzygium polyanthum)* AND PEGAGAN LEAF *(Centella asiatica)*

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ABSTRACT

Diabetes Mellitus (DM) is a degenerative disease that causes abnormal blood sugar levels are high in the body (WHO, 2010). Indonesia ranks seventh in the world as the country with the highest DM and Lampung became one of the provinces of 13 provinces with prevalence of diabetes mellitus (DM) on a national prevalence (MOH, 2013). The main problem in people with diabetes is high blood sugar levels and / or low insulin sensitivity which increase an oxidative stress levels in patient, then nutrition therapy into one of the early control of blood sugar levels. Herbs are rich in tannin and polyphenolic compounds which have effective efect as anti oxidant to improve metabolic glucose disorder and treatment for insulin sensitivity in DM. These herbs are being into alternative treatments that are often used in society. This study uses gotu kola leaf extract, soursop leaves, and the leaves to be tested effectiveness as an antioxidant that can affect blood sugar and oxidative stress conditions experienced by patients with DM.The highest yield was owned by either pegagan leaves in water and methanol extracts. The highest antioxidants activity was found in the leaves of the soursop with IC50 at the point of 0.99 mg/ml followed by a mixture of soursop bay extract 1.06 mg/ml, bay pegagan extract 1.08 mg/ml, soursop gotu kola 1.10 mg/ml, and pegagan 1.12 mg/ml. High effectiveness in inhibiting oxidative stress will improve the progression of glucose metabolic disorder due to metabolic disorders in patients with DM .

Keywords: antioxidant, herbal mixture, Soursop Leaf, Bay Leaf, Pegagan Leaf

1. INTRODUCTION

Diabetes mellitus is a degenerative disease that causes abnormal blood sugar levels are high in the body. According to data from the World Health Organitation (WHO) Indonesia ranks seventh in the world as the country with the highest number of people with diabetes mellitus (1). Lampung became one of the provinces of 13 provinces with prevalence of diabetes mellitus (DM) on a national prevalence (2). Type 2 diabetes mellitus (type 2 diabetes) or non-insulin dependent diabetes mellitus, the pancreas is still able to produce insulin, but because of the low sensitivity, insulin is not able to push the course of the metabolism of glucose (3, 4).

The main problem in people with diabetes is high blood sugar levels and/or low sensitivity to insulin which impact in oxidative stress level in DM patient, treatment for malnutrition conducted on patients with this disease aims to achieve and maintain blood sugar levels within the normal range, namely by balancing food intake with the availability or effectiveness of the use of insulin greatly influenced by food diasup (4, 23, 24). Method that taken to reduce the increase in blood sugar from diet, is inhibiting the hydrolysis of dietary carbohydrates by digestive enzymes in the small intestine (5). For this purpose drugs or herbs that have antioxidant acticity was used (5, 6, 7, 22). The enzyme α-amylase and α-glucosidase can be inhibited by tannin or polyphenols (8.9) which effectice as antioxidants. This compound is found in many plants used as traditional medicine or herbal medicine antidiabetic (10, 21).

Some studies show the herb has properties that are big in health with various active ingredients therein. Plant herbs such as bay leaves useful as an alternative to the prevention of the rise in blood sugar levels in patients with diabetes mellitus (11, 23). Active substance has effectiveness as antienzimatis involved in various metabolic processes and antioxidants. The advantage of using these herbs for the prevention and treatment of diabetes, among others, is a low dose of active ingredient

that can be consumed routinely and safely but have more efficacy as active component content is varied. To maximize the efficacy of the herbal plants, mixing is a step that can be done. But you need to know in advance whether the incorporation of herbs produces a synergistic effect or even antagonists (11, 12, 13, 14).

This study uses pegagan leaf *(Centella asiatica)*, soursop leaves *(Annona muricata)*, and the bay leaves *(Syzygium polyanthum)* to be tested effectiveness as an antioxidant that can affect blood sugar and oxidative stress conditions experienced by patients with DM. Leaves of the soursop *(Annona muricata)*, soursop leaves *(Annona muricata)*, and leaves pegagan *(Centella asiatica)* are herb that has been frequently used by means of boiling or in extract form and used as an herb for certain health problems. Herbs are rich in tannin and polyphenols, which are often used by the people of Indonesia as an antidiabetic include soursop leaf and bay leaves (9, 13). Pegagan leaf, bay and soursop is a herbal plant that has long been used as a medicinal plant. The basic photochemical screen soursop leaves *(Annona muricata)* revealed its contain saponins, glycosides, tannins and flavonoids (9, 11, 13) are effective to help treat diabetes and gastric disorders (12). Chemical constituents found in bay leaves are saponins, triterpenoids, flavonoids (quercetin, quercitrin, myrcetin and myrcitrin), polyphenols, alkaloids, tannins and essential oil (methyl kavikol and eugenol), sesquiterpene, lactones, phenols, steroids, sitral, lactones and carbohydrates (16). Pegagan leaf contains compounds called polyphenols are tannins (17) which is effective as an antioxidant that helps reduce oxidative stress caused by metabolic disorders in patients with DM. Herbal decoction more easily applied in the community compared to the use of extracts, but the quality of higher active ingredient in herbal extracts (16, 18).

This study was conducted to test the effectiveness of antioxidant activity of a mixture made from leaves, betel leaves and gotu kola leaves that can be used to lower blood sugar and oxidant activity levels. Although there is no information on the efficacy of these leaves for the treatment of diabetes, but the leaf is a herb that is widely used by people in a mix of traditional medicine and antioxidants (19, 20). Thus mixing pegagan leaves, soursop leaf and bay leaves is expected to increase the efficacy of these plants.

Synergistic or antagonistic effects of this mixture is very important information when the herbal plants will be developed as a drug or a functional food that is as guidelines for the preparation of antidiabetic prescription or formula. The results of this study is possible to develop a more nutritious concoction and have good organoleptic quality by mixing various herbs that antidiabetic efficacy and taste together.

2. MATERIALS AND METHODS

Material

Soursop leaves, bay leaves and pegagan leaves collected from various local traditional markets in the area of Bandar Lampung. Soursop leaves, bay leaves and pegagan leaves soon after collected, washed with water, cut into pieces and dried. , Drying by means of dried air the more effective to get the drying to a moisture content range of 12% and does not interfere with the content of the active compound. All the dry ingredients are pulverized using a grinder to produce a coarse powder.

To determine an antidiabetic activity of used enzyme α-amylase (α-amylase porcin) and the enzyme α-glucosidase (from Saccharomyces cerevisiae). The tools used in this study is a shaker bath for the maceration process.

Extraction

Powdered herbs respectively, gotu kola leaves, soursop leaf and bay leaves, weighed as much as 20 grams of water and then added to obtain a final volume of 200 ml. Furthermore boiled for 2 hours, after 2 hours added 200 ml of water again and continue boiling for another 2 hours. After completion filtered and proceed with the process of freeze-drying to obtain freeze-drying results in the form of crystals. maceration performed for 24 hours. After the water is evaporated and estrak obtained are considered extract 100%.

Antioxidant Activity

Antioxidant activity with DPPH scavenging measured by the method microplate reader spectrophotometer.

Statistic analysis

Experiments in the first year arranged in a complete randomized block design (RAKL) each with three replications. Data obtained from all stages of the research will be tested by analysis of variance to obtain variance estimators errors and differences between treatments. Data were analyzed with a statistical program SPSS version 21. Furthermore, the data in further testing with the smallest real difference on the real level 1 and 5%.

3. RESULTS AND DISCUSSION

Tannins and flavonoids in the leaves of the soursop, greetings, and gotu kola included in the phenol compounds having an aromatic ring containing hydroxy groups, carboxyl, methoxy and also a ring structure is not aromatic. Tannins can form a stable crosslinking with proteins and other biopolymers such as cellulose and pectin. When bound to proteins, tannin is a strong inhibitor of the enzyme that is not easily degraded (12, 16,18, 20). The active ingredient of this plant aakan inhibit hydrolysis of carbohydrate food and digestive enzymes in the small intestine by inhibiting the enzyme α-amylase and α-glucosidase (6.7, 22).

All extract (single or combined) which contains tannins and polyphenols inhibit the activity of antioxidant that can inhibit the enzyme α-amylase and α-glucosidase.

The extraction of soursop leaves, greetings and gotu kola

The extraction is done using two methods, the use of water and maceration with methanol. First method using hot water as the solvent extracts, so that the content of phenols, tannins, especially in the preparation of leaves can be extracted. Such compounds have properties easily soluble in polar or semi-polar solvents. Hot solvent temperature (above 90^0 C), can increase ekstrakbilitas compounds in the leaves. The yield of the extract, presented in Table 1.

The second method, preparations soursop leaves, greetings and gotu kola is extracted by maceration using methanol. This simple method can be used to extract natural ingredient components in the sample that are not resistant to heating (thermolabile) so that damage to the components can be avoided. The yield of the extract, presented in Table 1.

Tabel 1. Rendemen Soursop Leaf *(Annona muricata)* , Bay Leaf *(Syzygium polyanthum)* and Pegagan Leaf *(Centella asiatica)*

Types of leaves	Extraction Method					
	Water			Methanol		
	Weight of powder simplisia (gram)	Weight of extract thick (gram)	Rendemen (%)	Weight of powder simplisia (gram)	Weight of extract thick (gram)	Rendemen (%)
Soursop leaf	50	6,205	12,41%	50	11,047	22,094%
Bay leaf	50	1,39	2,78	50	14,881	29,762%
Pegagan leaf	46	7,76	16,87	50	15,61	31,2%

The antioxidant activity

In patients with diabetes found elevated levels of free radicals due to disruption of metabolic processes cellular and molecular occur due to increased blood sugar levels, so that the tendency to cause oxidative stress which triggers pathogenicity further complication of DM. Thus the need for

intake of antioxidants include phenolic content is quite effective to suppress improvement free radical or oxidative stress levels that occurs in patients with type 2 diabetes is.

The test results show that the antioxidant activity of the antioxidant activity of the extracts from the mean, either single or mixed, at a dose of 1.5 mg / ml ranged between 70.37% - 79.07%. Lowest extract IC50 value, either mix or single, is owned by the leaves of the soursop, ie by 0.99 mg / ml. This means soursop leaf extract has the highest antioxidant activity than other extracts. Nevertheless, the results of ANOVA test against a mean IC50 extract, either single or mixed, showed no significant difference ($p > 0.05$). Full results of the ANOVA test are presented in Table 2.

Tabel 2. Results of ANOVA test IC50 of various extracts from the inhibitory activity of antioxidant

		N	Rerata IC_{50} ± SD	p value
Types of leaves	Bay leaf	3	1,08 ± 0,03	0,298
	Soursop	3	0,99 ± 0,16	
	Pegagan	3	1,12 ± 0,02	
	Soursop+Bay	3	1,06 ± 0,02	
	Soursop+Pegagan	3	1,10 ± 0,01	
	Bay+Pegagan	3	1,08 ± 0,01	

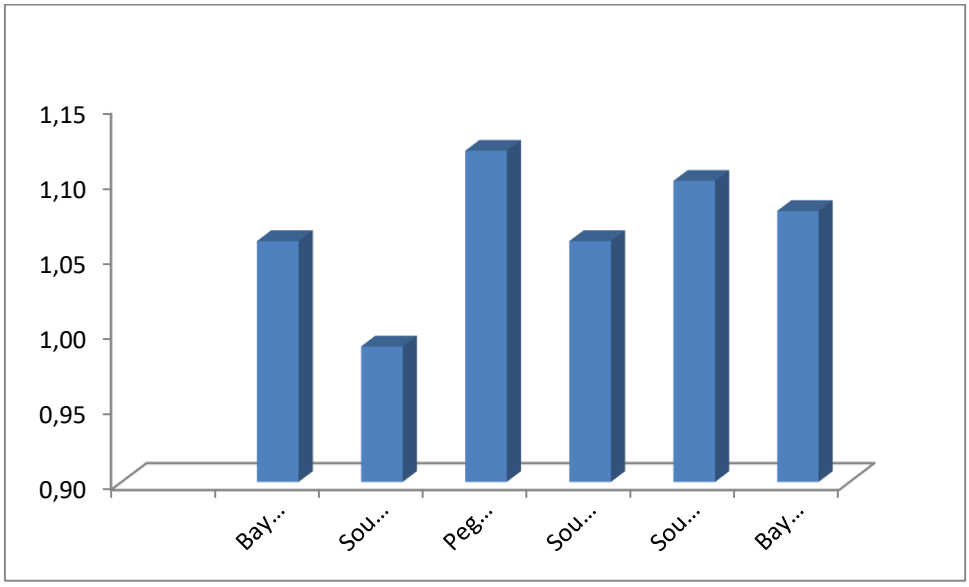

Figure 1. Effect of herbal plant extracts as antioxidants. Si, Sa and P is soursop, bay and pegagan. The remainder, SIP and SAP are a combination of Si and Sa, Si and P, Sa and P. box shows the average of three replications. Data points using serajat significance with p value <0.05.

4. CONCLUSION

Recovery rate of most high-owned by Indian pennywort leaves either the extract water and methanol, while the activity of the highest antioxidant owned by the extract of leaves of the soursop, followed by extracts of soursop leaf + greetings, bay leaf, bay leaves + gotu kola, soursop leaf + gotu kola and gotu kola leaves. Effectiveness of the highest antioxidant found in the leaves of the soursop with IC50

at the point of 0.99 mg / ml followed by a mixture of 1.06 soursop greetings, greetings gotu kola 1.08, 1.08 greetings, soursop gotu kola 1.10, and 1.12 mg gotu kola / ml.

REFERENCE

1. **I**DF. 2012. UN Resolution 61/225. http://www.idf.org/diabetesatlas/un-resolution. Diunduh Maret 2012.
2. Depkes RI. 2013. Riset Kesehatan Dasar 2013. Jakarta: Badan Penelitian dan Pengembangan Kementrian Kesehatan RI.
3. Kim SH, Reaven GM. Insulin resistance and hyperinsulinemia: you can't have one without the other. Diabetes Care. 2008; 31:1433–1438. [PubMed: 18594063]
4. Anderson JW. 2006. Diabetes Mellitus: Medical Nutrition Therapy. In Modern Nutrition in Health and Disease Tenth Edition. Shils ME (Ed.). Lippincott Williams & Wilkins.Philadelpia. Page1043-1066.
5. Chang CLT, Lin Y, Bartolome AP, Chen YC, Chiu SC, Yang WC. 2013. Herbal Therapies for Type 2 Diabetes Mellitus: Chemistry, Biology, and Potential Application of Selected Plants and Compounds. Evidence-Based Complementary and Alternative Medicine. Volume 2013, Article ID 378657, 33 pages.
6. Kim JS, Kwon CS, Son KH. Inhibition of Alpha-glucosidase and Amylase by Luteolin, a Flavonoid. *Biosci, Biotechnol, Biochem*. (2000) 64:2458-2461.
7. Xiao Z, Storms R, Tsang A. 2006. A quantitative starch-iodine method for measuring alpha-amylase and glucoamylase activities. Anal Biochem. 1(1):146-148.
8. Abdullahi, S and Olatunji, GA. 2010. Antidiabetic Activity of Anacardium Occidentale in Allozan-Diabetic Rats. *Journal of Science and Technology, Vol. 30, No. 3, pp* 35
9. Munir KM, Chandrasekaran S, Gao F, Quon MJ. 2013. Mechanisms for food polyphenols to ameliorate insulin resistance and endothelial dysfunction: therapeutic implications for diabetes and its cardiovascular complications. Am J Physiol Endocrinol Metab. 305(6):E679-86.
10. Bothon FTD, Debiton E, Avlessi F, Forestler C, Teulade JC, Sohounhloue DKC. 2013. In vitro biological effects of two anti-diabetic medicinal plants used in Benin as folk medicine. Complementary and Alternative Medicine 2013, 13:51. http://www.biomedcentral.com/1472-6882/13/51
11. Che CT, Wang ZJ, Chow MSS, Lam CWK. 2013. Herb-Herb Combination for Therapeutic Enhancement and Advancement: Theory, Practice and Future Perspectives. *Molecules. 18*, 5125-5141
12. Pidrayanti U (2009), Pengaruh Pemberian Daun Salam (Rugenia polyantha) terhadap Kadar LDL kolesetrol serum tikus jantan galur Wistar Hiperlipidemia. Universitas Diponegoro
13. Parera, PK and Li. 2012. Functional herbal food ingredients used in type 2 diabetes mellitus. Pharmacogn Rev. 6(11): 37–45.
14. Badan Pengawas Obat dan Makanan. Kandungan kimia sembilan tanaman obat unggulan. [Online]. 2004 [cited 2007 Feb 10];[1 screen]. Available from: URL:http://www.beritabumi.or.id
15. World Health Organization. Research guidelines for evaluating the safety and efficacy of herbal medicine. Manila: World Health Organization Regional Office for the Western Pacific. 1993 : 35.
16. Situmorang, Rimbun. 2013. "Perbedaan Perubahan Kadar Trigliserida Setelah Pemberian Ekstrak dan Rebusan Daun Salam (*Eugenia polyantha*) Pada Tikus *Sprague Dawley* yang Diberi Pakan Tinggi Lemak". *Skripsi*. Semarang : Fakultas Kedokteran, Universitas Diponegoro.

17. Syifaiyah B. (2008). Pengaruh pemberian ekstrak daun pegagan (centela asiatika) terhadap kadar SGOT dan SGPT hati mencit yang diinduksi dengan paracetamol. Skripsi. Universitas Islam Negeri Malang.

18. Murhadi, dkk. 2007. "Aktivitas Antibakteri Ekstrak Daun Salam (*Syzygium polyantha*) dan Daun Pandan (*Pandanus amaryllifolius*)". *Jurnal*. Jurnal Teknologi dan Industri Pangan Vol. XVIII No. 1.

19. Kim, G.S, et all. 1998. Muricoreacin and Murihexoxin C, Mono-tetrahydrofuran Acetogenins, School of pharmacy and Pharmacal sciences. Page 2.

20. Luciana, A.R, 2010. Acetogenins from Annona cornifolia and their antioxidant capacity. Departemento de quimica, Instituto Ciencias Exatas, Unversidade Federal de Minas Gerais. M.G, Brazil. Page 2.

21. Rao RR, Tiwari AK, Reddy PP, Babu KS, Ali AZ, Madhusudana K, Rao JM. 2009. New furanoflavonoids, intestinal α-glucosidase inhibitory and free radical [DPPH) scavenging, activity from antihyperglycemic root extract of Derris indica (Lam). Bioorg Med Chem. 17:5170–5175.

22. Xiao Z, Storms R, Tsang A. 2006. A quantitative starch-iodine method for measuring alpha-amylase and glucoamylase activities. Anal Biochem. 1(1):146-148.

23. Zhang DW, Fu M, Gao SH, Liu JL. 2013. Curcumin and Diabetes: A Systematic Review. Evid Based Complement Alternat Med. 2013;2013:636053. Epub 2013 Nov 24.

24. Giacco and Brownlee. 2010. Oxidative Stress and Diabetic Complications. Circulation Research. **2010;** 107: **1058-1070** doi: 10.1161

THE UTILIZATION OF ISOLATE *Bacillus thuringiensis* TO GRAYAK LARVAE PEST *(Spodoptera litura* Fab.) ON CABBAGE (*Brassica oleraceae* var. capitata Linn.).

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ABSTRACT

Isolate *B. thuringiensis* was isolated from the soil in Kopeng, Magelang. The isolate was characterized; the cell morphological, the colony, the gram staining, the spores formation, and the crystal protein of the isolate were identified and then classified as the member of *B. thuringiensis*. The purposes of this research are to isolate *B. thuringiensis* from soil sample, to test the pathogenic effect of *B. thuringiensis* on *S. litura* larvae, and to make a sustainable living bio-insecticide powder. The test result showed that the isolate can cause 20-100% mortality after 48 hours. There are only 8 isolates of *B. thuringiensis* (K_4, K_6, K_8, K_{12}, K_{14}, W_5, S_3, dan S_{10}) that can cause more than 50% mortality of *S. litura* larvae with concentration 1,5 x 10^7 spores/ml. One of the isolates, K_{14}, was special because it creased 100% of *S. litura* larvae for 24 hours. Therefore, isolate K_{14} is selected to be the substance for sustainable living bio-insecticide, and patented number P00201603458.

Keywords: *Bacillus thuringiensis, Spodoptera litura*, *Brassica oleraceae*.

1. INTRODUCTION

Cabbage is one of people's favorite vegetable. It contains vitamin, mineral, protein, carbohydrate, and fat to help the formation of human body's tissue and to increase the energy for human's muscle activity. The vitamins contained in the cabbage are Vitamin A, vitamin B, vitamin C, and mineral such as calcium, phosphor, iron, and sulphur.

One of the obstacle for Indonesian cabbage farmer is pest attack from *Spodoptera litura*. This pest can cause severe damage on cabbage. It eats cabbage crop to the growth point until the formation of crop is obstructed even stopped. The damage can decrease the harvests to 100% (Kalshoven, 1981).
The common control effort of *S. litura* larvae until now is using chemical insecticide (Suharto, 2004). The continuous usage of chemical insecticide can inflict negative impacts in health and agriculture, such as pest resistance, pest resurgence, secondary pest explosion, and pollution to the environment that is accumulated in plants so it can be dangerous to be consumed by human and other animals (Ahmad dan Hussain, 2002).

The worries of negative impact in chemical insecticide usage as a disease vector and pest controller has increased society's concern to use natural enemies (Regam, 1992). The role of this natural enemies is primly as predator, parasite, and pathogen depends on suitable pest's growth phase. Biological control does not intend to vanish pest, but to let pest exist in no harm number.

A pathogen that can control *S. litura* larvae is *Bacillus thuringiensis*. The main character of *B. thuringiensis* is the ability to produce crystal protein toxin (δ-endotoxin) which can paralyze digestive tract of larvae (Baum & Malvar, 1995). In Khetan (2001), strain *B. thuringiensis* have excellent characters, such as (a) have specific host, (b) no harm for natural enemies of the pest and non-target organism, (c) biodegradable by the environment, and (d) the pathogenic can be increased by genetic engineering. Therefore, *B. thuringiensis* has been chosen many times as an alternative bio-insecticide and produce in industrial level (Aizawa *et al.,* 1975).

Strain *B. thuringiensis* can be isolated from many sources, such as soil and water (Situmorang, 1993) with high population from insects that have been infected in the field. In Indonesia nowadays,

microbial insecticide with *B. thuringiensis* as a basic material has been revolved, there are *Thuricide, Dipel, Bactospeine* (Rukmana, 1994). The effort to isolate *B. thuringiensis* from Indonesian field is very important because each region has to face many pest attacks along with the different controls problem. The development of microbial insecticide that utilize *B. thuringiensis* in Indonesia is the important beginning to start sustainable living.

The purposes of this research are to isolate *B. thuringiensis* from soil sample, to test the pathogenic effect of *B. thuringiensis* to *S. litura* larvae, and to make a sustainable living bio-insecticide powder.

2. METHODS

Materials and Tools

Materials for this research are isolated *B. thuringiensis*, *S. litura* larvae Instar III as tested insect, cabbage, selective media Nutrient Agar (NA), Nutrient Broth (NB), gram stain, sterile distilled water, honey, and alcohol. Tools for this research are confinement screen with measurement 25 x 25 x 25 cm, jam bottle, autoclave, microscope, laminar air flow, analytical weigher, water bath, hemocytometer, glass tools, micropipette, loopful, and hand counter.

Soil Sampling

The isolation of *B. thuringiensis* utilized from collected soil of cabbage, carrot, mustard, and chili farm in Kopeng, Magelang. Soil sample taken as 50 grams.

Isolation of *B. thuringiensis*.

The method to isolate *B. thuringiensis* was Ohba dan Aizawa (1986). Suspension of 10^{-3} dilution was inoculated to the medium nutrient agar and incubated for 48 hours, then the characterization was performed along with the refinement to obtain the isolate *B. thuringiensis.* The form and color of the colonies observed visually, the spores and crystal protein of *B. thuringiensis* were checked by gram staining.

Multiplication of *S. litura*

S. litura larvae as tested insect was collected from cabbage farmer in Kopeng. Multiplication was done by rearing at Laboratorium Teknobio Lingkungan, Universitas Atma Jaya Yogyakarta. Larvae was fed with cabbage, while the imago was fed with mixture of honey and water. Stadia of larvae for this research is Instar III.

Pathogenicity Test

The ability of *B. thuringiensis* to kill *S. litura* was tested with Ohba *et al.* (1981) method by manufacturing the inoculums. Calculation of the number of spore was done by taking the diluted suspension with ringer solution by 100 times (10^{-2}). Haemocytometer used in this research has 0,0025 mm^3 broad and 0,1 mm depth, so the volume for each box is 0,00025 mm^2. Spore calculation was done on five sight view of microscope with 400 times magnification. The number of spores can be calculated with the formula below:

$$X = \frac{n}{0{,}0025\ mm^2} = \frac{400}{1\ mm^2} = \frac{4\ x\ 10^6 n}{ml}$$

Description:
X = number of spores per millimeter of suspension
n = average number of spores calculated on each box

Based on concentration, suspension was made with some dilution so that the concentration is 1,5 x 10^2 of spores/ml with volume 20 ml for each isolate. Then the suspension of *B. thuringiensis* is ready to be used in ability test to kill *S. litura* larvae.

The feeding treatment applied was Hamilton & Atia (1976) method with a leaf dipped method then it was enacted to the tested insect inside the jam bottle. The treatment repeated three times for each isolate, observed for 48 hours.

Preservation Technique of *B. thuringiensis* with Freeze Drying

The culture of pure isolate *B. thuringiensis* on agar slant harvested after 7 days old. The culture suspended in medium with 7.5% glucose broth medium as many as 0.2 ml. The suspension transferred into sterilized ampoule, and then ampoule covered with flannel. Ampoule was put into centrifuge for the freeze drying process. The final result of freeze drying is water content ranges 1-2%.

Bio-insecticide Production

Ampoule of isolate *B. thuringiensis* was put into capsule. Capsule packed into bottle. This bio-insecticide manufacture is ready to be signed for patent.

3. RESULT AND DISCUSSION

Isolate *Bacillus thuringiensis*

Based on observation results on characteristic of morphology, colonies, cells, and gram staining, 35 isolates were obtained as *B. thuringiensis*. The isolates showed the morphology as irregular form, have grainy, flat, and a bit shiny surface, the color is cream. Vegetative cell has bacillus shape with sub terminal spores. Along with the formation of spores, crystal protein also formed. The crystal protein just formed after 48 hours inoculation.

Pathogenecity Test of *B. thuringiensis* on *S. litura* larvae

Inoculum for this test was used 7 days old isolates. At this age, nutrition on the plate had been estimated ran out so that stationer phase was reached. At stationer phase, bacteria will form spores and crystal protein which were toxic for insects. The number of spores and crystal protein expected to be optimum from 7 days old cultures.

The test result of 35 isolates *B. thuringiensis* on *S. litura* larvae instar III showed that the isolate can cause 20-100% mortality after 48 hours. There are only 8 isolates of *B. thuringiensis* (K_4, K_6, K_8, K_{12}, K_{14}, W_5, S_3, dan S_{10}) that can cause more than 50% mortality of *S. litura* larvae, while others cause less than 50% of mortality even after 48 hours (Table 1).

Common symptoms of *S. litura* larvae which treated with *B. thuringiensis* are weak movement, less responsive to stimulus, and appetite decrease. Larvae's bodies become softer but undamaged until death. The dead larvae produce rotten smell before dry out. The infected larvae instar III form yarn to cover it's body but failed to form pupa, even some succeed, the shape and color is not normal.

The mortality of the larvae depends on the number of *B. turingensis* spores that has been sprayed. To cause the disease, the number of *B. turingiensis* spores depends on kind of pathogen and host. The number of consumed *B. turingiensis* spores also determine the time needed to kill. This related to activity of bacteria in digestive track, which include spores and crystal protein formation.

In Estela *et al.* (2004), dissolved crystal protein by protease enzyme in midgut will turn to toxic fragments. This toxic fragments cause leakage on midgut epithelium. This leakage lead to disturbed cell permeability so the transportation of K, Na, dan Ca ions were interrupted.

The infected larvae showed motionless behavior. Initial symptoms after *B. thuringiensis* consumption are less active, slow motion, and feed activity decrease. This symptoms suit Poinar and Thomas (1982) theory, that digestive track is the first organ attacked by bacteria. This symptoms related to feed behavior and metabolism activity.

Table 1. Average of Mortality Percentage of *S. litura* Larvae Treated with Isolate *B. thuringiensis*

No.	Isolate Code	Concentration Spore/ml	Mortality Percentage (%)	
			24 Hours	48 Hours
1.	K_1	1.5×10^7	20	0
2.	K_2	1.5×10^7	20	20
3.	K_3	1.5×10^7	40	0
4.	K_4	1.5×10^7	60	20
5.	K_5	1.5×10^7	40	40
6.	K_6	1.5×10^7	60	40
7.	K_7	1.5×10^7	20	0
8.	K_8	1.5×10^7	80	0
9	K_9	1.5×10^7	20	20
10.	K_{10}	1.5×10^7	20	40
11.	K_{11}	1.5×10^7	20	20
12.	K_{12}	1.5×10^7	60	20
13.	K_{13}	1.5×10^7	20	20
14.	K_{14}	1.5×10^7	100*	0
15.	K_{15}	1.5×10^7	20	20
16.	W_1	1.5×10^7	20	40
17.	W_2	1.5×10^7	40	40
18.	W_3	1.5×10^7	40	40
19.	W_4	1.5×10^7	20	40
20.	W_5	1.5×10^7	60	20
21.	W_6	1.5×10^7	20	0
22.	S_1	1.5×10^7	40	20
23.	S_2	1.5×10^7	20	20
24.	S_3	1.5×10^7	60	20
25.	S_4	1.5×10^7	20	0
26.	S_5	1.5×10^7	40	40
27.	S_6	1.5×10^7	40	20
28.	S_7	1.5×10^7	20	20
29.	S_8	1.5×10^7	40	0
30.	S_9	1.5×10^7	20	40
31.	S_{10}	1.5×10^7	80	0
32.	S_{11}	1.5×10^7	20	20
33.	S_{12}	1.5×10^7	40	40
34.	C_1	1.5×10^7	40	40
35.	C_2	1.5×10^7	20	40

The result of 100% mortality percentage and 24 hours killing the *S. litura* larvae are isolate K14. Isolate K_{14} was selected, multiplied, and was preserved with *Freeze Drying* method. According to Bahagiawati (2002) the success of *B. thuingiensis* strain isolation can be the guarantee to get decent Bt biopesticide which can be used by the farmers. In order to be commercialized the strain must be produced massively. Besides, the right formula and the good performance in the field are needed. Isolate K_{14} has been chosen as the base material to make eco-friendly biopesticides and patented number P00201603458.

4. CONCLUSION AND SUGGESTION

Conclusion

1. The isolation of entomopathogenic bacteria from soil samples in Kopeng, Magelang is 35 *B. thuringiensis* isolates in result which are characterized by the stem cells, the oval spores and the protein crystals.

2. There are 8 isolates of *B. thuringiensis* (K_4, K_6, K_8, K_{12}, K_{14}, W_5, S_3, dan S_{10}) that showed larvicide activity on *S. litura* larvae based on pathogenicity test.
3. Isolate K14 have become sustainable living bio-insecticide and patended with No. P00201603458.

Suggestion

1. Every found isolate that has been proved can kill *S. litura* larvae needs to be studied more on molecular level.
2. Filed test of bio-insecticide isolate K14 on summer and spring need to be done.

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REFERENCES

Ahmad, S. & Z. Hussain. 2002. Enthomophatogenic Nematodes Associated with Soil Types and Vegetation Cover in Potwar Region of Pakistan. *Pakistan Journal of Biological Sciences.* 5(6):640-642.

Aizawa, K.N. Fujiyoshi, M. Ogba & N. Yoshikawam. 1975. Selection and Utilization of *Bacillus thuringiensis* Strain of Microbial Control. *Poc. 1st International Conggres of IAMS.* 2:597-606.

Bahagiawati, A. 2002. Penggunaan *Bacillus thuringiensis* sebagai Bioinsektisida. *Buletin AgroBio*. 5(1):21-28.

Baum, J.A. & T. Malvar. 1995. Regulation of Insectidal Crystal Protein Production in *Bacillus thuringiensis. Molecular Microbiology*. 18:1-12.

Estela, A., B. Escriche., & J. Ferre. 2004. Interraction of *Bacillus thuringiensis* Toxin with Larvae Midgut Binding Sites of *Helicoverpa armigera* (Lepidoptera:Noctuidae). *Applied Environmental Microbial.* 70:1378-1384.

Hamilton, J.T. & F.J. Attia. 1976. Effects of Mixtures of *Bacillus thuringiensis* and Pesticide on *Plutella xylostella* and the parasite Thyracella collaris. *Journal Economic Enthomology*. 70:106-114.

Kalshoven, L.E.G. 1981. *The Pest of Crops in Indonesian*. Translated by P.A. van der Lann. P.T. Iktiar Baru Van Houve. Jakarta.

Khetan, S.K., 2001. *Microbial Pest Control*. Marcel Dekker, Inc. USA.

Ohba, M., K. Ono, K., Aizawa., & S. Iwanami. 1981. Two New Subspecies of *B. thuringiensis* Isolated in Japan. *B. thuringiensis* subspecies kumamotoensis (serotype 18) and B. thuringiensis subspecies tochigiensis(serotype 19). *Journal of Invertebrate Pathology*. 38:194-190.

Ohba, M. & K. Aizawa, 1986. Distribution of Bacillus thuringiensis in Soil of Japan. *Journal of Invertebrate Phatology*. 37:277-282.

Pionar, G.O. & G.M. Thomas., 1982. *Dianostic Manual for the Identification of Insect Pathogen.* Plenum Press. New York.

Regam, S. 1992. Biological Control: A Consumer Perspective. *Proceding of the Biological Control.* International conference on Plant Protection in the Tropics. Malaysia.

Situmorang, J. 1993. Isolasi Bakteri Tanah Entomopatogenik (Bacillus spp.) di Daerah Istimewa Yogyakarta dan Uji Patogenisitasnya terhadap Ulat Grayak *Spodoptera litura* (Fab). *Berkala Ilmiah Biologi*. 1(6):253-262.

Suharto, 2004. Patogenicity of *Beauveria bassiana* Isolates on *Plutella xylostella. Jurnal Perlindungan Tanaman Indonesia.* 10 (2): 8-12.

LEG AMPUTATION OF TIMOR DEER

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ABSTRACT

Legs, as locomotor organs, is the most important for the deer to move, especially when in danger and threatened. In the breeding season, often happen a chase or a fight, so the legs injury is a posible. The examination found that the right tarsal bones were broken seen sticking out through the skin as well as the visible presence of pus and necrosis. The fractures that occur are handled by means of fixation using spalk, unable to carry the weight of a deer's body, causing broken bones injure the skin. The amputation of dextra tarsometatarsus under the general anaesthesi and ring block anaesthesi, by cutting the tarsal bones in the proximal areas of necrosis. The healing proces and good adaptability, making the doe can live a normal life and even able to reproduce within one year post-surgery,by given birth to a healthy child doe. Good adaptability makes the doe can live a normal life and be able to reproduce normally.

Keywords: Timor deer, fracture, amputations, adaptibility, give birth

1. INTRODUCTION

Legs, as locomotor organs, is the most important for the deer to move, especially when in danger and threatened. In the breeding season, often happen a chase or a fight, so the legs injury is a posibilty.

Field Case

A brown female Timor deer (*Cervus timorensis*) with 2 years old, and about 30 kg, suffered a broken leg as a result of pinched fence at the moment will be mating by stag. She has been treated by spalk fixation, but one month post-treatment occurs swelling and visible bones protruding.

The broken of leg

Treated by spalk fixation

The leg post spalk fixation

2. CLINICAL EXAMINATION

Pulsus 188 bpm, frequency of breathing 40 times per minute and a rectal temperature 37,6^{0}C. From the results of the examination found that the right tarsal bones were broken seen sticking out through the skin as well as the visible presence of pus and necrosis. The fractures that occur are handled by means of fixation using spalk, unable to carry the weight of a deer's body, causing broken bones injure the skin. Improper handling and less hygienic cages lead to bacterial infection in the wound, so that the distal part of the leg fracture decay.

	
The broken bones injure the skin of leg	The broken bones sticking out through the skin, presence of pus and necrose

3. TREATMENT AND RESULT

Based on data of clinical examination, the doe was diagnosed complex fractures of dextra tarsometatarsus, with a dubious prognosis. The process of necrosis longstanding and complexity of the fractures, makes it difficult to do the pin bones, so it was decided to amputation of the leg. The amputation of dextra tarsometatarsus under the general anaesthesi and ring block anaesthesi, by cutting the tarsal bones in the proximal areas of necrosis. The necrotic tissue and the broken tarsal bone discarded, then some skin clenched as cover.

The doe treatment by injectable antibiotic, pain killer and vitamin. Postoperative wound care is done by the spraying local drug and systemic oral medications by inserting the drugs into a banana, then fed to the deer for 10 days. The process of adaptation and recovery of this doe run pretty well, so that within three months, the doe accustomed with three normal locomotor. The healing proces and good adaptability, making the doe can live a normal life and even able to reproduce within one year post-surgery,by given birth to a healthy child doe.

		
The amputation of tarsometatarsus	Bandaged of the amputated leg	Post operatif care

		
The doe with three normal locomotors	The doe with normal activity	Give the healthy baby doe

4. CONCLUSION

Complex fracture on deer can be treated with amputation. Good adaptability makes the doe can live a normal life and be able to reproduce normally.

REFERENCE

Santosa S.I, *Rusa Timorensis, Dari Hewan Konservasi menjadi Hewan Ternak Menuju Budidaya*, 2011, Graha Ilmu, Semarang

Knecht, C.D et al. *Foundamental Techniques In Veterinary Surgery*, 3th edition. WB Saunders Company, Philadelphia

Sardjana, I.K.W and Kusumawati, D, 2004. *Veterinary Anesthesia*, Volume 1. Press Gadjah Mada University, Yogyakarta.

Musabine, E.S, 2014. *Akhirnya kaki depan hariamu sumatra bernama elsa harus diamputasi*, http://ernisuyantimedikkonservasi.blogspot.com/2014/04/akhirnya-kaki-depan-seekor-harimau.html.

Anonymus, 2005. *Deer Anatomy*, http://www.deerhunting.ws/deeranatomy.htm

IDENTIFICATION OF THE SUMATRAN RHINO FOOD PLANTS IN WAY KAMBAS NATIONAL PARK LAMPUNG

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ABSTRACT

The research has purposed identify Sumatran rhino (Dicerorhinus sumatrensis) food plants in the Way Kambas National Park. Rhino's food samples were collected from following Sumatran rhinos daily activities in the SRS area including palatability of rhino's food, following SRS's rhino food collector which was collected rhino food supply from national park natural forest location and surrounding WKNP's villages location and WKNP's ranger including RPU team was collected sign rhino food plant in the natural WKNP habitat in 2004 – 2012. The result in this study was founded 60 families with 150 genus and 211 species of rhino browse (food) in the Way Kambas National Park Lampung. Rhino food base on genus is rubiaceae 13, annonaceae 9, euphorbiaceae 9, anacardiaceae 7, myrtaceae 7, apocynaceae 5, fabaceae 5, burseraceae 4, guttiferae/hypericacea 4, lauraceae 4, papilionaceae 4, combretaceae 3, menispermaceae 3, sapindaceae 3 and verberaceae 3. Rhino food base on species is moraceae 26 (2 genus), rubiaceae 20 (13 genus), euphorbiaceae 18 (9 genus), anacardiaceae 10 (7 genus), annonaceae 10 (9 genus), myrtaceae 9 (7 genus), guttiferae/hypericacea 8 (4 genus), apocynaceae 6 (5 genus), burseraceae 5 (4 genus), dilleniaceae 5 (3 genus), fabaceae 5 (5 genus), lauraceae 4 (4 genus), and papilionaceae 4 (4 genus). Rhino food base on Palatability (from top to down) is akar merah (Musaendra frondosa L), akar jitan (Strophantus caudatus), ara lebar (Ficus elastica), pulai (Alstonia scholaris), mahang (Macaranga triloba), sirihan (Piper retrofractum), kasapan (Croton caudatus Geissel), keputihan (Clibadium surinaraense), torop (Artocarpus elasticus), akar mencret (Merremia peltata/macrophyllus), cakar elang (Gardenia sp), sulangkar (Leea indica Merr.), waru (Macaranga trichocarpa Muell. Arg.), lemok (Artocarpus rigidus Blume), jambuan (Crypteronia cumingii Endl.), luwingan (Ficus hispida), soka (Ixora sp), akar manis (Urceola javanica (Blume) Boerl.), nangka (Artocarpus heterophilus), kopen (Baccaurea javanica (Blume) M. A.), anggrung (Tetracera scandens Merr.), terentang (Buchanania sessifolia Blume.), and paku andam (Selaginella sp). Rhino Food plants information is essential and important to manage rhino husbandry for the survival in the future including reference for habitat management and prepare rhino food garden.

Keywords: Sumatran rhino, Way Kambas National Park

1. INTRODUCTION

Way Kambas National Park (WKNP) located in East Lampung, Lampung province is among the protected areas and natural habitat for several endangered large mammal in Indonesia (critically endangered - APPENDIX I CITES) such as the Sumatran tiger (*Panthera Tigris sumatrae*), Sumatran rhinoceros (*Dicerorhinus sumatrensis*), Sumatran elephant (*Elephas maximus sumatranus*) and others wildlife (Dephut, 2006; IUCN, 2015).

The Sumatran rhinoceros (*Dicerorhinus sumatrensis*) is the smallest living member of the family Rhinocerotidae and is considered browser feeding on a great variety of plant species (van Strien, 1985). The population of Sumatran rhino has declined from year to year and based on the Sumatran Rhino Crisis Summit in Singapore in 2013, the Asian Rhino Range State Meeting in Lampung in 2013 and PHVA Bogor in 2015, the population of Sumatran rhino believed only about 100 individuals in the world including rhinos that exist outside their natural habitat (7 in SRS Way Kambas and 3 in BORA Sabah Malaysia), especially in WKNP does not occur drastic population decline with estimated about 30 wild rhino (WKNP, 2015; PVA, 2015). Sumatran rhino population was reduced in the world because of habitat destruction, poaching, disease factors and possibly also generic factors (inbreeding Depression). To date only remaining Sumatran rhino population in three conservation areas in Bukit Barisan Selatan National Park, Way Kambas National Park and Gunung Leuser National Park.

Sumatran rhino breeding is very difficult and unique, including in the captive or semi-captive situation. Since the Sumatran Rhino Sanctuary (SRS) was established in 1998, has on June 23, 2012 SRS produce a calf (Andatu). Andatu is the world's fourth calf born in captive or semi captive after Andalas, Suci and Harapan and Andatu is the first born since 124 years ago in Asia. The other rhino (Delilah) was born again in the SRS from the same parent in 2016. One of the key for this success is good rhino foods or browse for rhinos in the SRS. Currently food supply of rhino SRS collected from natural national park forests and surrounding WKNP's villages.

SRS existence brings a little hope for Sumatran rhino survivals in addition to their natural habitat conditions are uncertain. SRS tried to produce a more rhino calf with goal is produce as many offspring as safely possible and as insurance for Sumatran rhinoceros survival in future. Compared with rhino sanctuary in Sabah (BORA Tabin), SRS WKNP is the most conducive and enabling for the successful breeding of Sumatran rhinos because availability of healthy males and females for the pair and natural habitat conditions are still good, however to sustainable food supply for seven (7) rhino with just 100 ha habitat is not enough.

Rhino food

Availability and adequacy of rhino food quality is the main factor that should receive attention in the Sumatran rhino conservation in Way Kambas. The number of Sumatran rhino's dead animals in captivity is generally due to indigestion caused by unavailability of good feed for Sumatran rhino.

Goal for this study is identification rhino food plant of the Sumatran rhino in WKNP.

2. MATERIAL AND METHOD

Rhino food plant samples were collected from following Sumatran rhinos daily activities in the SRS area including palatability of rhino's food, following SRS's rhino food collector which was collected rhino food supply from national park natural forest location and surrounding WKNP's villages location and WKNP's ranger icluding RPU team was collected sign rhino food plant in the natural WKNP habitat in 2004 – 2012. Then the sample is made herbarium, further samples were sent to a laboratory reference (LIPI) to be Latin name identified.

3. RESULT AND DISCUSSION

The result in this study was founded 60 families with 150 genus and 211 species of rhino browse (food) in the Way Kambas National Park Lampung.

Rhino food base on genus is rubiaceae 13, annonaceae 9, euphorbiaceae 9, anacardiaceae 7, myrtaceae 7, apocynaceae 5, fabaceae 5, burseraceae 4, guttiferae/hypericacea 4, lauraceae 4, papilionaceae 4, combretaceae 3, menispermaceae 3, sapindaceae 3 and verberaceae 3. This result looks same with Lee (1993) study, the most common plants the rhino eats are many species from the Euphorbiaceae, Rubiaceae, and Melastomataceae families. The most common species the rhino consumes is Eugenia.

Rhino food base on species is moraceae 26 (2 genus), rubiaceae 20 (13 genus), euphorbiaceae 18 (9 genus), anacardiaceae 10 (7 genus), annonaceae 10 (9 genus), myrtaceae 9 (7 genus), guttiferae/hypericacea 8 (4 genus), apocynaceae 6 (5 genus), burseraceae 5 (4 genus), dilleniaceae 5 (3 genus), fabaceae 5 (5 genus), lauraceae 4 (4 genus), and papilionaceae 4 (4 genus).

Rhino food base on Palatability (from top to down) is akar merah (*Musaendra frondosa* L), akar jitan (*Strophantus caudatus*), ara lebar (*Ficus elastica*), pulai (*Alstonia scholaris*), mahang (*Macaranga triloba*), sirihan (*Piper retrofractum*), kasapan (*Croton caudatus* Geissel), keputihan (*Clibadium surinaraense*), torop (*Artocarpus elasticus*), akar mencret (*Merremia peltata/macrophyllus*), cakar elang (Gardenia sp), sulangkar (*Leea indica* Merr.), waru (*Macaranga trichocarpa* Muell. Arg.), lemok (*Artocarpus rigidus* Blume), jambuan (*Crypteronia cumingii* Endl.), luwingan (*Ficus hispida*),

soka (*Ixora sp*), akar manis (*Urceola javanica* (Blume) Boerl.), nangka (*Artocarpus heterophilus*), kopen (*Baccaurea javanica* (Blume) M. A.), anggrung (*Tetracera scandens* Merr.), terentang (*Buchanania sessifolia* Blume.), and paku andam (*Selaginella sp*). Palatablity is the most preferred food which is consumed more frequently than others routinely and some time rhino eaten for short term requirements of plant for natural remedy herbs.

The previous rhino's food study in WKNP was identification 82 food plants (48 saplings, 17 lianas, 9 seedlings and 8 trees) observed, 79 were able to be identified. Leaves and trunk (73 species), roots (18 species), fruit (11 species) and flower (1 species) as parts of plants have been eaten (Suharto *et al.*, 2005). Otherwise, Candra *et al.*, (2012), more than 100 browse varieties have been recorded in the diet of captive rhinoceroses at the SRS WKNP, and 8 to 10 varieties are routinely fed on a daily basis. The number of plant species which is about 150 Sumatran rhino species (Strain, 1985).

The Sumatran rhino feeds before nightfall and in the early morning. Much of the day is spent in wallows. Sumatran rhinos are solitary animals that are browsers where the rhino requires young fresh tropical forest plants to their food source by exploring forest every day. The consumption each rhino in SRS average 50 kg leaves and 5 kg fruits per day base on 10% of body weight.

Generally rhino's browse is bushes or shrubs, trees (leaves and twigs) and fruits including tubers. This is looks same with Groves (1972), the Sumatran rhino is a browser, with a diet of young saplings, leaves, twigs, bark, fruit, smaller shrubs, canes and vines. The rhinos usually consume up to 50 kg of food a day (Van Strien, 2005). Primarily by measuring dung samples, researchers have identified more than 100 food species consumed by the Sumatran rhinoceros. The largest portion of the diet is tree saplings with a trunk diameter of 1–6 cm (Van Strien, 2005). Sumatran rhino are like salt very much (lick soil, mud, water wallow, old three, sand, etc) and visits salt licks regularly. However rhino food plant have content good nutrition base on proximate analysis but in the same leaves there have content anti nutrition also such as tanin, saponin, fitat acid, etc. This is interesting behavior of rhino browse strategy, to reduce or neutralized the anti nutrition they are just eat food plant in small contents or portion daily but very high variety of plant which namely "browse" (van Strien, Nico, 2005). The Sumatran rhino species is a browser, feeding on a wide variety of plant material in their tropical habitat as they are an opportunistic feeder. Rhino as herbivores maintain their food habit by maintaining the ecological food in the rainforest, that way rhino need good and broad habitat to survive, if deforestation occurs will be big problem for the rhino.

The sad story about Sumatran rhino rescue program during 1985-1992 which 18 rhino was captured and send to captive program. Unfortunately just one rhino (Bina) survive to date, 17 rhino was dead with different cause. One of the causes is digestive problem because not good feeding quality. Sumatran Rhinoceros in the Sumatran Rhino Sanctuary (SRS) require rhino food plant supply like leaves and fruits from outside of sanctuary area. Location of SRS which only 100 ha insufficient to fulfill feed requirement of rhinos naturally because not all locations is used, some locations applied for rotation area. Rhino food plant (browse) supply is very important for the long term health and reproduction of SRS's rhinos.

One alternative to supply rhino feeding is to create a plantation (garden) specifically planted rhino Sumatran such as shrubs and trees and even fruit, so it is expected feed requirements can continue to be fulfilled in a sustainable manner or continuously and of course safe for rhinos. Local fruits that have collected from outside SRS have skinned and only the inner part fed to the rhinos (i.e. the water melon rind has cut off the melon prior to feeding to the rhinos). Vet is quality control of rhino's foods safety.

Tabel 1. Identification rhino browse in the Way Kambas National Park *Lampung*

No	Family		Local Name	Latin name (Species)	Part rhino eat	Type
1	Anacardiaceae	1	Jambu Mete	*Anacardium occidentale L.*	Daun	Pohon
2	Anacardiaceae	2	Raman	*Bouea burmanika/appositifolia*	Buah	Pohon
3	Anacardiaceae	3	Gandaria	*Bouea macrophylla Griff.*	Buah	Pohon
4	Anacardiaceae	4	Terentang	*Buchanania sessifolia Blume.*	Batang, daun	Pohon
5	Anacardiaceae	5	Rau	*Dracontomelon mangiferum*	Buah	Pohon
6	Anacardiaceae	6	Rengas	*Gluta renghas* L	Daun	Pohon
7	Anacardiaceae	7	Kemang	*Mangifera caesia*	Buah, daun	Pohon
8	Anacardiaceae	8	Mangga	*Mangifera sp/indica*	Buah	Pohon
9	Anacardiaceae	9	Pakel	*Mangifera spp*	Buah	Pohon
10	Anacardiaceae	10	Kedondong Hutan	*Spondias pinnata* Kurz	Buah	Pohon
11	Annonaceae	1	NN	*Alphonsea sp*	Batang, daun	Pohon
12	Annonaceae	2	Akar Larak	*Artabotrys suaveolens Blume*	Batang, daun	Liana
13	Annonaceae	3	Kenanga	*Cananga odorata*	Daun	Pohon
14	Annonaceae	4	Akar Sunar	*Friesodielsia sp.*	Batang, daun	Liana
15	Annonaceae	5	NN	*Mitrephora sp*	Daun	Pohon
16	Annonaceae	6	Sirsak	*Oxymitra sp*	Daun	Pohon
17	Annonaceae	7	Banitan	*Polyalthia lateriflora* (Miq.) King	Batang, daun	Pohon
18	Annonaceae	8	Karai	*Polyalthia rumphii* Merr.	Batang, daun, akar	Liana
19	Annonaceae	9	Pepisang	*Uvaria littoralis* Blume	Batang, daun, akar	Liana
20	Annonaceae	10	Antui/jangkang	*Xylopia malayana* Hook. f. et. Th.	Batang, daun, akar	Liana
21	Apocynaceae	1	Pulai Hitam	*Alstonia angustiloba*	Batang, daun	pohon
22	Apocynaceae	2	Pulai	*Alstonia scholaris*	Batang, daun	pohon
23	Apocynaceae	3	Sarsaparilla	*Ichnocarpus frutescens* R. Br.	Batang, daun	Pohon
24	Apocynaceae	4	Akar Jitan	*Strophantus caudatus*	Batang, daun	Liana
25	Apocynaceae	5	Akar Manis	*Urceola javanica* (Blume) Boerl.	Batang, daun	Liana
26	Apocynaceae	6	Cembirit/Karetan	*Voacanga grandifolia* (Miq.) Rolfe	Daun	pohon
27	Araceae	1	Akar Tampel	*Rhaphidophora sp.*	Daun, batang	Liana
28	Asteraceae/Compositae	1	Keputihan	*Clibadium surinaraense*	Daun, batang	Semak
29	Asteraceae/Compositae	2	Ki Rinyuh	*Eupatorium inulaefolium* H. B. K.	Batang, daun	Semak
30	Bignoniaceae	1	Kayu Lanang	*Oraxylum indicum* (L.) Kurz.	Daun	Pohon
31	Burseraceae	1	Kenari	*Canarium commune*	Daun, pucuk	Pohon
32	Burseraceae	2	Mentru sengir	*Canarium denticulatum*	Daun, pucuk	Pohon
33	Burseraceae	3	Kandisan	*Dacryodes rostrata* (Blume) H. J. Lam	Batang, daun	Pohon
34	Burseraceae	4	Asem-asem	*Santiria cf. tomentosa Blume*	Batang, daun	Pohon
35	Burseraceae	5	NN	*Scutinanthe brunnea*	Daun	Pohon
36	Caesalpiniaceae	1	Johar	*Cassia javanica/siamea*	Daun, pucuk	Pohon
37	Caesalpiniaceae	2	Menggris	*Koompasia malaccensis* Maing	Daun	Pancang
38	Celastraceae	1	Perupuk	*Lophopetalum multinervium* Ridley	Batang, daun	Pohon
39	Celastraceae	2	Akar pelanduk	*Salacia chinensis* Linn.	Batang, daun, akar	Liana
40	Celastraceae	3	Manggong	*Salacia oblongifolia* Blume	Batang, daun	Sapling
41	Combretaceae	1	Akar Kuningan	*Combretum cf. tetralophum* Clarke	Batang, daun	Liana
42	Combretaceae	2	Teluntum	*Lumnitzera sp*	Daun	Pohon
43	Combretaceae	3	Akar Dani	*Quisqualis indica* L.	Batang, daun, akar	Liana
44	Connaraceae	1	NN	*Agelaea trinervis Merr.*	Batang, daun, akar	Pohon
45	Connaraceae	2	Akar Gung	*Connarus monocarpus* L.	Batang, daun	Liana
46	Connaraceae	3	Akar ladaan	*Connarus sp.*	Batang, daun, akar	Liana
47	Convovulaceae	1	Kacangan	*Argyreia mollis* Choisy	Batang, daun	Liana
48	Convovulaceae	2	Akar Mencret/ulan	*Merremia peltata/macrophyllus*	Batang, daun	Liana
49	Crypteroniaceae	1	Jambuan	*Crypteronia cumingii* Endl.	Daun	Pohon
50	Dilleniaceae	1	Sempu Air	*Dillenia excelsa* (Jack) Mart.	Daun	Pohon
51	Dilleniaceae	2	Sempu Putih	*Dillenia grandifolia*	Daun	Pohon
52	Dilleniaceae	3	Akar Boh	*Tetracera akara*	Daun	Liana
53	Dilleniaceae	4	NN	*Tetracera macrophylla*	Daun	Pohon
54	Dilleniaceae	5	Anggrung	*Tetracera scandens* Merr.	Batang, daun	Pohon
55	Dipterocarpaceae	1	Minyak	*Dipterocarpus caudiferus* Merr.	Daun, pucuk, kulit	Pohon
56	Dipterocarpaceae	2	Meranti merah	*Shorea leprosula*	Batang, daun	Pohon
57	Dipterocarpaceae	3	Meranti	*Shorea sp*	Batang, daun	Pohon
58	Ebenaceae	1	Serutan	*Diospiros buxifolia* (Blume) Hiern.	Batang, daun	Pohon
59	Elaeocarpaceae	1	Ganitri	*Elaeocarpus sphaericus K. Sch.*	Batang, daun	Pohon
60	Euphorbiaceae	1	Mericaan	*Antidesma montanum* Blume	Daun	Pohon
61	Euphorbiaceae	2	Plangas	*Antidesma neurocarpum* Miq.	Daun, pucuk	Pohon
62	Euphorbiaceae	3	Teluntum, kisapi	*Antidesma stipulare* Blume	Batang, daun	Pohon
63	Euphorbiaceae	4	Meniran	*Antidesma tetrandrum*	Daun	Pohon
64	Euphorbiaceae	5	Rambai-rambai	*Aporosa frutescens Blume*	Daun, buah	Pohon
65	Euphorbiaceae	6	Berasan	*Aporosa nervosa*	Daun	Pohon
66	Euphorbiaceae	7	Kopen d besar/rawa	*Baccaurea javanica* (Blume) M. A.	Daun, buah	Pohon
67	Euphorbiaceae	8	Bolawah	*Baccaurea pyriformis* Gage	Batang, daun	Pohon
68	Euphorbiaceae	9	Kokosan/kepundung	*Baccaurea racemosa* (Reinw. Ex Blume) Muell. Ar	Buah	Pohon
69	Euphorbiaceae	10	Joho	*Baccaurea sumatrana* Muell. Ars.	Daun, pucuk	Tiang

No	Family		Local Name	Latin name (Species)	Part rhino eat	Type
71	Euphorbiaceae	12	Kelandri	*Bradleia hirsuta* Roxb	Daun	Pohon
72	Euphorbiaceae	13	Landri	*Breynia Virgata* (Blume) Muell. Arg.	Batang, daun	Pohon
73	Euphorbiaceae	14	Kasapan	*Croton caudatus* Geissel	Batang, daun	Semak
74	Euphorbiaceae	15	Pohon Ling/Rois	*Glochidion rubrum* Blume	Daun	Pohon
75	Euphorbiaceae	16	Waru	*Macaranga trichocarpa Muell. Arg.*	Batang, daun	Pohon
76	Euphorbiaceae	17	Mahang Hijau	*Macaranga triloba*	Daun	Pohon
77	Euphorbiaceae	18	Ladaan Pohon	*Mallotus subpeltatus* (Blume) Muell. Arg	Daun	Pohon
78	Fabaceae	1	Jalingan	*Archidendron sp.*	Daun	Pohon
79	Fabaceae	2	Kaliandra	*Calliandra*	Daun	Pohon
80	Fabaceae	3	Akar Doloan	*Centhrosema pubescens* Benth	Batang, daun	Liana

No	Family		Local Name	Latin name (Species)	Part rhino eat	Type
141	Moraceae	26	Kiara	*Ficus sp.*	Daun, batang	Pohon
142	Myrsinaceae	1	NN	*Embelia viridiflora* Scheff.	Daun	Pohon
143	Myrsinaceae	2	NN	*Maesa perlarius* (Lour.) Merr.	Batang, daun	Pohon
144	Myrsinaceae	3	Akar Katu	*Maesa ramentacea* Wall.	Batang, daun	Liana
145	Myrtaceae	1	Salam Sayur	*Acmena acuminatissima* (Blume) Merr. & Perry	Daun	Pohon
146	Myrtaceae	2	Cengkehan	*Eugenia sp*	Daun	Pohon
147	Myrtaceae	3	Gelam	*Melaleuca cajuputi*	Daun	Pohon
148	Myrtaceae	4	Jambu Biji	*Psidium guajava L.*	Daun, buah	Pohon
149	Myrtaceae	5	NN	*Pternandra caerulescens Jack*	Daun	Pohon
150	Myrtaceae	6	Tiga Urat 1	*Rhodamnia cinerea* Jack.	Daun	Pohon
151	Myrtaceae	7	Salam	*Syzigium polyanthum*	Daun	Pohon
152	Myrtaceae	8	Jambon	*Syzigium sp / Eugenia sp*	Daun, pucuk	Pohon
153	Myrtaceae	9	Salaman	*Syzygium sp.*	Batang, daun	Pohon
154	Oleaceae	1	NN	*Chionanthus nitens K. et V.*	Daun	Pohon
155	Oleaceae	2	Melati Hutan	*Jasminum multiflorum*	Daun	Semak
156	Papilionaceae	1	Johar	*Dalbergia mimosella* (Blanco) Prain	Batang, daun	Pohon
157	Papilionaceae	2	Akar tuba/Gadel	*Derris trifoliata* Lour.	Batang, daun, akar	Liana
158	Papilionaceae	3	Bengkoang	*Pachyrrhizus erosus L*	Buah	Umbi
159	Papilionaceae	4	Angsana/sono kembang	*Pterocarpus indicus Will.*	Daun	Pohon
160	Piperaceae	1	NN	*Piper aduncum L.*	Daun	Pohon
161	Piperaceae	2	Sirihan	*Piper retrofractum*	Batang, daun	Semak
162	Poaceae	1	Alang-Alang	*Imperata cylindrica* (L) Beauv.	Akar	Semak
163	Polygalaceae	1	NN	*Xanthophyllum flavescens Roxb.*	Daun	Semak
164	Polygalaceae	2	Minyak berok	*Xanthophyllum sp.*	Daun	Pohon
165	Proteaceae	1	NN	*Helicia robusta* Wall	Buah	Pohon
166	Rhamnaceae	1	Damar	*Ventilago sp.*	Daun	Pohon
167	Rhamnaceae	2	NN	*Zizyphus horsfieldii* Miq.	Daun	Pohon
168	Rosaceae	1	Akar Duri Kampretan	*Rubus moluccanus L.*	Batang, daun, akar	Semak
169	Rubiaceae	1	Nangi	*Adina Polycephala*	Daun, pucuk	Pohon
170	Rubiaceae	2	Nangok	*Adina sp.*	Daun	Pohon
171	Rubiaceae	3	Akar Duri	*Canthium horridum* Blume	Batang, daun	Liana
172	Rubiaceae	4	NN	*Coptosapelta tomentosa (Blume.) Val. Ex K. H.*	Daun	Pohon
173	Rubiaceae	5	Soka Putih	*Gaertnera vaginans* (DC.) Merr.	Batang, daun	Semak
174	Rubiaceae	6	Cakar elang	*Gardenia sp*	Batang, daun	Semak
175	Rubiaceae	7	Jambuan Tiga	*Gardenia tubifera* Wall.	Daun	Pohon
176	Rubiaceae	8	Kopen d kecil/darat	*Hypobathrum microcarpum* (Blume) Bakh. F.	Daun	Pohon
177	Rubiaceae	9	Soka Merah	*Ixora sp*	Batang, daun	Semak
178	Rubiaceae	10	Soka Bulu	*Ixora sp.*	Batang, daun	Semak
179	Rubiaceae	11	Soka Klewer	*Ixora sp.*	Daun	Semak
180	Rubiaceae	12	NN	*Lasianthus sp*	Daun	Semak
181	Rubiaceae	13	Akar Merah	*Musaendra frondosa* L	Batang, daun	Liana
182	Rubiaceae	14	NN	*Psychotria polycarpa* Hook.f.	Batang, daun, akar	Liana
183	Rubiaceae	15	Georan	*Psychotria sarmentosa*	Daun	Liana
184	Rubiaceae	16	Kepil	*Tarenna fragrans* (Blume) K. et. V	Daun	Pohon
185	Rubiaceae	17	NN	*Tricalysia singularis K. Schum.*	Daun	Semak
186	Rubiaceae	18	Cakar Elang Hijau	*Uncaria acida* (Hunter) Roxb.	Batang, daun	Semak
187	Rubiaceae	19	Gambir	*Uncaria gambir Roxb.*	Umbi	Semak
188	Rubiaceae	20	Lemok Akar	*Uncaria hirsuta* Havil.	Batang, daun	Liana
189	Rutaceae	1	Jeruk Hutan	*Citrus sp*	Buah	Pohon
190	Rutaceae	2	Karetan	*Evodia cf. pilulifera King*	Buah	Pohon
191	Sapindaceae	1	Pancang	*Allophyllus cobbe L. R*	Batang, daun	Semak
192	Sapindaceae	2	NN	*Lephisanthes sp*	Daun	Pohon
193	Sapindaceae	3	Rambutan	*Nephelium lappaceum*	Buah	Pohon
194	Sapotaceae	1	Nangkan	*Palaqium rostatum*	Daun, buah	Pohon
195	Selagillaceae	1	Paku Andam/cakar ayam	*Selaginella sp*	Batang, daun	Menjalar
196	Simaraubaceae	1	Pasak Bumi	*Eurycoma longifolia Jack.*	kulit kayu	Pohon
197	Smilacaeae	1	Gembilian	*Smilax sp*	Batang, daun, akar	Liana
198	Solanaceae	1	Terongan	*Solanum torvum*	Daun	Semak
199	Sterculiaceae	1	Walangan	*Pterospermum diversifolium* Blume	Daun	Pohon
200	Sterculiaceae	2	Bayur	*Pterospermum javenicum* Jungh.	Daun	Pohon
201	Sterculiaceae	3	NN	*Schapium macropodum Beume.*	Daun	Pohon
202	Theaceae	1	Teluntum	*Gordonia exelsa* Blume	Daun	Pohon
203	Theaceae	2	Mentru / Puspa	*Schima walchii* Choisy	Batang, daun	Pohon
204	Thymelaeaceae	1	Gaharu	*Aquilaria malaccensis Lamk*	Batang, daun	Pohon
205	Tiliaceae	1	Deluak/talok	*Grewia acuminata Juss.*	Daun, pucuk	Pohon
206	Verbenaceae	1	Winong	*Clerodendrum paniculatum*	Buah	Pohon
207	Verbenaceae	2	Laban kapur	*Vitex quinata* (Lour.) F. N. Will.	Batang, daun	Pohon
208	Verberaceae	3	Sungkai Hutan	*Pheronema canescens Jack.*	Batang, daun	Pohon
209	Vitaceae	1	Tribin	*Cissus nodosa Blume*	Batang, daun	Pohon
210	Vitaceae	2	NN	*Tetrastigma lanceolarium Planch.*	Daun	Pohon
211	Zingiberaceae	1	Tepus/laosan	*Alpinia galanga*	Daun	Semak

Habitat big herbivore mammal in WKNP

The other herbivore wildlife such as elephant, tapir and deer has been food plants competition with rhino because they have similar food plants, however natural habitat have natural mechanism in the ecosystem. Wild rhino population in WKNP has been stable since few year ago and is best population Sumatran rhino in Sumatera to date but they are habitat just in the middle of WKNP, probably one of reason rhino choice this area because feeding supply is good with high variety of browse plants.

4. CONCLUSION

Rhino Food plants information is essential and important to manage rhino husbandry for the survival in the future including reference for habitat management and prepare rhino food garden.

REFERENCES

Candra D, Radcliffe RW, Andriansyah, Khan M, Tsu IH, Paglia DE. 2012. Browse Diversity and Iron Loading in Captive Sumatran Rhinocoeros *Dicerorhinus sumatrensis*: A Comparison of Sanctuary and Zoological Populations. Journal of Zoo and Wildlife Medicine 43(3): S66–S73, 2012

Dephut. 2006. Taman Nasional Way Kambas. *http://www.dephut.go.id/uploads/INFORMASI/ TN%20INDO-ENGLISH/ tn_waykambas. html*. (Download: August 25, 2016)

Groves, Colin P.; Kurt, Fred (1972). "*Dicerorhinus sumatrensis*" (PDF).Mammalian Species. American Society of Mammalogists (21): 1–6. doi:10.2307/3503818. JSTOR 3503818.

IUCN (2015) IUCN Red List of Threatened Species v. 2015. IUCN, Gland, Switzerland. Http://www.iucnredlist.org [accessed 12 September 2016].

PVA. Population Viability Analysis for thw sumatran rhino in Indonesia. 2015. Bogor

Strien, N.J. van. 1985. The Sumtran Rhinoceros-*Dicerorhinus sumatrensis* (Fischer, 1814)-In The Gunung Leuser National Park, Sumatra, Indonesia; Its Distribution, Ecology and Conservation. De Landbouwhogesschool, Wageningen.

Strien, N.J. van. 2005. "Sumatran rhinoceros". In Fulconis, R. Save the rhinos: EAZA Rhino Campaign 2005/6. London: European Association of Zoos and Aquaria. pp. 70–74.

Suharto, I. E.L. Rustiati, M. Adi C.T.R. 2005. Tumbuhan Pakan Badak Sumatera di Suaka Rhino Sumatera, Taman Nasional Way Kambas, Lampung. Bioma (Desember) 7 (2): 57-59

WKNP. Way Kambas ntional Park Report. 2015. Lampung

SURVEILLANCE ANTHRAX (*Bacillus anthracis)* IN SURROUNDING WAY KAMBAS NATIONAL PARK LAMPUNG INDONESIA

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ABSTRACT

This purpose of this study was to conduct a survey of anthrax (Bacillus anthracis) in the 23 buffer villages that surround Way Kambas National Park in Lampung, Indonesia. Soil specimens were collected from buffalo and cattle terminals in each village. Twenty-three samples were collected and analyzed in a microbiology laboratory at the Balai Veteriner Lampung. Colony description from culture with blood agar media was used to support a suspected diagnosis of B.anthracis. All samples were negative result. However this study was negative result but this information is important base data to manage live stock in the village surrounding WKNP and to support wildlife conservation in WKNP.

Keywords: anthrax, buffer villages, Soil, Way Kambas National Park

1. INTRODUCTION

Way Kambas National Park (WKNP) is located in Lampung of Sumatra, Indonesia. WKNP is comprises about 1,300 square km2 of important lowland rain forest and 36 villages in surrounding with no border with national park. WKNP with secondary lowlands forest is ranked as the second highest priority area for Sumatran elephant conservation activity (Santiapillai and Jackson, 1990). The national park supports populations of critically endangered species- APPENDIX I CITES (Dephut, 2006; IUCN, 2015) such as Sumatran Rhino (*Dicerorhinus sumatrensis*), Sumatran elephant (*Elephas maximus sumatranus*), Sumatran Tigers (*Panthera tigris)* and Malayan Tapir (*Tapirus indicus*) (Foose & van Strien 1997; Franklin et al. 1999; IUCN, 2015). Especially for Sumatran Rhino at the Sumatran rhino sanctuary has been collected food (browse) suplly from fews village surrounding WKNP.

Anthrax is primarily a disease of herbivorous animals, although all mammals, including humans, and some avian species can contract it. Mortality can be very high, especially in herbivores. The etiological agent is the spore-forming, Gram-positive rod-shaped bacterium, *Bacillus anthracis*. The disease has world-wide distribution and is a zoonosis (OIE, 2012). Anthrax, caused by the bacterial *Bacillus anthracis*, is per acute, acute or sub acute, highly contagious disease of domestic and wild animals, and humans. In most warm blooded vertebrate species have been infected with characterized of a fatal septicemia, resulting in sudden death producing widespread edema, hemorrhages and necrosis (De Vos *et al.*, 2004).

In southern Africa, deaths due to anthrax have been recorded in at least 52 species. Browser herbivores are the most susceptible in the Kruger National Park (De Vos *et al.*, 2004). In wildlife the epidemiology of the disease varies according to geographic locality and mix ecosystem (De Vos *et al.*, 1961).

Anthrax case in Indonesia first reported in Kolaka, Southeast Sulawesi Province in 1832. Anthrax or spleen inflammatory disease is a zoonotic disease in Indonesia. According to the anthrax is already known in Indonesia since the Dutch colonial era in 1884 in Teluk Betung, Lampung. In 1975, the disease was found in six regions, like as Jambi, West Java, East Nusa Tenggara, West Nusa Tenggara and South Sulawesi, Southeast Sulawesi. According to available data there are currently 11 provinces are endemic anthrak Jambi, Sumatera Barat, Jakarta (South Jakarta), West Java (Bogor City, Regency, Bogor, Depok City), Central Java (Semarang, Kab. Boyolali), NTB (Sumbawa, Bima), NTT (Sikka, Ende), South Sulawesi (Makassar, Wajo, Gowa, Maros), Southeast Sulawesi, North Sulawesi and Papua. Reports last anthrax case occurred in 2012 in Boyolali and Sragen (Central Java), Maros and Takalar (South Sulawesi), which attacked the beef cattle and dairy cattle belonging ranchers (Manual

Penyakit Hewan Mammalia, 2014). The regions that have a historical record will remain endemic anthrax attacks potentially powerful for the next attack.
This purpose of this study was to conduct a survey of anthrax (*Bacillus anthracis*) in the 23 buffer villages that surround WKNP. Soil specimens were collected from buffalo and cattle terminals in each village. Twenty-three samples were collected and analyzed in a microbiology laboratory at the Balai Vetriner Lampung. Colony description from culture with blood agar media was used to support a suspected diagnosis of *B.anthracis*. All samples were negative result. However this study was negative result but this impormation is important base data to manage live stock in the village surrounding WKNP and to support wildlife conservation in WKNP.

2. MATERIAL AND METHOD

This purpose of this study was to conduct a survey of anthrax (*Bacillus anthracis*) in the 23 buffer villages that surround Way Kambas National Park in Lampung, Indonesia. The soil samples were taken from domestic livestock activity (grazing land, stall and wallow). Samples were collected about 10 cm from the surface and placed into a labeled plastic bag and stored in ice box. All samples were collected and analyzed in a microbiology laboratory at the Balai Veteriner (DIC : Disease Investigation Centre) Lampung to analyze the soil samples.

Materials: Bottle containing 90 ml of saline, Water bath, Six 9 ml saline dilution blanks, plates of blood agar, Pipettes and Spread stick.

Method: Soil culture with blood agar media

1. Prepare 10 g of soil in a bottle containing 90 ml of saline and mix well.
2. Prepare five, serial decimal dilutions of the soil suspension. Completely immerse the tube in the 62,5°C in Water bath for 15 (30-60) minutes. Heating and cooling constitutes the *heat-shocking* procedure to release spores.
3. Dilute up to 10, 100 or 1000 times. Inoculate 10-100 microliters spread plate of blood agar
4. Incubate the plates at 30-37°C for 1-2 days.
5. After 24-48 hours incubation, examine the blood agar plates for colonies of *Bacillus* species, which often are characterized by a flat and chalky appearance.
6. Characteristic: *Bacillus anthracis* produces non-hemolytic colonies on blood agar.

Colonies found on the blood agar media was described, recorded and used to support a suspected diagnosis of *Bacillus anthracis*. The characteristics of *Bacillus anthracis* is a non-hemolytic colony. We use the standard method for anthrax analysis that is routinely used at this diagnostic laboratory and the Laboratory technicians are very comfortable and familiar with the standard anthrax diagnostic method.


Bacillus anthracis on Blood Agar Plate

After overnight incubation at 37°C, *Bacillus anthracis* colonies are grey-white to white, 0.3 –0.5cm in diameter, non haemolytic, with a ground - glass surface, and very tacky when teased with an inoculating loop. Tailing and prominent wisps of growth trailing back toward the parent colony, all in the same direction, are sometimes seen. This characteristic has been described as a ‘medusa head’ or ‘curled hair’ appearance. Confirmation of *Bacillus anthracis* should be accomplished by the demonstration of a capsulated, spore-forming, Gram-positive rod in blood culture. Absence of motility is an additional test that can be done (OIE, 2012)

3. RESULT AND DISCUSSION

All soil samples was negative result.

This study is first anthrax assessment of the domestic livestock in the villages surrounding WKNP. The health assessment is an essential preliminary survey for anthrax in the wildlife conservation in WKNP and buffer villages surrounding WKNP. In order to safely wildlife conservation in the future, it is imperative to know the diseases that are common in the domestic livestock populations that will ultimately share common habitat. It is recommended that a larger soil survey with many more samples be conducted for a more comprehensive analysis of the region.

Transmission

Anthrax does not spread directly from one infected animal to other animals, but usually enters the body of animals through food, enclosures equipment, grass or soil is considered the most important and dangerous diseases. Spores in the soil may rise to the surface for further processing of the soil and the spores landed on the grass which then consumed by domestic livestock. Spores can also get into the skin when animals sleep on the contaminated ground. Spores will grow and develop in the tissues of the body spread throughout the body following the flow of blood (WHO, FAO, and OIE, 2008).

In essence, anthrax is "land sickness" which means that cause there are in the ground, then with food or drinks into the animal's body. In humans, infection can occur through the skin, mouth or breathing (Manual Penyakit Hewan Mammalia, 2014).

The level of vulnerable on animals:

1. Ruminants (cattle, sheep, and horses, deer, buffalo and other wild ruminants
2. Pigs are not so susceptible.
3. Dogs, cats, rats and a large part of the birds, relatively vulnerable but can be artificially infected.
4. Cold-blooded animals did not susceptible (not affected).

Risk factor

The cycle of anthrax infection is influenced by several factors are sporulation and germination (pH, temperature, mineral contens), grazing activity, health of host, insect populations and human activities. Anthrax are common in agricultural areas, certain areas are wet, high humidity and flooded areas. This is similar with condition in the villages surrounding WKNP with agriculture including livestock activities. Affected areas of anthrax usually have soil with rich in organic materials. In hot climate areas, flies can transfer of disease. Although it has not been observed in Indonesia so far, the flies are considered to have an important role in spreading anthrax mechanically especially in situations severe outbreaks in endemic areas. Most biting flies from Hippobosca and Tabanus species act as transmitters are responsible for the expansion of a major outbreak in Zimbabwe in 1978-1979, where the flies jump from one community to another domestic livestock community (WHO, FAO, and OIE, 2008). Basically the anthrax outbreak often occurs during the hot weather and dry climate. The occurrence of outbreaks of anthrax reported are often preceded by ecological or climatic changes are obvious, such as floods or rains followed by drought and the risk of recurrence of anthrax is unpredictable (WHO, FAO, and OIE, 2008; Lewerin *et al.,* 2010).

The initiation of an outbreak of anthrax depends on factors that include bacterium, environmental, affecting dissemination of the organism, and certain human activities. Warm climates favor the growth and sporulation of *B. anthracis* in body fluids of opened infected carcasses. Large numbers of spores are produced, resulting in contamination of the surrounding soil and vegetation. *B. anthracis* spores germinate at temperatures of between 20 and 40 °C at a relative humidity greater than 80 percent (De Vos *et al.,* 2004). Spores remain in a dormant state until germination is induced. Their survival in nature is dependent on their initial numbers and their environment such as climate, topography, other microbial life, and certain chemical and plant materials. Bacteria's anthrax do not survive for more than three or four years, but spores may remain dormant and viable in nature for at

least 50 years and up to 200 ± 50 years. In the dry condition, spora will survive at least 60 years (De Vos *et al.*, 2004).

Sometimes anthrax cases were difficult detected in Indonesia because:

- Samples collection and examination
- Unavailability of retrospective accurate data
- Public participation in reporting their animals are sick, the vaccination activities, and actions taken in the event of anthrax (Putra *et al.*, 2004)
- Delay in diagnosis (Lewerin *et al.*, 2010; Lembo *et al.*, 2011)

Effective surveillance is essential to prevention and control program for anthrax and encompasses mechanisms for disease detection, confirmation of diagnosis, reporting, collection data and feedback of the data to the source (WHO, FAO, and OIE, 2008).

Prevention

The treatment of diseased animals declared anthrax forbidden to cut. For free areas anthrax, preventive measures are based on strict regulation of the importation of the stricken animal. Anthrax in animal can be prevented by vaccination. Vaccination is carried out on all animals in enzootic areas anthrax once every year, along with ways of monitoring and stringent controls (Manual Penyakit Hewan Mammalia, 2014).

4. CONCLUTION

Surveillance *Bacillus antracis* is important as premilinary survey to support domestic animal manajemen and wildlife conservation in WKNP. Anthrax surveillance has providing an early warning system to zoonosis.

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REFERENCES

Dephut. 2006. Taman Nasional Way Kambas. *http://www.dephut.go.id/uploads/INFORMASI/ TN%20INDO-ENGLISH/ tn_waykambas. html*. (Download: August 25, 2016)

De Vos, V & Turnbull, PCB, 2004. Anthrax. In: JAW Coetzer, GR Thomson, RC Tustin (Eds.), *Infectious Diseases of Livestock, with Special Reference to Southern Africa* (second ed.), Oxford University Press Southern Africa, Cape Town, South Africa

De V, U. (1961). A second outbreak of anthrax amongst game animals in the Kruger National Park. 5th June to 11th October, 1960. *Koedoe*, 4(1), 4-17.

Santiapillai, C., Jackson, P., 1990. The Asian Elephant: An Action Plan for its Conservation. IUCN/SSC Asian Elephant Specialist Group, Gland, Switzerland.

Foose, T.J., van Strien, N., 1997. Asian Rhinos – Status Survey and Conservation Action Plan. IUCN, Gland, Switzerland and Cambridge, UK.

Franklin, N., Bastoni, Sriyanto, Siswomartono, D., Manansang, J., Tilson, R. 1999. Last of the Indonesian tigers: a cause for optimism. In Riding the Tiger: Tiger conservation in human–dominated landscapes, eds. J. Seidensticker, S. Christie, P. Jackson, pp. 130–147. Cambridge University Press, Cambridge, UK.

WHO, FAO, and OIE. 2008. Anthrax in humans and animals. Fourth Edition. WHO Library Cataloguing-in-Publication-Data. ISBN 978 92 4 154753 6.

Kementan.2014. Manual Penyakit Hewan Mammalia. Direktorat Jenderal Peternakan dan Kesehatan Hewan.

Lewerin S.S., Elvander M., Westermark T., Hartzell L.N., Norstom A.K., Ehrs S., Knutsson R.,

Englund S., Andersson A-C., Granberg M., Backman S., Wikstrom P., and Sandstedt K. 2010. Anthrax outbreak in a Swedish beef cattle herd 1st case in 27 years: Case report. Acta Veterinaria Scandinavia, 52:7

Lembo T., Hampson K., Auty H., Beesley C.A., Bessell P., Packer C., Halliday J., Fyumagwa R., Hoare R., Ernest E., Mentzel C., Mlengeya T., Stamey K., Wilkins P.P., and Cleaveland S. 2011. Serologic Surveillance of Anthrax in the Serengeti Ecosystem, Tanzania, 1996-2009. Emerging Infectious Diseases, 17(3): 387-394. DOI:10.3201/eid1703.101290.

Putra A.A.G., Zuhudin L., Dartini N.L., Sagung Dewi A.A., Arsani N.M., dan Butarnutar R.M. 2004. Wabah Antraks di Kabupaten Sumbawa, Provinsi Nusa Tenggara Barat pada tahun 2004. Balai Penyidikan Veteriner Denpasar dan Dinas Peternakan Provinsi NTB.http://www.docstoc.com/docs/28596582/wabah-antraks-di-kabupaten-sumbawa-provinsi-nusa-tenggara-barat. (Download: August 20, 2016)

OIE. 2012. Manual of Standards for Diagnostic Tests and Vaccines for Terrestrial Animals, 5th edn, vol.5.Paris: Office International des Epizooties, pp. 87-97

GENOMIC DNA ISOLATION OFGAJAH SUMATERA *(Elephas maximus sumatrensis)* IN ELEPHANT TRAINING CENTER, WAY KAMBAS NATIONAL PARK, EAST LAMPUNG

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ABSTRACT

Elephant Training Center, Way Kambas National Park holds 44 captive sumatran elephants*(Elephasmaximussumatrensis)*. This *critically endangered species* small population is in high risk of *inbreeding*. Its genomic DNA isolation was done to provide DNA amplification material for phylogenetic analysis. Individual blood sampels were collected from 8 different individuals based on age and sex characteristics and stored at EDTA-anticoagulated blood tubes. Qualitative test by 1% agarose gellelectrophoresis, visualized by UV transiluminator. Isolated genomic DNA was kept in -20^{0}C elution buffer solution.

Keywords: sumatran elephant, blood, DNA isolation, Way Kambas National Park.

1. INTRODUCTION

Sumatran elephant (*Elephasmaximussumatrensis*) is endemic asian elephant that lives at seven provinces in Sumatera, included Lampung (Soeharsono, 2007). Since 2011, InternationalUnion forConservationofNatureandNaturalResources(IUCN) classified the sumatran elephant as critically endangered species (Gopala*etal*.,2011). Elephant Training Center in Way Kambas National Park was established to be one of solution of this problem.

Elephant Training Center in Way Kambas National Park holds 44 captive sumatran elephants. The small size of the population of the sumatran elephant allows to increased the inbreeding probablity, then will made negative effect on gene flow in the sumatran elephant population. The bad gene flow of the population can adversely affect the viability of individual members of the population.

Research kinship patterns sumatran elephant has begun to do, especially regarding the relationship filogenik Asian elephants in Indonesia, Nepal, India and the elephants of the African continent. Fernando *et al* (2003) stated that the Sumatran elephants are related to elephants in Asia with diverse levels of phylogenetic closeness, while Sulandari and Zein (2012) states based on mitochondrial DNA genetic variation among populations of Sumatran elephants in Lampung, South Sumatra and Bengkulu is low.

Kinship patterns of captive sumatran elephants in Elephant Training Center in Way Kambas National Park has not been done. Potential high inbreeding and low genetic variation push for an immediate kinship between individual data collection of sumatran elephants in Elephant Training Center in Way Kambas National Park. Kinship patterns can be analyzed with DNA finger printing methods, for example methods Random Amplified Polymorphism DNA (RAPD) (Kumar and Gurusubramain, 2011). RAPD molecular markers are widely used in the analysis of genetic variation because it can be done without the need for data on the nucleotide sequence of the DNA template to be amplified (Yadav et al., 2012). Therefore, research on the molecular genetics of the Sumatran elephant population is an important step that must be waged. Through genetics approach, expected to conservation efforts more focused and able to rescue survival of the Sumatran elephant. RAPD molecular markers require genomic DNA as a base material for the amplification and analysis of genetic kinship.

2. MATERIALS AND METHODS

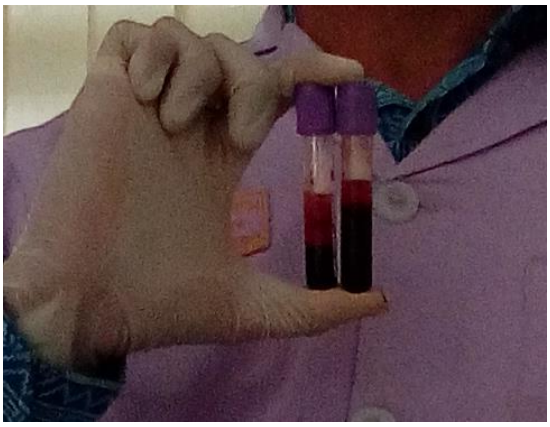
Blood sampling

Venous blood samples were obtained from 8 individual sumatran elephants in Elephant Training

Center, Way Kambas National Park, based on age and sex characteristics (Table 1). Whole bloods were collected by syringe and stored at 3 mL EDTA-anticoagulated blood tube (Pic. 1). All samples were kept at 4^{o}C before DNA isolation was performed.

Table 1. Sumatran elephants in Elephant Training Center, Way Kambas National Park

Number of Sample	Name of elephant	Sex	Age(years)
1	Agam	male	37
2	Daeng	male	29
3	Pangeran	male	2
4	Sugeng	male	6
5	Lingling	female	38
6	Suci	female	27
7	Yulia	female	3
8	Queen	female	5



Pic 1. Whole bloods were collected at 3 mL EDTA-anticoagulated blood tube

DNA Isolation

DNA was isolated from sumatran elephant's whole blood using Dneasy Blood & Tissue Protocol. Well mixed of 200 µL EDTA-anticoagulant-treated blood, 20 µL proteinase K and 200 µL buffer AL in 1,5 mL microtube was incubate in 56^{o}C for 10 minutes. Then 200 µL ethanol 96% was added followed by centrifugation at 8000 rpm for 1 minute. Washing step was done by added AW1 and AW2 with high rise centrifugation. AE buffer was added to center of the spin column for ellution step than centrifuge at 8000 rpm for 1 minute.

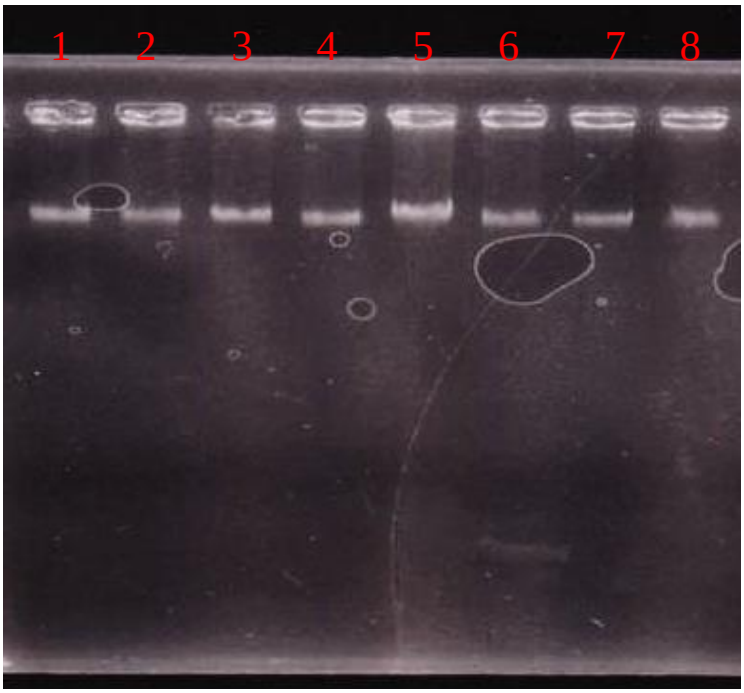
DNA Qualitative Test

Isolated DNA was test by qualitative method, loaded in 1% agarose gell electrophoresis. DNA was visualized by good view staining and photographed under ultravioled light. Isolated DNA kept at -20^{o}C before DNA amplification and another reaction performed.

RESULTS

Genomic DNA from 8 individual sumatran elephant was eluted in AE buffer sollution than kept in -20^{o}C (Pic 2). DNA was visualized by good view staining and photographed under ultravioled light as shown at Pic 3.

Pic 2. Genomic DNA from elephant eluted in buffer sollution



Pic 3. Photograph of qualitative test from genomic DNA under UV light
(1: Agam, 2: Daeng, 3: Pangeran, 4: Sugeng, 5: Lingling, 6: Suci, 7: Yulia, 8: Queen)

3. DISCUSSION

The type and condition of specimen and tissues, according to its origin, are key factors in selecting a DNA isolation method. The total genomic DNA from whole blood of sumatran elephant was isolated with Dneasy Blood & Tissue Protocol from QIAGEN®.The protocol concist of three step, lysis, washing, and elution, respectively. Lysis step using AL buffer, proteinase-K under incubating condition in 56ºC. This step will destruct the cell wall and nucleus membrane. Second step was done by twice washing step, with AW1 and AW2 buffer with centrifugation condition. This step will removed the other materials besides DNA. Third step will eluted the DNA from the sillica gell in buffer solution with AE buffer.

Using the silica-coated gell in DNA isolation step allows to reversibly bind and purify DNA away from cell debris, proteins, and another materials released upon directed cell lysis. The binding of DNA to silica gell seems to be driven by dehydration and hydrogen bond formation, which competes against weak electro-static repulsion. Hence, a high concentration of slat will help drive DNA adsorption onto silica, and low concentration will help to release the DNA from the silica gell. The total genomic DNA will kept in -20^{o}C condition before PCR analysis to construct the phylogenetic tree between sumatran elephant in Elephant Training Center, Way Kambas National Park.

4. CONCLUSION

The resulted quantity of genomic DNA is enough to conduct further PCR reactions. Using the above methode, good quality DNA samples from a sumatran elephant whole blood were isolated to study the phylogenetic analysis in sumatran elephant population.

REFERENCES

Fernando,P.,Vidya, TNC., Payne,J., Stuewe, M., Davison,D., Alfred, RJ., Andau, P., Bosi,E., Kilbourn, A., Melnick,DJ. 2003.DNA Analysis Indicater that Asian Elephants are Nativeto Borneo and are Therefore a High Priority for Conservation. *PloS Biology*.1 (1): 110-115

Frankham,R., Ballou, J.D .& Briscoe, D.A. 2002. *Introduction to Conservation Genetics*. Cambridge University.

Gopala,A., Hadian,O., Sunarto,.,Sitompul, A., Williams, A., Leimgruber, P.,Chambliss, S.E. & Gunaryadi, D. 2011. *Elephas maximus ssp. sumatrensis*. *The IUCN Red List of Threatened Species 2011*. http://www.iucnredlist.org/details/199856/0

Handayani. 2008. *Analisis DNA Mitokondria Badak Sumatera dalam Konservasi Genetik*. Tesis. Bogor: IPB.

Majumder, D.A.N., Hassan,L., Rahim, M.A., & Kabir, M.A. 2011. Development of an efficient protocol for genomic DNA extraction from mango (*Mangifera indica*). *Nusantara Bioscience*3 (3): 105-111.

Mikkelsen, S.R. & Corton, E. 2004. *Bioanalytical Chemistry*. John Wiley & Sons, Inc. New Jersey, pp:167-170.

Moyo, M., Amoo,S.O., Bairu, M.W., Finnie,J.F., & Van Staden, J. 2008. Optimising DNA isolation for medicinal plants. *South African Journal of Botany* 74: 771–775.

Sulandari, S. & Zein, MSA. 2012. Mitocondrial DNA Variation of the Sumatran Elephant Populations in Sumatera, Indonesia. *BIOTROPIA* 19 (2): 92-102.

Varma, A., Padh, H., & Shrivastava, N. 2007. Plantgenomic DNA isolation: Anartora science. *Biotechnology Journal* 2: 386–392.

Yadav, A., Ahmad, J., Ahmad, A. 2012. Development of Randomly Amplified Polymorphic DNA Sequence Characterized Amplified Region Marker for Authentication of Swertia Chirayita, an Endangered Himalayan Plant. *Plant Mlecular Biology & Biotechnology*. 3(1): 27-34.

INDUCE RESISTANCE OF *SPATHOGLOTTIS PLICATA* BL. TOWARD TO *FUSARIUM OXYSPORUM*

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ABSTRACT

Spathoglottis plicata attracts many people as an ornamental plant for parks, offices and housing complexes in urban areas. The most production constrain on Ground Orchid (*Spathoglottis plicata* Bl.) plantation recently has been caused by fusarium wilt caused by *Fusarium oxysporum* and until now still can not be solved effectively. In general, Indonesian farmers cope with fusarium wilt disease by using pesticides that often cause environmental pollution, while orchids are always physically close to the fans. Therefore, it should be an effective and environmentally friendly alternative. One of the most secure and efficient alternative diseases control for environment is by using resistant varieties. Ground orchid plantlets that are resistant to *Fo* have been selected by in vitro selection on Vacin & Went (VW) medium containing fusaric acid (FA) at different concentrations. The objectives of this research was to determine: Resistance criteria of *S. plicata* plantlet that was induced by fusaric acid on *F. oxysporum* infection through in vitro selection. This research was conducted at In Vitro Laboratory of Dept. of Biology, Faculty of Mathematics and Natural of Science, University of Lampung, Bandar Lampung, Indonesia. The research was compiled by using Completely Randomized Design (CRD) with one factor that is FA consisting of 5 levels: 0 ppm, 10 ppm, 20 ppm, 30 ppm, and 40 ppm on WV medium. Data analysis used ANOVA (analysis of varian) at significance level 5% and a further test with LSD (Least Significant Difference) at the significance level 5%. The result showed that: The resistance criteria of *S. plicata* plantlet on day 28 (0 ppm) was control and 10 ppm was susceptible. At 20 ppm and 30 ppm, its resistance criteria were moderate. At concentration of 40 ppm, its resistance criteria was resistant.

Keywords: *Spathoglottis plicata*, *Fusarium oxysporum*, Induced Resistance, Fusarium wilt, Fusaric Acid

I. INTRODUCTION

Orchid is a flowering plant that has economic value is high enough and the price is relatively stable. Ground orchid (*Spathoglottis plicata* Bl.) is one of orchids is much preferred. One of the obstacles encountered in the cultivation of *S. plicata* is the presence of pathogenic fungi which can attack several parts of plants such as stems, leaves or roots (Djatnika, 2012). Fusarium wilt caused by the fungus *Fusarium oxysporum* is an important disease and one of the obstacles in the quality and production of *S. plicata* (Palmer, 2011).

One alternative way to control the disease that is safe, efficient and effective, and safe for the environment, among others, using varieties that are resistant. The development of *S. plicata* resistant cultivars can be done by in vitro selection method that is explants form of tissue or organ in a medium containing fusaric acid (FA) that selective concentration (Bouizgarne et al., 2006). Use of FA as a selective agent in vitro selection may produce mutant cell or tissue which is insensitive to FA, so that after being regenerated into plants can produce resistant strains of pathogen infection (Arai and Takeuchi, 1993).

II. MATERIALS AND METHODS

Materials used are plantlets of *Spathoglottis plicata* Bl. aged 6 months were obtained from the personal collection of Dr. Endang Nurcahyani, pure Fusaric Acid manufactured by *Sigma chemical Co*. {Fusaric acid (5-butylpicolinic acid) from Giberella fujikuroi}, 70% alcohol, distilled water,

Benzine Amino Purine (BAP), indole-3-Acetic Acid (IAA), sucrose, Potassium Hydroxide (KOH), acid chloride (HCl) and chemicals medium Vacin & Went (VW) solid.

Research compiled by using a completely randomized design (CRD) with one factor: FA concentration which consists of 5 levels: 0 ppm, 10 ppm, 20 ppm, 30 ppm and 40 ppm. Each concentration was repeated 5 times and each replication consisted of three explants *S. plicata* in each culture bottle. Then testing the resilience of plantlets of *S. plicata* against *F. oxysporum.*

Medium VW on a sterilized bottle culture coupled with a concentration corresponding FA treatment. Fusaric acid before use, diluted with distilled water to obtain the concentrations specified, then filtered using a syringe filter having a diameter of 0.45 µm, was done 2 times and filter diameter of 0.22 µm was done one time. Filtering is done in a sterile room in the Laminar Air Flow (LAF) Cabinet. Furthermore, FA is added to VW medium. Before use, the medium was incubated for 7 days at room temperature (25 °C) to ensure that FA has been pre-screened. If within 7 days of no contamination on the medium, the medium can be used.

S. plicata plantlets are planted in the VW medium in the Laminar Air Flow (LAF) Cabinet. Plantlets from culture bottle issued with a sterile scalpel and one by one placed on a petridish, diameter of 10 cm, then plantlets sorted one by one, after it is planted on each bottle culture medium. Each concentration is done five replications and each replication consisted of three explants of *S. plicata* in each culture bottle. Selection plantlets carried out for 30 days At the end of the 4th week, were evaluated to determine the concentration of FA are tolerant to the selection of *S. plicata* plantlets in vitro.

Fusarium oxysporum inoculation was performed directly on the plantlets in the culture bottles (Hadisutrisno, 1995). Mikrokonidium fungus *F. oxysporum* with a density of 1.7 x 104 spores per ml is dripped onto the plantlets 1-2 drops, then incubated at room temperature (25˚C) for 24 hours. Observations were made starting on day 3rd after inoculation for four weeks by observing and counting the number of leaves that show symptoms of wilting index by He et al (2002). Disease Intensity (IP) is calculated according to the formula of Wibowo (2002).

$$DI = \frac{\Sigma(n \times v)}{N \times Z} \times 100\%$$

The level of plant resistance is determined by scoring with reference to the provisions of Wibowo (2002).

DI (%)	Criteria of Resistance
≤ 25	Resistant
25 < DI ≤ 50	Moderate
>50 or die	Susceptible

Information : DI = Disease Intensity

III. RESULT AND DISCUSSION

Fusarium wilt disease caused by *F. oxysporum* is an important disease that is one of the obstacles to the growth of orchids (Palmer, 2012). In orchids, fusarium wilt caused the death of more than 50% of the number of plants grown orchid (Wedge & Elmer, 2008).

Observation of wilting symptoms on the leaves of plantlets which is done every day for 4 weeks showed symptoms of wilting on *S. plicata* orchid plantlets in the culture bottle. Furthermore, based on the scoring of the symptoms that appear wilted or yellow can be determined intensity of the disease (DI) and the criteria for each treatment resistance.

Criteria of resistance on treatment outcome plantlets control and the provision of 10 ppm produced plantlets resistance that criteria are susceptible to the disease intensity at 91% and 83%, the highest disease intensity shown by the control that is 91%. Induced resistance to FA at concentrations of 20 and 30 ppm produces plantlets that have the disease intensity reaches 33%, so the durability criteria

was moderate. In the treatment of 40 ppm FA there are no symptoms of the disease that is resistant durability criteria.

Based on data from the disease intensity and endurance above it can be seen that FA treatment of 40 ppm able to induce the most good resistance so as to reduce the intensity of the disease up to 0% and raising the criteria become resistant. The above shows that FA is able to induce resistance orchid plantlets of *S. plicata* against fusarium wilt. The results of this study supported the opinion of Arai and Takeuchi (1993) which describes the correlation between plant resistance to the toxin with disease resistance, so that pure toxin FA can be used as a component selection.

This result is in line with research conducted by Nurcahyani *et al.* (2012) which states that Induced resistant of vanilla against fusarium wilt can reduce the intensity of the disease reached 25% at 110 ppm treatment. The results also support the statement Agrios (2005) which states that the expression of induced resistance is by decreasing the intensity of the disease.

IV. CONCLUSION

Based on the results of research and discussion above, it can be concluded that the criteria for resistance plantlets of *S. plicata* on day 28 (controls) and 10 ppm is vulnerable. At 20 ppm and 30 ppm which is a moderate resistance criteria. At a concentration of 40 ppm resistance criteria are resistant to disease intensity to 0%.

REFERENCES

Agrios, G.N. 2005. *Plant Pathology*. 5th *ed.* Elsevuer Academic Press, California.

Arai M dan Takeuchi M. 1993. Influence of Fusarium Wilt toxin(s) on Carnation cell. *Plant Cells, Tissue and Organ Culture* (34): 287 – 293.

Bouizgarne B, Bouteau H.E.M, Frankart C, Reboutier D, Madiona K, Pennarun A.M, Monestiez M, Trouverie J, Amiar Z, Briand J, Brault M, Rona J.P, Ouhdouch Y, and Hadramu E.I. 2006. *Early Physiological Responses of Arabidopsis thaliana Cells to Fusaric Acid* : Toxic and Signallling Effects. *New Phytologist* 169 : 209 - 218

Djatnika, I. 2012. Seleksi Bakteri Antagonis untuk Mengendalikan Layu Fusarium pada Tanaman *Phalaenopsis. J. Hort*. 22 (3) 276-284.

Hadisutrisno, B. 1995. *Taktik dan Strategi Perlindungan Tanaman Menghadapi Gangguan Penyakit Layu Fusarium*. Makalah Simposium Nasional I di Purwokerto, 2-3 Maret.

He CY, Hsiang T, & Wolyn DJ. 2002. Induction of Systemic Disease Resistance and Pathogen Defence Responses in *Asparagus officinalis* Inoculated with Pathogenic Strains of *Fusarium oxysporum*. *Plant Pathology* 51: 225-230.

Nurcahyani E, Sumardi I, Hadisutrisno B, & Suharyanto E. 2012. Supression of Development of Vanilla Foot Rot Disease (*Fusarium oxysporum* f. sp. *vanillae*) Throught In Vitro Fusaric Acid Selection. *Journal of Tropical Plant Pests and Diseases.* Acreditation of DIKTI No.110/DIKTI/Kep/2009. ISSN: 1411-7525. Vol. 12 /No. 1: 12-22.

Wedge, D.E and Elmer, W.H. 2008. Fusarium Wilt of Orchids. *ICOGO Bull*. 2 (3): 161-168.

Wibowo A. 2002. Pengendalian Penyakit Layu Fusarium pada Pisang dengan Menggunakan Isolat Nonpatogenik *Fusarium* sp. *Jurnal Fitopatologi Indonesia* 6: 65-70.

Palmer, G.D. 2011. *The control of orchids*. http://www.ebow.com/info_8525784_control-fusarium-wilt-orchids html. Di akses pada tanggal 20 January 2015

THE EFFECTS OF A HEXANE FRACTION OF RED BETEL LEAF (*Piper cricatum*) ON LEARNING AND MEMORY IN MICE

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ABSTRACT

Red betel leaf (*Piper cricatum*) is known for its vast medicinal properties. Leaf extract revealed the presence of tannins, flavonoids, alkaloids, triterpenoides, saponins, and streoids in the red betel leaf. This study is conducted to determine the effect of n-hexane fraction of red betel leaf to the memory of mice using the method of Y mize. Mice labyrinth totaling 25 animals were divided into 5 groups, 5 mice for each respective group. Negative control group (P0) given orally 1 ml of distilled water, the group P1, P2, P3 given fraction of n-hexane 1 ml of red betel alternately with doses of 31.2 mg, 62.4 mg, 124.8 mg/kg in mice, the comparison group (P4) were given a preparation containing *Gingko biloba*. Each group Y maze apparatus is passed on to one arm at 24 hours and 72 hours after administration of the test was stopped. The parameters measured were the time it took the mice to find food on one of the arms in minutes. The time required to find the food of mice in each group were analyzed with ANOVA and showed a decrease in the time of each throughput. From the results of this study concluded that there were significant differences of memory enhancement n-hexane fraction dose of 124.8 mg/kg in mice compared to the negative control, and there are no significant differences in the comparison.

Keywords: Memory, Mice, Red Betel (*Piper crocatum*), Y Maze

1. INTRODUCTION

A number of herbal medicines are routinely used for the treatment of neurological and psychological disorders. Red betel is one of medicinal plant commonly found in the Indonesian rainforest. This plant is included in Piper genus which has leaves in heart shape with a silvery red colour. This plant grows well in the present of enough water and moderate sunlight. Currently, some people cultivate it in their yard and adopt it as herbal medicine. Red betel known as an ornamental plant, it is useful to treat various diseases. Red betel can be used to treat diabetes, hypertension, cancer, inflammation, hepatitis, hemorrhoids, gout, ulcers, and others (Sudewo, 2005).

Red betel leaf contains secondary metabolites, flavonoids, alkaloids, tannins, steroids and triterpenoids (Serlahwatyet al, 2011). Triterpenoid compounds is an important compound in the formation of cognitive function due to the pharmacological action of compounds triterpenoids can revitalize blood vessels, so that blood circulation to the brain to be smooth. Triterpenoids can provide a calming effect and improve mental function better (Annisa, 2006). Memory is the psychic ability to receive, store and bring back the stimuli or events that never experienced by a person. Generally it is said that almost everyone will experience memory problems a while because the aging process. Moreover, in everyday life we are increasingly faced with unhealthy environmental conditions. Air pollution and unhealthy diet can lead to bad effects on health and brain function (Noverina, 2011).

Several studies have shown that plants contain compounds triterpenoids can increase and improve memory. Andhika study (2012) concluded that there are significant differences in memory enhancement of the ethanol extract of *Centellaasiatica* leaf containing triterpenoid compound dose 260 mg / kg body weight of mice compared to controls. Herlina (2010) showed that the total triterpenoids of *Centellaasiatica* 32 mg/kg in mice provide improvements in cognitive function learn and remember marked with mice treated triterpenpegagan managed through passive avoidance test with a time of just 15.20 seconds, while the untreated mice reached 505.03 seconds.Therefore, aim of this study was to investigate the effect of red betel leaf fractionation using n-hexane to memory.

2. MATERIAL AND METHODS

Plant Samples, Extraction and Fractionation

Plant sample of red betel (*Piper crocatum* Ruiz and Pav) were collected from the Sub-district of TanjungSenang, the District of Bandar Lampung, the Province of Lampung, Indonesia. Taxonomic identification of plant was done by botanist at the Botanical Garden Plant Conservation Center-Indonesia Institute of Science.The frest leaf red betel were washed with water and cut into small pieces and put into a flask for maceration. Maceration was done by soaking 500 gram of the samples in 96% ethanol for 24 hours and stirred three times daily. After 24 hours, the mixture was filtered and the pulp was soaked further in 96% ethanol until the pulp no longer change the color of the solvent. After being filtered and free from the pulp, macerate then concentrated by rotary vacuum evaporator.Red betel leaf extract was added n-hexane, shaken allowed to separate. N-hexane fraction was separated, then fractionated again with solvent n-hexane several times to obtain a fraction of n-hexane clear. N-hexane fraction was evaporated with a rotary evaporator to obtain a thick extract fraction of n-hexane.

Animals

Animals used in this study were male white mice (*Mus*musculus) aged 3-4 month weighing 20-30 grams in healthy condition and has not undergone any treatment obtained from animal house of the Veterinary Centers of Lampung, Indonesia. Before treatment the mice were acclimatized for the experimental room for one week.

Test Method Using Memory Maze

The test animals were divided into 5 groups, each group consisting of 5 mice, the negative control group (P0), the test group (P1, P2, P3), as well as the comparison group (P4). Prior to testing, the test animals were fasted for 18 hours beforehand, with a fixed given water to drink. Furthermore, each group was given orally the test preparation in the morning and evening for 7 days. Negative control group (P0) were given distilled water preparations. The test group (P1) were given the test preparation dose of 31.2 mg/kg in mice, the test group (P2) were given the test preparation dose of 62.4 mg/kg in mice, the test group (P3) were given the test preparation dose of 124.8 mg/kg in mice , As for the comparison group of mice (P4) given *Ginggobilloba* dosage of 9.75 mg/kg in mice. Testing is done by calculating the time it takes to get to the target animal (finding food on one arm of the Y maze). The labyrinth arranged to form the letter Y with a 120˚ angle between the arm and the length of each arm of ± 70 cm (Figure 1).

Figure 1. Y Maze

Observations were made at 24 and 72 hours after the last administration of the test preparation. For observations at 24 hours after administration of the test preparation, first stage of adaptation and learning phase before the test phase. While in the observation 72 hours after administration of the test preparation, directly carried out the test phase. In the stage adaptation, the test animals were left

through the door and reached the fork in the maze, food was dropped at the end of the arm to the right. The test were repeated until the animal managed to find a place that contained food. The learning phase is done by placing the food on the right hand end of the arm maze. The time required to find food recorded with a stopwatch. The test were repeated until the animal to the right place. Test phase was the testing phase of real memory. All the doors werefitted, the food was placed inside the door arm to the right. In this test the level observed whether success in finding food animals is the result of the process of remembering or because the process of sight / sense alone (Phywe 1997 and Hendrayadi 1999).

The data obtained is a response to the test animals in the form of time required to find food (speed of finding food). Observation time for each mouse are limited to 11 minutes. If the time limit 11 minutes, the mice have not been able to find food, then observation is stopped. For the purposes of statistical evaluation, data from mice that were unable to find food during the 11-minute observation stated "11 minutes". In this test also note the percentage of animals that were able to find food in less than 11 minutes (Andhika2012).

Statistical Analysis

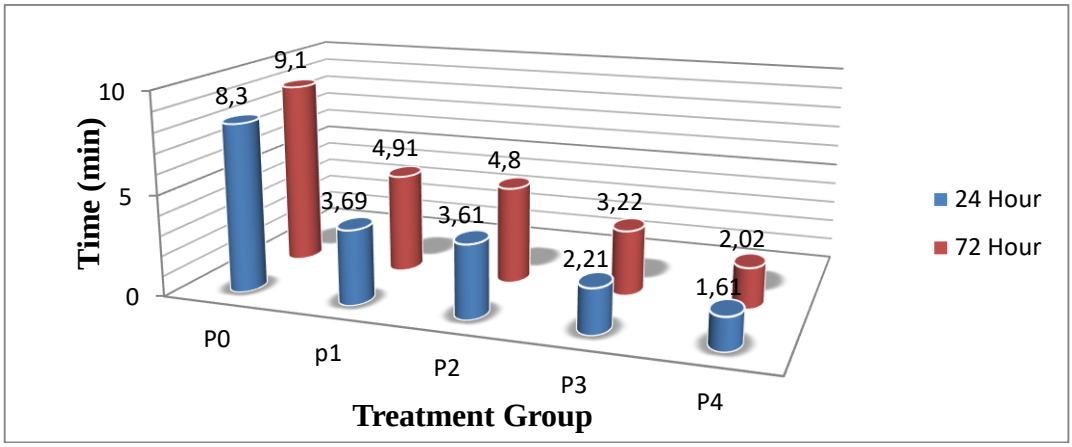
Data were analyzed using one-way analysis of variance (ANOVA) and the difference among samples was determined by Least Significant Difference (LSD) Test at $\alpha<.05$.

3. RESULT AND DISCUSSION

This study uses the fresh leaves, aims to extract that was obtained free of unwanted substances formed during drying and storage. Coarsely chopped leaves with the aim to facilitate the penetration of the solvent in the cell membrane so that it will speed up the process of solvent compounds contained in plants, the use of 96% ethanol as a solvent as ethanol can dissolve all the active substances contained in it, neutral and non-toxic. Maceration is a simple extraction, the active substance is likely more interested because every day stirring as much as possible. So that the results obtained as much as possible, it is relatively safe to use for compounds that do not withstand heating. Fractionation done to separate compounds that are polar, semi-polar and non-polar. Triterpenoids are compounds that are polar. To obtain compounds that are polar, liquid extract of red betel leaf was fractionated by adding the extract of red betel leaf and the solvent n-hexane at a ratio of 1: 1 in a separating funnel and shaken, and the fraction of n-hexane, then evaporated using a rotary evaporator to obtain condensed extract fraction of n-hexane.

In this study, using a positive control *G. biloba* preparations. Benefits of *G. biloba* is to increase the power of concentration and intelligence, a combination of flavonoids and terpenoid the combination of antioxidant function makes *G. biloba* efficacious as liquefying blood and vascular channels opener. Particularly the blood circulation to the brain that provide extra nutrients that are beneficial in improving memory (Talien 2007).

The method used in this research is the method that has been modified maze box and called the Maze Y. This tool is a modification tool that has been developed and used in previous studies. Y maze method has been used by researchers to observe, measure, simultaneously analyzing the parameters associated with learning and memory functions. Work tools are assessment maze memory where mice found the food at the end of the labyrinth of Y previously trained to find these foods. The manufacture of these are acrylic Y maze. This material is used for other than mild, acrylic water-resistant properties, so it is not easily damaged and can be easily cleaned from urine, feces, or food of mice. Mechanism of action of Y maze is to see the length of time needed by the mice to find food that is placed at the threshold of the Y maze and see the parameters of success in finding food animals is the result of the process of remembering or because the process of sight (Soemardji 2005).The result of this study showed that the higher the dose of n-hexane fraction of red betel leaf is given then the less time is required mice to find food, as shown in the figure below:



Based on the observation time required mice to find food (at the observation 24 hours after the last dose treatment) results are obtained average time group P0, P1, P2, P3, and P4 is 8.30 minutes, 3.69 minutes, 3, 61 minutes, 2.21 minutes and 1.61 minutes. Pursuant to statistical test group P4 (*G.biloba* dosage) had the fastest time for mice found food was not significantly different from the P3 (dose of 124.8 mg/kg) and was significantly different from P2 (a dose of 62.4 mg/kg) and P1 (a dose of 31.2 mg/kg), whereas in the group P0 (control of distilled water) had the longest time. This indicates that the group P3 (dose of 124.8 mg/kg) have almost the same effect with the P4 group (dosage *G.biloba*) wherein the P3 group test preparation treatment giving effect to improve memory in mice.

In observation 72 hours after the last dose results are obtained average time group P0, P1, P2, P3, and P4 is 9.10 minutes, 4.91 minutes, 4.80 minutes, 3.22 minutes, and 2, 02 minutes. Based on statistical test group P4 (preparation *G.biloba*) had the fastest time for mice found food was not significantly different from the P3 (dose of 124.8 mg/kg) but significantly different from P2 (a dose of 62.4 mg/kg) and P1 (dose of 31.2 mg/kg). P0 group (control distilled water) had the longest time. This indicates that the group P3 (dose of 124.8 mg/kg) have nearly the same as the group effect P4 (preparation *G.biloba*) wherein the P3 group test preparation giving effect to improve memory in mice, but the time required mice found food the observation 72 hours a little longer than the 24-hour observation of this happens because the process of absorption is reduced so as to improve memory, need to consume red betel leaves regularly.

Phytochemical screening of ethanol extract of red betel leaf positive for flavonoids, polyphenols, tannins, alkaloids, and terpenoids but negative for steroids which gave positive bioactivity effects. These compounds are equipped with functional groups which design them to have properties such as inhibiting oxidation in free fatty acid, encountering free radical activityor inhibiting unwanted cell growth. Therefore, these bioactive compounds have some potencies as an antioxidant, antiseptic, antimicrobial activity, and antihiperglycemia (Prayitnoet al. 2016)

Fresh red betel leaf contains secondary metabolites,a compound that can improve memory is triterpenoids which these compounds can accelerate blood circulation to brain, has a calming effect and improve mental function better (Annisa 2006). Terpenoids are lipophilic and permeate membranes. Many cross the blood-brain barrier (BBB) after inhalation. Terpenoids may remodel G-proteins via nonreseptor mechanisms, G-protein carry intracellular signals downstream from CB receptors. Some terpenoids act as serotonin uptake inhibitors, enhance norepinephrine activity, increase dopamine activity and augment gamma-aminobutyric acid (GABA), increases cereberal acetylcholine activity (decreases memory loss), increases cereberal blood flow, enhances cortical activity (Grotenhermen and Russo 2002)

4. CONCLUSION

The results using one-way ANOVA test 24 hours observation and 72 hours after the last test preparation award of given two times a day for 7 days. N-hexane fraction of red betel leaf with a dose of 124.8 mg/kg body weight of mice show a significant difference in finding food ($p < 0.05$) against the positive control.

ACKNOWLEDGEMENT

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REFERENCES

Andhika DS. 2012. Test of effect ethanol extract pegagan leaf (*Centellaasiatica* (L) Urb.) and the combination with ethanol seed black cumin (*Nigella sativa* L.) against memory mice method using maze Y. [Thesis].Faculty of Mathematics and Natural Sciences Pharmaceutical Islamic University,Bandung. [Indonesia]

Annisa.2006. Pegaganimprove memory. School of Science and Technology Bandung, Bandung.

Grotenhermen F, Russo E. 2002. Cannabis and cannabinoids pharmacology, toxicology and therapeutic potential. The Haworth Integrative Healing Press, New York.

Hendrayadi H. 1999. The effect of amphetamine and diazepam memory and behavior against swisswebster mice.[Thesis]. Department of Pharmacy, Faculty of Mathematics and Natural SciencesInstitutTeknologi Bandung, Bandung [Indonesia].

Herlina. 2010.The effects of triterpenes total of pegagan(*Centellaasiatica* (L) Urban)against the learning and cognitive function in mice given male albino (*Musmusculus*). [Thesis].Sriwijaya University, Palembang [Indonesia].

Noverina A. 2011, Senile at young age. Holistic Health Solution, Jakarta.

Phywe.1997. Laboratory experiments physiology. Phywesyteme GMBH, goettingen.

Prayitno SA, Kusnadi J, Murtini ES. 2016. Antioxidant acrtivity of red betel leaves extract (*Piper crocatum*Ruiz &Pav) by difference concentration of solvents. RJPBCS. 7(5): 1836-1843.

Serlahwaty D,Sugiastuti S, Ningrum RC. 2011.Extract antioxidant activities of water and 70% ethanol green betel leaf (*Piper bettle* L.) and red betel (*Piper cf.* Fragile Benth.) with damping method DPPH free radicals ", Journal of Pharmaceutical Sciences Indonesia. 9: 143-146.

Soemardji. 2005. Memory Test Method Using Modified Maze.Faculty of Mathematics and Natural Sciences Pharmaceutical Islamic University, Bandung.

Sudewo B. 2005. Exterminate Disease with Red betel. AgromediaPustaka, Jakarta.

Talien.2007, *Gingko biloba*.Faculty of Mathematics and Natural Sciences Pharmaceutical Islamic University, Bandung.

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THE LOCAL KNOWLEDGE OF COASTAL ETHNIC COMMUNITIES OF PLANTS THAT EFFICACIOUS AS MEDICINE IN 5 DISTRICTS OF SOUTH LAMPUNG REGENCY

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ABSTRACT

This study aims to determine the diversity of medicinal plant species which is based on the knowledge of the ethnic communities of coastal South Lampung regency. This research was conducted in 5 districts of South Lampung regency, such as : District Rajabasa, District Kalianda, District Sidomulyo, District Penengahan, and District Katibung from March to May 2016. According to the results, 101 medicinal plant species are obtained from 43 families. Plant species that are widely used are from the family of Zingiberaceae, Euphorbiaceae, Poaceae and Asteraceae. The many types of diseases that are treated using by medicinal plants by the coastal ethnic communities in 5 districts of South Lampung regency are diabetes and high blood pressure. The Habitus which is widely used was herbs and the least was liana, whereas the most part that often used is leaf.

Keywords : Medicinal plant, South Lampung Regency, Coastal Ethnic

1. INTRODUCTION

Medicinal plants are all plants that are known to have good efficacy in helping maintain the health or treatment of a disease. Medicinal plants are very closely related to traditional medicine, because most effective use of medicinal plants has not been based on clinical laboratory testing, but based on experience (Yuni et al., 2011).

The utilization of medicinal plants in Indonesia has been growing rapidly. The role of medicinal plants can indeed be developed extensively in Indonesia. The role of plants as medicine is very important to know the community, to maintain their survival (Wardah and Setyowati, 2010).

A data and information about medicinal plants in 5 District of South Lampung regency has not been known. Therefore, there needs to be an effort to document the knowledge of traditional medicine, one way is through his documentation ethnobotany study of medicinal plants. Ethnobotany is an interdisciplinary branch of science, namely the study of human relationships, the plant with its surroundings. Ethnobotany as a study that explains the relationship between humans and plants thoroughly describe the role and functions of plants in a culture.

Ethnobotany of medicinal plants is one form of interaction between people and the natural environment. Interaction on each tribe has its own characteristics and depend on the characteristics of the region and the potential wealth of existing plants. Assessment ethnobotany medicinal plants according to specific tribes intended to document the resource potential of medicinal plants and is an effort to develop and preserve it (Hastuti, 2012). While data and information on the medicinal plants in 5 District of South Lampung regency largely unknown, it is very important to develop medicinal plant species native local area especially in South Lampung regency.

2. MATERIALS AND METHODS

This study was conducted in March 2016 until May 2016 took place in the District 5 (Rajabasa, Trump, Sidomulyo, Mediation, and Katibung) South Lampung regency. Tools and materials used, among others register of medicinal plants Indonesia, a questionnaire to the respondents, the camera's object of study documentation and materials for herbarium. The data collection is done by observation and interview methods. Selection of respondents was done by using purposive sampling determines the respondents based on their specific considerations (Arikunto, 2006). To get expert traditional healers (respondents) should be based on recommendations from the traditional leaders or local community leaders (Purwanto, 2007). The data obtained is calculated using the formula (Fakhrozi, 2009):

Percent of special habitus:

$$\frac{\sum species\ of\ special\ \ habitus}{\sum all\ kinds}\ x\ 100\%$$

Percent of used part:

$$\frac{\sum special\ part\ which\ is\ used}{\sum all\ part\ which\ is\ used}\ x\ 100\%$$

Percent of family which is used:

$$\frac{\sum special\ kind\ of\ family}{Total\ of\ all\ \ kinds\ of\ family}\ x\ 100\%$$

Percent sum of deseae :

$$\frac{\sum\ special\ deseae\ infected}{Total\ of\ infected\ deseae}\ x\ 100\%$$

3. RESULTS AND DISCUSSION

Based on interviews and observations that have been made, obtained 101 medicinal plant species from 43 plant parts that are used in 5 Districts South Lampung regency in each village.

1. Parts of plants used

The number of plant species which are most widely used in the Zingiberaceae parts, can be seen in Figure 1.

Tribe of the plant most widely used is Zingiberaceae because these plant species are of the tribe is very familiar among the general public, such as ginger, turmeric, kencur, ginger, temu ireng, galangal and bangle. One of them is the kind kencur (*Kaempferia galanga*). Powder is a kind-finding meeting which is widely used as a traditional medicine. Chemical constituents of the rhizome kencur of which consists of saponins, flavonoids, polyphenols and essential oils consisting of (ethyl p-methoxycinnamate, isobutyl ß-2-furilakrilat and hexyl format), derivate monoterpenes oxygenated (ex, borneol and camphor hydrate), as well as monoterpene hydrocarbons (ex. kamfen and terpinolen) (Sukari *et al*., 2008). The content of secondary metabolites in kencur especially from the class of flavonoids and essential oils. Secondary metabolites produced by plants Zingiberaceae generally can inhibit the growth of pathogens that harm human life (Nursal *et al*., 2006).

Potential plant located in South Lampung regency is still high to be used as a medicinal plant while the local traditional healers know only plants that are always used daily, due to traditional healers memory has been reduced, then some plant species can not be remembered. So that knowledge is not passed on to their family and loved ones.

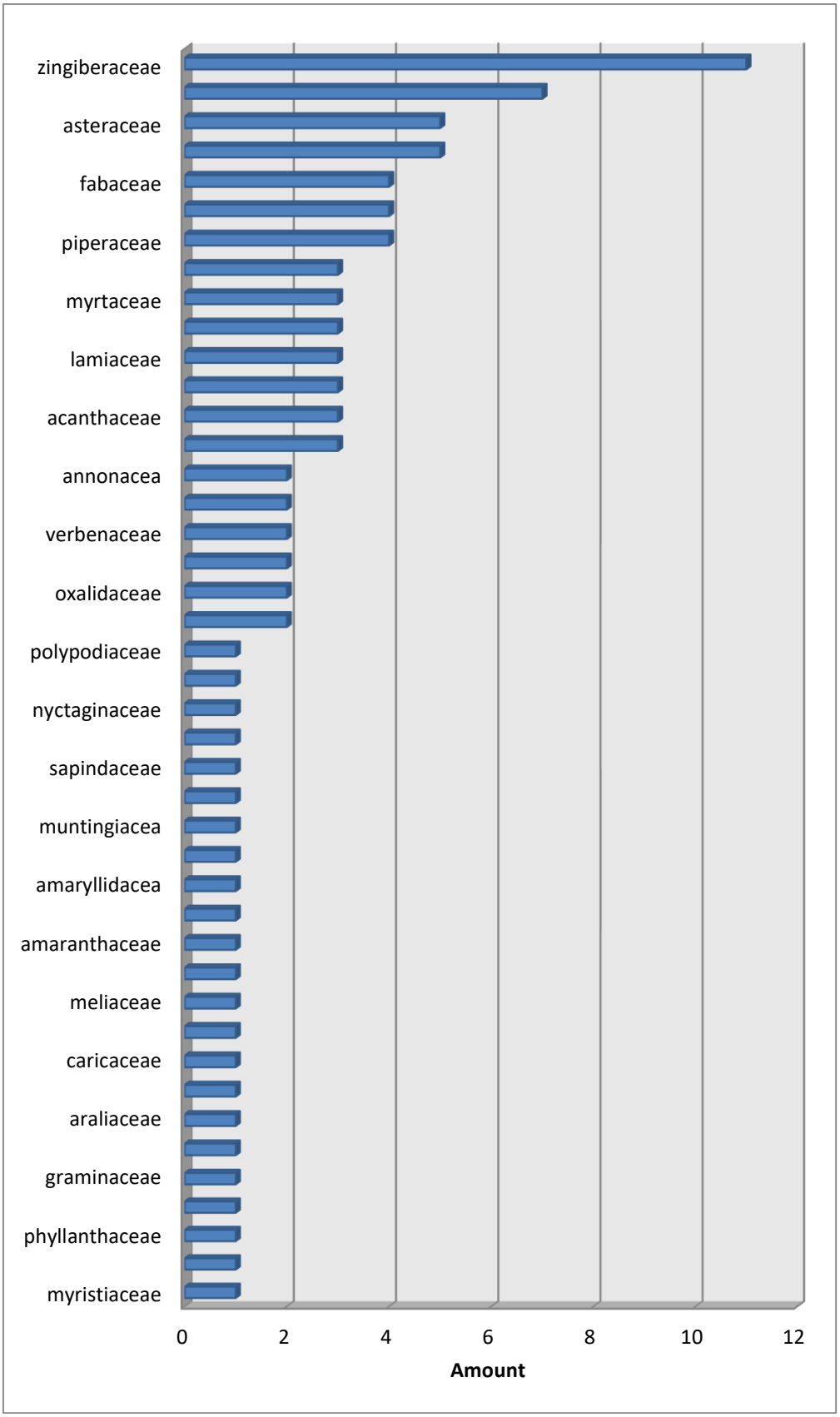

Figure 1. Graph of the percentage of plant parts used in the District of South Lampung District 5

2. **Habitus is widely used**

Based on the research results, habitus is the widely used herbs and the least was liana, can be seen in Table 2.

Table 2. Percentage of habitus which is widely used as a medicinal plant in South Lampung regency 5 Districts

No	Subdistric	Habitus (%)				
		Tree	Perdu	Semak	Herba	Liana
1	Rajabasa	21,42	14,28	14,28	50	0
2	Kalianda	17,85	32,14	14,28	32,14	3,57
3	Penengahan	8,69	13,04	21,73	52,17	4,34
4	Sidomulyo	30,43	0	8,69	56,52	4,34
5	Katibung	14,28	19,04	19,04	47,61	0

Total percentage habitus which is used can be seen in Figure 2..

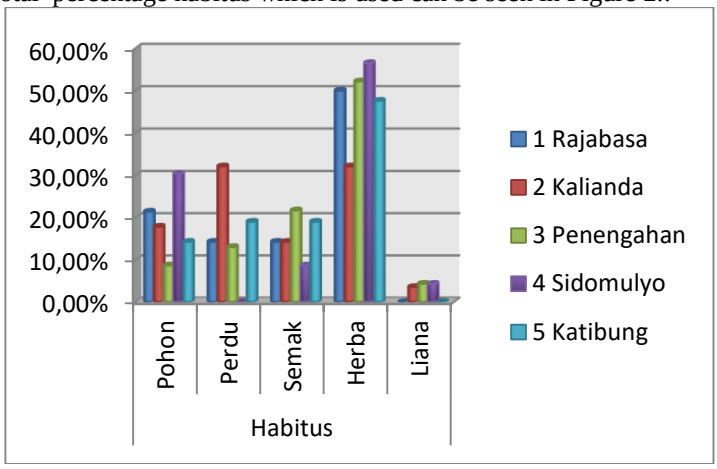

Figure 2. Graph of habitat is widely used as a medicinal plant in the 5th District of South Lampung regency

This is according to research Arizona (2011), at the level of herbaceous plants is a plant easily cultivated and does not require large tracts of land, enough to plant in the yard. One of herbaceous plants that are used are turmeric (Curcuma xanthorrhiza), ginger is thought to provide an antimicrobial effect for active ingredients such as essential oils. One element essential oil that is terpenoids which allegedly involves the breakdown of the membranes by lipophilic components. Other content is Phenol, suspected to be toxic to the bacteria through inhibition of the enzyme (Cowan, 1999). While habitus is little used by traditional healers in 5 District of South Lampung Regency is a liana. Liana is a plant vines, climbing or hanging. Plants including liana is green betel (Piper betle L.). According Kartasapoetra (1988), green betel also effective as a cough medicine, anti Septika and mouthwash owned betel leaf content in the form of essential oils, khavikol, estragol, eugenol, hidroksikavicol and karvacol. In addition there is also the use of red betel (Piper crocatum Fuiz. & Pav) that is trusted coastal ethnic communities can treat canker sores, bleeding gums, ulcers, and high blood pressure.

3. **Part used**

Part of the plant used in the form of roots, stems, leaves, flowers, fruits, seeds, rhizomes and sap. The most widely used are the leaves (Table 3).

Use of leaves as ingredients of medicines are considered as a way of processing more easily than the skin, stems and roots. The leaves also have high regeneration to re-sprout and had no impact on the growth of a plant even though the leaf is a point of photosynthesis (Fakhrozi, 2009). Plants that used the leaves by ethnic coastal District of South Lampung District 5 of them are bitter

(*Andrographis paniculata* Ness.), pegagan (*Centella asiatica* L.), waru (*Hibiscus macrophyllus* Roxb.), asoka (*Ixora palludosa* L.), sirih (*Piper betle* L.), jarak (*Jatropha curca* L.), daun dewa (*Gynura segetum* Lour.), meniran (*Phyllantus niruri* L.), salam (*Syzygium polyanthum*), bayam duri (*Amaranthus spinosus* L.), bakung (*Crynum asiaticum* L.), dll.

Table 3. Percentage of part of the plant used as a medicinal plant in South Lampung regency 5 Districts

No	Subdistric	Parts Used (%)							
		Root	Stem	Leaf	Flower	Fruits	Seed	Rhizome	Sap
1	Rajabasa	0	10,34	37,93	6,89	13,79	0	24,13	6,89
2	Kalianda	3,22	16,12	32,25	3,22	22,58	3,22	16,12	3,22
3	Penengahan	12,5	12,5	34,37	6,25	12,5	3,12	18,75	0
4	Sidomulyo	6,89	6,89	51,72	0	10,34	10,34	13,79	0
5	Katibung	18,18	0	40,90	4,54	22,72	4,54	9,09	0

Total percentage of parts used can be seen in Figure 4.

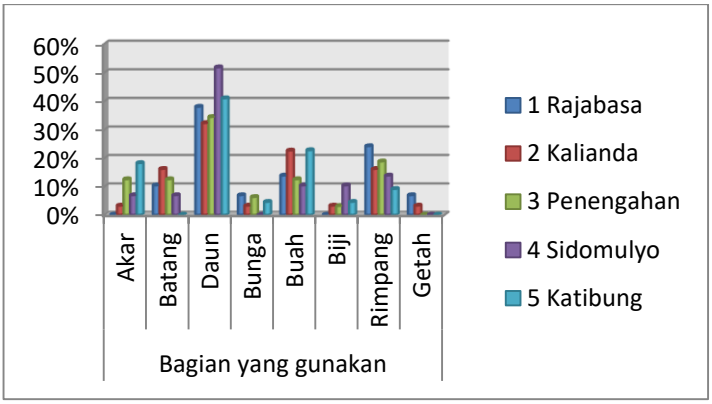

Figure 4. Graph part of the plant used as a medicinal plant in South Lampung regency 5 distric

Not only certain parts of the plant are used as medicine by ethnic coast in South Lampung regency, but there are also herbs that are used all the parts to be mixed as drug among which meniran (*Phyllantus niruri* L.), urang-aring (*Eclipta alba*), sesuruhan (*Peperomia pellucida* L.), anting-anting (*Acalypha australis* L.), kembang coklat (*Zephyranthes candida*), dan sangketan (*Heliotropium indicum* L.).

4. This form of processing of medicinal plants

Ways of processing medicinal plants can be divided into two, namely, singular and mix. Processing in a single form can be boiled, shredded, smeared, pounded, eaten directly, as well as shed. Shape mixture of herbs that is a mixture of plants that one and the other with a certain dose to be traditional herb medicine. How to use an herb used in traditional medicine in the form of a medication inside, outside or inhaled. The use of in particular by drunk or eaten directly, treatment with boiled, mashed or grated. While the user from the outside by means of smeared, taped, used as a poultice, dripped or even as an ingredient for a shower. The use of traditional medicine in a way that is inhaled inhaled the scent of the herb through the nostrils.

4.CONCLUSIONS

Based on the research that has been done it was concluded as follows:

1. Found 101 species of plants from 43 tribes, one of the most widely is Zingiberaceae rate (25.58%) were used in 5 Districts South Lampung regency.
2. Habitus is the widely used herbs (47.68%) and the least was liana (2.45%).
3. Part of the plant most widely used are the leaves (39.43%) and the least is the sap (2.02%)
4. Type a disease that affects many in the 5th District of South Lampung regency is diabetes and hypertension.

Recommendations:

The need for further research to determine the bioactive components and traditionally using by traditional healers can be proven scientifically.

REFERENCE

Arikunto, S. 2006. *Prosedur Penelitian Suatu Pendekatan Praktik*. Rineka Cipta. Jakarta

Arizona. 2011. *Etnobotani Dan Potensi Tumbuhan Berguna di Taman Nasional Gunung Ceremai Jawa Barat*. Fakultas Kehutanan. Institut Pertanian Bogor.

Cowan, Marjorie Murphy. 1999. Plant Products as Antimicrobial Agents. Clinical Microbiology Review, Vol 12: 564-82

Fakhrozi, I. 2009. Etnobotani Masyarakat Suku Melayu Tradisional di Sekitar Taman Nasional Bukit Tigapuluh (studi kasus di Desa Rantau Langsat, Kecamatan Batang Gangsal, Kabupaten Indragiri Hulu, Provinsi Riau). (Skripsi). Bogor : Fakultas Kehutanan, Institut Pertanian Bogor.

Hastuti. 2012. *Pemanfaatan Tumbuhan Obat Tradisional Di Desa Tranya, Kec Kintamani, Kab Bangli.* Universitas Udayana. Jurnal Bumi Lestari, Volume 13 No. 1. Februari 2012. Hlm: 120-122

Kartasapoetra, A.,G,. 1988. *Budidaya Tanaman Berkhasiat Obat*. Bina Aksara. Jakarta.

Nursal, Wulandari, S., Juwita, W.S.,. 2006. Bioaktifitas Ekstrak Jahe *(Zingiber officinale)* dalam Menghambat Pertumbuhan Koloni Bakteri *Eschericia coli* dan *Bacillus subtilis*. *Jurnal Biogenesis* Vol. 2(2): 64-66

Purwanto, Y. 2007. *Ethnobiologis*. Ilmu interdisipliner, metodologi, aplikasi, dan prosedurnya dalam pengembangan sumberdaya tumbuhan. Bahan Kuliah Pascasarjana. IPB. Bogor.

Sukarii, M.A., N.W.M. Sharif, A.,L.,C. Yap, S.W., Tang, B.K., Neoh, M. Rahmani, G.C.L. Ee, Y.H. Taufiq-Yap, and U.K. Yusof. 2008. Chemical Constituens Variations of Essential Oils from Rhizome of Four Zingiberaceae Species. *The Malaysian J. Anal. Sci*. 12:3, 638-644

Wardah dan Setyowati. 2007. *Keanekaragaman Tumbuhan Obat Masyarakat Talang Mamak Disekitar Taman Nasional Bukit Tigapuluh*. Riau. Volume-8

Yuni, V., F. Harmida dan Sarno. 2011. Studi Etnofitomedika di Desa Lawang Agung Kecamatan Mulak Ulu. Kabupaten Lahat Sumatera Selatan. *Jurnal Bumi Lestari*. Volume 14 (1D) 14110. Sumatera Selatan: Universitas Sriwijaya. Hlm.42

PHYTOTELMATA SPECIES AND ITS DISTRIBUTION IN SOUTH PRINGSEWU, LAMPUNG

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ABSTRACT

Phytotelmata is a unique morphological characteristic plant, it can keep waterbody that is use as breeding site for insect like mosquito. This research was done to identify phytotelmata and its distribution in South Pringsewu Village, Lampung on March 2016. Plant identification was in Botani Laboratory Biology Department Lampung University. Five phytotelmata species of 31 individuals were identify with two different types node (Ketiak Daun, KD) and tree holes (Lubang Pohon, LP). Value distribution and dispersal patterns of five species of plants have a value Ip>0 belonging to the clumped distrbution patterns.

Keywods : node (Ketiak Daun, KD), phytotelmata, pringsewu, tree holes (Lubang Pohon, LP)

1. INTRODUCTION

Indonesia is one country that has a high biological wealth of flora and fauna (Suryana, 2008). The high level of biodiversity causes traits and characteristics which are different in each region (Nandika, 2006). The existence of living beings in a place to be related to habitat and ecological niches. Living creatures that are in a habitat will be distributed to the appropriate areas for survival (Kramadibrata, 1996). Distribution can be interpreted as spread of any organism in a habitat. Spreading that occurs will cause patterns of spread of, ie the spread in various ways, random and clumped. Pattern - the pattern of spread can occur in both animals and plants, including plants phytotelmata (Indriyanto, 2008). Phytotelmata is a plant that can hold water in the body that can serve as habitat for breeding grounds by a variety of organisms, including insects (Kitching, 1971; Sota, 1996; Fish 1983).

Pringsewu is one of the districts with fairly rapid development and population growth are quite large. Increased population growth will be accompanied by development, particularly in housing construction. The existence of gardens around the housing will have an impact on the number of plant species that grows mainly phytotelmata types used by mosquitoes as breeding places naturally. Until now there has been no research on the distribution of plants phytotelmata and types of mosquitoes found in the District Pringsewu. Therefore, research is needed in order to know the type and distribution of phytotelmata in Districts South Pringsewu Village, Lampung in the hope of providing information to the public about the type and distribution of phytotelmata and the types of mosquitoes that inhabit it, and as a reference for relevant agencies in the efforts to control disease-carrying mosquitoes.

2. MATERIALS AND METHODS

This research was conducted in March 2016 South Pringsewu Village, Lampung. Identification phytotelmata conducted at the Botany Laboratory, Biology Department, Faculty of Mathematics and Natural Sciences, Lampung University. The tools will be used in this research is the 3200D NIKON cameras, thermometers, measuring cups, data sheets, stationery, sample bottles, large plastic, paper label, GPS, pH paper, volumetric pipette and hygrometer. Materials used are plant phytotelmata found. Location research is using *purposive sampling*. Sampling plant belonging to the plant criteria phytotelmata done directly. Data obtained from observations later in the analysis. To determine the distribution phytotelmata using the formula Morista Index (Krebs, 1989) are as follows:

$$Id = n\frac{\Sigma x^2 - \Sigma x}{(\Sigma x^2) - \Sigma x}$$

Information :

Id	:	Deployment Index Morista
n	:	Number of plots
Σx	:	Number of individuals of a species per sample plots
Σx^2	:	The sum of squares of each individual species plots
$X^2_{0,975}$	=	0,216
$X^2_{0,025}$	=	9,348

With the following provisions:

1. If the value of Ip <0 then a uniform distribution pattern
2. If the value Ip = 0, the pattern of random distribution
3. If the value Ip> 0 then the distribution pattern of clump

3. RESULTS AND DISCUSSION

a. Type and amount phytotelmata found in South Pringsewu Village, Lampung

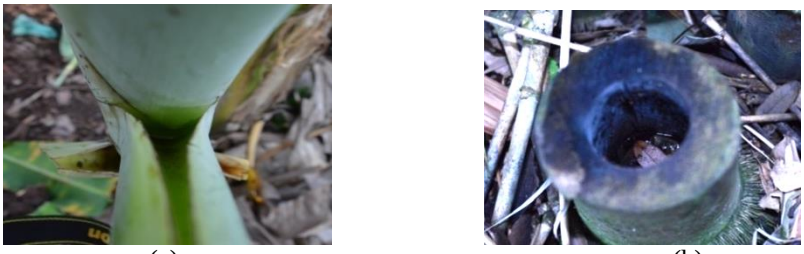
Observance of the kind phytotelmata in the village of South Pringsewu District of Pringsewu found three tribes and five types of plants phytotelmata. Phytotelmata types most commonly found are the type (LP) as many as 17 individuals. The average volume of water being stored in phytotelmata the highest type of tree holes (LP) of 30.52 ml (Table 1). The number of plant species most commonly found are Gigantochloa atroviolacea of Poaceae tribes of nine individuals who are able to accommodate a puddle of 160 individuals were found.

Table 1. Type and amount phytotelmata found in the village of South Pringsewu Pringsewu Subdistrict, Regency of Lampung Pringsewu

No.	Family	Plant Type	Type of Phytotelmata	Water Volume (ml)	Number of individuals	The total number of plants (individual)
1	Araceae	*C. esculenta*	KD	23	4	41
		A. macrorrhiza	KD	32,2	5	17
2	Musaceae	*M. paradisiaca*	KD	42	5	57
3	Poaceae	*G. apus*	LP	32,87	8	160
		G. atroviolacea	LP	28,4	9	160
Jumlah			**-**	**158,47**	**31**	**435**

Note: KD : Node ;
LP : Tree Hole

The observation of the type phytotelmata, found two types, namely the type KD phytotelmata (a) and type LP (b) (Figure 1).



(a) (b)

Figure 1. Types of phytotelmata found, (a) type phytotelmata node (Ketiak Daun, KD) and (b) type phytotelmata tree holes (Lubang Pohon, LP)

b. Distribution and dispersal patterns phytotelmata

Value distribution of five types phytotelmata found, on average, have a distribution value> 0. This value indicates that the distribution of phytotelmata found in the Southern District of Pringsewu Pringsewu village belonging to the type of clustered distribution patterns (Table 2).

Table 2. Results of the value of the distribution and pattern of spread in the village Pringsewu phytotelmata Southern District of Pringsewu

No.	Plant type	Distribution Value	spread pattern
1.	*C. esculenta*	1	Clump
2.	*A. macrorrhiza*	1	Clump
3.	*M. paradisiaca*	1	Clump
4.	*G. apus*	1	Clump
5.	*G. atroviolacea*	1	Clump

The identification results that have been committed against phytotelmata plants, plant species most commonly found are the type *Gigantochloa apus* (apus bamboo) and *G. atroviolacea* (black bamboo) of Poaceae tribes that as many as 160 individuals (Table 1). A large number of these plants is suspected because of the environmental conditions in accordance with the District Pringsewu environmental factors required by the bamboo plants to grow and reproduce. According to Sutiyono and friends (1996), bamboo plants will breed well if the air temperature ranges between 8.8°C-36°C and the humidity ranges between 40-85%. Temperatures in the village of South Pringsewu District of Pringsewu range 26-31°C and humidity ranging from 63-78%. It can be argued that the factor of temperature and humidity in the village of South Pringsewu District of Pringsewu suitable for the development of the bamboo plant. In addition to the temperature and humidity, soil type and texture is suspected to be a factor optimal plant growth bamboo. Sutiyono and friends (1996) adds that the bamboo plants can grow in all types of soil except soils located near the beach.

If seen from the history, the name of District Pringsewu from Javanese namely "Pringsewu" which means "Thousand Bamboo", so the District Pringsewu dubbed the City of Thousand Bambu. This may formerly District Pringsewu overgrown with dense bamboo plants and these conditions are still to be found (District Pringsewu, 2015).

M. paradisiaca plant species of the tribe Musaceae also found that as many as five people from 57 individuals (Table 1). This is likely due to environmental factors in the District Pringsewu support for the life of the banana plant, where the air temperature of about 26-31°C and the texture of the soil in such studies are clay and silty clay. According to Nakasone and Paull (1998), the banana can grow in an environment with a temperature of 15-31°C and the optimum temperature of around 27°C as well as soil texture can be planted banana plants in the form of clay, sand to heavy clay. Due to the environmental conditions that support, society deliberately planted banana plants so the plant is to be one of the featured commodities.

This is supported by data from Badan Pusat Statistics of Pringsewu that kind of fruits that lots produced in the District Pringsewu are bananas (BPS, 2015). Pringsewu a district whose land is quite widely used in the agricultural sector.

If seen from the numbers, the number of individuals that can hold stagnant water is fairly low when compared with the total number of plants, of which five species of plants found there are 31 people can accommodate a puddle of 435 individuals were found (Table 1). But suspected this amount can be increased if at the time of taking and observations in conjunction with the rainy season and the plants was not damaged by the activity of animals and humans.

To determine the distribution patterns phytotelmata, obtained from the analysis of the value of the distribution. Distribution value derived from analysis Morista Index (Katili, 2013), in this study the average - average> 0 showing the clumped distribution patterns. According to Indriyanto (2008) distribution patterns are common in both animals and plants are clustered pattern. Katili (2013) also

says that the distribution pattern mengolompok a pattern that often occurs in nature, this is due to the need for the same environmental factors. Plants will be clustered (grouped) in a region when soil and environmental conditions conducive to the growth (Campbell, 2010).

The distribution pattern of plants which groups can also be caused due to the reproduction the plants, such as plants that reproduce both by seeds wherein seed does not fall far from its parent and reproductive vegetative bud formation, where the shoots that grow not far from its parent (Campbell, 2000) , As the plant *G. atroviolacea* (black bamboo) and *G. apus* (apus bamboo) is the most abundant in this study had a vegetative reproduction (asexual) is a way of breeding involving only one parent and new individuals that appear to originate from the parent body , Vegetative reproduction is divided into two, namely natural and artificial. Vegetative reproduction is naturally there are several kinds, one of which is by way of the formation of buds. One such example is bamboo (Abdurahman, 2008).

4. COCLUSION

The conclusions that can be drawn from this study are:

1. The species most commonly found are the type *G. artoviolacea* and *G.apus.*
2. South Pringsewu village, sub-district administrative Pringsewu plant species are found to have a distribution value> 0 means have adequate clustered distribution patterns.
3. Type phytotelmata most abundant and capable of accommodating a puddle of water that is the type Node (KD)

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REFERANCES

Abdurahman, D. 2008. *Biologi Kelompok Pertanian dan Kesehatan*. Grafindo Media Pratama. Bandung.

(BPS) Badan Pusat Statistik Kabupaten Pringsewu. 2015. *Pringsewu dalam Angka 2015*. BPS Kabupaten Pringsewu. Lampung.

Campbell, N.A, Reece, J.b, Mitchell, L.G. 2000. *Biologi Jilid III*. Edisi Kelima. Erlangga. Jakarta.

Campbell, N.A, Reece, J.b, Mitchell, L.G. 2010. *Biologi Jilid III*. Edisi Kedelapan. Erlangga. Jakarta.

Fish, D. 1983. Phytotelmata Flora dan Fauna. In: *Phytotelmata Terestrial Plants as Host of Aquatic Insect Communicaties* (eds , J. H Frank & L. P. Lounibos), Plexus, Medford, pp 161 – 190.

Indriyanto. 2008. *Pengantar Budidaya Hutan*. Bumia Aksara. Jakarta.

Katili, A.S. 2013. Deskripsi pola penyebaran dan faktor bioekologis tumbuhan paku (Pteridophyta) di Kawasan Cagar Aalam Gunung Ambang kawasan Kabupaten Bolaang Mangondow Timur. *Jurnal Sainstek.* 2 (7) : 1-13.

Kitching, R. L. 1971. An Ecology study of water filled tree- holes and their position in the woodland ecosystem. *Journal of Animal Ecology* 40 : 281 – 302.

Kitching, K. L. 2000. *Food Webs and Container Habitats : The Natural History and Ecology of Phytothelmata*. Cambridge University Press. New York.

Kramadibrata, H. Ibkar. 1996. *Ekologi Hewan*. Institut Teknologi Bandung. Bandung.

Krebs, C.J. 1989. Ecological Methodology. Harper Collins *Publisher*, Inc. New York.

Nandika, 2005. *Hutan Bagi Ketahanan Nasional*. Muhammadiyah University Press. Surakarta.

Suryana, 2008. Keanekaragaman jenis tumbuhan paku terestrial dan epifit di Kawasan PLTP Kamojang Kabupaten Garut Jawa barat. *Jurnal Biotika*. No 1(7).

Sutiyono, Hendromono, Marfu'ah, Ihak. 1996. *Teknik Budidaya Tanaman Bambu*. Pusat Litbang Hasil Hutan. Bogor.

Sota, T. 1996. Effect of Capacity on Resource Input an Aquatic Metazoan Community Structur in Phytotelmata , *Researches Population Ecololy* 38: 65 -73.

THETOXICITY OF PURIFIED ISOLATE OF POLAR EXTRACT POWDER LEAFS *GLIRICIDIA MACULATA* HBR. TO CACAO MEALYBUG (*PLANOCOCCUS MINOR* MASKELL)

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ABSTRACT

One contributing factor in decreasing productivity of cocoa in the last years is due to pest attack. Cacao mealybug (*P. minor*) attack the young cacao fruits, by sucking them until dry and die. Therefore it should be controlled. Alternatives pest control of the insecticide has been widely searched. *G. maculata* leaves consist of rich flavonoid that potencial as botanical insecticide . In oder to get the purified isolate of polar extract pouder leaf *G. Maculata* that named (PIGR), and test its toxicity to cacao mealybug (*P. minor*), the powder leaf of *G. maculata* were extracted by using various organic solvents (n-hexane, dichloromethane, methanol and water). A set of laboratory experiment was conducted to test the toxicity by bioassay, and to know the type and structure of PIGR by spectroscopic analysis. Five different concentrations (0 % , 0,015 % , 0,030 % , 0,045 % and 0,060 %) of PIGR with each of 3 replications were tested to cacao mealybug mortality. Mortality observed at 12 , 24 , 48 and 72 hours after treatment. Probit analysis was conducted to obtain LC_{50} . The result indicated the PIGR was toxic to cacao mealybug (*P. minor*) with LC_{50} 72 hours metanol extract 0,054% and water extract 0,047%. Therefore water extract more toxic than metanol extract. The toxic compound of methanol extract and water extract *G. maculata* is flavon with the structural frame is 2 - phenyl - 1,4 - benzopiron .

Keywords : polar extract , powder leaf, cacao maelybug, flavon.

1. INTRODUCTION

Cocoa (*Theobroma cacao* L) is one of the important tree crops in Indonesia, which has many beneficial value. Production of cocoa in Indonesia is often decreased. The cause of the decline in the production of cocoa beans is due to pest attack mealybugs (Wijaya, 2007). Mealybug (*Planococcus minor* Maskell) was sucking immature fruit causing dry and die (Sumarno, 2015). The use of synthetic insecticides are not right will bring bad effects, more harm than benefit resulting. Leaves gamal (*Gliricidia maculata* Hbr.) Has the active ingredient coumarin which are insecticides, rodenticides and bactericide that can be used as environmentally friendly insecticide plant (Kementerian Pertanian Ditjen Peternakan dan Keswan, 2009). Gliricidia leaves contain toxins that dikumerol main compound, a compound capable of binding vitamin K to clot blood. Dikumerol represents the conversion of coumarin due to bacterial activity when it ferments. Coumarin is suspected flavonoid compounds can irritate the skin and can inhibit the transport of amino acids leucine (Nukmal et al, 2010)

The results of the study Nukmal et al., (2009 and 2010) also proved that extracts polar (water and ethanol) Gliricidia leaves can cause 100% mortality in the pest imago boils dadap (*Quadrastichus erythrinae*) after 72 hours of treatment at the laboratory scale.

From the results of studies have been done to prove that the *G. maculata* leaf powder extract has potential as botanical insecticide. Purposes this study to know the toxicity, the type and structure of the gliricidia (*G. maculata*) pure isolates powder leaf are effective in control (*P. minor*) to the cocoa (*T. cacao*).

2. RESEARCH METHODS

A. Tools and Materials

The tools used this research are Machete, sacks, grinding machines, scales, glass jars, filter paper, Rotary evaporation, separating funnel, Freezedrayer, UV light, aluminum foil, erlenmeyer flask, test tubes, spatulas, analytical balance, oven, beaker, beakers, pipettes, funnel, hot plate, electric heating, capillary pipette. The tools used to prepare the test insects is a plastic knife, jars, gauze pads, rubber bands, brushes and pins.

The materials are Gliricidia leaves, solvent n-hexane, dichloromethane (DCM), methanol, distilled, KK Amberlite XAD-4, Plate TLC cellulose, H_2SO_4 as an ingredient identifier solution, and HCl is used to adjust the pH at the time of fractionation. $CeSO_4$ visualization solvent, $AlCl_3$, H_3BO_3 and NaOH. HCl, NaCl and ethyl acetate to extract water hydrolysis, H_2SO_4 as an ingredient in a solution of identifiers when TLC. Cocoa mealybugs (*P. minor*), cocoa fruits.

B. Isolation and Purification of Flavonoid Compounds Group Methanol extracts

500 gr of Gliricidia powder leafes macerated using a solvent Hexana 1.500 ml, DCM solvent 1000 ml, methanol 1.200 ml and 1.200 ml water. Total filtrate of methanol was evaporated and then recrystallization method using freezedryer for 72 hours. Furthermore, to the purification of the methanol extract conducted by fractionation using column chromatography (CC) Amberlite XAD-4. Amberlite XAD-4 5 gr was added to column chromatography. Fractions that have been obtained are evaporated and TLC analyzed to obtain the active fraction rich in flavonoids.

Water filtrate was concentrated Gliricidia leaf powder by recrystallization method using freezedryer for 72 hours. After that extract water hydrolysed. The results of hydrolysis showed two-phase extraction, the water phase and ethyl acetate phase. Furthermore, the results of hydrolysis was monitored by TLC.

Bioassays were carried out is the test of mortality with residual effect (residual effect) Bioassay made by soaking the test medium with 5 level of concentration levels (0%, 0.015%, 0.030%, 0.045% and 0.060%) for 10 minutes, 10 test insects tail (*P. minor*) females who already acclimatized for 1 day before the treatment is placed on the test medium. Observations of insect mortality trial conducted at 12, 24, 48 and 72 hours after treatment. The percentage of deaths for each extract will be analyzed with probit analysis EXE program ,test ANOVA and continued with Tukey's test was used to determine an effective solution as botanical insecticide to determine the relationship with the concentration of insect death. Test solution is said to be effective if the solution is giving the LC50 value ≤ 5% (Prijono, 2005). These trials were conducted each with 3 replications. The data were then analyzed using probit analysis to determine LC_{50} values. Determination Pure Active Compounds Structure using spectroscopic methods.

3. RESULTS AND DISCUSSION

A. Isolation and Purification of Flavonoid Compounds

The resulting methanol extract as much as 53 gr. The resulting crude extract freezedryer process is as much as 20 grams in the form of pasta that is solid green.
Results fractionation methanol crude extract obtained 44 fractions. Of the 44 factions only 4 fractions which showed spots on the chromatogram as an indication of flavonoid compound that is the fraction 1, fraction 2, fraction 26 and fraction 27. Fraction 1 and 2 has a Rf value of 0,700. Fraction 26 and 27 have a value of Rf 0,875. Rf equal value can be said that the compounds identified as having the same or similar characteristics (Khopkar, 1990).

TLC analysis results after the evaporated fraction flavonoid addressing their spots on the chromatogram that the fraction 1, fraction 2, fraction 26 and fraction 27 with a value of Rf 0,725

whereas other fractions did not indicate the presence of flavonoid compounds. The same RF value is the active fraction methanol and allegedly have the same classes of compounds.

Extract the water produced as many as 10 grams of crude extract water in the form of a brown paste. Pure water extract obtained by hydrolysis with the aim to break bonds glucosides in the extract.Hydrolysis form crystalline precipitate 2 grams, water phase of 20 ml and ethyl acetate phase as much as 15 ml. Based on the analysis chromatogram TLC Rf value of the water phase amounted to 0,625 while on crystal or precipitation does not show stains on the TLC plate as an indication of flavonoid compounds therefore used during the bioassay is to extract the water phase.

B. Mortality *Planococcus minor* Maskell

Table 1. The average percentage mealybug pest mortality (*Planococcus minor* Maskell) treatment with the methanol extract and water extract leafs *G. maculata* with different concentration and time observation.

Time observation after treatment (hours)	Concentration (%)	The death of insects (%)	
		Methanol Extract	Water Extract
12	0	0,00	0,00
	0,015	3,33	0,00
	0,030	0,00	3,33
	0,045	3,33	3,33
	0,060	0,00	0,00
24	0	0,00	0,00
	0,015	3,33	3,33
	0,030	3,33	10,00
	0,045	6,67	10,00
	0,060	6,67	10,00
48	0	0,00	0,00
	0,015	13,33	13,33
	0,030	23,33	20,00
	0,045	13,33	26,67
	0,060	23,33	26,67
72	0	0,00	0,00
	0,015	33,33	30,00
	0,030	33,33	40,00
	0,045	36,67	46,67
	0,060	53,33	56,67

At 12 hours after treatment methanol extract and water extract can kill insects already test (*P. minor)* as much as 3.33%. But death occurs on lower concentration than the high concentration. This could be due to several factors. According Raini (2007) there are several factors that influence the toxicity of a compound of one of them is endurance test animals. Possibilities that occur in test animals (*P. minor*) were treated extract higher concentrations have more endurance stronger. The higher the concentration of the extract is treated persentation higher death rate insects. When compared with the methanol extract, extract the water was shut off more test insects between 3,34% - 13, 34%. This tends to occur due to the influence of several factors among which the dose of the extract, endurance test animals, and exposure times. Low dose will give the effect of compound toxicity is low. While high doses at the time of initial exposure will force the body to continuously defend themselves from substances that are toxic, but exposure times would make these toxic substances accumulate in the body resulting in chronic poisoning and death (Raini, 2007).

Results of analysis of variance showed a significant difference among the treatments. The average mortality mealybug by treatment concentration and time showed a significantly difference. While the

average mortality mealybug if seen from a comparison between extracts, concentration and extract, and extract the time, the concentration, time, and the extract did not show significant differences.

The results Tukey's at the level α 5% average mortality pest infestation white treatment of methanol extract and water extract at 72 hours after treatment showed that the methanol extract and extract water with a concentration of 0% was significantly different from the concentration of 0,015%, 0,030%, 0,045 and 0,060%. 0,015% concentration was significantly different from the concentration of 0,060%, but not significantly different from the concentration of 0,030% and 0,045%. The concentration of 0,030% and 0,045% is not significantly different from the concentration of 0,060%. The difference is not noticeable due to the difference in mortality rates between white lice are very small concentrations. There are real differences between the control and treatment groups showed that the concentration significantly affect mortality mealybug.

The results Tukey's at the level α 5% of the average number of deaths pest mealybugs were treated extracts of methanol and water extract of leaves of *G. maculata* at a concentration of 0,060%, ie death mealybugs were treated with methanol extract and extract water at 12 hours after treatment was not significantly different with 24 hours after treatment but significantly different with 48 and 72 hours after treatment. This suggests that the effect on the time of death mealybug pests. The longer the period of observation after treatment also increase the mortality rate of mealybugs.

Statistically methanol extract and water extract did not show significant differences but when seen from the effectiveness of the extract showed significant differences. It can be seen Table 2 and Table 3.

Table 2. Value LC_{50} results probit analysis of methanol extract and water at 12-72 hours after treatment.

Time (Hours)	LC_{50} value (%)		Difference (%)
	Methanol Extract	Water Extract	
12	-	-	-
24	-	-	-
48	0,104	0,082	0,022
72	0,054	0,047	0,007

LC_{50} value of the water extract of between 0,007 to 0,022 lower than the methanol extract of the same treatment period. This indicates that the water extract is more effective than the methanol extract to kill 50% of test animals.

Table 3. Value LT_{50} probit analysis results of methanol and water extracts at different concentrations

Concentration (%)	**LT_{50} value (hours)**		Difference (hours)
	Methanol Extract	Water Extract	
0,015	89,567	87,777	1,790
0,030	81,707	82,399	0,692
0,045	87,676	73,535	14,141
0,060	68,785	66,248	2,537

LT50 values were also lower water extract between 0,692- 14,41 hours than methanol extract. This indicates that the water extract is more effective than the methanol extract with the same concentration takes longer than methanol extracts even at concentrations of 0,045% difference very long time is 14,141 hours, it indicates the water extract is more effective than the methanol extract.

The ability of the power to kill the methanol extract and water extract of leaves of *G.maculata* caused their compounds which are toxic secondary metabolites. One of them is of secondary metabolites flavonoid. The content of flavonoid compounds in leaf extracts gliricidia seen from the TLC analysis using several solvents visualization (Table 4).

Table 4. Rf value on the analysis of secondary metabolites (flavonoids) methanol extract and water extract of leafs *G. maculata* with TLC methods using several solvents and solvent developers visualization DCM and methanol (4: 1)

Extract	Solvent Visualization				Average value of Rf
	$CeSO_4$	$AlCl_3$	NaOH	H_3BO_3	
Methanol Extract	0,727	0,750	0,675	0,850	0,750
Water Extract	0,625	0,828	0,750	0,625	0,707

Rf Value flavonoid compounds using some solvent visualization shows varying values, the value of Rf methanol extract using solvents visualization $CeSO_4$ and H_3BO_3 higher than the value of the Rf in the water extract but the value of Rf methanol extract using solvents visualization $AlCl_3$ and NaOH lower than the value of Rf on the extract water. This shows that the solvent visualization has the ability to identify different as the principle of KLT according Soebagio (2002) in which the adsorption is absorption at the surface, while the partition is the spread, or the ability of a substance or substances present in the solution to separate and move upwards depending on plate TLC and the solvent used. From the results of the average value of Rf obtained by the use of various solvents visualization of the average value of Rf extract water smaller than the average value of Rf in methanol extract. According to Yazid (2005) the higher the Rf value obtained, the lower the level of the polarity of a substance that, because the concept of the higher polarity of a substance, then a stationary phase which is polar compounds will bind to each other and form a very strong bond so that the distance spot or stains on the TLC plate gets smaller and the lower Rf value. Thus the degree of polarity of the water extract is higher than the methanol extract.

C. Types and Chemical Structure of Extract Leafs *G.maculata*

Based on the results of spectroscopic analysis of the methanol extract of leaves of *G. maculata* has absorbance value of 0,585 -0,849. The presence of flavonoid compounds can be seen from the maximum wavelength of between 230,00 295,00 nm- nm (Neldawati et al, 2013). The methanol extracts were analyzed to give two maximum absorption is from 310,00 to 350,00 nm and 250,00 to 280,00 nm (Figure 1).

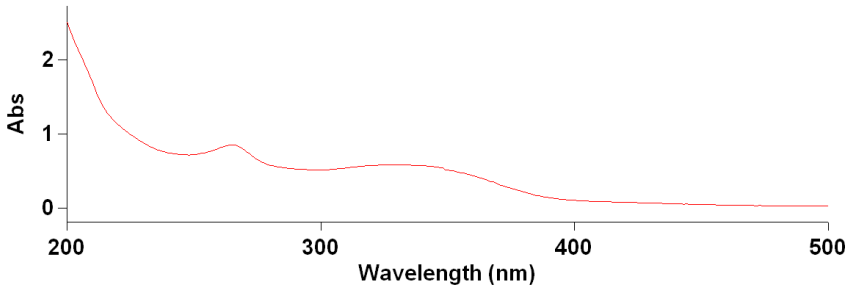

Figure 1. The spectrum of the methanol extract powder leafs *G. maculata*

The results of spectroscopic analysis of aqueous extracts were analyzed giving the maximum absorption is 250,00-280,00nm with the absorbance value of 0,736 (Figure 2).

According Neldawati et al, (2013) from 310,00 to 350,00 nm wavelength and 250,00-280,00nm included into the class of flavonoids types of flavonoids. Thus both polar leaf powder extract containing flavonoids gliricidia kind flavones. Demand Tapas et al, (2008) the characteristics of the flavonoids is almost the same as flavonoid compounds that have the basic structural framework C6-C3-C6 consisting of two C6 aromatic rings (A and B) and heterocyclic ring (C) (Figure 3).

Flavones are flavonoid class consists of the structural frame 2-phenyl-1,4-benzopiron. In chemistry, a phenyl or phenyl ring are one functional group in a chemical formula. In this group, six carbon atoms arranged in a cyclic ring structure. This ring is very stable, and is part of a group of aromatic compounds. The phenyl ring is hydrophobic (water repellent) and aromatic hydrocarbons. These

groups can be found in many organic compounds. This ring is estimated to be derived from benzene, (C_6H_6). Phenyl bergugus simplest compound is phenol, C_6H_5OH. While benzopiren is an organic compound with the formula $C_{20}H_{12}$ polycyclic aromatic hydrocarbons .Benzopiren itself is a chemical that is toxic (Marais, et al., 2006; Kumar and Pandey, 2013).

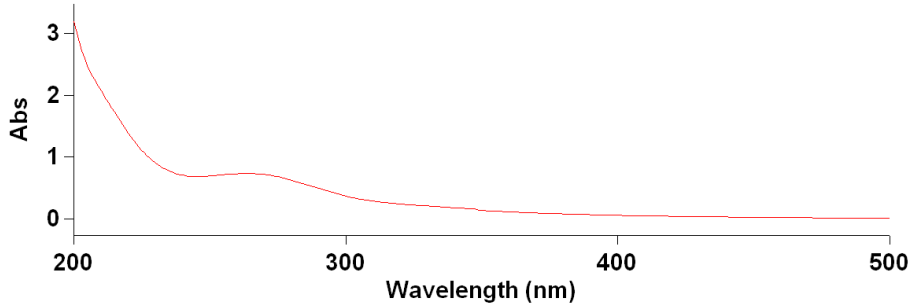

Figure 2. The spectrum of water extract leafs *G. maculata*

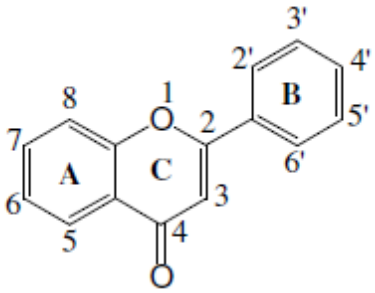

Figure 3. The structure of the flavonoids
(Source: Tapas et al, 2008)

4. CONCLUSION

Based on the research results obtained the following conclusions:

1. Methanol extract and water extract of powder leafs Gamal (*Gliricidia maculata* Hbr.) Has the power insecticides against mealybugs (*Planococcus minor* Maskell) on the cocoa plant (*Theobroma cacao* L).
2. Methanol extract the and water extract of powder leafs gamal of containing flavonoids, with type flavone that the structural frame 2-phenyl-1,4-benzopiron.

REFERENCES

Kementerian Pertanian, Ditjen Peternakan dan Keswan. 2009. *Keunggulan Gamal Sebagai Pakan Ternak*. BPTU Sembawa. Sumatera Selatan.

Khopkar, S. M. 1990. Konsep Dasar Kimia Analitik. UI Press. Jakarta.

Kumar, S., dan Pandey, A. K. 2013. Chemistry and Biological Activities of flavonoids.*The Scientific Word Journal.* Vol.2013.Article ID 162750,16 pages. India.

Marais, J.P.J., Vours, B. D., Dixon, R.A., Ferreira, D. 2006. *The Stareochemistry of Flavonoids*.Springer Science.ISBN-10 0-387-28821. United Dtates of America. America

Neldawati, Ratnawulan, dan Gusnedi. 2013. Analisis Nilai Absorbansi Dalam Penentuan Kadar Flavonoid UntukBerbagai Jenis Daun Tanaman Obat. *Pillar Of Physics, Vol. 2. Oktober 2013, 76-83*

Nukmal, N., Widiastuti, E.L., dan Sumiyani, E. 2009. Uji Efikasi Ekstrak Daun Gamal (Gliricidia maculata) Terhadap Imago Hama Bisul Dadap (Quadrastichus erythrinae). *Prosiding Seminar Nasional XX dan Kongres Biologi Indonesia XIV*. Malang 24 -25 Juli 2009.

Nukmal, N., Utami,N., dan Suprapto. 2010. Skrining Potensi Daun Gamal (Gliricidia maculata Hbr.) Sebagai Insektisida Nabati. *Laporan Penelitian Hibah Strategi Unila.* Universitas Lampung. 2010.

Prijono, D. 2005. Pemanfaatan dan Pengembangan Pestisida Nabati. *Makalah Seminar Ilmiah*. Jurusan Proteksi Tanaman, Fakultas Pertanian, Universitas lampung. 3 agustus 2005.

Raini, M. 2007. Toksikologi Pestisida dan Penanganan Akibat Keracunan Pestisida. *Media Litbang kesehatan Vol. XVII.No.3.*Departemen Kesehatan. Jakarta.

Soebagio. 2002. *Kimia Analitik*. Universitas Negeri Makassar Fakultas MIPA. Makassar.

Sumarno, E. 2015. *Jenis – Jenis Serangga Hama Berdasarkan Tingkat Kerusakan Yang DiTimbulkan*. Universitas Halu Oleo. Kendari.

Tapas, AR., Sakarkar, DM., Kakde RB,. 2008. *Flavonoids as Nutraceuticals*. Tropical Journal of Pharmaceutical Research(3): 1089-1099. Faculty of Pharmacy, University of Benin-Nigeria.

Wijaya, S. Y. 2007. *Kolonisasi Semut Hitam (Dolichoderus thoracicus smith) Pada Tanaman Kakao (Theobroma cacao L.) Dengan Pemberian Pakan Alternatif*. Skripsi. Universitas Sebelas Maret. Surakarta.

Yazid, Estien. 2005. *Kimia Fisika untuk Paramedis*. Andi: Yogyakarta.

SOCIAL BEHAVIOR OF SPOTTED DEER *(Axis axis)* IN GUNUNG MADU PLANTATIONS INC.SANCTUARY LAMPUNG TENGAH LAMPUNG PROVINCE INDONESIA

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ABSTRACT

Deer holds important role to the ecosystem equilibrium due to is level on food chain as consumer herbivore. Conservation effort through the species and habitat preservation has to be concern in term of prevent its extinction. The research in to social behavior of spotted deer (Axis axis) in Gunung Madu Plantations Inc.Sanctuary, Lampung Tengah, Lampung Province Indonesia, in January 2016. Adlibitum sampling and scan sampling method. The results shown that rubbing horn behavior mostly done by mate deer K (41,59%), grooming behavior mostly done by female deer N (98,32%), grazing behavior mostly done by male deer Q (11,46%) while interacting with human behavior was done by male deer K about (31,25%). Furthermore, avoiding human behavior mostly done female deer O and Q about (12,82%).

Keywords : Totol deer, Social behavior, GMP, Adlibitum Sampling, Scan sampling.

1. PRELIMINARY

The wildlife is a component of the ecosystem that plays a role in maintaining the sustainability of the energy cycle. Obliteration of a type (flora / fauna) will affect the balance of the ecosystem, which in turn will affect other components of the ecosystem, because the elements forming the system constantly interacts with its environment. Various attempts have been made to protect the wildlife and at the same time take advantage of it. One species of wildlife that is potentially a spotted deer *(Axis axis)*. Utilization of the deer, especially meat, horns, and skin (Garsetiasih and Herlina, 2005).

Captive cage PT. Gunung Madu Plantations Lampung Tengah Lampung Province, Indonesia is breeding that has a primary function as *ex-situ* conservation to make efforts for the maintenance and breeding of wildlife species spotted deer *(Axis axis)* in order to establish and develop new habitats as a means of protection and nature conservation. Aside from being a conservation area ex-situ captive deer in PT. GMP also as a hobby of the owner of PT. GMP. Change of residence for spotting deer cause structural patterns and social activities undertaken. Inc. sanctuary state deer in a limited area is 0.08 ha caused a social structure that is formed when grazing, grooming, interaction with humans and rubbing antlers.

Spotted deer have skin that is reddish brown, filled with large spots of white. There is a dark line that runs along the back. Abdomen and legs are white. On the neck there is a section of white, dark colored snout when compared to other parts of the face. Its tail is larger than the deer species in general.

The stag has the defense of antler horn. Spotted deer antler has three branches and the type of deer and other tropical, antlers are not certain of the season by a long body spotted deer (from nose to base of tail) 110 - 140 cm, tail length 20 - 30 cm, height 97 cm and 75- weight ranged between 75 - 100 kg. Life span spotted deer ranged between 8-30 years. Characteristic spotted deer has a chest circumference of 75-79 cm, has a long tail of 20-30 cm, shoulder height 110-40 cm, and weighs 75-100 kg adult life (Fajri, 2010).

Breeding habitat is different from the natural habitat. Based on the characteristics of their habitat, the breeding habitats are improved nutrition, increased intraspecific competition for food, reduced predation by natural predators, parasites and disease reduction and increased contact with humans (Dewi and Wulandari, 2011). Spotted deer *(Axis axis)* is not an endemic species that originated from

Indonesia but at this time developed many breeding attempts. The original habitat of these animals comes from Nepal, Bangladesh, India, Bhutan, Sri Lanka and Pakistan. Efforts ex-situ conservation is an important part of an integrated conservation strategy to protect endangered and strategies for *ex-situ* conservation is an approach that supports (Robinson, 1987).

The introduction of spotted deer *(Axis axis)* in Bogor, West Java occurred in 1814, when it was brought by Sir Thomas Stamford Raffles who import these types of deer from Nepal and India. The initial purpose in doing the import is for sport hunting is a sport that is often played by the English nobility. Until now, the population of spotted deer (Axis axis) contained in Bogor Palace ranged between 600-800 birds. In addition to the Bogor palace area there is also a wildlife breeding spotted deer (Axis axis) in various places, including at home to deer breeding PT. Gunung Madu Plantations (GMP) Lampung Tengah ten spotted deer tail.

Research on the social behavior of spotted deer need to be done because of the nature of the deer who choose to live in groups. If the social behavior of spotted deer can be managed by either the breeding success can be achieved by increasing the population of the spotted deer indicator.

2. RESEARCH METHODS

Location and Time Research

The research was conducted on the Moon in January 2016 covering the preparatory phase of the data and proceed with the processing and analysis of data. The location of the research is done in a breeding cage PT. GMP Lampung Tengah with an area of 0.08 ha (Figure 1).

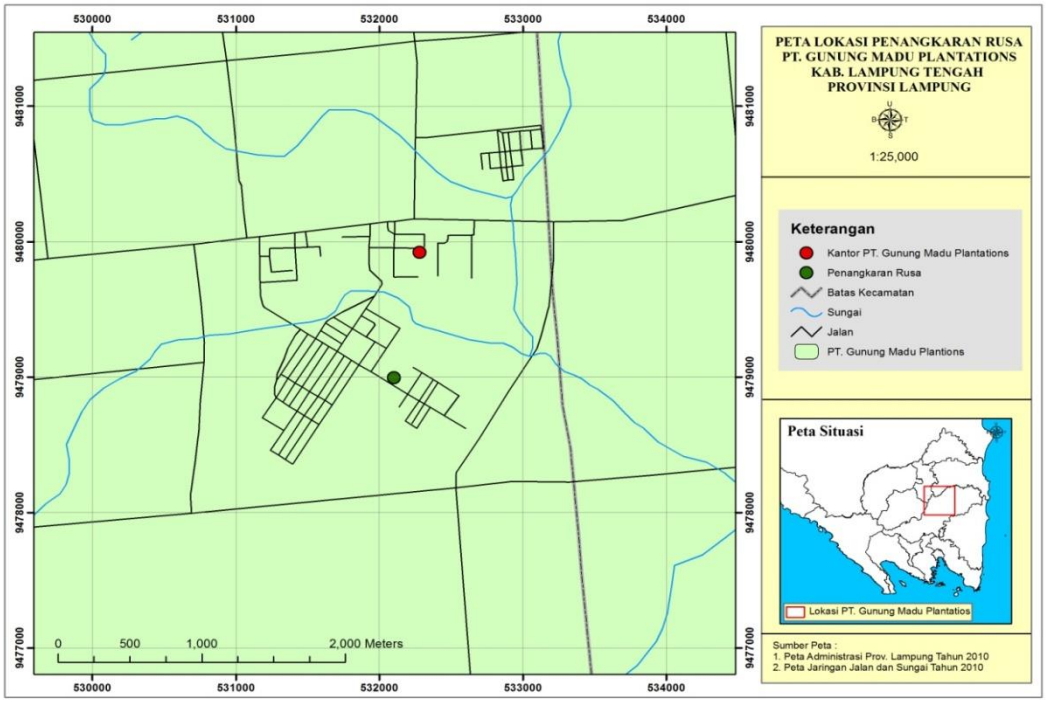

Figure 1. Map of the location study of social behavior spotted deer *(Axis axis*) contained in Captivity PT. Gunung Madu Plantations Lampung Tengah (Setiawan, 2015)

Data on the social behavior of spotted deer *(Axis axis)* contained in captivity PT. GMP uses *Ad libitum* sampling methods that record the behavior of certain wild life, for example communication between two people or more (Sionora, 2010). All gestures when communication or behavior is typical as is often done on deer recorded in the form of grooming behavior, rubbing antlers and interaction with humans. The observations described descriptively with tabulation of data and graphs.

The data retrieval behavior of grazing using scan sampling method is behavioral observations on particular individual animals or partner at any specific time interval (Altman, 1978; Subagyo, Arfan, Siburian, 2008; Putra, 2016). Observations were made directly and recording at intervals of 60 minutes (Subagyo et all, 2008). The results of the observations will obtain a frequent behavior of each individual adjacent.

Tools and materials

The tools used in this research are: digital cameras, binoculars, digital watches, stationery, tally sheet, Ms. Office and laptop. The object of research is ten spotted deer (Axis axis) contained in captivity PT. GMP.

Analysis method

The collected data were analyzed using three methods *Ad libitum* Sampling with behavior observation rub antlers and head (especially males), licking the body *(grooming)*, and interaction with humans. Scan Sampling methods used in behavioral observation grazing. Once the data is obtained from observations, then the data were analyzed descriptively to determine the percentage of times. Calculation of percentage for each individual study done using the formula (Martin and Batcson, 1988; Putra, 2016):

$$\text{Percentage frequency of Conduct} = \frac{A}{B} \times 100\%$$

Information :

A = frequency daily Behaviour

B = total number of times per day throughout the Behavior

3. RESULTS AND DISCUSSION

A. Conduct Licking Fur *(grooming)*

Grooming behavior is a manifestation of affection shown from one individual to individual animals other animals, is usually performed by the parent to the child or to a neighbor one species (Sionora, 2010). In deer fur licking behavior patterns of interaction (*grooming*) are usually done by the parent to the child or to the couple. Grooming behavior patterns during the 13-day time study at PT. GMP then spotted deer can be seen clearly in the following graph (Figure 2):

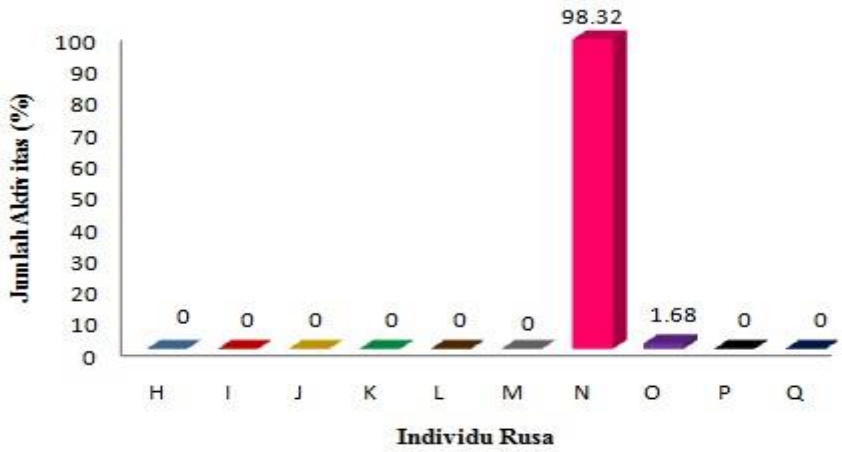

Figure 2. Graph of the total interactions deer conducting licking fur (grooming) 10 spotted deer in the study of social behavior of spotted deer *(Axis axis)* in the stable Captive PT. GMP January 2016.

Graph one explains that the fur licking behavior (grooming) is most often performed by a doe spotted N by 98,32% to doe spotted O who is the son of a doe spotted N. The difference in behavior is due to

the doe spotted N is the mother spotted deer the greatest and most dominant in the cage. The doe spotted N have offspring that the doe spotted O (F1), a doe spotted P (F1) and a doe spotted Q (F1). Fixed a tendency to interact grooming doe doe spotted with spots n O. Such behavior is a behavior that is caused by the affectionate relationship between the parent with a child or commonly referred to family relations (relationships). Such an interaction is the earliest evidence of affection toward the mother doe against children and against the opposite sex who marry a male deer during mating season (Sionora, 2010).

B. Conduct rubbing Horn (Special Males)

Horn (antler) is one of the character display of secondary sexual characteristic on a stag after reaching puberty, except for two species of deer are deer Chinese waiter (Hydropotes inermis) and deer musk (Moschus chrysogaster), both stag and females have antler (Grzimek, 1990). The male deer antler into a specific character (phenotype, performance) because it is closely related to the active reproductive period (Handarini, 2006). According to (Semiadi, Wirdateti, and Jamali, 2008) antler (Antler) are part of a limb deer mostly basic material is calcium, which grew out of the body, on the head, passing through a growth phase and fall in a cycle that is fixed.

Rubbing antlers iteration is an activity performed by a male deer stag against the other. This is usually done for power, for females or fight over food. Swipe behavior performed by a stag horn to attract attention doe will marry during the next breeding season, or this behavior is often done because the mule deer antler for change want to release the new antler (Suttie and Simpson, 1985). Behavior rubbing antlers found in a breeding cage PT. GMP is performed only on males have horns. There are six male spotted deer *(Axis axis)* are presented in the following two graphs:

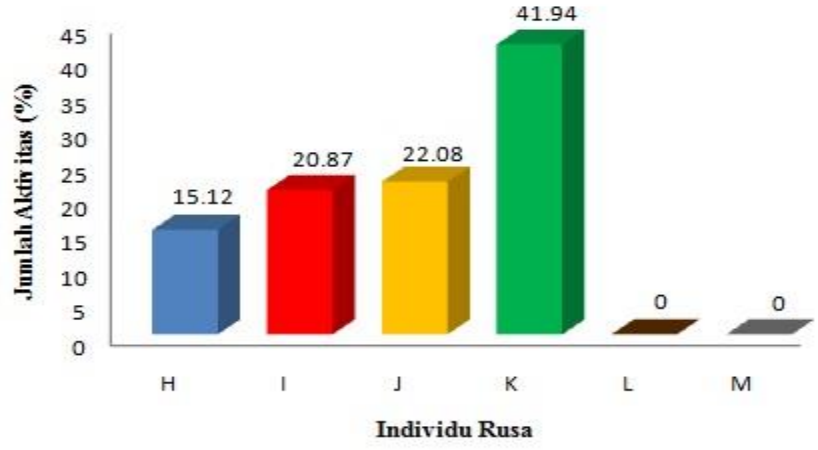

Figure 3. Graph of the total interactions deer antler rubbing conducting the study of social behavior spotted deer *(Axis axis)* in the stable Captive PT. Gunung Madu Plantations Lampung Tengah January 2016.

Stag often conducts rubbing antlers are male spotted Tusa K amounted to 41,94%. Stag spotted deer youngest K is contained in a breeding cage PT. GMP presence in new breeding, cage 4 months. Individuals deer K was not a descendant of the individual stag and doe first in the breeding cage, so its presence is still often a concern group of other males. Individuals stag spotted K often approached individuals, stag spotted J (moles blackish brown spots), the cause of frequent interaction rub antlers against both the fight over territory, the area where there are many sources of grass to eat. Horns rub longest time lasted for 56 seconds after the deer will be far apart back.

Spotted deer H, spotted deer I, spotted deer J, often visited by stag spotted K which often comes in the territorial groups of spotted deer (H, I, J), which first became residents in the breeding cage. spotted deer K, a male deer antler which has a new will grow, while the male spotted deer L and M are not rubbing antlers behavior occurs because not have horns. Horn swiping behavior is not always done by the opponent or partner there are also people who do rub deer antlers into the trees or the ground. Behavior rubbing antlers included into *angoistic* behavior is behavior that is divided into two categories. The first category, which means that the behavior, aggressive threatening or offensive

behavior, the second category, which means that the behavior submissive indicating strength and power.

C. The social behavior of grazing

According to (Gartesiasih, 2007) deer conservation ex-situ, the primary requirements to be met is an aspect that should be strived habitat approaching natural habitat. This is because the habitat is a place where the life of an organism in a wildlife must grow and multiply well. Grazing is one of the behaviors shown by species of deer in the daytime both living in the wild or in a breeding cage. Grazing is always done in the deer because the deer in the breeding cage
PT. GMP is given only feed (drop in) once a day, causing lack of food intake obtained by each individual deer.

Deer are herbivorous species that can take various types of forage. According to (Tirtayasa, Ichwan, and Wijaya, 2011) apart from the grass and foliage, deer feed in addition can be concentrates, vegetables, leaves, tubers or other agricultural wastes. Giving pellet containing the concentrate is also given to the spotted deer. The social behavior of grazing contained in a breeding cage PT. GMP done 10 spotted deer *(Axis axis)* is presented in the three following graph:

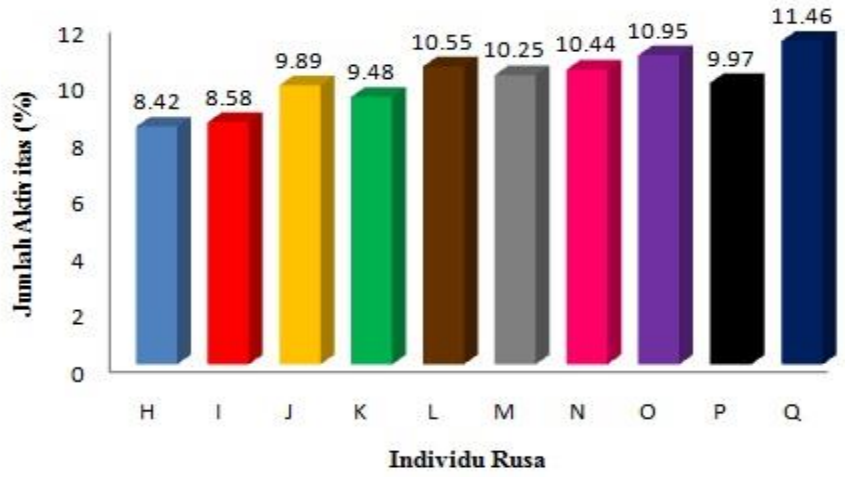

Figure 4. Graph total interaction deer grazing activities grazing on the study of social behavior spotted deer *(Axis axis)* in the stable Captive PT. Gunung Madu Plantations Lampung Tengah January 2016.

Observations meal grazing is performed starting at 7:00 to 17:00 pm in the breeding cage PT. GMP, in the breeding cage are reservoirs of grass as a drop in media feeding that has been provided by the manager of the captive deer enclosure PT. GMP. The graph above explains that the grazing behavior is most often performed by a doe spotted Q. The difference in level of a pattern of behavior on the show by each individual deer are not too much different because the spotted deer live in the two groups of male and female groups.

Females are usually more dominant group ruled the area that contained the supply of natural grass feed contained in a breeding cage. The N group spotted deer a female, female spotted deer O, female spotted deer P, female spotted deer Q, is more frequent grazing activities in areas surrounding the captivity without having to scramble with the other male deer.

D. Social Interaction with Humans

Gunung Madu Plantations Inc. sanctuary Lampung Tengah has a deer guard named Ismoyo oversees and provides feed deer and elk condition checking. In natural conditions the animals usually live in groups and deer will be active at night (nocturnal). Change of residence for spotted deer *(Axis axis*) caused a structural patterns and social activities undertaken. Spotted deer *(Axis axis*) are taken, and maintained at a certain place with conditions that resemble their natural habitat. Ex-situ conservation

is done in an effort to manage wildlife species that require protection and preservation of the impact of changing patterns of social behavior. The impact of ex-situ conservation is an encounter between wildlife frequent direct contact with humans that result in changes in behavior of the native wildlife.

The social behavior of grazing contained in a breeding cage PT. GMP has done 10 spotted deer (Axis axis) are presented in the following four charts :

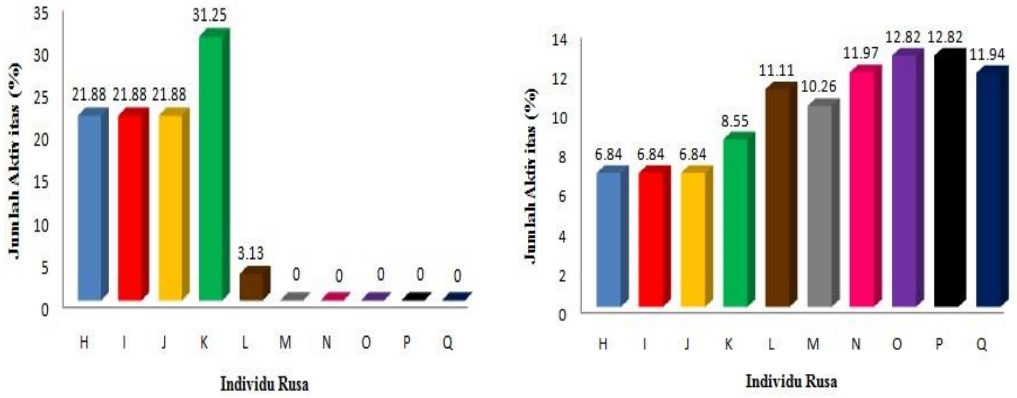

Figure 5. Graph of the total interactions deer conducting closer interaction with humans (left) and avoid interaction with humans (right) on the study of social behavior of spotted deer *(Axis axis)* in the stable Captive PT. Gunung Madu Plantations Lampung Tengah January 2016.

Interaction with human activities do animals are in captivity, good interaction with the handler or keeper or manager or with other visitors. Wildlife behavior is the expression of an animal raised by all the factors that influence it, the movement of individual animals is a strategy of the individual and of wildlife populations to adapt and utilize state of the environment in order to live and reproduce normally (Alikodra, 2002). Current conditions approaching human elk, deer usually will approach the guards at the time of the morning at the time of checking the condition of the deer. Spotted deer, which are often approaching the human is male spotted deer K amounted to 31,25%, while the doe spotted more often away from humans because it is more sensitive to the state of the environment. The doe spots should protect children so it is more visible alert to the threat.

Investigative behavior is suspicious guard against interference, characterized by upholding head silently and looked straight in one direction that is considered dangerous. The deer found in PT. GMP still have the wild nature or original properties, when compared with the deer breeding, cage contained in the University of Lampung. Deer contained in the University of Lampung no longer has a wild nature or original properties, when visitors come, the deer will approach and will immediately take the field offered or given by visitors (Sionora, 2010).

4. CONCLUSION

Based on research conducted in the cage captive deer PT. Gunung Madu Plantations Lampung Tengah, it could be concluded that the percentage of the number of social activities licking fur (grooming) was highest in the doe spotted N (98.32%). Percentage of the number of social activities grazing highest doe spotted Q (11,46%). Percentage of the number of social activities carried rubbing highest horn stag spotted K (41,94%). Percentage of the number of social activities interact highest human approach stag spotted K (31,25%) and the percentage of the number of social activities away from human interaction highest female spotted deer spotted P O and females (12,82%). Breeding habitat is different from the natural habitat of a lot of changes in physiological animal and changes in daily behavior patterns.

REFERENCES

Alikodra, A.H.S.2002. Wildlife Management, Volume 1. The Ministry of Education and Culture. Directorate General of Higher Education Between University Center of Biological Sciences. IPB. Bogor.

Altmann, J. 1978. *Observational study of behavior sampling methods. Jounal Behaviour* . XIXI : 228-267.

Dewi, B.S. dan Wulandari, E. 2011. Study daily behavior sambar deer (Cervus unicolor) in the Nature Park Bumi Kedaton. *Journal Sains MIPA.* 17(2): 75-82.

Fajri, S. 2000. The daily behavior of spotted deer *(Axis axis)* developed pasture Bogor State Palace courtyard. (Skripsi). Institut Pertanian Bogor. Bogor.

Garsetiasih, R dan Herlina, N. 2005. Germplasm Evaluation Spotted deer *(Axis axis)* Page Bogor Palace. *Bulletin Plasma Nutfah* . 1(11): 34-40.

Gartesiasih, R. 2007. Carrying Capacity of Forest Areas Baturaden As Captive Deer Habitat. R & D Center Forest and Nature Conservation. *Journal Penelitian Konservasi Alam.* 5(4): 531-542.

Handarini, R. 2006. Patterns and Cycles Growth Males Timor deer antler *(Cervus timorensis)* (The Pattern and Antler Development Cycle of Timor Stags (*Cervus timorensis). Journal Agribisnis Peternakan*, 1(2): 28-35.

Martin, P dan Batcson, P. 1988. *Measuring Behavior an Introduction Guide*. 2nd. Ed. Cambridge University Press. Cambridge.

Setiawan, T. 2015. Social Behavior Study Site Map Sambar deer (Cervus *unicolor)* and Spotted Deer *(Axis axis)* contained in Captivity PT. Gunung Madu Plantations Lampung Tengah. Lampung Tengah. Unpublished.

Semiadi, G., Wirdateti, Y., Jamali Brahmantiyo, B. 2008. Utilization Rusa As Livestock. *Animal Husbandry and Veterinary Technology Seminar 2008.*

Sionora, R. 2010. Social Behavior Sambar deer (*Cervus unicolor*) in the Cage Captive Deer Unila. (Skripsi). University of Lampung. Lampung.

Subagyo,A., Arfan, E., Siburian,J. 2008. Pattern of Behavior Daily monkey *(Presbytis cristata, Raffles 1821)* Forest Around Campus Pinang Masak. University of Jambi. *Journal Sains*. University of Jambi.

Suttie, J.M., Simpson, A.M. (1985) Photoperiodic control of appetite, growth, antlers, and endocrine status of red deer. In: *Journal Biology of Deer Production*. (eds. P.F. Fennessey & K.R., Drew), The Royal Society of New Zealand, pp. 429-432.

Putra, W.P. 2016. Daily behavior Timor deer *(Cervus Timorensis)* In the Green Valley Animal Park of Bandar Lampung. (Skripsi). University of Lampung.

Robinson, G. E. 1987. Modulation Of Alarm Pheromone Perception In The Honey Bee: Evidence For Division Of Labor Based On Hormonall Regulated Response Thresholds. *Journal Of Comparative Physiology A: Neuroethology, Sensory, Neural, And Behavioral Physiology.* 160 (5): 613-619.

Tirtayasa, R., Ichwan, S.R., dan Wijaya, G.H. 2011. Management of Spotted Deer *(Axis axis Erxl 1788)* at the National Monument Park in Jakarta. Third Report Practicum M.K. Wildlife Management. Department of Forest Resources Conservation and Ecotourism. Istitus Pertanian of Bogor. Bogor. 9 Hlm.

THE COMPARISON OF TOXICITY PURIFIED ISOLATE OF WATER AND METHANOL EXTRACTS OF PAWDER LEAF *GLIRICIDIA MACULATA* ON MORTALITY SOURSOP MEALYBUG *PSEUDOCOCCUS CRYPTUS*

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ABSTRACT

Soursop production in Indonesia continues to decline from year to year. One cause is the mealybug pest (*Pseudococcus cryptus*). The white lice suck the young fruits soursop to dry and stunted. To control the pest, using botanical insecticides more safety than synthetic insecticides. One of the plants that can be used is *Gliricidia maculata*. The leaves of *G. maculata* contain planty of an active compound flavonoid. The purpose of the study to compare the toxicity of the purified isolates of water and methanol extracts of *G. maculata* leaves on mortality soursop mealybugs (*P.cryptus*). Extraction was done by maceration series using various organic solvents (n-hexane, dichloromethane, methanol and water). Fractionation and purification of flavonoids from polar extracts were done by Chromatography Coloum. A set of laboratory experiment was conducted by using block design. Water and Methanol extracs (WE and ME) with 5 levels concentration i.e. 0%, 0.02%, 0.04%, 0.06% and 0.08%, and 3 replications. ANOVA was conducted to obtain the means and standarrd deviations of the experimental study, and Tukey's test at $\alpha = 5\%$ was peformed in order to obtain the different among the expelimental groups. Analisys Probit were used for compare the efectivities the exstracts. The result indicated the was toxic to mealybug pest (P. cryptus) with LC50 72 hours water extract 0,061% and metanol extract 0,096%. Therefore water extract more toxic than metanol extract.

Keywords : extract water , methanol , powder leaves (*G.maculata*) , soursop mealybug (*P.cryptus*)

1. INTRODUCTION

Soursop plant is one of the agricultural commodities. Soursop production in Indonesia has declined to 15% from the previous year (Agricultural Statistics 2009). One reason is that pests and diseases in plants soursop fruit. One of the pests that cause a decline in the production of soursop is mealybug (*Pseudococcus cryptus*). The existence of mealybugs can reduce the production of soursop fruit up to 58% (Ivakdalam, 2010).

To overcome the mealybug pest attacks on crops soursop typically used synthetic insecticides. The use of synthetic insecticides are not appropriate and for a long time will bring bad effects. That requires insecticide safer and environmentally friendly, such as using vegetable insecticides derived from plants (Prijono, 2005; Siswanto and Karmawati, 2012). One of the plants that can be used as an insecticide plant are the leaves of Gliricidia (*Gliricidia maculata* Hbr.). Gliricidia leaves has coumarin active ingredients that are insecticides, rodenticides and bactericidal (Manglayang Farm, 2006).

The purpose of this study was to determine the comparative toxicity of water extract and isolate pure methanol extract of leaves of Gliricidia against mealybugs on soursop.

2. RESEARCH METHODS

Tools and Materials

The tools used machetes and treasure, Disk Mill machine, scales, jars, gauze pads. Materials used in this research that plant leaves Gamal and mealybugs (P. cryptus). The tools used are glass jars, filter Bunchner, Freezedrayer, TLC (Thin Layer Chromatography), electric heating, capillary pipette, digital cameras stationery. N-hexane, dichloromethane (DCM), and methanol with a brand J.T Beker, distilled water. AmberliteXAD KK-4, Plat TLC (thin layer chromatography),. TLC Reagent SbCl3

Section, AlCl3, and CeSo4, aluminum foil, Erlenmeyer flask, test tubes, spatulas, analytical balance, oven, beaker, beakers, pipettes, funnels, filter paper, and hot plate.

The course of study

Materials prepared for bioassay ie 1x pistil soursop fruit as much as 30 pieces measuring 2-3 cm and are free of pests. Preparation for the bioassay ie plastic cups and containers to soak test medium. Gauze to cover plastic cups. Brush and a pin to move and put the test insects in the test medium. Extracts used to bioassay that extracts polar (water and methanol) Gliricidia leaf powder, sucking insects soursop fruit (*P. cryptus*) adult stage females who are already acclimatized for 1 day prior to treatment, soursop fruit as a test medium.

Gliricidia leaves that have been dried for milled using Disk Mill machine to a powder and wrapped in plastic, solvents Hexana, DCM, methanol and water.

Gliricidia leaf powder extract water maceration results that show the deposition of amorphous form is filtered with filters Buncher, in order to separate the sediment (EA) and the filtrate (FA) it. Furthermore EA drayer freeze dried. Pasta obtained do bioassay against mealybug pest. The filtrate (FA) was purified by fractionation by column chromatography method using KK-AmberliteXAD-4 and isolated slope (gradient elution). Fractions were collected based on volume. Each fraction was tested content of flavonoids by TLC method and positive fractions containing flavonoids will do bioassay against mealybug pest.

The methanol extract of dried Gliricidia leaves contain lots of chlorophyll, chlorophyll with a method to separate column chromatography (CC) using silica and isocratic. The filtrate methanol been cleared of chlorophyll (FM) direfraksikan using the method of using the column AmberliteXAD KK-4. Fractions were collected based on the volume and content of each fraction was analyzed using the method of flavonoids thin layer chromatography (TLC). The fraction of the isolated flavonoid-rich test keserangga tested pest mealybugs (P. cryptus) in plants soursop. The selected active fraction is the fraction rich in flavonoids with a low amount of matrix and provide a high activity against test insects.

Each compound found on the fractionation stages of bioassays performed against pest infestation white female adult stage and the test medium used was pistil soursop. This is done to screen for compounds active insecticide. Bioassays were carried out is the test of mortality with residual effect (residual effect).

Residue testing conducted by soaking soursop with 5 degree of concentration that is (0%, 0.05%, 0.010%, 0.015% and 0.020%) for 10 minutes, 10 heads mealybugs (*P. cryptus*) female adults who had been acclimatized for 1 days before treatment is placed on the pistil of soursop fruit that has been soaked with gliricidia leaf extract and maintained in test containers. Observations of insect mortality trial conducted at 12, 24, 48 and 72 hours after treatment. These trials were conducted each with 3 replications.

3. RESULTS AND DISCUSSION

A. Extraction Methanol Extracts Water And Leaf Extract Gamal

Results maceration storey of 500 grams of powdered leaves of Gliricidia, obtained methanol extract as much as 6 liters. The evaporated 6 liters of extract obtained 80 grams of crude extract. Results frezdrayer 80 grams of crude extract, obtained 23 grams of extract in the form of pasta. Results freezdrayer 500 ml of water extract obtained 6 grams of water extract, the rest of which is not in frezdryer stored in the refrigerator.

Test the water extract of crude extract and methanol extract of leaves of Gliricidia LC_{50} value obtained for 0.034% water extracts and methanol crude extract of 0.025%. The LC_{50} value is used as the determination of the concentration on testing water and methanol extract of leaves of Gliricidia against mealybug pest death.

a. Purification of the crude extract water (hydrolysis)

Hydrolysis of 2.5 grams of water extract obtained precipitate (EA) in crystalline form as much as 1 gram and filtrate (FA) in the form of the aqueous phase as much as 35 ml of yellowish and phase as much as 15 ml of ethyl acetate brownish (Figure 1).

a **b** **c**

Figure 1. Results of hydrolysis of water extract: a. aerobic phase. ethyl acetate phase, c. crystal water phase

Hydrolysis extract water to the water phase test TLC, the TLC plate looks are still many spots on the chromatogram indicates there are still many other compounds. Crystals to the water phase TLC test was done and the result is only one spot on the chromatogram and obvious, it is expected that the compound is already used as a pure and bioassays on mealybugs (P.cryptus) on soursop plant.

b. Purification of the crude extract methanol (fractionation)

Fractionation results obtained as much as 1 gram of methanol extract using KK Amberlite XAD-4 obtained 29 fractions. The same visual merged into one in order to obtain 6 fractions. The test results obtained TLC 6 fraction 1 fraction (19) is thought to be a pure compound content of flavonoids (Figure 2).

fractions 19

The test results purity done by monitoring by TLC with eluent same that DCM: methanol (4: 1), the plate TLC seen the content of flavonoid compounds in extracts of pure methanol and pure extract of leaf water gamal shown their patches of yellow and brown on TLC plate (chromatograms) after being sprayed visualization CeSo4, AlCl3, NaOH and H3BO3 (Figure 3).

The test results show only a fraction of the 19 flavonoids continued to test the purity by TLC, the results of purity testing that has been done is obtained in the form of chromatogram shows a single spot. These results indicate that the isolate is relatively pure in TLC (Suteja et al, 2016).

From the testing that has been done can be seen that the methanol extract and water Gliricidia leaves can be used as a vegetable insecticides to control pests on crops soursop mealybugs because they contain secondary metabolic compounds. Seen from RF Value (Retention Factor) of methanol extract and water extract of leaves of Gliricidia (Table 1).

Rf value of flavonoid compounds in the extract water is higher than the value of the methanol extract of leaves of Gliricidia RF (Table 1). This shows the polar extract more water from the methanol extract is seen that the yellow spots on the methanol extract thicker than the water extract caused during the process of hydrolysis do not break the glucoside flavonoid glycoside compounds. Water

extracts and methanol extract showed almost identical Rf values in any comparison with the 4 visualization reagent, it indicates that the compound is a compound identified. According to Khopkar, (1990), the value of RF indicates the identification of a substance that is sought.

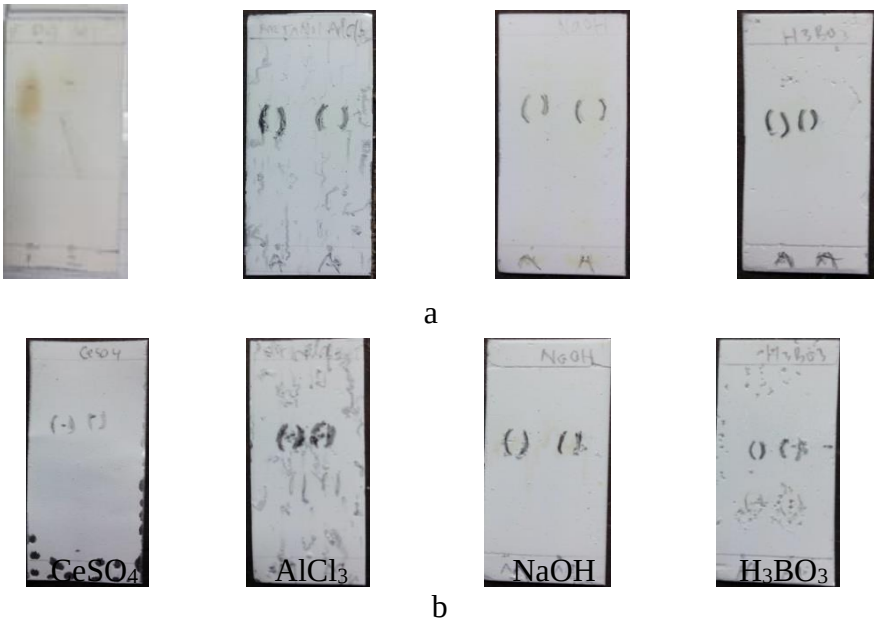

Figure 3. TLC chromatogram analysis results of water extracts (a) and the methanol extract (b) Gliricidia leaves with visualization CeSO4 solvent, AlCl3, NaOH, H3BO3.

Table 1. Values of RF on the analysis of secondary metabolites (flavonoids) with TLC methods methanol extract and water extract of leaves of Gliricidia with a developer solution DCM: methanol (4: 1)

visualization reagent	RF Extract Pure water	RF Pure Methanol
$CeSO_4$	0,87	0,82
$AlCl_3$	0,80	0,80
NaOH	0,80	0,75
H_3BO_3	0,75	0,70

c. Mortality Hama White Lice treated with water and methanol Leaf Extract Gamal

The percentage of deaths mealybug pests on crops treated with methanol extract of soursop leaves of Gliricidia can be seen in Figure 4.

In Figure 4 and 5 seen from the death of mealybugs (*P. cryptus*) on soursop plant extract with water occurs at 12 hours of treatment reaches 6.66%, while the methanol extract of 3.33% at a concentration of 0.02%. At the methanol extract at a concentration of 0.04% at 12 hours and 24 hours have not experienced death, so also the water extract at a concentration of 0.06% and 0.08% at 12 hours. This is presumably because at 12 hours and 24 hours has not happened death in white lice because the insecticide has not been taken into the body mealybug is very little that has not been damage organs mealybugs, but in the next hours as at 24 hours, 48 hours, and 72 hour at each concentration there have been many deaths (Figure 4 and 5).

Death of test insects is increasing along with the increase of time and concentration of observation, the higher the concentration of extract used, the percentage of deaths caused also higher due to the longer time and high concentrations into the body test insects it will cause a lot of damage to the body mealybug.

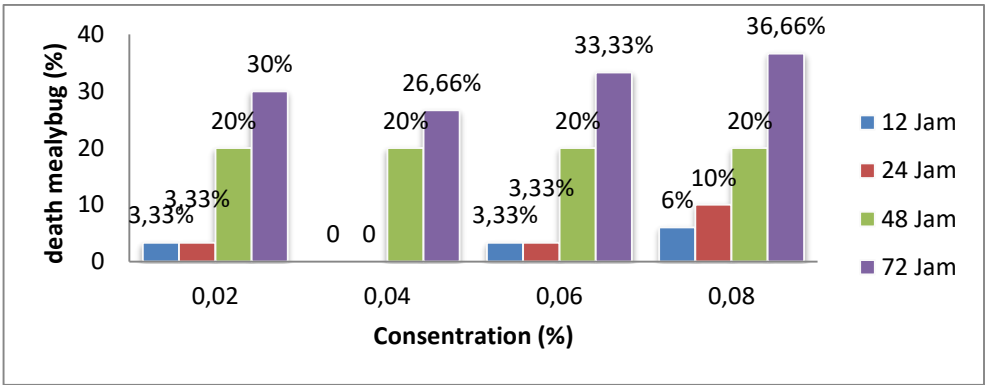

Figure 4. Percentage of deaths pest mealybugs (P.cryptus) on soursop plant (A.muricata) treatment of the methanol extract of leaves of Gliricidia at concentrations and at different times.

The percentage of deaths mealybug pest with Gliricidia leaves water extract treatment can be seen in Figure 5.

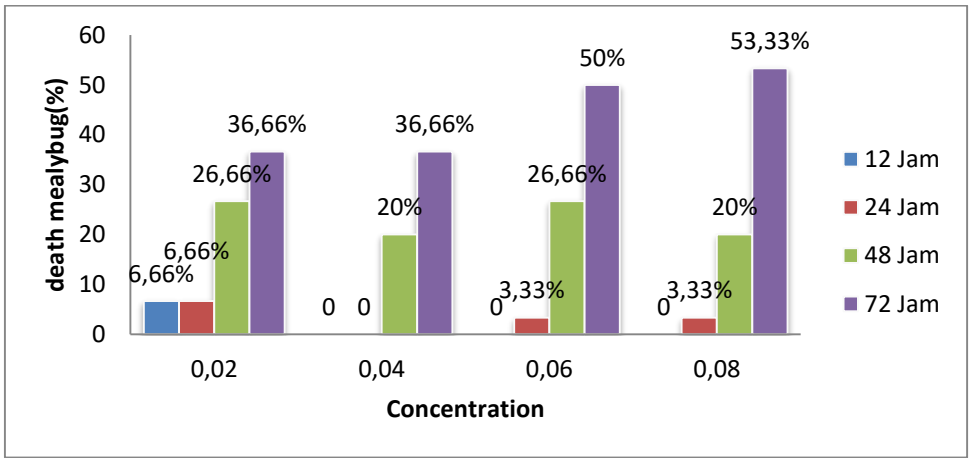

Figure 5. Percentage of deaths pest mealybugs (P.cryptus) on soursop plant (A.muricata) Gliricidia leaves water extract treatment at different concentrations and time.

The methanol extract and water extract of leaves of Gliricidia began to kill insects after 12 hours of treatment and at each treatment results of different test insect mortality. Water extract more lethal test insects between 10% - 20% compared with the methanol extract of leaves of Gliricidia (Figure 4 and 5).

Death mealybug treated water extract 16.67% higher than the methanol extract at 72 hours (Figure 15 and 16), it is suspected the existence of the resistance mechanism in plants soursop mealybug mealybugs due to be taken from a field while testing is done on a laboratory scale, Insect resistance to insecticides can be defined as the development of the ability of strains of insects to tolerate doses of poison that can kill most of the individuals in the normal population in the same species.

Results of analysis of variance showed a significant difference between treatments. Concentration of observation time, and the interaction of concentration and time, showed a significant difference ($P < 0.001$). While the average mortality mealybug when seen from a comparison between the extract, the extract concentration and, between the concentration, time and the extract was not significantly different ($P = .0,030 - 0,753$).

The results of Tukey's test at α level of 5% of the average death mealybug pests are treated extracts of methanol and water extract of leaves of Gliricidia at 72 hours after treatment can be seen in Table 3.

Table 3. Average mortality mealybug (*P.cryptus*) on soursop plant (*A.muricata*) (tail ± SD) after treatment with the methanol extract and water extract of leaves of Gliricidia.

Concentration (%)	The average mortality mealybug (tail) ± SD%	
	Extract metanol	Extract water
0,00	0,00±0,000 a	0,00±0,000 a
0,02	3,00±1,000 b	3,66±0,577 b
0,04	2,66±0,557 b	4,66±1,115 b
0,06	3,66±2,082 b	5,00±1,732 b
0,08	3,33±0,577 b	5,33±1,528 b

Description: The average value followed by the same letter are not significantly different line on the level of α = 5% by HSD test

Table 4. Average mortality mealybug (P.cryptus) on soursop plant (A.muricata) (tail ± SD) after treatment with the methanol extract and water extract of leaves of Gliricidia at a concentration of 0.08%.

Hours (time)	The average mortality mealybug (tail) ± SD%	
	Extract metanol	Extract water
12	0,66±0,577 a	0,00±0,000 a
24	1,00±1,000 a	0,33±0,577 a
48	2,00±1,000 b	2,00±0,000 b
72	3,33±0,577 c	5,33±1,527 c

Description: The average value followed by the same small letter in the column are significantly different at the level of α = 5% by HSD test

Water extracts and methanol extract at a concentration of 0.02%, 0.04%, 0.06% and 0.08% showed no significantly different results against the average death mealybugs but significantly different from the concentration of 0.00% (Table 3). Tukey's test results showed that the methanol extract and water ekstak not significantly different in the deadly mealybug. When viewed from different concentrations and time after treatment at the level of α = 5% was significantly different, it is suspected that a very small time difference. While both extracts significantly different when seen from the time difference. This is presumably the higher the concentration, the more toxins that enter the body that damage mealybug.

Death mealybugs were treated with an extract of water and methanol at 12 hours after treatment was not significantly different at 24 hours after treatment but significantly different with 48 and 72 hours after treatment. It shows that the effect on the time of death mealybug, the longer observation time after the treatment the higher the death rate mealybug.

Comparison of the average mortality mealybug between water extracts and methanol extract at all concentrations and at different observation showed no significant differences. This is presumably because the water extracts and methanol extract were treated against mealybugs have the same concentration between the extract.

Tukey's test results showed that the methanol extract and extract water in the deadly mealybug significantly different at the level of α = 5% at a concentration of 0.08%. It can be seen the number of deaths on mealybugs on plants soursop, in other words, a pure extract water more effectively kill pests mealybug than pure methanol extract (Table 4).

LC50 and LT50 Values probit analysis result of pure methanol extract and pure extract water can be seen in Table 5 and Table 6.

Based on the LC50 value, the average death mealybug pest with menggunakann extracts more water than the methanol extract of leaves of Gliricidia. Seen from the water extract LC50 lower than methanol extract of leaves of Gliricidia. LC50 value of the pure extract water is lower than 0.035% pure methanol extract. whereas LC50 at 12,24 and 48 hours have not detected due to the death of white pest infestation on plants soursop has not reached 50% (Table 5).

Table 5. The value LC50 probit analysis result of pure methanol extract and pure extract water Gliricidia leaves 12-72 hours after treatment.

Hours after treatment	Value LC_{50} (%)		
	Extract metanol	Extract water	Difference (%)
12 hours	**	**	**
24 hours	**	**	**
48 hours	**	**	**
72 hours	0,096	0,061	0,035

** Note: You can not be detected due to the death of mealybug is less than 50%

LC50 values below 5% concentration showed that the extract pure water more effectively kill pests on plants mealybugs soursop compared to pure methanol extract. If the vegetable insecticides kill insects by organic solvents with concentrations <5%, it is said to be effective (Prijono, 2005).

Table 6. Value LT50 probit analysis result of pure methanol extract and pure extract of leaves of Gliricidia water at different concentrations.

Concretation (%)	ValueLT_{50} (hours)		
	Extract Metanol	Extract Water	Difference (%)
0,00	**	**	**
0,02	91,288	84,912	6,376
0,04	86,406	71,887	14,519
0,06	83,210	69,411	13,799
0,08	95,876	69,296	26,58

Extract the water faster kill mealybug pests compared to the methanol extract of leaves of Gliricidia, as seen in the LT50 values at various concentrations (Table 6).

Based on the value of water extract lower LT50 26.58 hours of pure methanol extract, meaning that the power to kill time faster than the water extract of the methanol extract (Table 6). Based on the LC50 and LT50 values results of tests performed, extract pure water and pure methanol extract can be used as an insecticide can kill pests of vegetable and mealybugs on plants soursop. LC50 and LT50 values (Table 6 and Table 7) water extract is more effective than the methanol extract of leaves of Gliricidia.

4. CONCLUSION

Gliricidia leaves extract water more effectively kill pests on plants mealybugs soursop than methanol extract of leaves Gamal. The higher the concentration and the longer the time the more the higher the death mealybug.

REFERENCES

Direktorat Jendral Hortikultura. 2011. Peningkatan produksi, produktivitas, dan mutu produk tanaman buah berkelanjutan.
http://www.google.co.id/url?sa=t&rct=j&qNilai+ekonomi+tanaman+buah.pdf. diakses 27 November 2015

Ivakdalam LM. 2010. Dampak ekonomi serangan hama asing invasif *Paracoccus marginatus* (Hemiptera: Pseudococcidae) pada usahatani pepaya di kabupaten Bogor [*Tesis]*. Bogor (ID): Sekolah Pascasarjana, Institut Pertanian Bogor.

Manglayang Farm. 2006. *Hijauan Pakan Ternak.* http://manglayang.blogsome.com/2006/03/06/hijau-pakan -ternak-gamal-gliricidia/ . Diakses pada tanggal 18 Desember 2015.pukul 10.50 WIB.

Nukmal, N, N.Utami, dan Suprapto. 2010. *Skrining Potensi Daun Gamal (Gliricidia maculata Hbr.) Sebagai Insektisida Nabati*. Laporan Penelitian Hibah Strategi Unila. Universitas Lampung.

Nukmal, N., Utami, N., dan Pratami, G.D. 2011. Isolasi Senyawa Flavonoid Dari Ekstrak Air Serbuk Daun Gamal (*Gliricidia maculata*) dan Uji Toksisitasnya Terhadap Hama Kutu Putih Pepaya *(Paracoccus marginatus). Seminar Nasional dan Musyawarah Anggota 2011 Perhimpunan Entimologi Indonesia Cabang Bandung*. Tanggal 16-17 Februari 2011.

Prijono, D. 2005. *Pemanfaatan dan Pengembangan Pestisida Nabati.*Makalah Seminar Ilmiah. Jurusan Proteksi Tanaman Fakultas Pertanian. Universitas Lampung.

Siswanto dan Karmawati, E. 2012. Control Of Cocoa Main Pest (Conomorpoha cramerella And Helopeltis spp.) Using Botanical Pesticide And Biological Agents. Pusat Penelitian dan Pengembangan Perkebunan. *Perspektif* Vol. 11 No. 2. Issn: 1412 - 8004. Hlm 103 - 99. Bogor.

Tarumingkeng, R.C. 2001. *Pengaruh Pestisida Terhadap Kehidupan Organisme Tanah*. http://core.kmi.open.ac.uk/download/pdf/12217742.pdf. diakses tanggal 07 November 2015 pukul 14.35 WIB.

Tarumingkeng, R.C. 1992.*Insektisida; Sifat, Mekanisme Kerja dan Dampak Penggunaannya.* UKRIDA Press. 250p.

DEVELOPMENT OF BOTANICAL INSECTICIDE FROM FLAVONOID OF COMPOUND LEAF EXTRACT *GLIRICIDIA MACULATA* TO CONTROL COFFEE MEALYBUG *PLANACOCCUS CITRI*

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ABSTRACT

Coffee is an important commodity in Indonesia, its production continues to decrease from year to year. One of important pest is the mealybug (*Planococcus citri*), the production lost due to a severe attack can reach 90%. Farmers still using synthetic insecticides to control the pest, which have negative effect on the environment and humans buying. To reduce its, necessary to find the environment friendly insecticides (botanical insecticide). One of the plant can be used as botanical insecticide is *Gliricidia maculata*. The purpose of the study to obtain flavonoid compound from polar extract (water and methanol) of *G. maculata* leaves, as botanical insecticide throught out isolation and purification. To compare the effective concentration of the flavonoid compounds from polar extract (water and methanol) of powder leaveas *G. maculata* on mortality coffee mealybug. A set of laboratory experiment was conducted by using block design. Water and methanol extracs (WE and ME) with 5 levels concentration i.e. 0%, 0.01%, 0.02%, 0.03% and 0.04%, and 3 replications. Mealybug mortality observed at 12, 24, 48, 72 hours after treatment. Analisys Probit were used for Determine LC50 values, ANOVA and Tukey's test was used to determine an effective formula botanical insecticide. The results showed that the polar extract (water and methanol) Gliricidia leaves contains flavonoids that act as insecticides against coffee mealybug (*P.citri*) with LC50 72 hours water extract 0,033% and metanol extract 0,039%.

Keywords: Botanical insecticide flavonoids, powder leaves (*Gliricidia maculata*), coffee mealybug (*Planococcus citri*).

1. INTRODUCTION

Coffee is one of the results of agricultural commodity that has economic value that is high enough among other plantation crops and plays an important role as a source of foreign exchange. Coffee not only plays an important role as a source of income but also a source of income for not less than one and a half million coffee farmers in Indonesia (Rahardjo, 2012). Coffee production in Indonesia is still low which is third in the world. The low level of productivity of coffee plants one of them caused by the pest is relatively high, one of the pests that can reduce the production of coffee is mealybug (*Planococcus citri*). This pest attacks coffee plants on the young fruit, dark fruit, twigs, buds and young leaves (Wicaksono, 2013).

Pest control on the coffee plants at the farm level is generally still use synthetic insecticides. The use of synthetic insecticides are not right will bring dampakyang bad, can cause pest resistance, emergence of secondary pests, environmental pollution and product rejection due to a problem of residues exceeding the tolerance threshold. In addition the use of synthetic insecticides intensively, also provides a wide range of undesirable effects, such as damage to ecosystems agricultural land, disruption of the existence of flora and fauna around the farms and farmers' health impacts due to the use of insecticides. How to control a simple, inexpensive and environmentally friendly, such as by the use of plant-based insecticide to use the plants and the use of natural enemies (Siswanto and Karmawati, 2012). One of the plants that can be used as an insecticide plant is Gliricidia leaves. Gliricidia leaves contain the active ingredient coumarin which are insecticides, rodenticides and bactericidal (Ministry of Agriculture, Animal Husbandry and Health Directorate, 2009).

This study aims to Acquire flavonoid extract water and methanol extract of leaves of Gliricidia nature as an insecticide plant by means of isolation and purification.

2. Literature review

Hama is any organism that is damaging or potentially damaging to plants, plant products, products and foodstuffs, livestock and humans. Pest is very harmful because it can reduce the availability, quality or source of biological material (Koswara, 2006).

One of the alternatives that can be used as a pest controller is to use plant-based insecticides that are environmentally friendly. In addition, vegetable insecticides from plants readily biodegradable and relatively safe to non-target organisms. (Siswanto and Karmawati, 2012).

Herbal vegetable insecticide is extracted from plant material into a concentrate with no change in the structure of this kimianya.Insektisida easily decomposed or degraded so as not persistent in nature or in materials of vegetable makanan.Insektisida safe for the environment, to support organic agriculture in an effort to reduce the use of synthetic insecticides and the price is cheaper (Indriani, 2006).

2. RESEARCH METHODS

A. Tools and Materials

The tools used to make the water extract powder Gliricidia leaves that filter Bunchner for separating the precipitate and filtrate, Freezedrayer to dry the filtrate, UV-Vis, FTIR, GC-

MS. AmberliteXAD KK-4 for purification filtrate. TLC to monitor purification. Other tools used are jars for powder extraction Gamal, container for soaking the coffee fruit and jars to put the coffee cherries soaked gauze leaf extract Gamal as well as cover the jars, electric heating, capillary pipette. Digital camera as a documentation tool and stationery to write the data obtained.

The materials used to make the water extract of leaf powder is Gliricidia Gliricidia plants, mealybugs (Planococcus citri) as an insect host, feed coffee fruit as current treatments. N- hexane, dichloromethane (DCM), and methanol with a brand J.T Beker, distilled water to make a water extract of leaf powder Gamal. Plate TLC (thin layer chromatography) of aluminum with adsoben silica gel Merck 60 F254, Reagent AlCl3, CeSo4, NaOH and H3BO3. Fourth reagent serves to identify the presence of flavonoids contained in the sample.

B. Implementation Research

Making Extract (Isolation and Purification of Flavonoid Compounds Group)

Making water extract using multilevel maceration method, by soaking the leaf powder gliricidia using hexane solvent, dichloromethane, methanol and water. Furthermore, to sever the bond glycosides present in flavonoids done by hydrolysis. The results of the water extract of hydrolyzed by HCL and methanol solvent, then heated for 1 hour at a temperature of 600C and separated by a separating funnel with a solution of ethyl acetate and saturated NaCl. Water extract of dried Gliricidia leaves that show the deposition of amorphous shape was filtered with a Buchner filter to separate the precipitate (EA) and the filtrate (FA) it. Deposition (EA) was purified by recrystallization method and filtrate (FA) with freeze drayer.

Making the methanol extract us- ing maceration method stratified, by soaking the leaf powder gliricidia using hexane solvent, dichloromethane and methanol.

The methanol extract of dried Gliricidia leaves containing chlorophyll fractionated by column chromatography method (KK) using silica KK and isocratic to remove chlorophyll. The filtrate methanol been cleared of chlorophyll (FM) direkfraksinasi using the method of using the column AmberliteXAD KK-4. Fractions were collected based on the volume and content of each fraction was analyzed by TLC flavonoidnya.

Data analysis

The data were then analyzed using probit analysis to determine LC50 values, test Anara and continued with Tukey's test was used to determine an effective solution as vegetable insecticide.

3. RESULTS AND DISCUSSION

A. Compounds Flavonoids Extract Water and Methanol Leaf Extract Gamal

Extraction of Crude Extract Water and Methanol

Results maceration storied performed using 500 grams of powdered leaves of Gliricidia, obtained extract as much as 6 liters of water, 500 ml in frezdryer and water extract obtained in the form of pasta as much as 4 grams, the rest of which is not yet in frezdryer stored in the refrigerator.

Results maceration storied performed using 500 grams of powdered leaves of Gliricidia, obtained methanol extract as much as 6 liter, 6 liter evaporation results obtained 82 grams of methanol extract concentrated extract. Extract concentrated in frezdryer for 72 hours, the extract obtained in the form of pasta as much as 25 grams.

KLT Water and Methanol Crude Extract

The crude extract water and methanol crude extract obtained TLC test was done to determine the compounds contained in the extract. The results of TLC analysis showed the presence of crude extract of brown and yellow spots on the TLC plate after visualization CeSo4 sprayed with the solvent, AlCl3, NaOH and H3BO3.

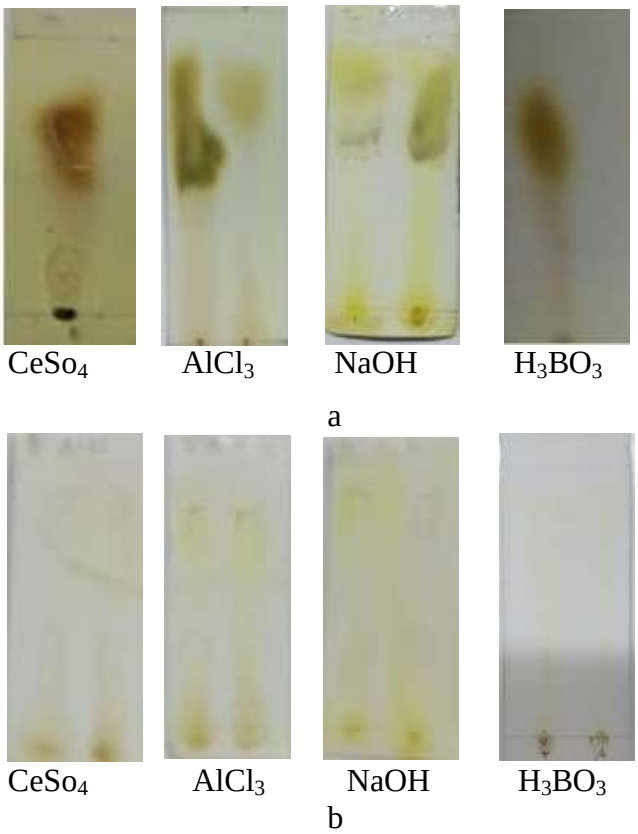

Figure 1. Kromotogram results of TLC analysis of the crude extract with water and methanol solvent CeSo4 visualization, AlCl3, NaOH and H3BO3 a) the methanol extract b) water extract

Purification of Water and Methanol Crude Extract

Hydrolysis of 2.5 grams of water extract obtained Deposition (EA) in crystalline form as much as 1 gram and filtrate (FA) in the form of 15 ml of water phase and phase 7 ml of ethyl acetate. TLC results showed that the water extract hydrolysis only filtrate (water phase), which is pure flavonoid compounds.

Results fractionation 2 grams of methanol extracts using KK Amberlite XAD-4 obtained 42 fractions. The results of TLC into 42 fractions known of the fractions that contain the same compounds that can be combined into one and gained seven factions. TLC results of seven factions are known to only a fraction of the fraction 19 already pure flavonoid compound.

TLC Extract Pure Water and Methanol

The content of flavonoid compounds in pure water and methanol extract of leaves of Gliricidia and results from the TLC analysis that showed the presence of yellow and brown on a TLC plate (kromotogram) after being sprayed with the solvent visualization CeSo4, AlCl3, NaOH and H3BO3 (Figure 2).

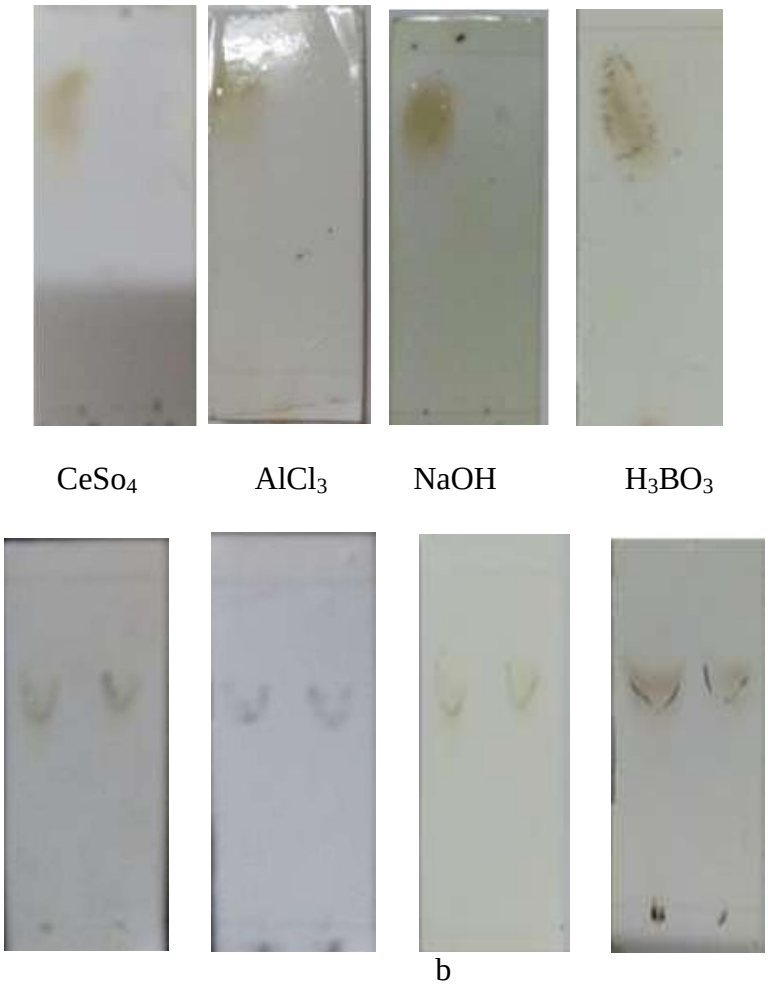

Figure 2. Kromotogram pure extract TLC analysis results of water and methanol with a solvent visualization CeSo4, AlCl3, NaOH and H3BO3, a) the methanol extract b) water extract.

TLC results showed that the pure water and methanol extracts of leaves of Gliricidia contains flavonoids with their yellow and brown spots on kromotogram. Nukmal research results, et al (2010), known secondary metabolites, compounds contained in extracts water Gliricidia leaves macerated results storey are alkaloids, terpenoids, steroids, and flavonoids. The flavonoid compound most commonly found in the water extract. So that the compound is responsible for insecticidal properties gamal leaf vegetable.

B. Mortality Mite Pests White Water Treatment Pure Extract and Pure Methanol Leaf Extract Gamal

Bioassay results indicate that both types of pure water and methanol extracts are used to give effect to the pest mealybug death. The average percentage mealybug pest death with pure extract treatment of water and methanol can be seen in Figures 3 and 4.

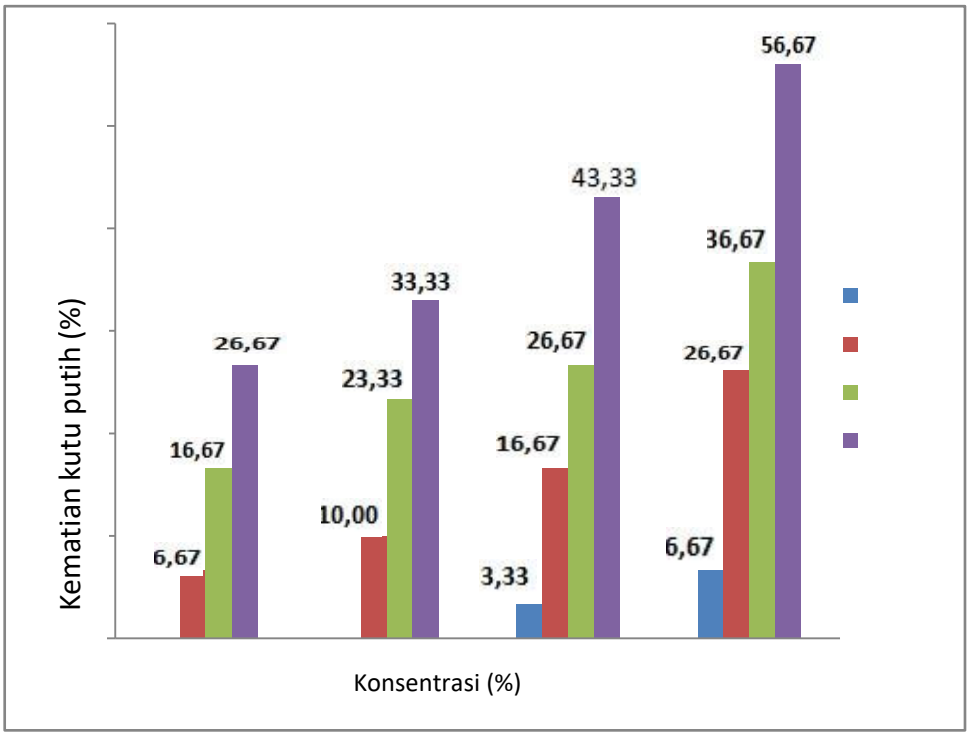

Figure 3 Average percentage mealybug pest death with pure water extract treatment Gliricidia leaves on the concentration and time of observation different

In Figure 3. and 4. it can be seen that the mortality rate mealybug in the water extract of leaves of Gliricidia higher than the methanol extract, which at a concentration of 0.04 after 72 hours of treatment the mortality rate mealybugs on water extract reached 56.67% while the extract methanol amounted to 46.67%. The increase in the percentage of deaths mealybug along with increased treatment time and concentration used. The longer the treatment time and the higher the concentration of extract used, the higher the percentage of deaths mealybug pests, since the higher the concentration of toxins that enter the body mealybug and the longer time it will cause

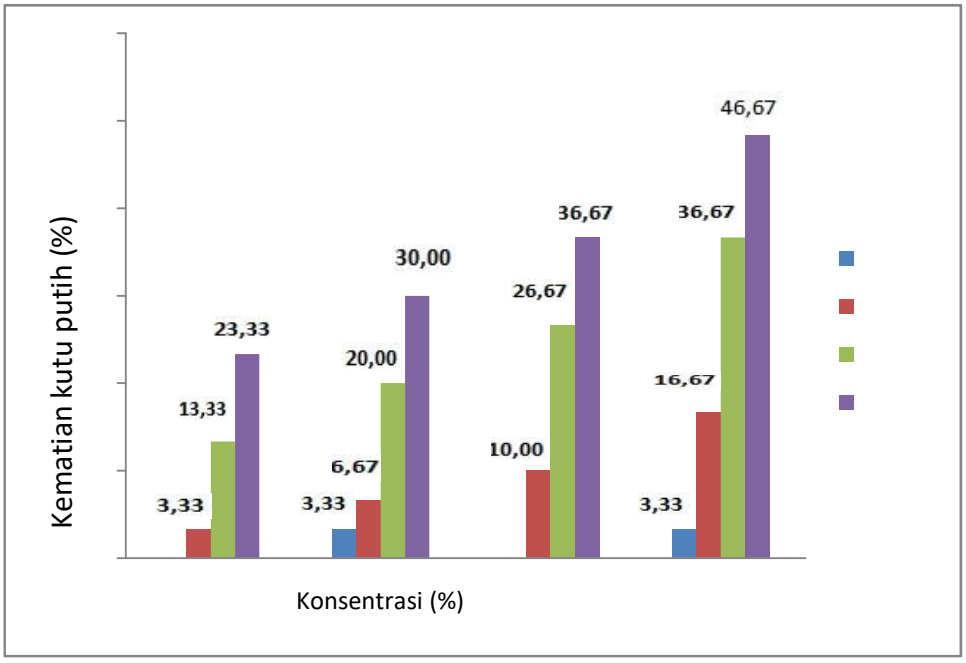

Figure 4. Average percentage mealybug pest death with pure methanol extract treatment Gliricidia leaves on the concentration and time of observation different

A lot of damage in the body mealybug.

The average mortality mealybug pest after further Tukey's test at 5% level can be seen in Table 3.

Table 3. Average mortality mealybug (tail ± sd) after being treated with an extract of pure water and pure methanol extract of leaves of Gliricidia 72 hours after treatment

Concentration (%)	**The average mortality mealybug (tail) ± sd**	
	Extract Pure Water	**Extract Pure Metanol**
0,00	0,00 ± 0,00 c A	0,00 ± 0,00 c A
0,01	2,67 ± 0,58 b A	2,33 ± 0,58 b A
0,02	3,33 ± 0,58 b A	3,00 ± 1,00 b A
0,03	4,33 ± 1,00 ab A	3,67 ± 0,58 ab A
0,04	5,67 ± 0,58 a A	4.67 ± 1,00 a A

Description: The average value followed by the same small letter in the same column and in capital letters on the same line are not significantly different at the level of a = 5% by Tukey's test

The death rate mealybugs on pure extract water Gliricidia leaves faster than a pure extract of methanol. This is because the water extracts performed hydrolysis to break the glycosides of flavonoid aglycone. Flavonoid aglycone has a higher toxicity than the flavonoid glycosides, the methanol extract is not done hydrolysis. Flavonoid aglycone flavonoid without sugar bound contained in various forms of structure (Markham, 1988).

Flavonoid aglycone generally have antioxidant and radical catchers is higher than the flavonoid glycosides because of the flavonoid glycosides phenolic hydroxyl group is an active group of antioxidants or radical catchers have binding force sugar (Harborne 1987).

LC50 and LT50 Values pure extract probit analysis results of water and methanol after treatment is shown in Table 5 and Table 6.

Table 5. Value LC50 results probit analysis extract pure water and pure extract of methanol at 12-72 hours after treatment.

Time after treatment (hour)	LC50 value (%)	
	Extract Pure Water	Extract Pure Metanol
12	0,063	0,123
24	0,059	0,067
48	0,048	0,051
72	0,033	0,039

In Table 5 it can be seen that the LC50 value pure extract water at all hours after treatment was lower than pure methanol extract is between 0.03% - 0.60%. So it can be said to extract pure water is more effective than pure methanol extracts kill insects in the test (P.citri).

Both kinds of extracts had LC50 values below 5% concentration, showed that both types of extracts can be said to effectively kill pests mealybug. This was confirmed by Prijono (2005) which states that a plant-based insecticide with organic solvents is said to effectively kill insects when the test has a concentration of <5%.

Table 6. Value LT50 results probit analysis extract pure water and pure methanol extracts at different concentrations.

Concentration (%)	LT50 value (%)	
	Extract Pure Water	Extract Pure Metanol
0,00	-	-
0,01	94,849	96,979
0,02	85,298	93,970
0,03	71,460	80,309
0,04	63,113	70,143

LT50 values pure extract water at all concentrations lower than pure methanol extract of between 2.1 to 8.6 hours means the time of the death of test insects occurs faster in water than the pure extract treatment pure methanol extract, so the water pure extracts are more effective than pure extract methanol.

Based on the LC50 and LT50 Values in Tables 5 and 6 can be said to be a pure extract water more effectively than pure methanol extract. This is supported by research Nukmal, et al (2011), found water with maceration extract storied effective in shutting down the papaya mealybug pests compared to extract water without maceration terraced, with LC50 = 0.75%.

4.CONCLUSION

Extract the polar (water and methanol) Gliricidia leaves contains flavonoids that act as insecticides against pests vegetable mealybug (Planacoccus citri) of the coffee plant.

REFERENCES

Afriyorawan. 2013. *Characterization of Flavonoid Compounds Isolation Results Methanol Leaf Extract Gamal (Gliricidia maculata).* Essay. University of Lampung. Lampung.

Asiedu, E., afun, J.V.K., Kwoseh, C. 2014. *Biology of Planococcus citri (Risso) (Hemiptera: Pseudococcidae) on Five Yam Varieties in Storage*.Scientific Research Publishing Inc. University of Science and Technology, Kumasi. Ghana.

Directorate General of Plantation. 2014. *Contributions average Sentra Coffee Production to Total National Coffee Production and Their Productivity 2014*. Ministry of Agriculture. Jakarta.

Elevitch, C. R and Francis, J. K. 2006. *Gliricidia sepium (Gliricidia) Fabaceae (legume family).* Species Profiles For Pacific Island Agroforestry. www.traditionaltree. org. Accessed May 7, 2015, 12:26 pm

Harbone, J.B. 1987. Methods Analyzing the Modern Way Guidance Phytochemicals Plant. Interpreting Kosasih Padmawinata. ITB. Bandung.

Herbert, R.B. 1996. *The biosynthesis of secondary metabolites*. Interpreting Bambang Srigandono. Teachers' Training College Press Publishers Semarang. Semarang. P. 103-123.

Indriani, T. 2006. *Efficacy of Several Types Potentially Swamp Plants For Botanical Insecticides Against Silkworm Fruit (Diaphania indica).* Technical Meeting of the National Power Functional Agriculture.

Joker. 2002. Gliricidia sepium (Jacq.) Steud. Danidia Forest Seed Centre. Denmark. Lu, F. C. 1994. *Basic Toxicology: Principles, Target Organ and Risk Assessment*. 2nd edition. Publisher U.I.P. It 412.

Nukmal, N., Widiastuti, E.L., and Sumiyani, E. 2009. *Efficacy Test Leaf Extract Gamal (Gliricidia maculata) Against Ulcer Imago Hama Dadap (Quadrastichus erythrinae).* Prosiding National Seminar XX and XIV Congress of Indonesian Biology. Malang 24 to 25 July 2009 Google

Nukmal, N., Utami, N., And Suprapto. 2010. *Potential Screening Leaves Gamal (Gliricidia maculata Hbr.) As Botanical Insecticides.* Grants Research Report Unila Strategy. University of Lampung. 2010.

Nukmal, N., Utami, N., and Pratami, G. D., 2011. *Isolation of Flavonoid Compounds From Air Extract Powder Leaf Gamal (Gliricidia maculata) and toxicity Test Against White Mite Pests of Papaya (Paracoccus marginatus).* Proceedings of the Research Grants Unila Strategy. University of Lampung. 2010.

Prijono, D. 2005. *Botanical Insecticide Utilization and Development*. Scientific Seminar Papers. Department of Plant Protection, Faculty of Agriculture, University of Lampung. 3 August 2005.

Siswanto and Karmawati, E. 2012. *Of Cocoa Main Pest Control (Conomorpoha cramerella And Helopeltis spp*.) Using Botanical Pesticide And Biological Agents. Research and Development Center of Plantation. Perspectives Vol. 11 No. 2. ISSN: 1412-8004. Pp 103 - 99. Bogor.

Stewart, J.L., Allison, G. E., and Simons, A. J.1996. *Gliricidia sepium Farmers Genetic.Resources.* Oxford forestry institude. Oxford.

Tarumingkeng, R. 1992. *Insecticide; Nature, Mechanism, Work and Impact of Its use*. UKRIDA Press. 250px.