

**Wildlife conservation compatible with local forest uses on Seram Island, eastern Indonesia: Focusing on interrelationships between humans and wildlife through indigenous arboriculture**



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# What is arboriculture?

- Arboriculture: Utilization, cultivation, protection of useful arboreal plants

## Useful arboreal plants:

- Plants used consumptively for food, medicine, construction materials, handicraft materials, etc.
- Plants used non-consumptively for purposes of shading, windbreak, attracting animals (for trapping), etc.



- Subsistence systems in Wallacea and Near Oceania: “Arboreal-based Economy”

## Arboreal-based economy:

“Subsistence economy whose practitioners meet a majority of their dietary, nutritional and economic needs through the exploitation of arboreal resources including located in or proximate to a forest environment [e.g. forest game animals]” [Latinis 2000:43]

# Why focus on arboriculture?

## ■ Growing attention to **human-modified landscapes**

### ■ Satoyama initiative [MoE Japan 2010]

*“The Satoyama Initiative is a comprehensive effort to spread awareness that protecting biodiversity entails the protection of both wild and human-influenced natural environments, such as farmland and secondary forest, which have been maintained sustainably over a long time”.*

### ■ Ecoagriculture [McNeely and Scherr 2002]

*“The management of landscapes for both the production and the conservation of ecosystem services, in particular wild biodiversity”*

## ■ Need to evaluate conservation values of human-modified landscapes (agroforest etc.)

■ Protected area : only 12 % of the terrestrial area of the Earth

■ The large part of the terrestrial area has been affected by agriculture



# Why focus on arboriculture ?

- Secondary forest in tropics that we can easily imagine: commercially logged; disturbed forest; slash-and-burn fallow forest; Industrial plantation...However, there are many secondary forest patches which are formed and maintained through arboriculture in the tropics
- **Human-modified forests** formed and maintained through arboriculture are **'invisible'** for outsiders. Why?
  - Extensively managed, and tolerate other species (non-crops and wild animals) existing and using the forest
  - Sporadically dispersed in forest area and there are no clear boundaries
- For biodiversity conservation, enabling ecosystem service use by local people, it is needed to be clarified :
  - **How arboricultural practices form and maintain what forests**
  - **What roles and meanings such human-modified forests have for the local livelihood and biodiversity**

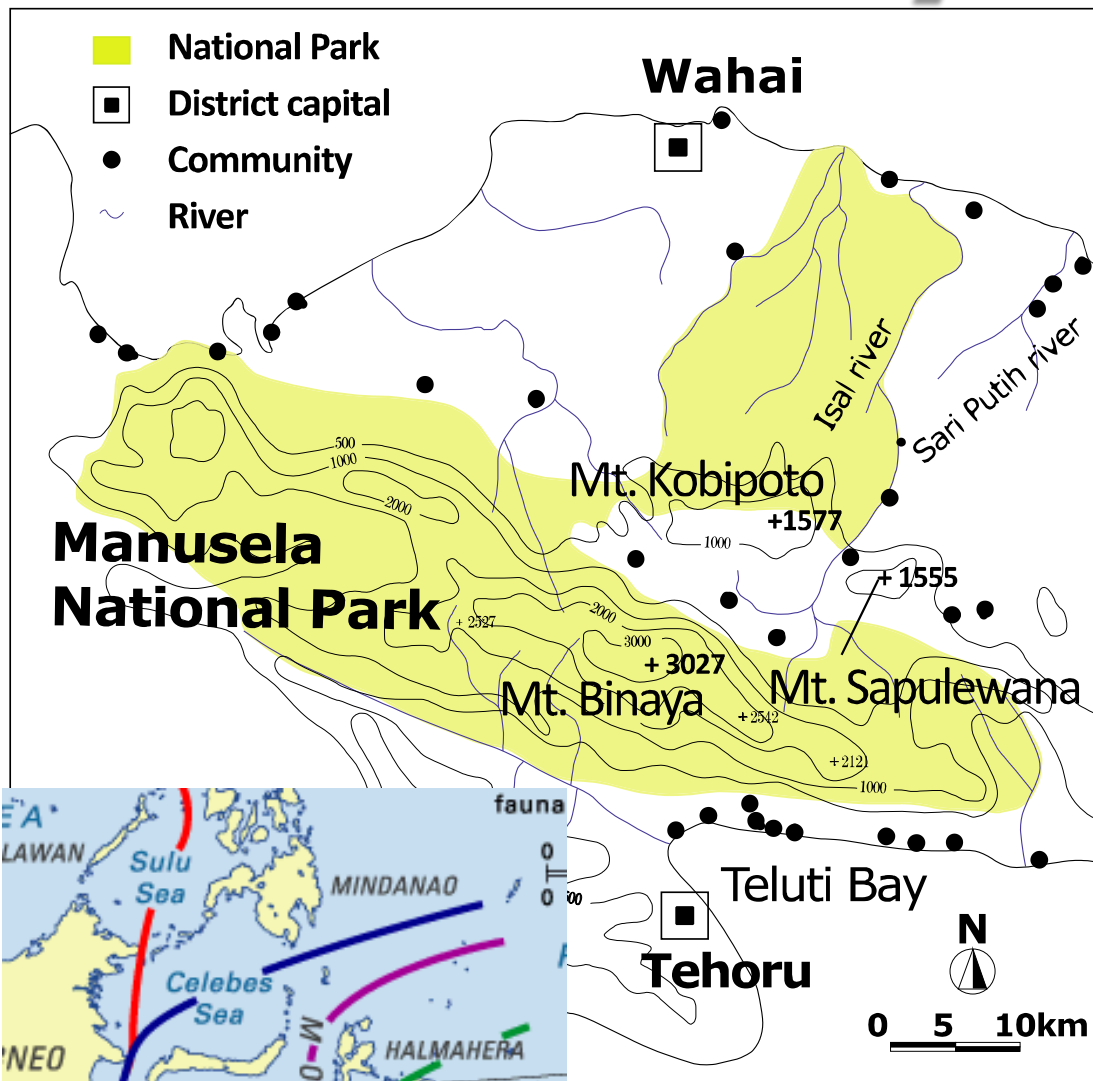


# Outline

- Study area
- Outline of indigenous arboriculture in Seram
- Human-wild animals interrelationships formed and maintained through arboriculture
- Implications



# Study Area



## Amani oho

- Population : ±320 (±60 households)
- Subsistence activities: sago-starch extraction, agriculture (vegeculture), hunting/trapping, collection of other NTFPs
- Main source of incomes:seasonal migrant work as harvester of clove, selling bush meat, parrot trade, etc.
- Access: to North : 2-3days on foot  
to South: 1day on foot
- Located in the interior of central Seram nearby National Park

## Research

- 2003-2010
- Method: Key informant interviews, one-on-one interviews, group interviews, participatory mapping and participatory observation





# Indigenous arboriculture in Seram



# Folk categories of land in Amani oho

Land types	Land use
Residential land and home garden ( <i>Amania</i> )	Residential land and home garden with coconut palm, betel nut palm, and various herbs.
Intensive root crop - vegetable garden ( <i>Lela</i> )	Intensively managed garden, of which main crops are taro, cassava, sweet potato, vegetables, tobacco, sugar cane, etc.
Extensive banana - taro garden ( <i>Lawa</i> )	Extensively managed garden with banana and taro.
Forest garden ( <i>Lawa aihua</i> )	Mixed tree garden with fruits trees (durian, jackfruits, etc.) and wild trees
Sago grove ( <i>Soma</i> )	Sago palm ( <i>Metroxylon sago</i> ) grove that supply sago starch, staple food for local people.
Cultivable land and low forest ( <i>Lukapi</i> )	Cultivable land where huge roots of trees have decayed and fallow forest that was formed in the ex- <i>lela</i> and ex- <i>lawa</i> .
<b>(3)</b> <i>Itawa</i> forest ( <i>Itawa harie</i> )	<i>Litsea mappacea</i> - dominated forest that has been made and maintained by local people and used as a trapping ground for edible wild birds.
Bamboo grove ( <i>Awa harie</i> )	Bamboo grove made by local people. Several species of Bamboo are used as handicraft materials, fuel wood, etc.
<b>(4)</b> Damar forest for resin collection ( <i>Kahupe harie</i> )	<i>Agathis damara</i> - dominated forest that has been made and maintained by local people and used for resin (damar) collection.
Forest for NTFPs collection ( <i>Ma harie</i> )	Semi-disturbed natural forest used for collecting fuel wood, construction timber, rattan, etc.
<b>(1)</b> Forest for hunting/trapping ( <i>Kaitahu</i> )	'Primary' and mature secondary forest situated far from the village settlement and used for hunting/trapping grounds.

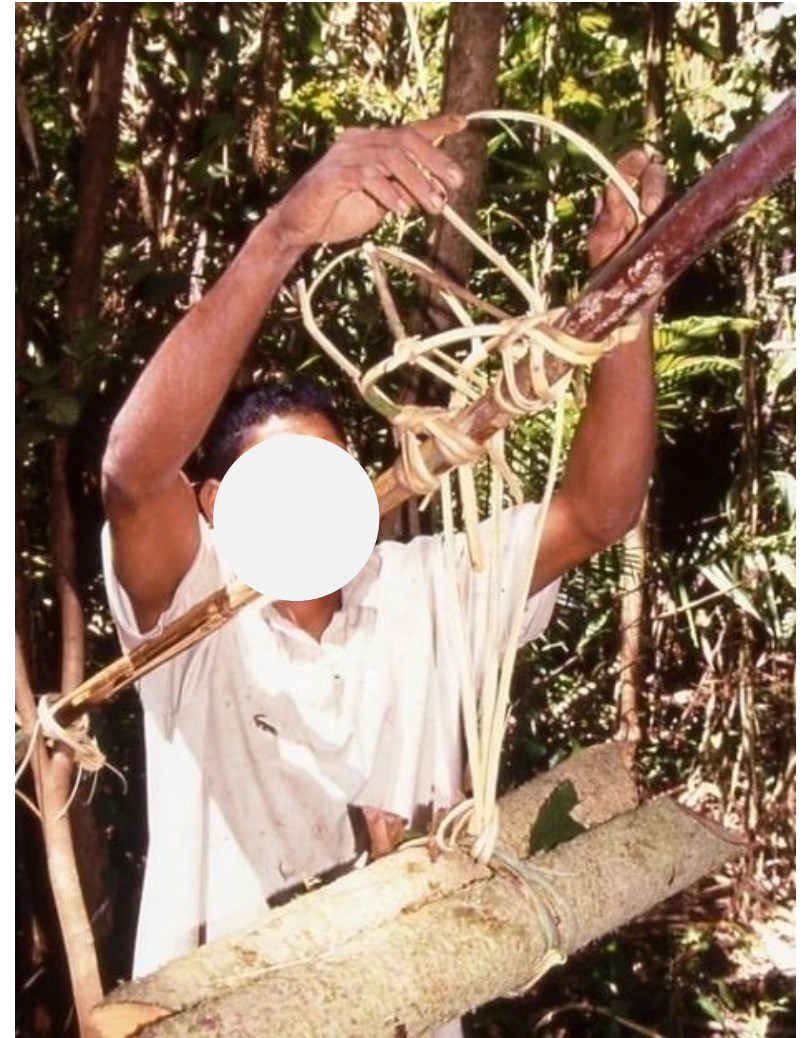
Source: Field research.



# (1) Forest used for hunting & trapping (*kaitahu*)



Cuscus (*Phalanger orientalis*)



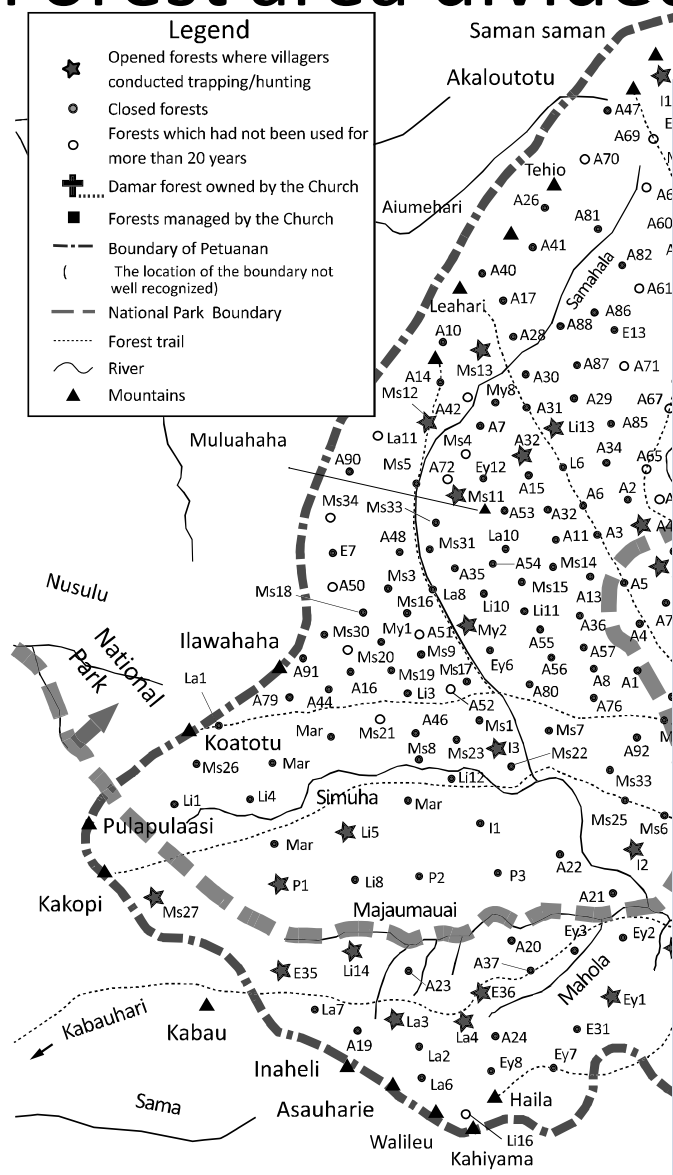
Weighted noose, a trap for cuscus

The left is of the cuscus, arboreal marsupials. According to my previous study, cuscus account for almost 50% of the wild animal food resources consumed by the villagers in terms of the amount of protein. Villagers sometimes hunt cuscus using bamboo spear, but in many cases, they trap cuscus using a weighted nooses made of rattan as shown on the right.

# Forest area divided into many forest lots (kaitahu)

**Legend**

- ★ Opened forests where villagers conducted trapping/hunting
- Closed forests
- Forests which had not been used for more than 20 years
- ✚ Damar forest owned by the Church
- Forests managed by the Church
- - - Boundary of Petuanan
- ( The location of the boundary not well recognized)
- - - National Park Boundary
- ..... Forest trail
- ~ River
- ▲ Mountains



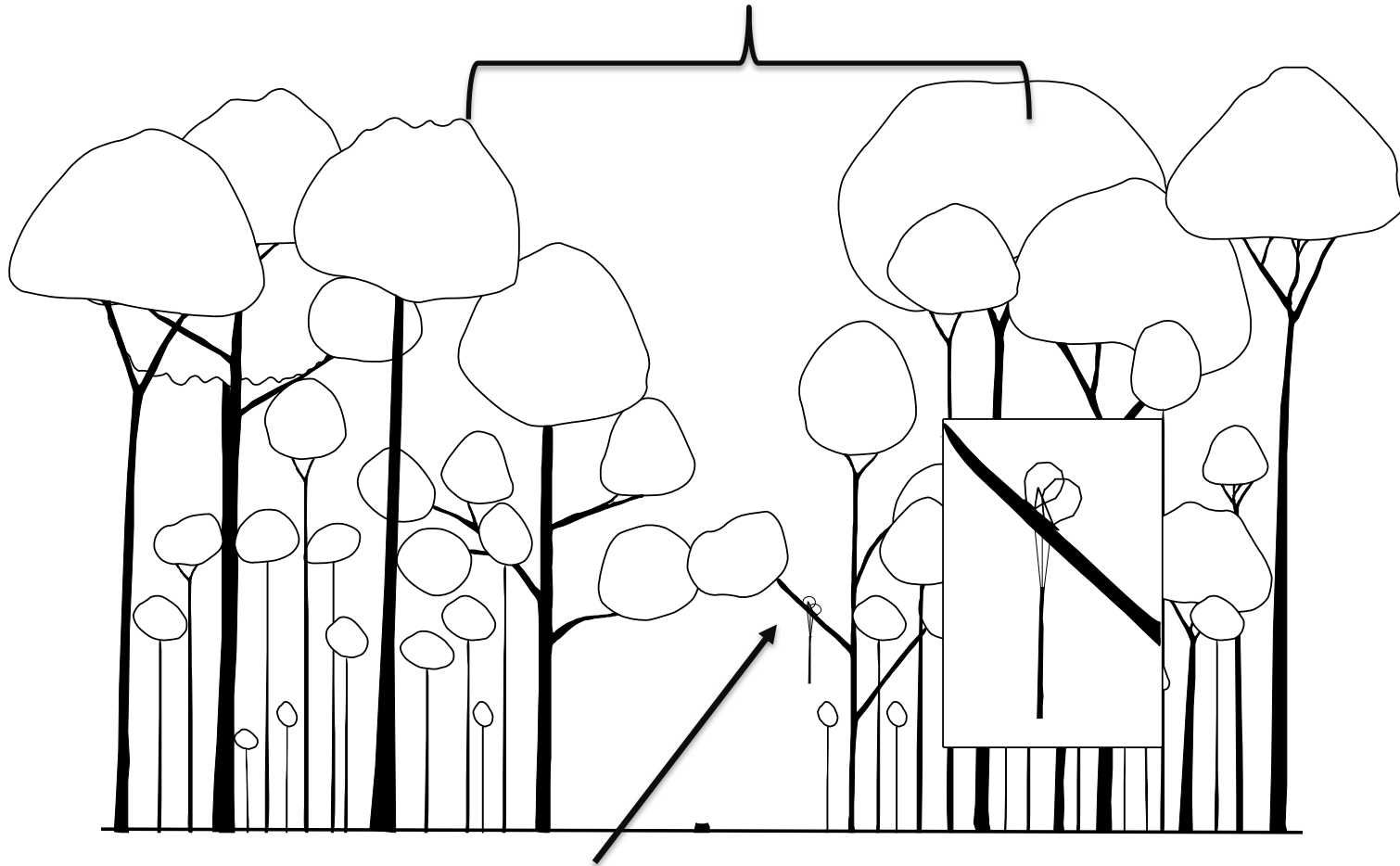
Kode	Nama kaitahu	Kode	Nama kaitahu	Kode	Nama kaitahu	Kode	Nama kaitahu
<b>Soa E</b>		E54	Makalasina	A52	Wasa(2)†	Li13	Lialelo
E1	Halulohu	E55	Sama Sama Lea	A53	Tiapohuhu	Li14	Melute
E2	Kukutotui	<b>Soa A</b>		A54	Hatuoto	Li15	Tuahata
E3	Aimusunuhata	A1	Wasa(1)	A55	Mulua Haha	Li16	Kahiya
E4	Kaipu	A2	Soa	A56	Utalohu	<b>Soa My</b>	
E5	Haluhari	A3	Sewatinueneri	A57	Atauhata	My1	Kikulih
E6	Liapoto	A4	Hilili Kule Kule	A58	Lilihalahari	My2	Tapuan
E7	Sahua	A5	Koaoaku	A59	Ramauhena†	My3	Atauhu
E8	Kasife	A6	Pakalula	A60	Nisaispateia†	My4	Maroh
E9	Silahata	A7	Sufeli	A61	Waeula†	My5	Mamar
E10	Mapaue	A8	Kasisu Haha	A62	Malilukola	My6	Tifu
E11	Liamumusi	A9	Tomoe†	A63	Suhula Sana Kete Kete†	My7	Lemai
E12	Liapihitan	A10	Sisoy Hata	A64	Koriwahatae†	<b>Soa Ms</b>	
E13	Salapika	A11	Sesehutu	A65	Hatutuhu†	Ms1	Amani
E14	Patate	A12	Hanahata	A66	Kohaha†	Ms2	Waese
E15	Halulohu Tapu	A13	Ahahae	A67	Matakaitupa†	Ms3	Haiman
E16	Liahaulu Ana	A14	Ulaipoto(1)	A68	Lumu Panu Panu†	Ms4	Sotitai
E17	Lehae	A15	Pahita Sia Tue tue(1)	A69	Kahupe Hatukesu†	Ms5	Anania
E18	Halule	A16	Manuelala	A70	Uwaela†	Ms6	Masala
E19	Enamasaie	A17	Kopa Hata Hata	A71	Kaulata Rahe Korია†	Ms7	Marilah
E20	Manusela Ana	A18	Lumah Ulai	A72	Lianahu Hatu†	Ms8	Omako
E21	Manusela Potoa	A19	Lirolepe Hani	A73	Hatusuha	Ms9	Hathur
E22	Ailulahari	A20	Kutulisa	A74	Kalae Pola-pola	Ms11	Wekela
E23	Awoua	A21	Unenehutu	A75	Taumusunue	Ms12	Silahut
E24	Hoale Ana†	A22	Lulakala	A76	Korie Waihitu	Ms13	Kokani
E25	Pahohi	A23	Sapatue	A77	Aimakasana†	Ms14	Haluha
E26	Totunie Paki-paki	A24	Maliluhata	A78	Keilekesana Kete-kete†	Ms15	Ataman
E27	Makalasina	A25	Aipaki	A79	Wekela(1)	Ms16	Malilu M
E28	Lusilala	A26	Tehio	A80	Mileu Kori Tupe	Ms17	Fouthu

This is a map of hunting and trapping grounds in Amani oho. According to group interviews and participatory mapping, the forest area that is used as hunting and trapping grounds is divided into more than 250 forest lots called locally kaitahu. Each dot on the map indicates the location of each kaitahu. Each kaitahu belongs to a certain individual or group, and has a specific name based on its topographic characteristics.



# Setting traps for cuscus

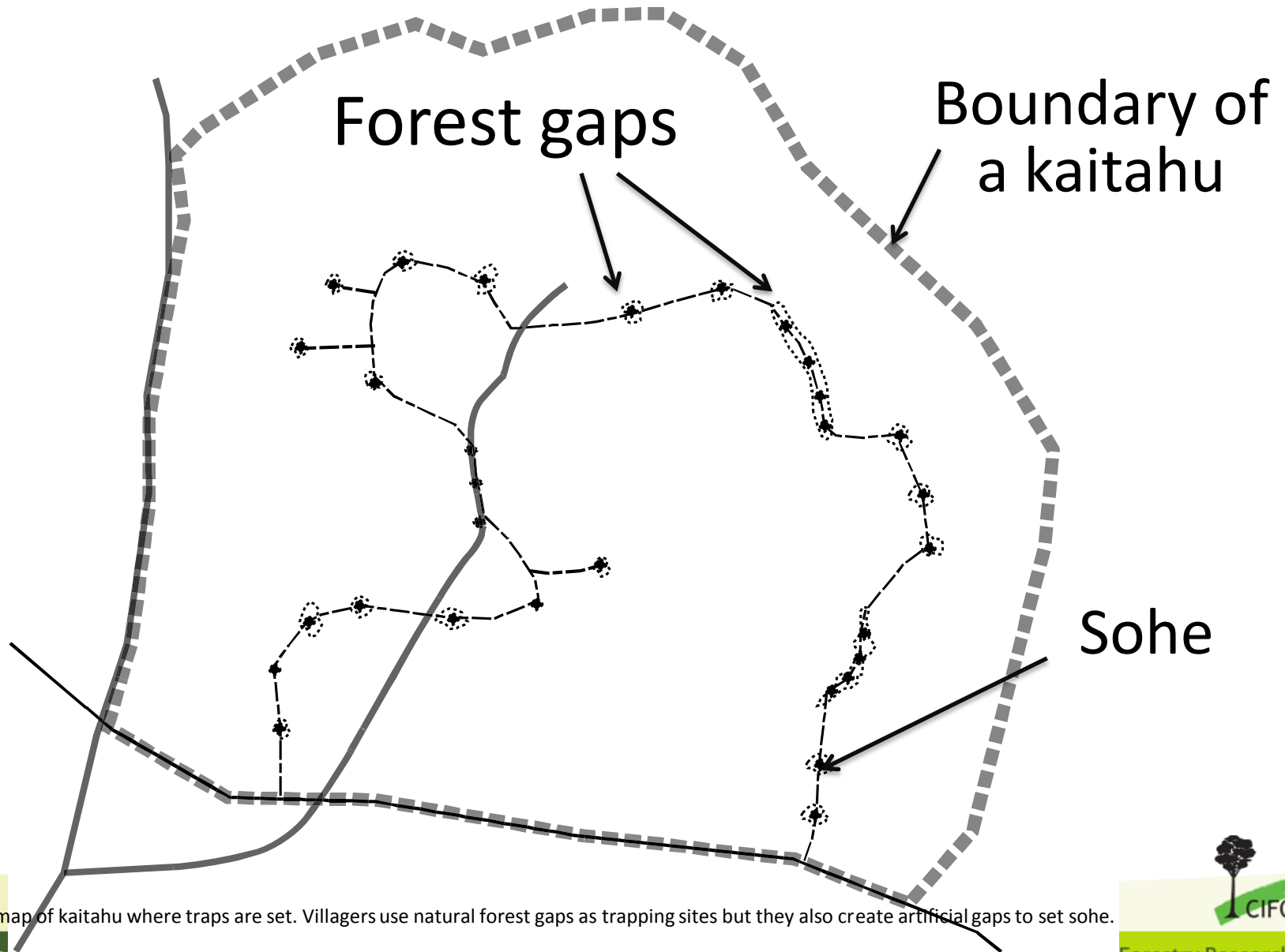
## Natural and artificial gap



### Sohe, weighted noose trap

Villagers set nooses called sohe at forest gaps as shown on this slide. Cuscus move along branches and leaves for foraging at nighttime. Villagers cut branches and vines so that only a single branch or vine connecting an adjacent tree remains in the gap. Traps are set on the branch or vine.

# Setting traps for cuscus



This is a conceptual map of kaitahu where traps are set. Villagers use natural forest gaps as trapping sites but they also create artificial gaps to set sohe.

# Protection of trees used by cuscus

- Cutting vines that are twined around the trunk of those trees
- Cutting down or barking trees covering those cuscus preferred trees

- **Trees, fruits of which are eaten by cuscus**
  - Atau (*Syzygium luzonense*)
  - Masapa (*Syzygium malaccense*)
  - Haana (*Gordonia excelsa* Blume)
  - Kori (*Lithocarpus celebicus* (Miq.) Rehder)
- **Trees, sap of which are lapped by cuscus**
  - Supa (*Ficus* sp)
  - Airula (?)
  - Solaoto (?) etc



Solaoto (?)



Atau (*Syzygium luzonense*)

Villagers also protect several trees, fruits or sap of which are eaten or lapped by cuscus. They set traps along these trees.

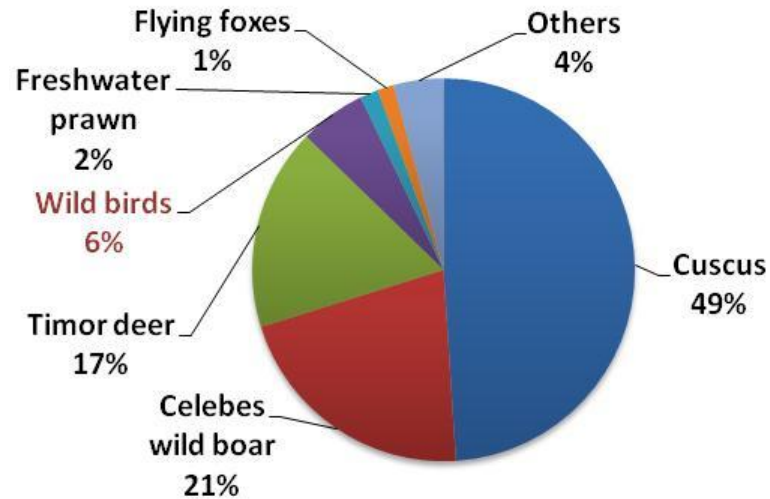
An aerial photograph of a vast, multi-layered forest landscape. The terrain is hilly and covered in dense green vegetation. In the distance, a small cluster of buildings is visible. The sky is bright and slightly hazy. A large white oval is superimposed over the lower half of the image, containing bold black text.

**Many human-modified  
forest patches are scattered  
in the forest area!**

Even though at a glance mature natural forest looks like intact primary forest without human intervention, there are many human-modified forest patches scattered in the forest area.

# (2) *Itawa* forest

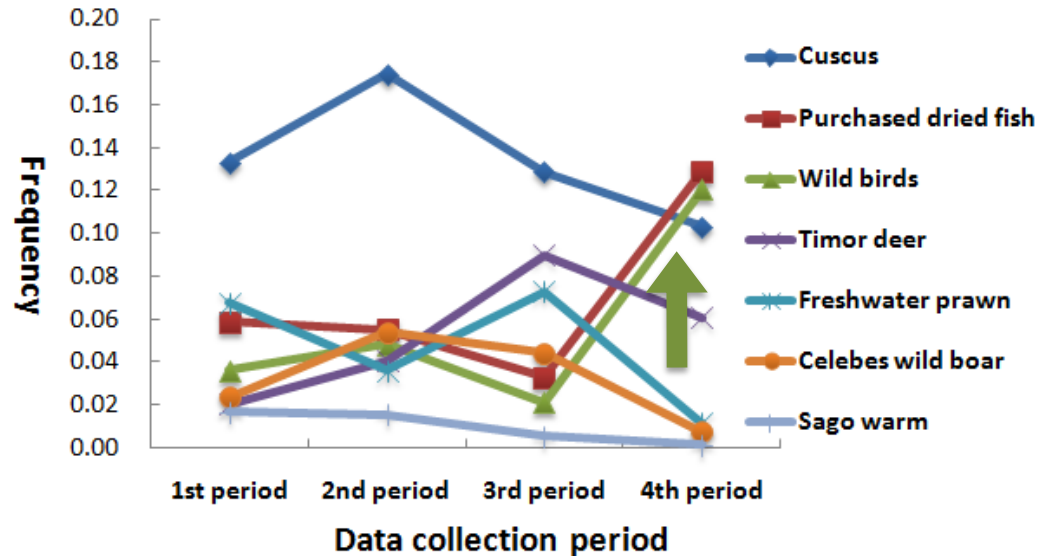
## Importance of edible wild birds in the local diet



**Dietary intake of main animal resources  
(in terms of amount of protein)**

Source: Field research

Note: The proportions was calculated on the basis of the number of animal resources caught by 15-19 households during 4 data collection periods (duration of each period is 18-29 days. The total data collection duration was 89 days).

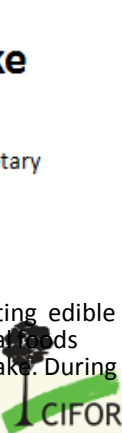


**Frequency of animal foods in dietary intake**

Source: Field research

Note: The figure shows the frequency of only 7 most frequently eaten animal foods in dietary intake.

The fruits of *Itawa* are preferred by many wild birds. *Itawa* forest is an *itawa* dominated forest that the local people created and maintain for the purpose of attracting edible wild birds, and trapping them. The left shows the proportions of dietary intake of main animal resources. Although wild bird account for only 6% of the wild animal foods consumed by the villagers in terms of the amount of protein. But wild birds are important during certain periods. The right shows the frequency of animal food intake. During this period, the frequency of wild bird intake drastically increased. So wild birds are seasonally important food resources.



# Frequently trapped wild birds



*Gymnophaps mada*



*Ptilinopus superbis*



*Aceros plicatus*

- Around 50 species trapped for subsistence purposes (food)
- Most of them are Columbidae birds
  - *Gymnophaps mada* (local name: mavene)
  - *Ptilinopus superbis* (ovota)
  - *Columba vitiensis* (nieli)
  - *Macropygia amboinensis* (pilaka)
  - *Aceros plicatus* (ka) etc.

In Amani oho I registered around 50 species of birds trapped for eating. Most of them were Columbidae birds.



# Wild bird trapping



Birdlime made from sap of *oma* (*Artocarpus* sp)



Villager setting birdlimes on a tree

Wild birds are trapped using birdlime made from sap of an *Arterocarpus* tree. The right shows a villager setting birdlimes on a tree. Birdlime is inside this bamboo cylinder.

# Trees used for catching wild birds and bats

Local name	Scientific name	Fruiting season	Wild birds and bats
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## Trees which are not felled when clearing land for agriculture

Oma	<i>Artocarpus</i> sp.	Feb-Apr	<i>solo musunu (Pteropus sp), solo puti (Pteropus sp)</i>
Leha	<i>Symplocos cochinchinensis</i> (Lour.) Moore	Dec-Jan	<i>fufualo(?), makatola(Basilornis corythax), mavene(Gymnophaps mada), ovota (Ptilinopus superbus), uniuni (Zosteropus Kuehni)</i>
Awou Tuni	<i>Prunus arboreus</i> (Blume) Kalkman	Jan-Feb	<i>fufualo, mavene, ovota</i>
Awou Lasa	<i>Prunus grisea</i> Kalkman	Jan-Feb	<i>fufualo, mavene, ovota</i>
Ketapi	<i>Geniostoma</i> sp.	May-Jul	<i>mavene, ovota</i>



## Trees, the growth of which is encouraged through seedling and protection

Itawa Kopi	<i>Litsea mappacea</i>	Jan-Feb	<i>fufualo, ka (Aceros plicatus), lesoa (Ivos affinis), loe, (Phiemon subcorniculatus), manu putia (Ducula bicolor), makatola, mavene, nieli (Columba vitiensis), ovota, sisai (Alisterus Amboinensis), totoro, ovota, sisai (Alisterus Amboinensis), totoro</i>
Itawa Tuni	<i>Litsea mappacea</i>	Mar-Apr	<i>fufualo, ka, lesoa, loe, manu putia, makatola, fufualo, ka, lesoa, loe, manu putia, makatola,</i>

# Arboricultural activities to form *Itawa*- dominated forest



## *Itawa* forest

- *Itawa* forest patchily distributed in fallow forest
- The largest one: around 1 ha

## Human interventions:

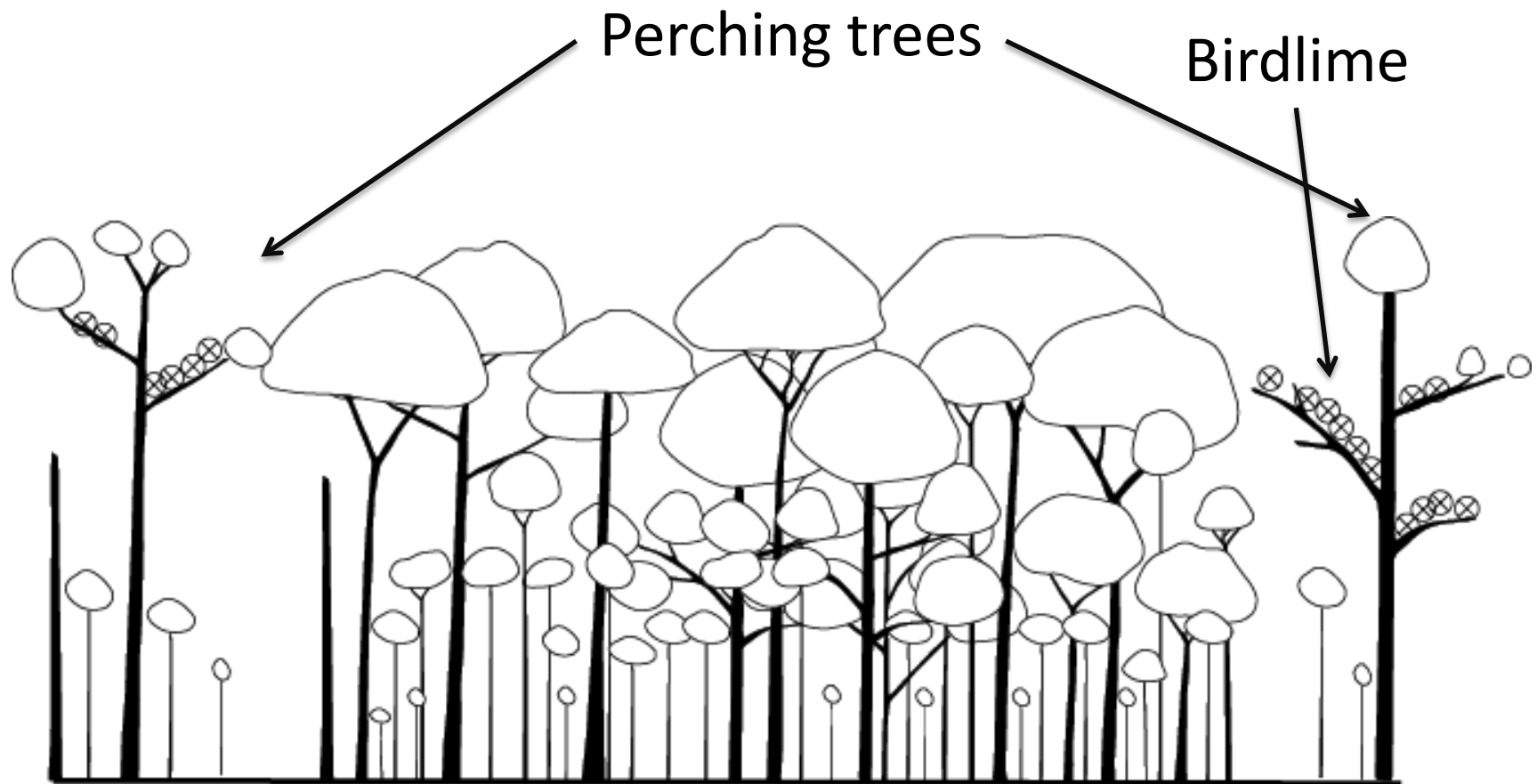
- Weeding, clearing underbrush, and cutting vines (Jan.-Apr.)
- Cutting and barking trees covering *Itawa*
- Collecting seeds of *Itawa* and seeding land



*Itawa tuni* (*Litsea mappacea*)

This slide indicates Arboricultural activities to form *Itawa*- dominated forest. Some villagers encourage the growth of *itawa* through weeding, clearing underbrush, and cutting vines, and felling and barking trees covering *Itawa* and hindering its growth, as well as collecting seeds of *Itawa* and seeding. *Itawa* forests are patchily distributed in fallow forests. I haven't yet conducted a sufficient survey to measure the sizes of *itawa* forests, but based on measurements by pacing it off, the size of largest one seemed to be around one ha.

# Use of Itawa forest as a trapping ground



## *Itawa* - dominated forest

According to villagers accounts, most wild birds attracted by the Itawa do not directly come to the Itawa tree. Before coming to the itawa, they usually perch on trees with a few branches and leaves where the view is not obstructed in order to make sure that there are no predators such as snakes. Therefore villagers set birdlime on the branches of these perching trees. Itawa- dominated forest can also be regarded as human-modified forest formed through arboriculture.

# (3) Forest garden

- Mixed fruits tree garden with durian, langsat, jackfruits, water rose apple, etc.
- The formation : planting seedlings or protecting seedlings and young trees growing wild(naturally) – mainly those seeds dispersed by wild bats (*Pteropus sp*)
- Patchily distributed in mostly old secondary forest (old fallow forest), and few in 'primary' forest
- Extensively managed: cutting underbrush and vines only when harvesting → non-clear boundary, mixed with many wild plants



Forest garden mixed with many wild plants

# (4) Damar Forest

- *Agathis damara* - dominated forest used for resin (damar) collection
- The formation: selective protection of seedlings and young trees which are growing naturally
- Patchily distributed in 'primary' and old secondary forest
- Damar is used as a fuel for lamps and kindling; had been an important source of income up to mid 1960's
- Felling and barking are strictly forbidden



Damar /copal (*kahupe*)



*Agathis damara*-dominated forest



# Human-wild animal interrelationships formed through arboriculture

# Moluccan cockatoo



- Endemic to Seram
- IUCN Red List: VU(vulnerable)



- Listed at CITES Appendix I
- Protected by existing Indonesian laws:
  - ➔ Undang - undang No.5 Tahun 1990 Tentang Konservasi Sumber Daya Alam Hayati dan Ekosistemnya
  - ➔ Peraturan Pemerintah No. 7 Tahun 1999 Tentang Pengawetan Jenis Tumbuhan dan Satwa

Moluccan cockatoo (*Cacatua moluccensis*)

Moluccan cockatoo is endemic to Seram. According to IUCN Red List, this parrot was evaluated as “vulnerable” that is high risk of endangerment in the wild. This parrot is also listed at CITES Appendix I and the international trading of the Moluccan cockatoo for commercial purposes is prohibited. Existing Indonesian laws also ban catching, breeding, and selling wild Moluccan cockatoos.





The cockatoo caught by a trap set on Durian tree



Trap for Moluccan cockatoo



Trapped Moluccan cockatoo

However, the local people sometime trap and trade this parrot. In uplands on central Seram, the major source of income is seasonal migrant work harvesting cloves in the southern coastal area. But the income from the migrant work is unstable because of the fluctuation in production and the price. So their dependency on wild parrots is enhanced during times of hardship caused by the decrease of the main source of income. As we can see from this slide, they use traps made of fishing line. They set the traps on fruits tree such as durian and jack fruits during fruiting season because the parrots like to eat those fruits.





Moluccan cockatoo put into a bamboo cylinder

A trapper who brought a trapped cockatoo to the south coast to sell it

This is a trapper who brought a trapped cockatoo to the south coast to sell it. The cockatoo was put into a bamboo cylinder like this.



# Utilization of human-modified forests by Moluccan cockatoo

Forest types	Utilization	Season
Forest garden	<ul style="list-style-type: none"> <li>● Eat fruits of durian, langsats, jackfruits</li> </ul>	Jan.-May.
Damar forest	<ul style="list-style-type: none"> <li>● Eat fruits of <i>Agathis damara</i></li> <li>● Nest in tree hollow of large <i>Agathis damara</i></li> </ul>	All the year around

Source: Field research



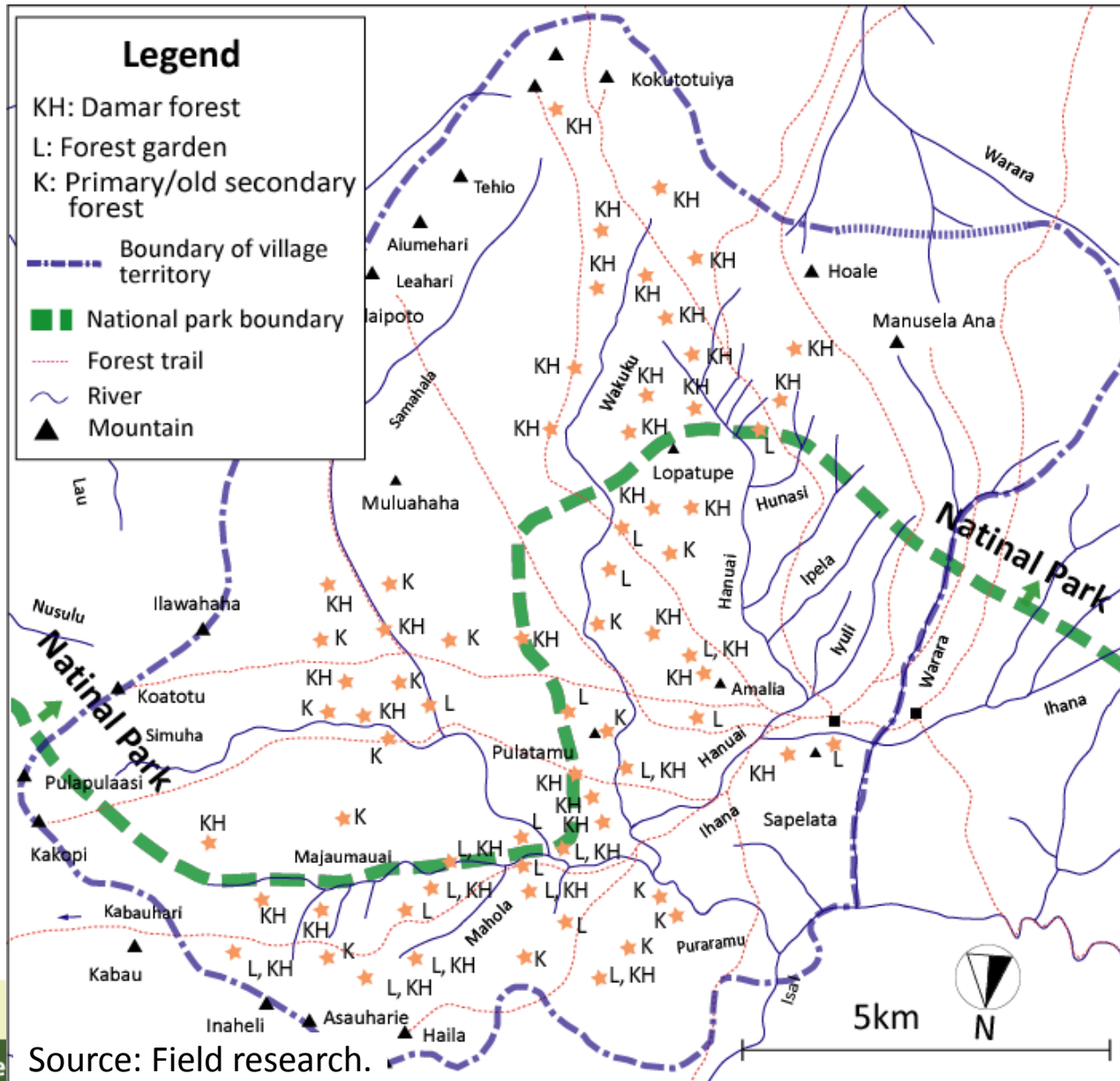
Feeding mark of Moluccan cockatoo on the Fruit of *Agathis damara*



*Agathis damara*

According to the accounts of villagers, the Moluccan cockatoo does not prefer to live in remote undisturbed forest but prefers to live in forests not so far from villages, because they frequently use forest gardens and damar forests. The cockatoo often comes to forest gardens during the fruiting season to eat durian, langsats, jackfruits etc. It frequently uses damar forests to eat fruits of *Agathis damara* and to nest in tree hollows of large *Agathis damara*.

# Sites where Moluccan cockatoos frequently seen or heard



Source: Field research.

# Relationship between human and Moluccan cockatoo formed through arboriculture

- Moluccan cockatoos are, to some extent, dependent on human-modified forests (forest garden and damar forest) which are formed and maintained by arboriculture
- Local people occasionally trap the parrots attracted to these human-modified forests to earn some money in times of hardship



Mildly interdependent relationship(?) between Moluccan cockatoo and human



Moluccan cockatoo, a parrot which are, to some extent, dependent on human-modified forests

# Use of Human modified natural environment by wild animals

Species	Type of land	Utilization
Celebes Wild Boar ( <i>Sus celebensis</i> )	<i>Lukapi</i> (cultivable land and fallow forest), sago groves, bamboo grove	Eating fruits of durian and jackfruits (fruits fallen on the ground), bamboo shoot, etc.
Grey Cuscus ( <i>Phalanger orientalis</i> )	<i>Lukapi</i> , sago groves, forest garden, <i>kaitahu</i>	Eating leaf stalk of sago palm, fruits of <i>atau</i> , <i>masapa</i> etc.
Bat ( <i>Pteropus sp</i> )	Forest garden, bamboo grove, forest garden, sago grove, <i>lukapi</i>	Eating fruits of sugar palm, langsung, jackfruits, oma, guava, water rose apple etc.
Malayan Civet ( <i>Viverra zangalunga</i> )	Forest garden, <i>lukapi</i>	Eating banana, fruits of durian, jackfruits, papaya, pineapple, itawa etc.
Lories ( <i>Eos bornea</i> , <i>Alisterus amboinensis</i> etc)	Forest garden	Eating Banana and durian
Papuan Hornbill ( <i>Aceros plicatus</i> )	<i>Itawa</i> forest	Eating fruits of Itawa
Wild birds ( <i>Gymnophaps mada</i> , <i>Ptilinopus superbus</i> etc.)	<i>Itawa</i> forest, edges of garden	Eating fruits of Itawa, leha ( <i>Symplocos cochinchinensis</i> ), awou ( <i>Prunus grisea</i> ), ketapi ( <i>Geniostoma sp.</i> ) etc.



Trap for wild bats set on *oma* (Artocarpus tree)



Malayan civet (*Viverra zangalunga*)

Source: Field research.



# Implications

# Implications

- The human-modified forests are extensively /loosely managed → anthropogenic forces to exclude wildlife other than main crops do not work strongly. This enables diverse wildlife to use human-modified forests.
- Various wild animals use human-modified forests as foraging sites, shelters, nesting sites etc. Meanwhile, humans utilize such wild animals as come to the human-modified forests → Human-modified forests secure local livelihood by providing various ecosystem services (mainly NTFPs ), and, at the same time, contribute to maintain the relative rich local biodiversity (?)
- Inter-disciplinary studies are needed, in evaluating conservation as well as socio-cultural and economic values of human-modified forests





# Future research

## ■ Future research activities

- Clarify human interventions to form human-modified forests and characteristics of their spatial distribution
- Evaluate quantitatively the importance of forest ecosystem services derived from the human-modified forests
- Evaluate the importance of human-modified forests as habitats for the Moluccan cockatoo by measuring relative abundance



## ■ Direction of Discussion

- Do human-modified forests secure local livelihood by providing various ecosystem services (mainly NTFPs ) and, at the same time, contribute to maintain the relative rich population of the endangered parrot, the Moluccan cockatoo?
- How extensive indigenous agriculture affects the possibility of the coexistence of human and wildlife.
- Is it appropriate to apply conventional 'zone-based conservation model ' to the conservation of rare species in the area where local people form and maintain sporadically distributed human-modified forests through extensive arboriculture?

# Thank you

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**Thinking beyond  
the canopy**

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