Orangutan Veterinary Advisory Group Workshop

2018

https://www.ovag.org

Photos provided by OVAG participants
Orangutan Veterinary Advisory Group new logo courtesy of Ricko Jaya and Emma Wood

Prepared with organizing committee of the Orangutan Veterinary Advisory Group: R. Commitante, S. Unwin, F. Sulistyo, R. Jaya, Y. Saraswati, C. Nente, S. Sumita, Soedarmanto Indarjulianto, P.Nagalingam, Nancy Lung (Editors).
Orangutan Veterinary Advisory Group Workshop 2018 Proceedings.

Copies of all the *Orangutan Veterinary Advisory Group (OVAG) Workshop Report of Proceedings* can be found on the Orangutan Conservancy website, **www.orangutan.com** and the official OVAG website: **https://www.ovag.org**

Participating Organizations:

Orangutan Conservancy, United States
Chester Zoo / NEZS, United Kingdom

ABAXIS Europe, Germany
Asia Sanctuary Trust Indonesia
BKSDA, Aceh
Borneo Futures
Borneo Orangutan Survival Foundation, Nyaru Menteng, Palangkaraya, Central Kalimantan, Indonesia
Borneo Orangutan Survival Foundation, Samboja Lestari, Samboja, East Kalimantan, Indonesia
Borneo Orangutan Survival Foundation, HQ, Bogor, Indonesia
Borneo Nature Foundation
Center for Orangutan Protection (COP) Indonesia
Cikananga Wildlife Center
Cummings School of Veterinary Medicine, Tufts University
Denver Zoo
Faculty of Veterinary Medicine, Gadjah Mada University, Jogjakarta, Indonesia
Fort Wayne Children's Zoo
Frankfurt Zoological Society/Jambi - Sumatra, Indonesia
Gibbon Protection Society, Malaysia
Hokkaido University
HURO Prgramme (gibbon)
Hutan, KOCP Sabah, Malaysia
Indianapolis Zoo, Indiana USA
International Animal Rescue, Indonesia (IAR Ketapang)
International Animal Rescue, Indonesia (IAR Bogor)
IUCN SSC Primate Specialist Group Section on Small Apes
Javan Gibbon Center
Javan Primate Rehabilitation Center (Aspinall Foundation)
Jejak Pulan (Vier Pfoten Indonesia)
Journal of Zoo and Wildlife Medicine
KSDA Lampung, Sumatran Rhino
KSDA, Riau (Balai Besar)
Nanjing Hongshan Forest Zoo, China
National Jewish Health Organization (NJH)
Orangutan Foundation United Kingdom (OFUK) Central Kalimantan, Indonesia
Orangutan Foundation International (OFI)
Orangutan Information Center, Aceh, Sumatera, Indonesia
Orangutan Species Survival Plan (SSP) National Zoo,USA
OVAID, United Kingdom
PT RHOI (BOSF)
Pusat Kasian Satwa Liar, Sumatran Elephant
Pusat Studi Satwa Primata, LPPM, Insitut Petanian, Bogor, Indonesia
Sabah Wildlife Department, Sabah, Malaysia
Sepilok Orangutan Center
Sintang Orangutan Center, West Kalimantan, Indonesia

Sumatran Orangutan Conservation Programme (SOCP), Medan, Indonesia
Sumatran Orangutan Conservation Programme, Jantho, Indonesia
Syiah Kuala University, Aceh, Sumatra
The Wild Animal Rescue Foundation of Thailand
USAID One Health Workforce
Universiti Putra Malaysia, Selangor, Malaysia
Universitas Gadjak Mada, Veterinary Faculty, Jogjakarta, Indonesia
University of Birmingham, UK (Exhibit Design Tool)
University of Liverpool, United Kingdom
University of Minnesota
Veterinary Faculty, Insitut Petanian, Bogor, Indonesia
Veterinary Society for Sumatran Wildlife (VESSWIC)
Whale Stranding Indonesia (WSI)
Wildlife Conservation Society (WCS – Wildlife Response Unit, East Aceh Region)
Wildlife Impact
Wildlife Rescue Centre, Jogjakarta, Indonesia

Supporting Organizations:

Orangutan Conservancy, United States **Chester Zoo/ NEZS, United Kingdom**

The Orangutan Project (TOP) Australia

Fort Wayne Children's Zoo, United States

ABAXIS, Germany

Arcus Foundation

HOSTED BY:

UNSYIAH
Universitas Syiah Kuala

PUSAT KAJIAN SATWA LIAR
FAKULTAS KEDOKTERAN HEWAN UNIVERSITAS SYIAH KUALA

Orangutan Veterinary Advisory Group Workshop

22 July – 26 July 2018

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22 July – 26 July 2018

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Executive Summary

Well, we made it!!! This 2018 Orangutan Veterinary Advisory Group (OVAG) Workshop marked our 10th year working together with so many individuals and organizations towards orangutan conservation. People who were once strangers 10 years ago have now become cherished friends and colleagues. This year, ten countries were represented, giving us the opportunity to make even more friends!

For our ten-year anniversary, OVAG was held in the province of Aceh in North Sumatra. Our in-city host was Dr. Muhammad Hambal, Dean of the Veterinary faculty at Syiah Kuala University in Aceh. This year's workshop was quite unique in that not only did we have our usual participants, but we also had gibbon vets from various parts of Asia and South East Asia join us (courtesy of Dr. Susan Cheyne and the IUCN Small Ape Specialist Group), as well as representatives from elephant, tiger, rhino, and marine mammal conservation organizations working in Sumatra. Having such a diverse group working with multiple endangered species allowed us to see what challenges we all have in common. We were nearly 80 participants from 60 different organizations!

Topics covered were conservation issues with non-primate species, welfare concerns, respiratory sessions, One Health review, orangutan gut biome, ZIMS record keeping, Gibbon health issues, scientific writing, managing disease outbreaks, anesthetics, reproduction, various diagnostic tools, and various individual case studies. A session on OVAG effectiveness and evaluation was also conducted (following up on previous years' evaluations) which the OVAG committee will soon publish a paper on.

This year we also had one-on-one sessions at the two Borneo Orangutan Survival Foundation locations which were given by Nancy Lung and Jennifer Taylor-Cousar. Another one-on-one session was by Liz Ball of Chester Zoo going to SOCP to train staff on the use of ZIMS for record keeping. OVAID (Orangutan Veterinary Aid, UK) also announced their new education scholarship grant and two OVAG vets, Arga (BOSF) and Pandu (SOCP) have been awarded the scholarship! Yet another OVAG vet, Jati (Sintang Orangutan Center) will be going to National Zoo in Washington D.C. and Fort Wayne Children's Zoo for continued professional development.

Other good news is that our own drh. Ricko Jaya (OVAG committee) has received a Chevening Scholarship to complete a Master's degree at Kent University in the UK. Three other vets, Dessy and Agnes (both of BOSF) and Meuthya (SOCP) have had their abstracts accepted to present at international conferences. Agnes will be going to Prague and Dessy and Meuthya to Bali.

We also added two new Committee Members, Nancy Lung of National Zoo and the SSP (Orangutans) and Pak Indar (Soedarmanto Indarjulianto) of Gadjah Mada University, Faculty of Veterinary Medicine.

Before the start of the workshop, both Sumita Sugnaseelan and Raffaella Commitante were invited to be the key note speakers at the VII National Biology Seminar at Universitas Islam Negeri Ar-Raniry. The OVAG committee also had a very fruitful meeting with Syiah Kuala University on building a more thorough wildlife curriculum, led by the Dean and Steve Unwin.

In celebration of our 10-year anniversary, we had a face painting contest, poster session, a morning of OVAG's beginnings and a two-day post conference trip to Pulau Wei, an island off the coast of Aceh, which many were able to attend. This was our farthest reaching OVAG workshop ever and we were so happy to be able to share our successes through the years with new organizations and new friends. It is our hope that the new participants will use OVAG as a model to begin their own networking group so that together, in unity and in strength, we can all hope to make a difference in protecting the amazing diversity we all share on Planet Earth.

On a sad note, OVAG would like to dedicate this report to veterinarian Diana Ramirez, member of the Sabah Wildlife Department who passed away in 2018. She will be missed by her friends and colleagues. May you rest in peace Diana!

Next year OVAG will be back in Jogjakarta and will be held from July 27th to July 31st, 2019.

With warm regards and respect,

Raffaella Commitante, PhD
Steve Unwin, B.Sc., B.V.Sc., Dipl ECZM, MRCVS
Ricko Laino Jaya, drh.
Yenny Saraswati, drh.
CitraKasih Nente, drh., MVS (Conservation Medicine)
Fransiska Sulistyo, drh., MVS (Conservation Medicine)
Sumita Sugnaseelan, DVM (UPM), PhD (Cantab)
Pakeeyaraj Nagalingam, DVM, SWD
Nancy Lung, DVM
Soedarmanto Indarjulianto, drh. PhD
Gavo (our mascot)

Orangutan Veterinary Advisory Group Workshop

22 July – 26 July 2018

OVAG 2018 Budget

(US Dollar after approximate conversion from pounds and rupiah)

International air fares	11,447.29
Local airfares	7,888.00
Ground transportation	979.30
Hotel accommodation	23,100.00
Office expenses/T-shirts	1,008.00
Ground support (food etc.)	1,848.53
Miscellaneous	347.00
Workshop Total	**46,618.12**
Supplementary budget	
(Continuing education/Conference Attendance/On Site Training):	
Ricko Jaya for UK Master's Program (Visa assistance)	127.00
Agnes Prague conference	515.65
Dessy Bali Conference	453.00
Meuthya Bali Conference	625.00
Jati (US internal travel assistance)	500.00
Citra (SRAK Meeting – omitted from last year's budget)	211.00
On Site Training (travel and accommodation for Nancy and Jennifer)	2,505.08
Jati to BOSF (to join above training)	275.00
Supplementary Total	**5,211.73**
FULL TOTAL……	**51,829.85**

(Some funds in rupiah were left in an account in Indonesia for pre-preparation for OVAG 2019 (about 1,000 US). Some additional rupiah is with Raffaella Commitante for OVAG 2019 pre-preparation (about 810 US). This replaces funds left from previous OVAG's so does not change the overall total.)

Orangutan Veterinary Advisory Group Workshop

22 July – 26 July 2018

Section Two

Letter of Invitation

Agenda

Participants Contact List OVAG 2018

Letter of Invitation

Orangutan Veterinary Advisory Group

OVAG 2018

June 10, 2018

RE: **Orangutan Veterinary Advisory Group Workshop 2018**

To Whom It May Concern:

This letter shall serve as an invitation for the person listed below to attend the Orangutan Veterinary Advisory Group (OVAG) Workshop 2018 sponsored by the Orangutan Conservancy, a United States not-for-profit organization, Chester Zoo (a zoological park in The United Kingdom) and in collaboration with Universitas Gadjah Mada and this year with Syiah Kuala University, Banda Aceh.

The workshop will be held in Banda Aceh, Indonesia

July 22-26, 2018

(Arrival: July 21 / Departure: July 27) at the:

The Kyriad Muraya Hotel

Jl. Teuku Moh. Daud Beureueh No.5, Laksana, Kuta Alam,

Kota Banda Aceh, Aceh 24415, Indonesia

Phone: +62 651 6300123

Contact information for OVAG:

Orangutan Conservancy/OVAG: Raffaella Commitante (rcommitante@gmail.com) Chester Zoo/OVAG: Steve Unwin (s.unwin@chesterzoo.org) Jogjakarta /OVAG: Fransiska Sulistyo (siska@orangutan.or.id) Aceh/OVAG: Ricko Jaya (rickojaya@gmail.com)

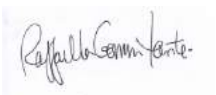
This will be our 10th anniversary international workshop and will continue work begun in 2009 to improve the work we collectively do to ensure orangutan conservation and health.

OVAG would like to extend full funding for travel and accommodation to:

Drh. Fransiska Sulistyo

We thank you for allowing your staff to attend.

Respectfully,



Raffaella Commitante, PhD
Orangutan Conservancy/Orangutan Veterinary Advisory Group

Agenda

OVAG 2018 AGENDA

TIME /DATE	21-Jul	22-Jul (at Hotel)	23-Jul (at Hotel)	24-Jul (at SKU)	25- Jul (Parallel workshop for the Gibbon Vets Group) (at Hotel)	26-Jul (at Hotel)
7:00	Participant early arrival	**Breakfast**	**Breakfast and group photo**	**Breakfast and bus to SKU**	**Breakfast**	**Breakfast**
7:30						
8:00		**Opening ceremony - Unsyiah, Governor* & OVAG**	**Conservation of Sumatran Elephant in Indonesia (drh. Arman Sayuti)**	**Case Study from reintroduction and rehabilitation station (4 presenters)**	**Reproduction (Anneke Moresco - Denver Zoo)**	**OVAG Journey 10th Year (OVAG Committee): 1. Raffaella & Steve: The Initiation of OVAG 2. Yenny/Ricko/Citra/Siska: Continuing the work of OVAG 2013-2018**
8:30						
9:00		**Ice breaker and introduction of Delegates**	**Conservation of Sumatran Tiger - William Marthy (WCS)**			
9:30				**Animal Welfare - Monitoring and Evaluating Animal Husbandry in BOSF Orangutan Reintroduction Center (Siska Sulistyo - BOSF)**	**Diagnotis tools: USG, Endoscopy, radiography (Prof. Deni Noviana - IPB)**	
10:00		**Evaluation Session**	**ZIMS for OVAG (Liz Ball - Chester Zoo)**			
10:30		**Break**	**Break**	**Break**	**Break**	**Break**
11:00		**One Health (Chris Whitter - Tufts University)**	**Conservation of Sumatran Rhino - drh. Dedi (KSDA Lampung)**	**Orangutan IUCN project (Marc Ancrenaz and Julie Sherman - IUCN)**	**Diagnostic tools: USG, Endoscopy, radiography (Prof Deni Noviana - IPB)**	**Evaluating the contribution of a wildlife health capacity building program on orangutan conservation impact (OVAG Paper presentation - Steve Unwin & OVAG Committee) OVAG Journey 10th Year (OVAG Committee): Poster presentation, OVAG book discussion, sharing experience with OVAG**
11:30				**Critical thinking and disease investigation break out groups (Marie Mcintyre and Steve Unwin - Liverpool University)**		
12:00		**Management of Gastrointestinal Issue - gut microbiome (Jonathan Clayton - University of Minnesota) Steve Unwin**	**Conservation of Marine mammals in Sumatra- WSI (Ida Ayu Dian Kusuma Dewi)**	**Anesthesia theory and practice - Nancy Lung - Orangutan SSP**		
12:30						
13:00		**Lunch**	**Lunch**	**Lunch**	**Lunch**	**Lunch**
13:30						
14:00		**Enclosure Design Tool: updates & training (Jackie Chappell & University of Birmingham team)**	**Gibbon disease problem (Susan Cheyne - IUCN Section on Small Apes)**	**Respiratory issues management in captive orangutan (Yayan Oki istiawan - BOSF, Jennifer Taylor-Cousar, MD, and Nancy Lung)**	**Banda Aceh Tour- Dinner at your own pleasure**	**Evaluation and wrap up**
14:30						
15:00			**Scientific writing (Nancy Lung -OU SSP, Siska - BOSF, Joe Smith - Fort Worth Zoo)**			
15:30						
16:00		**Break**	**Break**	**Break**		**Break**
16:30		**Enclosure Design Tool: updates & training (Jackie Chappell & University of Birmingham team)**	**Case Study from reintroduction and rehabilitation station (4 presenters)**	**Respiratory issues management in captive orangutan (Yayan Oki istiawan - BOSF, Jennifer Taylor-Cousar, MD, and Nancy Lung) Continued**		**OVAG Strategic Meeting (OVAG Committee)**
17:00						
17:30						
18:00		**Break**		**Bus back to hotel**		**Break**
18:30						
19:00		**Dinner at hotel**	**Dinner at hotel**	**Dinner at hotel**		**Conference Dinner**
19.30						

Participant List

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Orangutan Veterinary Advisory Group Workshop

22 July – 26 July 2018

Section Three

Proceedings

OVAG 2018 WORKSHOP PROCEEDINGS

July 22, 2018

Opening Day

Ricko Jaya – MC

"Welcome to the 10th workshop of OVAG 2018 - I am really excited as this has been an intense planning experience for the last three months…Welcome to the Syiah Kuala University (SKU) Dean, and the BKSDA (Forestry) head for Banda Ache"

Welcome Dance – Local traditional Dancers of Banda Aceh, SKU

First speaker: Dean of veterinary faculty, **Muhammad Hambal**, DVM, PhD.

"Welcome to Banda Aceh on behalf of Faculty of Veterinary Medicine, Syiah Kuala University. I am also a veterinarian, we as vets should think beyond the medical aspects of the orangutan but also its habitat. About 20 years ago, I worked in conservation with elephants; and whether elephant or orangutan, it is necessary that they have good habitat quality. Years ago, people were asking "who should we prioritize – man or orangutan?" – many non-government organizations (ngos) provided education to the local communities about the importance of local wildlife. Years ago they established a separate park in Northern Aceh different from Leuser – everybody has worked hard in Aceh to save the diminishing habitat situation, but today there are still many politicians who still ask the same question, who should we prioritize – human or orangutan? – but many people today realize the importance of the forest and how the forest can bring wealth to the community. So, ladies and gentlemen, distinguished guests, today we are here to increase the life of orangutans, their habitat and other species."

Second Speaker – **Pak Sapto**, Head of BKSDA Aceh

"Welcome to Ache, I am representing the director of KHKA as she could not come because of the recent situation of the death of the crocodiles in Papua. The director is very happy that veterinarians are coming together to share their information in the OVAG workshops here in Sumatra, and Borneo as well. There is a need for assistance because of the conflicts between humans and orangutans. As we already know, it is becoming more and more of a challenge for veterinarians to contribute to conservation in Indonesia. With the existence of OVAG, this will decrease orangutan fatalities to ensure the survival of the species. Welcome also to the gibbon vets as we have had more and more gibbon issues and in Aceh there is no gibbon rehabilitation center – so hopefully we will be able to support those efforts in the future. It is important to work together as veterinarians and government organizations. Hopefully you will have a successful workshop – welcome to Aceh, the coffee, the noodles, do not waste your time only in this room – but go out and explore Aceh."

Steve Unwin, OVAG Committee – welcome and showing of OVAG Champions video

"Over the past several years we have been trying to come up with a strategy to build OVAG's vision moving forward. Our aim over the next 5 years, is that there is a sustainable regional cadre of professionals able to provide capacity building, advice, guidance and management of One Health matters with wildlife in Indonesia and Malaysia using orangutans as a template species. The OVAG network and methodology becomes the gold standard in capacity building for those involved in conservation health in Indonesia and Malaysia. OVAG also becomes the 'go to' network to assist with successful outcomes in One Health matters with wildlife in Indonesia and Malaysia (is the world's leading referral organization for the health of orangutans and their habitats. Our 20 year framework is to mitigate the successful integration of One Health programs into conservation efforts leading to successful disease mitigation in wild populations and linked public health and environmental disease issues with a proven contribution to the protection of SE Asian wildlife, habitat and human health that can be used as a model for other regions"

Ice Breaker…

Break into 10 groups of about 7 or 8 persons – find 'new' GAVO (2 pcs.) and answer questions on the group sheet. The first letter of each word of your answer makes what word? The challenge is to create the longest word in Bahasa and English – extra points if you can create something that is connected to conservation. Winner: Popo's group

Introduction of participants.

Administration of quiz. This is Part of evaluation process…quizzes are administered before and after the workshop to determine if there has been an improvement.

One Health Session One

Steve Unwin, BSc BVSc Dipl ECZM (ZHM) MRCVS
OVAG / Veterinary Consultant / Wildlife Impact (with Felica Nutter, Tufts University: not present)

Abstract

Effective human, domestic animal and wildlife health is a product of good environmental management. The Global Health Security Agenda (GHSA) envisions “a world safe and secure from infectious disease threats.” However, weaknesses in the public and veterinary health workforces in many countries and mismatches between available training programs and modern needs have been exposed. Integrative approaches, such as One Health, unite different fields and require the development of mutual understanding and cooperation across disciplines. Unfortunately, the human animal is scientifically acknowledged to be very poor at accurately assessing risk in a variety of situations4-9. Highlighted areas that could have significant consequences in the area of wildlife health include:

An inability to assess catastrophic potential. That is we are naturally more adverse to situations were lots of people or animals are affected at once, rather than in small numbers over time.

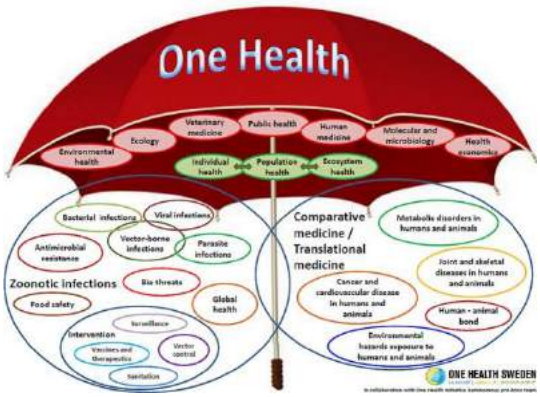
A lack of familiarity with a risk that isn't common knowledge. This remains an issue with environmental concerns with large parts of the general populace.

Loss of victim identity. As Joseph Stalin said, "One death is a tragedy; one million deaths is a statistic."

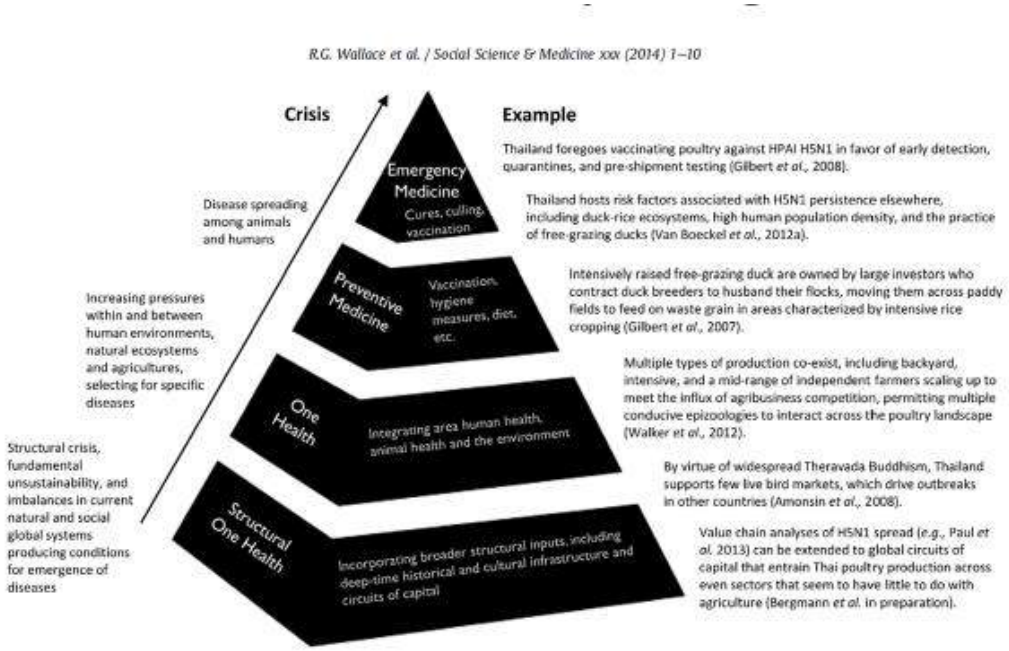
An inability to assess the origin of a risk. Man-made risks are viewed as more dangerous than ‘natural disasters’, that may in turn have an underlying human activity basis.

The IUCN have recently developed procedures for wildlife disease risk analysis10 to assist all involved in investigating disease threats to and from wildlife as part of One Health environmental management programs. The procedures focus on project managers and decision makers as the key to successful risk management and communication, thus the majority of the tools in the manual are written for use by them. This talk introduces the theoretical and practical nature of this analysis process, showing its important application in environmental management, including examples from orangutan and gorilla conservation.

One Health is the collaborative efforts of multiple health science professions, together with their related disciplines and institutions – working locally, nationally and globally – to attain optimal health for people, domestic animals, wildlife, plants and our environment. CONSERVATION MEDICINE is the branch of One Health that focuses on disease risk mitigation from the point of view of wildlife



Another way of looking at One Health is the One Health Paradigm presented below which we have focued on before. On the left of the pyramid are examples of crises. Most animal health work is conducted at the emergency medicine or preventative medicine level, with occasional but increasing examples at the One Health level. For true sustainability of pathogen spread method, efforts should be concentrating at the One Health and Structural One Health level. An example of H1N1 in Thailand is presented on the right. There are many websites on One Health and many institutes for One Health. The web link here is a portal to a resource center that is attempting to collate the growing resources for One Health practitioners.



The World Bank states in The Economics of One Health (2012): The economic case for One Health approaches, and the qualitative evidence on benefits from closer collaboration at the animal-human-ecosystem interface suggests future wider implementation. To this end, sustainable funding mechanisms will be required

Governments and international agencies may wish to review the estimated costs of investments in One Health systems for pandemic prevention, compare them to the expected benefits, and suggest (to the World Bank or other stakeholders) what further analyses or actions are required to substantially increase expenditures on pandemic prevention.

It is getting easier to transfer diseases because of river ways…many protected areas are areas that are not useful to humans -but neither is it useful to wildlife. Increased Oil Palm plantations have wildlife coming into contact with humans, other wildlife and domesticated animals. Much of the wildlife is sold in densely populated areas of cities, villages and towns. HIV issues, Bat rabies, TB reemergence in New Zealand, Monkey pox, SARS emergence in SE Asia, these are all relevant current problems. Typically, when you look up zoonotic, it focuses on human impact– as vets we need to look at a broader perspective – so One World/One Health allows for that perspective. Yes, there is an effect of wildlife infection coming into humans, but it is not a one-way street – it is not just about human health but also the ecosystem and the wildlife that inhabits that ecosystem.

The One World/ One Health research design below pushes the disparate sciences together as biological explanations for health and disease are contextualized by social, psychological and ecological experiences. Their data suggest that the way forward in One World/ One Health practice is to go beyond human and animal biological surveillance and incorporate the human social and structural context that opens potential zoonotic pathogen pathways.

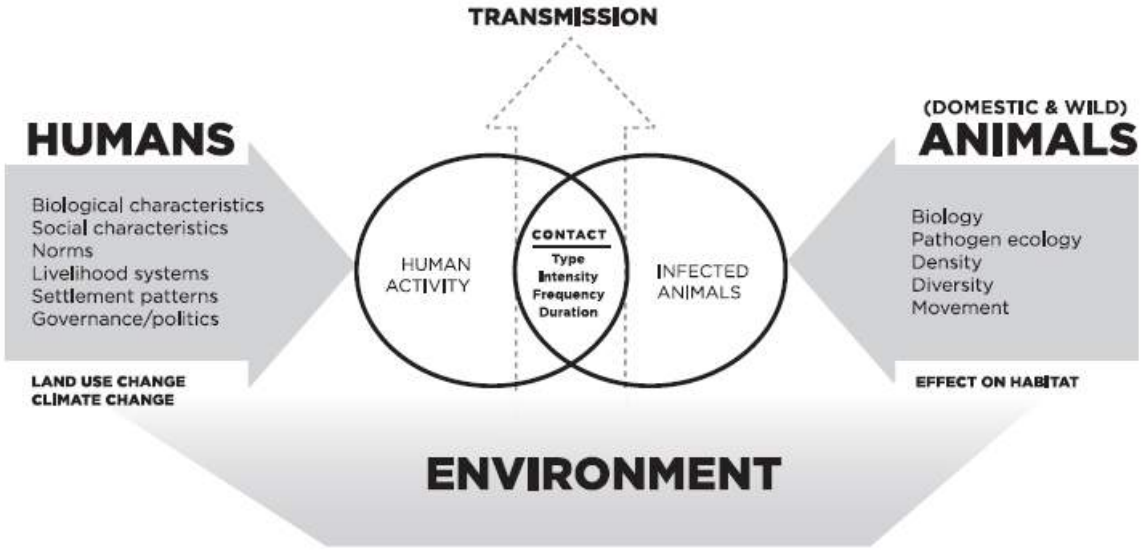
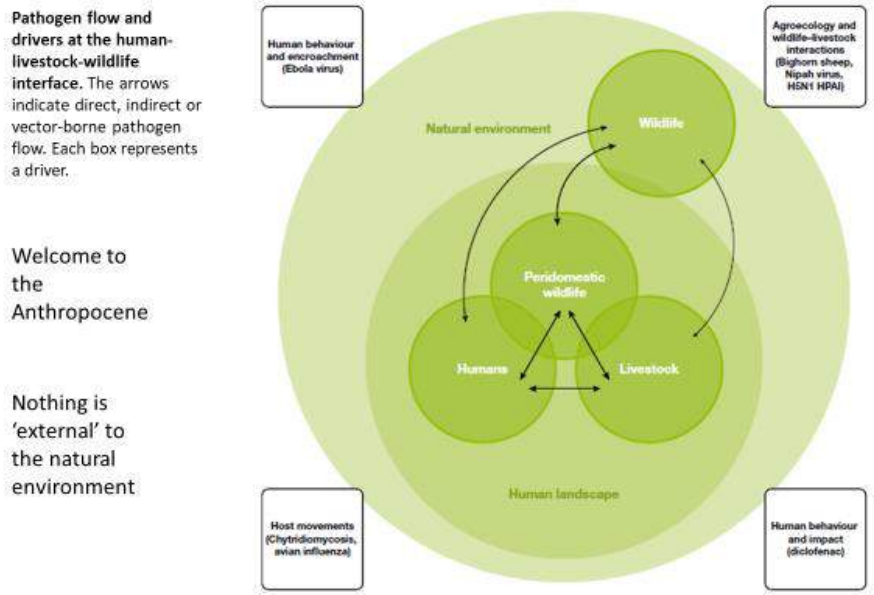


Fig. 1. Expanded One Health model of zoonotic disease transmission.

S. Woldehanna, S. Zimicki / Social Science & Medicine 129 (2015) 87–95

How can we improve people's livelihoods, and conserve the natural environment at the same time? While you think about this, consider also the consequence of human rapid population increase - a risk factor in the promotion of disease transmission between people, and with other animals.

Underpinning the One Health practice is a foundation of basic disease ecology, which studies the flow of pathogens between host and environment. Human landscape on the diagram below covers 78% of landmass and includes 84% of terrestrial mammals. The natural environment covers 22% and includes 16% of terrestrial mammals. 2/3rds of this 16% are located in places where people are not. Only 1/3rd of the 16% are in protected areas. Protected areas *per se* are doing a good job, but the potential issue is the interface with human systems, habitat fragmentation etc. Who is affected in these cases? The animal or animals in question (exposure to a pathogen or toxin) could cause disease outbreaks and/ or decline in a population; other animals exposed directly or indirectly during and after an event (the event could be animal movement, urban development, changing land use); other species of plants or animals that share the same habitat and humans that come into contact with wildlife



An overarching example of Disease Ecology and One Health in action:

Human, domestic animal and wildlife health is a product of good environmental management. Even in the idealized diagram above (from the Australian Government Department of the Environment, National Wildlife Corridors Plan) of strategies to maximize ecosystem health and biodiversity conservation, there are opportunities for pathogen movement - and management. In a DRA process the potential risks for particular pathogens, toxins and parasites to and from a protected area (or other area) can be identified. For certain risks, alternative risk management in buffer areas may be indicated. With habitats of humans and wild animals intertwining with greater complexity, the future promises more opportunities for humans to cause (reverse) zoonoses. Contributing factors include climate change and ecosystem disruption, anthropogenic development of habitats, and global travel and commerce. Human population growth and expansion encourages different species to interact in ways and at rates not previously encountered, and to do so in novel geographical areas. The term 'pathogen pollution' refers to the process of bringing a foreign disease into a new locality due to human involvement. An example would be African wild dogs that have been infected with Giardia duodenales, leading researchers to believe that pathogen pollution occurred through open deification in and around National Parks by tourists and local residents.

The rapidly changing face of the human ecosystems is putting pressure on biodiversity and the environment. It would thus seem logical that disease outbreaks often occur at the boundaries, as these are areas under the greatest rate of change and stress…remember we must think about the human impact

Because of increasing emerging disease threats, the one health movement gained its 'one world one health' trademark in 2004 at a WCS conference in New York. There was a concurrent call to action for preventing emerging diseases in human and animal populations and maintaining ecosystem integrity. By 2008 the UN agencies and the World Bank had drafted a strategic framework, introduced at the 'One World, One Health: From Ideas to Action' conference in 2009. The premise of One Health is that people, animals and the environment form an interdependent ecosystem that needs to be considered in a coordinated manner.

One Health: an attempt to increase emphasis on adaptive risk assessment and mitigation with effective risk communication and trust between professionals to improve resolution of disease ecology issues. It is a comprehensive approach to health that focuses on:

1. Improving health and well-being through the prevention of risks and the mitigation of the effects of crises (emerging diseases) that originate at the interface among people, animals and their various environments.

2. Promoting cross-sectoral collaborations and a 'whole of society' treatment of health *hazards*, as a systematic change of perspective in the management of risk.

Recent zoonotic disease emergence:

- HIV-1 virus – evolved from Simian Immunodeficiency Virus (SIVcpz) transmitted from chimpanzees to humans by the slaughter and consumption of infected wild chimpanzees (Gao et al, 1999, Nature397, 436-441)
- Bat rabies re-emerged - Deforestation in the Amazon Basin (Kuzmin et al. 2011, Emerging health threats journal 4).
- TB re-emerged in New Zealand - Farming of non-native deer and opossums (Nugent et al, 2015, New Zealand veterinary journal 63.sup1: 28-41).
- Monkeypox virus in the US - contact with pet prairie dogs exposed to a giant pouched rat recently imported from Ghana (EnserinkM. 2003, Science 300.5626: 1639-1639).
- SARS emergence in SE Asia – wildlife trade for food, medicine (Holmes ED and A Rambaut, 2004, Philosophical Transactions of the Royal Society of London B: Biological Sciences359.1447: 1059-1065).

A recent study of human infectious diseases determined that there are approximately 1,407 human infectious pathogens world-wide. Of these, 800, or 58%, are zoonotic pathogens transmitted to people from animals. Another recent study identified 335 human infectious diseases that emerged in just the past six decades. This represents 25% of all known human infectious diseases. Of these 355 recently emerged human diseases, 202 (60%) are caused by zoonotic pathogens and 144 (43%) are caused by pathogens for which the main source is wild animals. The rate of disease emergence has increased during the previous six decades.

The majority of emerging human diseases in the past six decades have been zoonotic and the predominant source of these zoonotic pathogens has been wild animals. Thus, wild animal pathogens have added major new burdens of disease to people and, although fewer data are available, wild animals also have been important sources of diseases affecting domestic animals.

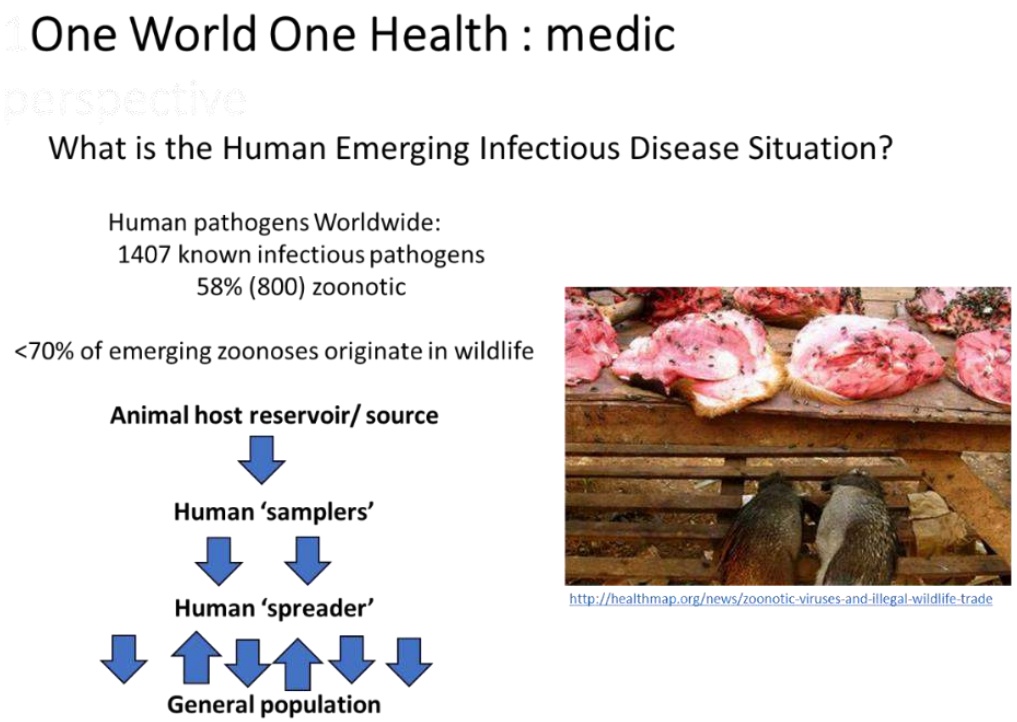
A major concern to human societies around the world is the recent increase in the number of important human and animal diseases, particularly infectious diseases. Previously unknown pathogens have caused previously un-recognized diseases, and the harm caused by some well-known pathogens has increased as well. These new or newly-important diseases have come to be called 'emerging diseases' or 'emerging and re-emerging diseases.' An 'emerging disease' generally is defined as a disease due to:

1) a new pathogen resulting from the evolution or change of an existing pathogenic agent, or

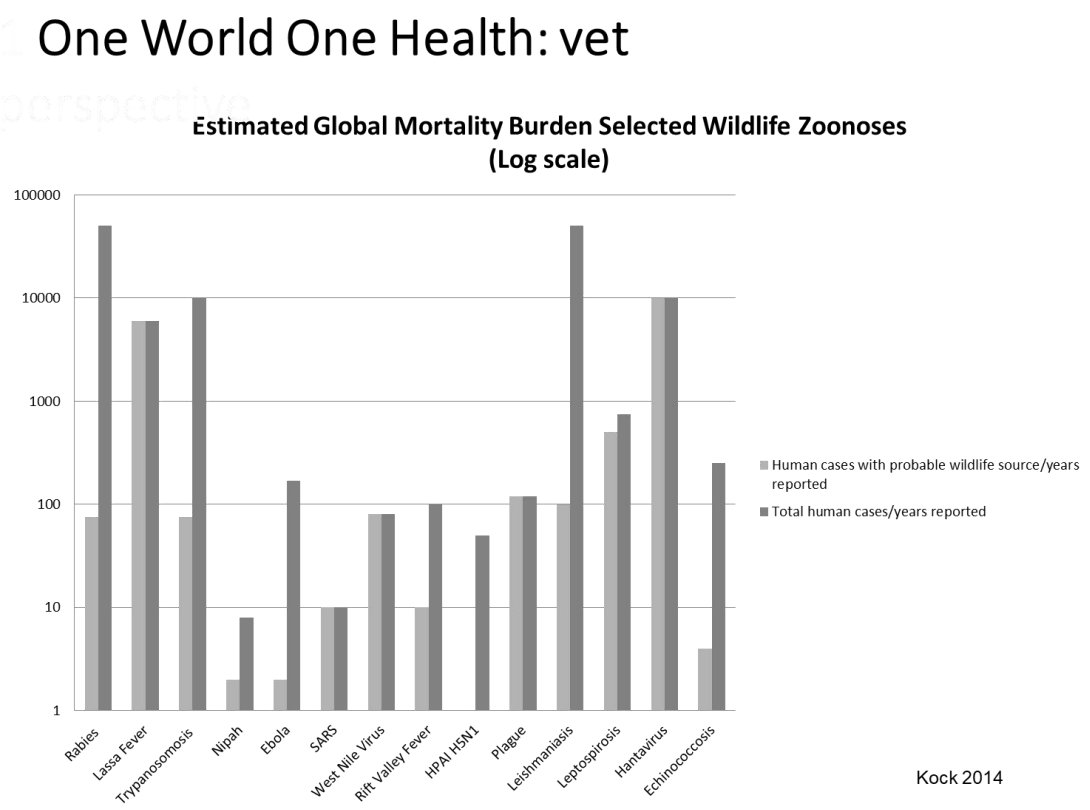
2) a known pathogen spreading to a new geographic area or population, or increasing in prevalence, or

3) a previously unrecognized pathogen or disease diagnosed for the first time and which has a significant impact on animal or human health.

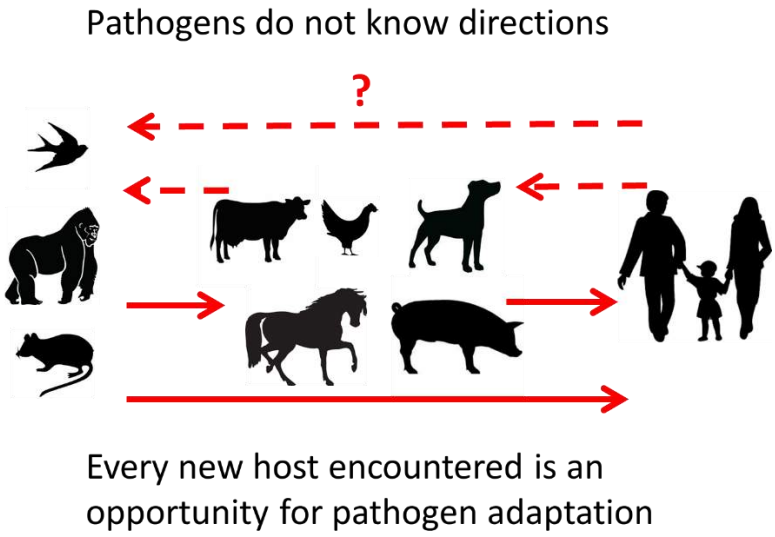
The term 'emerging disease' can be applied to diseases that affect people or to diseases that affect animals, and also plants. Many important emerging diseases are associated with pathogens which can infect many different host species and cause disease in wild animals, domestic animals and people.



However, when you look at the actual data for WIDLIFE, a log scale is needed for many pathogens of concern. Notable (large number) exceptions are Hanta virus and Lassa Fever. But for those diseases that raises most fear and anxiety worldwide (rabies, ebola, trypanosomiasis) wildlife causes are low.



One Health for One World: A compendium of case studies document will soon be available. There are many risk factors that promote adverse interactions between people, animals and the environment. One of the most startling is human population growth and the resultant looming resource squeeze.



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One Health Session Two

Christopher Whittier DVM, PhD
Research Assistant Professor & Director of Conservation Medicine Program / Department of Global Health and Infectious Disease / Cummings School of Veterinary Medicine

Background: Chris has worked with PASA (Pan African Sanctuary Alliance) but recently has been working in Malaysia and Indonesia. He used to be a Gorilla Doctor, now works with Smithsonian and is now with Tufts University.

The U.S. Government pays money to train and build capacity in other regions of the world. The U.S. feels it is a good idea to train and educate in order to stem an epidemic before it becomes a pandemic, as there is always the risk of an outbreak.

There is a One Health Workforce (OHW), which states the following:

Emerging Pandemic Threats 2 (EPT2) is focused on mitigating the impact of novel “high consequence pathogens” that originate in animals with a goal of enabling early detection of new disease threats, effectively controlling those threats, enhancing national level preparedness in advance of outbreaks, and ultimately reducing the risk of these diseases emerging by minimizing human behaviors and practices that trigger the “spill over and spread” of new pathogens. EPT2 consists of a suite of One Health Investments, PREDICT 2, One Health Workforce, and the Preparedness & Response, that contribute to each of these goals and are complemented by strategic investments in key partners including the U.S. Centers for Disease Control, U.N. Food and Agriculture Organization, and the World Health Organization.

One Health Workforce Goals/Objectives:

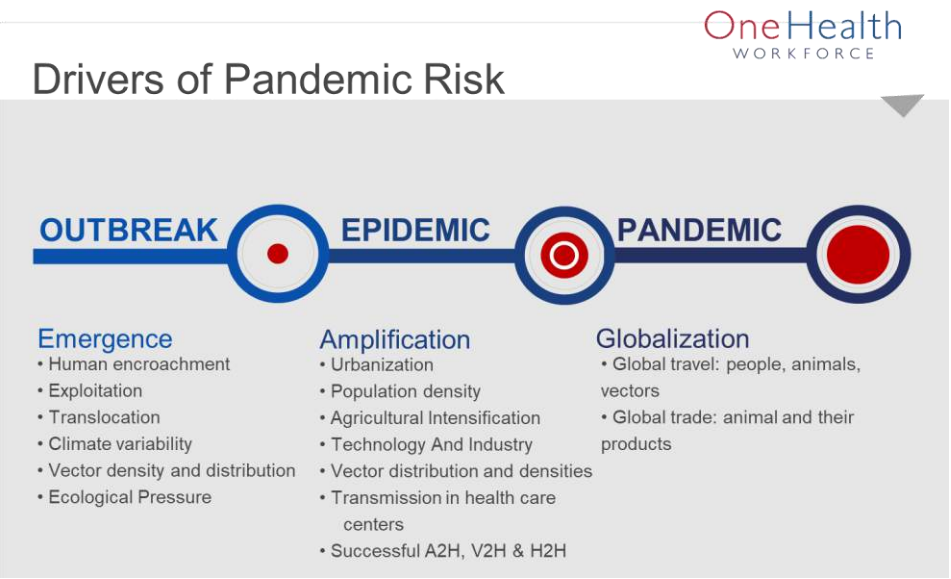
Support African and Southeast Asian One Health University Networks to participate with government, academia, and other key partners in defining One Health workforce needs.

Support networks to assist government ministries to train the future OH workforce.

Support the networks to assist government ministries to train the current OH Workforce.

Support developed country universities under OHW in strengthening faculty Capacities for OH teaching, research, and community outreach for the African and South East Asian University Networks.

Organizational Development: Positioning the One Health Networks as long-term sustainable leaders in One Health.



Outbreaks of infectious disease have the potential to cause significant impacts on human society. For example, the SARS outbreak in 2003 which cost 20 billion in U.S. dollars in China, Viet Nam, Hong Kong and Singapore and caused 70% reduction in tourism across Asia.

The One Health Workforce project mission is : Improved workforce capacity in target countries to prevent, detect, and respond to threats posed by infectious diseases and zoonoses.

The One Health approach brings together disciplines such as medicine, veterinary medicine, public health, nursing, and ecology to work together to more effectively address emerging challenges at the interface of animals, humans, and the environment.

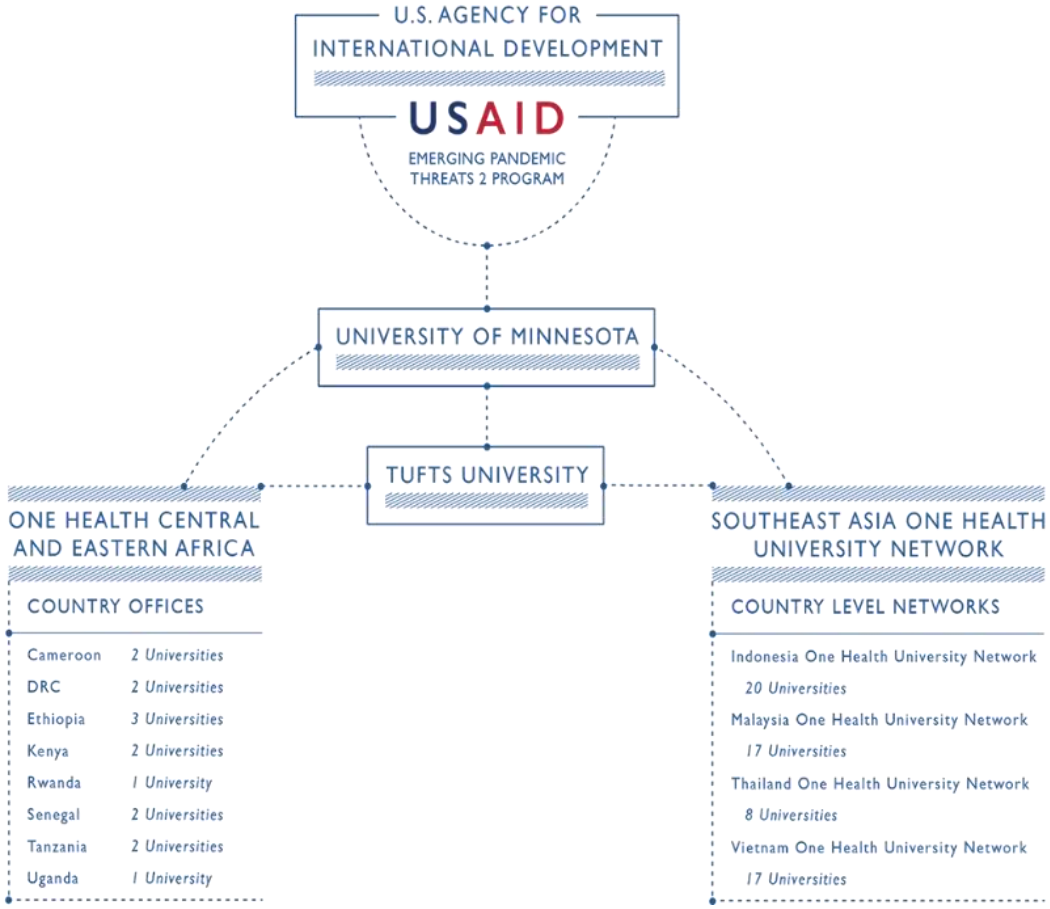
A One Health workforce fosters a multi-sectoral approach to infectious disease re=prevention, detection and response, through technical competence, multi-sectorial/multi-disciplinary engagement and supporting systems to enable timely, effective and multi-sectorial response.

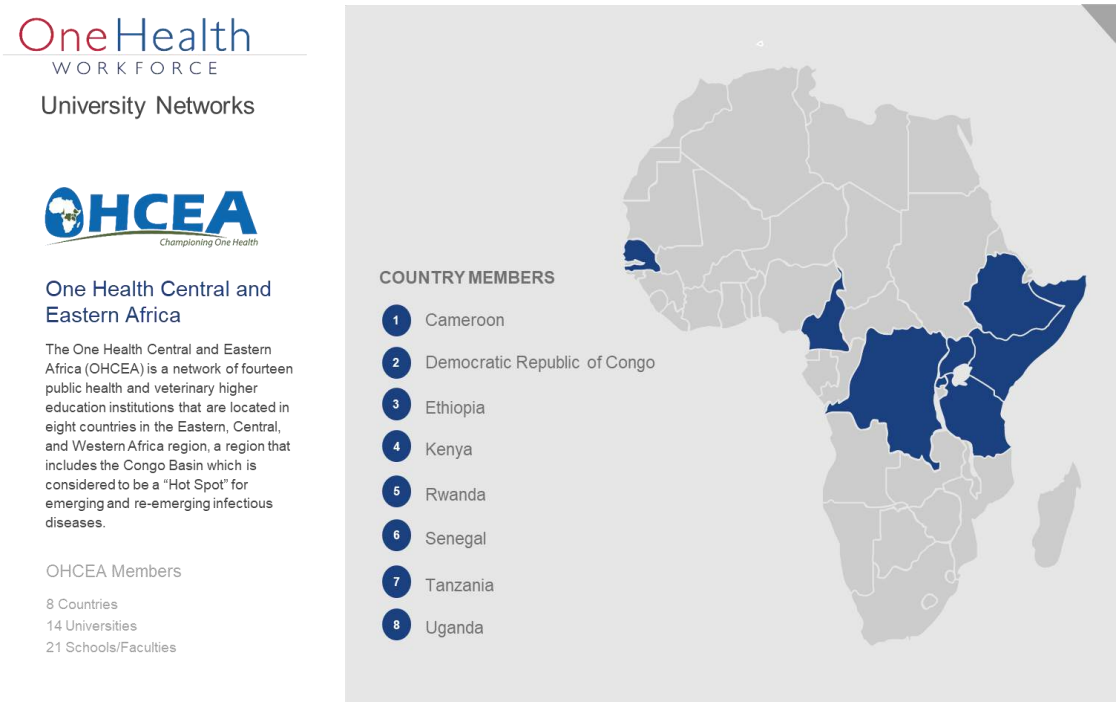
Emerging infectious diseases are one of the most pressing of such challenges

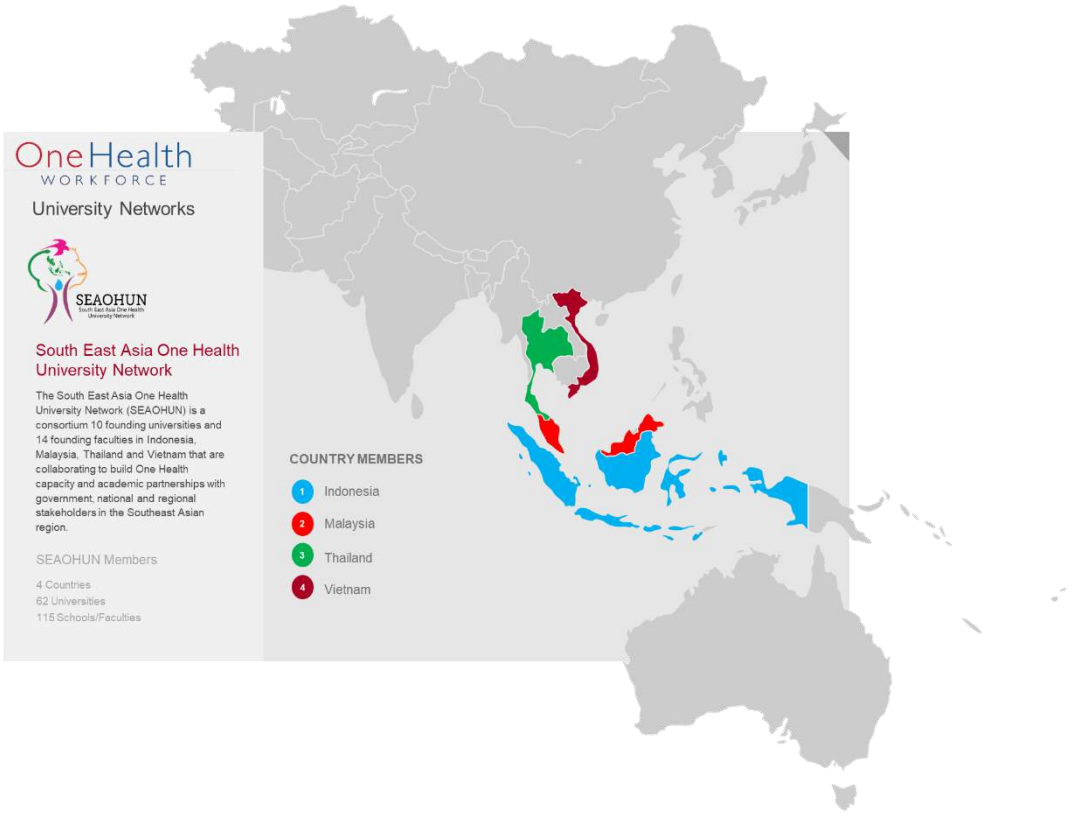
There is also the Global Health Security Agenda (ghsagenda.org) whose vision is to attain a world safe and secure from global health threats posed by infectious diseases…whether natural, deliberate, or accidental. It is made up of a network of countries that are recognizing that infectious diseases are a global problem – and cannot be approached from a human or a veterinary perspective but both. Infectious disease epidemics pose not only a local threat but also an international security threat. National multi-sectoral cooperation and preparedness are at the core of effective control of infectious diseases through strengthened health systems and preparedness. Operationalization of the One Health Concept at national and international level is key; as well as engaging the non-governmental sector in this effort.

In the third year of the project, One Health University Networks was added in Africa and Southeast Asia, as you are not going to change anything unless you assist in the training. One Health University Networks drive needed change in culture and competencies. Nearly all workers in at risk countries are trained through universities. Universities are historically among the most stable institutions in insecure regions of the world.

USAID is the primary funder, working with University of Minnesota and Tufts University with networks in One Health Central and Eastern Africa, Southeast Asia One Health University Network and at the country level with Indonesia One Health, Malaysia One Health, Thailand One Health and Viet Nam One Health University Networks.

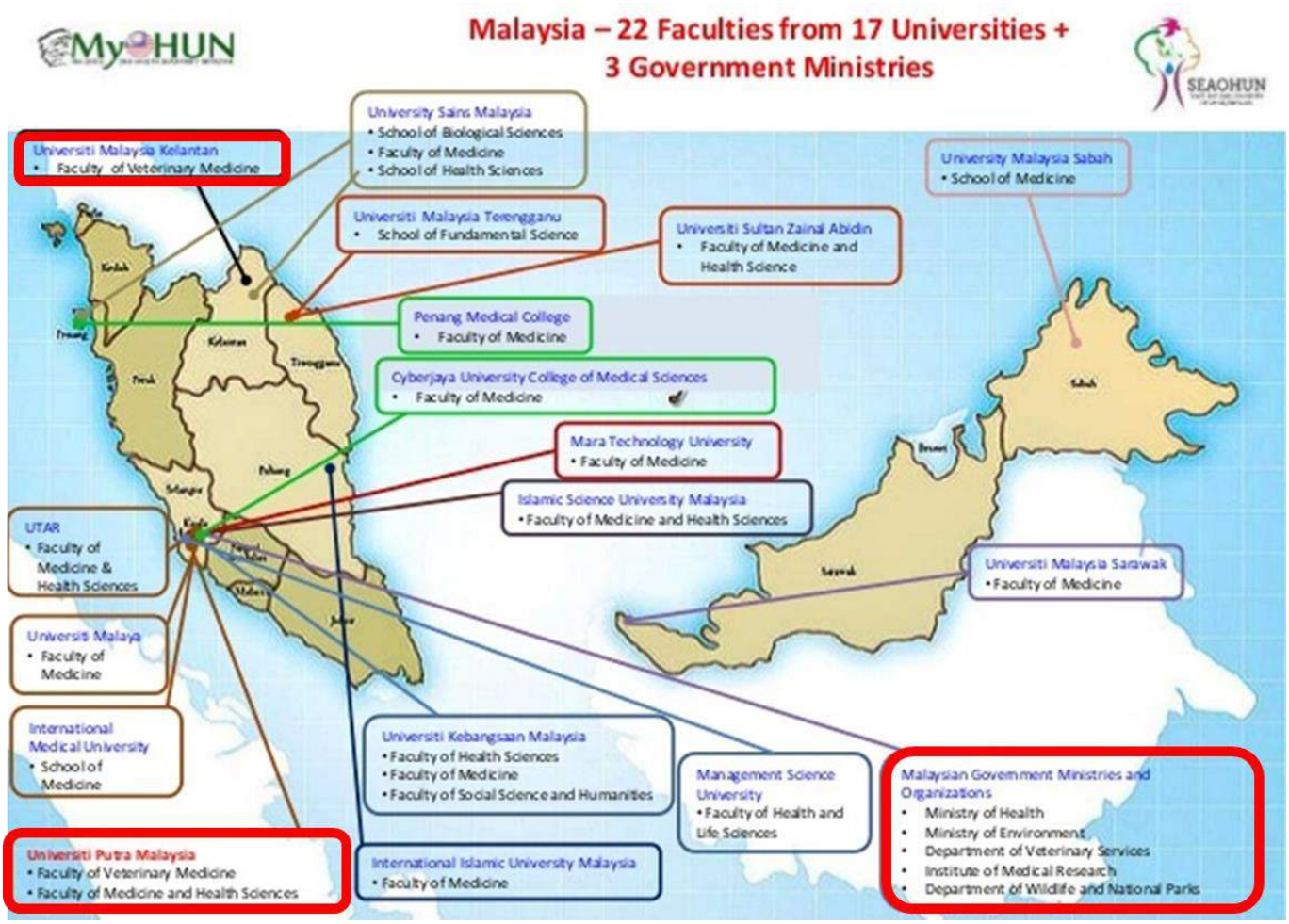






INDOHUN (Indonesian One Health University Network) is quite large:

Followed by Malaysia:



Working Towards One Health Workforce Transformation, the approach to One Health Workforce Transformation involves:

The approach to multi-sectoral engagement which involves workforce planning and assessment through supporting university and government partners from multiple disciplines/ sectors to align education and training initiatives with national and international workforce needs; through One Health Advocacy by Engaging university, government, and intergovernmental stakeholders to advocate for national and international policies and frameworks that support long-term collaborative health workforce initiatives; and through One Health Outreach by Working to build community health while providing students field-based learning experience and real world knowledge of One Health challenges.

The approach to education which focuses on student learning and in-service training via OHW supplements existing health training programs with interdisciplinary and applied experiences and the integration of One Health approaches and competencies, as well as interdisciplinary student field attachments where Participating students develop expertise in community engagement, communication, project management, and leadership by living and working on demonstration sites in small multidisciplinary teams to address complex community health problems, and also internships and fellowships where Participating students develop expertise in community engagement, communication, project management, and leadership by living and working on demonstration sites in small multidisciplinary teams to address complex community health problems.

Example of Applied student learning with Global Health True Leaders Program in Kelating Village, Indonesia, August 2016:

Applied student learning educates students outside of the classroom with real-world, complex health problems. Student field attachment programs are multidisciplinary, field-based activities led by faculty members, usually at a One Health demonstration site. Students are also placed on local response teams to investigate outbreaks to gain first-hand knowledge of the One Health approach. The purpose of applied student learning is to develop students who have expertise in their respective disciplines, and also share a vision and a commitment to holistic approaches to address complex community health problems. Intensive training program includes 16 in-class sessions; Fieldwork that promotes collaborative work across disciplines in response to emerging pandemic threats

Example of Student Field Assignment with the Amboseli Ecosystem in Loitokitok, Kenya in August 2016.

The Student Field Attachment program is a 1-6 week multidisciplinary, field-based activity led by faculty members, usually at a One Health demonstration site. The purpose of a student field attachment is to develop students who have expertise in their respective disciplines, and also share a vision and a commitment to holistic approaches to address complex community health problems. Identified key One Health problems in the community, prioritized One Health needs, and presented possible interventions to the identified challenges Photo: The One Health team with members of the Oltome village in the Amboseli ecosystem drew a community resource map during the demo site attachment

Example of Education and Training in response to HPAI Outbreak in Uganda on Lake Victoria in January 2017:

One Health students joined the Ministry of Health's investigation into the Highly Pathogenic Avian Influenza H5N8 outbreak in several districts along the shores of Lake Victoria. The students used a One Health approach in their outbreak response, including participating in stakeholder planning meetings, educating the communities on the problem and proper carcass disposal, and investigating the risk factors associated with the outbreak by interviewing key members of the communities.

Example of In-Service Training in Communication and Informatics in Bangkok, Thailand in July 2016:

Training for in-service professionals provides applied learning opportunities for the current One Health workforce. Outbreak simulations and table-top exercises train professionals to problem solve with a multi-sectoral approach. Training program on the capacity building on communication and informatics for emerging infectious diseases Included field and laboratory veterinarians, wildlife and public health professionals, as well as experienced research scientists

Example of institutional strengthening: 3,400 participants trained in year 2

Network Strengthening: OHW supports two regional and four national One Health University Networks to engage different One Health stakeholders, expand their membership, and provide strategic direction as well as administrative and technical support for local One Health activities.

University strengthening: OHW supports member universities through the expansion of innovative and interdisciplinary training programs and platforms, the creation of One Health courses and instructional materials, and faculty development activities.

Faculty development: OHW partners support faculty research, teaching, and outreach in One Health through various faculty development workshops as well as scholarships or special funds.

There is also a One Health laboratory Network which assists in finding areas for proper diagnostics. This network is trying to create a laboratory network in Indonesia.

Human/Animal interaction:

Chris's example from working with African Apes:

As a veterinary student from Tufts working at Gombe (Jane Goodall's site), the idea at the time was that chimpanzees were picking up human parasites. There is a degraded area in the forest with shared substrate between chimps, baboons, and humans. These chimps have acquired human diseases as a result such as respiratory diseases. We were working towards disrupting infectious cycles, not defecating in the forest, wearing shoes, not getting too close to wildlife etc. The bigger environmental problem is bringing people together – they stopped feeding chimps, removed fishermen from the beach, etc. There was a similar situation with mountain gorillas – you may have what is left of a pristine forested area that is completely surrounded by agriculture. Very heavy tourism for mountain gorillas who are often visited by 7 to 8 visitors everyday – they may have more contact with people than other people do. Which is worse? A foreigner or a local person? The rule is that you must be at least 15 years old to be able to see mountain gorillas as disease risk is higher with younger children. Domestic animals are also a risk – it is not legal to bring stock into the park – but gorillas often go outside the park area. Many farms use animal and human feces for manure to fertilize agricultural products. Most employees that work with mountain gorillas are not checked but now they are

beginning to go into a health screening program to insure they do not bring anything to the gorillas in an effort to conserve them.

Most vets working in sanctuaries are dealing with the day to day issues but hopefully it is much more comprehensive than that. By feeding orangutans in centers, it brings in other animals such as macaques. Normally orangutans and macaques would not meet all that often as macaques are mostly terrestrial while orangutans are mostly arboreal. A photo was circulated of a macaque eating a rat, head first – this s incredibly dangerous as they are eating brains which are a depository for disease (the rats and by ingestion, the macaque).

The mother of One Health problems is Climate Change!!!!!

Discussion: How do we teach about hygiene, use of gloves etc., more effectively? How is that handled? Is the use of masks and gloves doing any good? How do you enforce it? Are you creating more waste? No easy answer for that. We need better waste management. Maybe a case by case basis. Most centers work with local communities rather than universities – can that be linked to one health? There are opportunities through creating relationships – better questions for Felica Nutter to answer. Members of INDOHUN which are many universities can also be approached to provide assistance with the local community. USAID decided it was too expensive and inefficient to deal with community engagement. Can One Health look at environmental health or is it only focused on infectious disease control? – depends on who you ask! There are people that are working at school on environmental science – but that is most likely the hardest piece. Needs an economic as well as social science approach. There is an evaluation process within One Health.

Host-microbiome interactions in primate health

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University of Minnesota

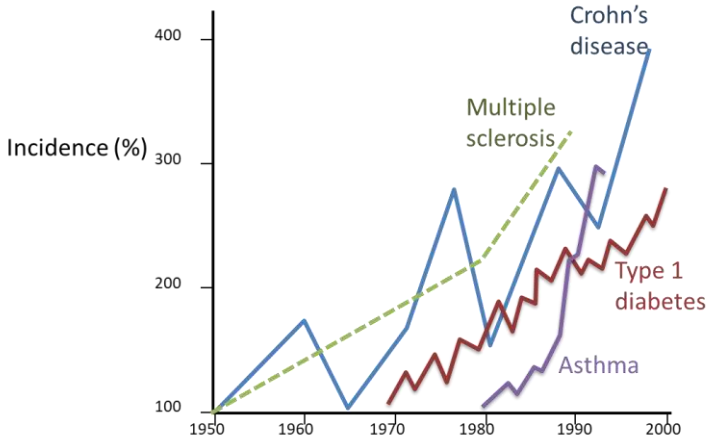
Abstract

The primate gastrointestinal tract is home to trillions of bacteria that play major roles in digestion and metabolism, immune system development, and pathogen resistance, among other important aspects of host health and behavior. Diverse communities of microbes are also present in many body sites other than the gut. While the research community has made substantial progress in understanding the role microbial communities play in human health and disease, much less attention has been given to host-associated microbiomes in nonhuman primates (NHPs). In an effort to bridge this gap, my collaborators and I established the Primate Microbiome Project (PMP). The overall goal of the project is to develop a systematic map of variation in microbiome structure and function across all primates. The PMP funds and executes microbial analyses of primate fecal samples and organizes the resulting data in a centralized public database for anyone interested in contributing to primate microbiome research. After data generation, we integrate information regarding sampled individuals' diet, health, ancestry, and other factors to better understand the roles of microbes in primate health, evolution, behavior, and conservation. We also provide standard data collection protocols to ensure consistency across the field. The first major finding resulting from the PMP described primate dysbiosis as driven by a loss of bacterial diversity. Microbes can act as indicators for health of the host, thus broad primate microbiome surveys may allow for development of predictive biomarkers for diseases. Additionally, broad sampling of microbiota across the tree of primate life will help improve our understanding of the co-evolution of host and microbes in primates.

What is the microbiome?

Microbes are found in and on the body. It contains 10^{14} of bacteria, a number more than human cells. The microbiome plays a major roles in health impacting: digestion, immune stasis, behavior, pathogen resistance, detoxification, and drug metabolism.

Microbiome-linked diseases are rising (due to dysbiosis which is when there is a microbial imbalance or maladaptation on or inside the body).



- Obesity
- Diabetes
- Asthma
- Allergies
- Crohn's disease
- Ulcerative colitis
- IBS
- Cancer
- HIV
- Autism
- Heart disease

Bach JF, N Engl J Med 2002

Host-microbiome interactions in primate health: We must first determine if captivity leads to convergence and If so, why? Does captivity result in dysbiosis? If so, why? This leads to determining if a link between lifestyle and microbiome composition in both non-human primates and human primates exists. If so, why?

What shapes the gut microbiome? There are two schools of thought: Host genetics vs. environment (e.g., diet). If it is the diet, this is good, because we can easily change diet and become healthier via lifestyle changes.

We need to study the structure of bacteria (16S Ribosomal RNA – as all bacteria have this).

The Human Microbiome Project (HMP) was a United States National Institutes of Health initiative with the goal of identifying and characterizing the microorganisms which are found in association with both healthy and diseased humans (the human microbiome). Launched in 2008, it was a five-year project, best characterized as a feasibility study, and had a total budget of $115 million. The ultimate goal of this and similar NIH-sponsored microbiome projects was to test how changes in the human microbiome are associated with human health or disease. This topic is currently not well understood.

But what about animal microbiome research? We know a lot but there is still more to learn – it is in its early years. Regarding animals, there are not many studies on animal microbiome research. The few studies out there are mostly involving agricultural animals. There is clearly a lack of information on the gut microflora of animals other than mouse models of human diseases, this is especially true for nonhuman primates.

Animal microbiomes are important to study because: a) Conservation (we only have one planet) and b) Health and Disease – Animals are translational models for human diseases. The use of anti-biotics is looked down upon now because of their overuse. As primates are in trouble globally (total taxa: 24; total threatened: 21 (88%); 5/25 on Top 25 Most Endangered List (20%), and we think about possible intinctions, there are so many species that live on or are impacted by a particular host – so not only might you lose the species but also the microbes. This is what initiated the start of the Primate Microbiome Project (PMP)… (primatemicrobiome.org).

The PMP aims to collect and sequence gut microbial communities from primates covering the entire tree of primate evolution. We will then integrate other important information regarding sampled individuals' diet, health, ancestry, and other factors to better understand the roles of microbes in primate health, evolution, behavior, and conservation. Some example expected impacts of the PMP lying in these four core areas of focus are as follows:

Health - Microbes can act as indicators for health of the host, and we expect that broad primate microbiome surveys will allow us to develop predictive biomarkers for certain primate diseases. Primates are the closest animal models to humans and understanding what drives the structure and variation of their microbiota will help us understand our own. Health and pathogen resistance in primates have direct links to human health, for example in the case of simian immunodeficiency virus.

Evolution - Broad sampling of microbiota across the tree of primate life will help improve our understanding of the co-evolution of host and microbes in primates. The gut microbiota may have played an important role in primate specialization of diet and gut physiology; the PMP aims to determine this role.

Behavior - Gut-brain communication is well established in other animal models. By collecting longitudinal and cross-sectional gut microbiome samples while tracking feeding and social behavior of individual animals, the PMP will allow us to determine how microbes may influence primate behavior.

Conservation - Some endangered primate species fail to thrive in captivity due to gastrointestinal issues; through comparison of wild and captive animals within the same species the PMP will determine whether shifts in gut microbiota are linked with gastrointestinal health in captivity.

Primates can act as sentinels for unhealthy shifts in their habitat ecosystems; the PMP will help determine if shifts in their gut microbiota accompany increased stress or other health issues related to habitat encroachment.

Health, evolution, behavior, and conservation of non-human primates allows for a better understanding of our own origins and health. There needs to be a standard platform to be able to use data across research projects – all the information needs to be standardized for this to happen (PMP will strive to perform all those functions).

The red shanked douc was the primate that initiated this project. It has a multi chambered stomach which functions like a ruminant. It is highly folivorous (eating mostly leaves) and they have health issues in captivity because of their guts. The scientific name is *Pygathrix nemaeus and* the local Vietnamese name is cha va chan nau. They are one of the world's top 25 most endangered primates, with 8 distinct species and are members of the subfamily colobinae. Of those 8 species, 5 are native to Vietnam with the other three found in Laos, Vietnam, and Cambodia. Labeled Endangered (EN) based on the IUCN Red List of Threatened Species, it was assigned the highest conservation priority rating in the Action plan for Asian Primate Conservation. According to the Red List, red-shanked doucs have undergone a decline of greater than 50% during the previous three generations.

In the wild, this species faces threats from both habitat loss and hunting, with the latter representing the major threat. It has been said that douc langurs likely have undergone a more significant decline than other diurnal primate species in Vietnam because they are easy to hunt. Habitat disturbance in the form of human population explosion, particularly in the central and southern Vietnam, and deforestation for agriculture (coffee, rubber, and cashew plantations) have taken major tolls on their native habitat. The current population trend for this species is decreasing, despite efforts to preserve them, including the establishment of nature preserves for their habitation. They are among the highest folivorous of all the colobines (Otto, 2005).

Studying this group was important because it developed an excellent test to determine how influential host phylogeny is sharing gut microbial composition. 4 populations (of the same species) living under 4 very different conditions (geographic gradient effect). In a way this is a dose response study, as we have four distinct populations. The red-

shanked doucs inhabiting Son Tra Nature Reserve, Da Nang, Vietnam represented the “normal” (control) group. The red-shanked doucs at the EPRC (Vietnam) served as the “mildly abnormal” group. The red-shanked doucs at the Singapore Zoo served as the “moderately abnormal” group. The red-shanked doucs at the Philadelphia Zoo served as the “severely abnormal” group.

The Philadelphia Zoo had a completely artificial environment (traditional zoological setting). The Singapore Zoo-had a much more natural environment than the Philadelphia Zoo, however, still very different from natural conditions. A portion of the population lives on an island within what is known as the primate kingdom, so they have space to move and forage. They feed both on the plant species on the island, as well as plants that are given to them daily (hanging foliage same as at EPRC). However, their diet is supplemented with fruits and veggies. The Endangered Primate Rescue Center has semi-natural conditions. While the doucs are housed in enclosures, they are still able to be outside year-round. Cuc Phoung where EPRC is located is outside of their normal range within Vietnam however, they are fed exclusively plants (no supplemental dietary items), which is more representative of natural conditions. They are also fed 3 times per day and allowed to eat throughout the day (also more representative of natural conditions). Lastly, for 2 hours each day (at lunch time), everyone leaves the compound to allow all the primates to sleep. Based on my experience with red-shanked doucs in the wild, this is similar to how the doucs behave in the wild. They typically sleep around lunch time (11-2 or so). They alternate between feeding and resting throughout the day. However, they are most active in the early morning and in the late afternoon (maybe because it is not as hot, thus they could possibly be conserving energy). At Son Tra Nature Reserve (Wild) the red-shanked doucs are living under completely natural conditions.

Additional Information:

Colobines are folivorous Old World monkeys, that are anatomically, physiologically, and ecologically unique amongst the living primates. They have specialized gastrointestinal (GI) systems similar to ruminants, including a multi-chambered stomach, allowing for consumption of extremely high fiber diets. One major source of variation exists in the GI anatomy and physiology of colobines, which is the stomach. Some genera have a tripartite stomach, or 3 chambered stomach, and some have a quadripartite stomach, or 4 chambered stomach. The genera with a tripartite stomach lack a presaccus.

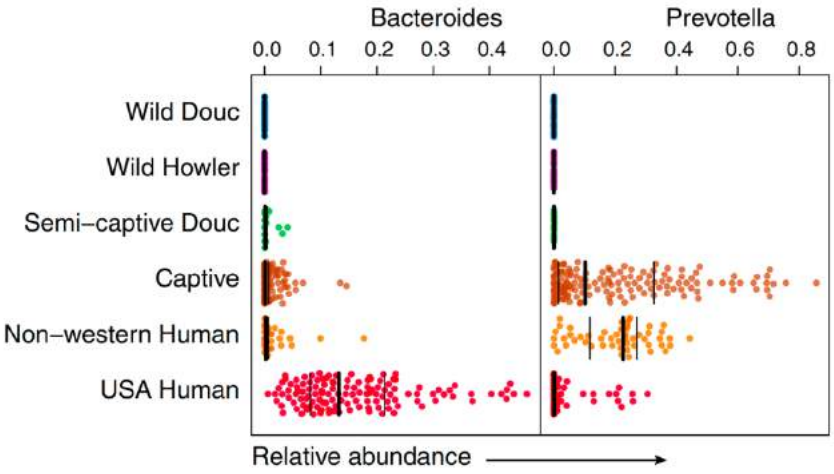
For colobines, the primary sites of microbial fermentation are in specialized fermentation compartments located in the stomach. This digestive specialization, where microbial fermentation predominantly occurs in the stomach, is known as foregut fermentation. Colobines also have enlarged salivary glands compared to other primates. The copious amounts of saliva they produce functions to buffer the forestomach pH. The saliva may also contain proline-rich proteins, which form complexes with tannins present in their diet, thus nullifying the potential tannin inference in the digestive process.

Colobines are capable of processing less nutrient-dense diets due to cellulolytic microorganisms in compartments of the GI tract, which play diverse roles in digestion such as the fermentation of polysaccharides and subsequent production of short-chain fatty acids. The complex gut and GI-associated microflora of colobine primates has led to their unique ability to neutralize digestive inhibitors and potential toxins present in plant materials, which constitute the majority of their natural diet.

Currently, the International Union for Conservation of Nature (IUCN) recognizes 612 species and subspecies of primate (543 species). The subfamily colobinae belongs to the Old World monkey family and consists of 59 species in 10 genera (11% of all primate species). Colobines are folivorous Old World monkeys, that are anatomically, physiologically, and ecologically unique amongst the living primates. They have specialized gastrointestinal (GI) systems similar to ruminants, including a multi-chambered stomach, allowing for consumption of extremely high fiber diets.

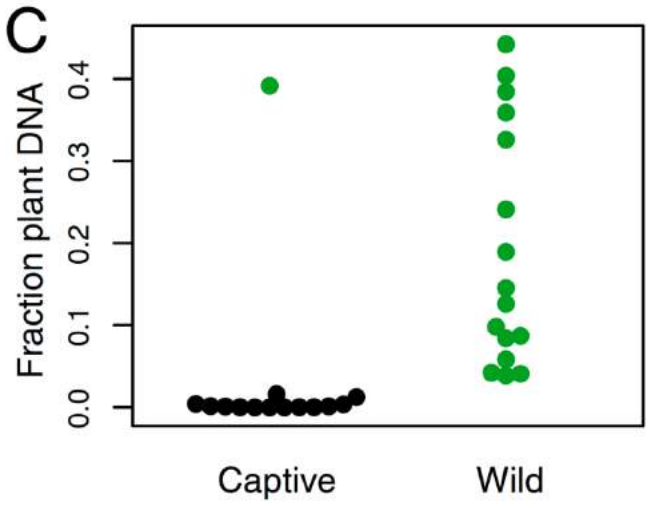
What happens to the microbiome in captivity? Captive monkeys becomes humanized! As shown below captive primates acquire Bacteroides and Prevotella, the dominant genera in the modern human gut microbiome. As

populations shift toward the captive state, their microbiomes become colonized by dominant human gut bacterial genera.



http://primatemicrobiome.org
Clayton, et al. PNAS (2016).

Why is this happening? Wild individuals have a high fraction of plant DNA in their stool; captive individuals have almost none, with the exception of a single outlier individual who was rescued for treatment of electrical burns (as seen below).



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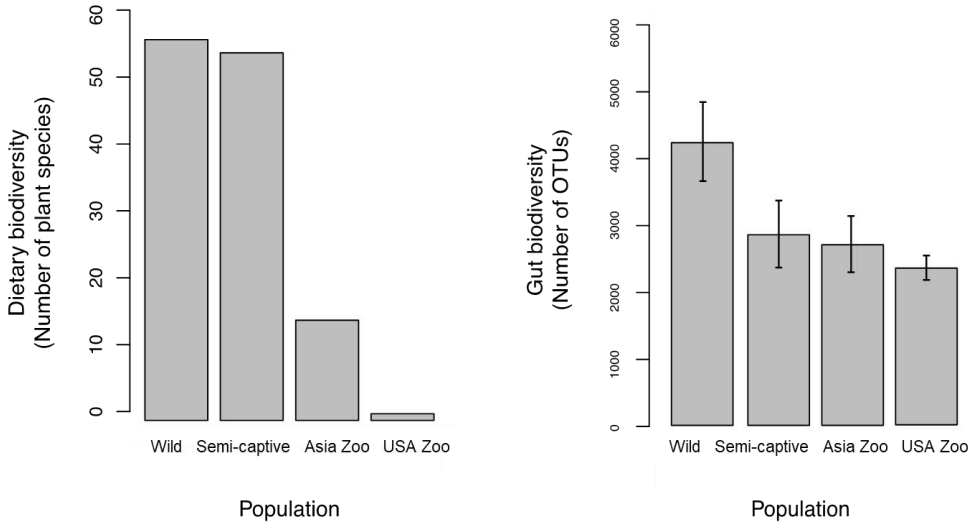
Clayton, et al. PNAS (2016).



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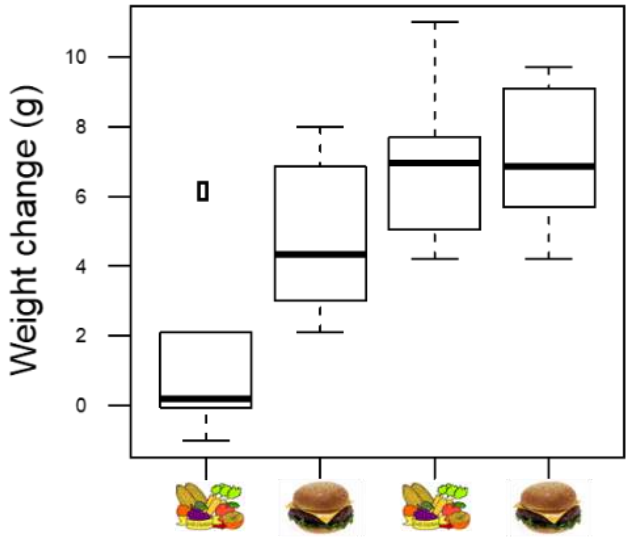
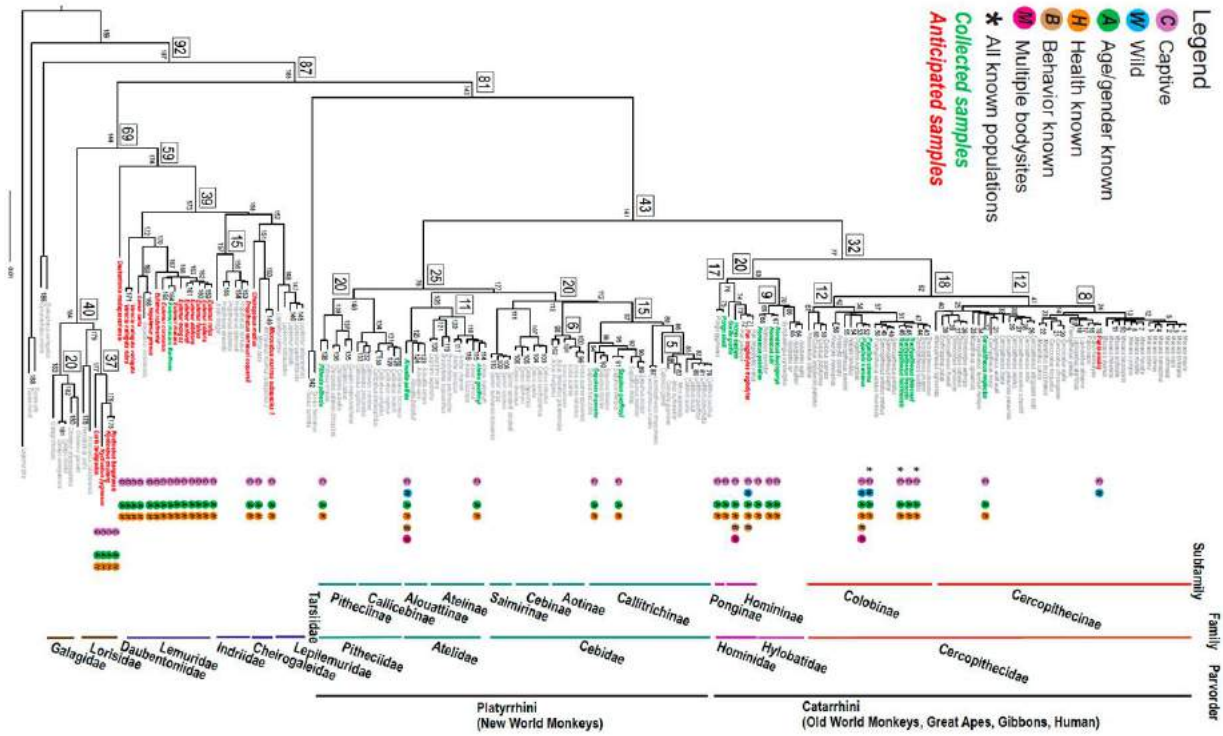
Captive microbes cause massive weight gains as can be seen in the chart below comparing douc diets:



What is needed:

1. A conserved signature microbial genetic and functional traits according to host phylogeny. An example schematic is presented below of the association between signature genetic traits in the gut microbiome, signature functional traits in the gut microbiome, and evolutionary history according to host phylogeny. Under our hypothesis, certain microbial genes, and likewise certain microbial functions, are conserved in certain primate lineages. Conservation of microbial functions is likely to supersede conservation of microbial genes due to convergent evolution. Our analysis will identify the keystone functional and genetic diversity in the gut microbiome for primate individuals spanning the tree of primate evolution and grouped by species, dietary niche, and gut physiology.



2. Establishing a primate-wide microbiome gene catalog. Understanding host-microbiome-function interactions: Experimental Design. Through our extensive global network of collaborating primatologists through the Primate Microbiome Project (PMP), we will sample and sequence the fecal microbiome from the majority of living primate species using deep shotgun metagenomics. The PMP provides standardized processes for sample collection, storage, and processing, as well as a centralized resource for data analysis and deposition. Our long-term goal is to sample and sequencing wild primate metagenomes from every living species of primate. Through our ongoing collaborations and network of contacts we expect to collect at least 5representative samples from each of over 250 primate species, covering all of the 79 primate genera, during the period of this project. This effort will allow us to characterize the majority of extant primate species and the vast majority of primate phylogenetic diversity. We will then perform deep shotgun metagenomic sequencing on every sample using cost-efficient sequencing on the Illumina Nova Seq platform. We will use these deep data to assemble and annotate genes and cluster them into putative functional groups by DNA sequence at several different levels of sequence homology. We will organize the resulting genes and functional annotations into a user-friendly publicly available gene catalog. This catalog will contain extensive annotations linking genes to traits including metabolic functions, putative natural product biosynthetic gene clusters, and antibiotic resistance. The primate-wide gene catalog is expected to contain many novel genes assembled de novo from the deep sequencing data. These will be annotated with important metadata including host species of origin, habitat status, and their position in larger assembled genomes and genomic contigs. This catalog will provide an invaluable resource for future efforts to identify keystone genes and functions in different lineages of primate evolution, and will support our integrative analysis of primate phylogeny, bacterial species, and functional traits.

Just published: the most comprehensive microbiome study ever done.

Discussion:

Probiotic therapy – most go right out – they do not stay – most probiotics sold do not have what naturally appears in the gut. Microbiome in primates can drastically change from wild situation to captive within a couple of weeks. Has there been a reverse with captive orangutans to a more wild microbiome? No – the orangutan diet is so complex – really difficult to recreate in captivity – other types of tools are needed. Might be possible to use the microbiome as a diagnostic tool. Landscape changes – so trying to get ahead of the situation is difficult but an area of interest. If there is diversity in the diet does that translate as a healthier microbiome? – but can this truly be replicated in captivity – so while a more diverse diet can lead to a healthy microbiome is that logistically possible? One area that really has been explored is fiber (for humans) probably for non-human primates as well. In a transition period, what needs to happen? Is that a smoking gun? You may be able to see the microbiome change, but can you see what initiated the change – it can be quick for some but for others it can be slow. The microbiome sees a lot of individual to individual variation. To truly understand was is healthy is difficult. One of the things coming is looking at OxyContin effects.

Supporting evidence-based rehabilitation: Using the Enclosure Design Tool (EDT) in sanctuaries

Susannah Thorpe – Presenter with Jackie Chappell, Jamie Dolling (Emily Saunders, and Julia Myatt: not present) School of Biosciences, University of Birmingham, Birmingham, United Kingdom.

Abstract

The transition from rehabilitation center to the wild is an extremely challenging one. Orangutans need to be able to express the full range of wild-type behaviors and skills to be able to thrive in natural habitats and enhance their welfare while in captivity. 'Forest Schools' are clearly effective in eliciting the physical strength and cognitive skills that orangutans need as they develop but it can be more challenging to ensure that these skills are not lost once orangutans are too old for Forest School. Moreover, skills can be lost at any stage of the lifespan if not practiced, so regular intervention from point of entry to release is needed. In addition, without an objective method of assessing readiness for release, it can be difficult for caregivers to know which individuals are ready, or which have formed positive social bonds, and should therefore be released together. We need to equip centers with techniques to understand which behaviors individual apes are not expressing appropriately, and methods to elicit these behaviors to ensure species-typical physical and cognitive development and maintenance.

EDT staff have been working with Samboja Lestari Orangutan Rehabilitation Center (BOSF) and our Advisory Board over the past year to develop and test our Enclosure Design Tool (EDT), which is designed to elicit wild-type behaviors

in orangutans housed in rehabilitation centers. The EDT is a framework of data collection protocols with a web-based tool. It enables rehabilitation centers to collect quantitative data on the behavioral ecology of their orangutans and upload this data to the EDT, which compares this behavior to that of wild orangutans and recommends enclosure modifications to encourage any missing or under-represented behaviors.

Three-part session:

One - The concepts behind the EDT, explaining the key behaviors, and why they are so important to orangutans in the wild. Present the results of work with BOSF, showing how effective the EDT can be in eliciting wild-type behaviors, and identifying areas where further development is still needed.

Two - Hands-on session, in which participants can work through using the EDT web tool themselves (dummy datasets provided). This part will enable participants to see what kinds of information the EDT provides about the behavioral ecology of orangutans, and the recommendations it provides. Guide participants through the data collection protocols and data entry templates. Feedback on this experience, to help improve how the EDT works.

Three - Bring everyone's expertise together to collectively innovate new ways to help sanctuary orangutans practice the behaviors they will need in the wild. The last part of the session will be an idea generation session to generate ideas, pool expertise and make sure that any recommendations are practical for sanctuaries to apply and can be easily and cheaply achieved using locally available materials.

Orangutans have cognitive and physical demand to life in the forest canopy. Their cognitive skills are Instinctive, learned and have advanced cognitive elements. There are high risks to getting it wrong – so they rarely make mistakes. They may evaluate the outcome of alternative actions mentally rather than physically. They must consider and identify the properties and physical behavior of multiple arboreal supports, the physical effects of their own actions, plan their routes in advance of their locomotion and the possibility of encountering new risks and opportunities if supports do not respond as predicted. They have very precise cognitive abilities. Their skills are acquired during development. Their physical adaptations require a high level of muscular control to allow orangutans to take account of change in substrate behavior and they need to react fast, reducing the risk of falls.

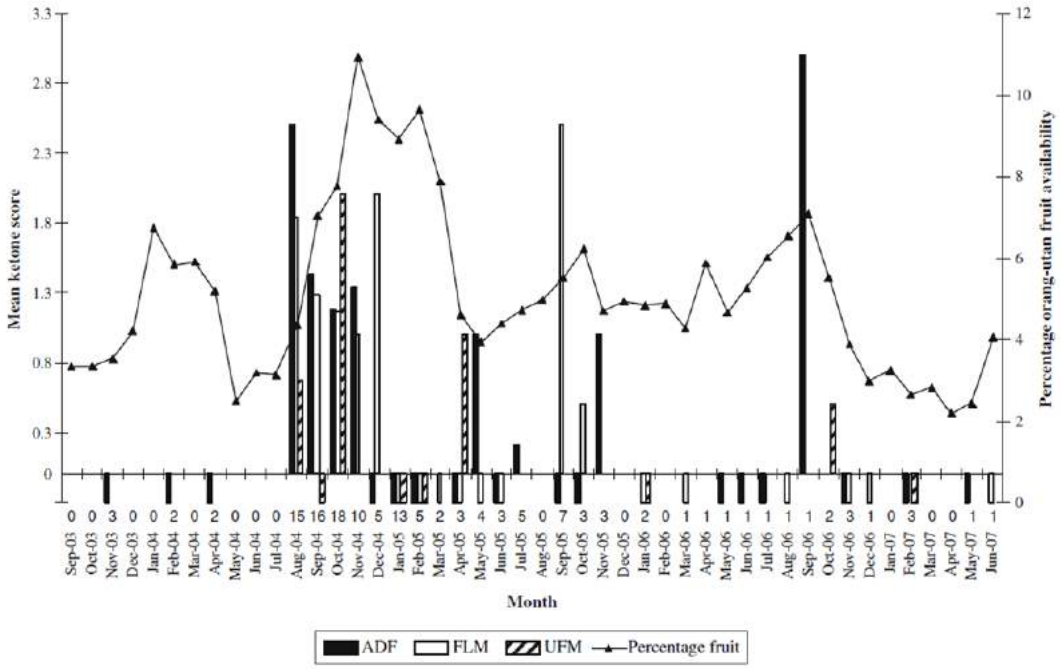
Having an elastic mechanism such as is found in humans, horses, greyhounds and other terrestrial species would allow for energy saving, power amplification, and force regulation during locomotion (Alexander 2002), but orangutans do not have this adaptation which optimizes energy return as the tendons stretch in one part of the stride and recoil later, returning energy to the muscle.

Since orangutans have to work harder at arboreal movement, there is likely to be an increased energetic load. Orangutans are the only great ape that experiences long periods of negative energy balance – which means that there are no ketones in the urine which in turn means they are using their own fat reserves. Orangutans need to eat a lot when there are times of food abundance in order to compensate for low food abundance. They use about 3% of their stored fat. Energy balance is important. Orangutans cannot routinely expend more energy finding food than they get from the food they find. Many orangutan populations live under high nutritional stress. As they cannot save energy in locomotion, they are at greater risk– limiting their ability to find food.

Ketones are produced when the body metabolizes its own fat reserves to produce energy.

Below are mean ketone scores for orangutans from Harrison, *et al,* 2019 IJP. It shows: Numbers above the x axis labels indicate the number of samples collected in that month for all age-sex classes combined. For display purposes, months in which no ketones were detected in the urine for an age-sex class are displayed with "negative" ketone scores, to distinguish them from months in which no samples were collected (which have no bars and, hence, appear as having a ketone score of zero). The chart also shows that negative energy balance is reasonably common in orangutans. This is found both in masting forest where short periods of high fruit availability are interspersed with long periods of limited availability, but also in non-masting peat swamp forest which has generally more consistent

fruit availability. Adipose tissue is one mechanism for storing energy to be used for maintenance, reproduction and other activities, such as migration, territorial and harem defence. Fat is light in weight compared to stored glycogen or protein because it can be stored in a relatively water-free state (CAHILL, 1970; WILLIAMS, 1976). This more concentrated form of energy is especially useful in arboreal animals with vertical travel requirements such as orangutans. These calculations show that the energy reserve of *M. fascicularis* has a much narrower margin of safety than that of *P. pygmaeus.* For example, if necessary, macaques would use about one-quarter of their stored fat energy per day whereas orang-utans would use about 3% of their stored fat energy per day. A more dramatic comparison shows that macaques might fast or risk starvation after only about four days whereas orangutans might fast for about 30 days.



Moving through the forest canopy: Forests are highly mechanically complex, are 3 dimensional, flexible (compliant), irregular (diameter, taper, material), and can be connected or discontinuous. They are dynamic, experiencing periods of growth, decay, and seasonality. They can contain fruits, with the narrowest gaps in 'terminal branch niches'. Multiple supports are needed to bear their weight. Support response can vary dependent upon animal's weight, position and action. Flexible supports behave much like trampolines, add another spring in series with the animal's locomotor system. For many animals the most challenging part of the forest canopy is called the 'terminal branch niche'. This refers to the highly flexible branches at the periphery of tree crowns which bend substantially under the animal's weight and vary enormously in their properties. Despite the increased risks of falling in the terminal branch niche, it is one of the most desirable parts of the forest canopy for arboreal animals because it is where fruits tend to be abundant and where the narrowest gaps between tree crowns exists for animals that travel at those heights.

Moving around a forest habitat is physically demanding as one is constantly opposing gravity. Nearly 60% of orangutan locomotion relies exclusively on supports that are less than 10 cm in diameter and therefore likely to bend under their body weight (Thorpe *et al,* 2007).

Energy budgets: Tree swaying. Comparing mother, mother and infant, and a sub adult male regarding how much energy is used if they climbed to the ground and went back up again – it is more energetically costing to climb up and down than tree swaying (to descend to the ground and climb up again is up to 23x more energetically demanding than tree sway and requires significant understanding of supports) – so giving them this option is important to allowing them to adapt to a wild environment as energy efficient locomotor adaptations are critical to their survival.

Work required, kJ	Mother	Mother & infant	Sub-adult male
Treesway	0.12	0.13	0.44
Descent & climb to height *h*	2.8	3.0	4.3

(Thorpe et al, 2007, Biol. Let)

For animals moving on compliant substrates, the external environment represents another potentially useful energy store. Compliant supports have been shown to increase the energetic cost of locomotion in monkeys and lemurs and the cost of takeoff in birds. They further may affect energetics by forcing arboreal animals to adopt longer travel routes to circumvent gaps in the canopy. But orangutans can manipulate their environment to utilize that energy. Since the work required to sway the tree is proportional to its stiffness, it would be greater if the tree were thicker. Swaying is advantageous only if the tree is sufficiently slender which, in these cases, it was…orangutans need to learn which trees are good, and that depends on the tree (different wood, different lengths, different stiffness), and on size of the orangutan.

In order to sway trees to utilize the elastic energy within them, apes must have an understanding of the flexibility of the given tree trunk relative to the size of the gap to be crossed. Juvenile orangutans regularly practice this behavior and both their frustration and perseverance can be observed when it does not work out. But failure seems to be a very rare result in adult locomotion. Given the unique set of materials and conditions for each tree sway/gap crossing event, this behavior supports the first three of our cognitive predictions. Anecdotal observations of tree sway reported in Thorpe et al., (2007) suggest that orangutans can also detect new positive and negative affordances if tree sway supports confound their expectations and exploit these appropriately. For example, when a female orangutan travelling with her adolescent son failed to oscillate a tree trunk to sufficient magnitude to cross a gap, the son moved to a higher bough in the tree. This increased the effective mass of the tree trunk about the point of oscillation and both were able to cross the gap. The fact that this positional adjustment worked the first time suggests they had a fairly nuanced understanding of how to modify the mechanical behavior of the tree trunk. It would appear that mother and offspring work together.

If we cannot ensure that orangutans in rehabilitation centers can move around like wild orangutans, then we are predetermining that they will always live towards the stressful end of the energy budget…descent/climb in these examples is between 10 and 23 times more physically demanding than tree sway; plus other issues of being too terrestrial.

There are 82 types of posture and 47 types of locomotion (within 13 postures and 14 locomotor families) used by orangutans and that is because they need to move through a very complex forest canopy. Orangutans have the broadest range of locomotion and posture of all primates. All these pastures and locomotive methods are cognitively demanding, and orangutan physical abilities change as they age.

There is a rough cognitive hierarchy, but appendicular movement involves multiple supports, balancing what weight each will support, transferring that slowing with any breaking, all cognitively very demanding.

Adult males are an order of magnitude larger in size than infants during the initial stages of locomotor independence (90 kg). As young orangutans differ in both body mass and cognitive development, orangutans must be able to perceive the affordances of supports to utilize them successfully and they discover these through play and exploratory behavior, much like human infants, or by observing their mothers when they are carried or assisted across gaps. Orangutan mothers further encourage independent behavior in their infants by systematically reducing the assistance they provide as offspring gain competence. While appendicular deformation of compliant supports does not appear to require much experience, certain forms of mass deformation are likely to require more advanced cognitive abilities and/or more experience. Chevalier-Skolnikoff *et al*, suggest that this behavior indicates that orangutans cross gaps

by forming mental representations of them prior to crossing, which they consider indicative of the most cognitively complex stage of Piaget's sensorimotor intelligence series, insight. Since the extent to which a substrate deforms depends on the body mass of the animal, orangutans must also adapt their locomotor behavior as they grow.

Appendicular deformation is generally used when the branches of an adjacent tree are within reach, and orangutans cross by pulling thin compliant branches towards their body until a more stable branch can be reached to transfer their weight onto. They use this behavior during both orthograde transfer and pronograde bridging behavior.

Mass deformation is where a support is intentionally deformed using body mass. It is used when crossing larger gaps in the canopy and might either be with the animal in a static position with the support simply deflecting under their mass, or when orangutans actively sway supports with increasing amplitude until a support on the opposite side of the gap can be reached, such as in tree sway.

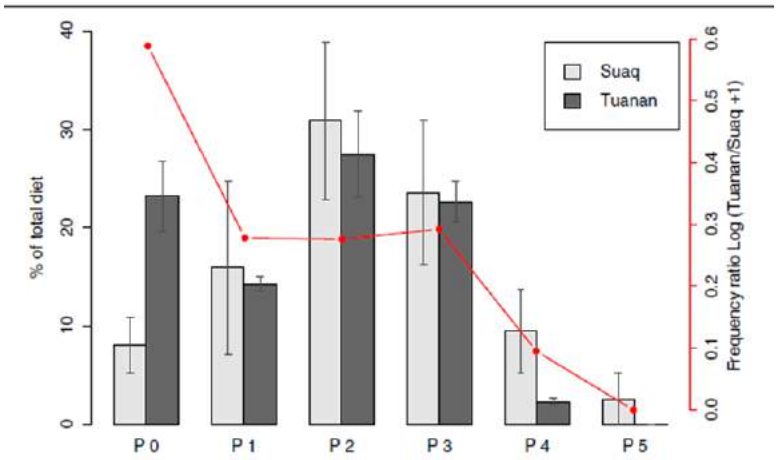
One of the primary ways orangutans adapt to their habitat is decreased stereotypy in locomotion and posture. There are many variations of sit and lie. 28,000 observations were made of positional behavior of which 2811 were locomotion! Differences between species are mostly simply different frequencies of the same broad behaviors that relate to habitat structure. The fact that they fall into families of behaviors is useful here because those families generally involve similar physical and cognitive skills.

Wild orangutans live in a complex foraging niche with a diet consisting of many difficult-to-process and hidden food items, many of which require tool use (van Noordwijk & van Schaik, 2005). Adult females at Tuanan (in central Borneo) each have diets comprising around 170 or more food items from around 110 plant species.

A paper by Schuppli *et al*, (2015), showed hierarchy of complexity. Levels of complexity were set up to show finer motor controls (tool use if foods are difficult to extract). Over 30 to 40% of their diet involves some really difficult manipulation of foods (at Tuanan and Suaq locations). Especially pith – a fall back food, yet cognitively it is really demanding. When we think about food diversity, we need to look at complexity.

Below is the dietary complexity of the different processing steps in percent of the total diet for the food items that form the top 90% of the total diet of 4 adult females at Tuanan and Suaq. The red line indicates the site frequency ratio of each given processing step – using an equation:

Processing steps	Description	Example
0	Pick and eat	Leaves
1	(a) Pick, peel and eat; (b) Pick, eat and spit out	(a) Fruits with indigestible skin (b) Fruits with indigestible seed
2	(a) Pick, peel, eat and spit; (b) Pick, bite in half, extract inside, eat	(a) Fruits with indigestible skin and seed (b) Hard shell fruits with edible internal fruit flesh
3	(a) Pick, bite in half, scrape out inside, eat, spit out; (b) Collect, scratch or bite open, suck, eat	(a) Hard shell fruits with edible internal pulp and indigestible seed; (b) Insects embedded in wood or other substrate
4	(a) Break off, peel, extract inside, eat, spit out (b) Break off, examine, bite apart, suck, eat	(a) Vegetative material ('pith') inside branches and liana (b) Sucking insects out of dead twigs
5	Break off, peel (optional), chew (optional), insert into tree hole/ nest/ fruit, and then extract, collect insects/insect product/seeds from tool tip, eat, spit out (optional)	Tool use (tree hole, insect nests and fruits)



Orangutan nest building: Involves thermoregulation, comfort, increase periods of REM, anti-predation and height/camouflage. Greater height provides protection from air borne parasites.

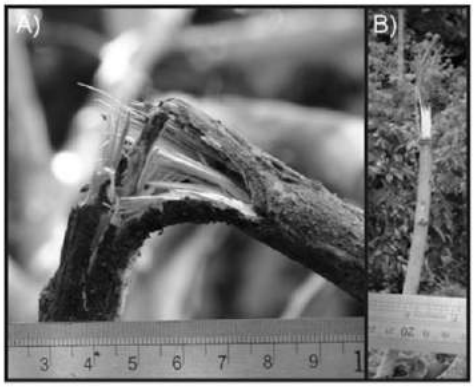


Fig. 3. (*A*) Example of a greenstick fracture found within an orangutan nest structure. (*B*) Detachment from branches surrounding the nests.

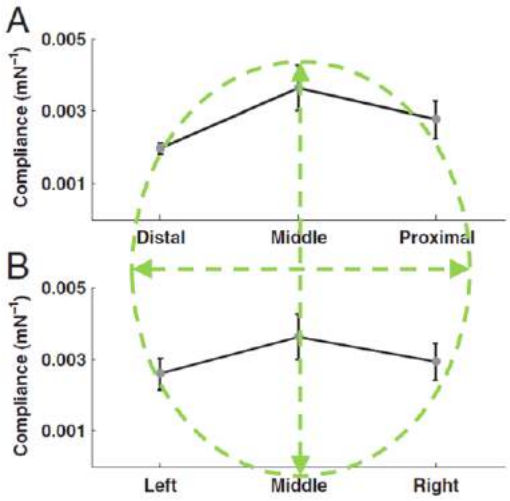
Once weaned, all great apes build nests on an almost daily basis. These nests are multilayered constructions in a tree or combination of trees and made of bent branches to which additional elements, such as pillows (small piles of small broken-off leafy twigs) or blankets (larger leafy twigs bent or laid over the nest, leaving the head area free), are added (Prasetyo *et al*., 2009).

Building a safe, structurally sound nest is a complex task, involving selection of an appropriate site and choice of suitable materials. The nest maker then needs to manipulate the materials in relation to each other and the nest substrate to create a nest with enough structural integrity to support its occupants and to withstand movement of the tree and nest in the wind. It is not an entirely instinctive behavior. Orangutans and chimpanzees are selective about the trees in which they choose to build nests, and research suggests that this relates to the innate flexibility of the wood of different tree species, and perhaps to an understanding of the requirement for branches that will exhibit 'greenstick' fractures, whereby the end of the branch fractures but does not detach completely (van Casteren *et al.* 2012). This phenomenon allows strength and rigidity to be built into the nest by weaving larger branches over a framework of more solid limbs to form a platform, then smaller twigs are folded over to form a raised rim (Figure 1) (van Casteren *et al*. 2012). In some cases, leafy material is detached and added to the nest bowl to form a sleeping surface (Stewart *et al.* 2007; van Casteren *et al*. 2012). These nest types therefore require the ape to have an understanding of the physical properties of different tree species and the effect of their own actions on the branch, meeting predictions P1 and P2 above. They also need to organize their behavior in the correct sequence to construct

a supportive nest that can bear their weight safely, which indicates an element of planning. It has been shown that immature individuals build nests more efficiently and of a higher quality when exposed to nest-building adults which also indicates a role for learning and innovation in the building of nests.

The act of breaking and weaving branches together during construction is essential to the success of the structure. However, breaking living, and hence compliant, branches is not as simple as one might think. The orangutan will bend and break branches inward toward a central point, weaving and twisting the branches to lock them into the basic nest structure.

Nest building is defined as bending branches towards itself to form the main structure of the nest, securing them with another body part, usually the feet, and weaving branches together. During construction orangutans use the fact that branches only break half-way across in a "greenstick" fracture to weave the main nest structure. They choose thicker branches with greater rigidity and strength to build the main structure in this way. After the completion of the base structure, smaller branches are bent from the edge inward to produce a "mattress" or "rim". They then detach thinner branches by following greenstick fracture with a twisting action to make the lining. These results suggest that orangutans exhibit a degree of technical knowledge and choice in the construction as these branches are significantly smaller, weaker, and more flexible than those used in the main nest.

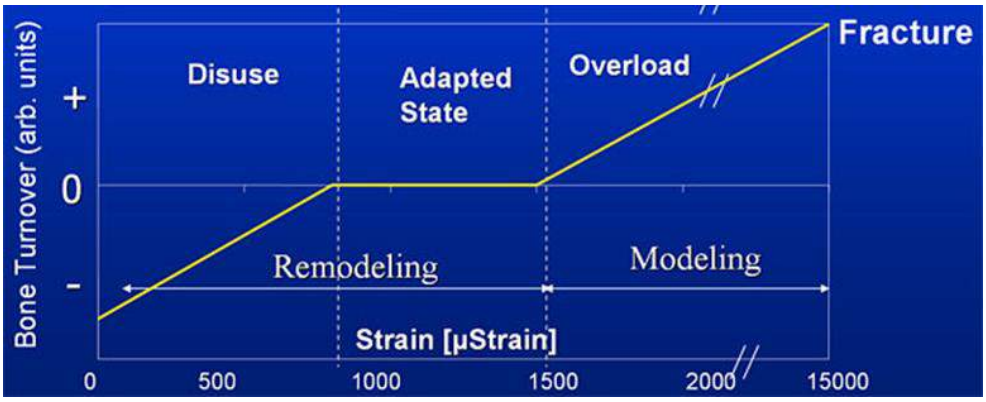


Smaller branches are bent from the edge inward to reinforce the edges.

Orangutans need to understand which trees can be used; select appropriate diameter branches; understand greenstick fracture mechanics; understand relationship between branches as they bend and weave and the motor control of hands and feet.

Developmental changes: Of all primate species, orangutans have the most extreme life history. They have the latest age at first reproduction of any nonhuman primate species and the latest age of weaning and interbirth intervals of any primate species. Immature Sumatran orangutans are weaned around the age of 7.5–9 years, which is 1–2 years later than their Bornean peers. Weaning is followed by a multiyear juvenile period during which individuals are fully self-supporting but not yet reproducing. Whereas Bornean orangutan females have their first offspring around the age of 13–14 years, their Sumatran orangutans wait for another 2–3 years until they start reproducing, around the age of 14–16 years. Orangutan diet includes hundreds of different types of foods (ca. 400).

Musculoskeletal health: Skeletal muscle mass and bone mass are regulated by a range of factors such as genetics, nutrition, hormones and growth factors and mechanical loading (Wolff's law: bone will respond to the forces placed upon it):



It is well known that an increase in mechanical loading of skeletal muscle results in an increase in skeletal muscle mass (i.e., muscle hypertrophy), while a decrease in mechanical loading leads to a reduction of skeletal muscle mass (i.e., muscle atrophy). Changes in mechanical loading are also known to play a major role in the regulation of bone mass and strength; increased mechanical loading at critical stages of growth and development result in increased bone mineral accrual, bone mass and strength, while reduced mechanical loading results in the loss of bone mass and strength. Importantly, evidence suggests that the development and maintenance of bone mass is, in large part, dependent on skeletal muscle-derived mechanical loading (Goodman *et al.* 2015).

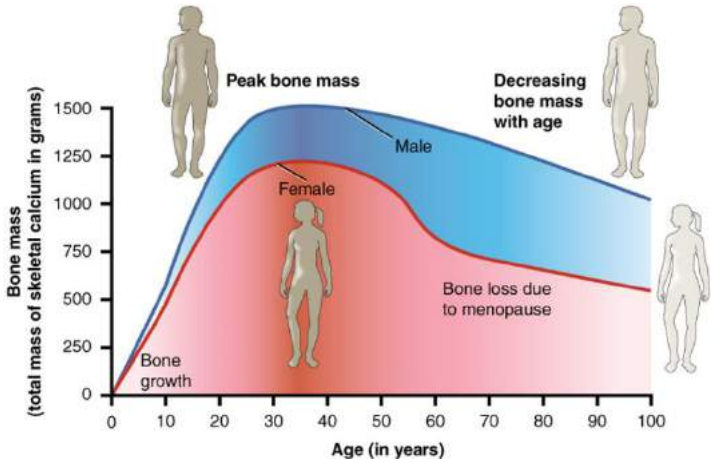
The Mechanostat is a term describing the way in which mechanical loading influences bone structure by changing the mass (amount of bone) and architecture (its arrangement) to provide a structure that resists habitual loads with an economical amount of material. As changes in the skeleton are accomplished by the processes of formation (bone growth) and resorption (bone loss), the mechanostat models the effect of influences on the skeleton by those processes, through their effector cells, osteocytes, osteoblasts and osteoclasts.

We know our muscles get stronger, but our bones also get stronger. However, this is not enough in rehabilitation orangutans to just increase activity levels – it will not necessarily increase the bones that need to bear weight in the wild.

As early as 1892, Julius Wolff recognized that the bone adapts to the force acting on. Thus, Frost postulated the existence of a mechanostat in bone tissue, which registers the force acting on bone and regulates modeling and remodeling to keep habitual strains within a constant window. For the mechanotransduction in bone (conversion of a mechanic stimulus into a cellular and molecular response), the forces on bone generated by skeletal muscles are higher than the forces generated by the gravity. Therefore, the mechanical interaction of muscle and bone is a crucial aspect of the functional muscle-bone unit. For the clinical evaluation of the functional muscle-bone unit, it was proposed, among other things, to evaluate the adaptation of the bone to the acting forces. A frequently assessed parameter to describe this interaction is the bone mineral content (BMC) determined by dual-energy X-ray absorptiometry (DXA) in relation to the lean body mass (LBM). BMC is a surrogate parameter for bone strength.

Key message: rehabilitant orangutans need species-typical physical and cognitive opportunities from quarantine onwards.

There is variation in the literature about how bone strength changes in humans with aging, which reflects whether they are looking at bone mineral content, bone density and also reflects the multiple other factors that influence bone strength. But in general, the graph below reflects the overall pattern that humans gain bone mass during ontogeny but can only at best maintain it in adult hood. Some graphs show males plateauing, and females reducing less, female results from menopause.

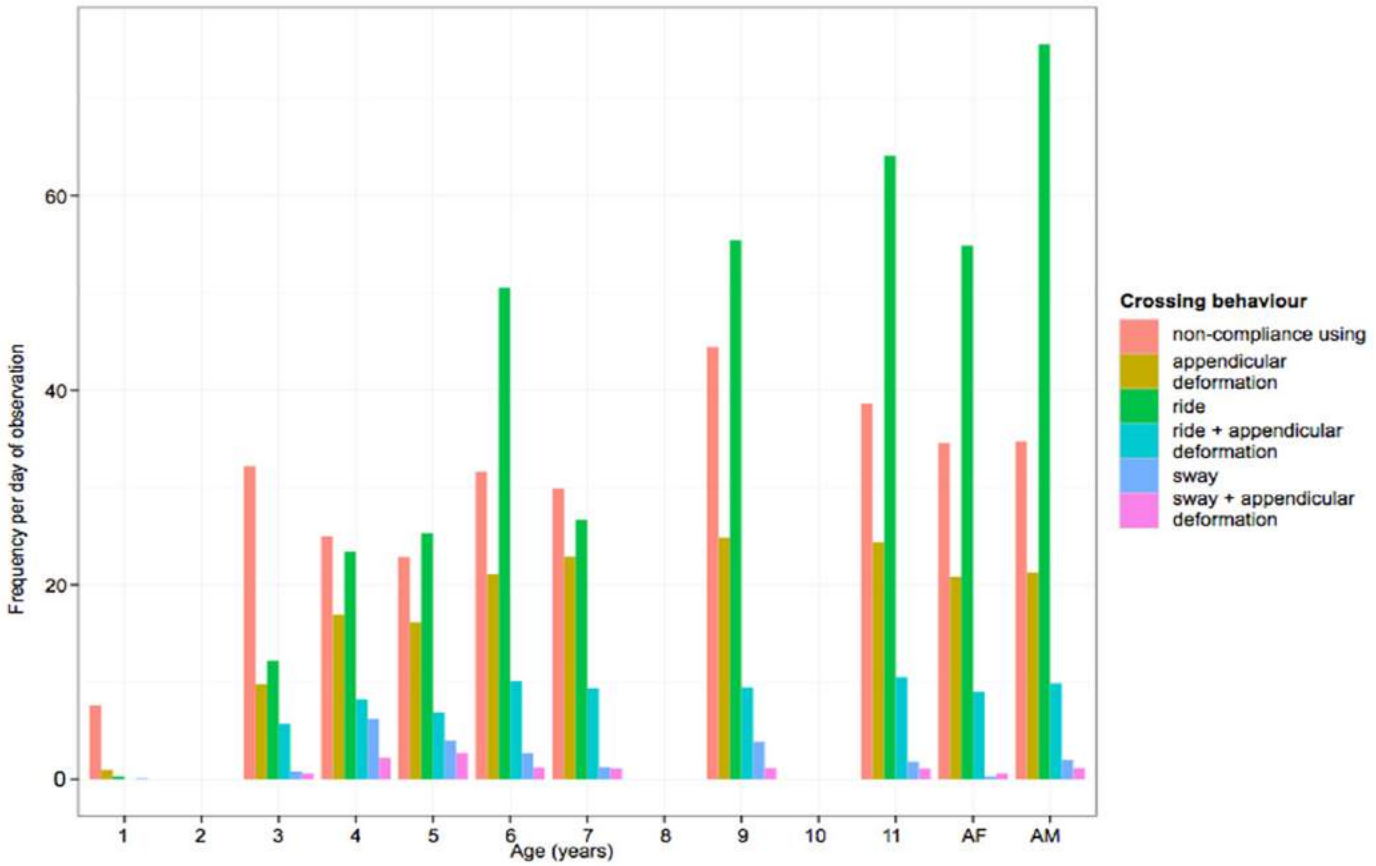


Bones become more brittle / may break more easily. Joint inflammation, pain, stiffness, and deformity. Movement slows and may become limited. Loss of muscle mass reduces strength. Zoo orangutans have skeletons that are significantly different to those of wild populations (Sarmiento, 1985)

"Exercise, Nutrition, Hormones, and Bone Tissue". Anatomy & Physiology.

This can be applied to some extent to orangutans, as we know great apes can get arthritis, but we do not know at what age the ability to build bone strengths slows/stops. For orangutans that come into centers, as soon as they come into quarantine, you need to be challenging their musculoskeletal system to start to strengthen it while they are still building bone strength…the later it is left the greater the negative consequences can be. It is important for the orangutan to use the same bones and muscles it would use once it is returned to the wild.

Crossing gaps: Orangutans cross gaps at least 50 times per day, adults up to 150 times per day – if they are going to move arboreally, they need to be skilled at gap crossing. Our results below suggest that gap crossing varies with both physical and cognitive development. More complex locomotor behaviors, which utilized compliant trunks and lianas, peaked in frequency much earlier than expected, between the ages of 4 and 5 years old, which probably reflects play behavior to perfect locomotor techniques. So at this key age, they are practicing lots of demanding behaviors at the stage when their bones are developing and building strength; what are the implications for their learning and strength if they miss this?



Development of other skills: seen in the chart below is the scaffolding structure of skills development.

Skill	Age (yrs)	details
Nest building	3	capable of building a nest good enough for a daytime nap /play platform
	4-5	made their own covers over a day nest
	6-8	build/ sleep in own night nest
Tree hole tools	4-6	started using tools in insect holes, often using tool discarded by mother
	6-7	made their own tools and sometimes used them independently of their mother's activity.
Neesia tools	<5	beg seeds from mother
	7	competent tool users

Anecdotal analysis from van Noordwijk et al, 2005, AJPA.

Thus, many skills seem to be learned, or at least practiced and perfected, during the second half of lactation. By the time an offspring was weaned, it was able to protect itself against the elements and recognize opportunities for tool use.

Around age 3, infants approach locomotor competence (although they still need help to cross major gaps), can build nests and protect themselves against rain, and begin to spend time in another tree than that of their mother. The next major change occurs at time of weaning, around age 7, when mothers stop playing with their offspring and occasionally become less tolerant around food, the youngsters sleep in their own night nest, and proximity (10 m) begins a precipitous decline. At this age, the weanling has already achieved an adult-like activity budget, and, by definition, foraging competence. Around the time the next infant is born, association time (50 m) declines steeply to reach adult levels at around age 10 or 11, indicating that immatures at that age have also achieved ranging competence.

From Schuppli *et al.* (2015): Orangutans live in a complex foraging niche: food availability in most orangutan habitats fluctuates during and across years without following any clear seasonal pattern. They have very broad diets and rely on a variety of difficult to process food items. Some populations habitually use tools in the foraging context. Foraging skills can be divided into food selection competence (what to eat), food processing competence (how to eat), and food locating competence (where and when to eat). Given their broad diets, complex processing techniques, and highly fluctuating food availability, each of these three aspects may limit orangutan skill development and their ability to compete in the adult niche. For any foraging skills to limit development, they must be learned rather than innate. Indeed, it takes immature orangutans multiple years to acquire their foraging skills. Also, there is evidence that they do so by a combination of social- and individual learning.

We found that with increasing age, immatures ate an increasing number of food items, and at the age of weaning they reached a repertoire size that is between 80 and 99 % of their mothers' repertoire size. When examining sex differences, we found a significant interaction effect between age and sex, implying that female immatures attained a broader diet earlier than their male peers, who by the age of weaning seemed to reach only 80 % of their mother's diet repertoire size.

Relevance for orangutan rehabilitation: Need to allow wild-type physical and cognitive opportunities from arrival to: optimize rehabilitation process; maximize natural physical/cognitive development and exploit benefits of social learning. Wild orangutans show a significant preference to learn from trusted individuals - may reflect the risks attached to exploration, such as injury or poisoning, especially when the items are novel.

We still need to understand, the Impact of emotional trauma on cognitive/physical development. In older confiscated individuals, is it possible to make up for lost immature learning?

There is very strong evidence that we need to encourage wildtype behaviors from early on. What about if there is an Inability to learn/motivation? Whereas wild orangutans avoid novelty, orangutans in zoos seek novel stimuli.

Depending on species and population (Sumatran orangutans tend to be more sociable than Borneans), independent immatures spend 30–80 % of their time on their own, whereas for the remaining time they mainly associate in small peer groups. It is possible that the late weaning is linked to the need to sustain themselves independently soon afterwards.

One possibility is that captivity offers a safe and stable environment, which includes a reduced need to find and process food and thus increased free time, reduced need to be vigilant for predators and plan travel routes and thus reduced cognitive load, and permanent gregariousness and thus more frequent opportunities for social learning. These circumstances allow individuals to approach and explore novel items and situations (Forss, Schuppli, Haiden, Zweifel, & Schaik, 2015; van Schaik *et al*., 2016), which, over time, results in larger skill repertoires (Haslam, 2013). In addition, the ability to attend to humans and their actions may increase an individual's knowledge of affordances or stimulate different cognitive processes (Fredman & Whiten, 2008) and might therefore indirectly stimulate innovation propensity. This idea is supported by recent findings in orangutans (Damerius *et al*., 2017) showing that human contact during ontogeny led to changes in the orangutan's attention structure that positively affected individual's problem-solving success. Thus, it appears that captivity may unleash curiosity in animals that are decidedly uncurious in the wild.

Observational social learning (learning by observing others) includes some forms of stimulus enhancement as well as imitation, emulation or observational conditioning (Hoppitt & Laland, 2013; Tomasello, 1994; van Schaik, 2010). Several authors have also pointed out that for many detailed actions, competence can only be acquired by individual practice (Byrne & Russon, 1998; Galef, 2015), suggesting that observational learning will often need to be accompanied by selective practice.

These studies have shown that in various primates the acquisition of complex skills is socially influenced. However, highly complex skills such as tool use often seem to be superfluous for an individual's survival, since not all populations of a species show them. Few studies have examined whether primates also rely on social learning for the acquisition of the more basic routine skills. Social learning is contrasted with individual learning, which is often treated as the default option for any learning since animals are expected to rely on social information when they are unable to solve a problem independently (Laland, 2004). However, individual learning is time intensive and carries the risk of injury or poisoning. In contrast, social learning is more efficient and less risky. Social learning may therefore be more common than previously assumed and might also be used for the acquisition of routine skills. The role of peering (attentive close range watching) in the skill acquisition process in immature orangutans, including widespread and routine skills such as the processing of common food items or nest building. We did so by examining peering contexts, choice of experts and subsequent practice.

The Enclosure Design Tool (EDT) is an interactive computer interface that translates research on wild apes into a format that can be used to encourage wild-type behaviors and enhance welfare in captive great apes. The tool compares behavioral ecology data from captive settings to data we have profiled for wild apes, and makes recommendations for how to modify enclosures to elicit missing or under-represented wild-type behaviors. A further dataset is collected to quantify the success of the modifications.

The EDT produces recommendations for each of the specified categories. With the partner organization, we take an open view of what could be changed; for example, by focusing on shaded spaces we can use the motivation for one behavior to elicit others or to compensate for things that cannot be changed. By focusing on these spaces we can use the motivation for one behavior to elicit others (e.g. attractive manipulative objects positioned to elicit missing/under-represented behaviors; or compensating for things that cannot happen – there are some elements of social organization that it is not possible to replicate in captivity, and this might cause elevated stress and/or aggression. Then we would work with the center to use locomotion and cognition to compensate for social constraint...so when we say it is about eliciting wild type behaviors – it is about having a holistic view of that behavioral ecology of that particular captive group, and using the comparison to wild conspecifics to both enhance their natural behaviors and mitigate for constraints of captivity, so in a central space we might do one thing and for social behavior we might do another. If you do not have natural social behaviors, then the first step would be to ask if we can elicit it by (for example) brining in other orangutans.

EDT recommendations are based on replicating the mechanical behaviour of forest canopy and the physical and cognitive challenges it poses to wild orangutans. Below is a sample of the possible categories:

Locomotion	Manipulation	Social
Posture/ locomotion, Height, number & flexibility of supports,	Manual manipulations as a proxy for cognitively demanding activities	Who, what, where and when,
behaviour		

<u>EDT at BOSF</u>

This past year, a sample study was conducted at the Borneo Orangutan Survival Foundation (BOSF) (Samboja Lestari location manipulation was focused on. Anything that is cognitively demanding requires feet and hands manipulation. BOSF has lovely high enclosure but with limited enclosure furniture and not much of it was flexible. Some males were a bit too close together which would cause stress. Large males are very difficult to introduce back in the wild as they must be introduced individually not in groups as you can do with females. The exercise was to focus on adult male orangutans to learn ways to increase the enrichment in the cages enough so that they could go direct from cage to release forest. We tried to give them a reason to move (post modification phase). An orangutan needs to have the strength and stamina to negotiate a forest environment. They need to use more locomotive movements more frequently to build that strength and stamina. Sway poles can be matched to body mass of orangutans in order to be more effective. Establishing core skills such as understanding that supports can break. Food enrichment can come from the roof of the cage. BOSF has created a list of the different behaviors that they need to engage in. Nest building is really important – EDT has increased it but not by much – there is no evidence of complex bending and weaving. At Chester Zoo, orangutans made a real uncomfortable nest. There also needs to be a criterion for orangutan relationships with humans. We also need to break the link that there is something they need on the ground, so they can begin to learn to spend less time on it. They need better locomotor skills, understanding of supports, and, they need to learn how to learn.

Dietary Diversity –orangutans must really know how to access fall back foods. Topics for future: Is anything missing? How are we going to move forward? What is our next step? We need to be studying post release orangutans that have been through the EDT process…this way we can identify things we may have not thought of. Hopefully this will give them post release longevity.

Discussion: Have you considered using video instruction? We prefer to have keeper or someone orangutans trust show them how to do things. Worth a try…similarity to American Ninja Worrier – great idea! Locomotion cannot happen soon enough in the wild even when quite young - they are already learning and testing things out. How are they at judging distances and when do they learn that? That certainly needs to be looked at.

EDT Breakout Session 1: Small groups to sample the EDT tool on line – a sample link was provided.

Post session suggestions discussion: use of tire strips – it has some give / flooded floor to force animals to stay arboreal / they have to move through the enclosures using swing and sways / make an artificial tree to hang rope or fire hose, make nests, bamboo, construction companies will give you bamboo, flooded forest problem as a concern for dengue and malaria (mosquitoes and standing water) / for flooded floor -disease risk would be too high…perhaps a graded floor would be better…the floor is empty so there is no infestation – use rubber rope / pole-vaulting poles / off bamboo idea but add rattan – weave rattan so it become artificial liana, it is strong and it can teach them to use real material

EDT Continued - Jackie Chappell

EDT is at the best stage at the moment, as we can add suggestion from feedback post use.

What do we need feedback on?

Males and females are doing different things in the wild – is that useful to know? What centers really need is to know which individuals are ready for release….if that is not the case – that can be changed.

Possible release assessment summary for recommendations page

Release criteria	Steve	Siska	Yenny
Time spent in locomotion			
Time spent on flexible supports			
Types of locomotion			
Types of posture			
Manipulation complexity			
Nest building			

When looking at chimpanzee data, chimps had several pages of social behaviors – is this data useful for orangutans? Do you need very simple information (aggression) or much more detailed information on social networks and which individuals might support each other?

Is there any other data that is missing that you would like to know? You must be able to use this tool – are you able to collect this data yourself – 6 hours per data set is needed (locomotor set and behavior per individual) so quite a lot of data needs to be collected – this needs feedback… is this is too much etc. can you cope with that?

EDT gives you an excel spread sheet that you can upload and data is automatically analyzed. There is not a lot of variation between individuals because EDT has not figured how to do that yet.

Collecting the data as outlined in the above chart allows you to make an informed decision regarding release candidates.

EDT Breakout session 2: Testing the information entered in sample site

Group Feedback Discussion: Social behavior, play behavior should be included in the analysis / Include temperature and humidity – might make a difference / If you see a behavior that is not on the existing list – can it be added? It will probably read as an error but there is an 'other' category / While we would like to include everything, we have to focus on their wild behavior – for stereotypies: we reward positive behavior only – but we can only focus on so many behaviors and we need to focus on the core wild behaviors / Data set gets loaded individually / We try to equip them with the full range of behaviors they show in the wild

Day 2 – 23 July

Center for Wildlife Studies - Future Collaborations

Dean of veterinary faculty, Muhammad Hambal

Overview of Pusat Kajian Satwa Liar (PKSL - Wildlife Research Center):

The goal of PKSL is to build capacity for wildlife medicine and provide service to key species conservation in Indonesia. They will attempt to achieve this goal through education, research, and public service.

Education: Increase the capacity of university lectures / Develop international post graduate program for wildlife medicine / Improve wildlife medicine curricula / Improve facilities for Wildlife medicine education / Build student competency in terms of wildlife medicine / Strengthen international networks and collaborations to enable sustainable education program.

Research: Develop Institutional research road map based on the needs for key wildlife conservation / Provide mentoring and networks for student research / Conduct research on wildlife medicine / Establish Indonesian wildlife medical journal / Take part in wider conservation needs, eg; Sumatran Rhino Captive Breeding Program / Collaborations with industry to develop local herbal use for wildlife medicine use (including intellectual property).

Public Service: Wildlife rescue / Wildlife release and reintroduction / Wildlife GPS collaring / Wildlife Translocation / Regular medical checkups in some captive facilities / Develop SOP for specific wildlife medicine administration (eg, SOP for GPS Collar fitting on elephant, tiger, sun bear and rhino) / Develop Indonesian policies on important emerging diseases / Contribution for policy and regulatory framework regarding wildlife conservation / Arrange summer school program for international student / Develop community service program for international student.

Conservation of Sumatran Elephant in Indonesia, an update

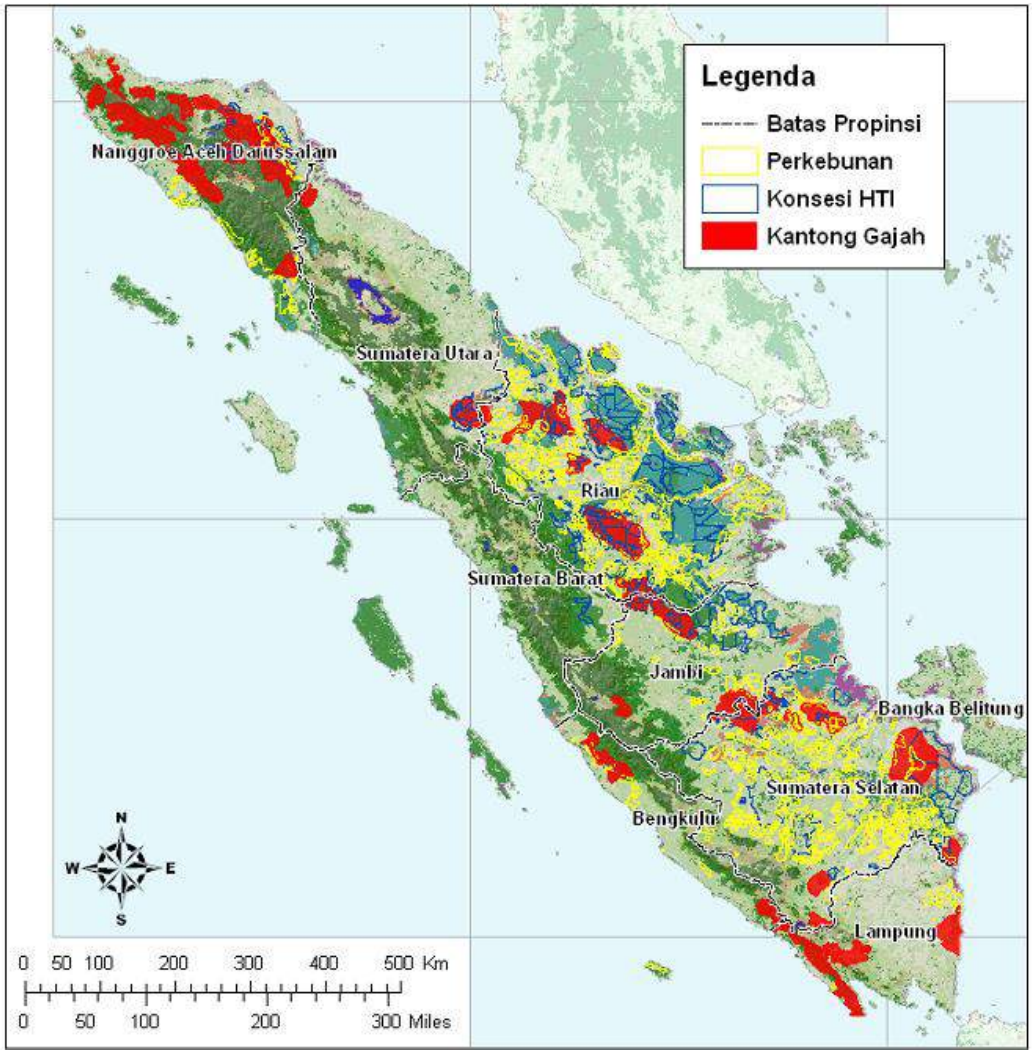
Wahdi Azmi, Center for Wildlife Studies, Syiah Kuala University, Faculty of Veterinary Medicine

Current status: Sumatran elephant (*Elephas maximus sumatranus*) is listed as Critically Endangered (CR) Appendix I CITES in 1990. It has had protected status by the Government of Indonesia since 1999. There is a current action plan in place: Indonesia Action Plan 2007-2017; the Sumatran elephant is the only critically endangered (it is a subspecies of the Asian elephant). A survey from 2014, places the population at 1,724 individuals and due to continued degradation of habitat, this is down from nearly 2,800 individuals surveyed in 2007. The Bornean elephant (*Elephas maximus borneensis*) is listed as Endangered (En) 20-80 individual (FKGI, 2014); declining 20 % (60-100 individual in 2007); Appendix I CITES; Protected by Government of Indonesia (PP. 7 tahun 1999).

Editor's note: as of 2018, both the Sumatran and Bornean elephants are on the IUCN Red List of Endangered Species.

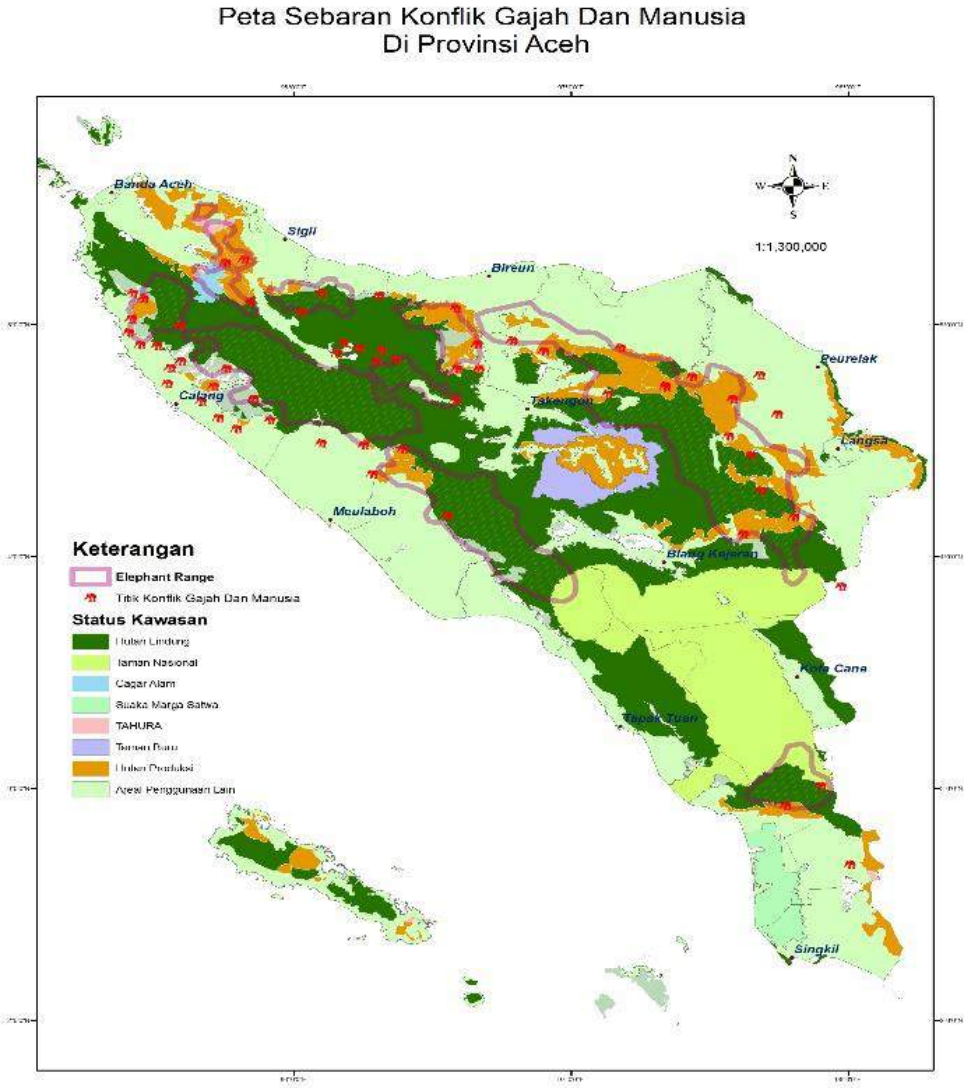
Elephant conservation issues – there are seven main causes… 1. Habitat loss and habitat degradation; 2. Habitat fragmentation; 3. Human-Elephant Conflict; 4. Land use change and lack of spatial planning; 5. Developmental activities such as roads, railway lines, dams, housing and agriculture; 6. Poaching for ivory; and 7. Disease.

The habitat and distribution map below shows dark green for the remaining forest cover, yellow for palm oil plantations with red as current elephant range:



Elephants are not living in the forested areas. However, in Aceh, as there is continuous forest, elephants use the forested areas, but the problem is that they still venture outside of designated conservation areas and into forested areas that are not protected. The habitat needs to be better managed in order to conserve the elephant population in Aceh. Human – Elephant Conflict (HEC) is one of the reasons that conservation organizations must talk to the government – it is a window in which to ask the government for support – as they are more willing to help if there is a human component.

Below is a distribution map of Aceh province showing areas of Human-Elephant conflict:



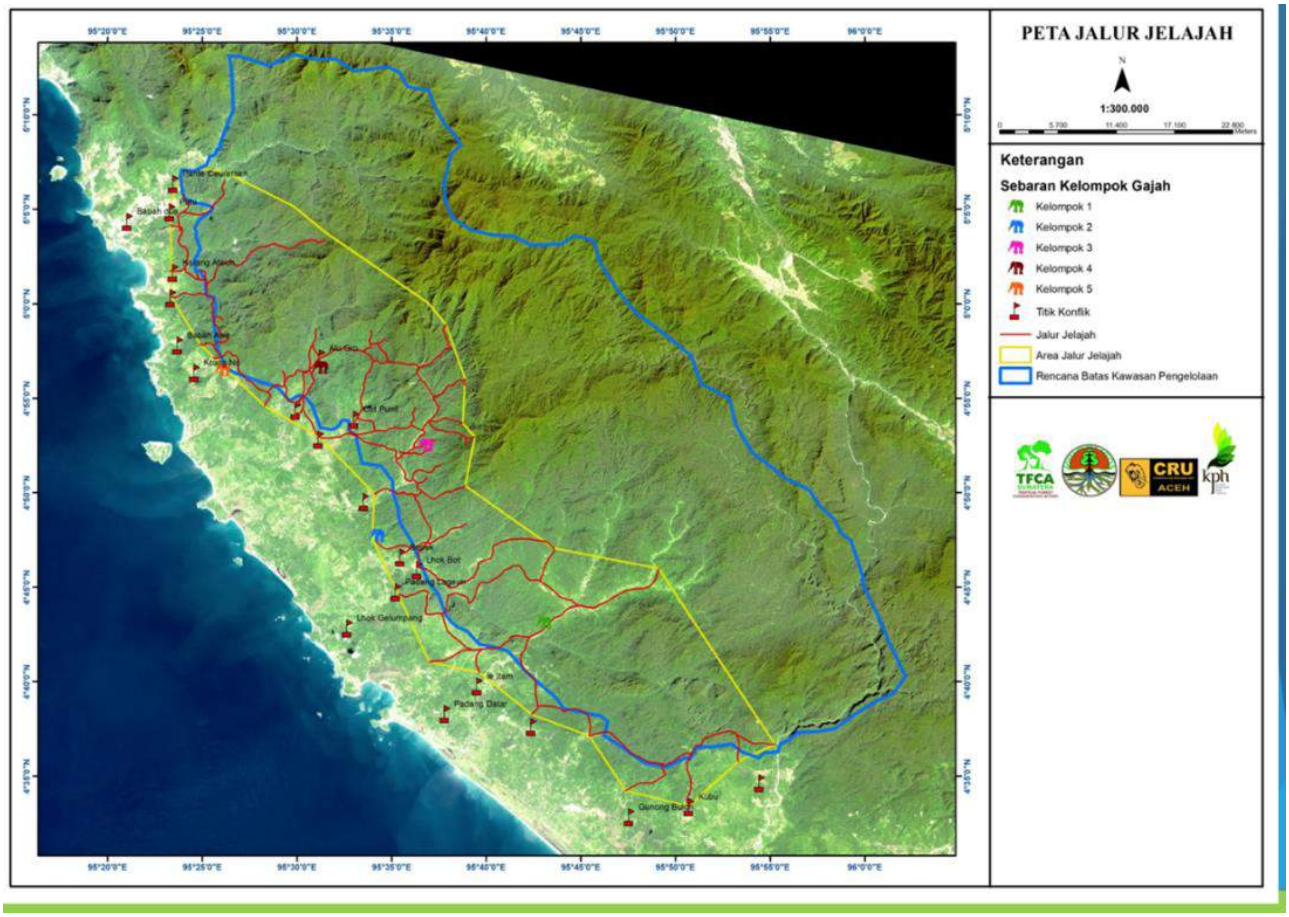
HEC Mitigation Strategy:

1. Barrier strategy – African elephants are different due to the varying topography of their land versus the Sumatran elephant topography. It is important to understand how they move to provide proper and efficient barriers. Currently, the only entity that is allowed to manage elephants is BKSDA (Indonesian government Forestry management program). Everything gets mainstreamed through BKSDA. They are the ones who collar the elephants with GPS to act as an early warning system if they come into human areas.
2. Early warning system – using GPS, teams can respond before a problem occurs by monitoring the GPS and movement of elephants.
3. Placement of crews in habitat areas

4. Promote compatible land use and offer alternative livelihoods to local people.

In the past, Aceh produced most of the world's nutmeg and pepper and the sultan at the time owned 1,000 elephants. As the kingdom was very rich, the sultan issued a decree to order the planting of more pepper plants. There is a need to find a product that is more compatible to elephants such as coffee as it is compatible with elephants because they do not eat the plant.

Currently there is an existing natural hilly barrier – but there are gaps that elephants can get through to unsafe areas. The map below shows elephant movement in blue, where natural barriers can be seen. Closing some of the areas where elephants can get through, can potentially better manage the elephant population. Elephants have been moving into local villages near a river system which is right outside a forested area. The area was blocked where elephants broke through to villages and the conflict was resolved.



There is a Conservation Response Unit that helps to mitigate Elephant Human Conflict. Elephants actually help this unit as they are used to patrol the areas along the barriers. The idea is to maintain a healthy forest elephant population and patrolling the gaps in the natural barriers using elephants. There was an action plan in place but it was not effective. Lessons, however, were learned such as: the lack of political buy-in from various stakeholders (Governments, NGOs, and Donors); not creating a sufficient budget to implement due to a lack of a legal basis for it; an unreasonable 10 year timeline; and, the central government versus local Government authority disputes. The government is in process of developing a new action plan for elephants as there is no incentive from the government to follow proper protocols for elephant conservation. The new action plan needs to be synchronized with the environment and forestry ministerial Action Plan. There needs to be more collaboration between the central

government and the local government for active management to occur. The must be engagement with legislative branch for elephant friendly spatial planning law to engage with multi sector development agencies (Aceh Caucus). There needs to be a trust fund initiative for the Sumatran elephant. There also needs to be an adoption of ASERSM (Asian Elephant Range States Meeting) recommendations and The Jakarta Declaration for Asian Elephant conservation which were outlined in a meeting in 2017. For the first time ever, governments of elephant range countries, came together (not since 2006's first meeting) – which successfully generated a declaration for Asian elephant conservation. It has been accepted by governments and donors – like U.S. Fish And Wildlife Service. This has drawn a lot of positive attention.

Main priorities outlined in the Jakarta Declaration:

Maintain	Maintain landscapes for elephant populations
Work	Work collaboratively on transboundary issues
Address	Address the root causes of HEC and develop long term solutions
Ensure	Ensure effective enforcement to prevent illegal killing and trade
Strengthen	Strengthen international collaboration, coordination, and communication
Develop	Cooperatively develop captive Asian elephant registration programs
Ensure	Ensure the welfare of captive elephants
Develop	Develop where necessary National Asian Elephant Action Plan and its timely implementation

Proposed mission statement: Protect, restore and conserve Indonesian wild elephant and its habitat (actively managed-habitat) / Manage Indonesian wild and captive elephant sustainably (and benefit) / Collaborate with diverse partners (stakeholders) / Community welfare / Sharing space to achieve life harmony (HEC management)

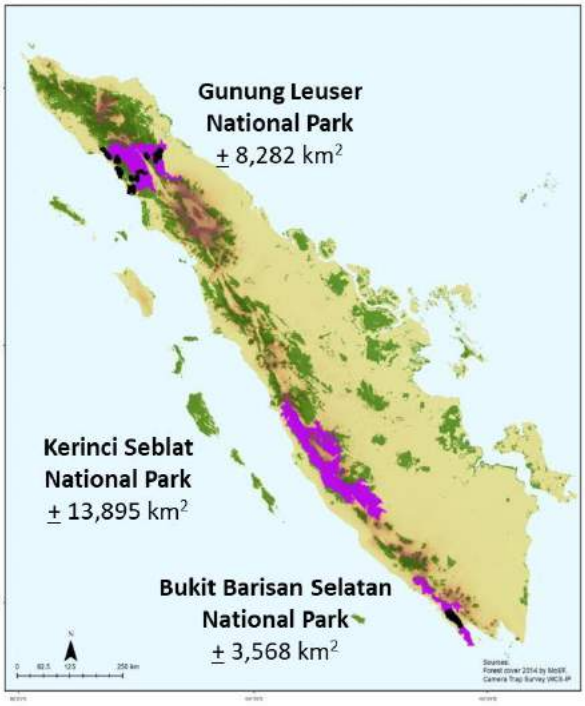
Discussion: Artificial barriers – is that electrical fencing? Who pays for that? Artificial barriers can be electric fencing, or concrete barriers…methods need to be site specific.

Challenges towards recovering Sumatran tiger populations in two UNESCO World Heritage Site protected areas

William Marty, PhD. Wildlife Conservation Society, Indonesia Program

Abstract

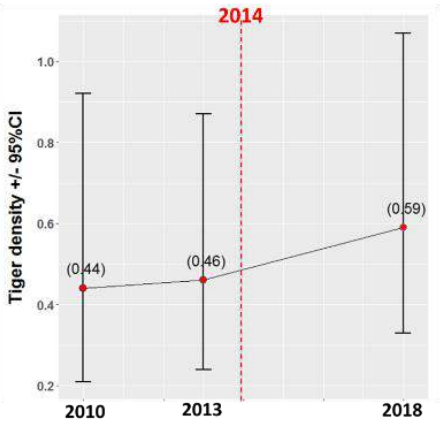
Gunung Leuser National Park (GLNP) and Bukit Barisan Selatan National Park (BBSNP) are two of the three of large protected areas that form the Tropical Rainforest Heritage of Sumatra, a UNESCO World Heritage Site cluster. The 870,161 ha GLNP, which is part of the 2.5 million ha Leuser Ecosystem, and 313,572 ha BBSNP contain approximately 40% of the entire Sumatran tiger population. However similar to other Sumatran protected areas they face multiple threats, especially from poaching and forest habitat loss that together jeopardize the tiger's population viability. Here, we report on camera trap surveys that were conducted in GLNP (from the years 2010, 2013 and 2017) and BBSNP (2002 and 2015). For GLNP, the tiger population was found to be marginally increasing from 0.34 to 0.53 and to 1.14 tigers/100 km2, but this is still considered a low-medium density and should be higher for the forest type surveyed. In BBSNP, there was a much more significant change with tigers increasing from 1.6 to 2.8 tigers/100 km2, which is indicative of a healthy tiger population in evergreen rainforest. Whilst the results are encouraging, there are several important points to note. Firstly, the BBSNP study area received a much higher intensity of ranger patrolling than the GLNP study area, which may partly explain the differences in tiger densities and the need to strengthen enforcement efforts in GLNP to enable greater population recovery. Secondly, both study areas received disproportionately high levels of protection than the surrounding areas of the national parks but, despite this, still had poaching and other forms of human disturbance. So, the threats in these adjacent areas may be higher and the tiger population trends may be in decline. Thus greater effort is needed to boost the law enforcement more widely so that tigers can begin to recovery across the landscapes. Finally, a recent population viability analysis highlighted the grave dangers of the tiger populations being fragmented by planned roads and other infrastructure developments, which another area for urgent attention, especially if BBSNP and GLNP are to be removed from the UNESCO World Heritage Site 'in danger' list.

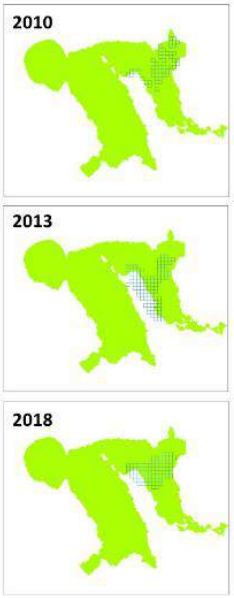


The reasons? Poaching, illegal logging, agricultural encroachment, and plans to build roads through the site. What is needed to prevent further damage and remove it from the danger list? 1. Forest cover; 2. Population trend data for key species; 3. No new road development; 4. No mining; 5. Clear boundary demarcation; 6. Law enforcement; 7. Management of the wider landscape.

The objectives to accomplish this are: Estimate tiger densities in core areas of two national parks within the TRHS; Determine the status of tiger prey and threats; Identify management recommendations for removal from the 'in danger' list. The methods used are: Pair camera traps placed in a grid system (grid size: 3 x 3 km) for a target camera trap spacing of 2-3 km.; camera trap active for < 90 days; and survey coverage areas range from 500 km2 to 1400 km2. Cameras were set in an area with tiger signs, without bait. 45-60 cm above ground, 3-4m from trail. A pair of cameras was set in each grid cell (@grid was 3 × 3 km), for a target trap spacing of 2-3 km. WCS tiger protocol of x-y cameras spaced in 3x3km grid cells over x-y km sq for <90 days. Pair camera traps placed in a grid system (grid size: 3 x 3 km) for a target camera trap spacing of 2-3 km. Camera trap active for < 90 days. Survey coverage areas range from xx to xx km sq.

Tiger density - Eastern Gunung Leuser National Park

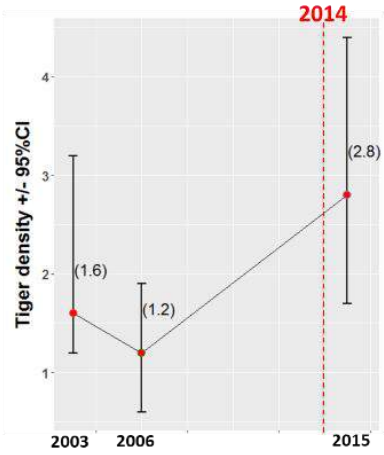




- Tiger density = stable, 0.59 tigers/100 km^2 (2018).
- Total individuals = 23 tigers (14 females, 5 males, 4 unknown).
- Sex ratio = 3 females – 1 male.

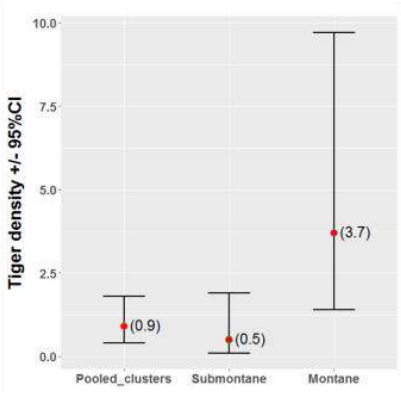
Tiger density - Bukit Barisan Selatan National Park

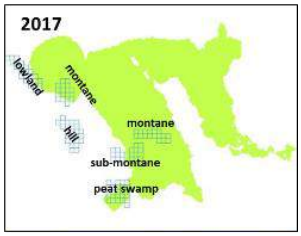
- Tiger density = 2.8 (1.7-4.4) tigers/100 km^2.
- Total individuals = 17 tigers (10 females, 4 males, 3 unknown)
- Sex ratio = 3.3 females – 1 male



Tiger density - Western Gunung Leuser National Park

- Tiger density = 0.9 (0.4-1.8) tigers/100 km^2.
- Total individuals = 15 tigers (4 females, 7 males, 4 unknown)
- Sex ratio = 2 females – 3 males



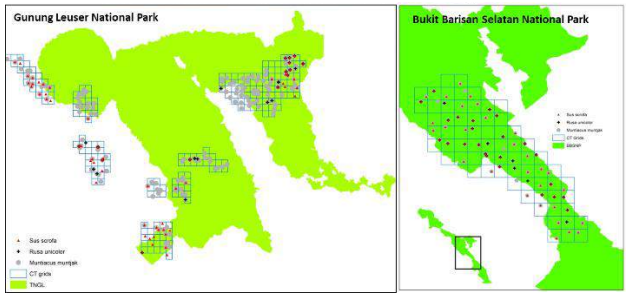


Monitoring of tigers to provide tiger density, available prey species also needs to be evaluated, identify management possibilities to ensure removal from endangered list – all activities are in cooperation with the government.

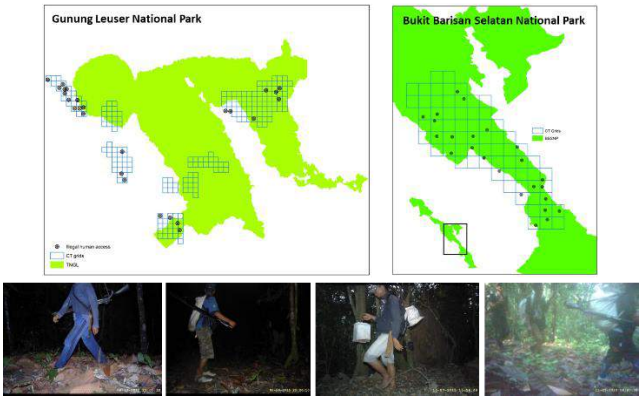
Tigers in Leuser (eastern part) after corrective measures were taken by the government in 2013 (where only 4 tigers were found), there has been a steady increase in the tiger population – we cannot say that it is successful, but it is an increasing trend – 23 tigers – good numbers exist with 2 to 3 females per male tigers and Leuser follows that. In 2018, there were 11 new tigers recorded. In Western Leuser, which is mountain, lowland, sub mountain, peat swamp there were 15 tigers (higher than eastern part), and the balance is off with 2 females for every three males – density is higher in mountain area. In Barisan, 17 tigers – better sex ration 3.3 females for 1 male.

Tiger prey availability: muntjak deer, macaques, wild pig, deer, there is still good tiger prey distribution in tiger landscapes – camera traps also catch illegal human activities. In Leuser, illegal activities are on the fringe of the area but in Barisan – it is more widespread throughout the area. Poaching risk maps have been developed – areas in red get more focus. There is good cooperation between local ngo and international conservation ngos. People were found to occur in 36% of the cells, and most were detected within 1.5 km of the Park border.

TIGER PREY



THREATS



Recommendations:

1. Maintaining the current protection level particularly in the core sites: Gunung Leuser NP , focus on the lowland in western Leuser part is crucial. Bukit Barisan Selatan NP, new patrol teams are required to increase patrol effort in the northern part.
2. Continue to conduct camera trap monitoring at least every 2 – 3 years to monitor tiger population trend.

Discussion: What is lifespan of Sumatran tiger? What other things is WCS is doing? Terrestrial population in Sumatra focus is to assist the government in its efforts for conservation – and manage patrol teams…camera traps are a really good tool – on Borneo clouded leopards have higher density in higher elevations, it is not clear if this is natural or if they are being pushed into the mountains – is it the same for the tigers? For tigers in the western part of Leuser, which is lower and flatter…so perhaps that is happening in Sumatran also.

ZIMS (Zoological Information Management System) For OVAG

Liz Ball, Registrar's Assistant & Records Coordinator,
Chester Zoo, U.K. The North of England Zoological Society

Abstract

Records, in various forms, have been utilized in Menageries, Zoological Collections and Safari Parks in the UK, Europe and Worldwide for almost a millennium. The first Menageries in the UK date back to the Tower of London, which first held animals approximately 800 years ago. Records have evolved greatly since this time, from paintings and drawings, to card records and stock books. In relatively recent years, animal record keeping has utilized computer programs and the internet.

Records of any kind are extremely important as they set information down in writing, or some other permanent form, for later reference. With regards to animal collections and their environments, records are an important tool in archiving past history, documenting current issues and helping to formulate future plans for captive and wild species.

Chester Zoo has utilized Species360 (formerly ISIS – International Species Information System) products since 1985, firstly in the form of ARKS (Animal Record Keeping System) and, since 2012, ZIMS (Zoological Information Management System). Chester Zoo is one of the most prevalent users, with one of the largest data sets in Europe, if not the World. These computerized systems enable Chester, and more than 1000 institutions worldwide, to record everything about an individual animal (or group) and its environment. These records can include basic biological information such as where and when it was born, how many young it has had and it's family tree, to other management and husbandry events such as when it last had a tooth removed, how much it weighed, and how much

anesthetic it needed during that procedure. This information is currently held for around 10,000,000 animals, of 22,000 species, and already there are approximately 220,000,000 husbandry records and 82,000,000 medical records worldwide, with this number increasing every day.

This internet accessible information can be recorded for both wild and captive animals, and means that this 'global data' can be shared and utilized easily between in-situ and ex-situ institutions and projects, bringing understanding from all fields together to aid future conservation and knowledge of species such as Orangutans.

As more organizations move towards the One Plan Approach to species conservation the management strategies initiated and developed by zoos and aquaria can, and should, be utilized by other institutions to ensure effective and healthy population management

ZIMS is the Zoological Information Management System. It was developed specifically for zoo record keeping at a cost of 10 million dollars U.S. There are currently more than 97% of the over 1,000 institutions worldwide (90 countries!) now using ZIMS.

History: Before computers, pictures, sketches, prints etc., were used to record animal information in zoological institutions. This was gradually improved upon by the use of hand written or typed record cards and stock books. As one can imagine, these took a long time to maintain and made it impossible to answer questions about specific animals quickly. All these documents are now being digitized - and once digitized it will enable anyone in the network to really begin to see what is happening within any given population.

Species360 (formerly International Species Information System) is a system of global information serving conservation that was formed in 1974. It speeds up the process of record management and gives easier access to information, but more importantly it keeps that information safe. Today, it has over 20,000 users in 1,100 institutions in 95 countries (Chester Zoo joined in 1985). Species360 is a not for profit organization working within a variety of areas and works closely with IUCN, CITES, US Fish and Wildlife Service, DEFRA (Department for Environment, Food and Rural Affairs, U.K.), TRAFFIC (wildlife trade monitoring network) and many other organizations to track animals worldwide.

SPECIES 360's first animal records product was ARKS (Animal Record Keeping System) which was a database system for keeping husbandry information. MedARKS (Medical Animal Record Keeping System) was then added. It was a .dos based system for keeping medical information. Lastly, SPARKS (Single Population Analysis Animal Record Keeping System) was developed also as a .dos based system for managing populations via studbooks.

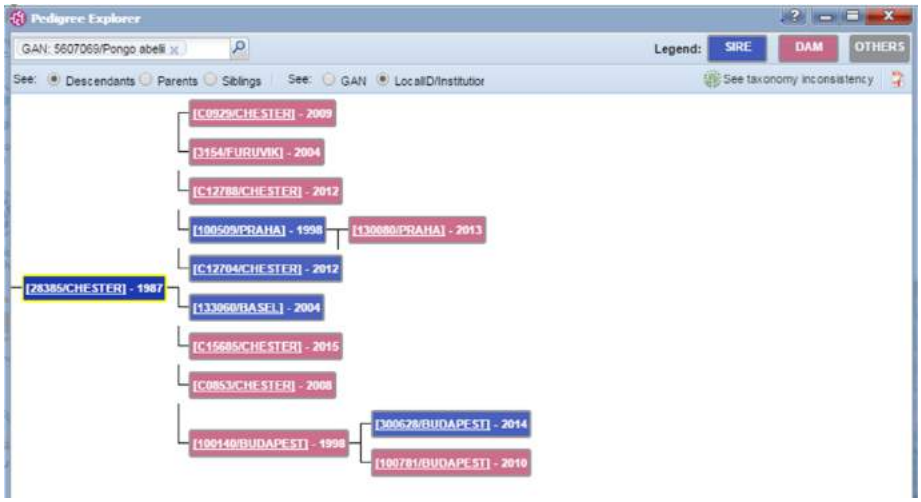
Today: The addition of ZIMS will allow data from ARKS, MedARKS, and SPARKS to be maintained as one record! It will also do a great deal more. ZIMS with medical is the second step in the ZIMS program development and has added all the MedARKS information allowing for integrated access of all animal information. All animal medical information can now be accessible internationally and will further develop research possibilities and communication between captive animal institutions and wild projects. And new beginning in 2017/18, studbooks are now being added on ZIMS. This is the last step in the ZIMS program development. This will allow for complete integrated access of all animal information for population management worldwide. Population and individual animal information will soon be accessible internationally and can further develop management and reproductive strategies and communication.

How it works: Each SPECIES360 member maintains records for the animals at their institution of project. SPECIES360 then keeps all pf the information for its members in a Global animal record database which currently has: over 10 million individual records for over 22,000 species. There are over 220 million husbandry entries and medical reference information for over 82 million entries. It includes population demographics and pedigree details.

What does this mean for OVAG? Data records at each rehabilitation/release project can be safe and secure. Should anything happen too the paper documents or computers, the information is held on 4 individual servers. Data will be shareable between sites in Indonesia and Malaysia, but also with other institutions such as zoos, vet bodies, sponsors, etc.

ZIMS data has been featured in more than 80 scientific publications, helping to advance knowledge in animal care and species conservation around the globe. It is a constantly evolving program, improving with the use of its members and what they need.

The practicalities: Each animal/group has a unique individual record (ZIMS 'GAN' number and a Local ID). This record is called a Specimen Report (a passport for each animal) which includes: Taxonomic/Common name; Date of Birth; Place of Birth; Parent details; Identification details and Photo. It also contains information about a particular species. This report can be set to a selected date span (e.g. historic/current), it could have basic information about individuals of a selected species such as: Date of Birth; Sire/Dam; Birth Location; Transfer dates; Death date and nay other Identifiers. It indicates ancestors, siblings and descendants. Below is a chart of Sumatran orangutan 'Puluh's descendants:



It can include weight and length charts and any other necessary information such as: Is supplementary feeding or hand rearing required? Is the animal receiving enough nutrition? Medical reasons for weight loss? (worm burdens?). Effects due to reproductive status? There is an age pyramid along with information valuable to the management of a population such as: Aggression: removal of sub-adult individuals may be required / Reduce inbreeding: removal of male/females at sexual maturity / Low breeding rate: may be owing to too few mature males/females. It includes inventories and historical populations. Other useful records are listed below:

Husbandry ZIMS

- Behavioural Data
- Reproductive Data
- Physiological Data
- Health Status
- Feeding Data
- Diet Choice
- Mortality

Medical ZIMS

- Anaesthesia Protocols
- Pharmacy Inventory
- Post Mortem Results
- Physiological Data
- Normal Values
- Health Status
- Drug Dosage

Benefits: ZIMS allows institutions, conservation centers and in-situ organizations to record much more data (giving us better quality records and data). It gives institutions the opportunity to share data with other institutions and programs worldwide. "Real time" entry and access so data is available immediately to others within the same

organization and externally. Data can be recorded for wild and captive individuals/groups allowing data to be shared and utilized between in-situ and ex-situ programs. In-Situ and Ex-Situ Partners to work towards the 'One Plan' approach.

At the click of a button there is a plethora of information on ZIMS that is incredibly useful. It is only as good as the information that is entered. Good to try to discover trends in managing your population.

SOCP will begin using ZIMS for their records keeping this year.

Discussion: You cannot break this system. If you enter something and it is incorrect it can be deleted. Not all organizations share their information which is why there is a sharing button. How much does it cost? SOCP gets it for free, but normally it costs 3,000 GBP per year. Might be worth approaching Species360 to develop a special package for students or rehab centers or field workers. But ZIMS does want to get people using it. SOCP wrote a letter asking for assistance and they found a sponsor for SOCP -so they still pay but it is much less. Anesthetic monitoring? Full reports can be made available. There is a teaching version, a training version – you can do everything, but data is not recorded.

ZIMS website: https://www.species360.org/products-services/zoo-aquarium-animal-management-software/

https://www.species360.org/products-services/zims-for-husbandry/

Sumatran Rhino Conservation: Past, Present and Future

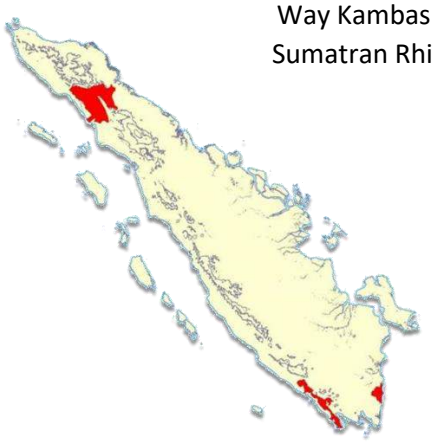
Dedi Chandra, M.Si Way Kambas National Pak, Lampung Indonesia

Abstract

Way Kampus National Park has both an elephant conservation team and a rhino team. Indonesia has Javan rhinos and Sumatran rhinos (which is the smallest). The Javan rhino living in Ujung Kulon National Park is a small population. This low population number might be due to the tsunami, volcano eruption, poaching and diseases. Inbreeding is most likely a problem as well along with invasive species coming into their habitat. The Sumatran rhino's history in early 1990, the population was at 400 individuals and were listed as already being critically endangered. Today, there are just 72 in three locations. In Sumatran they are in the northern part and southern most parts of the island and a recent survey put the number at 30!

History: In the 200 years since the Sumatran rhinoceros was first scientifically described (Fisher 1814), the range of the species has diminished from a broad region in Southeast Asia to three areas on the island of Sumatra and one in Kalimantan, Indonesia. From 1985 to 1992, a capture program was initiated between Indonesia, Britain and the US. They captured 18 rhinos. In 1998 the Rhino Sanctuary was completed. In 2012 Andatu (the first offspring from captive breeding) was born and in 2016 Delila was born. The first recorded Sumatran rhino calf born in captivity was in 1889 in India.

In Sumatra they are found in Gunung Leuser National Park, Bukit Barisan Selatan National Park, and Way Kambas National Park (PVA 2015, MIRADI 2015:Kalimantan 4-15, Way Kambas 31-36, Leuser 26-36, BBS 16-35)



Way Kambas National Park has several large species and has a Rhino Protection Unit and a Sumatran Rhino Sanctuary which was started in 1998. The sanctuary's aim is to produce as many offspring as is safely possible.

Rhino Characteristics: Males are solitary except when forming mating pairs, mothers are typically with their with young, Life span ranges from 35-40 years, gestation length is approximately 15-16 months, and age at sexual maturity is estimated at 6-7 years for females and 10 years for males. Home range: Males up to 5,000 ha, females 1,000 -1,500 ha. Daily movements between feeding sites and wallows are probably only a few kilometers per day. Longer treks are made when males and females go to salt licks (5-10 km) and by males exploring their large ranges. Water is never very far away in the habitats occupied by the Sumatran rhino. For breeding: there are several steps; 1. Introduction, 2. Courtship, and 3. mating. The female's cycle is 20-25 days where they are receptive for only 4 days. Conception can occur within 12 to 24 hours. They are seed dispersers!

In Captivity: Howlett and Port Lympne England; US (Bronx zoo, San Diego Zoo, LA zoo & Cincinnati zoo – Breeding 2001, 2004, 2007); Sungai Dusun and Zoo Malaysia; Sepilok and Borneo Rhino Alliance, Tabin Sabah Malaysia; Safari park Indonesia; Ragunan and Surabaya Zoos Indonesia; Bora Sabah Malaysia; and Sumatran Rhino Sanctuary Indonesia.

In Peninsula Malaysia the Sumatran rhino is extinct in the wild. There are currently only three in Sabah (Tabin).

Conservation: The main protocols for conservation include patrolling, protection, and intensive monitoring. The population has been in steady decline since 1980 with populations become smaller and more and more isolated. With 200 cameras running in the Danum Valley since 2013, only one rhino was seen (in 2014). Though the numbers have been decreasing in Indonesia, Indonesia holds the valuable remaining populations. This initiated the "Strategy and

Action Plan for the Conservation of Rhinos in Indonesia 2007-2017, but clearly a new 2018 Emergency Action Plan is needed. To further preserve the species, semen is collected for artificial insemination. This is done because animals can become very agitated during breeding and can become very aggressive when paired for mating, especially if the female is not receptive to the male. As the reproductive age is under thirty, increasing offspring is an arduous process. Added to that low genetic variation and we have a recipe for extinction. Currently there are: 4 breeding females (Rosa, Ratu, Bina and Dilila; and three breeding males (Andalas, Andatu, and Harapan). Any offspring have been returned to Indonesia. Zoo rhinos in Malaysia and Indonesia were sent to sanctuaries. Male and females only come together during peak of the female estrus cycle. Keepers check male sperm quality before breeding. Artificial insemination not successful as yet. No evidence of rhino poaching, but does not mean it is not happening. No clear information about numbers, reproduction status etc., What is the best strategy for rhino conservation? National Geographic along with IUCN will establish a national Rhino Project in Indonesia – hopefully that will prevent extinction.

Current strategy: The First METAPOPULATION: The Global strategy is 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. The second agreed action is the continued deployment of RHINO PROTECTION UNITS at sites with remaining breeding populations. The third proposed action is the creation OF INTENSIVE MANAGEMENT ZONES, with increased protection and monitoring in areas where the Sumatran rhinoceros breeds naturally. The fourth action of the conservation strategy is CAPTIVE BREEDING. The development of advanced reproductive technology for captive breeding + Advance Reproductive Technology. Diseases surveillance surrounding 3 different sites

Problems: One rhino is very acclimated to people, very docile. Even after relocation the rhino keeps going back to the village, it was finally sent to sanctuary. Andalas had eye surgery from a wound sustained during mating. Rhinos are prone to foot issues (similar to elephants). Foot treatment consisted of daily cleansing, debridement of necrotic tissue, boot application, antiseptic footbaths, systemic antibiotics and local therapies. Kidney Failure has occurred because of not receiving proper browse. Some were fed chocolate and cheese for 10 years. Rhinos are browsers not grazers. Both Citra and Imam have assisted in finding Sumatran Rhino in East Kalimantan as they were doing Orangutan surveys. They were found in West Kutai – difficult area as there is palm oil, mining, coal, etc A rhino was captured in Kutai but it died. It was old and stressed – but much was learned from this case.

Conservation without money is just conversation

Discussion: is there a concerned with artificial insemination, with only males being born? Technology is being developed for IVF for rhino to see if it can be successful – as it has not happened yet – difficult to say. All rhinos should go to sanctuaries – none should be in zoos as they typically die there. There are two sanctuaries one in Sumatran and another in east Kalimantan. Vortex analysis shows Sumatran rhino are gone. Situation is crucial now.

Citra statement: There are two orangutan vets (drh. Winda and drh.Meriam) that now work with rhino – our network can easily go outside of orangutans. OVAG members can be of great assistance as they have experience that can be shared between species. Working together with other species, gives us a stronger voice – we can help each other succeed. This is why we have asked other species conservation representatives to present – to extend our Orangutan network across multiple species.

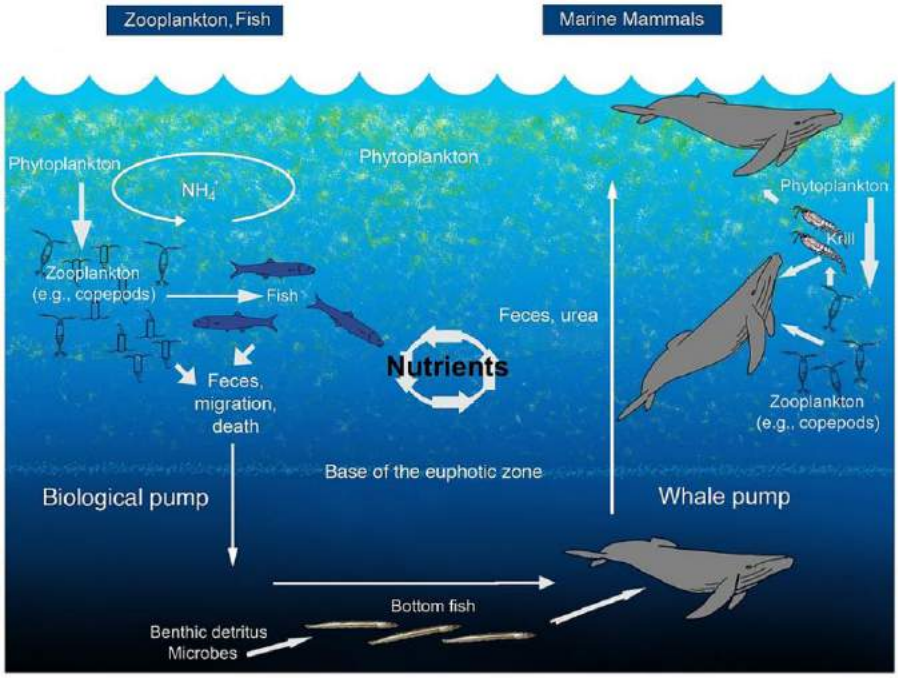
Wild female Najaq

Conservation of Marine Mammals in Indonesia

Ida Ayu Dian Kusuma Dewi, Whale Stranding Indonesia (WSI) – IAM Flying Vet

Marine mammals hold a vital role in marine ecosystems. Marine mammals are the "sentinels" of the ocean and help maintain the balance of the food chain in marine ecosystems Dolphin-whale tourism contributes to at least 2.1milliion in US dollars annually in 119 countries.

The image below shows how Sperm whale's stool acts as a carbon "sink" in the ocean which may affect climate.



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

There are about 239 species of marine mammals (including polar bears and otters). Indonesia is home to 35 of them in its 17,000 islands: whales, dolphins (33 are tooth and baleen whales), dugongs and porpoises.

Studying whales is a good indicator of what is happening in the ocean. Like other animals, marine mammals affect the food chain, tourism is tricky, but it does bring in a lot of money – whale-based tourism is very popular.

About toothed whales: Their diet consists of fish and squid. They are relatively smaller than baleen whales and have only one blowhole. Sperm whales are the largest members of the toothed whales (max. 20 meters long). Some species live in fresh water: Amazon river dolphins, Ganges river dolphins, and Irrawaddy dolphins (estuary). Females mature between 7and 10 years of age and males mature at 14 years. Sperm whales consumes fish, then drop down in deeper water to conserve energy. When they rise for mating, they eliminate a tsunami of feces – which contains rich iron and nitrogen and is very beneficial to plankton and fish that live near the surface. Some can live in fresh water (as do the Mahakam River dolphins). The Sperm whale got its name because when they first dissected its head, it was so thick they thought it was the penis. Their blubber was used to make candles and oil early in the days of hunting whales. They were also eaten for their meat. The teeth are used as a lucky talisman. Candles made from sperm whales can still be purchased on EBAY.

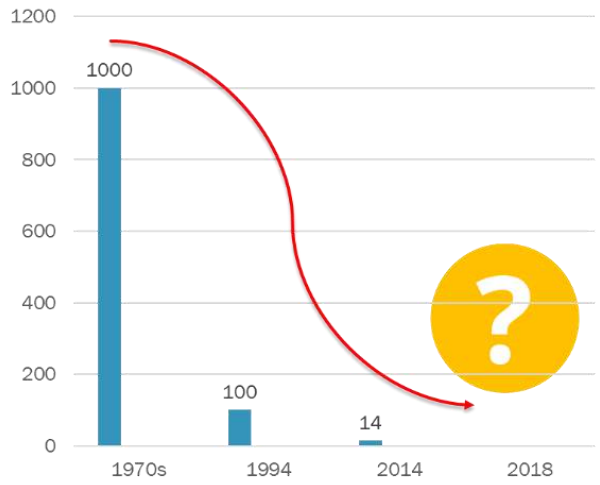
About baleen whales: Their diet consists of zooplankton (copepods and Krill - types of small crustacean). This is a type of symbiotic relationship as while they feed on zooplankton, the plankton population feeds on the whale feces. Baleen whales have two blowholes. The largest is the Blue whale (34 - 40 meters) and the smallest is the pygmy killer whale (6 meters).

About the Dugong: They are the only herbivorous marine mammal reaching 4 meters, weight 400-1,000 killos, and can live 70 years. They reach sexual maturity at 10 years of age. Female gestation lasts 13-15 months with an interbirth interval of 2 to 3 years. The calf is weaned at 18 months. Mother and calf have a very tight bond. They are very prone to stress.

There are a variety of IUCN designations from endangered (3 species) to vulnerable (4 species) to near threatened (1 species) with some data deficient. From the Indonesian government's perspective everything that lives in the ocean is regarded as fish – they do not separate out marine mammals, but they are protected under government regulation and national law (PP No. 7 year 1999; UU No. 5 year 1990; UU No. 31 year 2004. PP no. 7 was about preservation of plants and animals species (criteria for protected species, all protected species have to be protected, habitat of the protected species has to be maintained and preserved also, how to preserve the protected species-in situ and ex-situ); UU No. 5 was about conservation of natural resources (preservation, sustainable use, prohibition on hunting protected species); UU No. 31 was about fisheries: every species that spends most of its time in water is FISH. Some protected FISH species cannot be overfished.

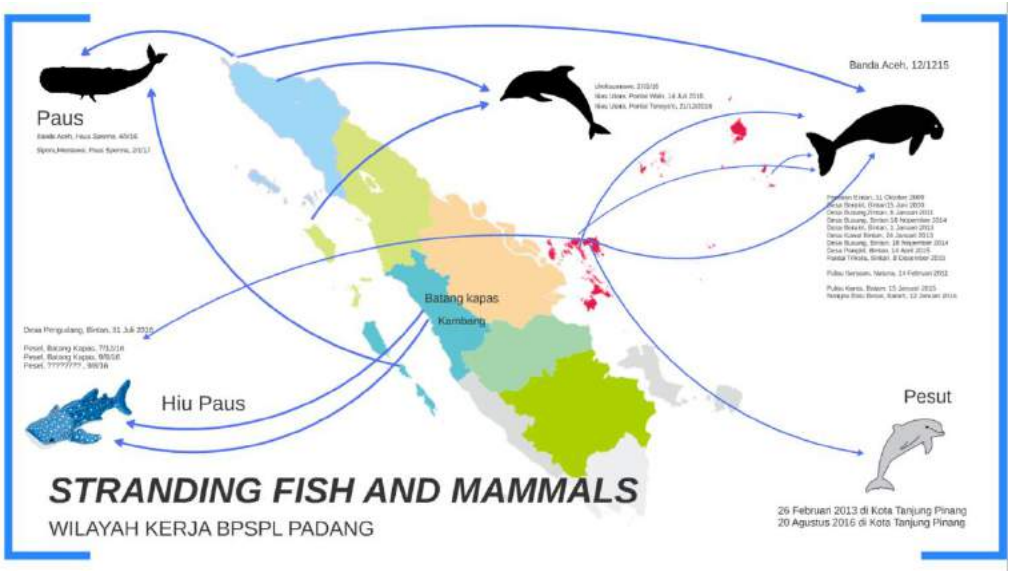
Population status in Indonesia: There is very limited knowledge on approximate number of the marine mammal population. Surveys are limited and expensive! Today NGOs, science institutions and the government conduct surveys. Ecology surveys on marine mammals have been conducted in some areas. Estimation only on population numbers and specific threats (especially for dolphins and dugongs). It is easier to track dugongs as they do not migrate and are costal – so more information is known about them. In 1970 there were 1,000 dugongs, 14 were found in 2014, current 2018 population is unknown.

Estimation of Dugong Population in Indonesia:



There are two main threats: humans and habitat loss. Tourism has been becoming a problem as best practices for tourism are not being followed – as people keep feeding them. Garbage left behind by humans (plastic bags, fishing nets, etc.) is ingested by marine mammals. Another human caused problem are oil and asphalt spills which kill vast numbers of marine mammals. Unsustainable human activities are: fish bombing, direct catch for consumption purposes or for fish bait, ex-situ tourism (captivity), in-situ tourism (sighting, swimming with animals, feeding), marine debris, boat collisions, and indirect impact of fisheries activity. Catching caused 75% mortality in toothed whales, and 64% mortality in baleen whales around the world. Fish bombing damages the auditory system. Habitat loss and destruction is due to: river and coastal development, disturbance from industrial and military activities, chemical pollution, diseases and bio toxin exposure, and climate change.

There is a definite increase in stranding events of marine mammals (mostly dolphins – which usually ends in death). There were about 10 sperm whales that were stranded – only 7 were able to be refloated, the others died.



Conservation efforts thus far: Establishment of database of cetacean in Indonesia, sighting training (location stranding), scientific reviews on marine mammal ecology, reducing the mortality rate / accidental event of marine mammal deaths, establishment of marine protected area especially in a few known marine mammal habitats, capacity building and human resource improvement to endeavor effective stranding event management (training people on how to float stranded animals and training of veterinarians in marine mammal medicine) and establishment of regulation to control the negative impact of underwater noise and coastal development.

Discussion: vets could provide recommendations on what should happen at a stranded event – if vets cannot get there sometimes they can evaluate via video – they also ask whoever has found the animals to see what buoyancy condition is, – but the priority is to refloat – keeping a marine mammal in captivity is difficult – ph value of water is tricky to maintain. There is no place now to keep mammals that cannot be refloated. It is important to educate people on marine mammals. Is there any reason that you are seeing more standings? More likely it has to do with people being more aware and reporting when they see a stranding. Also, people post things on social media and the rescue team can be sent. What about dolphin shows? There are many circuses and even the government cannot seem to do anything about it – that is not something that can be shut down very easily. As vets, we can only provide

information on why circuses are bad – but power to close them is tricky. Do you tag? Only two dugongs have been tagged. Foreign body obstruction? Not a lot of necropsies have been done. But we do see many fishing nets that make many wounds and have found oil inside a whale.

Gibbon Health – Disease and Welfare

Dr Susan M. Cheyne, Vice Chair IUCN SSC
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Abstract

Gibbon health is relatively poorly understood compared to that of the great apes. There are 20 species of gibbons across South-East Asia, all but 3 are reported in captivity either in zoos and/or the pet trade.

Until now there is no coordinated vet forum for gibbon projects. The SSA, working with the support of OVAG has brought together gibbon vets from in situ and ex situ organizations to identify actions to tackle emerging diseases in wild and captive gibbons and siamang.

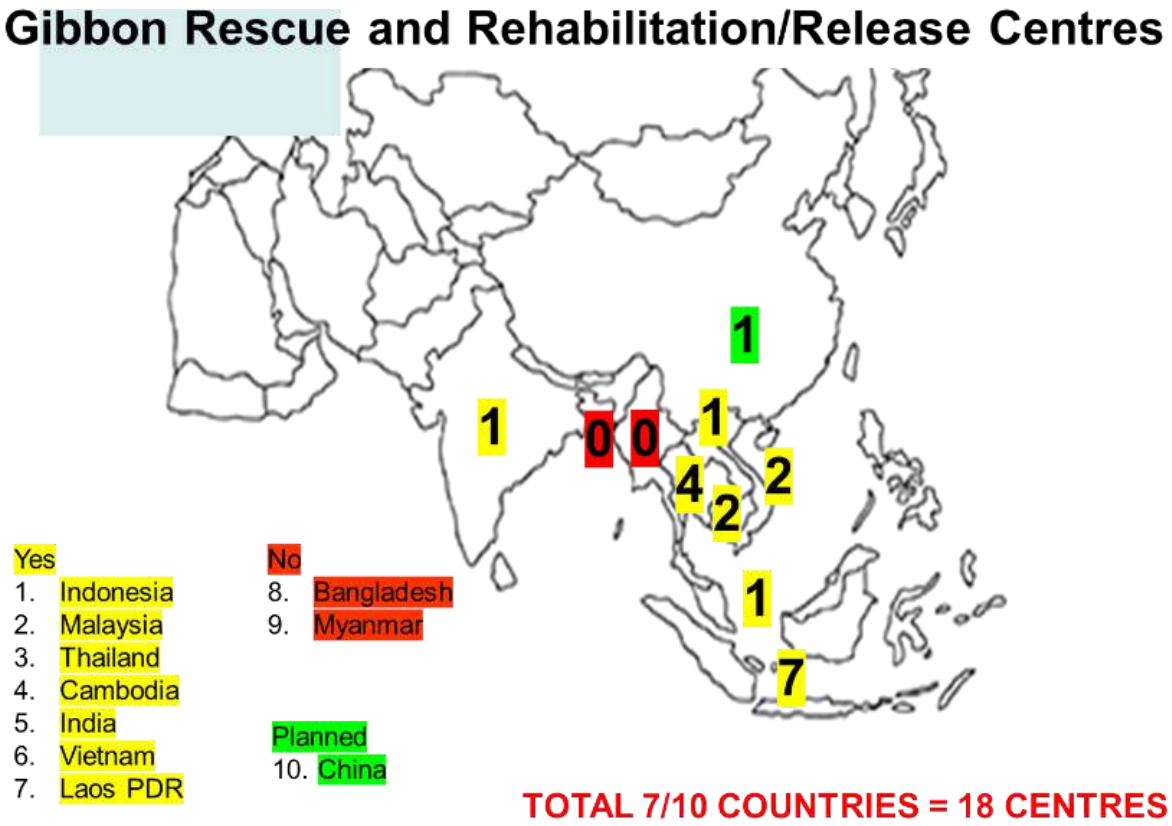
The knowledge of diseases, viruses and parasites affecting gibbons is limited and often untested in the wild or in captive settings. Much of our knowledge comes from a small number of case studies, though these data are crucial in helping learn about gibbon health and treatments.

As gibbon habitat becomes increasingly fragmented, and gibbons are found more frequently in bushmeat and as pets, the possibilities of zoonotic disease transmission increase. With 5 species listed as IUCN Critically Endangered, 14 as Endangered and 1 as Vulnerable, we must work to fill the gaps in gibbon health. I will present some of the current knowledge as an overview and to help lead into discussions for people attending the Gibbon-Specific workshop.

There has been good collaboration between gibbon rescue centers, everyone has accepted the fact that there needs to be ex-situ links. There is an SSA website where much information can be shared and accessed. Gibbons occur in the wild in 10 countries and at least 7 have one or more rescue centers. Bangladesh and Miramar have none. China is planning a rehabilitation center, but the species of focus is unclear. There has been an increase in online trading of gibbons. Predominately Javan gibbon babies. Some priced from 200,000 rupiah (about 15 US) to about 7,000,000 rupiah (about 450 US).

Gibbon diseases and disease transmission are complicated. Overview: Captive Management and Collaboration; Wild update; Trade; Health Overview; Diseases and Viruses; Parasites; Bones and Physical Injuries; Humans and Gibbons; Husbandry; Conclusions; and Knowledge Gaps.

Captive Management and Collaboration: Optimize rescue centers and rehabilitation centers to receive gibbons and carry out effective re-introduction following IUCN Guidelines on Gibbon Rehabilitation (Campbell, Cheyne and Rawson, 2015). All *ex situ* institutions should have a tangible link to *in situ* conservation, e.g. funding, sharing knowledge, staff exchanges. All centers must use standard husbandry, breeding and welfare guidelines.



Update gibbons in the wild: 20 recognized species of gibbon in 10 countries (4 genera): 5 - Critically Endangered; 14 – Endangered; 1 – Vulnerable. At least 3 species have no captive breeding plan (Hainan, Cao Vit and Skywalker).

Online trade: In a 3-month observation of online sites, Facebook and Instagram showed the most activity and most of the records of online gibbon trade comes from Indonesia. There were 9 Facebook groups and 10 Instagram accounts with gibbons for sale, 16 of them originating in Indonesia (only accounts with gibbons for sale were included), and at least 50 individuals who appeared to be selling infant gibbons.

Health Overview: In the example below, only qualitative analyses have been conducted and it is important to note that the numbers presented are only for assistance in comparing disease risk between pathogens. Until sufficient data are acquired, it should be considered that red pathogens are high risk, yellow pathogens are all medium risk and it is likely that all green pathogens are of low risk. For any risk assessment it is important to be transparent in the ranking methodologies used to develop such that the reader can understand the potential uses and limitations of such a document. This disease list is based on diseases reported in or assayed for in wild, rehabilitating or confiscated gibbons (inclusive of all species/subspecies) from the published literature.

Pathogen	Likely Prevalence in Wild	Transmission Route Risk	Risk of Transmission to Wild Gibbons	Morbidity	Severity	Risk of Fatality	Total Score
Mycobacterium spp. (tuberculosis)*	1.3	4.3	3.7	4.0	4.3	4.3	21.9
Plasmodium hylobati	2.8	4.0	4.0	2.8	2.6	2.2	18.4
Ternidens spp	1.8	3.3	2.3	2.3	2.8	2.3	14.8
Trichuris spp	2.3	3.0	2.5	2.5	2.3	2.0	14.6
Strongyloides fuelleborni	2.2	3.0	2.0	2.3	2.7	2.2	14.4
Brugia malayi	1.6	2.8	2.8	2.2	2.4	2.2	14.0
Brugia pahangi	1.8	2.8	2.8	2.2	2.2	2.0	13.8
Human herpes virus 1	1.0	3.0	2.0	2.0	3.0	2.6	13.6
Hepatitis b virus	3.3	3.0	2.2	2.0	1.6	1.4	13.5
Human herpes virus 4	1.3	3.0	2.2	2.7	2.2	1.8	13.2
Cercopithecine herpes virus 5	1.5	3.2	1.8	2.5	2.3	1.8	13.1
Balantidium coli	1.6	2.1	1.9	2.1	2.8	2.4	12.9
Lymphocryptovirus spp	1.7	2.8	2.2	2.2	2.0	1.8	12.7
Necator spp	1.8	2.3	1.3	2.3	2.5	2.0	12.2
Human herpes virus 2	1.0	2.8	1.5	2.2	2.4	2.2	12.1
Ascaris spp	2.1	2.1	1.7	2.1	2.3	1.7	12.0
Parastrongylus cantonensis	1.3	2.5	1.8	1.3	2.3	2.0	11.1
Cryptosporidium spp	1.3	1.8	1.5	1.8	2.0	1.7	10.1
Trichostrongylus spp	1.3	2.3	1.7	1.7	2.0	1.0	10.0
Simian foamy virus	1.6	2.2	1.6	1.8	1.2	1.0	9.4

Diseases and Viruses: TB, and herpes are the highest ranked. Herpes Simplex (HSV1 & HSV2) are both present in rehabilitation centers and zoos (e.g. EU). Also found in the Gibbon Center in California. Animals can die within 72 hours. Human-Gibbon transmission likely. Gibbon to human unclear. Gibbons can be infected with HSV without showing clinical symptoms (Mootnick, *et al.,* 1998). Once the symptoms do manifest, often triggered by an intense period of stress, the onset of cortical neuronal necrosis and degeneration is rapid and irreversible. Alopecia is also seen… why? Hepatitis B strain – not a lot of information about this but Aspinall is going to assist in father studies. Hepatitis B profile (HBV: HBVsAg: a gibbon-specific strain of HBV has been identified in both wild and captive populations of various gibbon species. It is yet to be determined if the disease causes long-term pathology, but elevated liver enzymes have been seen in a number of HBV infected gibbons. A significant proportion of the captive population of Javan gibbons is infected with the virus, which has been shown to be spread vertically and horizontally. Vaccination has proven to be a successful means of reducing disease transmission. For this, human to gibbon likely – gibbon to human unclear but unlikely. We need to see if it naturally occurs in the wild population.

Parasites (wild): Not much has been done about gibbon parasites. Langurs and orangutans have many parasites, especially in the wild populations. Orangutans had highest output of helminths (F = 3.320; df = 2; P = 0.040). Langurs had a substantially higher protozoa output (F = 22.004; df = 2; P = <0.001). Elevated output of Entamoeba coli in langurs (F = 5.423; df = 2; P = 0.08). Elevated output of hookworm in orangutans (F = 4.068; df = 2; P = 0.024). One-hundred and twenty two fecal samples were collected from five groups of langurs, four groups of gibbons and nine individual orangutans. A total of fourteen taxa of parasites were recovered, including six species of nematode, a trematode and five species of protozoa. Nematodes recovered included *Ascaris lumbricoides, Enterobius vermicularis, Strongyloides sp., Trichostrongylus sp., Trichuris trichuria,* hookworm sp. And an unidentified helminth. A digenetic trematode *Schistosoma mansoni* was also found in the gibbons and langurs but was absent from the orangutans. Infections of protozoa included *Entamoeba coli, Entamoeba histolytica/dispar, Balantidium coli, Blastocystis hominis* and an unidentified protozoan. Langurs were parasitized by thirteen different parasite taxa, while gibbons harbored twelve and orangutans eleven (Table below).

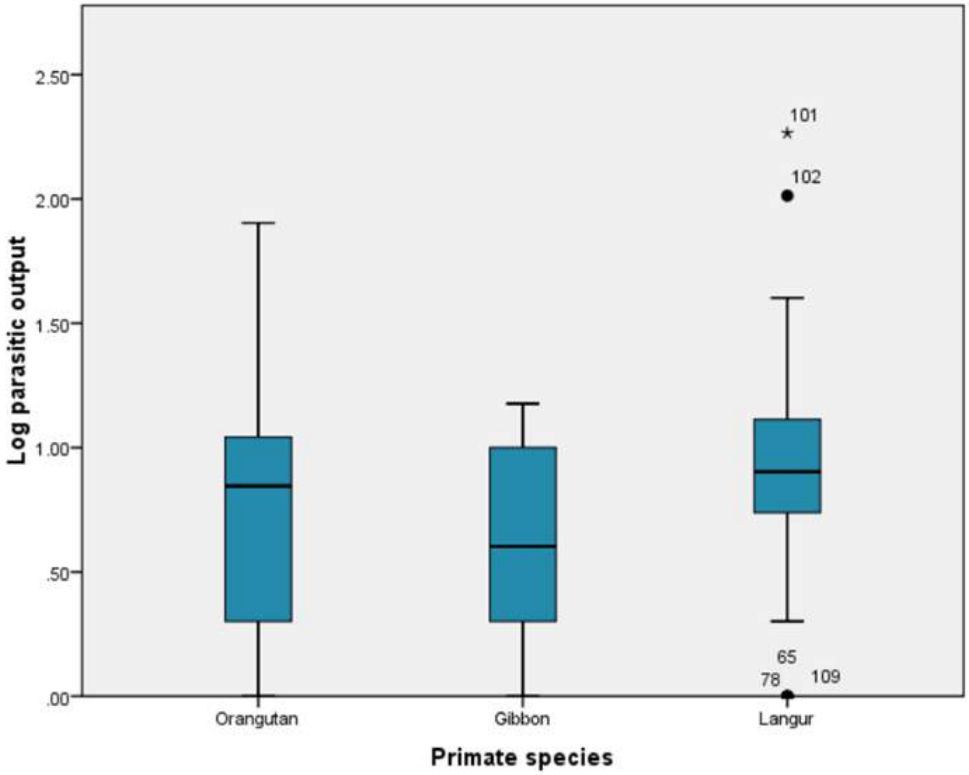


Fig. 7. Log transformed (x – 1) parasitic output (ova/larvae/cysts/trophozoites per gram) for orangutans, gibbons and langurs and in the Sabangau peat-swamp forest, Indonesian Borneo.

Orangutans had greatest prevalence values for a number of helminth taxa including *Enterobius vermicularis, Trichostrongylus sp.* and hookworm sp. Langurs had the highest prevalence of *Trichuris trichuria* and also the highest protozoa prevalence overall and for three individual protozoa taxa. Gibbons had the lowest prevalence values in all associations.

Parasite Taxa	% Prevalence					
	Orangutan	Gibbon	Langur	χ^2	df	P
Nematodes						
Ascaris lumbricoides	16%	30%	17%	2.7	2	0.259
Enterobius vermicularis	25%	7%	8%	6.545	2	**0.038***
Strongyloides sp.	19%	13%	13%	0.551	2	0.759
Trichostrongylus sp.	44%	10%	5%	24.05	2	**<0.001*****
Trichuris trichuria	6%	0%	28%	15.079	2	**<0.001*****
Hookworm sp.	56%	47%	28%	7.468	2	**0.024***
Unidentified helminth	22%	23%	22%	0.034	2	0.983
Trematodes						
Schistosoma mansoni	0%	10%	10%	3.455	2	0.178
Protozoa						
Entamoeba coli	22%	40%	57%	10.473	2	**0.005***
Entamoeba histolytica/dispar	9%	23%	52%	18.611	2	**<0.001*****
Balantidium coli	0%	17%	47%	25.206	2	**<0.001*****
Blastocystis hominis	0%	0%	12%	7.674	2	0.220
Troglodytella abrassarti	50%	10%	0%	40.621	2	**<0.001*****
Unidentified protozoan	13%	17%	3%	4.976	2	0.083
Total helminth infection	81%	60%	62%	4.316	2	0.116
Total protozoan infection	41%	53%	82%	17.184	2	**<0.001*****
Protozoan & helminth infection	28%	27%	45%	29.320	8	**<0.001*****
Total Parasitised	94%	87%	97%	2.113	2	0.348

Significant results in bold, reported with P value < 0.05 = *, P value < 0.005 = **, P value < 0.001 = **

Bones and physical injuries: Wild gibbons do break bones and recover. Gibbons can manage with amputated limbs (but are not suitable for release, but their quality of life is good). There are lots of healed fractures, falls do happen and they recover but are rare. Impact injuries: Bullets and pellets, broken teeth, dislocated bones, and lost fingers (e.g. from a fight).

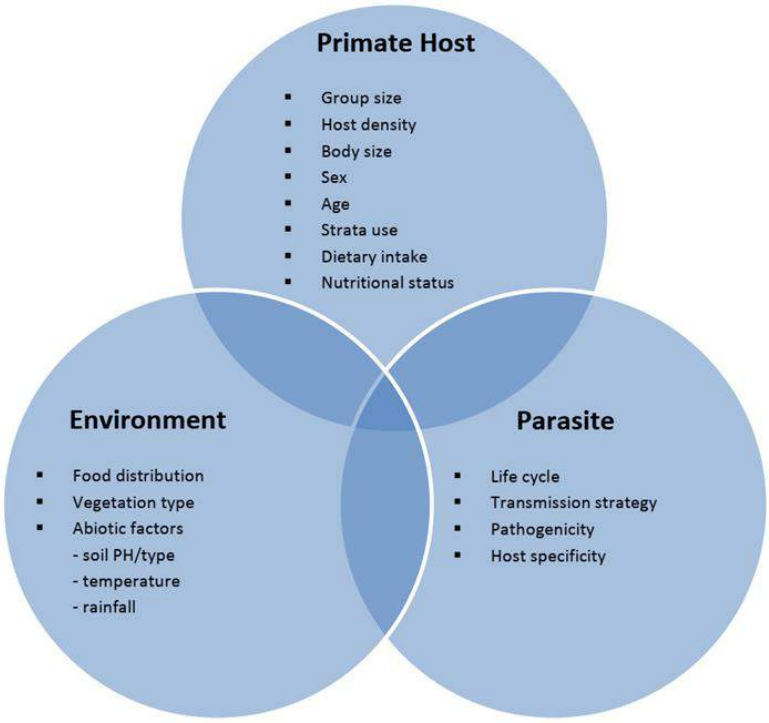
Human and gibbon interaction – not much is known – they appear to be skirting plantations, but humans are not killing them. They are being electrocuted on power lines as they use them as vines. However, in areas where there is human strife, gibbons are being hunted and gibbons are now biting humans which is a new development. This is not common, gibbons have been hunted for traditional medicine but not as a food source – this too is new. Aldo, many gibbons are found in high conflict Areas – no easy solution, for example: the displaced Rohingya refugees destroying gibbon habitat (Cox's Bazar, Bangladesh. Kachin and Shan States(Myanmar): all fighting for independence.

Husbandry: Many organizations are updating their guidelines on husbandry standards. Things like stereotypies need to be evaluated, they will bite through limbs, bite the same area, rocking etc. There needs to be more understanding of what is happening in the wild in order to better evaluate gibbons in centers. Javan gibbon husbandry manual along with the hand raising manual is being updated and will be circulated soon for input. We are aiming for the 3rd International Gibbon Husbandry and Conservation Conference to be held in Hanoi in the 2nd half of 2019. The Chinese zoo community working on husbandry guidelines and want to share and learn from EAZA. Also, emerging disease needs to be considered as well – as they can heavily impact small gibbon populations. Movement, parasites, health monitoring post release, etc.

Conclusions: Understanding parasite loads in the wild and transmission routes can help understand parasite loads when animals arrive at a center and to understand what levels we should expect to see when monitoring health post-release. Careful consideration of the spatial arrangement and connectivity of primate populations, coupled with

proactive management of health measures should reduce the risks of development and spread of infectious disease. The inclusion of health monitoring programs, such as those implemented in several field sites identified as important to the survival of primate populations, and the unification of conservation biologists and health practitioners is crucial with escalating risks of disease between primate species. It is the connection between the small and cryptic with the great and charismatic, illustrated aptly by the ubiquitous presence of parasites and the diminishing primates that remind us of the complexity of biodiversity, spurring us to broaden our perspectives and adopt multi-disciplinary approaches. Our study recognizes a high level of overlap in parasite assemblages highlighting the potential for pathogen transmission, calling for more comprehensive research of the patterns of gastro-intestinal parasites and the influence of sympatry on inter-specific disease spread.

Knowledge gaps: everything…diabetes, TB, malaria, kidney issues, heart disease, research, funding, training…. Proper training for vets is needed. The schematic diagram below representing the interactions between socioecological factors of the host with environmental features and biology and behavior of the parasite.



IUCN small apes started in 2007 (great apes 2001). Most people do not know what a gibbon is. There is an International Gibbon Day (October 24) to spread awareness and improve knowledge about gibbons. New logo and branding materials for all organizations to use to promote IGD. FREE logos etc. are available! Contact SSA 2017 – 10 events in 7 countries.

Discussion: Plasmodium, can it be transmitted to other species and vice versa? Not known. Identifying labs that yield proper results is tricky – Indonesian labs are good, but in other gibbon range countries availability is low. If a gibbon comes into an orangutan center, please take some blood samples and contact a nearby gibbon center. TB in gibbons – gibbons were exposed to it so it is assumed that this will be a problem for gibbons. However, there has never been a confirmed case of TB in gibbons. Of the gibbon centers present, there has been no reported confirmed case of TB. A gibbon in a Javan zoo was positively identified as having TB (in July) with a positive culture from use of rapid test -with TB the more tests you use the better as there can be false positives.

Publishing in a Scientific Journal / Peer Review: What is it and How Does it Work?

Nancy P. Lung, VDM, MS, Editor-in Chief, Journal of Zoo and Wildlife Medicine; Drh. Fransiska Sulistyo, BOSF

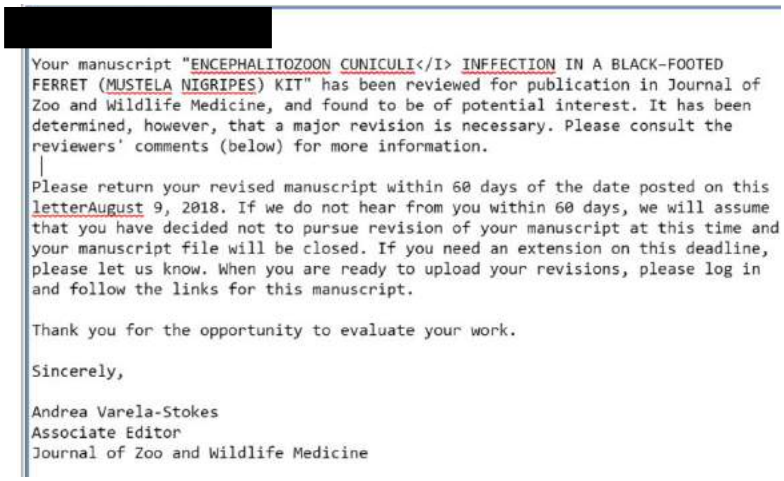
Abstract

Writing evokes feelings of dread and anxiety. It is a normal feeling to fear scientific writing. The peer review process can be challenging. But you can get papers published! The Peer review process is a good thing. What does it mean? Definition: "A process by which a scholarly work is checked by a group of experts in the same field to make sure it meets the necessary scientific standards before it is published" Peer: One that is of equal standing with another. Purpose and benefits: It ensures the validity of research methods. It helps the editors decide if the manuscript is worthy of publication. It really does improve the quality of the manuscripts!!! Some writers need only one revision, others four or five; but if the writer follows the reviewers' advice, the paper is usually better and will be published. While the editor is an important person, assistance comes from people in specific areas that match the proposed article. The author, however, is the most important, as he/she controls the quality of the work - then the editor, the team of associate editors, the reviewers, the publisher.

One of the key tools for scientific writing is to not be afraid to Ask! Contact someone at the journal to ask if what you want to write about would be appropriate to the journal. The editor-in-chief is someone you can communicate with to ask: Is the topic appropriate to this Journal? Would this topic be of interest to our readership? Would this topic make a significant contribution to the literature? Does the manuscript follow the formatting rules for this Journal? Are the figures of publication quality? Is the English of publication quality?

This will save you time. Formatting is important as well. Regarding English usage, you do need proper use of scientific English – but this is fixable. The associate editors have expertise in various areas. They are the ones who find peers to review. Do not be afraid to contact your associate editor. The reviewers: These people ARE anonymous to you and they tend to get much more specific. Question reviewers might focus on: Is the study design appropriate for the question being asked? Are the results presented in a useful manner (raw data vs summarized data)? Has the existing literature been adequately cited? Are the statistical tests appropriate for this dataset? Are the conclusions supported by the results?

What can you do to ensure a better, more positive experience and outcome? DO YOUR LITERATURE SEARCH FIRST!! If you are uncertain about the worthiness of your publication, e-mail the editor. Follow the formatting instructions EXACTLY. Use every tool at your disposal to ensure proper English usage. Have colleagues review your paper for you prior to submission. The process of decision making is: acceptance or minor revisions needed, or major revisions needed or rejection. Below is an example of a letter sent about a manuscript needing major revisions:



[redacted]

Your manuscript "ENCEPHALITOZOON CUNICULI</I> INFFECTION IN A BLACK-FOOTED FERRET (MUSTELA NIGRIPES) KIT" has been reviewed for publication in Journal of Zoo and Wildlife Medicine, and found to be of potential interest. It has been determined, however, that a major revision is necessary. Please consult the reviewers' comments (below) for more information.

Please return your revised manuscript within 60 days of the date posted on this letterAugust 9, 2018. If we do not hear from you within 60 days, we will assume that you have decided not to pursue revision of your manuscript at this time and your manuscript file will be closed. If you need an extension on this deadline, please let us know. When you are ready to upload your revisions, please log in and follow the links for this manuscript.

Thank you for the opportunity to evaluate your work.

Sincerely,

Andrea Varela-Stokes
Associate Editor
Journal of Zoo and Wildlife Medicine

As OVAG vets, you have terrific resources available to you for potential contacts at the Journal of Zoo and Wildlife Medicine (JZWM): Nancy Lung is editor and both Joe Smith and Steve Unwin are associate editors.

When evaluating sample OVAG papers, the weakest part of the drafts is structure – do a literature search first – think about your discussion before the other components. Get the format correct from the very first submission. Make sure your English has been reviewed before submission. Do your own peer review first!!!!

Scientific Writing – OVAG

Fransiska Sulistyo, **OVAG Committee**

Scientific Writing for OVAG: In the first part of the scientific writing session, a discussion about basic skills in writing for scientific publication using the perspective of an Indonesian speaking person. Issues discussed:

1. The language barrier: writing from Indonesian to English.
2. Choosing a topic and assessing the significance of the topic: new information, take home message, contribution to science.
3. Writing an accurate title that will entice readers
4. Breaking down your main topic into sub-topics (how to structure your paper)
5. Creating complete sentences
6. Paraphrasing and referencing
7. Translating from Indonesian writing to English

Publishing and Scientific Journal: Peer Review What is it and how does it work. This is geared toward orangutan and gibbon people to encourage publishing in scientific journals. Is anyone interested in being an author on a scientific paper? Do you think you have a case study that is worthy of publication? This will be a review of how to get this done! The quality of the submitted abstracts is getting better, you have the resources and the knowledge, but some abstracts are really written quickly without proper review. A very useful site for writing assistance is https://owl.english.purdue.edu/owl/. Do not be shy about asking help from anyone in OVAG – especially the committee members as they are all available to you – especially Raffaella, Steve and Nancy.

Reach out to colleagues and produce an article on several case studies on the same issue. What should you write about? Is the case: Interesting/useful for readers? Offer solution? Give significant contribution to science? Inform something new? (Are you sure?) What is the message that we want to share? (You should be able to summarize the paper in 1 word, and see if it offers solutions or provides valuable information. Do not just write a paper that says "me too" but offers no new solution. Do the proper research! Find out what is already published about your topic. Useful links: Google scholar (free) / PubMed (many OVAG people – such as Raffaella have access – ask!) / IVIS (free) / AAZV (annual subscription fee Rp 100.000,- with access to JZWM). Some topics of interest: 6 months persistent fever: FOU? Cancer? Brain damage? Chronic viral infection? Epstein Barr virus? Lymphoma?

The steps:

The title: Descriptive & interesting (do not leave it to the readers to question what the article is about). Key words (for future reference to be included in your abstract): species (include Latin name in italics), disease, location, etc. Use short, clear sentences. The layout should be: Title / abstract / full paper. Title example: BORNEAN ORANGUTAN (*PONGO PYGMAEUS*) TRANSMITTER IMPLANTATION: A 7 YEAR WORK OVERVIEW.

Creating a structure: Make a list of ideas first. Make a mind map. Make a problem tree (pohon masalah). See below:

Have one idea per paragraph with about three to five sentences per paragraph.

The chronological order should be:

Introduction with literature review
Case history
Results
Discussion
Conclusion

To creating a structure – practice: Pick up a scientific paper (or just the abstract) and break it down into structures: try to understand what the main idea of each paragraph is. This is a very effective way to study.

Tips for making sentences: Again, use short, clear sentences. Do not start a sentence with a conjunction (And,… Then,… So, … etc.) Always keep a good sentence structure with subject + verb + objectives / adverbs or subject + verb + clause. Common mistakes: Writing a species name (*Latin name in italic*); Writing numbers (1; 2; 3; 10; spell small numbers out one, two, three, ten); Postmortem results: gross necropsy (macroscopy) >< histopathology (microscopy) changes. Sentences are too long, sometimes up to one paragraph.

Paraphrasing: This is when you re-write a sentence you take from references **ALWAYS** using your own words. **NEVER** copy and paste sentences from reference sources/other papers as that is plagiarism. So if paraphrasing, not even one sentence can be copied, let alone an entire paragraph. Try using synonyms, antonyms, changing the sentence structure – but always make sure your sentence still makes sense! Summarize the longer sentences. Always put in the references (the citations) in the sentence where the factual information is that you have used from your resources and remember to be consistent with your citation style (as these can vary from journal to journal). Some citation styles: Harvard, Vancouver, APA, etc. Remember, www.scholar.google.com is a useful source to view citation styles and saves time. There are also other tools, such as EndNote.

The conclusion: In case reports, the conclusion usually will be the definitive diagnoses of the case presented. In many cases, we will not be able to find the definitive diagnoses, and that is fine. We can say that this is a possibility, based on the facts of (a)… (b)… (c) … But we cannot write a conclusion/definitive diagnoses based on assumptions, without giving the supporting data/facts. Use the title and the introduction to guide your conclusion as the beginning equals the end. Example: "Tuberculosis has been a significant health concern in orangutan rescue centers in the Borneo Orangutan Survival Foundation (BOSF)" "The case described has confirmed that tuberculosis is of great concern for the welfare of the animals as well as the health of the caretakers at BOSF".

Paper Review: Once you finish your first draft, leave it to cool down. We often do not see errors or problems when we review immediately after writing. Have a second look after a few days, and make any adjustments needed. Have a third, fourth, fifth look and keep reviewing it every time. Ask a colleague to proof read (e.g. a native speaker to check the grammar). NEVER submit your first draft.

The language barrier: Do not let the language barrier stop you from expressing your ideas. If you are not used to writing in English, start with Indonesian (or any mother language) and translate it later. However, translating from Indonesian to English should be done loosely (not word by word). Language is an expression of culture.

Again, let OVAG help you!!!! Indonesian / Malaysian / International colleagues are available to help with: Choosing your topic; Getting you the references; Review your draft; Proof-reading; And OVAG can even help you publish your paper.

Question & Answer with Joe, Steve, Siska and Nancy:

Think about what your case study is going to contribute to knowledge in general. Is what you found unique? What topics might be publishable…A common mistake is that in the writer's mind they know their own case – but it does not get expressed well in the writing of it…communications skills are important to get your idea across.

Case Studies – Moderated by Fransiska Sulistyo (BOSF)

<u>Case Studies</u>

Use of Radio Transmitter on Borneo Orangutan (Pongo Pygmaeus) At International Animal Rescue (IAR) Indonesia 2013-2018

Elizabeth Riana Dwi Prasetyawati, IAR

Re-introduction is an attempt to develop or re-establish a species from the region where the species has been lost or has gone extinct ("Re-establishment" is a synonym, but the term re-introduction seems more acceptable) (IUCN,1995). Once reintroductions are made, this necessitates the need for post -release monitoring. With post-release monitoring, the aims are to: monitor long-term orangutan activities, and measure and evaluate the success of the process of reintroduction. The process of monitoring orangutans is assisted by the use of radio transmitters implanted in a bag subcutaneously in the dorsal part of the neck.

The use of radio transmitters in wildlife has been long standing, in the 1960s they were used to track Grizzly bears, in the 1970s radio transmitters began to develop technologically, and in 2009 they were first used with orangutans. Use of radio transmitters at the IAR Foundation, Indonesia was first started in April 2013. Until 2018, 24 implants have been made on 20 orangutans.

Case 1: Name: Jack (Pongo pygmaeus subspecies) / Sex: Male / Age: + 10 years / Weight: 34.8 kg / Date rescued: 10th Dec. 2010 / Date release: 7th March 2018. History: On December 27, 2017: a radio transmitter was implanted with the number 150.760. On March 7, 2018, Jack was released in the Bukit Baka National Park. On March 27, 2018, the signal was lost. On April 16, 2018, inflammation began to appear at the implant site. On 25 April 2018, Jack was brought back to Ketapang (IAR rescue center) for a physical examination which revealed swelling at implant location with pain response, and when palpitating, part of the transmitter was felt. The medical therapies administered were Amoxiclav 12,5 mg/kg BW SC SID and Meloxicam 0,2 mg/kg BW ID SC SID. An operation was performed and serum and necrotic tissue was found around the transmitter. After operation, Amoxiclav 12,5 mg/kg BW PO BID and Meloxicam 0,1 mg/kg BW MD PO SID were administered. On May 18, 2018, Jack was released again.

Discussion: What caused the radio transmitter to turn off and/or caused the weakening of the signal? How does the radio transmitter break? Is there a safe standard for radio transmitter use in orangutans?

Possible Fatal Super Infection Of Chronic Viral Infection And *Chromobacterium Violaceum* In A Rehabilitated Bornean Orangutan (*Pongo Pygmaeus*)

Gregg Poetra (Pressenter), Agus Fahroni, Maryos Vigouri Tandang, Fiet Hayu Pathispatika, Arga Sawung Kusuma, Lia Kristina, Vivi Dwi Santi, Borneo Orangutan Survival Foundation, Central Kalimantan, Indonesia

Abstract

During the month of July 2016, a 6-year-old female rehabilitated Bornean orangutan (*Pongo pygmaeus*) was admitted to the Borneo Orangutan Survival Foundation (BOSF)-Nyaru Menteng clinic with health complaints that included high fever, lethargy, loss of appetite, and skin rashes. On clinical examination the liver was palpated enlarged, there was an accumulation of faeces in the stomach, and ascites.

Serial hematology and biochemistry test suggested leucocytosis with the activation of segmented leucocyte, elevated Alkaline Phospatase, and elevated Albumin (>20 10^9/l, >527U/L, dan >3.8 g/dL respectively). These findings were consistent during the onset of illness. Ultrasonography examination suggested multiple hiperechoic spots both in liver and spleen with free fluid inside abdominal cavity.

Serologic tests for Cytomegalovirus, Toxoplasma, and Hepatitis B came back negative. There was a seroconversion of Hepatitis C antibody at the late onset of illness. Additionally, several Polymerase Chain Reaction tests were conducted for Simmian T-Lymphotropic Virus (STLV), Lymphocryptovirus (LCV), and Tuberculosis. All came back negative but the LCV.

The animal died as a result of severe sepsis after seven months of treatment. Necropsy was done with significant gross findings as enlarged liver and spleen with multifocal abscesses of varied sized, severe reddening area in the lungs parenchyme, pus accumulation in the mesenterium, fluid accumulation in the heart and chest cavity, and enlargement of the heart. Histopathology result showed an edema in 80% of lung parenchyme with mononuclear cell infiltration, while the liver and spleen both had the same changes of multifocal lytic necrosis with mononuclear cell infiltration.

Bacterial culture from hepatic tissue came back with a growth of *Chromobacterium violaceum*. The condition of splenomegaly and hepatitis might be associated with Hepatitis C infection, while LCV might have contributed to the high fever persistence. Based on the clinical signs, post mortem examination, histopathology, PCR, and bacterial culture, the animal is diagnosed with fatal *Chromobacterium violaceum* septicaemia that may have been underlined by a chronic infection of Hepatitis C virus and Lymphocryptovirus.

Hepatitis C: Cause of Hepatitis C Virus, incubation period 7-8 weeks, transmitted through multiple avenues: injectable instrument, copulation, inherited, sharp instrument injury, blood transfusion, or organ transplant. 60-70% of chronically infected individuals develop chronic liver disease. Diagnostic tests with serology Anti-HCV and RNA HCV PCR. It takes up to 12 months for an infected individual to seroconvert and test (+) for Anti-HCV. *Lymphocryptovirus*: subfamilies are *Gammaherpesvirinae* and *Herpesviridae*. Natural infection restrictively occurred in NHP → self-limited, subclinical, clinical. Pathogenicity is relied on for its ability to immortalize host B-Cell → lymphoma. One of the most pathogenic species that affects human is Human herpesvirus-4 (HHV) or Esptein-Barr Virus (EBV) → Infectious Mononucleosis / Mono / Kissing Disease

Chromobacterium violaceum: Is a nonspore-forming, gram-negative*, facultativeanaerobic*, rod-shaped, bacillus bacteria. It is commonly found in water and soil and is restricted geographically to subtropical and tropical areas. This disease in humans and animals is rare, but mortality rate is high when it does occur. Clinical histories are brief and nonspecific, most animals are found dead without clinical signs. Gross lesions are characterized by septicemia which involves many organ systems, including lungs, liver, spleen, bone marrow, kidney, and adrenal glands. It is known to be multidrug and antibiotic resistant. Animals that have been infected with *C. violaceum* were also reported to have secondary infection by other bacteria. Few reports showed that antibiotic combination of benzylpenicillin and

enrofloxacin were effective to treat the disease completely in macaques and young baboons. In humans, the severity is usually predisposed by Chronic Granulomatous Disease (CGD) or G6P deficiency.

Background

6-year-old rehabilitant female had high fever, lethargy, was less active (July); had loss of appetite, wet lung sound and ascites (August); skin rashes and constipation (September); anemia, edema (October); labored breathing, weight loss (November).

Physical Exam showed: no external wounds [July]; no external parasites, no fracture, eyes, ears, genitals, anus were good, skin rashes [September]; no sign of nerve problem, no fracture, palpated enlarged liver [September]; chest auscultation was a bit wet and was not clear.

Laboratory Tests:

Hematology & Biochemistry: Leucocyte 26.5 x 109/L ↑ 36.94 x 109/L (72% segment neutrophil) ALP 578 U/L ↑up to 2898 U/L_ALT 251 U/L ↑_Glob 4.7 g/dL ↑

Blood film: (+) Plasmodium sp. (July)

Bacterial Culture: Blood culture (+) Staphylococcus saphropyticus (September)→one side arm vein Sputum culture(-)

Hematology, Biochemistry Profile, and Ab Treatment Highlight

Parameter	August	Sept	Oct	Nov	Dec
Wbc (109/L)	20.39-31.3	20.29-20.79	18.3-23.03	16.9-18.42	33.98-36.94
Alp (U/L)	823-1432	1964- >2400	1907-2100	2153-2243	2898
Alb (g/dL)	2.3	3.3	2.9		
Glob (g/dL)	4.0-5.2	4.5-4.9	4.7		4.7
Drugs	Enrofloxacin Meropenem	Doxycyclin	Cotrim	Benacillin	Benacillin

Laboratory Tests:

Serology: Hepatitis B Virus (-) [July '16] Hepatitis A Virus (-) [November 1'16] Cytomegalovirus (CMV) (-) [November '16] Toxoplasma (-) [November '16] **Hepatitis C Virus** (+) →seroconversion late onset of illness (4 weeks) [January '17]

PCR: Simmian T-Lymphotropic Virus (STLV) (-) Encephalomyocarditis Virus (EMCV) (-) Tuberculosis (-) Hepatitis B (-) Lymphocryptovirus (LCV) → (+) **Lymphocryptovirus macaca or Macacine herpesvirus-4**

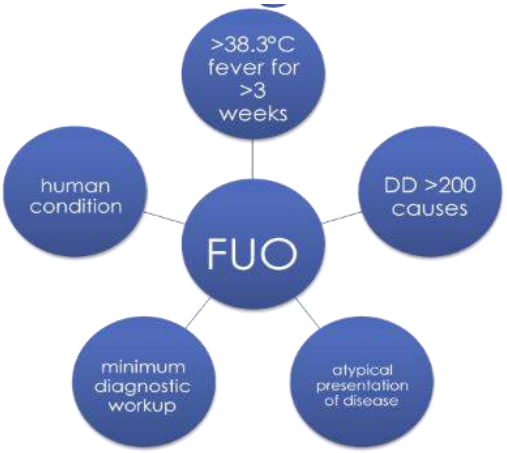
Other tests: Complement 3 and Complement 4 Erythrocyte Sedimentation Rate (ESR) Rheumatoid Factor (RF) G6PD (?) Carcinoembryonic Antigen Test (CEA) Alfa Feto Protein (AFP) Transferrin Ferritin Thyroid Stimulating Hormone (TSH) **Lactate Dehidrogenase (LDH)↑ Gamma Globulin Transferase (GGT) ↑ C-Reactive Protein (CRP) ↑**

Treatments:

Anti-Malarial: Dihydroartemisinin Piperaquine Maleate + Primaquine
Antibiotic: Amox LA (July) Ceftriaxone + Metronidazole (July) Enrofloxacin (August) Meropenem (August) Doxycyclin (September) Cotrimoxazole (October) Benacillin (November-December)

Other Drugs: Liver supplement (July) Blood transfusion (October & November)

The fever of unknown origin (FUO) never really went away.



Suggested Evaluation for Prolonged Febrile Fever & FUO: for patient with fever ≥ 38.3°C give

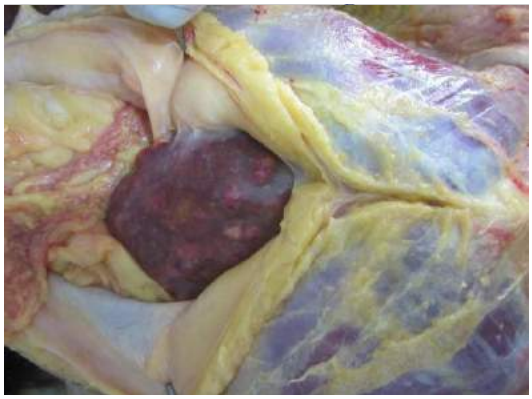
comprehensive history and physical exam; perform minimum diagnostic workup to include: CBC, chest x-ray, urinalysis, urine culture, ESR, CRP, electrolyte panel, liver enzymes, LDH, CK, blood cultures, antinuclear Ab, RF, serologic testing (EBV, CMV, HIV), Interferon-gamma release assay, abdomen USG, and computed tomography.

USG Image

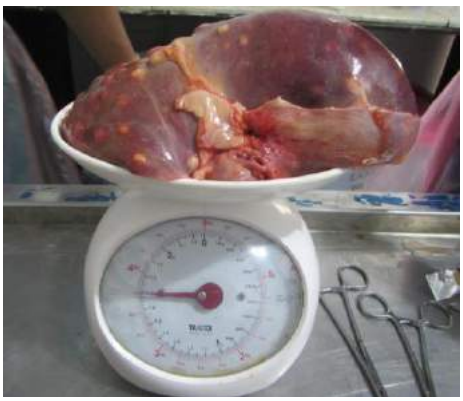
Hyperechoic spot in liver. Differential Diagnosis: Cytomegalovirus infection; Toxoplasmosis; Tuberculosis; Chronic Granulmatous Disease; G6PD Deficiency; Hepatitis; Malaria; Dengue Fever

The animal died on January 2017 more than 7 months after the initial clinical signs occurred.

Enlarged abscesses on liver



Liver



Liver

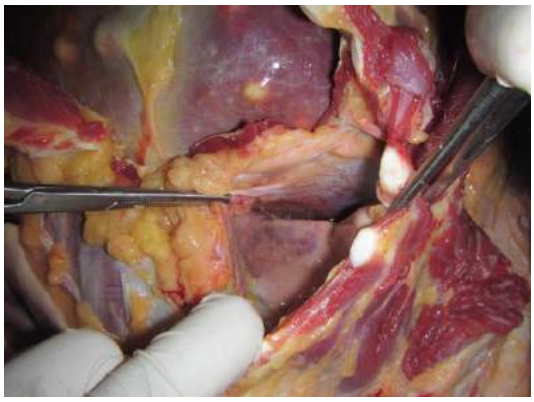
Spleen

Mesenterium

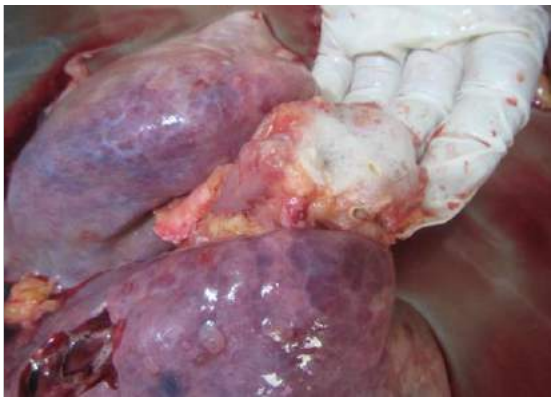
Caseous Mass in Mesenterium

Hydropericard

Hydrothorax



Fluid and Bubble Accumulation in Trachea



Colon mucosal is thickened and ulcerated

Histopathology Findings: Edema in 80% of the lungs parenchyme, mononuclear cells infiltration, alveolar macrophage proliferation, pleura is extensively thickened. Multifocal varied sized lytic necrosis both in liver and spleen with mononuclear cells infiltration. Coagulation and lytic necrosis with extensive mononuclear cells infiltration in mesenterium. Edema and necrosis is apparent in cerebrum and cerebellum parenchyme. Numerous mononuclear cells infiltration in multifocal interstitial kidney parenchyme.

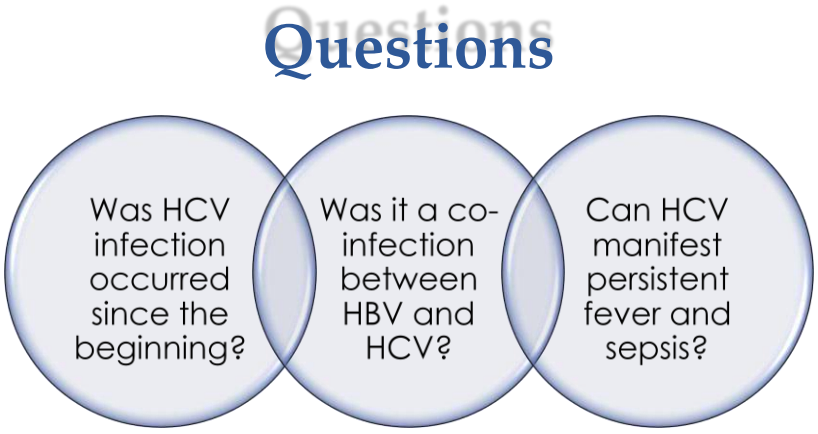
Aerob Tissue Culture: Cerebellum, spleen, kidney, lungs, mesenterium pus →E. coli. Heart muscle →*Corynebacterium jeikeium*. Thorax cavity free fluid →*Bacillus* sp. Liver →*Chromobacterium violaceum* and *Staphylococcus haemolyticus.*

Differential Diagnosis (post mortem)…Septic Shock: *Pseudomoniasis, Mycobacteriosis, Streptococcosis, Klebsiellosis*. Septic shock was the cause of death.

Conclusion: The orangutan suffered from a liver and spleen disease at the beginning (likely to be more of an inflammation than a tumor) which is thought to be Hepatitis C infection. There was a systemic bacterial infection during the onset time of the illness, which is resistant to several antibiotics. *Chromobacterium violaceum* infection is most likely the main cause of sepsis based on gross findings, histopathology, and bacterial culture. Persistent fever might be associated by LCV infection due to immunocompromised condition of other viral infection.

Suggestions: If there is a HCV infection suspected individual, do the PCR HCV RNA test then the Anti-HCV serology test alone (if the result is negative). A source said that a combination treatment using benzylpenicillin and enrofloxacin is effective to treat Chinese-origin adult macaque and young male baboon with *C. violaceum* infection. Combination of Co-trimoxazole, Chlorampenicol, Quinolones, or Carbapenems is likely to be effective in treatment against *C.*

violaceum infection. *C. vioaleum* clinical manifestation usually predisposed by several immunocompromised conditions.



SEPILOK Orangutan Rehabilitation Centre 50 Years Challenges and Lessons Learned

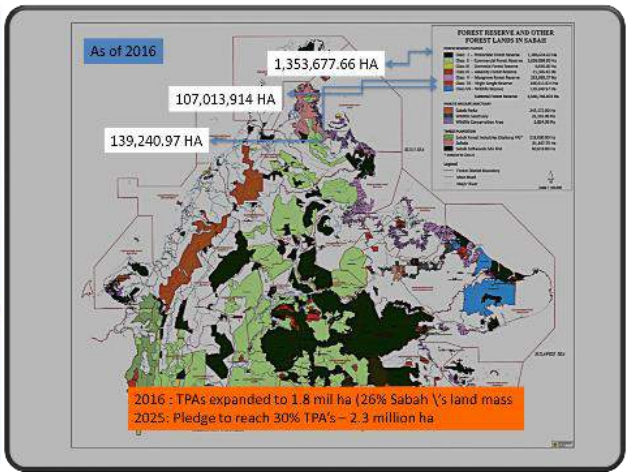
Sylvia Alsisto - Sabah wildlife Department SWD (Sepilok)

Abstract

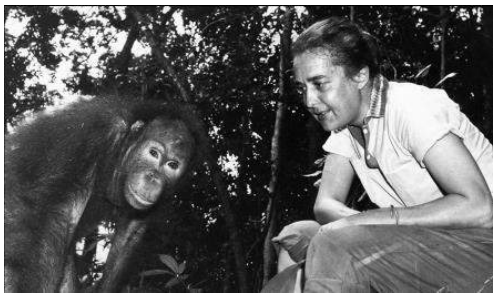
This presentation is based on *The Fluctuation of Orangutan Numbers at the Sepilok Orangutan Rehabilitation Centre (1964-2014)* - BSc. Honors Degree dissertation from the University Malaysia Sabah in 2016

Located in a primary protected forest in Eastern Sabah, Sepilok Orangutan Rehabilitation Centre has been in continuous operation since 1964. Though rescue of displaced orangutans and rehabilitation of orphans has been ongoing in Borneo and Sumatra for many years, Sepilok was a pioneer as the first to centralise management of supplanted individuals at a single site. As the government rehabilitation centre for Sabah, it has managed a diverse range of cases from young wild-born orphans, confiscated pets of various ages, wild animals injured in conflict situations, and those awaiting translocation. Sepilok also manages a free-ranging population in the forest surrounding the centre that includes the second and third generation offspring of rehabilitants. This centre is also unusual as it serves concurrently as an education centre for local, national and international visitors. Over the past five decades it has received over 700 orangutans. A study was carried out to quantify the population dynamics over time and to explore possible contributory factors. This presentation will highlight the results of this first comprehensive long-term descriptive analysis based on historical records including intake numbers, age, gender, place of origin, birth and mortality as a function of variation in population size. This revealed patterns reflective of changes over time, in wildlife legislation, anthropogenic events, land-use practice, biological factors and disease. It is hoped that these results based on such a long-span of continuous operation can serve as a reference to support improvements in management priorities and captive and semi-captive care of displaced orangutans going forward.

SWD is in charge of the protection of animals under Ministry of Tourism, Culture and Environment in Sabah.

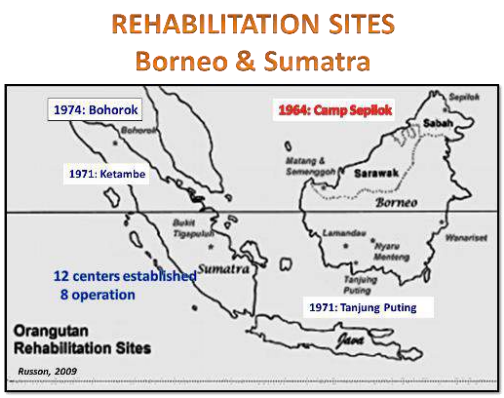


Sepilok is virgin forest and the government has agreed to extend the area. Indonesia was the first country to protect orangutans (early 1920s). In Malaysia, due to the work of Barbara Harrison, the true mother of rehabilitation an Orangutan Rehabilitation program was put to the test in 1961 in the Bako National Park in Sarawak. This was followed by the drafting of the FCO 1963 by P.F. Burgess (Conservator of Forest). In 1963 Sabah followed with the Fauna Conservation Ordinance. Also in Sabah, in 1997 the Wildlife Conservation Enactment. Sabah has also endured habitat loss, and land clearing for palm oil caused the highest influx of orangutans into Sepilok. The age of the highest group were infants followed by juveniles. The Malaysian government supports the center, and in 1992 they implemented an entrance fee which goes into a trust fund.



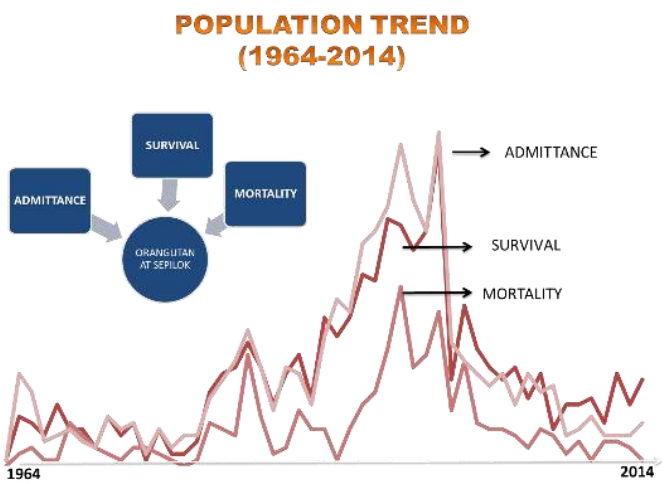
1961/1962 - Barbara Harrison

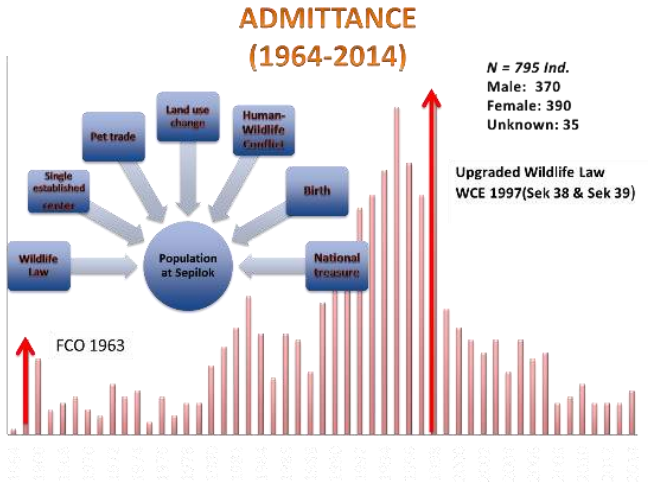
The Sepilok Orangutan Rehabilitation Centre - FCO 1963 when orangutans were given legal protection. In 1964, there was the formation of Game Branch Forest Department and the establishment of Camp Sepilok, Kabili-Sepilok Forest Reserve.



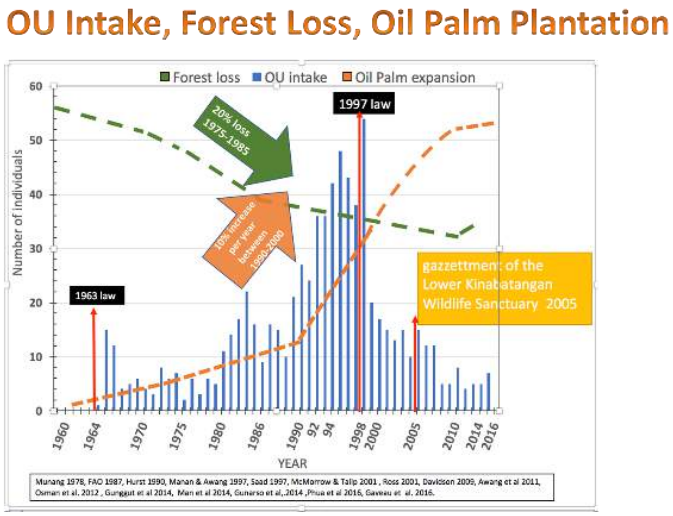
Kabili-Sepilok Forest Reserve VJR Class VII 1931 4,300 ha, 450 sp. of trees, 220 sp. of birds. 90 sp. Of mammals.

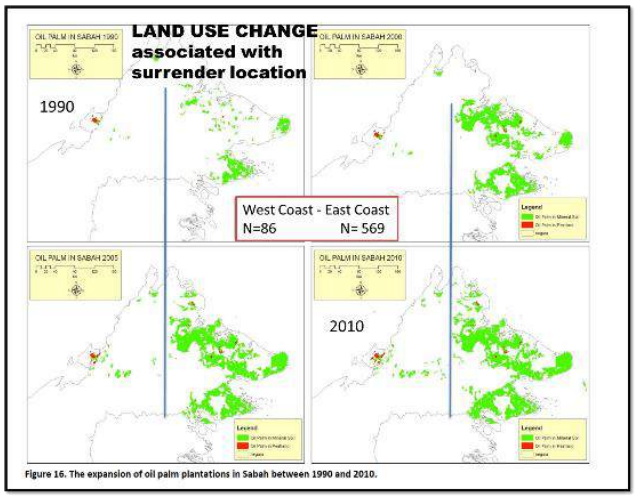
History of Sepilok: The first comprehensive and longest compilation of records from Sepilok Orangutan Rehabilitation Centre. The objective was to look at changes over the last 50 years as a function of: an upgrade in wildlife law, rehabilitation practice (i.e. disease and husbandry practices).

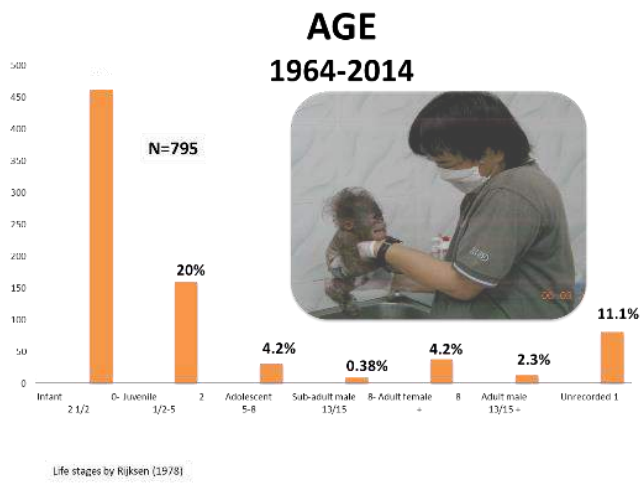


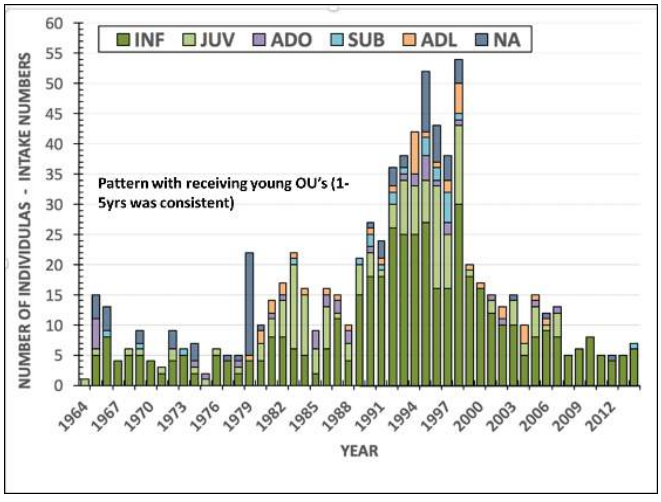


Wildlife Law in Sabah: Before and until the end of 1963, all confiscated orangutans were exported to zoos. FCO 1963: Enforced on the 15th of July 1964 Sabah Forest Department, formation of a Game Branch and the export of orangutan ceased. 1964 was the opening of the Sepilok Orangutan Rehabilitation Centre as a refuge center for orangutans.

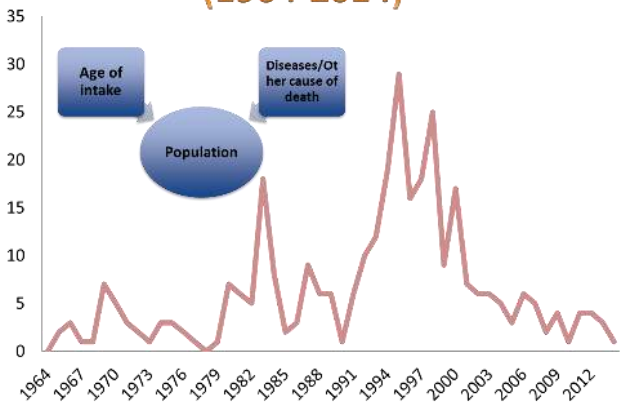




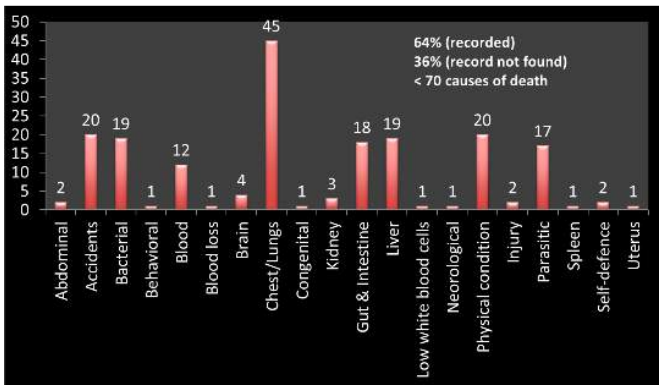




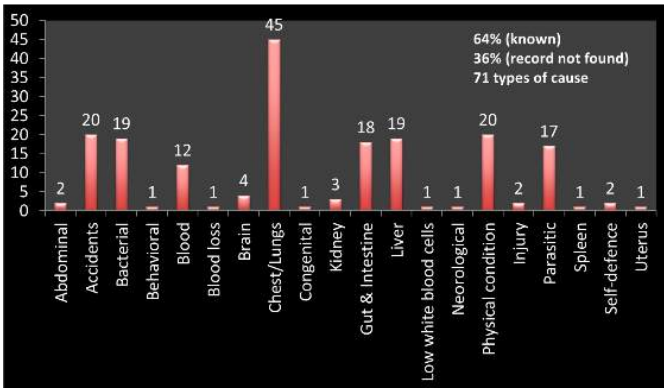
Mortality (1964-2014)



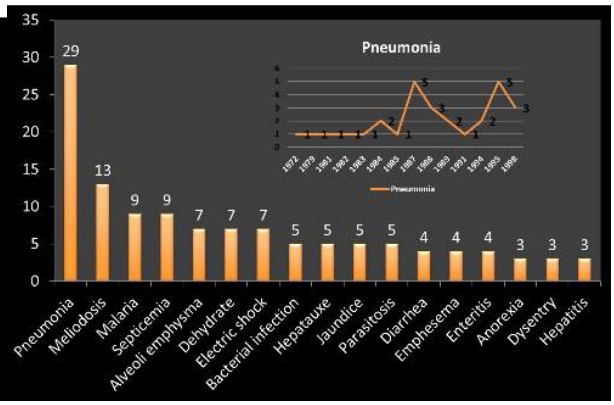
Disease/Cause of death



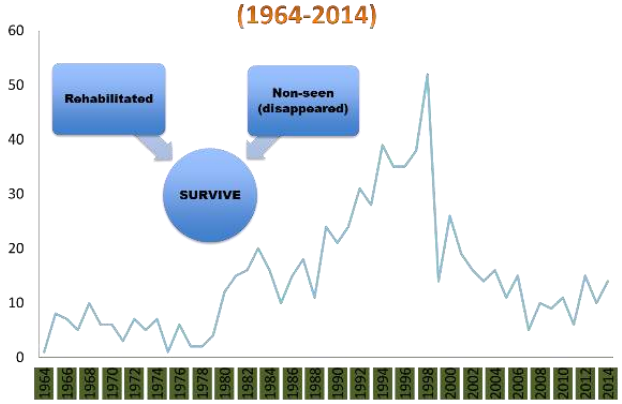
Cause of death (1964-2014)



Highest Disease Causing Death

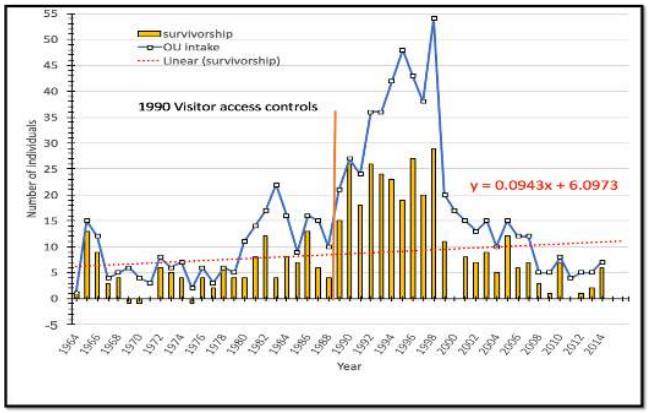


SURVIVAL (1964-2014)

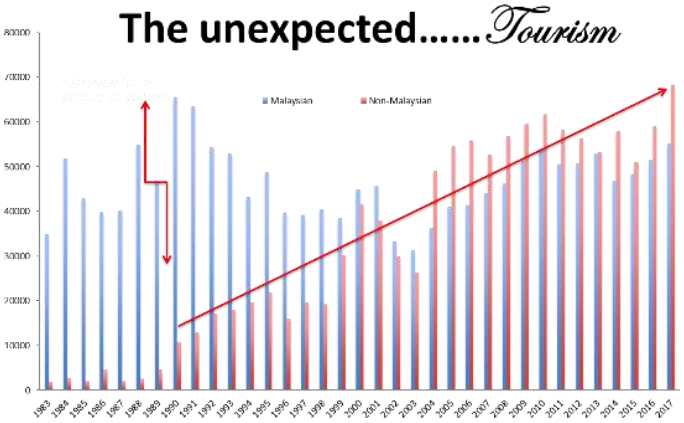


Raw admitted counts from records 1964-2014	795
Subtracted (released in 2015)	5
Subtracted (died on arrival)	2
Sub tracted (released outside of Kabili-Sepilok Reserve 1964-2014)	98
Subtracted (individuals with a record of admittance but no further records)	5
Adjusted total rehabilitant population known to have been released into Kabili-Sepilok Reserve from 1964 to 2014	685
Mortality counts from records of orangutans released into Kabili-Sepilok Reserve from 1964-2014	319
% Mortality	46.6 %
Total survivorship of rehabilitant orangutans released into Kabili-Sepilok Reserve (1964-2014)	366
% Survival (survivorship in this case is defined as no death reported in records)	53.4 %

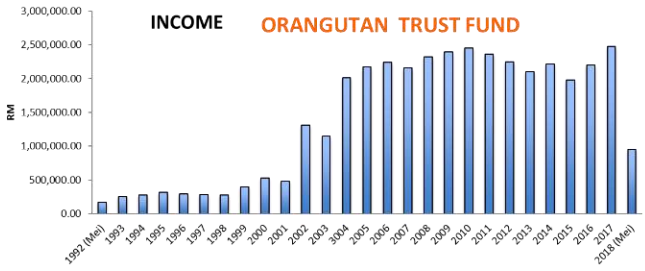
Orangutan Intake, Survivorship



The unexpected.....*Tourism*



GOVERNMENT ESTABLISHED CENTRE



Vet Care

1964-1980's:	Veterinary department * No vet on site
1980's	Vet Department/JOCV
1990's - present	Vet Department/SWD Vet/Appeal Vet/WRU Vets
	• Dr Sen Nathan • Dr Symphrosa Sipangkui • Dr Nabila Sarkawi
Challenges:	All over Sabah All types of animals All PM reports must be a done by
	Government Vet

Cages (Present condition)

Discussion: What is the carrying capacity of Sepilok? No one actually knows the number – estimated 80 to 100 can be there …but a new survey is in the works. There are release sites away from Sepilok so not all orangutans get transported there. Tabin is the Sepilok release site.

Predict – 2 Indonesia: Surveillance of Viruses in Wildlife and Human To Measure Potential Zoonosis

Suryo Saputro Country Coordinator Assist. USAID's EPT-2 Program

Abstract

PREDICT, a project of USAID's Emerging Pandemic Threats (EPT) program, was initiated in 2009 to strengthen global capacity for detection and discovery of zoonotic viruses with pandemic potential. Those include coronaviruses, the family to which SARS and MERS belong; paramyxoviruses, like Nipah virus; influenza viruses; filoviruses, like the ebolavirus; flaviviruses, like Japanese Encephalitis and Zika. PREDICT has made significant contributions to strengthening global surveillance and laboratory diagnostic capabilities for new and known viruses.

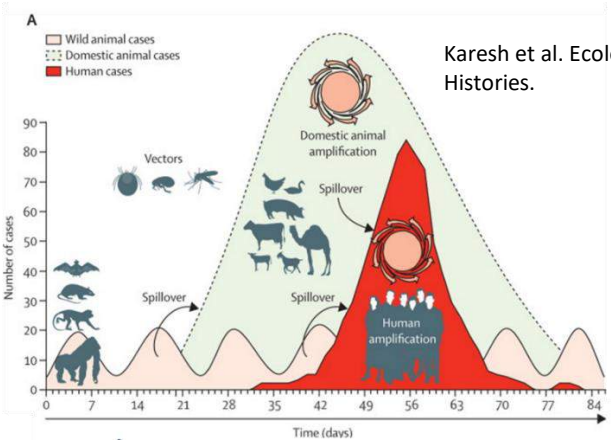
PREDICT-2 Indonesia is a collaborative effort of the Primate Research Center at Bogor Agricultural University (PRC-IPB), the Eijkman Institute for Molecular Biology (EIMB), EcoHealth Alliance, Metabiota, and the Smithsonian Institution, in coordination with the Ministries of Health, Agriculture, Environment and Forestry, the Indonesian Institute of Science (LIPI), the National Commission for Zoonosis Control, and in close collaboration with other partners from local universities and hospitals.

Increasing contact between wildlife and humans, due to expanding animal trade and rapid ecological changes, leads to greater risk of human exposure to new and previously known pathogens. Development of early zoonotic disease warning systems and collaboration between government agencies and research and academic institutions are urgently needed to better serve and protect the public. The threat of emerging pandemic diseases is facilitated by the interaction of wildlife, domestic animals, and humans (the human-animal interface). PREDICT Indonesia implements field and laboratory activities to enable the early detection and characterization of viruses across these high-risk, human-animal interfaces, and will conduct human behavioral studies to determine which human behaviors and practices are associated with potential disease spillover, and identify which risk mitigation measures may be the most effective.

From 2011 to 2018, PREDICT partners have collected ~4300 specimens from bats, rodents, and nonhuman primates from lowland forest, urban, mountain forest, and marine areas that have active interaction with humans, including ecotourism areas.

PREDICT has also screened samples from people with high wildlife contact from West Java, Papua and Sulawesi. Samples have been collected from important interfaces between animals and people, including wildlife markets, free-ranging wildlife in contact with researchers, areas with contact between tourists and wildlife, hunted wildlife, peri-domestic settings in and around human dwellings, and wildlife sanctuaries.

Predict is a project of USAID's emerging pandemic threats program: Towards a proactive paradigm for early disease detection and response. One Health approach to understanding the dynamics of zoonotic virus evolution, spillover from animals to people, amplification, and spread to inform prevention and control, looking at emerging pandemic threats sampling mostly bats and rodents as disease vectors.



Karesh et al. Ecology of Zoonoses: Natural and Unnatural Histories.

Risk vs. Benefit Analyses: Comparing two different systems/approaches and their inputs/outcomes. EPT program has suggested that preventive/early warning systems are more cost-effective than reactive systems, but there is no current data collection to prove it (i.e. no robust data on economic and health outcomes). Caveat that no systems are directly comparable - still provides useful comparisons on attributes/infrastructure (e.g. situations in concurrent Ebola outbreaks in 2014- Knowledge of EBOV circulation and capacity in DRC allowed for rapidly detection and containment, vs. unknown circulation in West Africa and ongoing transmission).

DATA: Compiling available evidence (indicators) to represent "cost" – economic where available for specific outbreaks, plus Disability-Adjusted Life Years (morbidity proxy), mortality, outbreak duration as a measure of containment/societal disruption, qualitative perceptions of preparedness, and types of functionality/capacity (single-silo vs. multidisciplinary).

SOURCES: Retrospective and prospective data assembly from: literature review, EPT partners, World Bank, P-2 country governments, etc.

USE: Developing a framework for analysis of One Health cost-effectiveness and compiling case studies, with attention to eliminating gender equality and integration bias

OUTCOME: Lessons learned can inform EPT-2 contexts- potential policy changes

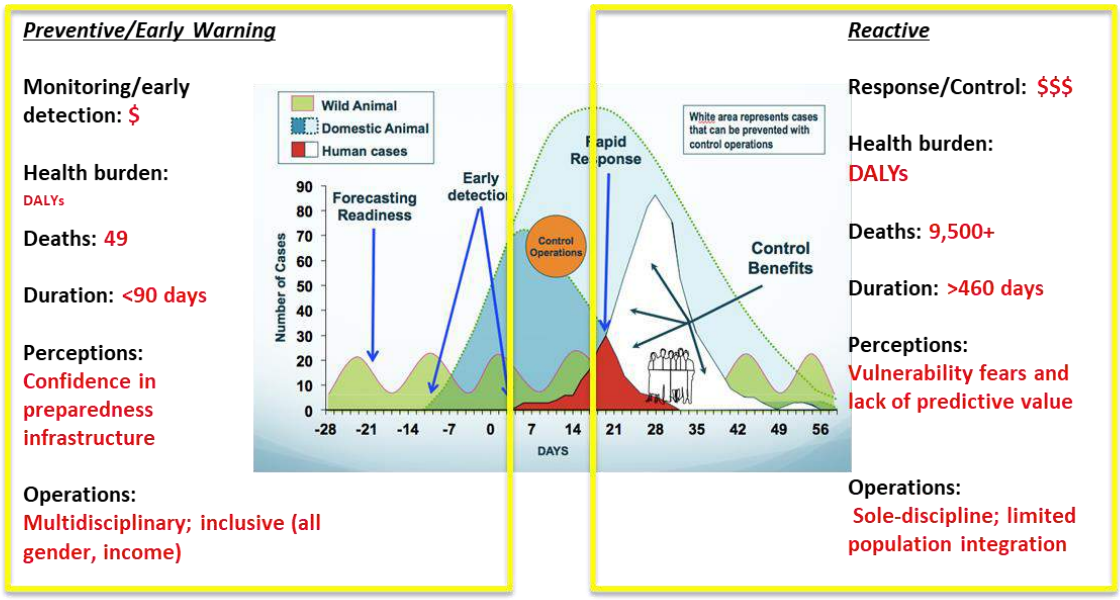
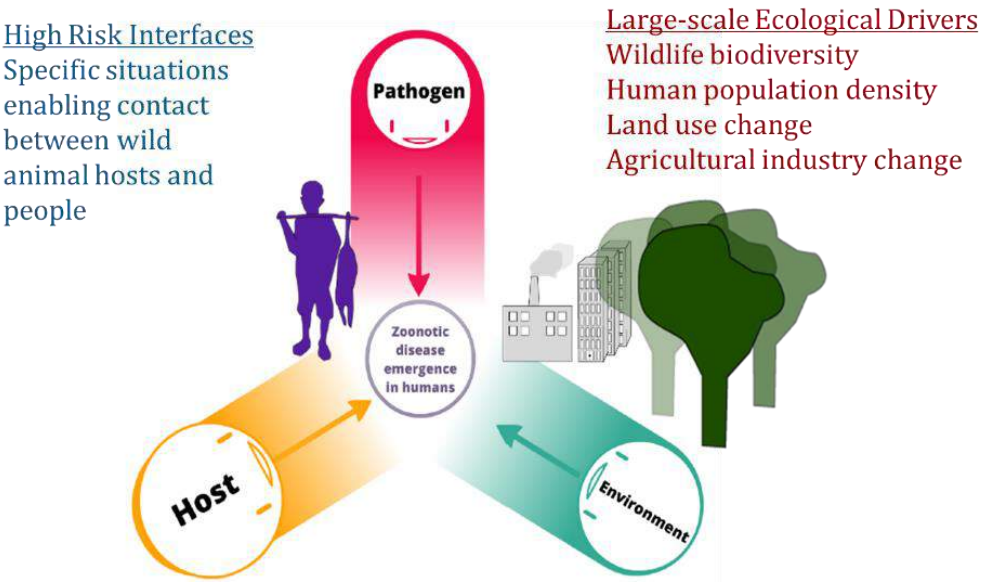


Figure from Karesh et al. Ecology of Zoonoses: Natural and Unnatural Histories. *Lancet*. 2012 Dec 1;380(9857):1936-45
Overlay by C. Machalaba, EcoHealth Alliance

EcoHealth Alliance

Targeted, risk-based surveillance:



Targeting: Human, nonhuman primates, bats, rodents, birds, suids, carnivores, ungulates, and others.

Implementing partners: Primate Research Center at Bogor Agricultural University - Detection and identification of novel and known wildlife pathogens that pose significant public health threats; Eijkman Institute for Molecular Biology - Detection and identification of new and known zoonotic pathogens that spill over into humans from wildlife

Consortium partners (from PREDICT Global): UC Davis, EcoHealth Alliance, Metabiota, Smithsonian Institution, Wildlife Conservation Society. Most of the analysis was done in North Sulawesi (Minahasa) at local markets where animals, hunters, and their families were checked.

Bat specimens collection:
- non-lethal sampling,
- release back to nature
- specimen types priority: 1) oral,
  2) fecal, 3) urine, 4) whole blood, 5) tissue

Rodents specimens collection:
- non-lethal sampling,
- release back to nature
- specimen types priority: 1) oral,
  2) fecal, 3) urine, 4) whole blood,
  5) tissue

PREDICT Lab. Protocol and Technology: Predict lab protocols utilize consensus PCR (conventional PCR) as the main screening tool to detect viral genetic materials by screening for viral families and/or genera to be able to broadly detect known and new viruses. Suspect positive samples detected by PCR must be cloned and sequenced for confirmation of the PCR results and to identify the virus detected.

Active Capture of Rats in North Sulawesi

Diagnostic Approach

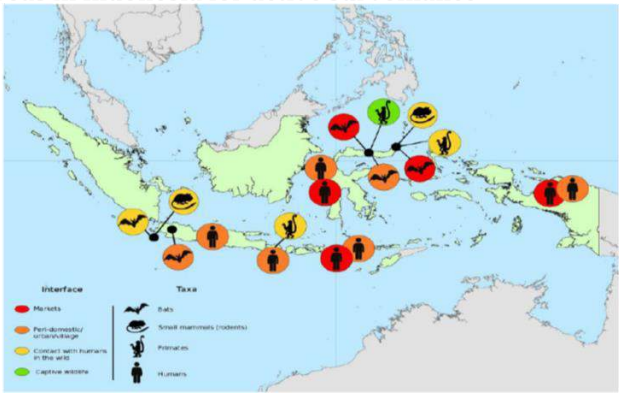
PCR: primers = key

Specific vs Consensus Primers

Traditional PCR	Consensus = Degenerate
Exclusive amplification and detection of one specific pathogen	Broad amplification of multiple, genetically related including previously unidentified pathogens

PREDICT-1 optimized 21 viral family protocols for screening human clinical specimens at EIMB; and 14 viral families for wildlife at PRC-IPB

EPT1 (2011-2014): Identified and chracterized zoonotic disease risk at critical human-animal interface in specific areas in Indonesia for active surveillance



PREDICT-Indonesia's EPT-1 Surveillance and Lab Findings:

	Human	Wildlife
No. of specimens	800 undiagnosed cryopreserved specimens from Acute Febrile Illness patients	1991 specimens from >400 animals from three taxa (nonhuman primates, rodents, bats)
Activity Sites	West Java, South Kalimantan, East Nusa Tenggara, North Sulwesi, Papua	West Java, North Sulawesi, Gorontalo, Bali
Lab Findings*	Herpesviruses (9), Rhinoviruses (4), Adenoviruses (4), Enteroviruses (2), Paramyxovirus (1), and Bocavirus (1)	Paramyxoviruses (7), Coronaviruses (9), Astroviruses (13), Rhabdoviruses (2), and Herpesviruses (2)

*** Reported to and approved by national authorities**

Summary of wildlife findings: A total of 221 samples were tested from 220 animals including bat, and 11 rodents. Samples were tested for up to 5 viral families/genera and included Astro-, Corona-, Henipa-, Nipah-, nd Paramyxo-virus families/genera. Seven viruses were detected in 37 animals, of which 2 are known viruses and 5 are new* (previously unknown) viruses. Specifically, the following known Coronavirus was detected: A strain of Bat Coronoavirus IFB2012 in one Black flying fox and four Sulawesi naked-backed fruit bats. This is a strain of the known betacoronavirus Bat Coronavirus IFB2012 (Genbank Accession No. AB918719) found in bats, and previously found in bats in Indonesia. The genus Betacoronavirus includes viruses that are of significance to public health such as SARS and MERS, however, this virus is not considered to be closely related to either of these viruses. Therefore, at this time, there is no evidence to suggest this virus poses a threat to human health.

The following known Paramyxovirus was detected: A strain of Paramyxovirus IFBPV32-2012 in one Sulawesi fruit bat. This is a strain of the known virus Paramyxovirus IFBPV32-2012 (GenBank Accession No. AB710472) found in a bat,, and found previously in bats in Indonesia. There is no evidence at this time to suggest this virus poses a threat to human health.

The following new Coronaviruses were detected: PREDICT_CoV-67 in 15 Black flying foxes, one Sulawesi fruit bat, and one flying fox bat in the Pteropus genus. This is a new coronoavirus found in bats belonging to the betacoronavirus genus. The genus Betacoronavirus includes viruses that are of significance to public health such as SARS and MERS, however, this virus is not considered to be closely related to either of these viruses. Therefore, at this time, there is no evidence to suggest this virus poses a threat to human health.

PREDICT_CoV-68 in 11 Black flying foxes. This is a new coronoavirus found in bats belonging to the betacoronavirus genus. The genus Betacoronavirus includes viruses that are of significance to public health such as SARS and MERS, however, this virus is not considered to be closely related to either of these viruses. Therefore, at this time, there is no evidence to suggest this virus poses a threat to human health.

PREDICT_CoV-73 in two Black flying foxes. This is a new coronoavirus found in bats belonging to the betacoronavirus genus. The genus Betacoronavirus includes viruses that are of significance to public health such as SARS and MERS, however, this virus is not considered to be closely related to either of these viruses. Therefore, at this time, there is no evidence to suggest this virus poses a threat to human health.

The following new Paramyxoviruses were detected: PREDICT_PMV-62 in one Sulawesi naked-backed fruit bat. This is a new paramyxovirus in a bat. There is no evidence to suggest this virus poses a threat to human health. PREDICT_PMV-92 in one Black flying fox. This is a new paramyxovirus in a bat. There is no evidence to suggest this virus poses a threat to human health.

Co-infections with the following combinations of viruses were detected: PREDICT_PMV-62 and a strain of Bat Coronavirus IFB2012 in one bat.

EPT-2: Focus on concurrent active surveillance for human and wildlife in areas with high zoonotic disease risks in Indonesia with human behavioral study. Virus families in order of priority: Paramyxoviruses, Coronaviruses, Filoviruses, Influenza viruses and Flavivirus – wildlife.

Wildlife specimens sampling (Year-4: October 2017 to September 2018): Gorontalo and North Sulawesi Provinces, Southeast and West Sulawesi Provinces: ~2900 bats sampled, ~1000 rodent collected, ~28000 specimens collected.

Coordination and Counterparts: In-country implementing partners (PRC-IPB and EIMB) under Ministry of Research, Technology, and Higher Education. Indonesian authorities (MoA, MoH, MoF), LIPI, and Coordinating Ministry of Human Development and Cultural Affairs. USAID-Indonesia and EPT-2 Partners. PREDICT Consortium Partners. Local universities, local offices of relevant ministries, local hospitals, local laboratories, etc.

Discussion: Predicts labs offered for use to orangutan centers!!!! What happens when there is a positive result for something? Predict double checks to be sure it is positive then the dangerous virus is reported to the ministry. How much can a center use your lab as a clinical source rather than a diagnostic? They are willing to help as long as the pathogen is of interest to them. Sample quality must be good. Can we send just random sample from gibbon and see if anything is there? This might be possible, but there must be a clear letter attached to the sample, so they know how to handle it. But it is possible in the future that they can expand what they do.

24 July (at Syiah Kuala University)

Case study: Medicinal Use Of Plants By Orangutans

(study conducted by H.C. Morrogh-Bernard, R. de Martin, L. Hoffmannová, K. Doležal, and I. Foitová)
Presented by Rosalie Dench, Borneo Nature Foundation

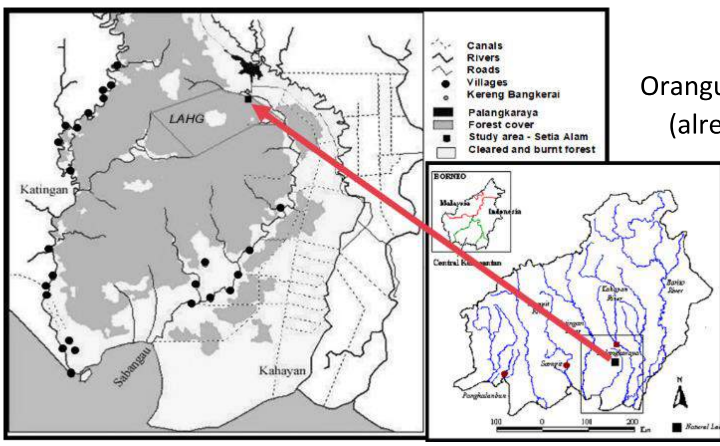
Abstract

Animals self-medicate using a variety of plant and arthropod secondary metabolites by either ingesting them or anointing them to their fur or skin apparently to repel ectoparasites and treat skin diseases. In this respect, much attention has been focused on primates. Direct evidence for self-medication among the great apes has been limited to Africa. Here we document self-medication in the only Asian great ape, orangutans (*Pongo pygmaeus*), and for the first time, to our knowledge, the external application of an anti-inflammatory agent in animals. The use of leaf extracts from *Dracaena cantleyi* by orangutan has been observed on several occasions; rubbing a foamy mixture of saliva and leaf onto specific parts of the body. Interestingly, the local indigenous human population also use a poultice of these leaves for the relief of body pains. We present pharmacological analyses of the leaf extracts from this species, showing that they inhibit TNFα-induced inflammatory cytokine production (E-selectin, ICAM-1, VCAM-1 and IL-6). This validates the topical anti-inflammatory properties of this plant and provides a possible function for its use by orangutans. This is the first evidence for the deliberate external application of substances with demonstrated

bioactive potential for self-medication in great apes. Self-medication in animals involves the use of natural and human-made products to alleviate or to control their illnesses.

Self-medication in animals involves the use of natural and human-made products to alleviate or to control their illnesses. It involves the ingesting or anointing of the skin or fur (fur-rubbing). Self-medication has been observed in mammals, birds and particularly in primates (Baker 1996; Dejoseph *et al*. 2002; Clark and Mason 1985, 1987; Clark *et al.* 1990; Hauser 1964; Huffman 1996a, 1997, 2003; Huffman and Hatoshi 2004; Verderane et al. 2007; Walker 1940). Until now, self-medication in great apes was only reported in chimpanzees and gorillas. The best-documented form of self-medication in primates is the bitter-pith chewing and leaf swallowing in chimpanzees and gorillas, where these substances are ingested. This behavior is directed at intestinal nematodes (Huffman 1996a, 1997, 2003). Another form of self-medication is 'fur-rubbing' which has not been documented in the African apes, but is well documented in neotropical primates including *Ateles* spp (spider monkeys) and *Cebus* spp (Capuchin monkeys) (Baker 1996). Most 'fur-rubbing' involves plant material that is rubbed into the skin or fur. Some capuchin spp use plants with pungent smells, like garlic or tobacco, where as other species rub ants into their fur or secretions from millipedes (Birkinshaw 1999; Valderrama et al. 2000; Weldon et al. 2003; Zito et al. 2003). Different forms of application have different functions including: ecto parasite removal; insect repellent; treatment of fungal or bacterial infections; treating wounds; conditioning the skin; scent marking; and as a form of food processing or social interaction.

Fur rubbing in orangutans, this is a previously-undescribed method of self-medication in apes. Below is a map of the Natural Laboratory in the Sabangau catchment, a 500km2 area of peat-swamp forest, in Central Kalimantan, Indonesian, Borneo



Orangutan behavior research started in 2003 and is on-going (already 15 years of data collection). In 2004 we observed the first recorded event of self-medication. Five observations of 'fur-rubbing' have been documented in 5 different individuals (4 females and 1 male); 2 were mother-infant pairs.

The Dracaena species has been used by orangutans on 4 different occasions over 7 years (only females).

Flowers

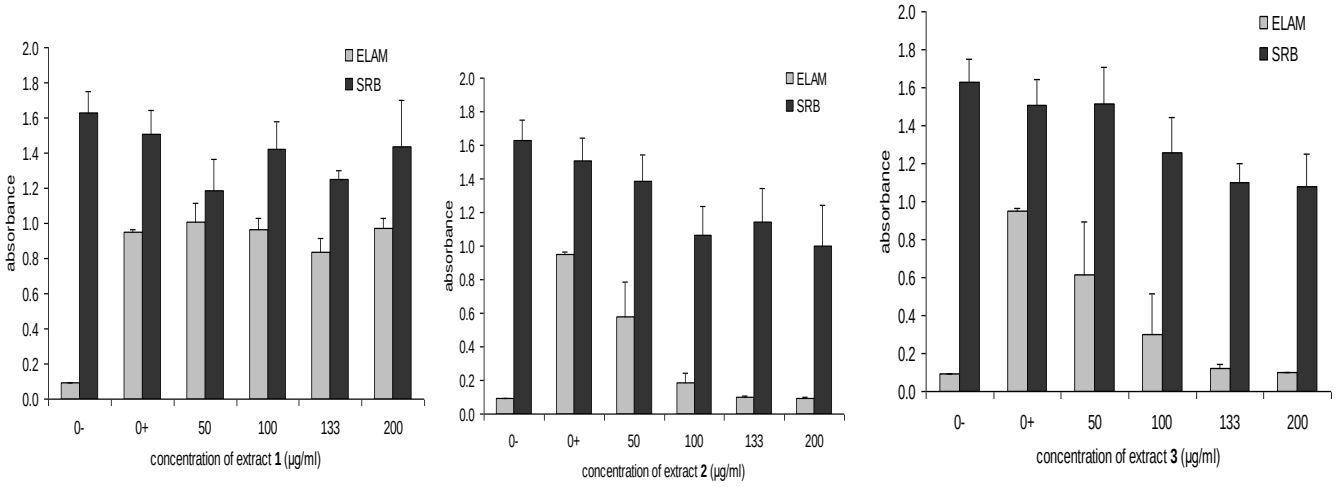
Leaves

In all cases, the leaves were chewed up and mixed with saliva to produce a leafy lather, which was then rubbed on to the arms or legs like a soap. The process lasts 15 – 30 minutes. It is always deliberate; not seasonal; and is not a social act.

Human use of Dracaena: Local people from the village use the same species to treat muscle pain or joint pain, and apply it to the body in a similar fashion as orangutans do. They also wash with it to treat paralyses after a stroke.

Chemical Analyses: Anti-inflammatory effects were measured using a cell surface ELISA assay for the detection of induction of the cell adhesion protein E-selectin (CD62E, ELAM). The inflammation stimulus tumor necrosis factor TNF-α (10 ng/ml) was used. This species was found to contain compounds which inhibit the effects of tumor necrosis factor (TNF-α protein E-selectin) (CD62E, ELAM).

Anti-inflammatory effects of extracts from Dracaena sp. in human umbilical vein endothelial cells (HUVEC):



This species has anti-inflammatory properties. Evidence to support the hypothesis that orangutans are using this species to control swellings or pain in the muscles and joints.

Other possible self-medication:

1. Fur-rubbing with Pornak:

Fur-rubbing using Pornak has also been observed in an unflanged male and an adolescent female. Fur-rubbing was conducted in a similar fashion, with the leaves from a sapling being chewed, then the foam rubbed on to the upper arms.

Sample used by orang-utans

2. Plaster:

A flanged male with a wound was observed chewing up leaves and then placed the chewed up leaves into a wound on his leg. The species of plant was not identified, but the male was sitting in a Jelutong tree at the time, a species which is tapped for latex. Local villagers use several species as plasters to stem the bleeding (but not Jelutong). Thus, it is plausible that orangutans are also using plasters as self-medication to stem bleeding.

These findings are important because they are a link between animal self-medication and ethno-medication which is important today, as herbal applications and the knowledge of which plants to use is a dying knowledge. These findings can only enhance the importance of medicinal plants. Highlighting the plants used in ethno-medication, and the areas where they are found, can help gain protection for these forests.

Discussion: did people learn this from animals? That is likely…But could they both have come to it independently? Yes...that is possible too.

Case Study: Series of Melioidosis Cases in a Population of Captive Bornean Orangutans (Pongo pygmaeus) in the Borneo Orangutan Survival Foundation (BOSF) Samboja Lestari, East Kalimantan,2016-2017

Presented by Yayan Oki Istyan (not present: Adinda Medina, Agnes Pratamiutami, Dessy Chrisnawaty, Hafiz U Riandita Yanan)

Abstract

Melioidosis is a bacterial disease caused by infection of *Burkholderia pseudomallei*, an environmental *saphrophyte*, that affects human and many species of animal. While some infections are subclinical, other results in acute or chronic disease of fatal septicemia. Infections can also remain locally or asymptomatic for months or years, and emerge to cause disease at a later time. Melioidosis is endemic in southeast-Asia and tropical Australia, but the global distribution boundaries of melioidosis continue to expand well beyond these traditionally recognized endemic regions 1,2. The epidemiology of Melioidosis in both human and animal in Indonesia is poorly known.

During 2016-2017, BOSF Samboja Lestari recorded 6 cases of confirmed melioidosis and 3 cases of suspected melioidosis in its population of captive Bornean orangutan (*Pongo pygmaeus*) in East Kalimantan, the Indonesian part of Borneo. Clinical symptoms in these cases are lethargy, fever, cough, anemic, and less appetite. The blood test results from the confirmed and suspected cases all showed an increase of SGPT and SGOT; anemia, but not common; *hypercreatininemia*, and *hyperuremia*. Urinalysis showed hematuria and proteinuria.

The six confirmed cases were all fatal septicemia that resulted in death. At necropsy, the major findings are multiple abscesses in the lungs, spleen, liver and kidney. Histopathology examinations showed infiltration of mononuclear inflammatory cells in the liver, lungs and kidney, as well as depletion of lymphoid cells in the spleen. Bacterial culture result from the lungs, liver, or spleen of all six cases confirmed to be *B. pseudomallei*

The three cases of suspected melioidosis were treated with ceftriaxone for 7-10 days and followed by a combination of Cotrimoxazole (8 mg/kg/day in 2 daily doses) and doxycycline (4 mg/kg/day in 2 daily doses) given for 3 months3. The treatment was successful, and all cases resumed well.

The main challenge with the management of melioidosis at BOSF Samboja Lestari is in getting a definitive diagnosis in live animals. Serology test for *B. pseudomallei* is not available in Indonesia, while biopsy of internal organs for bacterial culture poses a high risk and not suitable for screening of the disease.

Melioidosis (*Burkholderia pseudomallei*)is a bacterial disease that affects both humans and many animals. It is an infectious disease found in soil and stagnant water in areas where it is endemic. It is transmitted via inoculation, inhalation and ingestion. There is no pathognomonic (clinical) manifestation.

Below is a map of areas in Southeast Asia where is has been found:

This current case study was conducted in BOSF Samboja Lestari (east Kalimantan location) rescue center which houses 170 orangutans. The areas impacted by melioidosis are: cages and orangutan islands. In June of 2016 there was one case, followed by another case in August 2016, and another in November 2016. By December there was another with 2 additional suspected cases. Another three cases were diagnosed in January, March and August of 2017. Most of the orangutans diagnosed were from the socialization cages (7 individuals) and 2 individuals from the individual cages. One individual was diagnosed from the islands. The clinical signs were: lethargy, coughing, fever, anemia (which is not common) and little to no appetite.

Hematology results were as follows…

For known melioidosis cases: two orangutans increased (very high) values for anemia, liver and kidney functions, two showed CBC normal, but liver & kidney values were very high. Yet another showed anemia, leukopenia, with high liver and kidney values. One individual showed monocytosis, neutrophilia, low protein with high creatinine levels. For suspected melioidosis cases: one showed normal CBC with very high values for kidney and liver functions, another showed neutrophilia with normal liver and kidney function, and one showed leukocytosis with low protein levels and high creatinine levels and urea.

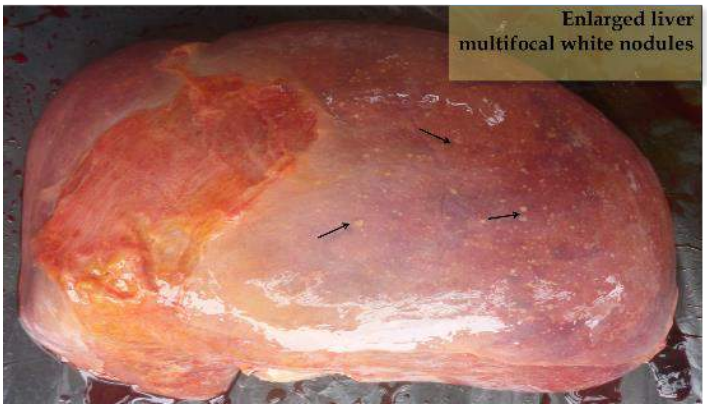
Urinalysis were as follows: For known melioidosis cases, four we not checked, the two that were checked showed hematuria, (+) for nitrite, leukocyturia, proteinuria, and urobilinuria. For the suspected melioidosis cases, one was unchecked, one showed proteinuria, and one showed hematuria, leukocyturia, urobilinuria, proteinuria and ketonuria. The most common abnormalities in urinalysis are hematuria and proteinuria.

Pre-diagnosis treatments were: for symptomatic: Ranitidine, Tramadol, and Meloxicam. The blind antibiotic treatment: Ceftriaxone and/ or Ciprofloxacin, or Amoxyclav. Vitamin treatment: Hematodin or Neurobion. For suspected cases: for intensive phase: Ceftriaxone, 50-100 mg/kg, IM, SID (7-10 days). For eradication phase: Doxycycline (4 mg/kg/day, divided in 2 daily doses, 3 months); Co-Trimoxazole (8 mg/kg/day, divided in 2 daily doses, 3 months) and vitamin: Neurobion.

Prognosis: Dubious (Poor if delayed treatment). Six out of six died within 3 days to 3 months (without melioidosis treatment). Three out of three were cured after melioidosis treatment (there were suspected melioidosis cases).

The post mortem results from the six dead individuals were:

Gross Pathology	Animals
Frothy trachea and lungs	2
Hydrothorax	2
Multifocal white nodules in lungs	4
Gastrointestinal hemorhagic	3
Enlarged liver , multifocal white nodules	6
Enlarged spleen, multifocal white nodules	6
Enlarged kidneys, multifocal white nodules	2



The histopathology results from the six deceased orangutans:

Histopathology	Number animal
Pneumonia, multifocal, chronic	6
Hepatitis	5
Splenitis	5
Depleted spleen (suspect)	3
Gastroenteritis	5
Nephritis	2
Hepatocellular vacuole degeneration (suspect lipidosis)	1
Congestion in kidney	1

The Burkholderia culture results:

	Orangutan 1	Orangutan 2	Orangutan 3	Orangutan 4	Orangutan 5	Orangutan 6
Liver	No growth	No growth	No growth	*B. pseudomallei*	No growth	*B. pseudomallei*
Lungs	No growth	*B. Pseudomallei*	No growth	No growth	*B. Pseudomallei*	*B. pseudomallei*
Spleen	*B. Pseudomallei*	No growth	*B. Pseudomallei*	No growth	No growth	*B. Pseudomallei*
Kidneys	No growth	*B. Cepacia*	No growth	No growth	Not collected	No growth
Heart	No growth	No growth	No growth	No growth	Not collected	No growth
Blood	*B. Pseudomallei*	Not collected	Not collected	Not collected	No growth	No growth
Urine	No growth	Not collected	*B. pseudomallei*	No growth	Not collected	Not collected
Abdominal fluid	No growth	No growth	*B. pseudomallei*	Not collected	Not collected	Not collected

Conclusions: The outbreak of the above deaths at the orangutan population in 2016-2017 at BOSF Samboja Lestari was caused by melioidosis infection. *B. pseudomallei* is thought to be endemic in Borneo, therefore cases are spread across Samboja's facilities.

Challenges and next steps: The main challenge with the management of melioidosis at BOSF Samboja Lestari is in getting definitive diagnoses in live animals promptly. Serology test for *B. pseudomallei* is not available in Indonesia, while biopsy of internal organs poses a high risk of spread of the infection and are not suitable for screening of the disease.

Discussion: 6 died, is there a way to get suspected cases diagnosed so that you do not get antibiotic resistance?

Distribution of Medical Supplies by OVAID: Nigel and Sara Hicks.

Digital x-ray machines for both BOSF Samboja and Nyaru Menteng. Also, introduction of their new scholarship for further training: The Brown Watson Orangutan Veterinary Aid Scholarship – will be ready in 2019 – Pandu and Arga were awarded this honor!!!!! **www.ovaid.org**

Also, if an endoscopy surgeon expertise is needed – contact OVAID.

Indianapolis Zoo: Melissa Fayette

Announced new scholarship opportunities for 2 OVAG vets to come to Indianapolis Zoo for continued professional training.

Evaluation of Bornean orangutan Strategic Action Plans (SAPs) - Wildlife Impact and Borneo Futures
Julie Sherman, Director Wildlife Impact, Borneo Futures

Abstract

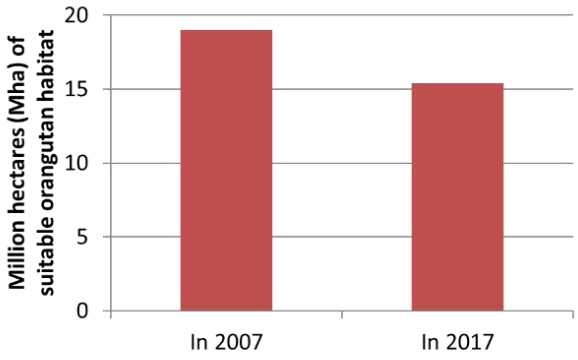
Wildlife Impact and Borneo Futures are conducting an independent evaluation of the three Bornean orangutan conservation action plans, the Sabah Orangutan Action Plan 2012 -2016 (SAP) and the Orangutan Indonesia Conservation Strategies and Action Plan 2007 – 2017 (OUAP), and the Orangutan Strategic Action Plan for the Trans-boundary Biodiversity Conservation Area of Batang Ai, Lanjak-Entimau Wildlife Sanctuary and Betung Kerihun National Park 2010- 2020 (trans-boundary plan). The evaluations are funded by the United States Fish and Wildlife Service (USFWS) and the IUCN Section on Great Apes (IUCN SGA). Our objectives are to analyze the impacts of activities outlined under these plans on Bornean orangutan populations, develop recommendations for improved conservation decision-making based on evaluation results and best available science, and use these findings to improve planning efforts and prioritize conservation activities based on empirical evidence of effectiveness. We are currently conducting an analysis of the relative conservation effectiveness and impacts of non-governmental organization (NGO) strategies on orangutan populations and habitats. We collected publicly available data from NGO websites and reports and independent news sources regarding NGO activities on orangutan rescues, rehabilitation and releases, orangutan habitat protection and wildlife law enforcement. We present these data and other lines of evidence available for this analysis. We are seeking feedback from orangutan rescue organizations to fill any gaps in these data in order for our analysis to capture the full breadth of rescue organization activities on orangutan conservation.

Bornean orangutan strategic action plans: Orangutan Indonesia Conservation Strategies and Action Plan 2007 – 2017 (SRAK) / Orangutan Strategic Action Plan for the Trans-boundary Biodiversity Conservation Area of Batang Ai, Lanjak-Entimau Wildlife Sanctuary and Betung Kerihun National Park (trans-boundary plan) / Sabah Orangutan Action Plan (Sabah SAP). Why evaluate the orangutan action plans? Orangutan populations have continued to decline. The Bornean orangutan status stands as follows: in 2007 - Endangered; in 2016 – Critically Endangered. About 100,000 orangutans have been lost since 2000. Key threats: Hunting (illegal hunting for conflict, bushmeat and trade), and Forest loss. The wildlife trade is mostly local. Hunting and forest loss don't happen necessarily simultaneously (i.e. OU still decline in forests where we don't have forest loss).

Unprotected forests everywhere on Borneo are declining. Forest loss prevented in some areas such as through new protected areas in Sabah, Malaysia forests in Indonesia are in decline even within some protected areas:

Forest loss continues across Borneo

Overall 19% decline in suitable orangutan habitat



calculated by Voigt using data from Gaveau et al 2017; Santika et al 2017; Voigt et al 2018

Your data can help improve orangutan conservation effectiveness! We need to understand WHY orangutan protection strategies have not halted the decline despite million of $$ and the tremendous effort spent to protect them. To do this we have to assess the implementation and effectiveness of conservation actions.

What are we evaluating? Key strategic action areas: Habitat conservation / Habitat connectivity / Law enforcement / Rescue (translocation and reintroduction, Awareness raising) / Alternative livelihoods (sustainable practices and capacity building) / Reviewing orangutan conservation policies.

Habitat conservation: Protected Areas (PAs) and Best Management Practices (BMPs). Orangutan population change / Forest cover change / Agriculture and extractive industry implementation of SAP / BMP plans available + implemented / PAs designated + implemented. Forest cover change includes tools such as Large scale reforestation to increase orangutan habitat.

Habitat connectivity: BMPs for lands connecting intact forests; corridor design. Spatial data on connectivity / Case studies of protected HCVFs compared with counterfactual (similar areas where HCVFs not protected).

Law enforcement: Detection and deterrence. Prosecution rates compared with infraction rates / Existing data from published literature / Other public data / Data that your groups collect - you are working on the front lines!

Rescue, translocation and reintroduction: How well do rescued orangutans survive in captivity? Post rescue survival / Do released animals survive, breed and reinforce or establish local populations? / Post release monitoring, survival / Do released orangutans affect conspecifics, other wildlife & habitat? / resident population changes compared to expected change and counterfactual (similar areas without releases) / Do rescues impact source forests? / Spatial data on forest cover change / Land tenure changes compared to counterfactual (similar areas without rescues) / Do releases help to protect destination forests? / Spatial data on forest cover change / Land use changes / Law enforcement coverage and effectiveness. Are there circumstances that work well for release of orangutans? Are some circumstances working less well? Why?

Pre-release management / Post-release monitoring / Site characteristics / Land tenure / Human settlements / Resident orangutan populations / Poaching rate / Biophysical attributes

Awareness Raising: Knowledge gains that lead to behavior changes impacting orangutans and their habitats / Knowledge gain and associated behavior change data.

Alternative livelihoods, sustainable practices and capacity building: Decreasing orangutan killing and habitat destruction and increasing conservation capacity. Uptake and duration / Long term behavior change / Capacity building for conservation careers and action.

Rescue center data: Improve understanding of rescue center impacts. What circumstances/areas are working best for release, and what type of circumstances diminish success? How rescue contributes to law enforcement, and what kinds of law enforcement collaboration efforts are most successful? How rescue center forest conservation efforts are contributing to preventing forest loss and fragmentation? Effects of community conservation, awareness raising and capacity building activities.

What we need from Borneo rescue centers: Rescue data and captive survival data / Law enforcement data / Translocation and reintroduction data / Other conservation, education and capacity building activities / Map of rescue catchment areas (we have maps to draw on). Meetings were set up throughout the week with veterinarians from various orangutan centers.

animals confiscated or handed over by people
animals released
animals translocated (subset of released animals)
animals reintroduced (subset of released animals)
animals born in captivity
animals died in captivity
Coordinates/site name of original habitat(s) animals were rescued or moved from
Parks, State or community forests, other orangutan habitats you protect
% of rescues that involved law enforcement action; actions taken
Pre-release studies to determine the suitability of the release site
Comparison of cost-effectiveness of release to other conservation solutions
Coordinates/site name of areas where animals translocated/released; # released
Health testing or monitoring done before release
animals followed after release ; Post-release monitoring method(s) used + duration
animals returned to captive care (note failure to adapt or illness)
deaths post-release
released animals surviving after 1 year
Overall health condition post-release (if known)
offspring born to released animals

Health as a conservation threat to ape conservation

Marc Ancrenaz, Hutan and Borneo Futures

Abstract

Diseases and health-related issues are currently considered a primary threat to ape conservation and wellbeing. In order to better understand how we could best respond to tackle this threat, we need to assess the risks of disease transmission and resulting morbidity/mortality in apes across their range, both in the wild and in captivity, and what actions/activities need to be taken to minimize these risks in the best way. In 2016, on behalf of the ARCUS Foundation, I interviewed 55 great ape practitioners working in Asia and Africa to collect their views on these questions. Overall, most practitioners considered diseases and health issues as a potential but significant conservation threat.

Several constraints were identified, such as (1) a lack of understanding of what are the real health-related risks, their seriousness, what should/could be done to minimize them, and how to do it; (2) Chronic and serious lack of diagnostic tools and of local veterinarians/health technicians who are properly trained to tackle health issues; (3)

Lack of collaboration/communication between different groups working on wildlife or human health. A series of recommendations about how best addressing this issue was also produced, based on the experience gained on the ground.

Practitioners working in sanctuaries recognized that captive apes were susceptible to many diseases from humans and from unknown origins, and that mortality due to infectious diseases was still a significant problem in orphanages. There was a consensus that we need to investigate the pathology and the causes of death or illness in captive apes more thoroughly. There is also a real risk for reintroduced apes to disseminate new pathogenic agents in the natural habitat in which they are released. It is essential to implement strict BMPs and to conduct proper health assessment before any release takes place.

Summarized major findings of interviews and discussion of what could be done to tackle this threat more efficiently.

Recommendations about how ARCUS (and the donor community) can respond to health issues: Identify priority areas of work to respond to these threats / Outline recommendations for engaging the mitigation of the disease threat to the apes / Desk-based analysis: Literature review and Interviews. The Interview survey: 83 practitioners reached out (64 persons answered or 80%). 55 persons interviewed: Do you think that health-related issues are a conservation threat to apes? What do you think is needed to tackle these threats? How could the Donor community assist? Global = 6 persons / Gibbon = 4 persons / Orangutans = 11 persons / African great apes = 34 persons.

Overall view about disease risks and ape conservation: Lack of understanding of priority issues: "Diseases matters, but we still don't know how much" / "Disease is a POTENTIAL threat", often minimized by organizations (donor, conservation and government agencies) / Sanitary risks are increasing / We know the questions that need to be answered, but we need more resources / Epidemiological research is needed / Different scenario – different risks: Habituated populations (tourism, research) / Small isolated populations / Captive populations / Lack of synergy between human and animal health professionals: Need to raise the profile of health issues / "One Health" or "Planetary Health" approaches / Need for a "science to policy and action continuum" / Lack of human resources: Need to move from the "international" intervention model to reinforce local capacities: Create, support and train local teams for outbreak investigation / Build on-site laboratories / Better collaboration and improved training. Increase the number of fellowships available for local veterinary students / Create "sandwich" programs / Create a network of strongly connected veterinarians, health workers and researchers (see examples above); Make budget available to organize exchange programs for veterinarians and health professionals between projects / Invest in local veterinary and science universities to reinforce the education level of young local students on health issues / Conduct an overall assessment and evaluation of what type of education is available in Africa and Asia for veterinarians and health personnel in order to identify: (1) weaknesses and gaps, and (2) the priorities to be developed for the next 20 years / Develop a curriculum to train veterinary students in the health of wildlife and non-human primates (OVAG is developing an MSc program in Indonesia for a relatively small amount of money).

1. Disease prevention: the PRIORITY… Importance of BMPs / Ape visitation / Human quarantine. BMPs need to be adjusted to the local context and explained in simple and clear SOPs that should be translated into local languages (n=12): need for a CHAMPION. MASK issues with tourism.

2. Health monitoring: Early warning system of infectious disease / Problem: health is not perceived as a priority by funding agencies or governments / Poor data about real sanitary issues and need to collect baseline data about "normal" populations / Example of ticks infestation in Asia / Melioidosis (or Whitmore's disease – *Burkholderia pseudomallei*) / Tuberculosis / And of course ….. Nothing on Gibbons!!!!!! / Need for better collaboration. Lack of information about what could be considered "normal" or natural in a population is a serious impediment to identifying the real sanitary issues that need to retain our attention / In South East Asia, ticks are increasingly found on newly captured wild orangutans, but scientists still don't know whether this is a result of close contact with cattle or people, the result of habitat fragmentation or an adaptation of the parasites to the new environmental conditions resulting from climate change / A few points were

suggested to improve our knowledge of the real health-related issues encountered in the field: Conduct a long-term multi-site comparison to better understand what are the perceived risks vs the real risks; Standardize tests across sites; Develop a streamlining process to make available online health data from various groups working on these issues (an "Ape-database" type of approach); Use existing tools, such as the "IUCN Disease Risk Evaluation" (Jacob-Hoff *et al.,* 2014; WOAH-OIE, 2014) to model the potential priorities for apes. Similar approaches have given powerful results for other taxa (Ciliberti *et al*., 2015); Develop a document that would flag up the major scientific questions that need to be investigated, the potential partners and a road map to address these unknowns.

3. Health monitoring: diagnostic tools: Lack of on-site tools and laboratory facilities / Protocols for sample collection: Poorly implemented, Need for practical SOPs and trainings / High reliance on international collaboration: Need for formation and trainings / Need to establish diagnostic laboratories / Disease outbreak investigation: Need for an efficient network of professionals and funding.

4. Health intervention: Debate: Intervention vs Non-intervention / Developing an intervention policy plan BEFORE any outbreak / Vaccination?

5. Sanctuaries and rehabilitation: Lack diagnostic tools / Risks of contamination of natural habitat / Need to improve management practices and enforce BMPs / Problems with volunteers / Overall improper pre-release screening / Redefine the role of sanctuaries to integrate them more with conservation of wild populations. Orangutans in captivity are often sick. Often symptomatic treatment only, without knowing the real cause.
   The overall role of sanctuaries could be redefined to be integrated more with conservation of wild populations. For example, health could become an entry point by making these facilities sentinels for emerging diseases; sanctuaries could also become ambassadors for wildlife by fostering their education value.

6. Asian apes: the least known taxa. Orangutans: Melioidosis – TB / Gibbons: well, we know now that we don't know (Susan Cheyne)…Little information – poor baseline data, High mortality rates of small isolated groups in fragmented habitats. Reason? Contamination from human origin: Human Herpes simplex 1 and 2 /
   Hepatitis (example of the survey conducted in Java) / Parasites and bacterial infection in captivity / Contamination when on the ground (captivity) / Need for an active Health Professional Network / Urgent need to secure baseline data on wild populations. Human herpes simplex viruses 1 and 2 are prevalent in the human population; in gibbons, infection can result in encephalitis and sudden death. These viruses are extremely contagious and humans who take care of captive gibbons need to wear masks permanently. Because of the precautionary principle, herpes-positive animals cannot be released except into isolated and empty patches of forest. However, we have no details about the real risks posed by these viruses, the epidemiology or transmission route of the disease. In Java, the Aspinall Foundation undertook a huge fecal survey of wild gibbons that showed that many individuals had developed antibodies against the same strain of hepatitis B virus as found in captive animals, showing that the virus had co-evolved naturally with wild gibbon populations. Following this report, the Indonesian Government decided that animals positive for this particular strain could actually be released back to the wild. This example illustrates the need to obtain better baseline data in the natural environment to guide our conservation activities.

Break Out Session: Critical Thinking And Disease Investigation

Marie McIntyre, University of Liverpool and Steve Unwin

Previously Undetected Disease in Orangutans in Indonesia……Facilitator answers are in ***in italic bold***

OVAG 2018 Outbreak Scenario Part 1 – The Case (15 minutes as a guideline)

Heavy deforestation occurs in an area of previously virgin rainforest in Indonesia. One orangutan from a small group in the pre-release enclosure (adjacent to a small protected forest pocket close to the deforested area) of a rehabilitation center starts to show a range of clinical signs including fever, fatigue, myalgia and headache.

1. How acute has the development of clinical signs been?
2. What aetiological agents could potentially be causing clinical signs?
3. What diagnostic methods do you use?
4. Is this the only animal showing clinical signs?

1. No set answer; for discussion

2. Clostridium perfringens, Pseudomonas aeruginosa, Campylobacter, Shigella flexneri, Yersinia pseudotuberculosis, Staphylococcus aureus, MRSA, malaria (P. falciparum, Streptococcus pneumonia causing meningitis, Strongyloides stercoralis, Encephalomyocarditis virus (EMCV), Marburg virus, Nipah virus

3. Take temperature at multiple time-points. Observe animal for pain using physical examination to pin-point sites of pain. X-ray to differentiate muscular and skeletal pain. Blood sample to check for inflammatory indicators. What specific tests COULD you start running to differentiate your answers in 2?

4. No set answer; for discussion.

OVAG 2018 Outbreak Scenario Part 2

1. Now you have greater understanding of the disease cause, what are the next management steps in this case?
2. Is it necessary to report the disease?
3. Fill in the table. Who are you going to call?
4. Who makes the call?
5. Who else needs to be informed and why?

Group role	Stakeholder/expert	Information needs	Communication method	When	Responsibility to contact
Operational/implementation					
Governance					
Compliance, auditing and monitoring					
Public					
Media					

1. Isolate animals showing clinical signs. Stop further animals coming into the reserve. Instigation of biosecurity protocols (including PPE, disposal of contaminated biological material, environmental decontamination). Investigate how this case relates to illegal harvesting of wildlife for food or trafficking.

2. Yes!

3. Vet Coordinator, Centre Manager (within 24 hours within organisation), BKSDA (Nature and Conservation Agency within Ministry of Forestry), PHKA (Ministry of Forestry), Indonesian government (within 48 hours)

4. and 5. completed using table contents.

OVAG 2018 Outbreak Scenario Part 3

Some dogs and chickens in the local village have reportedly died.

1. Whose responsibility is it to investigate these deaths?
2. What do you do about them?

1. ??

2. Request that dogs are no longer allowed to eat chicken carcasses. Create a line of communication for preventive measures against further spread. Carcass disposal.

OVAG 2018 Outbreak Scenario Part 4

Following diagnostic confirmation that the aetiological agent is Ebola virus (sub-type Zaire), the suggestion is made that a newly acquired vaccine could be used to protect Orangutans and other animals, in order to contain the infection.

1. What vaccine strategies could be employed?
2. What are their pros and cons?
3. What are the ethical requirements to vaccinating?

1.

Vaccination strategy	***Goals***
Single birth cohort routine vaccination (selective immunization)	***To eradicate, eliminate or contain future disease***
Mass immunization (entire population in affected area or priority risk groups)	
- ***Ring vaccination***	***To establish population immunity in contiguous animals and other populations***
- ***Blanket vaccination of local population***	***To rapidly limit morbidity and mortality due to the documented presence of a vaccine preventable disease***
- ***Blanket vaccination of all animals***	***To, in theory remove the threat of this Ebola-type***

2. No set answer; for discussion.

3. Generally, not thought to be a good thing to vaccinate unless you can guarantee it's not going to cause future disease in the wild population.

There are human health risk management considerations of having the pathogen circulating in the area.

Orangutan Anesthesia: Responsibilities and Drug Classes

Nancy P. Lung, VMD, MS. Veterinary Advisor, North American Orangutan Species Survival Plan. Editor-in-Chief, Journal of Zoo and Wildlife Medicine

Abstract

Proper anesthesia focuses on teamwork for problem solving and knowledge and actions of anesthesia drugs. The reason for this is because there is a wide variety of skills and knowledge gaps that can exist within veterinarians. These gaps range from basic anesthesia training to practice and advanced level anesthesia.

Every patient needs to be monitored every time. This is very important if you want to keep every patient alive! Anesthesia success is more than "not dead"! Anesthesia success means that you have supported your patient's homeostasis with the least physical and physiologic harm. Did they emerge from anesthesia in as good a condition as they went in? (temperature, hydration, pH balance, oxygenation……). The best way to achieve success is to conduct constant patient monitoring and take action to changes that are observed. You cannot fix it if you do not know its broken!!!

Why we monitor: To ensure patient safety / To improve the quality of patient care / To improve our knowledge and skills for patient management and support.

What we Monitor: Heart and breathing rate and sounds / Pulse rate and character / Depth and pattern of breathing / Capillary refill and color of mucus membranes / CNS responses – eyeball position / Pupillary size / Responsiveness / Muscle relaxation response to noxious stimuli / Oxygen Saturation / End Tidal Carbon Dioxide.

Use your eyes, ears, nose and fingers. They can tell you a lot!

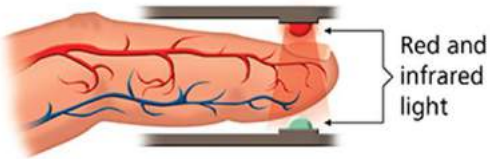
Eyes: look at mucous membrane color / watch the animal's breathing—too shallow? Too fast? Not breathing? / Watch the rebreathing bag.

Nose: Do you smell isoflurane? (the hose may have become dis-connected).

Fingers: Check Capillary Refill Time / Check blink reflex / Feel pulses—for heartrate, as well as blood pressure. Are the pulses strong or weak? / Femoral artery / Brachial artery—right under the biceps muscle / Anterior tibial artery—just over the anterior-medial ankle.

You do not need expensive technology to do good anesthesia monitoring. It takes a commitment on your part to pay attention during every procedure. It takes a commitment on your part to gain experience with using your senses to monitor each patient. Using your senses, you can assess both depth of anesthesia and stability of the patient. Do both, do it every time!! However, there are some tools of the trade:

Pulse Oximeter: It measures the percentage of hemoglobin that is carrying oxygen. It works by detecting the differential absorption of light between saturated Hb and bare Hb. The Accuracy is affected by: Low pulse pressure / Vasoconstriction / Hypovolemia / Pressure cuffs / Bandages or restraints / Tension or pressure on the probe / Motion / Bright light / Dry mucous membranes.

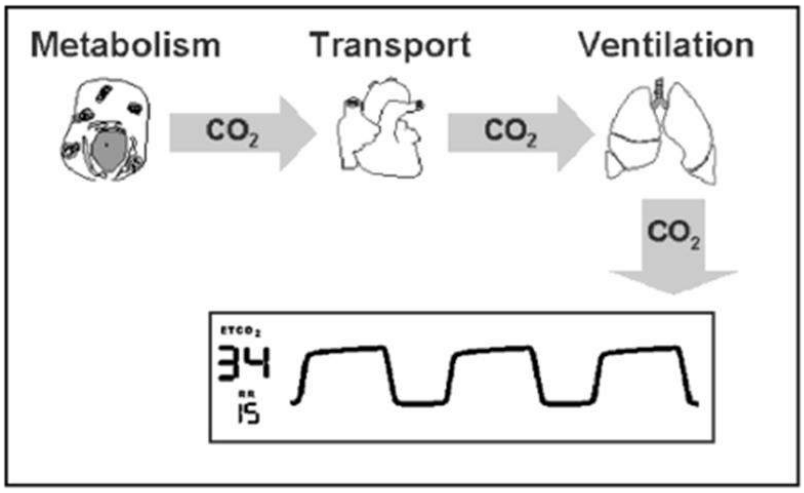


You want the SPO2 to be above 95%. If it is below 90%, check all of the things that affect its accuracy. Look at the patient. Do they look like they are in trouble? What is the mucous membrane color? Is the patient breathing? Is the patient dead?

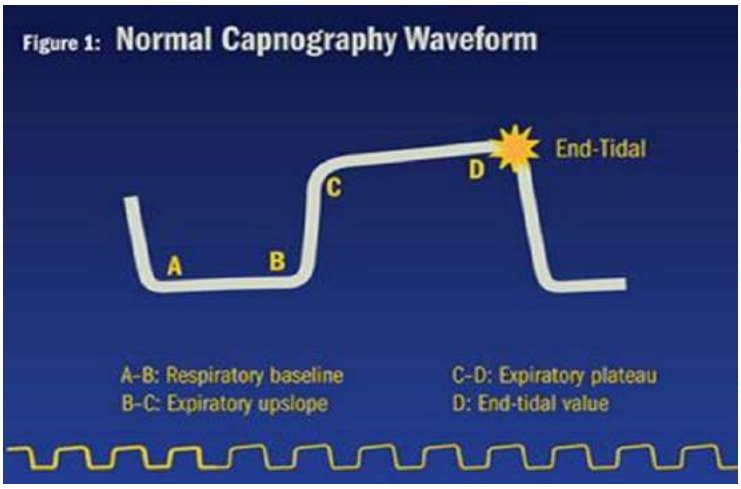
Where to Place the Probe: Because the probe uses light transmittance, it only works well on non-pigmented areas. Lip; Finger; Ear; Penis; Vulva. The light should point at the pink tissue. It works best if the contact mucosa is moist.

Capnograph = Monitoring Ventilation: Breathing ≠ Ventilation.

Ventilation: The exchange of air between the lungs and the atmosphere so that oxygen can be exchanged for carbon dioxide in the alveoli.



Capnograph measures ETCO2. ET = End Tidal = at the end of exhalation. CO2 = the partial pressure of carbon dioxide in the exhaled air. Normal range = 35-45mm Hg. >45 means the patient is not breathing frequently or deeply enough. The patient is not properly ventilated. <35 means the patient is breathing too much (hyperventilating). Therefore……if the ETCO2 is too high, you need to provide supplemental breaths 10x/minute until the ETCO2 returns to normal.



Anesthesia Monitors: Monitors do not replace people, they complement them. Monitors are developed to evaluate different system functions to provide a more comprehensive view of patient status. Do your homework so you

know how to properly use monitors to get accurate results. Do your homework so you know how to interpret results and respond to abnormal results.

Definitions to help understand anesthetic drugs:

Sedative: calms a patient, easing agitation and permitting sleep

Anxiolytic: reduces anxiety and panic

Amnesic: blocks the memory of the anxiety-producing event

Analgesic: reduces sensation of pain, usually without loss of consciousness

Anesthetic: completely eliminates the sensation of pain AND renders the patient unconscious

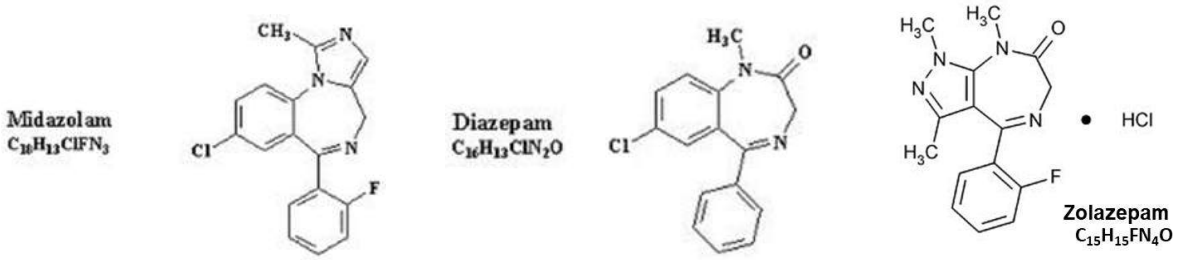
Muscle relaxant: relaxes skeletal muscle

Review of Anesthesia Drugs:

Sedatives and anxiolytics:

- Benzodiazepines (diazepam, midazolam, zolazepam)
- Alpha2-agonists – (xylazine, medetomidine, dexmedetomidine)
- Induction agents
- Cyclohexamines (ketamine, tiletamine)
- Maintenance agents
- Inhalational anesthetics (isoflurane, sevoflurane)
- Intravenous anesthetics (propofol)

Sedatives and Anxiolytics: Benzodiazepines. Benzodiazepines are centrally active sedatives whose structures are composed of a benzene ring fused to a seven-member diazepine ring. Two commonly used benzodiazepines are Midazolam and Diazepam. The structurally similar Zolazepam is also commonly used in veterinary medicine and is typically combined with the cyclohexamine Tiletamine to make the induction agent Telazol. Note that Zolazepam is missing the benzene ring that is bound to the diazepine ring.



Sedatives: Systemic Effects

Cardiovascular - No significant reduction in heart rate / Approximately 10% decrease in MAP (mean arterial pressure).
Respiratory - No significant decrease in minute ventilation / 40% decrease in VT (tidal volume) / 40% increase in frequency.

Foster, et al., Respiratory effects of Different Doses of Midazolam and Lack of Reversal with Naloxone – A Double-blind Randomized Study; Anesthesia and Analgesia, vol. 62, no. 10, 920-924. While the benzodiazipines have only

minimal systemic effects when given alone, they potentiate the systemic effects of other drugs. Benzodiazepines significantly increase the respiratory depression produced by opioid drugs.

Sedatives: Pharmacokinetics. Administration: Oral, IV or IM / Metabolized primarily in the liver / Metabolites are excreted by the kidneys.

	Diazepam	Midazolam	Zolazepam
Time to peak effect	1-1.5hr	20 min	?
Half-life	21-37hr	1-4hr	1-1.5hr
Duration of effect	4-6hr	1-4hr	?

Benzodiazepines can be administered orally, nasally, intravenously or intramuscularly. They are metabolized in the liver by either hepatic microsomal oxidation or hydroxylation and conjugation. Many hydroxylated metabolites are biologically active with long half-lives. The metabolites are excreted by the kidneys. Benzodiazepine activity is prolonged in hepatic and renal failure.

α2-Adrenoreceptor Agonists - Xylazine, Medetomidine, Dexmedetomidine:

Effects in the brain - Sympatholytic effects (Sympathetic nervous system controls the actions of consciousness) / Sedative / Analgesic /

Effects in the dorsal horns of spinal cord – Analgesic / Vasoconstriction

Alpha-2 agonists – Pharmacodynamics:

Pharmacokinetics - Distribution ½-life = 6 minutes / Elimination ½-life = 2 hours
Metabolism - Biotransformation in the liver to inactive metabolites / Excretion 95% excreted in urine

Medetomidine and Dexmedetomidine Sedation:

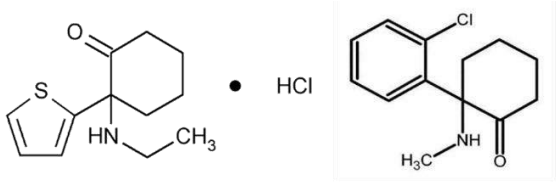
Sub cortical in origin / Does not involve GABA system - Site of action different than the benzodiazepines / Sleep most closely resembles natural sleep / High safety profile - Reports in humans have shown that inadvertent administration of doses sixty times the intended dose produced no significant adverse outcomes.

Side effects: Most common side effect is a transient increase in blood pressure and bradycardia.

Induction of Anesthesia:

Cyclohexamines - Ketamine or Telazol are the most commonly used. / Used either alone or in combination with other sedatives - Benzodiazepines / α2-agonists. / Can be administered intramuscularly, orally, rectally or intravenously.

Cyclohexamines Tiletamine Ketamine



Systemic Effects of Ketamine:
Cardiovascular - Increased HR, BP, CVP, CO / Baroreceptor function is maintained.
Respiratory – Bronchodilation / Increased respiratory rate / Relative preservation of airway reflexes.
CNS - Significant vasodilation resulting in increased cerebral blood flow / Increased ICP / Increased IOP
ANS - Increased salivation, nausea and vomiting.

Injectable Induction Agents:

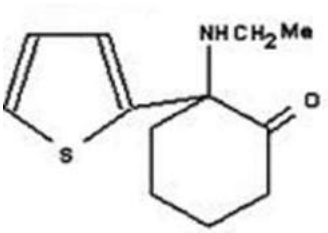
Drug	Chimpanzee	Gorilla	Orangutan
Ketamine	5-20mg/kg	6-10mg/kg	6-10mg/kg
Ketamine/ Xylazine	10-20mg/kg 1mg/kg		5-7mg/kg 1-1.4mg/kg
Ketamine/ Medetomidine	2-5mg/kg .02-.05mg/kg	2-5mg/kg .02-.05mg/kg	
Ketamine/ Midazolam		9mg/kg .05mg/kg	1-2mg/kg .03mg/kg
Tiletamine/ Zolazepam (Telazol)	2-6mg/kg	2-6mg/kg	2-6.9mg/kg
Telazol/ Medetomidine	1.25mg/kg .03-.04mg/kg		.8-2.3mg/kg

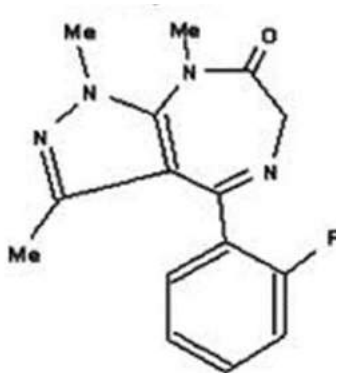
(Mammal Anesthesia; Chapter 33; table 33.1,)

Induction Of Anesthesia:

Induction agent(s)	Route of administration	Dose	Comments
Ketamine	IM	8-12mg/kg	Hypertension, increased ICP
Telazol (tiletamine-zolazepam)	IM	3-5mg/kg	Induction in 5-8 minutes
Telazol/ Ketamine	IM	2-4mg.kg 1-4mg/kg	Reliable, smooth induction
Ketamine/ midazolam	IM or Oral	5-10mg/kg 0.1-0.2mg/kg	Can give midazolam p.o.
Ketamine/ Medetomidine	IM	3-7mg/kg 30-40µg/kg	Unreliable, spontaneous arousal
Ketamine/ Midazolam/ medetomidine	IM	5-8mg/kg 0.1-0.2mg/kg 10-15µg/kg	Better than Ketamine/midazolam

Telazol: 1:1 combination of Tiletamine and Zolazepam





Combination of Telazol and Ketamine: Fort Worth Zoo:

Telazol dose	Ketamine dose	Onset of sedation	Time to recumbency
Mean: 2.96 mg/kg Range: 1.1-4.7 mg/kg	Mean: 2.81 mg/kg Range: 1.06-7.92 mg/kg	Mean: 5.63 minutes Range: 2-21 minutes	Mean: 14.47 minutes Range: 5-39 minutes

Medetomidine-Ketamine (M-K) vs. Medetomidine-Telazol (M-T):

	M-K	M-T
Time to sedation	2-5 minutes	2-5 minutes
Time to light anesthesia	3-15 minutes	5-10 minutes (deeper plane of anesthesia)
MAP (early)	121±8 mmHg	119±11 mmHg
MAP (at 50 min)	89±15 mmHg	73±7 mmHg
Heart Rate (early)	78±11 bpm	83±12 bpm
Heart Rate (at 50 min)	67±7 bpm	68±14 bpm
Respiratory rates (50 min)	31±8 resp/min	24±5 resp/min
$EtCO_2$	37-44 mmHg	Same
Oxygen saturation	93-100%	Same

(Horne, et al. 1998 Proceedings AAZV and AAWV Joint Conference p.22-25)

Recovery times for M-K vs. M-T: Anesthesia reversed with the α2-antagonist atipamezole - First signs of recovery 8-10 minutes in both groups / Full recovery (standing, alert, vocalizing, climbing) - M-K within 10-13 minutes / M-T 1-5 hours - Also showed signs of extreme drowsiness, dizziness, ataxia and GI disturbance.

Oral versus Intramuscular:

Naples *et al.,* Proceedings AAZV AAWV Joint Conference, 2009. Compared the anesthetic effects of oral verses injectable medetomidine with telazol in seventeen chimpanzees.

Raphael *et al.,* Proceedings AAZV, AAWV, ARAV, NAZWV Joint Conference, 2001. Pretreated Five 4-year-old gorillas with 5mg diazepam, orally - 2 hours prior to hand injection of ketamine.

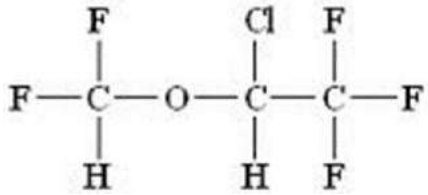
Miller *et al.,* Proceedings AAZV and IAAAM Joint Conference, 2000. Oral detomidine (α2-agonist) and ketamine given for induction in six gorillas prior to darting with Telazol.

All reported reduced stress reaction associated with intramuscular injection after receiving oral premedication.

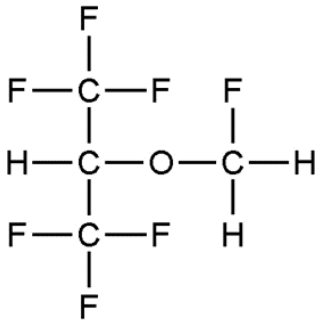
Maintenance of Anesthesia: Inhalational Anesthetics / Intravenous Anesthetics

Inhalational anesthesia: Most commonly used inhalational anesthetics:

Isoflurane



Sevoflurane



Minimum Alveolar Concentration (MAC): The concentration at 1 atm that prevents response to noxious stimulus in 50% of subjects. Isoflurane MAC = 1.15% / Sevoflurane MAC = 1.71%. Therefore, Isoflurane is more potent that Sevoflurane - Cannot put Isoflurane in a Sevoflurane vaporizer or visa versa.

Solubility: Solubility is measured by the Blood:gas partition coefficient (λ). The less soluble the gas, the faster the onset and offset of the anesthetic effects. Sevoflurane (0.59) < Isoflurane (1.4) - Sevoflurane is less soluble than Isoflurane - Sevoflurane theoretically has a faster onset and offset than Isoflurane - However, we have experienced prolonged emergence times with Sevoflurane.

Intertissue Diffusion: Five compartments for tissue uptake of inhalational anesthetics:

Lungs → Vessel rich groups (brain) →muscle → bone marrow → fat

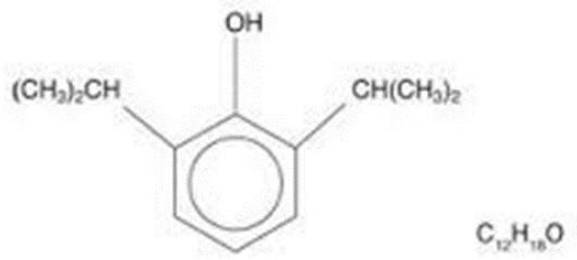
Central Nervous System Effects: Inhibition of synaptic transmission - Especially in the reticular activating system - Peripheral nerves continue to conduct normally. / Meyer-Overton Theory - Gas molecules dissolve in hydrophobic sites such as lipid cell membrane and distort Na+ channels and reduces Na+ conductance. / Protein Receptor Hypothesis - Inhibit the breakdown of GABA in the CNS.

Respiratory Effects: Pattern of breathing - Dose dependent increase in frequency of breathing. / Ventilatory response to CO2 - Dose dependent decrease in response to PaCO2. / Ventilatory response to hypoxemia - Profound depression of the ventilatory response to hypoxemia normally mediated by the carotid bodies. / Airway resistance - Dose dependent reduction of airway resistance.

Cardiovascular Effects: Myocardial contractility - Direct myocardial depression - Inhibition of CNS sympathetic outflow - Decreased carotid sinus reflex activity. / Peripheral vascular smooth muscle tone - Up to fourfold

increases in skeletal muscle blood flow - Can lead to significant hypotension. / Autonomic nervous system activity - Decreased adrenal release of catecholamines.

Intravenous Anesthetics: Propofol - Ultra-short acting sedative hypnotic. Substituted isopropylphenol 1% solution. Site of action is the β-subunit of GABA receptors in the CNS.



Dosing: Induction: 1-2mg/kg. Maintenance: 25-100µg/kg/min - This dose is five to ten times less than the dose used in humans (150 - 250µg/kg/min).

Propofol Pharmacokinetics: IV use only / Rapid onset within 30 seconds of injection / Short duration of action - Rapidly metabolized in the liver - Plasma clearance exceeds hepatic blood flow - due to redistribution to inactive tissues - Also metabolized by cytochrome P450 enzymes in plasma and tissues - Clearance not changed in liver failure. / Elimination half time is .5 – 1.5 hours.

Systemic Effects: Cardiovascular- Induction dose (2-2.5mg/kg) can produce a 25-40% decrease in systemic blood pressure.

Cardiac output	Decreased ≈ 15%
Stroke Volume	Decreased ≈ 20%
Systemic vascular resistance	Decreased ≈ 15-25%

Respiratory - Induction dose produces apnea and abolishes airway responses to intubation.

Anesthesia Jeopardy – Break Out Session - All Particpants

By using teams the veterinarians can learn from each other during problem-solving and competitive gaming. Break into 6 teams. Each team will work through 5 anesthesia challenges. Following this converge to three teams and play "Anesthesia Jeopardy". The questions will cover a variety of topics in anesthesia, with points awarded. One team will be crowned the winner and prizes awarded.

An Overview of Respiratory Disease Complex of Orangutan

Nancy P. Lung, VMD, MS. Veterinary Advisor, North American Orangutan Species Survival Plan. Editor-in-Chief, Journal of Zoo and Wildlife Medicine

This session will be divided into three sections. The first (presented by Nancy Lung) will review orangutan respiratory anatomy, pathologies that can occur in each part of the respiratory tract, and how we define Chronic Respiratory Disease of Orangutan (CRDO). Part II (presented by Yayan of BOSF) will review the work that is being done at BOSF Samboja to better understand CRDO and its treatment. He will present the grant that was received

through the American Association of Zoo Veterinarians Wild Animal Health Fund to assess the efficacy of treatment strategies for CRDO. Part III (presented by Jennifer Taylor-Cousar) will review treatment options for respiratory disease in general, including antibiotics, anti-inflammatories, bronchodilators, nebulization and mechanical treatments.

Orangutans are of interest regarding respiratory ailments because they do not react as other great apes do – including humans. When they have a respiratory episode they do not recover as quickly as gorillas, chimps, bonobos and humans do. Where a human will get ill, their lungs will heal, and they are well again. Orangutans are never free of it and will continue to be weakened by it.

There are several ailments that occur: Sinusitus – orangutans do not have frontal sinuses – with sinusitis there is fluid production (muchal purulent material with thickened lining) - can be diagnosed with CT scan – fairly common with orangutans is to see left or right sinus clear and the other completely blocked.

All great apes have air sacs but in the orangutans it is very prominent (humans air sac is mostly vestigial). In males, the orangutan air sac covers the neck region, down under the arm and up the back to the rear of the neck – which leaves a lot of room for pus to fill. Sometimes it is difficult to tell pus from fat. There was an orangutan that had an enlarged throat sac – they thought it was air sacculitus, but what he had was a heart issue – be open to problems with a throat sac being something other than air sacculitus.

Air sacculitis – it is the most reported, but it is not the most common (sinusitis is). Liquid pus is the easiest to clean out, the more peanut butter consistency is much for difficult – in chronically infected ones it is much more intense in structure that can block airways.

The impact of Respiratory Disease: Negative impact on the population / Reduced quality of life for the individual / Disruption of routines and social relationships / Drain on institutional resources

Orangutan Respiratory Disease:
North American Mortality Data 1980-2008 - respiratory disease is the most reported cause of death in adolescents / Accounts for 15.7% of adult mortalities.
2012 North American Health Survey - Respiratory infection #1 concern / 38% institutions manage chronic respiratory disease.
2009 European Health Survey - 20.4% of all animals had chronic URTD or air sacculitis
2017 informal health updates - Eight animals being managed for chronic disease

Orangutan Lungs in the Literature (Courtesy of J.T-C)

Year	Type	Subject	Author
1976	N=1	Plumonary nocardiosis	McClure
1979	N=1	Infant strongyloidiasis	Uemura
1980	N=1	Fatal air saculitis and pneumonia	Cambre
1981	N=1	Acinetobacter pneumonia	Iverson
1987	review	Air sacculitis in orangutans and chimpanzees	Goeltenboth
1995	N=1	Sinusitis with intracranial extension	Cambre
1995	N=1	Tuberculosis	Shin
2004	N=1	Orangutan herpesvirus	Sakulwira
2006	14 air sac cases	14 cases of air sacculitis at a rescue center	Lawson
2011	European study	Review across 20 European zoos	Zimmerman
2014	N=1	CF treatment on a chronic case	Weinreich
2014	serosurvey	Great ape serology to human resp viruses	Buitendijk

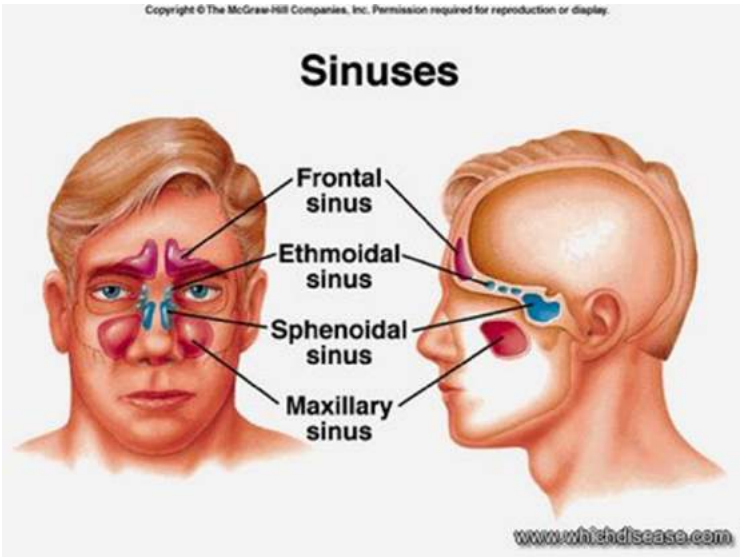
2014	N=1	Metacestode acute respiratory distress	Goldberg
2014	N=1	Strep pneumonia	Ihms
2016	N=1	Infant pneumonia in Malaysia	Dharmalingman
2016	N=1/CF	Chronic resp case--could this be CF?	Stringer

Orangutan lungs in the literature: AIR SACCULITIS IN FOURTEEN JUVENILE SOUTHERN BORNEAN ORANGUTANS (Pongo pygmaeus wurmbii). Lawson B., Garriga R, Galdikas BM. J Med Primatol. 2006 Jun;35(3):149-54.

RDCO - Respiratory Disease Complex of Orangutan - Remember it!! Use it!!

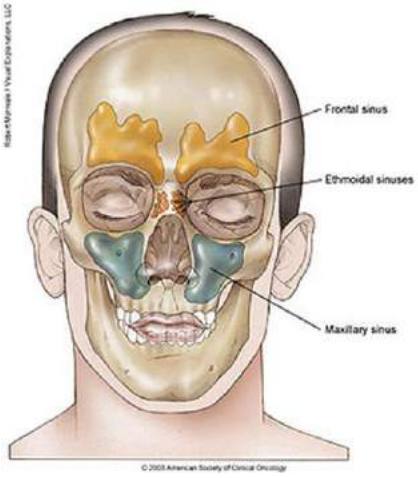
Anatomy: Main differences between apes and humans occur in the upper respiratory tract (Upper = sinuses, larynx, air sacs / Lower = trachea and lungs). Sinuses - Specific species differences. Laryngeal air sac - Specific species differences. Lower tract virtually ***the same*** across species.

Sinus Anatomy: (human and gorilla)

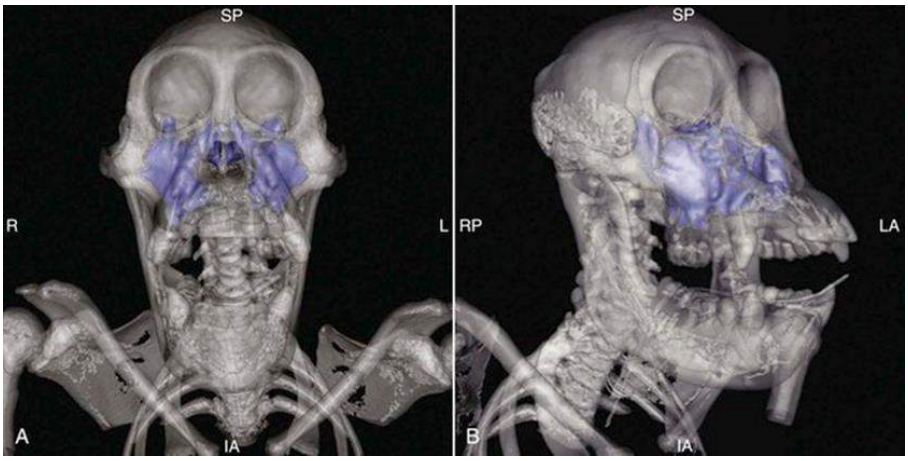


Sinus Anatomy: Orangutans lack frontal sinuses and ethmoid air cells. The maxillary and sphenoid sinuses in humans and orangutans are similar but sometimes a bit larger in the orangutans.

Human

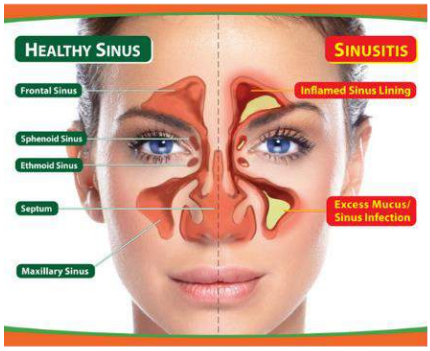


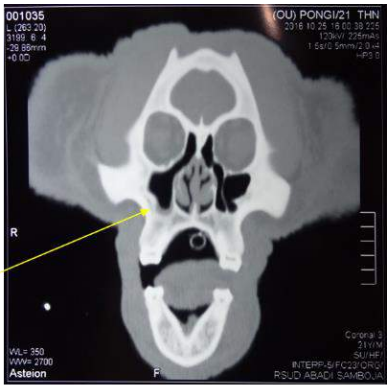
Orangutan

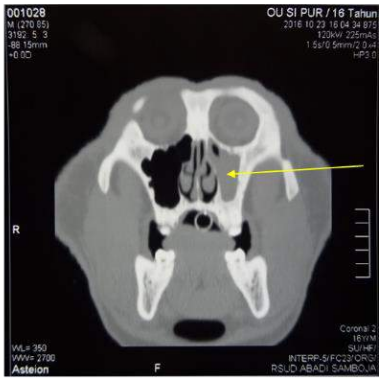


https://www.lasinus.com/conditions/nasal-and-sinus-anatomy/ https://veteriankey.com/computed-tomography-for-the-diagnosis-ofsinusitis-and-air-sacculitis-in-orangutans/

Sinusitis: Under-diagnosed and under-appreciated as a cause of morbidity in orangutans. Is sinusitis a risk factor for the development of air sacculitis/pneumonia? Yes, it probably is!! Don't ignore a runny nose.



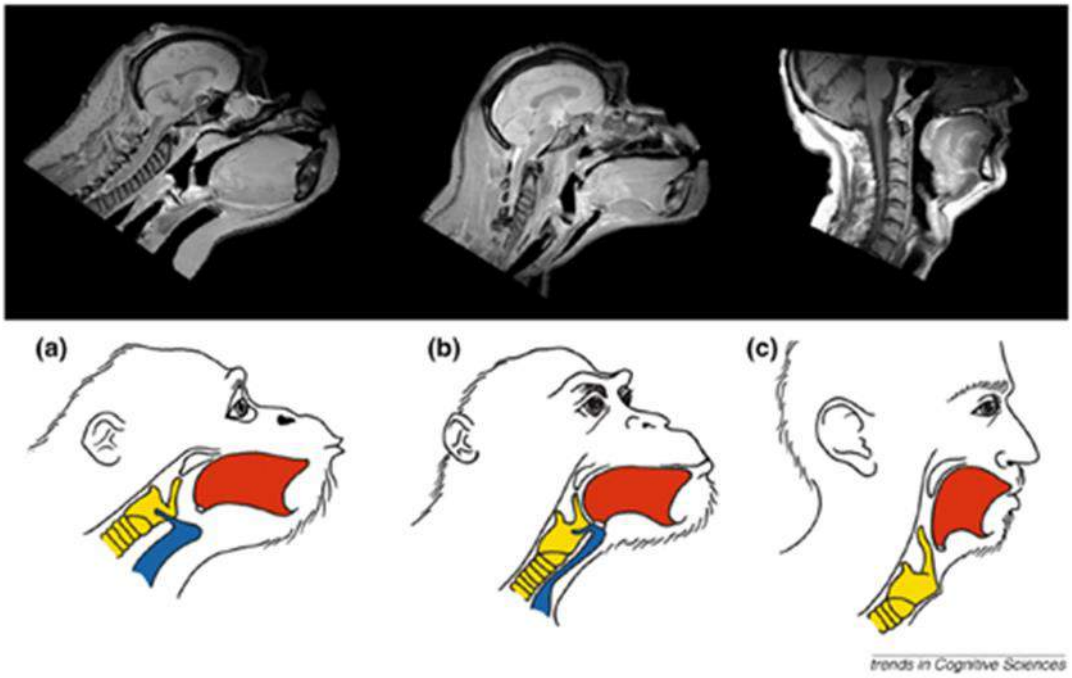




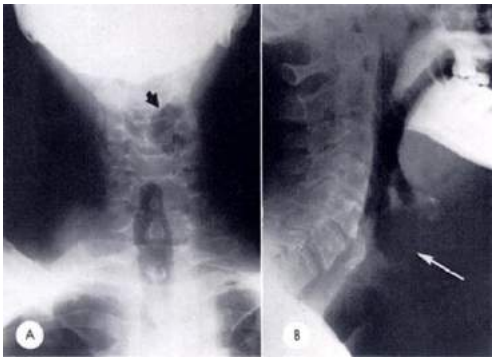
Laryngeal Air Sac Anatomy: Orangutans, Chimps and Gorillas all have paired laryngeal air sacs. Small, asymmetric in chimps and gorillas; Large and extensive in orangutans. Increases in size and complexity with age and gender.

Adult female orangutan

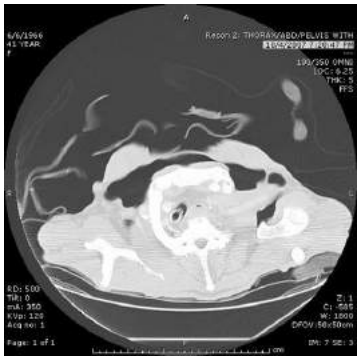
https://veteriankey.com/computed-tomography-for-the-diagnosis-of-sinusitis-and-air-sacculitis-in-orangutans/



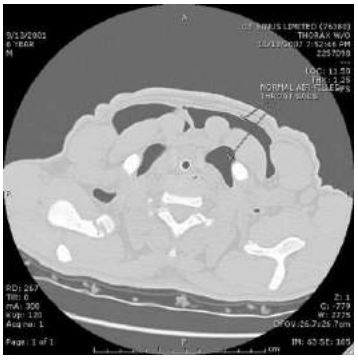
Human with “laryngocoele”



Gorilla normal throat sac

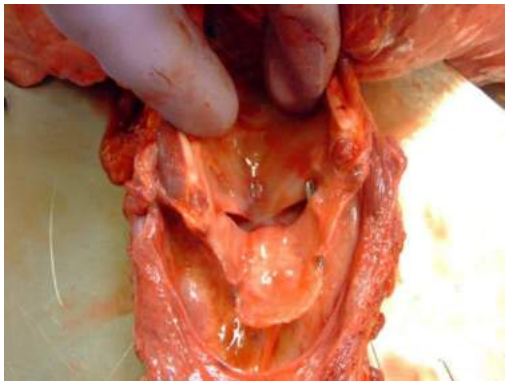


Orangutan normal throat sac

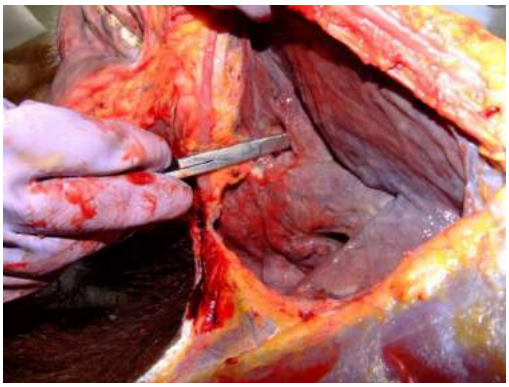


The Air Sac Enlargement: Air—vocalizations, behavioral trait / Fat—common in both sexes / Purulent material - Liquid pus - Thick, compressible pus / Edema

Ostia communicating with the larynx

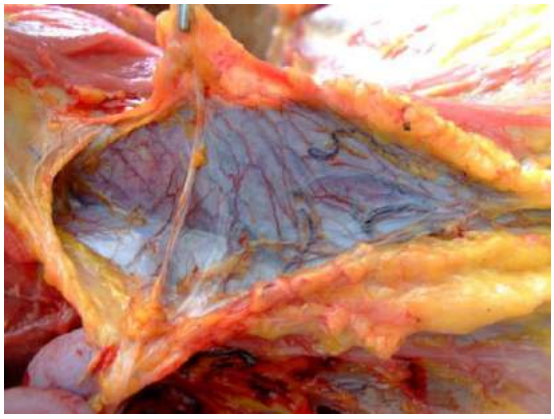


Internal view of the opening

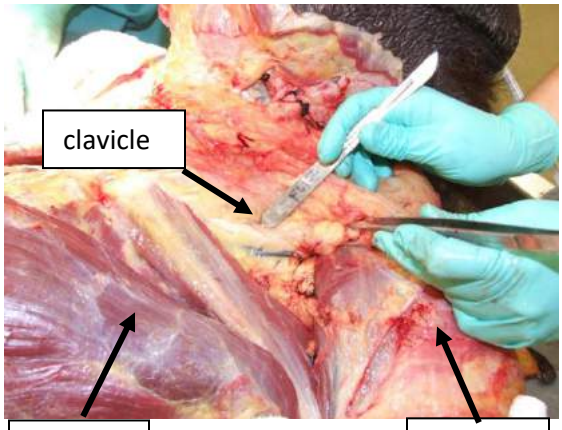


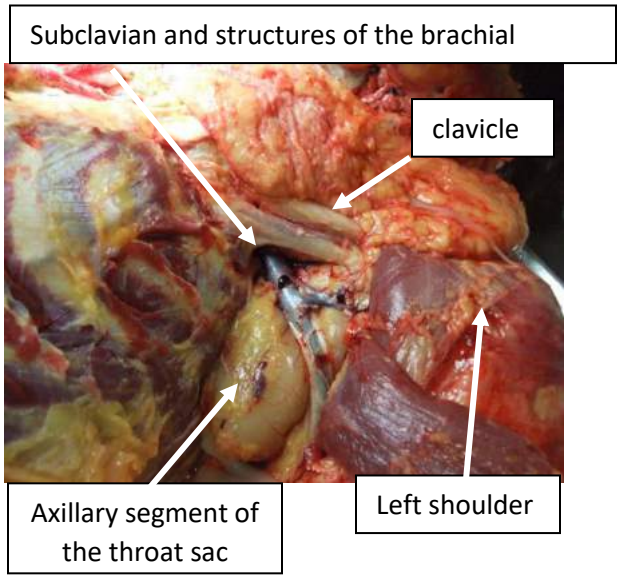
Thin-walled healthy mucosa

Thick, vascular mucosa with chronic infection

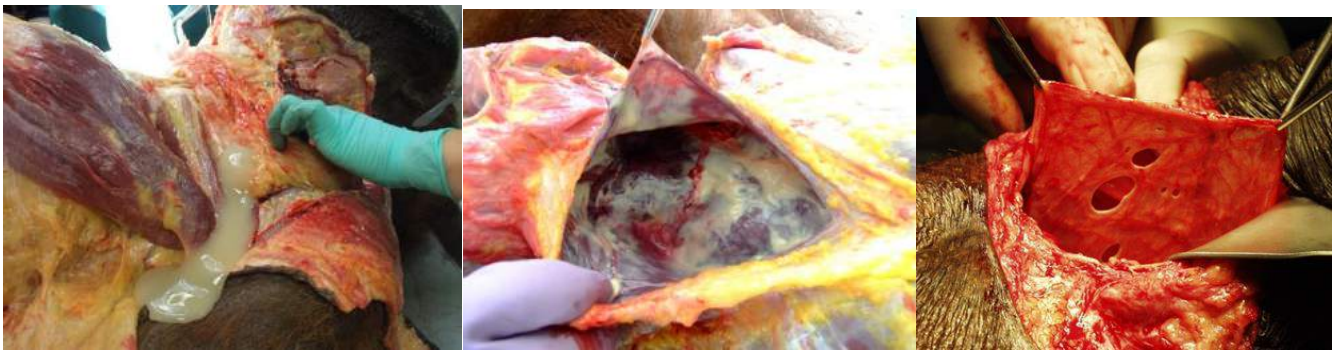


Head

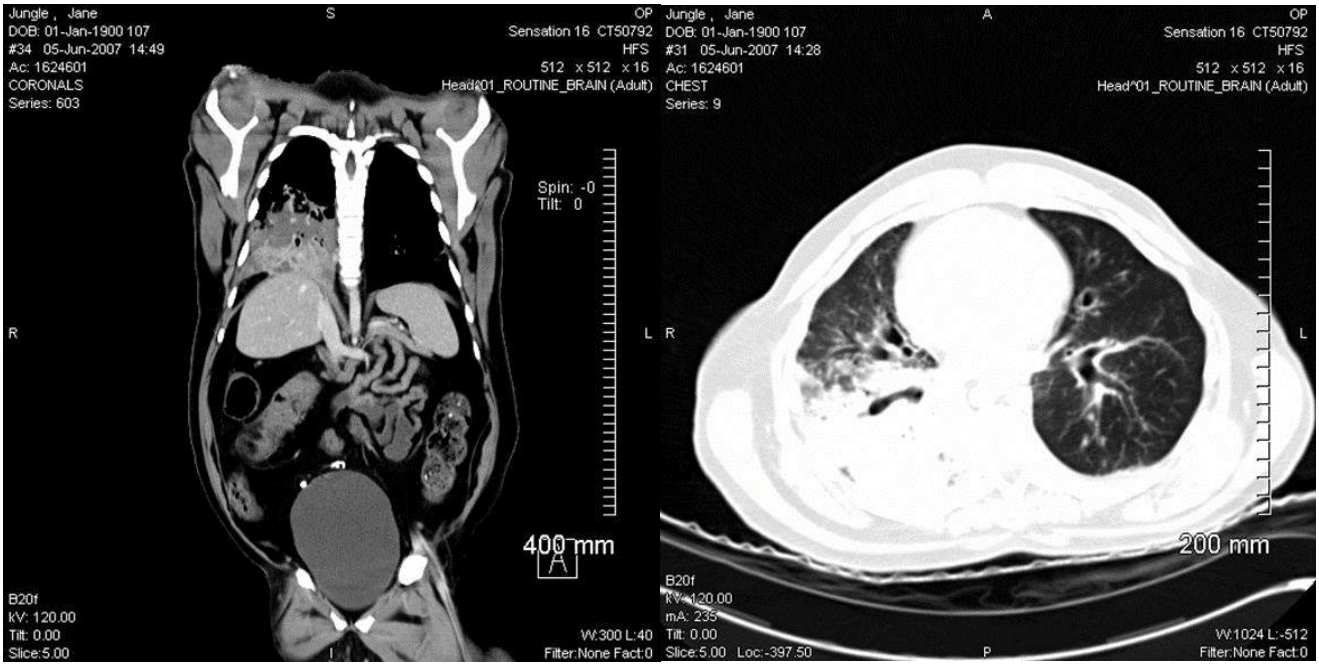




Air sacculitis: Most commonly reported respiratory disease in zoos. Can lead to secondary aspiration pneumonia. Mixed bag bacterial involvement. Typically, no viral or fungal component. Pus varies from liquid to “peanut butter”. Mixed mainly enteric Gram negative. Fibrous bands in chronically infected air sacs may form compartments.



Lower Respiratory Tract - Pneumonia: The under-appreciated culprit: Pneumonia / Bronchiectasis: 24% (humans--~1%) / Undiagnosed: Many more.



The similarities to cystic fibrosis are striking. Genetic/ultrastructural explanation? Orangutans with RDCO respond to CF therapy in a positive way.

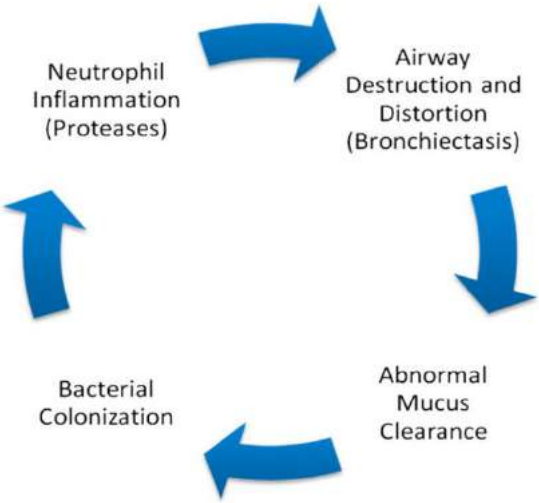
What is Bronchiectasis? From Greek words: Bronckos – airway Ectasis – widening

Imaging of Bronchiectasis:

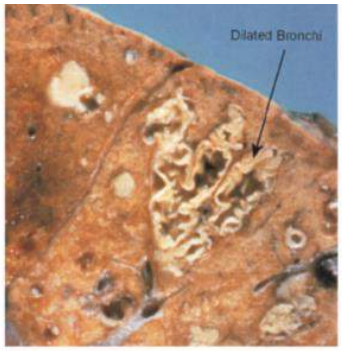
The specific criteria include the following: (1) The internal diameter of the bronchus is larger than that of its accompanying vessel; or (2) the bronchus fails to taper in the periphery of the chest

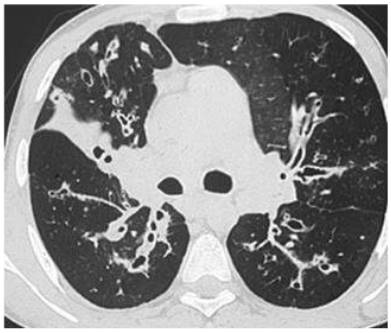
Case courtesy of Dr Ian Bickle, Radiopaedia.org, rID: 34599; McShane et al AJRCCM 2013; 188(6): 647-56

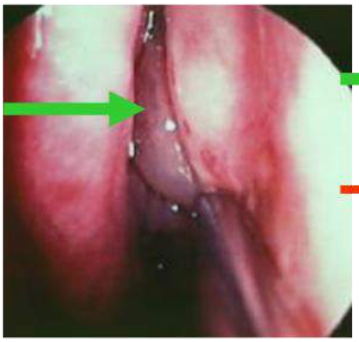
Vicious Cycle of Lung Destruction: McShane et al AJRCCM 2013; 188(6): 647-56.

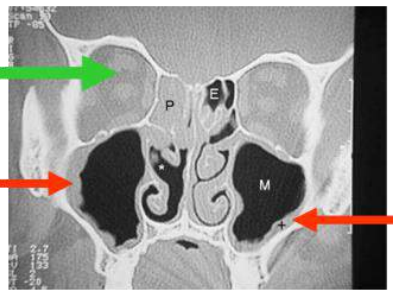


Respiratory Manifestations: Pulmonary infections – Cough / Sputum production / Chest pain / Airway reactivity Sinus disease - Nasal polyps / Chronic sinusitis









Slide courtesy of Jennifer Taylor-Cousar

Take Home Messages: DO NOT think of the sinuses, air sacs and lungs as three separate systems. They are ALL CONNECTED! What happens in one impacts the other. Embrace RDCO—think broad and long-term from the beginning. If you don't look for it you won't find it!

Identification of Respiratory Disease by Clinical Signs: Chronic nasal discharge / Sneezing / Enlarged, pendulous air sac / Coughing / Abnormal breathing pattern / Raspy breathing sounds / Foul smelling breath / Evidence of chronic headache.

A rare opportunity to study RDCO: Zoos only have a few animals per institution, so cross-sectional studies are difficult. Rescue centers are the perfect venue in which to study and better understand CRDO!

Chronic Treatment of Bronchiectasis: Principal One: Mobilize airway secretions (airway clearance) / Principal Two: Control airway infection.

Chronic Respiratory Disease: Diagnosis and Treatment

Jennifer L. Taylor-Cousar, MD, MSCS, ATSF; Associate Professor of Medicine and Pediatrics, Divisions of Pulmonary, Critical Care and Sleep Medicine and Pediatric Pulmonary Medicine; Medical Director, Clinical Research Services Co-Director and CF TDN Director, Adult CF Program, National Jewish Health

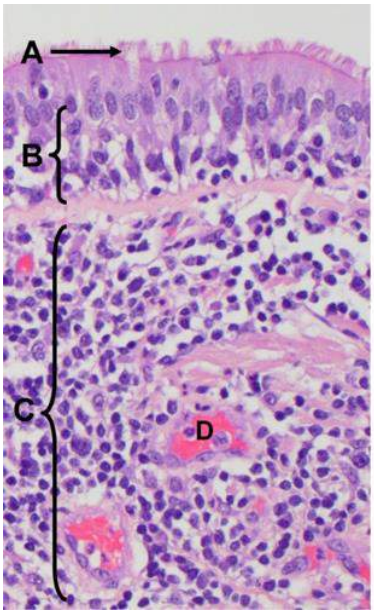
Sinusitis: Acute or chronic inflammation and infection of the lining of the sinus cavity.

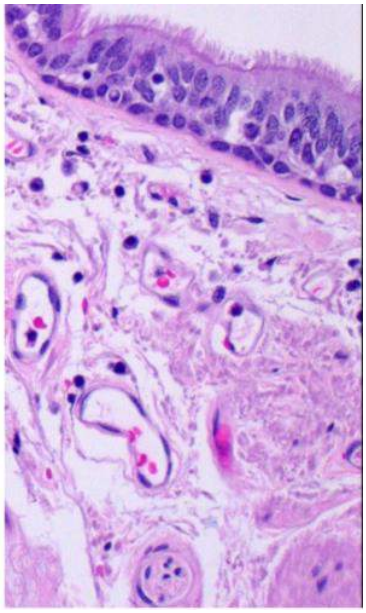
Signs and Symptoms: Nasal congestion / Nasal discharge / Cough / Postnasal drip / Halitosis / Sinus pain / Headaches / Fever / Malaise.

Physical Exam: Vital signs - Increased temperature. HEENT exam - Pain on palpation of sinuses / Facial swelling / Erythematous, edematous turbinates / Cervical lymphadenopathy.

Treatment of Sinusitis: Chronic treatment - Nasal washes / Nasal steroids / Nasal antibiotics. Acute treatment - Oral antibiotics.

Pathology of Bronchiectasis:





A = pseudostratified columnar, ciliated epithelium;

B = thickened epithelium with intraepithelial lymphocytes;

C = submucosa with dense infiltrate of lymphocytes and plasma cells;

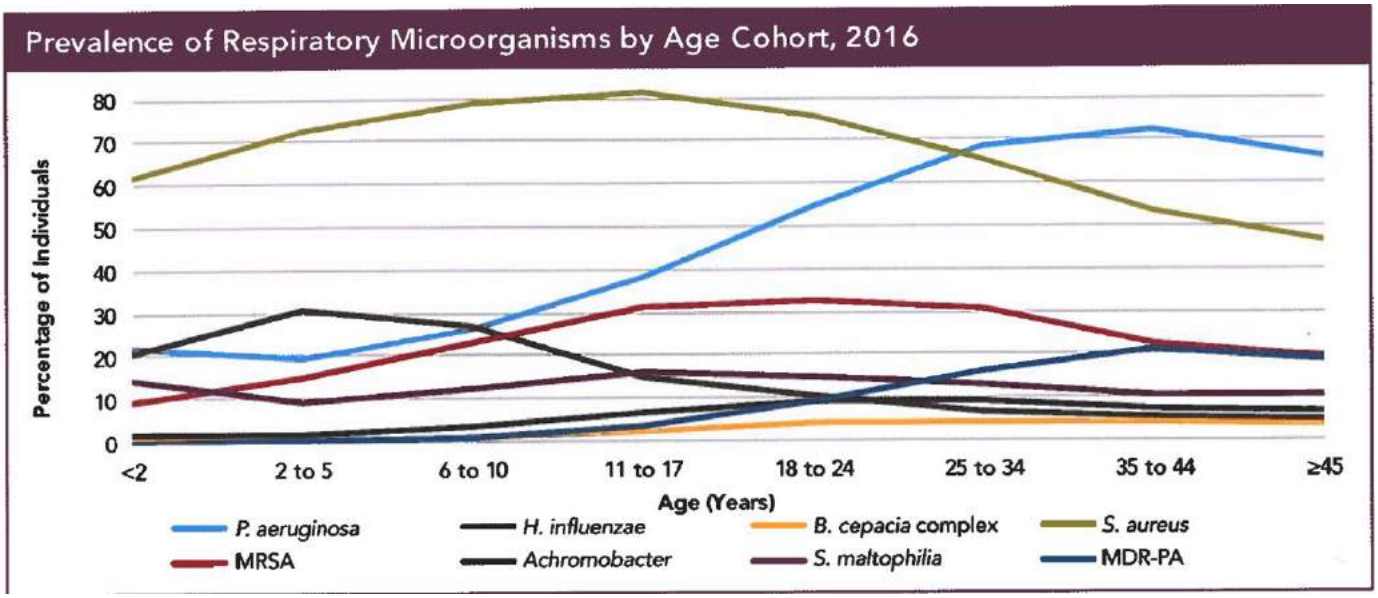
D = blood vessel with reactive endothelial cells.

McShane et al AJRCCM 2013; 188(6): 647-56

Causes of Diffuse Bronchiectasis in Humans: Cystic Fibrosis (CF) / Primary Ciliary Dyskinesia (PCD) / Immunoglobulin deficiency / Young's Syndrome / Rheumatologic Disease / Alpha-1 antitrypsin deficiency / Idiopathic.

Physical Exam: General – Tachypnea / Prolonged expiration. HEENT exam - Nasal flaring / Nasal discharge. Chest exam - Use of accessory muscles. Lung exam – Crackles / Wheezes / Rhonchi.

Prevalence of Respiratory Organisms:



CFF 2016 Annual Patient Registry Report

Diagnosis and Treatment Standards of Care:

Cystic Fibrosis Pulmonary Guidelines
Chronic Medications for Maintenance of Lung Health

TABLE 3. SUMMARY OF RECOMMENDATIONS UNCHANGED FROM PREVIOUS GUIDELINES

Treatment	Recommendation	Certainty of Net Benefit	Estimate of Net Benefit	Recommendation
Inhaled tobramycin—moderate to severe disease*	For individuals with CF, 6 years of age and older, with moderate to severe lung disease and *Pseudomonas aeruginosa* persistently present in cultures of the airways, the CF Foundation strongly recommends the chronic use of inhaled tobramycin to improve lung function and quality of life, and reduce exacerbations.	High	Substantial	A
Inhaled tobramycin—mild disease*	For individuals with CF, 6 years of age and older, with mild lung disease and *P. aeruginosa* persistently present in cultures of the airways, the CF Foundation recommends the chronic use of inhaled tobramycin to reduce exacerbations.	Moderate	Moderate	B
Dornase alfa—moderate to severe disease*	For individuals with CF, 6 years of age and older, with moderate to severe lung disease, the CF Foundation strongly recommends the chronic use of dornase alfa to improve lung function, improve the quality of life, and reduce exacerbations.	High	Substantial	A
Dornase alfa—mild disease*	For individuals with CF, 6 years of age and older, with asymptomatic or mild lung disease, the CF Foundation recommends the chronic use of dornase alfa to improve lung function and reduce exacerbations.	High	Moderate	B
Inhaled hypertonic saline	For individuals with CF, 6 years of age and older, the CF Foundation recommends the chronic use of inhaled hypertonic saline to improve lung function and quality of life and reduce exacerbations.	Moderate	Moderate	B
Azithromycin with *P. aeruginosa*	For individuals with CF, 6 years of age and older, with *P. aeruginosa* persistently present in cultures of the airways, the CF Foundation recommends the chronic use of azithromycin to improve lung function and reduce exacerbations.	High	Moderate	B
Oral antistaphylococcal antibiotics, prophylactic use	For individuals with CF, the CF Foundation recommends against the prophylactic use of oral antistaphylococcal antibiotics to improve lung function and quality of life or reduce exacerbations.	Moderate	Negative	D
Inhaled corticosteroids	For individuals with CF, 6 years of age and older, without asthma or allergic bronchopulmonary aspergillosis, the CF Foundation recommends against the routine use of inhaled corticosteroids to improve lung function or quality of life and reduce pulmonary exacerbations.	High	Zero	D
Oral corticosteroids	For individuals with CF, 6 years of age and older, without asthma or allergic bronchopulmonary aspergillosis, the CF Foundation recommends against the chronic use of oral corticosteroids to improve lung function, quality of life or reduce exacerbations.	High	Negative	D

Moygazel, et al. Am J Respir Crit Care Med Vol 187, Iss. 7, pp 680–689, Apr 1, 2013

Chronic Treatment of Bronchiectasis: Principal One - Mobilize airway secretions (airway clearance). Principal Two - Control airway infection and inflammation.

Airway Clearance: Mechanical. Active Techniques - Forced expiratory technique ("huff maneuver") / Autogenic drainage / Positive expiratory pressure mask / Oral airway oscillators (Aerobika®, Acapella®) / Vigorous exercise. Passive Techniques - High-frequency chest wall oscillator ("Vest") / Intrapulmonary percussor ventilator.

Mobilizing Secretions: Hypertonic saline - Australian study: BID 7% HS for 1 year- Small improvement in pulmonary function / Substantially fewer exacerbations. UNC study: QID 7% HS for 14d / Improved pulmonary function / Improved symptom scores. (Reviewed in Goralski JL, Donaldson SH. Exp Rev. Respir Med. 2014; 8:267-69)

Controlling Airway Infection: Inhaled antibiotics - Target P. aeruginosa / Preventive/maintenance therapy cycled 28 days on/off. Medicines – Tobramycin / Aztreonam / Colistin. (CF antimicrobial treatment recently reviewed: Ann Am Thorac Soc. 2014; 11:1120-29 and 11:1298-1306)

Anti-inflammatory Therapy: In the late 1990s, two reports from Japan describing the use of low dose erythromycin (400-600 mg qd) to treat diffuse panbronchiolitis. Patients had reduced morbidity and mortality. Chronic oral azithromycin (250 mg qd or 500 mg MWF) given to patients with CF - Improved lung function and reduced rate of exacerbation - Antimicrobial and immunomodulatory effects. (Koyama H, Geddes DM. Thorax. 1997;52:915-918; Kudoh S, Azuma A, Yamamoto M, et al. Am J Respir Crit Care Med. 1998;157:1829-1832; Jaffe A, Francis J, Rosenthal M, Bush Saiman L. Pediatr Pulmonol 2012; 47:641-8; Saiman L, JAMA 2010; 303:1707-15.)

Benefit and Risk of Chronic Antibiotic Use: Benefit - Suppress chronic infection/prevent exacerbations that lead to bronchiectasis / Preserve pulmonary function. Risk - Antibiotic resistance.

Antibiotic Resistance: Inhaled antibiotics - Achieve high concentrations in the lung / Long-term, intermittent cycling of inhaled tobramycin, levofloxacin, and aztreonam has been shown to be associated with little increase in in vitro resistance against *P. aeruginosa*. Chronic azithromycin - Cogen et al used data from CF Patient Registry to evaluate emergent resistance among chronic AZM users / Chronic AZM users had a significantly lower risk of detection of new MRSA, NTM, B. cepacia, compared with non-users / Risk of acquiring other pathogens was not significantly different between users and nonusers. (Ramsey et al. N Engl J Med 1999;340:23–30; Konstan et al J Cyst Fibros 2011;10:54–61; Oermann et al Pediatr Pulmonol 2010;45:1121–1134; Cogen et al. Ann Am Thorac Soc 2018;15(6)702-709)

Respiratory Virus Transmission: Incubation period: the time between exposure to infection and symptom onset.

	Range	Central tendency
Adenovirus	4-8	6
Coronavirus		
Human (non-SARS)	2-5	3
SARS-associated	2-10	5
Influenza	1-4	2
Human metapneumovirus	..	..
Measles	8-14	10
Parainfluenza	2-6	4
Respiratory syncytial virus	3-7	5
Rhinovirus	2-4	2

Lessler et at. Lancet Infect Dis 2009; 9(5):291-300

Droplet versus Airborne Masking:

Droplet

- An infection that can be spread through close respiratory or mucous membrane contact with respiratory secretions
- Particles are large and generally travel no more than 3 feet from the patient
- E.g. Influenza, RSV, *N. meningitides*, pertussis, rhinovirus (common cold)
- Requires standard precautions plus **surgical mask**

Airborne

- An infection that can be spread over long distances when suspended in the air
- Particles are very small (<5 µm), can also be transported in dust
- E.g. Chickenpox (varicella), measles, *Mycobacterium tuberculosis*
- Requires standard precautions plus **N95 mask**

www.cdc.gov

Wearing a Mask: Mask should fully cover the nose and mouth, and fit snuggly / Wash hands after removing mask

Signs and Symptoms of Pulmonary Exacerbation:

I		Symptoms
	A	Increased frequency, duration, and intensity of cough
	B	Increased or new onset of sputum production
	C	Change in sputum appearance
	D	New onset or increased hemoptysis
	E	Increased shortness of breath and decreased exercise tolerance
	F	Decrease in overall well-being—increased fatigue, weakness, fever, poor appetite
II		Physical signs
	A	Increased work of breathing—intercostal retractions and use of accessory muscles
	B	Increased respiratory rate
	C	New onset or increased crackles on chest examination
	D	Increased air trapping
	E	Fever
	F	Weight loss
III		Laboratory findings
	A	Decrease in FEV_1 of 10% or greater compared with best value in previous 6 months
	B	Increased air trapping and/or new infiltrate on chest radiograph
	C	Leukocytosis
	D	Decreased Sa_{O_2}

Treatment of Pulmonary Exacerbations: Rx guided by surveillance sputum cultures - S. aureus, P. aeruginosa, other gram negative bacteria - Higher doses of antibiotics and often longer duration - Intensification of airway clearance regimen.

Common Oral Antibiotics:
ciprofloxacin: 750 mg BID x 21 d

levofloxacin: 750 mg daily x 21 d

trim/sulfa: 2 DS tablets BID x 21 d

linezolid: 600 mg BID x 14-21 d

doxycycline: 100 mg BID x 21 d

Common IV Antibiotics:
pipercillin/tazobactam 4.5 g q6h

tobramycin 10-12 mg/kg q24hrs
(can be given IM at 1-1.7mg/kg q8h)

ceftazidime 2-3 g q8h
(can be given IM)

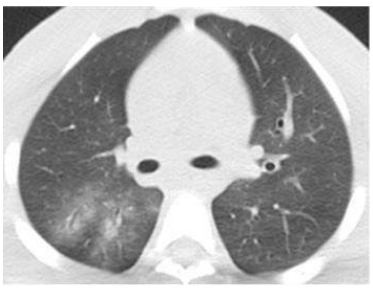
meropenem 2 g q8h

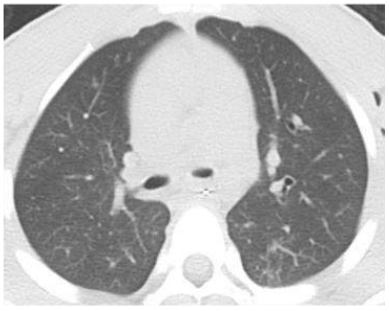
Medical Management of Airway Disease:

Case: Sinusitis and Early Lung Disease: 12 year old orangutan who was documented to have chronic nasal discharge for several years. Cultures showed GNR including Klebsiella, P. aeruginosa and E. coli. He received treatment with augmentin, Cipro and cefoxipime, but sx always recurred. In 2015, he was transferred to the Denver Zoo and was treated with BID Albuterol, BID 7% hypertonic saline, BID inhaled tobramycin (28 days on, 28 days off). Opacification of the paranasal sinuses and nasal passages improved.

2014 2015

Patchy ground glass opacity involving the right upper lobe – resolved on follow up imaging





2014 2015 2017

2014 2018

Summary: Bronchiectasis is a chronic disease. Best outcomes with chronic treatment / Acute "exacerbations" of chronic disease also occur and require additional treatment. Use of hand washing and properly fitting surgical mask should be used to prevent transmission of common respiratory viruses. Although there is some risk of antibiotic-resistance with chronic use, prevention of worsening chronic lung disease is a critical benefit.

Discussion: Bronchiectasis – the cilia do not work properly the vicious cycle – airway walls get destroyed. Cough, sputum, chest pain, airway reactivity (lungs squeeze abnormally) – breathing faster and have to work harder to get air out that has been trapped by mucous. It is typically thought that orangutan are in enclosures but that does not necessarily follow as humans get it too and they are not in enclosures. Thinning the mucous allows for an individual to cough it up (saline). You can train an orangutan to breath into a device that loosens the mucous and allows them to cough it up – especially the thick secretions – being active assists as well. Controlling airway infections – use inhaled anti biotics – go on and off to prevent resistance to any one antibiotic. What about resistance? Look at benefits and risks. Transmission, If orangutan workers are exposed at home – they could be carrier something but no symptoms as yet – so masks are important if they feel they have a sick person at home; But masks need to be worn properly and be tight and tied and after removal you need to wash your hands.

Continued Investigations into Chronic Respiratory Disease at BOSF Samboja Lestari

Yayan Oki Istyan, BOSF

Abstract

This represents a brief overview of orangutan respiratory disease (Chronic Respiratory Disease in Orangutan - CRDO) in Samboja (BOSF) and covers initial work on diagnostics and treatment since 2016 from a grant received for treatment trial using protocols from human cystic fibrosis therapy

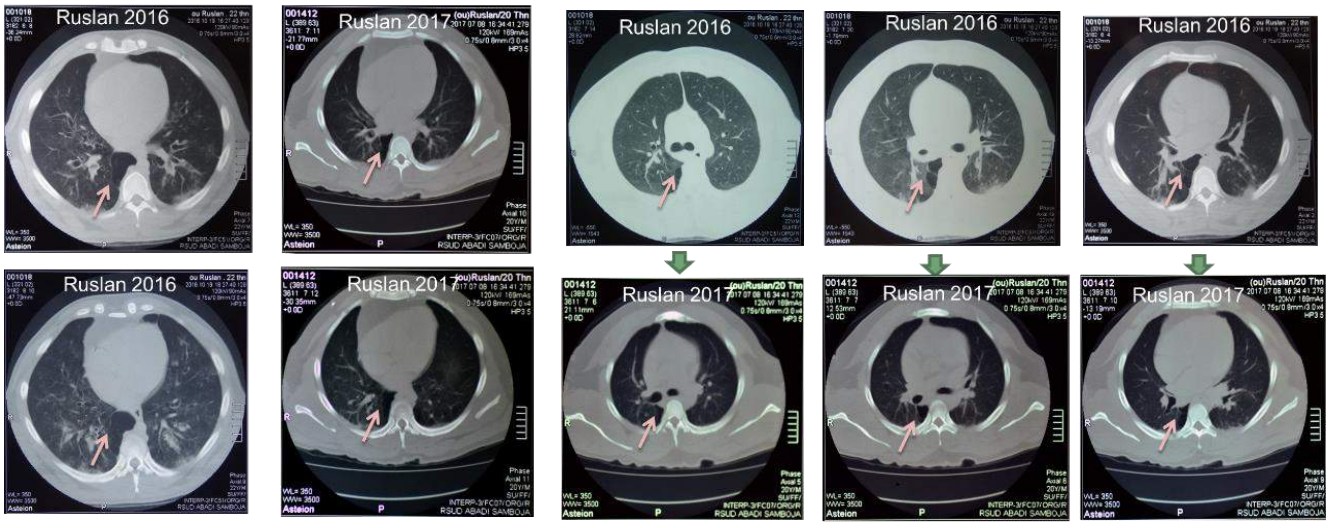
BOSF Samboja Lestari houses 176 orangutans. There are currently 38 adult permanent ex-TB captives; 74 adults ages 14 to 31 years (long term captives), and 58 that are in the forest school pre-release program. There are also 28 individuals that have been identified with respiratory disease varying from 6 to 25 years of age.

Clinical signs for identification of respiratory disease are: nasal discharge, audible respiratory sounds, air saculitis, coughing, and behavioral signs of headache. The use of traditional diagnostic tests has proved frustrating. Use of skull x-rays to look for sinusitis (Water's view x-ray) are not useful in orangutans due to the anatomy of their maxilla and sinuses. Use of chest x-ray to look for pneumonia and bronchiectasis can detect some pneumonia but is not sensitive enough for bronchiectasis in its early stages. Use of aerobic culture from nose, air sac and lungs produces a wide range of opportunistic bacteria. Auscultation of the lungs often shows them as normal.

Use of a CT scan is the only good option. BOSF Samboja Lestari has conducted 20 CT scans on 13 orangutans. The team at Samboja Lestari has developed a good working relationship with the radiology department at Samboja General Hospital (Rumah Sakit Umum Daerah (RSUD).

Once CRDO is diagnosed, treatment is started using: *Levofloxacin, Azithromycin, Salbutamol* with various doses and durations depending on severity.

Orangutan Ruslan: Permanent bronchiectasis and emphysema at right lung, no new inflammation, no pneumonia.



The next logical step: From the promising results of the initial cases, the treatment protocols need to be standardized and the treatment protocols need to be rigorously assessed. The only down side is that the treatments are expensive! Grant money is needed to help cover the costs. A grant has been written for this purpose. The title: Improving the Management of Chronic Respiratory Disease in Captive Bornean Orangutans (*Pongo Pygmaeus*) Utilizing Cystic Fibrosis Therapies In an Orangutan Rehabilitation Program In East Kalimantan, Indonesia. It was submitted to the Wild Animal Health Fund of the American Association of Zoo Veterinarians to: "optimize the health, welfare and conservation of zoo animals and wildlife through critical research and studies." This is the ONLY wild animal health program solely dedicated to funding professional veterinary studies to improve the health of zoo animals and wildlife. It is funded through private donations. Grant amount: $10,000 USD.

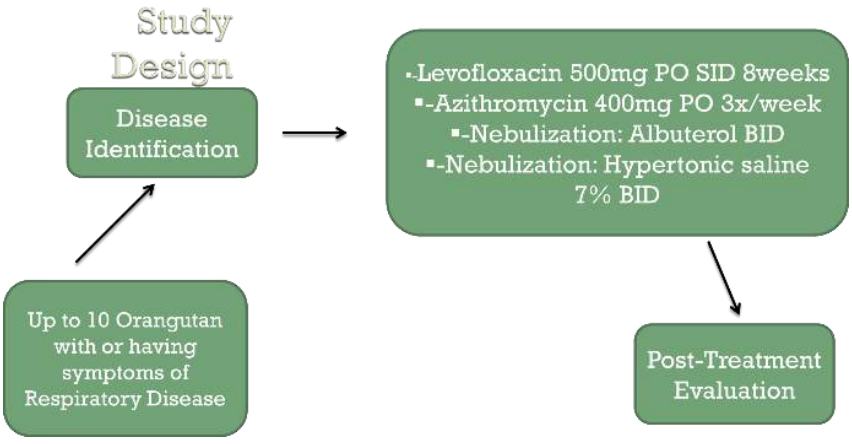
Below are the 2018 approved and funded projects of the Wild Animal Health Fund:

1. Cutaneous Nannizziopsis guarroi in Companion Lizards: An Epidemiologic Approach Using Quantitative PCR to Describe the Effect of Age, Species, Sex, and Location on Disease
PI.: Krista Keller, DVM, Dipl. ACZM. Co-P.I. Matt Allender, DVM, MS, Dipl. ACZM, PhD
Location: University of Illinois College of Veterinary Medicine, Urbana, Illinois

2. Developing diagnostic tools to characterize African tree pangolin growth and development, implications for species conservation and health assessments. PI.: Copper Aitken-Palmer, DVM, PhD, Dipl. ACZM. Co-P.I.: Michael Adkesson, DVM, Dipl. ACZM, Dipl. ECZM, Co-P.I.: Jimmy Johnson, DVM, MS, Dipl. ACZM, Location: Chicago Zoological Society & Columbus Zoo.

3. Improving the Management of Chronic Respiratory Disease in Captive Bornean Orangutans (Pongo Pygmaeus) Utilizing Cystic Fibrosis Therapies In an Orangutan Rehabilitation Program In East Kalimantan, Indonesia. PI.: Nancy Lung, VMD, MS. Co-P.I.: Agnes Pratamiutaminingsih, DVM, Co-P.I.: Fransiska Sulistyo, DVM, MVS, Co-P.I.: Jennifer Taylor-Cousar, MD, MSCS. Location: The Bornean Orangutan Survival Foundation, Borneo

The above is the first clinical scientific grant received by OVAG veterinarians. Benefits of collaboration between OVAG, SSP, NJH, etc., access to opportunities for outside funding, helps zoos as well as rescue centers, and potentially improves release and therefore conservation of orangutans.



Up to 10 orangutans diagnosed with or having symptoms of respiratory disease will have a comprehensive medical evaluation, including CT imaging of the head and thorax. Animals for which CRD is confirmed will receive a 6-month course of Cystic Fibrosis-based therapy.

Therapy includes antibiotics, anti-inflammatories, and nebulization with hypertonic saline and a bronchodilator. Post treatment, each patient will be re-assessed.

Predicted Benefits and Outcomes of this Study: Direct clinical benefits to animals in zoos and rescue centers / Define CRDO as a syndrome, with criteria for defining a Scale of Severity with treatment recommendations for each level / Establish criteria for the presumptive diagnosis of CRDO in the absence of access to CT imaging / Generate an atlas of

CT images of orangutan respiratory anatomy and pathology / Establish criteria for the releasability of rehabilitant orangutans who are diagnosed with CRDO.

Discussion: If they are chronic individuals – how can you release if they need treatment…orangutans with chronic resp. disease should be considered non releaseable so it was needed to make a proper diagnoses – if there is a clear cycle of something then they cannot be released – but if the disease can be caught early enough and treated it might be possible to release – but that is a difficult questions as many already released were probably undiagnosed but had some form of chronic respiratory disease. These orangutans should not really be released with an ailment that cannot be treated – in chimps they are not released as a potential for antibiotic resistance – but this disease is highly variable, we do not know enough about this – need more studies to show if this is a problem. From studies of treatments over the past few years there has been some positive findings – but to show efficacy of treatment there needs clearer follow-up – finish treatment then go to CT scan – then see …. cipro given to children as young as 6 – and other meds start as young as babies (if they have CF) – when first diagnosed given really aggressive meds then saline. What will this do to their microbiome -need to weigh the positive and negatives of both – Since CT scans are very expensive, for many centers they may not be able to do them – so how about x-rays for these cases – will they work? X-rays are not sensitive enough to pick bronchiectasis until it is severe – but with these new studies maybe we can come up with some signals and other ways to diagnose without CT scan – but this will be difficult as CT scans seem more useful – we really do not have good tools right now to make the diagnosis. BOSF seems to have a big problem with this – do other centers see this? SOCP, they do see air sacculitis – a female is constantly flushing but it relapses. She is also being nebulized and given anti biotics. In SOCP they have bronchoscopy (fiber optics) they use it – still experimenting but can see what is happening in the bronchii. The bronchoscopy might be a useful tool – the machine is at OFI they have released CR orangutans, but they relapse and come back to the center – 5 cases this year – there is a higher rate in Bornean than Sumatran. DO you see change in sinuses are there conformational changes which makes it more difficult – but problems are usually with their cilia – it is not necessarily structural – thank you from OVAG to everyone is working towards good clinical science in trying to address this issue.

Day 4 25 July

Concurrent Gibbon Session

Main Session:

Orangutan Reproduction

Anneke Moresco, DVM, PhD; Denver Zoo

Abstract

Great apes bear many similarities in reproduction to humans, in anatomy as well as physiology; however, there are some important differences including among the different species of apes. As veterinarians, we make use of these similarities for diagnostic, monitoring and treatment purposes

Social organization and reproductive behavior: In contrast to African pongidae, the orangutan does not live in large social groups, in fact they have been classified as solitary, but that is not the same as not being social. Their social interactions are more subtle and this difference is important for keeping them under managed care. Differences in sociality have also been documented even between Sumatran and Bornean orangutans. Social cues and social relationships are not as obvious and can be missed by humans, including some of the reproductive cues. Social environment is an important determinant of reproduction, especially in males. Breeding is a social activity and can occur in pregnant females. It is thought that the two different sexually mature male morphs (flanged and unflanged)

have different mating strategies, with associated different behavior (see male anatomy). Forced copulations are known in orangutans, but sexual contact is often solicited by females, and it seems they prefer flanged males. Orangutans have a polygynandrous mating system males and females mate with multiple individuals).

Reproductive characteristics: Repercussions for conservation: Very low compared to other apes / Mature late: Females 13-18yr in wild; 5-11yr in zoo / Long inter-birth intervals / Have only one offspring

Anatomy:

Female Orangutans have a simplex uterus, which can be very small in nulliparous females. Ovaries are found on either side of the uterus but can be difficult to visualize with transabdominal ultrasound. Primates tend to ovulate from only one ovary at a time. Orangutans have a small vulva and short vaginal vault. Menstruation occurs every cycle as in other pongidae but is very subtle (see below) and is not always visible with the naked eye. Vulvar swellings are not obvious indicators of stage of estrus cycle but are an indicator of pregnancy. The non-gravid uterus is small is contained within a narrow and deep pelvis. As the gravid uterus grows, it extends cranially and is more easily found with ultrasound or palpation. Placenta is discoid in shape and fetal maternal interface is hemochorial (similar to humans). The size of the placenta is 15 - 20 cm in diameter and 2 cm in thickness, the average weight was 300 g, but there were wide variations (266-430 g). The orangutan has a hemochorial placentation with about 15-20 cotyledons in the single disk. In the later stages of pregnancy and depending on the position, the placenta is visible with ultrasound. Twin placentas can be separate disks or fused. Evaluating heart rate, umbilical cord and other internal organs is also possible, with operant conditioning and adequate ultrasound equipment.

Male orangutans have paired, external testes, and should be symmetrical in size, shape and firmness. Testes are normally descended at birth. Similar to other great apes, males have a small os penis (~15mm long), is usually not palpable, but might be seen on radiographs. Testes size is small relative to body size compared to other primates. Orangutans are rare in that there are two sexually mature (defined as being able to sire offspring) morphs among males: a) unflanged, sexually mature males who have not developed full set of secondary sexual characteristics (cheek pads or flanges, long fur, large body size, inflatable throat sac, and emit long-calls) and, b) flanged, sexually mature males who have developed secondary sexual characteristics. In the past, the unflanged phase has been called “sub-adult”; however, they have fully developed testes and can sire offspring. At some variable point in time, the unflanged male irreversibly morphs into a flanged male, but there is a wide range of ages at which this happens, some 11yr males have flanges, while others did not develop these until 30 yrs of age. The proportion of flanged males and the rate at which unflanged males morphs into flanged males is higher in Bornean orangutans than Sumatran, possibly due to differences in social organization and food availability. One of these differences is that consortships (between flanged males and females) in Sumatra last longer than in Borneo. That is, flanged male monopolization of females is more extreme in Sumatran orangutans and implies a greater cost to subordinate flanged males, and would have even less reproductive success than unflanged males, putting evolutionary pressure to remain unflanged longer in Sumatra in order to achieve matings without the high cost.

Reproductive parameters: Low lifetime reproductive rate in orangutans is the result of late age at first reproduction, long IBI, and low twinning rates. Age at first reproduction in wild female Sumatran orangutan is 9-15 yr; in contrast, in zoos females have reproduced as young as 5.5 years (Bornean) and 7 years (Sumatran). Signs of sexual maturation typically begin at 7 to 9 years of age but may happen as early as 5 or as late as 17 years of age. Commonly, males are fully mature by the age of 14 (with functioning primary sexual organs and marked secondary sexual features).

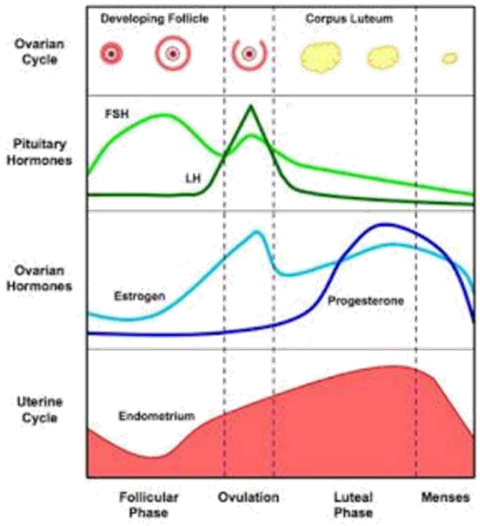
Orangutans have a longer inter-birth interval (IBI) than other great apes: 9.3 years for Sumatran orangutans in the wild (Ketambe and Suaq Balimbing) and 7.8 years Bornean orangutans (Tanjung Puting). A recent study looked at reproductive parameters in orangutans in zoos and found only a significant difference in IBI, with Bornean orangutans having a longer IBI, suggesting that many of the differences seen in the wild may reflect flexibility rather than true differences determined by evolution. Interbirth interval is not affected by sex of the offspring or by rank of female

but may be affected by increasing age of the dam. Although orangutans can live 50+ years, menopause has not been documented in the wild. Increased birth intervals are associated with increasing age and there is a proportion of females for which the interval between last birth and death exceeds the IBI, suggesting that fertility is negatively affected by age, even if not 100% terminated across all females. Twinning occurs but it is very rare. In captivity there is a 1-3% twinning rate, and in the wild it has only been reported once. The difference in twinning rate between wild and zoo populations may be an artifact of better observation but could also be due to a better nutrition plane. In captivity, orangutans have on average 2.5-2.8 offspring. Orangutans have naturally a low mortality rate and therefore a low reproductive rate has been enough to maintain population dynamics. However, in recent years mortality has skyrocketed due to habitat decimation, leading to a very fast decline in population size. This remarkably low reproduction rate complicates conservation efforts for these species.

Fetal growth: No fetal growth curves have been published, but a study is underway (Rizzo and Smith, pers comm); therefore, the main value of ultrasound at this point is to evaluate placental position, fetal heart beat and movement (fetal health), and potentially impending parturition. In cases where the female is trained for voluntary ultrasounds, regular intervals can provide data that can be used to monitor changes over time from the same pregnancy. Normal fetal position and presentation is occiput posterior (head first, facing the dam's abdomen). The baby can move a fair bit during pregnancy and can drastically change position until late in gestation. Finding the baby in the "wrong" position during ultrasound examination, should not be a cause for extreme concern, but if possible, should be rechecked.

Female endocrinology: Females begin to menstruate between 5-11 years of age, but the average is 7-8yr (in zoos), they ovulate spontaneously and have a menstrual cycle of about 28s (range 22-32 days) with only a small amount of menstrual bleeding that lasts a 2-4 days. Bleeding is slight and therefore can be difficult to see with the naked eye, but can be detected by testing morning urine for blood with Hemostix®, the presence of blood at regular intervals indicates menses. Because bleeding is short in duration and light in quality, this needs to be tested daily to determine the duration and regularity of the cycle. If Hemostix® are to be used to determine ovarian activity, it is important to monitor for an extended period of time (across at least two cycles, >60 days) to be able to determine regularity in cycling as well as to differentiate from other conditions such as UTIs or trauma.

Vulvar swelling during estrus is not obvious in this species, in stark contrast to the characteristic perineal swellings seen in chimpanzees. Hormonally, the follicular phase lasts about half of the cycle and the luteal phase the other half; with menstruation following progesterone withdrawal at the end of the luteal phase. In managed care, urinary steroids can be used to assess ovarian activity in a non-invasive manner. In contrast to most carnivores, estrogens can be high during the luteal phase, and pregnancy.



Pregnancy: Reports on duration of gestation in orangutans varies according to different references: 239-275 days; but the animal care manual (AZA) uses 245 days ± 12. Externally, early pregnancy can be suspected if vulvar swelling is seen. Pregnancy in orangutans is characterized by urinary estrogen concentration higher than during non-fertile cycles and 4-5 fold higher than gorillas and chimpanzees. In other primates, perineal swelling during estrus is associated with increased estrogen (gibbons, mandrills, macaques, chimpanzees). The high levels of circulating estrogen in orangutans during pregnancy could possibly explain the swollen vulva that characterizes early pregnancy. Chorionic gonadotropin (CG) is produced by the syncytiotrophoblast4 and its presence in pregnancy can be used for pregnancy diagnosis (see below).

Pregnancy diagnosis:

1. Within 2-4 weeks of conception, the labia majora/ perineum swell characteristically.

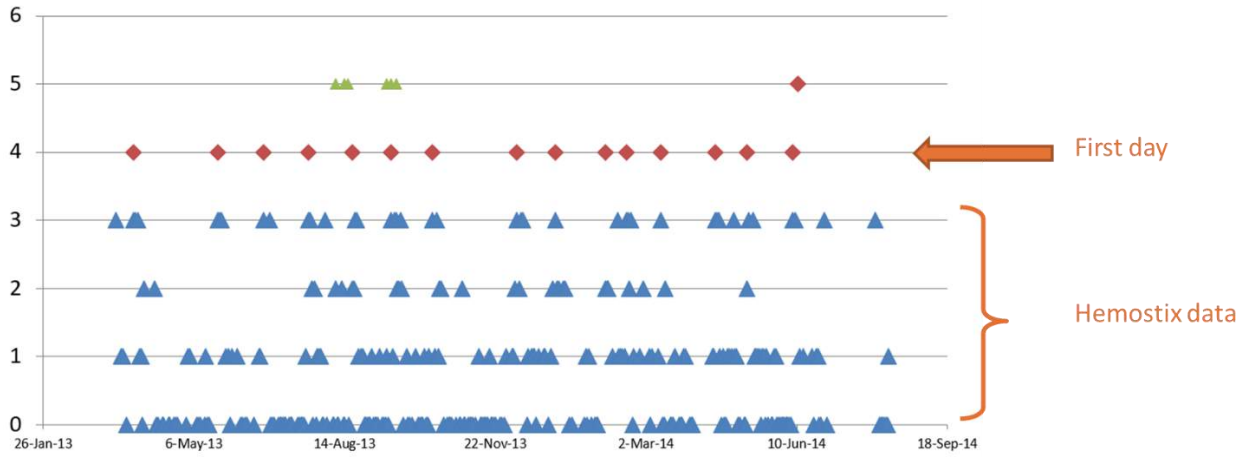
2. Pregnancy can be confirmed with hCG over-the-counter kits. The following have been used in orangutans, because of the cross reactivity between hCG and LH, a repeat test is needed to rule out LH peak corresponding to ovulation. LH and hCG cross react (in humans these molecules bind to the same receptor)8 and cross-reactivity with orangutan molecular structure is enough to be detected.

• OvuQuick® (but not in 3rd Trimester) • ICON® II HCG (but not in 3rd Trimester) • Cards Q.® (but not in 3rd Trimester) • Abbott TestPack PlusTM (but not in 2nd Trimester) • E.P.T.TM (not in 2nd or 3rd trimester) • Clear Blue Easy® • One StepTM • OscoTM

Good body condition before pregnancy is best. Diet: Naturally well balanced diet is best / Lactation will be more expensive than pregnancy (calorie-wise) / Can supplement w standard prenatal vitamins (through lactation so also post-natal).

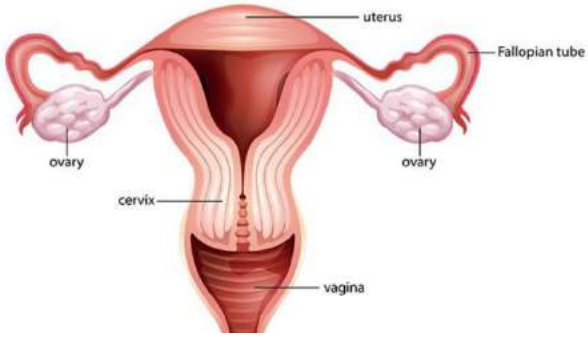
	date	Blood	Hemostix re	First day of	glucose	Fecal san	males	
46	5-Aug-13					1		
47	6-Aug-13	neg	0					
48	7-Aug-13	neg	0			1		
49	8-Aug-13	++	2				Curtis vocal and mas	
50	9-Aug-13	neg	0			1		
51	10-Aug-13	neg	0			1		
52	11-Aug-13							
53	12-Aug-13	++	2			1		
54	13-Aug-13	neg	0					
55	14-Aug-13	neg	0			1	Charlie calling	
56	15-Aug-13							
57	16-Aug-13						Charlie calling	
58	17-Aug-13	neg	0			1		
59	18-Aug-13							
60	19-Aug-13	++	2	4		1		
61	20-Aug-13	++	2					
62	21-Aug-13	+++	3			1		
63	22-Aug-13	+++	3				Jim staring	
64	23-Aug-13	+	1			1		

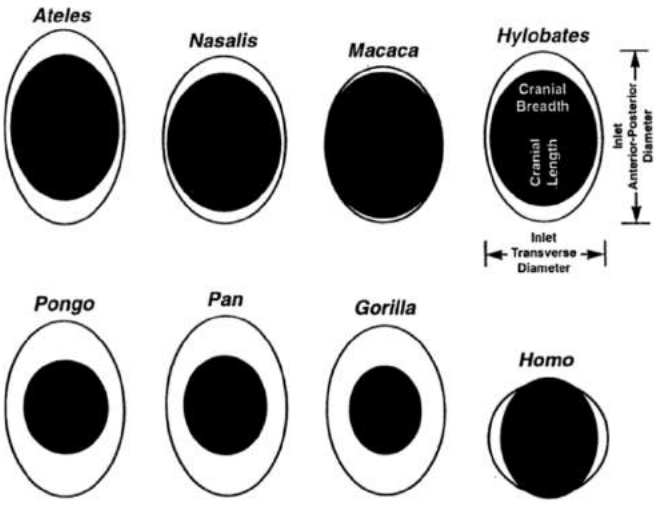
Cycle monitoring: Record Keeping…

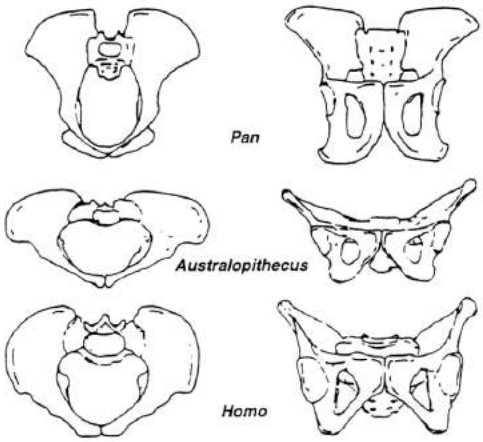


3. Ultrasound- more likely to be successful later in pregnancy as the uterus sits deep in a narrow pelvis, and it is necessary to wait until the uterus and baby are large enough to extend beyond the pelvis. In anesthetized animals, it is easier to obtain a more acute angle with the ultrasound probe and it may easier to see a fetus at an earlier stage.

Uterus simplex - All primates (except lemurs) / Smaller than expected / Deep pelvis Requires training.







(Rosenberg and Trevathan, 2002)

Equipment: EVO (EI Medical) / Others / Probes: Microconvex / OPU

4. Assaying serial urinary or fecal ovarian steroids (estrogens/ progestins)- requires urinary collection 3 x /week, a freezer, and an endocrine laboratory available. (Paper out of Bogor Agricultural University, Drh. Hera Maheshwari)

Detection: Labia majora swelling @ 2-4 week post conception. High urinary estrogen compared to other apes (Czekala et al., 1983)

Pregnancy diagnosis: Behavior…

Humans	**Orangutans**
Nausea (morning sickness)	Loss of appetite
Fatigue	Lethargy
Mood swings	Personality changes
Cramping	Personality changes

Pregnancy problems: Problems during pregnancy are rare in orangutans but do occur, and may be linked to other pre-existing conditions such as obesity, diabetes, and hypothyroidism.

Complications during pregnancy can include placenta previa or abruption, miscarriage, ascending infections and pregnancy toxemia. Dystocia is uncommon, but risk may be elevated in older primiparous females, very young primiparous females, and females that experienced malnutrition as youngsters. In 2016, 4 C-sections were reported to have been performed successfully and the baby and mother were reunited in all 4 cases. It is recommended that females that have undergone a C-section be scheduled for C-section deliver on subsequent pregnancies to avoid uterine rupture. Other factors that may complicate pregnancy and parturition are conditions such as obesity, diabetes, twins. Females may continue to mate during pregnancy. Cytologic evaluation of any discharge can help provide an etiology and determine whether additional diagnostics or intervention is indicated.

Complications summary: Abortion / Placenta previa (placenta covers cervical opening) / Fetal septicemia / Dystocia / Maternal - fetal incompatibility / Twins / Previous c-section / Diabetes. Example: Pregnant Orangutan; 26 weeks (8 to go) with vaginal discharge, lethargy and frequent urination. Diagnosis: Ascending infection, Fetal problems, Impending abortion.

Stages of Labor:

Stage	Description	Comments
Stage I	Contractions start. Thinning and dilation of cervix, membrane rupture	Membrane rupture can appear as clear, thin vaginal discharge
Stage II	Strong contractions. Birth of baby	Head first, but breach has also been delivered successfully.
Stage III	Placenta is passed (sped up by nursing- release of oxytocin)	Female may eat all or part of it, she may also chew through the cord. Maybe immediately after birth, but may also take a couple of hours

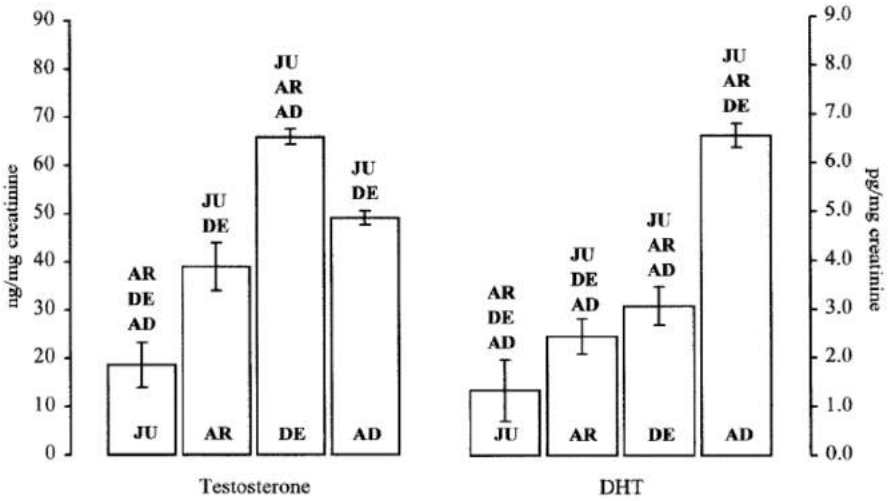
Labor is not always easy to observe and duration varies from 25-30 minutes to 3-4 hours. If placenta is not eaten by mom and can be retrieved, submit in clean container for evaluation by veterinarian. Bloody discharge can continue for several days-weeks. If amount increases or does not decrease, if foul smelling or grossly discolored, notify veterinarian (maybe indicative of ascending infection or excessive blood loss).

Dystocia: Uncommon / Be prepared / Birth plan / Estimate due date / Previous medical condition (obesity, diabetes, UTI, hypothyroidism, placenta previa) / Have an OB on call / C-section / Re-introduction of baby.

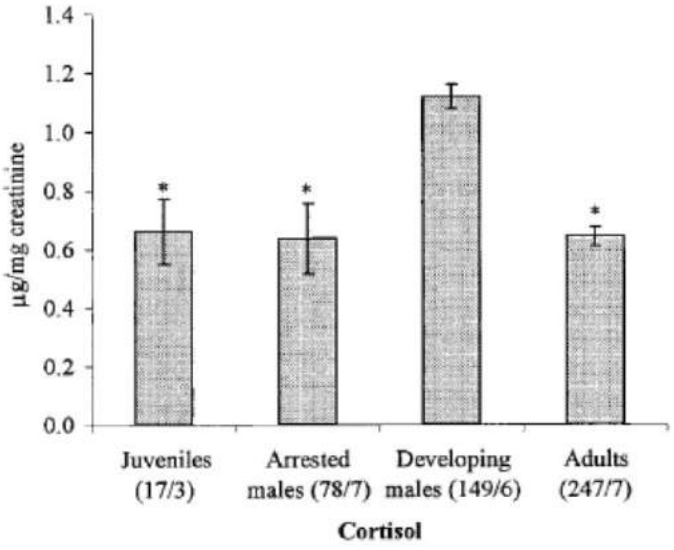
Menopause: Circumstantial evidence, Inter-birth interval increases with age, Maximum age at reproduction 40's, lifespan 50-60 years.

Male endocrinology: As expected, juveniles have lower androgen levels than adolescents and adult males. Developing males have the highest levels of testosterone and the second highest levels of DHT, while adult males have the highest levels of DHT and the second highest of testosterone. The onset of this development is linked to age as well as dominance as many unflanged males that live in the presence of flanged males will not develop until the flanged male is no longer there. It was originally thought that the effect of dominance was mediated though chronic stress and circulating cortisol. However, a study showed that unflanged males had cortisol levels similar to flanged males, suggesting that rather than being mediated by chronic stress, the lack of development is a way to avoid stress.

They have sufficient sex steroids to facilitate primary sexual development and spermatogenesis, but not enough to develop secondary sexual features / Developing males have highest levels of Testosterone



JU= juvenile AR=arrested adolescents DE= developing AD= Adult (Maggioncalda et al., 1999)



Maggioncalda et al., 2002

Secondary sexual suppression in some male orangutans is not stress-induced, but instead perhaps an adaptation for stress avoidance during the adolescent or "subadult" period. Dominance effect was thought to be stress mediated, but cortisol levels do not appear to be different.

Reproductive exam: Regardless of whether the exam is on a female or a male, for reproductive enhancement, to diagnose causes of infertility, or for determining the best contraceptive, a detailed and accurate history is necessary.

Indications	History
Known reproductive disease	Other diseases can affect reproduction
Known reproductively healthy	Need a healthy animal
Young	Basic physical exam
Infertile adult	CBC
Fertile adult	Chemistry
Post-partum adult	Urinalysis
Nulliparous adult	
Geriatric adult	

Important aspects are: Age. Because there are age associated changes in the reproductive tract age is always important to know. If exact ages are not available, estimates as accurate as possible will be useful. Parity/ last offspring. (has the individual reproduced before?)- some lesions are more likely to develop in nulliparous females than multiparous. How long ago? (date of last sired offspring or last parturition date). Lesions that impair fertility are less likely to be present shortly after a successful pregnancy. Date of last offspring sired (date of birth – gestation) is important when evaluating infertility in males, History of diseases (infectious or metabolic) even if not directly related to reproduction. Metabolic diseases can affect reproduction; infectious agents and low-grade endometritis can be asymptomatic except for infertility/ subfertility as they can interfere with fertilization, implantation or development of a fetus. Social situation and group history. A routine physical is important prior to reproductive specific exam. Additionally: Palpation (MG and abdomen) Vaginoscopy (speculum, otoscope w large cone) / Vaginal endoscopy/ transcervical Bx. / Foreign bodes / Ultrasound - Vaginal probe- size, most veterinary machines don't have one. Ovaries are easy to find. Transabdominal, Caudal uterus and cervix are difficult to reach. Swabs – Cytology / Culture.

General body condition and external appearance: Any lacerations or other wounds, chronic or acute

Lower reproductive tract: A reproductive exam that includes vaginal vault and external cervical os visualization should be performed whenever possible during routine exams. Visual examination can be performed with the aid of a disinfected otoscope or endoscope, and vaginal swabs can be obtained for cytological examination and bacterial culture as needed. Endoscopy can also be sued as a means to obtain transcervical endometrial biopsies. Gorilla and wolfs guenon have been found to have foreign bodies in the vaginal vault (sticks and stones, resp). This finding was interpreted as an effort by the gorilla and Wolf's guenon to alleviate irritation secondary to a primary infectious or inflammatory process. Other species may also be susceptible (itching due to trauma or infectious / inflammatory disease), and foreign bodies can lead to failure to reproduce or to more life-threating conditions.

Uterus and ovaries. It is possible to palpate the uterus, this is more challenging in overweight females. Transabdominal ultrasound is a good technique to visualize the uterus, including the endometrium. The caudal uterus is more challenging to image as the pelvis is narrow and deep. Vaginal ultrasound is possible, but a specialized probe is necessary. Additionally, orangutans tend to be smaller, so probes are frequently too big. However, if possible, the use of a vaginal probe greatly facilitates imaging of the tract; in particular of the ovaries is as it they are easier to find on either side of the uterus. The sonographic appearance of the endometrium can change drastically over the course of the menstrual cycle, and it is useful to gather other information about the stage of the cycle (last menses, structures on the ovaries, etc). Radiographs can also provide information about the reproductive tract, but with less detail.

Testes: should be descended at birth (generally) and symmetrical. Ultrasound can reveal diffuse mineralization (incidental findings) or cysts or other masses (anechoic areas or hyperechoic areas).

Contraception: In zoos, indications for contraception in females include those who: a) need reproductive rest / b) have had problems with pregnancy or parturition such that either they or the babies are at risk / c) have reached sexual maturity but are not in a good breeding situation (e.g. housed with closely related males) / d) are known to carry genetic diseases, be hybrids, or be overrepresented / e) are at high risk for dystocia (e.g. known diabetes, small pelvic size due to malnutrition during infancy / trauma) / f) have proven to not be good mothers.

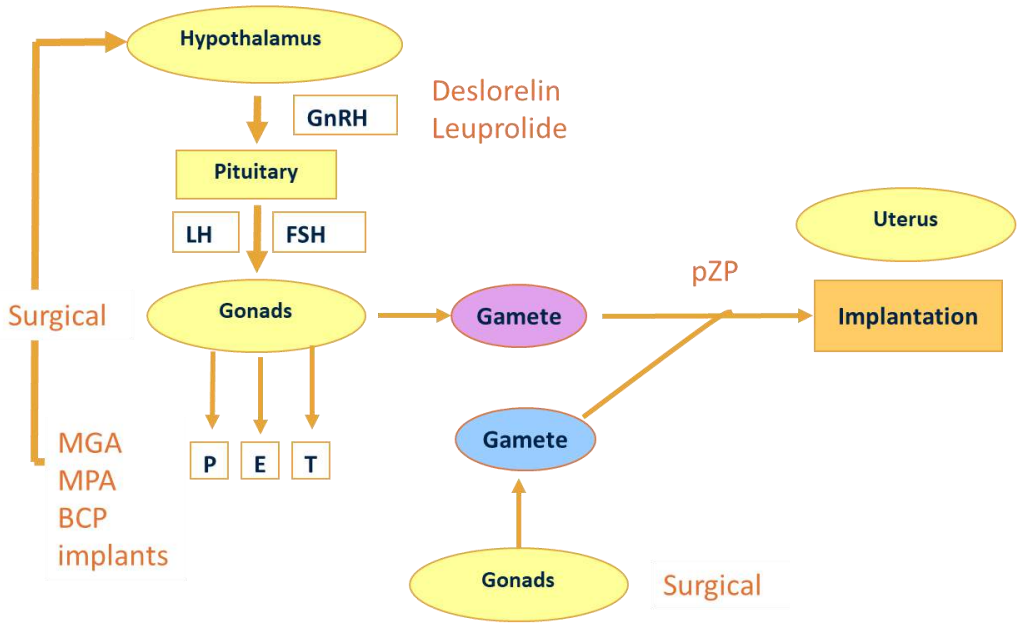
Indications for contraception and therefore choice of contraceptive may be very different when managing individuals living in zoos versus those living in rehabilitation centers, or those destined for release/ reintroduction. Birth control pills are the second most commonly used contraceptive in female orangutans in North American zoos, owing to the similarities in endocrinology, endometrial reaction, availability, ease of administration, and ease of discontinuation. There are many options for type and dose of estrogen in BCPs. The RMC recommends using a high estrogen to progesterone ratio as orangutans tend to put on weight on contraceptives. Progestin only pills are recommended for postpartum contraception up to a year after birth, because estrogens can negatively impact the production of milk, and to avoid exposing the babies (males in particular) to excess estrogens. Combination pills tend to be more effective than progestin only pills and it is therefore advised to switch back to combination pills after the baby is a year old. Failures are usually associated with poor compliance, that is, missing doses (not eating because they are sick, hiding pills) or interference from other drugs such as antibiotics. Orangutans are more prone to weight increase while on contraception than other great apes, so weight monitoring and / or diet management is important. Progestins have been anecdotally associated with diabetes developing in some primates; however, one study that looked at the glucose tolerance specifically in orangutans found no differences between contracepted and non-contracepted females.

Contraceptive methods used in orangutans are summarized below:

Method	Advantages	Disadvantages	Ref
Birth control pills (BCP)	Readily available in most countries Easy to administer (if daily contact is an option) Available in many formulations	Weight gain Difficult to administer if daily contact is not an option	42, 43
Melengestrol acetate (MGA)	Administration is only needed every two years (maybe more) Very effective as long as implant is not lost	Not readily available in many countries Minor surgery is needed for placement	43
Medroxyprogesterone acetate(MPA) DepoProvera®	Readily available in many countries Injectable (no surgery needed)	Provides only 2-3mo of contraception	43
Tubal ligation	Permanent Does not require re-dosing Hormonally intact	Requires specialized surgery Laparoscopic is less invasive but also requires specialized equipment	25
Intra-uterine devices (IUD)	Does not require re-dosing	Requires specialized skill Size may not fit Little data on adverse effects or efficacy	16
GnRH agonists (Deslorelin® and Leuprolide)	Small implant or injection Drug of choice for precocial puberty in humans	Chemical menopause, effects on bone density not studied Not readily available	

Pill Type	Pill Name	Progestin	Dose (mg)	Estrogen	Dose (ug)
Biphasic	Aranelle	Norethindrone	0.5/1.0	Ethinyl estradiol	35
Biphasic	Necon 10/11	Norethindrone	0.5/1.0	Ethinyl estradiol	35
Biphasic	Ortho-Novum 10/11	Norethindrone	0.5/1.0	Ethinyl estradiol	35
Monophasic	Alesse	Levonorgestrel	0.1	Ethinyl estradiol	20
Monophasic	Apri	Desogestrel	0.15	Ethinyl estradiol	30
Monophasic	Aviane	Levonorgestrel	0.1	Ethinyl estradiol	20
Monophasic	Balziva	Norethindrone	0.4	Ethinyl estradiol	35
Monophasic	Brevicon	Norethindrone	0.5	Ethinyl estradiol	35
Monophasic	Demulen 1/35	Ethynidiol diacetate	1	Ethinyl estradiol	35
Monophasic	Demulen 1/50	Ethynidiol diacetate	1	Ethinyl estradiol	50
Monophasic	Femcon Fe	Norethindrone	0.4	Ethinyl estradiol	35
Monophasic	Junel 1.5/30	Norethindrone	1.5	Ethinyl estradiol	30
Monophasic	Junel 1/20	Norethindrone	1	Ethinyl estradiol	20
Monophasic	Kariva	Desogestrel	0.15	Ethinyl estradiol	20/10

Contraception Point of Action



Assisted Reproductive Techniques: What has been done? Transfer of gametes without the need to transport individuals. Gamete rescue (post mortem).

Technique	Number	Reference
Semen collection (non-invasive; trained)	N=1	(Vandevoort et al., 1993)
EEJ	N=5; N=1	(Bowsher, 1997); (Joslin et al., 1995)
Semen cryopreservation	N=5	(Bowsher, 1997)
Oocyte retrieval, IVF, ET	N=1 (no pregnancy)	(Joslin et al., 1995)
Ovulation induction	N=1	(Joslin et al., 1995)

Challenges: Primate ejaculates form coagulum - Difficult to separate sperm to freeze or process - For all treatments animals need to be trained or performed during other anesthetic procedures.

Reproductive Pathology: As animals age, degenerative and neoplastic lesions of the reproductive tract become more common in all species. Although some of these age-related lesions are considered normal findings, they still contribute to infertility or subfertility. In general, female great apes appear to be less prone to developing reproductive tract lesions than humans, and orangs seem to be at a lower risk compared to other great apes. Morphologic correlates of ovarian senescence (depletion of primary oocytes) are considered normal geriatric changes and have been documented in chimpanzees and gorillas, but similar studies have not been performed in orangutans. However, it should be noted that many studies do not include pathologic evaluation of the reproductive tract. It is not possible to infer ovarian senescence solely based on the absence of births as it would be difficult to distinguish from infertility due to uterine pathology.

Neoplasms of the reproductive tract are not rare in orangutans but appear to have a lower prevalence than other great apes. No distinction has been made in the literature in prevalence between the two orangutan species. Although these are not likely all that has occurred, based on these numbers it seems reproductive neoplasms are not highly prevalent among orangutans.

Reported neoplasms in orangutans:

Sex	Organ	Diagnosis	N w Dx	Ref
F	Mammary gland	Carcinoma	1	48
	Ovary	Granulosa cell tumor	2	32, 39
		Teratoma	2	23, 48
	Uterus	Leiomyoma	2	29, 32
M	Mammary gland	Adenocarcinoma	1	7
	Testes	Seminoma	1	48

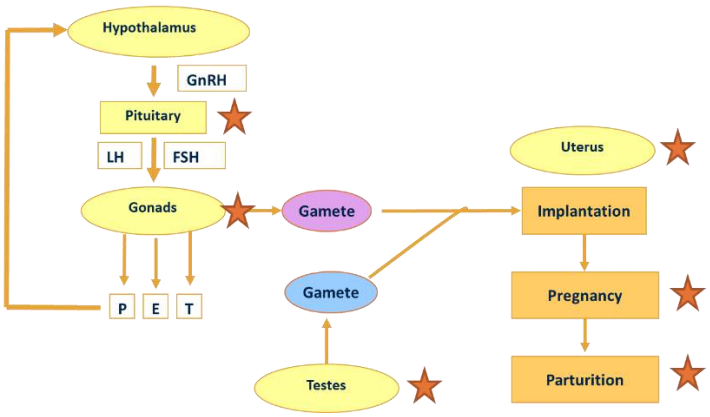
Non-neoplastic uterine lesions in orangutans include adenomyosis, endometriosis, and endometrial polyps. Endometrial carcinomas have not been reported in orangutans and have not been found in the archive of the

Reproductive Health Surveillance Program (RHSP). However, the RHSP database contains very few geriatric females. Surgery has been used to address multifocal myometrial endometriosis, adenomyosis, a leiomyoma and a teratoma. Endometrial atrophy in great apes and old world monkeys has been reported mostly in association with long-term progestin contraceptive use, and is considered to be reversible. Dysmenorrhea, endometriosis and uterine leiomyomas were the most frequently reported female reproductive diseases to the SSP (ACM). Menopause was only reported by two institutions. Dysmenorrhea is a clinical sign associated with several diseases but also with pre-menopause.

Infectious diseases of the higher reproductive tract are usually ascending from the lower reproductive tract, or urinary tract infections. Chorioamnionitis (inflammation of fetal membranes) and bacterial placentitis have been associated with abortion in orangutans. Additionally, perinatal mortalities have also been documented in association with systemic bacterial infections. Cytological examination of any discharge can be performed non-invasively, is inexpensive, and is very informative.

Testicular atrophy and hyposepermatognenesis does occur in orangutans and was reported in two 33 year olds. Benign prostatic hyperplasia has not been reported in any ape except chimpanzees, but a lack of reports is likely due to a relative deficiency in examining reproductive tracts at post-mortem.

Other miscellaneous reproductive-related pathologies and abnormalities include a trisomy and a report of herpes simplex-1 in a 6-month old female that died.



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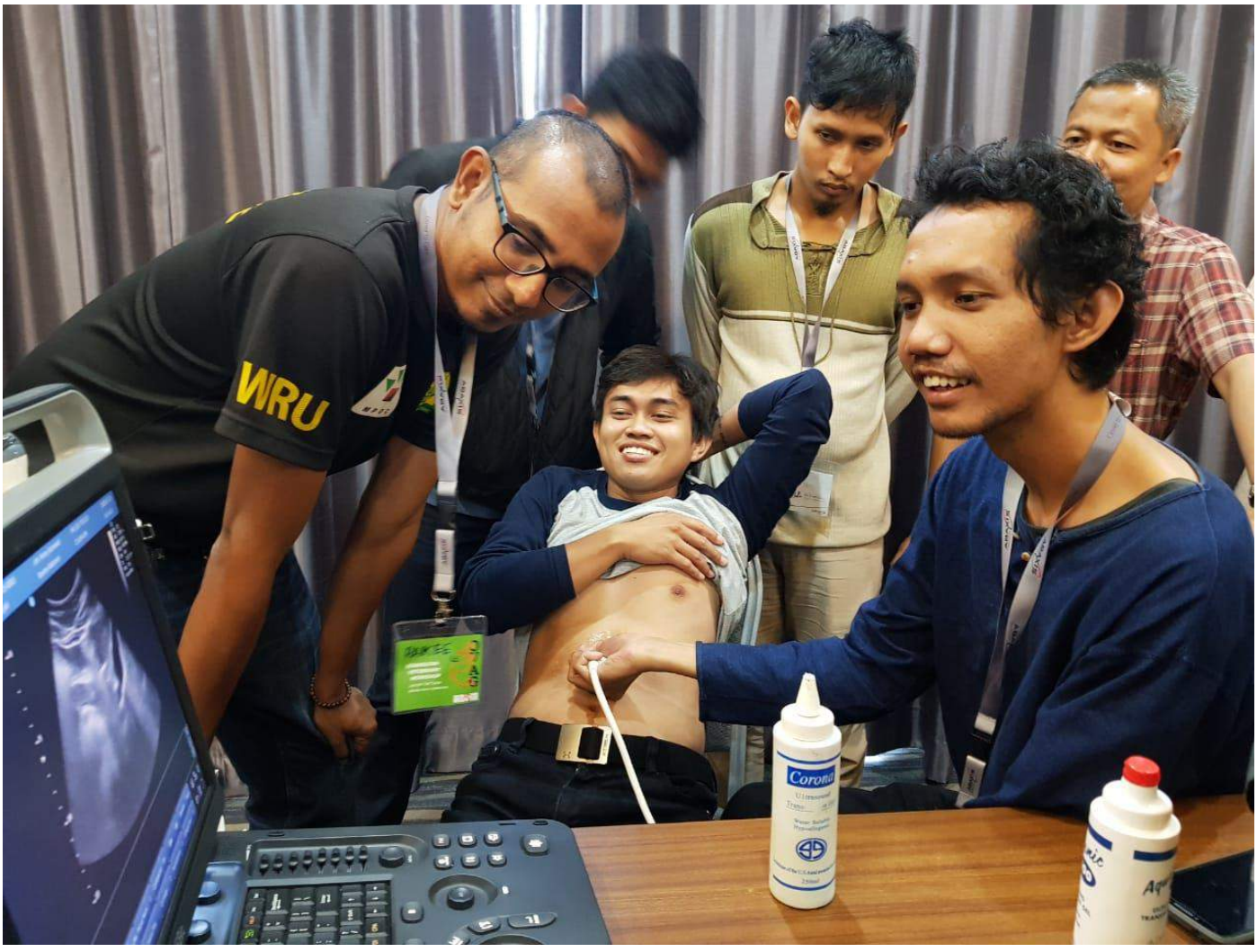
Discussion: Primates can remove implants – they also migrate and they need to be sterilized before insertion and sometimes are wired to prevent migrations. Can be replaced every year -can be removable – can take up to two years to be reversible. Progestins are an implant and are not removeable. Deslorelin can be given without anesthesia – can affect secondary sexual characteristic similar to castration in males. Leuprolide very expensive so not cost effective. At Chester, chimp's implantation through IUD they still got pregnant – chimps removed them themselves as three of the 5 got pregnant – but because orangutan uterus is small, iuds often do not fit properly. Every case is different. Many diseases need more research so perfect area of publication. Contraceptives can be used as treatment for some diseases. Important to know when and why animals start to develop lesions – the forgotten organ – look at the uterus, save material so they can be looked at so information is not lost – Anneke can help set up data collection protocols. Take samples from necropsies so data can be collected and later analyzed – use it or lose it or save it in formulin. An orangutan with different sized testes, but are not normal sized - could do aspiration and make a smear to look at under a microscope but most likely nonfunctional. Some males have been known to lose hair and then regrow after a year - could be hormonal – could be linked to stress or during maturation process. Patches of hair loss? Why? Could hair loss be related to the enclosures? Most likely stress as hair grows back if it was anything clinical hair would not grow back. Many orangutans at Samboja will never be released – so they will need to have contraceptives used – is it safe to keep them life long? – if they will never breed, perform a vasectomy on the males. An implant may not be strong enough. This is best option instead of continued implants – also this is difficult as endangered species in Indonesia cannot be

permanently stopped from breeding. Can OVAG make a recommendation for unreleasables to permanently prevent breeding. Government may make a comment with 18 males at Samboja being vasectomized. We need an OVAG statement of reproductive policy. SOCP problem is different – as the reason to sterilize is not due to disease but other issues so their life will be long, with females they have ovary diseases (cysts) so the ovaries are removed to prevent further disease. For permanency surgical option is best. Abnormalities in fetuses: orangutans can be compared to humans – Melissa has some incomplete data that can be shared – there is a report being compiled that would be helpful in monitoring fetal growth. Rejection of infants – can it be prevented? Many maternal rejections and need for surrogacies. There is a pre-birthing manual to be a better mother – it is not uncommon. There is no way to know who a good mom or a bad mom will be. But why are babies being born in rehab centers? It accidentally happens…does it happen a lot? Orangutans go out to the forest in mixed sex groups - so need to know when females will become reproductive, so implantation can happen. In zoos, IBI is getting shorter. There as much interest in this topic and needs further discussion.



INTRODUCTION OF RADIOGRAPHY AND ULTRASONOGRAPHY AS DIAGNOSTIC TOOLS IN ORANGUTAN

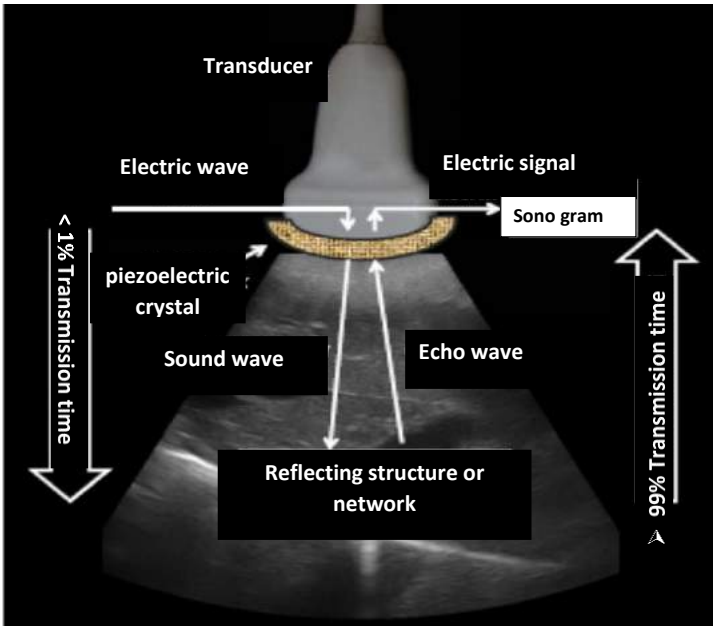
Deni Noviana, Faculty of Veterinary Medicine, Bogor Agricultural University, Division of Veterinary Surgery and Radiology, Department of Veterinary Clinic Reproduction and Pathology, Veterinary Teaching Hospital

Abstract

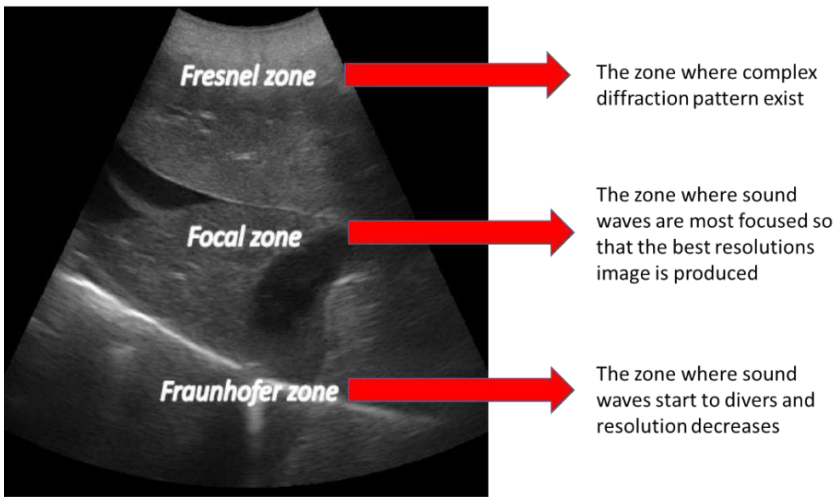
The use of USG and X-RAY are quick, precise and accurate tools to diagnose disease (especially when combined with clinical findings and laboratory examinations). The demand for health and the ability to diagnose orangutan disease are important reasons for veterinarians to continue developing their abilities and skills in applying and give proper interpretations

Ultrasonography Diagnostics: The technique to diagnose organ image (sonogram) produced by interactions between high frequency sound waves and these organs. The physical characteristic of ultrasound are: 2 – 15 MHz frequency; audible sound 20-20.000 Hz; short wave length (<1mm); medium to move → liquid (is best medium); cannot move through air → acoustic barrier.

Ultrasound Interaction with Tissues and Required Transmission Time:



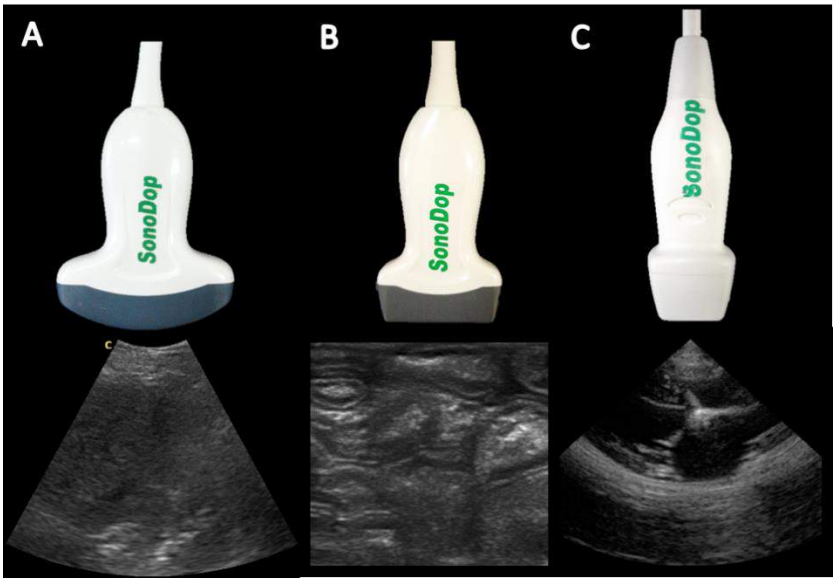
Acceptance Zone in Sonogram:



Probe/Transducer:

Standard probes/transducers mostly used are:

A. Sector/curved transducer B. Linear transducer C. Phased arrays transducer

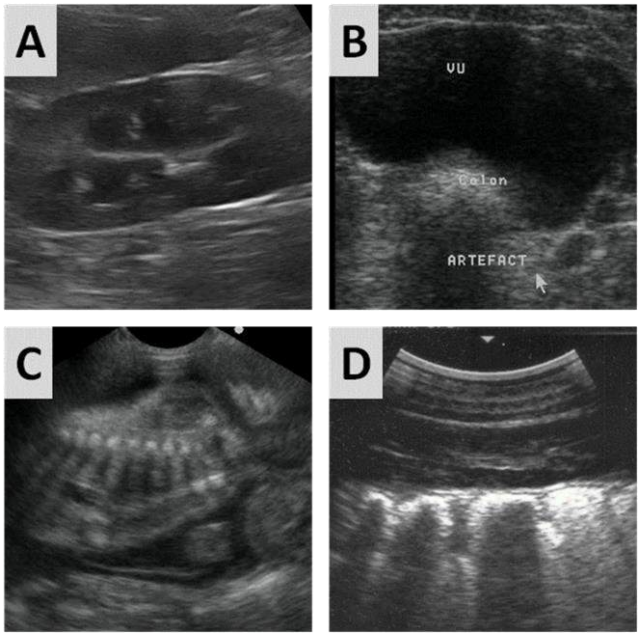


Frequency Selection: All ultrasound transducers have frequency ranges called bandwidths. Broad bandwidth technology produced transducers that have more than 1 frequency, such as: 2.5-3.5 MHz – for abdominal sonography and 5.0-5.7 MHz – for superficial sonography. Frequency suggestion during examination:

•2.5MHz	• *Deep abdomen, OB/Gyn*
•3.5 MHz	• *General abdomen, OB/Gyn*
•5.0 MHz	• *Vascular, breast, Gyn*
•7.5 MHz	• *Breast, thyroid*
•10.0 MHz	• *Breast, thyroid, superficial veins, superficial masses*

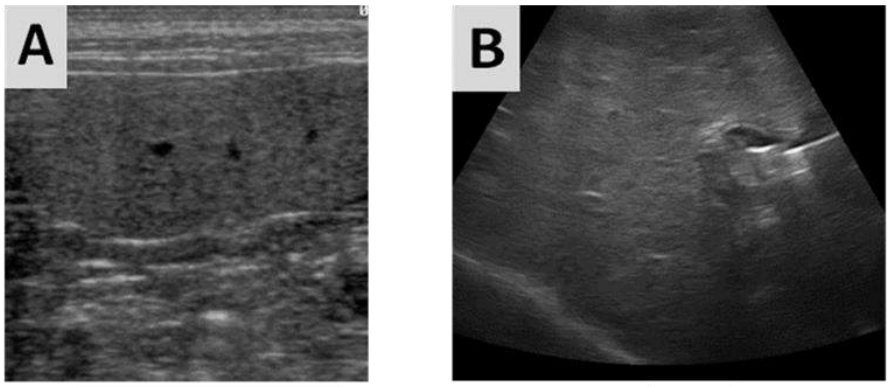
Interpretation Principles: The principle of image interpretation in ultrasonography is based on the strength or intensity of the waves reflected back by the tissues into the transducer. Based on the strength of the intensity, the depiction of ultrasonography is divided into hyperechoic, hypoechoic, and anechoic.

Hyperechoic: Bright echo is produced, white color visible on the scan result / Hyperechoic shows highly-reflective interfaces, such as collagen, fat, air, hard material and bone.



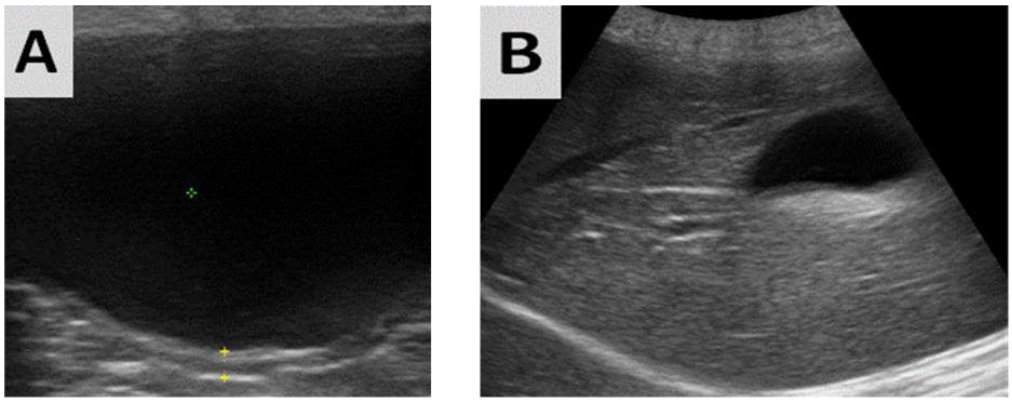
(A) Renal Capsule
(B) Colon filled with feces
(C) Fetus bones
(D) Intestine filled with air look like wave

Hypoechoic: Less echo is produced, black-gray color visible on the scan result / Hypoechoic shows intermediate reflection/transmission, such as most soft tissues.



Spleen Parenchyma Liver

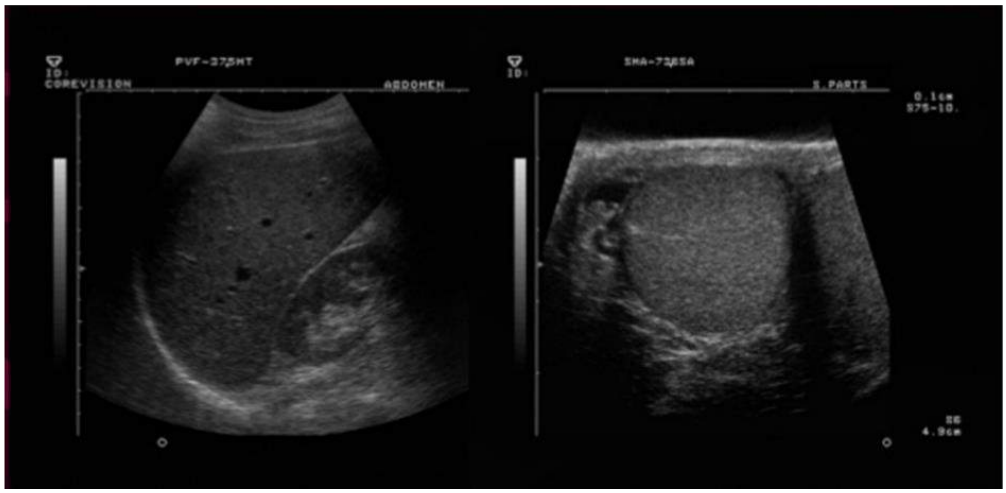
Anechoic: No echo is produced, scan results is black / It shows complete transmission from sound, such as liquid.



Vesica Urinaria Gall bladder

Influency of Frequency and Resolution:

3.5 MHz 7.5 MHz

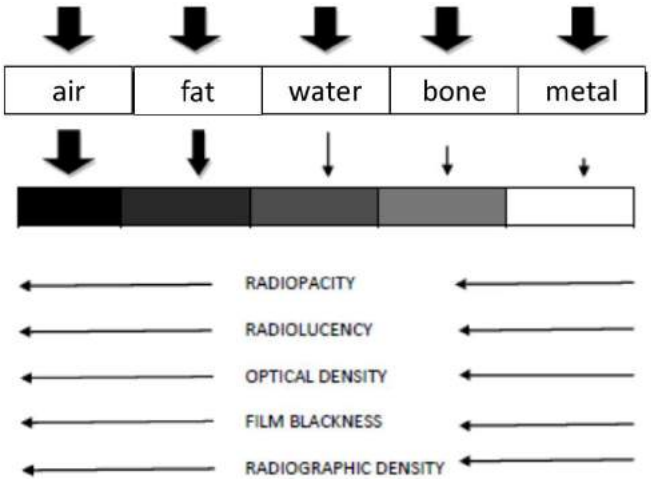


Radiography Diagnostic (X-Ray): X-ray technology which can depict inside of the body in two dimensions without having to do surgery. X-ray is an electromagnetic wave or can be called a photon as an electric wave and a magnetic wave.

Exposure Determinants Factor:

Setting	Change	Effect on x ray production	Effect on image density (blackness of image)
mA (milliampere)	Increase	Increased number of x rays produced	↑ density
	Decrease	Decreased number of x rays produced	↓ density
kVp (kilovoltage peak)	Increase	Increased number of x rays produced (secondary effect)	↑ density
	Decrease	Decreased number of x rays produced (secondary effect)	↓ density
Exposure time	Increase	Increased number of x rays produced	↑ density
	Decrease	Decreased number of x rays produced	↓ density
Subject thickness	Increase	N/A	↓ density
	Decrease	N/A	↑ density

The Five basics of radiography opacities are: air, fat, water, soft tissues, bone, metal



Radiography Technique: Preparation that needs to be done: Hair/fur must be dried; Restrain tools must be removed; Operator has to use personal protection equipment (apron, gloves, neck protector); A Marker for every radiograph taken is needed.

Radiograph Interpretation Principle: Radiograph evaluation is done to all parts of the photo obtained. The approach can be through systems, organs, regions (from the periphery to the middle or vice versa); Finding abnormalities; Determination of location and anatomical abnormalities; Make differential diagnoses from probability abnormalities that are found.

X-ray thorax:

1. Absolute indication: Symptoms of cardiorespiratory disorders : dispnoe, tachypnoe. / Cough / Screening for metastatic cancer / Chest trauma
2. Relative indication: Respiratory disorder or other abnormal sound / Abnormal heart sound (arrhythmia, murmurs, gallop) / Abnormal ECG / Jugular distension / Abdominal effusion /Syncope

X-ray Technique:

1. Setting machine –low mA, high kVp, short exposure times
2. Using grid (better)
3. View: 2 view projection, right lateral recumbent, and dorso ventral (DV) more preferable
4. X-ray images taken when the lungs reach maximum inflation (inhalation)

The changes that can be seen from radiogram:

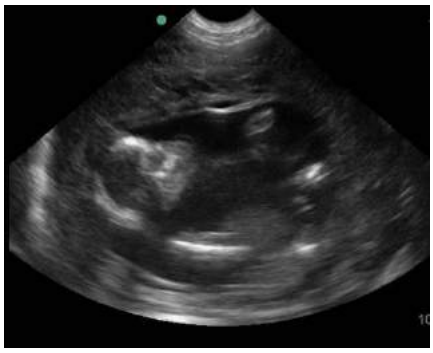
Changes	Example of abnormality
Size	Diffuse neoplasia, atropy, splenomeghaly, vesica urinaria distension, heart enlargement
Conformation	Fracture, exostosis
Amount	Complete or not (kidney), increasing number of digits
Location	Hernia diafragmatica
Margination	Renal appearance in case of chronic interstitial nephritis or presence of cyst in the kidney, osteosarcoma
Opacity	Fluid in bull tympanic, soft tissue calsification, foreign body, subcutaneus emphysema, osteoporosis, osteomyelitis, an neoplasia

USG and X-Ray Application on Orangutan:

The diseases that affect orangutan in ex-situ are: Hepatitis / Parasites / Respiratory disorders. Bornean Orangutans (*P. Pymaeus*) show more significant chronic respiratory signs than Sumatran Orangutans (*P. Abelii*) which is 13.8% versus 3.6%. Respiratory disorder is more common in male orangutans (15.8%) than females (3.9%)(Zimmermann *et al* 2011). Other diseases that can affect orangutans are: Inflammation (splenitis, cystitis, gastritis, etc.); Tumor, cyst and foreign bodies, Effusion, abscess, hernia; Heart disorder (DCM, HCM, endocardiosis, prolapse mitral, etc.). Ultrasonography can be used to diagnose orangutan disease in: Stomach, intestine, pancreas, Spleen, Liver and gall bladder, Kidney, Adrenal gland, Vesical urinaria, Male or female organ reproduction, Eyes, neck, muscle, and mammary gland, Abdominal cavity, thorax and heart (DCM, HCM etc.).

Pregnancy examinations on primates are: Fetal heart rate (FHR) examination, Placenta echogenity evaluation, Biparietal diameter (BPD) measurement. Schuler *et al.* 2010, measured fetal BPD to determine age in the owl monkey.

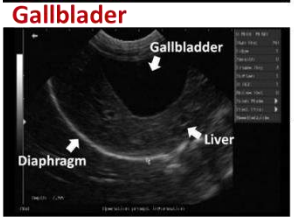
Pregnancy:

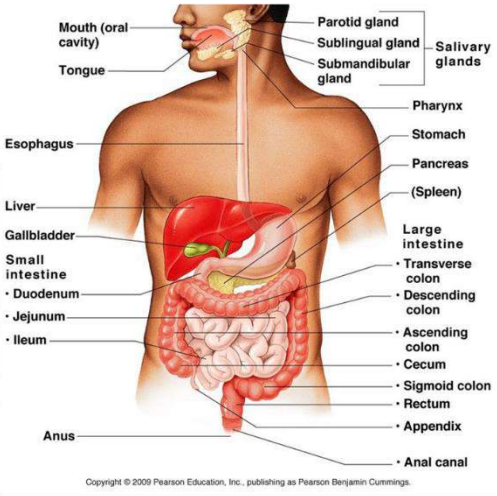


USG Examination in Human

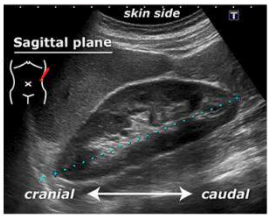
Liver

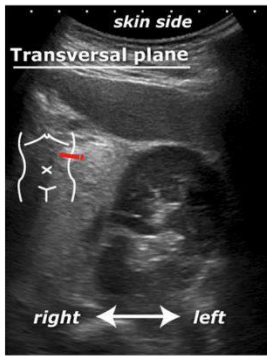
Gallblader





Kidney

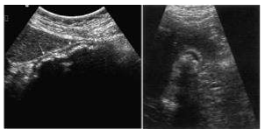




Pancreas

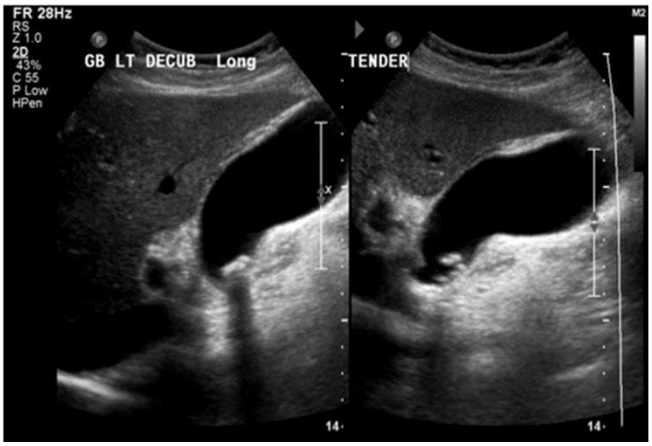
Spleen

Gastric & Intestine

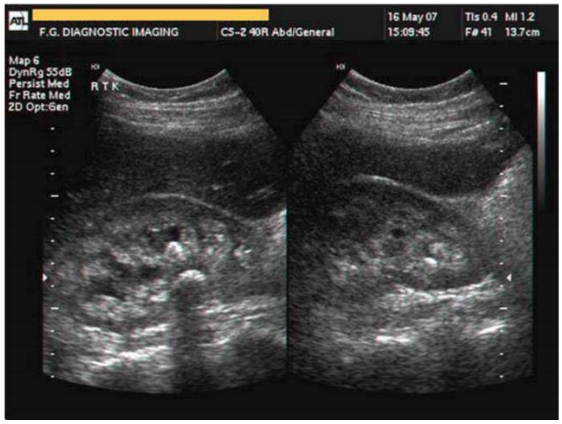


Cases in USG-Hepatitis

Cases in USG-Cholelithiasis

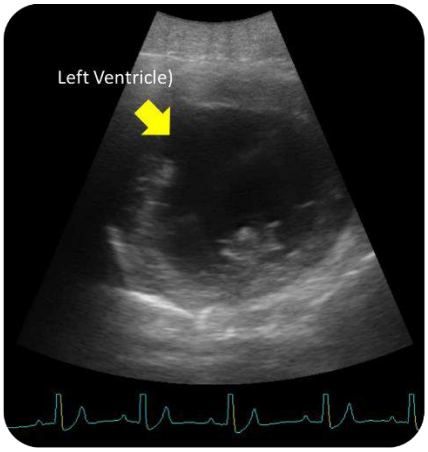


Cases in USG-Nephrocalcinosis

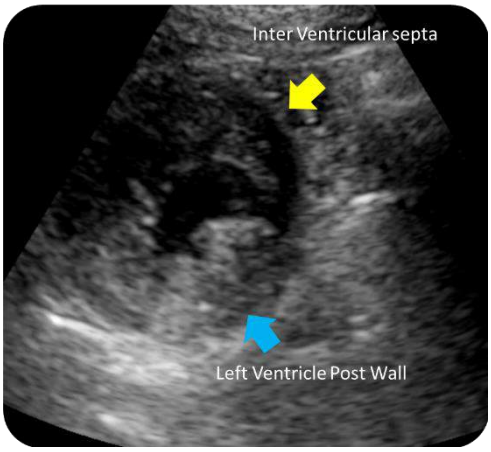


In cardiac disorders, dilated cardiomyopathy is characterized by expansion of ventricular and atrial spaces. In the later stages, the heart with a dilated cardiomyopathy condition will experience a decrease in the strength of contractions as an indication of decreased function.

Dilated Cardiomyopathy (dog)

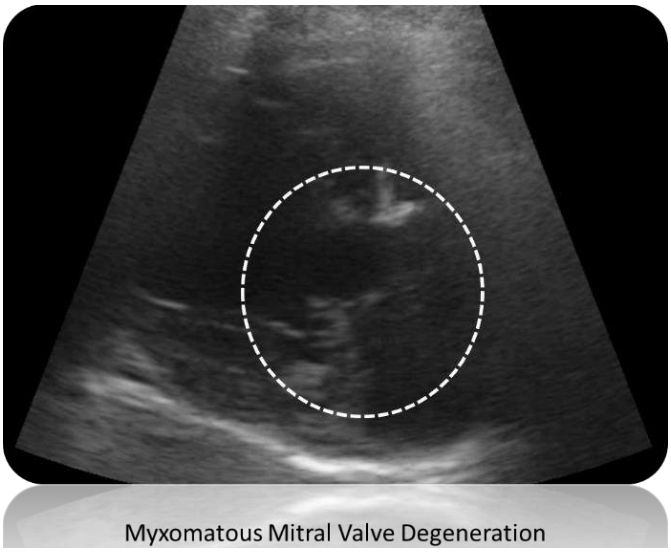


Hypertrophy Cardiomyopathy (dog)



In dogs with hypertrophic cardiomyopathy, the sonogram results in thickening of the interventricular septa muscle, ventricular muscle wall thickening and increased fractional shortening and ejection fraction.

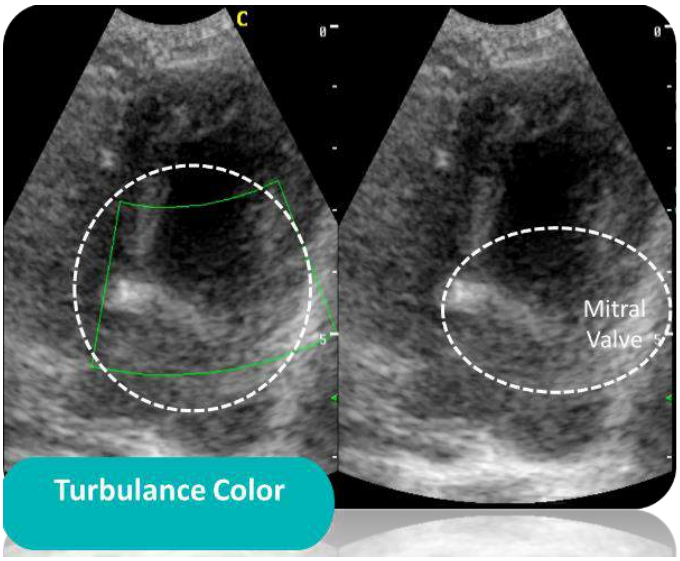
Endocardiosis: Prolapsed Mitral Valve (dog)



Myxomatous Mitral Valve Degeneration

Endocardiosis is a disease in dogs characterized by progressive myxomatous degeneration in the atrio-ventricular valve. In a case study of a small Pomeranian dog, the sonogram showed pathological changes in the mitral / bicuspidal valve in the form of nodular thickening, chronic fibrosis and valve prolapse.

Mitral Valve Regurgitation



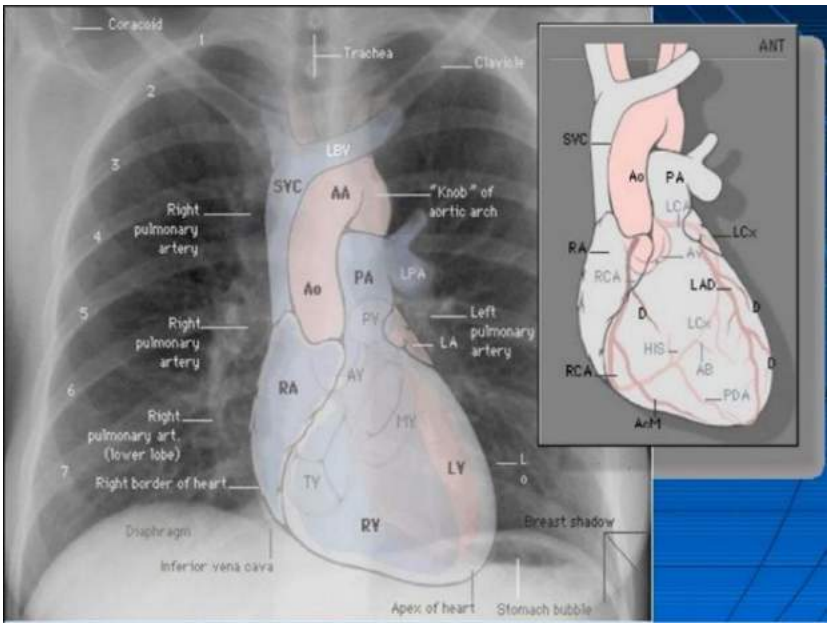
Endocardiosis cardiac abnormalities accompanied by valve leak, color flow Doppler shows yellow-orange regurgitation. In the later stages this leak will end in heart failure

Radiography on Orangutan commonly used to diagnose: Skeletal or bone, Organs abnormalities, Excess fluid, Hernia, Existence of foreign body. Radiographic examination is one of the standard procedures for routine health checks for Sumatran orangutans at the Sumatra-field orangutan quarantine center. Ecosystem Lestari Foundation, Sumatran Orangutan Conservation Program (YEL-SOCP).

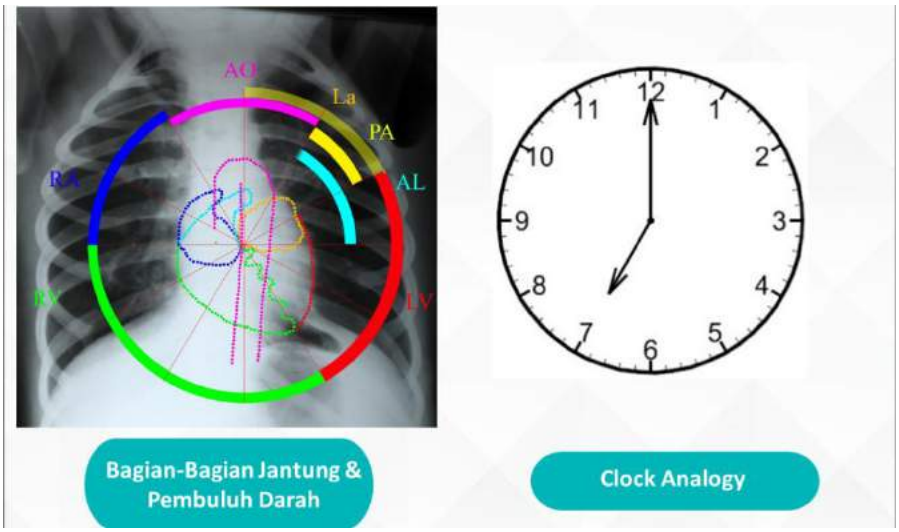
Heart radiography evaluation in Orangutan can be done using: Clock analogy method (measuring main heart blood vessel and explaining the heart part based on the clockwise position), Vertebral heart size (VHS) technique and calculation heart short axis and heart long axis, Cardio thoracic ratio (CTR) technique and right and left heart measurement of the projection centerline.

The changes that can be seen from radiogram:

Changes	Example of abnormality
Size	Diffuse neoplasia, atropy, splenomeghaly, vesica urinaria distension, heart enlargement
Conformation	Fracture, exostosis
Amount	Complete or not (kidney), increasing number of digits
Location	Hernia diafragmatica
Margination	Renal appearance in case of chronic interstitial nephritis or presence of cyst in the kidney, osteosarcoma
Opacity	Fluid in bull tympanic, soft tissue calsification, foreign body, subcutaneus emphysema, osteoporosis, osteomyelitis, an neoplasia

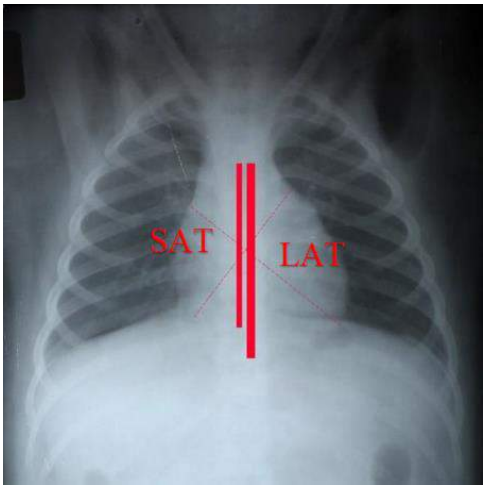


Clock Analogy and Cardiac Measurement:



Observation of chest radiographs is performed to observe cardiovascular organs which include parts such as the atrium, ventricles, aortic vessels and for cardiac measurements. Chest radiography is also used to interpret various changes in the respiratory system, especially the lungs.

VHS method is use to help diagnose cardiomegaly-related disease in the development of certain cases:



Long axis (LA) : Distance from the carina to the apex

Short axis (SA) : Widest part of the heart perpendicular to the long axis

The LA & SA were measured against the length of the thoracic vertebrae from vertebrae T4 caudally

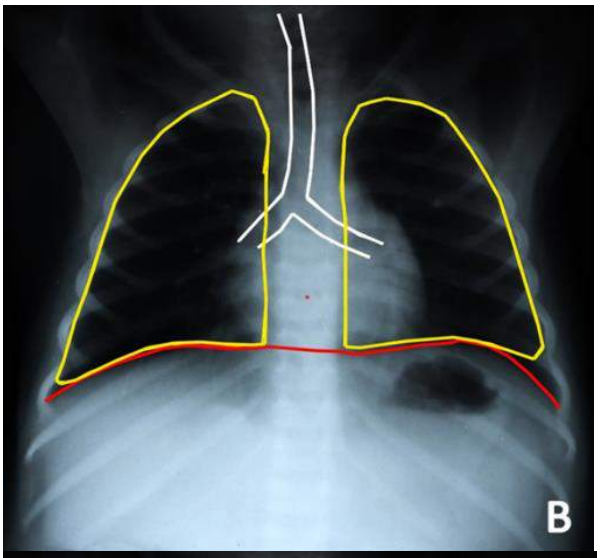
Tabel 5. Nilai rataan LAT, SAT dan VHS radiografi jantung orangutan pada posisi DV/VD.

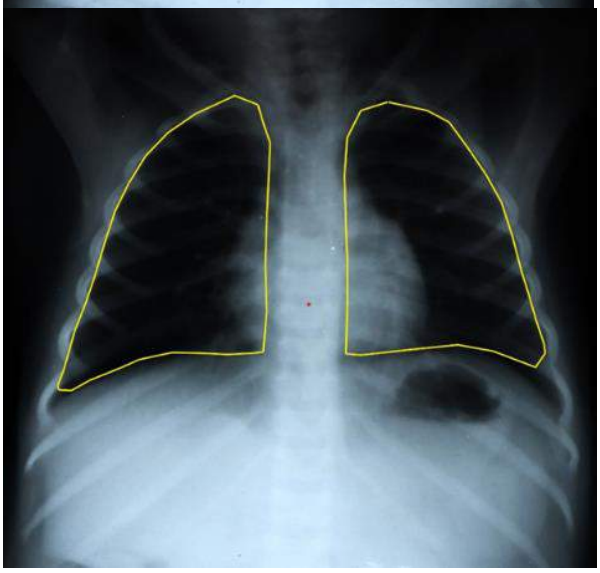
Umur	Jenis Kelamin	(n)	LAT	SAT	VHS
0-4 tahun (*infant*)	Jantan (♂)	9	6.87±0.55	5.49±0.59	12.36±1.00
	Betina (♀)	5	6.40±0.35	5.30±0.31	11.70±0.37
4-7 tahun (*juvenile*)	Jantan (♂)	6	6.30±0.63	5.35±0.52	11.65±1.10
	Betina (♀)	8	6.08±0.42	4.89±0.58	10.96±0.87
7-15 tahun (*adolescent*)	Jantan (♂)	3	5.37±0.40	4.37±0.60	9.73±1.01
	Betina (♀)	3	5.50±1.00	4.33±0.76	9.83±1.76

- Sumatran Orangutan shows a decrease in the average value of LA, SA, and HVS with age (Agussalim 2017)

(VHS = LA + SA)

Thorax Cavity





White line: Trachea
Yellow line: Lung
Red line: Diaphragm

According to Kealy et al. (2011), Respiration organs that can be found in thorax radiograph are trachea, lung, diaphragm, and bronchus branch and bronchioles.

The organs seen on the radiograph are influenced by the position, sex, and species (Schwarz and Johnson 2008).

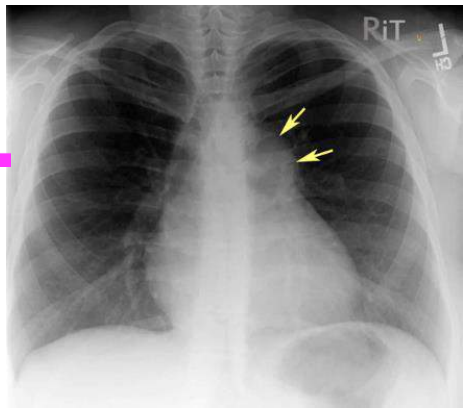
Lung

The black color (lucent) occurred because the lungs are filled by air from the alveoli, bronchioles, and bronchus (Schwarz and Johnson 2008).

The opacities in the thorax cavity is formed by amount of x-ray absorbed by thick organs such as the costae bone, blood vessels and bronchioles branch (Thrall 2013).

Lung Radiography Pattern

VASCULAR



Vascular pattern seen from the enlargement of blood vessels in thorax cavity, especially the pulmonary vein (Bradley 2017)

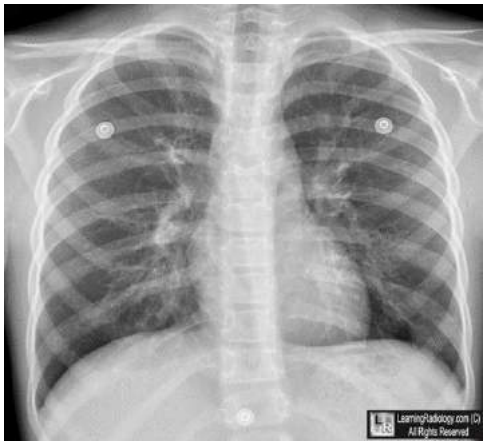
According to Feragalli et al. (2016), vascular pattern commonly indicate left heart abnormalities

INTERSTITIAL

Lung Radiography PatternAccording to Assayag *et al.* (2014), interstitial pattern is enhancement of lung density in interstitium. Interstitial pattern commonly indicate mineralization or fibrosis in interstitium, tumor, foreign bodies in lung, and liquid in emphysema pulmonum case (Anthimopoulos *et al.* 2016).

Lung Radiography Pattern

PERIBRONCHIAL



According to Kealy et al. (2011), this pattern commonly indicate allergic bronchitis, calcification, and/or foreign bodies.

Peribranchial pattern is found because of density enhancement around bronchioles wall it occurs because the bronchioles wall is filled with fluid which causes radiopaque (Bradley 2017)

Lung Radiography Pattern

ALVEOLAR

Alveolar pattern or air bronchogram is found because density enhancement on alveoli (Bradley 2017). According to Thrall (2013), alveolar pattern occurs
because of the amount of liquid or material that has higher density that fills the alveolar sacs due to alveolar edema or collapsed alveoli.

Lack of X-ray use: X-ray will contribute radiation to patients and radiographer. It cannot be used to detect moving organs in the body including determining the life or absence of the fetus. It cannot be interpreted directly like USG.

Advantages and Weaknesses of USG

Advantages	Weaknesses
Sonograph can be quickly and directly interpretated	Real time (must be interpretated during the examination to get an accurate picture and diagnosis)
Able to detect moving structures (intestine, fetus, and heart)	Operator dependent
Able to detect and monitor pregnancy and predict birthing time	Can't get through air or bone barriered structure
Have the ability in imaging muscle, soft tissues, and internal organ structures	Don't have ability in bone imaging
No side effect to patient	High sensitivity, low specifity
Dont need transquilizer/anesthesia	
Preparation only by shaving hair on the inspection area/surface	
No need water or food fasting	

Concurrent Gibbon Case Studies Session:

Case report: Recurrent Inguinal Hernia in a male Agile Gibbon (Hylobates agilis)

Aidell Fitri Rachmawati, Animal Sanctuary Trust Indonesia (ASTI)

Confiscated animals in ASTI: Reptiles / Primates / Carnivores / Birds
Crocodile (3) - Orangutan - Siamang (7) - Mueller's gibbon (2) - Agile gibbon (4) - Slow lories - Silver langur - Sumatran Tiger - Eagle - Cockatoo - Peacock - Cassowary - Bali mynah – etc.

Inguinal Hernia: Inguinal hernia is protrusion (outward bulging) of the abdominal lining, abdominal fat or a portion of abdominal organ(s) through the area around the inguinal. The condition may be unilateral or bilateral and may recur after treatment (recurrent hernia).

In macaque the highest incidence occurs in overweight, aged males / Trauma / High BMI intrabdominal pressure / Congenital abnormalities.

Case Study: 16- years old agile gibbon named Ajoy showed abnormal behavior – LIMP, ANOREXIA, LESS ACTIVITY- Body Weight : 6 kg. Examination: Anesthesia: Ketamine (8mg/kg) Xylazine (0,5 mg/kg). Result: Small bulge in the left inguinal Can be repositioned and pushed back into abdominal cavity. Diagnose: INGUINAL HERNIA. This is a recurring issue: previous case was eight years ago in the same location. Pre-operative: Moved into a small cage: to limit movement. Blood check, result: WBC (5.9 x 103 /µL) ↓ / RBC (5.24 x 106/ µL) ↓ / Hb (13,7 g/dl) ↓ / BUN (16,9 mg/dl) ↓ / Kreatinin (1.16 mg/dl) ↓ / ALT (44,6 U/L) ↓ ALP (112.9 U/L) ↓

Nutritional therapy and Multivitamin support: date palm honey) and Milk thistle . Anesthesia: Ketamine (8 mg/kg) Xylazine (0,5 mg/kg) IM - Induction time : 3 minutes - Maintenance : minute 60 - Total Duration :105 minutes. Animal did not show symptoms of complications due to anesthesia. Herniorrhaphy: Made the incision 0,5 cm from the inguinal ring. Cleaned the abdominal fat in the protrusion area. Made a new wound – inguinal ring. Suture: Muscle and skin: simple interrupted suture using absorbable material vycril 3/0. Post-Operative: 1st-3rd day Erofloxacine inj (5mg/kg) Dexamethasone (0,5 mg/kg) Biosan ATP. 4rd-10th day Oral antibiotic: Amoxicillin (10 mg/kg).

Conclusion: Inguinal hernia case can be recurrent. One of the cause in this case possibly is activity. Connective tissue alteration may also play a role.

References: Berg MR, MacAllister MP, Martin LD. 2017. Nonreducible Inguinal Hernia Containing the Uterus and Bilateral Adnexa in a Rhesus Macaque (Macaca mulatta). American Association for LaboratoryAnimal Science press: 537-540. Carpenter RH, Riddle KE. 1980. Direct inguinal hernia in the cynomolgus monkey (Macaca fascicularis). J Med Primatol 9(3):194-9. Jenskin JT, O'Dwyer PJ. 2008. Inguinal Hernia. BMJ 336(7638): 269– 272. Oberg S, Adresen K, Rosenberg J. 2017. Etiology of Inguinal Hernias:A ComprehensiveReview. Front Surg4: 52.

Cikananga Wildlife Center (PPSC) Kampung Cikananga, Desa Cisitu Kecamatan Nyalindung, Kabupaten Sukabumi, West Java Indonesia

Wahyu Hananto, Cikananga

The Cikananga Wildlife Center / PPSC has rescued 260 animals of 60 different species (mammals, birds and reptiles). They are currently breeding : 5 birds species and 1 pig species. Regarding gibbons, Cikananga has 2 Juvenile Agile Gibbon (*Hylobates agilis*) • 1 Baby Silvery Gibbon (*Hylobates moloch*) • 3 Siamang (1 Juvenile & 2 Adult) (*Symphalangus syndactylus*).

Case study: Idiopathic Diarrhea on Siamang (*Symphalangus syndactylus*). Siamang named 'Black', a 12 years old male. He cannot be released. He was kept as a pet for 8 years and loves human attention. Since July 21, 2017 to the present, his condition has been: soft - watery feces / ate well / nothing changed with behavior / bright, active and was

vocalizing. Fecal examination (was every 3 months, but now it is every 2 weeks) Parasitology negative, Protozoa *Giardia sp*., *Balantidium coli* & *Entamoeba histolytica* are negative, Feces culture *Salmonella spp*., & *Shigella spp* are negative.

Haematology

August 2017	Jan 2018
PCV 45%	PCV 48%
TP 7,5 g/dL	TP 7 g/dL
N 53%	N 55%
L 42%	L 41%
M 4%	M 3%
E 1%	E 1%
B -	B –

Treatment: Antibiotic (Metronidazole, Sulfatrim) • Anthelmenthic (Fenbedazole, Praziquantel) • Actived carbon (Norit) • Probiotic (Yakult(R) / bacterium Lactobacillus casei Shirota) • Wild leaves (papaya, kaliandra, guava) • Diet (trial and error with new diet formula).

Since July 2017 – present: Up and down, sometimes he gets worse (really soft fecal in a week) but sometimes he looks good (quite firm) but not perfect. ? Natural probiotic • fecal inoculation or natural microbiome.

C-Section in Javan Silvery Gibbon (Hylobates moloch)

Pristiani Nurantika, Javan Gibbon Center

The Javan Gibbon Center (JGC) focuses on: 1. Rescue & rehabilitation 2. Reintroduction 3. Education & awareness. The javan Gibbon Center is in Gunung Gede Pangrango National Park and the release site is in Mt. Puntang, Mt. Malabar, Protected Forest.

2013 – 2018 : 11 (at JGC) + 1 (at release site); from 7 females → 5 normal process, infants are survive → 3 normal process, infants are not survive → 4 C-section, 1 infant survived.

Normal process where infants survived: 5 maternities from 4 females • 1 female showed difficulties in carrying her infant. → 2nd infant, the 1st infant died 4 days after birth (lack of milk produced) → birth interval quite short: 1 year (Hodgkiss *et al.* 2010) Hodgkiss S, Thetford E, Waitt CD, Nijman V. 2010. Female reproductive parameters in the javan gibbon (Hylobates moloch). Zoo Biology. 29:449-456.

Normal process, where infants dif not survive: 3 cases •1st infant •No experience, was an ex-pet.

No	Name	Origin	Age
1	Kasy 21/8/14	Voluntarily donated in 9 Nov 2007	7
2	Sasa 23/6/15 14/1/17	Voluntarily donated in April 13, 2004	4
3	Cuplis 25/5/26 12/4/17	Voluntarily donated in April 7, 2008	7

C-section: 4 cases in 2 females • 1st & 2nd time of maternity.

#1. Dompu Birth interval: ~2 years 7 months (July 11, 2015 – Feb 5, 2018). July 11, 2015: 1st infant - Pre-eclampsia. Feb 5, 2018: 2nd infant - Attacked by her mate.

#2. Jolly Birth interval: ~1 year (April 23, 2017 – Apr 28, 2018). 1st infant; April 23, 2017 C-section perform 3 days after initial partus sign Lack of amniotic fluid. 2nd infant: April 28, 2018 (1 year interval).

Malasyia's Swinging Ape

Mariani Bam Ramli, Gibbon Protection Society, Malaysia

The Gibbon Protection Society, Malaysia is a Gibbon Rehabilitation Centre which focuses on research, education and awareness and the Illegal primate trade. Malaysia is home to several leaf monkeys, gibbons, macaques, lorises, tarsiers and proboscis monkeys. The gibbons species are Hylobatids lar, agilis and syndactylus.

Gibbon status in Malaysia: Population estimation?? = No current population estimation (IUCN, 2017). Wildlife Act 2010 [716] = Totally Protected / RM 200 000 / 10 years jail time. Wildlife Cons. Enactment 1997 = 1st Schedule (CITES) / RM 50 000 –RM 250 000 / 5 years jail time.

Family	No.	Species name	Common name (IUCN conservation status, 2017)
Lorisidae	1	Nycticebus bengalensis	Bengal loris (Vulnerable)
	2	Nycticebus coucang	Sunda slow loris (Vulnerable)
	3	Nycticebus menagensis	Philippine slow loris (Vulnerable)
	4	Nycticebus kayan	Kayan river slow loris (Not evaluated)
Tarsiidae	5	Tarsius bancanus	Horsefield's Tarsier (Vulnerable)
	6	Macaca nemestrina	Southern pig-tailed macaque (Vulnerable)
	7	Macaca arctoides	Stump-tailed macaque (Vulnerable)
	8	Macaca fascicularis	Long-tailed macaque (Least concern)
	9	Presbytis femoralis	Banded langur (Near threatened)
	10	Presbytis siamensis	Pale-thighed langur (Near threatened)
	11	**Presbytis chrysomelas**	**Bornean banded langur (Critically endangered)**
	12	Presbytis rubicunda	Red leaf langur (Least concern)
Cercophithecidae	13	Presbytis hosei	Hose's Langur (Vulnerable)
	14	**Presbytis hoseis sp. sabana**	**Crested grizzled langur (Endangered)**
	15	Presbytis frontata	White-fronted langur (Vulnerable)
	16	Trachypithecus cristatus	Silvery lutung (Near threatened)
	17	Trachypithecus selangorensis	Selangor Silvery Lutung (Near threatened)
	18	Trachypithecus obscures	Dusky Leaf monkey (Near threatened)
	19	**Nasalis larvatus**	**Proboscis monkey (Endangered)**
Hylobatidae	20	**Hylobates lar**	**Lar gibbon (Endangered)**
	21	**Hylobates agilis**	**Agile gibbon (Endangered)**
	22	**Hylobates Muelleri ssp. Abbotti**	**Abbott's Gray Gibbon (Endangered)**
	23	**Hylobates Muelleri ssp. funereus**	**Northern Gray Gibbon (Endangered)**
	24	**Symphalangus syndactylus**	**Siamang (Endangered) Hominidae**
	25	**Pongo pygmaeus**	**Bornean orangutan (Critically endangered)**

Threats: habitat destruction and fragmentation, encroachment cultivation, agriculture establishment and the pet trade. Gibbons can be purchased on the internet and photos of captive gibbons are shared on social media as if it is a good thing. The gibbons are: 1) Sent by Bus 2) Carry a Warranty (if it dies within 1 week - replaced with new one)

3) It comes with a Euthanize package 4) Seller Gains sympathy by showing the gibbon in dire conditions. This is true of many wild animals.

Wild Population Research Status: • Primate Conservation-edited by the late Prince Rainier III of Monaco during 1980s• How many gibbons in Peninsula Malaysia? Siamang29,000 / Lar gibbons 46,000 / Agile gibbons 4,000.

Research Challenges • Lack of research: Still a lot of future and specific research needed to ensure long term conservation and improve management • Common perception: Assumption of species is still abundant and less aesthetic value.

Case Study: 20135 (Daru): Date: 26. Aug 2014 In owner's house. Male in traumatic condition, keeps on self-hugging and fur plugging. Date: 15. Oct 2014 Arrival at rehab center. Blank eyes staring at the ceiling, not moving much, frequent stereotypic behaviors. Date: 25Oct 2015 Resting in the elevated cage. Active but still not brachiating much. Few stereotypic behaviors. Date: 09April 2018 Brachiating and foraging for food. Stereotypic behaviors have ceased. Starts producing male loud calls vital for survival in the wild.

What does the Gibbon Protection Society need? 1. SUPPORT: Letters of support / Promotion assistance / Collaborative events 2. FINANCE: Events / Operational Support / Breeding Cages

List of support letters

i. Wild Futures (United Kingdom) ii. Animals Asia (Hong Kong, China & Vietnam) iii. Douc Langur Foundation (United States) iv. International Animal Rescue (United Kingdom and Indonesia) v. Wildlife at Risk (Vietnam) vi. Wild and Free (United Kingdom) vii. KATALA Foundations (Philippines) viii. ACRES (Singapore) ix. TRAFFIC (Southeast Asia) x. Malaysian PrimatologicalSociety (Malaysia) xi. WildCare Society (Malaysia) xii. IUCN Primate Specialist Group, Section of Small Apes

The Work With The Gibbon In Our Zoo

Cheng Wangkun, MD, VET, Nanjing Hongshan Forest Zoo, China

Zoo Introduction: The zoo houses panda, a variety of birds, beasts of prey, koalas, primates (with a plan for gorillas) and a Australia section. There are 286 species. Nanjing Hongshan Forest Zoo has 22 Gibbons. It is one of the largest captive population in China. 17 of them have achieved sexual maturity. The ratio of male and female is 9:8. We have two families of gibbon, Da Huang , the Er Huang ,and they are responsible for breeding. The gibbon cages have plenty of vegetations and climbing areas. Food Enrichment: food is hidden in a plastic ball or plastic drink bottles. Hidden food is also in tubes made of paper, bamboo, or plastic. Food is sometimes hidden in books or paper boxes. Environmental Enrichment: rope ladder, water pipe, bed made of Fire hose, plastic baskets and tires.

There is a vet team of 9 people. The structure of the zoo: Management / Vet dept. / Animal Dept. / Maintenance, Fiance, HR, Mareting and education, all working together for the animals. The hospital has a director with 8 vets. There are two-part time laboratory staff and one part-time pharmacy staff. There is a plan for a new clinic.

The daily work: Morning meeting (not very day). Scheduled procedures: AM：Divide into three groups to ask each keeper about the animals / PM：Handling new cases or reading a book. Emergencies.

Prevention is better than cure! We take the following measures to prevent animal diseases:
Health surveillance ≠ Health Surveillance ≠ Disease surveillance. Daily inspection of animals' behavior, appetite, defecation, Weight, etc.） Scheduled exams (Pandas, Orangutans, Gibbons, Elephants).
Parasite management: Survey for parasites every 3 months / Treat only when needed. Disinfection. Vaccination programs / PM exams / Biosecurity / Pest control / Quarantine /Etc.

Research of gibbon: Artificial Feeding Of Infants (was presided over by Liang Zuomin): In all, we have bred 15 gibbons, 9 of which are artificially feeding. At present, 8 of them have successfully returned to the group, and 1 of them is still in the process of artificial feeding. The amount of food and behavior changes with age.

Years	Milk + Water	Frequency	Behavior
2 weeks	5g+30ml	8 times per day	sleep and eat
1 month	6.5g+35ml	8 times per day	sleep and eat
2 months	8.5g+45ml	6 times per day	start playing
3 months	10g+50ml	4 times per day	begin to grasp things
4 months	Gradually Reduce the amount of milk, and add some fruits		can stand, and can eat fruit

The weight of gibbon changes with age, the daily gain is 5.5 gram.

Research of the breeding of Gibbon (presided over by Cheng Rong): Through molecular biological identification, of the 22 gibbons, 19 were yellow-cheeked gibbon and 3 were white-cheeked gibbon. According to the data of E2(estradiol) and P4(progesterone) , we found that gibbons ' menstrual cycle is about 24 days.

Isolation, Screening of Lactobacillus with Captive Non-human Primates (presided over by Cheng wangkun): In the current study, 17 strains of Lactobacillus were obtained from the feces of Captive Non-human Primates. (Including gibbon, chimpanzees, squirrel monkeys and so on).

We found that 2(Lac 6-2、Lac 5-4) isolates exhibited good stability at low pH and high bile salt concentrations. And had good Cell adhesion and antibacterial function. These isolates were identified as Lactobacillus reuteri .

Zoonosis and retro-zoonosis control, Requirements of RRR (Rescue Rehabilitation and Reintroduction) projects: The example of HURO Programme, for Hoolock Gibbons (*Hoolock hoolock*) in Meghalaya

Presented by: Dr Susan Cheyne for HURO

Hoolock Gibbons? Three different species in one genera (Hoolock, 38 chromosomes) (*Hoolock hoolock, Hoolock Leuconedys* and the recent and still widely unknown Hoolock Tianxing). The *Hoolock hoolock*, or Western Hoolock Gibbon was twice classified amongst the 25 most endangered primates in the world, in 2005 and 2008, IUCN red-list, Their populations, till now, are spread over difficult geo-political places (North-East India, Myanmar and Bangladesh, with a little population in Yunnan, China).

HURO Program:

Created in 2008, by Florian Magne, a French national, under the patronage of Madam Maneka Sanjay Gandhi after alarming PHVA report on Western Hoolock Gibbon populations in North-East India • The program is focusing since March 2009 on Rescue Rehabilitation and Reintroduction of illegally kept (orphans, captured adults, etc.) Western Hoolock Gibbons in Meghalaya state, North East India region, • Successful releasing of a rehabilitated pair of Western Hoolock Gibbon back to the wild in February 2016, • New release of a single rehabilitated male along with a wild female being presently conducted.

Disease Risk Assessment for Rehabilitation and Release used at HURO Program (author Dr Jane Hopper, UK,) • Key: • Likelihood of susceptibility • Scale of 1 (low) to 5 (high). What is the likelihood that an individual animal to be released will be susceptible to this disease? • Likelihood of exposure • What is the likelihood that the animal to be released will be or has been exposed to this disease? • Likelihood of becoming infected • If an animal has been exposed, what is

the likelihood that the animal will actually become infected and capable of transmitting the disease? • Likelihood of transmitting to others • Is the disease-causing organism likely to be transmitted to other individuals? • Severity to the individual if clinical • If an individual in the wild population does become clinically ill with the disease, how severe is it? • Severity for the population • If the disease is likely to spread quickly through a population and kill many animals in that population, it would be considered severe for that population • Estimated significance to the program • Sum the numerical values assigned to each category. Disease which have the highest ranking will be the most significant disease to address. • P of transmission from humans to apes • Probability of transmission from humans to apes. Scale of 0 (not transmissible) to 3 (highly transmissible) • P of transmission between humans • Probability of transmission from humans to humans. Scale of 0 (not transmissible) to 3 (highly transmissible) • P of transmission between apes • Probability of transmission from apes to apes. Scale of 0 (not transmissible) to 3 (highly transmissible) • P of transmission from apes to humans • Probability of transmission from apes to human. Scale of 0 (not transmissible) to 3 (highly transmissible) • Updated significance to the program • Sum the numerical values assigned to each category. Disease which have the highest ranking will be the most significant disease to address.

What should be tested in priority in Quarantine?

After rescue, during the quarantine period, not all the described diseases can be checked in first hand, however the following infections come first: • Herpes simplex 1 and 2 (serology) • Hepatitis A, B and C (serology / PCR) • HIV (serology), eventually SIV if accessible (not possible for HURO) • Human T-cell Leukemia Virus (HTLV) (eventually STLV, not possible for HURO) • Tuberculosis (ID, read at 24, 48 and 72) done in priority and to be repeated twice during the quarantine period • Parasites (flotation and microscopy).

Controlling Zoonosis during Rescue, Rehabilitation and Reintroduction: principal keys…

All caretakers should be tested for Tuberculosis, Herpes, HIV, Hepatitis B, Regular vaccination and deworming should also be followed, • Any new infection should be reported immediately and contact with primates should stop during recovery • Protections such as facial masks and gloves should be worn during close contact, especially during quarantine period, More liberties can be taken between healthy gibbons and healthy caretakers, • Generally, caretakers should have excellent personal hygiene and hands should be disinfected as often as possible • No material should ever be passed-on from one enclosure to the other, even in rehabilitation • Gibbons should ALWAYS be kept off-floor, and should never be able to reach to the ground, a deadly place to be for them, at every levels.

Addressing malnutrition: A key for rehabilitation at HURO…

Severely undernourished gibbons, when reaching in Quarantine, most of the time have a very low immune system and are prone to more infections • We address dehydration with fluid therapy via oral, SC, or IV (in the worst cases) in first hand, • Undernutrition is approached very carefully, preferably using WHO formulas, F75 for stabilization period of 3 days and F100 for catch-up period, • 5 mg of Folic-acid is given at day 1 and other vitamin complements are given through-out the quarantine period, • Severely undernourished gibbons are put under broad-spectrum antibiotic for a period of 5 to 7 days• Infants bellow two years are fed on demand, with the help of 10 ml syringes, and fruits/leaves are proposed on demand.

It’s Not Just About Gibbons - **Photo Journal**……**Thanapat P., WARF**

HEPATITIS B IN JAVAN GIBBON (Hylobates Moloch) at Javan Primate Rehabilitation Center

Ida Masnur, Javan Primate Center

Project Focus: The Endemic primates of Java :1. Owa Jawa (Hylobates moloch); 2. Lutung Jawa (Trachypithecus auratus and T. mauritius); 3. Surili (Presbytis comata).

Mount Tilu Nature Reserve (8000 Ha): Production and protected forest manage by state owned forestry enterprise (PERHUTANI) Core Zone of Mt. Tilu Nature Reserve (8000 hectares) Manage by BBKSDA). Existing wild gibbon population 15 groups (42-45 Individuals). Enclave of tea plantation (600 ha) (Private company).

Background:

Distinct HBV sub-species in Chimpanzee and Gibbon subspecies
High number of infected H. moloch in captivity
Wild Status? Is this number representing the number of infection in the wild?
Policy is not releasing HBV positive Gibbons in to the wild
Quarantine and health screening protocols for wildlife prior to translocation and release into the wild (IUCN-SSC VSG, OIE, Care for The Wild, EAZWV-2000) – Primate Section: Since it appears that HBV infection can occur naturally, without any clinical signs, in some chimpanzee populations, it may be justified to release HBV-positive chimpanzees into wild populations, when these are already known to be infected by this virus and are suitably isolated from human settlements.

Testing wild Gibbons for HBV: Serum collection not ideal as it traumatic for animal and not practical for testing wild animals. Non-invasive sampling method required. Could HBV be detected in feces? "Traditionally" is not accepted. 1. tested feces from known infected captive gibbons -samples sent frozen and in RNA Later Buffer 2. tested feces from wild gibbons. Work was done by The Royal Society of Medicine, London.

Captive Gibbon Test: HBV DNA detectable in feces -DNA levels 10-100,000 lower -possible for testing wild animals - possibly sufficient for sequencing.

Wild Gibbon Test: Samples Origin: GHSNP, SNR, Central Java and JPRC • Habituated Gibbons followed, and samples collected as fresh as possible – 1 week • Samples stored and shipped frozen. Wild gibbon fecal samples: 14/23 positive by HBV qPCR •9/14 amplified by SPOL PCR (failures had lowest VL) •XCORE PCR failed due to sequence variation •6/14 amplified by WGPCR •XCORE region extrapolated from WG sequences. 18/32 were positive HbsAg for rescued gibbons • All positive HbsAg were Gibbon Hep B (except 1 need to be repeated) • 2 samples from the wild with negative result • collect samples from other species (Javan langur and grizzled langur) from the same area of release.

Conclusion:

HBV presence could be detected from fecal sample • HBV are circulating and infect Wild Hylobates moloch • HBV from H. moloch appear to be a unique subgroup • Closest HBV relations from Agile gibbons and orangutans.

Care of the Elderly Gibbons

Phillipa Dobbs BSc (hons) BVetMed (hons) MRCVS
Veterinary Associate, Twycross Zoo (UK)

What classes as elderly? Animals over 75% through their wild longevity (or captive longevity if information on wild not available) will be classed as 'elderly'. Agile gibbon: Wild longevity 20 years. White cheeked gibbon: Wild longevity 28 years. Pileated gibbon: Wild longevity 25 years. Siamang: Wild longevity 30 years.

Why are regular health checks of elderly animals important: Issues can be detected earlier / Treatment started earlier / Management changes instigated / Animals welfare regularly monitored.

What to do before a health check: Discuss any behavior concerns with animal carer / Discuss any changes in gibbons mobility/general demeanor/drinking and eating habits / Obtain weights if possible / Train if possible to reduce catch up stress e.g. injection training, crate training.

What to do during health check: Weigh and body condition score / Clinical and full dental examination / Radiographs – thorax, abdomen and joints / Ultrasound – abdominal +/- cardiac / Bloods and urine sample.

What to do after a health check: Discuss findings with animal carer / Discuss treatment plan if needed e.g. long term pain relief / Decide on frequency of re-examination.

Regular review / Daily keeper assessment / Monthly 'long term medication' rounds / Video assessment / Continuity

Anesthesia of elderly gibbons: Twycross Zoo protocol: - Gibbons trained into removable crush tunnel - 5mg/kg ketamine and 0.05mg/kg medetomidine given intramuscular OR - 5-10mg/kg ketamine and 0.25mg/kg midazolam given intramuscular. Once anaesthetized (usually within 5-10mins) intubated and then maintained on isoflurane as needed - Given intravenous fluids at 50ml/kg/day or increased as needed depending on hydration status and blood pressure.

Record keeping: Important to keep full written records of all health checks carried out / Anesthetic form showing heart rate, respiratory rate and temperature as a minimum / Ideally also include blood pressure, ETCO2 and SPO2 / Extensive notes on what is found during health check.

Common conditions seen in elderly gibbons: Dental disease / Spondylosis (degeneration of spine) / Osteoarthritis (stiff and painful joints) / Kidney disease.

Dental disease: Fairly common in all elderly gibbons / Can be related to poor diet (current or past) / Can be very painful / Clinical signs / Dropping food / Increased salivation / Favoring one side of mouth / Swelling of face / Not eating / BEWARE – could have NO clinical signs (Canine commonly affected). Treatment: Removal of tooth / Removing pulp and filling / Pain relief +/- antibiotics / Soft food.

Spondylosis: Very common in older primates, sometimes seen in gibbons / Clinical signs: Moving less/inability to jump or brachiate / Curved spine / Stiffness in back legs / Diagnosis: Radiographs. Treatment: Pain relief / Adaptation of enclosure e.g. easier points for brachiation, more resting points / Monitor weight and body condition – ensure not overweight putting extra strain on joints.

Osteoarthritis: Very common in older gibbons / Clinical signs: Thickened joints (particularly knees) / Moving less/Inability to jump or swing / Diagnosis: Radiographs. Treatment: Pain relief / Joint supplements / Adaptation of enclosure / Monitor weight and body condition score.

Kidney disease: Clinical signs: Drinking more / Urinating more / Losing weight. Diagnosis: Bloods and urine sample for dipstick/specific gravity. Ultrasound of kidneys. Treatment: Reduce protein in diet (if have access to this) / Feed kidney supplements / Monitor weight carefully / ACE inhibitors (to help with blood pressure).

Pain management: Non-steroidal anti-inflammatories: Meloxicam (Metacam) at 0.2mg/kg given orally once daily Carprofen (Rimadyl) at 2-4mg/kg given orally once daily. Additional pain relief: Tramadol at 1-3mg/kg given orally twice daily (Beware of side effects: sedation, excessive scratching) / Paracetamol at 10mg/kg given orally twice daily.

Supplements: Joint supplements / Human chondroitin/glucosamine e.g. Lintbells imove /
Dog chondroitin/glucosamine e.g. Lintbells yumove dog or VBS GLM advanced / Renal supplements / Help support

the kidney e.g. VBS Renal phos-less / Hepatic supplements / Help support the liver or can be given if giving drugs that can be toxic to liver e.g. VBS Hepatosupport.

Case Study 1: 26-year-old male White cheeked gibbon (*Nomascus leucogenys*). Clinical conditions: Mild spondylosis / Mild stifle osteoarthritis. Treatment: Daily oral joint supplement / Monthly visual assessment and yearly full health checks / Will probably need to start on oral non-steroidal anti-inflammatories as diseases advance with age.

Case study 2: 36 year old male Agile gibbon (*Hylobates agilis*). Clinical conditions over last few years of life: Dental disease (both upper canines) / Spondylosis / Stifle osteoarthritis / Cardiac disease. Treatment: Both upper canines removed via open extraction – given appropriate after care of antibiotics, pain relief and soft foods until recovery. Daily oral joint supplement and oral non-steroidal anti-inflammatory for stifle osteoarthritis and spondylosis / Cardiac disease – daily oral ace inhibitor / Monthly visual assessment and yearly full health checks. Euthanized at 36 years old due to decline in mobility and quality of life. Post mortem and histopathology confirmed: Extensive arthritis affecting stifles and elbows / Myocardial fibrosis / Benign splenic mass.

Case study 3: 38 year old male Pileated gibbon (*Hylobates pileatus*). Clinical conditions: Early kidney changes on bloods. Treatment: Monthly visual assessment and weights obtained through training / Opportunistic urine sampling / Yearly full health checks / Considering starting on oral renal phosphate binder.

Conclusion:

Elderly gibbons can be managed / Medications can be used if necessary / Enclosures can be adapted / Regular monitoring paramount to ensuring good welfare and quality of life.

Brain storming session for issues and future plans I :

Why a Gibbon Vet Meeting?

1. There is currently no coordinated vet forum for gibbon projects.
2. The SSA has to worked with OVAG to bring gibbon vets from *in situ* and *ex situ* organizations to the annual OVAG meeting.
3. Identify actions to tackle emerging diseases in wild and captive gibbons and siamang.
4. The SSA will ensure this meeting is regularly attended to ensure maximum knowledge exchange for gibbon vets.
5. Invite SSA members with a specific focus on gibbon rescue and rehabilitation and health to join Whatsapp Group. BaM Arrogancia is the admin (Gibbon Whatsapp Group): +60 168551770.

Brain-Storming Session – General Problems Gibbon Vets And Rescue Centre Managers Feel We Need To Address For The Future II :

This document will be developed and shared with vets/managers who were unable to attend and will be a work in progress. Individual centers will work with SSA for their specific needs.

1. MONEY FOR ALL THE ITEMS BELOW!
2. WILD POPULATION SURVEYS FOR JAVAN GIBBONS AND SUMATRA, SABAH, SARAWAK AND PENINSULAR MALAYSIA

To identify possible release sites and species distribution and density.

3. WARF – FUTURE PRESENTATION ON THE PROGRESSION OF THE PROJECT INC. RELEASE, REHAB, WORKING WITH GOVERNMENT, WORKING WITH TOURISTS Thanaphat to do this.
4. MEETING IN 2019 Find money and a venue
5. GO THROUGH ZIMS DATABASE TO IDENTIFY CASE STUDIES ON GIBBON DISEASE AND HUSBANDRY

Share these as there is such a lack of publications (identified for hernia, chronic diarrhea, Hep B, Herpes simplex etc.)

6. MORE WILD SURVEYS FOR FAECAL SAMPLES

Screen for Hep B, TB and other diseases and parasites etc.

7. PROBLEM OF ONLINE TRADE (AND TOURIST PHOTOS)

Need coordinated campaign to reduce demand e.g. online campaigns for slow loris and orangutans.

8. TRANSLATE WORK BY LOCAL RESEARCHERS INTO ENGLISH

Lots of work on gibbons especially available in Thai, Bahasa Indonesia, Chinese and needs to be more widely available i.e. in English.

9. EMERGENCY FUNDING Find some!
10. OTHER IDEAS (NOT FULLY DISCUSSED)

- More zoo vets to attend?

- Students to study gibbon health?
- Funding/training?
- Publications?
- Sharing of case studies especially TB?
- Tracking gibbons post-release (transmitters)?

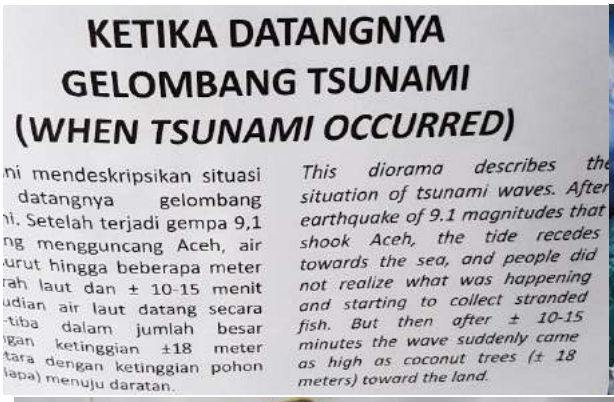
Link to the Report of Gibbon Session in Appendix D

Afternoon City Tour / Dinner at Beach

Kilometer 0

Mosque

Tsunami Museum



The Beach

Durian Feast

Day 5 – July 26

OVAG website

Steve Unwin

OVAG has been working as a network and capacity building workshop – but we have been building a lot of useful information and tools such as starting our own Whats App group and a google drive site – but that proved difficult to reach everyone. As we are starting to get a name for ourselves, more and more people are curious about what we do – it gets harder to do that over an email – and people always want to know more. Steve has talked about this to Chester zoo who employs a full-time web team. When the conservation team spoke to Steve, and about the problems of communication, Chester offered to open and run a website for OVAG for 3 years. Sara Aberu, who has created zoo websites (as a vet) will be assisting OVAG to get the website up and running. It is now up and running!!!!!

https://www.ovag

The website is in English and Bahasa Indonesia – you can write something in either language and the program will translate it correctly. You will be able to link to Gavo on Instagram – this is a public access website except for information that is for the OVAG network group only. For this you must register and be approved by the OVAG committee.

The committee will have full rights to it – so any information you want on the site – contact one of the committee member. If you want anything linked to your organization website, we can do that. The idea is that someone within OVAG will take over the mechanics of running the website – the news section is something that people in Indonesia and Malaysia can be really helpful with. We can have reports put on (for example OVAG annual reports are there) and any articles we can link to, etc. All the information including case studies, teaching and training, will be available as an a OVAG member for the resources area only.

Discussion: How will OVAG members gain access – who will monitor that? Initially this will be a case by case basis – people who have been to at least 2 workshops – no charge to join – at this stage – If you have any pictures of past and

present OVAG we can upload or if you have any activities that are relevant – or funny send it to one of the committee and we can upload it. Who is the target audience? Scientists or who? They are not mutually exclusive – public awareness – it will be mobile friendly – but they are developing that….

We are really moving forward. Can what we do be used as a model for other species? Starting with orangutans, but not limited to one species. Not that we will do other species as OVAG, but, that the model using orangutan exists for others. But we need to be evaluating what we have done up to now – if you are working with people who feel isolated and out of control – then showing people how to be in control would be very helpful. If they begin to think they are in control, then they will feel in control and can move forward. It is important to have quantifiable evidence that the OVAG model works. So, if we just say OVAG is fun, even just that can improve cultural awareness and be helpful. But we will be publishing a paper showing the efficacy of OVAG and its ability to be used as a model for other species conservation work. Part of the evaluation is asking how OVAG members have benefitted by the presence of OVAG in their lives. The authorship of that paper is the OVAG committee and a few others from an evaluation perspective. The OVAG article on Evaluating the Contribution of a Wildlife Health Capacity Building Program on Orangutan Conservation Impact**,** has been submitted to Conservation Biology for review.

Preliminary OVAG graphs for the article are very positive as we have shown that as a result of OVAG there is significant improvement that is measurable (basically anything over 2.5 is positive and OVAG comes in in the high 3 and even 4!)

OVAG Pathways of Change:

Impact statement 20 Year frame: Successful integration of One Health programs into conservation efforts leading to successful disease mitigation in wild populations and linked public health and environmental disease issues with a proven contribution to the protection of SE Asian wildlife, habitat and human health that can be used as a model for other regions.

Assumptions:

- Restoring wildlife within their ecological range will improve the health and resilience of the environment
- Will also enhance the ecosystems ability to adapt to a variety of climatic events….
- Creating a body of knowledge that creates the opportunity to successfully protect the environmental values that give wildlife habitats international significance

OVAG phase 2 / Completion 5 years (2022): PHASE OUTCOME STATEMENT: There exists a sustainable regional cadre of professionals able to provide capacity building, advice, guidance and management of One Health matters with wildlife in Indonesia and Malaysia.

OVAG network and methodology becomes the gold standard in capacity building for those involved in conservation health in Indonesia and Malaysia. *Target: All NGOs involved in conservation health are a part of OVAG or have modelled their work on OVAG.*

OVAG becomes the 'go to' network to assist with successful outcomes in One Health matters with wildlife in Indonesia and Malaysia (is the world's leading referral organization for the health of orangutans and their habitats. *Target: All Government and NGO decision makers take the OVAG networks consolidated opinions and expectations into account when producing and assessing policy in conservation health*

Assumptions:

- Participants remain in the One Health field in sufficient numbers to contribute to successful restoration of healthy wild populations

- Increased extent, diversity, condition and connectivity of biodiversity in Indonesia and Malaysia
- Full engagement of policy and decision makers
- Successful cooperation with regional, national and international institutions (OIE, WHO, WAHID / WAHIS)

Goals and Activities:

1. Capacity Building: OVAG will provide expert training on relevant disease investigation techniques and an appreciation of conservation management on a global scale.

2. Policy: OVAG champions to communicate process and lessons learnt from legislation development, academic program creation and crisis management systems.

3. Research. Embark on evaluated conservation medicine and welfare research.

Assumptions:

- Successful linking of participation, learning and outcome in mitigating health risks
- Successful knowledge sharing leading to a measurable legacy
- Successful orangutan health programs will assist in reconstitution of appropriate, self-sustaining and protected native habitat
- Decision makers in target organizations and Governments will be interested in participating in the project and commit to ongoing professional development of participants
- Sufficient funding and technical support is available to support the required number and diversity of participants for a successful One Health program
- Successful disease mitigation responses from participants who will be successful in reducing disease risk in wildlife populations and local community situations

OVAG PHASE 2. PATHWAYS OF CHANGE:

1. Capacity Building: Via project managers, veterinarians and Human Health Practitioners.

2. Policy: Via Government level decision-makers, Academia and Wildlife centers by providing timely and evidence-based support.

3. Research: Filling data gaps on emerging infectious disease in wildlife in SE Asia utilizing OVAG partners.

4. Raising Awareness: Target – high level government about information gathered from pathways 2 and 3 and promotion of pathway 1.

Challenges and target audiences:

Animal health professionals poorly trained in wildlife medicine and one health at point of graduation, and poor pay and conditions post-graduation.

Lack of wildlife disease surveillance in either Indonesia or Malaysia.

Data gaps in knowledge of disease threat on wildlife health or public health and what impact this potential threat has on conservation efforts in general.

To provide proof that by remaining a network of strongly connected veterinarians, health care workers and researchers we are successful in creating strong collaboration among conservation NGOs in Indonesia and Malaysia.

Targets: Field researchers, Veterinary students/ early career vets; Conservation project managers; medical practitioners (local community level); Government high level staff/ university chancellors.

Foundational (completion of OVAG Phase 1) 2017:

Assumptions:

- Decision makers in target organizations and Governments will be interested in participating in the project and commit to ongoing professional development of participants

Indicators OVAG Phase 2:

- Examples of Integration with other
- Successful assisted enforcement of current animal welfare and wildlife law in Indonesia and Malaysia. (Number of regulations issued)
- Number and location of successful; protected orangutan releases
- Number and success of OVAG participant organizations
- Number and position of participants as decision makers in conservation health
- Area protected
- Number of participants successfully trained (For example reliable vets increased by 70% on 2017 levels)
- Number and quality of scientific output
- Number of Indonesians and Malaysians involved in conservation
- Clear definitions obtained for a 'crisis'
- Successful scenario simulations carried out.
- Completion of an orangutan information database and input to WAHIS/ WAHID..
- Improved training of veterinarian participants in fundraising skills

Epidemiology revisited

Marie McIntyre, Liverpool University

13 Steps to a Disease Outbreak:

Communication is so important in controlling a disease outbreak.

Review of scenarios:

It is important to immediately isolate so whatever it is does not spread…the time to organize is before something happens…if this was a real incident, you are not the leaders in contacting media or government though you may be asked to be…and this needs to be determine beforehand. First contact with either media or government needs a relationship built before anything dire happens. Which groups already have a communication strategy? (BOSF only) – If relationships are built beforehand, then when something happens, people are already dealing with people they know and hopefully trust. So, flow of information can be smooth as well as any measures that may need to be taken quickly.

There are pilot programs in Central Java, Sulawesi, and Riau and they are trying to establish real time early response, early reporting, and proper protocols. There are websites being developed, in this way, all people working with wildlife will be able to feed information to the government. But people who will give this information will need to be registered so those reporting are known entities. There is an opportunity for all of us to improve this system in order to improve both animal and human health. There is also a focus on emerging infectious diseases. There will be a regional person to contact and many wildlife officers are available. But the first time this group is contacted should be done before the need to contact them occurs. Simulation exercises might be useful and perhaps collaborating can make these simulation exercises happen and can be a partnership between OVAG and Indohun. How does reporting occur? Based on the One Health program in Indonesia, the vet should be registered, and the information is reported and an investigation will begin. This network is increasing the number of people reporting.

Vaccinations:

There are different protocols to follow when vaccinating – can orangutans even be vaccinated? What is expected from you? If you feel that is clinically incorrect – if you had a previous relationship with an official, they may be more apt to listen.

There is are several Ebola vaccines but only one is currently being used in humans – Ebola is really devasting to chimps and gorillas – there is permission to administration to great apes, however, no one wants to have their great ape population vaccinated – and because Ebola is so scary – many do not want to participate. Gorillas have also died from Anthrax – and they vaccinated gorillas with the anthrax vaccine – no one objected to anthrax but without trials because anthrax does not have the same fear attached to it as Ebola. So, if opportunity comes to a rehabilitation center for testing, it could be beneficial to participants on a wider conservation scale (if possible).

Scholarships: Anneke

AAZV (American Association of Zoo Veterinarians) has scholarships for teaching, and going to conferences. If you are awarded, the scholarship covers: travel, registration and some accommodation. Sometimes hotels near the conference venue are cheaper and sharing will decrease costs. Available to those that are looking after animals, have published, etc. Points are awarded for abstracts accepted for talks, posters given, etc.

The Murry Fowler Scholarship – travel and registration

International ACZM Ultra Short Course Scholarship

Wildlife Pathology Workshop – only covers workshop – can apply to both (Murray Fowler)

Application form is online at the AAZV website – they will fund until they run out of money.

Discussion: where you are from matters (more points if you are from a poorer country), must be a vet, have you presented anywhere?, are you receiving any money from other places? or have you asked even if they said no? – it works better if they know you are searching – where will you travel from, where did you learn about this (OVAG)

Nancy Lung, as she did last year offered to sponsor AAZV membership to any OVAG participant.

OVAG Celebrating Our 10 Years Of bringing People Together

Raffaella Commitante, OVAG, Orangutan Conservancy

The beginnings and history of OVAG… The idea of starting a veterinarian working group began for me when I returned from living several years in Indonesia and wanted to do something to help the many wonderful dedicated people I met while there. Luckily, I was working with Orangutan Conservancy (OC), and Doug Cress who also worked with OC, was working for PASA (Pan African Sanctuary Alliance) as well. It was Doug Cress who thought to put Steve Unwin and I together. Steve had been organizing similar workshops for PASA for several years.

OVAG began in 2009. The first meeting was in Samboja Lestari, hosted by the Borneo Orangutan Survival Foundation (BOSF) in Balikpapan, Kalimatan Timur.

We were 26 participants, 15 organizations / Report: 38 pages

It was at that first meeting that we named our group The Orangutan Veterinary Advisory Group (OVAG).

The second workshop in 2010 was in Medan, Sumatera hosted by The Sumatran Orangutan Conservation Programme (SOCP) and Yayasan Ekosystem Lestari (YEL).

We were 28 participants, 19 organizations / Report:43 pages

In 2011, the workshop was in Jogjakarta, Java. It was the first partnership with Gadjah Mada University, Fakultas Kedokteraan Hewan .

We were 35 participants, 16 organizations / report: 58 pages

In 2012 the workshop ws held outside of Indonesia for the first time in Kuala Lumpur, Malaysia very generously hosted by Universiti Putra Malaysia and the Ministry of Environment and natural Resources.

We were 42 particpants, 25 organizations / report: 56 pages

It was in Kuala Lumpur that Popo named our new mascot from Chester Zoo….GAVO

In 2013, OVAG was hosted by Asliqewan andFaculty of Veterinary Medicine of IPB (FKH IPB), Bogor, Jawa, Indonesia.

We were 40 participants, 24 organizations / Report: 66 pages

In 2014, OVAG was held in Jogjakarta hosted again by UGM, Fakultas Ketokteraan Hewan.

41 Participants, 26 organizations / Report: 111 pages

In 2015 OVAg was held again in Jogjakarta an MOU was signed between OVAG and Gadjah Mada University to have the OVAG workshops there every year unless invited elsewhere (every other year).

We were 59 participants, 35 organizations / Report: 77 pages

In 2016 OVAG in Malaysia again, this time in Malaysian Borneo hosted by The Sabah Wildlife Department….and OVAG introduced its new logo.

In 2017 OVAG was held in Jogjakarta with our main collaborator UGM where all of the OVAG committee (and other OVAG friends) participated (taught) in a Wildlife Summer Course hosted by The Biology and Vet Departments of UGM.

with 68 partcipants, 41 organizations / Report: 153 pages

This year, 2018, the 10th year, OVAG was held in Banda Aceh, Sumatera where we were over 70 participants, 60 organizations.

Why the OVAG family works:

We are a cooperative, collaborative network

We respect each other and the knowledge we ALL have

We share what we know with each other

Everyone is equal, and all ideas are valid

We build and maintain long term relationships

We encourage each other and give each other confidence

We know that together we are strong!

OVAG Committee **Presenters: Yenny, Rico, Siska, Citra**

The OVAG Book - a collection of orangutan stories written by the people who know them best – the vets.
The OVAG Parasite Manual – in the works.

Citra's perspective: OVAG is operational but we wanted it and needed it so that gave it its longevity.

SIska's perspective : this workshop was mainly for vets working in Indonesia and Malaysia so others coming from various fields can offer their perspective….the idea is to share knowledge – so active participation needs to be higher from orangutan local vets…Once we felt confident in how OVAG works, last year we decided to invite other primate vets, (Susan Cheyne: Gibbons) and now this year gibbons vets joined as well as elephant, tiger and Sumatran rhino people came so collaborations can be more extensive as problems are similar.

Poster Session: 7 (Siska, Yenny, Ricko, Pandu) posters submitted from OVAG recipients of funding – to encourage other OVAG participants to seek out opportunities.

Face painting Session!






Thank you to the Indonesia/Aceh/Jogjakarta committee members for doing such an amazing job.

Post Workshop Pulau Weh Trip:

Orangutan Veterinary Advisory Group Workshop

22 July – 26 July 2018

Section Four

Appendices:

A: On Site Visits **B**: Quizzes and Review

C: Evaluation / Participant's Feedback **D**: Gibbon Report

Appendix A

One on One Site Visits:

Drs. Jennifer Taylor-Cousar and Nancy Lung of OVAG for on-site training at orangutan rescue centers in Borneo in 2018 had a strong educational impact in four key areas:

1. During the OVAG Annual Workshop: Eighty participants were reached through didactic lectures on the clinical diagnosis and management of chronic respiratory disease in orangutans. Eighty participants were reached through a group problem-solving workshop on orangutan anesthesia. All participants engaged in lecture and group discussion on the process of scientific peer-review, the importance of sharing the vast OVAG knowledge with the broader scientific community, and how to determine what information is worthy of publication. Participants also engaged in hands-on sessions on the use of bronchoscopy and radiologic interpretation.

2. The Nyaru Menteng Veterinary Team: Drs. Taylor-Cousar and Lung had three excellent days of learning and collaboration with the veterinary team at Nyaru Menteng. Six NM veterinarians participated. Formal lectures on chronic respiratory disease were presented to the team and to the NM director (not sure of his actual title or his name!). Excellent group discussions were had on respiratory disease diagnosis and management, clinical research, and how this information pertains to the animals at Nyaru Menteng (both pre-release and long-term captives).

3. Clinical investigation at Samboja lestari: In partnership with the Samboja veterinary team, Drs. Taylor-Cousar and Lung continued the investigations into chronic respiratory disease of orangutans that is funded by a grant from the Wild Animal Health Fund. This work provided excellent learning opportunities for all participants (7 veterinarians, one veterinary assistant, numerous animal technicians and several local human medical specialists). Learning opportunities occurred in the areas of anesthesiology, radiology, pulmonary medicine, animal training, and critical care medicine.

4. One-on-one clinical training at Samboja lestari: A recent veterinary graduate, newly hired veterinarian for Jejak Pulang and the solo veterinarian for the Sintang Orangutan Center (Jati) each came to Samboja lestari for direct clinical training. This training included didactic lectures, hands-on wetlabs, and the opportunity to participate in high level anesthestic and diagnostic procedures on adult male orangutans (part of the respiratory disease Internally, there were 4 or 5 SL (Patrick of PT Rhoi was there for some of it). Drs. Taylor-Cousar and Lung both participated in training for all but Jati, who received training earlier with Dr. Lung. These one-on-one training opportunities are an excellent way to quickly and efficiently improve the clinical competency of orangutan respiratory center veterinarians.

Liz Ball ZIMS/Chester Zoo – after the workshop, Liz spent an extra week in an onsite visit to SOCP working with Citra, Yenny, and others in SOCP management, converting their current records system to ZIMS. Even though it took some getting used to, the SOCP staff immediately were ab le to see the benefits of keeping records in such an organized way where information could be accessed so easily once inputted.

Appendix B

Respiratory Quiz:

Check ALL of the following that are TRUE regarding the re-breathing system of the gas anesthesia machine?

a. When using the re-breathing system, the patient inhales a mixture of fresh air coming out of the vaporizer and air that was exhaled in the previous breath.
b. When using a re-breathing system, all exhaled air leaves the system, so it is not necessary to have a way to remove CO2 from the exhaled air.
c. When using a re-breathing system, you must keep the oxygen flow very high to protect the patient from re-breathing CO2.
d. A re-breathing system includes a cannister of soda lime for the purpose of removing CO2 from the exhaled air.
e. A re-breathing system is safe because the soda lime cannister removes CO2 from the exhaled air

Check ALL that are TRUE about the anesthesia machine's "pop-off valve"?

a. The machine needs a pop-off valve to reduce the high pressure coming out of the oxygen tank.
b. Leaving the pop-off valve open during anesthesia is dangerous because in the open position the high oxygen pressure will reach the patient's lungs.
c. Leaving the pop-off valve open during anesthesia is essential for preventing a dangerous build-up of pressure in the patient's lungs.
d. The pop-off valve is necessary so that you can provide positive pressure ventilation to the patient.
e. The pop-off valve should only be in the closed position when giving positive pressure ventilation.

If you want to give the animal a breath, which one of the following is the proper sequence of steps?

a. Turn up the oxygen flow, turn off the vaporizer, squeeze the bag
b. Fill the bag with oxygen by pushing the flush button, open the pop-off valve, squeeze the bag, close the pop-off valve
c. Close the pop-off valve, squeeze the bag, open the pop-off valve
d. Deflate the cuff on the ET tube, squeeze the bag, re-fill the cuff on the ET tube

You are doing a surgery. You look over at the anesthesia machine and see that the re-breathing bag is tight/full. Which of the following could explain the reasons? Circle all that apply.

a. The oxygen flow is too high b. The isoflurane % is too high c. The ET tube is kinked
d. The pop-off valve is closed e. The pop-off valve is open

1. For the situation above, is an over-inflated bag dangerous to the animal? Explain why yes or why no.

1. For the situation above, name two of three things you can do to immediately resolve the problem?

You are doing a surgery. You look over at the anesthesia machine and see that the bag is flat. With each breath the animal is sucking the bag really flat. Circle all of the following that could explain this?

a. The oxygen flow is too high b. The oxygen flow is too low

c. The patient is breathing too much air and you need to make him breath less d. The isoflurane % is too high

For the situation above, is an under-inflated bag dangerous to the animal? Explain why yes or why no.

For the situation above, what immediate step should you take to resolve the problem?

The purpose of the "pink granules" (soda lime) in the canister next to the breathing bag serve what one purpose?

a. They absorb excess isoflurane so that the anesthetic gas does not leak into the room
b. They pull humidity from the air in the circle to reduce oxidation/rust in the machine
c. They disinfect the air, similar to a HEPA filter, to reduce the risk of transmission of pathogens from one patient to the next
d. They remove carbon dioxide from the air going from the machine to the animal
e. They remove carbon dioxide from the air going from the patient to the re-breathing bag

When the granules in the soda lime cannister change color, it indicates which ONE of the following?

a. You need to re-fill the isoflurane vaporizer b. The oxygen tank is empty and needs to be changed.
c. The CO2 tank is empty and needs to be changed. d. The pressure in the re-breathing system is too high and you need to open the pop-off valve. e. The granules are saturated with carbon dioxide and need to be changed.

The ETCO2 sensor measures which one of the following:

a. Carbon dioxide in the air going from the anesthesia machine to the patient
b. Carbon dioxide in the air being exhaled by the patient
c. The level of oxygen in the air going from the machine to the patient
d. Carbon dioxide in the soda lime absorber
e. Level of isoflurane being delivered to the patient
f. The amount of carbon dioxide in the patient's blood

The SPO2 sensor measures which one of the following:

a. The level of oxygen in the air going from the machine to the patient
b. The level of oxygen in the air being exhaled by the patient
c. The percent of hemoglobin molecules that are saturated by oxygen
d. The percent of alveoli in the lungs that are saturated by oxygen
e. The percent of oxygen dissolved in the blood

If the pulse oximeter is reading 78%, check all of the following things that could explain the reason for the low reading:

a. The sensor is not making good contact with the mucosa
b. The sensor has fallen off the lip and is sitting on the ground
c. The carbon dioxide level in the patient is too high
d. The oxygen tank ran out of oxygen, so the patient is not getting enough oxygen
e. The patient stopped breathing several minutes ago
f. The ET tube is obstructed so the patient is not getting oxygen
g. The patient has severe pulmonary disease so oxygen is not being delivered to the body
h. The patient has received too much oxygen

For the past hour the pulse oximeter has been reading 98%. It suddenly changes to 83%. The most likely explanation is:

a. The patient is in trouble and the reading is real b. The batteries on the machine died
c. The probe is no longer making good contact with mucosa

Which one formula allows you to accurately estimate the amount of air a patient should take with each breath (the Tidal Volume):

a. 10ml of air per 1kg of body weight b. 100ml of air per 1kg of body weight

c. 1ml of air per 1kg of body weight d. None of the above. Tidal volume should be measured using a machine, not estimated.

The isoflurane vaporizer is set to "3". Which one of the following is true?

a. The patient is getting 3ml of isoflurane per hour
b. The patient is getting 3 times more isoflurane than oxygen
c. The patient is getting 3 times more oxygen than isoflurane
d. Of the air going to the patient, 97% is oxygen and 3% is isoflurane

Check all of the following that are true regarding an isoflurane vaporizer?

a. It is calibrated by the manufacturer to deliver the amount you set on the dial.
b. It is calibrated for isoflurane, so other types of gas anesthesia should not be used in this vaporizer.
c. To deliver isoflurane accurately, the vaporizer must stay in the upright position

d. If the vaporizer accidentally tips on its side, you must stop using it, empty it, take it apart to dry, then re-assemble it.
e. The vaporizer will still deliver gas to the patient even when the oxygen is turned off

The expired carbon dioxide level of your patient is reading 64. Which one of the following statements is likely to be true?

a. The oxygen flow from the vaporizer is too low b. The carbon dioxide flow from the vaporizer is too low
c. The patient has not been breathing deeply enough or frequently enough
d. The patient has been breathing too deeply or too frequently

The expired carbon dioxide level of your patient is reading 64. Your response should be:

a. Breath for the animal more frequently b. Breath for the animal less frequently

Check all of the following that are true about the purpose of the cuff on the end of the Endotracheal tube.

a. It prevents regurgitation from the stomach into the pharynx
b. It fills the space between the endotracheal tube and the tracheal wall so you give positive pressure ventilation
c. You should not inflate the cuff unless you are worried about aspiration of purulent material
d. You should inflate the cuff as big as it will go so that it holds in place very well
e. It fills the space between the endotracheal tube and the tracheal wall so that if there is any fluid in the pharynx it does not drain into the lungs.

Check all of the following that are good places to feel a pulse on an anesthetized orangutan.

a. The brachial artery under the biceps muscle b. The femoral artery in the inguinal area
c. The anterior tibial artery over the front of the ankle d. The facial artery under the jaw
e. The sublingual artery

<u>Term Words Explanation/Meaning</u>

IPPV Intermittent Positive Pressure Ventilation / ETCO2 End Tidal CO2 / SPO2 Oxygen Saturation / IBP Invasive / Blood Pressure / NIBP Non-Invasive Blood / Pressure / CRI Constant Rate / Infusion / TV Tidal Volume

When, in the middle of a case, your soda lime absorbent completely changes color, what should you do?

a. Change the exhausted soda lime, replacing it with fresh granules.
b. Kiss the patient's forehead and wish them the best of luck.
c. Increase fresh gas flow to compensate for the exhausted CO2 absorbent
d. Increase the patient respiratory rate to blow off the excess CO2

Appendix C

Delegate feedback

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
New Knowledge: Did I gain useful knowledge?	51	11	1		
New Ideas: Did I gain new ideas that will improve the way I do my job?	24	36	3		
Applying the learning: Will I use the information?	29	33	1		
Applying the learning: Have I been shown how to impart this knowledge to colleagues and managers?	20	31	11	1	
Effect on results: Do I think the ideas and information provided at this workshop will improve the way I do my job?	28	32	3		
Effect on results: Do I think the ideas and information provided at this workshop will improve the health of the animals under my care?	30	23	10		

Best things comments
The best workshop I ever joined. Keep it up!
Knowledge sharing and networking - getting to know what others do through presentations and informal conversations
The mixture of vets and non-vets and the addition of talks from other species conservation to share the OVAG model
Learning new information and sharing knowledge x4
Networking/ new friends x6

Learning from the experts through findings and experiences
Opportunity to visit other locations and people in the field
Knowing that you are not alone! (x4)
Gaining confidence to present your own data and information to others
Great platform to discuss problems and capture and exchange knowledge
It's really amazing to meet face to face with wildlife vets from around the world. Everyone was so friendly
Microbiome, case studies, Jeopardy games
Diagnostic imaging lecturer and practical were really good
The topics were very well delivered and presented
First time attending - great camaraderie and networking. Nice scheduling with enough time for 1:1 with colleagues
Everything - format, opportunity for meeting others, presentations, food and accommodation
Very well organised
Things to improve comments
Nothing for now
Spent a lot of time in the same conference room - may have been an issue with the venue
Maybe add a session on combining health with the orangutan public education and orangutan protection
I hope we can work together on consensus/ agreement on visitor health guidelines
I hope OVAG can have a bigger voice/ influence in the Indonesian Government regarding law enforcement toward conservation of OU habitat
Expand practical sessions (dentistry, pathology etc) x2
Implementing the One Health concept - how OVAG will become more involved in OH actions within Indonesia
Could those vets who have benefited from out-of-country training feedback key learning points to the rest of the group?
Future session suggestion - how to prepare and deliver a good presentation. Management communication improvements.
Timings should be more closely adhered to

More case studies, but of shorter length - 15 minute presentation and 15 minute discussion
Opportunities either before or after the meeting to visit field sites and see wildlife
Maximum 50 people to make it more effective
Expand the gibbon session please
How will I use the information I have gained comments
Will share it with colleagues and people I know in the same field X10
Now have a better knowledge of what our vets do in house and how that is applied to orangutan rehabilitation and conservation
Knowing the limitations on rehab and wild conservation organisations and how I might be able to improve their recording of info, info sharing, and how to make things easier
Present at higher levels in Government agencies
Improve SOP's at my NGO
Use guidelines/ outcomes of OVAG in discussions with Government/ Forestry department
I will use the network I have formed to help me with future work with wildlife - I hope this is a 2 way exchange
Hopefully find future collaborations that will aid the network and orangutans
Through this meeting I've met many people and potential collaborators. The main takeaway is exposure to information about conservation and health in Indonesia. I hope to begin working with many individuals I met at the workshop

Appendix D

Gibbon Report Link:
file:///C:/Users/Raffaella/Downloads/SSA%20Vet%20Workshop%20Report%20July%202018.pdf