ORANG UTAN EEP

BEST PRACTICE GUIDELINES

2018

Edited By

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Great Ape Taxon Advisory Group
(GATAG)

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Preface

The orang utan is one of the most threated primates on earth. Recent data indicate that the Bornean orang utan population ***"Pongo pygmaeus"***, with its three or four subspecies, consists of about 54.000 individuals within 306 geographically distinct forest areas. In Sumatra, the orang utans ***"Pongo abelii"*** occur only in the Northern part of the island with an estimate of only 14.000 individuals. Both orang utan species in Borneo and Sumatra are **Critically endangered**.

In 2017, a new orang-utan species - the Tapanuli orang utan ***"Pongo tapanuliensis"*** - was described in Sumatra as third orang utan species (see Chapter 1.1.4). This small population of only 800 individuals from the southern most extant population in the highland rainforest of Batang Toru was found to be different from previously described Sumatran and Bornean orang-utans based on morphological characters as well as genomic evidence. Morphological evidence was based on a single deceased individual from Batang Toru (skull and teeth). Genomic data showed that the Tapanuli orang utan is genetically more closely related to the Bornean orang utan than to the Sumatra orang utan. However, autosomal data showed that this Tapanuli orang utan and the Sumatra orang utan shared a recent ancestor. This now defined "third species" is under ongoing scientific "observation" and discussion. However, we wonder if this new discovery will have any impact to the future policy within the EEP.

Once upon a time . . . from a manuscript to an EEP studbook

For approximately 35 years now we have been collectively managing orang utans in European zoos. In 1982, during studies on "orang utan play behaviour" involving more than 20 European zoos, I compiled the first manuscript for a regional orang utan studbook including 187 orang utans in 32 zoos in central Europe. At that time nearly 40 % of the animals in the studbook were wild born. After I was employed by Karlsruhe Zoo in 1985, the zoo took on the responsibility for this regional studbook.

At the International Union of Directors of Zoological Gardens (IUDZG; now WAZA) conference held in San Antonio in 1989, the European members of IUDZG agreed to the proposal of the EEP Committee to establish the Orang utan EEP and to enlarge the region to continental Europe with more than 250 orang utans in more than 50 institutions.

Our goals . . . to manage healthy *ex-sit*u populations of Orang utan species in zoos

When the program was established the *ex-situ* orang utan population was formed of Bornean, Sumatran and hybrid individuals of both species. The initial aims for these specific ape species were to reduce the high number of known hybrids (nearls 20%) and to establish through karyotyping three separate populations with the intention of managing the hybrid population to extinction.

After the first election of a species committee in 1990, a very important milestone was the ECAZA (now EAZA) conference in Budapest (1991) when zoos from the British Isles, who until then ran a Joint Managed Species Programme (JMSG) for orang utans (held by Bristol Zoo), stated their intention to join the EEP. A general decision was also taken to develop the

Bornean and Sumatran zoo populations as well as to reduce (eliminate) the hybrids, simultaneously. At that time the programme included 65 holders with 307 orang utans, including 16% hybrids and 25% remaining wild born apes. These "Budapest decisions" still stand today:

- It is essential for the future breeding management to establish over the long term separate and self-sustaining populations of Bornean and Sumatran orang utans.

- To preserve the genetic variability over many generations, all available orang utans have to be integrated into the founder population, and thus encouraged to reproduce, taking especially ethological aspects into account.

- All EEP members have to stop the breeding of hybrids and cease breeding with hybrids. Infertile hybrids can remain in the presently existing groups.

Further developments . . . and present situation

Since 1993, the EEP prioritised breeding according to mean kinship and made an effort to integrate and better represent the high ranking potential founders (that never bred) and genetically important founders (with few offspring) into the gene pool of the population. However, the EEP never completely eliminated low ranking animals from breeding. The EEP population is in the fortunate position of having comparatively large populations with a robust genetic profile for both species of orang utans maintaining 98% gene diversity of the founder population, and a realistic potential to keep this well above 90% in 100 years time. And since 2010, additional tools - like Population Management Programmes (PMx) - are used for a better managing of the two species.

At the end of 2017, there were 346 (137.209) orang utans held in EEP zoos. Of these 346 animals, 50.97% are of the Bornean species (68.108 individuals), 43.9% are of the Sumatran species (61.91 individuals) and 5.2% are hybrids (8.10 individuals) with only 4.9 % remaining wild born animals (only 3.14 individuals). Since the initiation of the EEP the growth rate of the two populations remains stable at an approximate replacement level, even considering the average annual birth rate of 16 animals and an effective population size of over 40%. Placing a growing number of younger males is an issue for the EEP. These males are needed for breeding purposes in the future, but are temporarily surplus due to the lack of available suitable accommodation. In the past years some holders tried to house all-male groups (only two or three males) which so far have not really successful due to the aggressive behaviour of subadult / adolescent males.

Social structure in the wild … our present holding system in zoos must change

The fact that both populations lack sufficient growth could be related to our existing system of housing orang utans, which does not sufficiently reflect their social structure in the wild. In most of our zoos, males and females live together for a large part of their lifetime. In the wild, females and juveniles are relatively social. Females only seek the company of flanged males (with fully developed secondary sexual characteristics) when seeking a partner for breeding. Unflanged males (no secondary sexual characteristics developed) are comparatively social and tolerant towards other males and actively find females for short and successful sexual contacts. In our zoos, females should have a choice between different (separated) males and should be able to choose when to be with that preferred male or when to be separated.

To enable this so-called “fission-fusion system”, the current holding systems for orang utans, with only limited potential for variations, must change over the coming years: bigger and more flexible orang utan facilities with a variety of inside and outside enclosures, with possibilities for separations and new combinations, must be constructed in the future. Such new enclosure systems must provide space to accommodate more males (flanged and unflanged) and/or to separate the sexes for certain time spans to stimulate sexual behaviour. These new types of facilities will also help to solve the male surplus problem, for which all holders have a shared responsibility. These different facts and estimates for the stability and growth of the populations in the future should be carefully compared and observed.

Future strategies … future for orang utans in zoos

In spring 2016, (unofficial) EAZA Quick Population Assessments (QPA) were provided by the EAZA specialists for demography and genetics for both populations. These QPAs are using simple but effective demographic and genetic analysis to provide overviews of the current status of both populations, based on the most current database available (data 2015). According to both analysis, the average annual birth rates in the last years were 7 births per year in in the Borneans and 5 births per year in the Sumatrans, while an average of 9 births per year for the Borneans and 8 births per year for the Sumatrans are expected to be necessary to maintain population size. Based on these informations, one would expect population sizes to slightly decrease in the coming years. This clearly indicates to be very careful in using methods for contraception. Simultaneously, the problems to place (temporarily) surplus male individuals in a timely manner are evident. In April 2018, a workshop will be held in Karlsruhe Zoo to develop an EAZA Long-term Management Plan (LTMP) for the orang utan species. At the same time, the EEP coordinator and his team will have published the 35th edition (2017) of the orang utan studbook.

We are now working since a considerable couple of years to develop and to define “Best Practice Guidelines” (BPG) for the orang utans in the EEP. Now, we are able to present this first edition that is devided into three main sections (biology & field data, management in zoos and references & appendices). Of particular importance are chapters for Enclosure Design, Feeding, Social Structure, Breeding, Behavioural Enrichment, Handling & Identification, Veterinary Aspects and Research. I would like to express my deep appreciation to all contributors for their enormous time effort and work they have put into compiling these guidelines. Hopefully, this will enhance the managing and care of orang utans in participating zoos in the future.

Clemens Becker
EEP Co-ordinator for the Orang utan

Acknowledgments

The following are the members of the Species Committee for the Orang utan EEP (2017) all of whom have contributed in some way to this publication.

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Summary

This document reflects our current knowledge about general biology and keeping requirements to provide adequate levels of well-being for orang-utans in captive environments. While providing information about different aspects that should be taken into account when managing orang-utans in captivity to ensure a healthy and self-sustaining population as part of the development of a global "ex situ conservation" programme, it also provides information about the situation of the species in the wild and various recognised "in situ conservation" projects supporting field conservation work in range countries. All zoo institutions keeping orang-utans are encouraged to support such projects in line with the IUCN strategy of a One Plan Approach.

Section 1: Biology and Field Data reflects our current knowledge of orang-utan species in the natural environment using the most recent taxonomic information. The philosophy behind this is that *ex situ* conservation can be used more effectively as a conservation tool if it is part of an integrated approach to species conservation (IUCN, 2014). The potential need for a conservation role of an EAZA *ex situ* population has therefore been decided in consultation with *in situ* specialists. This section provides wide and actual information about the species in its natural habitat.

Section 2: Management in Zoos covers housing and exhibition, nutrition, food presentation and enrichment, social structure and behaviour. Control of breeding is an essential component of successful managed programmes and comprehensive information to assist zoo veterinarians to decide on the most appropriate contraception method for their animals is provided. Managed programmes also rely on the movement of animals between zoos and advice on handling and transport is provided. It is essential that orang-utans are provided with complex environments and there is detailed practical information on environmental enrichment. One indispensable method of feeding enrichment is the use of browse and information on suitable plants species is provided. The veterinary section provides information on current knowledge on all aspects of medical care. Our knowledge can only increase through appropriate research and the final section is to be a 'living document' with links to on-going and recommended research topics.

Section 3: References & Appendices includes, amongst other documents, a summary of references to each section, examples of appropriate orang-utan enclosures and mixed species exhibits , a browse list, the contact details of those who contributed to these Best Practice Guidelines and lastly an EAZA Disclaimer Statement.

This document is for the orang-utan holders to gain a better knowledge about keeping this charismatic species in the most appropriate and best possible way. Therefore to regularly consult the Best Practice Guidelines and contact TAG members with any concerns or queries is recommended.

Mª Teresa Abelló
Chair, EAZA Great Ape Taxon Advisory Group (GATAG)

SECTION ONE

Biology

&

Field Data

1.1 Taxonomy & Distribution

1.1.1 Taxonomy

Historically, the Sumatran and Bornean Orangutans were considered subspecies of *Pongo pygmaeus* (e.g., Courtenay *et al*. 1988, Rijksen and Meijaard 1997). Recent taxonomic reviews (Groves 2001, Brandon-Jones *et al*. 2004) support the acceptance of the Sumatran Orangutan (*Pongo abelii*) as distinct from its Bornean relative (*Pongo pygmaeus*). This classification has since been widely adopted (e.g., Singleton *et al*. 2004). Based on this, the two species are treated separately within the following information.

Common name **Sumatran Orang utan**

Order	Primates
Family	Hominidae
Genus	*Pongo*
Species	*abelii*
Subspecies	None

Common name **Bornean Orang utan**

Order	Primates
Family	Hominidae
Genus	*Pongo*
Species	*pygmaeus*
Subspecies	Three

P. p. pygmaeus: **Northwest Bornean orang utan**

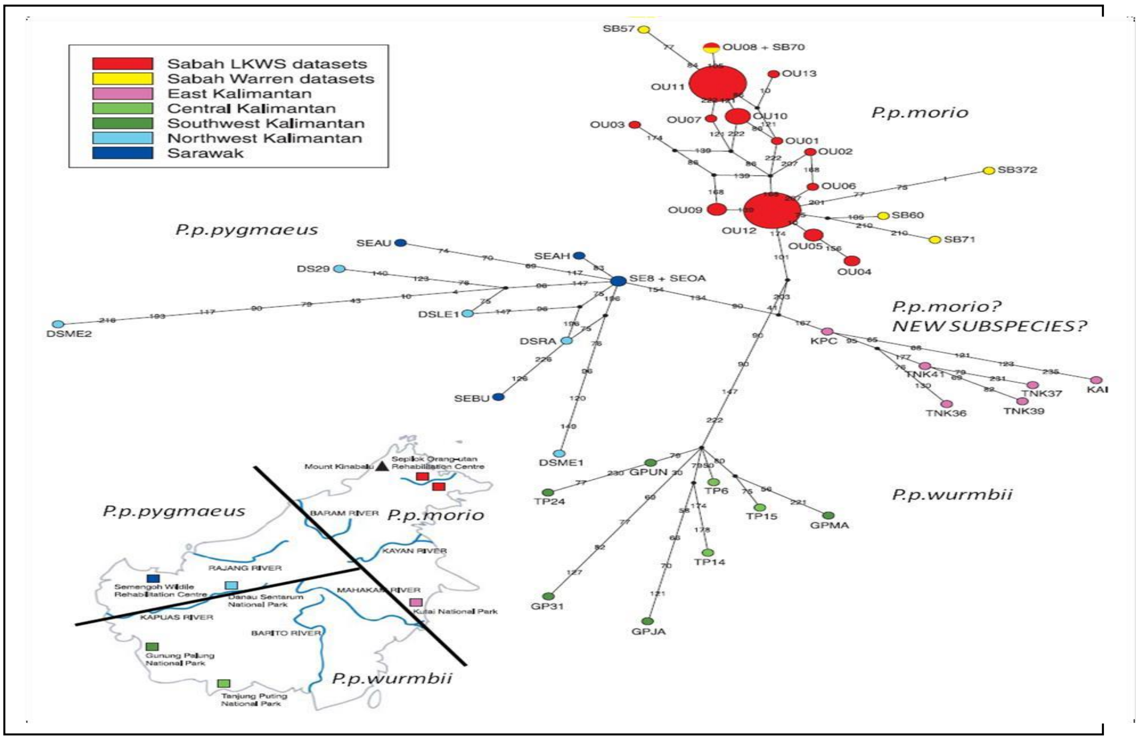
- Province of West Kalimantan (Indonesia)
- State of Sarawak (Malaysia)

P. p. wurmbii: **Southwest Bornean orang utan**

- Province of West Kalimantan (Indonesia)
- Province of Central Kalimantan (Indonesia)

P. p. morio: **Northeast Bornean orang utan**

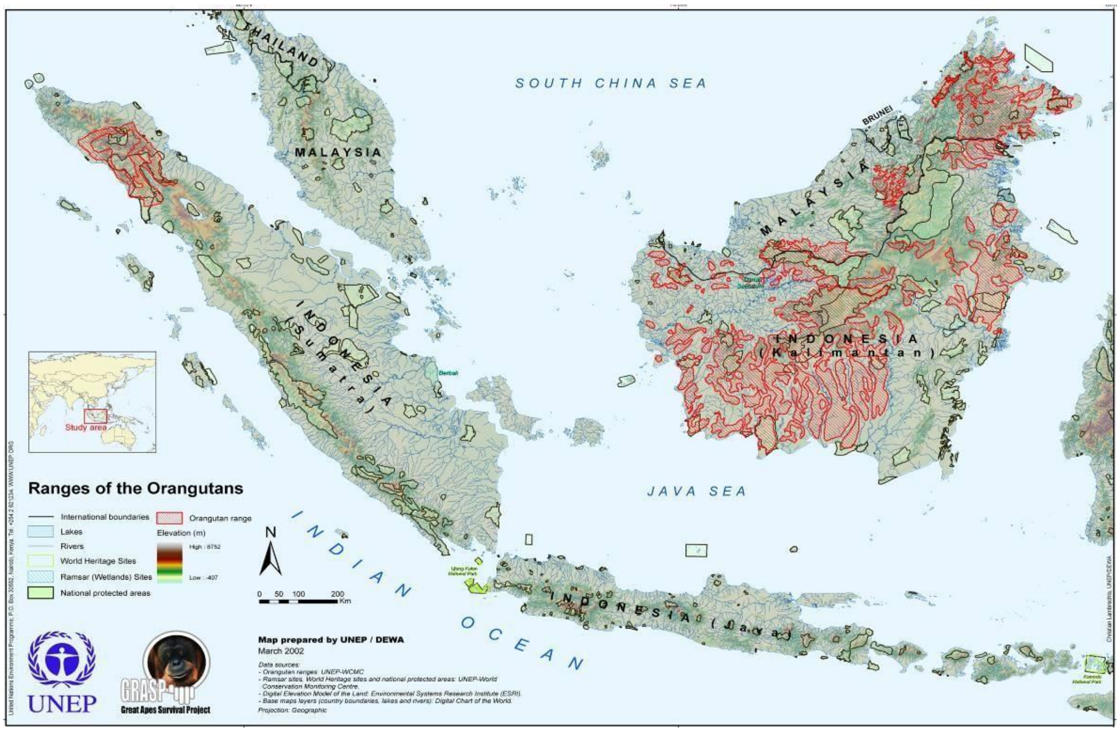
- State of Sabah (Malaysia)
- Province of North Kalimantan (Indonesia)
- Province of East Kalimantan (Indonesia)



The figure (modified from Jali *et al*., 2008) shows the current subspecies of Bornean orang utan and their relationships.

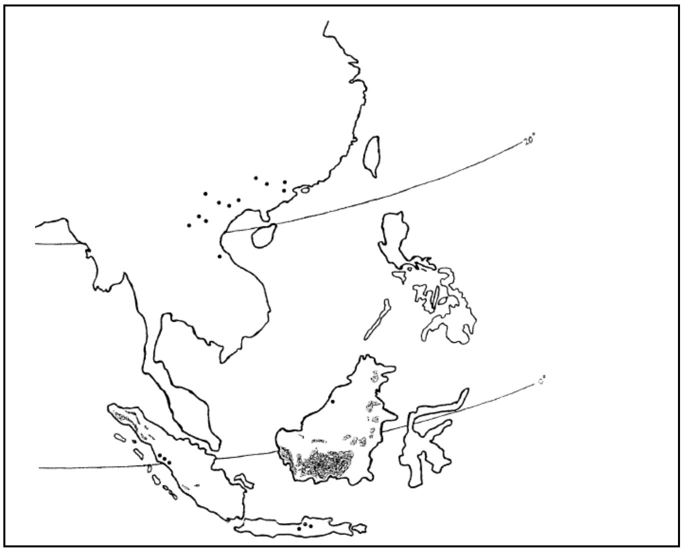
1.1.2 Distribution

Pongo abelii, the Sumatran Orangutan are endemic to Sumatra, Indonesia and *Pongo pygmaeus*, the Bornean Orangutan are endemic to Borneo, Malaysia and Indonesia. Both species exist in primary lowland forest. Their approximate distribution is shown on the map below. Map source: UNEP/GRASP



Historically, Bornean Orangutans were most abundant in inundated and semi-inundated lowland Dipterocarp mosaic forests, where movement between different habitat types could buffer them against shortages in food availability in a particular habitat type.

The distribution of orang utans is currently limited to restricted forest patches on Borneo and Sumatra.



During the Pleistocene, orang utans were present all over South-east Asia - including Southern China, Sumatra, Borneo and Java (Delgado and Van Schaik, 2000).

Recent studies have produced conflicting findings regarding the divergence time between Bornean and Sumatran orang utans (Muir *et al.,* 2000; Warren *et al*.; Steiper, 2006). There are different opinions about the colonization of Sundaland.

The population history has strongly been influenced by geological and climatic events:

- Raising and falling sea levels alternately connected and isolated the island of Sundaland, allowing more or less migration between the islands

- Major volcanic eruptions influenced the life of big mammals and may have lead to the extinction of some orang utan populations (Muir *et al*., 2000). For example, there was the so-called “Toba-eruption”, which happened some 74,000 years ago on Sumatra, and is considered to be the most powerful explosive volcanic eruption within the last 25 million years (Louys, 2007).

Molecular clock methods were used to date the split point between Bornean and Sumatran orang utans. The different studies came to different results for the divergence time, ranging from 1.1 million years (Warren *et al*., 2001) to 2.7 - 5.0 million years (Steiper, 2006).

They stated several reasons that make orang utans particularly vulnerable to extinction namely:

- large-scale habitat conversion
- destruction and fragmentation
- hunting for food
- hunting for the pet trade
- the large body size
- the long inter-birth interval (6.1 – 9.3 years)
- living in low densities in large home ranges
- restricted to lowland rainforest areas and increasingly restricted to small forest fragments

The main causal factors for the present threat to orang utans can be considered as:

- The Impact on the forest from the expanding palm oil industry (Indonesia and Malaysia are the two largest palm oil producers of the world with 80,5 % share of the global production)

- Forest conversion and degradation

  Ex. 1: Present road projects in the Leuser Ecosystem will fragment two of the three largest remaining orang utan populations.

  Ex. 2: The mega rice project in Central Kalimantan eliminated about 10.000 km² of primary peat swamp forest and killed about 15.000 orang utans from 1996 - 1999.

- Illegal hunting of orang utans is potentially a major factor contributing to their decline (especially in areas where agriculture is encroaching into orang utan habitats or where orang utans are hunted for food, such as areas with logging concessions).

As a result, on the IUCN Red List (2007):

- The Sumatran species is currently listed as "Critically endangered".
- The Bornean species with all subspecies is currently listed as "Endangered".

1.1.3 Analysis of existing orang utan populations

All areas in **Sumatra** where orang utans occur are in the northern part of the island with an estimation of only 14,613 individuals (Wich et al 2016), mainly in the Leuser Ecosystem. This is an increase on a previous estimate (2008) but is only the result of integrating information on new districts in Sumatra. The actual decreases within the isolated populations are still going on.

Within this are …

- populations from 250 to 1,000 individuals
- populations with more than 1,000 individuals

306 geographically distinct forest areas were identified on **Borneo** in which orangutans occur. The data indicate that the total Bornean orang utan population is at least 54,000 individuals with populations with more than 100 individuals and 17 populations containing more than 1,000 orang utans.

- *Pongo p. pygmaeus* is the most severely threatened subspecies with a total of only 3,000 – 4,000 individuals in Northern Borneo and Sarawak.

- *Pongo p. wurmbii* is the most numerous subspecies with an estimated total of nearly 35,000 individuals in Central Kalimantan.

- *Pongo p. morio* (may be in two distinct taxa) survives in several smaller populations in East Kalimantan (estimated 5,000 individuals) and in Sabah / Malaysia (with est. 11,000 individuals)

As a result, it was analyzed that 250 individuals is the minimum number for a viable population and there are only 6 such populations on Sumatra and 32 such populations on Borneo.

1.1.4 The Tapanuli orang-utan (*Pongo tapanuliensis*)

In 2017, a new orang-utan species in Sumatra was described (Nater et al., Current Biology). Orang-utans from the southernmost extant population in Batang Toru were found to be different from previously described Sumatran and Bornean orang-utans based on morphological characters (teeth and cranium) as well as genomic evidence. Morphological evidence was based on a single deceased individual from Batang Toru that had been killed in a human-animal conflict situation. Skull and teeth of this individual were compared to Bornean (*P. pygmaeus*) and Sumatran (*P. abelii*) individuals of the same sex and similar developmental stage.

1.1.5 Consequences for the future EEP management

We need to carefully analyse and to evaluate the situation that the ***Sumatran species*** is found to be critically endangered in the wild with only 5,000 – 7,000 remaining individuals in contrary to the Bornean species (with subspecies). We have to examine if this fact will lead to a ***new priority*** in our breeding policy with limited space.

With regard to the three or four ***Bornean subspecies*** in the wild, we have been “mixing” these subspecies in our zoos for a long period of time, at this point, we estimate the chance to unravel the subspecific hybridisation of these Bornean orang utans as very low, with only few exceptions. However, genetic analysing methods have to be established and performed to identify the possible pure and the majority of hybridized individuals of living Bornean orang utans in our zoos.

On the other hand, it has to be considered if such genetic analysis are of any help with respect to the fact that most of the natural rainforest habitats and consequently most of the remaining Bornean populations will disappear within the next 10 years in the wild.

Genomic data showed that based on mitochondrial DNA, *P. tapanuliensis* is genetically more closely related to *P. pygmaeus* than to *P. abelii*. This can be explained to the extreme strong philopatric tendencies female orang-utans have in the wild. However, autosomal data, which have a much stronger bearing on species designation that mtDNA, showed that *P. tapanuliensis* and *P. abelii* shared a recent ancestor. Genetic exchange between *P. abelii* and *P. tapanuliensis* ceased 10-20,000 years ago, rendering both species on independent evolutionary trajectories since then.

1.1.6 Recent concerns about the increased illegal trade in orangutans

There is growing concern that the illegal trade in orang utans, including ongoing poaching from the wild, is on the increase. EAZA and the Orangutan EEP condemns this activity and would take action accordingly if it came to light that any EAZA member was found to be involved in the trafficking of orang utans.

1.2 Morphology, Physiology & Longevity

1.2.1 Morphology

Bornean Orangutans are the largest arboreal mammals in the world, living a semi-solitary life and rarely aggregating in groups. Males are the dispersing sex: upon reaching sexual maturity (at 10–12 years old), they leave the area where they were born to establish large territories covering several hundred hectares. Female territories are smaller, with actual size depending on forest type and availability of food resources.

The Sumatran orangutan is almost exclusively arboreal. Females virtually never travel on the ground and adult males do so only rarely. This is in contrast to Bornean orangutans (especially adult males) which more often descend to the ground. (Ancrenaz *et al*. 2014).

While both species depend on high-quality primary forests, Bornean orangutans appear better able to tolerate habitat disturbance. In Sumatra densities plummet by up to 60% with even selective logging. (see Rao and van Schaik 1997).

1.2.2 Physiology

Orang utans show a characteristic sexual dimorphism. Fully grown males are about 2 or 3 times heavier than adult females, but in addition, recent studies have confirmed the existence of male bimaturism i.e. two forms of sexually mature males namely:

- Flanged males
- Unflanged males

The ***Flanged males*** are the large adult males. They have fully developed secondary sexual characteristics like hair coat, cheek flanges, throat pouches and produce "long calls". They are mostly solitary, have overlapping territories with home ranges of several females and are sexually active; they do not tolerate other flanged males, but are relatively tolerant towards unflanged males in their home ranges.

The ***Unflanged males*** are also called "arrested males". Their secondary sexual characteristics are not developed and they are as big or bigger than adult females. They were previously believed to be subadult males, but we now know that they are sexually active and fertile.In contrast to the flanged males, they are comparatively “social” and tolerant towards other males and do not produce “long calls”. There is evidence (even in our zoos) that the change from unflanged to flanged males is influenced by social factors. The secondary sexual characteristics may occur relatively suddenly (within some months) in subadult males or in later periods of a life. Sometimes the form of an unflanged male will last a major part of an individual´s lifetime.There are different theories about the existence of the two separate appearances of males. However, in total all experts accept these two forms of adult males as an alternative reproductive strategy as both unflanged and flanged males are known to be mating at the same rate..

It is possible that there are ***two different alternative parallel tactics or strategies*** with about equal fitness:

- The ***flanged males*** with their strategy ***“Sit - call - and - wait”:*** They are waiting in their large home ranges and producing long calls to attract the females to them for sexual consort ship.

- The ***unflanged males*** with their strategy ***“Search - and - find”***: They actively find females for short sexual contacts.

The coexistence of flanged and unflanged males can be indicated as strategies … and both strategies have success. In this system, females can make a choice between different males. As a result we can see that orang utans are in an evolutionary stable situation.

General characteristics:

- Length: 78-97 cms
- Weight: 60-90 kg (male) ; 40-50 kg (female)

Bornean Orangutan: rounder face than the Sumatran Orangutan with fur that can vary in colour from orange/red to chocolate brown.

Sumatran Orangutan: more oval-shaped face than the Bornean Orangutan with longer pelage which is also brighter orange in coloration.

1.2.3 Longevity

Longevity in the wild appears to range upwards of 35-40 years; captive specimens have lived more than 50 years. Sexual maturity occurs at about 7-10 years of age for females (in captivity, females have given birth reliably as early as 7 years of age), though they typically do not give birth until about 12-15 years. Males, while fertile as early as 7 years old, do not begin to develop secondary sex characteristics until about 10-15 years, and are not typically somatically or socially mature until about 20 years of age. The ages of reproductive senescence are uncertain; in captivity, females have given birth into their early 40s, and males have sired offspring at similar ages.

1.3 Conservation

1.3.1 Conservation Status

Current IUCN Red List Conservation Status:

- Sumatran Orangutan, *Pongo abelii* - **CRITICALLY ENDANGERED** with a decreasing population trend. (Assessed 2008)

- Bornean Orangutan, *Pongo pygmaeus* - **CRITICALLY ENDANGERED** with a decreasing population trend. (Assessed 2016).

Orangutan numbers are estimated to have dropped by around 80% in the past century. The IUCN/SSC Primate Specialist Group estimate that 30 - 50,000 orangutans remain in the wild. (www.iucnredlist.org)

Main Threats:

- **Habitat Loss** - 80% of suitable orangutan habitat has been lost in the last 30 years. Approximately 2% of what remains is legally protected. Principal causes of habitat loss are commercial and illegal logging, clearance for agriculture and conversion to plantations.

Between 2000 and 2010, the mean annual rate of deforestation for Borneo was 3,234 km² per year (Gaveau *et al*. 2014). Assuming a similar deforestation rate in the future, 32,000 km² of forest could be lost by 2020; 129,000 km² by 2050 and 226,000 km² by 2080 (Wich *et al*. 2015). In the early 2010s, only 22% of the current Bornean Orangutan distribution was located in protected areas (Wich *et al*. 2012). Approximately a third of the entire Bornean Orangutan range was in commercial forest reserves exploited for timber, and about 45% was in forest areas earmarked for conversion to agriculture or other land uses. A business-as-usual scenario, whereby non-protected forests would be converted along the lines of current development plans, will result in the loss of more than half of the current orangutan range on the island of Borneo in the next 50 years or so.

- **Forest Fires** - Fires and associated drought has become a yearly occurance increasingly common in the last few decades.

Fires occur in Borneo on a yearly basis and are responsible for significant forest loss with dramatic results for certain orangutan populations. For example, 90% of Kutai National Park was lost to massive fires in 1983 and 1998 and its Bornean Orangutan population was reduced from an estimated 4,000 individuals in the 1970s to a mere 600 (Rijksen and Meijaard 1999); over 4,000 km² of peatland forest in southern Kalimantan was burnt to ashes in six months of 1997–1998, resulting in an estimated loss of 8,000 orangutans. In 2015, more than 20,000 km² of forest were lost to fires, which resulted in hundreds (or more) of additional orangutan deaths.

- **Illegal Hunting** - Hunting for food as well as body parts, particularly skulls. There is also trade in infant orangutans as pets, which also results in death of adults during the capture process.

Illegal killing of Bornean Orangutans is a major cause of their decline. Recent interview surveys conducted in Kalimantan revealed that several thousand individuals are killed every year for meat consumption, as a way to mitigate conflict, or for other reasons (Davis *et al*. 2013). Overall Bornean Orangutan mortality rates in Kalimantan seem to significantly exceed the maximum rates that populations of this slow-breeding species can sustain (Marshall *et al*. 2009, Meijaard *et al*. 2011). If hunting does not stop, all populations that are hunted will decline, irrespective of what happens to their habitat. These findings confirm that habitat protection alone will not ensure the survival of orangutans in Indonesian Borneo, and that effective reduction of orangutan killings is urgently needed.

- **Habitat fragmentation**. With the current scale of habitat exploitation and forest conversion to other types of land uses in Borneo, only a small percentage of current orangutan habitat will remain undisturbed by infrastructure development by 2030 (Gaveau *et al*. 2013).

Several orangutan PHVAs have shown that Bornean Orangutan populations of fewer than 50 individuals are not viable in the long term (Marshall *et al*. 2009), and that many small populations will go extinct unless they are actively managed (Bruford *et al*. 2010).

- **Lack of awareness**. A recent study suggested that 27% of the people in Kalimantan did not know that orangutans are protected by law (Meijaard *et al*. 2011).

Campaigns to effectively inform the public and encourage rural people to support the principles of environmental conservation and be actively responsible for the management of their resources are therefore a crucial requirement for successful orangutan conservation.

- **Climate change**. Spatial models point to the possibility that a large amount of current orangutan habitat will become unsuitable because of changes in climate (Struebig *et al*. 2015).

Across all climate and land-cover change projections assessed in a recent analysis, models predicted that 49,000–83,000 km² of orangutan habitat will remain by 2080, reflecting a loss of 69–81% since 2010. This projection represents a three to five-fold greater decline in habitat than that predicted by deforestation projections alone. A major reduction in the extent of suitable orangutan habitat can be expected. However, core strongholds of suitable orangutan habitat are predicted to remain to the west, east and northeast of the island where populations of *P. p. wurmbii* and *P. p. morio* are found.

- **Biology** - Slow rates of reproduction and long inter-birth intervals increase susceptibility to extinction.

1.3.2 Conservation Action Priorities

Source: Orangutan Action Plan, WWF, PHPA & CERC

- Improve protection in existing parks and reserves:
  - Active enforcement of regulations; prosecution of those engaged or supporting illegal activities.
  - Increase public awareness.
  - Assess the degree and impact of local resource extraction.
  - Train rangers and students.
  - Create economic incentives for conservation.

- Establish new protected areas in areas with significant wild Orang-utan populations, including creating corridor links between populations.
- Improve protection in areas outside of parks and reserves.
- Improve habitat quality in degraded areas through enrichment planting.
- Locate remaining populations and determine population size.
- Conduct genetic studies to address migration, dispersal, and speciation questions.
- Translocate and establish new populations.
- Rehabilitation.

Links to Recent Regional Action Plans:

- Indonesian Orangutan National Action Plan 2007 - 2017: http://www.primate-sg.org/PDF/Indonesian_Orangutan_National_Action_Plan_2007-2017.pdf

- Sumatran Orangutan Conservation Action Plan 2006: http://www.primate-sg.org/PDF/SOCAP.2006.pdf

- Orangutans and Economics of Sustainable Forest Management in Sumatra: http://www.orangutanreport.un-grasp.org/

- Sabah Wildlife Department Orangutan Action Plan 2012 - 2016: http://www.borneotrust.com/BorneoTrust/BCT-Orang%20Utan%20Action%20Plan%202012.pdf

What Zoos can do

All EAZA zoos that maintain either species of Orang utan in their collections should ensure that they are priority species conservation efforts, over and beyond holding and breeding them as part of the EEP. Zoos can assist field conservation efforts for Orang utans in a number of ways including:

- Raising awareness of the plight of wild Orang utans to their visitors. Including that Orang utans are critically endangered and the reasons why.

Describing what palm oil is and the scale of the problems that the use of non-sustainable palm oil is creating for wild Orang utans. Zoos should explain to their visitors what the visitors can do to assist - which types of every day products contain palm oil and how people can ensure that they only choose products that contain sustainably produced palm oil.

- Ensuring that zoos are 'practicing what they preach' by ensuring as far as possible that products used by the zoo and products purchased for sale by the zoo are ones that only contain sustainably sourced palm oil e.g. Foods and confectionary sold in the catering and retail outlets. A full palm oil audit of products purchased by the zoo is recommended.

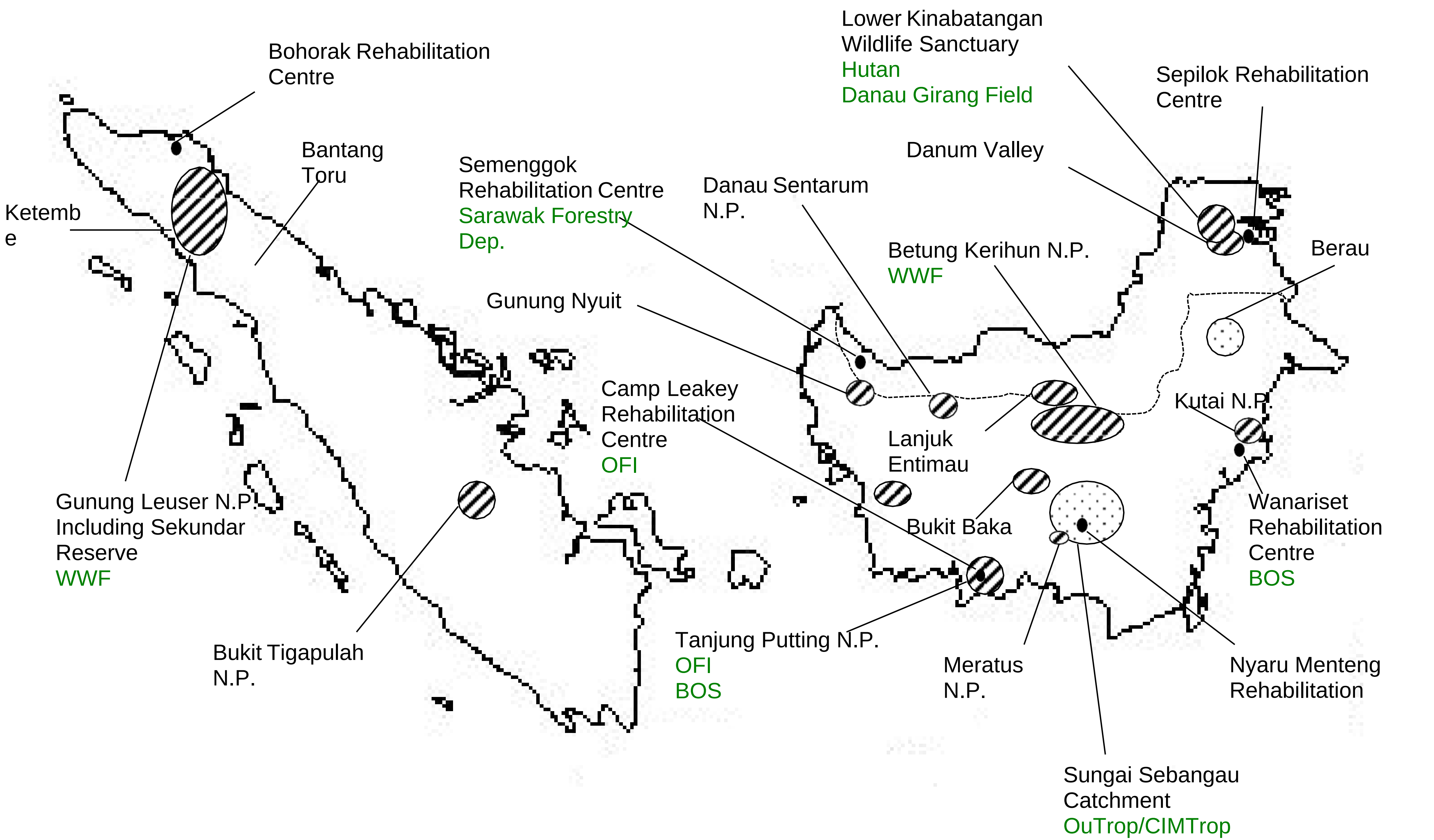
- Raising awareness and campaigning more widely for use of sustainably sourced palm oil, through local cafes, restaurants and businesses and schools.

- Funding field conservation efforts through the numerous NGO's working in the field. A number of NGO's working on Orang utan field conservation can be found below.

Other resources:

- The Orangutan Network provides links to most organisations involved in Orangutan conservation and research: http://www.aim.uzh.ch/orangutannetwork/FieldsiteList.html
- A list of Orang-utan groups can also be found on the Ape Alliance web site: http://www.4apes.com/orangutanwg

Main Areas of Orang-utan Populations and Conservation Activity and Associated Organisa



1.3.3 Orangutan Conservation Organisations

i. Sumatra

The Sumatran Orangutan Conservation Programme (SOCP)

Location: HQ in Medan, Aceh with activities distributed across Sumatra.

History: Established in 2002 by the Swiss NGO PanEco Foundation, Frankfurt Zoological Society, Yayasan Ekosistem Lestari and the Indonesian Nature Conservation Authority PHKA.

Mission: To implement a holistic approach to the conservation of orangutans in Sumatra.

Activities: Confiscation and reintroduction of illegal pet orangutans, habitat protection, education and awareness, population surveys and monitoring, orangutan ecology research.

Website: http://www.sumatranorangutan.org

Orangutan Information Centre (OIC)

Location: Various locations in northern Sumatra including Gunung Leuser National Park.

History: Founded in 2001 in partnership with Dr Panut Hadisiswoyo and the Sumatran Orangutan Society.

Mission: To work with local communities to promote the conservation of Sumatran orangutans.

Activities: Reforestation, school education and community awareness projects, training and promotion of sustainable living and ecotourism development, OranguVan Mobile Awareness Unit.

Notes: The Sumatran Orang-utan Society (SOS) is the official funding agent for this programme.

Website: http://orangutancentre.org/

Sumatran Orangutan Society (SOS)

Location: Offices in the UK, USA and Bali

History: Founded as an international charity in 1997 by Lucy Wisdom.

Mission: To raise awareness, to support grassroots projects and to campaign on issues threatening Sumatran orangutans.

Activities: Provides funding for OIC and SOCP

Website: http://www.orangutans-sos.org/

Wildlife Conservation Society (WCS)

Location: Leuser Ecosystem, Northern Sumatra

Mission: To improve law enforcement, encourage sustainable logging and agricultural practices, expand protected areas and support effective protection.

Activities: Wildlife Crime Unit, habitat and species protection.

Notes: Partnership with the Indonesian Department of Forestry

Website: http://www.wcs.org/saving-wildlife/great-apes/orangutan.aspx

ii. Indonesian Borneo

Orangutan Foundation International (OFI)

Location: Tanjung Putting National Park and Lamandau Reserve, Central Kalimantan

History: Established in 1986 by Dr Birute Galdikas.

Mission: Conservation of orangutans through the protection of forest habitat, working with local communities, orangutan rehabilitation, scientific research and education.

Activities: Conservation, education and research

Notes: OFI has various sister NGO's including Orang-utan Foundation based in the UK, which acts as a fundraiser and to raise public awareness.

Website: http://www.orangutan.org/ and http://www.orangutan.org.uk

The Balikpapan Orangutan Survival Foundation (BOS)

Location: Wanariset Orang-utan Reintroduction Project and the Nyaru Menteng Orang-utan Project Eastern Kalimantan.

History: Founded in 1991 by Dr Willie Smits.

Mission: Seizure, rehabilitation and the reintroduction of orangutans, Illegal activity monitoring, habitat protection, environmental education, awareness raising, creation of alternative livelihoods for local people, reforestation, sustainable resource development and fire protection.

Notes: There are various BOS organisations across the world.

Website: http://www.orangutan.or.id/

Orangutan Tropical Peatland Research Project (OuTrop)

Location: Sebangau River Catchment, Central Kalimantan.

History: Founded in 1999 by postgraduate students from University of Nottingham.

Mission: To carry out conservation-orientated research, providing important information for, and training to, local conservation practitioners; and to encourage and support locally-led conservation initiatives.

Activities: Orangutan Behaviour Project, other research on primates, felids and forest ecology and three conservation initiatives; fire-fighting, dam building and a plant nursery.

Website: http://www.outrop.com/index.html

iii. Malaysian Borneo

Hutan-Kinabatangan Orangutan Conservation Programme (Hutan-KOCP)

Location: Kinabatangan river floodplain, Sabah

History: A French NGO established in 1996 by Drs. Marc Ancrenaz and Isabelle Lackman.

Activities: Biological and ecological research, Hutan Environmental Awareness Project, Honorary Wildlife Wardens scheme, habitat restoration and Human-wildlife conflict mitigation.

Notes: Partners with Sabah Wildlife Department and close links with Danau Girang Field Centre.

Website: http://www.hutan.org.my/

Wildlife Conservation Society (WCS)

Location: Sarawak

History: Work began with research in the 1960's.

Mission: To improve law enforcement, encourage sustainable logging and agricultural practices, expand protected areas and support effective protection.

Activities: Wildlife surveys and monitoring, conservation action planning and development, community awareness programmes.

Website: http://www.wcs.org/saving-wildlife/great-apes/orangutan.aspx

iv. Other Organisations

Orangutan Conservancy (OC)

An independent non-profit organisation based in the USA dedicated to the protection of orangutans in their natural habitat through research, capacity building, education and public awareness programs. Activities include funding provision, scholarship programmes, public awareness and the OCVG annual veterinary workshop.

Notes: Provides funding to SOCP and OuTROP.

Website: http://www.orangutan.com/

The Great Apes Survival Partnership (GRASP)

GRASP is United Nations Environmental Programme (UNEP) initiative first launched in 2001. The partnership works to bring together stakeholders to address issues relating to the conservation of apes. In 20 GRASP produced the report 'Orangutans and Economics of sustainable Forest Management in Sumatra'.

Website: http://www.un-grasp.org/

World Wildlife Fund (WWF)

In Borneo, WWF have helped secure the declaration of governments in Borneo, Indonesia and Brunei, to conserve 22 million hectares of forest as part of the 'Heart of Borneo'. This initiative includes research in Sebangau National Park, habitat protection in Danau Setarum and Betung Kerihun national Parks. WWF focus on regional land-use planning outside of protected areas. In Sumatra, WWF have a long running project in Gunung Leuser N.P. WWF are also working with TRAFFIC to tackle issues of illegal trade of orangutan and with local and international companies within the logging and oil palm industries to address forest habitat sustainability.

Website:
http://wwf.panda.org/what_we_do/endangered_species/great_apes/orangutans/

IUCN/SSC Primate Specialist Group (PSG)

PSG work in through Africa, Asia and Latin America to promote the conservation of primates, by supporting field research, conservation measures and education initiatives. PSG's primary responsibility is to evaluate the conservation status of primate species and sub-species for the IUCN Red List and to coordinate the production of species-specific conservation Action Plans.

Website: http://www.primate-sg.org/index.htm

Stiftung PanEco

Location: HQ in Berg am Irchel, Switzerland.

History: Founded in 1996 by Regina Frey who had been active in orangutan and rainforest conservation on Sumatra since 1973.

Mission: Nature and species conservation and environmental education in Switzerland and Indonesia. Specificly in Indonesia: Implement a holistic approach to the conservation of orangutans in Sumatra by running the Sumatran Orangutan Conservation Programme SOCP (together with YEL and PHKA).

Activities: Bird of Prey Station and Nature Centre Thurauen in Switzerland; Sumatran Orangutan Conservation Programme SOCP in Indonesia: Confiscation and reintroduction of illegal pet orangutans, habitat protection, education and awareness, population surveys and monitoring, orangutan ecology research.

Website: www.paneco.ch

Websites showing images of orang utan primary and secondary rain forest habitat, including oil palm plantation:

https://www.shutterstock.com/search/orangutan

https://www.istockphoto.com/photos/sumatran-orangutan

https://www.arkive.org/bornean-orangutan/pongo

1.4 Feeding Behaviour in the Wild

1.4.1 Feeding Ecology

Wild orangutans live in very seasonal habitats. In Sumatra, seasonal masting of fruit trees is more predictable and routine, however, Bornean orangutans must cope with lean seasons lasting 2-10 years where fruit availability is low and sporadic (Ashton et al. 1988). Because of this, orangutans are very adaptable and are known to consume over 1693 different food items (Russon et al. 2009). They also have a reduced basal metabolic rate (BMR), nearly 23% lower than a similarly sized mammal (Pontzer et al. 2010). Undoubtedly, this helps them survive their long periods of low quality diets in the wild.

Male and female Bornean orang utans ingest approximately 8422 kcal/day and 7404 kcal/day respectively during the periods of masting, but had to reduce their caloric intake to 3824 kcal/day and 1793 kcal per day respectively between masting seasons (Knott 1998). Their maintenance intake level when free-ranging is somewhere in between as there is tremendous weight gain during the masting seasons and weight loss during the leaner season (Vogel 2012). During this period, they will ingest food items referred to as "fallback" foods, which are food items ingested only when preferred food items (fruit) are not available. On average, food items ingested by orangutans are high in fibre, variable in protein and fat (**See Table 1**).

Even the fruits eaten during periods of weight gain have as little as 50% fibre fractions. Orangutans are often seen chewing fleshy, fibrous fruits for up to 20 minutes before spitting out a wad of intact seeds and/or chewed fibres (Rodman 1988). Alternatively, they have been observed crushing fruits and ingesting the small, unripe soft seed coatings and discarding the husks (Leighton 1993).

For both species, when fruit abundance is low, they will regularly feed on unripe fruits, leaves, epiphytes, lianas, bark and apparently also on wood (MacKinnon 1974, Rodman 1977, 1988, Rijken 1978, Galdikas 1988, Leighton 1993, Unguar 19941,b, Knott 1998). In a peatswamp area (non-masting), fruit was the most important contributor to energy to the diets, providing on average 77.1% of energy intake, followed by leaves (9.7), flowers (7.8), bark (2.3), invertebrates (1.6) and pith (1.4) (Harrison 2009).

1.4.2 **Table 1** – Range of nutrients from food items eaten yearly by Bornean orangutans in West Kalimantan

Food Item	Crude Protein (%)	NDF (%)	Crude Fat (%)
Seeds	2-19	9-84	0-52
Pulp	5-13	9-77	0-18
Leaves	12-19	21-72	1-2
Bark	6-17	53-73	0-8
Flowers	10-13	46-57	2-3
Whole Fruits	4-12	50-65	0-4
Pith	3-7	51-82	0-2

Data from Knott (1988)
NDF = neutral detergent fibre and is a measure of lignin, cellulose and hemi-cellulose.

Sumatran orangutans are primarily frugivores, but also eat leaves, insects (termites and ants) and on occasion, the meat of slow loris (Fox *et al*. 2004, Wich *et al*. 2006). Female home ranges are 800 to 1,500 ha. The true extent of male home range size is not fully known, although ranges in excess of 3,000 ha are inferred (Singleton and van Schaik 2001).

There are overall less studies that focus on Sumatran orang utans. Generally, fruits were always available (in Ketambe), with at least 30% of their diet being fruit although they still included a good proportion of vegetive plant parts, bark, pith cambium and insects (Wich et al. 2006).

There are definitely strong differences within the natural feeding ecologies between *P. abelii* and *P. pygmaeus* as evidenced by **Table 2.**

1.4.3 **Table 2** – Average time spent feeding on fruit, vegetation and bark of both orangutan species in the wild.

Species	Fruit	Vegetation	Bark
Bornean	50.9 (0-100)	29.6 (6.4-76.3)	11.4 (0-52.8)
Sumatran	66.9 (60.1-70.6)	16.0 (11.7-19.2)	1.9 (1.5-2.4)

Reproduced from Taylor 2006.

1.5 Development & Breeding Behaviour

1.5.1 Developmental stages to sexual maturity

Most authors follow the distinction of the development phases according to Rijksen and MacKinnon, as explained below.

Infancy lasts until 2.5 years of age. Typical physical treats are light skin zones around the eyes and at the muzzle clearly contrasting the darker coloured other facial skin. The hear on the had is long and pointed upwards. Nutrition wise breast feeding is most important and the infant shares a sleeping nest with its mother. For a period of about four months uninterrupted body contact between mother and infant is maintained. In the wild an infant is always carries by its mother while travelling between trees, independent true travelling does not occur during infancy whereas climbing exercises with the mother close by do.

Juvenility starts at the age of 2.5 years and lasts until 5 years of age according to Rijksen and until 7 years of age according to MacKinnon. In this phase the youngster's face still shows light skin marks. The young orangutan will lose its long infant-hair on the head in the third year of life and look quite bold until the head's hair grows back, pointed more downwards like in the adults.

In this stage of live, in the wild weaning occurs. An infant orangutan might mouth food items already with at the age of a couple of monts. At the age of about six months of age the infants starts to feed on solid food (Maple, 1980). Still, for many more months breastfeeding provides the most important nutritional source. Weaning can start between 2,5 and 4 years of age, in the wild – where the interbirth interval is longer and the feeding situation less secure – weaning can occur at any age between 3,5 and 7 years (Rowe, 1996). Older infants and juveniles often suckle irregular and show this behaviour more often in stressful situations (Munn, Fernandes in Sodaro, 1997).

In the wild the juvenile offspring is still often carried by its mother. By the way, in contrast to the African great apes, dorsal transport is quite unusual in orangutans. Even older offspring are mainly carried in ventral of ventral-lateral position (Munn, Fernandez in Sodaro, 1997). During the juvenile stage the youngster starts to build its own sleeping nest. Independence is often enhanced by the birth of a younger sibling that draws most of mother's attention.

Adolescence

Adolescence is the phase following juvenility. The infant leaves its mother in the wild at the age between four and six years, and sometimes even nine years, which represents a huge range. After loosening the bond with its mother, adolescent orangutans enter the most social phase in their lives, when they associate with conspecific of the same age-sex-class.

1.5.2 Breeding behaviour in the wild

Bornean Orangutans are very slow breeders and produce on average one offspring every 6–8 years, which explains their extreme sensitivity to hunting pressure. Females reach maturity at 10–15 years old; they generally give birth to a single infant after a gestation period of approximately 254 days (Kingsley 1981).

Female Sumatran orang utans first give birth at about 15 years of age (Wich *et al*. 2004). Interbirth intervals are 8.2 to 9.3 years (compared with 6.1 to 7.7 years for *P. pygmaeus*; Wich *et al*. 2004, van Noordwijk and van Schaik 2005) and gestation lasts approximately 254 days (Kingsley 1981).

1.5.3 Locomotion & activity

Orang utans have long arms, elongated hands (with reduced thumbs) and prehensile feet which enable them to move by means of grasping branches with their feet while their hands take hold of the branches or trunk of another tree. They can also brachiate whereby they swing below branches using just their hands and arms for support. Females, especially those with offspring, rarely if ever come to the ground whereas adult males will do so on occasion.

Periodically, orang utans will aggregate in large fruit trees. In rich fruiting seasons, this may lead to the development of small social groups with animals travelling and foraging together. The most common associations occur, when a male and a female join one another in a so-called “consortship” which is characterised by regular sex. Such a pair may travel together for days or weeks.

In some Sumatran populations it has been noted that individuals are more likely to move around the forest in small groups, whereas Bornean orang utans are generally more solitary by nature. Both species have been observed making use of various type of tool whilst feeding in order to break open certain fruits or to gain access to insect nests.

SECTION TWO

Management

In

Zoos

2.1 Enclosure Design

Important general remark: Zoos planning to reconstruct their orang utan enclosures or build new enclosures for orang utans are expected to contact the species coordinator for approval as early as possible. Not complying with this will affect transfer recommendations

2.1.1 Fission fusion system

Ideally an Orang utan enclosure consists of a minimum of four or more units that are connected with each other. Each unit can be seen as a full Orang utan enclosure. including night quarters, inside and outside area.

The units are connected with each other creating almost endless combinations that meet the Orang utans' needs. In an example of 4 units, one can say that units one and two are occupied by two males. Each female has the choice in which unit she wants to be. When she chooses not to be in company with a male, she stays in area three with the other females. Because it is also rather common that females are (temporarily) not compatible with other females, the females can be split up in unit three and four. With this simple fusion fission system one can cover most possible situations.

Appropriate separation space (i.e. not just night quarters) is also required for housing old over-represented animals with some company, or for housing males that are temporarily surplus or that are not (any longer) compatible with the other individuals. Such separations can be urgent but it should be possible to accommodate these.

For introductions it is good to have the possibility to keep individuals completely separated (also visually) as well to make it possible for the animals to see each other through the mesh.

New or renovated orang-utan facilities can be expected to meet all the above mentioned.

2.1.2 Function

The indoor living space for orang utans serves a number of **functions**:

i) To provide space for the actual social unit (male with female, female or females with offspring) **to live together during the day** in the winter, when the climate makes the outside enclosure unsuitable for the orang utans. As long as the climate permits, it is preferable that the orang utans have free choice between the use of this inside room and the outside enclosure.

ii) To provide space for the orang utans **to over-night**. It is preferable that the actual social unit (male with female, female or females with offspring) spends the night together in the same space. However there may be special reasons to separate one or more orang utans from the group during the night: during introductions or periods of social instability it may be better not to leave they unobserved together for the night. There may also be veterinary reasons to separate an animal for the night.

iii) To provide space for the orang utans **to be shifted to** when the other areas are being serviced.

iv) **To introduce** new members into the group. Introductions require an arrangement of the various rooms that can easily be changed. By providing either double wide mesh or completely closed separations between various combinations of rooms the introducee can be given the possibility to see, hear, touch and smell the others, or only one or more selected and separated individuals. It is preferable to give the introducee the possibility to withdraw from the view of the other orang utans. When the animals are actually brought together, the facilities must allow a circular pattern of movement between including two access points. Rooms should not include places where individuals can get trapped. The use of selective doors between rooms and selective barriers within rooms can give a smaller orang utan a quick escape from a bigger pursuer.

v) **To quarantine** orang utans when this is legally required just before or after transportation to a new locality, or for veterinary reasons. For the mental well-being of the orang utan it is preferable to avoid the use of quarantine, in particular when a single animal is concerned. This should be taken into account when the decision to transfer an animal is made.
For veterinary reasons it is much better not to have the quarantine in the same building or even within the same facility as the other orang utans. In most cases this will also be the legal requirement.

vi) **To permanently separate** orang utans when this is necessary, until a destination for them is found and a transfer can take place. Such accommodation should provide proper housing for one or a few individuals even over a longer period if needed. It allows young males to stay for much longer in the family unit.

This extra accommodation should be able to accommodate two or three individuals and can also be used to house old over-represented animals with some company or males that are temporarily surplus or that are not (any longer) compatible with the other individuals. In order to avoid the possible stress caused by the presence of a nearby competitor, it should at least be possible to reduce the visual, olfactory and auditory contact between the inhabitants of the extra accommodation and those of the main enclosure to a minimum.

The option for institutions to take on this “extra accommodation” role for just holding single males, or non-breeding individuals, rather than having to invest resources for a facility suitable for a breeding fission-fusion group will also be considered by the EEP. This may also be a preferred option for the adaptation of older, more functional and sometimes smaller exhibit. Single animals in particular would benefit from being part of appropriate mixed specis exhibits. See 3.2.2

vii) **Medical care**. It is preferable that immediate medical care takes place in a separated area in direct contact with the general holding area.

viii) To **display** the orang utans to the public when climate conditions restrict the use of the outside enclosure, or when the orang utans choose to be inside in the situation where they have a choice to do so.

ix) To provide **linkages** from one space into another. There should be two direct animal access points from the indoor areas to the outdoor areas without the need for transfer chutes/tunnels. Such links that run through off public show areas will result in animals possibly not being allowed ‘free access’ if they are to remain visible to the visitors. Where transfer chutes/tunnels are deemed essential e.g. either overhead (across keeper corridors or public paths) or on the floor, they should be a minimum of 1m Wide x 1m High with mesh on at least one side (or glass above public). They should be no longer than 5m in length and be accessible for cleaning.

x) To provide opportunities for **training sessions**. For this purpose a special off-exhibit room could be considered. Alternatively special access points for safe interaction between keepers and orang utans with good visual opportunities (light) could be created. Transfer 2.1 and 2.2 into separate set-up chapter. Before indoor enclosure.

xi) **Combining the rooms**

Any orang utan accommodation should provide space for the above mentioned functions. It is of course possible to use rooms for some of these functions or to subdivide rooms in order to create a more complex living environment for the inhabitants. All these rooms should be arranged and connected in such a way that it is always possible to move orang utans between any two of the spaces, without limiting the use of the other spaces.

When the orang utans are given free access to a number of the rooms, there should always be at least two passages between any two of the rooms occupied. By opening the appropriate passages, the rooms can be arranged to form a circuit. In such a way one single animal is not able to block the passage between the two rooms, or chase another into a dead end. It is preferable that containment barriers between combined rooms are such that the orang utans have a choice between maintaining visual contact or hiding from view while being in the other room.

2.1.3 Boundary

All barrier materials should be non-absorbent and easy to clean and/or disinfect if needed. Ceilings can either be kept out of reach of the inhabitants or can at least have the same characteristics concerning strength, moisture resistance and wash ability as the walls. Additional strength should allow for the use of hanging furniture and enrichment elements.

A wire-mesh ceiling is very suitable for this purpose and in addition provides excellent possibilities for top cage feeding and change enrichment furniture. In particular in inside enclosures, the use of windows in barrier walls can dramatically increase the size of the visual environment of the orang utan and provides a view on neighbouring animals, keepers, public and the surroundings outside. Windows definitely reduce stress and are great enrichment.

i) Water moats

Water moats are often used as the preferred barrier for Great Ape outside enclosures. They provide a natural looking landscape element. However, despite continuous efforts to improve the safety of water moats, drowning of great apes in such moats still occurs. This concerns victims of all species, including orang utans.

Drowning can of course be excluded by avoiding the use of water moats, but if they are to be used then the next suggestions may improve their safety for orang utans.

- The water moat should be 6m wide or more. The width of the moat helps to reduce the direct interaction between orang utans and visitors, which is one of the factors that can induce an orang utan to try and cross the moat and possibly drown. A wide moat also helps to create a gentle slope of the moats bottom.

- The slope of the bottom of the moat, from above water level on the enclosure side of the moat, to the deepest point of the moat, should be gradual with a slope of max 25cm/m. There should not be a ‘step’ into the water at the waterside.

- The moat should be at its deepest on the visitor side, unless it is much wider than the indicated minimum width. This contributes to a gentle slope of the bottom.

- On the visitor side of the moat, a planted area of a few meters wide increases the distance between visitors and orang utans and reduces the interaction that may lead to the orang utan entering the moat.

- Ropes or rope nets can be fixed onto the sloping bottom of the moat on the enclosure side for orang utans to find a hold and help to get out of the moat.

- In the shape and furniture of the enclosures 'dead ends' of possible routes for the orang utans leading to the moat side should be avoided.

- Min depth at the deepest point: 1.5 m

- Animals that try to drive opponents into the moat should be separated and the coordinator should be contacted for advice.

- Bridges that connect the moated outside enclosure to the building with the inside facility can become dangerous when the door to the building in closed. The bridge than becomes a dead end in which orang utans can be cornered by others. They may then end up in the moat and drown. It is advised to avoid bridges that directly adjoin the houses.

ii) Glass barriers

Glass walls are often used as barriers in order to provide close-up visitor experiences. To limit the costs, smaller glass windows built into vertical walls can be used. Glass can protect the visitors from the dirt and objects, which apes may throw, and it also discourages visitors from throwing food items or other materials into the enclosure. Glass can also protect against an exchange of transmittable infections between the animals and visitors.

The big advantage of glass for the visitor experience, the close-up contact with the animals, can be a disadvantage for the orang utans. Interactions with the visitors may affect the intra-specific behavior of some individuals. This effect can be reduced by planting a vegetation belt between the visitors and the glass wall. In some cases so called one-way glass can be considered.

The thickness of the glass sheets may vary depending on the sheet size. On average 42 mm thickness of tempered, laminated glass seems reliable. When broken , the break generally stays limited to a single layer, and the connecting foil keeps the glass in place. Glass sheets can be built into the vertical walls, or can be combined with electric wires running across the top of the glass panels. As for walls a minimum height of 4 meter has proven sufficient for glass panels for orang utans.

Because any thickness of glass is potentially breakable, consideration must be given to ease of replacement. Acrylic panels are less breakable, but scratch easily, therefore they are not the best option. Static calculations must always be done by glass specialists, based on the size of the openings and assumed loads.

When using glass, special care should also be given to the destructive capacities of orang utans, that may use stones, bolts or other hard objects to break or scratch the windows. Multilayered, hardened glass is more resistant to this behavior, but daily control of the enclosure and removal of any of such objects should be standard practice.

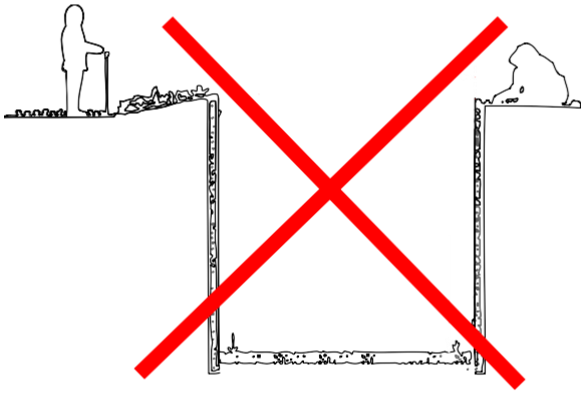
Care should be given to the frame of the window. It should be seamless and flush connected to the surrounding structures (such as a wall), and even fairly small nuts and bolts extruding from the surface should be avoided as they can be used to climb the barrier. Orang utans are also capable of unscrewing bolts and nuts that can usually only be unscrewed by technicians with the use of tools

iii) Dry moats and walls

“U” shaped dry moat
Dry moats, made of “U” shaped parallel walls

(**Figure 1**), **are not recommended** for Orang utans as these could fall into the moat.

Fig. 1



“V” shaped dry moat

If a “V” shaped dry moat **(Figure 2.)** is used as a barrier for an Orang utan enclosure, then the vertical part on the visitor’s side has to fulfil the same criteria (distance from climbing structures, minimum height) as in the cases of the other walls, see below. The animal’s side of the moat should slope at less than 45 degrees and should be able to allow for the natural containment of the soil on the orangutan’s side.

For the wall on the public side of the moat a minimum hight of 4 meters is necessary. If the animals can go into the shallow moat, it will give them more extra space.

The visual disadvantages of these moats are very similar to those of the “U” shaped dry moats or to those of other walls, see below.

Fig 2.

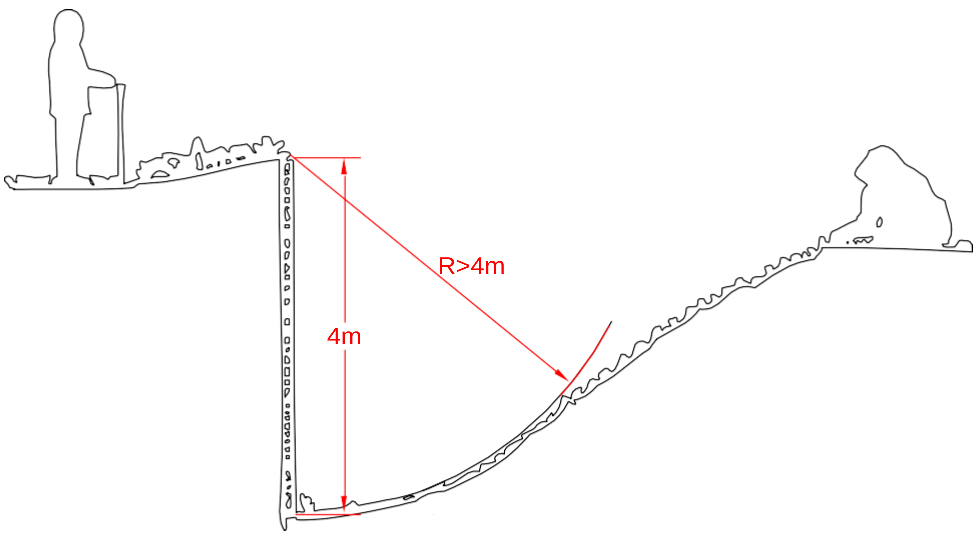


Fig. 3.

The moat in Chester (**Figure 3**), with water running over the slope on the enclosure side, shows how access to the moat can be made less attractive for the inhabitants without any risk on drowning.

Walls

The goal, obviously, is to create non-climbable walls. The texture must be smooth to prevent foot or finger holds. Doors and window sills with their hinges, or nuts and bolts, which are used for attaching constructive elements to the walls, may be critical points. They should all be kept flush with the surface of the wall itself.

Overhangs may be added to prevent climbing The layout of the walls should avoid perpendicular or acute angles to adjoining walls to prevent "chimneying" out, or they should be capped at these dangerous intersections.

Advantages of walls are that they take up very little room and can be less costly than moats or glass walls. Although walls take up very little horizontal room, they minimise the vertical climbing space of the animals. The distance from climbing structures to the walls should be at least 4 metres, (including branches of living trees) to prevent leaping out (click picture (ctrl + click)underneath for a video):

It is also essential to avoid loose hanging ropes near the outside wall or moat as these will invariably allow the animals to escape from the enclosure.

Fig.4. Female orang utan in Apenheul in full free jump between two neigbouring islands

Vertical climbing space is important for orang utans, and for smaller walled enclosures, it is therefore better to make a wire-mesh roof. The minimum height of the walls should be 4 metres. Orang utans are masters in escaping from enclosures using branches which they put in an angle against the wall. They should not have access to branches longer then ca 1 meter that are strong enough to be of any use to them in this way or a ny other objects that they can use to climb the walls.

Completely enclosed wall space can be very stressful for great apes, as they can often hear noises from behind the walls but cannot see anything that is happening. Therefore, each wall should have several windows. An additional disadvantage of the completely enclosed wall is that wind cannot cool the enclosure when temperatures are very high.

In zoos, we try to encourage the visitors to **respect the animals**, and it has been shown that visitors have less respect for animals if they only see them from above. They can easily throw food or other objects in the enclosure, and they can spit on the animals. All these behaviours are a threat to the health of the animals, but even if visitors behave, for arboreal animals it can be threatening and stressfull to have visitors “above” them.

Finally there are several cases of **careless visitors**, mainly children, falling over the edge of walls into enclosures.

iv) Fences

Fences are perimeters made out of rows of posts with steel fencing material installed along the line of the posts. For type of fencing material care should be given to how far the support structures are apart, which very much affects the strength of the barrier. Steel barrier elements should be non-corrosive (stainless steel, or hotdip) and securely attached. The possible deformation of steel fence elements through regular pounding on the fence with the full weight of an adult male should be seriously considered.

The type of fencing material can vary:

- **Welded mesh**, which has the disadvantage of being less resistant to impacts from heavy blows etc. The welds can break then. Mesh width ca 50mm x 50-100 mm, steel thickness 6-10mm, welded in a frame of rectangular steel tubes

Figs. 5 & 6 Welded mesh

- **Steel bars.** With the required heavy framework this type of barrier, given the right dimensions are chosen, can certainly be strong enough for orang utans. There is also a safety issue with this type of mesh. Orang utans can put sticks through it and than swing with it up and down which can be dangerous for keepers. It is better not to use this type for this reason. Recommended dimensions: Solid steel bars 15-16mm in diameter, centre distance 30-56 mm, distance between transversal bars (flattened steel or rectangular tubes) 440-700mm.

Figs. 6 & 7 Steel Bars

- **Steel crimped mesh**, difficult to obtain in a sufficiently heavy quality (6mm), but is a very suitable product. Recommended dimensions for this type of mesh: 6 x 50 x 50mm. 5x50x50mm is also suitable, but requires a denser support frame.

Fig. 7 Steel crimped mesh welded in a steel frame

- **Wave mesh.** Similar to steel crimped mesh. The waved strands could with sufficient force be more easily be stretched, and the mesh deformed. The space in between the steel profiels can be filled with epoxy to prevent dirt and debris from collecting there.

Fig. 8 Wave mesh welded between steel profiles.

- **Woven mesh** from stainless steel cables, an expensive but visually pleasing material. Available in two types, one in which the cables are attached with soft metal rings that are clamped , and one in which the cables are interwoven at the attachment points. (see pictures).

Fig. 8 Woven mesh with rings

Fig. 9 Woven mesh with interwoven cables

Unfortunately a few individual great apes from several institutions have so far developed skills to damage this type of mesh (Fig 9). **If used it is important to check the mesh routinely**, monitor the 'tool using' behavior of the animals, and intervene before any individual has improved its skills and passed this on to exhibit mates.

- **Chain link mesh**, is generally **not recommended**. It is vulnerable for the destructive skills of orang utans. However, it may be successfully protected by hotwires at several heights, but may lead to a reduced use of enrichment objects attached to the perimeter of the enclosure.

Fig. 10. Smooth overhanging structure as containment on top of a chainlink fence in Monkeyworld (Wareham). Note the hotwires to protect both the lower and upper sections of chainlink.

Naturally all these fences may be used by the Orang utans as climbing structures to their advantage, but where such enclosures are open-topped, they need to have an un-climbable structure at the top of the verticals for containment. These can be smooth plates from sufficient widths (heights) preferably with an overhang, or even special structures, such as those used in Wareham. (**see Figure. 10**)

v) Safety distance

In open top enclosures with walls, glass panels or fences as boundaries, any furniture, climbing structures, branches from live trees etc in the enclosure should not have a smaller horizontal distance to the boundary than 4 m.

vi) Mesh cages

Steel mesh enclosures can be large outdoor cages made of structural steel columns and beams with in-fill panels of mesh, or post-and-cable structures with less rigid forms. These are totally enclosed exhibits, so there is no need to consider safety distances or minimum heights for the walls, moats etc. The only dimensions to consider for this type of enclosure boundaries are those related to the strength of the material and construction of the barrier, such as mesh width and strand thickness for the various types of mesh, thickness and layering of glass etc. In these enclosures, orang utans can use all areas and the full height of the enclosure as climbing opportunities. In addition to that, this barrier type itself provides the opportunity to be used as a climbing structure.

Wire ceilings are useful for enrichments like ropes, and roof feeding is also beneficial for animals. Provided that the cage is high enough for the arborial orang utans, this type of enclosure allows for the most efficient use of the available 3 dimensional space. Because furnishings such as trees cannot be used as escape methods, this barrier increases the flexibility with which such furnishings can be used.

Fully enclosed exhibits reduce the chances on an escape of the inhabitants. Stainless steel net structures are expensive, but maintenance costs are very limited.

The support structures of enclosed exhibits provide opportunity to hang climbing facilities, resting platforms or structures for food provision. In order to service these in the for orang utans necessarily high enclosures, such structures can be raised and lowered using electric winches, or reached by staff trained in working at heights, using harnesses etc. Hook-up points for carabineers can be attached to the climbing structures.

These additional loads should be taken into account when calculating the statics for the exhibit construction.

To avoid direct orang utan-visitor contact, the public should be kept at a sufficient distance to exclude the risk of being spat or urinated on by the Orang utans, or glass panels should be placed on the visitors' side to reduce the potential for disease transmission.

Any type of mesh or fencing should naturally be subject to periodic and reliable maintenance, according to its nature.

Check mesh routinely and keep an eye on what OU are doing with it.

vii) Electric barriers

Hot wires are not suitable as primary barriers, but can be used to add safety, for instance over the top edge of a wall. Hot wires or so called 'hot grass' or 'hot lianas' can be used to protect vegetation within the enclosure. It should be noted that some Orang utans will develop skills to destruct or to pass the hot wires using objects available in the enclosure as tools. This may lead to an undesired limitation in the provision of enriching items. Orang utans are even able to use relatively 'soft' materials like grass or straw to make tools from.

viii) Service access to the enclosures

Normal access doors should be wide enough to allow for comfortable passage with a wheelbarrow and high enough for any person to pass upright. In practice 1.20 m wide and 2.2m high will be sufficient. Official building regulations may require a greater hight.

In order to replace biofloor material, soil, exhibit furniture or technical service equipment, additional service access should be made larger. Recommended width: at least 3m.

In some cases, service access for cranes must be planned and maintained over time to replace furniture and landscape materials as decay and safety concerns are revealed.

All doors into enclosures or the immediate neighbouring part of the boundary should provide good visibility into the enclosure.

Details of the doors and doorframe should be carefully considered regarding strength and climability. If the last cannot be excluded, there should be at least 3m not climbable boundary above the doors.

The doors should be locked at least at two, preferably three, different heights.
Locks should be kept out of reach of the orang utans.
Doors should open into the enclosure
Doors should be self-locking (see picture) (slam lock)

ix) Barriers between the enclosures

It is very important to protect the orang utans not only from visitors, but also from unwanted or stressful neighbouring animal enclosures. Extra outside enclosures with additional orang utans can be separated using the same types of barriers as with enclosures in general. It is important to create almost full visual barriers between the enclosures, with only a few “peeping” areas, in order to provide an opportunity for the animals to escape the attention of the other individuals or other species in the neighbourhood. These visual barriers can be made by planting high vegetation between the enclosures, or by building a screen from vertical stumps or rockwork. In such cases, the distance from climbing structures to the screen should be at least 8 metres.

At times, the presence of other great apes in the neighbourhood may be disturbing or even stressful for the orang utans. This may be the case with chimpanzees in particular, which can be quite noisy and which like to throw different things into the neighbouring enclosures during their display. Such kinds of unwanted attention can be avoided if there is a distance of at least 10 to 15 metres between the enclosures, and if there are more visual barriers in place than are generally used.

x) Doors

To provide more flexibility there should be at least two doors between each pair of neighbouring enclosures, including between separation boxes, and these doors have to be positioned as far apart as possible and preferably at different heights. This will reduce the chance that an Orang utan gets cornered and will facilitate circulation between the enclosures. For the same reason it is very valuable to have two doors between each inside enclosure and the neighbouring outside enclosure(s).

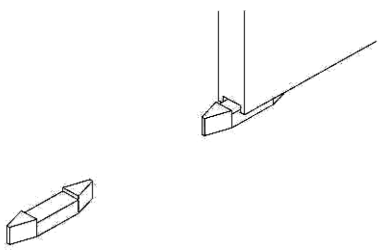
Doors between enclosures should all have an extra security mechanism to prevent orang utans from opening the doors themselves. In designing the mechanism for opening the doors between enclosures, it should be kept in mind that orang utans might move the door with great force while a keeper is opening or closing the door. In some designs, parts of the mechanism might hit the keepers and injure them. In particular doors sliding horizontally and operating manually include this risk. They should preferably move away from the keeper when being opened.

There are different kinds of mechanisms for sliding doors: mechanic, air-hydraulic, oil-hydraulic, etc.

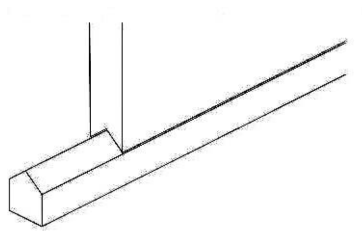
Cables, which are often used for vertically moving sliding doors, should be well protected and out of reach for the Orang utans. Nevertheless the condition of the cables should be checked frequently, similarly with other moving parts and attachments like bolts and nuts. Keepers should not be forced to come within the reach of the orang utans in order to handle the doors, for protection against possible aggression.

Bedding can often block a door from being completely closed. The design of the door can be such that the collection of bedding in the door-opening can be limited. The door opening can be raised in the wall, so that bedding does not reach the door (this also allows for a change to deep bedding later).

When doors can also be locked while still leaving a small opening free (ca 3 cm) it is possible to approach the door from the other side and carefully remove any material that is blocking total closure of the door. Horizontally sliding doors of the type hanging from wheels in a rail on the topside, can be guided by torpedo guides or guiding wheels instead of in a guide channel. Doors sliding horizontally with support on the bottomside could slide over a ridge rather than inside a channel (see drawings).



Sliding door with torpedo guides



Sliding door on a ridge

The design can also be such that bedding is moved away by the moving door, or at least that the door can be locked in an “almost close” position. In that case a keeper can enter the room on the safe side of the door and carefully remove the bedding from that side

Keepers must always have a complete view of the full opening of the door when opening or closing it. Hydraulic doors should be such that the movement of the door stops instantly when the keeper lets go of the button. It is also necessary to provide a manual override for hydraulic, pneumatic or electric doors so that these can be used and locked even when the system fails.

The speed of such doors is also critical. They should be fast enough without risking injuries to the orang utans.

Doors must allow either visual contact, limited physical contact or no contact to facilitate different management of the individuals when needed. In those areas where the introduction processes are done double slide doors are very useful with one solid slide and one lattice slide. For additional safety in such situations one could also consider double mesh doors, at a distance just enough to allow for two orang-utans from both sides to touch each others fingertips. For the introduction of chimpanzees a “Gap” has proven valuable. This could also be of value for the introduction of orang utans. The sliding door is locked leaving an opening of ~12 cm free. Orang utans that are being introduced to each other can have some physical contact this way, while still being largely protected. It should be emphasises that this is just one stage of an introduction procedure. (see: It should also be possible to safely lock the doors in different other positions, to allow selective passage of, for example, all but the adult males or the youngsters only.

The recommended doors size is: 80 cm wide x 100 cm high.

Before the keeper opens the door giving access to the service area adjoining the enclosures, they should have the means to check through a window or fence that this area is free from escaped orang utans.

xi) Observation facilities

Keepers should be able to observe the orang utans in any part of the inside areas. This can be achieved by different windows made from glass or mesh or through closed circuit video cameras. Being close relatives to humans and having complex behaviour, orang utans are “looked for” subjects of ethological studies.

On the other hand, the management of this species can greatly benefit from the presence of observers. It is advised to consider special facilities for observers when designing orang utan facilities. Observation can also be enhanced by means of video cameras and recorders. Even if a decision to use these cannot be taken for financial reasons at the time of designing the facility, at least the conduit-pipes and cables could already be installed.

2.1.4 Landscaping & Topography

Well-designed, naturalistic enclosures can encourage species-appropriate behaviour, which are primary conditions for the health and well-being of animals. The physical complexity of the enclosure is also a very important issue. An enclosure with different elevations is much better than a completely flat area.

The sunny and the shaded areas should alternate within the enclosure, so the animals can choose where to go. In warmer climates, such as in the Southern European countries, the emphasis should be on shade - a few small, shaded places will not be sufficient.

i) Vegetation

Plants and vegetation are very important for dividing the terrain in a natural way, and provide nesting and foraging material for animals. They are also important for visual barriers and providing seclusion. Some bushes, shrubs and trees can be protected by electric fences, fibreglass or metal bark wraps. Trees and large shrubs can also contribute to an essential high proportion of shaded area in the enclosure.

Importantly, poisonous plants have to be removed and controlled on a regular basis. For the further details about the suitable vegetation please refer to the EAZA primate plant compatibility database, developed by Sergio Pacinotti for the EAZA Zoo Horticultural Group. This database can be found on the EAZA website. (www.eaza.net, enter the Member Area using your Login and password, then go to Committees, EAZA Working Groups, Zoohorticulture group, animal and plant compatibility database, then download the WinZip-file.)

Waterfalls or shallow pools can enrich their behaviour and increase their daily activity. The introduction of water in streams and pools adds a tremendous dimension to the daily environmental experience for both orang utans and visitors. Depths of less than 50 cm can be considered safe for Orang utans.

ii) Substrate

It is strongly recommended to only use natural substrates. Leaf litter, bark shavings, exposed roots, thickets, brambles, marshes, packed earth, and cultivated field are examples of the complex variety of substrates which can be used to recreate the natural landscapes that would be found in the wild. For enrichment it is valuable to have several types of substrate in an enclosure.

iii) Flooring

For the purpose of easy cleaning, concrete or epoxy floors should preferably be sloped 2 to 5%. Drains should be placed outside the actual enclosure and can be used as urine collector. To allow for good cleaning and disinfection, the use of special coatings should be considered, but care should be taken in its choice.

Coatings can either make a floor too smooth, forcing the inhabitants to move about in a careful, cramped gait, or too abrasive**.**

For the recommended use of deep (> 40 centimetres) bedding, the floor and draining system can be designed in such a way that it is possible to close the drain and fill the floor with a layer of water, deep enough to have the water standing above the bedding. This will help to counter the possibility of mice or even rats in the bedding.
Those who consider a biofloor for their Orangutan enclosure are advised to get in touch with Dr. Marianne Holtkötter, Stuttgart Zoo for the results of the Great Ape TAG biofloor survey.

The main conclusions from that survey were:
If you plan a biofloor, take care of the following things:

- Doors and sliding doors should be high enough above biofloor level to work properly
- Bringing in and removing biofloor substrate should be technically easy (corridors and access to enclosure for tractors, ramp, possibility to blow substrate in …)
- It should be possible to remove the biofloor completely time wise in case of diseases
- Drainage system (to avoid dust, raise humidity, and control pests, you must water the biofloor!)
- Pest control
- Great Ape TAG veterinairy guidelines: do recommended tests before introducing a new animal!
- Detergent: biodegradable?

Deep bedding of bark creates a comfortable floor surface for the inhabitants, helps to increase and stabilise the levels of humidity of the enclosure and provides enrichment when combined with scattered food. It also improves the quality of the air by removing bad smells. Access to allow for easy exchange of the bark bedding, possibly with a machine, should be provided for. Some zoos use earth as substrate in their Orang utan enclosures. Examples are Leipzig Zoo, Frankfurt Zoo and Chester Zoo - See Appendices

2.1.5 Furnishings & Maintenance

i) Furnishings

Physical complexity includes not only the well-designed topography and the landscape, but good furnishing as well. In a good, naturalistic enclosure use of primarily natural materials is recommended such as deadfall trees, stumps and logs, reversed old roots, and rocks. Branches can serve not only as browse, but also as a very useful play objects and potential tools.

Furniture has to be designed to fulfil the basic behavioural requirements of different sex and age groups. Young or subordinate animals need to be able to escape the attention of adults. Each individual needs occasional privacy, to be out of view from other oprang utans or from visitors. Good furniture should serve this requirement as well.

Variety in the furnishings and enrichment items offered increases the possibility for the Orang utans to develop and display their full behavioural. Spatial variety helps to give different areas and spots different functions. Favourite areas for sleeping, playing, feeding etc. can be provided. Sight-screens, selective barriers etc. help to reduce social tension by providing opportunities for quick flight or hiding. The variety of ideas for behavioural enrichment is enormous. Many of them can only be applied when integrated into the architecture and engineering system. The opportunity to integrate such elements in the design of a new or renovated enclosure should not be missed. At least a large number of attachment-points, such as eyehooks, should be provided. These can be placed on walls, floors, ceiling but also on the furniture)

ii) Climbing structures

Orang utans are primarily arboreal animals. Therefore they need trees to climb on. For this reason the diameter of some climbing structures should fit to all age-groups. Height and complexity of the climbing structures, composed of both vertical and horizontal elements, is very important. The higher, the more complex the structure can be. Orang utans use various types of locomotion in the canopy and the climbing structure should facilitate this sufficiently. They walk quadrupedally over heavy branches, move bipedally over lighter branches (finding support for their hands on higher branches), brachiate, hanging from branches thin enough to grasp with their hands , and sway on flexible branches from one site in the canopy to another. Fibre glass or carbon fibre poles have been successfully used to facilitate this swaying. It might be necessary to limit the freedom of movement of such poles to prevent the orang utans from leaping out of the enclosure, or overstretching the poles and break them. For such a purpose the reach of the poles can be limited by obstructing climbing structures around it, or by ropes, fire hoses or webbing attached to the poles. Climbing structures can be constructed using wooden poles, tree stems, ropes, nets and platforms

Great Ape enclosures are not playgrounds for apes, and climbing structures are not meant for them to demonstrate or practice their gymnastic skills. Great Apes in nature inhabit a complex and very three dimensional habitat in which they find food, sleep, meet conspecifics avoid predators etc. In our zoos they should be able to find their ways in a similr way through a three dimensional climbing structure, that includes routes that can lead them to all the places in the enclosure that meet their requirements.

Orang utans also need privacy, and both on the groundlevel and in the furniture sightscreens and secluded nesting places on various hights can provide these.

ii) Flexible climbing material

For arboreal primates like Orangutans, flexible climbing material is of very great value. Traditionally ropes are being used for that purpose. It should well be realised however that ropes can be dangerous for Orang utans. The ropes can be untwisted, and then orang utans can put their heads through and hang themselves. Frayed ropes can also be eaten, and in particular some synthetic rope types can curl up and block the intestines.

For those reasons it is very important to select, prepare and hang the ropes with great care, and make sure that through good maintenance the presence of frayed ropes is being avoided. Braided ropes are much harder to untwist than twisted ropes. Some types of rope are more tightly twisted than others. The ends of the ropes deserve extra care, since these are the places were fraying starts. Attaching both ends of the ropes makes it harder to untwist the rope etc.

There are also good alternatives for ropes, such as fire hoses and special webbing as traditionally used for safety equipment. These are also very suitable for making comfortable hammocks for the orang utans.

iii) Nesting places

A variety of constructions from other materials have been successfully used to provide nesting places. These can include wooden platforms, steel frames, hammocks made out of fire hoses, webbing or a dense rope net.

Inter-individual distances between nesting places and choice of nesting places are important for all Great Apes. There should be more nesting places than individuals in the enclosure and some of the nesting laces should be large enough for co-nesting (Weiche I, Anderson JR, 2007)

iv) Shelter and hiding places

Shelters and hiding places are essential for shade and protection from heavy rain, severe weather or blazing sun. Hiding places should provide privacy from other individuals and from the public. Hiding places also should be set up preferably so that they cannot be monopolised by high-ranking animals. Shelters should be provided on different hights.

Orang utans are very strong and have the patience to losen much that was fastened by skilled technicians. It is important to spend great care on the attachments and connections of the furniture in the enclosures.

2.1.6 Environmental Conditions

i) Lighting

In addition to the natural light from well protected sky-lights and/or windows (think of the risks of broken glass falling into the enclosures) Artificial light is needed to increase the day length in our darker seasons, compensate the reduced light levels of gloomy days and provide sufficient light for good working conditions for the staff.

In their natural habitat orang utans always encounter spatial variation in light levels. A choice between different light levels (average ca 300 lux or more, variety between 80 (shaded places)and 500 lux at ground level) might be beneficial to them. If necessary an additional light system could be provided. This should create good working light conditions for servicing the enclosures, even in areas normally kept shaded for the orang utans. The colour of the lights has a psychological effect on the orang utans. A colour temperature of 5000-6000 K is most similar to the colour temperature of sunlight. For fluorescent lights nr. 83 is recommended.

For colour representation an Ra of 80 or more. (This is not the colour of the light, but a measure for the reliability of the way colours are being seen by humans).

Light intensity should come on gradually and also be switched off gradually. The presence of low intensity lighting (max. 5 lux on the floor) during the night can be very helpful Next to allowing some vision for the orang utans during this period, it also allows a visual check on the facility and its inhabitants without the need to disturb these by switching on the main lights.

With a combination of day light and articificial lighting, the light period of the day should be at least 10 hrs throughout the year (Daylight length has generally hormonal effects affecting lactation, cycle etc.)

When climatic conditions allow for very limited access to the outside area, insufficient exposure to UV light may lead to vitamin D3 deficiencies. This can be overcome by feeding vitamin supplements, but since vitamin D3 is not transferred by lactation from mothers to nursing babies, they may still become deficient for this vitamin at a time in thir development at which they badly need it.

Exposure to UV light is very important for a good health, but supplying artificial UV light has many disadvantages. It is extremely difficult to give the proper dose, and while overexposure has serious health risks, underexposures will fail to have the desired effect.

Access to the outside for as long as the weather permits, if only for a short period a day is very important for that reason. Rooflightmaterials that have good UV passage should also be considered.

All lights have to be well protected, to avoid broken lights falling to the enclosure floor.

ii) Outdoor climatic conditions

While in the EEP region as a whole a combination of inside and outside enclosures is required for the keeping of orang utans, it should be remembered that the climatic conditions within the region differ considerably. As a result some of the typical functions of inside accommodations can be provided outside when the orang-utans are kept in a warmer climate. One can also expect the orang utans to spend more time in the outside enclosures. The conditions in and dimensions of outside accommodations in these warmer climates can be expected to reflect this emphasis on the outside, and so should the complexity of the lansdscape and climbing structures. Nevertheless inside accommodations should even in southern Europe be suitable to provide a complete living space for the colder part of the year.

It is essential to realize that complexity of the facility is an important element for Orang utans. When for climatic reasons less of this complexity is offered inside, this can be compensated outside. All species of Great Apes are inhabitants of tropical forests where they are used to live in the shade of the dense canopy. Shade is a very important element in the exhibits and should dominate in these. Free choice between shaded and sun-exposed areas is important regardless of the social situation. It is obvious that shade is even more important in those parts of the EAZA region with high summer temperatures.

On the other hand in the more northern parts of the EEP region it is to be expected that the orang utans will spend most of their time indoors. The size and conditions of the inside accommodations in these regions can be expected to far exceed those traditionally seen in milder climates. Sun exposure of the outside enclosure is more important in those facilities though shade is still required.

iii) Indoor climatic conditions

Providing choice of individual preferred temperature, there should be a gradation of temperatures throughout the enclosure. Inside temperatures should not normally exceed 30º C throughout the whole enclosure. During the colder season heating should provide for an average temperature of 18-20º C. In autumn and spring, when the outside temperatures may just allow free choice access to the outside enclosure (minimal 10º C when rainy and cloudy, minimal 5-6º C when sunny and without wind), the inside temperature can be kept a few degrees lower than normal to reduce the difference in temperature between the inside and the outside.
By providing several doors between each inside enclosure and the neighbouring outside enclosure(s) orang utans are never forced to stay outside by others or involuntarily exposed to extreme temperatures.

If the orang utans are exhibited in an outside enclosure with no access to an inside one, one has to evaluate the climatological conditions before allowing the orang utans to go outside. Rainy, windy, cloudy days and temperatures under 13ºC are conditions under which orang utans should not remain outside for a long period of time.

iv) Humidity

Relative humidity with the recommended temperatures during the colder season can range between 50% and 80%. A deep bedding of fir bark helps to increase and stabilise the humidity. Sprinkler systems can be used to keep the deep bedding moist and raise the air humidity.

v) Ventilation

Sufficient ventilation of the inside facility is important to keep the summer temperature within limits, remove excess gasses like ammonia, carbon hydroxide, carbon monoxide, and reduce virus infections. Draught, noise and removal of badly needed humidity are negative consequences of ventilation so well balanced ventilation is important with lost humidity being replenished and the airflow diffused in order to minimise any draughts.

2.1.7 Dimensions

Size is only one important aspect of the quality of an enclosure.

In case of orang utans it is very important to highlight that the proper height of the enclosure is an essential requirement. Knowing that in the wild orang utans are living on the higher level of the trees, the higher the inside enclosure the better. Best practice would be for heights to start at 7m in all, but with lower ceilinged separation enclosures. In the last years, there has been a tendency to build large enclosures and the benefits are now being seen in terms of flexibility of management and breeding success.

<u>Examples of best practice sizes:</u>

i) The Realm of the Red Ape exhibit in Chester Zoo, UK

The overall exhibit is 4920m². 72% of the area is allocated for animals and 22% is allocated for visitors. The building is made up of three large, ten metre high indoor enclosures, each covered by a mesh ceiling and with mesh walls allowing the apes full three-dimensional use of the space.

Each indoor enclosure has an area of 145m² and a cubic volume of 1435m³. The keeper area makes up 755m² of ground floor space. Visitors have over 200m of walkway including an external entrance and an exit ramp.

Space allocation in square meters:

use	indoors		outdoors		total exhibit
	accessible	total	accessible	total	
animals	430	460	2,950	3,070	3,530
visitors	400	400	665	665	1,065
others	155	155	170	170	325
total	985	1,015	3,785	3,905	4,920

Due to the size and structure of the enclosures the primates have the opportunity to hide from the visitors whenever they want, although they often spend time interacting with the public. Importantly, the primates also have 24-hour access to their enclosures, meaning that they are not required to retire to a designated sleeping area during the night.

During the day the primates have access to their enclosures by passing through tunnels, giving them space and the choice of where to roam. The open outside enclosures give access to all kinds of natural influences that stimulate exploration behaviour of the orang-utans.

Wide corridors on the ground floor allow safe and easy access for keepers around the exhibit. They contain eighteen over-head tunnels and six slides where the orang-utans and gibbons can pass through, and where the keepers can trap them separately if necessary by using the attached sliding doors. Removable sections of tunnels also can be used to capture and transport the apes.

Three holding areas are also available to separate individuals easily and safely. Each slide includes a simple ratchet system that will only allow the slide to be pulled in one direction for safe operation.

Stairs lead to high platforms above the primate enclosures enabling the keepers to have good access to the animals and to scatter food to encourage more arboreal behaviour. PTZ cameras are situated around each enclosure allowing the keepers to monitor the animals from the staff room.

ii) Orangseum Apenheul Primate Park 1999 The Netherlands

The 4 inside enclosures have a capacity of 1500m3 and are connected to 8 islands (1.000 m2);what gives the animals 10.000 m3 of accessible space. All 4 inside enclosures are connected with each other on 2 levels.

There are 8 separation rooms. 2 for every inside enclosure, but also usable as a corridor. When it is necessary to separate an animal in one of the separation rooms it does not block the circular connections.

24 hydraulical slide doors of which 10 slide doors can be put in a position that the orang utans can operate them themselves. 160 wooden poles are used, each 12 meter in height. 50 fibre glass poles for brachiation. and 600 m2. of hammocks.

Animals have access to the inside enclosures 24 hours a day. Around the whole enclosure visitors can walk around it on a pathway that elevates slowly at the highest point approx. 4 meters above ground level they can enter the inside enclosure where they can see the animals on eye level. The enclosures all have balconies on that level.

2.2 Feeding

2.2.1 Introduction

Apes are known to be selective in their food choices. Being human-like in appearance, zoo professionals fall into the pit fall traps of anthropomorphism, especially with regards to nutrition. Often, diets contain only preferred sweet foods, not because this is best for the animal, but because they like the taste of it. Even if provided with a mixture of foods, naturally the more preferred will be consumed first, often leaving zoo keepers to reduce those less quickly consumed because “they don’t like it” with fear that increasing the “healthier” foods will force anorexia upon an animal. This is never the case however, and animals will only deprive themselves of food long enough to test their keepers willpower. Eventually they will give up and eat the food provided to them and eventually make new favourite healthy foods. Orangutans are frugivorous-folivores, prefering to ingest fruits when they are in season, with leaves, roots, bark, tubers and other plant parts being eaten in larger proportions between fruiting seasons.

This feeding ecology is difficult to replicate in captivity with obesity, diabetes and cardiovascular disease found within the captive population (Cocks 2007, Gresl et al. 2000, Bauer et al. 2011). For this reason, a unified guideline for the EAZA EEP population of orangutans must be maintained if we are to reduce prevalence of nutrition related diseases.

2.2.2 *Ex situ* orang utan diets

Zoo diets differ heavily with up to 50 different food items being fed. A dated review in 1997 identified that overall, captive diets are very low in fibre fractions and high in soluble carbohydrates (Dierenfeld 1997).

Currently within the EEP, average proportions of ingredients are broken down as follows: pellets 7.3%, fruits 27.1%, vegetables 37.4%, greens 24.6%, legumes and grains 2% and animal products 1.4%. Consequently, these diets can contain appropriate amounts of most nutrients with fibre and sugars possible being the most inadequate and more than half of the diets were deficient in protein, vitamin D and calcium. (Charlesworth 2012).

The sampled EEP population was 54% overweight or obese, with males being more prone to obesity than females. There was no association with energy intake and body weight which is strong evidence that food presentation, activity, enclosure use and sociality all impact weight of these animals.

2.2.3 Diet Recommendations

The interpretation of *Pongo* feeding ecology must be made cautiously as these animals are in completely different situations which make them less comparable to captivity. Their energy expenditure is much higher and food resources not assured. They are also under heavy seasonal and reproductive stress which do not occur in EAZA zoos. The energy amounts and food proportions ingested are almost always too high (during fruiting seasons, re-building weight stores) or too low (between fruiting seasons, eating low quality food, living of fat stores). Orangutans in captivity are being fed generally more similarly to a permanent fruiting season, which as mentioned above, may lead to some health consequences. Even using the estimated nutrient intake from the wild will provide different results depending on field site location, which is why these must only be used more as suggestions than guidelines (Appendix X). For this reason, although one diet recommendation my suit orangutans in general, twogeneral guidelines will be required. One for more active, and one for more inactive orangutans. This is expected to suit their individual needs better. Nutrient recommendations and wild feeding observations were combined to create one nutrient recommendation guide (Table 1).

Table 1: Proposed nutrient recommendations of captive orangutans

Crude Protein (%)	12.0-16.0
Crude Fat (%)	2.4-7.2
NDF (%)	30.0+
Ca(%)	0.3-0.6
P(%)	0.2-0.4
Mg(%)	0.07-0.2
Cu (mg/kg)	1.8
Zn(mg/kg)	11-19
Fe(mg/kg)	16-200
Vit A(IU A /g)	5.3-14
Vit D(IU D /g)	0.8-3.3
Vit E (mg/kg)	30-60

2.2.3.1 Foods to include

While most of current diets contain a majorty of fruit, it is suggested that the proportion of fruits in diets be reduced if active or eliminated in less active, and vegetables increased. Increasing the proportion of fibrous, less calorie-dense foods has been shown to improve ape overall health and increase their feeling of satiation (Remis & Dierenfeld, 2004). This can be accomplished by using a low starch primate browser primate pellet, replacing the fruit within the diet by vegetables, increasing browse presentation by offering alfalfa lucerne or silage.

PELLETS Selection of a commercial feed should be based on high plant fibre content (> 25% NDF based on native diet) and low fat (< 7% total fat). Pellets should be given to provide essential nutrients, and not to be used as sources of energy. Pellets are so dense in energy that providing an entire diet in pellets is not conducive to naturalistic feeding patterns. We should aim to feed 30% of energetic requirements as pellets and no more.

VEGETABLES The bulk of the diet should be vegetables. In order to save on costs and provide ample foraging opportunities, vegetables may be grouped into three groups and used interchangeably. The amount of water is so high in vegetables that using vegetables that are local and seasonal and reducing the diversity of food items given in a day, but increasing it over a week will not compromise nutrient intake. Instead this will reduce picky eating, decrease wastage and keep the animals' interested year long. Below are the three vegetable groups used successfully at Paignton Zoo Environmental Park (UK) however other successful combinations are possible.

A Veg	**B Veg**	**C Veg**
Cabbage (any sort)	Broccoli	Swede
Chicory	Cauliflower	Squash (any sort)
Collards	Celery	Pumpkin
Kale	Corn	Sweet potato
Lettuce (any sort)	Cucumber	Turnips
Spring greens	Fennel	Jerusalem artichoke
Spinach	Leeks	Mangels
Swiss chard	Mushrooms	Beetroot
Turnip greens	Okra	Carrots
Asparagus	Peas	Celeriac
Brussel sprouts	Onions	Parsnips
	Peppers	Kohlrabi
	Radishes	Aubergine
	Tomatoes	Potato
	Green beans	
	Broad beans	
	Artichoke	

BROWSE Although difficult to source in some countries during winter, browse is one of the best foods that can be given to Orangutans. This is the best way to provide minerals, vitamins and fibre to the orangutans. When browse is available it should be given in preference to other produce food items, ad libitum.

2.2.3.2 Food not to include

FRUIT The composition of wild fruits is significantly different than the cultivated fruits fed to zoo housed primates (Oftedal and Allen, 1997; Schwitzer and Kaumanns, 2003). The soluble sugars found in cultivated fruits are much higher than that of the wild fruits. There is also a difference in protein and fibre amounts, both being significantly less in cultivated fruit. Sugar, protein and fibre amounts of wild fruit were generally more similar to our cultivated vegetables. Obesity, dental diseases and diabetes are prevalent in the EEP population and a reduction in fruit is believed to help with these health issues (Oftedal and Allen, 1997; Schwitzer and Kaumanns, 2003; Less et al. 2014). Only in groups that are very active and have trouble putting on weight are some fruits then recommended. In all other situations, fruit is unnecessary and perhaps even harmful.

MEAT and DAIRY Orangutans have only been documented eating vertebrate preys on eight different occasions. They obtain most of their protein requirements from leaves and shoots and have a relatively low protein intake and requirements.They do not require to be fed animal parts (chicken, beef, eggs etc.) or derivatives (yogurt, cheese, milk etc.) to ingest their daily protein requirements. The average free-ranging orangutan diet is only 4.9% fat, most of which is from plant sources such as seeds. Animal products are all much higher in fat (and different types of fat) and should not be fed in captivity for this reason as well.

Although they have been reported to consume a variety of insects (up to 10% feeding time in some sites), the overall nutritional impact appears to be quite limited due to their extensive size. For insects to make an actual difference in their nutrition intake, an unsustainable amount of insects would have to be fed. For this reason insects are not recommended as part of the diet however, as part of enrichment they are encouraged. Insects seem to have a higher benefit for allowing the orangutans to express natural feeding behaviours than for a nutritional purpose.

SUPPLEMENTS If a diet is well balanced, there are absolutely no needs for any supplements. Mineral or vitamin supplements must only be given in response to nutrient intake calculations of individuals or from veterinary prescriptions. They must never be given as prophylactics. Instead the diet should be adjusted to treat the possible malnutrition diagnosed.

2.2.3.4 Amount and Composition of Diet

Here we will present two different guides, one for active groups and one for less active groups. There is no clear cut way to identify which group your orang-utans belong to, therefore you must choose whichever sounds more like yours.

ACTIVE GROUP

- Live in an active social group of mixed ages
- Are generally slim or normal, no overweight individuals
- Live in a very large complex enclosure or are free ranging

A general guideline for feeding active orangutans is to aim for a total daily quantity of 5.0 % of ideal body mass (on an as fed basis i.e. fresh food) comprising, 90% plant matter (35% A veg, 20% B veg, 15% C veg, 15% browse, 15% fruit) and no more than 10 % dry high-fibre primate browser pellets. A very small amount of whole seeds/nuts is also recommended if underweight individuals are seen (seeds with shell/husk only). If more pellets are necessary to reach adequate micronutrient concentrations, perhaps it would be wise to seek out a more appropriate pellet. If more browse is available then it should replace A and/or B veg or even given ad libitum if there is little to no food left over.

LESS ACTIVE GROUP

- Live solitary or with one offspring
- Are generally overweight
- Live in standard enclosures

A general guideline for feeding less active orangutans is to aim for a total daily quantity of 4.5 % of ideal body mass (on an as fed basis i.e. fresh food) comprising, 90% plant matter (35% A veg, 25% B veg, 15% C veg, 20% browse) and no more than 10 % dry high-fibre primate browser pellets. If more pellets are necessary to reach adequate micronutrient concentrations, perhaps it would be wise to seek out a more appropriate pellet. If more browse is available then it should replace A and/or B veg or even given ad libitum if there is little to no food left over. The more browse, the better.

2.2.4 Food Presentation

Food should be distributed to maximise foraging and food processing time. At least four feeds per day are recommended. Food items should be dispersed and not chopped up. Whole, large chopped up food can increase total feeding time, allow subordinate individuals to ingest more food and overall reduce wastage. Cutting produce into small pieces does not encourage great apes to spend more time foraging (Hempill & McGrew 1998). The processing of whole vegetables allows orangutans to express its species-typical food processing behaviours such as food handling, peeling, breaking, biting and masctication. A study conducted at Paignton Zoo fed primates either chopped produce or whole produce or measured differences in feeding time for the group and individuals. Feeding time was significantly longer when fed whole vegetables Subordinate individuals also ingested a larger diversity of food items (Plowman et al. 2009).

Although variety is great and a diverse array of produce is recommended to be fed daily, too much variety may allow animals to be too selective and increase wastage. Orangutans ingest on average 6-9 food items per day in the wild (Knott 1998). Similarly no more than 6 different vegetables (1-2 from each veg group) are suggested to be fed daily however a different selection of vegetables can be given later during the week. The veg system allows for a variety of vegetables to be given over a period of time.

2.2.5 Pregnant and Lactating Females

Pregnant females’ will require larger quantities of food than non-pregnant females necessary to support her and her foetus. The actual ratio of ingredients does not need to change as long as the diet is adequate (NRC, 2003). Special attention should be paid to the calcium to phosphorous ratio of the diet and MUST be above 1.2:1. Calcium supplements must be added to the diet if this isn't the case.

During the first trimester, the diet can remain identical before gestation. Although it is normal for their appetites to increase during their first trimester, they will actually be metabolizing more energy and assimilating more nutrients than they normally would from their current diets, rendering giving extra quantities of food unnecessary (Kemnitz et al. 1984). During the third trimester, the total energy of the diet should be increased by 14-20% according to Kemnitz et al. (1984) and the NRC (2003). Most zoos would increase it by 30-50% to be on the safe side.

Lactation is the most energetically expensive state for mammals. The NRC (2003) suggests the increase of another 15% of diet (on top of the lactation diet) increase. The actual diet proportions can be kept constant and the total quantity increased. Some slight and very gradual weight loss during this period is expected and is no cause for concern.

A target weight should be arranged with the veterinarians and if the animal falls to this weight, then diet should be increased again, but lactation can be used as an important tool to help reduce the body fat % of females.

2.2.6 Young Animals

Young orang utans have been known to be fed adult diets after weaning. Diets offered to juveniles would follow the same general category proportions (35% A veg, 25% B veg, 15% C veg, 20% browse and 10% pellets). Adding half of the diet of an adult when a youngster is born will serve two purposes: first, this will go towards the female's lactation costs and eventually become the youngster's diet after being weaned. Its diet can slowly be increased to full adult's amounts. The diet should remain with slightly more pellets in its diet as it matures. Total amounts offered to young orang utans can be increased to approximately 6.5% of total body mass (on an as fed basis). If the BMR and FMR calculation method is preferred, then the BMR must be multiplied by 2 to obtain the FMR (and not 1.25 used for maintaining adults).

2.2.7 Overweight/Obese Animals

Overweight apes are difficult to manage in captivity. Simply reducing overall calories is not an effective method, as their natural adaptations lead them to reduce their overall behaviour when energy is decreased, causing them to remain overweight (see photo). There is no clear cut way to reduce weight off orangutans, however there are many tactics that can be trialled.

- Ensure that the diet given is for the individual's healthy target weight for their age, sex and body frame. Discuss with your veterinarian on this. Providing energy for your 80kg female orangutan will not support any weight loss to a healthy weight. Instead the diet must be given for a healthy weight in increments.

- Increasing activity is the most efficient way to counteract obesity. Being creative with food presentation (making orangutans work daily for their food) such as having food high above and alternating with below.

- Keeping the same amount of food in their diet but reducing overall simple carbohydrates and increase fibre. Although they can digest some fibre, the energy will still be less, yet they will feel full. This means that by giving plenty of leafy and green vegetables and reducing fruits and C veg, the animals will still feel full but ultimately absorb less energy without modifying their behaviour.

2.2.8 Water source

Clean water must always be provided. This can be done by drinking nipples or by a natural or artificial waterfall with a small pool.

Water pools should be made from safe and solid materials, which can be cleaned easily. In addition to wáter ad libetum, it is recommended that an orang utan receives a weak flavoured drink by hand (bottle source) e.g. tea or something similar every morning and evening. This will help when needing to administer oral treatments as of all the apes orang utans in particular can be very distrusting.

2.2.9 **Table 2** Estimated nutrient intake

	Captive Orangutan[1]	Old World Monkey[2]	Captive Orangutan[2]	Humans[2]	Wild Seasonal[3]	Wild not seasonal[4]
Crude Protein (%)	16.3	16.7	14	6	5.3-16	12.6 (7.0-32.5)
Cr ude Fat (%)	5.6				7.2-16.8	4.9 (2.4-11.3)
NDF (%)	15		20		24.1-60.8	31.7 (16.6-52.0)
Ca(%)	0.6	0.56		0.22		
P(%)	0.4	0.44		0.14		
Mg(%)		0.17		0.074		
Cu (mg/kg)				1.8		
Zn(mg/kg)		11		19		
Fe(mg/kg)		200		16		
Vit A(IU A /g)		14		5.3		
Vit D(IU D /g)	3.3	2		0.8		
Vit E (mg/kg)		56		30		
Reference	Jansen & Nijboer 2003	NRC 2007	NRC 2007	NRC 2007	Knott 2001	Harrison 2009

1 Described as nutrient recommendations
2 Described as nutrient requirements
3 An estimated range of intake based on different seasons (from fruiting season to lean season)
4 An estimated average of intake rates with seasonal maximum and minimums in brackets (from fruiting season to leaner season, although there was no significan lean season at this field site)

2.3 Social Structure

2.3.1 Changing Group Structure

Orang utans (Utami Atmoko and Van Hooff, 2002), the only great apes in Asia, are almost exclusively arboreal and are comparatively solitary. Adult individuals spend most of their time and most of their life on their own. As largest and heaviest arboreal mammal species, orang utans are not able to cover large distances in their habitat, but - at the same time - they have to consume large amounts of food. Thus moving in bigger social groups is largely inhibited by resource competition. While not living in social groups, orang utans do have ***a complex social structure***:

i) Social aspects of males

Unlike Chimpanzees and Gorillas, Orang Utans do not live in social groups. They do however have a complex social structure with Sumatran Orang utans being more social than Bornean. Orang utans show a characteristic sexual dimorphism: Fully grown males are about 2 or 2.3 times heavier than adult females. But in addition, the various studies of the last years have reported the existence of two forms of sexually mature males (the so-called male bimaturism): Flanged males and unflanged males.(Utami Atmoko S.S. & van Hooff J.A.R.A.M., 2002) (Dunkel et al, 2013) (see: http://www.frontiersinzoology.com/content/pdf/1742-9994-10-12.pdf)

In the wild, flanged males are mostly solitary, have overlapping territories with home ranges of several females and are sexually active; they do not tolerate other flanged males, but are relatively tolerant towards unflanged males in their home ranges.Unflanged males, contrary to flanged males, are comparatively "social" and tolerant towards other males and do not produce "long calls".It is known, that both unflanged and flanged males are mating at the same rate.

ii) Social aspects of females

It has been demonstrated in experiments with zoo living orang utans that females approach males actively and selectively with regard to the phase of their menstrual cycle. If females are allowed to control the access to the male on their ovulatory phase, the male will beless aggressive when she approaches him and initiates copulations.(Nadler, R.D.,1994).

In the wild, females have a preference for fully adult males and seek the company of these flanged males for sexual consorts, whereas matings with unflanged males take place mostly outside such sexual consorts.

iii) Flexibility

In the future, our orang utan holders and their enclosure systems must provide possibilities and space to accommodate two or more males (flanged and unflanged) and/or to separate the sexes for certain time spans to stimulate sexual behaviour ("fission-fusion system"). This will also help to solve the male surplus problem, for which all holders have a shared responsibility. To enable the "fission-fusion system", the current holding systems for orang utans with only limited potential for variations must change over the next years: Bigger and more flexible orang utan facilities with a variety of inside and outside enclosures with possibilities for separations and new combinations must be constructed in the future. We must move away from the currently common arrangement of only one inside and one outside enclosure for the public and a few sleeping boxes.

iv) Consequences for EEP management, care & enclosure design

The fact that the two populations (Sumatran and Bornean) in our zoos lack sufficient growth (Kaumanns, W., Krebs, E., Nogge, G., (2004) could be related to our existing keeping system, that does not reflect the described social structure in the wild, sufficiently. In nearly all of our zoos, males and females (mostly one male and one, two or several females) live together for a large part of their lifetime. We have seen that in the wild, females only seek the company of "flanged males" when seeking a partner for breeding (for some days or weeks) or are mated by "un-flanged males", occasionally. Females should have a choice between different (separated) males and a choice on when to be with that preferred male or when to be separated.

Because of the very low growth rates in both, the Bornean and Sumatran orang utan populations, the EEP and all EEP participants must take immediate action to bring orang utans of both sexes into breeding situations, especially individuals that have never bred (potential founders) or that have not bred successfully.

Females should have a choice between different (separated) males and a choice on when to be with that preferred male or when to be separated.

- keepers can be trained to recognize what females want
- females can be trained to show the keepers what they want
- females can be trained to open doors with special buttons, combined with sensors for their transponders
- females can be shown video images of males and their reaction can be monitored (in this way they could potentially choose their partner from all males in the population).

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Another possibility to enable the "fission-fusion system" is close cooperation between nearby zoos with regular exchange of adult females and/or unflanged males. This practice will combine individuals that are familiar with each other in specific time intervals and will help to reduce paper work and necessary permits from Veterinary or Cites authorities.

"Youngster groups" of juveniles and subadults in some zoos may help to let the individuals learn further social skills (after the first years of life in the company of their mothers) that are essential for the later social (sexual) life. Younger females should only be removed from their mothers and/or the existing group after having made the experience of a birth and the growing up of younger conspecifics.

Older individuals of such "youngster groups" may be transferred into breeding situations. This will enable other young individuals from other zoos to join the "youngster groups" to develop social skills on her part and to be adapted to transport situations with stress, at the same time.

We probably still do not understand the probably important role of dominant or sub-dominant zoo keepers in our ape facilities in their possible role as flanged or unflanged males in the orang utan´s social system. For example it is well known that so-called "subadult" males ('unflanged') immediately started to develop secondary sexual characteristics after the departure of a dominant (flanged ?) zookeeper or a transfer into another holding system. And it is known, too, that orang utan females sometimes seek the presence of dominant ('flanged') zookeepers during their ovulatory phase (while presenting their genitals at the fences of their inside cages).

More experiences are required with male groups (bachelor groups) to solve the temporary problem of surplus males. However, the depression of the development of secondary sexual characteristics in such parings/groupings may only reflect the natural system of the two alternative strategies "Flanged-unflanged males". The experiences of some holders that tried to house male groups during the last years are not of great help. More complex facilities are needed to undertake long-term research on the development and social welfare of different males (flanged and unflanged) inside such groups.

This new policy in the OU EEP and revised opinions on facility construction would:

- enable a faster growing of the two zoo populations
- allow a better imitating of the natural social system and sexual strategies from the wild in our zoos
- solve the “problem of temporarily surplus males” (and/or females) in our zoos
- improve the (psychological) wellbeing of orang utans in captivity

2.3.2 Mixed species exhibits

There is an increased tendency to house other species together with orang utans. It enriches the environment of both species and often provides at least one of the species with a much larger area than would be the case when housed separately. Even when housed together outside with great success, it might be difficult to combine the species’ in the generally smaller inside facilities. The use of selective passages, either to parts of the enclosure or to neighbouring enclosures, could improve the chances to successfully house several species together. When designing a new facility it seems wise to leave both options open: housing the species separately or combined in the inside accommodation. Colombo A.(2011); Lester B.(2002); Cocks L.(2004)

2.4 Breeding

2.4.1 Mating

Like in the wild, males and females may take the initiative to copulate in the captive situation, and in zoos many different mating positions have been noticed. Mating might even occur between males and females in adjoining enclosures when only separated by bars/mesh or by sliding doors that are not totally closed.

Males chasing females around before a copulation takes place, is quite common; in these cases serious aggression (biting, bleeding wounds) is normally not part of this ritual behaviour. Also forced copulation can occur in the captive situation, by flanged as well as as non-flanged males. Forced copulations by flanged males are thought to be more common in zoos than in the wild. It has been suggested that this is the result of the captive environment, where a female might have more difficulties to escape a male’s avances even if she would like to. However, some ‘rapes’ by flanged males might be misinterpreted regular copulations after a chase. Female orang-utans don’t have mating calls like some other primates do, and as the females act rather passively once a copulation has started (eg often no eye-contact, often no active movements), it might be difficult in some instances to interprete whether a flanged maled forces a female into a copulation or not.

2.4.2 Pregnancy

Pregnancy duration is mainly known from data in zoos. Average pregnancy duration in orangutans is 240 days, with a variation in 19 cases between 223 and 261 days (Markham, 1990).

During early pregnancy it is not uncommon to notice symptoms like abnormal fatique and lack of appetite in pregnant individuals. Pregnancy can be confirmed using human pregnancy tests (see 3.2.4 Veterinary). However, from all non-human great apes hormone levels in urine of pregnant orangutans ressemble the level of humans the least. Therefore tests may fail to indicate pregnancy correctly during a certain period of pregnancy, it might be wise to retest after a while to exclude false-negative test results.

2.4.3 Contraception

See 2.3.5 Veterinary

2.4.4 Birth

Like in the wild, births most often occur during the night. Birth weight is between 1.5 and 2.3 kilograms. Thus newborns are relatively small compared to an adult female and delivery normally proceeds smoothly without dramatic blood loss. After keepers notice labour in a bearing female, the birth process can be finished in as little as half an hour, but usually within a couple of hours.

There are huge individual differences in how a delivering females deals with the placenta and the umbilingual chord. In some cases, the mother bites through the umbilingual chord, in other cases, she carries around the infant supported in one hand and the placenta with the chord attached in the other hand. The placenta can be ignored, sniffed or licked on, partly eaten or fully eaten.

Without the need to follow travelling group members like other great apes females face after giving birth, wild orangutan females often stay in or very nearby the nests they delivered in for two or three days. Also in zoos, after a delivery females often prefer to rest a lot and move little for couple of days.

Different strategies have been used in the past on whether to separate a highly pregnant female from the breeding male and/of other individuals of not, with different results. Males may get sexually aroused by the process of giving birth, probably by the smell, and consequently haress females in labour. On the other handside, there is anectotal evidence of a breeding male assisting the delivering female actively during the birth process.

Presence of unrelated females results in high cortisol levels and thus stress in female orangutans. Shortly after a delivery, mothers with a subdominant character might be less able to keep distance and avoid more dominant females the way they would like too, therefore it is not advised to keep delivering females in a larger group with unrelated females during giving birth and the days after.

2.4.5 Development & Care of Young

In the safe environment of zoological gardens, some infants might be treated by their mothers with a bit less caution than they would be in the wild; depending as well on character, mothering style and maternal experience of the dam. The female might leave an older infant changing the different compartments of the enclosure, clearly expecting her infant to follow independently.

At the end of the infancy (that is at the age of 2.5 years) one can still expect a percentage of body contact in captivity between infant and mother of between 11% and 33% of the daytime. Another 11% to 24% of time is spent within arm reach of the mother (Melicharek, 2001). In almost all mother-infant-pairs it is in this stage of development at the edge from infancy to juvenility the offspring initiating body contact in the majority of cases, and also the offspring that stops body contact in the majority of cases. To say in other words, it is mainly the infant initiating contact with the mother. This trends gets more and more clear within the third year of life (Melicharek, 2001).

Contact with the father

In the wild the father (nor any other adult male) does not play any role in the experience word of a youngster. As long as the adult female is not cycling again it is rather unlikely that she will spend time with a flanged male. In zoos, management often chooses to rejoin the sire to a mother-infant-couple several days or weeks after birth. In literature, some social negative reactions of sires towards infants are known

(Cocks, 1998). Therefore for example Cocks (1998) advises to separate a male at least for first six months after birth. However, in most cases the sires stay rather uninterested in the newborn offspring, while labour in the female might cause sexual arousal in a male.

Research in two to three year old infants show that at this later stage, the father as well as unrelated adult males can be very welcome playmates for youngsters for joined object play and rough-and-tumble-play. Even carrying of an older infant appropriate way by an adult male can occur. The intensity of the male-infant contact varies a lot depending on individual animals (Melicharek, 2001).

2.4.6 Hand-rearing & Foster-rearing

See Vet chapter 2.7.11

2.4.7 Population Management

In spring 2016, an EAZA Quick Population Assessment (QPA) was provided by Elmar Fienieg (EPMAG Assessor) for both populations. These QPAs used simple, but effective demographic and genetic analyses to provide overviews of the current status of both populations, based on the most current database available at that time (data 2015).

According to both analyses, the average annual birth rates in the last years were 7 births per year for the Borneans and 5 for the Sumatrans, while an average of 9 births per year. 8 for the Sumatrans are expected to be necessary to maintain population size. Based on these information, one would expect population sizes to slightly decrease in the coming years. This clearly indicates to be very careful in using methods for contraception. Simultaneously, we have problems to place (temporarily) surplus male individuals in a timely manner.

New enclosure types and possibilities to enable the “fission-fusion system” in our zoos (see above) will also help to solve this present "male surplus problem", for which all holders have a shared responsibility. These different facts and estimations for the stability and growing of the populations in the future should be carefully compared and observed.

In April 2018, a workshop was hosted by Karlsruhe Zoo, Germany during which an EAZA Long Term Management Plan covering both species was drafted. This will be published within the next 12 months in conjunction with an Orangutan EEP Annual Management Plan.

2.5 Keeper Care & Behavioural Enrichment

2.5.1 Keeper Time

Based on the fact that orang utans are diurnal in the wild and therefore ordinarily will only be awake during the day time (~12 hours), at least one keeper should be in attendance for no less than 8 hours per day (to include observation, feeding and provision of enrichment) with each animal being checked every hour. Time dedicated to training for veterinary procedures is strongly recommended.

If the orang utans are restricted to sleeping dens only at night i.e. without access to a main exhibit area, then this period should not exceed 12 hours. Individuals that are being kept separated in smaller quarters for treatment, or other reasons, should receive more attention accordingly.

There should be at least two main feedings (morning and afternoon) and at least 3 smaller feedings in between (browse, enrichment devices).

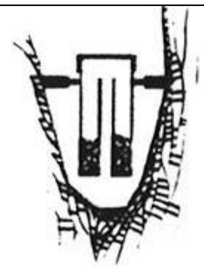
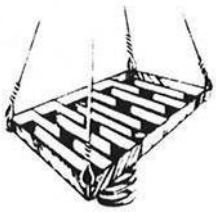
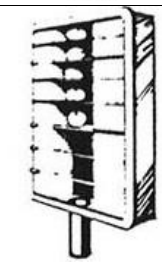
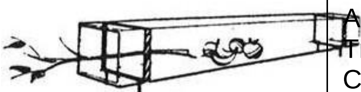
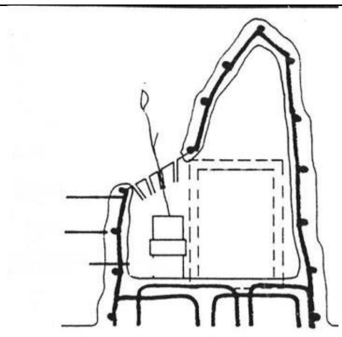
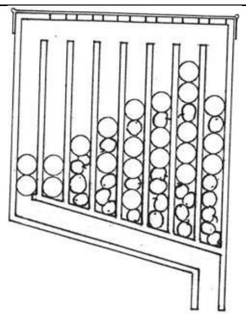
Access to the outside enclosure should be given as much as possible, if weather allows.

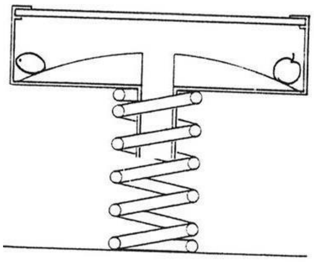
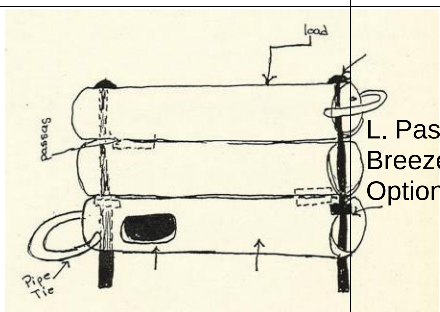
2.5.2 Behavioural Enrichment

There are five basic enrichment categories: Social, cognitive, physical habitat, sensory and food.

The following table shows examples of devices that have been used by orang utans and other apes.

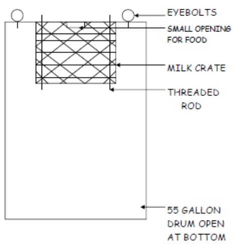
No.	Enrichment Method	Detailed Method	Use	Picture	Source
1.	The Ape Drum	Hollow tree trunk with a drumhead made of thin iron plate	Sensory enrichment [1]		Tekno-Zoo. Lars Lunding Andersen. Copenhagen Zoo. Trends for the future, Copenhagen Zoo. October 12-17, 1987.
2.	The Raisin Blocks	Holes in blocks are stuffed with raisins. Primates must use thin sticks to get them.	Food enrichment		Tekno-Zoo. Lars Lunding Andersen. Copenhagen Zoo. Trends for the future, Copenhagen Zoo. October 12-17, 1987.

3.	The Sunflower Castor	Whenever the primate turns the castor sunflower seeds are coming out.	Food enrichment		Tekno-Zoo. Lars Lunding Andersen. Copenhagen Zoo. Trends for the future, Copenhagen Zoo. October 12-17, 1987.
4.	The Nut Maze	By turning the maze, nuts are coming out.	Food enrichment	No image available at present	Tekno-Zoo. Lars Lunding Andersen. Copenhagen Zoo. Trends for the future, Copenhagen Zoo. October 12-17, 1987.
5.	The Shaking Table	By shaking the table, grain is sprinkling out of the holes.	Food enrichment		Tekno-Zoo. Lars Lunding Andersen. Copenhagen Zoo. Trends for the future, Copenhagen Zoo. October 12-17,1987.
6.	The Fruit Automat	By shooting the plates between the layers to the side, fruits are coming out.	Food enrichment		Tekno-Zoo. Lars Lunding Andersen. Copenhagen Zoo. Trends for the future, Copenhagen Zoo. October 12-17, 1987.
7.	The hollow Tree Trunk	By using branches the fruits inside the trunk can be caught.	Food enrichment		Tekno-Zoo. Lars Lunding Andersen. Copenhagen Zoo. Trends for the future, Copenhagen Zoo. October 12-17, 1987.
8.	The Termite Mound	Mound constructed with cement. With sticks the animal has to fetch the food inside it.	Food enrichment		1. J.A.Turner. The Shape of Enrichment. Vol 4. No 3. Aug 1995 2. Tekno-Zoo. Lars Lunding Andersen. Copenhagen Zoo. Trends for the future, Copenhagen Zoo. October 12-17, 1987.
9.	The fruit organ	Filled with fruits and hard plastic balls. By poking with a branch, fruits can be gained.	Food enrichment		Tekno-Zoo. Lars Lunding Andersen. Copenhagen Zoo. Trends for the future, Copenhagen Zoo. October 12-17, 1987.

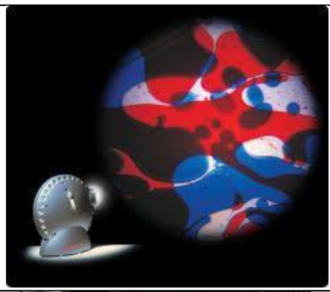
10.	The tilting table	To get the food, the primate has to tilt the table.	Food enrichment		Tekno-Zoo. Lars Lunding Andersen. Copenhagen Zoo. Trends for the future, Copenhagen Zoo. October 12-17, 1987.
11.	Monkey Cake	2 eggs, 2 cups oatmeal, ½ cup honey, ½ cup whole wheat flour, 1 ¼ cup fruit juice, 2 apples. Microwave for 20min.	Food enrichment	No image available at present	The Shape of Enrichment. Vol. 11, No 3. 3. Aug. 2002. S. Nice. Cookbook for Enrichment.
12.	Humus	2 cans chick peas, parsley, garlic, green onion, lemon juice. Blend it.	Food enrichment	No image available at present	The Shape of Enrichment. Vol. 11, No 3. 3. Aug. 2002. A. Seyfried. Cookbook for Enrichment.
13.	Warm Juice	Warm fruit juices (sweet potato, apple, orange). Seasoned with honey or cinnamon.	Food enrichment	No image available at present	The Shape of Enrichment. Vol. 11, No 3. 3. Aug. 2002. H. Fisher. Cookbook for Enrichment.
14.	Coconut Halves	Half of cleaned coconut, put a hole in it and attach it to a branch.	Food enrichment	No image available at present	The Shape of Enrichment. Vol. 4, No. 3, Aug 1995. M. Muniz. Primates and Coconut Halves.
15.	PVC Pipe Puzzle	3 attached PVC pipes with holes in them. To get to the food, the ape has to move it with its fingers or with sticks.	Food enrichment		L. Pastorello. The Zoo, Gulf Breeze, FL. Enrichment Options.
16.	Automatic Food Device	Box, which only opens to specific times.	Food enrichment	No image available at present	Rotterdam Zoo
17.	Herb Garden	Several of herbs planted under a metal bar. Therefore the ape gets some leaves but not the whole plant.	Food enrichment	No image available at present	Zoo Duisburg

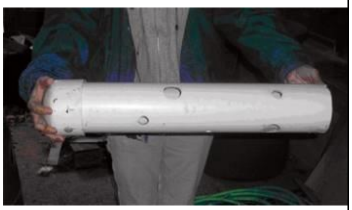
18.	Jungle Gym	Structure with lots of strings connecting platforms.	Physical Habitat enrichment		1. Zoo d'Amnéville 2. Picture: http://www.zoobesuche.at/wordpress/wp-content/uploads/2010/09/aussenanlage_orangs_4aept10.jpg
19.	Computer-Joystick Enrichment	A computer–joystick system, designed to increase in complexity with learning, as a potential form of enrichment.	Cognitive enrichment	No image available at present	Computer-assisted enrichment for zoo-housed orangutans (Pongo pygmaeus). Tarou, LR; Kuhar, CW; Adcock, D; Bloomsmith, MA; Maple, TL. Animal Welfare, Volume 13, Number 4, November 2004, pp. 445-453(9)
20.	Touch screen	A computer-controlled touchscreen apparatus: Zoo Atlanta Allows cognitive research to take place on exhibit.	Cognitive enrichment		Technology at the Zoo: The Influence of a Touchscreen Computer on Orangutans and Zoo Visitors Bonnie M. Perdue, Andrea W. Clay, Diann E. Gaalema, Terry L. Maple, and Tara S. Stoinski. Zoo Biol 31:27–39, 2012.
21.	Jute sack	Small packages out of jute. Tied up by cord or sewing.	Food enrichment	No image available at present	Tierbeschäftigung im Pongoland. S. Schorr. Zoo Leipzig.
22.	Paper bundle	Around pellets paper is glowed with flour paste.	Food enrichment	No image available at present	Tierbeschäftigung im Pongoland. S. Schorr. Zoo Leipzig.
23.	Pinatas	Fully blown air ballon taped with paper (glue: flour paste or flour and water mix). After drying, fill paper ball with food.	Food enrichment		Tierbeschäftigung im Pongoland. S. Schorr. Zoo Leipzig. Picture: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Pinatas/Pinata
24.	Pulp	Flour paste, tomato, honey, grey glued to banana leaves.	Food enrichment	No image available at present	Tierbeschäftigung im Pongoland. S. Schorr. Zoo Leipzig.

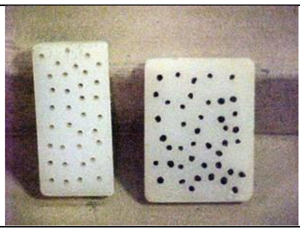
25.	Ice food	Freeze fruits/vegetables. Ice juice. Ice with stick, to handle food without getting hands sticky.	Food enrichment		Tierbeschäftigung im Pongoland. S. Schorr. Zoo Leipzig. (picture Zoo Zurich)
26.	Freezed foliage	Freeze leaves (for winter time)	Food enrichment	No image available at present	Tierbeschäftigung im Pongoland. S. Schorr. Zoo Leipzig.
27.	Turn table	Several layers above another with holes in them.	Food enrichment	No image available at present	Tierbeschäftigung im Pongoland. S. Schorr. Zoo Leipzig.
28.	Jute ,brown paper, bamboo ,wood wool, t-shirt	Let the apes handle these objects without any further explanation.	Sensory enrichment	No image available at present	Tierbeschäftigung im Pongoland. S. Schorr. Zoo Leipzig.
29.	MPW Device	Device where the ape has to open the box either with a stick by dipping or by probing into holes.	Food enrichment		Stephan Lehner. 14.10.2008. Universität Zürich.
30.	Browse	Non-toxic browses for nest-building, tool use, play item and as food.	Food enrichment		Katrina McCauley/Jane McEvoy – Columbus Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Browse
31.	Cheerio Twist	Long tube with several layers containing holes. Twisting, shaking leads to food.	Food enrichment		Jodi Carrigan - Zoo Atlanta: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Cheerio-Twist

32.	Hammock	Hammock out of different material. (Hammocks can be purchased at: Cosner Manufacturing Company)	Physical habitat enrichment		Cheyenne Mountain Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Cheyenne-Mountain-Zoo
33.	Tub	Object made of fabric.	Sensory enrichment/ physical habitat enrichment		Cheyenne Mountain Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Cheyenne-Mountain-Zoo
34.	Painting	Brush, canvas and non-toxic color for painting.	Cognitive enrichment/ Sensory enrichment		Cheyenne Mountain Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Cheyenne-Mountain-Zoo
35.	Moving platform	Platform out of several tree logs, fixed above ground.	Physical habitat enrichment		Cheyenne Mountain Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Cheyenne-Mountain-Zoo
36.	Enclosure furniture	Different natural/ non-natural looking objects as a bank made of wooden board or a chair.	Physical habitat enrichment		Danielle Fogarty - Brookield Zoo/Chicago Zoological Society : http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Enclosure-Furniture
37.	The Down Under	Made of a barrel with one open end. On the other side there is food hidden.	Food enrichment	 	Jodi Carrigan, Zoo Atlanta: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Down-Under

38.	Blue barrel	A gallon fitted with shelves and had 6 cm holes drilled into it. The barrel was closed at both ends and hung in the indoor exhibit from a chain.	Food enrichment		Katrina McCauley/Jane McEvoy – Columbus Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Feeder-Box---Barrel
39.	Wooden feeder box	The wooden box has four shelves with holes drilled in the bottom at random so that the food or treats don't fall straight out. There are also holes drilled in the sides of the box to encourage tool use.	Food enrichment		Katrina McCauley/Jane McEvoy – Columbus Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Feeder-Box---Barrel
40.	Food trough	Metallic trough in front of enclosure so that ape has to reach through grid to get to food.	Food and sensory enrichment		Danielle Fogarty- Brookfield Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Food-Trough
41.	Forage Board	Purchased board with holes inside. Hung outside the enclosure.	Food enrichment		Danielle Fogarty – Chicago Zoological Society/Brookfield Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Forage-Board
42.	Hanging Forage Ball	Hard plastic ball with drilled holes in it. Small holes that raisins can't fall out.	Food enrichment		Danielle Fogarty - Chicago Zoological Society/Brookfield Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Hanging-Forage-Ball

43.	Hose Hook-Up	Hose for water enrichment. Can be hooked in outside enclosure. For detailed description see homepage.	Sensory enrichment		Danielle Fogarty – Chicago Zoological Society/Brookfield Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Hose-Hook-Up
44.	Jell-o Boards and Balls	Each device is filled with Jell-o and then allowed to set in refrigerator. Board is made of lexan material or a thick cutting board can be used. Shallow holes of varying sizes are drilled out on 1 side. A small or medium sized hard plastic jolly ball is used with 1 small hole drilled.	Food enrichment		Danielle Fogarty – Chicago Zoological Society/Brookfield Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Jello-Boards---Balls
45.	Juicer	Offer juice from a pipe outside the enslocure. Ape has to get to juice via absorbent fabric.	Food enrichment		Danielle Fogarty – Brookfield Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Juicer
46.	Liquid Light Projector	Projector displays several visual pictures on the wall. Projector can be purchased.	Sensory enrichment		Jodi Carrigan – Zoo Atlanta: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Liquid-Light-Projector Picture:www.mathmos.com
47.	Nuts and Bolts Toy	Wire out of bolts, nuts. Secured at the mesh of enclosure.	Cognitive and Sensory enrichment		Jodi Carrigan – Zoo Atlanta: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Nuts---Bolts-Toy

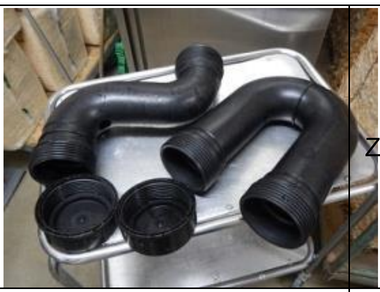
48.	Open Hanging Ball	Half of a hard plastic ball attached outside to the enclosure in hanging position. Fill half with food.	Food enrichment		Danielle Fogarty – Chicago Zoological Society/Brookfield Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Open-Hanging-Ball
49.	Paint Roller Feeder		Food enrichment		Jodi Carrigan - Zoo Atlanta: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Paint-Roller-Feeder
50.	Pump Plunge Feeder		Food enrichment		Jodi Carrigan - Zoo Atlanta: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Pump-Feeder
51.	Puzzle Feeder	Table-sized device outside the enclosure. Various holes, openings for food. Resemble to a marble game for kids. For details check website.	Food enrichment		Matthew Owens, Brookfield Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Puzzle-Feeder
52.	PVC Feeder Tube	PVC pipe with caps on each end and random drilled holes. Secured by bolts.	Food enrichment		Katrina McCauley/Jane McEvoy – Columbus Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/PVC-Feeder-Tube
53.	Puzzle Paradise	Metallic box including several different puzzle plates for food enrichment.	Food enrichment		Sally Singleton- El Paso Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Puzzle-Paradise

54.	PVC Forage Tubes	Needed: Plastic wood plate, 2 U-bolts, 2 PVC coupling pieces, 2 PCV tubes	Food enrichment		Danielle Fogarty- Brookfield Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/PVC-Forage-Tubes
55.	Raisin Boards	Lexan board with small holes drilled in. Put some raisins inside and freeze it over night.	Food enrichment		Jodi Carrigan- Zoo Atlanta: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Raisin-Boards
56.	Wheel Barrow Top	Plastic object which replace arboreal nesting. Needed: Wheel barrow top, fire hose. Stainless chains, padlocks.	Physical Habitat enrichment		Danielle Fogarty- Brookfield Zoo: http://www.czs.org/czs/Animal-Care/Animal-Husbandry/Orangutan-Husbandry-Manual/Enrichment-Catalog/Wheel-Barrow-Top
57.	Meshed food box	‘caged’ food, box can be hung up	Food enrichment		Gorilla section Melbourne Zoo
58.	‘Cascade’ food dispenser	Food has to be moved from level to level	Food enrichment		Gorilla section Melbourne Zoo
59.	PVC-tube	The food has to be worked to the ends of the PVC-tube with the help of tools	Food enrichment	 	Zoo Zurich

60.	Raisin log	Holes in blocks are stuffed with raisins. Primates must use thin sticks to get them.	Food enrichment		Zoo Zurich
61.	Bath	A temporary offer of a basin with water	Physical Habitat enrichment		Zoo Zurich
62.	Tube	The food has to be worked to the ends of the tube with the help of tools	Food enrichment		Zoo Duisburg
63.		Blank newspaper paper as nesting material	Physical Habitat enrichment		Zoo Zurich
64.		Bottle with an attractive liquid	Food enrichment, tool use	 	Zoo Zurich

65.		Feeder: Access to food made difficult through fence and integrated golf balls	Food enrichment		Zoo Zurich
66.		Rat trap, throwing seeds or pellets into the enclosure when touched with a stick	Food enrichment	 	Zoo Zurich
67.	'Shanking box'	Hanging box with a transparent bottom to be moved with a stick	Food enrichment		Zoo Zurich
68.	Pipe with slit	PVC pipe with a slit and an enlarged opening, filled with nuts, pellets,…. Animal needs a stick to move the items out	Food enrichment	 	Zoo Zurich

69.	Rotatable log	Not centrically fixed logs with a drilled hole on top, have to be turned with the help of a stick	Food enrichment	 	Zoo Zurich
70.	Multi-level cylinder	Multi-level acrylic glass cylinder with a hole on each level; the food has to be worked down from top to bottom through swinging the cylinder	Food enrichment		Zoo Zurich
71.		Different objects hanging outside of the enclosure containing food, accessed by a stick	Food enrichment		Zoo Zurich
72.	'Egg'	'Eggs', made of plumbing material, threaded cover fixed with a hexagon socket screw. Filed with grains and pellets	Food enrichment		Zoo Zurich
73.	PVC Feeder Tube	PVC pipe with caps on each end and some drilled holes, threaded cover fixed with a hexagon socket screw.	Food enrichment		Zoo Zurich

74.	PVC Feeder Tube	PVC pipe with caps on each end and some drilled holes, threaded cover fixed with a hexagon socket screw.	Food enrichment		Zoo Zurich
75.		Hard plastic balls with openings of different sizes (even so small, that the content has to be crushed with a tool to get access of it)	Food enrichment		Zoo Zurich
76.	Rotatable 'labyrinth'	Wooden 'labyrinth', covered by acrylic glass. Opening for filling on the backside	Food enrichment		Zoo Zurich

2.6 Identification & Handling

For the purpose of medical examination or treatment, or for transport there are various ways to capture an orang utan.

2.6.1 Individual identification and sexing

Experienced staff can distinguish between individuals either by their general physical demeanour or facial recognition, but this can naturally change over time especially once males begin to mature. It is therefore recommended that all orang utans are micro-chipped at an early age (3-4 years of age?) before they become indistinguishable from conspecifics of the same age and sex, or earlier if anaesthesia is necessary for another reason.

Sexing of orang utans is not difficult. That said experienced mothers will keep new borns close to them so unless the baby has to be removed for some reason e.g. urgent treatment or for handrearing, it may take a sharp eye to ascertain its sex within the first few days. As with most primates, the gap between the vulva and anus in females is much closer that that of the penile opening and anus in males (See right below). The penis, albeit surpising small for an ape of this size, is quite obvious, especially when urinating (see left below). The testes, although not in a hanging scrotal sac as in chimpanzees are also generally visible from a young age.


2.6.2 Catching/restraining

Physically restraining an orang utan over the age of 3 years old is impractical.

Primates, especially apes, quickly learn to associate the presence of the veterinarian and anaesthetizing equipment, namely blowpipes and dart guns, with the unpleasant experience of being anaesthetized. Since the advent of operant conditioning in recent years, training for hand injections is by far the less stressful method and results in a smoother induction and recovery.

If darting equipment has to be used it is important that there are no hiding places in the room or bedding materials that can be used as a shield. Regardles of method it must be ensured that the orang utan cannot climb and possibly fall after being anaesthetized and that there is a soft landing of some sort. An anaesthetized orang utan can be carried by the use of a hammock; a piece of canvas with handles on the edges or with seams in which long poles or tubes can be passed through. Such a hammock can also be used for weighing the orang utan in conjunction with scales.

2.6.3 Crating and transport

A transport-crate for an adult male can be 120cm L x 100cm W x 160cm H and weigh (empty) ~300 kg so it is advisable to incorporate means of lifting by trolley jack and fork-lift. It needs be constructed of robust materials. See IATA Regulations–International Air Transport Association: for crates suitable for adult and young orang utans.

2.6.4 Operant conditioning as management tool

Training an orang utan to step into a transport-crate of its own free will is the most stress free method of crating. The best way of doing this is by installing the transport-crate, well attached, to a door of a separate holding room, and conditioning the orang utan to get his food, or other training exercise, in the crate. Once the orang utan is fully used to being in the crate, the crate can be closed. Once closed in the crate, the orang utan should be let out before it gets anxious whereupon it will be more likely to repeat the exercise. One disadvantage of this method is that it requires the individual concerned to be separated from his conspecifics for some time which can cause stress, so short training sessions are usually best. Conditioning an orang utan to the crate should be planned well ahead of an intended transport date.

2.6.5 Use of squeeze cages

The internal moveable walls of this type of cage race make it possible to force an animal into a crate positioned on the other side of a slide. Once a orang utan has had the experience of being squeezed, it is not likely to enter the cage again, and can only be forced to do so with additional stressful threats, so it is best used only on the day of a transfer away from the facility if needed. Hand injecting of anaesthetics within the squeeze cage is not recommended as there is the risk of needles snapping as the animal attempts to twist and turn.

2.6.6 Safety

It is inadvisable to put ones hand in the hand of an anaesthetised orang utan especially when lifting as there can still be a reflex action that can make its fingers grip; far better to hold by the wrists/forearms or under the armpits if practicable.

For medical treatment of adult animals it is advised to carry out procedures in the holding facility rather than transferring to a veterinary hospital in case the animal comes out of anaesthesia prematurely.

2.7 Veterinary

2.7.1 General considerations for health & welfare of orang utans

Animals that are in good general health and wellbeing are far less likely to carry or suffer from infectious diseases than those living on impoverished diets or in suboptimal physical or social conditions. Constant attention must therefore be paid to good husbandry practice.

All EEP-approved orangutan collections should have a preventative health programme implemented by the responsible veterinarian

The programme should include:

- good record keeping practice
- bi-annual faecal testing for pathogenic bacteria and parasites
- review of body conditions, exercise and diets
- regular evaluation of a potential vaccination program
- storage of serum and tissue samples
- testing of most common diseases when opportunity arises
- comprehensive post mortem examination
- a preventative health program for employee working with orangutans

Veterinary services are a vital component of excellent animal care practices. The veterinarian should make regular inspections of the animal collection. Animal recordkeeping is an important element of animal care and ensures that information about individual animals and their treatment is always available.

2.7.2 Transfer examination and diagnostic testing recommendations

The transfer of orang-utan between zoos occur due to EEP recommendations to preserve this species. These transfers should be done according to European and country specific legislation and with specific examination and diagnostic testing for determining the health of these orang-utans. If an immobilization is required, it is a chance to adhere as much information as possible.

Minimal preshipment database for orang-utans are:

- Signalment - age, sex, origin, studbook #, ISIS #, transponder
- Anamnesis – Previous medical history (including previous health screens, medical problems, diagnostic test results, treatments, contraception, anesthetic data and diet information)
- Complete physical examination (ophthalmic, otic, dental, lymphatic, cardiovascular, respiratory, abdominal palpation, musculoskeletal, urogenital, neurologic).
- Body weight. Morphometric data if requested by the EEP
- Fecal analysis:
    - Negative parasite screen – direct, flotation and sedimentation of feces for detection of endoparasites

    - Negative fecal culture for enteric pathogens (Salmonella sp., Shigella sp., Campylobacter sp., pathogenic E.coli).
- Tracheallavage for tuberculosis culture
- Blood collection for
    - Hematology, full blood cell count
    - Serum biochemistry panel: including cholesterol, triglycerides, HDL, LDL and VLDL, and protein electrophoresis. Consider adding baseline thyroid testing (free and total T3, free and total T4 and TSH), Vitamin B12 and folate.
    - C reactive protein
    - Serologic testing for: Parainfluenza I, II and III, Influenza A and B, Hepatitis A, B and C, Herpes simplex – contact Veterinary Advisor regarding positive individuals. If screened for other diseases please decide what to do when tests are positive.
    - Serum banking min 2ml and genetic material as recommended
- Thoracic Radiographs in upright position

Additional tests when needed:

- Abdominal radiographs, VD and lateral. Include hip of geriatric individuals to screen for arthritic changes. Oblique views of teeth taken with jaws open to screen for dental pathology is recommended.
- Cardiovascular status (age and history dependend), using electrocardiogram, echocardiogram, and blood pressure measurements

2.7.3 Calming animals for transport

Good preparation is the best way to calm an orangutan for transport. Crate training allows the individual animal to get used to the crate and avoids an additional anesthesia for loading. An experienced keeper who the orangutan trusts, should accompany them on the transport. The keeper can help to calm the animal and the orang is more likely to readjust to new surroundings if a familiar person is present and if their usual routine is maintained.

Medical calming during transport is controversial. A possible option are the use of neuroleptics (see section below). Currently no specific recommendation is made due the unknown site effects especially during flight. Thus a careful individual assessments should be done and decide on individual advantages and disadvantages.

2.7.4 Quarantine

Orangutans entering a collection, irrespective of their origin, should undergo a period of quarantine. The stress of separation and transport can cause immunosuppression and lead to a higher risk of pathogen shedding. Thus, during this period a variety of screening tests should be performed to establish their health status, review their vaccination status, and establish a serum bank if not done before transport. Ideally, quarantine should last for at least 30 days, although, if animals are being transferred between approved institutions within

Europe a shorter period may be adequate. Quarantine facility should be easily cleaned and desinfected, but should fullfil natural animal needs.

The welfare must be taken into consideration. If the facility sending an animal is effectively a “sealed unit” (i.e. no imports within the past year and a clean health record) there may be occasions when a shorter quarantine period is appropriate.

2.7.5 Use of neuroleptics

The use of drugs to treat animal behavioral problems is a relatively new field of veterinary medicine. When using drugs to moderate or change behaviour it is important to realize the limitations of medical therapy. Drug selection should be based upon a careful behavioral assessment and the animal monitored for side effects of the drugs. It should also be noted that many of the drugs that may be used in this area have potential for human abuse and so their prescription and use should be carefully controlled. Drugs alone are unlikely to be successfully in producing long lasting behavioral changes unless they are used in conjunction with a behavioral modification program. Teamwork, therefore, between the veterinarian, the animal keepers and animal behaviorists, trainers and human medical professionals is essential to ensure a successful outcome.

Categories and use of neuroleptics

Neuroleptics, also referred to as antipsychotics in human medicine, include butyrophenones (haloperidol and azaperone), phenothiazines (perphenazine, fluphenazine), thioxanthenes (flupentixol, zuclopenthixol) and substituted benzamides (sulpiride). These drugs cause a range of degrees of sedation, alpha-adrenoceptor blocking activity, extrapyrimidal and antimuscarinic effects (Brearley et al 2001). These drugs generally tranquilise without affecting consciousness or excitement but should not be regarded merely as tranquilisers. In the short term, in humans, they are used to calm disturbed patients whatever the underlying psychopathology.

Newer neuroleptics such as risperidone, also called atypical antipsychotics, may be better tolerated as extrapyramidal symptoms are less frequent (in humans). Antidepressants may also be used to moderate abnormal animal behaviours particularly the selective serotonin re-uptake inhibitors (SSRI) e.g. citalopram and fluoxetine (Prozac) and monoamine oxidase inhibitors (MAOIs) e.g. clomipramine. Interaction between these two groups can complicate the switching from one drug to another; MAOIs are rarely used in human medicine because of the dangers of dietary and drug interactions. Other antidepressants should not be started for two weeks after treatment with MAOIs has stopped (three weeks in the case of clomipramine). Conversely a MAOI should not be started until at least two weeks after anticyclic or related antidepressant (three weeks in the case of clomipramine) has stopped. For this reason the selection of SSRIs or MAOIs for the treatment of zoo animals should be undertaken with great care as the time required to change drugs if one is not working is prolonged which may lead to an exacerbation of the welfare issue for which the drugs are being used.

Drug selection in human medicine is based upon the degree of sedation required and the patient's susceptibility to extrapyramidal effects. This susceptibility is generally unknown when dealing with great apes. Prescribing more that one antipschychotic at a time is not recommended unless under close medical supervision as it may increase the hazard and there is no evidence that side effects are minimized.

Given the lack of data in great apes, it is likely that a number of regimes may be tried before one suitable for the particular patient and condition is found. In particular, care should be taken to selecting the drug regimes in a certain order to avoid potentially dangerous drug interactions. It should therefore be obvious that these drugs should be carefully selected for use in great apes as they do not pose a simple and safe solution to the behavioral management of zoo animals. However when used carefully they can provide an extra tool for managing difficult cases which are unresponsive to behavioral therapy alone.

2.7.6 Precautions with anaesthesia

Training allowing handinjection for anesthestetic induction in orangutans could prevent the excitement of darting. Oral premedication can also reduce the excitement, different protocols are available in the literature.

A major threat of anesthesia arises from an infection of the laryngeal air sac. The air sacculitis can be a life threatening proces due to aspiration of pathological air sac content. Thus it is always important to expect the worse and intubate orang utans immediatly after induction in upright (sitting) position, and not in the easier emergency room style to reduce risk of aspiration. Orangs have narrow, short tracheas and a fleshy pharynx. It is important to choose narrower and shorter tubes than in other species of similar size. It is advisable to check for accidental single bronchial intubation by bagging the animal and listening for bilateral breath sounds and /or using chest radiographs.

Older orangutans as well as animals with a history of cardiovascular disease should be carefully evaluated prior to anesthesia, and carefully monitored during the procedure. In doubt contact the veterinary advisors or the ape heart project for further advice.

Obesity is still frequently observed in captive orangutans and can contribute to fatal acute respiratory distress syndrome during anesthesia. Additional contributing factors are upper airway obstruction (air sac content, regurgitation), laryngospasm frequently seen in orangs, the fleshy pharynx and long palate. Thus proper positioning is essential to ensure patent airways. For longer procedures positive pressure ventilation should be considered.

Animals with pain do not eat and thus will not take the necessary medication postopperatively. Thus analgesia should always be provided initially before surgery and in a multi-modal, pre-emptive manner. Injectable opioids and NSAIDs in addition to local anesthetics will provide significant analgesia, eg. buprenorphine,, meloxicam, or ketoprofen have a good effect without apparent adverse effects. Consider also the recovery time during the animal does not eat. Oral human formulation (eg. ibuprofen, naproxen, tramadol, or meloxicam) can be used for follow-up.

2.7.7 Diseases of concern in orang utans

Viruses

Herpes simplex virus (*herpes hominis)* 1 nor 2 are normally carried by orangutans, thus staff members with acvtive Herpes simplex lesions should not work with orangutans.

Measles can be fatal in orangutans. Thus, vaccination of staff and orangs, depending on enclosure design, should be considered.

The prevalence of asymptomatic hepatitis B virus (HBV) carriers reaches in gibbons around 30% and in orangutans 15%. The non-human primate HBVs is nearly identical to that of human HBVs. It is suspected that cross-transmission of HBV between species can occur.

Parasites

Orangutans seem very susceptible to infection with Strogyloides via colostrum and can get severe disease in young orangutans where you see vomiting and diarrhea resulting in death from pneumonia and peritonitis. Adult orangutans in contrast generally only exhibit intermittent diarrhea. In general preventative measurements including biannual regular screening of native and fixated fecal samples (flotation, sedimentation, Baermann-Wetzel method) and treatment with eg. albendazole or ivermectin is recommended.

Even if those tests are negative and the animal has been treated it might be a carrier of Strongyloides due to hibernating larvae.

Bacteria

Campylobacter, Shigella, Salmonella or Yersinia species can lead to severe diarrhea. Regular screening or in case of disease, fresh samples should be collected using an appropriate transport medium.

Orang utans are also suceptible to tuberculosis and the population should be monitored. Orangutans should be screened with radiographs of the lungs in upright position, culture of material recovered from bronchial washings and gastric lavage.

Upper respiratory tract disease

A significant disease in captive orang-utans are chronic upper respiratory tract disease, such as the common cold, sinusitis, and air sacculitis. It is suspected that repeated chronic upper respiratory tract infection lead to sinusitis and air sacculitis.

During every health check the air sacs should be assessed. In orangutans with chronic upper respiratory tract disease an evaluation of the sinuses should be considered. Functional endoscopic sinus surgery might prevent further disease progress (please contact veterinary advisor).In this context every post mortem examination should include the inspection of sinuses and the air sacs.

Examine the skin over the air sac for signs of fistulae or scars. Note thickness of the skin and presence of fat or muscle overlying the air sac.

1. Incise the air sac through the skin on the anterior aspect.
2. Note color and texture of air sac lining.
3. Note presence or absence of exudate.
4. Note presence or absence of compartmentalization by connective tissue and presence of diverticulae.
5. Note extent of air sacs (eg under clavicle, into axilla, etc.)
6. Identify and describe the opening(s) from the larynx into the air sac (eg. single slit-like opening, paired oval openings etc). Note any exudate.
7. Note the location, size and shape of the opening in the larynx (e.g. from lateral saccules or centrally at the base of the epiglottis). Note length of any connecting channel between larynx and airsac and direction a probe must take to go from inside the larynx to the air sac.

Cultures: Please culture several different sites within the air sacs

Vitmin D supplementation to winter housed orangutans

All apes are susceptible to vitamin D deficiency if they are housed away from natural sunlight. Dietary supplementation via commercial pellets, should be standard. For youngsters that are housed inside for extended periods; whether due to Winter regimes or during introductions consider extra supplementation with oral vitamin D. Vitamin D deficiency has been implicated in issues with the immune system, reproductive systems and heart disease and so should not be merely associated with bone issues. There have been cases of fractures in suckling infants; they can be given oral vitamin D even when not yet eating solids if they can be trained to take oral drops from the staff.

2.7.8. Vaccinations for orang utans

A vaccination program depends on the region, available vaccines, collection and design of enclosures. Under certain circumstances it might be recommended to vaccinate orangutan against tetanus, measles and poliomyelitis and other infectious diseases (refer to veterinary advisor).

Measles: Orang utans are susceptible to measles. Depending on enclosure design vaccination should be considered. Also the vaccination of staff members should be evaluated as a prevenative measurement. In this case a combination vaccination of measles, mumps, rubella (MMR) should be used. Orang utans should be vaccination at the age > 12 months, followed by a booster 6-12 month later and whenever possibel 6 years later. Measles vaccine should not be given at the same time as other vaccines, or to animals with other infections, or to any immuno-suppressed animal, or pregnant animals. Vaccination may cause false negative intradermal TB test.

Tetanus and poliomyelitis have yet to be reported in European orangutan collections and thus are currently not recommended.

In general it is recommended serum samples from vaccinated oranutans should be tested to establish the effectiveness of the vaccine schedules when the opportunity arises.

2.7.9 Guidelines for human personal health

It is essential that all staff members working with orangutans are in good general health and all vaccinations are current. Staff who are immuno-suppressed for any reason (eg. chemotherapy, HIV infection, pregnant) should not be working with orangutans.

Sick staff members should not work with orangutans or prepare food. Especially staff with active herpes simplex lesions, staff with children or other family members suffering under infectious diseases like measles, mumps, chicken pox, scarlet fever, student kissing fever (mononucleosis, EBV) should not work.

All injuries, accidents and illnesses of staff should be recorded. Bites and scratches should be immediately (stop work) thoroughly washed (not scrubbed) and medical attention sought if severe.

If a doctor is consulted about illness in a staff member, he/she must be made aware that the patient's work involves care of orangutans.

2.7.10 Pest control as important preventative health measurement

Many infectious diseases of apes can be carried by invertebrate and vertebrate pest species frequently encountered in and around primate facilities. Specialist advice should be sought to reduce or eliminate such pests, which include ticks, cockroaches, snails, rodents and birds. This can be especially challenging in enclosures with natural vegetation, ponds and moats which may require constant attention in this respect.

Organisms such as Shigella, Salmonella, Campylobacter, Chlamydia, Leptospira, Yersinia and even nematodes such as Angiostrongylus and Capillaria can all be introduced or spread by pest species.

In endemic areas of Echinococcus spp. dogs and foxes might cause serious problems by contaminating outside enclosures, bedding material, material for behavioural enrichment and even food. Deworming these animal living on zoo grounds on a regular basis is essential when exclution is not possible.

2.7.11 Reproduction

Pregnancy Testing

Pregnancy can determined by routine methodology such as radiology and ultrasound. In addition commercial human pregnancy tests (measuring human chorionic gonadoptropin hCG) can be used for pregnancy diagnosis in all apes.

Contraception

All orangutan contraception should be taken under advisement via the responsible EEP coordinator. Please check regular uptodate recommendation from the EAZA Group on Zoo Animal Contraception on http://www.egzac.org.

Hormonal contraception

Human oral contraception are commonly used in orangutans, however some individuals may not swallow the pills resulting in contraceptive failure. In addition, it is known that some therapeutics or diseases can reduce the effectiveness of oral contraception. Nevertheless, it is one of the safest and most reliable contraception methods.

Combination pill: Combination birth control pills are NOT recommended during the first year of lactation because the oestrogen can suppress milk production. Combination pill have the advantage that they do not need to be given everyday at the same time, but have the disadvantage of the break and might be forgot to give.

Progestogen-only pill (mini-pill): The mini-pill is recommended for older and lactating animals when necessary because the mini-pill is not associated with thrombosis and heart disease. The mini-pill has no break and must be given every day at approximately same time.
Needle-applied implants (eg Implanon):

Typically placed subcutaneously in the region of the inner forearm. The needle site can be glued closed. Migration can occur and finding the implant for removal might be difficult. The implant can be visualized usually by ultrasound. Application and removal require an anesthesia.

Gonadotropin agonists**:** (GnRH agonists) such as deslorelin can also be used for contraception. Depending on the implant works for 6 to 12 month. It can also be used in males to reduce male, aggressive behavior comparable to castration. There is no experience in orangutans, thus efficiency, reversibility and safety has not been tested yet and should be used with precaution (not recommended).

Medroxyprogesterone acetate: injections and melengesterol acetate (MGA) implants are two common contraceptives used. Melengesterol acetate implants are placed subcutaneously and have an approx. 2 year life span. One potential complication is abscessation of implant site however new recommendations for allowing a longer period after gas sterilization has reduced the number of abscesses. Medroxyprogesterone acetate injections need to be given every 2-3 months at a of dose 5 mg/kg IM.

In summary the preferred method in females are modern human contraceptive pill (if ape will take reliably) or subcutanous implant. In males reversibility remains problemmatic and great caution must be exercised considered in future breeders. Such methods should only be used with the approval of the EEP because reversibility might be difficult and is not warranted.

Surgical contraception

Vasectomy: A scrotal or prescrotal / inguinal approach may be utilized. The scrotal approach is easier; however, the inguinal skin appears to be less sensitive and if the incision is made in this location, great apes appear to less likely traumatize the incision postoperatively. It can be challenging to identify the vas deferens and distinguish it from other structures, thus it is wise to submit the removed reproductive pieces for histologic confirmation. Sperm granulomas have been reported following vasectomy. Ligating or hemoclipping the vas on both ends should minimize the risk of granuloma formation, but will reduce the successfull reconstruction surgery when needed. Thus the open-ended vasectomy make it more easily reversible. Following vasectomy, males remain fertile for 3-4 weeks.

Castration: Castration is most easily performed through bilateral transverse scrotal incisions. Social implications have to be considered.

Tubal ligation: Tubal ligation is preferred to ovariohysterectomy. If there is any chance that the procedure may need to be reversed in the future, it is best not to remove a section of the oviduct and only apply a clip or ligature to it; however, with this technique there is a greater possibility the procedure will fail and the animal will become pregnant.

Non-breeding females

Hormonal assessment: Non-invasive methods for monitoring and assessing reproductive status have been developed. In general, sex steroid hormone metabolites (estradiol, progesterone) can in urine or feces; both methods are used to monitor gonadal function or pregnancy. Also testosterone metobiltes can be measured to monitor testicular activity in males has been used. Some specilized laboratorios like the German Primate Center have steablished valided methods and baseline data for orangutans.

Generally ovulation occurs mid-cycle and the human ovulation tests will work as well in orangutans. Best is to collect first-voided morning urine if possible twice a day for 3-5 days during mid-cycle.

Fertility treatment for non-ovulating ape females: There have been a few cases of female apes appearing to cycle i.e. staff note signs of oestrus and regular matings without apparantly conceiving. It is importamt to use a sensitive (human) pregnancy test kits on fresh urine, 1-2 time daily from days 12-16 following oestrus, to establish whether in fact the ape is conceiving and losing early pregnancies or not conceving at all.

Likewise (human) ovulation test kits may be used on fresh urine samples throughout the oestrus period (over 3-5 days) to detect ovulation; the lack of ovulation at all is more difficult to definitivelt determine as the short window of time for the test may be missed if the animals are not trained to urinate at least twice a day.

For the avoidance of doubt, blood tests taken shortly after oestrus should allow further investigation of ovarian activity; it is therefore useful to time routine procedures according to the oestrus cycle, if possible, to avoid anesthesia purely for these investigations (unless absolutely necessary).

Hand rearing formula

Hand-rearing is only the last solution and the decission should always be confirmed with the studbook keeper. When faced with hand-rearing an orang it is advisable to solicit information from other institutions that have experience with it (Contact EEP Coordinator).

Bottle fed babies should be hold in orangs physiological position comparable to natural nursing. Human products are commonly used for bottle feeding great apes, the liquid formulation is preferred as the powdered product has been associated with constipation. The low iron formula is generally offered for the first 30 days and then the iron enriched formula is offered. Hypothermic or otherwise compromised offsprings should initially be offered an oral electrolyte solution until stabilized. Feeding volumes should not exceed the estimated gastric capacity of 50 ml/kg at any one feeding. Approximately 15 -20 % of the body weight in formula is offered daily. The number of feedings per day is determined by the age, growth rate, volume intake and health status. Weaning should be slowly by diluting the formula gradually.

2.7.12 The risks of mixed exhibits with orang utans

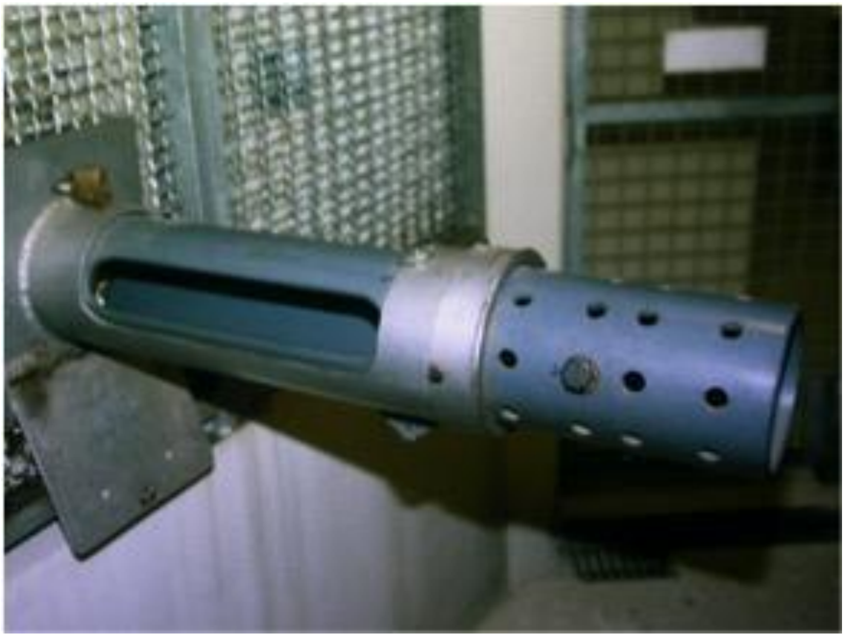
Enclosure design should minimize direct or indirect contact between different primate species, especially between African and Asian species, keepers and visitors. With the increasing popularity of mixed species exhibition new challanges in disease transmission should be considered. Special attention are required to prevent the introduction of pest animals as good as possible.

2.7.13 Use of blood sleeves

The figures show two examples of successfully used blood collection sleeves for Orangutans. Important is the safe access to the animal for blood collection. The two systems differ because some trainers prefer the cheaper mesh design with regular openings while the other has a longitudinal port opening for better access to the veins. Each institution should accept responsibility for the possible risks inherent in their choice of materials and opening sizes.

The superficial brachial vein at or distal to the antecubital fossa or the median antebrachial vein are available for venipuncture. A butterfly-winged collection set is recommended for blood collection to absorb slight movements from the animal. Either a normal syringe or an evacuated tube system can be used for collection. To locate the vein develop a sense of touch and using your eyes.

Under warm conditions veins are more prominent. Use the appropriate size tube with the appropriate sized needle. Fishing for a vein or moving the vein around inside the arm is painful. If the vein is missed, the needle should be withdrawn, replaced and a new venipuncture should be tried.



2.7.14 Guidance on when to euthanase

Prior to any invasive medical or surgical treatment with longterm implications of any great ape the prognosis and longterm welfare of the individual animal must be considered and in doubt discussed with the responsible studbook keeper and veterinary advisor. Advice should take into consideration all aspects of animal welfare and the breeding program.

Euthanasia should be considered as an option where longterm welfare is compromised. This includes besides medical aspects (eg. pain, treatment stress), as well social (eg. isolation, communication), behavioural (eg. climbing, grooming) and breeding (eg. space, genetics) aspects. EAZA euthanasia guidelines should be consulted.

2.7.15 Postmortem examination

In the event of an orangutan death within your collection, please do the following:

1. Ensure a full post-mortem examination is performed (see attachment)
2. Ensure sample collection for all EAZA approved research projects
3. Inform the GATAG vet advisor (send completed postmortem report, studbook keepers and send copies of the results
4. Arrange for all surplus samples to be sent to the EAZA Great Ape Biobank

A thorough post-mortem examination according to postmortem with further diagnostics should be carried out by a competent and experienced pathologist or veterinarian without unnecessary delay. Orangutan anatomical specialities should be known and inspected. Particular care should be taken with oranutans dying in quarantine as these animals must be assumed to be of high zoonotic potential until proven otherwise.

It is important to measure and describe all organs even when they appear normal. If certain bodyparts will not be dissected due to specimen preservation a postmortem CT scan should be carried out to establish references and to find any abnormalities.

After post-mortem examination carcasses should be offered to reputable scientific institutions or museums. However, this must be approved by the veterinary authorities and staff working with this material must be informed about possible zoonotic risks. Even if the cause of death seems obvious a post mortem examination is strongly advised as valuable information about the health of a group of animals can be obtained.

For more information regarding veterinary care for Great Apes refer to the EAZA Veterinary Guidelines Chapter 8. Great apes.

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2.8 Research

2.8.1 Projects

Ape heart disease see website link for all forms and protocols
http://twycrosszoo.org/conservation/research-at-twycross-zoo/current-research/ape-heart-project/)

SECTION THREE

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&

Appendices

3.1 References

3.1.1 Behavioural Ecology & Taxonomy

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3.2 Appendices

3.2.1 EAZA Great Ape Taxon Advisory Group (GATAG) Handrearing Statement

<u>GUIDELINE ON THE HAND-REARING AND EARLY INTEGRATION OF INFANT APES</u>

It is strongly recommended to leave young apes with their mothers whenever possible.

The following circumstances are examples where the welfare of the individuals concerned demands to take some sort of action:

- when a mother gives birth to twins, but cannot cope.
- when social conditions threaten infant survival.
- when a mother is too ill or inexperienced to care for her young.
- when an infant is abandoned by its mother.
- when the baby is too ill or weak to suckle.

Under such circumstances, one or more of the following actions should be considered to bring about natural rearing:

- encouraging the mother vocally.
- separating the mother and baby to give them some peace.
- separating aggressive group members if it helps to calm the mother down.
- a trusted keeper showing the mother what she is supposed to do.
- anaesthetizing the mother and putting the baby in the right position to suckle.
- supplementary feeding with the infant still being with its mother or another female of the same species willing to accept it.
- surrogacy / foster rearing by another ape (maybe at another zoo).

In the event of a potential case of maternal neglect a mother should be given as long as possible (taking due account of the welfare of the baby and drawing upon the experience of colleagues) to try to suckle/rear her offspring. At least 48 hours can usually be allowed to elapse before non-suckling becomes a concern as newborn apes can usually survive at least as long as this without having suckled. The ability to hold the head up, strength of clinging reflex and frequency of crying may give indications of the condition of infant and the degree of urgency to take action in one of the ways mentioned above. Therefore, after the female gives birth, the situation should be watched closely by preferably only one person and at least for the first 3-4 days, especially in the case of a primiparous female or a female who has shown a lack of maternal behaviour before. Care must be taken that the mother/group does not feel disturbed by being watched or by the presence of video camera equipment.

In such situations of potential maternal neglect, it is strongly recommended that institutions contact the EEP coordinator of the ape species concerned or other

experienced colleagues from the species committee to help them find the best solution and decide if hand-rearing is unavoidable and/or if early (re-)introduction or the transfer to a nursery is advisable. In case that an institution does not follow the advice of the EEP, *it must be prepared to keep the animal for the rest of its life.*

An infant's long-term future and the likelihood of successful reintegration should also be taken into account before finally deciding to hand-rear it. Euthanasia should only be considered (if allowed under national laws) after consultation with the owner, the EEP coordinator, the TAG or species vet advisor, the zoo vet, and (depending on the zoo's policy) the vet of the official authority. It is an option where long-term welfare is compromised. This includes besides medical aspects (eg. pain, treatment stress) as well social (eg. isolation), behavioural (eg. inability to climb or groom) and breeding (eg. "bad" genetics, lack of space) aspects. The EAZA euthanasia guidelines should be consulted.

It is better to leave the infant with its mother for as long as the mother is behaving in an acceptable way, to give her more maternal experience.

<u>Guidelines if hand-rearing is decided</u>
If the baby has to be taken away from the mother to save its life, initial care should preferably be given by an experienced keeper and following methods, which have proved to be successful.

The hand-rearing of apes alone or with other species, when there is a possibility to rear them with conspecifics, is to be avoided whenever possible

In the case that there is no realistic prospect for an early socialization / reintegration into a group or when attempts to do so have failed, it is recommended to rear the baby together with conspecifics in an ape nursery. In such a nursery, contact to/socialization with adult conspecifics is desirable to prepare the infant for the integration into a family group.

If an infant is to be transferred to a nursery this should take place before the age of 4 month so that it gets contact with conspecifics as soon as possible.

Early introduction to a group other than the natal group should only be considered if there is no anticipated risk of infanticide.

Early (re-) introduction is only recommended if conditions seem promising.

<u>Conditions which are more likely to result in a successful early introduction include:</u>

- a well-balanced, stable group
- an adult and socially experienced group member that is:
    - willing to take, keep and protect the baby.
    - allowed to do so by the other group members.
    - lactating, or trained to allow bottle-feeding of the baby.

- suitable facilities e.g. an enclosure which:
  - allows visual, auditory and olfactory contact by the baby to the group.
  - offers protected physical contact through wire mesh.
  - has selective sliding doors through which only the infant can pass in order to be fed or to escape from aggression.
- other (preferably mother-reared) infants in the group (whilst being mindful that
- juveniles may be aggressive towards a new infant).
- availability of competent keepers who can maintain the appropriate critical
- distance in keeper/animal relationship during the introduction process i.e. not
- trying to be the "better" mother.

In the case of early introduction / reintroduction of the hand-reared baby to the natal or another group, this must be started as early as possible. Building up a relationship starts with carrying the baby to the group (as soon as its health is stable enough) and making contact through the wire-mesh for the initial months of life.

Such integrations should be finished (i.e. the infant being in the group all day) at 18 months of age. However, full integration may be possible much sooner.

If a collection is experiencing a second case of maternal neglect, then it should consider:

- re-examining the present husbandry management of the ape taxon concerned.
- possible transfers within the EEP in discussion with the relevant EEP species committee.
- preventing the female concerned from being mated / contracepting the female concerned in order to avoid pregnancy i.e. until she has observed a model for maternal behaviour.

If an infant is removed for hand-rearing and later (re-)introduced to a group, the reasons for removing it as well as records of the hand-rearing and (re-)introduction techniques, physical and behavioural development and subsequent breeding of the individuals concerned must be documented and made available.

Produced for EAZA Great Ape TAG by
Neil Bemment, Bengt Holst, Marianne Holtkötter, Jan Vermeer. 1 January 2006

(Reviewed by the Great Ape TAG, 2 July 2018)

3.2.2 Mixed Species Exhibits

The following are historical reports from institutions that have attempted to create mixed species exhibits with orang-utans. It should be noted that the circumstances for individual institutions may have changed since these reports were submitted.

- **Amnéville:**

Family of **Small-clawed otter *(Amblonyx cinera)*** – no problems
0.1 **Siamang *(Hylobates syndactylus)*** – no problems

Report Aug. 2011:

With otters: "All is without problems. The adult orang utan are a little affraid by the otters. The otters can go for a walk calmly near the Orang Utan. Just Putri (6 years old) can play with the otters and the otters like this. During the first year (in 2007 , sometimes Putri catched the otters and put them in a sack and went up in the structure with all the family otters. and we were very afraid because we believed that Putri left to fall the otters but she never made that. She went for a walk in the enclosure with this sack with the otters inside and after she liberated them. When we open the door to go inside. it's the otters that go in and after it's the Orang Utans."

With the Siamangs: "All is without problems, too, for the moment. It's new (two months). In the beginning, we passed the Siamangs in the enclosure of Orangs and then the Orangs hade the choice to go or not with the Siamangs. First, Putri went with the Siamang but after a few minutes , when the Siamangs came very near , she preferred to return to her mother Julitta. Juliitta went outside in secondly and the Siamangs came very near. Julitta chased them away several times. During the introduction of all Orang members , there was no fight. Now all are together outside and inside for the night. Sometimes, the Siamangs give some slaps on the head of Orangs. All Orangs Utans go with the Siamangs because we have two group of Orangs Utans. We know that this is the beginning and we wait the winter when all are inside during few weeks." Delphine Leroux

- **Arnhem:**

0.1 **Siamang *(Hylobates syndactylus)*** – no problems

Report (Febr. 2008):

" We have just one old siamang female 'Finita' with the Orangutans. She is now ca 44 years old and since her partner Mannit died in 1995, she has been living with the Orangutans. Before we had a single male Müllers gibbon 'Dennis' for many years with the Orangutans. Both combinations have been very succesfull. A real enrichment for both sides. Both gibbons have always been very active socially in the orang utan group. Dennis copulating with the females, defending them against our former Orang male

'Geertje', teasing Geertje, stealing food, playing with the young. Finita is still at 44 years playing often with the orangutans, and since Sabatini had this baby she is always within one meter distance. At first she was allways trying to touch the baby. Sabatini responded by patiently and gently pushing Finita's hand away from the baby. In the meantime Finita is allowed to touch the baby. Finita also 'defended' the baby and attacked our Orang male Guru whenever he came too close by for her taste." Tom de Jongh

- 2010: all orang utans send to Sosto Zoo; including 0,1 Siamang … see Sosto.

- **Aywaille:**

1.1 **Lar gibbon** ***(Hylobates lar)*** – no problems
6.0 **Lion-tailed macaque** ***(Macaca silenus)*** – no problems

Report (Aug. 2011):

"We started in 2005 to mix a neutered couple of hylobates lar with our 2.1 Orang utans without problems. The couple of gibbons was very old and they stayed a lot time on the floor. It was not very nice for the public. So we decided to change the mixed exibit with lion-tailed macaque in 2008 (macaques were more active). We received a group of 6 males from Cologne Zoo and we mixed them with the orangs. In the begining, the macaques were very afraid by the orangs and some times, they left the island by swimming. After 2 months, all was ok. Now they can stay near the orangs and sometimes take away the food of the hands of the orangs. For me it's a positive interaction, the old orang are more active like this and didn't stay all the time in the same place to sleep." Jean-Christophe Bertho

- **Berlin:**

1.1 **Siamang** ***(Hylobates syndactylus***) – no problems

Report 2010:

"During a period of one year (2009), an adult Bornean orang utan male was kept together with the gibbons without any problems. "André Schüle

- **Boras:**

1.1 **Lar gibbon** ***(Hylobates lar)*** - problems

Report 2011:

"Before transferring the young male "Benjaming" (born 98) to Aalborg in 2006, we had to separate him and tried to put him in the same outside enclosure with the gibbons during daytime. He spent most of his time on the ground and the gibbons were mostly up in the trees. After two months Benjamin and the gibbon female had a quarrel and the orang utan was bitten in the arm. After that we kept them separated, since Benjamin was due to go to Ålborg. Our own thoughts were that the female gibbon was in heat." Carin Mortensen

- **Chester :**

0.5* Small-clawed otter *(Amblonyx cinerea) – no problems
2.0* and *0.1* White-handed gibbon *(Hylobates lar) – no problems

Report: Aug 2011:

"With the Sumatran orang utans s we have 2.0 Lar gibbons and these interact a lot with the young oranges. They do also tease the adult male but it seems to be good fun for now. We also have 0.5 short clawed otters in the outside enclosure as well with really no interaction from the gibbons and a little from the oranges when they come down to the ground but nothing bad. I think it works really well at Chester due to the social orang group and the fact they have three large insides and two very large outside paddocks and only one of these the otters can go in. For our Borneans we have 0.1 Lar gibbons sharing the same inside and outside enclosure with every one but the adult male who is separated at the moment." Tim Rowlands

- **Dortmund:**

1.1* Malayan tapir *(Tapirus indicus) – no problems
***1.0* Tree shrew (Tupaia glis)** – no problems

Report 2011:

"No problems with the tapirs or the tree shrews"

- **Fuengirola:**

4.2.1* Small-clawed otter *(Amblonyx cinera) – large breeding group; no problems
breeding group of **Siamangs *(Symphalangus syndactylus)*** – problems

Report Aug. 2011:

"At Bioparc Fuengirola we used to keep a breeding group of Siamang together with orangutans. At first, they were together with a bachelor group, and there was not a problem. The siamang moved out of their way and there was no rivalry. It was clear for the siamang that orangs were larger and more powerful. In 2005, we introduced two young female orangutans (both 10 year old), and trouble started. The young orangutans hated the siamang, as they viewed them quite large and powerful, and often chased them away. The females were new in the exhibit and needed to prove their authority. One day they were attacked by the siamang. We could separate them, and it all ended with a few minor bites. So we decided to discontinue this combination and sent the siamang away.

In my humble opinion mixing species, I would rather mix orangs with smaller gibbon species (like Nomascus sp.).” Gonzalo Fernández Hoyo

- **Gran Canaria / Palmitos:**

1.1 **Lar gibbon *(Hylobates lar)*** – no problems

Report 2010:

“Some physical contact with orangs utans … no problems”

- **Gelsenkirchen:**

1.2 **Small-clawed otter *(Amblonyx cinerea*) -** no problems
3.9 **Hanuman langur *(Presbytis entellus)* -** no problems

Report Aug. 2011:

“Since the combination of 1.4 Sumatran Orang Utan plus 1,2 Small clawed otter (*Amblonyx cinerea*) worked well for more than one year, in late April 2011 we introduced a group of 3.9 Hanuman langur (*Presbytis entellus*) additionally. These three species share an inside enclosure of 300m² and more of 10m height. For each species a number of separated "night boxes" exists. Otters and hulmans may retire whenever they want. The Orang utan's night boxes are only opened for the night or for separation purposes, but they have access to outside enclosures, too. Our experience up to now is very good: only on the first two days the youngest orang female tried to chase the hulmans, but the hulmans were too fast. Very soon the hulmans learned that they were always able to escape, the orang-utans representing no danger. Today there are often close and relaxed encounters, and the hulmans spend the whole day in the enclosure without retiring in the separated boxes.

The relationship **otter - orang utan** is totally without any tension, too. Even when the otters often are quite cheeky, pulling the orangs long hairs, the orangs try to ignore them. Both otters and hulmans already visited the orang utan's night boxes when the slider opened. Especially the young hulmans like to play with the otters close to the water. Since every species has its own activity phase, during the whole day there is always some action in the enclosure making it a special highlight for the visitors, too.“
Wolf-Dietrich Gürtler

- **Hamburg:**

Family of **Small-clawed otter *(Amblonyx cinera)*** – no problems

Report 2010: no comments

- **Jersey:**

1.1* Lar gibbon *(Hylobates lar) – no problems

- **Kiryat Motzkin:**

1.1* Buff-cheeked gibbon *(Nomasus gabriellae)

Report Aug. 2011:

"Our experience in keeping apes began in September 2009 with the arrival of two male orangutans (born 1992 and 1989). They are not compatible, that's why each of them kept in a separate enclosure. In March 2010, came eight-year-old male gibbon (*Nomascus gabriellae*), which until October 2010 was kept with male orangutans alternately without any problems with positive interaction. In August 2010 came a female Sumatran orangutan, which housed with one of the males. In October 2010, arrived another, 17-year-old female orangutan and a 13-year-old female gibbon.

A female orangutan joined to the male, while the pair of gibbons joined to the second pair of orangutans. The problems began almost from the first day. The female gibbon orangutan started to attack the female of orangutan, while male orangutan did not even tried to defend her. Therefore, it was decided to combine a female orangutan with another pair of orangutans. Currently, we have kept together three orangutans in one enclosure and a pair of gibbons and the male orangutan in another enclosure. In this case a male orangutan from time to time is a subject to attacks of gibbons and according to recent analysis of hair, is under stress.

The only way of solving the problem - building a new enclosure for gibbons for separate keeping, which now is under construction." Alex Kantorovich

- **Kristiansand:**

1.1* White-handed gibbon *(Hylobates lar) – no problems (2008 and 2009)

Report 2010 :

"We had problems with female orang utan Nele (arrival Aug 2009; born 2006) and the gibbons. They bite her once in the arm" Helene Axelsen

- **La Boissière du Doré:**

Family of **Small-clawed otter *(Amblonyx cinerea*** – no problems
Breeding pair **White-handed gibbon *(Hylobates lar)*** – no problems

Report Aug 2011 :

“From my side we have a family group of Orangs with a breeding pair of White-handed Gibbons and 3 Small-clawed Otters and all is doing very very well. The young Orangs are playing during hours and hours with the gibbons and the otters are a very good enrichment.” Sébastien Laurent

- **Las Aguilas / Jungle Park:**

1.1 **Müller´s Gibbon *(Hylobates lar muelleri*)** - in general: no problems

Report Aug 2011:

“Orangutan males came to Jungle in 2000 and 2001, in 2003 a couple of Hylobates muelleri arrived to the zoo. I started working in the zoo in 2005 and since my time here we never had problems between the animals till 2009. The pair of gibbons gave birth in 2004 to a lovely male, the gibbon grew up with the orang-utans, and the orang-utans got used to him and the gibbon family that increased after that without apparently any problems.

One of our orang-utan males does not have a normal behaviour, it could be described as if he had Down Syndrome (he was tested with the human test and was negative). Although never before problems came from this suspected condition, in 2009 there was a very sad incident: this orang-utan grabbed the five year old gibbon and put his head inside his mouth, he did not kill him instantly. We managed to take the gibbon out of the enclosure but the wounds were too severe and the animal died.

We are not sure if this incident was due to the five year old gibbon feeling over confident being with the orangs since he was born, getting too close to the orang and fooling around with him, he had a very playful nature, but sadly it ended in a very tragic way. Since 2009 the gibbons don't go out when this orang-utan male is in the outside enclosure, we take turns for all the animals (gibbons and this orang-utan) to go out but not at the same time.

With the other two orang utan males, there is not a problem; both orang utan males have to go out separately because they fight. With any of these two other males the gibbons are outside with them in the enclosure.” Candelaria González

- **Leipzig:**

0.1 **Yellow-cheeked gibbon *(Hylobates concolor gabriellae)*** – no problems

Report August 2011:

“No problems, best harmony with young orang utans; intensive play behaviour”. Gerd Nötzold

- **Lisbon:**

1.0 **Pileated giibbon *(Hylobates lar pileatus)***

Report (March 2009):

"1.1 (presently 1.0: Since the opening of the enclosure (in May 2006) we have been keeping 1.1 *Hylobates pileatus* with the orang-utans without any problem. In December 2008 we exchanged the female and during the last introduction phase of the new female she was found dead in the enclosure water moat. According to one visitor, "one of our orang-utans grabbed the new female Pileated gibbon and threw her into the water moat and she drowned".

Report 2010: no comments

- **Madrid:**

1.4 **Lar gibbon *(Hylobates lar)*** – last 0.1 born Dec. 08 - no problems

Report 2010:

"**1.2** ***Hylobates lar***; no important problems; the young gibbon sometimes try to play with the orangs and then get bored or frightened at the beginning, but later the orang utans ignore the gibbons most of the time." Maria Delclaux Real de Asia

- **Münster:**

4.0 **Lion-tailed macaque (Macaca silenus)** – no problems (report 2008)
1.2 **Small-clawed otter (Amblonyx cinera)** – no problems

Report (Jan. 2009):

3.0 Lion-tailed macaque (*Macaca silenus*) - problem: The macaques bullied the young male Ito (born 26.12.2006). Ito had viewable scratches and behaved very anxiously. That is why we separated the macaques from the Orang Utans in the middle of the year 2008 until now.

1.1 **Small-clawed otter (*Amblonyx cinereus*)** - no problems

Report 2010:

"**0.8** ***Oriental small clawed otters***: no problems
3.0 (castrated) ***Macaca silenus*** – separated from the young orang male Ito (born Dec 2006) since 2009, because he suffered from some wounds caused by the macaques. They now live separated together with Nonja (adult female) – sometimes together with some of the other adult orang utans." Dirk Wewers

- **Prague:**

1.1 **White-handed gibbon *(Hylobates lar)*** - no problems

Report (2008):

1.1 Lar gibbon (*Hylobates lar*) – together with 2.0 younger orangs that are mating the lar gibbon female; lot of playful behaviour

Report (Jan. 2009):

Young orangs do regularly mate the lar gibbon female. Female gibbon did join the dominant orang female and together they attacked submissive orang male (happened only once). No other problems seen. Lot of playfull behaviour between gibbons and young orangs.

Report 2010: no comments

- **Sosto Zoo:**

0.1 **Siamang *(Hylobates syndactylus)*** - no problems

Report (Aug. 2011):

"At the present, one adult male, two adult females and two offsprings live in the Green Pyramid of Sosto Zoo. The group is divided into two parts, they are separated both outside (in the enclosure) and inside (in the boxes). One group consists of the adult male Guru, one adult female Sabatini and the female siamang Finita, respectively the other one comprises the old female Sarita with Maya (female) and Tigu (male). Finita is sometimes allowed to go to the other group but she prefers the older animals' company, especially Sabatine's one. Both Guru and Sabatini tolerate well Finita's impertinent behaviour that occurs during feeding, namely Finita pulls the orangutans at the hairs and to steal some food items. They live together in peace, Finita always lays about 2-3 m away from Sabatini, and she visibly has fun but we have already seen laying/sitting in close contact together with Guru." Napsugár Zengo, Zoological assistant

- **St. Aignan:**

1.1 **Lar Gibbon *(Hylobates lar)*** – no problems
1.1 **Hanuman langur *(Semnopithecus entellus);*** sometimes together - no problems

Report 2010: no problems

- ## Tel Aviv / Ramat Gan:

1.1 **Siamang *(Hylobates syndactylus)*** - problems

Report Aug. 2011:

“We have a new young pair of siamangs (age 4 and 6) from 2 different zoos who bonded immediately on arrival about 5 months ago. They have a night house outside of the great ape facility, so their calls will not reverberate inside the building , and their access to the enclosure is separate from the orangs. We introduced them about 3 months ago to our 2.2 orangs (Mushon, Rochele (in their 40s), the one year old baby and Tussi age 20++).

At the beginning it was delightful for about 2 months. Lots of interest, action, noise and mostly positive interaction. There is sufficient space in 3 dimensions for the siamangs to use the upper enclosure and climbing structure areas, and the orangs mostly stay down below as they did before. In the last 2 -3 weeks the orangs have been "zapped " by the male siamang in particular. He teases and jabs and chases the orangs. The siamang male bit Mushon, and Mushon tried to fend him off with a short bamboo stick. Rochele now hugs her baby and refuses to let him loose when the siamangs are out. Tussi is the only one playing the game with the siamangs. The orangs don''t enjoy coming out in the morning and in fact when they see the siamangs, the orangs try to go back inside. So we have conceded being temporarily vanquished by the young siamangs.

Our current situation is now "shared use of the enclosure by 2 species, but at different times" . We know that Kiriat Motzkin had a similar experience to us and they ended up separating the siamangs from the male orang , yet I was quite certain that these ‘pairing’ did work in other places. Since there must be at least 25-30 zoos doing this combination. I found a detailed report from Adelaide in which the results were similar to ours - great relationship between the 2 species at the beginning, but deteriorating with time. Our next option is to remove the siamangs and introduce our lar gibbons to the orangs , hoping the smaller gibbons will be more easy going with the orangs, but we would really like more information.” Amelia Terkel

3.2.3 Examples of Good Enclosures for Orang utans

A. The Realm of the Red Ape in Chester Zoo, Mark Pilgrim, 2007 (parts of a presentation, held at the EEP meeting orang utan, Warszaw, 2007)

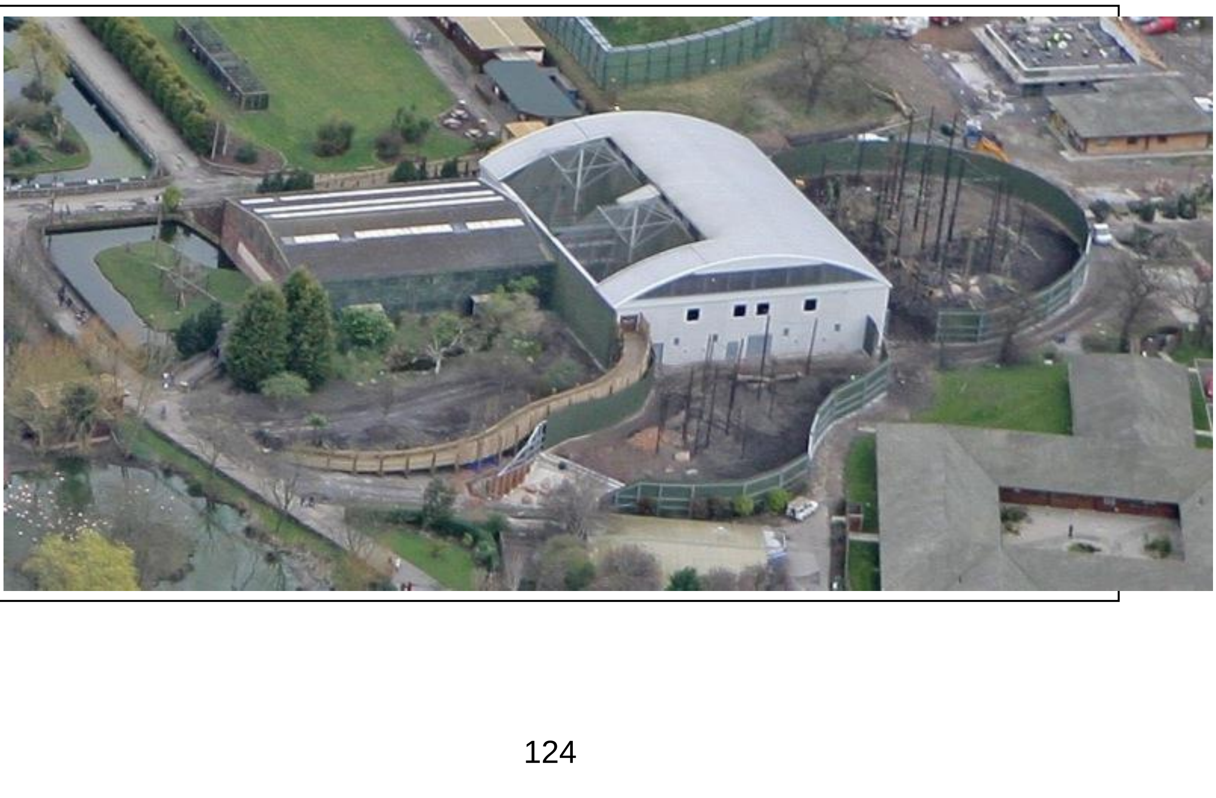
B. Flexibility of orang utan enclosures in Apeldoorn Zoo, Warner Jens, 2003

C. New orang utan enclosures in Amnéville Zoo, Alexis Maillot, 2007 (parts of a presentation, held at the EEP meeting orang utan, Warszaw, 2007)

D. Examples of orang utan enclosures with modern structures in different zoos (Frankfurt, Hamburg, Cologne, La Boissiere, Madrid, Wareham, Gävle)

E. Further examples for climbing structures: Orang utans have to climb

A. The Realm of the Red Ape -
The new orang-utan experience at Chester Zoo.
By Mark Pilgrim, 2007



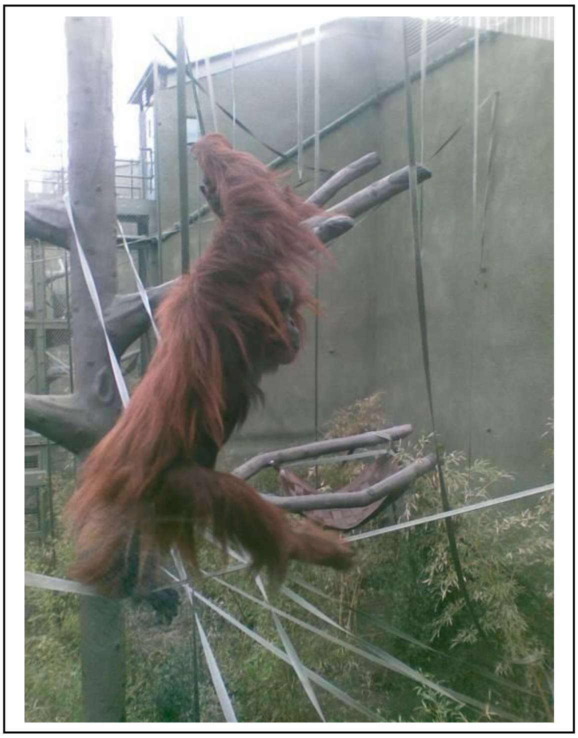
Enclosure sizes

Two storey building linked to the existing orang-utan house:

- 3 netted indoor encl., each 101 m^2, 10 m high
- 2 netted outdoor encl., each 146 m^2, 15 m high
- 2 'walled' outside enclosures, 1500 m^2 and 1470 m^2

Old orang-utan house becomes off-show:

- 3 indoor enclosures, ca. 150-200 m^2, 4 m high



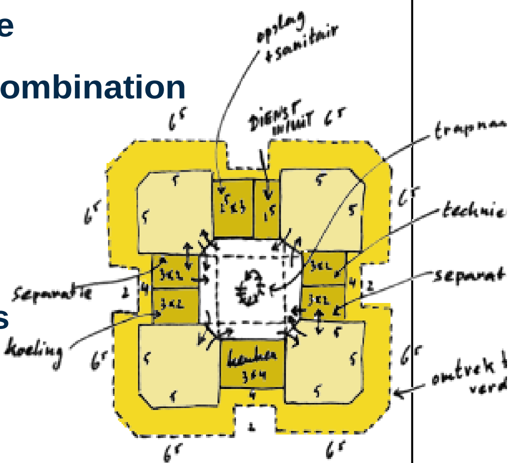
orangutans

Three major factors essential in developing an Orangutan facility:

- **Highest possible degree of social flexibility**
- **Highest possible degree of environmental complexity**
- **Creation of a maximum of climbing volume**

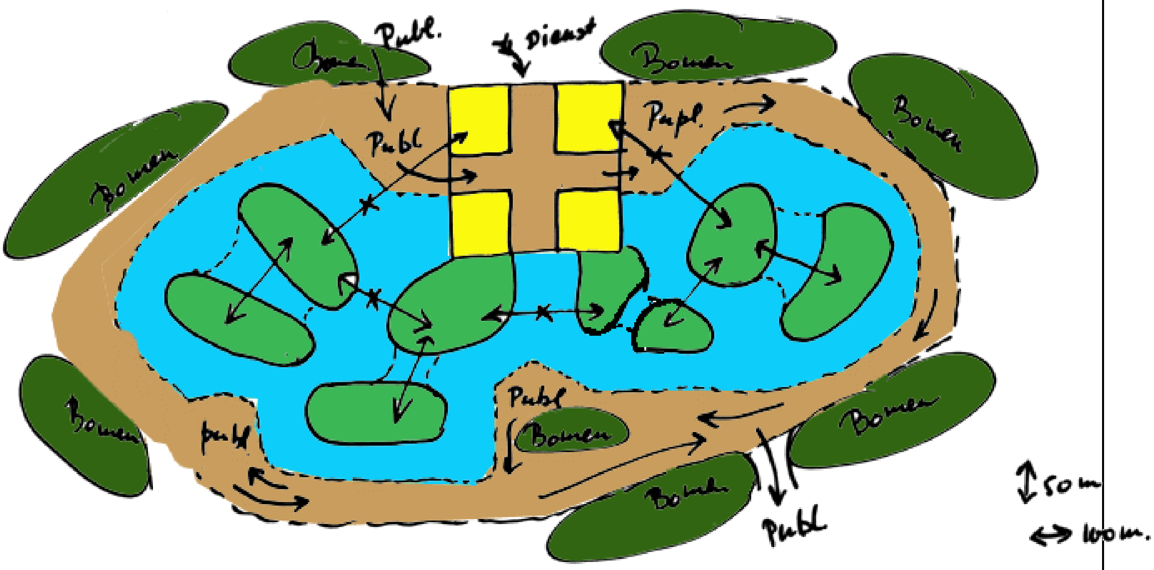
Highest degree of social flexibility

- **Social structure that differs from other great apes**
- **Orangutans live solitary most of the time**
- **Zoos keep orangutans in almost every combination**



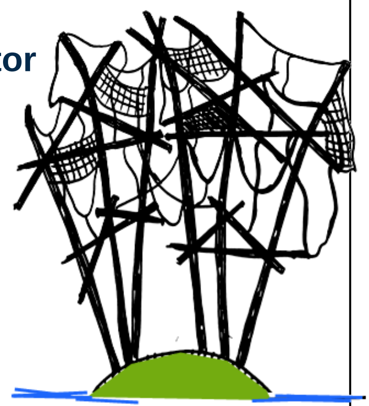
- **Construct a building for keeping animals in both ways: solitaire and/or social**
- **Construction of more enclosures interlinked on two levels**

Island

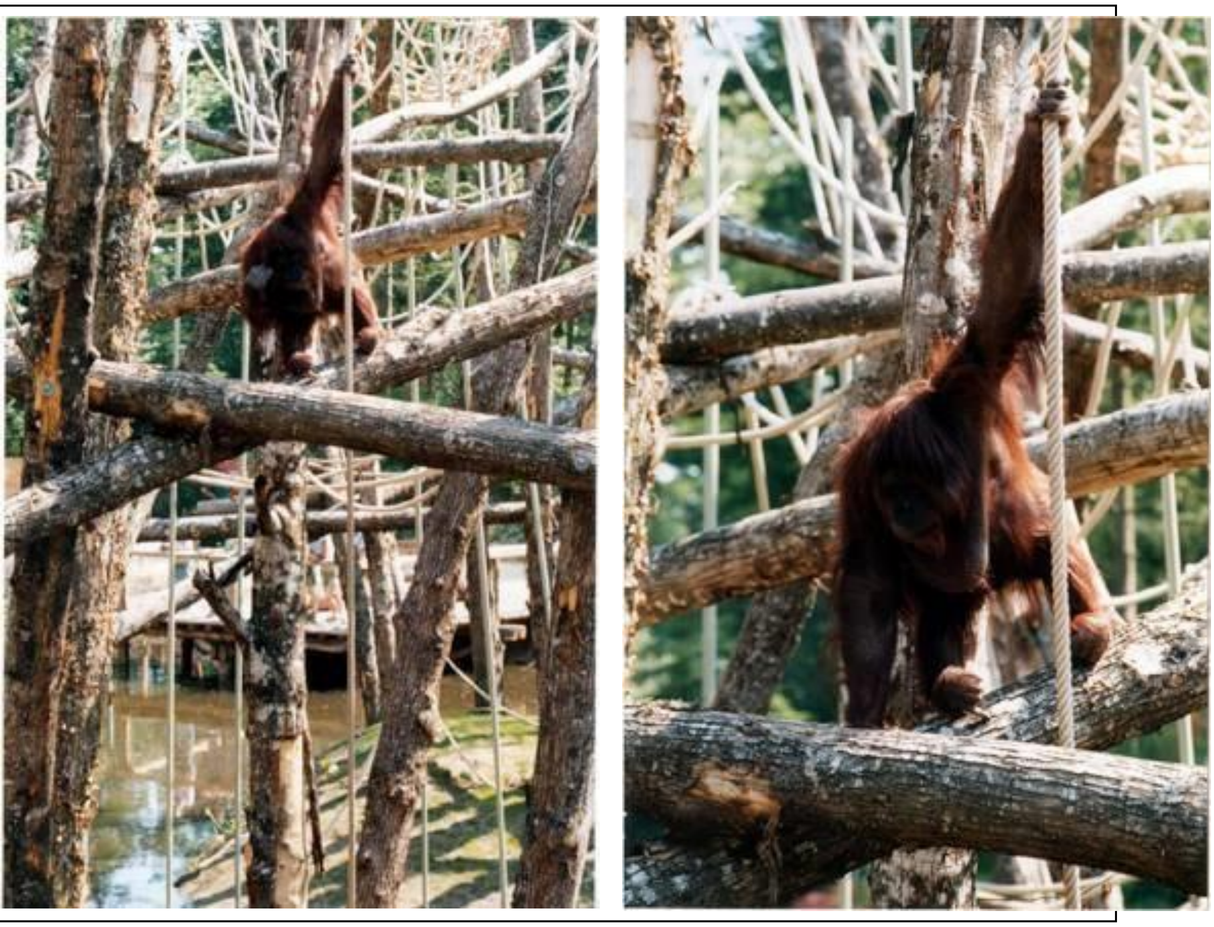


Creating maximum of climbing volume

- Orangutans are more arboreal then other great apes.
- Normally orangutans in zoos have limited possibilities for climbing
- Making it Orangutan-proof is a limiting factor

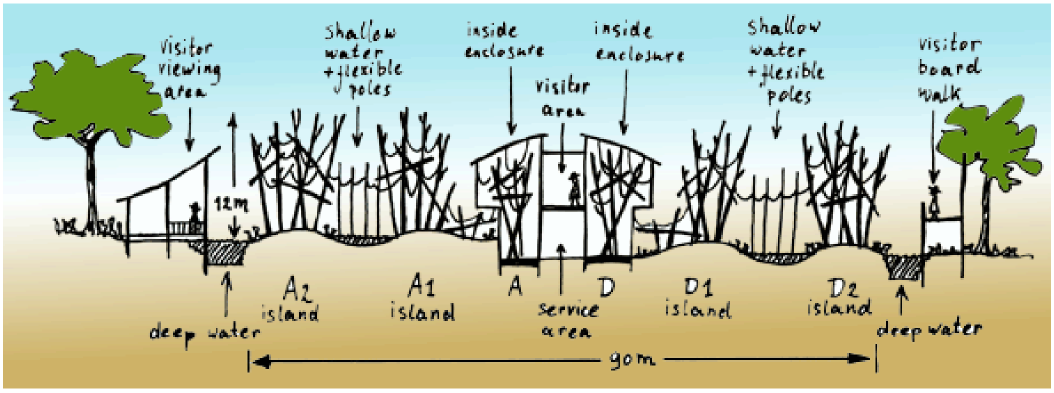


- How higher they climb the more complex the climbing structure
- Much variation and level differences



Visitors (1)

- **Bring visitors on eye-level with Orangutans in climbing frames**
- **Bring visitors as close as possible to the animals**



Fact and figures

• Total enclosure costs	3 million dollars
• Islands	8, total: 1000 m2; 400 m2 coastline
• Inside enclosures	4, total 1500 m3
• total explorable space	10.000 m3
• Separation-rooms each	8, between 10 and 15 m2
• Hydraulic slide-doors	24
• Slide-doors	10, Orangutan-manageable
• Hydraulic pipes	2,5 km
• Sweet chestnut trees	220, between 10 and 15 meters long.
• Climbing nets	35, 400 m2
• Climbing ropes	5 km

C. New orang-utan enclosure in Amnéville Zoo.
By Alexis Maillot, 2007

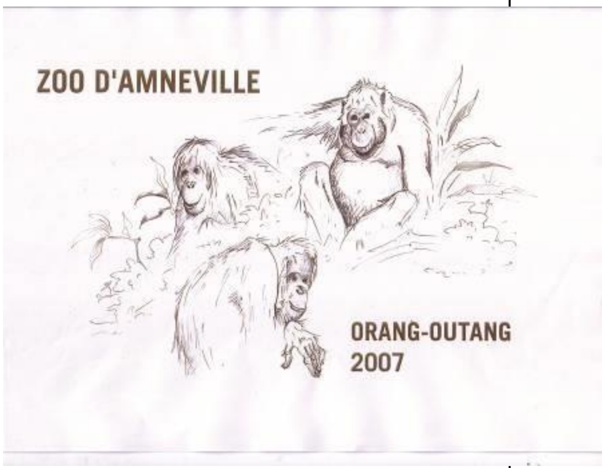
Some news from Amnéville:

- Summary:

The inside enclosure:

- Habitat area 1
- Habitat area 2
- Night quarters

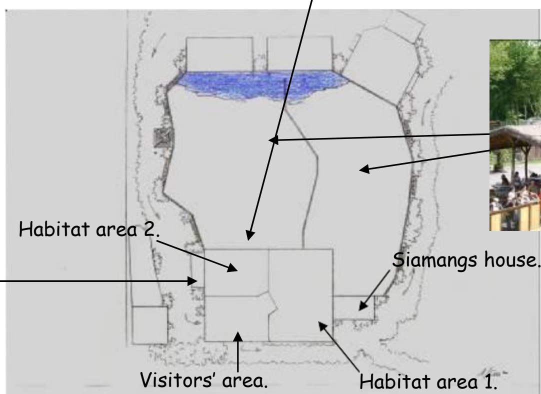
The outside enclosure
Julitta , Putri and Ludi:
Their first encouter.
And today…



The Orang-utans exhibit:

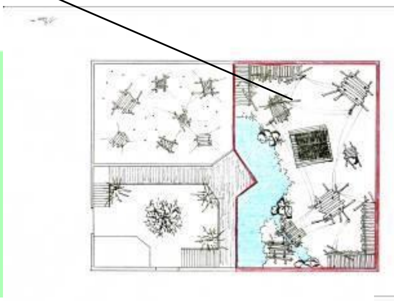
Some figures:
Inside total surface:600 square meters.
Outside total surface:2500 square meters.

General view.



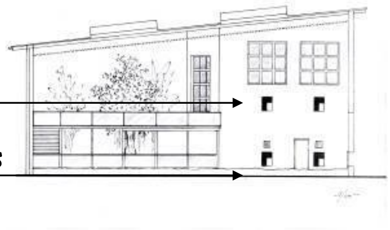
The inside exhibit-Habitat area 1:

Some figures:
24 meters long, 17 meters large.
Surface: 400 Square meters.
Elevation: 10 to 7 meters.
Access to outside enclosures: 4 slide doors.
Access to night quarters: 2 slide doors.
Access to habitat area 2: 2 slide doors.



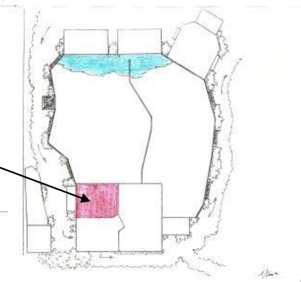
Access to habitat area 2

Access to Night quarters

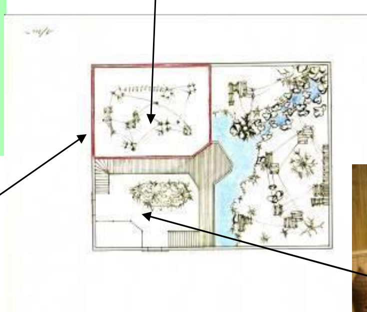


The inside exhibit-habitat area 2: (Above the night quarters).

Habitat area 2.

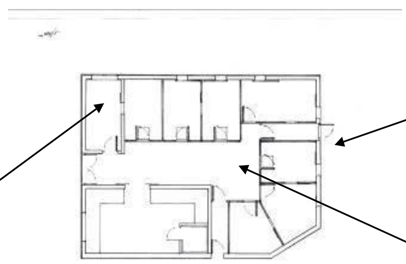


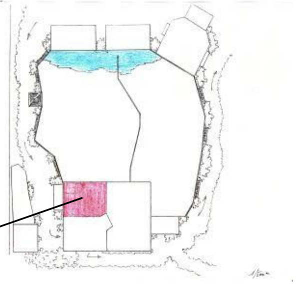
Some figures:
17 meters long, 12 meters large.
Surface: 200 square meters.
Elevation: 6 to 5 meters high.
Access to outside enclosure: 1 slide door.
Access to habitat 1: 2 slide doors.
Access to night quarters: 5 slide doors.



Access to the night quarters

The night quarters: (Under the habitat area 2).





Some figures:
8 boxes.
Minimum size of a box:
4 meters deep, 3 m. large, 3 m. high.
Access to area habitat 1: 2 boxes.
Access to area habitat 2: 5 boxes.
Direct access to outside enclosure: 3 boxes.

The climbing structures.

Style 2

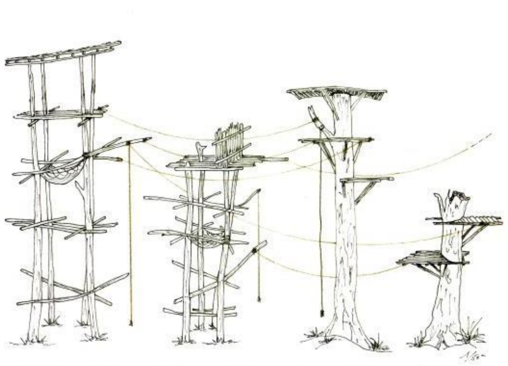
Style 3

Style 1

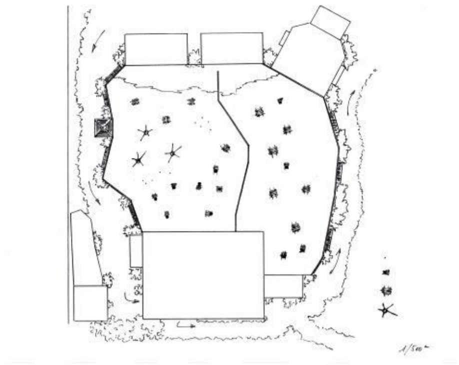
Some figures:
Style 1: 8-10 meters.
Style 2: 5-7 meters.
Style 3: 7-9 meters.
Style 4: 3-5 meters.

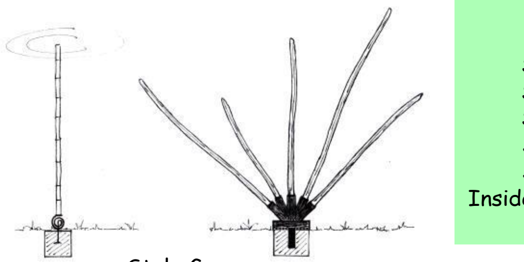
Style 4

The climbing structures



Style 1 Style 2 Style 3 Style 4

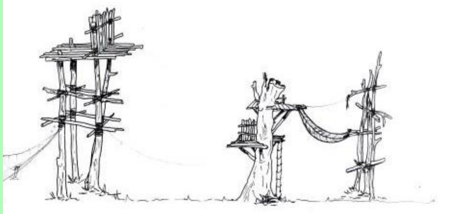




Style G

Some numbers:

Style 1: 8-10 meters.
Style 2: 5-7 meters.
Style 3: 7-9 meters.
Style 4: 3-5 meters.
Style G: 3-5 meters.
Inside structures: 4-8 meters.



Inside structures

D. Examples of orang utan enclosures in different zoos

Frankfurt Zoo, inside

Frankfurt Zoo, inside

Hamburg Zoo, outside view

Hamburg Zoo, inside

Hamburg Zoo, inside

Hamburg Zoo, inside

Cologne Zoo, inside

Gävle Zoo, outside

Gävle Zoo, outside

Gävle Zoo, inside

La Boissiere Zoo, outside

La Boissiere Zoo, outside


Madrid Zoo, outside


Madrid Zoo, outside view


Madrid Zoo, outside


Madrid Zoo, outside


Wareham Zoo, outside


Wareham Zoo, outside

Wareham Zoo, outside

Wareham Zoo, outside

E. Further examples for climbing structures

Apeldoorn Zoo

Boras Zoo

Gran Canaria Zoo

Duisburg Zoo

Munich Zoo

Wareham Zoo

Frankfurt Zoo

Gävle Zoo

3.2.4 Browse list

The leaves of the following species can be used for feeding to apes:

- Acacia
- Alfalfa (*Medicago sativa*)
- Alder (*Alnus spp.*)
- Amaranths (*Amaranthus spp.*)
- American Beech (*Fagus grandifolia*)
- Apple (*Malus spp.*)
- Apple leaf croton (*Codiaeum cadierei*)
- Aralia (*Polyscias balfouriana marginai*)
- Arbovitae (*Thuja spp.*)
- Areca palm (*Crysalidocarpus lutescens*)
- Artillery plant (*Pilea microphylla*)
- Aspen (*Populus spp.*)
- Banana (*Musa acuminata*)
- Bamboo (*Arundinaria spp., Phyllostachys spp., Semiarundinaria spp., Sinarundinaria spp., Thamnocalamus spp., Shibataea spp.*)
- Bamboo palm (*Chanaedorea erumpens*)
- Beech (*Fagus spp.*)
- Birch (*Betula spp.*)
- Blackberry (*Rubus spp.*)
- Black locust / False acacia (*Robinia pseudoacacia*)
- Black willow (*Salix nigra*)
- Bottle palm (*Beaucarnea recurvata*)
- Bush honeysuckle (*Lonicera spp.*)
- Butterfly bush (*Buddleia spp.*)
- Cattails (*Typha spp.*)
- Chicory (*Cichorium intybus*)
- Clover (*Trifolium spp.*)
- Coffee plant (*Coffea arabica*)
- Comfrey (*Symphytum spp.*)
- Coleus (*Coleus spp.*)
- Corn plant (*Dracaena fragrans massangeana*)
- Cotoneaster (*Cotoneaster spp.*)
- Cottonwood (*Populus spp.*)
- Croton (*Codiaeum spp.*)
- Daylily (*Hemerocallis spp.*)
- Dogwood (*Cornus florida*)
- Dracaena (*Dracaena spp.*)
- Dragon tree (*Dracaena draco*)
- Dwarf palm (*Chamaedorea elegans*)
- Dwarf rose (*Cryptanthus roseus pictus*)
- Elaeagnus (*Elaeagnus spp.*)

- Elm (*Ulmus spp.*)
- Eucalyptus (*Eucalyptus spp.*)
- Eugenia (*Eugenia spp.*)
- Flowering dogwood (*Cornus florida*)
- Forsythia (*Forsythia spp.*)
- Fragrant honeysuckle (*Viburnum spp.*)
- Fig (*Ficus spp.*)
- Grass family (*Graminae*)
- Grape (*Vitis vinifera*)
- Greenbriers (*Smilax spp.*)
- Gloxinia (*Sinningia spp.*)
- Hackberry (*Celtis occidentalis*)
- Hazelnut (*Corylus spp.*)
- Hawthorn (*Crataegus spp.*)
- Hibiscus (*Hibiscus rosa*)
- Hornbeam (*Carpinus betulus)*
- Jade plant (*Crassula argentea*)
- Kentucky coffee tree (*Gymnocladus dioicus*)
- Kerria (*Kerria spp.*)
- Kudzu (*Pueraria spp.*)
- Lady palm (*Rhapis excelsa*)
- Lime (*Tilia platyphyllos*, *Tilia cordata)*
- Maple (*Acer spp.*) except Sycamore (*Acer pseudoplanatus)*
- Mock orange (*Philadelphus spp.*)
- Mulberry (*Morus spp.*)
- Nasturtium (*Nasturtium spp.*)
- Oregon grape holly (*Mahonia spp.*)
- Pear (*Pyrus spp.*)
- Peperomia (*Peperomia spp.*)
- Pickerelweed (*Pontederia cordata*)
- Plane (*Platanus spp*.)
- Poplar (*Populus spp.*)
- Primula (*Primrose spp.*)
- Purslane (*Portulaoa oleracea*)
- Raspberry, Blackberry (*Rubus spp.*)
- Redbud (*Cercis canadensis*)
- Rose (*Rosa spp.*)
- Snowberry (*Symphoricarpos spp.*)
- Sweetflag (*Acorus calamus*)
- Sweetgum (*Liquidambar styraciflua*)
- Violet (*Viola spp.*)
- Water hyacinth (*Eichornia spp.*)
- Weeping fig (*Ficus benjamina*)
- Willow (*Salix spp.*)

It is recommended that the following species of are NOT fed to browsing animals:

- Black locust (*Robinia pseudoacacia*)
- Crab apple (*Malus spp.*)
- Cherry (*Prunus spp*.)
- Sycamore (*Acer pseudoplanatus*)

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3.2.6 EAZA Best Practice Guidelines Disclaimer

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