The Orang-utan in Sabah Today

A Study of a Wild Population in the Ulu Segama Reserve

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PART ONE: BACKGROUND

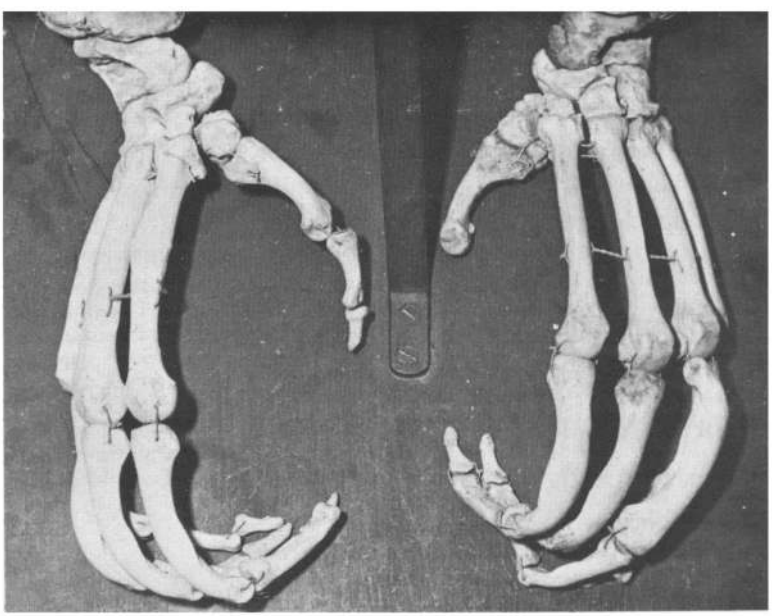
Introduction

Anyone who has ever kept orang-utans would agree that they are the most lovable and fascinating of animals. Their sad expressions and reserved ways give them a depth of character rare outside our own species. Man's interest in them has been great for hundreds of years and cave deposits from Sarawak show that our ancestors of thirty thousand years ago shared this interest. Yet the orang-utan or 'man of the woods' has now become the rarest, most threatened and least understood of all the apes.

At the 1965 Bangkok conference of the International Union for Conservation of Nature it was proposed that a sanctuary should be made in the Ulu Segama Forest Reserve in Sabah, so that a large area of primary forest, the orang-utan's habitat, should remain undisturbed. This paper gives an account of my first visit into this reserve to study the orang-utans there. But its encouraging report of orang-utan affairs in this area only heightens the tragedy that still no sanctuary has been made. In the next few years the reserve will be thoroughly logged for its valuable timber, which may well be catastrophic for the orang-utans there, and a large proportion of the world population of this species could be lost.

The paper also draws on the available data of morphology, mythology, palaeontology and behaviour studies of captive and wild orang-utans in an attempt to understand how this species has

Plate 1 Curved bones of orang-utan's hooked feet



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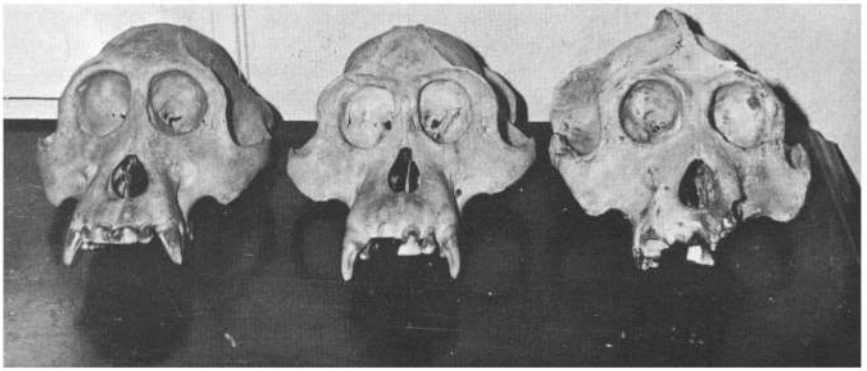

Plate 2 Variation in skulls of adult males: Borneo

compromised and adapted itself from its ancestral way of life to its present ecological needs.

My first trip to the Ulu Segama in June 1968 lasted three and a half months, and in October 1969 I returned for a further twelve months. Populations of orang-utans on both sides of the river Segama were studied.

Anatomy, Morphology and Biochemistry

The orang-utan is a large arboreal anthropoid ape, the males sometimes weighing over 300 lbs. Its short legs, broad and flattened thorax and extremely large long arms have been interpreted by anatomists as adaptations for brachiation, a mode of locomotion that consists of swinging along beneath the branches, propelled by alternate arm pulls. The orang's hands are long and broad, with reduced thumbs, and the feet long with a short hallux; both hands and feet are extremely curled and hook-like (Plate 1) – a young orang-utan can hang beneath a branch, holding on with only its feet and sometimes even with only one foot. These adaptations are interpreted as being for tree gripping, and are more developed than those of either the chimpanzee or gorilla. The orang-utan's hands lack the chimp's and the gorilla's hard developed calluses on the phalanges, which act as soles to the hand in quadripedal ground locomotion. Also, due to their extremely hooked shape, the orang-utan cannot put its feet flat on the ground and has to walk on the outside edges.

The orang-utan has a reddish brown coat, the colour varying from a bright orange to a dark chocolate. The hair varies greatly in length from individual to individual, but is never very thick. The facial skin is paler in the young, darkening to black with age, as in chimpanzees. The orang-utan has no externally visible sexual oestrus swellings such as are found in a number of terrestrial primates, including chimpanzees, but it shows considerable sexual dimorphism. The males, which are about twice the size of the females, develop large cheek callosities of fatty and fibrous tissue, grow long beards and have large sac-like dewlaps (Figure 1), displaying great individual variety in these features (Plate 2).

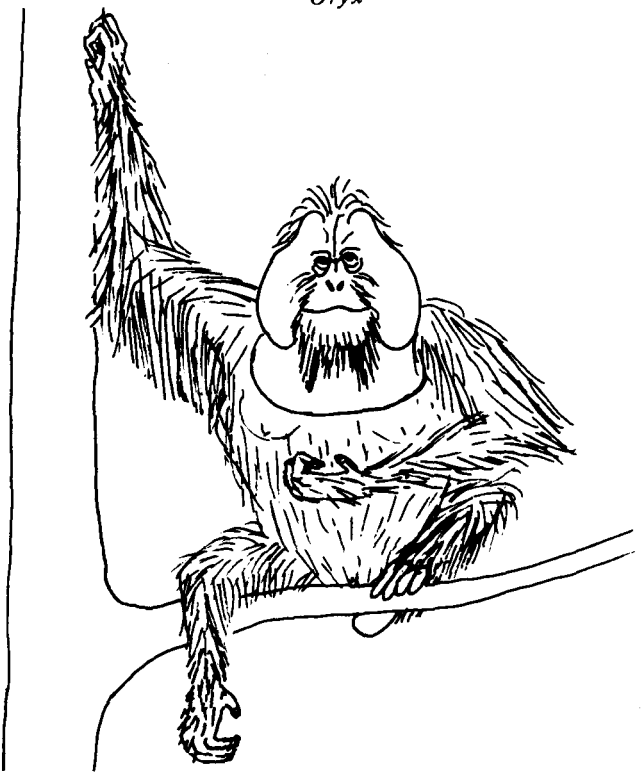

Figure 1 A large male

From anatomical features it is possible to separate off the gibbon as being not so closely related to other apes, but among the chimps, gorillas and orang-utans natural relationships cannot be determined, as each ape has adapted its anatomy so closely to its environment. Anatomical differences in the orang-utan can be attributed to its more arboreal way of life. The apes show several features primitive to Old World monkeys, including the arrangement of the main arteries, and in having a lachrymal ethnoid suture in the eye orbit of the skull. In these respects they resemble the Tarsiers and Ceboids more than the advanced Cercopithecoids. The orang-utan and man appear to be more primitive in these respects than the chimp and gorilla, but this does not necessarily mean a close relationship between man and orang-utan. The anthropoid apes must have split off from the Old World monkeys very early and thus maintained features primitive to this group. The gorilla and chimp may subsequently have converged more closely to Cercopithecoids in these respects than have the orang-utan and man. Analyses of biochemical, serological and parasitological data show a close relationship between man, gorilla and chimp with the orang-utan somewhat distinct. Many zoologists now classify chimp and gorilla in the same genus *Pan* on biochemical grounds. The table shows some of the biochemical data:

	Percentage tasting of PTC	ABO blood series	2n Chromosomes	Haemoglobin
Man	Europe – Middle East 70 – 80	ABO all phenotypes	46	Polymorphic
Chimp	66	A + O	48	Closely resembles gorilla and man. Manufactures polymorphic
Gorilla	77	ABO O phenotype absent	48	Insignificantly different from man.
Orang	6	ABO O phenotype absent	48	A_2 variant 2.5% of that in man.
Gibbon	46	A, B, AB	44	Hb pattern slightly different from man.

Blood groups and chromosome numbers show how different the gibbon is but do not help unravel the others. Data from PTC tasting experiments and from haemoglobin similarities, however, show a close affinity between man, chimp and gorilla. Serum precipitation data also demonstrates this affinity. Finally further relevant information is obtained from parasitology. Endoparasites evolve with their hosts and thus relationships between the parasites of different animals to some extent reflect the relationships between those animals. The helminth parasites of gorilla and chimp are more closely related to those than infect man than those that parasitise orang-utans and gibbons. Slightly more convincing, several strains of malaria plasmodia are identical in chimp, gorilla and man; others show subspecific differences, whilst the plasmodia of orang-utan and gibbon are very different from those of man.

Fossil evidence suggests a closer relationship between the chimp, gorilla and orang-utan than their biochemistry suggests, but even so it appears that the different lines were already separate in the Miocene; it has been suggested that one of these fossils found in Kenya is an ancestral orang-utan.

Prehistory, History and Mythology

In the Pleistocene orang-utans inhabited the great forests of south-east Asia. Fossil teeth show that they occurred near Peking, near Hong Kong and in India. They occurred all over Sumatra and Borneo and on Java and the Celebes. Quite why large numbers of orang-utan teeth should accumulate in rock crevices in China and in caves in Sumatra is not known. These teeth collections show a high proportion of adults. One explanation is that old or injured orang-utans shelter and die in these crevices. Another explanation suggests that the teeth have been collected by porcupines. Schaller found gorilla footprints in caves, and a young male orang-utan, Arthur, released by Barbara Harrisson in the

Bako National Park, Sarawak, regularly explored, rested and sheltered in caves. Orang-utan remains found in the Niah caves in Sarawak by the Harrissons are easier to explain. Some of these show signs of charring and are present with remains of early man. It would seem that man has eaten orang-utans for at least 35,000 years. These remains show an excess of females and young in contrast to the remains from China.

The autochthonous animals of an area sometimes survive in local folklore long after the animals themselves are extinct; also man has a great ability for imagining monsters that have never existed. Stories of the union of man and beast, producing animals half-man half-beast, are found all over the globe as are stories of other manlike and terrible monsters. Thus the presence of manlike animals in the folklore of south-east Asia does not necessarily tell us anything about the past distribution of apes or the origins of those people. According to Porteous, the Maoris of New Zealand have various legends of a tree-dwelling people, the Nuku-mai-tore; of small stature and always chattering, they were said to have lived in the great branches of long-leaved astelias and grasses which grew in the tree forks. As Porteous noticed, these creatures are very reminiscent of the orang-utan and the gibbon. There are no animals in New Zealand today that could have given rise to such a story, nor is there any anthropological evidence that the Maoris ever came from Indonesia. The Maoris are Polynesians and no similar story occurs among other Polynesians; if genuine it must have originated in New Zealand. There are also in New Zealand stories about giant lizards, which, like crocodiles, are common in Maori artistic designs; again, the nearest large lizards are in Australia and the nearest crocodiles are in Australia or in Fiji.

Even closer to the present home of the orang-utan in Sumatra there have been many stories and eye-witness accounts of the 'orang-pendek', or 'short fellow' in Malay, an upright, walking, hairy man about five feet high with a long black mane, very shy and living deep in the forests. Several known animals could lead to such a belief, including dark old male orang-utans encountered on the ground. However sightings of orang-pendek fall outside the orang-utan's present range and the natives swear it is something different.

The Legends

Around the orang-utan itself have accumulated the numerous stories that such a man-like creature deserves from imaginative people. The Javans say that the orang-utan can talk but is afraid to do so for fear that men would make it work. Some tribes tell of the origin of the orang-utan. One such tale tells of a man who, ashamed of some misdeed in the village, fled into the jungles and remained there ever since. Another tells of two bird-like creatures who, after several poor attempts at making man, finally found the right ingredients and succeeded in making several people. Pleased at their success they celebrated and then slept. On waking they returned to their task, but had forgotten something about the recipe and succeeded only in producing orang-utans.

Some tribes believe that they are spiritually related to the orang-utan, and such ideas are not confined to 'local' peoples. In the 18th century, long before the hypothesis of man's evolution, Lord Monboddo concluded that the orang-utan was some low form of man. 'The orang-outangs . . . . are of our species but though they have made some progress in the art of life, they have not advanced as far as to invent language. There can be no sort of reason why we should doubt that this wild man or orang-outang is a real man or at least a being most nearly related to us in his rational faculty . . . . . And if there were nothing else to convince me that the orang-outang belongs to our species his use of sticks as a weapon would alone be sufficient.'

Just as with the gorilla, the chimpanzee and the still unverified South American apes, the orang-utan is accused of sexual assault on humans. The great eighteenth-century naturalist Buffon quotes Schouten as saying 'that they are passionately fond of women, and that there is no safety for them in passing through the woods they inhabit, as these animals immediately attack and injure them'. Most of the Borneo tribes have similar tales. One most frequently recurring is of an orang-utan that seized a native girl and took her up into the trees where he kept her captive and fed her on fruit. Eventually she had a baby that was half man, half ape. One day the girl made a rope of coconut fibre and when the orang-utan was not looking she climbed down out of the nest and started running through the jungle clutching the baby. The orang-utan noticed and came swinging through the trees after her. She made for a river ahead and saw a boat just about to leave the shore, but the orang-utan was nearly on her. The men in the boat saw her and told her to throw down the child to distract the animal. She did this and the orang-utan stopped to seize the child giving her time to reach the boat and get away. In rage the orang-utan tore the baby in half and hurled the human half after the departing boat, the ape half he threw back into the jungle. The loud groans that orang-utans sometimes make are said to be the sighs of the orang-utan searching for his lost bride.

So universal is the idea of woman being abducted by hairy monsters that we can learn nothing from such a tale. Other ideas in the story remind us of the Minotaur myth and of Medea's murder of Absyrtus to distract the pursuing Aëetes. What is perhaps more interesting is that there are also tales of men being abducted by female orang-utans. This is a more unusual story and as we shall see may throw a little light on the active role played by the female orang-utan in sexual affairs.

When the first Europeans reached Indonesia the orang-utan's range was already reduced to Borneo and Sumatra. Man's predation may have been a cause of this, but we do not know. What is certain, however, is that Europeans were responsible for the slaughter that has so reduced their numbers in the last two hundred years. Orang-utans were killed for sport, because they were considered a dangerous menace, and in the name of science; they were killed in the process of obtaining young ones as pets, and killed and trapped in collecting for zoos. Now their habitat, the jungle, is being cut down for its valuable timber. Present numbers have been estimated at a mere 5,000.

Today there is a pocket of animals in north Sumatra, and a few

scattered individuals on the Sarawak-Kalimantan border. The distribution in Kalimantan is not very well established but thought to be limited. The largest surviving population, probably half the world population, is in Sabah, where, in addition to a very small pocket in the forests to the west of Sandakan, they occur throughout the jungle to the south in the Kinabatangan, Segama and Tinkayu river areas. (Figure 2).

Orang-utans in Captivity

Thousands of orang-utans have been kept in captivity, but until recently their fate has been a tragic one, few surviving more than a few months. Confined to a small steel and stone cell in a cold climate without even the sight of a longed-for tree, an arboreal tropical animal could hardly live very long. The orang-utan simply pines, becomes sickly and dies. Those that survive become disinterested, lazy and grossly obese – in many zoos this is still the case. Good zoos, however, give them reasonable space, playthings, warmth, daily fresh bedding, company and occasional branches, and with such treatment an orang-utan can grow in fair health, live a long time and breed. A number of successful zoo births have now been recorded, and in the largest captive collection of orang-utans, at the Yerkes Primate Laboratories in the USA, a number of births occur each year.

Captive orang-utans are on the whole very silent, though some individuals have been known to make loud calls. One zoo keeper early this century referred to the 'singing' of a big male orang-utan, but the 'crying' of young orang-utans is probably a more familiar sound in zoos. Young animals are playful and enjoy such simple toys as a suspended tyre or two parallel hanging ropes. However, the orang-utan has a destructive mechanical flair and systematically dismantles anything that offers an opportunity. The captive orang-utan is not as energetic, playful or excitable as its extrovert cousin, the chimpanzee, nor as aggressive or as anxious to dominate. An orang-utan kept with chimps is usually bullied and badly treated by them. In zoos orang-utans seem fond of hiding inside sacks and under their bedding and are often seen picking up their bedding and piling it on their heads; we shall come to this again in their behaviour in the wild.

Orang-utans deprived of their mother at too early an age show similar deprivation characteristics to other monkeys and apes, clinging and huddling on to similar orphans or to their sack bedding, self-hugging and rocking in a corner, clasping the back of the head and crying; they are frightened by the approach of other animals and unwilling to play with them. Even in the best zoos, with the most attractive toys and facilities, orang-utans spend much of their time sleeping. Big males become lazy and grow to over 300 lbs. in weight.

Captive orang-utans have been taught to paint and many other tricks. They are slower to learn than chimpanzees, due more to their unwillingness to ape the antics of their captors than to lack of intelligence. Chimps are easily disciplined by corporal punishment but this is not so effective with orang-utans.

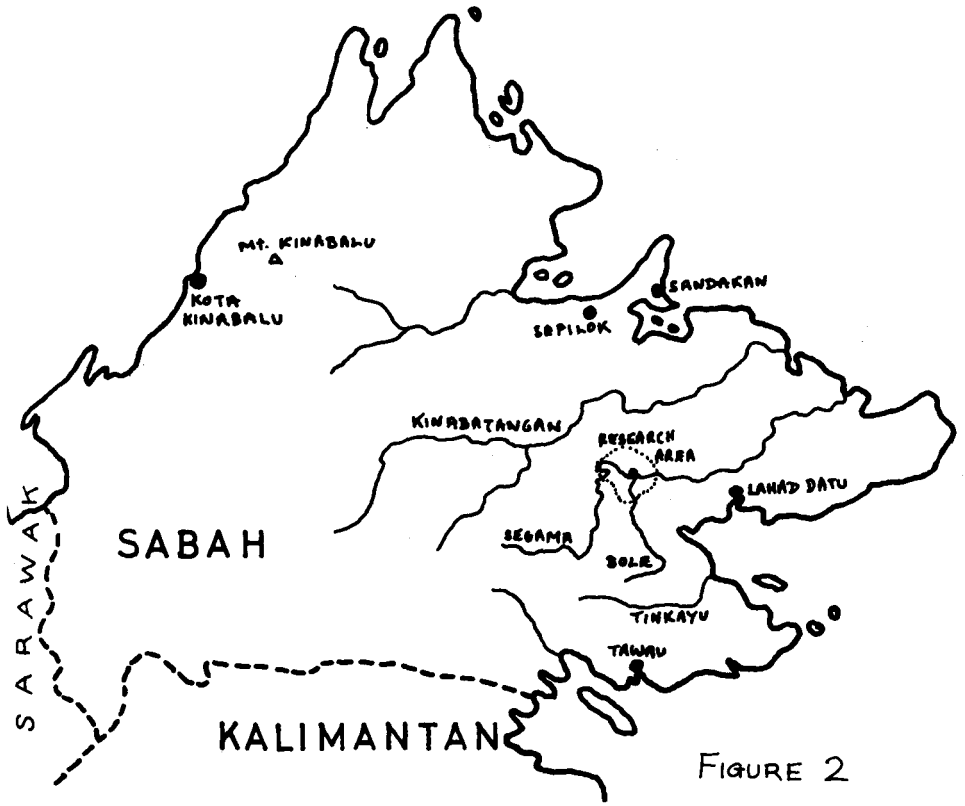

FIGURE 2

Attempts at Rehabilitation

In Sarawak Barbara Harrisson decided that instead of sending confiscated orang-utans to western zoos, attempts should be made to put them back into the wild. Throughout 1962 she tried ways of re-establishing three young orang-utans to wild living and self-sufficiency in the Bako National Park, Sarawak. The operation proved difficult and it became obvious that several years of full-time work was required. Also the Bako National Park was not very suitable as it contained no wild orang-utans.

A similar scheme was started by the Sabah Government in the Sepilok Forest Reserve, about 15 miles inland from Sandakan. Davenport, working in Sabah, decided that the Sepilok was about the best area for wild orang-utans, and after initial problems the project got under way. Eventually Barbara Harrisson's orang-utans were also brought over to the Sepilok (Plate 3). Today there are about 20 orang-utans there in various stages of rehabilitation (Plate 4). Two animals have not been seen for many months and it is hoped that they are now fully self-supporting somewhere in the forest. A nine-year-old female has made regular excursions into the jungle, sometimes for

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several weeks at a time, and two years ago had a baby, presumably of a wild father she had met on her trips as there are no mature males being rehabilitated. She is nearly always accompanied by another female a year younger than herself who is now fully rehabilitated and due to be transported and released in some other reserve. Game rangers live in a permanent house. Animal houses provide shelter and sacking for the orang-utans, and are cleaned each day. All except the smallest animals go off into the jungle each day, but usually return to their shelter at night and for the fruit and milk that is provided.

If improved conditions enable zoos to breed orang-utans and thus provide not only their own stocks but an excess which can be returned to Borneo, these could be rehabilitated in the Sepilok or similar places and released into wild areas where the numbers need boosting. Any illegally acquired orang-utans can now also be put back where they belong. This sort of operation could well be of great importance in preserving this species.

The Study of Wild Orang-utans

> ". . . . . considering its size, the Maias is remarkably inconspicuous in its natural surroundings. Until men can acquire arboreal habits it seems likely that the domestic arrangements of the ape will remain undiscovered.'
> R.W. Shelford, 1910, in *A Naturalist in Borneo.*

Apart from a long interest in orang-utans by the Harrissons, no serious attempts were made to study these animals in their natural environment

Plate 3 Orang-utans of the Sepilok rehabilitation centre

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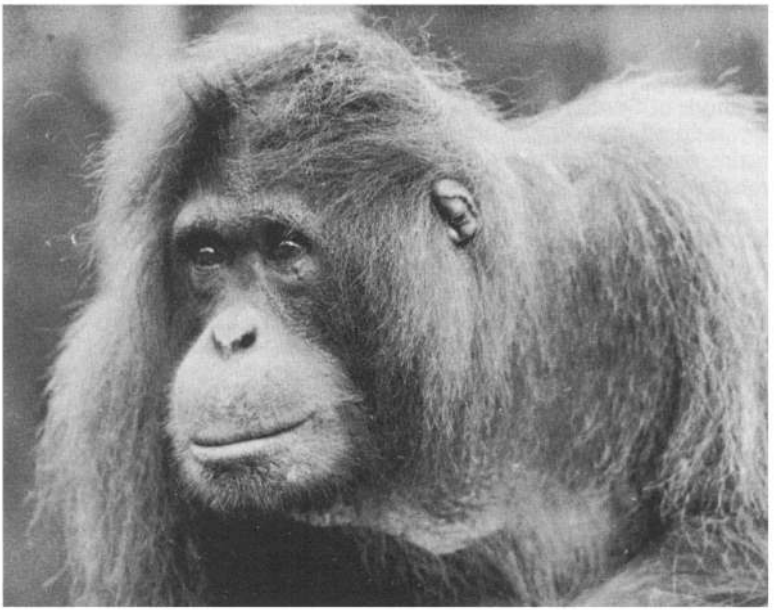

Plate 4 Cynthia, one of Barbara Harrison's orang-utans now at Sepilok

in Borneo until 1960, when George Schaller spent 2½ months studying them in Sarawak. He saw them briefly on four occasions, and investigated nests and populations, but decided that there was not enough material to work with. Two more Americans, Ken Scott and Jackson Selsor, after a brief trip, reported optimistically about orang-utans in secondary forest in the Gomantong area of Sabah and watched them feeding in durian trees, but made no record of behaviour. Barbara Harrisson, on a trip to Sabah for the World Wildlife Fund, made comparisons of nest density for different areas, but saw no orang-utans, and her results contradict those of Scott and Selsor concerning secondary forest. Various Japanese spent several months in Sabah but had little success; in three months K. Yoshiba heard orang-utans several times but was unable to see any. Davenport, another American, made a more extensive study over nine months and saw 16 animals; he concluded that the main stronghold of orang-utans was the Sepilok Forest Reserve area. At the end of 1967 David Horr working under Irven de Vore started work further south on the Kinabatangan river. Huge floods drove him back to the coast, but he returned the next year. By June, when I arrived in Sandakan, he had made observations on 20 orang-utans. Reports from a geological expedition up the Segama and Bole rivers suggested that a good area for orang-utans might be the Ulu Segama Reserve further south; previous workers had avoided this because it is remote and river transport, impeded by numerous small rapids, frustrating. It was in this area that I decided to start my work.

PART 2: THE STUDY

June–October 1968, October 1969–October 1970

Methods of Study

My method was to maintain a mobile base camp beside one of the main rivers where two or occasionally three Dusun natives lived, catching fish and hunting pigs with their spears, the locality being changed at various times. From this camp I made reconnaissance trips into the jungle alone to find out where orang-utans were. If I was working in the same area of jungle for a while, I got my men to make a shelter with a food dump in the area, which gave me greater independence of the base camp. From nests and fruit trees I could tell where and when orang-utans had been; when I found them I stayed observing them for as long as possible; when they started nesting in the evening I returned to camp, collected what equipment I wanted for a study trip, and returned just before dawn the next day. Having relocated the animals I would remain close to them for as long as I could, or until my food ran out, which meant returning to camp for more supplies. The longest study trip I made was 10 days, six of which were spent watching the same animals. At night I slept in the nearest suitable spot to where my subjects were nesting, preferably between the buttresses of the large trees. I carried a piece of polythene with me as shelter from the rain but otherwise had as little equipment as possible – 8x binoculars, notebook, compass, torch, medicine, water bottle and a few tins of food. Occasionally I took a small cassette tape recorder or a 16 mm. ciné-camera. I had no firearms but always carried a parang (jungle knife) which was often needed.

When orang-utans were not aware of my presence I would try to remain unseen, and many of my best observations were made when I was unnoticed. When an orang-utan saw me, and this was usually obvious from its behaviour, I made no attempt to conceal myself. I usually sat down in some clearly visible spot and engaged in 'domestic affairs' such as making ground nests, digging holes, chewing leaves, grooming myself and other activities that I hoped orang-utans would regard as unaggressive. I avoided, as much as possible, direct staring at orang-utans and refrained from looking with my binoculars when the orang-utan was watching me. I wanted to convey the impression that I was not interested in the orang-utan but had other reasons for being there.

I collected all bits of fruit etc. that orang-utans had been feeding on, and examined any dung that I was fortunate enough to find. However the latter was usually very dispersed after its long fall and difficult to investigate.

When searching for orang-utans I relied mainly on hearing, moving slowly through the jungle and stopping frequently to listen very carefully. At first I was aware of noises all round, but after a few weeks I became very sensitive to particular sounds and could distinguish between the different types of animals moving through trees. An orang-utan moving about can be heard at about 100 yards; one quietly feeding at about 30 yards. Sometimes if one was lucky enough to hear

one of the loud calls from up to half a mile away, the caller could be found by following a compass reading on the sound. Similarly if I heard calls at night I could set my luminous compass on the sound and set off to find them at first light the next day. As the orang-utan does not move far it is better to take time and follow a compass course very accurately rather than go quickly and miss the animal by a few yards.

Two hundred hours of observation were made during the first trip and a further thousand hours on the second trip. Over two hundred orang-utans were observed.

Ecology of the Habitat

The Ulu Segama Forest Reserve consists of several hundred square miles of primary dipterocarp jungle rising from about 800 feet above sea level to over 5,000 feet in the mountains to the south and west, and comprising the collecting areas of the Segama, Bole and Kawag rivers. Where I was working, around the junction of the Bole and Segama rivers, the jungle was fairly hilly, with small rivers and streams falling several hundred feet in a few miles. There was a nearly continuous canopy at about 50 to 90 feet, and larger trees up to 200 feet stood out above this canopy. Where the large shade trees were absent – beside rivers, on land slides, and where trees had fallen – dense secondary jungle grew; bamboo, lianas, spiny rattan canes and spiked bushes. A great variety of fruits are available through most of the year. Other animals sharing food types with orang-utans were the very common gibbons *Hylobates mulleri*, the red and grey leaf monkeys *Presbytis rubicundus* and *P. hosei*, proboscis monkey *Nasalis larvatus*, the pig-tailed and long-tailed macaques *Macaca nemestrina* and *M. irus*, hornbills and squirrels.

No one now lives in the reserve, though from the time of the Japanese occupation until a few years ago there was a large kampong (village) a few miles inside the present boundaries, and no one has ever lived further up the river than its junction with the Bole river. On pig-hunting expeditions the natives sometimes come up-river as far as Butok Batu, where the Segama bends south, and also a short distance up the Bole. The Segama Dusun, who are very conservative hunters, say that they have never eaten orang-utans; they do not set traps and they hunt only pigs and occasional deer. They live mostly off fish.

Pigs are very common, as are three kinds of deer. Rhino tracks were seen, bears twice, and elephants five times; numerous other smaller mammals inhabited the forest. I saw large pythons and several other types of snake, including a flying snake; crocodiles were rare in 1968, only two small ones being seen, but several large specimens were seen on the second trip. Large monitor lizards were common along the rivers; a smaller monitor lizard lived in the forest. The annual rainfall is about 150 inches, and humidity very high. Leeches were extremely plentiful on low vegetation in the jungle. At ground level temperature and humidity are very stable: humidity remains at about 100 per cent, temperature varies from about 24°C at night to about 28°C at midday. Up in the tree canopy, however, there is more fluctuation. Humidity may fall below 70 per cent in the daytime and temperatures rise from about 22°C at night to 32°C at noon.

Nests: Distribution and Structure

Large bowl-shaped platforms of branches, constructed by orang-utans for resting, are common in smaller trees (100 ft range) in forest inhabited by orang-utans. As at least one nest is usually made by each independent animal each day, a few orang-utans soon make quite a visible effect on an area of forest. Nests are essentially similar to those constructed by chimpanzees and gorillas (Plate 5); no ground nests were found. Nests seemed fairly evenly spread through low-lying flat jungle; quite often they were made in trees beside or overhanging streams and in sheltered corners under hillsides. On more hilly ground they were more concentrated on or just near the top of ridges rather than on the slopes.

The orang-utans show preference for specific areas and certain tree types as nesting sites, and in favoured areas there may be several nests of different ages in one tree. Sometimes they return to nest near the nest of the previous night or nights. They seem to have good knowledge of the local geography, and sometimes when they have finished feeding they move relatively long distances to a suitable nest area. But if they had continued feeding late, they usually nested either in the food tree or very close to it, and would feed at it again early the next morning.

As data have already been collected on orang-utan nests by Schaller and Yoshiba and Davenport, I did not spend much time in collecting more data in this line. Figure 3 shows a frequency histogram for those nests that were examined. The mean height of 65 feet is somewhat greater than that found by Schaller for a larger sample in Sarawak, and

Figure 3

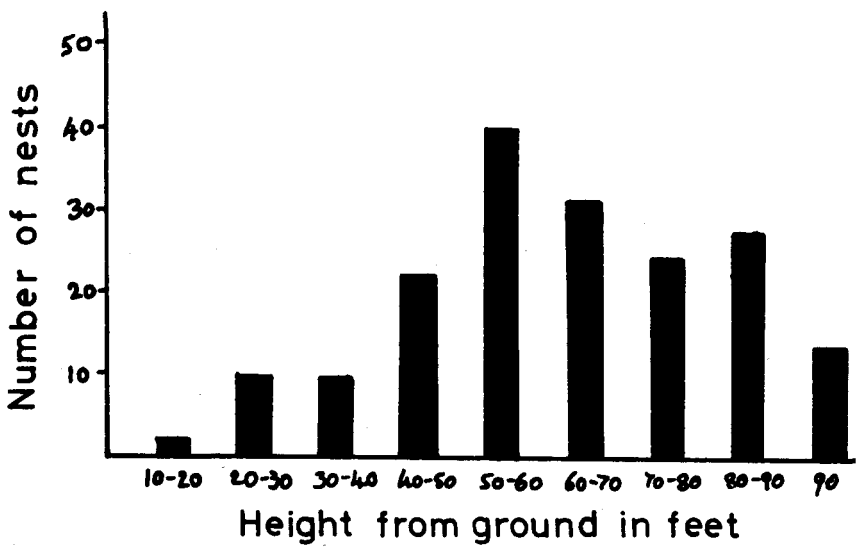

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Plate 5
Orang-utan
nest

probably indicates a difference in the type of forest being studied. Several nests were cut down to enable a closer examination of their structure.

Having found a suitable site an orang-utan bends in the surrounding small branches and holds them under itself with its feet, twisting them and tucking them together to form a concave springy platform. This takes only two or three minutes but improvements may continue long after this. Examination of the structure of several nests showed that branches had been used in four main ways: (1) rimming: a branch bent horizontally to form the rim of the nest, held in place by other branches bent over it; (2) hanging: a branch bent down into the nest from above and tucked in to form part of the nest bowl, giving the nest suspension support; (3) pillaring: a branch coming up beneath the nest which is bent over into the nest, holding in the rimming branches and giving the nest support from beneath; (4) loose: a branch broken off entirely and laid in the bottom of the nest floor. Although of course, not evident from examined nests, orang-utans often hold or balance loose branches over their heads to form a roof or give shade. Nests are usually built against the main trunk or branch of a tree, but sometimes they are made in the main crown of a small tree, in the minor branches or even where branches of two trees cross, thus being suspended like a bridge across the gap between the trees.

Orang-utans make a new nest each night. Infants share a nest with their mothers; juveniles make their own nests at night close to their mothers, though they will nest with the mother if there is no younger sibling. Nesting time in the evening varies with the weather and the state of the animal. 17.30 hours is about the normal nesting time, but a hungry animal may go on feeding and nest later than usual – the latest observed was 18.30 hours. If, as is often the case, the evening is cloudy and dark, orang-utans nest earlier than usual. Often they make a nest in very heavy rain, and if this is done in the afternoon and the rain does not stop before dusk, they may remain in it all night. After a morning feed, orang-utans sometimes return to their previous night's nest and

rest again. Most orang-utans rest for a few hours through mid-day, sometimes making a new nest for this, sometimes lying down on some branch or epiphytic platform, or occasionally using an old nest, usually after placing a few new branches in the bottom of it. Day nests that I watched being made were higher than average nest height – this might be because of my presence. One night nest that was certainly abnormal was made by a sub-adult male, who, after showing signs of discomfort at my presence, climbed very high up an enormous tree and started to make an enormous nest at about 140 feet high. For about twenty minutes he went on adding more and more material until he had a nest about 7 feet deep and 4 feet across.

Branches were placed or held above nesting animals for four reasons: as a shelter from heavy rain, a sun shade, to hide the animal from my view, as a play-hat by young animals who had just made a play-nest (see page 180).

Locomotion and Posture

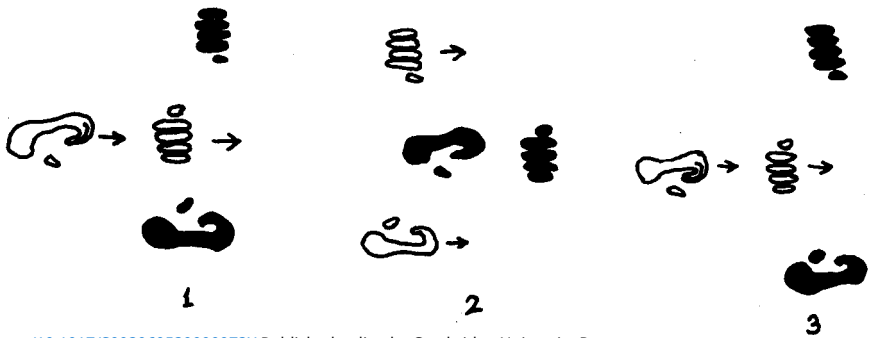
The orang-utan lives in a very irregular environment of tree canopy. No single simple patterns of locomotion would suffice for its need to move through branches of different sizes and angles and capable of bearing different loads. It must improvise all the time and modify its movements to fit any given problem. Thus we find that the orang-utan is anatomically very flexible and that its motor sequences are also very flexible. Sometimes it comes down into the ground, and probably did so even more in the distant past, and thus it has well developed ground locomotion motor sequences in its repertoire. Young orang-utans spend about two years learning how to move efficiently, learning balance, the strength of different sized branches etc., and for a year or so their movements remain awkward and wobbly. Juveniles still sometimes perform awkward movements especially when frightened, though usually by that age they are fairly efficient, and indeed, because of their light weight, enjoy a freedom of tree movement they will never have when adult. When males get old and obese, weight problems again make movements difficult; only their immense strength enables them to continue living up trees, and when even this wanes they must come down and wander through the jungle on the forest floor, climbing up major trunks only to nest and obtain fruit.

The locomotion of orang-utans in trees has been classed as modified brachiation. True arm brachiation does occur for brief moments even in large males but is not a common movement. More common is a careful manner of climbing, hanging from branches above, moving arms alternately forward as in brachiation but holding onto any available support with the feet also. The orang-utans' feet are more prehensile than those of any other ape or monkey, (see Plate 1), enabling them to maintain some very unusual postures and of enormous help to them in climbing. Using both hands and feet orang-utans can easily climb up a liana and can do so with a number of different rhythms. Normally an orang-utan would move the leg and arm of one side, placing the arm ahead of the opposite arm and the leg between the opposite arm and leg. It would climb down a liana in the same way, the head remaining up so it would come down backwards. If the liana was not vertical but

Plate 6 *right* and Figure 4 *below:* Diagonal couplets. In the drawing black indicates contact with the ground, white a limb moving

at an angle, it would hang beneath it and still move in the same way; if the liana was nearly horizontal the orang-utan might climb down it either head first or rear first.

On a slightly inclined branch, however, the orang-utan would remain above the branch and climb along it in a different sequence, putting its right arm forwards, the hand well ahead of its left hand, then moving its right leg forwards with the foot just in front of its left hand; then it would move its left arm forwards, placing this well in front of its right arm and so on. This is its normal quadrupedal gait on horizontal branches; it is different from its quadrupedal gait on the ground, of which I saw three types. First, diagonal couplets which is the normal locomotion on flat ground: one arm and the opposite leg are splayed apart and form a gate through which the other arm and leg are moved at once, the arm being in front of the leg. The first movement is stable laterally while the second movement is stable longitudinally. An orang-utan can move in this way using either leg and its opposite arms as the gate. (Plate 6 and figure 4).



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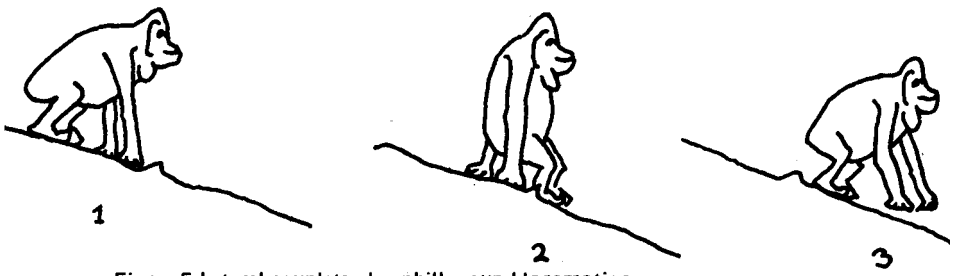


Figure 5 Lateral couplets; downhill ground locomotion

Chimps and gorillas have hard knuckle calluses which they use for walking on; orang-utans lack these calluses and show great variation in which part of the hand is placed on the ground in quadrupedal walking. Many, however, place the hand palm down with the knuckles at the rear – a very different position from that of chimps.

Going downhill the rhythm may be changed and the arm of the central pair put down before the foot which follows it. Down steep hills the animal may form a gate with the two arms and bring the legs through this (Figure 5). Bipedal walking is sometimes seen in captive animals (Plate 7).

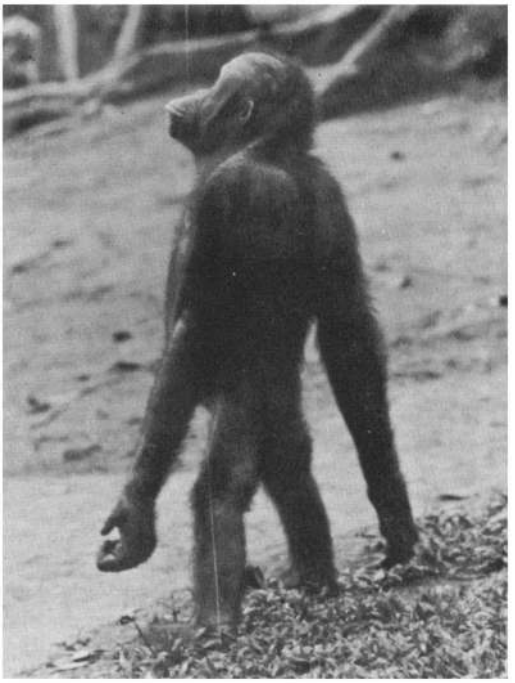
Thus we have six quite different rhythms of limb movement:

Bipedal walking	RL, LL, RL, LL
Liana climbing	(RA + RL), (LA + LL) longitudinal couplets
Horizontal climbing	RA, RL, LA, LL
Level ground walking	(RA + LL), (LA + RL) diagonal couplets
Downhill ground walking	RA, LL, (LA + RL) diagonal triplets
Alternate downhill ground walking	(RA + LA), (RL + LL) lateral couplets

The last rhythm is also used in another form of locomotion, 'bear climbing'. This is rarely used for climbing up trees, but small orang-utans quite often descend this way. The arms and legs hug the tree trunk and the animal lowers itself by alternate movements of its arms and legs, rather like the looping locomotion of a geometrid caterpillar or a leech. Normally the animal descends back first, but I have seen a baby climb head first in this fashion down a branch at about 45 degrees (Figure 6).

When crossing from one tree to another an orang-utan will climb as far out as is safe on one tree, reach out and grab a twig of the other tree, pull it towards itself, get a grip of the branch and then pull it in. Only when it has sufficient hold of the other tree to support itself will it transfer its weight to that branch and swing across. Often the next tree is out of reach and the orang-utan has to swing its own tree backwards and forwards in increasingly large oscillations until it can catch hold; it then releases its hold of the first tree and the new tree

Plate 7
Bi-pedal
walking



swings back past its normal position, enabling the animal to grab at the next tree along. If trees are the right size and distance apart this form of locomotion can be quite quick. (Plate 8). This tree-rocking locomotion is very important to large males which cannot venture to the extremities of the branches. An animal moving in this way makes a lot of branch noise and can be heard about a hundred yards away.

Orang-utans are normally very careful movers, testing everything before they place their whole weight on it. They hold on to as many different branches as possible, distributing their weight better and having other holds if anything should break. I have only once seen an

Figure 6 Head-down bear-crawl

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Plate 8 Swinging one tree while stretching out for another.

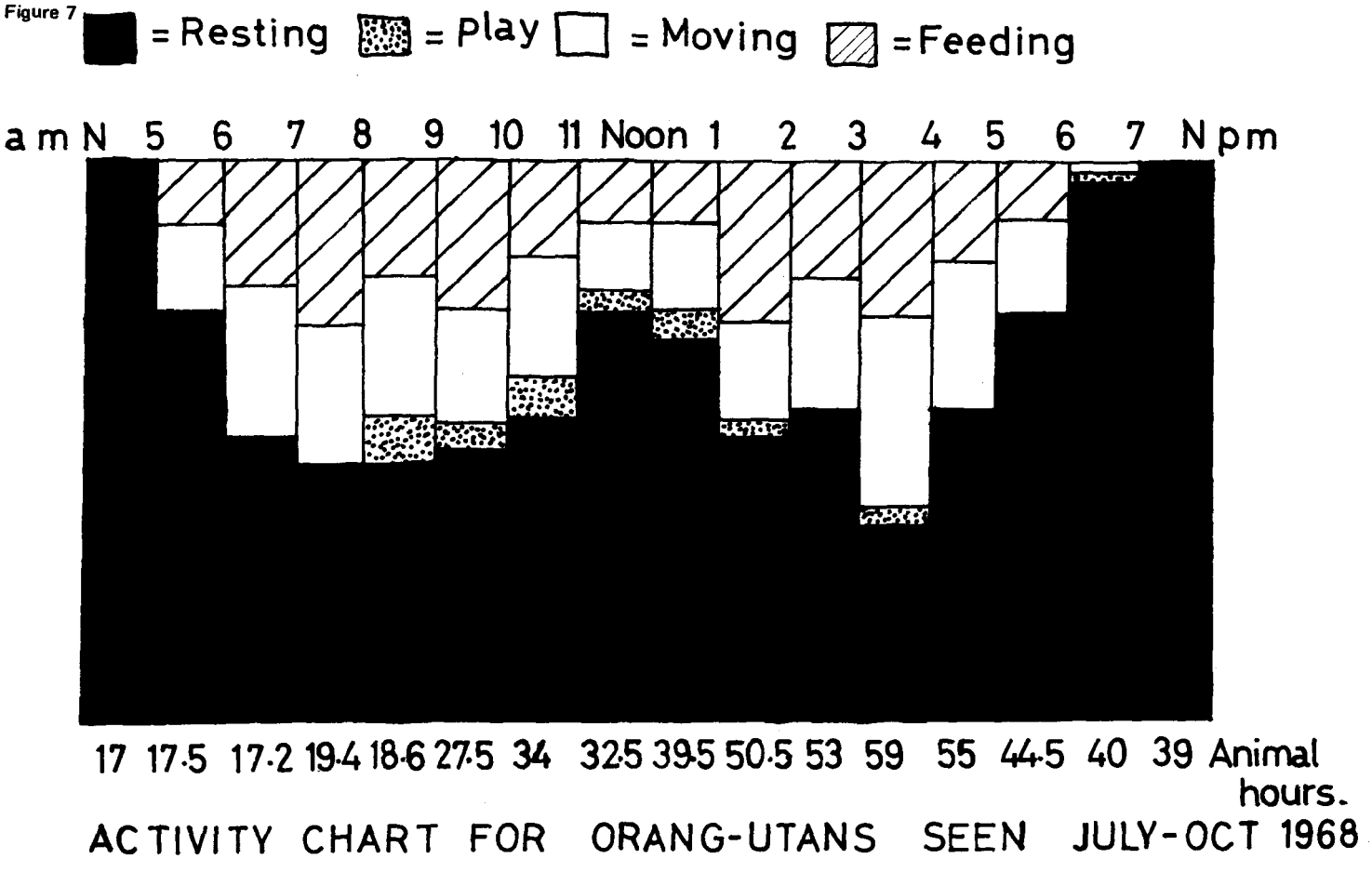
orang-utan fall; this has also been observed by David Horr in the Kinabatangan area (personal communication). When disturbed, however, they are sometimes less careful and dash about violently in trees, often purposely putting enough force on branches to break them and displaying by shaking branches and vines. If very frightened they may flee, moving fast and wasting no time testing the strength of branches. One method of descending a tree quickly I have termed the 'tumble descent'. The orang-utan virtually allows itself to fall but catches on to branches with hand or foot as it goes down. The animal may perform cartwheels in its hurry to descend. I have only once seen a 'leap', when a lone female adolescent climbed very fast up a large tree, out along a branch and leapt off, landing in a large bush about fifteen feet below and continuing through the trees at great speed. However, this sort of 'blind flight' is rare in orang-utans, which do not normally show much fear of human observers. Shyness, curiosity and annoyance are more normal.

The orang-utan's legs are hinged to the pelvis in such a way that they can be easily bent back into positions not possible for a man, enabling the animal to maintain numerous difficult postures in trees for collecting food, mating, moving, etc. Normally the orang-utan keeps its spine nearly vertical and its head up, but it usually lies down to rest and sleep. Orang-utans can hold on by their feet to enable them to pick fruit below them with their arms.

Daily routine: feeding, drinking, resting.

Orang-utans often nest for the night close to where they last fed, and remain in the nest throughout the night. If restless they sometimes make calls and sometimes feed. The local Dusun people say that on moonlit nights in the durian season they can be seen feeding in these trees well into the night. On one moonlit night a young orang-utan left its nest twice between 18.00 hrs. and 19.30 hrs., broke off and dropped

Figure 7



branches and made vocalisations at me. On another occasion an adult female was feeding out of her nest on the fruit of the nest-tree in nearly complete darkness at 05.15 hrs., and then returned to her nest. Animals were often active before and at first light. Davenport found in the Sepilok area that he was losing contact with orang-utans during the night; I suspect that these were mostly slipping away just before dawn in an attempt to escape surveillance. Several orang-utans that I observed made efforts to 'get lost'. I think that leaving the nest in the night and not returning is unusual.

The Weather

The weather is a decisive factor in early morning activity. Often an orang-utan will leave its nest, feed and return to it soon after dawn, but on cold, misty or windy mornings, they tend to remain longer in the nest. After one very wet night a female with infant moved and made a fresh nest in the early morning.

Typically the morning is spent in sporadic movement and feeding. Each bout of feeding being followed by a period of rest. There is usually one long period of rest through the midday, for which a day-nest is often constructed, or an old nest may be renovated, or the animal may lie down on a natural platform. Young animals seem to require or desire less midday rest than older ones, often leaving their resting mothers to wander off on their own, feed or play; when they return their mothers will sometimes play with them.

The afternoon and evening are again spent in bouts of feeding and moving followed by periods of rest. Nest-building for the night starts when it begins to get dark, usually at about 17.30 hours. Sometimes they go quite long distances, but usually they nest close to their last feeding place, so that food is near at hand for an early meal next day. The presence of good abundant fruit, especially if the animal has not had much food that day, may delay nesting time; rain and bad weather may hasten it.

Normal daily routine may be upset by the weather. Heavy rain may induce long resting periods at unusual times of the day and may cause an animal to miss normal feeding periods. In heavy rain animals sometimes make nests and may even place broken branches over themselves for shelter. Light rain does not seem to bother them; they continue feeding or moving and may lick water from their fur or from vegetation.

The presence of a disturbing influence such as myself also sometimes upsets their routine. Animals may expend a lot of energy in vocalising and displaying with branches, or they may simply climb up a tree and sit still for several hours. They may go unusually long distances unusually fast in attempts to escape, or at unusual times such as in the dark or in a heavy rainstorm.

Small animals do not require so much food and do not need to spend so long feeding as adults. Thus the young play during much of the time that their mothers are feeding; adult males sometimes sit eating continuously for several hours.

Feeding

The orang-utan is by preference a fruit eater, but as fruits are seasonal it must make do with less nutritious foods for much of the year. Because they are large and have a great capacity for building up fat stores organ-utans can to a certain extent use this fat to get through the monsoon. By January there is little fruit and they are feeding largely on lianas, leaves and epiphytes that grow on the great Dipterocarp trees. Come March the weather becomes drier and a lot of flowers and fresh growth appear, which they eat together with a lot of lianas. During April the commonest of the forest vines, locally known as Ramus, puts out new leaves, limp and pink, and for nearly two weeks the orang-utans feed almost exclusively on these. They then move down into the smaller valleys and eat the new shoots of a common creeping cane *Dinochloa pubiramea.* By June there are various small fruits but the one they most commonly eat is that of the very abundant creeping cane. By July there is a great variety of fruit, and they eat the famous durians and rambutans, even though still unripe. This habit of eating unripe fruit probably gives the orang-utan an edge over other fruit-eaters, such as gibbons and hornbills, which prefer it ripe; it also prolongs the season of each fruit which is very important for a nomadic animal. The trees that have fruited produce a lot of young leaves in August and September which they eat. There are still quite a few later-ripening fruit, but towards the end of the year the number of available species diminishes as the next monsoon begins. Fig trees fruit all the year, but these are mostly monopolised by such specialists as gibbons and hornbills. Only when the big strangling-figs give fruit do orang-utans compete for the fruit. Throughout the year they eat insects in small quantities, especially ants and little bees. I have seen an adult male orang-utan eating one of the big hanging bees' nests in a giant mengaris tree, sitting above the nest and reaching down. Surrounded by a swarm of angry bees, he kept his eyes closed, occasionally waving an arm at them but mostly just quietly munching the comb of honey and grubs. The grunts he made periodically may have been grunts of pleasure at the good food but were more likely caused by bee stings.

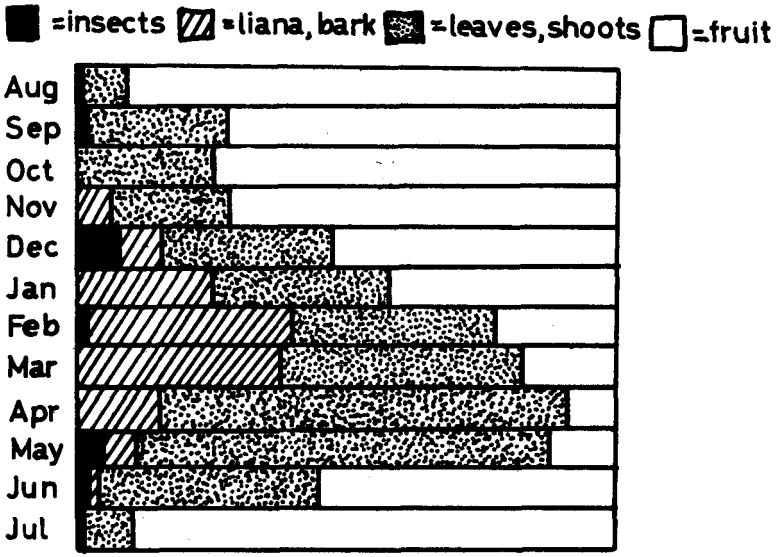
There has been some conjecture whether orang-utans catch and eat animal meat in the way chimpanzees do. Captive orang-utans accept meat readily. According to Bornean natives large males do become carnivorous when they grow too heavy to live up trees. I have been chased by ground-moving males on five occasions but do not feel that such behaviour is motivated by a desire for animal meat. However, I have often seen orang-utans investigating tree holes and believe them to be searching for nests. On one occasion an orang-utan threw down a lot of nesting material from such a hole, but I could not see if it found anything. I am sure they would eat eggs, young birds or baby squirrels if they found them, but I doubt if they ever catch anything more active.

The histogram (Figure 8) shows the proportions of different food types making up the total food each month as calculated by the number of occasions each food type was eaten. These data are determined from direct observation of feeding, dung analysis and finds of other positive signs of orang-utans eating.

The list of food plants on pages 166 and 167 gives some idea of the enormous variety eaten. From a wide census of two thousand trees in the area it was possible to work out the relative abundance of these various foods, and by dividing their abundance by the number of times each fruit was in fact eaten it is possible to estimate the popularity of each one. We find that the fruits most favoured by orang-utans are all uncommon. Eleven of the top twelve fruits are classed as rare (less than one tree per acre). The orang-utans' nomadic habits enable them to forage these rare and dispersed fruits more efficiently than monkeys that are restricted to small territories, for they can congregate in areas where fruit is abundant, move into different types of forest in the different seasons, and follow ripening seasons over large tracts. Due to small weather differences one area of forest may be especially rich or especially poor in fruit in a given season. Only a large nomadic animal with very loose social cohesion could succeed in exploiting such a seasonal and unreliable food source.

Unlike the wild chimpazee which is very conservative in its diet and will not attempt any new food unless it sees another chimpanzee eating it, the orang-utan will try almost anything that looks edible. I have found discarded fruit of obnoxious flavour which an orang-utan had tested with his teeth, and also fruit marked by orang-utan teeth that was so hard as to be physically inedible. As there are 3000 species of tree in Dipterocarp jungle there are too many types of fruit in the jungle for even a forest botanist to remember never mind an orang-utan,

Figure 8



Monthly composition of diet.

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Figure 9 Bending a branch to get the fruit

it is worth while testing anything unfamiliar. Some fruits orang-utans pick off the tree with their hands; with very large fruit, such as *Durio* and *Artocarpus*, they may have to bite through the stem, and they then take two or three of these big fruits to a large branch or a day-nest where they sit to eat them and then return for more.

It is not unusual to see one walking about with a large fruit in its mouth and another in one foot. With smaller fruit the orang-utan may merely bend branches towards its mouth and pluck the fruit off with its lips or teeth, (Figure 9) or it may break off a whole branch of small fruit and take it to a nest or somewhere where it can sit and eat at leisure. Some fruits are bitten open, some broken open with a finger-nail; a feeding orang-utan is often audible from 50 yards or so by the noise of dropping shells and fruit stones. Many jungle fruits have sweet flesh attached to a hard stone. The orang-utans fill their mouths with these and grind them round, rasping off the flesh, occasionally pushing some of them on to its extended lower lip, and squinting down at them to see how it is getting on; eventually it spits them all out. Some stones are consumed and found in the dung next day.

Orang-utans sometimes come down to the ground to eat small portions of mineral-rich soil, usually near a large limestone rock.

Drinking

The jungle is very humid and it rains nearly every day, but the tree canopy is considerably less humid than the forest floor and an animal as large as the orang-utan must need a great deal of water in such heat. By resting through mid-day and being active for only about five hours a day, the orang-utan probably reduces its water requirements; also it does not sweat much. Most of its water it gets from the fruit and shoots that it eats, like gorillas. In a one-year study in the Virunga volcanoes, Schaller did not see any gorillas drinking though they have been seen drinking in other areas.

When it rains orang-utans sometimes lick water from their forearms and from vegetation. I saw one animal stoop down and suck up water from a puddle forming at the base of a branch, and with so much rain they probably get a fair amount of water in this way. At other times

Orang-utan foodplants in the Ulu Segama *(genera only)*

Anacardiaceae – the mango family	
Dracontomelum	2 sp
Koordersiodendron	1 sp
Annonaceae – the custard apple family	
Neouvaria	2 sp
Polyalthia	8 sp
Xylopia	1 sp
Apocynaceae – the chewing gum family	
?	1 sp
Bombacaceae – the durian family	
Durio	3 sp
Burseraceae	
Canarium	2 sp
Santiria	1 sp
Combretaceae	
Combretum	1 sp
Connaraceae	
?	1 sp
Cucurbitaceae	
?	1 sp
Dilleniaceae – the simpoh family	
Dillenia	2 sp
Dipterocarpaceae – the winged fruit family	
Dipterocarpus	3 sp
Dryobalanops	1 sp
Ebenaceae – the ebony family	
Diospyros	2 sp
Euphorbiaceae – the rubber family	
Baccaurea	1 sp
Drypetes	1 sp
Fagaceae – the oak family	
Castanopsis	1 sp
Lithocarpus	3 sp
Flacourtiaceae	
Hydnocarpus	3 sp
Gnetaceae	
Gnetum	3 sp
Gramineae – the bamboo family	
Dinochloa	1 sp
Guttiferae – the mangosteen family	
Garcinia	4 sp
Lauraceae – the laurel family	
Eusideroxylon	1 sp
?	1 sp
Lecythidaceae	
Barringtonia	1 sp
Leguminosae – the pea family	
Crudia	1 sp
Dialium	2 sp
Fordia	1 sp
Intsia	1 sp
Phanera	1 sp
Saraca	1 sp
Sindora	1 sp
Sympetalandra	1 sp

?	1 sp
?	1 sp
Loganiaceae – the strychnine family	
Strychnos	2 sp
Magnoliaceae	
Michelia	1 sp
Talauma	1 sp
Meliaceae – the mahogany family	
Amoora	1 sp
Aglaia	1 sp
Dysoxylon	2 sp
?	1 sp
?	1 sp
Lansium	1 sp
?	1 sp
Moraceae – the fig family	
Artocarpus	4 sp
Ficus	7 sp
Prainea	1 sp
Myristicaceae – the nutmeg family	
Myristica	1 sp
Knema	1 sp
Myrtaceae – the eucalyptus family	
Eugenia	3 sp
Orchidaceae – the orchid family	
Eria	1 sp
Coelogyne	1 sp
Oxalidaceae	
Sarcotheca	1 sp
Palmae – the palm family	
Calamus	1 sp
Rosaceae – the rose family	
Prunus	1 sp
Rhamnaceae	
Ziziphus	2 sp
Rutaceae – the citrus family	
Glycosmis	1 sp
Merope	1 sp
Sapindaceae – the lychee family	
Euphoria	2 sp
Nephelium	5 sp
Pometia	1 sp
?	1 sp
Sapotaceae – the gutta-percha family	
Ganua	1 sp
Palaquium	1 sp
Simaroubaceae	
Irvingia	1 sp
Sterculiaceae – the cocoa family	
Pterospermum	1 sp
Tiliaceae – the jute family	
Microcos	1 sp
Vitidaceae	
Leea	1 sp

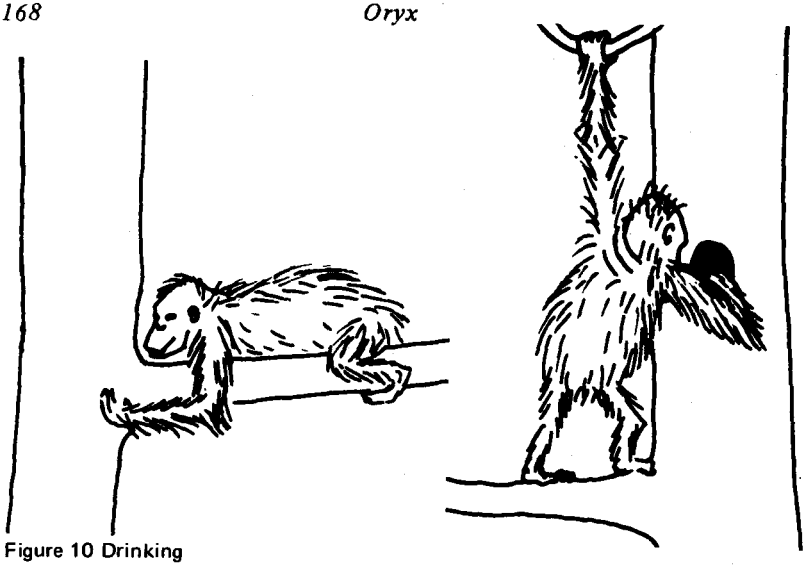

Figure 10 Drinking

they must rely on water trapped in tree holes. I once watched a young male orang-utan drinking continuously for twenty minutes at a hole in a tree trunk, holding on to a branch above with his left arm, and keeping his mouth close to the opening, while with his right arm he scooped up the water very fast; from the occasional loud sucking noises I gathered he was sucking the water off the back of his hand and wrist. He brought his hand up about every three seconds, making quite a splash each time; every few minutes he would stop, look around and then continue. Although I was only 10 yards away just beneath him, he did not notice me till he had finished and left the tree. From the way he had approached the tree and come down straight to the hole, which was on the far side from him and therefore invisible, I suspect that he had been to it before (Figure 10).

During the monsoon, when fruit becomes increasingly scarce, orang-utans obtain a great deal of water from lianas. They tear strips off the thick woody vines and chew these up, sucking out the juice and eventually spitting out the mass of fibre. Bornean natives also obtain a good deal of water from vines; a good vine will hold up to a pint of water per metre of its length.

I have seen orang-utans on the forest floor on 19 occasions but there is no evidence that they come down to drink at streams. Several times I have watched them for a whole day without their drinking at all.

In captivity and in the semi-wild state in the Sepilok, they drink a lot of water and also enjoy playing with it and even in it. They do not show the great dislike and fear of cold water that the chimpanzee does, although captive chimpanzees often develop a great fondness for playing about in water. In the Sepilok I have seen animals drop head first into a large tub of water, but this is the only water they play with and drink; they do not drink from the stream only a few yards away, though I did see one animal go down to this stream, dip one hand in the water and swirl it about in play.

Wild chimpanzees drink from streams, puddles and tree hollows; when possible they stoop to suck up water, otherwise they too use the backs of their hands and fingers, and in the Gombe Stream Reserve they have been observed using a sponge of chewed leaves. Gorillas also drink by scooping up water and sucking it from the backs of their hands or by stooping down and sucking it.

Group Composition

Whereas all other higher primates are sociable, forming groups or at least family parties, the orang-utan is primarily a solitary animal. Of 146 sub-groups I encountered, the average size was 1.83; 84 per cent contained only one independent animal, usually a female accompanied by dependent young. Young animals seem to leave their mother relatively early and several juveniles and almost all adolescents were independent. Animals were classed in the following way:

1. Infants (I) – small animals always close to adult females. Any animal that rode on a female, suckled or nested in the same nest as a female. Approx. 0 – 2½ years, 3 – 20 lbs.
2. Juveniles (J) – small animals often with adult females. Independent of female, showing little or no physical contact with her; nesting alone if mother has a more recent baby. Approx. 2½ – 5 years, 15 – 16 lbs.
3. Adult females (F) – medium-sized animals whose sexual maturity is shown by pregnancy, possession of a baby or old age. Approx. 8 years, 60 – 100 lbs.
4. Adolescents (A) – small to medium sized animals, difficult to sex unless good genital view is obtained. Independent of female, larger than juveniles. Approx. 5 – 9 years, 50 – 120 lbs.
5. Adult males (M) – large broad animals obviously male but often having beards and fatty callosities and enlarged dewlaps. Approx. 9 years, 90 – 250 lbs.

The following groupings were seen:

Grouping	Frequency	Number of animals
F	4	4
FI	16	32
FJ	32	64
FIJ	13	39
FIA	1	3
FJA	1	3
J	8	8
A	10	10
AA	1	2
M	40	40
FIM	4	12
FA	1	2
AAM	1	3
JA	1	2
FJM	5	15
FJF	1	3
FIAM	2	8
FMM	1	3
FM	1	2
FJAMM	1	5
JM	1	2
FIJM	1	4
Totals	146 groups	266 animals

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We see that adult males are usually alone; the very few involved in consort bonds with adult females were usually younger or sub-adult animals. Adolescents were sometimes found on their own but were usually with other young dependent animals. Otherwise animals were very rarely seen with other animals of the same class, male/male and female/female bonds being virtually non-existent.

The small size of orang-utan groups seems to be advantageous for foraging efficiently and predator avoidance. Groups must be small and well-spaced as individuals can only forage a small area each day and the primary foods are rare and dispersed. As the orang-utan is easily outpaced by its chief predator, man, it must avoid predation by being inconspicuous, solitary and quiet. Only when it knows it has been seen does the orang-utan show its secondary defence behaviour of intimidation display.

Display, vocalisation and communication

Orang-utans have a reputation for quietness. Most of their vocalisations are only audible at close quarters and several are made by inhaling rather than exhaling. The only call which has a long carry is the 'long call' of the adult male, consisting of a series of groans, to which the partially inflated laryngeal pouch gives a deep and resonant tone. The call rises to an early climax, at which point the animal can aptly be described as roaring, then tails off gradually into soft sighs, and ends in a glorious string of deep bubbling noises as the pouch deflates. Such calls, which may last up to three minutes and are audible from a distance of a kilometre, are made rather infrequently, being heard only 241 times during 394 days spent in the field.

The reactions of other orang-utans, seen on 83 occasions, showed that the function of the call is not to attract females, as the Bornean natives traditionally believe, but to maintain spacing between males. Females typically showed no reaction, not even turning to face the call. Adult males, however, showed considerable, though varied, response. Sometimes they gave 'long calls' in reply, at other times they remained unusually quiet themselves. On one occasion an animal hurried towards the caller as if to chase him off, shaking branches as he went; on another an animal moved away in the opposite direction. Thus the calls seem to keep the males apart, each calling male defending vocally an area around himself wherever he goes. This hypothesis is supported by the rarity of male/male encounters. In 1200 hours of direct observation only one such meeting took place. One male remained quiet and hidden at the top of a tree as he watched a larger male come down the hill towards him; finally he rushed away through the trees in violent display when the larger animal was about thirty yards away.

'Long calls' are given irregularly, sometimes several in a day sometimes none over several days. There is no significant change in calling rate month by month, and calls may be given at any time of day or night. There is a certain variation through the day, however, with an early morning peak about dawn and a larger peak in the late morning. Males were observed when they called on 59 occasions. Sometimes calls seemed to be given spontaneously but very often they immediately followed a sudden sound cue. Calls were apparently triggered by the

sound of pigs (1 occasion), the bark of a deer (1), a human sneeze (1), a distant gunshot (1), a sudden gust of wind (2) and a clap of thunder (1). Far more effective cues, however, were the calls of other orang-utans (11), the crash of a nearby treefall (12) and the sound of breaking branches (8). Various characteristic behaviour features prior to, during and after calling indicate that the animals were 'angry'; these included the inflation of the laryngeal pouch, hair erection, shaking of branches, rocking, and the performance of sudden and violent minor movements. On one occasion such an animal chased and attacked a female; on another a male avoided meeting a female, who could be heard coming through the trees, by climbing down and moving away quickly along the ground. Such calling males are particularly unsociable; of twenty-five individuals observed all but one were alone, and all appeared to be in an anti-social, bad-tempered mood and irritated by such trivial disturbances as the calls of other males and falling timber, the 'long call' being almost an ululation of displeasure at their environment; the presence of other males nearby seemed to intensify this mood. It is possible that this anti-social behaviour which is induced by overcrowding, affects the birth-rate, as males no longer form consort pairs that appear to be necessary for successful mating. This idea is supported by the fact that if we compare the populations on either side of the Segama river we find that on the north side males give calls on average three times as frequently as those to the south. Judging from the percentage of males found with company in the different areas, we can also say that the northern males are less than half as sociable as their southern counterparts. The female/infant ratio in the northern areas is 0.3 as compared to 0.8 in the south. As the range of the northern population is being reduced by the activity of timber companies it is possible that the population has become overcrowded and that the males are consequently less sociable with a resultant drop in the birth-rate.

Reaction to Disturbance

When an orang-utan is disturbed by the presence of some other animal, especially man, it makes a variety of noises and gestures, often accompanied by violent bouts of shaking, breaking and throwing of branches. Such displays vary greatly with the mood and nature of the animal and the source of the disturbance; fear, anger, frustration and inquisitiveness are probably the main motivations.

Noisy displays involving branch manipulation, missile projection and vocalisations are found in other apes and many arboreal monkeys. Normally orang-utans were not frightened of me and exhibited variations of fairly standard threat pattern of which branch-shaking was a prominent feature. Branches were often broken off and thrown to the ground. Normally they were simply dropped; sometimes they were swung underarm before being released, but this I feel is a combination of waving and dropping a branch and not a conscious attempt to direct its fall. Branches were sometimes broken off from above the animal and hurled down overarm. Again I do not feel there is any intended direction, the throw is merely a violent extension of the breaking

movement. None of these methods achieved any more than a vertical drop of the branch, so only someone directly beneath would get hit. On four occasions orang-utans moved towards me so that they were directly above me when dropping, and on two of these the animals followed overhead when I moved away. Once a young male pushed a termite pile off a branch; it hit the ground a few feet away from the tree and burst into pieces that crashed around me.

This behaviour shows a use of directed projectiles similar in degree to that found in gibbons, leaf monkeys and proboscis monkeys, which will move above a disturbing animal and urinate or defaecate; proboscis monkeys and macaques will drop branches. Baboons have been reported as dislodging rocks to roll down hillsides; this has been discredited by some research workers, but I have myself twice seen this sort of behaviour in baboons in Africa.

The orang-utan seems to show a crude use of projectiles no more advanced than gibbons and monkeys and far less advanced than in the chimpanzee, where aimed throwing is well developed. In their displays, male chimps throw rocks underarm, though not usually directed; at other times, however, they stalk other individual chimpanzees or baboons and throw aimed rocks. Most of the staff at the chimpanzee research camp in the Gombe Stream reserve have at one time or another been hit by rocks thrown by chimpanzees (personal observation).

Threat Pattern

The standard threat pattern of the orang-utan is to raise the head, extend the lips into a trumpet and suck sharply inwards producing a loud kiss-like squeak. This is followed by about two deep grunts 'grumph grumph', which in turn may be followed by a series of gulps 'clomp clomp' etc. at about one-second intervals; branch shaking or dropping often occurs after the kiss squeak and grunts. Different parts of this sequence can be omitted or exaggerated, and other threat calls can be interspersed. The sequence is not always regular. Barbara Harrisson describes a noise she called 'blowing a raspberry' this is made with the lips in the same position, but air is blown out through the lips and not sucked in. I have heard this noise often in animals in the Sepilok but only once in the wild.

Another noise used in threat displays is a single-tone sharp bark, which seems to be made when an animal is aware of the intruder but has not seen him, and may be a warning call. The other noises made I have tried to fit into the scheme below, but as each animal makes these noises with a different tone and rhythm it is difficult to categorise them. Some of the noises are exhalations, some inhalations; some are a combination of both. None are clear sounds; they have a lot of rasping in them. The 'lork' noises are quite loud and often in repeated series of up to a dozen. The barks are also quite loud, but most of the others are difficult to hear clearly over the normal loud noise of the jungle.

Screaming or crying, which I have often heard from young orang-utans in captivity, was heard several times in the wild. The noise is a double sound consisting of an exhilatory high-pitched cry drawn out for two or more seconds, often wavering, followed by a hoarse

Name of Vocalisation		Description of Sound	Situation
1.	Crying, screaming	Long high-pitched screams interspersed by choking intakes of air	Young animals when frightened or in pain
2.	Frustration scream	Long wavering screams lacking choking sound	Young animals when food withheld
3.	Fear squeak	Small short squeak	Young animal when frightened
4.	Soft hoots	Pout-face hoots	Young animals when worried; also mothers to indicate worry to their infants
5.	Play grunts	Huffy 'haah' noises	Noises made in high intensity play
6.	Kiss squeak	Sharp intake of air through trumpet lips causing long kiss sound	Excitement; part of intruder display, fear.
7.	Raspberry	Sharp expulsion of air through liquid lips again extended	Similar occasions to kiss squeak
8.	Chomping	Sharp raising of lower jaw forces air out of mouth cavity in an internal gulp; mouth can be closed for this noise	Intruder display
9.	Lork noises	Loud repetitive noises	Made by animals frustrated by my persistent observation
10.	'Ahoor' calls	Loud long exhalations	Threatening intruder
11.	Barks	Single sharp exhalations	Warning call?
12.	'Grumphs'	Deep throaty grunts and gulps, head often turned away; following kiss squeak	Part of display
13.	Complex calls	Long strings of deep guttural noises sometimes repetitive, combination of several noises above	Threat display
14.	Long calls	Very loud series of long groans	Males when upset, sometimes in reply to other calls
15.	Mating cries	Loud piercing shrieks	Female during mating

choking inhalation rather like the glottal cramp screaming of a chimpanzee. If the animal is very upset this sounds like a roar.

Babies screamed in this way when they were frightened and separated from their mothers. Usually the baby would rush back to its mother and cease crying as soon as she embraced it. On one occasion a baby started crying when its mother continued moving at a fast pace through the trees although it was getting dark and well after normal nesting time. They went several hundred yards before they stopped for the night with the crying baby following its mother. They had not seen me. On the occasions I have been present at matings the baby has invariably screamed at the male in apparent fear. I heard a similar screaming from a five-year-old male in the Sepilok when food was withheld from him. This frustration screaming lacked the choking intakes of air that characterised the crying.

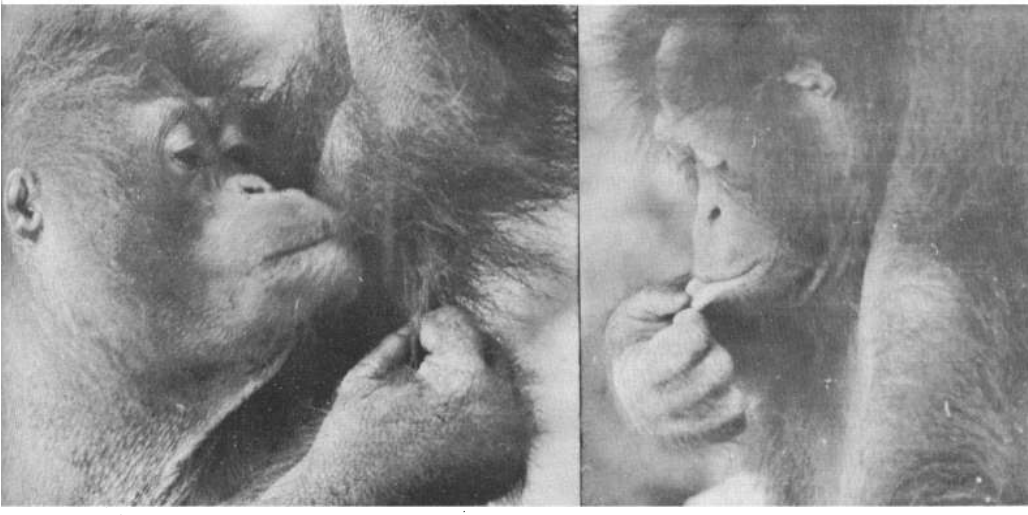
Fear squeaks were heard twice in the wild when infants saw me and ran to their mothers. I have also heard this in the Sepilok when one of the rangers chased a young tame orang-utan in play. Joan and her baby in the Sepilok made soft hoots if either of them was worried. The sound is made from a pout face, i.e. lips pushed forwards, which is slightly different from the pouted shape of the lips when making kiss squeaks.

Screams were sometimes made by females during mating and these differ from baby screams in the lower pitch, lack of a choke and regular fashion in which they are made over several minutes.

Sometimes displays at me were accompanied by arm and leg shaking or waving gestures, which may be intentional throwing gestures. One adult female held an arm out towards me and held the position for several seconds; as this is a chimpanzee ingratiation gesture I wondered whether the orang-utan was seeking reassurance. I held out my own arm in reply; she remained holding out hers, then let it fall back. She remained quiet for about 10 minutes watching me then she resumed her threat noises. I have seen the gesture since on several occasions but its significance still remains unclear.

One young animal at the Sepilok rehabilitation centre was sitting down on the ground when a cat approached him. He waved his left arm above his head with the hand bent over so that the wrist and back of the hand faced the cat, as though trying to brush it away. This movement is extremely like the 'arm raise' with 'soft bark' threat of the chimpanzees in the Gombe Stream Reserve. I have since seen this gesture used by young orang-utans in threatening other orang-utans.

Changes in mood in orang-utans are recognizable by changes in the facial expression. As with other monkeys and apes such expressions play a role in orang-utan interaction. The playface and a particular jaunty approach communicate a desire to play; the playface then becomes greatly intensified during play (plates 11, 13 pages 179, 182). Fear is expressed as in other higher primates by drawing back the side of the mouth and exposing the teeth in a grimace. Mild worry is expressed by a pouting of the lips.



Plates 9, 10 Female grooming

Social Bonds: grooming and aggression

As in chimpanzees, orang-utan populations break up into foraging sub-groups of rather loose cohesion and permanence, and in both species family ties are the strongest. However, in the orang-utan, sub-groups are much smaller than with other monkeys or apes averaging only two individuals, and all social interaction seems to be minimised.

When two animals meet in the wild there is no visible sign of greeting and usually no sign of fear, excitement or even interest; the normal activities that help to form and strengthen social bonds hardly occur in orang-utans, and also grooming which seems to serve the function of 'polite conversation' in primates and other animal society, is rare. Mothers groom their infants infrequently and most animals groom themselves occasionally, but grooming seems to be limited to its hygienic and comfort (scratching) function, and, as in chimpanzees, involves going through the hair with a finger or thumb or both, and occasionally picking things off with the lips. The grooming orang-utan does not have the look of deep interest and concentration that the grooming chimpanzee does. Plates 9 and 10 show a female grooming herself.

The mother functions not only as a source of food, reassurance and transport, but also as a playmate to the infant, and a strong mother-infant bond is formed. However, young orang-utans seem to become independent at an early age and leave their parents earlier than young chimpanzees or gorillas. Females have young at approximately three-year intervals.

Because of the small group size, young orang-utans rarely have a peer to play with. If lucky an infant will have a juvenile sibling to play with; otherwise it can only play with its mother except on the rare occasions when they meet another sub-group with a youngster.

Fifteen consort pairs were seen of adult males and adult females. These were of varying stability but were usually maintained for the entire time I was able to follow them, and seemed to be mutual, females following when males took the initiative and vice versa. It is probably within the context of such relationships that most successful matings occur.

In the Sepilok rehabilitation camp, most of the animals are orphans, removed from their mothers earlier than is normal. Some have formed friendship bonds and split into small sub-group units. Thus, for instance, a female Coco, about seven years old, always went around with the adult Joan and her baby. Young orphans in the Sepilok, deprived of the reassurance of their mothers, find mutual comfort and reassurance in each other. Weaker friendship bonds probably account for the adolescent/adolescent and adolescent/male linkages that are found in wild sub-groups.

As one would expect in animals that rarely meet, aggression in orang-utans is rare, and they remain unaggressive even when crowded together as they are in the Sepilok. Squabbles are rare even at feeding time. However, Joan, who is the largest animal there, did once bully and seriously bite a baby orang-utan, and because of this infants there are now enclosed until they are large enough to look after themselves among the bigger animals.

Orang-utans have been known to injure people, usually by biting them, but this is only if the animal is wounded, enraged or frightened. The natural temperament of the orang-utan is placid, shy and easy-going, very different from the excitable chimpanzees.

Sexual Behaviour

Sexual behaviour was seen very rarely, but then it was uncommon to see adult males and females together. Seven of the eight matings seen were examples of unwilling females being raped by aggressive males. The females showed fear and tried to escape from the males, but were pursued, caught and sometimes struck and bitten. Sometimes the females screamed; their dependent young always did so, biting, pulling hair and hitting at the males during mating. The male usually grasped the female by her thighs or round the waist with his prehensile feet, but by pulling herself about by her arms a female can keep moving and the male is forced to follow. One mating started at the top of a tree and ended on the ground. Such rape sessions lasted about ten minutes. The males gave pelvic thrusts for most of this time irrespective of whether the female was dorsal or ventral side up, but with the female moving about so much they rarely if ever achieved penetration. It seems unlikely that such uncooperative matings often lead to pregnancy.

This is rather different from observed zoo matings where females joined in long bouts of sex-play and copulation, sometimes showing signs of thoroughly enjoying such activity. These zoo females, however, become used to their mates and lose their fear; they would be afraid of and avoid a newly introduced male. As it is essential for successful arboreal mating that the female cooperates, it is probably only in the context of pair-bonds that successful mating occurs in wild orang-utans.

Only fifteen such pairs were seen and no matings, but on one occasion a female did invite sex-play by taking hold of a male's penis, only to be rebuffed.

As suggested earlier (page 171) the tendency to form pair-bonds seems to drop when the population becomes overcrowded; animals become more aggressive and anti-social, leading to a drop in birth-rate which may be beneficial.

Both male and female orang-utans in captivity show a great deal of masturbation and rather perverted sexplay with other animals but no such behaviour was seen in the wild.

Infant Development

Wild birth has not been described, but orang-utans have now been born in several zoos and accounts of some of these births have been published. Joan, an eight-year-old female orang-utan rehabilitated in the Sepilok Forest reserve, became pregnant by a wild male and notes were made at the birth of her daughter, but have not been published. They are very similar to an account by Graham Jones of an orang-utan birth at London Zoo. Mothers normally bite through the umbilical cord and sometimes eat bits of the afterbirth. It is usually several hours or even a day or two before the infant first suckles.

Due to the briefness of encounters in the wild no infants were observed growing up, but observations of thirty-seven infants in different stages of development, coupled with observation of Joan's baby in the Sepilok, make it possible to build up a pattern of infant development. I first visited the Sepilok in June 1968; when I returned in October Joan's baby was noticeably more independent. As I was able to get much closer to Joan and her baby than any infants in the wild I was able to observe much more closely such interactions as suckling and grooming, and could hear maternal hoots that would have been inaudible in the wild.

For the first few months of an orang-utan's life it clings to its mother's hair on her ventral surface, the mother giving it support when necessary. The infant is very wobbly and clumsy in its movements and only climbs about on its mother's body. It does not start to leave its mother and explore its surroundings until it is nearly a year old. Gradually it becomes better coordinated and more skilful in its movements, and play patterns appear. It climbs about and dangles from small branches, becoming more inquisitive as it gains confidence and wandering further afield until restrained by its cautious mother. It is still very dependent upon its mother for food and locomotion. The normal carrying position of the infant changes from the ventral position to a sideways position, a change that is analogous to that shown after a few months by chimpanzees, gorillas, baboons and other higher primates. The dorsal position is rare in orang-utans; I only saw this on three occasions. In the side position the infant clings with one arm and leg to the hair of its mother's back while the arm and leg on the other side hold on to her front, its head within reach of the nipple. This position is far more convenient for carrying an infant through difficult terrain than the dorsal position. When a chimpanzee carrying a dorsal

baby goes through a thicket or moves through a tree canopy the baby usually slips down into the old ventral position. As the orang-utan lives its whole life in difficult places the dorsal riding position is rarely seen.

As the baby becomes more independent, it plays more often and starts eating solid food, which it either finds for itself or obtains from its mother. Chimpanzees sometimes squabble when a baby tries to take food away from its mother, and a mother will sometimes steal food from her own infant. Among orang-utans such troubles are usually solved fairly peaceably.

> 15 July 08.30
> Margaret is eating Durian fruits. Midge comes over to her and holds out his hand. He takes hold of the food in his mother's hand and pulls at it. She tries to put it in her mouth but he pulls it away; she releases it and he eats it.

Through the second year of its life the infant spends less time on its mother and more time moving about independently. When frightened it will run back to its mother and it will also sometimes run back if it sees that its mother is worried. Suckling becomes rare.

At two years old the infant is feeding itself and normally moving independently of its mother, though mother sometimes helps.

> 2 Sept. 09.00
> Hydi swings across from one tree to another the baby walking along behind her gets left behind as the tree swings back. Hydi leans back, holds out her arm, grabs hold of a bit of the tree and bends it back again; the baby however has climbed round another way. Hydi lets go of the tree again and carries on.

The infant becomes an agile and sure mover, is strong enough to bite open the big prickly fruits of the jungle and plays vigorously and for long periods each day. It still shares nests with its mother, though it may make experimental nests of its own, and it will still ride on its mother if she goes too fast or is frightened.

Mothers can have babies as little as three years apart, so infancy may be terminated by the arrival of a new baby or because the infant has become independent. It can now be classed as a juvenile; it builds its own nest at night and may wander out of sight of its mother during the day. Sometimes I met lone juveniles, but most were with an adult female. Eventually all ties are broken and the juvenile or adolescent goes off alone or with some other individual or group.

Play

I have categorised as play those activities for which there seems no obvious or immediate purpose other than the enjoyment of their performance.

Play is of great importance to higher primates for learning skill at movement, manipulation and defence; it is also necessary for normal development. Movements and activities that are self-rewarding become

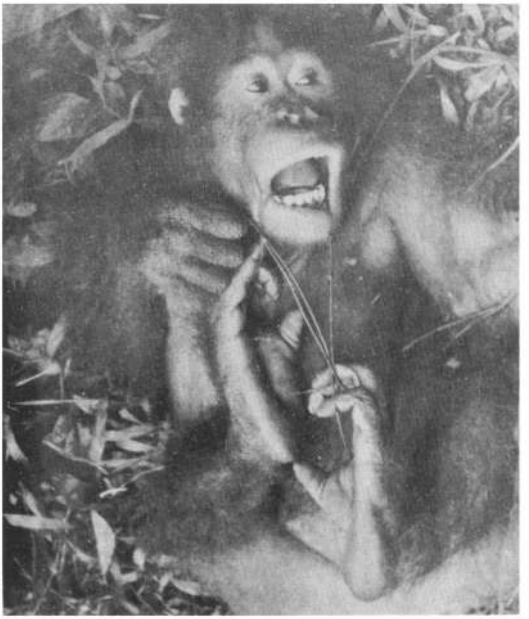


Plate 11 Playing with a vine

reinforced into play patterns or games.

As the orang-utan is such a non-social animal there is usually no suitable playmate for a young animal and much of an animal's play behaviour must therefore be conducted alone. This solo-play starts with the first exploratory movements of the infant, which develop with increasing skill into more stereotyped games such as swinging on lianas and dangling, which involves hanging from some vegetation by one or two limbs and wriggling its body about. Play also includes the manipulation of local objects or 'toys'; animals twizzle leaves, twigs or vines (Plate 11) between their fingers, bite and wave sticks or small branches, break off small branches and place them over their heads as 'hats', or tuck them in the 'neck pocket' between the cheek and shoulder. Similar play occurs in wild chimpanzees. Even adult orang-utans sometimes play with things, as this note of an adult male in a day-nest shows:

> 29 Sept. 12.30
> Gets very hot and sunny. He breaks off a branch and covers himself with it (as a sunshade?). This branch is renewed from time to time. Plays with leaves etc. hand outstretched breaks them off, twizzles them round and drops them.

A juvenile plays a similar game and also a finger game.

> 08.00
> He plays at poking his left index finger into the hole between the

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thumb and first finger of his closed right hand. He also bites off short lengths of vine stem and plays with them, twisting them about and dropping them.

Plate 12 shows a rehabilitated orang-utan in the Sepilok carrying a 'toy', On the ground there are more loose objects lying about than in the trees. The Sepilok animals spend a lot of time on the ground and find all sorts of objects to play with: logs, stones, sacks, food dishes.

Apes, especially chimpanzees, learn many behaviour patterns by imitation, and in their play young animals copy the behaviour of others. Thus a baby chimp watches with interest as his mother catches termites by inserting a piece of grass into a hole in a termite mound. The baby copies – plays with the grass, inserts it badly and in a jerky playful fashion. Only after much practice will the chimp learn this delicate art, and it is in imitation play that they learn such skill. Nest-building behaviour in orang-utans appears to be partly cultural and must be learned from the mother. Young animals sometimes copy their mothers and make 'play-nests' i.e. nests they are not going to use for sleeping in. Barbara Harrisson found that if baby orang-utans were removed from their mothers at about 2½ years old they would be able to make nests without any encouragement, but orang-utans of anything under two years had not learned how to make nests and would not do so when they were older unless they learned it from some other orang-utan. The following is an account of an infant making a play-nest.

15 July 11.50
He goes past his mother and starts to make a little nest of his own. He takes about 2 or 3 minutes to make a compact little nest. He lies down in it and reaches up, grabs the branches above him and starts playing with them, bashing them down on his head and shoulders. He breaks off a few bits and piles them on his head, tucks some in his neck pocket. He makes a little hat then stops playing, leaves the nest and goes back to his mother.

Anyone who has tried to keep an orang-utan in captivity will know how destructive these animals are. They seem to get great pleasure from dismantling things, and play sometimes consists of no more than breaking off bits of tree and dropping them. When this is done in earnest as part of the threat display, they again seem to enjoy their noisy destruction and show great interest in the descent of the pieces they drop. Often I felt that their display was almost a game for them.

Mothers quite often play with their babies. This normally consists of tickling, biting and poking. Sometimes the two animals do a lot of swinging about whilst thus grappling. Mothers sometimes play with their young in a nest after an early feed.

28 Sept. 08.20
They are playing in a large nest, knocking at each other with closed fists. The young one with a playface, lips curled inwards and mouth open wide. It then waves a small branch and drops it over the edge of the nest, and looks over to watch it fall to the ground.

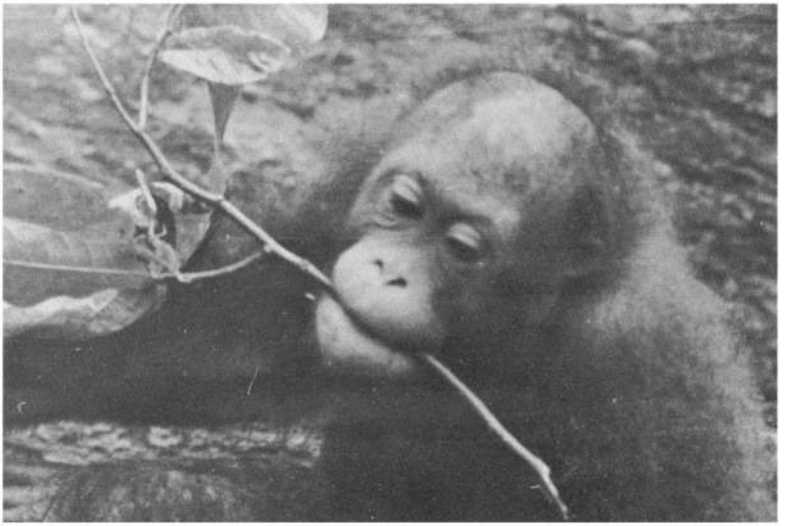

Plate 12 Young animal with a toy

Sometimes an elder sibling plays with a youngster, the play taking the form of a mild fight, with biting of ears, feet and other extremities, licking and soft hitting. The animals may chase each other up and down through the branches, the larger catching the struggling youngster and drawing him back when he tries to get away. On rare occasions two groups meet and an orang-utan has an opportunity to play with an animal of its own size. One animal will initiate play by approaching the other with a characteristic jaunty approach; he may nod his head and the lips are either loose and floppy or already parting and forming into the playface (Plates 13 and 14), in which the mouth is open and the lips curled back tight; the animals may cover their teeth but usually at least one set of teeth is visible and used in the play biting. The nose is snarled up close to the eyes so that facial wrinkles are exaggerated; the eyes are normally open. During intense play, huffy 'har' noises are emitted.

A common game for orang-utans of similar size is for them to grapple with each other whilst they swing about on lianas or branches. Swinging to and fro till they meet, they then grapple, bite, kick and tickle each other and then push away to swing apart again.

Group Interaction and encounters with other animals

Just as social interactions within sub-groups are rare and limited, so are interactions between different sub-groups when they meet. Typically, meeting groups pay no attention to each other. Twenty eight such meetings were seen. No interaction was ever noticed between adult females when these met. Sub-groups may pass each other without a glance or a greeting and two or more sub-groups may climb up and feed in the same tree with still no interaction to be seen. Young animals,

however, quite often initiate play with the young of other groups, juveniles sometimes leaving their mother for a couple of hours or so to play with another group. Such play between members of different sub-groups was seen seven times. In the only male/male encounter seen one animal fled away in display when a larger male came close. On five occasions females climbed high and hid when they heard males approaching, and on two of these occasions the males chased after them, one female being caught and raped. On another occasion a female was raped by a male she encountered, which stayed close for a day and a half and caught and raped her twice more before he left. On another ten male/female encounters, however, no interaction or interest was shown by either party.

Orang-utans paid little attention to other species of forest animal. Several times I have seen pigs feeding and once even fighting beneath them, but no reaction was seen, and only once did I see a juvenile female shake branches at pigs. On one occasion two animals paid no attention to the sounds of elephants moving about nearby. Gibbons and orang-utans fed peacefully in the same tree on seven occasions, and grey leaf monkeys were also seen in the same tree as an orang-utan. Twice orang-utans shook branches in display at gibbons and once gave a 'shiew' vocalisation at red leaf monkeys; each time the animals concerned were being particularly noisy. An orang-utan was seen to vocalise apparently at a noisy squirrel and another at a noisy hornbill in the same tree, but otherwise squirrels and hornbills were often seen near to orang-utans. Once a juvenile orang-utan seemed to be frightened by a large hornbill that landed at the top of its tree. It rushed down lower only to climb back up to where it had been hiding from me as soon as the bird flew away again. On three occasions the long-call of the

Plates 13 and 14 ***opposite*** **The playface**

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adult male orang-utan seemed to be triggered by the sounds of pig (2) and deer (1).

Orang-utans sometimes took advantage of noise to try to slip away unheard. Noise caused by strong wind or rain or dripping branches helped hide the sound of the moving animal, and animals sometimes waited for hours for a suitable moment to try to slip away from me. On three occasions orang-utans moved away under cover of the noise made by leaf monkeys and once they used a gibbon commotion.

Although orang-utans seemed to pay little attention to other animals in the jungle they seemed very interested in me. Reaction on seeing me varied greatly from individual to individual and also with what I myself was doing, but immediate flight was rare and only happened twice. Normally animals would perform some sort of display, as already described. Frightened animals sometimes defaecated and showed distress, dashing about aimlessly. If I was creeping about quietly or if the animal did not know it had been seen, it would sit still sometimes for hours. Often it would first climb up very high into dense foliage to hide. Such behaviour made life very boring for the observer. Some animals did not like being looked at and would react immediately if I looked up at them. Some animals tried to keep the canopy between themselves and me, others tried to find gaps in the canopy so that they could get a good view of me, or even approached and came above me to have a better look. Young animals especially showed interest in me whilst young mothers seemed the most distressed at my presence. Adult males varied greatly. Three of them paid very little attention to me at all and got very close to me; others seemed ridiculously upset. One

reaction which I saw twice, both times when an orang-utan had spotted me while walking along a branch, was for the animal to drop suddenly to a pendulum position below the branch, hanging onto it by one arm and a leg.

Sounds of men working did not seem to upset the one orang-utan I saw in such circumstances. On August 8th, while the men were hollowing out a canoe and making a loud noise with their axes on the wood, an adolescent male orang-utan feeding in an Artocarpus tree only about 150 yards from our riverside camp continued to feed undisturbed by the noise.

Population Density

Absolute determination of population density by systematic nest counts, as adopted by Schaller in Sarawak, has been used by other workers (B. Harrisson and K. Yoshiba) in Sabah. Results obtained by this method give densities of about one animal per two square miles of jungle or in particularly good areas per one square mile. In one isolated spot on Mt. Kinabalu, Barbara Harrisson found nearly two animals per square mile. The method can be used to compare different areas, but as it is based on a number of unproved assumptions and approximations its accuracy for arriving at absolute figures is questionable. It assumes that on average animals build only one nest a day and that a nest remains visible for about six months; that all nests within one hundred feet on either side of one's line of travel are noticed; that the speed of progress is on average one mile per hour unless guessed corrections for difficult terrain are included; and that the transects made are a fair representation of the whole area. It is, however, the only practicable method for a short stay and if nests are the only clues as to the presence of orang-utans.

I had hoped to find by direct means exactly how many animals lived in a certain area of jungle, then see how many nests were visible in this area and so get a better calibration for this indirect method of estimating densities. But on the first trip I soon found that it was impossible to count the number living in any area, as orang-utans are nomadic, wandering over enormous areas, so that one area will sometimes be occupied by many animals then be left for long periods virtually free of them. Estimating animal densities from the average distance that I walked between each orang-utan encounter gave figures very much in excess of those obtained by nest counting. This seems to be due to my luck at being in two areas just at a time when orang-utans happened to be temporarily abundant there.

On the second trip I was able to make a more accurate estimate of the density by working over a small area of about two square miles so thoroughly that I knew of virtually every orang-utan that entered this area during one year. The average length of time each animal remained within this area was about eleven days. In one year 160 animals were seen, which gives a minimum density of 2½ animals per square mile. Various animals were heard and not seen, and I also found traces of nesting and feeding by other animals that I did not see so that the figure of three orang-utans per square mile is still a conservative

estimate. Much of the Ulu Segama region is mountainous and probably not suitable for orang-utans. Even so if only half the reserve supports a density of about this figure there must be about one thousand animals present. Orang-utans are also found in fair numbers in the Ulu Kinabatangan and Ulu Tinkayu areas and also across the border in Kalimantan. The Sabah population is probably between two and three thousand.

PART 3: CONCLUSIONS AND DISCUSSION

Summary of Study

The orang-utan population is split up into small sub-groups averaging two animals. Although they do not move far in any day they do not remain long in any area and there seems to be some co-ordination in the movements of the population as a whole in seeking areas of available food. Individual animals seem to have a good knowledge of their local geography. They feed on many types of fruit, also leaves, bark, insects and possibly animal protein. They sometimes drink from water traps in trees and lick rain from themselves and from the vegetation, but do not come down to drink except from streams. Extremely large males are rarely seen on the ground. They nest at night and often at midday. They show sporadic activity patterns and spend most of the day resting. Young animals remain with their mothers but usually leave before they are adolescent. Apart from mother-offspring relationships, they show little social interaction, and little interest in each other or in other familiar forest-dwelling animals. They are unaggressive and do not seem to develop dominance relationships or defend territories.

Sexual behaviour is infrequent; females do not seem to use the males' loud calls to locate them; consort bonds seem to develop from chance encounters. Adult females seem to have a high rate of successful births, judging from the number of infants and juveniles that accompanied them. They are good at manipulating objects but make little use of tools. Branches are used to make nests and for shade, and for displays; otherwise loose bits of vegetation were used only for play, for scratching or as projectiles. Throwing in orang-utans is poorly developed, without aim or any horizontal element, and can really be described as dropping.

Discussion

Of all the world's truly arboreal animals the orang-utan is the largest. Why should a tree-living animal be so large? Or why should such a large animal occupy a niche traditionally filled by smaller ones?

The tree canopy is much hotter and drier than the forest floor, and movement in trees is much slower and more strenuous for a large animal than ground locomotion. Because the orang-utan has to rest for several hours through the heat of the day, cannot move far or fast and can only move sporadically, the area that can be foraged in a day is limited, thus necessitating the dispersal of very small groups. Most of

the difference in anatomy and behaviour between the orang-utan and its African relatives can be almost exclusively attributed to its arboreal way of life. What is difficult to understand is why it is so arboreal anyway. If it were a ground mover like a gorilla it could cover more ground each day and thus encounter more food, climbing into the canopy to feed and rest. This would enable it to enjoy a more social existence with large groups, and under such conditions we would not be surprised to find sexual dimorphism arising, males becoming larger and adorned for defence of the group against predators and intruders and for their own dominance disputes.

Teeth in Caves

There is evidence suggesting that this was indeed how orang-utans lived in the Pleistocene. On the Asian continent and in Sumatra large numbers of orang-utan teeth have been found in caves and rock shelters, which we are fairly sure have not been accumulated by man, as man's orang-utan collections always show a predominance of females and young animals, such as we find in the Niah cave deposits. The remains in China and Sumatra show the sort of age distribution expected of a natural graveyard with notably few young animals. The question arises whether these animals actually died in these crevices or whether their remains were collected by some foreign agency.

The Sumatra teeth do indeed show signs of having been gnawed by porcupines, but this is not enough to lead us to believe in a race of porcupines living in caves that collected, rather exclusively, old orang-utans' skulls. The sheer numbers of the teeth rule out any other explanation than that the orang-utans did actually die there, and as it was thought that orang-utans never came down to the ground, this was difficult to believe. However we now know that orang-utans and especially very large old males, do come down to the ground, and what more natural than that, when animals are too weak or too heavy to climb trees, they should seek shelter in caves or rock crevices and that such places should thus collect more than their share of the old and dying? Schaller saw a gorilla that slipped into a cave and also found gorilla footprints in a cave; Dr. Kortlandt (personal communication) has found evidence that chimpanzees sometimes use rock shelters for nest sites. Barbara Harrisson's tame orang-utan Arthur used to show great interest in caves and was often attracted down from the trees to investigate them. Thus it would seem that all apes are liable to enter caves and, as there were tigers in the jungles of Sumatra and the Asian mainland, there would have been a sound reason for orang-utans to shelter in caves at night if they were unable to nest up trees.

Larger than Gorillas?

Analysis of the teeth remains show two more interesting facts: first, they are considerably larger overall than those of existing orang-utans, suggesting that these races were larger than present-day ones; second, they show a greater degree of sexual dimorphism. As even today male orang-utans eventually get too big to move through the trees and have to come down on to the forest floor, any race in the past that was even larger must have been more terrestrial. From what we can

deduce from the teeth, the mainland race of orang-utan may have been larger than modern gorillas, and a completely arboreal existence for such monsters is inconceivable. If, as seems likely, the present arboreal race of orang-utans has evolved from a terrestrial race, the accompanying evolution towards smaller size and diminishing sexual dimorphism is easily explicable and is probably continuing. Thus the large size of the orang-utan and the secondary sexual characters of the male, which seem unnecessary and handicapping for its present mode of life, may be vestigial remnants of past terrestrial importance.

We are left with the difficult question of why the orang-utan did leave the forest floor. Large predators such as tigers, leopards, bears, pythons and crocodiles might certainly make terrestrial life dangerous, but it was among these animals that the orang-utans occurred originally and it is presumably because of them that it became so large. The African apes, gorilla and chimpanzee, seem to be little bothered by leopards and lions. In parts of West Africa chimpanzees come out of the forest and walk out across the savanna to feed in isolated fig trees, making a lot of noise so that they could easily be found and ambushed by lions on their way back; there is no evidence that they ever are – a band of chimpanzees would be a dangerous object for a lion to attack. Predators therefore do not seem to be a likely explanation. Another reason could be disease spread by blood parasites that are confined to the lower humid regions of the forest. Mosquitoes, elephant flies, sand flies, ticks and leeches are all common blood parasites near ground level but are scarce or absent in the less humid canopy layers. It would be unusual, however, for an animal to be forced out of its habitat by its parasites and diseases. A natural balance would surely be reached between the host and its infestants.

Another explanation would be that much of the area became swamp, and so ground locomotion was impossible. Indeed much of the jungle is periodically flooded, and orang-utans also used to occur in low swamp jungle close to the Sarawak coast. However, although the sea level has been rising since the Pliocene, so have the mountains. There has always been high ground for animals to fall back to in the event of swamping.

Where the Food was

It may be that, as all the food was found in the canopy, it was not worth the effort of climbing up and down trees but more efficient to move through the canopy. This is supported by the fact that other animals in the jungle are distributed in horizontal layers and have evolved means of moving from tree to tree without having to come down to the ground. The jungle is the home of the flying lemur, three types of flying squirrel, the longest leaping monkeys and apes in the world (proboscis monkey, leaf monkeys and gibbon) flying lizards, a flying snake, a flying gecko and even a flying frog. The orang-utan, however, normally moves about only 30 feet above the ground and uses considerably more energy in moving 50 yards through the trees than if it came down, walked along the ground, and climbed up again at the other end. Some of the orang-utan's food plants might be less easily

seen from the ground, as a terrestrial walking orang-utan cannot easily look up at a steep angle. I feel this is more than compensated for by the extra ground that could be covered for the same effort and there is a lot of food it could eat on the ground if it lived there. A large male orang-utan that I followed did stop to feed on the ground.

None of the above explanations seem satisfactory. I think that there must be a link between the extinction of the large terrestrial race and the survival of the present arboreal race. The selective pressure that has forced an arboreal way of life on the present race must be the same as has caused the extinction of the orang-utan in many of its former haunts. Extinction is usually the sign of some fast ecological change. The same tropical rain forest exists in south-east Asia now as it did in the Pleistocene. The only thing that has changed in that time is man. The appearance of a new successful ground-living ape made existing ground-living apes redundant.

Man and Chimpanzee

Dr. A. Kortlandt has long been interested in the problem of why the African apes are not as like man as they might be, why they have not used their manipulative ability and great intelligence to develop technology. After several years of work both in the field and with captive apes, he believes that the chimpanzee evolved in the open woodlands and savannas and lived a fairly hominid existence hunting animals and gathering fruits. Such an environment is expected to stimulate the development of hunting techniques and language, and is believed to have been responsible for man's own humanisation. However when man started spreading across the globe he came into direct competition with the chimpanzee, and as the chimpanzee was a relatively easy prey and a nourishing meal it was soon eliminated from the savanna. The chimpanzees' tendencies towards humanisation brought them into greater contact with man and exposed them to predation. Man did not penetrate far into the African rain forests, so the boundary between man and ape became the forest edge and the apes have dehumanised to their present forest state. This theory is supported by the fact that in those areas where chimps do live in savanna they show more hominid features of behaviour than those that live in the forests. Unfortunately for the orang-utan, man in south-east Asia has penetrated, by way of the rivers, far deeper into the rain forest than he did in Africa and the divergence process has had to continue further even than in Africa. The more the orang-utan can diverge in its habits from those of man, the less likely are their paths to meet, an event usually disadvantageous to the orang-utan, as the sad collection of their remains in the Niah caves demonstrates. It may even be that the Himalayan range still hides yet another ape forced by man into an unsuitable habitat, the abominable snowman or yeti.

The Long Arms

Critics of the dehumanisation theory point to the long arms of the apes and other anatomical features that are supposed to indicate their arboreal past, long arms being interpreted as adaptations for brachiation. As adult great apes very rarely brachiate the fact that they

have long arms is taken as indicating that they have evolved from their evolutionary past as smaller arboreal brachiators something like gibbons. This idea goes against fossil evidence which indicates that modern apes have relatively longer arms than their ancestors and that two species at least, the gorilla and orang-utan, had ancestors even larger than present forms. Of course, prior to their specialisation as apes, this line of primates was probably arboreal, but the great apes as such (i.e. excluding gibbons) are essentially less arboreal than other primates. Modern species are probably more arboreal than any previously existing type of ape. Long arms and prehensile toes have been evolved, and are being evolved, for greater efficiency of movement in trees where apes obtain most food. Long arms have many advantages other than for brachiation. Long-armed apes can climb broad trees with trunks too broad for monkeys and thus feed there without much competition; they provide a longer reach for food or for crossing from tree to tree; they increase the potential climbing speed and the purchase that can be exerted on branches to break or bend them for making nests or for feeding. The method of brachiation sometimes employed by young apes is distinct from that of gibbons and has not been commonly derived.

Man is the great threat to the orang-utans' survival today, and it seems that his ancestors were the greatest threat to the orang-utans' ancestors in the past. Competition is always severest between like animals. It is we who are responsible for the fate of the orang-utan and we should surely therefore do all in our power to conserve our cousin species.

What hope?

Tom and Barbara Harrisson have made great efforts in the last 15 years to bring to people's notice the plight of the orang-utan, and the steps that have been taken to protect orang-utans are largely due to their efforts. In most countries in the world it is illegal to ship orang-utans, offer them for sale or buy them. Thanks to international goodwill and cooperation it has become difficult to export orang-utans illegally from the Far East; all animal crates at Singapore and Hong Kong are checked by Customs. There is a census operant of all animals in zoos and any recent orang-utan acquisitions are traced. On top of this the animals are now protected in both Indonesia and Malaysia. It is illegal to kill or capture orang-utans or to keep one as a pet. Large areas of jungle have been laid aside as forest reserves where the cutting of timber is forbidden, thus protecting the orang-utan's habitat.

Nevertheless orang-utans are still being killed for their babies, which are sent falsely labelled, only to be intercepted by customs at Singapore or Hong Kong.

Also the orang-utan has for thousands of years been a prize for the pot of the Bornean hunter and in areas where orang-utans and hunters still overlap the eating of this animal continues. It is impossible to control the eating of orang-utans over quarter of a million square miles of jungle, but it is hoped that most areas now know that hunting orang-utans is illegal. In many areas such as the Segama orang-utans are not eaten anyway. Much of what children learn at school gets back

to their parents so it may be possible to develop among the villagers, by means of education, a pride in the continued existence of the rare and wonderful orang-utan in their area.

One of the really crucial points is whether there are enough animals still left for the species to survive. The present distribution of orang-utans as far as we know it shows them to be present in small isolated localities scattered over an enormous area of jungle. It is probable that in many of these areas numbers have fallen too low for recovery to be possible. In Sarawak the animal is virtually extinct already and can only be found near the Kalimantan border. In Sumatra only one reasonably large pocket remains where orang-utans occur. Oliver Milton's report of this area is reasonably hopeful and there may be enough animals remaining for this population to survive.* In Kalimantan little is known about the numbers of orang-utans, and our greatest hope there is in the vast size of the country, which may hide unknown pockets of animals, although much of the country is mountainous and may not be suitable for them. The best hope for the orang-utan is in Sabah, where large forest reserves in the south-east may hold half the world's population. The greatest threat to these animals is the logging of timber, and logging trails have already penetrated deep into the forests, splitting up breeding areas and reducing the habitat. Two American zoologists, Ken Scott Jnr. and C. Jackson Selsor, reported optimistically on orang-utans re-inhabiting secondary forest in areas that had been recently logged. However, two years later Barbara Harrison reported that the area was virtually barren of orang-utans and local opinion seemed to confirm this view. This matter should be cleared up as it is very important to know whether orang-utans will move back into logged areas that are allowed to grow up again. Logging in areas where there are orang-utans should be planned so that when trees grow up again they are not cut off by roads and further logging from areas where orang-utans remain.

The discovery of unexpectedly high densities of orang-utans remaining in the forests of Sabah pinpoints this area as the most hopeful for conserving the species from possible extinction. However, despite the proposals of the IUCN conference at Bangkok and the enthusiastic efforts of the Sabah Game Warden Mr. de Silva in stopping the illegal trade in orang-utans and in developing the rehabilitation scheme, no adequate game sanctuary exists in Sabah. The Mt Kinabalu National Park contains a population estimated by Barbara Harrisson a few years ago at less than twenty animals. The Sepilok orang-utan sanctuary contains the twenty or so animals involved in the rehabilitation project but probably no more than five wild animals. No other sanctuaries exist, and the plan to make a sanctuary in the Ulu Segama has been dropped. Virtually all the orang-utans in Sabah inhabit the various forest reserves along the big rivers of the east coast. It is illegal to trap or kill these animals, but it is quite permissible to kill them indirectly by destroying their habitat. All these reserves will be cut for timber in the next few years.

*Since this paper was written Dr Fred Kurt has visited the Loeser Reserve in Sumatra and reported on the orang-utan populations both inside and outside the reserve to the World Wildlife Fund, Morges, Switzerland. See *Oryx*, December 1970, page 348.

The Timber Threat

The declared policy of the Sabah Government towards its heritage of forest is to exploit its resources as quickly as possible so as to raise the standard of living in the state. A large-scale forest inventory is at present in progress to determine the best way to exploit this, but one can expect that timber will be extracted wherever it is economically possible. Already £50,000,000 worth of timber a year is being exported, mostly to Japan. No international organisation for conservation should rest content so long as such a wealth of unique fauna remains so jeopardised. There seem to be only two possible ways to save the orang-utans. Much the better would be the establishment of a new game sanctuary of a realistic size – two hundred square miles if it is to support a viable population. If, however, the government is not prepared to protect its natural heritage in this way it may be necessary to capture animals from doomed areas before they are logged and transport them to the relative safety of a national park or sanctuary. Suitable sites for such releases could be found in either Sarawak or Malaya. Either course will require a great deal of money and a lot of international goodwill and cooperation.

A description of an orang-utan's birth at Sepilok (see page 177: infant development) by G.S. de Silva, will be published in the International Zoo Yearbook, volume 12. See also *The Malayan Nature Journal* Vol. 24 (1970-71) No. 2.

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