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Management of a captive kakapo on Maud (Te Hoiere) Island

**Report covering 'Hoki' kakapo's first two years
July 1992-June 1994**

by

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Abstract

A female kakapo (Hoki) was rescued from a nest on Codfish (Whenua Hou) Island in Autumn 1992, hand-reared at Auckland Zoo and released into a pen on Maud (Te Hoiere) Island in the Marlborough sounds in July 1992. This report describes the management of Hoki carried out by Department of Conservation staff between July 1992 and June 1994. The construction and maintenance of kakapo pens, the food consumed, weight changes and behaviour of Hoki are described. Hoki appears to have thrived in captivity, she remains very tame but is more confiding with people she is familiar with.

1. Introduction

In 1990 an enclosure was built on Maud (Te Hoiere) Island for the kakapo captive breeding programme. On 7 January 1991 an adult male kakapo 'Gerry' (transferred from Stewart Island and released on Maud (Te Hoiere) on 12 June 1990) was caught and placed in the enclosure. Gerry was observed closely and offered a wide range of foods. He constructed a bowl system and commenced booming but became very stressed and escaped from the pen on two occasions. He was recaptured both times and the stress continued. Gerry became very weak and sick and on 27 February 1991 was released back into the wild on Maud (Te Hoiere), but his condition did not improve. He was then flown to the Wellington Zoo on 4 March for veterinary care but died on 5 March 1991. An autopsy was inconclusive but suggested that he may have died of bracken poisoning since he had lesions on the brain, a symptom consistent with bracken poisoning in cattle. This suggests that there is still much to be learned about the captive maintenance of kakapo, especially during a breeding season.

No further captive management attempts were made until July 1992 when a partially hand-reared kakapo chick 'Hoki' was brought to the captive facilities. Reared from about 5 weeks of age at the Auckland Zoo, Hoki was one of three starving kakapo chicks to be transferred from Codfish (Whenua Hou) Island when rimu berries failed to ripen, and females were unable to find enough food to raise their chicks.

Hoki was 13 weeks old and weighed 1.32 kg when released into the Maud (Te Hoiere) Island facilities on 6 July 1992. She appeared to enjoy human company and did not appear to be stressed by captivity.

2. Holding facilities

Maud (Te Hoiere) Island has two facilities for holding kakapo. The first 'kakaporium' (Figure 1) is on a gentle slope around a small cluster of trees and scattered shrubs near the south-east corner of the remnant forest. Areas have been planted but ca. 70% remains in dense grassland. It has a small secure pen constructed of concrete and steel framework with mesh caging and observation room. This can be used separately from or opened up to a larger 120 m² open plan enclosure. A hide is attached to the outer wall looking into the large enclosure.

The second kakaporium (Figure 2) is also on a gentle slope on the north-east corner of the remnant forest, and is an open plan design. The enclosure is predominantly covered with secondary growth forest but has approximately 10% grass cover around the inner walls. The pen has an area of 180 m². The walls of both pens are constructed with a framework of 100 x 50 mm timber and 100mm² posts spaced 1.5 m apart. Painted 'Hardy plank' lines the inner walls and is dug 20-30 cm into the ground to prevent the bird digging out or unwanted animals getting in. Man-made roosts and a feeding table (which houses a weighing system) have been in each pen. Water is supplied to concrete ponds from the house water supply (No. 1 pen) and roof catchment (No. 2 pen).

On arrival on Maud (Te Hoiere) Island, Hoki was released into a small area within the secure pen which had been divided by corrugated plastic sheeting and a sliding door. This area was planted to simulate a forest scene. For first week of captivity Hoki was observed 24 hours a day and her food was presented in sturdy glazed pottery bowls or staked out on wires. She remained in this part of the secure pen for a little over two weeks by which time she was attempting to climb over the sliding door. The door was removed and Hoki had access to the rest of the secure pen, as well as the original smaller part where her feeding bowls remained.

After a further month in the secure pen, Hoki had stripped all the vegetation, so on 20 August 1992 she was released into the larger open plan enclosure. She was eventually prevented from using the secure pen and re-planting began. Before the 1993-1994 breeding season, Hoki was transferred to the bigger, fully vegetated, (No. 2) kakaporium.

3. Diet

3.1 SUPPLEMENTAL FOODS

Hoki's supplementary diet is summarised in Table 1.

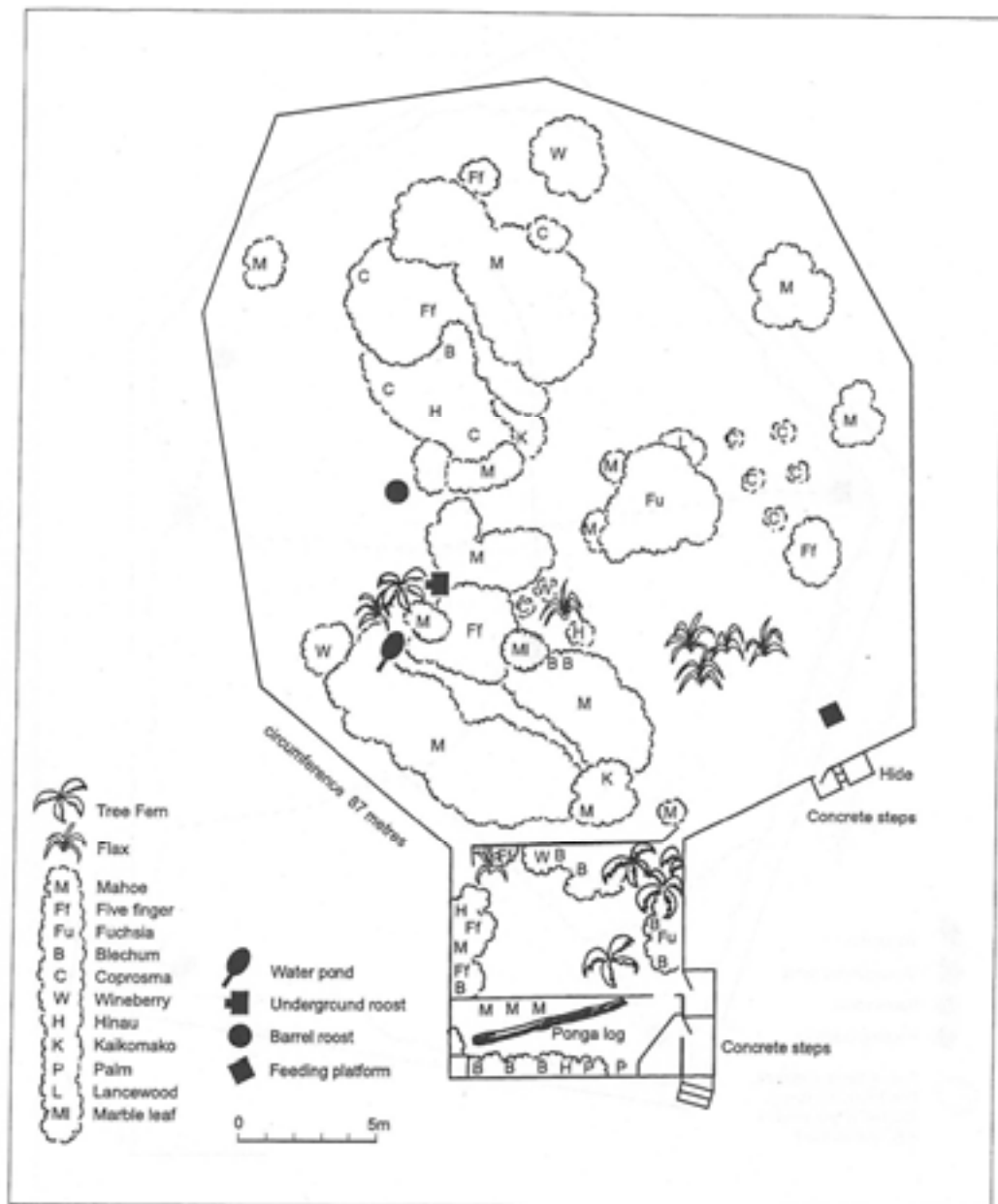


FIGURE 1. KAKAPO ENCLOSURE NO. 1.

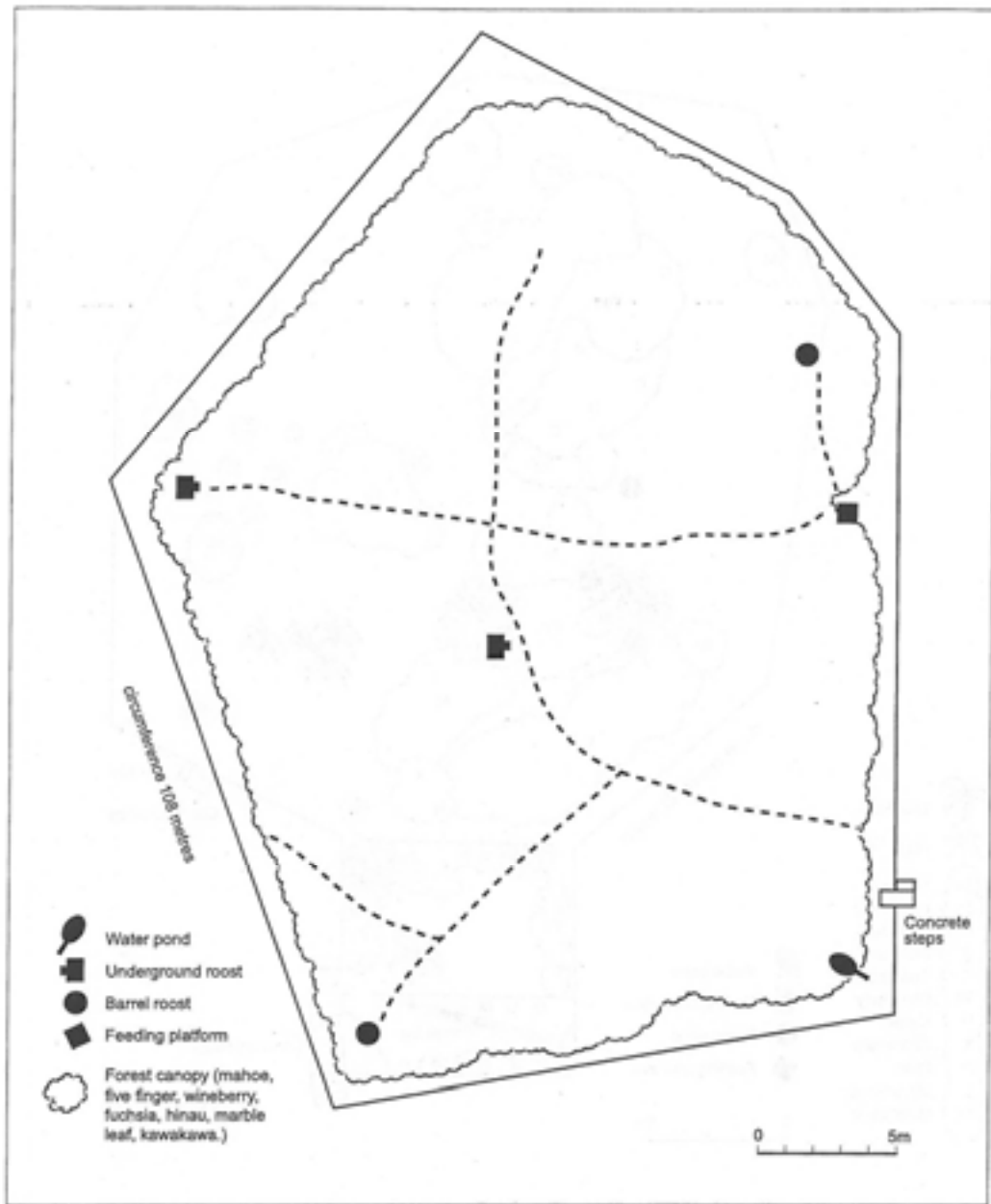


FIGURE 2. KAKAPO ENCLOSURE NO. 2.

TABLE 1. INTAKE OF PROVIDED FOODS.

	KUMARA (g)	APPLE (g)	CORN (g)	PELLETS (g)	NUT-MIX (g)	PUMPKIN SEEDS (g)	HONEY WATER (ml)	TOTALS (g)
July 1992	No regular diet established							
August	403	315	636	246	896	-	-	2496
September	465	40	438	480	615	-	-	2038
October	869	193	336	716	484	-	-	2598
November	828	880	149	833	501	-	-	3191
December	2002	813	107	1039	85	-	-	4046
January 1993	2355	1020	32	1043	2	-	-	4452
February	1863	909	80	1065	6	-	-	3923
March	1292	583	549	655	23	-	-	3102
April	1555	480	55	1136	12	-	-	3238
May	2890	1585	69	1272	2	-	-	5818
June	2653	1918	478	1155	7	-	-	6211
July	3457	1454	126	1274	8	-	-	6319
August	3231	1688	136	1155	30	-	-	6240
September	2899	1929	10	1309	8	-	-	6155
October	3182	1581	638	885	117	-	-	6403
November	670	not fed	422	1089	262	-	-	2443
December	27	47	not fed	402	294	-	-	770
January 1994	325	198	84	665	187	-	546 ml	1459
February	503	341	109	681	120	-	840 ml	1754
March	349	311	110	897	233	-	930 ml	1900
April	242	194	-	779	150	-	900 ml	1365
May	1372	788	425	1047	156	-	930 ml	3788
June	1207	779	-	857	129	-	900 ml	2972
TOTALS	34 639	18 046	4489	20 680	4328		5046 ml	82 681

She had been 'weaned' onto a variety of foods including celery, corn, carrot, broccoli, apple, pear, grapes, beans, nuts and a mixture of 'Roudybush' hand-feed No. 3/'Nutra-pet'. These foods remained on offer to Hoki after she was released into her enclosure. The recommendation at that time for Hoki's supplemental diet was 'Roudybush' parrot pellets, nuts, kumara, corn and apple.

Thus, from mid July 1992 some foods including broccoli, celery, pear and beans were withdrawn so that her staple diet became foods she preferred and foods of high nutritional value. Nuts remained her favourites and at times she ate little else. To encourage Hoki to eat pellets and kumara etc., a feeding routine which involved two feeds a night proved helpful. Pellets, kumara etc. were fed out just after dark, then two hours later nuts were offered.

Soaked pellets were also smeared on walnuts and put inside her kumara and corn. Eventually I made a large 10 g pellet from Roudybush which had nuts blended in to increase the oil content. The size of this pellet and the concentration of nuts lessened as she became more interested.

Roudybush pellets soon comprised 20-30% of her diet - up to 50 g of pellets were regularly consumed each night, as well as kumara, corn and apple. To prevent Hoki becoming bored with the 'blandness' of her diet, nuts were offered every 3-4 days and occasionally other foods such as pears, nectarines and natural fruiting plants (flax, *Coprosma* and nikau palm).

For the first year Hoki's food hoppers were replenished each night after dark and cleaned first thing each morning. At present the replenishing of foods and cleaning up is done each morning and foods are presented in clean 'trough' hoppers with lids.

Hoki's regular diet now consists of kumara, corn, apple, nuts, pellets and honey water in the same amounts each night. Her preferences change throughout the year in a manner similar to that of wild birds. Kumara, corn and pellets are preferred from April to September but she loses interest in these (sometimes completely) from October to March. There do not appear to be fluctuations in nut acceptability although the amounts of each type eaten varies. Over a period of three nights during September 1992, a variety of sweet and fatty foods including soaked raisins, sultanas, apricot, cheese and shredded coconut were offered to Hoki. Hoki tasted most items but cheese and shredded coconut appeared to be most favoured.

3.2 NATURAL FOODS

The natural foods that Hoki has been recorded eating are shown in Table 2.

Soon after Hoki's release into the pen she quickly showed a lot of interest in the many natural foods growing within the enclosure. Vegetation such as fruiting *Coprosma robusta*, clumps of canary grass and varieties of ferns were also brought into the enclosure for Hoki to try. Most plants fell victim to Hoki's curiosity and were destroyed while she experimented with them. It was not long before she was supplementing her diet with a lot of natural foods and it was noted on 21 October 1992 that Hoki was leaving distinctive kakapo feeding signs on plants in the form of typical 'chews' or 'pellets'.

Over the first three months after release Hoki had sampled and fed on 17 species of plants and was becoming increasingly aware of what parts to target and what was best to eat. One dropping that was collected contained 300 five-finger seeds, i.e., about 150 berries had been eaten. Many observations have been made on her feeding behaviour and a close eye kept on which plant species she utilises throughout the year. It has been hard to compare seasonal trends of Hoki's diet with those of the free-living birds since the latter have access to many plant species which are not available to Hoki.

TABLE 2. NATURAL FOODS EATEN.

Five finger (<i>Pseudopanax arboreus</i>)	-	petioles, young shoots, stems
Mahoe (<i>Meliclytus ramiflorus</i>)	-	new shoots
<i>Coprosma robusta</i>	-	new shoots, berries
Rangiora (<i>Brachyglottis repanda</i>)	-	new shoots, petioles
Wineberry (<i>Aristotelia serrata</i>)	-	new growth, stems
Tree Lucerne (<i>Cbamaecytisus palmensis</i>)	-	leaves, bark
Fuchsia (<i>Fuchsia excorticata</i>)	-	berries, new shoots
Ponga fern (<i>Cyathea</i> sp.)	-	roots, leaves, fronds
<i>Blechnum capense</i>	-	leaves, stems
Kaikomako (<i>Pennantia corymbosa</i>)	-	new leaves, stems
Canadian fleabane (<i>Conyza canadensis</i>)	-	stems, flowerlets
N.Z. Flax (<i>Phormium</i> sp.)	-	roots, plant base, leaves
Clover (<i>Trifolium</i> sp.)	-	roots, leaves
Canary grass (<i>Pbalaris canariensis</i>)	-	seed head, leaves
Fumitory (<i>Fumaria</i> sp.)	-	stems, leaves
Yorkshire fog (<i>Holcus lanatus</i>)	-	leaves, seed head
Bracken (<i>Pteridium esculentum</i>)	-	roots
Dock (<i>Rumex</i> sp.)	-	bases, roots

3.3 ARE KAKAPO STRICTLY VEGETARIAN?

It is generally believed that kakapo are vegetarian and there is no documented evidence to the contrary. However, Hoki has sampled and eaten invertebrates, the first observation being on 20 September 1992 when a pill millipede I saw at night near her feeding station was found crushed the following morning. It did not appear, however, that Hoki had actually eaten any of it. Evidence of her eating a darkling beetle was definite on 4 January 1993 when Hoki was sitting near me and had spied a darkling beetle that was walking past my boot. Hoki grabbed the beetle and instantly started crushing it up and shaking her head as she did so. This sent a bit of it flying away to the ground but she swallowed every bit she had crushed in her bill then searched for the other bit and crushed and swallowed that as well.

The second observation of Hoki eating an insect was on the night of 13 March 1993 when she had flung a moth to the ground that was flying around her head. Moths which were drawn to the lamp were numerous that night and Hoki appeared uncomfortable with them flying around her and my head. She watched the moth as it flapped about on the ground, then snapped it up in her beak, crushing and flicking her head as she bit and swallowed it, wings and all.

In another instance a 'Rhytida' snail was found crushed up near one of Hoki's feeding sites which suggested she had actually crushed it up. Snails and slugs occasionally were seen at night feeding on the staked out apples and kumara.

These occurrences may well have been 'one-off events of opportunistic feeding, but kakapo often feed on the ground and dig for roots and bulbs and they must encounter insects of all kinds. Many insects may be 'crushed' on purpose or

TABLE 3. HOKI'S AVERAGE MONTHLY WEIGHTS.

	NUMBER OF WEIGHTS	AVERAGE WEIGHT (kg)
July 1992	29	1.29
August	21	1.36
September	17	1.46
October	14	1.51
November	7	1.56
December	18	1.64
January 1993	3	1.70
February	1	1.68
March	4	1.57
April	8	1.56
May	4	1.60
June	3	1.63
July	2	1.57
August	1	1.62
September	1	1.68
October	1	1.66
November	1	1.66
December	1	1.7
January 1994	1	1.35
February	3	1.38
March	3	1.42
April	-	-
May	3	1.62
June	-	-

	NUMBER OF WEIGHTS	AVERAGE WEIGHT (kg)
July 1994	1	1.7
August	1	1.65
September	-	-
October	2	1.7
November	1	1.82
December	-	-
January 1995	3	1.43
February	2	1.37
March	5	1.30
April	3	1.34
May	3	1.37
June	3	1.49
July	4	1.52
August	3	1.55
September	4	1.53
October	3	1.62
November	3	1.64
December	3	1.64
January 1996		
February		
March		
April		
May		
June		

incidentally when kakapo dig for food. Kakapo might eat more invertebrates at some times of year, perhaps as a source of calcium, and protein when raising chicks.

4. Condition measures

4.1 WEIGHTS

Hoki's average monthly weights are shown in Table 3.

Just before her transfer from Auckland Zoo, Hoki weighed 1.3 kg and the day after her arrival on Maud (Te Hoiere) (7 July), her weight had dropped to 1.24 kg. During the first week it gradually increased to 1.28-1.29kg, then fluctuated for two weeks, then gradually increased again after a change to her diet. By the

end of her first month on Maud (Te Hoiere), Hoki weighed 1.37 kg. Her weight was similar during August but fluctuated during September. (This fluctuation can be related to the period when Hoki was fed primarily a pelleted diet and different methods were used to entice her to feed.) Hoki's weight did not seem to drop at all during the times she was released into the different parts of pen No. 1, but after her transfer to pen No. 2 (i.e., the larger, northern enclosure), her weight dropped from 1.7 kg to 1.35 kg over two months; however, her weight normally declines at that time of the year. Five months after her transfer to Maud (Te Hoiere) Island, her weight was constant at 1.64 kg, but one month later had reached 1.70 kg.

Hoki's weight variation follows the same seasonal pattern as that of free-living females. (However, she does not appear to put on as much weight prior to a breeding season as they do.) She normally maintains a weight of 1.64 kg from July to November and increases weight to approx. 1.7 kg during November and December, after which she slowly loses weight between January and April and increases again to her normal weight of 1.64 kg during May and June.

At first Hoki was weighed by placing her on the weighing platform or by enticing her to use the platform as a perch while feeding from the feed-table. When she was released into the open part of the enclosure, an automatic recording system was installed under the feeding platform which is a permanent structure inside the pen. A feeding hopper can then be placed there when weights are required. This arrangement is still in use at present and proves to be a very reliable system.

4.2 MOULT

Hoki's first moult began in late May 1993 with the loss of a few body feathers and finished early in October. The heaviest moulting time was when she lost most of her wing and all of her tail feathers. All but one of Hoki's tail feathers were lost during 17 days starting in late July. The last was lost on 7 September, 45 days after the first. On 25 August many new tail feathers about 5 cm long were recorded and one week later there were 10 feathers, all between 4 and 7 cm long. The moult slowed down in September with the occasional body feather still being picked up, but by the end of the first week in October her moult had finished.

The following year's (1994) moult started earlier. It began in March but the heaviest moulting seemed to be during May and June, though many wing and tail feathers were still found in August and September. Many new tail feathers were recorded on 10 August. The moult again slowed late in September and finished at the end of September.

4.3 BEAK AND LEG MEASUREMENTS

Hoki was not measured during the time this report covers but her measurements were taken before her transfer from Auckland Zoo on 3 July 1992. These were:

Right tarsus	=	52.2 mm
Right tarsus depth	=	10.9 mm
Right tarsus width	=	9.4 mm
Right toe (longest)	=	56.6 mm
Bill length	=	31.9 mm
Bill width	=	21.4 mm

4.4 PARASITES AND TREATMENTS

Before leaving Auckland Zoo Hoki passed a tape-worm. On veterinary advice she was given follow-up worm treatment on 13 July 1992. This was administered to her in a grape.

Her droppings have been tested periodically for eggs of intestinal parasites, but none have been found.

At the time of her arrival on Maud (Te Hoiere) Hoki had a heavy infestation of lice. On veterinary advice, she was treated with 'Masterpet' Red Mite powder (permethrin) on 16 July and this effectively curbed the infestation.

5. Behaviour

5.1 BEHAVIOUR IN RELATION TO WEATHER AND MOONLIGHT

I have regularly made notes of my visits to Hoki in rainy weather and have thought that it tends to have a 'calming' effect on her, especially if she becomes sodden. Her behaviour seems very calm and she generally wanders about on her own, making little contact with me. But when she does she is very gentle and just sits close to or on me. Neither stormy wet weather nor weather changes affect her food consumption, but during rain or stormy weather when the pen is rather darkened and misty even during the day, Hoki wanders about as if it were night. Weather also seems to affect roosting behaviour (see 'Use of roosting sites').

It is apparent that moonlight as well as weather affect the booming behaviour of male kakapo. Being nocturnal birds it seems likely they would be very aware of the moon. On bright moonlit nights male kakapo tend to stop booming and resume it when the moon sets or clouds obscure it. On one occasion when cloud cover was variable on a bright moonlit night, two male birds on Maud (Te Hoiere) Island skraaked. However, calling ceased when the moon appeared from behind the clouds and began again once the clouds closed in. Hoki has sometimes shown increased wariness on bright moonlit nights. On nights without moonlight she often ventures into open spaces without much caution, though she generally remains near the bush margin. On bright moonlit nights however, I have often observed Hoki in the tops of trees when I first arrived. Her behaviour does not seem to change much on bright nights.

5.2 REACTION TO OTHER KAKAPO

On several occasions Hoki has had the chance to interact with free-living kakapo and her response has varied. At 10.40 pm on 14 January 1993 a sharp reply was heard from Fuchsia after Hoki gave her usual farewell skraak as I left the pen. Hoki's call had been unusually long. The two birds exchanged loud for a further 35 minutes, after which Hoki stopped replying to Fuchsia. However, Fuchsia continued skraaking for at least a further 30 minutes sounding louder and much like a squealing pig. Hoki did not reply for the rest of the night, though she reacted to Fuchsia's calling by stopping to listen for a while. Initially Fuchsia must have been within 50-60 m of Hoki but by 1.15 am she had moved away from the enclosure and stopped calling. Hoki's behaviour this night was recorded in the log as '...in an unusual mood; very stubborn and would not stop trying to climb my legs; in a real fidget - bit my legs'.

On another visit, this time from the male bird Smoko on 17 March 1992, Hoki did not reply to his 'angry sounding' calls. Smoko came within 60 m of the pen for about 15 minutes and made his 'donkey bray' skraaking every 1-2 minutes. Hoki did not reply and after about an hour he quietened down.

On occasions during the breeding season booming was audible from Hoki's pen. On some occasions Hoki was very aware of this calling and would lift her head up to listen when booming occurred, and she would then continue on with her activities. On other occasions when booming could be heard, Hoki showed no signs of acknowledgement.

Hoki's behaviour on the night of 8 January 1993 was quite unlike her normal gentle and calm antics. Hoki persistently tried to climb onto me. At every movement I made she jumped at my legs and clung to me and I became immobile in the face of this attack. On this night booming was heard, and she stopped to listen and look in the direction of the calling male. Was this a behaviour change in response to booming or to the bright moonlit night? She did not skraak at me when I left the pen that night.

However, the following night a photographer visited Hoki with me for about an hour. Hoki mostly ignored us and spent little time investigating the stranger. On numerous occasions during the visit Hoki left us and wandered away on her own. She went to the top wall, stood on a rock and loudly twice then paused and looked up towards the top of the island as if listening for a reply. She returned to the visitors for a while then left again moments later and continued her loud skraaking. We visited Hoki again on the next night and she again went to her rock to skraak but soon lost interest-was she calling to a female or trying to get the attention of a male? I have not seen this behaviour since.

5.3 BEHAVIOUR TOWARDS PEOPLE

Aspects of Hoki's behaviour have changed as she has become older. For example, Hoki's 'defence' of her roost place was not apparent in the first 5 months after her arrival on Maud (Te Hoiere), but she has since become very protective of her roosts. (She was about 33 weeks old when she became protective, and this

behaviour change may be related to the time of fledging.) Her behaviour also changes during the year, and during the breeding season she sometimes becomes hyperactive.

Hoki's behaviour towards people (including myself) also varies greatly with the amount of contact she experiences during night visits. Lots of contact with people leads to 'aggressive' behaviour.

Hoki's typical behaviour with people she is most familiar with is very and placid. It seems as if she feels more secure in their presence. She comfortably carries on with her own activities or involves the people she is most familiar with in her playful antics without departing much from her normal behaviours. In the presence of unfamiliar people she becomes uneasy and fidgety, often performing her defence display. However, she usually becomes curious and after scrutinising unknown people from a safe distance she eventually relaxes. This reaction varies from person to person and sometimes she will not go near an unfamiliar person or will retreat to a nearby hiding place.

The following summarises the different behaviours that have been shown by Hoki in the company of people. They fall into six main groups:

Playful Skipping and hopping about the place often flapping her wings in excitement and running and darting across feet and climbing on to people. She does not always involve people in her activities and can play comfortably on her own, climbing and jumping out of trees, zooming around the bases of trees, and throwing sticks and leaves.

Defence Hoki occasionally appears to defend her roost (first noted 10 February especially during the day if she is well settled. There is normally a defended zone of about 2-3 m around her roost, and she usually displays when anyone enters this zone. During this display she raises her wings until they touch at the ends, raises the feathers around her shoulders and forehead so that her head has a rather square look, lurches forward and snaps her beak, picks up leaves and twigs and bites them in half. This display is also used when she feels under threat, e.g. if people tower over her, strangers move too close or when sudden movements surprise her. Occasionally, when apparently not so threatened, she gives a less aggressive version of this display.

Aggression Hoki also has aggressive behaviour that is distinct from her defence display. It usually occurs in the breeding season. When aggressive, Hoki becomes very stubborn and fidgety and she persistently leaps at legs, bites boots and tries to climb on people. She often bites any part of people that she can get hold of, and painfully digs her claws into them.

This aggressive behaviour mainly develops when people have prolonged contact with Hoki, and she rarely gives up until they leave the pen.

No deliberate attempts are made at handling or touching Hoki since this seems to encourage aggressiveness.

Curiosity When curious about unfamiliar people or activities in the enclosure, Hoki will at first keep a safe distance and slowly creep along like a clockwork toy, keeping extremely quiet and staying entirely focused on the object of interest. During this time she is very alert and any distractions can send her

fleeing. She then peeps out from behind trees and often perches and watches from a distance, swaying her head like an owl, before deciding if she will investigate further.

Displacement activity Displacement activity is obvious when Hoki seems uncomfortable, usually in the presence of unthreatening but unfamiliar people in my company. However, she sometimes also displays displacement activity when a close approach or movements appear threatening someone crouching near her roost place. During displacement activity Hoki becomes very fidgety and hops from foot to foot, lowers her head and touches the ground with her beak. She often picks up twigs and leaves and bites them or even throws them towards you. At times this can be similar to her defence behaviour and she raises her wings a little in a way that almost looks like flapping.

Disinterest This behaviour developed as Hoki became familiar with her keepers and it mainly occurs in my presence. Hoki appears very calm and relaxed and though aware of my presence, she continues with her own activities without involving me. When she is in this mood it is possible for me to sit next to her and observe her feeding or playing about, and at times she is even tolerant enough for me to check her transmitter or tail feathers. She greets me in a very gentle and peaceful way and sometimes just climbs up and sits on my knee as if I were a tree to perch on.

5.4 VOCALISATIONS

During Hoki's rearing at the Zoo her keepers noted that Hoki 'purred' loudly when she was expecting food. For the first four months after Hoki's arrival on Maud (Te Hoiere) Island a 'grunting' was often heard from her while she explored and wandered about the enclosure. She sometimes grunted constantly when undertaking activities such as cleaning droppings from her roost which she did most nights. It was also not unusual to find her quietly grunting when one of her keepers arrived to check on her at nights.

Before 1 November 1992 Hoki had not been heard skraaking. From November onwards Hoki began two or three times as the enclosure door was shut after her keeper had left on the nightly visits. It soon became a 'custom' for Hoki every night as a 'farewell' to her keeper.

Recordings of these farewell skraaks were made over many nights and on one occasion they were played back to her several times but no reply was heard.

It is interesting to note that typical 'grunting' has not been heard from Hoki since November 1992 when she first started skraaking. Maybe this corresponds to the time at which Hoki would have become independent of her mother.

5.5 BEHAVIOURAL PROBLEMS DUE TO CAPTIVITY

Hoki has appeared to be 'bored' on numerous occasions during the past two years. As Hoki was hand-reared and has always been confined it is not surprising

that the surroundings in her small (by kakapo standards) enclosure should become boring. Boredom was first noted on 30 October 1992, four months after her release into her pen. Night observations were being made for 5 hours with a night vision scope and Hoki spent much of this time pacing back and forth and tapping her beak along the walls. She would often just sit and stare up to the top of the wall, then continue pacing. It appeared she was bored and needed new things to keep her active.

In an attempt to reduce her boredom I constructed an 'adventure playground' which consisted of a beam, ladders and a swing made from branches and logs. Rata vines were wired up through existing trees for her to climb and more swings were made hanging from trees. This seemed to reduce her pacing for some time. Rocks and branches were also placed along the walls to make pacing difficult. It soon became apparent that Hoki needed constant change to prevent boredom. This sparked development of a feeding system which makes her search for her supplementary food. Hopper brackets are positioned around the pen-up in trees, on the ground, at the 'adventure playground', mounted on pegs and food hoppers are placed at different sites each day. Occasionally other things, such as branches of fruiting trees, flax seed stems, and arrangements of fern fronds, are taken into the pen and these keep Hoki occupied for many nights. All these things have greatly reduced signs of boredom.

Another recurring problem is that the vegetation within the enclosure cannot sustain itself due to Hoki's destructive habits. The ground cover suffers the most with any young plants, ferns or new growth being clipped. The soil becomes exposed from kakapo and human activities and the enclosure starts to look run down. This problem has been reduced by swapping Hoki between the two enclosures to allow the vegetation to recover and replanting to take place. Moving Hoki to another enclosure also has the benefit of allowing her to explore new ground.

5.6 USE OF ROOST SITES

In the original enclosure (No. 1 pen) Hoki usually found adequate cover under the shrubs and dense grass, but during hot, windless periods in summer she also made good use of an artificial shelter. On windier days over the summer period she generally chose to roost high in the trees where she could catch the wind.

During a particularly hot summer (February 1993) it was noticed that Hoki was shifting out of the artificial shelter to shady natural roosts. Because of its position in the pen the temperature in the shelter rose to unacceptably high levels and it was later dismantled and reconstructed in a more favourable position with added ventilation.

Prior to Hoki's transfer (December 1993) to the No. 2 pen, a more favourable underground roost was designed and constructed. The roost is 0.8 m deep and 0.6 m square. The chamber is 'double-skinned' and both the inner and outer walls have removable lids to allow easy access for cleaning and to monitor any nesting attempts that may occur. The entrance is a 50 cm long tunnel, lined with dry leaf litter and covered by rocks.

During the day Hoki usually gets off the roost while her food is being replenished and watches with interest as the hoppers are changed and the cleaning done. Sometimes, however, she does not come out. As a general if Hoki is roosting in a site where she is exposed to the elements or visible to predators, she does not move from her roost. Usually any droppings in the roost are to the side or piled away from where she rests, though sometimes Hoki has scraped out droppings and feathers from her roost chamber and discarded them at the entrance. It is not unusual to find Hoki has fed a little on grasses and herbs within the roost during the day.

6. Discussion and summary

Hoki has been in captivity since mid 1992. Her survival in good health indicates that both diet and accommodation are satisfactory and that it is feasible to maintain kakapo in captivity long term. However, this may also be due to the fact that Hoki was partially hand-reared.

There are, however, problems associated with holding kakapo in captivity (see problems due to captivity), and boredom and the sustainability of vegetation within the pen are recurring problems. New problems might arise as Hoki's behaviour changes when she becomes sexually mature.

The presence of both the captive facilities and the small wild kakapo population on Maud (Te Hoiere) Island provide a range of possibilities for getting Hoki to successfully mate and nest.

One option is to release Hoki at an appropriate time (maybe judged by behaviour changes) so that she can mate with a wild male, then recapture her so that she nests in the enclosure. It is possible that she recognises the enclosure as her home range and would return to nest there of her own accord. Possible adverse reactions to freedom and later re-capture require that she be closely monitored.

Artificial insemination has also been suggested as a way of getting Hoki to breed successfully, but this would have to be a last resort since it requires males that are conditioned to handling.

Another option is to hand-rear a male for release into an enclosure beside Hoki's. This enclosure could be joined to Hoki's with a swinging door that allows the two birds to interact. It might take up to 10 years to rear a male kakapo to sexual maturity, and this would therefore waste some of Hoki's most fertile years.

This also poses potential problems for breeding in that it does not allow Hoki any mate choice, which is a characteristic of the kakapo lek breeding system. Another problem could arise through the holding of two birds in such close proximity to one another.

Summary of Hoki's first two years on Maud (Te Hoiere) Island

- Hoki is the only surviving female kakapo fledged since 1981 and, since 1996, is the longest lived captive kakapo.
- Certain aspects of Hoki's behaviour have changed with time/age.
- On average Hoki eats about the same amount of supplementary food as the free-living females.
- For her first 18 months Hoki was fed a diet primarily of 'Roudybush' parrot pellets.
- Hoki has maintained good condition and weight (i.e. within the normal weight range of other females).
- She is supplementing her diet greatly with natural foods from within the pen.
- Like the wild birds Hoki has a preference for nuts but is also partial to sweetcorn, sweet potato (kumara) and apple.
- On two occasions Hoki has been observed apparently deliberately eating invertebrates.
- Hoki has interacted with the wild females visiting her enclosure, but is not known to have responded to any of the visiting male birds.
- Hoki appears to become bored in captivity and requires ongoing care stimulate her.
- Her behaviour is influenced by the amount of contact she receives at night.
- Hoki appears to defend her roost site.
- She 'skraaks' each time her keeper leaves the pen at night.
- Night visits were made each night for the first year, then reduced to 1-2 visits a week.
- She has been weighed at weekly and sometimes daily intervals.
- Droppings have been collected for steroid hormone analysis by John Cockrem of Massey University.
- Hoki recognises 'booming' and sometimes is a little hyperactive when booming can be heard at her pen.