

Behaviour and Range Movements during the post-fledging dependence period of the Madagascar Fish-eagle *Haliaeetus vociferoides*

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ABSTRACT

The Madagascar Fish-Eagle *Haliaeetus vociferoides* exhibits fratricide and probably polyandry. I monitored the dispersal of six fledglings from 1995 to May 1997 in central-western Madagascar, four of which resulted from 'sibling rescue'. Observations focused on behaviour and movements. The chicks fledged at 85.8 ± 10.7 days of age ($n = 6$), during September to October. They spent 88% of their time perched on trees near water, but also did short flights and spent <25% of their daily time on the ground on the lake shore. The first dispersals from the natal territory occurred on January and April, both by females when they began to hunt for themselves. Three males and one female still remained in parental territories in May 1997, but occasionally made a distant soaring flight to places without territorial pairs ($n = 4$). The post-fledging dependence period varied from 5 to 8 months, until the beginning of the next breeding season in May. At 20 months of age, one young, still in juvenile plumage, remained in the parental territory. I suspect that if juveniles remain in their parents' territory until reaching maturity, they become 'extra adults', or occupying the territory of their parents when they die.

INTRODUCTION

The Madagascar Fish-eagle *Haliaeetus vociferoides* is endemic to Madagascar and is one of the rarest birds of prey in the world (Meyburg 1986). Unfortunately, many wetlands on the island have been transformed into rice fields and the highest human population densities are concentrated around them since rice is the dietary staple (Langrand & Goodman 1995). The eagle exhibits fratricide and 42% of pairs have one or two helpers, which may reduce the annual potential productivity. Consequently, the rate of population size increase is low while the home range and territories are large. Many studies have been done concerning the biology and ecology of the species, but little information is available during the post-fledging period. Previous observations over several years in western Madagascar had shown that the majority of fledglings had left their parents after several

months of age. Only a male, hatched in 1993, remained on the parental territory when I started this study in September 1995. This study aims to describe the main behaviours of fish-eagles during the post-fledgling dependence period and the factors that may influence range movements and natal dispersal.

STUDY AREA AND METHODS

This study was conducted in west-central Madagascar, a flat lowland area liable to flooding which contains many wetlands such as lakes, mangroves, swamps and rivers. About 10% of the total population of Madagascar Fish-eagles are concentrated around a complex of three lakes in the Antsalova region (Befotaka 3.86 km², Soamalipo 4.86 km² and Ankerika 3.09 km²). These lakes determine the southern limit to the primary deciduous forest of Tsimembo (between 18° 59' - 19° 03' S and 44° 24' - 44° 29' E), which covers 32,800 ha at a mean altitude of 10 m a.s.l. The lakes lie about 10 km inland from Mozambique Channel.

Observations around the three lakes were made from September 1995 - May 1997, particularly in territories of pairs with young. The technique of 'sibling rescue', first suggested by Meyburg (1974) as a method to double annual production in rare species, was successfully applied to Madagascar Fish-eagles (Watson *et al.* 1996). Three fledgling males and three fledgling females were observed during the field study, three of which hatched in 1995 and three in 1996. All young were from pairs on three lakes. [In 1995, three pairs out of 10 monitored produced chicks, namely Ankerika 3 (female and 'sibling rescue' male), Ankerika 5 and Soamalipo 2 (female). In 1996, four pairs out of 10 monitored produced chicks, namely Befotaka 3, Soamalipo 2 and Soamalipo 3 with two chicks, and Ankerika 3 with one chick. Four individuals were killed at nests and so only three chicks fledged for 1996, including two from 'sibling rescues' (42% overall mortality before fledging).

Five young were radio-tagged and I tracked their movements using a TRX-1000 S receiver (Wildlife Materials Inc.). Each eagle was banded for quick identification, by an aluminium numeric band on one leg and by one or two coloured plastic bands on the other. Sexes were distinguished by the relatively smaller size and higher-pitched vocalizations of the males. Adults were distinguished from juveniles by their vocalizations and by the completely white plumage on the tails and faces (Langrand & Meyburg 1989).

I focused my attention on the behaviours and movements of juveniles, but also observed any adults that I could see. I recorded the activities of each individual at a 10-minute sampling interval. Other important events during this period were also noted and described briefly. To quickly locate accurate coordinates during observations, I used a grid-scale drawn over a 1:40,000 scale map of the three lakes. When the eagles moved away from the vicinity of lakes, I used a global positioning system receiver (Trimble Ensign) to establish my location. To measure home range area and utilization, and the distance covered by fledglings, I used the computer programme Ranges IV (Kenward 1990).

RESULTS AND DISCUSSION

Behavioural development

A total of 1,225.27 hrs of observations were made. At about 65-75 days of age, young spent much of the time exercising their wings and flapping full strength by standing on branches about 2-3 metres from the nest (but rarely in the nest). This behaviour profited especially from the windy periods during the middle of the morning and the afternoon. The first flight occurred at 85.8_10.7 days (n = 6), during September to October which is in the dry season. Males appeared to leave the nest earlier (mean 78.66 days) than females (mean 91.33 days). I did not always directly observe the first flight from the nest, as sometimes it was difficult to determine exactly the age of fledging. This was because initially the young spent much time on branches near the nest, but even during the first two weeks of flight they returned frequently to the nest for food brought there by the adult. Aerial food transfer was not seen at this stage.

Direct sibling aggression appeared to be common the Madagascar Fish-eagles. Competition was

ferocious once chicks learnt to grapple for larger items and any food not swallowed quickly is liable to be stolen by a sibling. However, juveniles were no longer aggressive when they approached the age of fledging, so that attacks from elder towards younger siblings became rare and even disappeared.

The Madagascar Fish-eagles did little flying, mainly only perch-to-perch flights. Their size and weight may have an influence on the performance, such that they spent much of the day (88%) immobile, waiting for their parents to bring food. They perched in full view on large or dead trees, usually near the nest but also over water, moving closer to the water as nest trees varied in distance of 24.5 - 640 m from the lakes. The eagles moved only during the heat of the day to leafy perches from which continued surveillance.

Soaring flight appeared at about 9-10 weeks after fledging, and in general at hot temperatures with clear skies (> 23_C, cloud < 60%). Sometimes the young eagles soared to such a high altitude that I could not detect them without the aid of binoculars. Some fledglings remained in the parental territories at this age but visited other sites using soaring flight, influenced by, among other factors, thermals. In these the raptors spiral upwards on the rising warmer air then glide down to enter another bubble of rising air, on which they may be carried effortlessly along for tens of kilometres.

Stooping was used for catching prey from an observation point. Prey capture was first observed at about 6-10 weeks after fledging, when I saw the young eagles catch fish or sometimes small crabs. At first, they tried to catch dead fish left by fishermen and then, as they became experienced, they were successful at live fish. In general, success varied between 20-35%, according to the age and experience. Training on hunting technique may not depend directly on the parents, as during this stage the young went their separate ways, not necessarily in the presence of an adult.

Calling by juveniles was an important behaviour that helped to maintain contact between parents and young. Most calling occurred when they begged for food, and calling differentiated juveniles from adults and males from females (Figs. 1-3). In general, a call was formed by 4 notes "ko ko koy koy", which was accentuated to 5 notes when demanding food and lasted for about 2 secs. The frequency can reach 8-10 kHz for juveniles but only 5 kHz for adults (Figs 1,2). As described by Langrand & Meyburg (1989), in the case of a duet, the calls of an adult pair are generally alternated, with the male's calls higher-pitched than the female's. The posture adopted during calling is not typical for juveniles, with head and beak held slightly more horizontal than for adults. Calling in flight was rare, most frequently only during soaring.

Figure 1. Sonogram of a juvenile female's call.

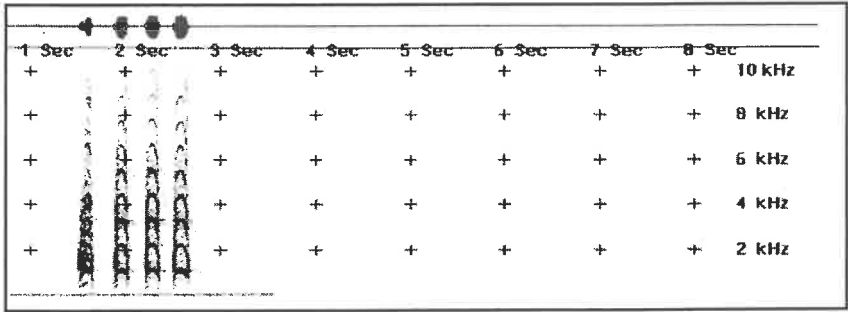


Figure 2. Sonogram of an adult's call (sex unknown).

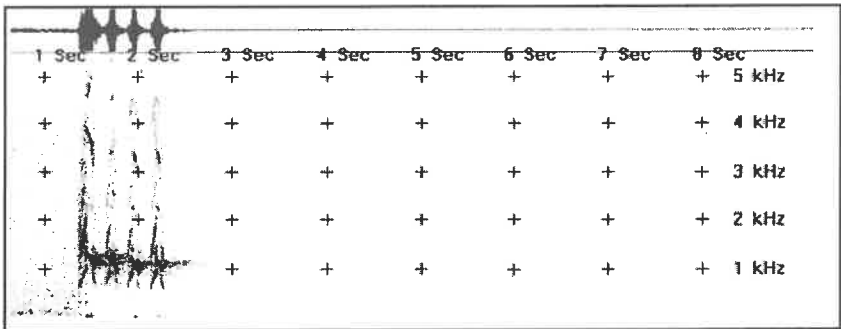
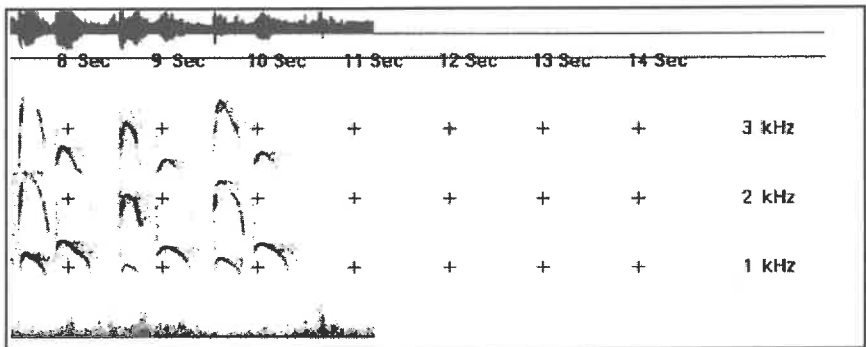


Figure 3. Sonogram of 2 adult's calls in duet.



Range movements and area utilization

Young spent much time perched on a large tree near water and only rarely moved up to 80 metres from lake into the forest. Their range surrounded the nest until they were experienced in flight, after which they tended to move close to water. They did not pass beyond their parents' territories at this age, nor did they defend them. They landed on the ground only on shore, never in the middle of the forest, and spent <25% of their daily time on the ground.

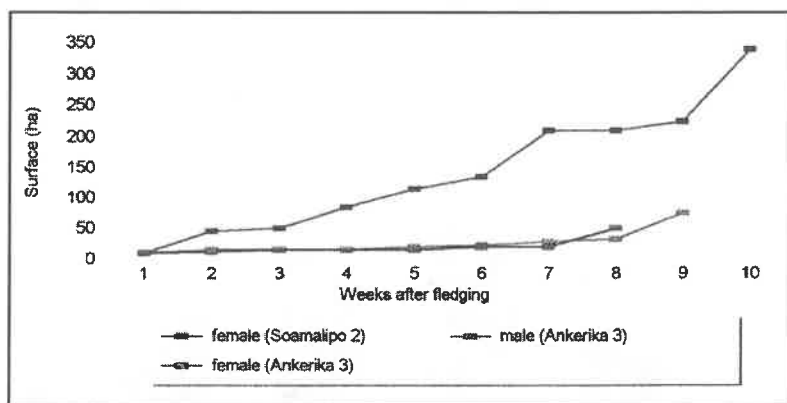
The area covered varied from one young to another (Fig. 4) but, in general, it seemed to depend on the total area available in the parental territory. The young started to go beyond the three lakes after several months of age, making use of thermals. For example, I located a young male of the Befotaka 3 pair at about 19 weeks after fledging. He moved for about 3 km alongside the river that flooded the lakes during the wet season and then, after several days of getting no food, he returned to his natal site. I also located a young male of the Ankerika 3 pair at 45 weeks of age, along a river and about 18 km from his natal territory at Lake Ankerika. Effectively, some young made round trips between their natal sites and other wetlands surrounding the complex of the three lakes. Several juveniles ($n = 4$) were noted in other places where there was a dominance of water (rivers, lakes, mangrove swamps or marshes), so I assume that sites visited by all young were wetland areas.

The post-fledging dependence period

Parents continued to feed each individual juvenile for a variable period after leaving the nest. Young moved soon moved away from the area surrounding the nest, since they were not able to catch fish. Later, I rarely saw parents feeding young over 5-6 months of age. Some juveniles remained

in the parental territory after the behaviours of the next breeding season appeared in early May. On average, there were 8-9 months between the hatching date (July) and the next breeding season (early May). This time corresponded to that in which I observed parents feeding young. The first recorded dispersal occurred in January 1996, by the young female of the Soamalipo 2 pair, 13 weeks after its first flight. A second female of the Ankerika 3 pair only left her territory after 8 April 1996, 25 weeks after fledging. I observed that these juveniles were still being fed by their parents several days before they dispersed, but that they had started to catch fish. In May 1997, the 20-month old male of Ankerika 3 (hatched in 1995), and a male and a female of Soamalipo 3 (hatched in 1996) still remained in their respective territories and were still in their juvenile plumage.

Figure 4. Area covered by young.



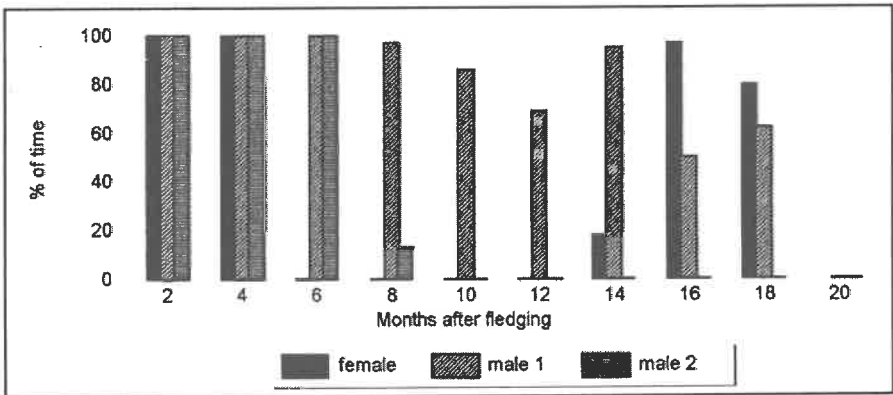
When the breeding season begins in late April, members of every pair are aggressive towards juveniles, especially of the opposite sex. The post-fledging period may vary individually and sometimes it was confusing to delimit this period exactly because of the mobility of the juveniles. Two main factors may influence young to leave their parents: non-feeding by parents and aggressive dominance by certain adults. However, prolonged care by parents characterizes most large raptors, and delayed maturity may also occur in this species. I suspect that if juveniles remain in their parents' territory until reaching maturity, they then become 'extra adults' (helpers), or occupy the territory of their parents when these die. Polyandry does not seem to be common because in this reproductive strategy, females should at least lay eggs in different nests. That may explain why there are only 42% of pairs that have 1-2 extra adult male helpers.

The success or failure of natal dispersal of young fish-eagles affects the species' population size. It also affects their ability to repopulate suitable habitat within its former range once the factors affecting the species' decline have been resolved, such as hunting, persecution and habitat degradation (Watson *et al.* 1993). With the conservation programme initiated by The Peregrine Fund, involving habitat preservation management and surveys, fewer than 100 pairs have been found to remain between Belo sur Mer and Antsiranana in western and north-western Madagascar (Rabarisoa *et al.* 1997).

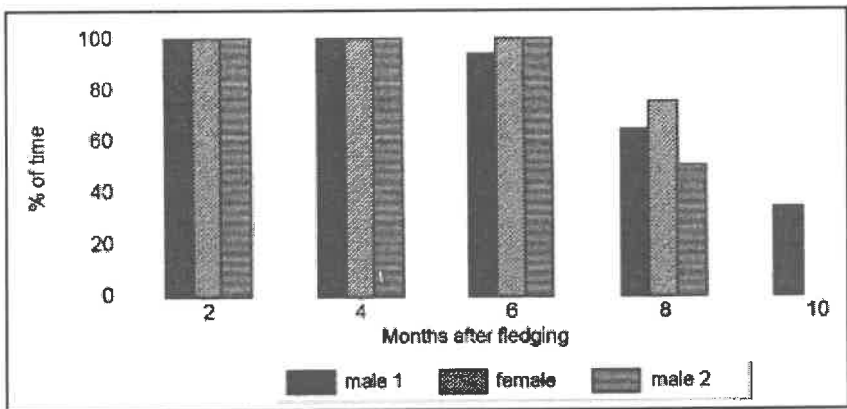
In 1993, biologists from the project first tested with success the 'sibling rescue' technique. When I studied four birds from this method, I observed that this technique may really increase the population size and I did not hear of any fledglings' death since I ended my observations. In their movements, fledglings may find different habitats that ecologically and biologically satisfy the species. This may explain why some eagles did not return to their natal territories, although it was quite difficult to locate the movements of all birds, given the short range of transmitters (4-5 km). However, some young did move over long distances of up to 10 km.

Figure 5. Time passed in parental territories.

a) Young from 1995



b) Young from 1996.



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