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Population monitoring for the flightless rail *Dryolimnas cuvieri aldabranus*

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Summary

The last flightless bird of the western Indian Ocean, *Dryolimnas cuvieri aldabranus* survives only on Aldabra. Its population numbered some 8,000 in 1973–1976. Surveys suggest numbers remained roughly constant between 1968 and 1988 (with a fluctuation of only 4% in responses to call playback between 1983 and 1988), but distribution continued to contract. Longevity can reach over 8.5 years (but is probably lower on average), and some birds remain within 100 m of the site of ringing for at least five years. Feral predators remain a threat, and captive populations are recommended. The monitoring procedure may have value for other Gruiformes.

Introduction

The Aldabra White-throated Rail *Dryolimnas cuvieri aldabranus* (Gunther 1879) is considered a flightless subspecies of *D. cuvieri cuvieri* of Madagascar, although no hybridization studies have been attempted and full specific status is plausible. *D. cuvieri* formerly occurred on Mauritius (Benson 1967).

Other atolls of the Aldabra Group supported rails either of the same subspecies or the disputed subspecies *D. c. abbotti*, but these were reportedly exterminated through habitat destruction, predation by humans, rats and cats (Meade-Waldo 1908, Benson 1967, Gaymer 1967, Ridgeway 1895, Stoddart *et al.* 1970; reviewed by Collar 1982: reprinted this volume). *D. c. aldabranus* is listed as "Rare" in the Red Data Book (Collar and Stuart 1985, Appendix F). The rail recently occurred widely on Aldabra, but is now confined to two of the main subislands, and one of the few small islets, having disappeared from Ile Michel in the early 1970s (Collar 1982). Ile Malabar (Middle Island) supports the largest population, and Ile Polymnie the next largest.

A metatarsal bone found on Ile Picard (West Island) in post-Aldabra Limestone Pleistocene sediments indicates that rails survived there at some stage between 100,000 and 15,000 years ago (Harrison and Walker 1978, Taylor *et al.* 1979). Although the suggestion is controversial (Collar 1982, Collar and Stuart 1985), rails may have been eliminated from Ile Picard and from Grande Terre (South Island) by feral cats *Felis catus* and/or black rats *Rattus rattus* – as the first observers suggest.

The almost mutually exclusive distributions of cats and rails on Aldabra have been described as "precarious" (Penny and Diamond 1971). We suggest that even rails with reduced powers of flight could have reached Grande Terre – which is separated by only a few hundred metres from Ile Malabar, Ile aux

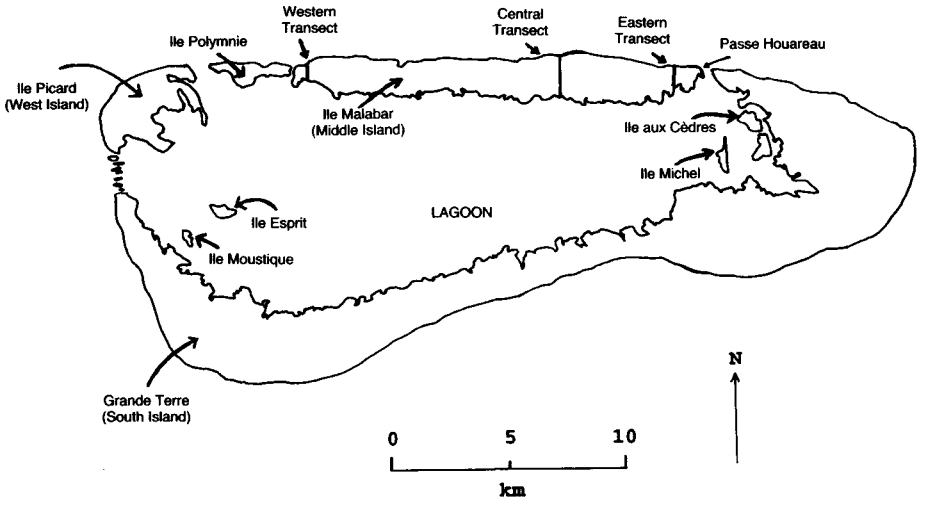

Figure 1. Aldabra Atoll, showing location of monitoring transects.

Cèdres, and Ile Picard – if they were capable of reaching Aldabra from other atolls or from Madagascar.

Cats are rarely sighted on the islands supporting rails. The minimum numbers of records of cats since 1967 are: Ile Malabar 11; Ile Polymnie 1; Grande Terre 110; Ile Picard 25 (Seabrook 1987, and pers. obs.). Rats are present on both main subislands (Malabar and Polymnie) and, whilst they are responsible for considerable mortality of the endemic giant tortoise *Geochelone gigantea* and of passerine species (Prŷs-Jones 1979, Prŷs-Jones and Diamond 1984), they have apparently not yet prevented the rail from breeding successfully. However, there are no records to indicate the population density or nesting success the rail reached before rats were introduced, and it should be noted that predation impact may vary greatly between rat populations on nearby islands (MacFarland *et al.* 1974, Moors *et al.* 1992).

The simplest explanation for the distribution of rails on the subislands of Aldabra is that it follows the same pattern as on other atolls and their subislands: progressive eradication from a near-ubiquitous distribution. It is less likely that the current distribution of the rail is natural, with the largest expanse of good habitat (Grande Terre) unoccupied – or that the almost mutually exclusive distributions of rails and cats is a coincidence. There are areas on Ile Malabar which are sufficiently open for cats to hunt with ease, and although lack of water may limit Ile Malabar's suitability, cats are well established on the equally arid Ile Picard.

In view of the global vulnerability of rails (15 full species alone have become extinct since 1600: Johnson and Stattersfield 1990), it is important that studies of the rail continue. Aldabra is a World Heritage Site, and the rail is important to the ecosystem and to carefully controlled tourism.

A monitoring method of the type described here may have more general use in the conservation of Gruiformes, which often respond strongly to the calls of conspecifics (Huxley and Wilkinson 1979).

Figure 2. Rails often respond to call playback by running to the source, attacking it if possible, seeking and chasing other rails, and duetting with the mate. (Photo: C. Hambler.)

Study methods

For a map of Aldabra see Figure 1; habitats are given in Gibson and Phillipson (1983). Detailed studies of the rail between 1973 and 1976, using metal and coloured rings, assessed population densities (Huxley, cited in Collar 1982). The Cambridge Aldabra Rail and Brush Warbler Expedition in 1983 designed the monitoring methods below, and these were used in 1986 by P. Roberts, a warden on the island, and by the Oxford University Expedition to Aldabra, 1988. Some 137 rails were ringed by C. R. Huxley between 1973 and 1976, and 37 on the 1983 expedition, mainly in the east of Ile Malabar.

The monitoring protocol was developed after intensive survey of rails in one area of Ile Malabar, and then applied at two other locations on the island. Monitoring work can be difficult on Aldabra for reasons of logistics, danger, and expense, and the very dense and impenetrable vegetation in much of the rail's range constrained the methods which could be considered.

Survey in 1983

At the eastern end of Ile Malabar, a pre-existing path transect was studied in detail between 29 July 1983 and 9 August 1983. This transect starts at the northern cliff edge, and small rock cairns were constructed at 10 m intervals.

Call playback was used, since it is particularly effective at inducing rails to reply with counter-calling and to approach aggressively even outside of the breeding season (Figure 2), and will often result in both members of a pair

duetting loudly (Huxley and Wilkinson 1977, 1979). The calls played included the "solo" and "simultaneous" songs, which are mainly used in territorial contexts (Huxley and Wilkinson 1977). Several birds or pairs may be stimulated to approach and/or respond in this way in the vicinity of the played call, and generally birds habituate within a few minutes if they are unable to locate the "intruder". Usually, such birds will respond again a few hours later. The species is thought to have good powers of individual recognition of calls (Huxley and Wilkinson 1979). Territorial behaviour is described by Penny and Diamond (1971).

If a bird or birds replied to call playback with solo or simultaneous song, or ran towards the tape source, then we assumed there was a territory at that site; pairs could be deduced from defence of the same area by two birds, or by duets. Birds responding to playback always had limited, persistent ranges on the transect.

Rails were marked with numbered yellow plastic spiral rings sealed with acetone. An attempt was made to sex the birds by examining the shape of the cloaca, and bill parameters (Penny and Diamond 1971), but these proved very variable in a small sample. Some birds distinguished by small size, tatty plumage, and because they were tolerated within territories, were presumably juveniles of the previous nesting season (approximately September to March). These juveniles wandered widely between territories and did not respond to playback.

Calibration transect

The eastern Ile Malabar transect was used to determine how mobile the birds were, and the mean length of path which a pair would defend. It was possible to identify the linear ranges of all territories along this path. We checked if areas with slow response or no response supported rails by working off the transect.

Territorial boundaries were estimated by observation of aggressive encounters between birds near the transect, or as the mid-point between the most southerly record of one member of a pair and the most northerly record of a member of the adjacent pair.

Although response times were not recorded, these appeared slower in more open, northerly areas, where territorial density is probably lower and border conflicts rarer. Responses often occurred within half a minute of starting playback, and rarely began after five minutes.

Having studied the rail over several days in this area, visiting various sections as required to find and trap new birds, a final visit was made in which the responses were noted along the full length of the transect, using a method which could be repeated on paths in other areas of the island where the population was not known. On this visit we tested (calibrated) a quick and simple method of investigating the contiguity of territories along a path.

Calibration

On 4 August 1983, the eastern transect was walked slowly whilst continually playing calls at a slightly louder than natural volume. If a solo or simultaneous song was heard in a 50 m section, it was assumed to be territorial and a "positive

response" was recorded for that section. Such responses were only recorded if clearly within the section (not too far ahead, behind, or to either side of the observer to be sure of the location of origin with respect to the path section markers). Visual records were ignored.

If no response was obtained whilst a section was being walked, the observer would stop at the marker at the end of the section, and wait there playing calls for up to five minutes. If there was a response from behind or in front of the observer during this period, a positive response would be entered for the appropriate section. If there was no response from the section just walked, a "negative response" would be recorded and the observer would continue along the path. This was repeated for the length of the path, and the presence or absence of a response in the final section (to the southern coast) was also recorded, although this final section is less than 50 m on the path.

If a response was obtained from the same individual bird on both sides of a section boundary, a plus was scored for both sections.

Monitoring method and transects

The transects chosen for monitoring were at the west, east, and middle regions of Ile Malabar, where paths crossed the island from coast to coast on roughly north–south bearings, and where numbered paintmarks, posts or cairns built of rocks were present at approximately every 50 metres.

Details of these transects are given below and their positions shown in Figure 1.

The transects should be representative of Ile Malabar as a whole, running through open scrub, dense mixed scrub, and *Pemphis acidula* scrub, in close approximations to their proportions on Ile Malabar. Transects are only about a metre wide where cut, but often have an intact canopy, and increase access for people but probably not for other animals; the vegetation composition is not affected significantly by cutting (Gibson and Hambler in prep.), and the invertebrates are unlikely to be greatly influenced at ground level where rails forage.

(a) Eastern Transect A well-marked path (the "Coccid Transect" or "Second Goat Path"), starting behind a small bay. This path was divided into 50 m sections marked by pairs of cairns made of piles of rocks. The final section extends into the mangrove. Monitoring dates were 4 August 1983; 21 August 1986; 15 August 1988. This was also the calibration transect.

(b) Central Transect The "Anse Malabar Lagoon Path", starting behind Anse Petit Malabar and marked by paint numbers on the rock or cairns. The final section extends into the mangrove from number 20 painted on the ground. Studied 21 August 1983; 20 August 1986; 17 August 1988.

(c) Western Transect The "Gionnet Z Path" (Prŷs-Jones 1979), starting behind Anse Porche, in the interval between posts marked Z1 and Z2, and ending in a short section facing the lagoon. Studied 3 September 1983; 19 August 1986; 13 July 1988.

Time of day and year

The monitoring studies were performed when there was some spontaneous calling of rails occurring, generally in the afternoon from 15h00 and before dusk. Spontaneous calling was rare compared to response calling. Since responses during the detailed study of the eastern transect appeared strong and rapid throughout most of the day, the time of day is probably not critical, although responses appeared slower at midday. Time of year is probably not critical, since responses are strong in both the non-breeding season (personal observation) and breeding season (Huxley and Wilkinson 1977). For greatest comparability it is now preferable to continue this method in the dry season (particularly July to September), when most scientists visit the island. Wet season (November to March) data would be complementary.

Results

The details of territories along the eastern transect are given in Table 1.

In total, at least 24 individuals were observed along this transect. Of these, 10 pairs were holding territories, and four were unresponsive juveniles or unpaired birds ranging between territories. The mean length of interception by the transect was 70 m and variation between 25 and 175 m.

The data on presence or absence of a response are given in Table 2A–C for the different regions of Ile Malabar. These results include the surveys in 1983, 1986 and 1988.

Comparison of density between years

In 1973–1976, Huxley (cited in Collar 1982) found a territory every 70 metres along a transect through dense mixed scrub on eastern Ile Malabar, and fewer (one per 120 m) in more open scrubland. In 1983 the average distance between territories in a nearby transect through mostly dense mixed scrub and dense *Pemphis acidula* scrub was also 70 metres; this limited study implies that the population in this area was as numerous in the early 1980s as it was 10 years before.

Table 1. Distance along path (from northern coast) with discrete but contiguous numbered territories: eastern transect, Ile Malabar

Distance along path (metres)	Transect section numbers	Territory number
0–200	1,2,3,4	1
200–260	5,6	2
260–282	6	3
282–312	6,7	4
312–387	7,8	5
387–487	8,9,10	6
487–530	10,11	7
530–560	11,12	8
560–660	12,13,14	9
660–703	14,15	10

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In 1973–1976 Huxley made detailed studies of pairs and used data on the numbers of territories along transects in different habitats (Collar 1982) to obtain an overall density of about 1–2 birds per hectare (Huxley and Wilkinson 1977). To convert between the density and the mean length of territory intercepted in a habitat, we have assumed that territorial area varies exponentially with the

Table 2. Full data on positive or negative responses to playback in 50 m transect sections, at three sites in three years

A, Western Ile Malabar transect

Section	1983	1986	1988
1(Z1–Z2)	–	+	–
2	+	–	+
3	+	+	+
4	+	+	+
5	+	+	+
6	+	+	+
7	+	+	+
8	+	+	+
9	+	+	+
10	+	–	+
11	–	+	+
12	+	+	+
13	–	–	+
Total positive	10	10	12
Sections positive	77%	77%	92%

B, Central Ile Malabar transect

Section	1983	1986	1988
1	+	+	+
2	+	+	+
3	–	+	+
4	+	+	–
5	+	+	+
6	+	+	+
7	+	+	+
8	+	+	+
9	–	+	+
10	+	+	+
11	–	–	+
12	+	+	+
13	+	+	+
14	+	+	+
15	+	–	+
16	+	+	+
17	+	+	–
18	+	+	+
19	+	–	+
20	+	+	+
21	+	?	+
Total positive	18	17	19
Sections positive	86%	85%	90%

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C, Eastern Ile Malabar transect

Section	1983	1986	1988
1	+	+	+
2	+	+	+
3	−	−	+
4	+	−	−
5	+	+	+
6	+	−	+
7	+	+	+
8	+	+	+
9	+	+	+
10	+	+	+
11	+	+	+
12	+	+	+
13	+	+	+
14	+	−	+
15	+	+	+
Total positive	14	11	14
Sections positive	93%	73%	93%

square of the linear dimension (as measured from the transect). Huxley's transects indicate that the ratio of territory interception lengths in dense mixed scrub/open mixed scrub is 70/120 = 0.583. The density of rail in dense mixed scrub is thus $(1/0.583)^2 = 2.9$ times that in open scrub. In 1967–1968 Penny and Diamond (1971) found about 11 birds in an area some 400 m by 400 m in more open habitats at the eastern end of Ile Malabar, at a population density of 0.7 birds per hectare; their results suggest a population density of (2.9 × 0.7 =) 2.0 birds per hectare in dense scrub.

Comparison of response rate between years

Calibration indicated that the monitoring method elicited responses in 94% of the sections of path known to be within territories, and at least 50% of the known territories.

In all three transects, responses were obtained from a high percentage of sections, varying between 73% and 93%, with a mean of 85%. This implies a similarly high territorial contiguity, if not density, in the three regions.

For each transect between 1983 and 1986 the change in the number of positive responses was a small percentage of the total positive responses (Table 3); the

Table 3. Number and percentage of positive responses by region of Ile Malabar, and the increase or decrease in positive responses for all sections of the transects between monitoring years

	Western transect	Central transect	Eastern transect
Total number positive responses 1983–1988	32	54	39
Positive responses 1983–1988	82%	87%	87%
Change 1983–1986	0	−1	−3
Change 1986–1988	+2	+2	+3
Change 1983–1988	+2	+1	0
Change 1983–1988	+6%	+2%	0%

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Table 4. Summary of positive responses, all transects

	1983	1986	1988	Overall 1983–1988
Number positive	42	38	45	125
Positive	86%	79%	92%	86%
Change in number positive	–	−4%	+4%	+0%

western transect has slightly more variation, as expected by chance since it is shorter.

No section has been consistently without response and in only four cases is there a series of two negative responses. In contrast, 32 out of 48 (= 67%) sections have had a series of three positive responses.

In 1983, 86% of 49 records were positive; by 1986, 82% of 97; and by 1988, 86% of 146. Overall, there was no net change between 1983 and 1988 (Table 4). A lack of response does not preclude the presence of a territory, and experience suggests that chance, and the intensity of recent territorial defence in a section, may account for some of the variation.

Other populations

In 1983, Ile Esprit, Ile Michel and Ile Moustique were searched using call playback without success. Rails were still common on Ile aux Cèdres, where there is a population of slightly larger individuals (Huxley, cited in Collar 1982). Rails were also common there in 1986 (P. Roberts *in litt.*). "Unnamed Island" (south of Ile aux Cèdres) was not visited in either 1983 or 1988 (but no rails were found using playback in 1986: P. Roberts *in litt.*). Ile Polymnie supported a thriving population in 1983 and 1988, with very rapid responses to call playback at both the north-eastern and south-western regions.

There is no evidence of rails recolonizing (or colonizing) any of Grande Terre, including the area near Passe Houareau and the south-west region, which were surveyed in 1983 and 1988; no response was obtained to call playback in 1983. Ile Picard is also still devoid of rails, so far as can be seen from observations around its western coast and inland near Anse Var (pers. obs. 1981, 1983, 1988).

Site persistence and longevity

Although some 200 rails have been ringed since 1967, few recaptures have been recorded.

We saw and recaptured two ringed individuals. A bird ringed by C. R. Huxley on 18 January 1976 with a British Museum metal ring (ED 43211) was recaptured on 4 August 1983. The recapture location was Passe Houareau Camp (Middle Camp) at the eastern tip of Ile Malabar, 600 m east of, and 100 m north of, the ringing location. The bird was ringed as a breeding male of unknown age, which had just moved into a new territory (C. R. Huxley *in litt.*). It must have been at least 8.5 years old on recapture.

A bird, ringed on 3 September 1983, was recaptured on 12 July 1988. It was ringed as a female holding territory at the Gionnet Camp, and was still holding

territory when recaptured within 10 m of the ringing site, when it must have been at least 6.5 years old.

A bird with a distinctive broken and drooping right wing was observed on 2 August 1983 at between 400 and 500 m on the eastern transect. A bird with the same (rare) injury was observed at between 300 and 350 m along this transect on 15 August 1988. On both the dates, the bird did not respond to playback and appeared subordinate. This was almost certainly the same bird, at least 5.5 years old.

Although several rails were reported with plastic rings (from 1983) in Research Camp logbooks in the mid-1980s, it appears that few of the birds survived or stayed in the locations at which they were marked for five years. Large numbers of birds with metal rings from the 1973–1976 study have vanished.

Injuries observed

It is notable that a few birds with legs missing from the knee down were apparent in 1988, at the eastern end of Ile Malabar and on Ile Polymnie. How they were injured, and the impact on survival, is unclear, although such birds have been noted occasionally before on Ile Polymnie (e.g. by M. S. Gould, report in Polymnie Camp log, 22 June 1985). These birds seemed otherwise healthy, but subordinate to other rails.

Discussion

The population density seems to have remained remarkably constant in the study periods of 1967–1968, 1973–1976, and 1983. The less precise monitoring method suggests little change by 1986 or 1988.

Site persistence appears to be high in some cases, but not all (Penny and Diamond 1971). Rapid dispersal within Ile Malabar would lead to very few recaptures on the tiny percentage of the island that is accessible to researchers. However, it is interesting that despite large numbers of rails being seen in the general areas where birds had been ringed at least five years ago, and extensive ecological research elsewhere, so few ringed birds were subsequently observed.

It may be that the longevity of the birds is generally less than 10 years, and site persistence generally less than five years.

To be valuable as an alarm system for conservationists, the monitoring method must be able to detect major declines in rail populations. If density declined greatly in a region of the island near a transect, then territorial contiguity would be unlikely along transects, and many sections should yield no response. It is important that if the population is reduced, the remaining birds do not expand their territories substantially, or become much more mobile. Since the territory size is lower in high-quality habitats (dense shrub with abundant invertebrates), the normal costs of territorial occupation (Davies 1978) are evidently applying to rails. The birds are minimizing defence costs when possible, and not defending unnecessarily large territories – which suggests that if birds were removed only the best territories would continue to be occupied and be defended by counter-call responses.

However, given the uncertainty over the behaviour of rails at low density, it should be noted that whilst a great reduction in the number of positive

responses must cause concern, a lack of change or increase should not lead to complacency. We suggest the monitoring method is used at least every five years, and limited ringing studies on the eastern transect at roughly 10-year intervals. If results suggest a maximum density of less than the minimum of 1973–1976 (that is less than one rail per hectare), then investigations should intensify.

Should poor responses be obtained on any of the transects, this may signal a local increase in mortality as might arise from a change in feral predator abundance. Colonization by cats might be countered if prompt action were taken. Cats, well established everywhere except on the islands with rails, are in our opinion (and despite the caveats by Huxley, cited in Collar 1982) a major threat to the long-term security of the population. They certainly reduce the potential of other islands to support rails. We endorse the calls for eradication of cats – including that following a survey by Seabrook (1987). Moreover, rat behaviour is very flexible, and there is no scope for complacency deriving from the apparent tolerance of rats by the rail populations.

The 50 m section markers along the transects, including paired cairns, paint numbers and numbered posts, should be maintained routinely, since this proved the greatest problem in repeating the method in 1986 and 1988.

Captive breeding populations of this species were recommended decades ago, and were planned in detail by ourselves. There is every likelihood that rails would thrive in captivity in reputable zoos around the world, and interest was expressed in 1983 by several institutions in Britain. Aviaries in the granitic Seychelles could be made suitable for the species. Captive populations are likely to be successful, on the evidence of two birds (unfortunately of the same sex) taken to England from Assumption (Meade-Waldo 1908). The prospects for reintroducing the species to other subislands and atolls of the Aldabra group should also be reviewed; such colonies could reveal how rails behave at low density.

Although the rail is not a high priority for conservation funding (in comparison with more highly endangered full species), the body of knowledge of this bird, and the consequently good prospects for success, should encourage serious consideration of further relatively simple precautionary conservation action for it.

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