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CONSERVING THE SEYCHELLES WARBLER *Acrocephalus sechellensis* BY TRANSLOCATION FROM COUSIN ISLAND TO THE ISLANDS OF ARIDE AND COUSINE

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Abstract

The Seychelles warbler *Acrocephalus sechellensis* was once a highly threatened single-island endemic species with a population of 26 individuals confined to Cousin Island in the inner Seychelles. Following long-term management of Cousin, the population steadily recovered to around 300–360 birds. Given the vulnerability of one small island in the Indian Ocean, the possibility of establishing the species on additional islands had been proposed as a priority conservation measure, in order to give the species the security of additional breeding populations, lest some ecological disaster should befall the parent population. Successful translocations of warblers to the islands of Aride and Cousine took place in September 1988 and June 1990 respectively. Given the presence now of three healthy breeding populations, it is considered that the Seychelles warbler will soon no longer be a globally threatened species. It is not often that people are allowed to pull a species so dramatically back from the brink of extinction.

Keywords: Seychelles warbler, island quality, niche overlap, translocation, breeding activity.

INTRODUCTION

The oceanic islands of the western Indian Ocean support 26 globally threatened bird taxa that are listed in the ICBP/IUCN Bird Red Data Book and include some of the smallest and most threatened bird populations in the world (Collar & Stuart, 1985). In the central group of the Seychelles eight taxa are threatened. One of these is the Seychelles warbler *Acrocephalus sechellensis* (Oustalet, 1878), which at one time was reduced to a population of 26 individuals, entirely confined to Cousin Island (29 ha) (Crook, 1960). Since Cousin Island has been managed as a nature reserve, the warbler population reached carrying capacity of around 320

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birds. In September 1988 29 warblers were transferred to Aride Island (68 ha) and in June 1990 29 warblers to Cousine Island (26 ha). This paper describes the ecological studies carried out prior to, during and after the translocations and documents the subsequent establishment of the new populations.

Past and present distribution of the Seychelles warbler

The Seychelles warbler is known only from the Seychelles Islands, where in 1870 it was recorded on Marianne and Cousine (Oustalet, 1878; Fig. 1). Between 1910 and 1920 both islands were planted with coconuts *Cocos nucifera*. Coconut palm are vulnerable to root competition, so to maintain reasonable yields plantations had to be kept clear of other vegetation by regular cutting. This policy caused the removal of most indigenous vegetation, which resulted in the disappearance of the species from both islands. Odd records have been reported from Mahé and Félicité and there is some confusion as to whether the original Cousine record may have been in error for Cousin (Collar & Stuart, 1985). The species was certainly present on Cousin in 1938 but was by then considered rare (Collar & Stuart, 1985). No records exist of the composition of the original vegetation of Cousin but in the list of the flora of the Seychelles only one species, *Pisonia grandis*, is mentioned from Cousin (Summerhayes, 1931). However, it has been suggested that Cousin Island was mainly covered by mature *Pisonia* forest (Fosberg, 1970). Between 1910 and 1920 Cousin was planted with coconuts, leaving very little suitable natural habitat for the warblers. Fortunately alien predators, such as cats, rats and mice, have never found their way onto the island. The introduction of these species would create by far the greatest threat to the future of the warblers. No other self-sustaining population existed until September 1988.

In 1959 a survey revealed a population of 26 birds only (Crook, 1960). Since the species was believed to be on the verge of extinction, Cousin was purchased for the International Council for Bird Preservation (ICBP) in 1968, which has since managed the island as a nature reserve. Management has been directed towards

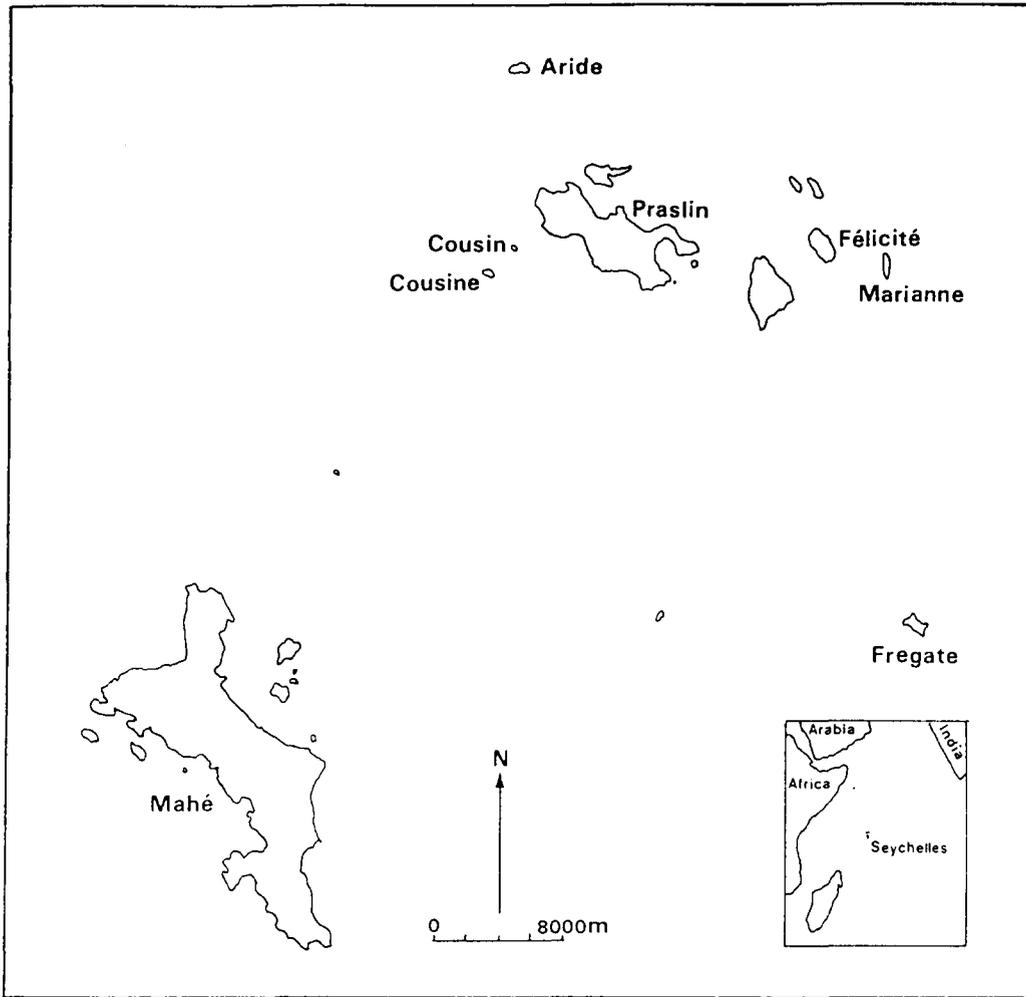


Fig. 1. Map showing the Seychelles islands under discussion.

increasing suitable habitat for the warbler. In order to allow the original vegetation to regenerate, the regular clearing of bush growing up under the coconut palms was stopped. In addition the coconut crop continued to be harvested so as to prevent regeneration of coconut palms which, if allowed to grow unchecked, results in an impenetrable thicket of young palms, probably crowding out everything else. As a consequence the in-

digenuous vegetation has quickly regenerated and is now tending towards predominantly *Pisonia grandis* forest. This has led to a spectacular recovery of the warbler, numbers rising to nearly 320 birds in 1982 (Fig. 2). This recovery is partially documented in a Collar & Stuart (1985), who record a somewhat slower recovery than shown in Fig. 2. The data in Fig. 2 are based on a re-examination of the original territory maps of Bathe

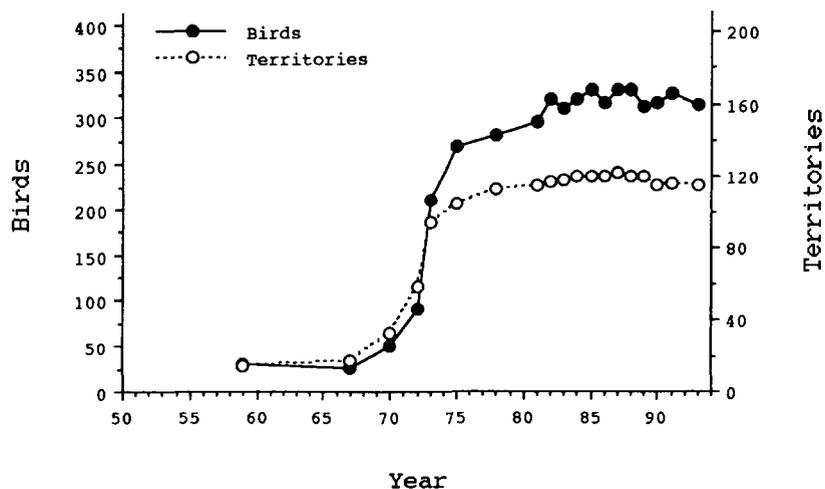


Fig. 2. Increase in Seychelles warbler numbers and territories since 1959.

and Bathe (1982) and N. J. Phillips (pers. comm.) as well as more recent total counts. Since 1982 the population has fluctuated around that level, suggesting that this is the carrying capacity of the island. The increase in number of territories showed the same trend, but reached its saturation level of *c.* 115 territories earlier, in 1973.

Justification for a Seychelles warbler translocation

The Seychelles warbler has a clutch-size of one which, when combined with low breeding success, leads to a low reproductive rate (on average only 0.32 young per warbler pair per year become adults). This need not be a severe problem if the pressures placed on reproduction are only temporary, since warblers are long-lived (mean annual adult survivorship—the probability of surviving to the next year, starting at age one year old—is 83.5% and mean adult life expectancy is 3.9 years) and can therefore tolerate periods of low recruitment. They are particularly vulnerable to factors which lead to increased adult mortality and/or prolonged reduction in recruitment.

As the Seychelles warbler population on Cousin had reached carrying capacity, many young birds were unable to establish new territories (Komdeur, 1992). Thus in order to give the species the security of more breeding populations, lest some ecological disaster should befall the parent population, King (1978–79) and Collar and Stuart (1985) recommended the establishment of other populations on other islands.

Several islands were investigated for their suitability for a transfer. While suitable habitat, including adequate insect food supplies, was clearly a priority, the absence of cats and rats was also considered a precondition and some form of sustained commitment to conservation management seemed highly desirable. Of the possible islands fulfilling these criteria (Aride, Cousine and Fregate) Aride was selected in the first place, and Cousine in the second (Fig. 1). Aride, 9 km north of Cousin, is a nature reserve run and owned by the Royal Society for Nature Conservation (RSNC). Cousine is a privately owned, rat-free island in a near-natural state and lies only 1.6 km south-west of Cousin. The native woodland on the proposed islands has recovered as swiftly as that on Cousin.

METHODS

Data collection

The data included in this study were based on the whole world population of Seychelles warblers, which is a group-territorial species. Since January 1986 all 115–123 groups of the warblers (300–360 birds) have been studied on Cousin Island. From September 1988 to June 1991 an additional 13–36 groups (29–165 birds) were studied on Aride Island, and from June 1990 to June 1991 an additional 12–16 groups (29–43 birds) on Cousine Island. To detect breeding activity all territories on Cousin and Aride were checked weekly, and on Cousine fortnightly, for active nests.

Similarity in feeding ecology among landbird species

Between January 1987 and March 1988 the feeding ecology of all six landbird species inhabiting Cousin Island was studied: the barred ground dove *Geopelia striata*, the turtle dove *Streptopelia picturata*, the Madagascar fody *Foudia madagascariensis*, the Seychelles sunbird *Nectarinia dussumieri*, the Seychelles fody *Foudia sechellarum*, and the Seychelles warbler. The first three and the first five mentioned were at the time of this study the only breeding landbird species occurring on Aride and Cousine respectively, the islands selected for the establishment of new warbler populations.

Twice each week a fixed transect (1.5 km) was walked, once in the morning (0600 h–0800 h) and once in the afternoon (1630 h–1900 h), stopping for 2-min periods at 30 points, each 50 m apart. The transect passed through all the main habitats. All instances of feeding movements by landbirds that appeared to involve prey-capture were recorded; searching behaviour was not included. For each half-minute (with no more than four observations per bird) the following observations were made (*n* = number of categories):

(1) The feeding height. All foraging was recorded as occurring in one of the following bands: 0 m (ground), 0–4 m, 4–8 m, >8 m (*n* = 4).

(2) Plant species under or in which the bird was found foraging: *Morinda citrifolia*, *Pisonia grandis*, *Ficus* sp., rest trees (other tree species), herbs (*n* = 5).

(3) Part of the plant involved: branch, leaf, flower, or fruit (*n* = 4).

(4) Food item taken: insect, fruit/seed, nectar (*n* = 3). Direct observations to score type of food item taken were possible because the birds were remarkably tame and could sometimes be observed from just a few metres.

In order to quantify similarities in feeding ecology between the Seychelles warbler and other landbirds present, overlaps in feeding ecology were calculated. The data were transformed to proportions of occurrences in each of the 195 combined feeding categories (Appendix I). The overlap between species *i* and *j* (O_{ij}) was calculated as the sum of the smaller proportion (P_{\min} ; the shared proportion) in each feeding category *k*:

$$O_{ij} = \sum_k P_{\min}(i \text{ or } j)$$

For example, the feeding observations of the Seychelles fody (sf) and Seychelles warbler (sw) were categorized as percentages (Table 1). The sum of the least shared proportions for this pair of birds is 0.0 + 10.6 + 3.5 + ... 0.2 + 0.0 = 47.9.

The overlaps can be illustrated by means of a phenogram, which graphically shows the results of the clustering process, using UPGMA (Unweighted Pair-Group Method using arithmetic averages; Both *et al.*, 1985). The overlap varies from 0% (no similarity) to 100% (feeding patterns of birds identical).

Table 1. Example of categorization of feeding observations of the Seychelles fody and Seychelles warbler in order to calculate the feeding overlap between these species; see also Appendix 1

Feeding category	Seychelles fody (%)	Seychelles warbler (%)
<i>Pisonia grandis</i> , 0 m, insect	0.7	0.0
<i>Pisonia grandis</i> , leaf, 0–4 m, insect	10.6	24.8
<i>Pisonia grandis</i> , leaf, 4–8 m, insect	3.5	4.4
—	—	—
Herb, fruit, 0–4 m, insect	0.8	0.2
Herb, fruit, 0–4 m, fruit or seed	4.2	0.0 +
Total	100.0	100.0

Island quality

Island quality could be measured in several ways, for example in terms of availability of nest sites, density of (nest) predators or food availability. Nesting places had no obvious features (within the same territory on Cousin Island nests were found from 1 m to as high as 20 m) and were plentiful on the three studied islands. Adult Seychelles warblers lack natural predators. Nest-predators (Seychelles fodies and skinks *Mabuya wrightti* and *Mabuya sechellensis*) were less common on the islands of Aride and Cousine than on Cousin Island (Brooke & Houston, 1983; Owen, 1986; Bullock, 1989; personal observations). Island quality, which was not determined by the presence of nest sites and nest-predators, was measured in terms of insect prey available. The foraging behaviour of Seychelles warblers provided an excellent opportunity to assess the island's quality. As the warblers are insectivorous, taking 98% of their insect food from leaves (Komdeur, 1991), the quality of an island depends on insect prey available and amount of foliage. Island quality (iq) was therefore expressed in terms of mean number of prey insects available using the following equation:

$$iq = \sum_{x=1}^{12} (c_x * i_x)$$

where c_x = mean yearly foliage cover for plant species x , and i_x = mean monthly insect totals for plant species x .

Island quality of Cousin and Aride was studied between May 1987 and June 1990, and quality of Cousine from August 1989 to June 1990. Insects and vegetation were monitored simultaneously on Cousin and Aride, and on Cousine at a later stage at 67, 28, and 20 randomly chosen sites, respectively.

To monitor effects of drought and wind direction on the vegetation, the amount of foliage at each site was measured using a transect method, during both the dry (May–September) and wet (November–March) seasons. Each transect was 250 m long. Every 5 m the presence or absence of foliage and the plant species was noted in the following height bands: 0–0.75 m, 0.75–2 m, 2–4 m, etc. Mean foliage cover for plant species x (c_x) is two times the total number of cases of presence at all heights along a transect, divided by the number of transects.

To assess prey availability (i_x) at each site, 50 leaves per plant species (12 dominant species) were searched for insects monthly (between 15th and 20th). Totals of the following groups were counted on upper and lower sides separately: Arachnida, Coleoptera, Diptera, Formicidae, other Hymenoptera, Hemiptera, Lepidoptera and Orthoptera.

RESULTS

Suitability of Aride Island and Cousine Island for Seychelles warblers

It was predicted that on the new islands the warbler would fill an open niche (based on similarities in feeding ecology) without competing with the other landbird species present (Fig. 3). The species have different feeding patterns and fill their own niches thereby lessening interspecific competition. The warbler competes very little with the Seychelles fody and Seychelles sunbird and its feeding is distinctively different from the other species. Therefore a joint research programme on the islands was carried out to assess Aride's and Cousine's suitability for Seychelles warblers (Komdeur & Bullock, 1988; Komdeur, 1990b).

Between May 1987 and September 1988 the quality

bird species:	sf	sw	ss	mf	gd
sw	47.9				
ss	49.7	49.1			
mf	15.0	1.4	6.0		
gd	11.9	2.1	1.4	19.9	
td	11.2	1.8	0.0	8.9	63.4

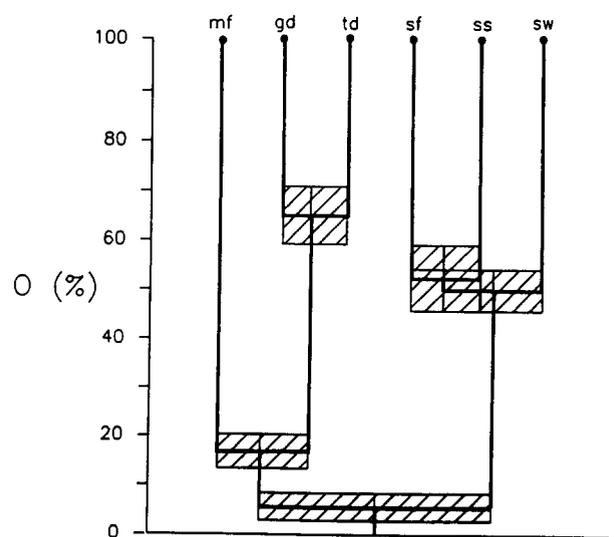


Fig. 3. Half matrix and phenogram of UPMGA clustering (see Appendix 1) showing similarities ($0 \pm 95\%$ confidence limits) in feeding behaviour between landbird species on Cousin Island (January 1987–March 1988). Sf, Seychelles fody; sw, Seychelles warbler; ss, Seychelles sunbird; mf, Madagascar fody; gd, ground dove; td, turtle dove.

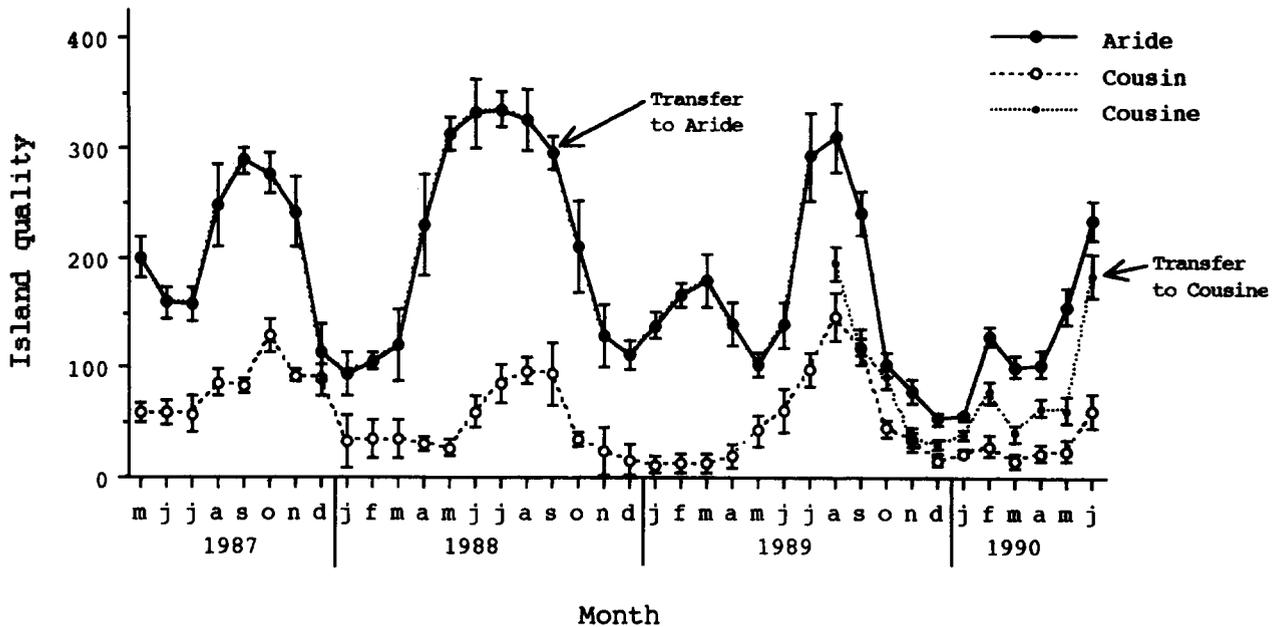


Fig. 4. Monthly island quality (\pm SE) of Aride Island, Cousine Island and Cousin Island (May 1987–June 1990).

of Aride in terms of feeding opportunities was on average 4.4 times higher than that of Cousin (mean monthly island quality was 242 and 55, respectively) and the minimum quality was almost as high as the maximum recorded for Cousin (Fig. 4). Because of the open niche present and this significantly higher quality, Aride was judged to be suitable for the establishment of a second population. Because of the successful translocation of warblers to Aride Island (see below), Cousine Island was studied with a view to assessing its suitability for a third warbler population. From August 1989 to June 1990 parallel studies showed that the quality of Cousine in terms of feeding opportunity was on average 0.6 as high as that of Aride Island (mean iq: 90 vs 155) and 1.7 as high as Cousin Island (mean iq: 89 vs 52; Fig. 4).

Transfer of Seychelles warblers to the islands of Aride and Cousine

Once Aride had been established as a suitable site for the Seychelles warbler, ICBP, RSNC and the Seychelles government formally approved the translocation. For the transfer a target of 30 adult birds, with equal numbers of both sexes, was considered to be a reasonable number for the establishment of a new population (M. F. Mörzer Bruijns, pers. comm.), and to remove from the Cousin population (Komdeur *et al.*, 1988).

Research indicated that September 1988 would be a good time for the transfer. At this time moulting is complete, breeding mostly finished and food supply is still high enough for birds to be in prime condition (Komdeur, in press).

In mid September all territories were checked for breeding birds and birds undergoing rectrices moult, in order to select 30 adult individuals for the transfer. Over the period 23–29 September trapping took place between 0500 h and 0800 h each morning, in four localities. At each locality two mist-nets and a portable

tape-recorder with a continuous loop cassette of male song was used to attract birds. If possible, experienced breeding pairs (which had held a territory and bred at least once) were caught.

The birds were weighed immediately after catching. To prevent aggression between territorial birds, each bird was kept in a separate $15 \times 15 \times 20$ cm cardboard transfer cage, well-ventilated, but dark inside in order to keep the birds inactive, thus reducing stress and energy loss. A stick trellis, 1 cm off the floor of each box, was also provided to allow the birds to perch inside. Birds were then taken to the laboratory, ringed, weighed again and sexed by measuring weight and wing length (Diamond, 1980), and transferred immediately.

During the period 29 adult warblers (16 males and 13 females) were rapidly transferred to Aride by motor-boat, a journey of *c.* 45 min. The cardboard cages were kept secure in a wooden carrying cage and placed on a thick foam mattress to absorb shocks in a rough sea.

Immediately on landing, the birds were taken to their release sites—three different, insect- and vegetation-rich areas on Aride. Birds belonging to the same territorial group were always released at the same sites. The inter-island transfer of New Zealand black robins *Petroica traversi* (Flack, 1977) showed that the transferred birds will settle as close to the release point as possible when the habitat is suitable; otherwise they move about and/or fail to form pairs. Before release birds were weighed again and water was provided by throwing buckets of water over the vegetation within a few metres of the cages.

Because of the successful translocation of warblers to Aride Island and the proven suitability of Cousine Island 29 colour-ringed adult warblers (15 males and 14 females) were transferred in a similar way over a three-day period from 29 June to 1 July 1990 to Cousine, a journey of *c.* 15 min by boat.

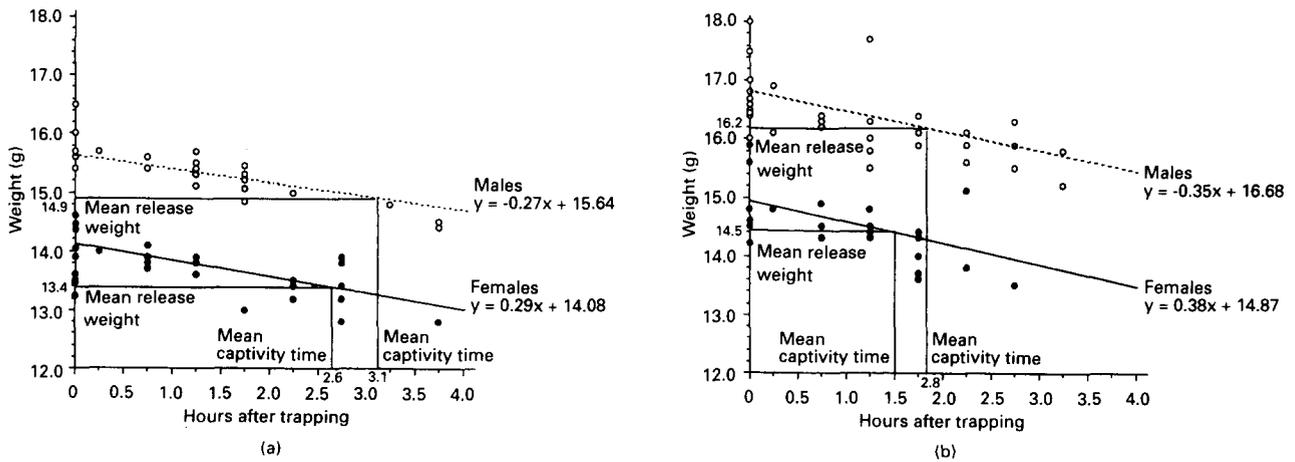


Fig. 5. Weight loss of Seychelles warblers in captivity during translocation to (a) Aride Island (September 1988; males: $r = -0.83$, d.f. = 20, $p < 0.001$; females: $r = -0.61$, d.f. = 26, $p < 0.001$) and (b) Cousine Island (June 1990; males: $r = -0.61$, d.f. = 29, $p < 0.001$; females: $r = -0.60$, d.f. = 20, $p < 0.002$). (Mean release weight and mean captivity time are given for both sexes).

Evaluation of the transfer method

The effect of the transportation method on the birds was assessed by weight changes of birds during captivity, the visual condition of birds at release and by survival and behaviour in subsequent weeks.

The alimentary canal of small insectivorous birds is adapted to continuous digestion. If stomach and intestine are completely empty (e.g. after fasting following catching and transport) then immediately after the loss of the last intestine contents a haemorrhagic diathesis can develop. This can arise very quickly in small birds with a high metabolism level and leads rapidly to death. There is a minimum weight below which birds will die so it is clearly vital that the handling of birds and total time in captivity is kept at an absolute minimum to prevent their weight falling below this critical level.

On average the birds spent just over 3 h in captivity. The minimum known survival weight is 14.6 g for males and 12.6 g for females, calculated as the lowest weight of known birds on Cousin Island still alive (Komdeur, unpublished data). All birds survived the transfers and were released before they reached the

minimum weight (Fig. 5). During the transfer to Aride, males lost on average 0.9 g, females 1.0 g (respectively 5.7% and 7.1% of body weight). The weight loss of birds during the relatively short transfer to Cousine was on average 0.6 g for males and 0.5 g for females. Male and female warblers caught for transfer to Cousine weighed 7.0% and 7.1% respectively more than birds of the same sex caught for transfer to Aride, both differences being significant (males: $t = 3.78$, d.f. = 29, $p < 0.005$; females: $t = 3.51$, d.f. = 25, $p < 0.005$). This extra weight is possibly an insurance against the forthcoming energetic-demanding period of breeding from June onwards (the transport to Aride occurred just after the breeding season). Due to this extra weight and to the relatively short captivity time, the release weight of both males and females after the transfer to Cousine was on average 1.3 g (16.2 vs 14.9 g) and 1.2 g (14.6 vs 13.4 g) respectively higher than that of birds released on Aride. Moreover, release weight of males and females on Cousine was even higher than catching weight in 1988 before transfer to Aride (Fig. 5). Generally, it is advisable to start a transport at the onset of the breed-

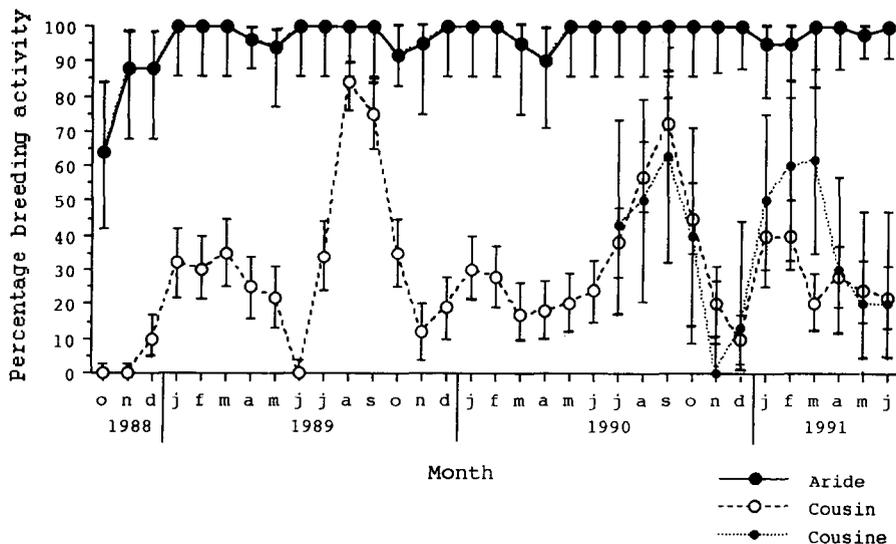


Fig. 6. Percentage territories with breeding activity each month (\pm 95% confidence limits) on the islands of Aride, Cousin and Cousine (mean: 97.0% (mean $n = 22$), 25.1% (mean $n = 117$) and 37.5% (mean $n = 13$) respectively).

Table 2. Comparison of annual adult survival and breeding performance of Seychelles warblers on Cousin Island and Aride Island two years following the transfer to Aride (September 1988–September 1990) (a), and on the islands of Cousin (C), Cousine (C^c) and Aride (A) one year following the transfer to Cousine (June 1990–June 1991) (b). (Figures in parentheses are number of observations; ^b = number of bird years.)

(a)

	Cousin	Aride	Statistic
Annual adult survival	0.84 (198 ^b)	1.0 (63 ^b)	$\chi^2 = 10.15^{**}$
Mean clutch size	1.0 (103)	1.8 (44)	$t = 17.36^{**}$
Mean no. days to fledge	19.1 (72)	14.0 (43)	$t = 41.22^{**}$
Mean yearly young fledged/territory	0.6 (210)	5.6 (36)	$t = 8.45^{**}$
Mean yearly young reaching one year of age/territory	0.19 (210)	3.10 (36)	$t = 9.51^{**}$

(b)

	Cousine	Cousin	Aride	Statistic (C ^c –C)	Statistic (C ^c –A)
Annual adult survival	1.0 (29 ^b)	0.82 (151 ^b)	1.0 (49 ^b)	$\chi^2 = 4.78^{***}$	$\chi^2 = 0.00$
Mean clutch-size	1.1 (8)	1.1 (22)	1.7 (21)	$t = 0.00$	$t = 2.75^{**}$
Mean no. days to fledge	18.8 (4)	19.0 (39)	14.1 (15)	$t = 0.27$	$t = 10.31^{**}$
Mean yearly young fledged/territory	1.4 (10)	0.5 (39)	5.5 (32)	$t = 4.00^*$	$t = 8.54^{**}$

* $p < 0.001$, ** $p < 0.005$, *** $p < 0.05$

ing season and not thereafter, because the birds are in a much better condition (body weight of seven same breeding females before and after the breeding season in 1989 was 15.2 g and 14.0 g respectively ($t = 8.35$, d.f.=6, $p < 0.001$)).

All birds survived the trapping and transfer. Immediately after release, birds started feeding and drinking water from wet leaves. They swiftly accepted their new

habitat and (re-)formed pairs within days, and in some cases hours, of being released.

Breeding activity following the transfers

The most striking aspect of both transfers was the dramatic burst of nesting activity by birds immediately following release. On both islands successful nesting occurred within a few weeks, and in some territories

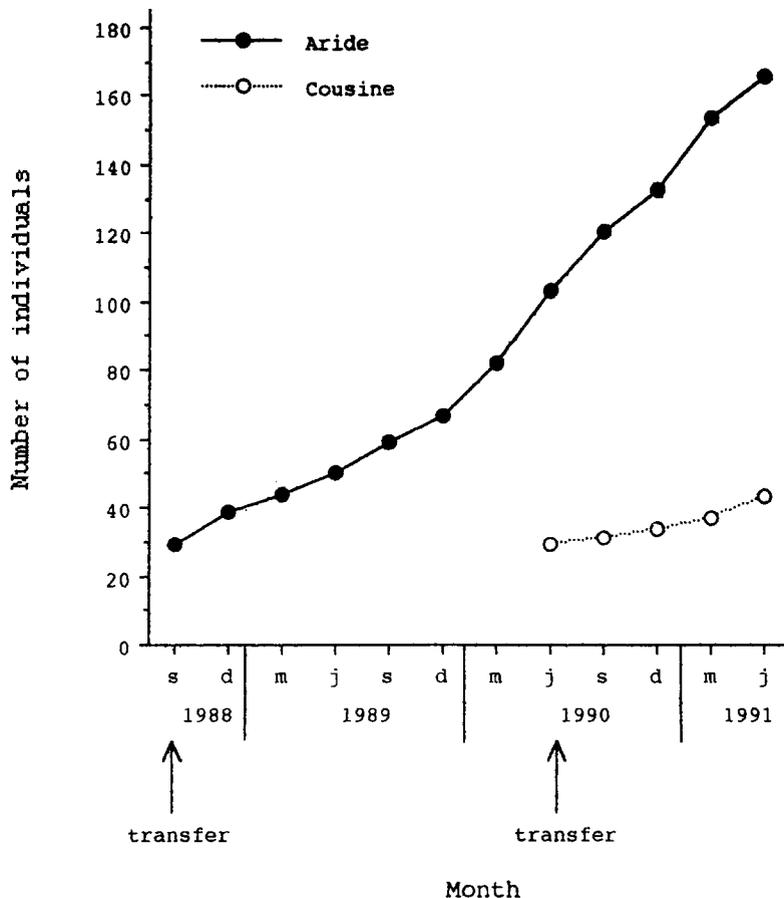


Fig. 7. Increase in Seychelles warbler numbers on Aride since September 1988 and on Cousine since June 1990.

within three days, of release. The first young on Aride (twins) and Cousine hatched four and three weeks respectively after the transfer. All vacancies on Cousin Island created by removals were filled immediately, some within hours, by previous helping and/or one-year-old birds (Komdeur, 1992).

Comparing breeding activity on Aride and Cousin two years and nine months after the transfer (Fig. 6), Aride birds showed on average 3.9 times more breeding activity than Cousin birds. A minimum of 64% of pairs bred on Aride in October 1988 and a maximum of 90–100% of pairs were breeding from January to September 1990. Over the same period the percentage of breeding pairs on Cousin varied from 0% (October and November 1988 and June 1989) to 84% (August 1989 only). On Cousin birds undergo a pre-breeding moult; of all the possible monthly moulting and breeding activity combinations, the only significant correlation found was between the percentage of territories with nests and the percentage of moulting birds two months earlier ($r = 0.68$, d.f. = 52, $p < 0.001$). On Aride moulting birds were still able to sustain active breeding at the same time. Comparing breeding activity on the three islands for one year following the transfer to Cousine (Fig. 6), Cousine birds showed the same breeding activity as Cousin birds, but 2.7 times less than Aride birds.

Greater reproduction output on Aride was sustained for the two years and nine months following the transfer (Table 2(a)). Among the most notable differences between Aride and Cousin were that on Aride annual adult survival was significantly higher, mean clutch-size per pair was almost twice as high, young fledged five days earlier, mean number of young fledged per pair was 9.3 times as high and mean number of young reaching one year of age per pair was 16.3 times higher. Given that island quality was 4.4 times as high and that territories were 4.8 times larger, on Aride the transferred birds have access to 21.1 times more food than birds on Cousin and so were able to sustain high continuous breeding activity. During the year following the transfer to Cousine, mean clutch-size per pair and mean number of days nestlings spent in the nest was the same for Cousin and Cousine (Table 2(b)). However, on Cousine adult birds survived significantly better and pairs fledged 2.8 more young than pairs on Cousin. During the same period pairs on Aride sustained greater reproductive output, but adult survival was the same on both islands (Table 2(b)). These results are in agreement with the fact that the quality of Cousine for warblers is lower than Aride's quality and higher than Cousin's.

In June 1991, two years and nine months after the transfer to Aride and one year after the transfer to Cousine, all transferred birds were still alive and 150 young (136 and 14, respectively) had fledged successfully on the new islands, bringing the total warbler population to *c.* 530 birds (Fig. 7). In one year the Aride population grew from 29 to 59 birds, whereas the Cousine population increased slightly more slowly,

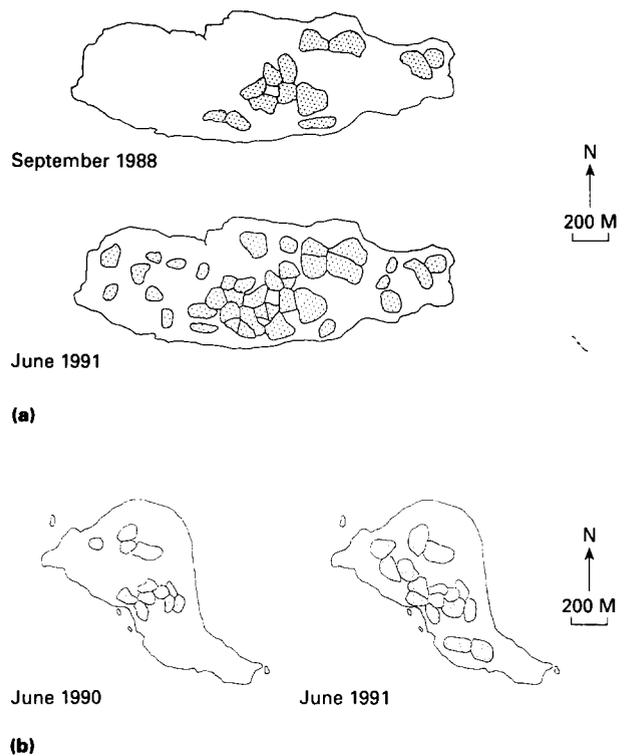


Fig. 8. Seychelles warbler territories on the islands Aride (a) and Cousine (b) at the time of transfer and in June 1991 (two years and nine months and one year after the transfer respectively).

from 29 to 43 birds. As there is enough suitable space still remaining on Aride and Cousine for young birds to establish territories (40.8 ha and 18.0 ha, respectively) and mean territory size on saturated Cousin Island is very small (0.25 ha), the population is still growing (Fig. 8). Given the presence now of three healthy breeding populations, the Seychelles warbler is well on the way to being listed as 'out of danger'. Hopefully this study has provided some lessons for other translocations which have not (yet) succeeded. It is not enough simply to release rare bird species on other islands and gamble on their survival without conducting proper research beforehand.

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APPENDIX 1
 Percentage feeding observations of six landbird species (for abbreviations, see Fig. 3) on Cousin Island, classified by plant species, part of plant, feeding height, and food item taken
 (i, insect; fs, fruit or seed; n, nectar) (January 1987–March 1988, n = number of observations)

Species:	<i>Pisonia grandis</i>			<i>Morinda citrifolia</i>			<i>Ficus</i> sp.			Rest trees			Herbs																
	sf	sw	ss	mf	gd	td	sf	sw	ss	mf	gd	td	sf	sw	ss	mf	gd	td											
Plant part	Height (m)	Food item	i	0.7			0.1	0.5			1.8	0.3	1.0	1.5	3.8			0.7	1.8										
			fr																										
			n				0.3				2.8	5.4	0.1		1.4	8.8	1.1		44.8	60.7									
leaf	0-4	i	10.6	24.8	15.4	5.1	16.2	2.2	0.8	1.1	1.8	5.4	10.2	9.7	7.5	17.1	2.2	0.7											
		fr																											
		n	3.5	4.4	8.3	2.2	6.0	2.6	0.4	0.3	2.4	4.3	4.4	0.1	0.3														
4-8	i																												
	fr																												
	n			1.8	0.3				0.3	0.8	1.3	1.3	0.4	1.0															
>8	i																												
	fr																												
	n																												
branch	0-4	i	5.3	1.4	4.4	2.8	1.1	2.2	1.1	0.5	1.3	5.6	0.8	2.6	0.8	1.0	0.9	4.6	0.7										
		fr																											
		n	3.2	0.3	0.9	1.4	0.2	0.9	0.1	2.1	0.3	0.9	2.1	0.3	0.9														
4-8	i																												
	fr																												
	n																												
>8	i	0.3							0.7			0.6	4.8	0.4															
	fr																												
	n																												
flowers	0-4	i				0.4	0.2			0.2		0.6			1.3														
		fr										0.4																	
		n				3.5	2.2	0.8			4.4		0.1	14.5															
4-8	i																												
	fr				0.3																								
	n			0.4	2.1	3.9	3.9		2.2																				
>8	i																												
	fr																												
	n																												
fruit	0-4	i				0.7	0.3	1.3				0.4	4.1	0.8	0.2	0.4	1.5												
		fr				0.4			1.8	4.0	4.2	5.4	4.2	19.2															
		n																											
4-8	i																												
	fr																												
	n																												
>8	i				0.3																								
	fr				0.1	0.5					0.3																		
	n				0.3			0.1	6.7	6.2																			
n:		169	195	71	0	0	142	157	35	12	9	26	18	7	0	8	10	254	112	67	16	30	16	128	147	48	232	252	80