Threatened Birds of Asia:
The BirdLife International Red Data Book

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Recommended citation
BirdLife International (2001) *Threatened birds of Asia: the BirdLife International Red Data Book.* Cambridge, UK: BirdLife International.

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BirdLife International is a UK-registered charity

ISBN 0 946888 42 6 (Part A)
ISBN 0 946888 43 4 (Part B)
ISBN 0 946888 44 2 (Set)

British Library-in-Publication Data
A catalogue record for this book is available from the British Library

First published 2001 by BirdLife International

Designed and produced by the **Nature**Bureau, 36 Kingfisher Court, Hambridge Road, Newbury, Berkshire RG14 5SJ, United Kingdom

Available from the Natural History Book Service Ltd, 2–3 Wills Road, Totnes, Devon TQ9 5XN, UK. Tel: +44 1803 865913 Fax: +44 1803 865280 Email nhbs@nhbs.co.uk
Internet: www.nhbs.com/services/birdlife.html

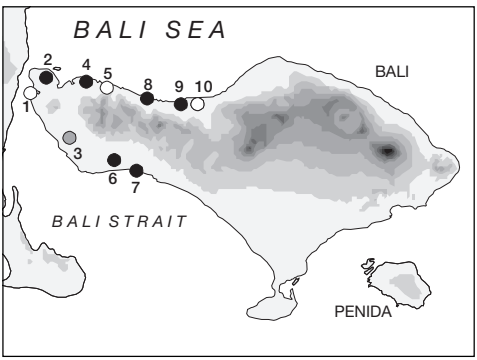
BALI STARLING
Leucopsar rothschildi

Critical ■ A1a,d; A2b,d; B1+2e, C1; C2b; D1
Endangered □ —
Vulnerable □ D2

This starling qualifies as Critical because it has an extremely small range (confined to one locality) and population and, despite conservation intervention, the number of mature individuals continues to decline (and may at any time be swiftly eradicated) owing to illegal poaching for the cagebird trade.

DISTRIBUTION The Bali Starling (also known as the Bali Myna or Mynah, Rothschild's Myna or Mynah, Rothschild's Starling, Rothschild's Grackle and White Starling; see Remarks 1) is now confined to a restricted area (under 40 km^2) within Bali Barat National Park, Bali, Indonesia, having only ever been known from the north-west coast, extreme western peninsula (Prapat Agung peninsula), adjacent south-west facing coast and adjacent hilly interior, from Bubunan west to Bali Barat and south-west to Negara (von Plessen 1926a; also van Helvoort *et al*. 1986a, van Balen and Gepak 1994, van Balen *et al*. 2000a; see Remarks 2). Interviews with local people suggested that the species disappeared from the south-west coastal area of westernmost Bali in the 1960s, and from the area east of the present-day Bali Barat National Park as far as Bubunan in the 1970s (van Balen *et al*. 2000a). By the mid-1980s its range had shrunk from c.300 km^2 at the time of its discovery to c.60 km^2 (van Helvoort *et al*. 1986a). By the mid-1990s all breeding was confined to an area of only 2.5–3 km^2 in the area of Teluk Kelor and Teluk Brumbun, although birds continued to range over a much wider area in the non-breeding period (Jepson *et al*. 1997). Records are from:

■ ***INDONESIA*** *Bali* **Gilimanuk**, Jembrana, where birds were rather common in the 1920s (van der Paardt 1926), April 1938 (three females in RMNH); **Prapat Agung peninsula**, Bali Barat National Park, Buleleng, breeding in the Teluk Kelor and Batu Gondang area (north coast) and dispersing in the dry season to the southern parts of the peninsula, including Cekik and Sumberklampok, 1970s (de Iongh *et al*. 1979, 1982, SvB), and currently (see above); **Manistutu**, September 1976, when 12–25 birds were seen (Suwelo 1976); **Banyuwedang**, Bali Barat National Park, Buleleng, June–July 1925 (von Plessen 1926a,b), July 1933 (five birds in NHMW, ZMB) through into the mid-1980s (de Iongh *et al*. 1979, 1982, SvB); **Pulaki**, September 1930 (Kuroda 1932); **Penyaringan** and **Yeh Embang**, July–August 1980 (Hayward *et al*. 1981); **Grokgak**, Buleleng, July–August 1980 (Hayward *et al*. 1981); **Tegallengah**, 1984



The distribution of Bali Starling *Leucopsar rothschildi*: (1) Gilimanuk; (2) Prapat Agung peninsula; (3) Manistutu; (4) Banyuwedang; (5) Pulaki; (6) Penyaringan; (7) Yeh Embang; (8) Grokgak; (9) Tegallengah; (10) Bubunan.
○ Historical (pre-1950) ● Fairly recent (1950–1979)
● Recent (1980–present)

(van Helvoort *et al*. 1986a); **Bubunan** (type locality), Buleleng, March 1911 (Stresemann 1912, 1913; see Remarks 3), March and May 1931 (Kuroda 1932, 1933a); Munduk Tumpeng, Jembrana, by local report breeding in coconut trees some years before 1993 (SvB).

An escaped pair at Jakarta Zoo, West Java, attempted twice to breed in the zoo grounds during 1977 (van Helvoort *et al*. 1986a), but there is no further evidence for a feral population (which would assuredly be trapped out before it could establish itself: see Threats).

POPULATION Stresemann (1913) recorded that in 1911 the species "appears to be very rare". Numbers at the time of discovery have been retrospectively guessed at 300–900 birds (West and Pugh 1986), based on the species's range, (presumed) available habitat and (presumed) territory sizes; this has, however, been regarded as a considerable underestimate (van Balen *et al*. 2000a). In the first quarter of the twentieth century there were certainly still plenty of birds in north-west Bali, as "hundreds" used to gather in an abandoned papaya *Carica papaya* plantation near Teluk Terima, in flocks of 20–30 birds (von Plessen 1926a). However, in the 50-year period from the mid-1920s to the mid-1970s there appear to be no reports or accounts of the Bali Starling to indicate the status of its population; but from 1974 surveys suddenly became extremely common.

Surveys in the 1970s If the report of 200 captive birds being found on a train in the early 1970s (see Threats: Trade) is true, then it is entirely likely that there were many hundreds of birds left in the wild at the start of the decade. However, in October 1974 a survey estimated 100 birds (Sungkawa *et al*. 1974) and in February 1975 a range of 68–144 was recorded (Natawiria 1975), allowing the assumption of 100 birds as the approximate population at that time (van Helvoort *et al*. 1986a). In September 1975 as many as 175 birds were judged to be present inside the forest reserve, with another 25 outside, making 200 in all (Suwelo 1976). A short study in 1976–1977 produced a sighting of 25 birds in one flock, and a total of 127 birds seen at a total of nine sites in about one-third of the species's estimated available habitat, and on this basis it was judged that—despite an estimation of 1,000 birds (Pranoto 1975; also Susanto 1977)—the total population must then have been under 500 birds (Sieber 1978; see Remarks 4). Indeed, two other contemporaneous assessments (the first also in 1976, the second some time in 1977) put it at "at most 300–400" (van der Zon 1980) and only 110 birds (Alikodra *et al*. 1978), although a claim of 550 birds *seen* and 1,000 *estimated*, based apparently on the same fieldwork, was also made (Jusuf 1978). A survey by I. S. Suwelo in 1978 resulted in a population estimated between 95 and 217 birds (van der Zon 1980). In October 1978 observations suggested that the situation was "much worse" than in 1976, with far fewer records of far fewer birds (van der Zon 1980). A census in March–April 1979 resulted in a count of 84 birds in 40% of the available habitat, suggesting that the total population did not then exceed 200, and a comparison of counts at two sites (Banyuwedang and Batu Gondang) in 1976 (35 and 21), 1978 (23 and 22) and 1979 (7 and 11) indicated that, overall, a decline appeared to be in progress (de Iongh *et al*. 1982; see Remarks 5). Some time in 1979 a survey (by I Made Suta Adi) revealed 172 birds inside the forest reserve and 28 outside, i.e. 200 in total (Hayward *et al*. 1981; see Remarks 6).

Surveys in the 1980s In August 1980 some 207 birds were counted inside the forest reserve and 22 outside, totalling 229, with an estimate that the total population was then 230–280 birds (Hayward *et al*. 1981; see Remarks 6). In October 1981 an estimate of 254 was made (I Made Suta Adi in van Helvoort *et al*. 1986a), while in October 1983 fieldwork by J. Rustandi resulted in an estimate of 142 birds (van Helvoort *et al*. 1986a, van Balen *et al*. 2000a). Between these two surveys (whose methods are unknown), in 1982 the largest number seen together was 26 in a daytime roost, the species was regarded as "greatly endangered" and the situation probably unrescuable (Ash 1984). In August 1984 104 birds were counted inside the national park, with a singleton outside it (van Helvoort *et al*. 1986a; see Remarks 7), and the total wild population was estimated to be 125–180 birds (van Helvoort 1987). In the course of 1986 there

appears to have been no survey report issued, but a figure of 100 was given to Pagel (1994) and is in Collins *et al*. (1998). For the rest of the decade there are some slightly divergent census figures which were evidently the basis for various extrapolations and estimates: (***1987***) 47 were counted in October 1987 (Pagel 1994), although this reportedly equated to 60–70 a month later (Bruning 1989), and 50 is given in Collins *et al*. (1998); (***1988***) 31 (van Balen *et al*. 2000a) or 35 (Pagel 1994) in October 1988, hence judged to be 55–100 (B. E. van Helvoort in Collar and Andrew 1988) or 40 (Collins *et al*. 1998) or 47 (B. E. van Helvoort and Soetawidjaya in MacKinnon and MacKinnon 1991); (***1989***) 28 (MacKinnon and MacKinnon 1991), 30 (Pagel 1994), 24 (Collins *et al*. 1998) or 23 (van Balen *et al*. 2000a).

Surveys in the 1990s At the start of the 1990s, when the actual population was very approximately 20 birds, the expected carrying capacity of the available suitable areas within the national park was judged to be up to 375 birds, with the potential for 150–300 more if other areas of habitat could be restored and villages relocated (Wind 1991). Tabulation of numbers recorded in surveys (for methods see van Balen 1995b) reveals (sources for each year to 1994 are given at the end of 1994, numbers in brackets at the end of each year are those tabulated in Collins *et al*. 1998): (***1990***) 13 or 14 in October (14); (***1991***) 38 in May, 34 in September (37); (***1992***) 55 in June (with eight active nests that year), 45 in October (55); (***1993***) 45 (despite 36 young fledging from nine nests) in June, 33 in October (47); (***1994***) 40 (despite 30 young fledging from seven nests) in June and 25 (22–29) in October (38) (van Balen *et al*. 2000a; also van Balen and Jepson 1992, van Balen and Dirgayusa 1993b, 1994, 1995, van Balen and Gepak 1994); (***1995***) 26 (Collins *et al*. 1998); (***1996***) 20 (Collins *et al*. 1998); (***1997***) 12–17 in October (Collins *et al*. 1998); (***1998***) fewer than 15 (van Balen *et al*. 2000a), although (following the release of 12 birds in February and April) around 21 birds towards the end of the year (Pagel 1998, Seibels 1998); (***1999***) 37, February 1999 (I. Mauro *in litt*. 1999) and c.35, March, of which 12 were birds released in 1998 and 23 were wild birds including fledged young from the previous season (D. Pain *in litt*. 1999), and 37 in October as censused by national park staff (R. F. A. Grimmett *in litt*. 2000); (***2000***) 15, July, including three young birds just released (B. Wirayudha *in litt*. 2000), 14, August, as censused by park staff (R. F. A. Grimmett *in litt*. 2000); (***2001***) nine, early in the year, apparently as censused by park staff (T. Tilford *in litt*. 2001).

The rise in numbers after the near-extinction in 1990 was mainly due to a combination of increased protection and increased productivity, the latter following more favourable weather conditions (van Balen *et al*. 2000a). Fluctuations in the numbers of birds in the wild throughout the 1990s were due principally to the programme of releases of captive-bred birds and to the impact of persistent poaching of these and other birds.

Numbers of birds in captivity (and available for involvement in programmes to benefit the survival of the species) are outlined in Measures Taken. In addition to this, there are two fairly large collections of the species in Bandung, West Java, and Madium, Central Java; and there is possibly a third large collection in Yogyakarta, West Java (R. F. A. Grimmett *in litt.* 2000).

ECOLOGY ***Habitat*** In the 1920s the species was reported from "dry savanna", "shrub woodland" and even "tall and dense forest" (van der Paardt 1926, von Plessen 1926a). The formations in questions all represent a type of monsoon ("tropical moist deciduous") forest then growing along the low northern coast and adjacent hilly hinterland of Bali, with a dry season (<60 mm rainfall monthly) from May to November, the bigger trees being mostly deciduous, although perhaps only briefly, with relatively few climbers and epiphytes (Whitmore 1984, SvB; photographs and meteorological data in Pagel 1999); nevertheless, the accounts by van der Paardt (1926), von Plessen (1926a) and de Voogd (1937) indicate that areas from which the Bali Starling was known consisted of what they called tree savanna or woodland savanna, characterised by the scattered emergent pilang trees *Acacia leucophloea* (van Helvoort *et al*. 1986a), and *not* closed-canopy forest or woodland (van Helvoort 1990). In the past the

birds were known to occur and even to nest in coconut groves near villages (van Helvoort *et al.* 1986a), and Stresemann (1913) shot the type specimen out of the crown of a coconut palm. In the species's present range the typical breeding habitat is fire-induced open shrub, tree- and palm savanna and adjacent closed monsoon forest, found below 150–175 m; the vegetation (see Remarks 8) is dominated by *Acacia leucophloea* and gebang *Corypha utan* and lontar *Borassus flabellifer* palms, with an undergrowth of *Lantana camara* and *Eupatorium* shrubs and *Imperata cylindrica*, *Heteropogon contortus* and *Saccharum spontaneum* grasses (van Helvoort 1987, van Balen *et al.* 2000a). The savannas are intersected by moister, more densely forested valleys dominated by the trees walikukun *Schoutenia ovata*, talog *Grewia eriocarpa*, kemloko *Phyllanthus emblica*, tekik *Albizia lebbeckoides*, intaran *Azadirachta indica*, kesambi *Schleichera oleosa*, laban *Vitex pubescens* and bekol *Ziziphus nummularia* (van Helvoort 1987, SvB). In the non-breeding season birds disperse into the open mixed forest edge and flooded savanna woodland in the southern parts of the Prapat Agung peninsula (SvB). The fact that, at least seasonally, the birds favour savanna-type habitat—possibly kept open as much by large ungulates (banteng *Bos javanicus* and deer in the past, cattle more recently) as by fire—as against closed-canopy woodland is an important consideration in the long-term management of the reserve (R. F. A. Grimmett *in litt.* 2000; see Threats and Measures Proposed).

In December–January (the start of the breeding season) birds roost in small groups (within which they are almost always in pairs) in high trees in company with other bird species such as pigeons, drongos and Black-winged Starlings *Sturnus melanopterus* (Sieber 1978). They leave the roost before dawn and presumably go to forage; but at around 11h00 they go to drink and bathe at particular places where fresh water remains (Sieber 1978).

Outside the breeding season, birds roost in loose aggregations (often with groups of Black-winged Starlings, which, however, are not permitted to mingle but are kept at the "edge" of a roosting area) 2–4 m up in shrubby undergrowth in fairly sheltered areas a short way up into the hills; the areas chosen are often used repeatedly for several months, but then abandoned for a time (or permanently), although usually a roosting aggregation will use suitable adjacent sites, so that a general roosting area can be predicted (van Helvoort *et al.* 1986a). Roost trees have included tamarinds *Tamarindus indicus* (de Iongh 1982, 1983), although the attribution of coconuts to van der Zon (1980) in Feare and Craig (1998) appears mistaken. The birds emerge soon after dawn in groups of 2–6 and move downhill, often towards the shore, hardly showing themselves as they keep mostly to the canopy of the trees (flying from one tree to the next) in the slightly denser vegetation along valleys; then in the course of the morning they tend to move back upslope to the deciduous forest, spending the middle of the day largely concealed, but in mid-afternoon they again move down towards the coast, returning once more at 16h30–17h00 to the roost site (van Helvoort *et al.* 1986a). Adult birds are decidedly sensitive to rain: although they may forage (at least in captivity) in light drizzle (M. Wedana *in litt.* 2000, SvB), at the first sizeable drops they take shelter in the undergrowth, well before other bird species, and do not reappear before the vegetation is dry; sometimes rain even prevents their communal roosting, and sudden heavy rainstorms can soak and disable them, leaving them to be "picked up from the fields like ripe fruits in the garden" (van Helvoort *et al.* 1986a, van Helvoort 1990).

Food Bali Starlings are arboreal feeders, spending most of their time in trees and shrubs, unlike Black-winged Starlings, which appears mainly to feed on the ground (see relevant account) (von Plessen 1926a). The majority of foraging time is spent in the undergrowth and shrub layer of deciduous forest, particularly in the ecotone with woodland and savanna formations, and in gallery forest and denser patches within savanna-like areas (van Helvoort *et al.* 1986a). However, in the dry season the birds occasionally descend to the ground to search for invertebrates (van Helvoort *et al.* 1986a, SvB), and they have even been seen foraging on dry reef flats (van Helvoort 1987, 1990). The birds also visits the trunks of *Acacia leucophloea* trees, using their strong, high-ridged bills to prize back the fissured bark: although

invertebrate foods taken could not be identified, inspection of visited trees disclosed bark-boring insects and ants (van Helvoort *et al*. 1986a). Birds were never observed to sally for flying insects (van Helvoort *et al*. 1986a), but the observation of dragonflies as food has occurred twice (see below)—possibly involving moribund individuals.

The diet consists of invertebrates and vegetable material, the proportions varying with season. The berries of non-native *Lantana camara* constitute an important part of the diet at the start and towards the end of the dry season (van der Paardt 1926, van Helvoort *et al*. 1986a; see Remarks 9). At the height of the dry season flocks seem to follow the flowering of *Erythrina variegata* trees, taking the nectar and wandering from one area to another (van Helvoort 1990, van Balen and Dirgayusa 1993b). At the end of the dry season and start of the rains, the birds eat fruit from bushes and trees at the edge of forest, including *Morus indica*, *Manilkara kauki* (see Remarks 10), *Passiflora foetida* and *Strychnos ligustrina* (or *S. lucida*) (Sieber 1978; also Sungkawa *et al*. 1974, van Helvoort *et al*. 1986a); other vegetable foods include seeds of *Sterculia foetida* (Suwelo 1976, de Iongh 1982, 1983), berries of *Deeringia amaranthoides* (van Helvoort *et al*. 1986a), drupes of *Ziziphus jujuba* (de Iongh 1982, 1983), figs *Ficus* (de Iongh 1982, 1983) and papaya (von Plessen 1926a,b).

A study of a pair in 1990–1991 showed that geometrid caterpillars form the main diet during the first weeks after hatching (Cahyadin 1992), and captive studies confirmed that animal protein is crucial to the chicks at this early stage (van Bemmel 1974, Hughes and Turner 1975, Schürer 1977, Sieber 1977, 1983, Jeggo 1981). Small skinks have also been seen being fed to the young (van Helvoort 1990). Other animal foods reported (taken mostly during the wet season) include ants, termites, dragonflies and grasshoppers (Sungkawa *et al*. 1974, Tondok 1974, Suwelo 1976, van Helvoort *et al*. 1986a). However, reports of ants in the diet may refer to anting behaviour (van Balen 1996b). Small reptiles such as lizards have been reported (Sungkawa *et al*. 1974, Suwelo 1976, Bruning 1989), and it appears this was based on the fact that birds in pre-release aviaries on Bali readily took them, along with scorpions and millipedes, if they entered the cages (van Balen *et al*. 1990, van Balen and Gepak 1994). Birds released on Menjangan island as the wet season began foraged first on beetles and ants emerging from the ground, then primarily caterpillars, and over five weeks took 76% caterpillars in tree foliage, 15% ants on the ground, 7% beetles on the ground and 3% moths on branches (Collins *et al*. 1998).

In the wet season birds drink at pools (Sieber 1978, M. Wedana *in litt*. 2000; see Habitat above). In the dry season, when no water is available, they drink dew (van Helvoort 1990).

In captivity birds thrive on a soft-billed diet (Morris 1976): various fruits, concentrated pellets, live invertebrates, especially mealworms (Jeggo 1981), small fish (van Helvoort 1990) and chopped young mice (SvB).

Breeding Bali Starlings form monogamous pair-bonds, and from field observations it appears that the bond is maintained all year round (van Helvoort *et al*. 1986a). The breeding season runs from September to May (Suwelo 1976), but is chiefly focused in the 13-week period from January to March (van Helvoort *et al*. 1986a), thus coinciding (in its latter half) with the rainy season, which triggers growth in leaves and in the abundance of caterpillars, which form the main diet of nestlings (Cahyadin 1992). Territories are therefore usually established in October–November, but shifts of several months have been known to occur in this schedule, perhaps related to ENSO events (Schreiber 1994). A home range of 2.4–3.5 ha was found for a breeding pair at Teluk Kelor (Cahyadin 1992), which may be typical, although it was noted in an experiment with released captive birds on an inshore island in Croatia that 40 ha of apparently appropriate habitat was insufficient to support four pairs, two of which were driven off by the other two (Sieber 1978). Some territories seem to be held by established breeding pairs throughout the year (SvB), and are even defended against Black-winged Starlings and Spangled Drongos *Dicrurus bracteatus* (Jepson *et al*. 1997).

Eight tree species are known to have hosted nest sites: *Grewia koordesians* (de Iongh *et al.* 1982, van Balen *et al*. 2000a), *Vitex pubescens* (Natawiria 1975, de Iongh *et al.* 1982, van

Balen *et al*. 2000a), *Borassus flabellifer* (de Iongh *et al.* 1982, van Helvoort *et al.* 1986a), *Terminalia edulis* (Cahyadin 1992), *Cocos nucifera* (Hayward *et al.* 1981, van Helvoort *et al.* 1986a), *Schoutenia ovata* (SvB), randu hutan *Bombax malabaricum* (SvB) and *Acacia leucophloea* (van Helvoort *et al.* 1986a). However, it would appear that the species will select any suitably large and reasonably secure nest hole irrespective of species, and there is even a report of nesting in a coconut tree in a garden at Brangbang village, Jembrana, around 1984 (I M. W. A. Putra *per* M. Wedana *in litt*. 2000). Nest holes are old excavations of woodpeckers and barbets, or cracks in old trees, 4–10 m above ground (Feare and Craig 1998, van Balen *et al*. in prep.). Although *Acacia leucophloea* has often been cited as a nest-tree, recent studies show it to be very seldomly used (SvB). Breeding pairs bring twigs, grass, feathers and leaves to the nest hole (van Helvoort *et al*. 1986a), but it is mainly the male who provides the material, and the construction occupies some 10–21 days (Sieber 1977, 1983, Breunig 1982). In captivity Bali Starlings are catholic in their choice of nest sites; broods have been raised in conventional nestboxes and logs, in underground holes, and even on radiator systems high up in aviaries (SvB; also R. E. Seibels verbally to SvB).

In a favourable wet season of five to seven months Bali Starlings commonly raise two and occasionally even three broods, from clutches of up to three eggs, fledging two or three young per clutch (SvB). In captivity 2–5 eggs, usually three, are laid, at 1–2 day intervals, with only a 50–90% hatching rate, but reportedly with successful breeding up to six times a year (Schmidt 1968, Spilsbury 1970, Sieber 1977, 1983, Breunig 1982). No accurate data on incubation time in wild birds are available, but in captivity an average of 13 days is found, with the female doing most of the incubation (Hughes and Turner 1975, Marshall 1981, Sieber 1983, West and Pugh 1986, Williams 1998). Fledging in captive birds takes places at around 23 days (Sieber 1983), with 21–28 days forming the extremes (Schmidt 1968, Hughes and Turner 1975, Jeggo 1981), the longer periods apparently being correlated with brood size (Lensink 1975). A breeding cycle can be completed in 57 days (eight weeks) (van Helvoort *et al*. 1986a). By the middle of the year, however, breeding is normally over: von Plessen (1926a) collected birds in June/July which included adults at the end of small feather moult and in the middle of large feather moult, while young birds were in full juvenile plumage without a trace of moult. Captive birds are fairly long-lived, with some reaching nine years old (Greenwell 1980); in another account the life-span is 7–12 years (Spilsbury 1970), yet an age of 30 has also been reported (without attribution, however) (Jepson *et al*. 1997), but in any case up to the mid-1980s females older than 11 years have not been recorded laying eggs (West and Pugh 1986) and detailed analysis of production rates in captive birds demonstrated that outbred birds between three and five years old have the highest reproductive capacities and fertility (van Helvoort 1988; see Remarks 11).

Migration Some post-breeding dispersal and wandering occurs in response to weather-related food distributions, with birds apparently following *Erythrina* blossoming events (see Food) and seeming to concentrate in coastal areas, from which they may be absent during the wet season (van der Paardt 1926, von Plessen 1926a). In recent years the distribution has been more obviously seasonal, with birds being confined in the breeding season (November–April) to the Teluk Kelor and Teluk Brumbun areas, dispersing in the dry season (May–October) 8–9 km to the south and south-west, or wandering more widely (Jepson *et al*. 1997, Pagel 1998).

THREATS When the Bali Starling was first listed as threatened in the mid-1960s, it was for being "rare because localized", not for any known decline, although "some drain on the population" from the cagebird trade was noted (Vincent 1966–1971; see Remarks 12). In fact, it is now clear that in the first half of the twentieth century the largest threat came from the conversion of a large part of the birds' natural habitat along the north-west coast of Bali, but that in the past 25 years this has been wholly eclipsed by a pernicious and to date ineradicable demand for cagebirds, much of it domestically driven. The Bali Starling is one

of (now) four threatened members of the suite of 20 bird species that are entirely restricted to the "Java and Bali Forests Endemic Bird Area", threats and conservation measures in which are profiled by Sujatnika *et al.* (1995) and Stattersfield *et al*. (1998).

Habitat and resource loss The explanation for the dramatic contraction of range since the species's discovery in 1911 is habitat conversion, which appears to be attributable almost entirely to local human pressures; but it is also possible that habitat restoration is of a mistaken type and is equally resulting in the exclusion of the species.

Towards the end of the 1970s, it was found that the Bali Barat reserve had, since its establishment as a forest reserve in the 1940s, declined from 194 km^2 of continuous cover to five or six separate patches totalling 115 km^2, a 40% loss in around 30 years (Seidensticker 1978, van der Zon 1980). In a further near-contemporaneous study it was noted that 35 villages then existed—with concomitant intensively farmed land all about them—in the 85 km strip along the north coast of Bali between Gilimanuk and Singaraja, where the Bali Starling once occurred (Sieber 1978). Already in 1976 the authorities were planning the relocation of 4,500 people (the "enclave community") living within the boundaries of the Bali Barat Wildlife Reserve (King 1978–1979); but the people/nature conflict had not been resolved by the mid-1990s (see below). Chronic pressure from timber collection and fires has steadily reduced the number of old, fissured trees (notably *Acacia leucophloea*) suitable for nesting, creating a shortage of nest sites and relatively immature forest (van der Zon 1980, van Helvoort *et al*. 1986a, van Balen *et al*. 2000a). The adjacent farmland was being sprayed with insecticides and there seemed to be a relatively insectless plantation monoculture in the area (Sieber 1978). Land-use changes in the early 1980s continued to cause problems in the reserve (national park from 1982), with maize and coconut plantations further fragmenting the forest, and fuelwood collection and fires compromising its quality (van Helvoort *et al*. 1986a) (although fire may be necessary to maintain savanna-like conditions: R. F. A. Grimmett *et al.* 2000). By 1990 there were still areas inside the national park whose status was disputed, and these problems were recognised as a constraint on the ability of authorities to plan for development and management, including the protection of the Bali Starling (Wind 1991). In recent years the construction of hotels on the fringes of Bali Barat National Park has been regarded as a potentially very serious threat to remaining patches of appropriate habitat at Banyuwedang and Gilimanuk (Jepson *et al*. 1997); a hotel annex discotheque has been built "not that far" from the last natural breeding locality of the starlings, and is run by one of the park staff (SvB), and several holiday cottages have been completed at Teluk Kotal and others started near Banyuwedang (M. Wedana *in litt*. 2000).

While this trend is clearly lamentable, the maintenance of areas of closed-canopy woodland inside the park and the management of cleared areas so that they return also to closed-canopy woodland may also be inappropriate, since the Bali Starling appears to be optimally associated with semi-open savanna-type habitats (see Ecology). Thus the species may be being pinched both ways, by full clearance on the one side and by closed forest on the other.

Trade *(=theft)* The greatest threat to this species comes from illegal trapping for the cagebird trade. Despite an early reassurance that "this bird is loved and widely protected by the Balinese [such that it] seldom is exported" (Lint 1962), before the end of the 1960s it was recognised that trade pressure might be a very serious influence, with one report of a shipment of 50 birds triggering an appeal for cooperation among bird fanciers (Harrison 1968) and other reports of similar-sized shipments reaching the USA (King 1974). Around 1970 T. Harrisson saw 24 birds in a Singapore "bird garden" and a Dr Schmidt of Zurich saw 75 in the same establishment soon afterwards, believing that "hundreds... were being sent from Bali to California and to German and Dutch dealers" (R. S. R. Fitter typescript note on file at BirdLife International). In the early 1970s some 200 birds were confiscated from a train in Jakarta (K. Oesman in van Balen *et al*. 2000a), and at that time the species could "frequently be seen for sale in the Jakarta bird market" despite its protected status (Oesman 1979). The Surabaya bird market was offering

15 for sale in September 1976 (Suwelo 1976) and 11 in July 1979 (van Helvoort *et al.* 1986a), and in the five years 1976–1980 the Nature Conservation Service in Jakarta confiscated 43, 12, 6, 11 and 4 birds (van Helvoort *et al.* 1986a). It was estimated that, despite its legal protection at that time, as many as 40–60 birds were being taken off Bali *every month* for sale in Surabaya and Jakarta, Java (Suwelo 1976). Certainly the species was commonly being exported, with "a whole aviary full containing about 30 birds in Singapore Bird Park in 1972", and with "19 for sale in one Singapore bird shop" in May 1979; thus it was acknowledged that the Bali Starling was "acutely threatened by illegal trapping", and the situation represented "the worst example of avicultural damage to a species in Indonesia" (Morrison 1980).

In 1982 direct evidence of trapping inside the park was obtained involving a decoy and birdlime, but the use of a suspended cat, whose cries attract birds, was also reported (Ash 1984, NJC); it was later determined that birds were also taken out of their nest holes, preferably at night (van Balen *et al.* 2000a). As many as eight birdcatchers were resident within Bali Barat National Park in 1982, when the local price of a bird was the equivalent of US$130 (Ash 1984). As many as 16 birds were seen in a single home in Denpasar at a time when the maximum number seen in the wild was 26 (Ash 1984), and inquiries in Denpasar market in 1982 led immediately to a house with a freshly captured bird and offers to procure more (NJC). One important speculated impact of trade contributing to the population decline was the practice of taking birds at night from nests, a time when the female is present, resulting in a skewed sex ratio and, hence, a claim that, in the 5–6 years prior to the 1990 releases, "breeding activity had ceased almost entirely" (van Balen *et al.* 2000a).

In 1991 the species was adopted as the faunal symbol of the province of Bali, which resulted in an increase in its popularity amongst local communities on the island (Jepson *et al.* 1997). This ought to be considered a conservation measure taken but is here deemed a threat, since (perhaps as with the CITES listing: see Measures Taken) it probably inflamed cupidity amongst the island's less scrupulous dignitaries (in much the same way that the elevation of the Javan Hawk-eagle *Spizaetus bartelsi* to Indonesian national bird caused many of its kind to be captured for trade: see relevant account). Certainly in the 1990s black-market prices of birds spiralled—having once been a fairly modest US$9–20 in the mid-1970s—to between $33 and $66 around 1980, $130 in 1982 and $2,000 in the mid-1990s (de Iongh *et al.* 1982, Ash 1984, van Balen *et al.* 2000a) and $3,000 by 1997 (Collins *et al.* 1998). With financial incentives of this kind, it is scarcely surprising that the species has been on a downward trajectory ever since 1992, and the poachers have begun using increasingly sophisticated equipment (telescopes, two-way radios, mist-nets: van Balen *et al.* 2000a) and ever-bolder methods (armed hold-ups; see below).

In 1993 the wild population fledged as many as 36 young, yet in June the population was no higher than it had been the year before, and by October it was 20% lower; with no environmental perturbations to account for these losses, the conclusion was reached that poaching had significantly increased that year (van Balen and Dirgayusa 1993b), with 20–30 birds presumed to have been taken (Pagel 1998). Much the same thing happened in 1994, when a breeding pair and their two young were known to be poached (van Balen and Dirgayusa 1994). As a measure of how serious the situation had by then become, in December 1993 and January 1994 two birds were apparently poached from the released population on Menjangan island (see Measures Taken), in May 1994 seven of 11 birds (including two breeding pairs) actually held in the Pre-release Training Centre inside the park were stolen, and in July one of the engines of the Bali Starling Project patrol boat was stolen; even birds registered and transpondered under the national "whitewash" scheme (see Measures Taken) disappeared to be replaced by unregistered birds, with no action being taken against the offending individual (van Balen and Dirgayusa 1994). The poachers, who are known to live in the national park's enclave and on Java, switched to mist-netting birds, and coordinated their work with telescopes and two-way radios (van Balen *et al.* 2000a). Ironically, the failure

of the authorities either to deal with the problem of trapping or to support the park staff at Bali Barat has led to a perverse double human dependence on a low but constant population of birds, a circumstance that guarantees the park guards their jobs and the poachers their prices (van Balen *et al*. 2000a). However, there is an unresolved conflict between the people of the settlement inside the park (the "enclave community") and the park authorities, and it is felt that the enclave community is a major source of trapping activity (Jepson *et al*. 1997).

Ever since the initiation of the Bali Starling Project the profiteers who have been stealing birds from the wild have also (though not necessarily the same people) been stealing birds from captivity. In August 1989 a pair of birds was stolen from Surabaya Zoo, and the following month a second pair was taken (van Balen *et al*. 1990). In 1993 a bird was stolen from the release cages on Menjangan island (M. Wedana *in litt*. 2000). On 20 November 1999, an armed gang with suspected links to the Indonesian military stole 39 birds at the Pre-release Training Centre (PTC) in Bali Barat National Park, and simultaneously a senior official is reported to have disappeared with a substantial quantity of money donated to manage the project (Nicholson-Lord 2000; see Remarks 13 and further details under Measures Taken). On 31 August 2000 the PTC suffered a further theft of 13 birds at a time when, having earlier received 10 new birds, the total held there was 52 (R. F. A. Grimmett *in litt*. 2000). One or both of these last two robberies appears to have been committed by a gang of poachers from a single village in East Java who are sufficiently ruthless that even the police are reportedly too frightened to confront them (T. Tilford *in litt*. 2000).

Other human factors Apart from effects on habitat, a much more obscure but deeply felt notion is that Bali Starlings shun man (van der Paardt 1926, von Plessen 1926a, Sieber 1978), the birds, for whatever reason, disappearing from areas as soon as human settlements encroach into their ranges (van der Paardt 1926, van Helvoort *et al*. 1986a). There is certainly a strong match between the species's retreat eastwards along Bali's north-west coast and man's expansion westwards, although there are recent reports of birds—but possibly captive-bred and therefore habituated—occurring around the enclave area and in the rural area north of Negara town (SvB).

The problem of the enclave inside the park has several dimensions, relating in particular to building expansion, sustainable use of adjacent resources, local poverty and the harbouring of bird trappers; moreover, within the staff of the park there are certain tensions relating to ethnic origins (SvB). Amongst *both* these communities the feeling developed (perhaps abetted by some intentional or unintentional misrepresentations), and unfortunately in some cases hardened, that the Bali Starling Project (see Measures Taken) was an external superimposition, excluding them from "ownership" of their immediate environment (SvB, T. Tilford *in litt*. 2000). There is, therefore, a cocktail of volatile and negative sensibilities inside the national park which the limited dynamism of the authorities and NGOs have yet to address and neutralise. Meanwhile, the morale of park staff is extremely low, owing to low wages, poor facilities and inadequate training (A. Taufik [current head of BBNP] *per* T. Pagel *in litt*. 2000).

A further indirect human factor in the demise of the Bali Starling, and which is extremely difficult to account for in detail in print, is the problem of trust and faith; a quotable instance is the circumstance in which, for 18 months, AZA remained uninformed about a second MOU which would give other parties exclusive rights to provide conservation support for the Bali Starling captive population at BBNP (see the penultimate paragraph under "Bali Starling Project" in Measures Taken). Clearly those dedicated staff inside the park and interested parties elsewhere in the world are being thwarted by forces of considerable power, both operationally and politically, and until the authorities in Indonesia devote sufficient resources and attention to the problem the situation will not improve, and the steady withdrawal of support by outside agencies and, ultimately, the complete extinction in the wild of the Bali Starling can be predicted.

Natural factors The Black-winged Starling has been considered the closest relative of the Bali Starling (van Balen *et al*. 2000a) and therefore considered a possible competitor (Sieber 1978) for food resources and nest-holes. However, this starling was reported as being very scarce in western Bali in times when the Bali Starlings were still numerous, and the two species would only tend to come into contact towards the end of the dry season when foraging on *Lantana* (von Plessen 1926a). However, it has been suggested that the opening up of woodland and recent losses of certain fruit trees has allowed a range expansion by Black-winged Starlings into Bali Starling heartland (Sontag 1991, 1992), and certainly in 1984 the two species were found nesting in the same tree in cavities 8 m apart (van Helvoort *et al*. 1986a)—whether this is a sign of mutual tolerance or increasing resource pressure cannot be judged. In any case, as the Black-winged Starling has itself now become extremely rare through trapping (see relevant account), this putative conflict will certainly have been minimised.

A record of a snake entering a nest-hole and consuming two Bali Starling nestlings (van Helvoort *et al*. 1986a) is the only confirmed case of predation. Other possible nest predators include monitor lizards *Varanus salvator*, geckos *Gecko* and macaques *Macaca fascicularis* (W. Suryawan *per* SvB). Possible predators of full-grown birds are birds of prey: during a release in November 1993 of captive-bred Bali Starlings, birds were believed lost to a pair of Black-winged Kites *Elanus caeruleus* and perhaps a Peregrine Falcon *Falco peregrinus* (van Balen and Dirgayusa 1994). ENSO events in 1982–1983 and 1986–1987 correlated with a 50% drop in numbers of birds, and in 1989–1990 with the virtual elimination of the species in the wild (van Balen *et al*. 2000a). The dry-season drought may well be a direct constraint on numbers, or it may be an indirect influence by forcing birds to a few water sources where they can be easily trapped by poachers (Jepson *et al*. 1997).

Geography Bali Barat National Park is adjacent to the ferry that connects Java and Bali, which means that birds can very easily be spirited away (T. Tilford *in litt*. 2000). Moreover, there were plans to build a road-bridge across the strait between the two islands, which would have involved a new main road cutting through the park and, of course, resulted in huge new levels of disturbance, seriously altering the character of north-west Bali; although dropped with the collapse of the Suharto regime (SvB), these plans are apparently about to be revived (R. E. Seibels *in litt*. 2000). In the current economic climate, however, the bridge is unlikely to be built; on the other hand, it is highly plausible that the plan to build the bridge might be used as a pretext to build a road into the park (R. F. A. Grimmett *in litt.* 2000).

Disease In captive birds a variety of diseases have been reported, including atoxoplasmosis, haemochromatosis, avian pox, cataracts and endoparasites such as gapeworms and tapeworms (Spilsbury 1970). Atoxoplasmosis is the most important mortality factor in captive the population (Jeggo 1981, Partington *et al*. 1989). Atoxoplasma-like protozoa have been found in faeces of wild birds (E. Greiner *in litt*. 1994), but fledging success suggests the disease is not a serious problem (Jepson *et al*. 1997).

MEASURES TAKEN The following two accounts of measures taken and proposed cannot be entirely separated, since many proposals made in key documents have been acted upon while others have not.

Legal and spatial protection This species has been protected under Indonesian law since 1957 (Somadikarta 1967) and with renewed force since 1970 (Inskipp 1986), this being Decree of Minister of Agriculture SK 421/Kpts/Um/8/1970 (M. Wedana *in litt*. 2000); it was placed on CITES Appendix I on 1 July 1975, i.e. from the day the convention came into force (an event which *could* have had the perverse effect of increasing demand: R. F. A. Grimmett *in litt.* 2000). The area where it currently occurs was declared a protection forest before 1936 (van Helvoort *et al*. 1986a) and became a wildlife reserve in 1947 (Sieber 1978) and a national park in 1982 (see Robinson and Rustandi 1982), with full implementation in May 1984 (van

Helvoort *et al*. 1986a, van Balen *et al*. 2000a). By 1999 the park covered 190 km², of which 150 km² was terrestrial, having suffered certain excisions for plantations and tourist facility development (F. R. Lambert *in litt*. 1999). At the time of full implementation of the park there was a concerted attempt to regulate fuelwood collection by a system of permits and registration, with some 600 people being registered by September 1984 (van Helvoort *et al*. 1986a). The area also holds Black-winged Starling and sometimes also hosts Lesser Adjutant *Leptoptilos javanicus* and Java Sparrow *Padda oryzivora*.

Captive breeding An appeal by Harrison (1968) appears to have prompted an early attempt to track and register birds held in captivity (Partridge 1969, Spilsbury 1970) and the consideration that captive breeding could be vital to the species (Hartmann 1970); Jersey (now Durrell) Wildlife Preservation Trust began its comprehensive programme in 1971 (Roles 1975, Jeggo 1981). It was acknowledged that, since the live bird trade had been singularly responsible for the plight of the species, "zoos have a particularly clear obligation to breed this species in sufficient numbers to halt further raiding of the wild population" (Hughes and Turner 1975)—although in fact, by 1978, the proportion of captive-bred Bali Starlings in captivity worldwide had already risen to c.77% from only c.10% in 1964 (King 1978–1979, van Helvoort *et al*. 1986a, van Helvoort 1990).

Seemingly independently of other calls to action, although possibly in response to the dip in numbers of captive Bali Starlings in the late 1970s following the collapse in the market for surplus birds (Seibels and Bell 1993), Greenwell (1980) initiated a focused attempt in North America to maintain outbred captive stock, and Sieber (1977, 1978) conducted an experiment on the 1 km² island of Lokrum, off the coast of Dubrovnik (Croatia), releasing four captive-bred pairs and demonstrating that the species retained the capacity to adapt immediately to a novel wild environment. Jersey Wildlife Preservation Trust, having acquired four birds in 1971, had reared over 185 by the late 1980s, and at that stage the European captive population stood at over 700, with over 1,000 birds in zoos worldwide (Bruning 1989). In fact, in 1980 alone as many as 109 institutions reported breeding an estimated 612 birds (*International Zoo Yearbook* 1981); the zoo population in North America was pushing 500 in the early 1980s, and saturation level was already being reached, so that considerable interest was developing in releasing some of these birds back into the wild (Bruning 1989). By the end of 1991 the UK studbook had registered 110 birds held between 20 institutions, while by mid-1992 the US studbook had registered 381 birds held between 68 institutions (van Balen and Gepak 1994). Soon afterwards the European population also began to be managed, with 209 birds registered as of June 1993 (Pagel 1994). By the end of 1995 in the UK there were at least 166 birds shared amongst 27 zoos and private institutions (Fisher undated); a tabulation of total holdings of the species as reported to the *International Zoo Yearbook*, 1962–1995, is in Pagel (1999). At the end of 1999 there were judged to be some 3,000 birds in captivity around the world, many held illegally (Nicholson-Lord 2000); however, by then over 1,000 were registered with the European (458), North American (238), British (205), Indonesian (131) and Japanese (66) studbooks (Pagel 1998, 1999).

Bali Starling Project (BSP) Since at least 1979 the International Council for Bird Preservation (ICBP, since 1993 BirdLife International) and World Wildlife Fund had been in dialogue over a programme to conserve the Bali Starling, with the involvement of captive-bred birds (W. B. King–J. A. McNeely and S. D. Ripley–K. Oesman correspondence on file at BirdLife International). In 1983 the Indonesian government's Directorate General for Forest Protection and Nature Conservation (PHPA) and the International Council for Bird Preservation established the basis for a long-term programme of conservation on the Bali Starling; the first component of this programme was a three-year period of field investigation and inter-institution discussion (van Helvoort *et al*. 1986a), which produced a five-year recovery plan whose main components were (1) habitat improvement based on (a) guard installation to control wood-cutting, fire and poaching, (b) restoration to forest of various

areas within the park cleared for plantations, (c) deployment of 100–150 nest-boxes to plug the gap in nest-site availability, and (d) the planting of indigenous fruit trees; (2) captive breeding in various Javan zoos, followed by the establishment of an artificial wild population on or in Nusa Penida, Baluran National Park, Blambangan Reserve or Nusa Barung, followed in turn by the release of offspring from this wild population into Bali Barat; and (3) an awareness campaign on Bali and in East Java (van Helvoort *et al*. 1986a).

The notion that captive-bred birds might be used to replenish populations or re-stock areas had been in currency since at least 1974 (van Bemmel 1974). In 1983 the American Association of Zoological Parks and Aquaria (AAZPA, since 1994 AZA) developed the Bali Mynah SSP (Species Survival Plan) (Seibels and Bell 1993), and in 1985 its Annual Conference formally adopted the plan (Coordinator: R. E. Seibels) to focus on three major objectives: (1) development through ICBP of a cooperative breeding programme with PHPA (now PKA) at a location on Java or Bali; (2) separation of known and unknown heritage lines in the studbook; and (3) management of birds of unknown heritage lines to extinction, in order to allow zoos more space to work with birds of known heritage lines (Seal 1990, Seibels 1996, R. E. Seibels *in litt*. 2000). This managed decline was real: from around 600 birds to fewer than 300 in 1992, but with the difference that the modern population consisted of high-quality individuals capable of sustained growth (Seibels and Bell 1993).

In 1987 PHPA and ICBP, along with Bali Barat National Park, enlisted the support of AZA and JWPT (Jersey Wildlife Preservation Trust) to implement what was then intended to be a three-year recovery plan (Collar and Andrew 1988, Bruning 1989) but which rapidly evolved into a five-year project (later classified as Phase III of BSP) to build a self-sustaining population of Bali Starlings inside Bali Barat National Park, with the following means objectives: (a) to monitor and protect the wild population; (b) to establish a captive breeding programme at Surabaya Zoo in East Java, Indonesia, with resources supplied from zoological institutions in the USA, Jersey and elsewhere; (c) to restock the wild population; and (d) to increase public awareness (van Balen and Gepak 1994). US zoo participants in the project included Baltimore Zoo, Cincinnati Zoo, Denver Zoo, Houston Zoo, Jacksonville Zoo, Kansas City Zoo, Lincoln Park (Chicago) Zoo, National (Washington, D.C.) Zoo, Riverbanks (Columbia, South Carolina) Zoo, San Diego Zoo and Woodland Park (Seattle) Zoo, based on initiatives from D. F. Bruning of New York Zoological Society (Greeley 1988).

In 1987 the breeding facility in Surabaya Zoo, East Java, which already held 16 birds, was renovated and stocked with 37 captive-bred birds donated by the institutions associated with the project, and in 1992 Surabaya held 44 birds; a Pre-release Training Centre (PTC) was completed in June 1988 in Bali Barat National Park, and the following month it received its first group of three birds from Surabaya, and these were duly released in August, although this "failed", with one bird becoming a "casualty" and the other two immediately disappearing (van Balen *et al*. 1990, van Balen and Dirgayusa 1993a, van Balen and Gepak 1994). With the support of a population viability analysis workshop, at which it was agreed that ICBP would continue to monitor the wild population while AZA would take over direct financial and management control of the captive breeding and release portions of the project (Seal 1990), a second group of 12 captive-bred birds was released in April 1990 (wet-season release being considered important since food is then in greater abundance: van Balen *et al*. 1990), and at the end of that year a female from this group paired with a wild bird and reared three young in 1991 (Cahyadin 1992, van Balen and Dirgayusa 1993a). Over the next two years further releases took place, and although there were some losses—including a transponder-fitted bird found back in the hands of a local dealer—at least two birds (one of them the above female) integrated fully (van Balen and Gepak 1994). Subsequently it was judged that some released birds, through their tameness in visiting a dripping water pipe at Sumberklampok, may have enticed three wild-bred birds to the site, since a group of five birds was poached there (Collins *et al*. 1998). At this time further support for the project

emerged in Germany with the coordination of captive breeding work through an EEP (Europäisches Erhaltungszuchtprogramm, or European Endangered Species Programme) (Pagel 1989, 1990, 1993, 1994, 1997, Büngener 1992).

In 1992 a new three-year plan (Phase IV of BSP) was developed to continue the original aims and (a) to stop the illegal capture of wild birds, (b) to reduce the demand for wild-caught birds, (c) to establish new populations within the species's putative range using captive stock, (d) to undertake management-oriented research into the behaviour and ecology of the species in the wild, and (e) to render Bali Barat National Park capable of managing the species full-time (van Balen and Jepson 1992, van Balen and Gepak 1994). A subcomponent of this programme was a "whitewash campaign" designed to register but legalise birds (all of which were assumed to be wild-caught) held in captivity within Indonesia (ownership transferring to the state, but no prosecution, sometimes with captive-bred birds being exchanged for them); by early 1993 as many as 367 birds had been registered (van Balen *et al*. 1990, van Balen and Dirgayusa 1993a). A studbook for Indonesia was also introduced during this phase, and 139 live birds were registered by June 1994 (van Balen and Dirgayusa 1994). Moreover, in late 1993 a pilot project, releasing captive-bred birds on offshore Menjangan island, was initiated with the aim of habituating birds to wild conditions in relative security; of six birds released, two were probably poached and two predated, but two survived to June 1994 (van Balen and Dirgayusa 1993b, 1994) and one to March 1995 (Collins *et al*. 1998).

In the 10 years following the establishment of the AZA SSP, this American-led component of the Bali Starling Project had (a) returned nearly 75 captive-raised Bali Starlings to Indonesia; (b) helped establish four captive-breeding facilities; (c) released 21 birds back into the wild; (d) funded construction of a breeding centre, a medical quarantine facility and a home for the birdkeeper at BBNP; (e) trained and equipped an Indonesian project veterinarian who also served as national studbook keeper; (f) established medical protocols; (g) conducted numerous clinics and training sessions on husbandry and medicine; and (h) funded an American researcher studying released birds in BBNP (Seibels 1996).

At the end of this Phase IV of BSP, in December 1994, BirdLife International judged that its own goal in the BSP, which had been (e) above through the provision of technical expertise, had been achieved, and duly wound down its involvement (van Balen and Dirgayusa 1994), although it continued to participate in work into 1996 (R. F. A. Grimmett *in litt*. 2000). During its long period of involvement it had (a) supported park staff through training and provision of a wide range of equipment, (b) supported protection efforts through the provision of boats, patrolling systems and manuals, and the upgrading of guard posts, (c) provided considerable input, with AZA and JWPT, to the captive breeding and re-stocking effort, (d) monitored wild populations and put in place a standard field survey methodology, (e) undertaken basic field research, (f) experimented with the use of nestboxes, (g) undertaken numerous public awareness initiatives, and (h) coordinated and published a species recovery plan in close partnership with the Directorate of Species Conservation in the Ministry of Forestry (R. F. A. Grimmett *in litt*. 2000).

A year later, following a workshop in October 1995, AZA SSP made the difficult decision to suspend financial support for the field project until the problem of poaching in BBNP had been brought under control, and PHPA developed a new security plan which it was hoped would produce the evidence necessary for the resumption of AZA support (Seibels 1996). In fact, two years passed before, in 1997, it appeared that guard posts were being upgraded and patrolling schedules altered randomly to foil poachers, and it also emerged that some poachers had even been caught, tried and gaoled; consequently the decision was taken by the SSP Committee to resume its involvement, and M. Yoder was appointed director of the Indonesia programme (Seibels 1998).

At this time, the recovery plan (Jepson *et al*. 1997) had been finalised and formed the basis for the continuation of conservation work by all parties through to 1999, with the

following components: (1) "*essential activities*"—maintain good personnel management of the park guards, regularly patrol the park and prosecute all poachers; guard all nest trees and consider installing alarms and other deterrents on them; integrate the enclave community in the park; review the recovery plan; census birds before and after breeding, and assess breeding output; ensure the health of all released captives; (2) "*important activities*"—improve conditions of guards and provide them with refresher courses; prosecute illegal holders of birds; develop a liaison committee for the enclave community, and provide appropriate new enterprises for the community; develop a source of captive-bred birds for sale in Indonesia, and promote the legal and local means for achieving this; hold regular action plan meetings; study habitat dynamics (e.g. phenology); ensure suitable birds are chosen for any release and monitor subsequent survival; promote the project in schools; (3) "*desirable activities*"—improve guards' work environment; promote popular local support for the project; promote general awareness through the media; improve facilities for the enclave; study the demography, seasonal movements and feeding ecology of the wild population; study the effects of providing water and artificial nest sites for wild birds.

Releases into the wild had occurred in August 1988 (three birds), April 1990 (16 birds) and late 1993 (six birds, on Menjangan island), and in 1998 two further releases took place from a large new cage (17 m across and 17 m high) near the roosting area of the wild population, in February (six birds) and April (six birds) (Pagel 1998; see also above). In their first week the six February birds remained within 200 m of the cage and depended on provided food and water, but in their second week they ranged increasingly widely and began feeding from wild sources, and by the third week they had integrated with the wild birds (Pagel 1998). The April birds fared less well, and were still dependent on provided food and water in August (Pagel 1998).

Unfortunately, in August 1997, when M. Yoder began duties for AZA SSP, the Indonesian economy took a very serious downturn, and work had to be suspended for several months, although PHPA continued to make progress in asserting its authority at BBNP, so that SSP work in the park was rejigged to become a comprehensive long-term re-introduction and radio-telemetry monitoring programme (Seibels 1998). A seven-page MOU between AZA SSP and the Indonesian government, drafted in mid-1997, took 18 months in Indonesian bureaucracy before it was returned to AZA for signature in December 1998, and it had still not been signed by the Indonesian authorities in February 1999 (Seibels 1999). Meanwhile, however, the Indonesian government proceeded to develop an MOU with two for-profit organisations, the Brehm Fund (headed by W. Brehm, Germany) and Bali Bird Park, for financial support directly to BBNP under the auspices of an umbrella organisation called the Bali Starling Foundation (BSF), under which a sum of US$75,000 (the total operating budget of BBNP) would be paid annually for a five-year period, on condition that no other parties would be permitted to contribute to the conservation effort for the species; on discovering this, and on being informed of unfounded allegations made against SSP representatives concerning their attempts to perform medical checks on captive birds at BBNP, AZA withdrew from further involvement ("after 14 years of frustration and futility") with the Bali Starling in Indonesia (Seibels 1999). Subsequent events could scarcely have proved more ironic or more damaging to the cause of the Bali Starling: in the course of 1999 W. Brehm was declared bankrupt (R. Wirth verbally 2000), and at the time of the major robbery at BBNP in November 1999 (see Threats) the park's head inexplicably left his post and, simultaneously, the funds for the park made over by the Brehm Fund and Bali Bird Park under the BSF agreement also disappeared (T. Tilford *in litt*. 2000). The circumstances of these events have not been clarified, and as a consequence Bali Bird Park pulled out of the MOU with the Indonesian authorities (T. Tilford *in litt.* 2000).

In March 1999, when there were c.35 birds in the wild (see Population), 10 birds were being held in the PTC for release later in 1999, while the Bali Barat captive breeding facility,

4 km east of the park headquarters, held 64 birds at that time and was "guarded by eight guards on rotation armed with sub-machine guns" (D. Pain *in litt*. 1999). Despite a theft of four birds from a quarantine station in the park during the course of the year, by the start of November the park premises collectively held 81 birds, and the wild population was reported to be 26 birds (including at least 10 birds said to have been released in the "last year") (F. R. Lambert *in litt*. 1999); the theft of 39 birds on 21 November halved the park's captive population (see Threats), although with 10 new birds donated in the first half of 2000 that population rose to 52 in August, when (on 31 August) another 13 were stolen (see Threats). Following this incident, BirdLife International Indonesia Programme made strong representations to the Governor of Bali to pursue the guilty parties and improve security in and around Bali Barat (R. F. A. Grimmett *in litt*. 2000). Around the world there are about 1,000 Bali Starlings held in zoos available for captive breeding (Nicholson-Lord 2000). In November 2000 the captive breeding facility in BBNP held 41 birds, of which seven were chicks (B. Wirayudha *in litt*. 2000).

Site management at Bali Barat An attempt to solve the perceived nest-site shortage through a programme of nest-box erection (96 were deployed) in 1984–1986 sadly failed, with only Black-winged Starlings, geckos and social insects using the artificial sites (van Helvoort *et al*. 1986a, van Balen *et al*. 1990, van Balen and Jepson 1992, Jepson *et al*. 1997). The pattern of burning of Bali Barat National Park may have had a positive impact on the Bali Starling: certain plants important for Bali Starling biology (e.g. *Lantana*, *Acacia leucophloea*) have certainly benefited from wild fires (SvB). Moreover, the resulting open grazing fields of alang-alang grass attract large ungulates, with which the Bali Starlings are said often to associate: they have been reported perching on cattle and deer (W. Dirgayusa *per* SvB). Some limited cattle-grazing may therefore even benefit Bali Starlings (P. Jepson *per* SvB) if indeed the species prefers (as it appears to do) savanna-like habitat (see Ecology, Threats), although it has to be stressed that much more field data are needed on foraging patterns before a commitment to such a management response would be appropriate. In November 1999 a workshop was held in Denpasar to review the recovery of the Bali Starling in the context of the development of Bali Barat National Park, and set up a strategic plan among related institutions to conserve the biodiversity of the park (R. Saryanthi *in litt.* 2000).

New populations The island of Penida off the south-east coast of Bali was assessed in 1986 as a potential location on which to establish a reserve population of Bali Starlings, but was found to contain no suitable habitat (including no appropriate nesting trees) and a very high human population (van Helvoort *et al.* 1986b).

According to Nicholson-Lord (2000), a supposedly secret and inaccessible release site has been identified at which to establish a new population using captive-bred birds, but recently it was discovered this site is on the itinerary of local tour companies. This story needs elucidation. In the past a pair has lived "at semi-liberty" (Fletcher 1967), and there may be some merit in considering whether a formal attempt at establishing semi-wild populations in certain "safe" areas might be feasible, if only to reduce the pressures of space on existing captive populations. In the late 1990s PKA was keen to establish a population in the vicinity of a luxury hotel in Nusa Dua, south of Denpasar (R. F. A. Grimmett *in litt.* 2000).

Aviary-based scientific research The biology and management of this species in captivity has been very well documented, in both general and certain very particular aspects, but with the major emphasis on reproduction (Ezra 1931a,b, Lint 1962, Harrison 1963a,b, Schmidt 1968, Baier 1973, Ertl 1973, Hughes 1973, van Bemmel 1974, Hughes and Turner 1975, Lensink 1975, Roles 1975, Landoldt and Kocan 1976, Schürer 1977, Sieber 1977, 1983, Jeggo 1981, Marshall 1981, Breunig 1982, Gosselin and Kramer 1983, Schmidt 1983, Horrer 1985, West and Pugh 1986, Taynton and Jeggo 1988, Mey 1989, Partington *et al*. 1989, Pagel 1990, Williams 1998, 1999). A review of much of this material is in Pagel (1999); a considerable body of articles has also appeared in Indonesian (see van Balen 1995a).

MEASURES PROPOSED The 1990 population viability assessment and species survival plan identified the need to establish a total population of at least 1,000 birds distributed in wild populations in secure areas and an additional 1,000 birds in managed captive populations, and to accompany the work needed to achieve this with programmes (outlined in 10 pages of recommendations) of appropriate monitoring, research, awareness campaigning, habitat restoration and husbandry (Seal 1990, Seibels and Bell 1993). Indeed, it was then reckoned that a population of over 600 wild birds could have been (and presumably could still be) built up at Bali Barat National Park in the long term, under the provisions of the park management plan, with up to 375 birds sustainable on then existing habitat cover, and a further 300 when other areas had been restored appropriately (Wind 1991). Strict implementation of the species recovery plan, including the pursuit of the provisions in the park management plan, is clearly vital to the success of any future Bali Starling conservation programme.

In the early 1990s it was recognised that the scientific understanding of the Bali Starling's ecology was still weak, and that information was required on such things as feeding rates and habits over the annual cycle, habitat preferences, niche use and possible overlap with other species, home range size and nest-site selection, all of which, combined with habitat mapping, would help assess the carrying capacity of Bali Barat as currently managed (van Balen and Dirgayusa 1993a). A detailed plan of study was drawn up, addressing the feeding and breeding ecology of the species, and monitoring the fate of released birds (van Balen and Dirgayusa 1993a), and a suite of recommendations for maximising the effectiveness of further releases are in Collins *et al*. (1998), who implemented the plan in van Balen and Dirgayusa (1993a). Even now, however, the precise habitat needs of the species remain uncertain, which renders management difficult (this particularly relates to the relative importance of open tree-savanna areas and closed-canopy woodland). The problem with much of this fieldwork is that statistically significant sampling is very difficult to achieve with so low and so persistently plundered a population.

In November 2000 the BirdLife International Indonesia Programme began a modest suite of activities—involving breeding and population surveys, public awareness initiatives, review of park security and the development of a new conservation plan involving local NGOs—with financial support from Vereinigung für Artenschutz, Vogelhaltung und Vogelzucht (AZ) e.V. (T. Pagel *in litt*. 2000). It was at this stage felt that probably the best means of preventing further poaching will be to attempt to breed up large numbers of birds in captivity so as to meet commercial demand (A. Taufik *per* T. Pagel *in litt*. 2000); the fact that wild-caught birds are more highly prized than captive-bred ones (Pagel 1998) is presumably neutralised by the fact that a high proportion of birds now in the wild are themselves captive-bred, as most consumers must be aware.

There is a need for independent investigation of the circumstances in which poaching and theft have been able to continue at Bali Barat National Park despite the resources that are deployed to prevent such things. Based in particular on experience with the Bali Starling and with Gurney's Pitta *Pitta gurneyi* (see relevant account), there is a strong perception (synthesised here from comments made *in litt.* by R. F. A. Grimmett and P. Jepson) that protected-area management is susceptible to subversion from and control by economic interests in direct proportion to the value of the resources not only under protection but also being deployed from external sources to provide that protection: these interests tend to remain invisible or unacknowledged, but can significantly pervert and distort conservation efforts. In situations where the degree of endangerment of particular species compels conservation organisations to seek to support government agencies, it is important to be aware of the corrosive (rather than constructive) potential that such support can have.

REMARKS (1) The discovery of this extraordinarily beautiful bird only in the second decade of the twentieth century was a remarkable event, or at least appears so now. W. Rothschild,

after whom it was named, had directed the collector W. Doherty to the island in 1896, yet despite several months' endeavour, during which he and his assistant "on different occasions met tigers face to face" (Hartert 1896b), he and all other explorers before E. Stresemann missed the species.

It is, moreover, a highly distinctive taxonomic entity. Nevertheless, Wolters (1975–1982) elected to extend *Leucopsar* to cover the Black-winged Starling *Sturnus melanopterus* and Vinous-breasted Starling *S. burmannicus*. His opinion has found no great favour, however, and the broad consensus remains that *Leucopsar* sits as a monotypic genus between *Sturnus* and *Acridotheres*, distinguished by its startlingly white plumage, high-ridged culmen, notched inner vanes of the primaries (a feature otherwise only found in two sibling species of *Lamprotornis*) and long occipital crest (Stresemann 1912, Amadon 1943, 1956, Harrison 1963a,b).

(2) The remark that the species also occurs on Nusa Penida (Hartmann 1970), which was repeated in King (1978–1979), was mistaken (van Helvoort *et al*. 1986b), and another that it occurs in the extreme north-east of Bali (Schürer 1977) is clearly a slip for north-west.

(3) The year of discovery has mistakenly been given as 1910 (von Plessen 1926a, Sieber 1977) and 1912 (Ezra 1931a, Sieber 1978).

(4) Van Balen *et al*. (2000a) misrepresented Sieber's (1978) findings by indicating "125" as her estimated total.

(5) Van Balen *et al*. (2000a) mistakenly gave 110 as the estimated total of this study, evidently transposing this figure from a draft table that included the results of Alikodra *et al*. (1978).

(6) Van Balen *et al*. (2000a) mistook and misattributed numbers for August 1979 and August 1980: for both years they accidentally indicated 28 and 22 instead of 12 and 2 for Penyaringan, and entered the *estimated* totals of 175 and 200 when these numbers (clearly) belong under March 1979 and August 1979 respectively. Three points arise: (a) although it is true that the August 1979 figures can be found in Hayward *et al*. (1981), they are from the census by I M. Suta Adi; (b) the figures for August 1980 originate from Hayward *et al*. (1981), not, as indicated, van Helvoort *et al*. (1985); and (c) the correct estimated total for August 1980 is 230–280.

(7) Van Balen *et al*. (2000a) gave 86 for this count, presumably as part of their stated revision of original estimates to take into account possible double counts.

(8) Nomenclature follows Backer and Bakhuizen van den Brink (1963–1968).

(9) The statement in van Balen *et al*. (2000a) that in October–November in the 1920s flocks of birds "foraged solely on... *Lantana camara*" must slightly simplify the situation—a two-month exclusive dependence on one (exotic) plant seems wholly improbable.

(10) This tree is used for carving in Indonesia and is now rare and protected, but the Prapat Agung peninsula is one of the last places in the country where it is fairly common, occasionally even forming pure stands (van der Zon 1980, van Helvoort *et al*. 1986a).

(11) The North American studbook now has numerous examples of males older than 20 years and females older than 15 (males are reproductively active and live longer than females), but female fecundity falls off dramatically after 11–12 years (R. Seibels *in litt*. 2000).

(12) This tempered view of the impact of trade is somewhat surprising in view of a letter from J. Vincent to L. M. Talbot, 1 July 1964 (on file at BirdLife International) in which S. D. Ripley was reported as having told JV that the species was then "constantly and regrettably gaining the attention of bird dealers... [and that] considerable numbers of specimens are in transit and arriving at those large dealers in Antwerp and Holland, and if such trade continues the starling will disappear very quickly indeed."

(13) This raid took place at night immediately after a delegation of army officers turned up at the PTC claiming to be interested in birds and conservation; it was undertaken with military precision by a heavily armed gang which easily disarmed the army personnel guarding the facility, no shots were fired, and no attempt was made by the authorities to apprehend those responsible (T. Tilford *in litt*. 2000).