SPIX'S MACAW *Cyanopsitta spixii* **E**[1]

This enigmatic and exquisite macaw, known for over a century and a half from small numbers of traded birds from somewhere in the interior of Brazil, was traced in the 1980s to some remnant caraiba gallery woodland adjoining the rio São Francisco in northern Bahia. However, at that stage only three birds remained and these were all believed captured for illegal trade in 1987 and 1988, although a single bird, now well publicized and guarded, was discovered at the site in July 1990 (still present in June 1992). At this time evidence was assembled to suggest that the species might have been heavily dependent on caraiba woodland for nest-sites, so that its long-term rarity could be attributed to the long-since loss of most such habitat, although its exploitation for the illegal bird trade since around 1970 is certainly responsible for its current proximity to extinction. As this plight became clear in the mid-1980s, efforts were made to identify birds held captive around the world, and the total of publicly acknowledged birds was 27 in June 1992, although at least 14 of these are offspring and the degree of relatedness between all the birds is unknown. A Permanent Committee for the Recovery of Spix's Macaw has been established by the Brazilian government and this includes most holders.

DISTRIBUTION Spix's Macaw is a distinctive parrot (see Remarks 1) endemic to the arid interior of east-central Brazil, and is known with certainty from just one site in northern Bahia, at which a single bird survives. Many other localities have been claimed for the species, such that they constitute an area embracing some 300,000 km^2 in north-west Bahia, southern Pernambuco, southern Piauí, southern Maranhão and eastern Tocantins (as northern Goiás is now known) (Roth 1988b, 1990). In particular, an 80,000 km^2 area called the "Gerais", where the states of Bahia, Piauí, Maranhão and Tocantins meet, has been the source of most unconfirmed reports of this parrot (Roth 1988b, 1990); Silva (1989a) reported a Belém dealer in 1986 giving the Gerais as a source of a few birds in recent years. However, modern evidence of the species's habitat requirements suggests that most if not all unconfirmed sites are false (see Remarks 2). On the basis of the following two paragraphs, the species's original range may now be proposed as a 50 km wide belt of the 150-200 km stretch of the rio São Francisco between Juazeiro (and possibly even Remanso) and Abaré, the south side in Bahia, the north side in Pernambuco (see Remarks 3).

Bahia The only entirely certain records (possibly but not provenly from the same site) are from the banks of the rio São Francisco, near Juazeiro (Joazeiro), where the type was collected in April 1819 (von Spix 1824, Hellmayr 1906c), and from the riacho Melância (Melância Creek), some 20 km south-east of Curaçá, where one bird was found to be present in July 1990 (Roth 1986, 1990, Juniper and Yamashita 1990, 1991, Juniper 1991; see Population) and was still there in early June 1992 (M. A. Da-Ré *per* F. B. Pontual *in litt*. 1992). There is also a strong but second-hand report from the riacho da Vargem, near Abaré, some 100 km east of Curaçá (Juniper and Yamashita 1990, 1991).

The view that the type came from Curaçá, since birds there were reported to appear irregularly on the rio São Francisco (Roth 1985, 1987a, 1990), has been widely repeated (Arndt *et al*. 1986, Strunden *et al*. 1986, Forshaw 1989, Silva 1989a), even to the point of identifying one specific area (Barra Grande) as the type-locality (Juniper and Yamashita 1990; see Remarks 4). All of this is no more than possible; Juazeiro lies 90 km south-west of Curaçá (both being on the right bank of the São Francisco) and it cannot conceivably now be established that the locality where von Spix found his bird in 1819 is identical to that discovered in the 1980s (see Remarks 5, 6). The fact that Juniper and Yamashita (1990) were able to find a new (but recently trapped-out: hence not absolutely certain) locality, riacho da Vargem, on the basis of their identification of the species's habitat constraints, further indicates the inappropriateness of assuming the precise origin of von Spix's bird. Indeed, Roth (1986) himself suggested that the species's distribution, if allied to caraiba trees *Tabebuia caraiba* along creeks, would originally have extended 50 km either side of the São Francisco between Juazeiro in the west and Santa Maria de Boa Vista in the east (indeed the caatinga formation extended as far west as Remanso and east to Orocó) and, now that this association has been affirmed (Juniper 1990, Juniper and Yamashita 1990, 1991), such a proposed original range appears very plausible, although in fact riacho da Vargem extends it much further eastwards, to Abaré; Roth (1985, also 1986, 1987c) referred to local reports of birds from Curaçá wandering as far as Orocó (Pernambuco), but Orocó is well west of Abaré. (It is clear, of course, that birds would once have ranged widely through

BirdLife International (1992) Threatened Birds of the Americas.
Cambridge, UK: BirdLife International.

the general region indicated by the localities mentioned above, and even now would not necessarily be inhibited from travelling between islands of habitat.)

The most widely accepted other area for the species is the Formosa do Rio Preto, Riachão (i.e. rio do Ouro region, in the Gerais), where three and then four individuals were seen flying over a buriti palm grove on 25 December 1974 (Sick and Teixeira 1979, Sick 1981, 1985; incorrect year in King 1978-1979). This record was carefully followed up by Roth (1986, 1988a, 1989b, 1990; also by Juniper and Yamashita 1990), who could find no-one who knew the species among several with great experience of the local avifauna, and the cerrado habitat was fundamentally different from that at Curaçá: the conclusion was that either the species might be found in the denser gallery woodland of the region, or it is more nomadic there (see Ecology, last paragraph), or the record was a misidentification; but in any case that any population there must now be extinct or nearly so. However, it is to be noted that, for reasons unknown, Pinto (1938, 1978) listed both rio Preto and rio São Francisco in Bahia as recorded localities, and indeed was a party to the search for it there in 1958 (Pinto and de Camargo 1961).

Pernambuco The former occurrence of Spix's Macaw in southern Pernambuco, along the stretches of the rio São Francisco adjacent to the known sites in Bahia, is based only on local information given to Roth (1985, 1986, 1987c), but is consistent with his evidence that appropriate habitat (caraiba woodland) existed there in former decades. Indeed, in 1991 a trapper working for the main dealer in the species (Carlinhos: see Threats: Trade) reported that a few decades ago the species was commoner in the state than in Bahia, but that with the loss of the trees the birds moved south across the São Francisco; however, he claimed to have seen a pair along the rio Brígida in 1988 (F. B. Pontual *in litt*. 1992).

Piauí On 18 and 21 June 1903, respectively three and two Spix's Macaws were seen at Lago de Parnaguá, the first observation being of birds coming to drink, the second of a pair flying from south to north (Reiser 1926; also Hellmayr 1929a), and these records form the main basis for the inclusion of southern Piauí in the range of the species (e.g. Forshaw 1978, Ridgely 1981a, Sick 1985). Pinto (1938, 1978), for reasons unknown, also included the upper rio Parnaíba (which divides southern Piauí and Maranhão) in his summary of the species's distribution (see under Maranhão). The Lago de Parnaguá area was investigated in 1958 without success (Pinto and de Camargo 1961), but it is not clear that it was ever visited by P. Roth (see, e.g., Roth 1990). It was, however, investigated in June 1990 without success (Juniper and Yamashita 1991). A confident 1979 report of the species at Fazenda Bom Recreio, near Manoel Emídio, in the Gurgueia valley close to the Uruçui Preto river system, was followed up, but inquiries at the fazenda, and a search of the region extending to the headwaters of the rio Estiva, revealed no evidence to confirm the report; and, again, the habitat was cerrado (Roth 1987d, 1988a, 1989b, 1990). Roth (1985) found a trapper at Gilbués who clearly knew Spix's Macaw, and Silva's (1989a) version of this could be read to imply that the birds had been seen locally, but Roth (1988a) indicated that the man in question had trapped the species at Curaçá (although it was also he who was responsible for identifying the rio Parnaibinha in Maranhão as a locality). A pair of macaws fitting the species's description was seen during an archaeological survey at Serra Branca in Serra da Capivara National Park, March/April 1975, and local people around the park appear to know the species, although it seems now to have disappeared there (Olmos in press); such information, while valuable as a possible pointer, inevitably has to be treated with caution.

Within the Gerais, the region of São Raimundo Nonato, Piauí, claimed for the species by several aviculturists and dealers, has the most similar habitat (in terms of its caatinga composition) to that at Curaçá; moreover Remanso (Bahia), where in 1903 Reiser (1926) saw a captive bird, is not distant; however, searches in April 1986, July 1987 and January 1988 yielded nothing (Roth 1986, 1988a), and it appears that the habitat similarity did not include mature gallery woodland.

The Piauí section of the Chapada das Mangabeiras was also reported in 1989 as a source of recent possible sightings, and was therefore investigated in 1990, along with other reputed areas for the species in southern Piauí not covered in surveys, 1985-1988; results were negative, and misidentifications seemed to be responsible for all these records. Nevertheless, Keller (1992) revived the idea that a small population (at least six birds) might still exist somewhere in the state, and implied that P. Roth had seen and photographed them.

Maranhão Apart from the inclusion of the upper rio Parnaíba in the species's range (see under Piauí above), five specimens in trade, 1976-1977, including two young, were reputedly from southern Maranhão (three of them, seized in 1976, went to São Paulo Zoo) (Sick and Teixeira 1979; hence Ridgely 1981a, Roth 1988a). Local reports at first suggested birds might be found on a 60 km stretch of the rio Parnaibinha from Morro da França and Fazenda Promissão to Fazenda Galiléia, but investigation revealed that all this appeared based on misidentification, and no other evidence – including that of a search around Curupá just west of the Parnaíba, and at Baixa Funda, just across the border from Lizarda in Tocantins – was found to confirm or suggest the species's presence in Maranhão (Roth 1987d, 1988a,b, 1990), although Roth (1985) himself referred to four small unidentified macaws he glimpsed in Serra do Itapecurú, between Buritirana and Balsas (apparently never followed up).

Tocantins In eastern Tocantins (the region adjacent to southernmost Maranhão) the species was reported by hunters to H. Sick and R. S. Ridgely in 1977 (Ridgely 1981a), although Goiás (as Tocantins then was) did not earn mention by Sick and Teixeira (1979) or Sick (1985). The most specialized trapper of Spix's Macaw reported regularly visiting the border region between Tocantins and Maranhão, and some recently captured birds probably originated in the region (Roth 1988a). Keller (1987) reported being offered birds that came from "northern Goiás", and referred to repeated allusions by trappers and traders to Tocantinha and Filadélfia, to which Roth (1988a) added the sites of Pedro Afonso and São Miguel do Araguaia. Inquiries and surveys in 1988 in the "Xalapão" region (untraced), and from Filadélfia through Tocantinha and Lizarda to the rio do Sono and Dianópolis, produced no evidence of the species (Roth 1988a,b, 1989b, 1990).

POPULATION A single bird was all that was known to survive in the wild in July 1990 (Juniper 1990, Juniper and Yamashita 1990), while there were 16 acknowledged birds in captivity in November of that year (see penultimate paragraph, this section). In June 1992 the single bird remained (M. A. Da-Ré *per* F. B. Pontual *in litt*. 1992), while the conclusively proven captive stock stood at 27.

Population in the wild The Curaçá population (i.e. that at the Barra Grande and adjacent riacho Melância) was judged to consist of 30 or more pairs at the start of the century (Roth 1985, 1986, 1990) and on the evidence in Threats: Trade it would appear that a good proportion of this number was still present in the late 1970s. However, by 1985 no more than five (including two pairs) were reported remaining, following 15 years of trapping and no successful breeding (Roth 1985, 1986, 1990). In that year the eggs of a breeding pair were broken by a trapper during a nest inspection (Roth 1985), although in a later account this event was not mentioned, rather that at least one pair attempted to breed, but failed owing to heavy rains; later in the year one bird was shot dead by local trappers trying to cripple it and capture it alive (Roth 1986 *contra* Roth 1990, who said it was shot for food, and Keller 1992, who said it was shot by the proprietor of a local fazenda). In 1986 only three birds remained, including a pair which attempted to breed; trappers damaged the eggs and, when the birds relayed at a site 4-5 km distant (but still along the riacho Melância), trappers sealing the nest entrance caused the eggs again to be broken (Roth 1986). From December 1986 to early March 1987 the birds were not reported as present; they appeared with the first rains (10 March) and seemed not to have bred (Roth 1987b,c), although two young were taken at some locality by trappers that February/March (see below). The three birds were present up to the end of April 1987, but from May only two were observed (Silva 1989a indicated, without giving a source, that the missing bird had been trapped), and in December 1987 one of these two was reported captured, in January 1988 the other (Silva 1988b imparted the information, without indicating a source, that one of these two birds died soon after capture); this was done by a trapper with a group of armed men under instructions from a dealer in Petrolina, after which the species was considered extinct at Curaçá (Roth 1988a,b, 1990, Munn *et al*. 1989). However, in July 1990 a new search of reported and reputed localities finally resulted in the discovery of a single bird, probably male, at riacho Melância (see above; also Remarks 7).

It is widely agreed that any surviving or recent populations of Spix's Macaw must be or must have been small, and that the species must always (i.e. in the past two centuries) have been "rare" (King 1978-1979, Ridgely 1981a, Sick 1981). The degree of rarity might have depended on the extent of its range, but its relative rarity within that range would seem to have been constant (see Remarks 8). It seems never to have been noted that von Spix (1824), in his original description, referred to the species as "very rare" (see

Remarks 5), which for so relatively large and conspicuous a bird is clearly good evidence that indeed its population was low and scattered even at the start of the nineteenth century. From its discovery in 1819 to its rediscovery in 1985/1986, the species was recorded in the wild only twice in published sources, in 1903 (Reiser 1926) and 1974 (Sick 1985), but neither of these records can be regarded as unassailable (see Distribution, Remarks 2). Very small numbers of birds have been in trade at least since the 1870s, and the species has always been considered extremely rare in aviculture (Dutton 1897, Low 1972). Museum skins are also very rare, and most are preserved specimens of captive birds, although the labels do not always help in judging this (ANSP has two skins acquired from Paris in 1846 or soon afterwards: M. B. Robbins *in litt.* 1991; MHNG has one labelled "Bahia, Brazil" which it received in 1892). The very low but relatively constant volume of live and dead specimens over the decades is consistent with an interpretation of the ecological evidence that the small numbers of the species lived in a specific and limited habitat close to the rio São Francisco, a main channel of communications from interior Brazil (Juniper and Yamashita 1990; see Ecology, also Remarks 8).

That populations of the species, albeit small and scattered, might exist elsewhere other than at Curaçá had long been indicated not only by records and reports (see Distribution) but also by evidence of birds entering trade, especially in recent years. In March 1987 two young Spix's Macaws were seized by the authorities in Paraguay (see Measures Taken), and although Thomsen and Munn (1988) maintained that they originated from Curaçá, Roth (1987b, 1988a) believed that they were from another (albeit pressurized) population, particularly as he had evidence that two different young birds were being sold illegally in 1987 and knew of offers to obtain young in 1988. Such evidence, coupled with the view (almost certainly mistaken) that the species's habitat was intact, continued to suggest to Sojer (1989) and Sojer and Wirth (1989) that Spix's Macaw occurred somewhere else at low density, and presumably stimulated Roth's further pursuit of hearsay reports at the expense of searches for new areas of the habitat he had already identified for the species. The persistence of a population elsewhere was confirmed and the likely provenance of new birds on the market identified when in July 1990 ICBP-backed researchers, using habitat features as a guide, discovered the gallery woodland at riacho da Vargem, which local people reported to have held a steadily trapped-out population up to as recently as 1989 (Juniper and Yamashita 1990). Moreover, Keller (1992) referred to chicks being exported from Brazil that had been captured after 1988 and not in the Curaçá area.

The problem posed by lack of certainty concerning other populations, particularly when the range is believed vast and the ecological requirements assumed to be unspecialized, is illustrated by the fact that, only 10 years ago, Spix's Macaw was not regarded as the most endangered Neotropical parrot after the probably extinct Glaucous Macaw *Anodorhynchus glaucus*, the distinction going instead to the Red-tailed Amazon *Amazona brasiliensis* (Ridgely 1981a), and indeed the species was not even discussed by Greenway (1958, 1967) or listed as threatened by Vincent (1966-1971).

Population in captivity Trade in Spix's Macaw has always been light, indicating the long-term rarity of the species; but it has still been considered easier to find a captive bird than a wild one. BMNH received a specimen from a dealer in 1859 and a second in 1884, this latter having been held in London Zoo since 1878 (see also *Proc. Zool. Soc. London* 1878: 976); AMNH has a specimen received in London Zoo in 1894 and which died there in 1900 (longevity recorded also in Mitchell 1911). These two London Zoo birds were evidently the only two that Dutton (1897) reported ever having seen (the former being acquired from the Jardin d'Acclimatation, the latter by W. Rothschild from a Mr Jamrach), although he evidently soon saw (and bought) a third specimen (Dutton 1897, 1900) which was six or seven years old and "picking up a good deal of conversation" in 1902 (*Avicult. Mag.* 8 [1902]: 277). At this time Blaauw (1900) noted Spix's Macaw in the collections at Berlin Zoo, de Grahl (1986) and Brack (1987a) indicating that one had been there in 1893, and Neunzig (1921) affirming that it had arrived that year and at least one other had followed it.

From this, Low's (1972) assertion that the first specimens of the species came to Europe in the 1920s can be seen to be mistaken. However, in the 1920s there certainly was a flush of importations into Europe and North America, Tavistock (1929) referring to the species as "formerly extremely rare, but a few have been brought over during recent years" (see Remarks 9), indeed in sufficient quantity that he could add that it "sometimes makes a fair talker". Thus in the U.K. Paignton (Primley) Zoo held one in

1926 and a pair in 1927, although these were not being held together in 1931 (Seth-Smith 1926, Hopkinson 1927, 1931). What were apparently two different birds from the above were exhibited in 1927 and 1930–1932 (Seth-Smith 1927, 1932, Prestwich 1930a, 1931), at least two were in London Zoo in 1930 (Prestwich 1930b) and another was at a private zoo in Liverpool in 1932 (Stokes 1932), suggesting at least seven in the country around 1930, although any resale would mean some double counting: it is impossible, for example, to tell if two that had been kept by Marsden (1927) died or were sold on. In the U.S.A. Plath (1930, 1934, 1937, 1969) reported keeping one from 1928 to 1946, and knew of no authentic records in the country before 1927. However, AMNH possesses the skin of a captive bird (male) which either died or was received in 1926; another was received in 1928, and a third in 1935; USNM has a female from the National Zoo in 1937; and ANSP has two from Philadelphia Zoo, received in August 1931 and January 1947. A Miss Dalton-Burgess (English, according to de Grahl 1986) held a female that laid an egg in 1927 (Brack 1987a); egg-laying had already been recorded without details the previous year (Tavistock 1926). There was at least one in France in 1929 or 1930 (Stokes 1930) and Vienna Zoo held a bird in 1929 (Brack 1987a).

After the importations of the 1920s the trade in the species appears to have waned. Low (1984) remarked that the number of specimens documented in the avicultural literature of the previous 50 years did not exceed single figures outside Brazil. That birds went abroad in this period, especially in the 1970s, is borne out by, e.g., Ridgely's (1981a) encounter in 1977 with Paraguayan dealers who had obtained specimens in the recent past. A captive female received by MNHN in 1953 may have been a long-lived bird from the 1920s. The only record otherwise of captive birds in the 1950s is amongst the conflicting accounts of the first successful captive breeding of the species, by Alvaro Rossman Carvalhães, of Santos, São Paulo: according to Low (1984, 1986, 1990) and Keller (1987), Carvalhães had a pair that produced eight young over several years in the 1950s, one of which went to Naples Zoo, the rest remaining in Brazil, and most dying as non-reproductive adults; the breeding pair is presumably that referred to in King (1978-1979) as dying in the mid- to late 1970s. However, according to Silva (1989a; also 1990a, 1991a), Carvalhães bred over 15 in the 1960s and 1970s, and some of these "reared young for Ulisses Moreira" (this apparently indicating second-generation breeding) three times in the late 1960s (Roth 1987a referred to Ulisses Morães's [*sic*] success as occurring in the 1970s). According to F. Simon, Carvalhães hatched over two dozen birds (documentation provided by J. B. Thomsen *in litt.* 1991); according to Nogueira-Neto (1973), Carvalhães held no fewer than four pairs of this species (by implication these were all caught from the wild), but he had also bred them and a pair had been passed to Moreira. Moreira's success may explain why Sick (1981, also 1969) implied that there had been more than one breeder of the species in Brazil, while Low (1984, 1986) and Roth (1986) insisted that no other breeding had occurred there or elsewhere. A report that several birds came on the market in the late 1970s that had been bred at São Paulo Zoo (Brack 1987a) is patently erroneous (confirmed by F. Simon *in litt.* 1992); Brack (1987a) reported Carvalhães's success ("many chicks") as being in 1970, and successful breeding in Santos in 1983. There were two birds in Rio de Janeiro Zoo in January 1974 (Strunden 1974), and one was found at the home of J. L. do Nascimento in Macururé, Bahia, in July 1979, this bird having been a gift three years before from D. L. de Moraes of Amargosa (also Bahia), who had kept it for 15 years (LPG).

The errors, contradictions, silence and disinformation that afflict the history of Spix's Macaw in captivity were magnified as fieldwork in the 1980s highlit the species's critical plight in the wild and placed the last hope of saving it on captive breeding, engendering a series of initiatives to identify the whereabouts of birds. Initially Ridgely (1981a) had reported "extremely few in captivity even in Brazil, and now almost none abroad", although King (1978-1979) was told there were then 13 in Europe. G. A. Smith (*in litt.* to W. B. King 1978) knew of two six-month-old birds being sent (apparently from the U.K.) to the U.S.A. in early 1977. Decoteau (1982) asserted that at the start of the 1980s there were three "known" pairs in the U.S.A., all breeding ("well-kept secrets, and rightfully so"), and that there were several pairs in Europe, of which one, in Belgium, had been most prolific, producing three good young for six years down to the time of writing, with another pair breeding in Germany; none of these claims gains support from independent testimony, but A. Decoteau (*per* J. R. van Oosten *in litt.* 1991) asserted that the birds in the U.S.A. were in Maine and are all dead, while the whereabouts of those in Belgium is no longer known to him. Low (1984) wrote that no more than 10 were held in Brazil, one of which was in Paraná,

although Low (1986) revised the figure up to around 20, adding that N. Kawall had told G. A. Smith that three or four birds, probably from two nesting pairs, came onto the market in Brazil each year. Roth (1985, 1986, 1987a) simultaneously wrote of 40-50 in captivity, half of them in Brazil, thus: at least 12 in São Paulo (including three in the zoo), at least three in Rio de Janeiro, four in Recife, and scattered individuals elsewhere; then 1-2 in Walsrode (Germany), a pair in Naples Zoo (reported to be two females: G. A. Smith *in litt.* to W. B. King 1978), a pair in Portugal, four in Yugoslavia, a pair in Singapore, four with the "Caribbean Wildlife Preservation Trust" (confirmed by W. L. R. Oliver *in litt.* to J. B. Thomsen 1991), two at "Canary Island Parrot Park" (= Loro Parque, Tenerife), and one in California. De Grahl (1986) and Brack (1987a,b), more retrospectively, reported a pair in the Rio de Janeiro Zoo, 1974 (one of these had died by December 1975: Aguirre and Aldrighi 1983), a pair held by G. Rossi dalla Riva, Brazil, one of which died in 1976 (in fact he had two pairs, possibly all dead in 1976: see Bertagnolio 1981), and, outside Brazil, a pair on exhibition in Rotterdam in 1971, one held by G. A. Smith in 1978 (imported from Portugal in 1976: Smith 1975-1977, also Low 1980a; see Remarks 10), four in the Philippines, two in 1975 (then four, but by 1986 one) at Walsrode, two at Loro Parque, and two in 1975 (then one) in Naples Zoo. Arndt *et al*. (1986) and Strunden *et al*. (1986) provided similar lists, adding that at least two were in Switzerland and that others might be in Portugal, U.K., Japan, U.S.A. and Yugoslavia. Yugoslavia was discounted after investigations by Vestner (1987), while Thomsen and Munn (1988) added Singapore and France to the list of possible countries where birds were held, and Hoppe (1988) anticipated a fairly large number of clandestine holders, reporting a colleague being shown a photograph of two birds for sale from a dealer in Thailand. A bird was in the possession of Sir Crawford McCullogh of Lismore in Northern Ireland (U.K.) in 1969, as a recording of it, deposited and catalogued at the British Library of Wildlife Sounds, was made on 4 March that year (R. Ranft *in litt.* 1991). DeDios (*sic*) and Hill (1990) referred to a bird in a Los Angeles "pet home" around 1980 (A. de Dios *per* P. Scherer Neto *in litt*. 1992 has disclaimed responsibility for this information). A pair is reported to have gone to Sweden in recent years (J. Cuddy verbally 1992).

For the Tenerife initiative (see Measures Taken), Keller (1987) could only enumerate 14 (and possibly only 11) in Brazil: possibly three with an unnamed São Paulo holder (Pedro Callado, according to Roth 1988b); one, probably female, with an unnamed Rio de Janeiro holder; a pair with N. Kawall, São Paulo; one, Piauí; two with J. A. Camargo Cardoso, São Paulo (who obtained them from a dealer in Floriano, Keller [1992] claiming that these were taken as chicks from the wild in 1982); and five in São Paulo Zoo. This was duly repeated by Arndt (1987) and Roth (1988b), the former adding that seven of the 14 were illegal and therefore unlikely to become available for a breeding programme, while only 10 birds existed outside Brazil, the latter noting that Kawall now only had one bird and that Camargo Cardoso, having had four, now only possessed one or two; the lost birds were presumably the "at least three" noted by Roth (1987d) to have died in July–August 1987 (with the comment that "not all holders... give their birds optimal conditions and the birds still suffer an unnecessarily high mortality in captivity"). C. Keller (*in litt.* 1991) recorded that Callado's birds either died or were sold, that the Rio bird died, that the Piauí bird went to Europe, and that Camargo Cardoso's birds died. Sojer (1989) and Sojer and Wirth (1989) noted the loss of the Naples bird, and Roth (1989b) the loss of one at São Paulo Zoo (in 1988), all of Camargo Cardoso's by 1988, and one at Walsrode, and the apparent addition of two in the Philippines. Silva (1989a; and 1990a, 1991a) gave two rather differing accounts of these last – in one of which the pair and two young were acquired from Singapore (see Remarks 11), in the other the pair producing all their young in the Philippines – adding that their number in 1990 was seven; DeDios (*sic*) and Hill (1990) give the second version, as does Low (1990), and it is accepted as true by T. Silva (*per* P. Scherer Neto *in litt*. 1992).

At November 1990 the birds publicly acknowledged in captivity numbered 16, with others acknowledged early in 1991 (in Hämmerli 1991), as follows: *São Paulo Zoo* (Brazil) four (three males aged 13, four and four years respectively, one female aged 13 years, all chromosomically sexed); *N. Kawall* (São Paulo, Brazil) two (one female, chromosomically sexed, this bird being taken as an adult from the wild in 1982 [Keller 1992], one male – estimated to be about 20 years old [Patzwahl 1991] received the month before from *W. W. Brehm of Vogelpark Walsrode* in Germany: see Measures Taken: Permanent Committee); *M. G. F. dos Santos* (Recife, Brazil) one (a female, said by the holder in notes to the

Permanent Committee to have been taken from the wild as a six-month-old in July 1987, which matches a newspaper report by Cesar [1990], but in another version it was taken as a chick from a nest in riacho da Melância in February 1988: Keller 1992); *A. de Dios of Birds International* (Philippines) seven (three males, three females, one sex unknown, all derived from a pair acquired in November 1979: DeDios [*sic*] and Hill 1990); *W. Kiessling of Loro Parque* (Tenerife, Spain) two (male and female, endoscopically sexed: Silva 1990a, 1991a), these last not being old enough for breeding until 1989, when a single egg was laid (Low 1990; see Remarks 12). In addition, in early 1991 *J. Hämmerli* possessed a pair in Switzerland that he acquired in 1978 and from which he had successfully bred five offspring (Hämmerli 1991). There are also reports of a second pair with an undisclosed number of offspring, again in Switzerland; moreover, in early 1991 the Brazilian government was apparently in negotiations with an unnamed Brazilian aviculturist who had come forward under amnesty claiming to hold a pair and two captive-bred young (J. B. Thomsen *in litt.* 1991).

At November 1991 the birds publicly acknowledged in captivity numbered 25, as follows: *São Paulo Zoo* three (one male transferred to M. G. F. dos Santos); *N. Kawall* a pair, *M. G. F. dos Santos* a pair, *A. de Dios* a pair and eight offspring, of which one was male, five female and two unsexed, *W. Kiessling* a pair, *J. Hämmerli* a pair and four offspring (M. G. Kelsey *in litt*. 1991). In addition there was reportedly a 12-year-old bird in Germany whose owner wanted DM 30,000 for it, a pair also in Germany, a pair in Madrid, two in Argentina, two in Brazil, one in the U.S.A. and possibly one in Japan (T. Silva *per* M. G. Kelsey *in litt*. 1991). By June 1992 the Loro Parque pair had produced two offspring (T. Silva *in litt*. 1992 to M. G. Kelsey).

ECOLOGY Spix's Macaw is now believed, with ample justification, to be associated with gallery woodland in which mature specimens of caraiba, caraibeira or craibeira trees *Tabebuia caraiba* dominate, within the caatinga (i.e. dry scrub) zone of the Brazilian interior (Juniper 1990, Juniper and Yamashita 1990, 1991; see Threats). The importance of gallery woodland and the caraiba tree was first reported by Roth (1985), who was told how Spix's Macaw preferred the more humid areas of caatinga near small rivers ("riachos") where water was available and where the vegetation formed gallery forest. Roth (1986, also 1987c) later himself remarked that the most striking feature of the species's habitat was the high number of (mostly seasonal) creeks characterized by caraiba growth. The caraiba tree was reported to him as important for nesting and roosting, and direct observation in 1986 tended to confirm this, the birds habitually perching on the same branches, typically the most prominent and least leaved, and indeed they would use the same breeding holes (the first site used by the surviving pair in 1986 was one reputedly used continuously by the species for 50 years) and even the same flight-paths; such very traditional behaviour greatly facilitates the endeavours of trappers (Roth 1985, 1990). The one survivor at riacho Melância was flying around 20 km each day in late 1991, and was difficult to follow (M. A. Da-Ré *per* M. G. Kelsey *in litt*. 1991).

Juniper and Yamashita (1991) also determined that Spix's Macaws probably favour caraiba woodland because of nest-site availability, and they thought that this woodland was related to caatinga vegetation, since caraiba trees do not appear to form such formations elsewhere; the requisites for these formations included seasonally inundated watercourses above a certain size (8 m in width) and the presence of fine alluvial deposits. On the basis of discussions, aerial photographs and surveys, only some 30 km^2 of such woodland remain in Bahia, in three patches (Juniper and Yamashita 1990).

The general caatinga habitat of the region is characterized by the predominance of Euphorbiaceae (*Jatropha* and *Cnidoscolus*), along with caatingueira *Caesalpinia*, joazeiro *Zizyphus joazeiro* and several species of cactus, e.g. facheiro *Cereus squamosus* (on the highest tops of which Spix's Macaws were reported sometimes to roost), xique-xique *Pilocereus gounellei*, *Opuntia* spp. (Roth 1986, 1990). Spix's Macaw eats the seeds of favela or faveleira *Cnidoscolus phyllacanthus* and pinhão-brabo *Jatropha pohliana*, and the fruits of *Z. joazeiro* and pau-de-colher *Maytenus rigida* were reported eaten also, as well as (though this Roth doubted) those of the very local licuri palm *Syagrus coronata* (Roth 1985, 1986, 1988b, 1990; see Remarks 13). Food could not then be a limiting factor, as *Cnidoscolus* and *Jatropha* are among the commonest plants in the region and available even during very dry periods (Roth 1986). Mari-mari *Geoffroea spinosa*, a characteristic tree along the creeks, was said by one trapper to be a food source

(F. B. Pontual *in litt*. 1992). However, in 1991/1992 the lone survivor was seen to use only one food source, the fruits and/or seeds of braúna *Melanoxylon* sp. (various observers *per* and including F. B. Pontual *in litt*. 1992). An early record of the species favouring passion-fruit may well refer to a taste developed in captivity (see Remarks 3). Reiser (1926) recorded birds coming to drink at a lakeside, "evidently from a great distance", the birds showing considerable wariness although, when finally drinking, doing so deliberately and uninterruptedly. The lone survivor has also shown a clear lack of confidence when drinking (from small pools), moving slowly down from branch to branch, calling nervously, and quickly flying to a high perch as soon as finished (C. R. Moura and M. A. Da-Ré *per* F. B. Pontual *in litt*. 1992).

Stands of buriti palm *Mauritia flexuosa* do not occur in the habitat at Curaçá (Roth 1986, 1990), yet groves of this plant, which grow locally within the caatinga in swampy or seasonally wet areas, have been identified as the key habitat of the species (Meyer de Schauensee 1970, Sick and Teixeira 1979, Ridgely 1981a, Sick 1985). Roth's (1986, 1987c, 1990) clear perception of the importance of caraiba woodland did not lead him to question the veracity of these reports about buriti palm use, since (despite finding evidence from the Gerais unconvincing) he presumably felt the records in question were indisputable; hence searches for the species in such habitat continued (and occupied much time), and resulted in the speculation – possibly influenced by similar comments in Keller (1987) – that Spix's Macaw's structural proximity to Red-bellied Macaw *Ara manilata* might reflect an ecological proximity, since the latter has a close association with buriti palms (Roth 1988a). Indeed, a dependence on buriti palm was speculated to be a cause of Spix's Macaw's unpredictability and even nomadism within a region, since stands would ripen in different areas depending on local conditions; equally, however, the rarity of Spix's Macaw was regarded as puzzling, given the general abundance of such stands in the "Gerais" region (Roth 1988a; see Remarks 14).

The breeding period was reported to be November to March, though variable with rainfall; birds use traditional holes in caraiba trees (also, according to two trappers, holes in braúnas: F. B. Pontual *in litt*. 1992) for nesting (and are very traditional in their habits in general); the number of young is two or three, and because they have a relatively small crop they need to be fed more frequently than other macaws (Roth 1985; also 1987c, 1990). In captivity up to four eggs have been laid in a clutch, with two-day intervals between eggs; the incubation period is 26 days, the fledging period is two months, and the young are fed by their parents for some three months after fledging (Hämmerli 1991). Birds remain normally in pairs (the single bird in July 1990 had formed a bond with a Blue-winged Macaw *Ara maracana*: Juniper 1990, Juniper and Yamashita 1990), though in the past they would occur in flocks up to 15 (Roth 1985); their occurrence in flocks was noted by von Spix (1824; see Remarks 5). They sometimes disappear from an area for several days or even weeks (Roth 1985, 1990). The survivor at riacho Melância was again paired with a Blue-winged Macaw in December 1991 and was then seen investigating a nest-hole (M. G. Kelsey *in litt*. 1991).

If the identification of birds at buriti stands was correct, it is worth considering that caraiba woodland clearance may have resulted in the displacement of populations for which only the availability of nest-sites was a problem; they might thus have become chronically nomadic (being long-lived birds suffering no food shortages) through the inability to locate suitable breeding habitat, and chance observation could have been responsible for the misattribution of habitat preference in the species. It is conceivable (if highly improbable) that the reappearance of the species at riacho Melância in 1990 was a genuine reoccupation, and explicable through tree loss elsewhere (but locals claim that the lone bird was always at the site: F. B. Pontual *in litt*. 1992).

THREATS The rarity of this species has always been puzzling, and could not be attributed to its present most serious threat, trade. However, an explanation is immediately apparent in Juniper and Yamashita's (1990, 1991) new evaluation of its habitat, whose destruction has evidently been proceeding over centuries (see below).

Trade The single most immediate threat to Spix's Macaw in the past 20 years has been, as speculated by Ridgely (1981a), trapping for the cagebird trade (Roth 1985, 1990; Thomsen and Munn 1988). There was evidently a period in the late 1960s and early 1970s when captive-bred birds (evidently

Carvalhães's: see below) were available more than wild-caught ones (Sick 1969, King 1978-1979), but before this period wild nestlings were usually targeted (Sick 1969) and after it predominantly wild adults (Roth 1988b *contra* Sick 1985). Ridgely (1981a) thought the species's rarity in aviculture reflected the difficulty in procuring specimens, but in reality it seems to have reflected the species's genuine rarity in nature. Decoteau (1982) reported being offered a pair by an English dealer for US$20,000 in 1979, which indicates the costs likely to have been incurred by bird-fanciers who now hold or recently held specimens.

Despite this, Keller (1992) wrote of some 40 birds in the Curaçá population being reduced by trappers to four. In the years immediately preceding and including 1985, over 25 birds were reportedly taken from the Curaçá population, at first only young birds but later also adults caught on limed sticks (and without much care: on at least one occasion the parents were shot in the process of removing young from the nest) (Roth 1985). In 1984 12 birds (seven adults, five young) were reportedly removed, all but two young (which were hand-reared and sent to São Paulo) by a dealer in Piauí; two adults died soon after capture, some were sold in São Paulo for the equivalent of US$2,000 each (at a time when Hyacinth Macaws *Anodorhynchus hyacinthinus* were traded for $50), and others probably left Brazil through Paraguay (Roth 1985, 1986). Thomsen and Munn (1988) independently found sources to account for 23 birds being removed from the Curaçá population in the period 1977-1987, when trade in the species was controlled by two dealers: from 1977 to 1985, one ("Carlinhos" from Petrolina, Pernambuco) traded 15 birds, of which 13 were adults, the two nestlings being the first to be taken from the breeding area (in 1988 they were held near São Paulo); from 1984 to 1987, the other (Nascimento from Floriano, Piauí) moved eight birds, four of them nestlings taken in 1986 and 1987 from the same nest as the 1985 nestlings (the 1987 nestlings seized in Paraguay – see Measures Taken – being described as from the one remaining nest).

There is thus a conflict with Roth's evidence (see Population) that no breeding occurred in 1986 or 1987, although the discovery of a new site at riacho da Vargem supports Roth's (1988a) contention that another population must then have existed (there is a another less important conflict over the taking of adults and young, one study suggesting adults were the initial target and only later the young, the other *vice versa*). Keller (1987), presumably on the basis of solid inside information, reported no fewer than six young Spix's Macaws being for sale in 1987, all being exported from Brazil: two died during transport (a point noted also by Roth 1987d), two were then captured in Paraguay, and two "got away". More recently, Keller (1992) judged that as many as 25 young were taken in the period 1978-1988, and claimed that in 1982 alone no fewer than 21 birds (19 adults and two young) were caught with lime: of these, 13 adults died of food privation or poor treatment, one died on the way to São Paulo, one adult (female) went to N. Kawall, four could not be traced, and the two chicks went to J. A. Camargo Cardoso (see Remarks 15).

Inbreeding There is as yet no clear evidence that genetic relatedness might be causing problems, but it needs to be recognized that, apart from the fact that half of the known birds in the world are the offspring of the other half, the parents and current non-breeders are themselves very possibly closely related; it is even possible that one or more existing pairs are composed of siblings or of parent and offspring.

Private ownership Private ownership of Spix's Macaws has become a serious obstacle to the conservation of the species (a) because private demand is responsible for fuelling the exploitation of remaining populations, (b) because ownership is a matter of jealousy, prestige and possessiveness that is fundamentally different in psychological origin from the spirit of cooperation and selflessness needed to generate a scientifically based recovery programme (see, e.g., comments in Strunden *et al.* 1986, Brack 1987b, Forshaw 1989, Silva 1989a, Smith 1991a), and (c) because there are questions of legality that at least until very recently have remained intractable both inside and outside Brazil. As long ago as the late 1970s it was observed that "because most captive specimens are in private hands, there has been no comprehensive program to ensure that they are paired and housed under conditions conducive to breeding" (King 1978-1979). A broadsheet entitled "No chance for the Spix's Macaw?" put out by ZGAP, translating Arndt *et al.* (1986) and Strunden *et al.* (1986), concluded (English corrected) that "anybody who opposes an international coordinated breeding project can only be acting out of selfish reasons and would personally be responsible for the extinction of this species. The present owners should consider that

they have caused the present situation by the demand and by buying the birds". Evidence that the attitude of most private owners remained intransigent as late as 1988 is given under Measures Taken concerning the Tenerife and Curitiba initiatives.

Hunting Hunting for food was identified as a serious pressure on all edible wildlife in interior Brazil, and one that Spix's Macaw was reported to have experienced in the Curaçá region (Roth 1985, 1990).

African bees When a hybrid African strain of the bee *Apis mellifera* spread through the Curaçá region some years previously (when invading new areas they are supposedly at their most aggressive), they were reported to have attacked incubating Spix's Macaws (which are tight sitters), killing some of them (Roth 1985); this was later modified and recorded as a possible occurrence (Roth 1988b, 1990). Thomsen and Munn (1988) were also told by trappers that recent breeding success had been low owing to hole occupation by African bees. However, Juniper and Yamashita (1990) found that only two out of 40 potential nest-holes obviously held bees in July 1990.

Habitat destruction The assumption that habitat loss has not been a significant factor in the decline of Spix's Macaw has long prevailed (e.g. King 1978-1979, Ridgely 1981a, Sojer 1989, Sojer and Wirth 1989), and even Roth (1988a) wrote of a puzzling abundance of food and habitat for so rare a species, seemingly thus discounting the report he was given that Spix's Macaw had disappeared from Pernambuco and that caraiba trees had been cleared there (Roth 1986). It appears to have been Silva (1989a) who first expressed the causative link in these two events when he wrote "where craibeiras have been felled, as in the Pernambuco side of the São Francisco River, the species has disappeared"; yet Roth (1990) continued to ask why the bird could be so rare and what special circumstances determined its population size and distribution.

The rio São Francisco forms a major corridor down which settlers of interior Brazil have moved for over 300 years, and local farmers have indicated that caraiba woodland grows in places most favoured for the cultivation of subsistence crops such as maize; they are also the areas where pasture lasts longest into the dry season, and hence most human habitation has been along creeks, posing additional pressure through firewood-gathering (Juniper and Yamashita 1990, 1991). Moreover, very old specimens of caraiba now dominate the remaining woodlands, the result of chronic and excessive grazing pressure by domestic stock that has largely prevented regeneration (there is some – see Measures Proposed: Preservation in the wild): the gallery woodlands are themselves in real danger of disappearance (Juniper and Yamashita 1990, 1991). All this is evidence that habitat destruction over the centuries almost certainly explains the rarity of Spix's Macaw since it first became known to science, and it indicates that even now habitat degeneration remains a threat to the species (Juniper and Yamashita 1990, 1991).

MEASURES TAKEN Spix's Macaw is protected under Brazilian law (Bernardes *et al.* 1990) and is listed on Appendix I of CITES (King 1978-1979).

Preservation in the wild The initial (as well as the most recent) searches for the species in the wild, sponsored in both cases by ICBP and perhaps prompted by Ridgely's (1981a) call for a thorough study of the situation, were responsible for its precise location (Roth 1985, 1986, Juniper and Yamashita 1990, 1991). The first efforts to protect the wild birds, as recommended by Roth (1986), were taken by ZGAP, which provided funds to pay local people to act as guards at Curaçá, apparently from May 1986 to May 1987 (Roth 1987b,c, Sojer 1989, Sojer and Wirth 1989). Later survey work was also funded by IBDF and WWF (Roth 1988b, 1989b). Following the discovery of one bird at Curaçá in 1990, ICBP sought to make funds available for its temporary surveillance until appropriate government protection (through IBAMA, and overseen by M. A. Da-Ré) could be established (in July 1991: see below). Local enthusiasm for the species at Curaçá has led to the opening of an "Ararinha Azul" restaurant and the use of an effigy on a float during Independence Day celebrations, and this sense of community pride has been boosted by the local distribution of 5,000 posters and some tee-shirts (M. G. Kelsey *in litt.* 1991).

Searches for other populations This was naturally a major feature of the work undertaken by Roth (1985, 1986, 1988a, 1989b), and considerable progress was made in evaluating and eliminating areas. Still further progress – almost to the point where possible sites were exhausted (but see Measures Proposed) – resulted from survey work in 1990 (Juniper 1990). In 1991 M. A. Da-Ré and F. B. Pontual made further

searches in southern Pernambuco and northern Bahia, but without finding new populations or evidence of them (M. G. Kelsey *in litt*. 1992).

Control of trade The rescue and return (to São Paulo Zoo) of two wild nestlings, smuggled via Petrolina (Keller 1987) to Paraguay (see Remarks 16) in late March 1987 (not 1988 as in Sojer 1989, Sojer and Wirth 1989), and bound for West Germany where a buyer was prepared to pay $40,000 for them (details, with some background inaccuracies, in, e.g., Hardie 1987, Ress 1987, Graham 1988), was a particular credit to TRAFFIC (notably J. S. Villalba-Macías), CITES, IBDF and various conservation personnel from WWF-U.S. and WCI.

Captive breeding Calls for urgent action involving private owners have been made since the critical situation in the wild was first grasped: Arndt *et al.* (1986) proposed an action plan with (a) a species management plan developed by CBSG in collaboration with IBDF, (b) the support of all captive holders, and (c) the retention of any offspring to build the captive stock. On 5 May 1987 TRAFFIC (Sudamérica) issued a memorandum proposing the formal establishment of a recovery committee (J. B. Thomsen *in litt.* 1991). Brack (1987b) and at one stage Silva (1989a) proposed the confiscation of privately held captive birds, at least in Brazil, perhaps unaware of the insurmountable practical and legal difficulties in such a measure. Roth (1987c) called for the urgent cooperation among holders in Brazil to begin a captive breeding programme. Thomsen and Munn (1988) sought a recovery plan which would (a) establish an *in situ* breeding operation in Brazil, as legal and logistical obstacles there appeared less than outside the country, and (b) concentrate studies on the known wild birds rather than on searches elsewhere (but between the drafting and publication of this proposal the last birds then known were trapped). Details of captive management in the Philippines are in Low (1990) and in Switzerland in Hämmerli (1991).

The Tenerife initiative on captive breeding In 1987 an initiative involving ICBP, CBSG, ZGAP and Loro Parque to bring together the holders of captive birds and develop plans for a consortium resulted in a meeting in August at Loro Parque itself. Despite considerable efforts by many interested parties to identify and invite them, no holders of birds attended except the host, W. Kiessling, and the meeting "largely failed" (Silva 1989a); certainly Low's (1988) assertion that the holders outside Brazil agreed to cooperate in pairing and lending birds is wrong. The meeting was, however, a step forward (Arndt 1987; see also Low 1987, Kiessling and Low 1987), as the CBSG proposals and conditions for the practical needs of a captive breeding programme remain valid (see Measures Proposed, last section).

The Curitiba initiative on captive breeding On 16 September 1988 an agreement on the captive breeding of Spix's Macaw, preliminary in nature while the involvement of IBDF was still pending, was signed by A. Mafuz Saliba for São Paulo Zoo and J. S. Villalba-Macías for both the CITES Secretariat and TRAFFIC (documentation provided by J. B. Thomsen *in litt.* 1991). At the ICBP/IUCN Parrot Specialist Group meeting in Curitiba, Brazil, October 1988, this agreement was introduced to the Brazilian private holders (who did not receive it well), and it was forwarded to IBDF for endorsement and participation. Silva (1989a) wrote that "news of this event stimulated several aviculturists into sending their birds to other, more capable collections", which is no more true than Low's (1988) remarks about the outcome of the Tenerife meeting. On 19 December 1988 IBDF issued a formal endorsement of and declaration of participation in the agreement (documentation provided by J. B. Thomsen *in litt.* 1991). (IBDF was replaced by IBAMA by law 7735/89 on 22 February 1989.)

Permanent Committee for the Recovery of Spix's Macaw This committee only formed after a series of meetings with varying degrees of official endorsement, as follows.

On 24 August 1989 the first unofficial meeting of a "committee for the Spix's Macaw" was held in São Paulo Zoo, and on 22 September 1989 IBAMA established a Spix's Macaw Working Group to establish the sexes of birds in Brazil, develop a management plan for the species, investigate its wild status, propose the structure of a permanent committee for its recovery, and identify interested institutions and individuals for their involvement in this committee (N. Schischakin *in litt.* 1990). Four days later a second, but still unofficial, meeting of this group took place to discuss sexing of birds (documentation provided by J. B. Thomsen *in litt.* 1991). In October 1989 the CITES meeting in Lausanne was the forum for a discussion involving W. Kiessling, A. de Dios, TRAFFIC and CITES, evidently concerning the movement of birds between certain facilities (see Silva 1990a, 1991a). The first two official meetings of the Working Group took place at São Paulo Zoo on 23 and 30 October, and resulted in draft statutes of the

proposed Permanent Committee being prepared and forwarded to IBAMA (documentation provided by J. B. Thomsen *in litt.* 1991). The sexing of all birds in São Paulo was achieved in early 1990 by N. Schischakin of the Houston Zoo (*in litt.* 1990), and the Permanent Committee and its statutes were established under law (Portarias 330 and 331) on 13 March 1990 and formally published on 20 March (documentation provided by J. B. Thomsen *in litt.* 1991).

The inaugural meeting of the Permanent Committee was held at IBAMA's headquarters in Brasília on 12-13 July 1990, establishing C. S. Schenkel as its president and P. T. Z. Antas as studbook keeper, and binding itself to meet at least once a year and to develop an action plan involving literature surveys, the identification of areas to be investigated, a survey of birds in captivity and a management plan for them (minutes provided by J. S. Villalba-Macías *per* J. B. Thomsen *in litt.* 1991). The only published account of this meeting claimed that it "resulted in the Brazilians accepting all Spix's Macaws as legal – they had considered a great part of them as smuggled native fauna – and in a resolution calling for the governments of the countries where the birds are held to consider the birds as legal, provided their owners join the special committee and agree to work towards saving the species by 15 October of this year" (Silva 1990b); in fact, a formal announcement of this was still pending much later in the year (see Silva 1991b, and below).

An unofficial meeting of the committee took place in September 1990 when it was decided (1) to implant a microchip in and take a DNA record of each bird before the next meeting in March 1991 (Silva 1990b, 1991b), (2) to reject ICBP's proposal (to release a captive bird to form a mate for the last wild individual: see below) on the grounds of there being too few captive specimens and of too great a risk to wild birds from trappers (Silva 1991b), and (3) to build a massive aviary at the Curaçá site into which to induce the wild bird to fly and breed in semi-captivity with a suitable mate (Silva 1991b,c); at this meeting discussions also took place on how to involve currently secret and illegal holders of the species (Silva 1991b). Simultaneously, US$35,000 were raised by the Loro Parque Association for the Preservation of Parrots to support fieldwork on the species, to help construct a giant aviary within its range, and to guard the remaining bird and any mate provided for it (Silva 1990b, 1991c). At this meeting the expectations of the committee were that a male held in São Paulo Zoo would be exchanged with a female in the Philippines (Silva 1990b, 1991b). Soon afterwards, in October 1990, the male at Walsrode was loaned to N. Kawall to pair with the latter's female (Silva 1990b, *Papagaien* 6 [1990]: 169, Patzwahl 1991).

Only on 25 October 1990 did the Brazilian government issue a decree (Portaria 2161) not to confiscate or seek to confiscate specimens of Spix's Macaw if the holders agreed to participate in the Permanent Committee's work to manage the remaining captive population (documentation provided by J. B. Thomsen *in litt.* 1991), and only on 5 February 1991 was this resolution notified to parties by the CITES Secretariat (the whole exercise being an attempt to enlist the cooperation of those holders with sufficient conscience and public-mindedness who otherwise would be driven to conceal their illegal possessions for fear of prosecution under international law) (documentation provided by J. B. Thomsen *in litt.* 1991).

The second meeting of the Permanent Committee took place on 20 April 1991 at São Paulo Zoo, at which one of the holders (M. G. F. dos Santos) donated US$2,000 and CI donated US$8,000 towards the conservation of the species, allowing, among other things, for the appointment of a biologist to guard the single wild bird, and in July 1991 M. A. Da-Ré took up this position (M. G. Kelsey *in litt.* 1991).

The third meeting of the Permanent Committee took place on 28-29 November 1991 in Recife, at which, among many other matters, (1) a population viability analysis conducted by CBSG was commissioned, (2) the exchange of a Swiss-held female with a Philippines-held female, to form two new pairs, was made conditional upon the acceptance by the Swiss authorities of the legality of the stock held by J. Hämmerli, and (3) a working group was established to consider reintroducing birds to the wild, following the offer by A. de Dios of an individual to join the wild bird (M. G. Kelsey *in litt.* 1991).

MEASURES PROPOSED In the following account the "Measures to avert imminent extinction of Spix's Macaw" outlined by ICBP in September 1990 are treated in the first section, although point four refers to captive breeding.

Preservation in the wild Following the discovery of one wild bird at riacho Melância in July 1990, ICBP made the following recommendations (adumbrated in Juniper 1990 and Juniper and Yamashita 1990; also *CBSG News* 2,1 [1991]: 17). (1) An immediate priority must be to continue to safeguard the one remaining bird in the wild, a vital step because (a) it is likely to be much easier to introduce captive-bred birds to the area if a wild one is present (so much traditional knowledge held by that bird could be lost by its capture for any breeding programme), and (b) the conservation of the gallery woodland, very necessary if birds are to be set free there in the future, is much more defensible if a wild bird remains present. (2) A mate for this bird (thought to be male) should be found from among the captive stock for release at the earliest stage, so that wild breeding can commence as soon as possible, and so that other birds can begin to learn from the wild bird, whose experience of the local environment (food resources, roost-sites, predators, etc.) may be absolutely critical to the re-establishment of a wild population. (3) The gallery woodland habitat needs fencing in sections for 5-10 year periods, to allow regeneration beyond the reach of grazing and browsing stock. (4) A breeding facility needs to be established in the immediate area, fully equipped and professionally run, the benefits of which would include (a) a neutral site encouraging cooperation, (b) the optimal climate for the species and the proper setting for the eventual release of birds, (c) a facility from which to monitor and manage wild and captive birds as a single entity, and (d) the generation of local interest and goodwill, which is of ultimate importance to all these efforts.

A project has now been developed by the Permanent Committee to investigate the distribution and conservation of caraiba woodland in Bahia (M. G. Kelsey verbally 1991); further research by the Royal Botanic Gardens in Kew in 1991 indicated that this formation is indeed of enormous botanical interest and that caraiba trees grow extremely slowly, the majority being some 200-300 years old and with little regeneration in at least the past 50 years (C. Stirton *per* M. G. Kelsey verbally 1991). However, at least one farmer already fences off areas (to provide forage when the annual supply reaches its lowest point), and experiments are now being conducted by M. A. Da-Ré to decide management regimes for further regeneration (M. G. Kelsey *in litt*. 1992).

Search for other populations Any further search for other wild birds must not compromise efforts to conserve the single known specimen by implying that such work may prove superfluous. However, now that a specific habitat type has been identified, it is important to visit every other area where such habitat is or may be found, including (a) a more extensive survey of the riacho da Vargem; (b) a detailed survey of the north side of the rio São Francisco between Abaré and Petrolina in case some stands of caraiba trees survive, despite reports; and (c) a survey westwards from Petrolina and Juazeiro as far as Remanso, which Roth (1986) regarded as the westernmost extension of the same caatinga habitat as that at Curaçá, and which might hold some creeks with caraiba gallery woodland. In addition to this, Roth (1986) argued for surveys of more humid valleys with gallery forests in the Gerais (Roth 1987d saw caraiba-lined creeks in the Parnaíba and Parnaibinha headwaters in southern Maranhão; and Roth 1988a also wanted Xique-xique, Bahia, investigated), and, as they seem not to have been done in his subsequent fieldwork, there is a case for undertaking them now. There is also, obviously, a case for mounting a concerted search for mature gallery woodland anywhere else within the 300,000 km^2 area from which reports of the species have emerged, but this should be done in consultation with naturalists and scientists who already know the areas as well as with maximum use of modern aids such as aerial photographs (or indeed aerial surveys). Roth (1988b) also advocated using dealers, by whatever means available, to help identify new sources of birds; but this has obvious drawbacks.

The search for other birds in captivity, to maximize the number of specimens available to help the important captive breeding initiative now under way, must proceed, and avicultural societies should do all they can to urge covert holders of the species to surrender them to their national authorities, if necessary through third parties.

Control of trade Roth (1988b) identified the dealers and trappers specializing in Spix's Macaw and called for their activities to be stopped, which would require full-time work by a Brazilian. IBAMA clearly has an opportunity to bring charges against dealers known to have acted illegally.

Captive breeding Although plans for captive propagation are now the responsibility of IBAMA's Permanent Committee for the Recovery of Spix's Macaw, the provisions of the CBSG's proposed

Memorandum of Agreement, drawn up after the Tenerife initiative, are summarized in the following paragraph for information.

The current known captive birds constitute the founder stock for the propagation programme, and are to be registered with any offspring in a studbook, never offered for sale, and managed to a plan developed and directed by a Consortium for Propagation, this plan seeking to achieve optimal age matches and genetic lineages. The consortium, consisting of holders, plus representatives of the Brazilian government, CBSG and ICBP, shall meet once a year at its own expense to review events and discuss recommendations, including the commissioning of scientific or husbandry studies to secure the species's captive breeding. Action shall be taken by consensus if possible, otherwise according to majority vote, and all actions taken to manipulate the husbandry of the species shall be part of a systematic plan, to be properly documented in reports to the consortium. Offspring from the managed captive population, when it is secure, shall be donated to a release programme in due course.

Amongst other recommendations made in pursuit of successful breeding are (a) medical examination and quarantine for any birds being paired for the first time, (b) genetic fingerprinting of all birds to help determine their relatedness and confirm their identification, (c) sexing of all birds by laparoscopy or chromosome analysis, (d) protocols on housing and dietary quality and on veterinary management, and (e) preservation of skins, bodies and tissues of all birds that die (N. Schischakin *in litt.* and verbally 1990).

Comments on the captive breeding of this species, by Smith (1991a), are as follows: "The truth is that captive-breeding attempts so far have been appalling. The few reared do not make up for the numbers of adults that have died, and continue to die". If the most recent results tend to offset these remarks, made by a former holder of the species, their value remains in reminding all parties that time is as critical a factor as any other in the conservation of Spix's Macaw; and in this regard it certainly appears that the minimum of one meeting per year for the Permanent Committee is too few for the optimal management of its complex affairs (NJC).

REMARKS (1) Spix's (or Little Blue) Macaw, an exceptionally beautiful species, much smaller than members of the genus *Anodorhynchus* with which it is associated because of its colour, occupies its own genus and, according to Sick (1981), is "not a real macaw". Low (1984) thought no-one would consider it a parakeet ("conure"), evidently unaware that this is precisely what Dutton (1900) had done.

(2) The uniform doubt accorded in this account to all sight-records except those from Curaçá seems preferable to an exercise that gives more weight to some sightings than others, but, as suggested in the last paragraph under Ecology, the possibility exists that some records could have been genuine, referring to displaced birds. An example of a patently erroneous sight record (readily repeated by Goeldi 1894) is from the río Ucayali in Peru (von Berlepsch 1889).

(3) It is of interest to note that the species appears to have been seen and described ("grösser als ein *Psittacus*, das ganze Gefieder ist graublau") by G. Marcgrave when he worked in Pernambuco in 1638 (Herrmann 1989), although (as with the more certain Golden Parakeet *Guaruba guarouba*: see relevant account) the individual(s) in question may have been in captivity (particularly as Marcgrave remarked its preference for passion-fruit).

(4) Barra Grande and the riacho Melância are adjacent and, seemingly, contiguous, so although treated separately by Juniper and Yamashita (1990), they are here regarded as one area (as evidently they were by Roth 1985, 1986, 1987b).

(5) Von Spix (1824) actually wrote: "habitat gregarius, rarissimus licet, propre Joazeiro in campis ripariis fluminis St. Francisci, voce tenui insignis" ("it lives in flocks, although very rare, near Joazeiro in the region bordering the rio São Francisco, [and is] notable for its thin voice"); the point about its voice is confirmed by Smith (1975-1978).

(6) Juniper and Yamashita (1991; also Juniper 1991) drew attention to a sighting by E. Kaempfer of the species in 1927 "at a railway station at Joazeiro in Bahia" (Naumburg 1928, 1935), which they took, with some reason, to indicate a specific field record. However, copies of Kaempfer's correspondence (held in AMNH and forwarded by M. LeCroy *in litt.* 1990) reveal that the record was of one "alive on the railway station", i.e. in a cage presumably awaiting transportation. That the species was either so coveted

that disinformation about it existed as long ago as the 1920s (which seems improbable) or that it was genuinely rare and little known at that time, at least in the vicinity of Joazeiro, is indicated by the facts that before he made his discovery on the station Kaempfer wrote from the town (twice) that "nobody knew anything about such a parrot", and that when finally found he was informed that it came from the central Bahian mountains (see Naumburg 1928). It is worth noting that Reiser (1926) also met with professed ignorance of the species when he asked after it in Joazeiro in 1903.

(7) Keller's (1992) version is that, after the bird was shot, two others "fled" towards Barro Vermelho (in the Serra da Borracha), and the fourth and last remained under the protection of the same proprietor who had shot its companion.

(8) As a sidelight on how little was known of Spix's Macaw in the last century, Forbes (1881) noted that he found a stuffed specimen in a Recife museum labelled from Angola.

(9) It would appear that the importations occurred in and after 1926, since in that year Tavistock (1926) had baldly reported it "very rarely imported".

(10) Smith (1975-1978) readily conceded that "as my chances of obtaining another are nil I shall try to hybridise it with another species of small macaw".

(11) The magazine *Singapore Aviculture* 3(2), June 1983: 13-16, carried photographs of "Mr. & Mrs. Spix's... and family" which appear to represent an adult pair and two young, although all four are not shown together and it is conceivable that the adults shown are just the two young at a later stage of development. It is these four birds that Silva (1989a) indicated went to the Philippines, by implication in 1983. If it is the case that only a pair went to the Philippines, and in 1979, the question obviously arises of the fate of the birds illustrated in the magazine.

(12) Low's (1990) assertion that the Loro Parque birds were too young to breed until 1989 must be set against their registration (incidentally, as two males) in the *International Zoo Yearbook* 26 (1986) (see Silva 1990a), which indicates that the birds must have been in Loro Parque in 1985 or earlier. Indeed, it is not without exasperation that one reads in an article, clearly based on an interview with the holder himself, that "Wolfgang Kiessling managed to obtain a doddering pair in 1984" (Stern and Stern 1990: 70). Keller (1992) considered them probably the survivors of three birds (one died) he once saw in private hands in São Paulo and which were sold and taken to Tenerife some years ago.

(13) C. Yamashita (*in litt*. 1990) pointed out that faveleiro and pinhão are both colonizers, and that only *Maytenia* would seem to have been in the original vegetation of the region. Licuri palms are the staple of Lear's Macaw *Anodorhynchus leari*, and therefore would seem unlikely to be utilized by the much weaker-billed Spix's.

(14) What is surprising is that Roth's early recognition of the importance of caraiba woodland at Curaçá – he even indirectly equated the loss of Spix's Macaw in Pernambuco with the clearance of these trees – did not promptly lead to a survey of the region for similar habitat, since such action by Juniper and Yamashita (1990) resulted in the immediate discovery of an entirely new site which, from local reports, held birds up to 1989; Roth (1985, 1986) had also had the testimony of certain trappers, confirmed in 1987 by Thomsen and Munn (1988), that the source of all captive birds was the one small area around Curaçá.

(15) Keller (1992) apparently obtained this information in an interview with Carlinhos on 8 November 1991, when F. B. Pontual (*in litt.* 1992) was also present, this latter indicating that on subsequent days (when Keller was no longer present) other versions and figures were offered, so that no confidence can be placed in any one account of the trapping-out of the last population.

(16) The dealers in Asunción who were caught in possession of young birds in 1987 were E. Koopmann and his daughter G. Cáceres (J. B. Thomsen verbally 1991).