

PHILIPPINE EAGLE

Pithecophaga jefferyi

Critical ■ C1

Endangered A1c,d; A2c,d; D1

Vulnerable —



This flagship species qualifies as Critical because it has an extremely small, rapidly declining population, estimated to number perhaps fewer than 250 mature individuals. Since the 1960s, there have been strong and repeated predictions of its impending extinction.

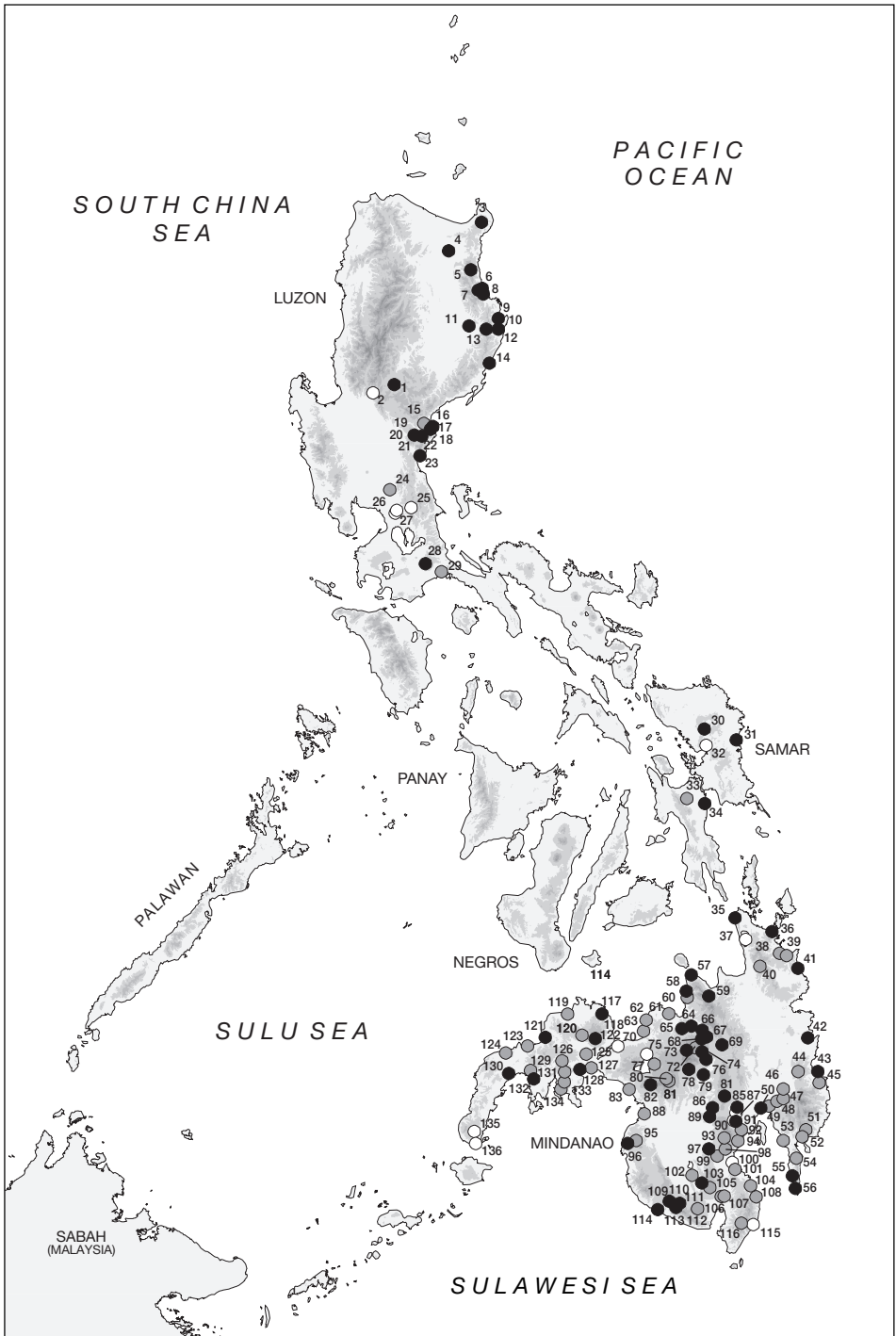
DISTRIBUTION The Philippine Eagle (see Remarks 1) is endemic to the Philippines, occurring on four islands, namely Luzon (Sierra Madre), Samar, Leyte and Mindanao, with an anomalous and probably mistaken record from Cebu, a report from Polillo and another from Negros, and an observation of birds high over a small island off northern Mindanao. It was at one stage reported—albeit without foundation—as occurring throughout the Philippine archipelago (Hachisuka 1932a), whereas by the 1960s it was assumed to remain only on Luzon and Mindanao (Grossman and Hamlet 1964, Talbot and Talbot 1964, Rabor 1965, 1968, 1971, Brown and Amadon 1968), or even just Mindanao (Anon. 1964, Gonzales 1968, Gonzales and Alcalá 1969, Sitwell 1975; see Remarks 2). The island of Biliran was prospected for the eagle in late 1980, with negative results, although further fieldwork was then deemed necessary (Kennedy 1981a, 1985); but this has not been carried out. A view that the Philippine Eagle has always been confined to eastern Luzon, Samar, Leyte and Mindanao is based on the greater and more extended annual rainfall in these areas, whereas western Luzon and the archipelago west of Samar and Leyte are subject to marked dry periods which coincide with the normal eagle breeding period, and are therefore supposedly unsuitable (Alviola 1997).

■ **PHILIPPINES Luzon** It appears to have been accepted for many years that the eagle does not occur in the Cordillera Central of Luzon, yet there is the testimony from Kalinga-Apayao, Mountain Province and Benguet (below) plus the report by Rabor (1971) that old natives told him “of large eagles, most likely of this species, which they used to see in soaring flights and actually met with inside the forests of the area, about twenty years or even earlier, prior to 1959, when they were still young men going out on hunting trips, deep into the interior of the Cordillera Mountain Range” (see Remarks 3). Rabor (1971) also commented that “the species was no longer reported as occurring in the mountain localities of Albay, Camarines Sur and Sorsogon... I am afraid [it] has already disappeared in southern Luzon”, yet it appears that there is only the one rather vague Albay record (see below) that ever indicated any presence of the species in the region (this one record does, however, predicate a population formerly spread throughout the southern peninsula). A record from Mt Makiling (Laguna), September 1920, rightly regarded with suspicion by McGregor (1921b) (who, however, admitted that the Agus River record showed that the species might be expected near Mt Makiling), was repeated uncritically by Davidson (1934) but is not accepted here. Sightings, captures and/or rescues have been reported in the following localities (province names in brackets beforehand): ■ **Kalinga-Apayao** one reported killed at an undisclosed site, 1970–1978 (Kennedy 1978); ■ **Benguet** by local reports of eagles taking pigs, 1894 (Whitehead 1899a), and with a probable but unconfirmed sighting at Irisan on an unstated date (presumably, since it was by R. C. McGregor himself, in the period April–June 1903 when he worked the area: see McGregor 1904a), the observer recording “I feel reasonably certain that I fired at a bird of this species at Irisan” (McGregor 1904b, 1918); ■ **Cagayan Mt Santa Ana**, one found dead by

DENR personnel in the 1980s (Danielsen *et al.* 1992); one reported seen at an undisclosed site, 1970–1978 (Kennedy 1978); **Baggao**, April 1989 (R. Crombie *in litt.* 1998); **Mt Cetaceo** at 1,500 m, May 1992 (Danielsen *et al.* 1994, Poulsen 1995), and at Bayan, two birds in October 1997 (P. L. Alviola verbally 1997); ■ **Isabela** reported by local people as present though becoming rarer, 1960 (Rabor 1971); one seen and three reported at undisclosed sites, 1970–1978 (Kennedy 1978), and a specimen obtained from an unknown locality in 1984 (Danielsen *et al.* 1992); **Dinapigue** (or Dinapiqui), where one was shot in 1964 (Talbot and Talbot 1964), two were found dead (preserved by DENR personnel) in the late 1970s (Danielsen *et al.* 1992), one was seen in 1983 (Danielsen *et al.* 1992), and one hatchling was caught, specifically at Dibulo, 1989 (Danielsen *et al.* 1992), with apparent presence in 1995 (PEWG 1996); **Blos**, where seen in 1994 (Eduarte 1994); **Dikayatan river**, where seen in 1994 (Eduarte 1994); **Maconacon**, one seen in April 1983 (Danielsen *et al.* 1992) and other sightings made in 1994 and 1995 (Eduarte 1994, PEWG 1996); **Diabut**, where one was caught by Aetas in 1991 (Danielsen *et al.* 1992); **Didian** (vaguely marked on map in PEWG 1996:12), Palanan, 1995 (PEWG 1996); **Mt Dikabayo**, Palanan, where seen by a NASI pilot in 1993 (Eduarte 1994, M. M. Eduarte verbally 1998); **Mt Dipalayag** at 1,050 m, April 1991 (Danielsen *et al.* 1992, 1994), and south of which towards San Mariano three nest-sites were reported by local people, one on a cliff near Mount Libertad (F. Danielsen *in litt.* 1997); **San Mariano**, where two were observed in 1987 and a nest reliably reported in 1988 (Danielsen *et al.* 1992, 1994); ■ **Quirino** one reported seen and three reported killed at undisclosed sites, 1970–1978 (Kennedy 1978), this being a virtually unexplored and apparently unexploited part of the Sierra Madre and well worthy of intensive research; ■ **Nueva Vizcaya** reported by local people as present though becoming rarer, 1960 (Rabor 1971); **Dupax**, where three were caught in 1989, dying in 1990 (Danielsen *et al.* 1992); **Mt Ballong**, 1,200 m, 6 km west and a little south of Imugan, January 1917 (McGregor 1918, Davidson 1934); one reported killed at an undisclosed site, 1970–1978 (Kennedy 1978); ■ **Aurora** (see also under Quezon for undisclosed localities) **Maria Aurora**, specifically at Bedit Creek, Nangunatan, Dila, 450 m, where evidence of nesting (a nestling female from a recently cut nest-tree) was obtained in June 1978 (Kennedy 1978; specimen in LSMZ); **San Luis** near the Diteki river, where one was observed preying on a monkey in April 1991 (Danielsen *et al.* 1992), and presence reported in 1995 (PEWG 1996); **Diteki** at the

The distribution of Philippine Eagle *Pithecophaga jefferyi* (map opposite; sequence not as in text): (1) Dupax; (2) Mt Ballong; (3) Mt Santa Ana; (4) Baggao; (5) Mt Cetaceo; (6) Dikayatan river; (7) Blos; (8) Maconacon; (9) Diabut; (10) Mt Dikabayo; (11) San Mariano; (12) Didian; (13) Mt Dipalayag; (14) Dinapigue; (15) Maria Aurora; (16) Baler; (17) Dimanayat; (18) San Luis; (19) Lamig river; (20) Maria Aurora Memorial National Park; (21) Mt Bilao; (22) Diteki; (23) Dingalan; (24) Angat; (25) Agus River; (26) Montalban; (27) San Mateo; (28) Mt Banahaw; (29) Pagbilao; (30) San Jose de Buan; (31) Taft; (32) Bonga; (33) Jaro; (34) Binahaan river; (35) Tigbao; (36) Cagdiano; (37) Lake Mainit; (38) Madrid; (39) Lanuza; (40) Mt Hilong-hilong; (41) Tandag; (42) Bislig; (43) Cateel; (44) Mt Agtuanganon; (45) Compostela-Cateel-Baganga; (46) Nabunturan; (47) Mainit Hot Spring National Park; (48) Maco; (49) Tagum; (50) Carmen; (51) Mt Mayo; (52) Tarragona-Lupon-Manay; (53) Lupon-Banaybanay; (54) Marbel; (55) Gov, Generoso-San Isidro; (56) Mt Malumat; (57) Mt Duyog; (58) Balinguan; (59) Lagonglong; (60) Mt Balatukan; (61) San Juan; (62) Opol; (63) Na-awan; (64) Manticao; (65) Manolo Fortich; (66) Libona; (67) Impasugong; (68) Dalwangan; (69) Kinubalan; (70) Cabanglasan; (71) Kolambugan; (72) Dulang-dulang Peak; (73) Mt Kitanglad; (74) Sangaya; (75) Lantapan; (76) Camp Keithley; (77) Valencia; (78) Lumba-Bayabao; (79) Pangantocan; (80) La Roxas; (81) Mt Ragaang; (82) Mt Piapayungan; (83) Butig Mountains; (84) Malabang; (85) Mt Sinaka; (86) Salaysay; (87) Kiandang; (88) Davao; (89) Cotabato City; (90) Amabel; (91) Calinan; (92) Baguio; (93) Guianga; (94) Mt Apo; (95) Tudaya Falls; (96) Upi; (97) Liguasan Marsh; (98) Mt Libadan; (99) Santa Cruz-Toril districts; (100) Magsaysay; (101) Padada; (102) Malalag; (103) Upper Linan; (104) Malita; (105) Mt Matutum; (106) Malungun; (107) Tacalman; (108) Talagutong; (109) Laconon; (110) Mt Three Kings; (111) Lake Sebu; (112) Mt Parker; (113) Mt Busa; (114) Luhan; (115) Mt Tuduk; (116) Caburan; (117) Dullao; (118) Supit; (119) Katipunan; (120) Mt Dapiak; (121) Sindangan; (122) Mt Malindang National Park; (123) Salug; (124) Labason Mountains; (125) Molave; (126) Mt Sugarloaf; (127) Tukuran; (128) Pagadian; (129) Mt Kabasalan; (130) Ipil; (131) Mt Timolan; (132) Siay; (133) Mt Imbing; (134) Labuyan; (135) Zamboanga; (136) Tumaga river.

○ Historical (pre-1950) ● Fairly recent (1950–1979) ● Recent (1980–present)



Upland Programme, 15 Area, May 1991 (Danielsen *et al.* 1992); **Mt Bilao** (also “Mt Mabilao-bilao”), 1995 (PEWG 1996) including at Tawang, just above the Diteki river headwaters, September 1997 (P. L. Alviola verbally 1997); **Dimanayat**, near San Luis, one seen in 1991 (Danielsen *et al.* 1992); **Baler**, where one was shot in the mid-1970s (Danielsen *et al.* 1992), and also recorded 1995 (PEWG 1996); **Maria Aurora Memorial National Park**, where one was shot in 1964 (Talbot and Talbot 1964), with one observed “flying on thermals below the cloud layer” near the PLDT microwave station in what is now the national park, June 1996 (D. W. Billing *in litt.* 1997); **Lamig river**, where one was caught in 1988 (Danielsen *et al.* 1992); **Dingalan**, 1994 (Eduarte 1994), also 1995 (PEWG 1996); ■ **Nueva Ecija** one reported seen and one captured at undisclosed sites, 1970–1978 (Kennedy 1978); ■ **Bulacan** “the **Angat** localities”, one captured, 1964–1965 (Rabor 1971); ■ **Rizal Agus river**, May 1907 (McGregor 1907b, Davidson 1934; see Remarks 4); **Montalban** at the subsequently designated Bozo-bozo water reservation, early 1907 (Hachisuka 1931-1935); **San Mateo**, where two birds were seen in a canyon about 8 km distant (Seth-Smith 1910a; see Remarks 5); ■ **Quezon Pagbilao** (then part of Tayabas province), June or July 1926 (McGregor 1927); reported by local people as present though becoming rarer, 1960 (Rabor 1971); in the survey that included Aurora subprovince, nine reported sightings, seven reported killed and three captured, all but one (Maria Aurora, above) at undisclosed sites, 1970–1978 (Kennedy 1978); **Mt Banahaw** at Sariaya, one caught alive in 1989 (Danielsen *et al.* 1992); ■ **Albay** unspecified locality (“It is said that the bird came from Albay Province”), undated but probably before 1904, since the specimen involved, a male, was received as an exchange and was reported to have been “taken alive and kept for some time in a cage”, which its condition certainly suggested (McGregor 1904b, Davidson 1934; see Remarks 6).

Polillo Local reports indicate that the species is present in an area where a particular monitor is fairly common (R. Crombie *in litt.* 1998).

Negros On a visit to Negros in 1945–1946 J. Hamlet was shown a photograph of an eagle allegedly captured on the island; Kennedy (1977), in reporting this, took it as evidence that the species may have been more widely spread in the Philippines than otherwise recognised or judged (but see *Ecology Migration*).

Cebu A captive female that died in Philadelphia Zoo in 1975 is tagged as having been caught as an adult in 1955 on Cebu (ANSP label data), although elsewhere it was said to have been captured on Mindanao (Wylie 1974; see *Ecology Migration*).

Samar Records are from: **San Jose de Buan** on Mt Huraw, where a dead bird was seen in December 1995 (Torno 1994); **Taft**, San Rafael, in the 1990s (Makabenta 1994, PEWG 1996, A. S. Manamtam verbally 1998); **Bonga** (type locality), June 1896 (Ogilvie Grant 1897; see Remarks 7).

Leyte No Leyte specimens are known to exist, and the sole published testimony for the occurrence of the species on the island down to 1973 appears to rest with J. Whitehead, who never saw it but frequently heard its calls when based in the mountains evidently in the north of the island at **Jaro** (Ogilvie Grant 1897; see Remarks 7); even so, Whitehead’s (1899a) own account was slightly less emphatic, declaring that he believed it to inhabit the forests of the island. Biological exploration of Leyte was conducted in 1937 and May–July 1964 (see Remarks 8), resulting in no contact with the species or with any indigenous people who knew it, and it was thus regarded as having become extinct there in the early 1930s (Rabor 1965, 1971; hence also Alvarez 1970 and, presumably, duPont 1971). However, Parkes (1973) judged that exploration of the interior forests had probably been insufficient to establish the extinction of the species with certainty, and even as this view was in press the bird was confirmed as still present there (Lovejoy 1973), with records (at unspecified localities in the province of Southern Leyte) from 1951, 1963, 1965 (two birds killed), 1968, 1969 (nest with young observed) and November 1970 (Kennedy 1977). A six-week survey (for methods, see Remarks 9) produced one record, on the **Binahaan river**, November 1980 (Kennedy 1981a, 1985). Kennedy (1985) marked a second site on the island (“site 2”) as presumably one from which a reliable report

was received, and as read from his map this appears to be Mt Nacolod. A survey in September 1982, in five areas in north and central Leyte, “to supplement the surveys completed there in 1980”, made no contact with the species and it was judged that “the structure of the large tracts of remaining virgin forest is not suitable for eagles” (Kennedy and Alvarez 1984); what this means is not clear, but it seems to apply only to the areas surveyed in 1982, not to the entire island, and in any case it needs to be treated with caution—R. Crombie (*in litt.* 1998) reported that his record from Baggao, Luzon, took place after an eagle expert had pronounced forest in the area unsuitable for the species. Curio (1994) did not encounter the species on Mt Pangasugan, 13 km north-north-east of Baybay, in 1993, but remarked that “since the entire mountain massif is still well forested all the forest species recorded for Leyte should still exist”, so his negative results do not exclude the site from further study.

Mindanao From the 1960s through to the 1990s—i.e. for the duration of the period of scientific research on the species—this island was commonly believed to be the only hope for the survival of the Philippine Eagle. So much activity was focused on Mindanao that it often appears as if the eagle had no range or potential for conservation elsewhere. Nevertheless, a complete record of survey and study on the island is difficult to assemble, reflecting in part the differences in effort and emphasis according to the perceptions of successive field teams and also to the political conditions over the years. All the same, in 1972–1973 the distribution across the island was regarded as rather even (Kennedy 1977). Records of the species (some of which will clearly be of historical interest only, while others may yet prove to reveal neglected and potentially still important areas for investigation and protection) are as follows: ■ *Surigao del Norte* **Tigbao**, seen around 1988 (Tubongbanua and Ramayrat 1988); **Cagdiano** (Kagdayanao), seen around 1988 (Tubongbanua and Ramayrat 1988); **Lake Mainit** in November 1921 (Davidson 1934); over an unspecified island in the Surigao Straits, apparently in the 1940s (Kennedy 1977; see *Ecology Migration*); ■ *Surigao del Sur* around **Madrid, Lanuza** and **Tandag** on the eastern side of Mt Diwata range, at unspecified times (Rabor 1971), and at Tandag (Aras-asan timber concession), before 1910 (see Remarks 10) and November 1987 (PECP *Fourth Quarter Report 1987*); the PICOP concession, **Bislig**, November 1977, where it was later found nesting (Kennedy 1981b,c; see Remarks 2) and was still nesting on road 6P in 1984 (Krupa 1985); ■ *Agusan del Norte* **Mt Hilong-hilong** behind Cabadbaran at 1,200 m, March and April 1963 (Rabor 1965, 1968, 1971, Gonzales 1968), a specimen having been shot there as a trophy in 1962 (Rabor 1971); ■ *Davao Oriental* **Cateel**, stuffed specimen and good habitat found in 1991 (PECPFI *Second Quarter Report 1991*); **Mt Mayo** at Mati (i.e. presumably the southern slopes), May and June 1965 (Rabor 1965, 1968, 1971); **Lupon-Banaybanay** municipalities, 1974–1975 (Bonnit *et al.* 1977); **Tarragona-Lupon-Manay** municipalities, 1974–1975 (Bonnit *et al.* 1977); **Gov. Generoso-San Isidro** municipalities, 1974–1975 (Bonnit *et al.* 1977); Gov. Generoso (Sigaboy) municipality, 1974–1975 (Bonnit *et al.* 1977), in particular on **Mt Malumat** (guessed at 6°31'N 126°08'E) at Barrio Upper Luzon (presumably upslope from the commonly mapped Luzon), December 1983 (Krupa *et al.* 1984), and on **Mt Duyog** (guessed at 6°22'N 126°10'E) at Barrio Surop (presumably the commonly mapped Surup), December 1992 (Krupa *et al.* 1984; see Remarks 11); ■ *Davao del Norte* **Mt Agtuaganon** (“Mt Ayuuganoon”), Monkayo, present through the 1960s (three shot in 1967), also reported around 1970, and with records from 1974–1975 in this (“Munkayo”) municipality (Bonnit *et al.* 1977; also Gonzales 1971), and an active nest from which a young bird was removed 17 km south-east of Monkayo at 650 m, April 1982 (specimen in PNM; see Remarks 12); **Nabunturan** municipality, 1974–1975 (Bonnit *et al.* 1977); **Compostela-Cateel-Baganga** municipalities (apparently focused on Mt Bagumbun), overlapping the border with Davao Oriental, 1974–1975 (Bonnit *et al.* 1977); **Tagum** municipality, 1974–1975 (Bonnit *et al.* 1977); **Mainit Hot Spring National Park**, Nabunturan municipality, 1974–1975 (Bonnit *et al.* 1977); **Maco** municipality, 1974–1975 (Bonnit *et al.* 1977; see Remarks 13); ■ *Misamis Oriental* **Mt Balatukan** at Tagoloan, seen around 1989 (Tubongbanua and Ramayrat 1989); **Opol, Na-**

awan and **Manticao**, by local report up to at least 1964, with a feather collected at Camp Dunque, Manticao, in December 1968 (Rabor 1971); **Lagonglong**, 1984–1985 (Krupa 1985); **Balinguan**, nesting possible, 1984 (Krupa 1985); **San Juan**, July 1961 (female in DMNH); ■ **Bukidnon Manolo Fortich** (= Tankulon), 1995 (PEWG 1996); **Libona**, bird captured in 1982 (Krupa *et al.* 1984); **Impasugong**, 1995 (PEWG 1996); **Dalwangan**, nesting in 1982 and present thereafter down to at least 1993 (Krupa *et al.* 1984, BRT); **Kinubalan**, nesting, 1984 (Krupa 1985); **Mt Kitanglad** at and opposite Malaybalay at 1,500–1,800 m, 1959–1964 (Rabor 1965, 1968, 1971, Gonzales 1968), but with a large number of other records in the 1960s, including four shot (Gonzales 1971), and nesting there at 1,350 m, December 1989 (Lambert 1993c); Kalatungan Mountains, seen in 1993 (Bojo *et al.* 1993), with specific records there from **Lantapan** at “Victory” in 1988 (Tubongbanua and Ramayrat 1988) and in 1995 from Lantapan, plus **Valencia** and **Cabanglasan** (PEWG 1996), and three birds consisting of a mating pair in an aerial courtship display and a young adult, ca. 2 km apart, in October 1997 at La Roxas, Maramag (A. S. Manamtam verbally 1997); **Pangantocan** in Mt Bagik-ikan forest, seen in 1988 and 1989 (Tubongbanua and Ramayrat 1988, 1989); **Dulang-dulang Peak** in the Kitanglad Range, Songco, one seen in October 1994 (BRT); **Sangaya**, bird killed for food, 1991 (PECPF I *Second Quarter Report 1991*); ■ **Lanao del Norte Kolambugan**, “some months” before January 1920 (McGregor 1921b, Davidson 1934); unspecified locality, two in 1965 (Gonzales 1968), more specifically (but by report only) on Munai mountain, Munai municipality, throughout the period 1962–1967 (Gonzales 1971, Rabor 1971); ■ **Lanao del Sur Camp Keithley**, Marawi City, Lake Lanao, unsexed specimen taken alive around 1906, and a male, September 1906 (Clemens 1907, McGregor 1907b, Davidson 1934); **Malabang**, around six in 1960 (Gonzales 1968); **Lumba-Bayabao**, eastern side of Lake Lanao, pair shot in June 1969 (Rabor 1971); **Mt Piapayungan** (Piagayongan) at Saronayan and Siwagat, April and May 1970, a nest with a young bird, and an adult later shot, being reported from the latter site during that period (Rabor 1971); **Butig Mountains**, regularly down to 1970 (Rabor 1971), with one individual illegally shot and collected from Butig and offered for sale (but died) in Iligan City in 1994 (BRT); ■ **Davao City** four suspected nest sites on the northern and north-east slopes of **Mt Apo** at 7°18'N 123°15'E, 7°15'N 125°16'E, 7°12'N 125°18'E and 7°06'N 125°20'E, late 1970s (read from map in Kennedy 1985), plus Baracatan and Sibulan, Toril, 1974–1975 (Bonnit *et al.* 1977), with a nestling found at Mitondo, Baracatan vicinity, July 1997 (BRT); **Guianga** district, 1974–1975 (Bonnit *et al.* 1977); near **Davao City**, September 1904 (Mearns 1905a, Davidson 1934); **Salaysay**, Marilog district, Davao City, nesting, April 1986 (Selvador 1994, PEWG 1996), with a pair in August 1997 (BRT); ■ **Davao del Sur Magsaysay**, at Barrio Bakungan, nesting in 1978 but not subsequently (Kennedy 1981b, Krupa *et al.* 1984); **Baguio** district, 1995, including Wines, where a bird was captured some time prior to July 1985, when it was transferred to the PECP (PEWG 1996); **Calinan** (sometimes Catalnan), 10 km (north-)west of Davao, around March 1928 (Davidson 1934); Mt Apo at various localities since 1963 (Rabor 1971), including **Tudaya Falls** (also known as Kalian) in 1972–1973, 1977–1978 (nesting confirmed) and subsequently (Kennedy 1977, 1981c, Krupa 1985, Lewis 1986), the **Santa Cruz–Toril** districts, 1974–1975 (Bonnit *et al.* 1977), notably in 1984 at Sitio Batuno, Barrio Rizal, Santa Cruz, December 1983 (Krupa *et al.* 1984), and two suspected nest sites at 6°52'N 125°15'E and 6°50'N 125°19'E (read from map in Kennedy 1985); **Padada**, January 1930 (specimen in YIO); highlands of **Malalag** and **Malita** municipalities, 1963 (Rabor 1965, 1968), and hence specifically at Kibawalan, a sitio of barrio **Malungun** at an altitude of 480 m, 1963–1964, and at adjacent **Tacalma** (sometimes Takalon), 1967–1968 (Gonzales 1968, Rabor 1968, 1971), and at **Talagutong**, Malita, December 1963 (Gonzales 1968, Rabor 1971); **Caburan**, January 1947 (specimen in FMNH); ■ **Maguindanao Cotabato City**, 15 m elevation, 1954 (Kennedy 1977); **Upi**, near Mt Blik, February 1973 (Kennedy undated); forested areas within **Liguasan Marsh**, 1980s (by report in Scott 1989); ■ **North Cotabato Mt Ragaang**, around 1970, on unclear evidence (Rabor 1971); **Mt Sinaka**, where a bird was seen and an abandoned, isolated nest-tree found,

December 1990 (Lambert 1993c); **Carmen**, 1995 (PEWG 1996); **Kiandang** and **Amabel**, nesting in the early 1980s (Kennedy 1981a,b, 1985, Krupa 1985), with other suspected nests on the north-west and south-west slopes of Mt Apo (see Davao City) at 7°14'N 125°09'E, 7°11'N 125°13'E, 7°07'N 125°14'E, 7°03'N 125°11'E and 6°54'N 125°10'E (read from the map in Kennedy 1985); **Mt Libadan** at Kabilaw, Makilala, nesting, 1983–1984 (Krupa *et al.* 1984, Krupa 1985); **Mt Impit** (untraced) at Lamodan, August 1984 (Krupa *et al.* 1985); ■ **South Cotabato Mt Matutum**, on the western slopes above Kablon, Tupi, with sightings there and elsewhere (e.g. Akomonan river, Bolisong) over several years down to 1969 (Rabor 1965, 1968, 1971, Gonzales 1968, 1971); **Lake Sebu**, captive bird found, 1984 (Krupa *et al.* 1985), and two birds seen, August 1997 (BRT); **Mt Three Kings** at Sitio Kangko, 1,200 m, two birds in August 1997 (BRT); **Mt Busa**, Kiamba, April 1993 (Kennedy 1993); **Mt Parker**, some time (by report) in the 1960s (Gonzales 1971); **Marbel**, San Isidro, March 1973 (Kennedy undated; male in LSMZ); **Laconon**, T'boli, nesting, 1984 (Krupa 1985, Krupa *et al.* 1985); **Luhan** (= Luan), T'boli, nesting, 1983–1984 (Krupa *et al.* 1984, Krupa 1985); **Upper Linan**, Tupi, where a nest was found abandoned and a bird seen over Mt Tamgong, December 1987; **Mt Tuduk** (Tudok, Tudut), Glan, May 1966 (Gonzales 1968, Rabor 1971), plus an unspecified locality on the Sarangani Peninsula, late in 1946 (Wharton 1948; see Remarks 14); ■ **Misamis Occidental Mt Malindang** at Masawan, May 1956, and Gandawan, 1,360–1,670 m, April 1956 (Rand and Rabor 1960, Gonzales 1968; two males in FMNH, SUNSM), with subsequent sight records in 1959 and 1961 (Rabor 1965), 1963 (bird collected by D. S. Rabor: Gonzales 1971), 1978 (Sinha 1994), and 1988 at Don Victoriano, Masawan (Tubongbanua and Ramayrat 1988); **Supit**, Maparog, Bonifacio (Tubongbanua and Ramayrat 1988); **Dullao**, Mapurog, Bonifacio, seen in 1992 (Torralba *et al.* 1992); **Salug** at the western end of the range, March and April 1969 (Gonzales 1971); ■ **Zamboanga del Norte Katipunan** at Sigayan, 1950 (Rabor 1965); **Sindangan** (= Sungdangan), nesting possible, 1984 (Krupa 1985); **Labason Mountains**, last seen around 1960 and certainly extinct by 1969 through habitat loss and trapping (Gonzales 1971); ■ **Zamboanga del Sur Mt Dapiak** “localities”, 1952 (Rabor 1965, 1968) and December 1962 (Rabor 1971); also with many encounters with local people who reported it “in the southern localities of Zamboanga Peninsula” (Rabor 1965); **Tukuran**, November 1953 (male in YPM); “Malaue” (evidently **Molave**; see Remarks 15), April 1954 (Meyer de Schauensee and duPont 1962; two males, dated same day, in DMNH); **Mt Sugarloaf** (Mt Pinukis), 1965–1969 (Rabor 1971); Lourdes in **Pagadian City**, a recently active nest around 1974 (Bonnit *et al.* 1977), with nesting possible, 1984 (Krupa 1985); **Mt Kabasalan**, around four in 1962 but none judged present by 1969 (Gonzales 1968); **Ipil**, nesting possible, 1984 (Krupa 1985); **Siay**, nesting possible, 1984 (Krupa 1985); **Mt Imbing**, last seen in 1963 and devoid of forest in 1969 (Gonzales 1971); **Labuyan** (Lapuyan), July 1963 (Gonzales 1968); **Mt Timolan**, May 1969 (Gonzales 1969, 1971) and in 1975 (Sitwell 1975); **Zamboanga**, January 1932 (male in MCZ); **Tumaga river**, c.18 km inland from Zamboanga, September 1945, and by reliable report frequently near the Pasonanca Waterworks in the Tumaga Canyon in the years up to 1945 (Lint and Stott 1948).

POPULATION Attempts at articulating a fully reasoned estimate of population size in the Philippine Eagle have persistently been compromised by the absence of solid data on its density and the extent of its habitat, and by an understandable but perhaps over-cautious reluctance to accept or even attempt extrapolations using data that appear to overturn the traditional view of its great rarity based on field encounter rates.

Estimates of original population size Gonzales (1969) considered the evidence as indicating that the Philippine Eagle was formerly common on Mindanao, and by assuming 65% (62,132 km²) of the island to have been forested in the 1910s, and that each pair requires 100 km², he postulated that there were at least 600 pairs on the island in 1910. Evidently extrapolating from this, using values of 50–100 km² per territory, Lovejoy (1973) proposed an original maximum of 1,900 pairs on Mindanao, which implies that the global population

can never have been greater than several thousand individuals. Likewise, Krupa (1989a), using the 100 km² value, asserted that the species's global population could never have exceeded 6,000 individuals (given an original 300,000 km² of forest throughout the archipelago). However, there are grounds for regarding these and other extrapolations using the 100 km² value as highly and perhaps inappropriately conservative (see Remarks 16, and *Commentary and overview* below).

Early subjective assessments of population status Estimates of original population sizes imply relatively good numbers, and this is supported by two subjective early assessments of status. In one, evidence accumulated in the 35 years after the species's discovery (by which time at least 15 examples were known in "public and private collections"; see Remarks 17) suggested to Hachisuka (1932a) that the species was not rare, but simply very hard to encounter ("atteindre"). In the other, apparently casual fieldwork on Mindanao in 1945–1946 by J. Hamlet led him to consider the species "not uncommon", and in that short time he found several active nests and "many other pairs" (Kennedy 1977).

Luzon The status of the species on Luzon is extremely difficult to judge. Rabor (1965) was only able to confirm its survival there owing to a bird brought to officials in 1963 that purportedly came from montane forest in the Isabela–Nueva Vizcaya region (also Gonzales 1968); as late as 1977 it was being said that this was "the last known record from this island" (Kennedy 1977), as if implying its probable extinction there. On the other hand, the following year it was reported that "a vast amount of forest" remained on Luzon (Kennedy 1978), and in 1991 more specifically that "extensive areas of habitat suitable for the Philippine Eagle remain... in Isabela and Cagayan provinces" (Danielsen *et al.* 1992), although the failure to find the species in the lowlands at that time was judged to reflect its real absence, blamed on relatively intensive habitat destruction and hunting pressure (Poulsen 1995). Rabor's (1965) insistence on the ease with which it can be found owing to its soaring habit—although seemingly supported by Kennedy's (1977) assertion that it is "a bird that frequently soars"—was clearly misjudged (see Remarks 2), and evidently resulted in its presence being overlooked. Kennedy (1978; also 1985) said the results of his seven-week survey in June and July 1978 "clearly show that there is a fairly sizeable population on Luzon": he saw one bird, gathered reported sightings of 15, reported killings of 12 and reported captures of four (data as given in *Distribution Luzon*); puzzlingly, these figures rose to 16, 13 and five respectively in Kennedy (1981c). Given that Kennedy (1981c, 1985) put the Mindanao population at 200–400 birds and then suggested the global total in 1979 was 300–500, it is clear he did not feel that—allowing for small numbers on Samar and Leyte—there were more than 100 birds on Luzon at that time; nevertheless, his records (Kennedy 1978) of as many as 19 birds being sighted, killed or captured in Quezon alone, 1970–1978, is notable evidence of abundance in a province still largely ignored as a target of investigation and conservation action. At any rate, by the mid-1980s it had come to be realised that "the forests of Luzon now represent the largest single area for the eagles", although it was accepted that "since the forest structure is different from that of Mindanao, habitat quality and eagle density may be different too" (Lewis 1986). Krupa (1989a) estimated that in the late 1980s there were 33–83 pairs divided between five forest patches totalling 8,300 km² (further details under *Total population assessments*). In the 20 years to the mid-1990s, roughly 50 different individual birds were judged to have been recorded in the Sierra Madre, with some 25 shot or captured and about the same number seen (Danielsen *et al.* 1992, Poulsen 1995).

Samar Hachisuka (1931–1935) reported the account of A. Worm that collecting from September 1927 to June 1928 produced no records nor any evidence that local people knew the species, although "some pairs" were thought possibly to survive in the interior mountains. Biological exploration of the island was conducted in March–May 1957, resulting in no contact with the species or with any natives who knew it, and it was thus regarded as having become extinct there in the early 1930s (Rabor 1965, 1971; hence also Alvarez 1970). This assertion is

utterly and inexplicably at variance with the testimony of Rand and Rabor (1960), who, while failing to encounter the species themselves, were told by settlers “about a very large eagle that they sometimes saw in flight over the dense forests of the Mount Capoto-an locality”. Nevertheless, the view that the species had apparently become extinct on the island around 1930 prevailed in the literature (e.g. Brown and Amadon 1968, Kennedy 1977, King 1978–1979) until its survival there was confirmed by fieldwork apparently around 1979 (Kennedy 1981b). Krupa (1989a) estimated that in the late 1980s there were 8–19 pairs divided between eight forest patches totalling 1,950 km² (further details under *Total population assessments*). Fieldwork by DENR personnel since 1994 is reported to have confirmed “a colony...thriving in the wild between the provinces of Samar and Eastern Samar” (*Philippine Daily Inquirer*, 5 January 1996, cited in *Newsletter of the World Working Group on Birds of Prey and Owls* no. 23/24, 1996: 25–26).

Leyte The population on Leyte in 1970 was put at 8–10 by the regional director of parks (Kennedy 1977). The paucity of sightings during a survey targeting the species in October–December 1980 suggested it was then “very rare”, although poor weather may have influenced results (Kennedy 1981a, 1985). The 1982 survey appears to have fuelled the view that “the number of eagles there may be so few as to be almost extinct as a viable breeding population”, and that they were too remote from Samar or Mindanao to allow immigration (Lewis 1985, 1986). Similarly, Krupa (1989a) estimated that in the late 1980s there were 1–4 pairs divided between two forest patches totalling 400 km² (further details under *Total population assessments*); the record from 1994 under Distribution suggests that the species still survives on the island.

Mindanao: assessments in the 1960s By the 1960s not only was the species pronounced extinct on Samar and Leyte but also to be extremely rare (“very few individuals left”) on Luzon and at most about 40–50 pairs on Mindanao (minimum 50 individuals) (Rabor 1965; also 1968). Likewise, both Anon. (1964)—based on information from D. S. Rabor—Vincent (1966–1971) and Gonzales and Alcala (1969) gave its numbers on Mindanao as “less than 100”. Alvarez (1970), using the results of two 1969 surveys (see *Measures Taken 1960s*), revised this number down to “only about 40” for that year (breakdown in Table 1), and Gonzales (1969, 1971) likewise concluded that only 36 birds survived (Table 1). As a result of the earlier 1969 survey (for methods, see Remarks 9), which focused on 13 areas, it was concluded that the species is “certainly on the brink of extinction”, the total complement for Mindanao being “almost certainly less than 50 and probably as low as 36” (Gonzales 1969, 1971). Using these data augmented by his own and others’ records, Rabor (1971) estimated the population surviving on Mindanao at 20–25 pairs “at the most”, although this figure rose to 25–30 pairs in the paper’s “summary”, which actually furnished entirely new judgements on the present status of the species: 7–8 pairs were possibly then extant on the Zamboanga Peninsula, 15–18(–20) pairs in the large masses of the main eastern portion of Mindanao, and 3–4 pairs on Mt Apo and the others distributed on Mts Piapayungan, Butig, Ragaang, Kitanglad, Matutum and elsewhere (numbers mapped by province, as shown in Table 1). Simultaneously, Gonzales (1971) specified the distribution of his 18 known birds (listed by province in Table 1, column 2) as: Mt Kitanglad 3 (minimum), Mt Hilong-hilong 0 (probably), Bislig mountains 0 (confident; but see Remarks 2 concerning PICOP, which is adjacent to these mountains), Mt Agtuuganon 2 (probably), Kibawalan and Takalon 3 (confident), Mt Matutum 4 (reportedly), Mt Parker 0 (confident), Mt Timolan 2 (confident), Mt Imbing 0 (confident), Mt Kabasalan 0 (confident), Labason mountains 0 (confident), Mt Malindang 2 (apparently), Munai Mountain 2 (at least).

Mindanao: assessments in the 1970s Alvarez (1973) conceded that fieldwork, on which he did not directly report but which evidently reflected studies undertaken some time in the period 1971–1973 (possibly therefore R. S. Kennedy’s), now suggested that there were more than the 40 birds he had projected three years earlier (Alvarez 1970), but “only about 5 to 6

pairs more”, i.e. 50–52 birds in total. However, surveys conducted in 1972–1973 with the participation of Kennedy (1977) first caused the speculation that there might be more than 200 birds (Lovejoy 1973)—Kennedy (1977) himself thought that in parts of Davao del Norte, Davao Oriental and North Cotabato the eagles were probably as common in the remaining habitat as they had ever been—and eventually resulted in a set of estimates for the Mindanao population as follows (and as given in Kennedy 1977): 580 birds if there were 29,000 km² of suitable habitat (see Threats) and each pair needs 100 km² of forest; 408 based on the sample of an area of known size, i.e. nine birds in 640 km² extrapolated for 29,000 km² (the 640 km² referring to Mt Apo: see below); and 309 based on verified records (29 sightings, 16 captured, 19 shot) and reliable reports (74) gathered from approximately one-third of the available habitat surveyed (the captured and shot birds were discounted, leaving 29+74 = 103 in one-third the habitat = 309). Kennedy (1977) regarded this third method as most reliable, and thus decided that the population on Mindanao in 1972–1973 was 300 ± 100.

Table 1. Data on the provinces of Mindanao relating to Philippine Eagles, 1969–1989.

	Early published population accounts ^a				Survey quality, 1972–1973 (Kennedy 1977) ^c		January 1970–April 1973 (Kennedy 1977)						1989 ^e
	1. 1969	2. 1969	3. 1970	1–3 combined ^b	v	a c	Habitat remaining (km ²)	No. of breeding pairs calculated	No. of birds actually sighted ^d	No. of birds reported sighted	No. of birds known or reported shot	No. of birds known or reported captured	
Agusan del Norte	-	-	-	-		e	900	9	-	-	-	-	1
Agusan del Sur	-	-	2	2		e	3,200	32	-	-	(1)	-	1
Bukidnon	3	3	2	3		p/e	2,900	29	-	2	1	-	4
Davao City	-	-	-	-	f	F	900	9	(1)	(3)	-	-	9
Davao del Norte	2	2	-	2	f	p/e	2,800	28	(4)	2(4)=6	(1)	(2)	6
Davao Oriental	2	-	2	4	f	p/e	2,800	28	5(10)=12	9(15)=24	1(5)=6	1(3)=4	5
Davao del Sur	9	3	4	11	f	F	800	8	3(5)=5	8(1)=9	1	(2)	5
North Cotabato	11	-	8	11	f	p/e	3,700	37	3(6)=6	6	5(2)=7	3	8
South Cotabato	4	4	4	6	f	p/e	2,100	21	-	6	1	2	7
Lanao del Norte	2	2	2	2	p	p/e	700	7	-	2	-	-	-
Lanao del Sur	-	-	6	6		F	1,800	18	-	-	-	-	-
Misamis Occidental	2	2	8	8	p	F	400	4	-	6	-	2	3
Misamis Oriental	-	-	2	2		e	900	9	-	-	-	-	1
Surigao del Norte	-	-	-	-		e	300	3	-	-	-	-	-
Surigao del Sur	3	-	2	3		e	1,600	16	-	-	-	-	5
Zamboanga del Norte	-	-	2	2	p	p/e	1,800	18	-	8	1	1	2
Zamboanga del Sur	2	2	6	8	p	p/e	1,400	14	(1)	2	-	-	4
Total	40	18(=36^f)	50	70^g			29,000	290	11(27)=29	51(23)=74	10(9)=19	9(7)=16	61

^a Published population accounts by 1, Alvarez (1970); 2, Gonzales (1971); 3, Rabor (1971) (as tabulated in Kennedy 1977).

^b Non-repetitive combined data.

^c These columns are derived from data in Kennedy (1977) to help review adequacy of coverage. v = visited; a = aerial surveys; e = estimated; coverage of Mindanao in surveys in 1972–1973: f = “greatest coverage” (but evidently not full), F = full survey; p = partial coverage; e = estimate of forest cover (the text refers simply to “other areas” being estimated, and it is assumed this applied not only to provinces neither visited nor surveyed, but also to provinces only partially covered by aerial survey).

^d First numbers are data collected by Kennedy (1977). Numbers in parentheses are unpublished data collected by personnel from the Bureau of Forest Development and were subject to revision. Following numbers equal the combined total, as given by Kennedy (1977), who did not state that his “combined totals” were for non-repetitive data (3 + 6 do not normally = 6).

^e This column is derived from PCEPFI *Fourth Quarter Report 1989*, which published a table of Mindanao eagle nests/areas “which require financial support for field verification and sustained monitoring”. It is assumed that all known nests/areas were included. The dashes indicate no information. The meaning of “eagle area” is not explained; presumably it implies a site where one or more birds has been recorded, not one at which several pairs (or more) are or may be present. If this is correct, each province number must roughly be regarded as referring to the number of pairs.

^f Gonzales (1971) considered the population size to be twice the total records he collected; thus 2 x 18 = 36.

^g This must be the source of the figure given by Bronzini (1978), who cannot have read the rest of Kennedy (1977).

Mindanao: assessments in the 1980s In a popular account, Gonzales and Rees (1988) gave a total of 100–300 birds, evidently basing this on a somewhat pessimistic view of Kennedy's figures above, and adding that Mt Apo National Park was “not large enough to support more than three or four pairs at most”. Krupa (1989a) estimated that in the late 1980s there were 46–115 pairs divided between 22 forest patches totalling 11,520 km² (further details under *Total population assessments*).

Mindanao: assessments in the 1990s Only 64 eagles could be accounted for in the early 1990s: 17 in captivity and 47 known to be associated with wild nests (D. Salvador verbally 1993). By 1995 this total had risen to 66 (17 captive, 49 wild) (PEWG 1996). However, these figures represent *minima*, not (as their recent use has tended to imply: see below) *maxima*.

Total population assessments Based on fieldwork without indicating its extent or how (if at all) the results were related to new estimates of forest cover, Kennedy (1981b,c, 1983) reported the total global population as “less than 500” and “between 300 and 500” in 1979, and also “probably fewer than 300” (Kennedy 1983); this latter number was also given, apparently as an independent guess, by Lewis (1985). Krupa (1989a) used the 100 km² value to calculate population numbers in the late 1980s, depending on percentage of land used by the eagles (range: 40%–100%), in the 37 major disjunct forested areas he believed then to remain in the country (although no source is cited for this number or for the sizes of each area), resulting in a global total of 88–221 pairs spread throughout 22,170 km² (see Remarks 18; breakdown by island given above). In December 1995 “a total of 79 birds could be counted for the entire species”, breaking down as 49 wild and 17 captive on Mindanao (66), 10 wild and two captive on Luzon (12), and one wild on Samar (PEWG 1996; see Remarks 19).

Rates of decline and predictions of extinction For over 30 years there have been strong predictions of the Philippine Eagle's impending extinction. In the mid-1960s the bird was regarded as “definitely on the road to extinction”, an event predicted to occur within 25 years (i.e. by 1990) without remedial action (Rabor 1965; also 1968). On the basis that there were indeed 600 pairs on Mindanao in 1910 and 36 birds in 1970, the rate of decline was calculated at 1.61% (=1.62%) per year and the number of birds lost annually 19.3 (=19.4), a rate that would have resulted in total extinction within two or three years of the latter date, a prediction not then regarded as absurd or at variance with the facts, given a reported deforestation rate of 20 ha per hour (i.e. 1,752 km² per year) in Mindanao (Gonzales 1969, 1971).

Kennedy (1977) also offered a figure for annual human-induced mortality (31.2 birds per year based on 35 eagles known to have been shot or captured in 40 months in about one-third of the available habitat on Mindanao), although this is in fact an absolute minimum estimate, since dozens of cases cannot have been registered in the period in question. On the assumption (highly conservative and arguably over-cautious: see *Commentary and overview*) that the total population lay between 309 and 580 birds, Kennedy (1977) translated this mortality into a rate of 5.4–10.1%. The assumption was, at least, that “a good percentage” of birds caught or killed are birds whose habitat has been destroyed and which are thus “surplus” (Kennedy 1977). At mid-1970s rates of habitat destruction the species was expected to be extinct by the early 1980s (Basan 1976). In the mid-1980s the then rate of forest loss, if left unchecked, was expected to eliminate the eagle in the wild in about 10 years, i.e. by 1994 (Lewis 1985). Less categorically, Krupa (1989a) merely commented: “the long-term prognosis for the Philippine Eagle is bleak indeed”.

Commentary and overview The consequence of the rigid adherence to the 100 km² value for a breeding territory size (see Remarks 16) is that all population estimates have been alarmingly and perhaps misleadingly low (particularly given their failure to factor in immature birds: see Remarks 20). Because of the inherent conservatism of the human imagination, which persistently results in the underestimation of population sizes of species (see, e.g., Gaston 1994)—and indeed in premature assumptions of extinction—and because of the

difficulty in believing that so rarely seen yet so large a raptor could possibly exist in “high” numbers, no attempt has been made to apply lower values for territory size to generate population estimates. In Kennedy’s (1977) calculations, substitution of the values of 12.5–25 km² per territory, derived from actual observation at Tudaya Falls (see Remarks 16), results in a 1973 population on Mindanao of 2,320–4,640 birds, while 30–35 km², based on J. Hamlet’s work (see Ecology *Habitat*), yields 1,657–1,933 birds, and 43 km², based on evidence from Mt Apo (see Remarks 16), yields 1,350 birds. In Krupa’s (1989a) calculations, substitution of 12–25 km² results in an original population of 24,000–48,000 (excluding immatures and floaters), with the numbers surviving in the late 1980s in Krupa’s 37 patches totalling roughly 352–884 pairs; with values of (a) 30–35 km² and (b) 43 km², the equivalent figures are (a) 17,143–20,000 (original population) and 631–736 pairs (surviving in the 1980s), and (b) 13,953 and 205–514 pairs. If first breeding only occurs at 6–8 years (see Remarks 20), all these figures (even Kennedy’s and Krupa’s own) can perhaps be *doubled* to take account of immature birds (see Table 2 for other options).

However, Kennedy (1977) preferred the most conservative of his three population estimates (309); he did not give a reason for this choice, although it was possibly in order not to appear too seriously out of line with previous assessments, and possibly because of the inherent difficulty in crediting higher numbers to so rarely encountered a species. Indeed, Kennedy himself (in Dickinson *et al.* 1991:70) alluded to “this more realistic assessment” (i.e. more realistic than the figures of around 50 birds), indicating his doubts about earlier opinions; yet he had also by that stage clearly found his chosen estimate sufficiently well accepted to assume its truth, since he also then wrote: “we now know that the population in the late 1970s was in fact c.300 birds on Mindanao alone”. Nevertheless, the diffidence in his three

Eagle population	closed-canopy (km ²)	if 1 pair per 100 km ²	if 1 pair per 50 km ²	if 1 pair per 25 km ²	if 1 pair per 12.5 km ²
Luzon	6,561	65 (26)	130 (52)	260 (104)	520 (208)
Samar	724	7 (3)	14 (6)	28 (11)	56 (22)
Leyte	236	2 (1)	4 (2)	8 (3)	16 (6)
Mindanao	6,678	66 (26)	132 (53)	264 (106)	528 (211)
Total	14,199	140 (60)	280 (113)	560 (224)	1,120 (447)
Total adults		280 (120)	560 (226)	1,120 (448)	2,240 (894)
x 1.5 for immatures		420 (180)	840 (339)	1,680 (672)	3,360 (1,341)

Table 2. Philippine Eagle population estimates based on different densities, different proportions of habitat occupied, and presence/absence of immatures, using closed-canopy forest cover data (excluding mossy and pine forest, but otherwise undiscriminated) for 1992 generated by DENR (Development Alternatives, Inc. 1992). Numbers outside brackets in columns 3–6 and rows 2–7 are the pairs if 100% of the habitat is occupied; those in brackets are the pairs if only 40% is occupied (a precaution first exercised by Krupa 1989a). In the worst-case scenario, each pair occurs in only 100 km², only 40% of the habitat is occupied, no breeding success has occurred in the past eight years in any pair, and no open-canopy habitat is occupied: 120 birds survive. In the best-case scenario, each pair uses only 12.5 km², 100% of the habitat is occupied, two surviving offspring have been produced in the past eight years, and additional birds occupy open-canopy habitat: a minimum 4,480 birds survive. However, the evidence seems to point to a density of a pair every 25–50 km² (see also Remarks 16 concerning the Harpy Eagle *Harpyia harpyja*). Assuming only 40% of the habitat being used, only one surviving young produced per pair, and no occupancy of open-canopy forest (all of which seems “responsibly pessimistic”: see Introduction), the total population of eagles in 1992 was 339–672 (bottom line, italic), or in rounded terms 350–650 birds; however, allowing for mature individuals only and admitting further influence of the precautionary principle, this choice of figures yields an adult population of 226 birds (penultimate line, bold), and this is the number used here to set against the IUCN criteria, and by which the species is judged to be Critically Endangered. Accepting 100% occupancy but no surviving offspring yields 560–1,120 birds (penultimate line, italic). Many other interpretations can of course be made: for example, allowing for a 70% habitat occupancy, a density of one pair per 45 km², and only a single surviving offspring per pair yields 792 birds.

1977 estimates is extreme: in making the first, Kennedy (1977) actually stated that the range “can be as large as 100 km²”, so to have used what he explicitly regarded as a maximum value as if it were a mean was in itself a considerable risk, indicating that the figure of 580 was in fact a minimum population value; yet, by basing the other two estimates on birds seen or reported captured alive, he was making the still more daring assumption of 100% detectability in a species already known to be exceptionally difficult to observe, with the result that the density of his preferred population estimate of 309 works out at a somewhat implausible one pair every 188 km². Unfortunately, such (clearly well-intentioned) cautiousness may now perhaps be considered to have been counter-productive, by offering an overly pessimistic assessment of the species’s survival prospects, and hence re-ranking the options for the most appropriate management responses (see Collar 1997a; also below under Measures Proposed *The problem of captive breeding*).

Meanwhile, it is clear that the Philippine Eagle still survives despite several predictions of its impending loss, and on the basis of less pessimistic extrapolations made above, and given that it is clearly exceptionally elusive, it seems reasonable to conclude that it occurs in moderate numbers in several areas of the country, some of them still largely unsurveyed (see Measures Proposed *Defence and extension of the protected area network*). Table 2 provides a variety of options for assessing total eagle numbers, and tends to indicate that 350–650 birds might very reasonably be assumed to have been extant in 1992, but with the exclusion of immature birds the figure drops to 225–450, and the lower of these extremes has been used in the IUCN status evaluation (see legend to Table 2).

ECOLOGY Habitat The Philippine Eagle is an inhabitant of primary forest, but also occurs in second growth and gallery forest, and crosses clearings (Dickinson *et al.* 1991; also Kennedy 1977). Although Kennedy (1977) claimed that dipterocarp forest was “undoubtedly” the original habitat of the Philippine Eagle on Mindanao, he indicated that this habitat only reaches to elevations of 800 m while reporting the eagle’s upper elevational limit as 2,000 m; and he only produced one record (Cotabato City: see Distribution *Mindanao*) to back up the assertion that the species once “occupied lowland forest down to sea level”, while his perception that the eagles are well adapted to soaring in steep terrain (ravines, canyons, etc.) caused him to “believe that steep mountains are important in the eagle’s habitat”. The species probably does not nest above 1,700 m, as beyond that elevation the trees are significantly smaller (Lewis 1985); indeed, Krupa (1989a) considered 1,450 m as the likely upper limit (1,800 m is the highest record given under Distribution), and although dipterocarp forest is reported to reach 1,500 m on Mindanao (L. R. Heaney *in litt.* 1997, *contra* Kennedy 1977), the upper elevational limit on one prey species, Philippine flying lemur *Cynocephalus volans*, is 1,200 m (Wischusen *et al.* 1993) and on Luzon dipterocarp does not reach 1,000 m (F. Danielsen *in litt.* 1997). Clearly elevation of both habitat and prey species may vary with aspect, latitude and local climate, apart from any human influences. Although seen on some occasions in second growth, the birds still prefer primary forest (Bonnit *et al.* 1977); or, in Kennedy’s (1977) version, they have partially adapted to human upslope encroachment “by hunting over cleared land and living in second growth forest”, an assertion which was then qualified by: “the birds mainly confined their activity to virgin forest or advanced secondary growth”. In fact, unpublished research on prey density and diversity (what was taken to be prey is not stated) indicates a positive correlation with primary forest (in PEWG 1996), clear evidence for the vital importance of such habitat to the long-term survival of the species. Occasional records away from usual habitat, such as one shot in a cornfield 10 km from the nearest forest (this is the specimen from Marbel, South Cotabato: see Distribution *Mindanao*), may involve birds displaced by forest clearance (Kennedy 1977), although natural dispersal between forested areas must also occur. Gonzales (1968)—hereafter referred to as the 1963–1964 nest or study—found that the species prefers lowland and mid-elevation primary forests, 150–1,200 m (300–1,360 m in

Gonzales 1971), each breeding pair staying in a defined territory apparently of some 40–50 km² (see Remarks 21) (Rabor 1965, 1968), although Gonzales (1968) himself considered that the pair he studied (which were the source of Rabor's judgement) actually ranged over 100 km² (see Remarks 16). Grossman and Hamlet (1964), based evidently on J. Hamlet's personal experience (given the use of his other data in Kennedy 1977), gave a home range of roughly 30–35 km². Observations in 1972–1973 (at Tudaya Falls) suggested that the area of forest used by a pair of eagles (albeit not apparently breeding) was 12.5–25 km² (Kennedy 1977). A reasonable assumption is that established breeding pairs will maintain and defend a territory throughout most or all of their lives (Krupa 1989a).

Food Activity and hunting methods Eagle observability on Mindanao appeared to be highest in the morning, between 09h00 and 10h00, with a smaller peak at around 14h00, and this activity was judged to be associated with hunting (Kennedy 1977). In one set of observations, a typical hunt began at a perch high on a forested hillside, the bird dropping (without flapping) in a short glide to another perch 75–125 m away where it paused and scanned for 5–10 minutes, then glided down to another perch, and so on for an hour or so until near the floor of the valley; then it glided off in horizontal flight, found a thermal updraught and circled up to regain its previous elevation (Kennedy 1977). The structure of the eagle (its goshawk-like appearance: see Remarks 1) is an adaptation to allow high manoeuvrability during sudden rapid attack, but the species frequently soars and is rarely seen in flapping flight (Kennedy 1977); however, in what was then thought the first direct observation of an eagle hunting, a bird was observed (at 10h40) “in a hard-flapping flight through the canopy of trees and crashed into the tree crowns and aerial epiphytic plants [during] 8 short flights... the quick twists and turns of its head and rapid flight style [indicating its] purposeful intensity” (PECP *Fourth Quarter Report 1987*) (this account suggests that the bird may have been attempting to flush prey by noisily “attacking” certain forest features either themselves likely to contain an appropriate animal or, by virtue of the disturbance, so as to induce panic and movement in nearby unseen animals). Rapid pursuit is not, however, the only hunting method: Kennedy (1981c) claimed to have discovered why the species has such long legs, and how it manages to exploit such strictly nocturnal mammals as flying lemurs, when he observed a young bird fly to a knot-hole in a tree, grasp the rim with its feet, propping on its tail and embracing the trunk with its wings, poke its head briefly into the cavity and then one long leg, only to pull out a “toy” in the form of a piece of rotten wood, which it proceeded to dismember. Studies of flying lemurs nevertheless suggest that they generally roost in the crowns of trees and are presumably caught there (N. R. Ingle *in litt.* 1997). Birds are reported to hunt both singly and in pairs, in the latter case apparently when targeting monkeys (Kennedy 1977).

Food: general considerations The variety and size of prey items recorded (from 10 g bat to 14 kg deer) at a nest studied by Kennedy (1985; see below) suggest that Philippine Eagles are opportunistic feeders. This is supported by various general statements from earlier investigators: Wharton (1948) described them as feeding on almost all native mammals and some reptiles, often catching flying lemurs, while Grossman and Hamlet (1964), evidently based on J. Hamlet's personal experience (see Kennedy 1977), reported that the eagle “feeds on monkeys... as well as hornbills, and also preys on small dogs, pigs and poultry in native villages” and that “pairs may specialize and bring up their young on an almost exclusive diet of any one of these items, depending on the location of the nest and whatever is most available and vulnerable”. Whether, however, Hamlet had any direct evidence of predation in villages is not certain; Krupa (1985, 1989a) insisted that “no... preying on domestic livestock has been recorded”, although J. Whitehead himself was told by natives of Samar when he first made his discovery that although the species mostly ate monkeys “it not infrequently visits the villages and carries off domestic poultry” (Ogilvie Grant 1897) and that it “is well known to the natives as a robber of their poultry and small pigs” (Whitehead 1899a). A captive bird readily ate chickens (only the entrails when not so hungry) (Clemens 1907) and another did

likewise during its voyage to London, where it appeared to prefer newly killed pigeons to rabbits and other small mammals (Seth-Smith 1910a). Wharton (1948) reported that one of the three eagles he caught ate two pounds of beef per day. An important consideration is that prey species may differ from island to island, partly because they occur in different abundances, and partly because they do not occur at all: Mindanao possesses flying lemurs (reputedly the main prey: see below), flying squirrels, monkeys, snakes and lizards; Samar and Leyte are similar except for lacking the flying squirrels; and Luzon lacks both flying lemurs and flying squirrels, but possesses the monkeys (an eagle was seen taking an adult female monkey in Cagayan, carrying it in one foot: R. Crombie *in litt.* 1998) and reptiles, and in addition giant cloud-rats *Phloeomys pallidus* that weigh 2–2.5 kg (over twice the weight of flying lemurs) (L. R. Heaney *in litt.* 1997). Gonzales (1971) had a local report of a bird being captured alive after falling exhausted in combat with a large python.

Food: monkeys The generic name of the Philippine Eagle, *Pithecophaga*, which led to its original English name “monkey-eating”, was the result of the natives of Samar reporting that it “preys chiefly on the Green Monkeys”, and indeed the man who bestowed this name, Ogilvie Grant (1897), considered that “the worn tail and broken ends of the quills of both wings and tail no doubt bear witness to many a savage struggle amongst the branches”. In Whitehead’s (1899a) view, “monkeys... are the only animals sufficiently abundant in these forests to support such a large bird”. However, Gonzales (1968) found that monkeys formed only a small proportion of the diet of a breeding pair, and considered the name “lemur-eating eagle” to characterise the species better; indeed, as part of his laudable attempts to generate greater pride in the species by obtaining a name change, Kennedy (1981b,c, 1983, 1985) made much of the fact that he too found very few monkeys being brought to nests under observation (“the eagle rarely preys on monkeys”). Nevertheless, in the very first stomach known to have been examined, that of the male from Camp Keithley, September 1906, there was “a monkey, not yet digested”, which had been dismembered and eaten, starting with the paws, then the next joints, and so on, “hair and all” (Clemens 1907). Lewis (1985) implied witnessing a proportionately higher take than that reported by Kennedy (1981b,c, 1983, 1985), while Krupa (1989a), without indicating his evidence, simply stated “sometimes monkeys are the favoured diet”. In reporting that individual male monkeys defend the troops they lead against attack, deliberately exposing themselves to view while the others escape, and that they appear to be too powerful for single combat, Gonzales (1968) concluded that eagles would be more successful at taking monkeys when hunting in tandem. This was endorsed by various locals who told Kennedy (1977) that the birds course through the forest in pairs looking for troops, one eagle distracting a monkey while the other captures it from behind. It also tends to be borne out by the fact that Wharton (1948) exported a live eagle captured by locals after it broke its leg in a fall during a struggle with a large monkey. Clearly an interpretation here (as suggested by Grossman and Hamlet 1964) is that, as with many raptors, individual birds or pairs may have developed particular preferences and skills in relation to prey and its capture, so that no simple generalisation can be made on the frequency of individual prey species. Moreover, it may well be that diets change with area, elevation, forest type, rainfall distribution and/or stages in the breeding cycle: during the incubation and brooding periods (when nests have been most studied) one member of a pair is required for nest duty, so the hunting of monkeys may then be greatly reduced, however locally abundant they are.

Food at nests The main food brought to nests on Mindanao appears to be flying lemurs *Cynocephalus volans* (these being regarded as much easier to catch than monkeys: see Remarks 22): at the 1963–1964 nest, of 48 items seen in or brought to it (presumably of those that could be identified) 43 were flying lemurs, three were monkeys “*Macaca philippinensis*” (= *M. fascicularis*), one was a flying squirrel “*Petinomys mindanensis*” (= *P. crinitus*) and one was a tree squirrel *Callosciurus* (now *Sundasciurus*) *philippinensis*; no domestic animals were recorded

(Gonzales 1968; also Rabor 1965, 1968). At various nests studied in Mindanao, 1977–1979, flying lemurs were the principal food (54% of prey items), also palm civets *Paradoxurus hermaphroditus* (12%), flying squirrels *Petinomys* (8%), fruit bats (genus *Rousettus* originally given, but this doubted: N. R. Ingle *in litt.* 1997) (5%), monkeys (3%), plus a rat, a 30-pound Philippine deer *Cervus*, a small bat (10–15g), an unidentified fledgling owl, two unidentified hawks, Rufous Hornbills *Buceros hydrocorax* (6%), and several species of reptile (8%) including snakes and a monitor lizard (Kennedy 1981b,c, 1983, 1985). However, at a nest in Aurora province, October 1997, prey items seen comprised flying foxes *Pteropus*, macaques *Macaca* and snakes (P. L. Alviola verbally 1997).

Feeding regime of a young bird The pair at the 1963–1964 nest appeared to keep a larder (“garner”) where food was hoarded and prepared: at least, most carcasses brought to the chick were already decapitated and eviscerated (Gonzales 1968). The female eagle was never seen to bring food to the nest, but probably hunted for her own food on occasions, and presumably did so regularly after the abandonment of brooding at around eight weeks (Gonzales 1968). Initially the chick at this nest was fed an average of 15 pea-sized morsels of meat at each of two or three feeding sessions per day, rising to 256 thumb-sized items per meal per day (number of meals per day not stated but other evidence indicating one only), the most pronounced shift in regime occurring in the eighth or ninth week when brooding was finally abandoned (Gonzales 1968; see Remarks 23). The chick first attempted to feed itself at eight weeks (see Remarks 23) and first succeeded at just over 10 weeks; pieces of bone entered the diet during the ninth week, entrails by the fourteenth (Gonzales 1968). The female parent was chiefly responsible for feeding the chick in the first three weeks of its life, but thereafter the male performed most of this work (Gonzales 1968).

Breeding Monogamy and timing Philippine Eagles studied at nests have proved to be in monogamous pairs (Gonzales 1968, Kennedy 1977), and it is an assumption that runs through all work on the population and biology of the species that monogamy is the exclusive condition under which it reproduces (see Remarks 24). Data from five Mindanao nests, 1977 and 1978, revealed that breeding began in the period from late September to early December, irrespective of rains, but evidence from Luzon suggested that breeding (egg-laying) in the Sierra Madre commences between mid-December and mid-January (Kennedy 1981b,c, 1985), and this fits well with reports from local people that the species has young chicks during the dry season, which usually runs from February to May (F. Danielsen *in litt.* 1997).

Nest sites The nest has been reported as sometimes being situated in a cave (Kennedy 1981b), and one current site is supposedly on a cliff (see under Mount Dipalayag in Distribution), which gives some support to the old account of the species nesting on coastal crags (see Remarks 10). However, in all recorded instances it is built typically at a major junction (often on a large epiphytic fern or orchid, when few sticks are used, or else on a bed of smaller epiphytes, when many sticks are used) within the canopy of the tallest tree (e.g. *Sapium luzonicum*, *Shorea polysperma*, *S. almon*, *Parashorea plicata*, *Petersianthus quadrialata*, *Octomeles sumatrana* and, by reliable report, *Agathis alba*—this last being the first record of a nest from Luzon: Danielsen *et al.* 1992); thus it is sometimes situated as much as 45 m from the ground, commonly on the lower half of a slope in a very deep ravine; several old nests are sometimes present in the same tree, and at the base of some nest-trees are accumulations of bones three or four layers thick, indicating many years’ occupation (Grossman and Hamlet 1964, Gonzales 1968, Kennedy 1981b, 1985). The nest-trees themselves need not be located in tracts of primary forest, and at Magsaysay (Davao del Sur) one stood in two hectares of forest at the base of a cliff, surrounded for more than a kilometre by cogon grass and cornfields (Kennedy 1981b); this chiefly indicates, however, that nest-site fidelity is extreme, and although it can also be construed to show that birds can continue to breed in disturbed sites, increasing isolation of such sites from good forest (since all prey items recorded have been forest animals) appears to place increasing stress on the nesting endeavour (at another heavily deforested

nest-site, an eaglet went five days without food: Kennedy 1981b), and it may well be that breeding success is below replacement rates at such sites.

Eggs, incubation and brooding One or two eggs may be laid, although one appears much the more frequent (Kennedy 1981b) and in cases of two generally only one eaglet fledges (two have been known to do so, once) (Grossman and Hamlet 1964); a captive female in San Diego laid two eggs on successive days, and one in Philadelphia laid a second egg 14 days after the first (Wylie 1974). One egg was laid in the 1963–1964 nest (in mid-November), incubated by both parents but mostly by the female (apparently including most though not all overnight sessions); the male was present on the nest or incubated the egg for under a third of the total presence/incubating time recorded, but did most of the hunting through to fledging (Gonzales 1968). At nests studied by Kennedy (1981b) the pattern was similar, with the male doing most of the hunting from incubation up to the first third of the nestling period, and the female doing roughly two-thirds of the incubation and almost all of the chick-feeding duties in this period, thereafter the two adults sharing hunting and provisioning the eaglet (Kennedy 1981b, 1985). The incubation period at the 1963–1964 nest was c.60 days, the nestling period being about 105 days (Gonzales 1968; also Rabor 1965, 1968). In 1981–1982 an incubation period measured from egg-laying (11 November to 8 January) lasted 58 days (Kennedy and Alvarez 1984). For the first seven weeks of the chick's life the parents at the 1963–1964 nest shielded it from sun and rain, but thereafter left it entirely to care for itself in this regard (the crown of the nest-tree providing partial shading); both daytime and night-time brooding virtually ceased at seven weeks of age (see Remarks 23) (Gonzales 1968).

Growth and dependence of young In the young bird studied by Gonzales (1968) wing-flapping exercises began at around six weeks, at 12 weeks such exercises took the bird's feet off the nest simultaneously, and by 15 weeks the eaglet would frequently wander along the nest-branch and flap back some 2–3 m into the nest, the bird fledging (leaving the nest-tree entirely) at the end of its fifteenth week. Thereafter the eaglet preferred two perches and was commonly provisioned at them, usually by the male, and both parents would protect it from crows and hornbills, although if attacked when left on its own it would emit distress calls until a parent came to its rescue (Gonzales 1968). In nests studied by Kennedy (1981b), eaglets remained in the nest for almost five and a half months (164 days) after hatching, and were entirely dependent for several months more; in one case in 1978 a radio-tagged juvenile (which had fledged in May at four and a half months: Kennedy 1981c) was off the nest for six and a half months before it was seen to catch its own food, and this bird remained within its parents' home range for almost 17 months after leaving the nest (Kennedy 1981b, 1985). The day after it had departed, the parents copulated on the old nest, thus indicating that a successful nesting cycle requires two years (Kennedy 1981b).

Maturity and longevity Rabor (1965, 1968) commented that sexual maturity appears to be reached at three years, with breeding generally taking place once a year thereafter (also Grossman and Hamlet 1964). However, on what evidence this was based is not known; by contrast, a captive male was still not producing semen at four and a half years (Lewis 1985), and Krupa (1989a) judged that sexual maturity was only reached at 6–8 years (see Remarks 20). Moreover, as just noted, a natural breeding cycle appears to require two years, not one (Kennedy 1981b), although breeding may be opportunistic and not necessarily tied to an annual cycle; at least, in the case of the 1963–1964 nest (Gonzales 1968), the egg was laid a maximum of only a month after the disappearance (killing: see Threats) of a fledged young which, even if as old as five months when killed, would have hatched (based on 1963–1964 data) in mid-May from an egg laid in mid-March (although it is possibly that in this instance the observer entirely misjudged the age of the young bird). The species is as long-lived as it is slow-breeding: Alvarez (1970) was evidently repeating another source in referring to the life-span being estimated at 40 years, a judgement confirmed by a male in Rome Zoo which was

received full-grown in December 1934 and died in July 1976, a total of 41 years and seven months in captivity (Bronzini 1978). Krupa (1989a) thought that birds live 30–60 years.

Breeding success and mortality Krupa (1989a) postulated that breeding (as fledging) success would be 30–50% in disturbed and 60–80% in undisturbed areas; he also assumed that success in surviving from fledging to maturity would be 30–60% in disturbed and 50–70% in undisturbed areas, and he put mortality at 7.5–10% per year for the total population. Death by apparent asphyxia (perhaps a bone in its throat) in a 27-day-old chick has been recorded (Kennedy 1981b); also death from malnourishment and dehydration following gastroenteritis (but only apparently after two weeks in captivity), and a probable death due to exposure during incessant rains (Kennedy and Alvarez 1984). A specimen from Zamboanga del Sur (not listed under Distribution as no locality specified) dated August 1953 died of a stomach ulcer and had internal parasites (MCZ label data; it is not clear if this bird was captive or wild).

Migration The highly tentative reports of birds from Polillo, Negros and Cebu (see Distribution) can be interpreted in three ways: first, as wrong; second, as evidence of unsuspected, relict, resident populations; and third, as evidence of dispersal to or wandering among various islands. All three views are plausible; the first is the most likely, the second perhaps the least (except for Polillo, which can be viewed as an extension of Luzon), since other evidence would be expected to exist, while the third is strengthened by the record of two birds “soaring” over a small island in the Surigao Straits (see Distribution *Mindanao*), and indeed by other evidence that the species rises to very great heights on occasion (Sitwell 1975), suggesting that it must be capable of long-distance dispersal across barriers represented not only by open country but also by relatively short stretches of sea. Nevertheless, Lewis (1985, 1986) reported the view that the species has limited powers of dispersal and that its increasing confinement to isolated patches will render it vulnerable to local extinction. More emphatically, Krupa (1989a), in expressing concern that “perhaps only two forest fragments contain eagle populations in excess of fifty”, was clearly thinking in the same terms, especially when claiming that “genetic ‘bottle-necking’ poses a serious problem for a majority of the fragmented eagle populations and must be avoided at all costs” (which he was proposing could be done by exchanging wild- and captive-bred birds, hence establishing a further justification for captive breeding). Indeed, Krupa (1989a) claimed that eagles are unable to disperse across more than 20 km of open land or water, basing this on (a) five eagles being recovered alive from the sea close to shore, and one from a lake, (b) lack of records from open country, (c) records of captures normally being in forested areas and the fact that eagles have never been sighted over open water, and (d) absence of records from other islands (including Borneo) separated by deep water (for a critique of this view, see Remarks 25).

THREATS The Philippine Eagle is the top predator of the Philippine archipelago, and inherently vulnerable to human activities through several characteristics commonly associated with this trophic position, namely (a) relatively low population density, (b) relatively slow reproductive output, and (c) capacity to accumulate chemicals from prey in tissues that further reduces reproductive output. However, it is particularly susceptible because of its confinement to tropical rainforest in a highly circumscribed range which it shares with a substantial and increasing human population. The threats to this species are therefore complex and interrelated, and could be defined and labelled in different ways to those selected below. In the following accounts, most generalised information and interpretation is based on the situation in Mindanao, where virtually all conservation efforts have been undertaken; all large figures in hectares (except in quotation) have been substituted by square kilometres.

Habitat loss Destruction of tropical rainforest in the Philippines, as elsewhere on the planet, is the result of two seemingly independent but partly interrelated activities, namely timber extraction (“selective logging”) conducted as a major export business, and slash-and-burn or shifting (“*kaingin*”) agriculture practised by landless and impoverished peasants

(Myers 1988). The interrelatedness of these two activities lies most obviously in the way that logging directly facilitates *kaingin*, through the thinning of forest and the construction of access roads (Caufield 1983); generally, therefore, the association between logging and *kaingin* is so close that it is difficult to discuss or assess their effects separately. On paper, the relationship ought not to exist: not only are there stiff penalties for companies that cut down trees less than 60 cm in diameter (i.e. logging is supposed to be selective), there are also laws (whose extension and attempted enforcement caused such a backlash when invoked by conservationists in the 1980s: see *Measures Taken 1980s: attempts at law enforcement*) that require companies to hire guards to prevent the takeover of logged land by squatters (Sitwell 1975). In practice, of course, things are very different: indeed, in one case a concessionaire encouraged settlers into a logged area to keep them away from valuable timber in primary forest (Lewis 1986).

In the 1960s the problem of habitat loss was considered subordinate to several other factors affecting the eagle, including zoo trade: as only the sixth item on his list of threats, Rabor (1965) referred to the “indiscriminate destruction of large areas of lowland and medium-elevation forests, both on Luzon and Mindanao, as a result of ruthless logging”, but he noted that such cut-over areas were immediately cleared totally by settlers for shifting agriculture. Nevertheless, even back in the 1963–1964 study the nest was being threatened by logging, the sounds of which could be heard steadily approaching and were thought likely in themselves to cause the eagles to desert the area (D. S. Rabor *in litt.* 1964 to S. D. Ripley in BirdLife archives). Indeed, the west side of the hill in question, forested in 1964, was largely cleared by 1967, and clearings close to the nest-tree itself had been opened up, while a road had been built into the area, greatly facilitating human access (Gonzales 1968), and by 1969 such was the pressure from logging and *kaingin* that “in a few short years the whole area will be as bald as a coot” (Gonzales 1971). Thus by the 1970s perceptions had radically changed: Sitwell (1975) despaired for the eagle because of “the world’s inexorable demand for timber, and the insatiable land demands of the Philippines’ exploding human population”; and of 12 eagle territories definitely found by Bonnit *et al.* (1977), 1973–1975, 10 were at least partially within logging concessions.

From the late 1980s onwards, however, the greater cause for concern was *kaingin*, because almost all commercially valuable timber had by then been extracted (N. R. Ingle *in litt.* 1997), logging was perceived as less final (regeneration can occur so long as squatters are excluded), and there was at least in theory the possibility of effective intercession for given areas. Thus Krupa (1989a) noted that, for ultimate success in conserving the eagle, human depletion of natural resources is the fundamental issue to be addressed, because (e.g.) with 38 million people living in rural areas and one million officially listed as forest occupants “virtually no forest area is unaffected by illegal activities and the laws governing them are unofficially perceived as unenforceable”; he reported that ethnic groupings and population pressures were a formula for social unrest, precipitating an 18-year communist insurgency and a 15-year Moslem uprising, and concluded: “The multiple pressures of economics (logging to service the [US\$30 billion external] debt) and land for the landless (clear forests) and the other tree removal processes on the remaining 6 million ha [60,000 km²] of timber-land clearly indicate that the forested habitat of the Eagle will disappear unless there is a major shift in the Filipino’s attitude towards the environment and his role in it”. Salvador (1994) further acknowledged that logging and *kaingin* were compounded by corruption, inadequate law enforcement, and an ambiguous state policy towards forest conservation, and he indicated that around 1990 there were some 17 million people, the poorest in the country, in the uplands, poised to wipe out the remaining fragments of forest. It is clearly important to acknowledge the enormous difficulties these various circumstances represented to the effective operation of a coherent conservation strategy on behalf of the eagle.

It is worth noting that there are inevitably many considerable discrepancies over the statistics relating to forest cover and forest loss. Myers (1988) cited data indicating that in the

mid-1980s only 66,000 km² of “adequately stocked forests” remained, of which only 25,000 km² were old-growth dipterocarp forests and only 8,500 km² of these were of the best quality. Krupa (1989a) also referred to around 60,000 km² of timberland (above), but then tabulated and mapped eagle habitat as totalling 22,170 km² (unless this was equivalent to the 25,000 km² of dipterocarp mentioned by Myers). Dickinson *et al.* (1991) gave a total forest cover figure of 71,042 km² based on Swedish Space Corporation evaluation (SSC 1988), with 41,940 km² of open-canopy dipterocarp and 24,342 km² closed-canopy dipterocarp (but this includes other islands than the four in question here). Then Salvador (1994) referred to a USAID report from 1989 indicating that just 7,000 km² of old-growth dipterocarp remained throughout the archipelago, and PEWG (1996), using 1989 DENR statistics, put the figure at “about 9,220 km²”, with 6,218 km² on Luzon, 433 km² on Samar and Leyte, and 2,557 km² on Mindanao. Clearly these figures all represent results based on different methods of assessment and different information filters applied in the process; but inevitably their contradictoriness greatly reduces their usefulness to conservation biology.

Luzon Until recently the forests of Luzon largely escaped commercial logging owing to the smaller (typhoon-related) size of their trees (Lewis 1986). In 1988 Luzon (107,912 km²) retained 7,621 km² of closed-canopy and 16,034 km² of open-canopy dipterocarp forest (Dickinson *et al.* 1991); alternatively, according to Krupa (1989a) based on undisclosed sources, at around this time (1988) the island held five large blocks of forest totalling 8,300 km². Most of the remaining areas of lowland forest in the northern Sierra Madre (i.e. those within the Luzon range of the Philippine Eagle) are, however, under logging concession, and within a few years no such habitat will exist in northern Luzon (Danielsen *et al.* 1992), and this is doubtless also true of the southern Sierra Madre. Construction of several planned roads across the Sierra Madre will permit access to interior forests hitherto protected by the steepness of the terrain, resulting in settlement and destruction of habitat (both of eagles and of indigenous peoples) on a grand scale (Danielsen *et al.* 1992). A new industrial complex on the coastal side of the Northern Sierra Madre Natural Park has been proposed by the new governor of Isabela province (F. Danielsen *in litt.* 1997).

Samar At the time of the first discovery of the Philippine Eagle, a century ago, the “greater part” of Samar was “covered with a dense and lofty forest, many of the trees being over 240 feet high” (Ogilvie Grant 1897); Whitehead (1899a) himself said these tracts of forest were “still very vast, especially on the Pacific coast”, but noted that “for miles inland those of the western coast have been destroyed”; he found that it was only when he reached 300 m that primary forest began, and that “this forest is becoming annually smaller owing to the cultivation of hemp on suitable soils”, only drawing comfort from the fact that much country was unsuitable owing to its rough limestone topography. Somewhat later, Hachisuka (1932a) referred to the great majority of Samar being covered in high dense forest, but this was probably just a reworking of Whitehead’s statements. In 1988 the island, whose 13,429 km² must once have been almost or entirely covered by forest, possessed 1,359 km² of closed-canopy dipterocarp forest and 2,868 km² of open-canopy dipterocarp forest (Dickinson *et al.* 1991); alternatively, according to Krupa (1989a) based on undisclosed sources, at around this time (1988) the island held eight large blocks of forest totalling 1,950 km².

Leyte D. S. Rabor, reporting on his expeditions to the island (in Parkes 1973), recorded that in 1937 “the entire interior regions of both the Mount Lobi and Mahaplag areas, even in the lowlands, were predominantly original dipterocarp forests, which were only beginning to be logged”, but that both these regions “were well on the way to being badly deforested in 1964”. In 1988 Leyte, whose 7,995 km², like Samar’s, must once have been almost or entirely covered in rainforest, possessed a mere 104 km² closed-canopy dipterocarp forest plus 973 km² open-canopy dipterocarp forest (Dickinson *et al.* 1991); alternatively, according to Krupa (1989a) based on undisclosed sources, at around this time (1988) the island held two large blocks of forest totalling 400 km².

Mindanao In 1973, apparently suitable habitat still covered no less than 29,000 km², or about one-third of the entire land area of the island (Kennedy 1977); important if subjective assessments of the condition of some of the major eagle areas, already under pressure in the late 1960s, are recounted in Gonzales (1971). In 1988 the island (97,923 km²) retained 9,740 km² of closed-canopy and 18,122 km² of open-canopy dipterocarp forest (Dickinson *et al.* 1991); alternatively, according to Krupa (1989a) based on undisclosed sources, at around this time (1988) the island held 22 large blocks of forest totalling 11,520 km². The two figures in Dickinson *et al.* (1991) amount to almost 28,000 km², but the comparability of this figure with Kennedy's for 1973 is impossible without knowing what was meant by "apparently suitable habitat", or by "open-canopy dipterocarp forest". Nevertheless, Mindanao was long regarded as the stronghold of the eagle owing to the relative extent of its forests, but it is clear that there has been an extremely rapid deterioration of conditions on the island since the 1950s, compounded by political difficulties. Two particularly celebrated cases are the high mountain ranges focused on Mts Kitanglad and Apo, both major sites for Philippine Eagles. Mt Kitanglad in 1969 was reported to have had no logging operations but the threat to both the forest and the eagle was from armed squatters and *kaingineros* (Gonzales 1971); on the Malaybalay side, by 1989–1990, encroachment by impoverished farmers had extended generally to around 1,200 m, in places as high as 1,600 m (Lambert 1993c), i.e. penetrating close to or beyond the upper elevation for the eagle (see Ecology *Habitat*). In autumn 1983, presidential decree PP2282 proposed that half of Mt Apo National Park would be sold off to squatters, legalising their presence in and clearance of the mountain's forests; according to a memo of the Wildlife Division (opposing the decree), only about 265 km² of primary forest then remained in the park (BirdLife archives). Settlers petitioned a government organisation known as KKK (under the Ministry of Human Settlements run by Mrs Imelda Marcos) to allow title on all "denuded" land, and as a result some 15,000 km² of government land were released in a number of parcels which had been simply drawn off satellite images, and two of which, Parcels 16 and 17, happened to cover 56% of Mt Apo National Park (BirdLife archives). One area was cleared, cultivated and settled by a substantial human population within 10 years of being selectively logged, and an entire township was established there (see Lewis 1986). Encroachment at Mt Apo has meant that at Tudaya Falls the eagle pair has relocated their nest three times since 1977, each time moving higher up the valley away from farmers (Lewis 1985). The Mt Apo Geothermal Project, implemented by the government's Philippine National Oil Company, is seen as a threat to the remaining forest stands in Mt Apo National Park because the construction of a road system provides easy access for illegal loggers and settlers (D. Salvador verbally 1993). At Bislig good primary forest is being clear-felled (under the PICOP logging concession) and the land planted with exotic trees for paper production (B. Gee *in litt.* 1997; also Caufield 1983). The deliberate conflagration of forests—associated with insurgency—is a problem, particularly on the Zamboanga Peninsula (D. Allen verbally 1997).

Rates and extent of habitat loss Gonzales (1969) stated that Mindanao was "still largely covered by relatively extensive forests" but also reported a destruction rate of 2.47 acres every three minutes, which works out at 20 ha per hour and 1,750 km² per year (a figure also evidently computed from the same data by Sitwell 1975); he added that "no mountain on Mindanao seems high or remote enough today to escape human invasion". Kummer (1992) recorded rates of loss in the years 1980–1987 of between 951 and 2,103 km² per year. Deforestation is continuing at a rate of 1,000 to 2,700 km² per year (DENR data made available to BRT). Calanog (1978) reported a decrease (in fact a halving) of dipterocarp forests from 138,000 to 69,000 km² in the period 1968–1976, a rate of around 8,600 km² per year, and on Mindanao a rate of forest destruction of about 900 km² per year (this latter figure being reported as if enormous—"in Mindanao alone"—in relation to the national rate). Krupa (1989a) reported recent estimates that old-growth forest covered only 10,000–27,000 km² and that all such

forest would be logged by the early 1990s and “the entire forest wiped out as early as 2007”. There was also a prediction that by 1990 all primary lowland forest in the country would have gone, and that by 2000 all accessible forest, leaving only forest at elevations too high to be habitat for the eagle (see Lewis 1986; also Krupa 1989a). By 1987 (based on figures dating back to 1969) deforestation in the Philippines was proceeding at a rate of 1,900 km² per year, and by the end of the 1980s only some 7,000 km² of old growth dipterocarp forest was judged to remain (see Salvador 1994; also PEWG 1996). Given that total forest cover declined from 155,400 km² at the start of the century to 71,000 km² in 1988, an annual rate of deforestation of 1,100 km², equivalent to 3 km² per day, has been computed, although it is believed that the current rates are far higher than these averaged figures would suggest (Dickinson *et al.* 1991).

Impact of selective logging Apart from the fact, already noted, that selective logging opens up areas for *kaingin* and therefore leads to the intentional clearance of all tree cover, in 1982/1983 there was a prolonged dry season apparently related to the El Niño phenomenon, which, exacerbated by already very patchy distribution of forest and exploited by the *kaingin* practices of burning, led to the outbreak of forest fires that accidentally destroyed huge areas of eagle habitat (“whole forested mountains were burnt”) (Lewis 1985, 1986); this also happened in the early 1990s (L. R. Heaney *in litt.* 1997). In terms of eagle biology, preliminary findings of 1981 studies suggested that particular logging practices (not specified) had little effect on breeding success if restricted during the courtship, egg-laying and incubation periods (Kennedy 1982a), although this seems of no long-term relevance in the context of forest loss generally in Mindanao and given that it was based on a sample size of one; the eaglet in question did in fact die of malnourishment and dehydration caused by a bacterially induced gastroenteritis (Kennedy 1982b). Lewis (1986) was somewhat ambiguous on the issue: on the one hand he asserted that “logged-over areas may yet prove to have a high conservation value, provided subsequent human settlement is prevented and forest regeneration takes place” because “eagles will remain and attempt to breed so long as the nest tree is undamaged, and disturbance minimized during the breeding season”; yet on the other he reported that “prey deliveries by the male to the female and chick are a lot less frequent (up to five days between deliveries) in poorer habitat” and that at one 1983 nest “so little food was brought to the incubating female that she... finally deserted the egg”. At the Kibawalan study site, 1963–1964, the eagles chiefly frequented an area of forest which was still largely intact with few human habitations, on the assumption that their preferred food items were present there (Gonzales 1968); this suggests that there may be an important effect on prey abundance, although this could in part be a function of human occupation of logged areas (see *Local exploitation* below).

Other factors Many further factors afflict the Philippine Eagle. These commonly act in concert with habitat destruction and are sometimes closely related to the forces causing this loss.

Persecution At the time of first discovery, local people reported that the eagle “not infrequently visits the villages and carries off domestic poultry” (Ogilvie Grant 1897). Moreover, on Luzon (specifically in Benguet: see Distribution) Whitehead (1899a) had been told by natives that “sometimes their small pigs were carried away by Eagles”, and early live specimens were caught in a noose at a trap baited with a small pig (Seth-Smith 1910a, McGregor 1918). In southern Mindanao the species is reported to take dogs, cats and pigs from the yards of native dwellings, in the period when they are feeding their young (Wharton 1948). The records of four being shot at Mt Kitanglad, 1966–1968, four (five counting one taken by D. S. Rabor) at Mt Matutum, 1966–1969, three at Mt Agtuaganon, 1967, two at Mt Timolan, 1967–1968, and one at Munai, 1968 (Gonzales 1971)—i.e. a total of 14 (15) in four years—hint at the extent of the damage to the population that must have been inflicted by this uncontrolled persecution (for whatever cause). At least 25 birds were known to have been captured or shot in the Sierra Madre, Luzon, in the years 1970–1991 (Danielsen *et al.*

1992), and the species was judged to avoid lowland forest in the Sierra Madre in part owing to habitat destruction and in part owing to hunting pressure (Poulsen 1995). Human persecution of eagles because they take domestic animals was not supported by evidence from the 1963–1964 nest study, and indeed circumstantial evidence suggested that this was possibly a self-perpetuating myth (Gonzales 1968).

Local exploitation Wharton (1948), whose comment appears to have been based on information received in southern Mindanao, reported that “tribesmen trap and eat it, using a white dog as bait”. This practice was confirmed at Mt Matutum in 1969, where all four eagles reported shot (see above) were for food (the flight feathers of one bird being used as a broom) (Gonzales 1971); indeed, at this site a Bila-an hunter reported having shot over 12 birds in the 12 years 1957–1969, all for food (Gonzales 1971). Moreover, the rapid decline of the eagle’s prey populations, attributable in part to human exploitation, is considered an exacerbating factor in the eagle population decline (D. Salvador verbally 1993). Even in remote parts of the Sierra Madre local people report that bushmeat is increasingly difficult to obtain (F. Danielsen *in litt.* 1997).

International trade Hachisuka (1936) referred to the persistent interest of museums in obtaining specimens of this species, but five years later he reported (Hachisuka 1941) that, after the 20 or so specimens referred to in his book (Hachisuka 1931–1935), the only material exported from the Philippines were four study skins procured in 1927–1928 by T. Hirazawa and two live birds in San Diego and London Zoos respectively. In 1946–1947 Wharton (1948) obtained three live eagles from southern Mindanao which he exported to the National Zoo, Washington, USA, and Mindanao was singled out as the source of “many records” of birds captured (in snares baited with puppies, baby monkeys or other small mammals) for the zoo and museum trade (Manuel 1953). In the early 1960s there was considerable concern at the number of eagles being exported for zoo exhibition around the world, and this problem was identified as the principal cause of decline (e.g. Anon. 1964, Rabor 1965, 1968). Between 1963 and 1970 birds were known to be held in locations as diverse as Abidjan (Ivory Coast), Beira (Mozambique) and Saigon (Vietnam) as well as in many zoos in Europe and the USA, the highest total number of captive animals (23) being reported to the *International Zoo Yearbook* in 1965 (still a minimum, since many others would not have been reported at all) (T. P. Inskipp *in litt.* 1981). In late July 1964 alone, six specimens were exported (Talbot and Talbot 1964). In 1968 two eagles were captured alive at Mt Malindang and exhibited in Ozamis City but, despite this being reported to the authorities, lack of personnel prevented any action being taken (Rabor 1971). Some parties were believed to be smuggling eagles from Mindanao to Singapore, for sale from there (Rabor 1971). In 1984 a captive eagle, Tsai, was returned to the Philippines from Taiwan for breeding purposes; how it came to leave the Philippines in the first place is not clear (N. R. Ingle *in litt.* 1997).

Trophy hunting and the local pet trade Uncontrolled hunting “for mounting as parlour trophies” was significant in the 1960s, such trophies being status symbols (often bought by non-hunters from hunters), with strong competition to obtain the biggest ever recorded (Talbot and Talbot 1964, Rabor 1965, 1971). Moreover, to kill a bird with one’s own gun, as proof of one’s prowess as a hunter, was considered highly prestigious (“People are ruthlessly catching them alive and shooting them for trophies, all over Mindanao”: Rabor 1965), the great number of people bearing arms rendering the situation virtually uncontrollable except through a public education campaign (Talbot and Talbot 1964). Throughout the 1960s the situation barely improved: from the Kibawalan pair (studied 1963–1964) “several young eagles were known to have been captured alive or dead” (Rabor 1971); in 1968 a bird from two pairs reportedly inhabiting Mt Sugarloaf was shot and sold for taxidermy in Midsalip (Rabor 1971); and the pair shot at Lumba-Bayabao, Mindanao, June 1969, were seen in “an embalmer’s establishment” (Rabor 1971). Moreover, the continued capture of nestlings for pets in the private residences of prominent families, and for local zoo exhibition, “does not help” (Rabor

1965; also 1968). Even in the past decade there have been several rumours of eagles being sold as pets (N. R. Ingle *in litt.* 1997).

Lack of law enforcement or institutional interest Rabor's (1965, 1968) final item in his list of threats was "the total lack of enforcement of whatever conservation laws and regulations have been promulgated by the government, for the protection and the conservation of this rare eagle" (too few personnel, too concentrated on peace and order). In January 1964 he wrote to S. D. Ripley (BirdLife archives) about the threats to the eagle: "The worst thing is that there is nobody to appeal to, for help; not even the government entity supposedly in charge of the conservation of the species. Any report will just be lost in red tape." These comments refer to (lack of) controls on both logging and hunting.

Civil strife It was difficult to survey forests in North Cotabato and Lanao del Sur in the late 1960s owing to unstable political circumstances (Gonzales 1969, 1971), and the Moslem rebellion on Mindanao in the 1970s and New People's Army (NPA) insurgency there in the 1980s effectively made the entire island unsafe for would-be eagle collectors and led to a banning of firearms, which was thought likely to buy time for the eagle (Basan 1976). Nevertheless, the civil conflict on the island also greatly exacerbated the problems of achieving real conservation on the ground: it repeatedly curtailed field studies, from R. S. Kennedy's first visit (Lovejoy 1973) and his second with FREE (Kennedy 1981a, 1985) down to the work of PECP in the 1980s, when for example many areas and many nests became off-limits to study, even when well known and close to PECP headquarters, such as those on Mt Apo at Amabel and Kiandang (Krupa *et al.* 1984). Several unsubstantiated reports referred to government troops shooting eagles, and this may in fact have had a significant impact on local populations (N. R. Ingle *in litt.* 1997). On Luzon NPA activities were until recently a great hindrance to fieldwork (F. Danielsen *in litt.* 1997). In 1996 an agreement was struck between government and at least some Moslem groups, and NPA resistance has been waning since the retrenchment of communism in the late 1980s; however, these developments may do no more than expose previously inaccessible eagle habitat to timber extraction and human invasion.

Toxic chemicals Species at the terminus of food-chains may accumulate pesticides which reduce their reproductive output; Lovejoy (1973) drew attention to the possibility, albeit small (given that the eagle is a deep-forest dweller and feeds on deep-forest prey), that this problem might affect the Philippine Eagle. Several captive-laid eggs of wild-caught birds had thin shells attributed to pesticides (N. R. Ingle *in litt.* 1997). Pesticide usage in the Philippines in the 1990s is unabated (BRT) and the potential for this effect must exist in some areas.

Natural problems Natural enemies include Rufous Hornbill, Writh-billed Hornbill *Aceros leucocephalus* and Large-billed Crow *Corvus macrorhynchos*, all of which are very aggressive and noisy, and will never leave the eagle alone when it alights in their vicinity (Gonzales 1968; also Rabor 1965, 1968); these birds are, however, only likely to pose any kind of threat to young or weak birds. Combat with a large python has been reported at least once (see Ecology *Food: general considerations*), but probably as a result of the latter being attacked as prey; however, some large snakes may be a threat to nestlings or very recently fledged young. There is a reported instance of a very thin female being captured when grounded and drenched by rain (McGregor 1927), which clearly invites much speculation: a wandering bird (e.g. young, recently expelled from its parents' territory), an orphaned bird, a sick bird, an old bird.

MEASURES TAKEN In this account, the various initiatives taken over 30 years are dealt with chronologically, except for captive breeding, which belongs in a section of its own.

First phase: the 1960s In response to the fears that the zoo trade represented a significant threat to the Philippine Eagle, total prohibition of the export of eagles was called for (Anon. 1964) and implemented without success (Rabor 1965). However, simultaneously ICBP spearheaded a campaign to persuade American and European zoos to observe a self-imposed

ban on exhibiting the species, and the zoo community appears to have reacted with prompt and uniform goodwill (BirdLife archives). Certainly by the 1970s the number of eagles held in zoos had declined, and an assessment of the years in which they were received indicated that zoos had established a self-imposed embargo on the acquisition of specimens (Kennedy undated). A year's biological study of the species, July 1963–June 1964, was inaugurated by ICBP with funds from WWF and the Frank Chapman Fund of AMNH, and conducted (with brief follow-up work in late 1967 and April 1968) by Gonzales (1968). Publication of Gonzales's study helped fuel renewed interest in the species, and in 1969 two surveys, paid for by the British and US sections of ICBP (Rabor 1971), were conducted on Mindanao, one by Gonzales (1969) in April–June, and one in September and October by the government's Parks and Wildlife Office (PWO), both targeting nest sites and eagle concentrations in an attempt to assess the feasibility of establishing research centres on the island at which to formulate conservation and management programmes for the species, and to draw up a research project designed to take five years from January 1970 (Alvarez 1970; also Gonzales 1969, 1971). The PWO's public awareness campaign was given impetus by a visit from the celebrated aviator Charles Lindbergh in 1969, when a bill providing for the protection and conservation of the eagle, and aiming to declare it the national bird, was prepared (Alvarez 1970).

Second phase: the 1970s The Monkey-eating Eagle Conservation Programme (MECP) was launched in mid-1970 by the Philippine Wildlife Conservation Foundation involving the PWO: three teams covered eight provinces in Mindanao under direction from a project office in Davao City, aiming to work for five years on identifying key areas, establishing research centres in them to formulate management programmes, and achieving reserve status for them ("as many areas as there are nests and certain of the original forests within the eagle range") (Alvarez 1973). The MECP also pursued the surrender of captive birds with a view to their release into the wild ("Return to Freedom project"), and by 1972 five were held for this purpose (see Remarks 26); much energy was also invested in publicity for the eagle and its plight, as a way of ensuring greater public support for the project overall (Alvarez 1973). An immediate initiative was the advocacy of legislation protecting the eagle and its habitat, resulting first in a Presidential Proclamation prohibiting the persecution of the species and providing for the reservation of nesting areas, then in Republic Act no. 6147 formally establishing this protection in law (Alvarez 1973, Krupa 1989b). However, the Parks and Wildlife Administrative Order of 1971, which provided for a sanctuary within a radius of 1 km of an eagle nest, was thought to have resulted in no reserves being established by 1975 (Bonnit *et al.* 1977), although in fact at least one did then exist and was being respected, even if the real need was for a 5 km radius (Sitwell 1975). By this stage, government law prohibited the hunting, trapping, killing or mere possession of the species (Calanog 1978).

The MECP evidently failed to meet its objectives: by around 1975, when the project's initial term was due to end, "the legislation has not been enforced, eagles are still being killed and captured, and no sanctuaries have been established... The information campaign, which in any case touched city people and not forest dwellers, has all but ceased... [and] the attempt to re-introduce captive animals to the wild has failed" (Basan 1976). The project was supported by US Peace Corps volunteers, in the first instance in 1972–1973 by Kennedy (1977), then in the period 1973–1975 by the co-workers of C. B. Bonnit (Bonnit *et al.* 1977).

Listing on CITES Control of international trade in eagles was considerably advanced when the species was included in the first batch of listings on CITES Appendix I, effective from 1 July 1975, which continues to prohibit the movement of live or dead specimens or parts of specimens (including feathers), or their eggs (with or without living embryos).

The FREE initiative Films and Research for an Endangered Environment (FREE), Ltd, was formed in 1976 with a first target of studying and filming the eagle, and "to initiate a breeding programme with the captive eagles at the rehabilitation station in Mindanao"; fieldwork towards these aims began in October 1977 and a captive breeding programme

commenced two months later (Kennedy 1981b,c). FREE's exact aims were enumerated in Kennedy (1985) as: (1) to conduct a preliminary population survey of the eagles on the islands of Luzon, Samar and Leyte; (2) to document the breeding ecology and behaviour of the species; (3) to determine the post-fledging activities of a juvenile eagle; (4) to initiate a captive breeding programme; (5) to film the entire nesting cycle and use it in educational programmes in the Philippines.

The 20-minute film about the eagle, *To live and be free*, was made in the period 1977–1981 (Anon. 1983, Kennedy 1985; see [*Third phase*] *the 1980s: Education*), but a second film, on sustainable forest use, was never completed (Kennedy 1983).

Education In a study in the mid-1970s on Mt Apo, 64% of settlers were indifferent to the species, 33% were positive and 3% were hostile; an education programme was therefore regarded as vital to the conservation of the species at the site (Calanog 1978), and this perception has been widely endorsed as applying throughout the eagle's range, underpinning the promotion of *To live and be free*.

Change of name In May 1978, following lobbying by FREE, President Marcos changed the bird's name from Monkey-eating to Philippine Eagle by special presidential decree (no. 1732), without, however, officially declaring it the national bird (Kennedy 1978, 1981b,c). The appeal to national pride in this name change was clearly felt desirable, particularly as in the mid-1970s foresters, frustrated by initiatives to protect nests and to compel their companies to observe the rules of their concessions, had begun to refer to the species as the "money-eating eagle" (Basan 1976).

Third phase: the 1980s A three-year plan for the eagle, prepared in collaboration with FREE and BFD (Bureau of Forest Development) by the ICBP Birds of Prey Group (which, however, ceased its involvement soon after the start of the project, with IUCN taking responsibility for the WWF-funded components) received support from WWF (Project 1531) and elsewhere (Kennedy 1981a, Anon. 1983, plus BirdLife archive documents). The proposal's original workplan envisaged the following activities: (1) improvement of population estimates for all areas of habitat (to be mapped using apparently existing facilities in the Philippines for Landsat image analysis), extending (for no clear reason) to north-east Kalimantan (Indonesia); (2) intensive studies on longevity, home range and habitat requirements in Mt Apo National Park using colour-marked and radio-tagged birds; (3) expansion of the captive breeding programme to a nucleus of pairs (four at Baracatan, two elsewhere in the Philippines and two abroad, with the declaration that no wild birds would be needed for this expansion); (4) a public awareness campaign hinging on the films and other material being prepared by FREE; (5) recommendation of areas that should be established as sanctuaries, these being a minimum of 200 km² in extent (BirdLife archive documents).

This project began in July 1980, starting with survey work at Mt Apo, Mindanao, but, after a guerilla attack on the camp, its focus quickly shifted to Luzon and Leyte; the objectives were to establish the true number of pairs in the Mt Apo range, to determine the population size on Leyte (and check for presence on adjacent Biliran), and to initiate a quantitative censusing programme for the eagle (Kennedy 1981a, Anon. 1983). Within two years of its commencement, the project was being described as having started in 1970 (Kennedy 1982a), and was presumably thus being conceived as an extension of the work reported under the second phase above. However, at this stage the emphasis fell most strongly on captive breeding, with research and education following behind: the research was planned to improve estimates of the population throughout its range, and to locate 5–10 nests to study breeding biology, home range, habitat needs, prey abundance, and the effects of logging (in 1981 two active nests were found and measurements of prey abundance and habitat use initiated), while the education involved showing a film to about 8,000 people (mostly schoolchildren in Manila and Davao) and the distribution of about 25,000 colour brochures throughout the country (Kennedy 1982a, 1985). In 1980 projected field survey work, needing to adapt to problems of

security, was scheduled to include further work on Leyte and Biliran (suggesting that the negative evidence from this latter island was not conclusive), safe areas of Luzon (two months), Negros (1.5 months), Mindoro (two months) and the “northeast mountainous region of Borneo” (one month) (Anon. 1983). The BFD completed a survey of eagles on Mindanao, finding them in almost all the provinces of the island (Kennedy 1982a). Logging companies worked to help set aside small sanctuaries within concessions to protect nest sites (evidently in compliance with the 1971 administrative order), and an education-reward scheme (which apparently became “Adopt-a-nest”: see below), in which company employees and concession-dwellers were taught about the eagle and rewarded for finding nests, was tested at PICOP (Kennedy 1982a,b). In 1982 the research was aimed again at documenting the breeding biology and behaviour, habitat requirements and prey species, just of the two pairs at PICOP found in 1981, both of whose nests however failed (Kennedy and Alvarez 1984). The educational work involved translating the voiceover on a film into two major Philippine dialects (Kennedy and Alvarez 1984).

The attack on the camp at Mt Apo was evidence of the deteriorating security conditions in Mindanao which clearly inhibited any coherent surveys and studies of wild birds. This was later compounded by an increasingly severe debt crisis in the Philippines (US\$29 billion in 1987) which exerted even greater pressure on remaining forest tracts and on potential croplands, which were converted to cash-crops for export (Myers 1988). Unemployment rose rapidly (labour became the Philippines’ largest export industry), with many people returning to the land, often to squat in the forest (BRT). It was in this context that releases of eagles *into* the wild converted to nestling acquisition *from* the wild, the Adopt-a-nest scheme fell into disuse, and the PECP modified itself increasingly into a captive breeding project.

It is not known to what extent the objectives stated in WWF/IUCN 1531 were successfully followed up between 1980 and 1982. So far as can be judged, the status and distribution of the eagle remained unclear because some of the objectives originally stated were not achieved, namely: habitat requirements of the eagle were not identified in detail, extent of available habitat (from Landsat images) was not mapped, home ranges in different regions or habitats were not elucidated, possible occurrence in Borneo was not investigated (money well saved), and population dynamics studies (including telemetry and colour marking) were not accomplished. In this regard the project was as much a disappointment as the MECP begun in 1970 and commented on (see above) by Basan (1976).

Releases into the wild Kennedy (1982a) reported that it was an intention to release as many birds as possible that were donated or confiscated back into the wild (i.e. without entering the captive breeding programme). According to Kennedy (1985), two birds were released into the wild in 1981 and were still alive in January 1982, although this is not mentioned in any other publication traced, and no account is given of the techniques for preparing for and monitoring of such an event. Lewis (1985) reported that in early 1985 two adult eagles, both in good condition and both recently captured, were released back into the wild with radio transmitters on their tails, the areas chosen being already partly encroached and denuded, the intention being to ascertain the ecological requirements of the birds and the truth about their alleged exploitation of domestic animals. No results of this experiment appear to have been published.

Adopt-a-nest Krupa (1989a) described this PECP programme (which appeared to consist of a reward of US\$150 to local groups who monitored a nest through to fledging) as “the most promising management scheme” which, since its launch in 1985, had resulted in natives and logging-concession workers reporting a total of eight occupied nests. However, within a few years the programme appeared to be failing from loss of eagle habitat (Salvador 1994), although another explanation of its demise was the ill-feeling it generated through the perceived injustice of the reward system, culminating in the burning of a nest tree at Mt Matutum in 1987 (P. L. Alviola verbally 1997).

Education FREE's film had enormous impact, quickly engaging people's sympathy, but lack of funds meant that it was only shown around Davao (Lewis 1986); however, a further—and entirely inherent—shortcoming was that it failed to express an understanding of the problems and provided no answers (Krupa 1989a). Nevertheless, the education component of PECP's work as outlined for 1985 (Krupa 1985) was very feeble (see *Captive breeding*, below), even though Krupa (1989a) argued that the eagle could serve “as a significant rallying point for conservation awareness and can lead to the creation of a conservation ethic which... is the major prerequisite of any successful species preservation effort”. Indeed, it was the captive eagles that represented the genuinely powerful education tool in motivating people over the bird's plight and over forest conservation in general (Lewis 1986). Krupa (1989a) enumerated the educational initiatives of PECP, which included posters, pamphlets, brochures, lectures, public displays (at airports, civic centres) and goods (t-shirts, towels, carstickers, dolls, postcards). All of this clearly may have helped establish and maintain the plight of the eagle in the general public's mind, but (as with the shortcoming Krupa identified in FREE's film) it clearly can have done very little to bring the real problems and solutions to the attention of key figures such as politicians, businessmen, government officials and local communities, and it is by no means clear that the conservation message of any of these initiatives was sufficiently strong or constructive. The breeding centre at Malagos appears to have received around 100 visitors a day, perhaps more in recent years (N. R. Ingle *in litt.* 1997), which indicates the potential that such a place has for helping establish the plight of the eagle in the public mind (although of course the message transmitted there needs to alert rather than assure visitors over the tasks to be undertaken).

Attempts at law enforcement Kennedy (1983) reported an incident after the law was revised to provide for a 2 km disturbance-free radius from a nest, which researchers duly attempted to impose: the disastrous result was that about 200 families who were instructed to relocate themselves reacted by seeking to kill anyone from the eagle team, and the project was therefore hurriedly redesigned to attempt to promote the importance of forest as a renewable resource (as noted earlier, however, the film to help with this was not completed owing to lack of funds). This may well be the same incident described by Krupa (1989b), although he attributed the backlash to the logging companies, since the conservationists had pointed out that under law it was the concessionaire that should protect the area: the presidential cancellation of the concession turned loggers against conservationists and government officials against what they—having no particular regard for conservation—evidently saw as so petty and counter-productive a law.

Fourth phase: the 1990s The present decade has seen certain changes in the pursuit of conservation of the Philippine Eagle, including the final recognition of Luzon as a target of study and conservation effort, the installation of a Philippine national at the head of PECP (most recently named PEFI), and a fuller perception that a solution to the eagle's plight must ultimately be part of a solution to the plight of poverty-stricken local human populations, precisely because it is their unsustainable exploitation of natural resources that stands to negate every conventional management response on behalf of the eagle (education, biological surveys, delineation of sanctuaries, and the laying down of regulations) (Salvador 1994). The PECP Socio-Economic Project was accordingly launched in May 1990 as a pilot study at a former eagle nest-site settled by people in “grinding poverty” (average annual income US\$168), who “knew of the destructive consequences of their activities, but acknowledged it as a necessary sacrifice to sustain their daily needs”; a PECP team drafted a programme jointly with the local community consistent with available resources and perceived needs, covering social preparation (seminars reviewing current circumstances and prospects), training, implementation of livelihood, cooperative formation, reforestation and phase-out (Salvador 1994). Social preparation showed them that “their own resignation to their plight was the only real obstacle to development”, and by the second month of the project the community had stopped all

illegal logging and *kaingin*. The current state of this project is unknown, but the little reported here shows (1) how much can be achieved through the deployment of sound ecological knowledge, community-oriented thinking, and relatively small financial resources, and (2) how massive is the task facing conservation if this exercise is to be replicated successfully throughout the regions in which the Philippine Eagle occurs. It is, perhaps, also reasonable to make two further comments here: (a) that there is still a reluctance to acknowledge the need for restriction and rationalisation of commercial timber extraction in relation to the eagle's future, and (b) that the conventional management responses mentioned above had also included captive breeding, which appears to have absorbed the great majority of the funds and attention spent on the eagle in the entire period of the 1980s, whereas if the primary emphasis had remained, from the outset, the conservation of the species *in situ* then the other management responses might have been more effectively implemented (which inevitably would have meant highlighting and addressing the issue of habitat destruction by migrants and other landless human populations, as well as that wrought by commercial interests).

Activities on Luzon The survival of the species in eastern Luzon into the 1960s was attributed to "the really wild state of the virgin forests", the sparse human populations there, the presence of head-hunting tribes (discouraging hunters and collectors), and the presence of remnant HUK (communist) forces there following the early 1950s uprising (Rabor 1965, 1968). In May 1991 a survey of eagle habitat in the Sierra Madre mountains of Isabela province, and aerial surveys of Cagayan and Isabela, were conducted by a joint Danish-Filipino team (Danielsen *et al.* 1992). In 1979 all forest land within a 45 km radius of Palanan, Isabela province, had been declared a Wilderness Area, which prohibited its settlement; yet in 1991 21,000 people were found to be living within its confines, most of them unaware of their transgression (Danielsen *et al.* 1992; see Measures Proposed). Conservation of the region is being paid for by various international bodies, including GEF through DENR and NIPAS (which includes the Northern Sierra Madre Natural Park), the World Bank through NORDECO and Haribon Foundation, the Dutch government (DGIS) through Plan International, and the MacArthur Foundation through Conservation International (BRT). In February 1997 PAWB submitted to the Secretary of DENR the text of a proposed presidential proclamation which will establish 2,870 km² of land as a protected area (F. Danielsen *in litt.* 1997).

According to PEWG (1996), in 1990 DENR/PAWB initiated the Philippine Raptors Conservation Program (PRCP) "to focus activities in the Luzon and Visayas Regions", but no further information on this is given.

Installation as national bird Presidential proclamation no. 615, dated 4 July 1995, established the Philippine Eagle as the national bird of the Philippines, and all government offices, agencies and instrumentalities are consequently enjoined to ensure the proper conservation, protection and management of the species (PEWG 1996). In 1997 the eagle was featured on an environmental awareness poster as part of the "Only in the Philippines" series, funded by British Airways Assisting Conservation and FFI, with text in English and Tagalog (W. L. R. Oliver verbally 1998).

Protected areas The species occurs at three CPPAP sites (Northern Sierra Madre Natural Park on Luzon; Mts Kitanglad and Apo on Mindanao) and one NIPAP site (Mt Malindang on Mindanao; see Appendix). In addition, Mt Matutum on Mindanao was reportedly established as a forest reserve in the late 1960s, although confirmation was lacking (Gonzales 1971); it now receives FPE funding for conservation-related activities (see Appendix). Maria Aurora Memorial National Park on Luzon is classified as a national park, although the effective protection conferred by this status is unclear given recent alterations to the protected area system (see Appendix). Also on Mindanao, Mainit Hot Springs National Park held the species in the 1970s, but whether this area is still gazetted is unknown. Mt Timolan was reportedly a forest reserve, owing to its watershed importance (Gonzales 1971), which if true

(DENR appear not to have it registered as such) suggested that the site had considerable conservation promise.

Implementation of CITES There were (at least) two cases in the mid-1990s involving smuggling of dead eagles that resulted in prosecutions: in one, a Danish citizen, A. Birkekvis, was found in possession of a stuffed eagle which was impounded and returned to the Philippines in September 1994 (PEWG 1996); in the other, a Dutch citizen, N. P. Peters, was jailed for two years in the UK in May 1996 for receiving from P. Cua, a dealer in Manila, an eagle skull (brain still inside, therefore from a recently dead bird) (*Traffic Bull.* 16 [1996]: 72–74, NJC).

Captive breeding It was R. Fyfe in August 1974 who originally suggested that captive breeding of the variously confiscated or zoo-held stock of eagles might be a valuable supplement to *in situ* conservation endeavours (Bonnit *et al.* 1977). Ten years earlier it was asserted that the species was unlikely to breed in captivity (Anon. 1964), and after Fyfe's suggestion it was argued that the birds would certainly not do so as then (1975) kept in the Philippines (King 1978–1979; see also Remarks 27), for two reasons (neither of which is actually an argument that the species would not *breed* in captivity): (1) because the confiscated birds were fed on chickens, once released they would be likely to endanger their lives by hunting such prey near habitations; and (2) imprinting of captive birds on humans (which in raptors can apparently occur beyond the fledging stage) would be likely to result in maladjustment in the wild (Bonnit *et al.* 1977). Nevertheless, during the period 1975–1980 the idea of using the captive stock in the Philippines for a breeding initiative took root, for although Kennedy (1977) made no mention of it even as a recommendation, a FREE/BFD programme involving R. Krupa began in December 1977 at Baracatan within Mt Apo National Park, using donated and confiscated birds (Kennedy 1981b). The rationale for this venture appeared to be that “if the species should ever be eliminated in the wild due to human-caused environmental problems, the offspring from the captives can be used to restock areas when conditions favorable for them have been restored” (Kennedy and Alvarez 1984; see Remarks 28). In 1980 plans were approved to establish a second facility (the Philippine Raptor Center) at Mt Makiling, on the UPLB campus, with funding for construction and operation from the BFD (Kennedy 1981a), but this was still unbuilt in 1981 (Kennedy 1982a) and was in fact only completed around 1992; three rescued eagles brought to the centre have already died (BRT).

In 1981 there were six eagles at the project site, including two “compatible” pairs, one of which laid a probably infertile and in any case weak-walled egg (Kennedy 1982a). In 1982 the female of one compatible pair killed its mate, the other compatible pair produced an egg which, as before, quickly broke, and the addition of a new arrival meant that the project concluded the year again with six birds; negotiations were opened with the Peregrine Fund for a cooperative venture (Kennedy and Alvarez 1984). In late 1984, when the species had not been successfully bred there or anywhere else in the world, the facility held 10 eagles, many so heavily imprinted that artificial insemination using human keepers as sexual partners was being practised (Lewis 1985).

In fact, as far back as 1980 (i.e. at the time of the initiation of the three-year plan drawn up by the ICBP Bird of Prey Group), the project had been advised by “captive breeding specialists throughout the world” that “to insure [*sic*] success, we must use young birds that will imprint on their trainer”, and WWF had been invited to comment on a proposal to remove 2–4 nestlings from the wild (Anon. 1983), even though this flew in the face of a commitment made only a year or so earlier that no wild birds would be needed (see [*Third phase*] *the 1980s*, above). The importance of such anticipated success was presumably related to the declared overall target of perpetuating the eagle until such time as habitat was once more available for it; this emphasis is perhaps more understandable as the security situation in the country at the time appeared (from the map of no-go areas in Anon. 1983) to place virtually every area where eagles might occur off-limits to fieldwork. In 1984, the by then

named Philippine Eagle Conservation Program, hereafter PECP (as managed by the Philippine Eagle Conservation Foundation, hereafter PECF), drew up a plan for 1985 that involved targeting a number of nests (apparently the four nearest to the breeding centre) for egg or chick removal (two of the former, one of the latter) (Krupa 1985).

Krupa's (1985) report suggests a decided managerial shift in priorities for the PECP, with greatest project activity emphasis falling on captive breeding, and even much of the fieldwork being weighted towards the finding of nests from which material for captive breeding might be obtained (although monitoring of areas, population surveys and habitat analysis are listed, evidence of real scientific rigour in their implementation is absent); as further evidence of this trend, office routine outlines related to the running of the facility occupied three times as much space as education workplans. By the late 1980s, PECP was seeking to recover eggs and chicks "from the doomed fragments" that the government admitted it could not protect, for distribution to a consortium of captive breeders, with the intention to "seed back" offspring through foster parenting and hacking (Krupa 1989a). This initiative to remove eggs and young from what was then termed "selected, critically threatened nest sites" was described as being "hampered by individual professional 'opinions' and political 'feelings'" (Krupa 1989a). In response to a review that sought to place captive breeding in general in a proper conservation perspective (Imboden 1987), the PECP *Third Quarter Report 1987*: 1–2 had issued an incoherent declaration from which it could be inferred that the new expectation and target of the eagle captive breeding programme was to produce a line of semi-domestic animals for preservation in highly modified or restricted habitats with a high degree of constant human intervention. It is evident from the number of staff biologists who left the project during the period 1983–1990 (as inferred from various sources) that significant management difficulties existed in PECP which prevented, against the wishes and judgement of many, the fulfilment of the field initiatives which are now so much more urgently needed.

Whether or not the ultimate justification of the captive breeding programme has changed or been refined since this statement is not known. Very little has been published on PECP policy and thinking in this regard; the fourth programme objective in PEWG (1996) refers to establishing facilities inside and outside the Philippines "to maintain a captive population indefinitely from which progeny can be translocated to maintain or re-establish wild populations", where perhaps the most surprising word is *translocate*, which gives the impression that the birds are in a semi-wild condition in captivity and need very little manipulation to achieve wild status (which cannot in fact be true: see Measures Proposed *The problem of captive breeding*, point d). There are now sensible informal guidelines (Black 1991) to which all re-introduction programmes should refer before becoming committed to courses of action whose full implications have not been evaluated. Meanwhile, the results of the captive breeding programme are as follows: to date (December 1998), only two have been truly captive-bred (albeit both through artificial insemination) and are still alive, "Pag-asa" ("Hope", hatched January 1992) and "Pagkakaisa" ("Unity", hatched October 1992), both from the same parents, of which the female died in 1995 (BRT). On the other hand, a recent initiative to remove eggs or eaglets from the wild (see Measures Proposed *The problem of captive breeding*, point g) resulted in the death of the one eaglet taken, although post-mortem examination apparently revealed that it was already diseased (B. Puentespina verbally 1996).

MEASURES PROPOSED In 1990 PECP established a steering committee, which soon became the Philippine Eagle Working Group (PEWG), chaired by a representative of the Protected Areas and Wildlife Bureau (PAWB) from within the government's Department of Environment and Natural Resources (DENR), charged with the preparation of an integrated conservation plan for the eagle (i.e. PEWG 1996). This plan was drawn up to be non-prescriptive and non-competitive, and "merely suggests some possible avenues of approach". Many of these suggestions are, however, essential elements in any conservation strategy for

the eagle, and it cannot be left to chance whether they are implemented or not; on the other hand, the document also contains proposals that are less clearly necessary or valuable, and which require reconsideration or clarification.

Meanwhile, assessment of evidence from the wide range of work to date permits an entirely fresh evaluation of the Philippine Eagle's needs (see Remarks 29), and these are presented below as a conservation strategy that sets the key elements of PEWG (1996) in a broader framework of activities and relations in what appears to be most appropriate and achievable approach (always accepting that its financing represents a major challenge): a Philippine Eagle Conservation Strategy (PECS). However, it needs to be understood that the conservation of the eagle, while certainly one of the most critically important and difficult long-term species survival projects ever, not only directly guarantees the survival of a huge array of other threatened and endemic life-forms (see Remarks 30), but is also ultimately related to the wisest use of indigenous forest by the Filipino people and government, so that there are enormous advantages in terms both of biodiversity preservation and of real, if slower-showing, economic benefits to the nation at stake.

Overall strategy coordination via a reconstituted PEWG An institutional framework is needed for the implementation of PECS; indeed, its development and maintenance must be an integral part of PECS. The entire undertaking requires management and administration through a nationally based but internationally composed consortium of parties, including the Philippine government (PAWB in the chair) and PEFI, operating under a formal Memorandum of Agreement detailing the parameters of cooperation between all participants. The existing body for this is PEWG, and the most appropriate development would be to reconstitute this in such a way that its members would effectively form a management committee operating to clear terms of reference and representing the consortium of participating institutions and individuals (government departments, NGOs and international organisations and experts appropriate to the strategy), with the following main tasks: (1) development, approval, promotion and progress review of the strategy; (2) coordination of the activities of governmental and non-governmental agencies participating in the strategy; (3) development and review of the funding strategy; and (4) development and coordination of the national promotion campaign.

National and international organisations Participation in the consortium of appropriate national and international organisations would promote the comprehensive planning and fulfillment of the strategy, and allow advice on and help with its particular aspects (i.e. the elements below: fundraising; habitat management; research; education and training) based on an official agreement between the government and such organisations clearly identifying respective commitments and responsibilities. With the upgrading of eagle conservation work to a new level of intensity and integration with development activities, PEFI's most valuable roles within the consortium would appear to lie in education and certain integrated land-use initiatives where its experience is most obvious.

Emphases of PECS The three general areas of concern for the conservation of the eagle and therefore for the attention of PEWG (other than funding these things) are: (1) management of known and potential eagle areas; (2) research involving surveys for new areas and biological study of the species, coupled with the retrieval and integration of many pieces of unpublished data with analyses of the results of this new fieldwork; and (3) well-targeted lobbying, campaigning, information and education work.

Funding PEWG would identify the annual budget and ensure that necessary efforts are undertaken to secure funds from the following different sources: (1) the Philippine government; (2) private foundations, business communities and private individuals in the Philippines; (3) foundations, organisations and individuals abroad; (4) foreign government aid.

Habitat management actions The key emphasis in PECS must fall on the creation or improvement of strict forest reserves in the most important areas, and on the rigorous

management of other significant tracts of forest for permanently sustainable use by man and by wildlife. Since the future of the Philippine Eagle is so closely linked with that of its forest habitat, the full implementation of forest conservation measures is clearly the highest priority. Many different government bodies are directly or indirectly involved in the fate of the country's forests (DENR, Department of Agriculture, Department of Agrarian Reform, National Irrigation Administration, National Power Corporation, Philippine National Oil Company, National Economic Development Authority, Department of Public Works and Highways) and are responsible for certain management aspects; their involvement with PECS—given that, according to a government report, the Philippines needs 46% of its land area under forest for both economic and environmental wellbeing (Lewis 1986)—is crucial. PEWG members should be granted an advisory role in the affairs of authorities and NGOs with responsibilities in the following areas.

Watershed protection Lewis (1985, 1986) reported that the government was embarking on a programme defining watershed areas and that this, if carried through as full forest conservation, would naturally favour the eagle in some degree. A total of 99 watershed areas had been proclaimed as of 1993, covering a total of 12,667 km² and distributed in the 15 regions of the country (DENR-PAWB 1993). The extent to which these proclamations have been translated into active conservation programmes remains unclear, and the distribution of the 99 areas remains to be determined. All relevant government agencies dealing with forests, agriculture, irrigation, hydroelectric developments, etc., should continue to cooperate in the identification of watershed areas throughout the country, and strong, fully explained measures are needed to protect such areas from any further encroachment by people.

Defence and extension of the protected area network Effective protection, from any kind of encroachment, must be given to all forests already situated in NIPAS sites, declared national parks or other reserves, with boundary relocation where appropriate. The Philippine government is at last embarking on a major programme of protected area implementation (NIPAS), and many areas important for the eagle ought to benefit (see Measures Taken); World Heritage Site status for some of these areas might further enhance their prospects for long-term survival (Danielsen *et al.* 1992). However, many additional forest reserves (through extending the network of national parks or other kinds of sanctuaries) are needed in other areas for the eagle, such as the southern Sierra Madre on Luzon and, on Mindanao, the Lanao area (west, east and south of the lake), Lake Sebu area and westwards into Sultan Kudarat, Mt Tuduk and the entire Kalatunga Range focused on Mts Kimangkil and Lumot (this is the major unexplored forest area between Kitanglad and the Agusan River), *and particularly all remaining major lowland tracts of forest*. Apart from areas targeted for conservation in the Measures Taken section, the species has been recorded from localities in or near 11 “key sites” (Mt Cetaceo and Angat Watershed on Luzon; Mts Hilong-hilong, Diwata, Dapiak, Sugarloaf, Agtuuganon, Piapayungan, Mayo, Matutum and Three Kings on Mindanao; see Appendix P) and these all deserve formal designation and protection under the NIPAS process. In the Sierra Madre of Luzon the need is for a series of protected areas linked together through several provinces and managed on principles of local welfare and support: the Northern Sierra Madre Natural Park is just one of these protected areas and needs to be run as an integral part of a continuous area of forest cover extending south to Quirino and Aurora, not as an end in itself (F. Danielsen *in litt.* 1997). Moreover, it needs to be emphasised that this is a *minimum* prescription for protection: there are areas on Luzon, Samar, Leyte and Mindanao—and possibly other islands—that may yet be identified as of special importance to the eagle.

Protection of eagle nest sites Regulations (Act No. 6147) prohibiting human disturbances around a Philippine Eagle nest site should be enforced, but with great sensitivity (the “Adopt-a-nest” scheme, with its divisive financial incentives, no longer seems to be an option: see above). It might be possible to replace the current no-disturbance zone of 1 km radius by a

system of two zones, an inner complete protection zone (500 m radius) serving as a permanent reserve, and an outer permanent buffer zone (perhaps as much as 5 km radius) where ecologically sound forest management (very limited selective logging, harvesting of forest produce) could continue.

Enforcement of legislation The enforcement of existing regulations regarding logging, slash-and-burn farming and forest clearance requires serious new investment in the equipping and training of an expanded forest service staff, which should be paid for through appropriate hikes in taxation affecting the timber industry.

Integrated land-use management It is now widely accepted that forest conservation cannot be successful without the full collaboration and participation of local people: “top-down” habitat preservation is ultimately unsustainable. Interdisciplinary projects should therefore prepare strategies for integrating conservation and land-use development throughout areas identified as holding several pairs of eagles, including environmental awareness programmes among local communities to illustrate the links between conservation and sustainable use of resources (see, e.g., Danielsen *et al.* 1992). As PEWG (1996) indicates, based on PEFI experience, “site-specific, community-based, self-help projects in and near suitable eagle habitat regions can be implemented to mitigate the impacts of human-related habitat destruction”; however, what is important to determine is the scale on which this kind of intervention would be needed in order to have the desired effect throughout the eagle’s range, and this would be another aspect of the research called for below under *Socio-economic studies*.

Research and policy development An integrated programme of research, blending national and international expertise and with a strong emphasis on training of Philippine personnel, is needed to provide the best possible sets of data on a continuing basis for the administration and revision of PECS. This research must target key information needs such as the:

- status of the species in important protected areas;
- importance of lesser known sites listed under Distribution (every site to be tracked in a database);
- status of the species in unexplored areas disclosed by maps and other means;
- amount of forest still within the eagle’s range below 1,400 m;
- survival rates and breeding success in different types of forest and at different elevations;
- prey composition on the four islands;
- constraints on prey abundance on the four islands;
- reasons for and measurement of different densities on different islands;
- differences in persecution pressures in different areas;
- effects of habitat fragmentation on survival and breeding;
- threats in different areas and the most appropriate solutions;
- determination of optimum habitat and the value of corridors between areas of such habitat.

These and other questions, worked out in advance by consultation of PEWG with appropriate conservation biologists, should provide the basis of the workplans of those engaged in studying the species along the lines proposed below.

Field survey and study A team of national and international scientists should be assembled to pursue a comprehensive programme of research to be drawn up in detail by PEWG and coopted parties to fulfil the following general tasks: (1) provision, within one year, of up-to-date maps and estimates of the extent, quality and status of forest cover below 1,400 m within the eagle’s range, drawing fully on the information in Distribution above and without omitting potential areas in (e.g.) western and eastern Luzon (Tarlac/Zambales, Aurora/Quezon and Quirino are obvious targets) and on Mindanao (such as Mts Kimangkil and Lumot; see above); (2) determination, within three years, through intensive field research and local interviews, of the presence and abundance of the eagle and/or conditions appropriate for the eagle within these areas (see Remarks 31); (3) long-term monitoring of the extent, quality

and status of forest habitat in all areas where eagles are known to occur; (4) location, regular seasonal monitoring and negotiated protection of as many nest sites as possible; (5) detailed investigation, over an initial five years, of breeding ecology and success at up to six sites within the range of the species (at least one and preferably two on Luzon, and at least one on Samar and/or Leyte), including studies on local prey availability and the conditions that determine this (partly as a means to determine if eagle densities are different on the different islands); (6) radio-telemetry (or satellite-based) studies of fledglings and any wild-caught birds released back into the wild, to assist in the determination of territory size, home-range size and dispersal capability; (7) provision of input into the development of new branches of research and conservation effort based on information and expertise generated.

Forest management policy In 1990 the Philippine government's comprehensive forestry plans were unveiled and included "a strategy for consolidation of the protected area system" (DENR 1990). This document appears to have been misunderstood by the authors of PEWG (1996), since it sets forth a scenario for timber extraction and forest conservation that is incompatible with the eagle's needs, basically claiming to be establishing a ban on logging in 9,800 km² of forest that in any case is either inaccessible or commercially irrelevant, i.e. for which a self-imposed "ban" already exists (see Appendix) while sanctioning the further logging of as-yet insufficiently regenerated second-growth dipterocarp forest, the habitat of the Philippine Eagle. This plan therefore needs complete revision as a national forest management policy, based on the principles of the World Conservation Strategy, thereby recognising that the remaining forests are an important natural and, in part, renewable resource essential for the future welfare of both Filipino people and wildlife. PEWG (1996) calls for the promotion of reforestation with the use of "local species only", and this is certainly a long-term aim that needs a place in any forest management policy in the country. To this end, forestry policy needs reorientation from timber harvesting towards habitat management.

Farming policy and practice A genuine agrarian reform programme must ensure that further encroachment into upland and forest areas is stopped through the provision of land to all marginalised farmers. Policies and practices are needed that enable farmers to remain permanently on established clearings without undue loss of soil fertility, in order to reduce their demand for new land; this would be integrated into a zonation plan to protect core areas of forest and allow various degrees of land use outside them (Lewis 1985). Simple socio-economic incentives are needed for slash-and-burn farmers to replace their destructive practices with agro-forestry and improved methods of using existing farmland. Attention simultaneously needs to be given to the problem of human within-island migration, which can quickly result in the occupation and conversion of apparently secure forest.

Logging policy and practice In the 1990s logging was banned in all provinces (i.e. 64 out of 73) in which forest cover is less than 40% (BRT). However, it is not known whether this ban is effective, or how forest cover (or its decline; under selective logging, still allowed in nine provinces, it is not supposed to decline at all) is measured. Nevertheless, it is now time for an *immediate total and unequivocal ban on the logging of all remaining old-growth forest* in the Philippines: it is now too late to seek merely the imposition of stricter regulations or more zealous enforcement of existing rules as a means of preventing permanent ecological damage in any forest. Primary forest probably now only represents 3–5% of its former extent, and the value of the remaining tracts (especially in the lowlands) in terms of biological diversity, as well as sources of material for appropriate reforestation and watershed management, cannot be overstated (L. R. Heaney *in litt.* 1997).

Socio-economic studies A team of national and international scientists should be assembled to pursue a comprehensive programme of research, again to be drawn up in detail by PEWG and coopted parties, to work in areas where eagles and man are most in conflict, to determine the nature and scale of the problem at these sites (and in its entirety), the ways of resolving

the situation through local community support under what PEWG (1996) calls the “Livelihood Program”, and the costs to be met in doing so.

Forest management studies A team of national and international scientists should be assembled to pursue a comprehensive programme of research, again to be drawn up in detail by PEWG and coopted parties, to help determine the most appropriate forest management regimes for the integration of long-term exploitation and restocking of timber, using native (and no exotic) species, in designated areas with eagle populations and other key elements of Philippine biodiversity. The fundamental imperative in this initiative is one of long-term investment in appropriate broad mixes of Philippine tree species, so that the result is forest, not plantation.

Eagle population management studies The ultimate aim of PECS must be the survival of the eagle through a multiplicity of management approaches, but including the creation of a series of areas on each island in which forest and eagles survive under different regimes (national parks, strict nature reserves, well-managed logging concessions, watershed protection areas, etc.) and in which the eagle can be managed as a single island-wide population. Planning and overseeing this arrangement is a major challenge for PEWG.

Information, education, capacity building The activities of PEWG should be publicised and thereby facilitated through a carefully planned strategy of information dissemination and targeted campaigning (such as has been conducted in the Caribbean and Pacific by RARE: see, e.g., Butler 1992), occurring on four levels: (a) on a broad front aimed at the Philippine people at large, including schoolchildren (the use of the two current eagle breeding centres on Luzon and Mindanao could serve as headquarters for the planning and part of the implementation of this work); (b) more intensively for the purpose of educating local inhabitants in logging concession areas, watershed areas, as well as in communities where nest sites are known or suspected to be (such campaigning needs to be developed by or with the team researching socio-economic problems and forest management options); (c) continuous priming of government and non-government bodies associated with conservation in relevant areas (although part of the aim of PECS must be to bring these elements into the strategy as participants in its evolution); and (d) through persistent exposure of decision-makers to the issues at stake.

Release, analysis and publication of information Kennedy (1982a) revealed several pieces of research which appear never to have been published (as also noted in the PECP *Fourth Quarter Report 1989*), including studies of prey abundance and habitat use at two nests in Mindanao, and a BFD survey of the island which found birds in almost every province. According to Lewis (1985, 1986) a detailed study of the eagle’s territory usage based on recent telemetry work was being prepared (= “Kennedy in press, Philippine Eagle Conservation Program Report, WWF Project 1531”); this work was commenced in January 1985 with the release of an adult above Lagonlong, Misamis Oriental, apparently the site of its capture (Krupa 1985). The details of the findings from the study of the 1978 radio-tagged juvenile (see *Ecology Breeding: growth and development of young*) are unavailable, as are those of the seven-week survey of Luzon in that year (see Population), although both are clearly of crucial value to present and future endeavours; moreover, even a simple remark like the fact that the structure of the forests on Leyte makes them unsuitable for eagles (Kennedy and Alvarez 1984) needs to be substantiated with evidence and reasoning. The intention behind this present account of the Philippine Eagle is to provide the firmest possible basis for sensible action for the species, but clearly there is more to be done other than just tracing the unpublished material in the studies mentioned above: for example, it would be helpful to assemble and synthesise all survey materials held in PECP offices and elsewhere, including data on earlier unreported studies by R. S. Kennedy and FREE, in order to produce a comprehensive and accurate analysis of all surveys, identifying areas still with real potential and extending a new phase of survey into those and other areas. This should include all four islands. There is a

comment in Krupa *et al.* (1984) that when attempting to review the entire programme in January 1984 efforts were hampered by “the absence of significant records of past field activities”, which indicates that some materials for such a review must be held elsewhere than with PECP. All such material is clearly of enormous importance to future work on the species and should immediately be volunteered and assembled for analysis, and the information conflated into a new review of the species.

Capacity building in the forestry sector The training of foresters in the Philippines and throughout the world is directly geared to timber extraction as an economic activity, and therefore there is little expertise in the area of forest management for biological diversity: building capacity in this regard is a fundamental need, along with the reorientation of forestry policy to make habitat management the central target over timber extraction (C. M. C. Nozawa *in litt.* 1997).

The problem of captive breeding PEWG (1996) identified a central need and role for captive breeding in the conservation of the Philippine Eagle (see Remarks 32). By contrast, however, there are some serious claims against captive breeding (these are not necessarily specific to the case of the eagle: see, for example, Balmford *et al.* 1995, 1996, Snyder *et al.* 1996) which need to be considered, as follows.

(a) The need for the programme remains unproven. (i) There is no point in introducing captive-bred birds into areas where the species is at carrying capacity (which would mean that new birds would be directly or indirectly forced out of the area and thus very likely starve); so (ii) captive-bred birds could only be introduced into areas where the species was below carrying capacity, which would almost certainly be related to hunting; so (iii) releases of captive-bred birds would then have to go hand-in-hand with campaigns to reduce hunting (captive-bred birds would be tamer than wild birds, hence easier targets); but (iv) if the campaigns were successful, a *natural* restocking of the areas might occur anyway, rendering the captive-breeding programme redundant (restocking of very isolated areas, which might take wild birds many years to rediscover, might better be done with rehabilitated wild birds). It has already been suggested that eagle populations have consistently been underestimated, fuelling the notion that the only solution must lie with *ex situ* intervention. The eagle is, of course, very seriously threatened; but it must ultimately exist in a wild state, so the primary emphasis of all work relating to it must fall on preserving tracts of habitat that may or do provide opportunities for its *in situ* conservation (see *Defence and extension of the protected area network* above).

(b) The rationale for the programme is not clear. Two justifications have emerged from a review of the captive breeding work: (i) that the captive stock would tide the species over until forest could be restored, or (ii) that the species could be habituated to survive in conditions of semi-domesticity in highly modified habitat. Neither has been formally established with a detailed rationale and a clear articulation of principles; both remain as unworked ideas and assumptions buried in general writings about the eagle.

(c) Costs are disproportionate to achievements. The captive breeding programme has absorbed large sums of money over some two decades, with hundreds of thousands of dollars being donated from many different national and international, corporate, private and conservation sources, including such things as relocation costs in the face of insurgency problems (see, e.g., Chancellor 1988). The total cost of the captive breeding programme since its inception has doubtless never been calculated, but may run into millions of dollars. Nevertheless, almost 20 years since it began, and despite the advice and participation of the most reputable and capable of experts, captive breeding has yielded only two surviving offspring to date, and simply troubleshooting *ex situ* management problems has become a major preoccupation and focus of all eagle work.

(d) Costs will remain disproportionate to achievements. If it is normal for a young bird to take over six months after leaving the nest before it catches its own food, and to remain

within its parents' home range for another year after that (i.e. two years to full independence, as reported in Ecology *Breeding: growth and development of young*), then the human resources needed to manage re-introduction of captive-bred birds on an appropriate scale (perhaps five a year for 10 years) would be greater than those currently deployed, and the expertise involved would have substantial additional costs. Even if birds could be nurtured into successfully hunting for themselves, their reduced fear of man would increase their susceptibility to hunters (see Remarks 33).

(e) It poses a potential or actual distraction from what can and should be done. By its very existence, the programme draws funds that conceivably could be spent on fieldwork and conservation, and may even weaken the will to conserve habitat by offering the excuse that, because the eagle is being treated elsewhere, the forest itself needs less attention (particularly if the main rationale is that the captive eagles are waiting until habitat is regrown: short-term profiteers will simply assume that the birds can wait a little longer).

(f) There is the danger of transmission of disease acquired during captivity to wild birds. This has recently been recognised as a very serious problem in conservation biology in general (Snyder *et al.* 1996).

(g) The acquisition of wild nestlings to increase the number of captive eagles in the programme may have little effect on the species in the wild, if indeed there are more pairs than have previously been judged; but the commonly expressed view that these wild nestlings are likely otherwise to die because of lack of food needs a basis in science (this does not mean the citation of one or two instances), and without it there seems no good reason to sanction further removals of nestlings (PAWB has now produced guidelines for the retrieval of eaglets: W. Pollisco *in litt.* 1997).

PAWB (1996) stated: "As a matter of principle, *ex-situ* conservation will be undertaken only as a last resort and only to complement *in-situ* conservation efforts... the protection of habitats is deemed as the most effective way of conserving biodiversity". If, therefore, there is justification for the eagle captive breeding operation then it is more as (i) a component of the nature and research centre where local visitors can see and learn about their eagle, and (ii) two stations where injured and confiscated birds can be nurtured and in some cases released back into the wild. Public awareness and training has been a successful aspect of the PECP to date, and this element might be built up, with entirely new emphases related to forest conservation, to substitute for the *ex situ* efforts (see above; also Remarks 34).

REMARKS (1) The Philippine Eagle is a highly distinctive species in its own genus, and "perhaps the most remarkable bird which has been discovered in the Philippines" (Ogilvie-Grant 1897). It was originally believed to be most closely related to the two *Harpyhaliaetus* eagles of the Neotropical region (Ogilvie-Grant 1896d), although this genus was quickly replaced by *Thrasaetus* (= *Harpia*) in the describer's opinion (Ogilvie-Grant 1897). Whitehead (1899a) himself thought it "possibly allied to *Spilornis*, as well as to the Harpy Eagles of South America". The species cannot, however, be closely related both to *Harpia* and to *Spilornis*, given their distance from each other, and Shufeldt (1919) judged that *Harpia* was much the worthier candidate; more recently, it is assumed to have evolved within the Philippine archipelago (perhaps originally on Luzon: Krupa 1989a) and to be most closely related to certain Asian eagles (Lewis 1986) or New Guinea Harpy Eagle *Harpyopsis novaeguineae* (PEWG 1996). Certainly it would seem most likely to share affinities with larger raptors in New Guinea; similarities with *Harpia* may represent convergence, while differences—most notably in bill structure (the Philippine Eagle has the deepest, most laterally compressed bill of any bird species)—seem far more striking. Very recent osteological study indicates that the species is, in fact, completely isolated from other raptors (S. J. Parry verbally 1996). In life, both at rest and in flight, it has been judged to resemble a huge goshawk *Accipiter* (Finn 1909, Seth-Smith 1910a, 1940, Wharton 1948, Grossman and Hamlet 1964). Trematodes

from the intestine of a captive bird proved to be a new genus and species, *Phagicola pithecophagicola*, for which a new subfamily, Phagicolinae, was erected (McGregor 1921b).

(2) The problem of negative evidence in surveys is much more acute than Rabor (1965) believed: his insistence on the ease with which the species can be found owing to its soaring habit (“certainly, their presence in any specific region cannot be missed”) was clearly mistaken, and evidently resulted in its presence being repeatedly overlooked and therefore denied. Kennedy (1977), however, also averred that it is “a bird that frequently soars”, although Brown and Amadon (1968) speculated whether soaring “is indulged in only during a part of the nesting cycle”. Ogilvie Grant (1897), by contrast, in commenting on the triumph of Whitehead’s discovery of the species, remarked: “That so large a Raptor should have remained unknown till the present time only shows how easily these great Forest-Eagles may be overlooked... in the dense and lofty forests where these birds make their home it is almost impossible to see them...” Gonzales and Rees (1988) backed this up by reporting that “most of [the species’s] time is spent hidden in the forest”, although this did not prevent them from taking a pessimistic view of Kennedy’s already pessimistic figures (see Population). The unreliability of negative evidence and subjective assessment of habitat is perhaps best indicated—apart from in Rabor’s denials of the bird’s survival on Samar and Leyte and of its survival prospects on Luzon—by the fact that in 1969 Gonzales (1971) considered the PICOP concession “a disaster area” for the Philippine Eagle, yet in 1977 birds were found nesting there and continued to be recorded down to the 1990s (see Distribution).

(3) Inexplicably, this old testimony went unreported and indeed was flatly denied by Rabor (1965), who stated that extensive and intensive biological survey work, including interviews with local people, took place in the Cordillera Central (La Union, Ilocos Sur, Ilocos Norte, Abra and Mountain provinces) in 1959, in the northern Sierra Madre (Cagayan and Isabela provinces) in 1960, and in the forested areas of the south (Camarines Sur, Camarines Norte, Albay and Sorsogon provinces) in 1961, without any record of the Philippine Eagle or any evidence from local people that it was known to them then or in the past. Rabor’s (1965) testimony was clearly flawed. The species *was* still present on the two islands where he declared it extinct, and it was still to be found in the northern Sierra Madre, despite his own failure to encounter it or anyone who knew it (he did, however, concede the possibility of its survival in this region, but to the south of the part he surveyed); even more oddly, Rabor (1971) stated that he *did* obtain reports of large eagles soaring over Mt Cagua and Mt Cetaceo, even up to 1960. The story of the eagle’s discovery—that is, the fact that it was the accidental (but perhaps providential) loss of John Whitehead’s first collection of Samar birds that compelled him to return there and so find the eagle at the second attempt (see Hachisuka 1932a, Collar 1996b)—and of course the fact that it was missed by so many other explorers on Luzon, Mindanao, Samar and Leyte—should have induced greater circumspection in Rabor’s pronouncements (which of course also influenced the prospects of Cebu’s endemic avifauna: see Measures Taken under Cebu Flowerpecker *Dicaeum quadricolor*). He further remarked that the eagle “normally indulges frequently in soaring flights over the particular region where it lives, so that a bird as large as this species can never escape being observed by the people who live in that particular area”, which is clearly overstating the situation (see, e.g., Danielsen *et al.* 1992). Nevertheless, his evidence from the Cordillera Central and southern Luzon must have some value, and it certainly seems likely that any surviving eagle populations in the Cordillera Central and southern Luzon will prove very small. It is, moreover, very possible that there is a real difference in densities between Luzon and Mindanao, which may reflect ecological differences not yet measured, such as relative abundance of prey animals (see Measures Proposed).

(4) No “Agos river” can be traced in Rizal, but Anon. (1945) and many maps reveal an Agos river meeting the Pacific in Quezon at 14°47’N 121°39’E, and the two relevant AMS

(1961–1965) maps appear to indicate that this rises in Rizal as the Lenatin river at Mt Minalunad; the coordinates for the latter are used here for this record.

(5) It is not entirely clear from context in Seth-Smith (1910a) whether San Mateo or “Montalban” is the locality near which the canyon lay, but the more appropriate reading appears to favour the former, although Montalban was chosen by Kennedy (1977), possibly because of its mention in Hachisuka (1931–1935). Irrespective of this issue, it is a wholly remarkable thing that W. P. Lowe, whose notes are being quoted, should have been able to inquire in Manila where to find the Philippine Eagle, depart by railway for a recommended site and on the very next day, on foot with a guide, encounter a pair. The circumstance in which a massive bird unknown with certainty from Luzon until May 1907 should be found with such ease in August of that year, just a day’s railway journey from Manila, is almost impossible to credit; and the fact that the two birds seen were too high overhead to shoot must raise *some* suspicion as to their identification. Nevertheless, Lowe (1932:58) repeated the story without suggesting any second thoughts on this point.

(6) According to Davidson (1934), the Albay specimen was in the Philippine Bureau of Science and marked (the only one to be so) as an exchange; he speculated that it was from the museum of the Jesuit Fathers. The reason he did so was evidently that W. P. Lowe (in Seth-Smith 1910a) had reported that the Bureau held a specimen exchanged with the Jesuit Fathers; the date of Lowe’s visit to the Bureau was 1907.

(7) Ogilvie-Grant (1897) gives no precise localities for the collecting undertaken in Samar and Leyte; he simply mentions that the type specimen of the eagle was taken “in the forest opposite Mr Whitehead’s camp”, and that on his arrival in northern Leyte Whitehead “moved inland to a small village near the mountains”. Whitehead (1899a) himself added nothing in his text to clarify these sites, but published a map of the Philippines depicting his routes and principal collecting stations. The only inland sites on Samar and Leyte marked on this map are Bonga and Jaro respectively, and it seems safe to assume that these are the camp and the village referred to in Ogilvie Grant’s account (the only other site identified on Samar is Paranas, which clearly cannot be where Whitehead’s forest camp stood, as his account makes it clear he had to travel far inland from the west to encounter forest). Bonga may thus be identified as the type locality of *Pitheophaga jefferyi*.

(8) Inexplicably, Rabor (1965) gives the period of study on Leyte as March–May 1963, which (as Rabor’s museum specimen material testifies) is certainly wrong.

(9) In Gonzales’s (1969, 1971) 1969 survey the census method “consisted of employing, as a gauge of size, the frequency of certain manifestations of the bird’s population in any particular area...[i.e.] the frequency of verbal reports of natives, hunters, loggers, etc., concerning the numbers of live eagles seen in their localities, and the numbers shot or trapped in the recent past as well as the number of live eagles actually seen by the team”. In Kennedy’s (1977) survey of Mindanao undertaken in 1972–1973 the work involved: travel to 10 of the 17 provinces (coverage “greatest” in six), collecting records of eagles killed, captured or sighted since 1970; aerial surveys of 12 provinces (coverage full for four) to facilitate the plotting of habitat on 1:250,000 air maps current to 1969; and the estimation of habitat extent from topography and human density as expressed on the same maps (Table 1). In Kennedy’s (1981a) 1980 survey of Leyte the method was “two observers watching... from separate vantage points that overlooked a major river drainage with extensive virgin or advanced second growth dipterocarp forest. One observer occupied the same vantage point from 0700–1500 daily for four days” (Anon. 1983); there were nine such survey sites (mapped in Anon. 1983).

(10) Seth-Smith (1910b) gave the source of a specimen received by London Zoo as “Sandag, Sarigas”, and this site was repeated by Davidson (1934). Neither name can be traced, but Seth-Smith was evidently misreading handwriting which actually stated “Tandag, Surigao”. This tends to be confirmed by the fact that the other information he reproduced on the species, based at third hand on native reports, refers to its occurrence along the coast, where

indeed Tandag is situated. The other native information on the species, which Seth-Smith (1910b) cautioned against, was that the nests, neither large nor deep, are held together by the bird's excrement, normally hold four eggs that take 24 days to incubate, and are ferociously defended; that the food is fish "captured along the seashore, but... also hogs, monkeys, cats, etc."; and that the birds live "generally near the shore, in the high rocks and crags". This sounds like White-bellied Sea-eagle *Haliaeetus leucogaster*.

(11) Hachisuka (1941) reported on four specimens being taken at an unspecified locality on the same peninsula ("Agustin Peninsula") as that on which the Gov. Generoso-San Isidro localities lie.

(12) This specimen is labelled as "emaciated, died shortly after being removed from nest of enteritis and gastritis" (PNM label data).

(13) The area indicated by Bonnit *et al.* (1977) has various different locality names, or none, on different maps; on PCGS (1969) it seems to fall on the upper Agusan river between "Lamiawan" and "Sabaki".

(14) PEWG (1996) mentions "Saranggani" as the site of a recent record, but maps it west of the Sarangani Peninsula.

(15) No "Malaue" can be traced on maps, but it is notable that the specimens in DMNH are catalogued as from "Malave"; a Molave (which is a reasonable interpretation of the label inscription: G. K. Hess *in litt.* 1996) appears on some maps as a moderate-sized town, and although NBS (1985) places it just inside Misamis Oriental, MOP (1963) puts it just in Zamboanga del Sur; AMS (1961–1965) shows no such place, but a comparison of all three maps suggests the coordinates as given in the gazetteer.

(16) The value of 100 km² as the area of forest needed by a pair of Philippine Eagles has repeatedly been used to estimate populations, first by Gonzales (1969), then by Kennedy (1977), Bonnit *et al.* (1977) and Krupa (1989a). This figure came into currency because Gonzales (1968) reckoned, with no supporting evidence, that the pair he had under surveillance in 1962–1963 covered 100 km² in their chick-rearing stage ("From this nest tree, the great eagles ranged the whole countryside, an area of not less than 100 square kilometres"); even if true, of course, there is no particular reason why density should be the inverse of foraging range, which would imply strict territorial defence along c.35 km of boundary, an altogether improbable circumstance. There are, however, at least four lower values that emerge from the literature: first, Kennedy's (1977) own study of a pair at Tudaya Falls led him to assess its home range at 12.5–25 km²; second, Grossman and Hamlet (1964) gave a value of 30–35 km², apparently based on direct experience (see Ecology *Habitat*); third, in 1973 the total area of forest at Mt Apo was 640 km² (Kennedy 1977), while the number of nest-sites there in 1980 was probably *at least*—given that the study was abruptly curtailed—15 (Kennedy 1985), and these two figures yield a putative density of one pair per 43 km² (although measuring the distances between nearest nest-sites on the map in Kennedy yields a mean of 6.15 km and hence one pair per 33 km²: C. J. Bibby *in litt.* 1996); fourth, Rabor (1965, 1968) had suggested a value of 40–50 km² and indeed Gonzales (1968) himself judged that his 1962–1963 birds were "observed to restrict their flights to the confines of the area", the southern half of which "appeared to be one of the most frequented". The use of 100 km² by Bonnit *et al.* (1977) was reportedly based on (undisclosed) evidence in the literature for territory size in the Golden Eagle *Aquila chrysaetos*, "another large, wide-ranging eagle which subsists on small mammals", when in fact 50 km² for that species (derived from Cramp and Simmons 1980) appears to be cautiously appropriate or even very generous. Why therefore Bonnit *et al.* (1977) chose to double this value for the Philippine Eagle, unless they simply regarded it as double the mass of the Golden Eagle, is not clear; but in any case a tropical forest is essentially a three-dimensional hunting environment, and presumably therefore capable of supporting a far higher biomass of appropriate-sized prey animals than temperate mountain slopes. Recent analysis of Harpy Eagle *Harpia harpyja* densities in various parts of its range reveals the

species—almost exactly the same size as the Philippine Eagle and occupying the same habitat—to occur at one pair per 13–60 km², the lower figures (i.e. higher densities) being associated with fertile soils (E. Alvarez Cordero verbally 1996); since Philippine soils are for the most part fairly fertile, the use of a 25–50 km² value (as in Table 2) seems entirely justified and possibly itself a little cautious.

(17) This comment by Hachisuka (1932a) referred possibly to live birds, possibly to museum material. Hachisuka (1936), who referred to no more than 20 such individuals, was equally ambiguous.

(18) It is difficult to interpret the tabulation in Krupa (1989a), but the figures he derived can only be understood as referring to pairs of birds. Salvador (1994) and PEWG (1996) were therefore both mistaken in representing Krupa's estimate as "between 89 and 222 individuals". Moreover, these sources were wrong in implying that these figures embrace the population extremes to be derived by application of the value of 60 km²; only 100 km² was used.

(19) Although it is not clear over what time-frame the figures in PEWG (1996) were generated (i.e. at what point back in time records were excluded as insufficiently recent), there is no attempt to suggest that they are, as they must be, the absolute *minimum* number of surviving eagles, and indeed there is a table in PEWG (1996), an important official document, that refers to the 60 wild birds recorded in its review as the "Total Wild Population", a highly repeatable but completely misleading phrase. PEWG (1996) certainly admits that improved estimates of eagle numbers are needed, yet it is relaxed about confusing total population with the total number of birds actually encountered. A popular article (Dingle 1996) reflects and perpetuates this confusion by contrasting an *estimate* (Kennedy's 1970s figures) with the 67 Mindanao and seven birds from other islands *encountered* in 1994, concluding that "when an entire species has no more than 74 known members... it is in serious trouble perhaps to the point of no recovery" (but the piece then immediately introduces the captive breeding programme as the intercessionary saviour).

(20) If Krupa (1989a) was correct in judging sexual maturity at 6–8 years, then the population figures he and other researchers have put forward need some reconsideration: the basic question is whether immature "floaters" within a population can survive on their parents' breeding territories until such time as they attempt to establish territories of their own. On the basis of Krupa's figures, for every pair accounted for there should be at least two immature offspring at large somewhere in the forest, and if it is assumed that these birds stay within their parents' 100 km² then the population estimates can all be doubled.

(21) Rabor (1965) erroneously reported this figure as 40–50 kilometres square.

(22) Gonzales (1968) thought that flying lemurs were easy targets for eagles through their habit of becoming stranded at dawn in the crowns of trees or low down on trunks, far from their diurnal roosting holes; however, apart from the fact that natural selection can hardly have favoured the persistence of such negligent behaviour, it seems slightly improbable given that the main period of hunting activity for eagles starts several hours later, and it may well be that most flying lemurs are caught in their day-roosts, as suggested by Kennedy (1977). Rabor's (1965, 1968) explanation of the preponderance of flying lemurs in the diet at the time of the 1963–1964 study—that it reflected "radical depletions in monkey populations" over the previous 10 years (i.e. back to c.1955) for Salk vaccine production in the USA—was entirely mistaken: Gonzales (1968) actually stated that monkeys were more abundant than flying lemurs in his study area.

(23) Gonzales (1968) stated that the chick was already eight weeks old on 1 March 1964, when day-time brooding all but ceased (one further instance, lasting an hour, was recorded on 6 March); in fact, hatching having occurred on 12/13 January, it was seven weeks, which is why he was also wrong in stating that first attempts at self-feeding (11 March) were at nine weeks. His Figure 2 is ambiguous in the way it tabulates weeks, but it appears that the enormous

increase in food provision coincided precisely with the abandonment of brooding, hence in the course of the eighth week and not, as he stated, the ninth.

(24) The explanation of records of threesomes in Bonnit *et al.* (1977)—that they are evidence of some form of polygamy which might be an effect of declining numbers (surviving pair members unable to obtain mates elsewhere)—came before the length of dependence of offspring was recognised. Even though these authors had discounted the idea of small birds in such trios being young, deciding instead that they were aberrant individuals, it seems quite certain now that they were indeed young birds.

(25) Krupa's (1989a) evidence that eagles cannot traverse more than 20 km of open sea or country is unconvincing. He gives no indication that his reports (all second-hand) of downed birds might not be correct, yet in Krupa *et al.* (1985) two of them are treated with due scepticism (through the use of "allegedly"), although in one of these cases—the lake ditching (Lake Sebu)—the bird was already very weak and had been pursued to the edge of the lake by crows and then by people attempting to catch it, so clearly it did not ditch simply because Lake Sebu proved too large an expanse to cross. It seems probable that these were all sick or starving birds, perhaps immatures dispersing from territories: it is worth noting that several records under Ecology *Food* involved birds known or claimed to have become exhausted or injured while taking prey, and the specimen from Pagbilao, Quezon, Luzon, was caught "while it was on the ground drenched with rain [and] very thin" (McGregor 1927). Absence of observations from open country or over sea cannot be taken to mean that birds never occur in such situations, and in a species which reportedly soars frequently it is more than likely that travel across non-forested areas is undertaken at a height where detection would be all the less probable. Absence from other islands separated by deep water suggests a belief that it is the *depth* of the water that acts as a barrier, which is clearly absurd; what such deep water indicates is length of separation of the landmasses in question, and hence biogeographical differences and adaptations that would truly help explain the eagle's absence (such as presence or absence of prey species).

(26) This initiative may have been counter-productive by attaching a financial reward to cooperation: it was quickly noticed that very freshly caught birds were being surrendered with injuries including gunshot wounds, suggesting that the reward itself had induced their capture. The scheme was soon terminated (D. Salvador verbally 1995).

(27) Two Philippine Eagles in the USA, one in Philadelphia and one in New York, were brought together in the late 1960s or early 1970s in hopes of breeding (Lovejoy 1973); nothing resulted, and the female (the bird from Cebu reported under Distribution) died in 1975 (ANSP label data).

(28) It hardly needs to be said that the use of the words "should ever" implies acceptance of an investment of potentially infinite length, and the expression "can be" implies that this is an accepted fact, with no insuperable obstacles. A shift in thinking had clearly occurred since the declared intention of Kennedy (1982a) to release "as many birds back into the wild as can be released" and only after this to attempt to breed whatever birds remained.

(29) A series of early recommendations is worth retaining partly for historical reasons and partly in anticipation of ideas that may still prove useful to the eagle's conservation. Rabor (1965, 1968) argued for: (1) no logging or cutting, "in any manner", in primary forests on mountain slopes and valleys, with only selective logging and reforestation being practised; (2) no more logging inside national parks, even where legal; (3) absolute prohibition of exportation to foreign zoos; (4) outlawing both the capture and the possession of eagles, alive or dead, with harsh penalties; (5) designation of the species as a national or natural monument or national bird; (6) faithful and strict enforcement by government agencies of all relevant laws; (7) change in school curriculum to allow education in schools on wildlife and environment, with emphasis on the eagle. Gonzales (1968) felt that local education by civic groups to reduce local persecution would be most appropriate.

Rabor (1971) understood that a serious programme of conservation had been launched for the species in 1969, involving PWO with the aid of IUCN and the involvement of the newly formed Conservation Foundation of the Philippines, but he noted that the work of survey appeared to have been entrusted to someone with no knowledge of the interior of Mindanao and its various dangers, when in fact the kind of party needed for the work should consist of at least 10 well-armed members. He therefore recommended: (1) really effective measures to minimise ruthless logging impact (he acknowledged it cannot be stopped); (2) better training of Filipinos to observe the law faithfully, through conservation education in schools; (3) a more dedicated attitude amongst field researchers and law-enforcement personnel, to avoid the “blatant... violations... by some parties backed by powerful politicians”; (4) radical change in attitude of officials managing conservation, who failed to listen to calls to aid the eagle until Charles Lindbergh arrived on the scene; and (5) conservation bodies to involve those who really understand nature. Rabor (1971) also enumerated the sites which (then) still contained “good areas of dense forests” as Mt Malindang, Mt Sugarloaf, Mt Dapiak, Mt Butig, Mt Piapayungan, Mt Ragaang, Mt Kitanglad, Mt Diuata range (= Mt Hilong-hilong), Mt Mayo, Mt Apo range, Mt Matutum range, Mt Tuduk, and a few more peaks not very well known (there is a footnote symbol next to this remark about the poorly known peaks, but no footnote is given).

Gonzales (1969, 1971) recommended: (1) declaration of each of the following mountain ranges a game refuge, bird sanctuary or conservation centre: Mt Kitanglad; Kibawalan–Takalon (including nearby Mainit) forests; Mt Matutum; Mt Timolan; and Mt Malindang; (2) an education programme, using the mass media to the fullest extent, to stimulate an interest in the eagle and in conservation (three-week courses in conservation for teachers and hunters in each town, with incorporation of conservation into college and university curricula, and adult education in rural areas); (3) establishment of the eagle as the national bird of the Philippines.

Kennedy (1977) emphasised the importance of (1) educational programmes on the conservation of natural resources, and (2) the establishment of wildlife sanctuaries and protection of land from illegal logging and agriculture. Judging that habitat loss was the prime cause of decline rather than hunting, he specified: (1) the establishment of reserves, encompassing at least 200 km² each, where logging and agriculture were not feasible; (2) a minimum interval of 30 years between selective logging, to allow for native forest regeneration; and (3) the use of native plants in the reforestation of areas.

(30) It is difficult to compute how many species of bird would automatically be secured through the conservation of the eagle on at least Luzon and Mindanao, partly owing to taxonomic considerations and partly to the higher-altitude spread of certain endemics (but for a list of species see Stattersfield *et al.* 1998). Nevertheless, as Hauge *et al.* (1986) observed, “making sure that the Philippine Eagle... is still with us 100 years from now is perhaps the most challenging conservation objective in the Philippines [and] If enough habitat can be protected in Mindanao and Luzon to perpetuate the eagle populations of these two islands, it seems probable that a majority of all Philippine vertebrates will be secure along with them”. This idea cannot be commended too highly or too emphatically.

(31) Salvador (1994) admitted that “scientifically acceptable surveys of Philippine Eagle populations have not been conducted, primarily because of financial constraints and secondly because of lack of expertise on raptor survey techniques”.

(32) PEWG (1996) prefaced the announcement of the first captive breeding success of PECP (a chick hatched in January 1992) with the entirely unsupported assertion that “there is still limited survival and reproduction of birds in the wild”. Clearly, however, the effect is to contrast *in situ* failure with *ex situ* success, thereby encouraging the assumption that captive breeding merits “integration” in an “integrated plan”, and thus promoting the continuation and indeed expansion of the initiative, which now seeks to establish a major facility at UPLB.

Another way PEWG (1996) does this is by setting the number of captive birds currently held against the number of wild birds recently *seen*, and implying that both are absolute totals (see Remarks 19), which has the effect of suggesting a higher-than-true percentage of captive birds in the world population and thereby endowing the *ex situ* endeavour with a wholly disproportionate significance (see Table 2). Further evidence of this process lies in the way PEWG (1996) moves directly from urging a Population Viability Analysis (PVA) for the species to predicting its outcome, namely recommendations for “a variety of procedures involving the moving of eagles and eggs to and from the various wild and captive subpopulations”, and hence for training in “tree climbing and work with active nests..., collection and transport of viable eggs...and birds” (no emphasis falling on problems relating to returning the species *to the wild*, all of it being laid on those of taking it *from the wild*).

(33) As an example of the problem of hacking back captive-bred birds, the following note from D. S. Rabor (*in litt.* to S. D. Ripley, 9 January 1964), concerning not even a captive-reared youngster, is revealing: “About ten days after the discovery [of a nest with a young eagle just fledged], the young bird was shot by a native Taga-Kaolo hunter. The young bird was confiding in nature and allowed the hunter to approach it to within effective shooting distance, with a .22 calibre rifle. The parent birds, used to the danger that man poses, never allowed any one to approach them closely enough.”

(34) Alternatively, and as an entirely different way of perceiving the value of these captive birds, each bird (with a strict embargo on taking any more for this purpose from the wild, except for genuine medical cases) could be loaned to a major international zoo to be exhibited as a special attraction, through its enormous rarity and grandeur, with each holding institution pledging to raise US\$5,000 per year over an initial 10-year period to go direct into a fund to support the programme of work outlined below (17 eagles at \$5,000 each = \$85,000 per year = \$850,000 over 10 years). This idea is floated not necessarily as a concrete proposal but merely as an indication that other ways of thinking about the problem *may* help generate support for what, to most ornithologists and ornithologically oriented conservationists, probably remains the most important single-species conservation issue on the planet today.