SHORT COMMUNICATIONS

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SUMMARY OF PHILIPPINE EAGLE REPRODUCTIVE SUCCESS, 1978–98

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The Philippine Eagle (*Pithecophaga jefferyi*) is one of the rarest eagles in the world. Its present status has always been regarded as critically endangered. Previous estimates of the Philippine Eagle population have been speculative (Alvarez 1970, Gonzales 1971, Rabor 1971). The most recent estimate suggests that the total population consists of between 300–500 individuals (Kennedy 1977, 1985). Philippine Eagles lay a single egg and have a 2-yr cycle between successive breedings when pairs breed successfully, but in cases when breeding attempts fail, adults breed the following year. Since work began in earnest on this species, a large amount of information on nesting successes and failures in Mindanao have been amassed. Here, we report this information based on records collected over the past 20 yr, and provide insights as to the key reason for the decline of the population.

METHODS

We compiled all existing information on the reproductive success of Philippine Eagles based on published (Kennedy 1985) and unpublished documents gathered by the Philippine Eagle Foundation (PEF) between 1978–98. We defined a successful breeding attempt as those with young eagles that survived until fledging. Nests were located by daily surveillance from vantage points, usually along mountain ridges and in areas where eagle presence was reported by local settlers. Observers stayed in these areas for about a week during the breeding season between August–December and from 0600–1500 H. Blinds were built in trees adjacent to nest trees, usually about 50–100 m away. Life history information was obtained and daily activities were recorded. A reward system for reporting occupied nests was initiated in 1981. From 1985 to the present time, the reward system was intensified and coupled with other on-site programs such as the development of community-based initiatives and conservation education activities. Reports of sightings were improved further by forging partnership arrangements with broadcasting stations in Mindanao Island.

RESULTS AND DISCUSSION

Prior to 1970, only one nesting pair of Philippine Eagles was located (Gonzales 1971). From 1978–83, several nesting pairs were intensively studied within the logging concession of the Paper Industries Corporation of the Philippines (PICOP) in Surigao del Sur and Davao Oriental provinces, and within the Mount Apo National Park (Kennedy 1981, 1985). This was a period when intensive logging operations occurred on Mindanao Island and many nesting areas were logged or altered by slash-and-burn farmers. Eight breeding attempts by 6 pairs failed (72.7%) out of a total of 11 attempts during this period (Fig. 1). One nestling was retrieved from a nest at Mount Apo National Park and is currently being kept at the Philippine Eagle Center in Davao City.

From 1984–88, the PEF and the Department of Environment and Natural Resources (DENR) monitored the breeding population. Of the eight pairs monitored, there were 11 breeding attempts. Four failed (36.4%) and four young (36.4% nesting success) were produced. This represented an 18.2% increase in fledging success compared to the previous period.

From 1989–93, 11 breeding attempts by nine pairs resulted in eight fledglings (72.7% nesting success) and, from 1994–98, 17 breeding attempts by 12 pairs resulted in a higher success rate (88.2%). The increase in breeding pairs was mainly due to an increased awareness by local people and increased observer effort and was not indicative of the recovery of the population. Other strategies such as the reward system and media-based information campaign have also been widely used by the PEF since the early 1990s to increase the information on the number of breeding pairs in the population. The increase in breeding pairs during the last decade may also have been due to increasing fragmentation of lowland dipterocarp rainforest that result in increased contact with settlers.

Breeding success based on eight pairs with >1 nesting attempt was estimated at 0.38 ± 0.14 (±SD) young/pair/

Table 1. Summary of Philippine Eagle nesting records from 1978–98. All information taken from Philippine Eagle Foundation records unless otherwise stated.

LOCATION[a]	YEAR(S) OBSERVED	NESTING STAGE OBSERVED	FLEDGING SUCCESS	COMMENTS
Mount Apo, Toril, Davao City[b]	1977, 78	Egg to nestling	Failed	Nestling died at 27 d
Amabel, Magpet, North Cotabato[b]	1978, 79	Nestling to post-fledging	Successful	
Kiandang, Magpet, North Cotabato[b]	1978, 79	Nestling to post-fledging	Successful	
PICOP, Surigao del Sur[b]	1978, 79	Incubation to nestling	Failed	Young died
Rd. 6P, PICOP, Surigao del Sur	1981	Courtship to nestling	Failed	Young disappeared after a storm
Rd. 78, PICOP, Surigao del Sur	1981, 82	Nestling	Failed	Young died
Mount Apo, Toril, Davao City	1983	Egg to nestling	Failed	Nestling died after retrieval due to apparent sickness
New Dumangas, Tiboli, South Cotabato	1983	Nestling	Failed	Young died after 4 mo
Amabel, Magpet, North Cotabato	1983	Egg	Failed	Egg abandoned, nest tree burned
Mount Apo, Toril, Davao City	1983, 84	Egg to post-fledging	Failed	
Rd. 6P, PICOP, Surigao del Sur	1983, 84	Egg to nestling	Unknown	Not revisited for verification
Laconon, Tiboli, South Cotabato	1985	Nestling	Unknown	Not revisited for verification
Upper Linan, Tupi, South Cotabato	1985, 86	Incubation to post-fledging	Successful	
Dalwangan, Malaybalay, Bukidnon	1986	Incubation to nestling	Failed	Eaglet retrieved by locals
Laligan, Valencia, Bukidnon	1986	Nestling	Failed	Eaglet retrieved by locals, later died
Salaysay, Marilog District, Davao City	1986	Post-fledging	Unknown	
Rd. 6P, PICOP, Surigao del Sur	1986	Incubation	Unknown	Not revisited for verification
Allah Valley watershed, Tiboli, South Cotabato	1986, 87	Incubation	Failed	Egg disappeared
Salaysay, Marilog District, Davao City	1987	Incubation	Failed	Egg addled
Dalwangan, Malaybalay, Bukidnon	1987	Post-fledging	Successful	
Salaysay, Marilog District, Davao City	1988	Post-fledging	Successful	
Mount Apog-apog, Magpet, North Cotabato	1988	Post-fledging	Successful	
Dalwangan, Malaybalay, Bukidnon	1989, 90	Nestling to post-fledging	Successful	
Mount Apog-apog, Magpet, North Cotabato	1990	Nestling	Unknown	
Tambobong, Baguio District, Davao City	1990, 91	Incubation to post-fledging	Successful	
Guilang-guilang, Manolo Fortich, Bukidnon	1992	Nestling to post-fledging	Successful	
Freedom, Cabanglasan, Bukidnon	1992	Post-fledging	Successful	
Mamag, Ganatan, North Cotabato	1992	Nestling to post-fledging	Successful	
Mount Apo, Toril, Davao City	1992	Post-fledging	Successful	
Kibidtud, Tambobong, Davao City	1992	Nestling to post-fledging	Successful	

Table 1. Continued.

LOCATION[a]	YEAR(S) OBSERVED	NESTING STAGE OBSERVED	FLEDGING SUCCESS	COMMENTS
Salaysay, Marilog District, Davao City	1992	Nestling to post-fledging	Successful	
Dalwangan, Malaybalay, Bukidnon	1993	Nestling	Unknown	Nest not revisited
Kabalantian, Arakan Valley, North Cotabato	1993	Nestling	Failed	Young retrieved by locals after nest tree burned
Freedom, Cabanglasan, Bukidnon	1994	Post-fledging	Successful	
Dumalaguing, Impasug-ong, Bukidnon	1995	Post-fledging	Successful	
Guilang-guilang, Manolo Fortich, Bukidnon	1995	Post-fledging	Successful	
Mount Apo, Toril, Davao City	1995	Courtship to incubation	Failed	Egg addled
Dalwangan, Malaybalay, Bukidnon	1995	Incubation to post-fledging	Successful	
Mount Sinaka, Arakan Valley, North Cotabato	1995, 96	Incubation to post-fledging	Successful	
Salaysay, Marilog District, Davao City	1995, 96	Incubation to post-fledging	Successful	
San Fernando, Cabanglasan, Bukidnon	1995, 96	Incubation to nestling	Failed	Eaglet died
Lamlahak Lake, Sebu, South Cotabato	1996	Post-fledging	Successful	
Sobrecarey, Caraga, Davao Oriental	1996	Incubation to post-fledging	Successful	
Guilang-guilang, Manolo Fortich, Bukidnon	1997	Nestling to post-fledging	Successful	
Minlanga, La Paz, Agusan del Sur	1997	Post-fledging	Successful	
Mount Sinaka, Arakan Valley, North Cotabato	1997, 98	Egg to post-fledging	Successful	
Batian, Maitum, Sarangani Province	1998	Post-fledging	Successful	
Minlanga Range, La Paz, Agusan del Sur	1997, 98	Incubation to post-fledging	Successful	
Mount Apo, Toril, Davao City	1998	Nestling to post-fledging	Successful	
Salaysay, Marilog District, Davao City	1998	Incubation to post-fledging	Successful	

[a] Entry for location generally proceeds as a combination of the locality (barangay, mountain range or a road marker [e.g., Rd. 6]) and the municipality (or district), followed by the province (or city).
[b] Kennedy (1985).

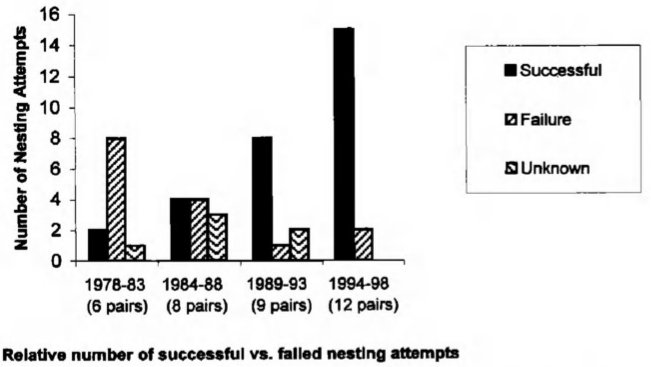

Figure 1. Summary of the success and failure of Philippine Eagle breeding attempts based on 7-yr intervals.

yr and nesting success averaged 76.3% (Table 2). This was a conservative estimate since we did not take into account that eagles may have nested in following years after previous breeding attempts failed, instead of their typical 2-yr cycle. Many pairs had only one nesting record and these were excluded in calculating percent breeding success to minimize bias. One such pair at Rd. 6P PICOP, Surigao del Sur was documented to have bred three times during which one nesting attempt failed and the fate of the other two attempts were unknown. Some pairs, especially those within the Bukidnon province, had 100% breeding success rates while others like the pair at Mount Apo, Toril, Davao City had a 33.3% success rate and a productivity of 0.17 young/pair/yr. These differences may have been due to variation in food supply between the areas, differences in the ages of the breeding birds (Newton 1979), or simply an artifact of the small sample size. The overall success of Philippine Eagles averaged about 58.0% for 50 breeding attempts by 29 pairs from 1978–98. Based on the assumption that each breeding attempt had equal probability of success or failure, and that no regional differences existed among different pairs or subpopulations, we considered this productivity to be high and not indicative of a population suffering from breeding failures.

Precise assessment of the causes of breeding failure is difficult. Birds exposed to food shortages and disturbances during critical periods of the nesting cycle may abandon eggs or nests (Newton 1979). Our summary of causes of nesting failures (Table 1) was not complete because field methods varied over the years. Moreover, our results showed that many of the breeding pairs were disturbed by logging operations, slash-and-burn farming and by the observers themselves. Three of 15 failures (20.0%) were due to removal of young from nests or felling of nest trees with young. Most individuals currently kept at the Philippine Eagle Center in Malagos, Davao City were either confiscated or surrendered as juveniles. There were also three cases (23.5%) wherein eggs were addled and/or abandoned, but the causes of nest abandonment were unknown.

The information we obtained may also have been based on the most conspicuous or accessible breeding pairs and, therefore, it may not be indicative of the true productivity of the population of Philippine Eagles. Some Philippine Eagle pairs may be more experienced breeders and may also be overrepresented in our sample which could account for the high reproductive success we recorded. Also, the high breeding success may also reflect the diminishing persecution of Philippine Eagles by the local people. Despite the limitations of the data we collected, we believe that it provides important baseline information to help focus future research and conservation efforts on the Philippine Eagle.

The current status of the Philippine Eagle as Critically Endangered is based mainly on the fact that this is a large-sized bird requiring a large territory and adapted to a tropical rainforest ecosystem that is fast disappearing in the Philippine archipelago. Theoretically, the assessment of raptor population stability involves integration of reproductive data with survival data for various age classes (Henny et al. 1970), but the lack of information on survival of Philippine Eagles after fledging limits the precise assessment of their population status. Although it is clear that the major threat to tropical birds of prey is forest destruction (Thiollay 1985, 1989, 1992), it was un-

Table 2. Breeding rates of Philippine Eagle pairs with more than one recorded nesting attempt.

BREEDING PAIR LOCATION	NO. BREEDING ATTEMPTS	% SUCCESS	BREEDING RATE (YOUNG/PAIR/yr)
Dalwangan, Malaybalay, Bukidnon	5	60	0.30
Minlanga Range, La Paz, Agusan del Sur	2	100	0.50
Freedom, Cabanglasan, Bukidnon	2	100	0.50
Guilang-guilang, Manolo Fortich, Bukidnon	3	100	0.50
Mount Apo, Toril, Davao City	6	33.3	0.17
Amabel, Magpet, North Cotabato	2	50	0.25
Mount Sinaka, Arakan Valley, North Cotabato	2	100	0.50
Salaysay, Marilog District, Davao City	6	66.7	0.33
Mean		76.3	0.38

clear whether the population decline of the Philippine Eagle is mainly due to reproductive failures or to increased mortality of juveniles, subadults and/or adults. A high rate of nesting failures could explain the population decline because Philippine Eagles lay a single egg and normally breed once every two years. Our data indicate that it is not nesting failures that are responsible for the population decline but that decreased survival of juveniles and subadults and their inability to disperse between forest islands to establish eventual breeding territories may be limiting the number of breeding pairs in this population. Past studies have suggested that the stability of breeding raptor populations is not related to prolonged good production of young but could be maintained by immigration or dispersal (Mebs 1964, Ratcliffe 1972, Newton 1979, Grier 1980). Nevertheless, forest fragmentation has untold effects on large tropical forest raptors such as the Philippine Eagle. Future research should focus on aspects of metapopulation dynamics such as survival and dispersal studies in a highly fragmented habitat, continued monitoring of reproductive performance of known breeding pairs in Mindanao and initiation of basic population ecology studies in other islands of the archipelago where Philippine Eagles are historically known.

RESUMEN.—El éxito reproductivo total del águila de las Filipinas (*Pithecophaga jefferyi*) promedio 58.0% de los intentos reproductivos por 29 parejas desde 1978–98. El éxito reproductivo con base en ocho parejas con mas de un intento reproductivo fue estimado en 0.38 ± 0.14 (±SD) juvenil/pareja/año y el éxito reproductivo promedio 76.3%. Hubo 15 fracasos reproductivos, tres de los cúales se debieron a la remoción de juveniles del nido o caídas del nido, y en tres casos los huevos fueron infértiles o abandonados. Nuestro análisis sugiere que los fracasos reproductivos no son un factor mayor en la declinación poblacional del águila de las Filipinas y apunta a un decrecimiento de la sobrevivencia de los juveniles y subadultos y su inhabilidad para dispersarse entre los fragmentos de bosque como la causa de la declinación numérica de esta especie.

[Traducción de César Márquez]

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