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A POSSIBLE NEW SUBSPECIES OF THE PHILIPPINE HAWK-EAGLE (*SPIZAËTUS PHILIPPENSIS*) AND ITS FUTURE PROSPECTS

MONIKA PRELEUTHNER AND ANITA GAMAUF[1]
Konrad Lorenz-Institute for Comparative Ethology, Austrian Academy of Sciences, Savoyenstraße. 1a, A-1160 Vienna, Austria

ABSTRACT.—On the basis of 19 study skins from eight different museum collections, five captive birds, and 67 field observations (cumulative observation time 6.8 hr), we here describe a possible new subspecies of the Philippine Hawk-Eagle (*Spizaëtus philippensis pinskeri*). This new subspecies is restricted to the rain forests of the southern part of the Philippine Archipelago. Its altitudinal range reaches from 0–1900 m and it occurs at least on Mindanao, Samar, and Negros. The population size of *S. p. philippensis* is estimated to be 200–220 pairs, that of *S. p. pinskeri* does not exceed 320–340 pairs. We emphasize the current treats to the entire species due to the ongoing destruction of its natural rain forest habitat.

KEY WORDS: *Philippine Hawk-Eagle*; Spizaëtus philippensis; *new subspecies*; *morphology*; *distribution*; *conservation*; *Philippines*.

Una posible nueva subespecie de *Spizaëtus philippensis* y su futuro

RESUMEN.—Con base en 19 pieles de estudio de 8 colecciones diferentes, 5 aves en cautiverio y 67 observaciones de campo (tiempo de observación acumulado 6.8 horas), describimos una posible nueva subespecie de *Spizaëtus philipensis* (*S. p. pinskeri*). Esta nueva subespecie está restringida a los bosques de lluvia del sur del archipiélago de las Filipinas. Su rango altitudinal es de 0–1900 m y se encuentra en Mindanao, Samar y Negros. El tamaño estimado de la población de *S. p. philippensis* es de 200–220 pares, el de *S. p. pinskeri* no excede a los 320–340 pares. Enfatizamos las actuales amenazas para la especie entera debido a la continuada destrucción del habitat natural, el bosque de lluvia.

[Traducción de César Márquez]

Taxonomically, birds of prey are well studied. Although only a few new species have been recently discovered, the number of accepted species has increased because some subspecies have been raised to species status (Peters 1931, Brown and Amadon 1969, Mayr and Cottrell 1979, Weick 1980, Amadon and Bull 1988, Sibley and Monroe 1990). According to the recent compilation of del Hoyo et al. (1994), the order comprises 302 species and 702 subspecies. Within the genus *Spizaëtus* (Vieillot 1816), 10 species (including 20 subspecies) have been described. Five new subspecies have been added during this century, three from Southeast Asia and two from Central and South America.

In 1993–94, we assessed the habitat use and behavior of 21 species of raptors in the Philippines. As part of this ecomorphological study (Gamauf et al. 1998), we measured specimens in 13 museum collections worldwide. One part of the project focused on the endemic Philippine Hawk-Eagle (*Spizaëtus philippensis* Gurney in Gould[2] (1863)). Because it is a forest-dwelling species with low population densities, the hawk-eagle is difficult to study and information on its population size and habitat use is rather limited (McGregor 1909, Delacour and Mayr 1946, Amadon 1953, Brown and Amadon 1969, Mallari 1992, Danielsen et al. 1993). We searched in various museum collections (17 were contacted by mail, 13 visited personally), but preserved specimens were available in only eight collections. Although the Philippine Hawk-Eagle has been con-

[1] Present address: Museum of Natural History Vienna, 1. Zoological Division—Bird Collection, Burgring 7, A-1014 Vienna, Austria.

[2] Since Peters (1931) the authorship for *S. philippensis* usually was credited to Gould. The specific name together with a description satisfying the criteria for availability was published verbatim as proposed by Gurney, who according to Art. 50(a) ICZN (1985) should be cited as the author.

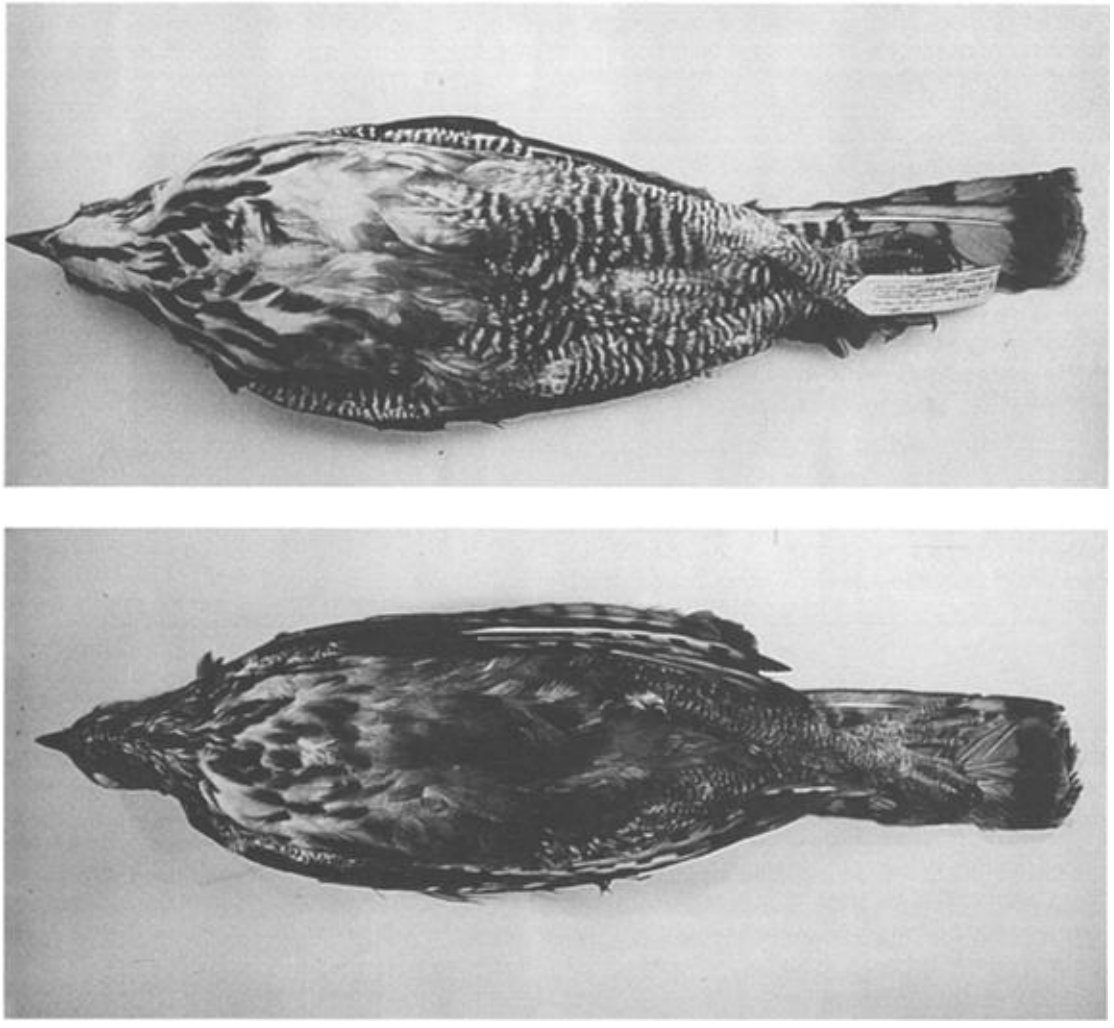

Figure 1. Top—holotype of *Spizaëtus philippensis pinskeri* (USNM, Catalog No. 578113). Bottom—Typical adult representative of *Spizaëtus philippensis philippensis* (AMNH, Catalog No. 459 063).

sidered to be monotypic, we found a striking dichotomy in the 19 museum specimens we examined. The differences in size, plumage patterns, and coloration were found to be correlated with the geographic origin of the specimens whether they were of northern or southern portions of the Philippines. The distinction was consistently observed in skins, captive birds, and individuals in the wild. On the basis of our comparisons, we concluded that there are two morphologically different and geographically separated populations of hawk-eagles in the Philippines.

Although the morphological differentiation appeared clear-cut, the typical disyllabic calls are very similar and there is no proof that there is any reproductive barrier between the two morphs. Since the degree of genetic isolation is unknown, we propose to recognize the northern and southern populations as two distinct subspecies rather than separate species. The type specimen (The Natural History Museum—Tring, BM 1955.6.N.20.424, type location substituted Luzon by Swann and Wetmore 1945) is herein recognized as a representative of the northern nominotypical subspecies *S. p. philippensis* Gurney in

Table 1. Holotype and paratype measurements of *S. p. pinskeri* subsp. nov. in comparison to the nominotypical form dependent on age and sex. Number of study skins are given in parentheses. F = female, M = male. * = $P < 0.05$, ** = $P < 0.01$ (*t*-test).

Age Class Sex Specimens	*Spizaëtus philippensis pinskeri* subsp. nov.					
	Adult F (3)[1]		Adult M (2)[2]		Juvenile	
Measurement (mm)	$\bar{x} \pm$ SD	Range	$\bar{x} \pm$ SD	Range	M (1)	F (1)
Body length	609.0 ± 1.0	608.0–610.0	543.5 ± 41.5	502.0–585.0	550.0	—
Wing length	365.5 ± 15.5	350.0–381.0	326.0	—	336.0	378.0
Kipp's distance	92.5 ± 7.8	87.0–98.0	77.0 ± 7.1	72.0–82.0	87.0	93.0
Number of notched primaries	8.7 ± 0.6	8.0–9.0	8.0	—	8	9
Length of central tail feather	244.0 ± 5.7	234.0–248.0	211.0 ± 5.0	208.0–215.0	216.0	232.0
Length of outermost tail feather	253.0 ± 5.0	248.0–258.0	214.0 ± 15.6	203.0–225.0	221.0	240.0
Length of hind toe	26.9 ± 3.2	24.5–30.5	22.9 ± 1.2	22.0–23.7	23.5	30.0
Length of middle toe	50.9 ± 2.7	49.3–54.0	44.5 ± 3.5	42.0–47.0	49.5	44.2
Length of hind claw	36.9 ± 1.5	35.6–38.5	30.7 ± 1.0	30.0–31.4	34.6	36.2
Length of middle claw	24.7 ± 1.1	23.9–26.0	21.8 ± 1.1	21.0–22.5	23.0	25.0
Tarsus length	82.5 ± 1.3	81.5–84.0	74.7 ± 6.4	70.2–79.2	68.0	88.0
Bill length with cere	40.9 ± 2.1	38.7–42.9	36.5 ± 1.0	35.8–37.2	40.8	41.5
Bill width of distal edge of cere	29.4 ± 1.0	28.3–30.0	28.6 ± 2.6	26.7–30.4	29.5	31.8
Bill depth	24.8 ± 0.5	24.3–25.3	20.5 ± 0.4	20.2–20.8	—	23.8

[1] Holotype included.
[2] Subadult included.

Gould (1863). We propose that the southern subspecies be designated a new subspecies *Spizaëtus philippinsis pinskeri* subsp. nov.

DESCRIPTION

Holotype. It is an adult female that weighed 1281.2 g and was collected on 16 May 1963 by D.S. Rabor in the Car-Can-Mad-Lan Area, Surigao del Sur, Mindanao, Philippines (elevation 330–700 m). Originally, this specimen was in the collection of Silliman University Natural History Museum (Catalog No. 35020), but it is now in the U.S. National Museum, Smithsonian Institution (USNM, Catalog No. 578113, Fig. 1).

Description of Holotype. The holotype of *S. p. pinskeri* is very colorful (Fig. 1). The head and crown show a pale olive buff (S10: Y10, M00) (nomenclature taken from Ridgway [1912], color codes from Küppers [1984]) with a background color of blackish streaks which are more bold on the crown. The head contrasts with the deep brownish olive (S80: Y80, M30) back. The long, prominent crest consists of 4–5 black feathers of unequal length (longest 7 cm). The throat is white, divided by a bold, black median stripe and bordered by black, lateral moustache stripes composed of fine black streaks. The plumage on the ventral side is divided into three regions showing different colors. The upper breast is white with bold longitudinal, black streaks edged with tawny olive (S30: Y99, M50). The adjoining area is clearly separated from the upper breast and carries a tawny olive (S30: Y99, M50) band with some white, spotted feathers. The lower belly as well as the feathered legs and the undertail coverts are contrastingly barred, from dark clove brown (Y99: M70, C99) to blackish and white. The wings are short and roundish with tips extending less than halfway to the tailtip. Like the lower belly, the underwing coverts are finely barred clove brown (Y99: M70, C99) to blackish and white. The upperparts beginning at the hind neck are uniform brownish olive (S80: Y80, M 30). The long tail has the same color. A broad black subterminal bar is separated by a broader unmarked zone from five narrower bars. The cere and bill are sooty black (S90: Y20, M00) and the toes yellow (faded in the specimen).

Measurements of the holotype are as follows: body length 608 mm, wing length 350 mm, Kipp's distance (primary projection) 87 mm, number of notched primaries 9, length of central tail feather 240 mm, length of outermost tail feather 248 mm, length of hind toe 25.6 mm, length of middle toe

Table 1. Extended.

SPIZAËTUS PHILIPPENSIS PHILIPPENSIS GURNEY IN GOULD (1863)					
ADULT F (4)[2]		ADULT M (6)[2]		JUVENILE M (2)	
$\bar{x}$ ± SD	RANGE	$\bar{x}$ ± SD	RANGE	$\bar{x}$ ± SD	RANGE
618.0 ± 16.6	601–634	563.3 ± 22	543–587	—	—
399.0 ± 1.0**	398–400	358.0 ± 7.3**	352–372	358.0	—
104.0 ± 5.5	98–108	92.8 ± 5.5	86–99	87.0	—
8.3 ± 0.6	8–9	8.2 ± 0.4	8–9	8.5 ± 0.1	8–9
246.8 ± 11.5	236–249	222.3 ± 11.6	208–236	247.0	—
257.7 ± 5.9	251–262	232.7 ± 7.9	222–245	249.0	—
29.3 ± 1.7	27.8–31.6	25.0 ± 1.4	23–27	26.9 ± 0.8	26.3–27.4
50.6 ± 3.4	47–55	46.0 ± 3.3	43.0–49.5	47.6 ± 1.1	46.8–48.3
38.7 ± 2.0	37.0–40.7	34.6 ± 0.7**	33.8–35.7	32.5 ± 1.3	31.5–33.4
26.8 ± 1.2*	25.2–28.0	25.4 ± 1.0**	24–27	24.3 ± 0.4	24.0–24.5
86.8 ± 5.6	81–94	81.7 ± 2.0	79–84	—	80.1
45.6 ± 2.1	44.3–48.1	40.7 ± 1.4*	39.5–42.5	39.3 ± 1.9	37.9–40.6
30.3 ± 4.0	29.0–35.6	27.1 ± 1.0	25.5–28.3	28.4 ± 0.1	28.3–28.4
25.0 ± 1	23.6–25.9	21.2 ± 1.0	20.3–22.4	20.5	—

49.3 mm, length of hind claw 35.6 mm, length of middle claw 24.4 mm, tarsus length 84.0 mm, bill length with cere 41.1 mm, bill width of distal edge of cere 30.0 mm, and bill depth 24.3 mm.

Measurements from Museum Specimens. We obtained measurements on 42 morphometric characters from 19 museum specimens of Philippine Hawk-Eagles, 14 of which were prominent and discriminative characters (Table 1). Despite the pronounced sexual dimorphism, the measurements of *S. p. pinskeri* give clearly smaller values than those of *S. p. philippensis.* This finding was corroborated by discriminant function analysis (Fig. 2) which separated both species in both sexes. The clearest discriminating feature found was the size of the feet and bill, although the distinction held even when wing measurements were included. All specimens were correctly classified and there was no multivariate overlapping of the groups.

Discriminant function 1 (DF 1) concerned characters related to the mode of handling and killing the prey as well as indirectly to prey size. The length of the bill was loaded the highest on axis 1, followed by the length of hind claw and the length of the hind toe. DF 2 was correlated with characters describing the killing apparatus but also with the type of prey (especially birds vs. mammals). It was dominated by the length of the claws of middle toe and hind toe and secondarily by the length and width of the bill (Table 2). Bird hunters typically have longer claws on their middle toes (positive correlation) and shorter hind claws, their bill is shorter and the cross-section of the bill (reflected in the width of the bill) is more roundish compared to the mammal hunters. This suggests that members of the bigger *S. p. philippensis* may have a higher proportion of mammals in their diet whereas *S. p. pinskeri* may preferentially feed on birds (Rochon-Duvigneaud 1952, Wattel 1973, Brown 1976, Hertel 1995, Gamauf et al. 1998).

ETYMOLOGY

Scientific Name. The proposed new subspecies is named in honor of Prof. Dr. Wilhelm Pinsker, Institute for Medical Biology, University of Vienna, for his excellent scientific work as well as his eminent skill in the guidance of his students as a teacher. We wish to emphasize our gratitude for the invaluable help he has given to both of us.

English (German) Names. According to the geographical distribution of the two subspecies, we propose the name Southern Philippine Hawk-Eagle (Südlicher Philippinenhaubenadler) for *S. p. pinskeri* and Northern Philippine Hawk-Eagle (Nördlicher Philippinenhaubenadler) for the nominotypical subspecies *S. p. philippensis.*

Paratypes. The three specimens from Mindanao are herein designated paratypes:

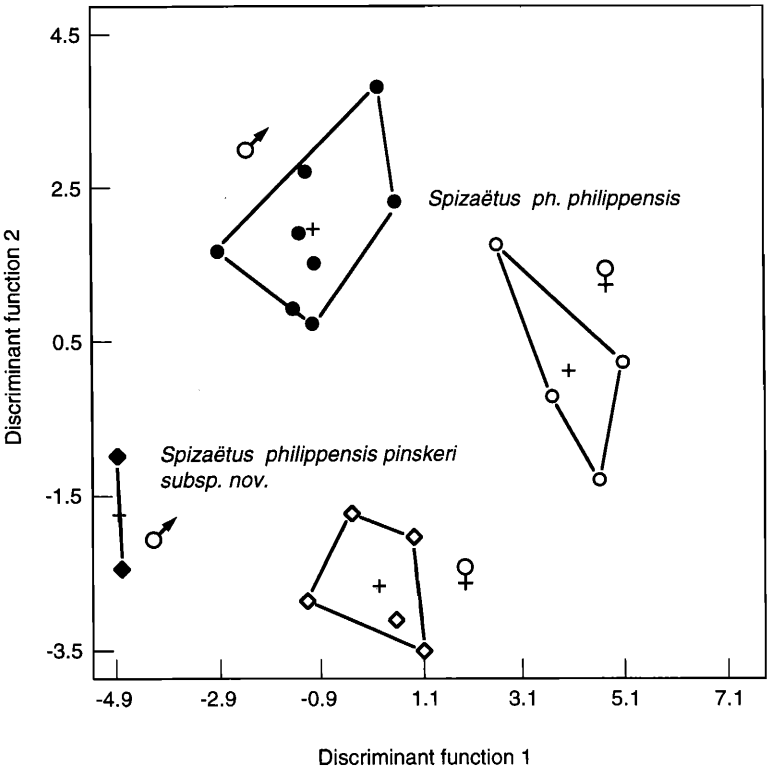

Figure 2. Separation of *S. p. philippensis* ($N = 12$, round symbols) and *S. p. pinskeri* ($N = 7$, square symbols) according to discriminant function analysis of 5 morphological variables (bill length, bill width, length of the hind toe, hind claw and middle claw).

1. Adult male collected on 30 January 1964 by D.S. Rabor at Tucay, Mt. Matutum, South Cotabato, Mindanao (Museum of Natural History, University of the Philippines at Los Baños [UPLB], Philippines, Catalog No. 108).
2. Subadult male collected on 12 March 1953 by F. Solomonsen at Talacogon, Agusan del Sur, Mindanao (University Museum of Zoology [UMZC], Copenhagen, Denmark, Catalog No. 936).
3. Immature female (we determined it to be a male) collected on 30 October 1946 by D.S. Rabor at Maduum Tagum, Davao del Norte, Mindanao (Field Museum of Natural History [FMNH], Chicago, IL U.S.A., Catalog No. 1247).

Table 2. Canonical disciminant analysis of four hawk-eagle groups (*S. p. philippensis, S. p. pinskeri,* males and females). Shown are loadings on discriminant function axes and results of univariate F-tests.

CHARACTER	AXIS 1	AXIS 2	F	*P*
Length of hind toe	0.255	−0.067	4.610	<0.05
Length of hind claw	0.430	−1.294	17.512	<0.00001
Length of middle claw	−0.119	1.819	10.136	<0.001
Bill length with cere	0.508	0.459	16.199	<0.0001
Bill width of distal edge of cere	0.175	0.289	2.208	n.s.
Percent variance explained	62.1	37.2		

The three remaining specimens from the southern population were collected in Samar and Negros. One was an adult female collected by D.S. Rabor on 6 April 1957 at Matuguinao, Samar (FMNH, Catalog No. 247 377). The second was an adult male (we determined it to be a female) collected on 21 December 1955 by D.S. Rabor at Basey, Bayawan, Negros Oriental (UPLB, Catalog No. 107) and the third specimen was an immature female collected on 1 August 1871 by A. Everett at Nueva Valencia, Negros Oriental (Tweeddale Collection, The Natural History Museum [BMNH], Tring, Herts, U.K., Catalog No. 87.11.1.333).

Description. In adults of *S. p. pinskeri,* the colors of the head and nape vary from ivory (S00: Y10, M10) to pale olive grey (S20: Y00, M00) or dark olive buff (S30: Y50, M20) with more or less fine black shaft streaks. These shaft streaks can become very bold so that the crown appears black such as the specimen from Samar. The black occipital crest has a maximum length of 8 cm. The throat is always completely white. The upper breast has a white ground color with pronounced black streaks, in some cases especially at the distal side of the body edged with tawny olive (S30: Y99, M50). The color of the lower breast and flanks is more variable, ranging from yellow ocher (S20: Y80, M20) to cinnamon (S20: Y70, M40), clay color (S30: Y60, M50) or tawny olive (S30: Y99, M50) with more or less pronounced bars. This pattern appears only in adult birds, which are at least in their fourth calendar year. The lower belly and the legs are invariably barred clove brown (Y99: M70, C99) to black and white. Back varies between raw umber (Y99: M70, C80), brownish olive (S80: Y80, M30) or sepia (S80: Y99, M40). The cere and bill are sooty black (S90: Y20, M00) in study skins and living birds. The unfeathered toes are apricot yellow (S00: Y60, M20) to lemon crome (S00: Y90, M30) in living birds, bright lemon crome are also the eyes.

Since juvenile hawk-eagles are difficult to distinguish from other species, we give a rather detailed account of the plumage pattern. The juvenile plumage is white at the ventral side, also on head and neck, except the long black crest feathers. Only one young bird, observed and photographed at Mt. Kitanglad, Mindanao, had dark grey flanks. The feathered legs are white with fine warm buffy (S20: Y60, M20) bars on the tibiotarsus. There is a gradual change in color from the white head to the dark back. The broadly pale-edged feathers vary between mouse grey (S70: Y10, M10) to chaetura drab (S80: Y30, M30). The uppertail coverts are also white. The cere and bill are sooty black (S90: Y20, M00) and together with the black lores they form a dark mask. The toes in living birds are yellow as in adults, whereas the eye coloration changes from dark grey in juveniles to bright lemon crome (S00: Y90, M30) in subadults (at least in Basic III) and adults.

The median and lesser wing coverts are white and form a broad band on the upper side of the wing. The secondaries are deep mouse grey (Y40: M30, C50), the primaries blackish. Both are heavily barred with 7–9 relatively fine bars. In soaring birds, a narrow white sickle-like panel is seen in backlighting along the base of the primaries. On the mouse grey (S70: Y10, M10) to chaetura drab (S80: Y30, M30) colored tail, 6–7 bars are regularly spaced or one broad subterminal bar is discernible.

Specimens Examined. Including the holotype, seven study skins of *S. p. pinskeri* were available. In addition, two captive birds were examined at the Breeding Center of the Philippine Eagle Conservation Program Foundation in Toril, Davao. Sixty individuals were observed in the field on the island of Mindanao. For comparisons, measurements were taken from 12 skins of representatives of *S. p. philippensis* (five including the holotype from BMNH—Tring, three from the DMNH, one from the CMNH, one from the RNMS, one from the AMNH, and one from the FMNH). Ten of these 12 birds come from Luzon but the origins of the other two specimens could not be traced. We also studied three captive birds, one in the Manila Zoological Garden and two at the Wildlife Research Center in Manila. In Luzon, we observed the nominotypical subspecies eight times. The cumulative observation time for both subspecies in their natural habitat was 6.8 hr during three field trips to the Philippines (January–April 1993, November 1993–February 1994, and March–July 1994). The study of plumage changes in captive birds was essential for age determination.

Diagnosis. The proposed new subspecies can be distinguished from *S. p. philippensis* by the smaller size of both sexes (Table 1), and by the different plumage coloration and plumage patterns on the head, breast and belly. In contrast to *S. p. pinskeri,* the head of *S. p. philippensis* is raw sienna (S30: Y80, M50) to antique brown (S40: Y99, M50) with broad blackish streaks and the throat is mainly fine ivory

to warm buffy (S20: Y60, M20) with fine dark streaks. The breast is ochraceous-tawny (S30: Y90, M50) and the belly somewhat darker, antique brown (S40: Y99, M50) to cinnamon-brown (S40: Y90, M50). The bold black streaks on the breast are less contrastful. Individuals of *S. p. philippensis* have fine whitish bars on the cinnamon-brown (S40: Y90, M50) to clove brown (Y99: M70, C99) feathered legs and undertail coverts. Almost all illustrations of Philippine Hawk-Eagles found in the literature (e.g., Walden 1875, Brown and Amadon 1969, Weick 1980, del Hoyo et al. 1994) depict representatives of *S. p. philippensis*. One exception is the individual shown in duPont (1971), which matches with *S. p. pinskeri* in the most important characters. To our knowledge, only a single photograph by M.C. Witmer published in Gonzales and Rees (1988) shows an adult *S. p. pinskeri* (captive bird at the Philippine Eagle captive breeding center, Barracatan, Toril, Davao City; R.S. Kennedy pers. comm.).

The morphological traits and differences in color patterns do not vary clinally from north to south. Our data indicate that the boundary between the subspecies runs along the San Bernardino Channel which separates Luzon and Samar by a distance of less than 20 km. Within the Philippines, this line is also known to separate taxa of other vertebrates (birds, mammals, reptiles) with limited ability to disperse across saltwater channels (Heaney 1986, ICBP 1992).

Effects of the Pleistocene history, with repeated land bridge connections between many of the islands, may serve as an explanation for the present distribution pattern (Hauge et al. 1986). Growth and recession of continental glaciers during the Pleistocene were associated on a global basis with changes in sea level and temperature. In the late middle Pleistocene (about 160 000 yr ago), sea level was about 160–180 m below the present level. The shallow (140 m) San Bernardino Strait between southern Luzon and northern Samar may have been dry during this period, allowing free exchange throughout much of the archipelago (Heaney 1985) and also to the large Visayan islands like Negros. At the end of the Pleistocene, about 18 000 yr ago, sea level had risen to 120 m below the present coast line covering the channel with a body of water 20 m depth that cut off the connection between the islands. Thus, the separation of the two subspecies must have happened after the geographical isolation, which cannot be dated accurately. Due to particular morphological features, especially the short, broad and round wings, the Philippine Hawk-Eagle is well adapted for rainforest habitats. These apparent adaptations do not allow long-distance flights across open habitats as it is actually the case between Luzon and Samar (Gamauf et al. 1998). Therefore, disruption of the gene flow by such a geographic barrier could have led to genetic isolation between the northern and southern populations and subsequently to the divergence into separate subspecies. This isolation process is enhanced by further subdivision of the extant populations through the fragmentation of the habitat.

To explain the size differences between *S. p. pinskeri* and *S. p. philippensis* we have to take into consideration interactions and competition with other species. One reason for the smaller size of *S. p. pinskeri* could be niche separation with respect to other sympatric eagles also specialized for the hunting of large mammals and birds. In the south, two larger eagle species exist, the Changeable Hawk-Eagle (*Spizaëtus cirrhatus*) and the Philippine Eagle (*Pithecophaga jefferyi*). In contrast, on the northern island Luzon, only the Philippine Eagle is larger than the Philippine Hawk-Eagle. The Rufous-bellied Eagle (*Hieraaetus kienerii*) comes next in size, a species which has been recorded from the whole Philippine Archipelago. Thus, both subspecies fit approximately into the respective size gap between their food competitors. The size difference to its larger competitor is greater in *S. p. philippensis* than in *S. p. pinskeri*. The wider niche reflects the larger body size and the more pronounced sexual size dimorphism in *S. p. philippensis* (Fig. 2).

ACTUAL SITUATION AND FUTURE PROSPECTS

Habitat and Distribution. We found the Philippine Hawk-Eagle in large, continuous areas of dipterocarp rainforests. It definitely prefers extensive primary, or well-structured, old secondary forests which were selectively logged 20–30 yr ago. Occasionally even transitional stages to semi-open habitats are used. With respect to altitude, *S. p. pinskeri* was observed from almost sea level up to 1900 m.

Of the 11 islands from which the species has been recorded so far (Dickinson et al. 1991, Brooks et al. 1992, Evans et al. 1993a, 1993b), only the main island Luzon is inhabited by *S. p. philippensis* with certainty. Mindanao, Negros, and Samar are doubtlessly populated by *S. p. pinskeri* as docu-

mented by study skins. Individuals recorded from Leyte and probably also from Biliran, Basilan, Siquijor, and more recently from Bohol (Hornskov 1995) presumably belong to *S. p. pinskeri*. No unequivocal evidence for the occurence of either subspecies is known so far from Palawan. The only museum specimen labeled as "Philippine Hawk-Eagle" from the locality Palawan was a misidentified Changeable Hawk-Eagle (Staatliches Naturhistorisches Museum Braunschweig, Catalog No. 14158, collector Dr. C. Platen). In general, information on the distribution of the Philippine Hawk-Eagle (and other bird species) is still insufficient and further studies are needed.

Conservation. Most current threats to raptors in the tropical forest belt are related to habitat destruction (Kennedy 1986, Thiollay 1994). Owing to the construction of new roads for timber harvesting, often in a very damaging way, the final destruction is conducted by shifting cultivators who enter the region illegally. An additional threat arises from the fact that the Philippines are one of the most densely populated countries in Southeast Asia, with more than 65 million people on 300 000 km^2.

Dickinson et al. (1991) have presented data on the extent of forests remaining on the major island groups. They found that only the major islands possess sufficiently large forested areas. According to Collins et al. (1991), the deforestation rate (determined for the period 1986–90) is 1380 km^2/yr for the whole Philippines. In 1988, the forested area with closed canopy cover on the island of Luzon was determined as 7621 km^2. Assuming a uniform rate of deforestation over the Philippines, the remaining forest habitat is roughly estimated to be 5000 km^2.

Knowing the inhabitable area and the present population density, we attempted to gauge the actual population number. In six study areas, we determined the number of pairs using two methods: census from exposed points (cliffs, clearings, prominent trees) and line transects. These two methods have been used successfully in studies on tropical rain forest raptors (Thiollay 1989, Whitacre et al. 1992). Point censuses proved very suitable to map the locations of hawk-eagles since they are year-round residents that often fly above the canopy. In each study area, the total time of observation was at least 2 wk. The density of the Philippine Hawk-Eagle in Luzon was determined in two study areas in the Sierra Madre mountain range in the south of Quirino province. Around Asaclat (35 km^2, 500–900 m), we found two pairs (5.7 pairs/100 km^2) and in Don Mariano Perez (32 km^2, 400–1100 m) one pair (3.1 pairs/100 km^2). Based on this survey, we estimated the size of the *S. p. philippensis* population on Luzon to be about 200–220 pairs. For *S. p. pinskeri*, we surveyed four study areas in Mindanao. In the lowland forests of PRI (former PICOP) (Surigao del Sur, 58 km^2, 90–180 m), we found 3–4 pairs (5.2–6.9 pairs/100 km^2) and in Carmen-Cantilan (Surigao del Sur, 27 km^2, 80–540 m) one pair (3.7 pairs/100 km^2). At the gentle slope on the Dalwangan side of Mt. Kitanglad (Bukidnon, 38 km^2, 900–1800 m), we found three pairs (7.9 pairs/100 km^2) and on the steep slope on the Barracatan side of Mt. Apo (Davao City, 25 km^2, 950–1800 m) we found one pair (4 pairs/100 km^2). Thus, in the total 7500 km^2 of closed canopy forest available, we estimated the number of pairs may be about 320–340.

In the world list of threatened birds (Collar et al. 1994), the Philippine Hawk-Eagle is listed as Vulnerable with a high risk of extinction in the wild within the medium-term future. Based on our recent investigations, the estimated maximal number of mature individuals is <1200, a population size clearly below the criterion of <2500 set by BirdLife International for endangered species. According to this criterion the classification of the Philippine Hawk-Eagle as an Endangered species seems appropriate.

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