J. Raptor Res. 32(1):3–18

CONSERVATION STATUS OF TROPICAL RAPTORS[1]

KEITH L. BILDSTEIN, WENDY SCHELSKY AND JORJE ZALLES
Hawk Mountain Sanctuary, 1700 Hawk Mountain Road, Kempton, PA 19529 U.S.A.

SUSIE ELLIS
IUCN Conservation Breeding Study Group, Minneapolis Zoo, Minneapolis, MN U.S.A.

ABSTRACT.—Seventy-six percent (222) of the world's 292 species of diurnal raptors are found mainly or completely in the tropics. Forty-six percent of all tropical raptors are threatened by habitat loss, 11% by environmental contaminants, and 19% by direct persecution. Seventeen percent are threatened by two of these factors, 2% by all three factors. Regionally, 42% of all Neotropical, 60% of all Afrotropical, 60% of all Indomalayan, and 77% of all Australotropical raptors are threatened by one of more of these factors. IUCN classifies 27% of all tropical raptors (59 species) as Near Threatened, Vulnerable, Endangered, or Critically Endangered. Similar statistics are 23% (17 of 73 species), 14% (11 of 80 species), 33% (21 of 63), and 34% (12 of 35), for the Neotropical, Afrotropical, Indomalayan, and Australotropical regions, respectively. Thirty percent of all tropical raptors are endemics. Fifty-seven percent of all tropical raptors are complete, partial, or irruptive migrants. The degree of endemism and migration behavior varies among the four regions. Although some of the regional differences in conservation status reflect regional differences in knowledge, many appear to reflect ecological differences among the four regions.

KEY WORDS: *Conservation status; tropics; tropical raptors; endemics; migration.*

Estado de conservacion de las aves rapaces tropicales

RESUMEN.—Setenta y seis por ciento (222) de las especies de aves rapaces diurnas del mundo (292) se encuentran en los trópicos. Cuarenta y seis por ciento de todas las aves rapaces tropicales están amenazadas por la pérdida de habitat, 11% por contaminantes ambientales y 19% por persecución directa. Diez y siete por ciento están amenazadas por dos de estos factores, 2% por los tres factores. Regionalmente, 42% de todas las aves rapaces neotropicales, 60% de todas las afrotropicales, 60% de todas las indomalayas y 77% de todas las especies tropicales de Australia están amenazadas por uno o mas de estos factores. La IUCN clasifica el 27% de todas las aves rapaces tropicales (59 especies) como Cercanamente Amenazadas, Vulnerables, Amenazadas, o Críticamente Amenazadas. Estadísticas similares indican 23% (17 de 73 especies), 14% (11 de 80 especies), 33% (21 de 63) y 34% (12 de 35), para las regiones neotropical, afrotropical, indomalaya y australiana respectivamente. Treinta por ciento de todas las aves rapaces tropicales son endémicas. Cincuenta y siete por ciento de todas las aves rapaces tropicales son migratorias totalmente, parcialmente o en forma irruptiva. El grado de endemismo y comportamiento migratorio varia entre las cuatro regiones. Aunque las diferencias regionales en el estado de conservación reflejan las diferencias regionales de conocimiento, parece que también son el reflejo de las diferencias ecológicas entre las cuatro regiones.

[Traducción de César Márquez]

Tropical ecosystems are some of the most biologically diverse habitats on earth (Wilson 1988). Seventy-six percent of all centers of avian endemism (e.g., "endemic bird areas," Bibby et al. 1992) occur in tropical regions, and the same is true for many plant and animal taxa (Gentry 1986, McNeely et al. 1988, Myers 1988, Thirgood and Heath 1994). Biogeographically, 27% (8 of 30) of the world's ecoregions are represented in the tropics (Bailey 1996). Tropical rainforests, which cover only 7% of the earth's land surface, are estimated to contain more than half of the world's species (Wilson 1988).

Previous studies suggest that 90% of all species of raptors occur, wholly or in part, in the tropics

[1] This paper is dedicated to the memory of Hawk Mountain Sanctuary's longtime friend, Roger Tory Peterson.

(Kennedy 1986), and that 45% of all species of raptors occur in tropical rainforests (Thiollay 1985a, 1994). Half of all tropical countries have at least 50 species of raptors (Table 1).

Many tropical raptors, especially forest dwellers, are secretive and difficult to study. The distribution and status of many species are poorly known (Meyburg and van Balen 1994, Thiollay 1994, van Balen 1994; but see Thiollay 1985b, Kennedy 1986, Burnham et al. 1994, Watson and Lewis 1994). Even so, several patterns are apparent. The major threat to tropical raptors is habitat destruction (Thiollay 1989a, 1992, 1994), followed by environmental contamination and shooting (Thiollay 1985a). Overall, endemic species are more likely to be threatened, as are nonmigratory and Old World species.

Previous studies of tropical raptors have focused on individual species, countries, regions, or habitat types (e.g., Meyburg and Chancellor 1989, 1994, Baker-Gabb 1994, Thiollay 1994, van Balen 1994, and references therein). We use these and other published sources, including del Hoyo et al. (1994), together with the unpublished IUCN Raptor Conservation Assessment and Management Plan and Hawk Mountain Sanctuary *Hawks Aloft Worldwide* databases, to provide an overview of raptor diversity and conservation status in the tropics.

Specifically, we assess regional differences and the influence of ecological circumstances on the conservation status of tropical species. We detail the distribution of the world's tropical raptors regionally, assess regional differences in diversity and conservation status, and determine the extent to which endemism and migratory behavior are associated with conservation status. We also discuss how conservationists can better protect tropical raptors. Because our focus is global and regional, individual species are mentioned in the text only as examples of general patterns. A list of the conservation status of individual species appears in Appendix 1.

STUDY AREA AND METHODS

The Tropics Defined. Geographically, the tropics include regions on both sides of the Equator extending to 23.5°N and S (the Tropics of Cancer and Capricorn, respectively). Terrestrial ecosystems within the region are characterized by near constant day lengths, relatively high solar radiation, and, when adjusted for altitude, relatively high diurnal and nocturnal temperatures (Deshmukh 1986). Although the tropics have a somewhat more complex ecological definition that takes climate, as well as geography, into account (Deshmukh 1986, Bailey 1996), the regions defined both ways are largely coincident. We define the earth's four tropical regions, the Neotropics, Afrotropics, Indomalayan Region, and Australotropics, geographically as the land masses between the Tropics of Cancer and Capricorn in each of these four regions.

Approximately 85% of the Neotropics is in the Humid Tropical Domain ecoregion (Bailey 1996), of which slightly more than half is savanna; the remainder is tropical rainforest. Dry Domain ecoregions in the Neotropics include both steppe and desert. Overall, approximately 40% of the Neotropics is in the Tropical Rainforest ecoregion.

The Afrotropics include the southern half of the Arabian Peninsula and most of Africa and Madagascar. Approximately 55% of the region is in the Humid Tropical Domain ecoregion (Bailey 1996). Dry Domain ecoregions in the Afrotropics are mainly deserts, including the southern Sahara and the Namib, with some steppe. Approximately 10% of the Afrotropics is in the Tropical Rainforest ecoregion.

The Indomalayan tropics cover much of southeast Asia and neighboring islands. More than 95% of the region is in the Humid Tropical Domain ecoregion (Bailey 1996), of which half is savanna, and half is rainforest. Dry Domain ecoregions are limited to eastern India. Overall, approximately 50% of the Indomalayan region is in the Tropical Rainforest ecoregion.

The Australotropics include the Moluccas, parts of Australia, and all of New Guinea. Approximately 60% of the region is part of the Humid Tropical Domain (Bailey 1996), slightly more than half of which is savanna. Dry Domain areas of the Australotropics include tropical portions of the Great Sandy Desert of interior Australia, and its associated steppes. Approximately 30% of the Australotropics is in the Tropical Rainforest ecoregion.

Tropical Raptors Defined. We consider raptors to be members of the avian families Accipitridae, Sagittariidae, and Falconidae; and the avian subfamily Cathartinae (Sibley and Monroe 1990), the birds that most authorities call diurnal raptors (Brown and Amadon 1968, Amadon and Bull 1988, del Hoyo et al. 1994, Griffiths 1994). For our purposes, tropical raptors include the subset of these 292 species (Amadon and Bull 1988) whose combined breeding and nonbreeding distributions, as detailed in del Hoyo et al. (1994), occur wholly or mainly (>50%) within the tropics. Species (e.g., Swainson's Hawk [*Buteo swainsoni*]), whose migratory routes include the tropics, but whose breeding and nonbreeding ranges lie wholly or mainly outside of the tropics, are not included as tropical raptors.

Endemic Raptors Defined. As a group, raptors are relatively large, frequently migratory birds that occur at low densities across large areas. Few can be characterized as restricted-range, or endemic species (e.g., species with breeding ranges below 50 000 km^2, Bibby et al. 1992). Even so, some species have relatively small ranges compared with others. Such species often are used as "umbrella" or "flagship" species for local and regional conservation efforts (e.g., Philippine Eagle [*Pithecophaga jefferyi*, Kennedy 1983], Barred Forest-falcon [*Micrastur ruficollis*, C. Márquez, pers. comm.], Mauritius Kestrel [*Falco punctatus*, Jones 1981]). Here, we consider endemic spe-

Table 1. Wholly and mainly tropical countries with at least 50 species of raptors; together with the migration, distribution, and conservation status (*sensu* Collar et al. 1994) of those raptors.

	Number of Species					
Country	Total (Migrants)	Endemics	Vulnerable	Near Threatened	Endangered	Critically Endangered
Neotropics						
Argentina	61 (39)		1	10		
Bolivia	68 (40)		1	7		
Brazil	66 (39)	1	2	7		
Colombia	75 (43)	1		10	1	
Costa Rica	53 (34)			6		
Ecuador	72 (37)	4	1	9	2	
French Guiana	55 (31)			5		
Guyana	50 (30)			6		
Mexico	54 (41)			4		
Panama	57 (34)			7		
Paraguay	51 (37)		1	6		
Peru	57 (38)	2		9	1	
Venezuela	75 (38)			8		
Afrotropics						
Angola	58 (47)		1	1		
Botswana	54 (47)		2	1		
Burundi	54 (34)		1	1		
Cameroon	59 (47)		1	1		
Central African Republic	55 (43)		1	1		
Chad	52 (47)		1	1		
Djibouti	50 (47)		2	1		
Ethiopia	71 (61)		4	1		
Ivory Coast	50 (38)		1	1		
Kenya	72 (62)		3	2		
Madagascar	16 (4)	11		3		2
Malawi	56 (46)		2	1		
Mozambique	60 (50)		3	2		
Namibia	56 (47)		2	2		
Nigeria	59 (47)		1	1		
Senegal	51 (44)		1	1		
Sudan	74 (64)		3	1		
Tanzania	69 (58)		2	2		
Uganda	71 (59)		1	1		
Zaire	65 (52)		1			
Zambia	58 (49)			2	1	
Zimbabwe	56 (47)			2	2	
Indomalayan						
India	63 (59)	3	4	14		
Indonesia	62 (51) (39 [39])[a]	16 (8)	2 (1)	8 (6)	1 (1)	
Myanmar	52 (47)		4	10		
Australotropical						
Indonesia	62 (33) (39 [22])[a]	16 (9)	2 (1)	8 (2)	1 (0)	

[a] Indonesia, which spans the Indomalayan and the Australotropical regions, appears twice in the table. The data presented above represent country- and (tropical-region) totals.

Table 2. Distribution of the world's diurnal raptors as a function of tropical distribution. Taxonomy based on Amadon and Bull (1988); distribution based on del Hoyo et al. (1994).

	Number of Species (%)[a]				
Extent of Range in Tropics	Worldwide	Neotropics	Afrotropics	Indomalayan	Australotropics
All of range	78 (27%)	20 (22%)	17 (15%)	22 (26%)	20 (41%)
More than half of range	144 (49%)	53 (58%)	63 (56%)	41 (49%)	15 (31%)
Less than half of range	60 (21%)	19 (21%)	32 (29%)	21 (25%)	14 (29%)
None of range	10 (3%)				
Total	292	92	112	84	49

[a] Worldwide percentages represent proportions of all species, including those that occur only outside of the tropics. Regional percentages represent proportions of species of raptors from that region.

cies to be raptors whose overall ranges are limited to one or two countries. We consider endemic genera to be genera that occur in only one tropical region.

Threats to Tropical Raptors. Human threats to tropical raptors include habitat destruction and fragmentation, pollution and pesticide use, and direct human persecution (Newton and Chancellor 1985, Diamond and Lovejoy 1985, Meyburg and Chancellor 1989, 1994, and references therein).

Statistical Tests. We used log-likelihood ratio (G) tests with Yates correction in tests where df = 1 (Zar 1984), to assess regional differences in the endemic, migration and conservation status of tropical raptors, as well as to determine the extent to which endemism and migration were associated with differences in the conservation status of the birds. In all analyses, differences were considered significant if $P < 0.05$.

Results

Distribution, Endemism, and Migratory Status. Seventy-eight species of raptors (27%) occur wholly within the tropics. An additional 144 species (49%) occur mainly within the tropics. Overall, 282 species (97%) of the world's raptors have breeding or wintering distributions that occur, at least in part, within one or more tropical regions (Table 2). Seven countries have 70 or more species of tropical raptors (Table 1). The distribution and status of the world's 222 wholly or mainly tropical raptors appear in Appendix 1.

Raptor faunas differ considerably among the four regions. Eighty-nine percent of tropical raptors occur in a single tropical region, and except for the contiguous Indomalayan and Australotropical regions, there is little species overlap among regions (Table 3). Regional faunal specificity is greatest in the Neotropics, where 72 of 73 species have tropical distributions restricted to that region; the single exception being the nearly cosmopolitan Osprey (*Pandion haliaetus*) (Table 3). Twenty-six Neotropical genera (50 species) occur only in that tropical region, compared with 12 (19), 5 (10), and 4 (5), genera (species), respectively, in the Afrotropics, Indomalayan Region, and Australotropics (Table 4).

Table 3. Regional distribution of tropical raptors. Species with region-restricted ranges are those that occur in only one tropical region. Widespread species occur in more than one tropical region.

	Number of Species (%)				
Extent of Range	Worldwide	Neotropics	Afrotropics	Indomalayan	Australotropics
Wholly tropical raptors					
Region-restricted	77 (99%)	20 (100%)	17 (100%)	21 (95%)	19 (95%)
Widespread	1 (1%)	0	0	1 (5%)	1 (5%)
Mainly tropical raptors					
Region-restricted	121 (84%)	52 (98%)	48 (76%)	18 (44%)	3 (20%)
Widespread	23 (16%)	1 (2%)	15 (24%)	23 (56%)	12 (80%)
Wholly and mainly tropical raptors					
Region-restricted	198 (89%)	72 (99%)	65 (81%)	39 (62%)	22 (63%)
Widespread	24 (11%)	1 (1%)	15 (19%)	24 (38%)	13 (37%)

Table 4. Distribution of tropical endemics. Endemic species are species whose range is restricted to one, or at most, two countries; endemic genera are genera restricted to one tropical region.

REGION	NUMBER (%) ENDEMIC SPECIES	NUMBER (%) ENDEMIC GENERA
Neotropics	7 (10%) (a)[a]	26 (76%) (a)
Afrotropics	12 (15%) (a)	12 (38%) (b)
Indomalayan	18 (29%) (b)	5 (21%) (b)
Australotropics	22 (63%) (c)	4 (25%) (b)
All regions	67 (30%)	47 (70%)

[a] Regions with the same letters are not significantly different from one another (log-likelihood ratio [G] test; species: df = 1; $P < 0.05$; genera: df = 1; $P < 0.05$).

Endemism is high in tropical raptors. Fifty-six percent of all wholly tropical raptors (44 of 78 species) occur in only one or two countries, compared with only 12% of all other raptors (log-likelihood ratio test: G = 54.3, df = 1, $P < 0.001$). The Australotropics have more endemic species than any other tropical region (vs. Neotropics: log-likelihood ratio test: G = 30.7, df = 1, $P < 0.001$; vs. Afrotropics: G = 23.6, df = 1, $P < 0.001$; vs. Indomalayan: G = 9.6, df = 1, $P < 0.005$; Table 4).

Ninety-one percent of all endemic tropical raptors (51 of 58 species) occur on islands, mainly in the Indian and South Pacific oceans. Three countries, Indonesia (16), Papua New Guinea (14), and Madagascar (11), together have 41 species of endemic raptors.

Nine percent of all wholly, and 32% of all mainly tropical raptors, are complete or partial migrants (Kerlinger 1989). An additional 6% and 24%, respectively, are local or irruptive migrants (Table 5). There are significantly more migratory raptors (local-irruptive species included) in the Afrotropics than in any other tropical region (vs. Neotropics: log-likelihood ratio test: G = 17.4, df = 1, $P < 0.001$; vs. Indomalayan: G = 4.8, df = 1, $P < 0.05$; vs. Australotropics: G = 11.5, df = 1, $P < 0.001$; Table 5).

Conservation Status. More than half of all tropical raptors are threatened by habitat loss, environmental contaminants, direct persecution, or combinations of these factors (Table 6). Habitat loss appears to be the greatest threat (habitat loss vs. environmental contaminants: log-likelihood ratio test: G = 69.3, df = 1, $P < 0.001$; habitat loss vs. direct persecution: G = 35.2, df = 1, $P < 0.001$; Table 6). Neotropical raptors appear to be less threatened than those from other tropical regions (Table 6). Direct persecution, especially, appears to occur less in the Neotropics than in other tropical regions (Table 6). Environmental contaminants, including pesticides, appear to be particularly important threats in the Australotropics (Table 6).

Thirty-seven species of wholly or mainly tropical raptors (17% of the world's tropical raptors) are listed as Critically Endangered, Endangered, or Vulnerable (Collar et al. 1994; Table 7). An additional 22 species (10%) are listed as Near Threatened. Two species are listed as data deficient (Table 7). Wholly tropical raptors appear be at greater risk than are mainly tropical raptors (log-likelihood ratio test: G = 17.1, df = 1, $P < 0.001$; Table 7). Nonmigratory species appear to be at greater risk than migratory ones (log-likelihood ratio test: G = 19.3, df = 1, $P < 0.001$; Table 8). Forty (68%) of all Threatened and Near Threatened species are forest-dependent (Appendix 1). Twenty-eight at-risk species (47%) are restricted to islands. Twenty-one at-risk species (36%) are both forest-dependent and island-restricted.

Countries with Endangered or Critically Endangered tropical raptors include Colombia (1 Endangered, 0 Critically Endangered), Cuba (1,0), Dominican Republic (1,0), Ecuador (2,0), Haiti (1,0), Peru (1,0), Madagascar (0,2), Mauritius (1,0), In-

Table 5. Migratory status of wholly and mainly tropical raptors. Status is based primarily on Kerlinger (1989), as modified by del Hoyo et al. (1994) and *Hawks Aloft Worldwide.*

MIGRATORY STATUS	WORLDWIDE	NEOTROPICS	AFROTROPICS	INDOMALAYAN	AUSTRALOTROPICS
Complete	11 (5%)	2 (3%)	7 (9%)	7 (11%)	3 (9%)
Partial	61 (27%)	16 (22%)	33 (41%)	21 (33%)	7 (20%)
Local-irruptive	54 (24%)	16 (22%)	24 (30%)	11 (17%)	6 (17%)
Total migratory	126 (57%)	34 (47%) (a)[a]	64 (80%) (b)	39 (62%) (a)	16 (46%) (a)
Nonmigratory	96 (43%)	39 (53%)	16 (20%)	24 (38%)	19 (54%)

[a] Regions with the same letters are not significantly different from one another (log-likelihood ratio [G] test; df = 1; $P < 0.05$).

Table 6. Threats to tropical raptors. Threats are based, principally, on information in del Hoyo et al. (1994).

	Number of Species Affected (%)				
Threat	Worldwide	Neotropics	Afrotropics	Indomalayan	Australotropics
Wholly tropical raptors					
Habitat loss	38 (49%)	7 (35%)	10 (59%)	8 (36%)	14 (70%)
Environmental contaminants	6 (8%)	0	2 (12%)	0	4 (20%)
Direct persecution	10 (13%)	1 (5%)	2 (12%)	2 (9%)	5 (25%)
Total number of species affected	40 (51%)	7 (35%)	11 (65%)	8 (36%)	15 (75%)
Number of species affected by:					
two threats	12 (15%)	1 (5%)	3 (18%)	2 (9%)	6 (30%)
three threats	1 (1%)	0	0	0	1 (5%)
Mainly tropical raptors					
Habitat loss	64 (44%)	20 (38%)	25 (40%)	26 (63%)	8 (53%)
Environmental contaminants	18 (13%)	6 (11%)	10 (16%)	7 (17%)	5 (33%)
Direct persecution	33 (23%)	5 (9%)	22 (35%)	13 (32%)	8 (53%)
Total number of species affected	81 (56%)	24 (45%)	37 (59%)	30 (73%)	12 (80%)
Number of species affected by:					
two threats	26 (18%)	6 (11%)	16 (25%)	10 (24%)	4 (27%)
three threats	4 (3%)	0	2 (3%)	3 (7%)	2 (13%)
Wholly and mainly tropical raptors					
Habitat loss	102 (46%)	27 (37%) (a)[a]	35 (44%) (a, b)	34 (54%) (a, b)	22 (63%) (b)
Environmental contaminants	24 (11%)	6 (8%) (a)	12 (15%) (a, b)	7 (11%) (a)	9 (26%) (b)
Direct persecution	43 (19%)	6 (8%) (a)	24 (30%) (b)	15 (24%) (b)	13 (37%) (b)
Total number of species affected	121 (55%)	31 (42%) (a)	48 (60%) (b)	38 (60%) (b)	27 (77%) (b)
Number of species affected by:					
two threats	38 (17%)	7 (10%)	19 (24%)	12 (19%)	10 (29%)
three threats	5 (2%)	0	2 (3%)	3 (5%)	3 (9%)

[a] Regions with the same letters are not significantly different from one another (log-likelihood ratio [G] test; df = 1; $P < 0.05$).

donesia (1,0), the Philippines (0,1), Papua New Guinea (1,0), and the Solomon Islands (1,0) (Collar et al. 1994).

Discussion

Our analyses demonstrate several patterns that should be of use to conservationists. They show that there are high levels of within-country diversity and endemism in all tropical regions, there is high congruence of raptor species diversity and endemism with those of other taxa, there is an indication that habitat loss (as opposed to environmental contaminants and direct persecution) poses the greatest threat, there are associations between at-risk conservation status and endemism, sedentary behavior, forest-dependence and island-dwelling, and there are significant regional differences in the extent of migration behavior, endemism, and conservation status.

Diversity and Endemism in Tropical Raptors. More than three-quarters of the world's diurnal birds of prey occur wholly or mainly within the tropics, and more than one-third of these occur only within this region. Three "megadiversity" countries (*sensu* Mittermeier 1988) in the Neotropics (Colombia, Ecuador, and Venezuela) and four in the Afrotropics (Ethiopia, Kenya, Sudan, and Uganda) each contain 70 or more species of rap-

Table 7. Conservation status of tropical raptors based on Collar et al. (1994).

CONSERVATION STATUS	WORLDWIDE	NEOTROPICS	AFROTROPICS	INDOMALAYAN	AUSTRALO-TROPICS
Wholly tropical raptors					
Critically endangered	3 (4%)	0	2 (12%)	1 (5%)	0
Endangered	6 (8%)	3 (15%)	1 (6%)	1 (5%)	1 (5%)
Vulnerable	7 (9%)	1 (5%)	0	3 (14%)	3 (15%)
Total Threatened	16 (21%)	4 (20%)	3 (18%)	5 (23%)	4 (20%)
Near Threatened	18 (23%)	3 (15%)	1 (6%)	8 (36%)	6 (30%)
Not Threatened	42 (53%)	13 (65%)	13 (76%)	8 (36%)	9 (45%)
Insufficient data	2 (3%)	0	0	1 (5%)	1 (5%)
Mainly tropical raptors					
Critically Endangered	0	0	0	0	0
Endangered	1 (1%)	0	0	0	1 (7%)
Vulnerable	5 (3%)	2 (4%)	2 (3%)	0	1 (7%)
Total Threatened	6 (4%)	2 (4%)	2 (3%)	0	2 (13%)
Near Threatened	19 (13%)	8 (15%)	5 (8%)	8 (20%)	0
Not Threatened	119 (83%)	43 (81%)	56 (89%)	33 (80%)	13 (87%)
Insufficient data	0	0	0	0	0
Wholly and mainly tropical raptors					
Critically Endangered	3 (1%)	0	2 (3%)	1 (2%)	0
Endangered	7 (3%)	3 (4%)	1 (1%)	1 (2%)	2 (6%)
Vulnerable	12 (5%)	3 (4%)	2 (3%)	3 (5%)	4 (11%)
Total Threatened	22 (10%)	6 (8%)	5 (6%)	5 (8%)	6 (17%)
Near Threatened	37 (17%)	11 (15%)	6 (8%)	16 (25%)	6 (17%)
Not Threatened	161 (73%)	56 (77%)	69 (86%)	41 (65%)	22 (63%)
Insufficient data	2 (1%)	0	0	1 (2%)	1 (3%)

tors and have at least one-quarter of the world's raptor species each. Fourteen rainforest "hot spots" (Myers 1988) which together comprise less than 1% of the earth's land surface contain more than 30% of the world's raptor species (Thiollay 1994).

Tropical islands, many of whose natural habitats have been or are being destroyed (Green and Sussman 1990, Hannah et al. 1994), host 24% (18 species) of all Threatened and Near Threatened species of raptors.

Table 8. Conservation status of nonmigratory and migratory wholly and mainly tropical raptors compared (conservation status based on Collar et al. [1994]).

CONSERVATION STATUS	NON-MIGRATORY	MIGRATORY
Critically endangered	3 (3%)	0
Endangered	6 (6%)	1 (1%)
Vulnerable	7 (7%)	5 (4%)
Total threatened	16 (17%)	6 (5%)
Near threatened	24 (25%)	13 (10%)
Not threatened	54 (56%)	107 (85%)
Insufficient data	2 (2%)	0

The tropics are home to most of the world's endemic raptors, as well as to most of its endangered species. Indonesia, alone, has 24% (16 of 67 species) of all endemic birds of prey. Indeed, one reason for the high species diversity of tropical raptors is high regional endemism. For example, while the Nearctic and Western Palearctic share 11% (8 species) of their combined raptor faunas, their tropical counterparts (e.g., the Neotropics and Afrotropics) share less than 1% (1 of 152) of their combined faunas. Although overlap among the Afrotropics, Indomalayan Region, and Australotropics is higher than that between these regions and the Neotropics (Table 3), differences in faunal composition among tropical regions is extensive, overall. Seventy percent of all tropical genera (47 of 67) occur in a single tropical region.

Congruence of Raptor Diversity with Biodiversity in Other Groups of Plants and Animals. Geo-

graphic centers of raptor diversity and species endemism are highly congruent with those for many groups of plants and animals (Gentry 1986, McNeely et al. 1988, Myers 1988, Bibby et al. 1992, Thirgood and Heath 1994). Countries with extremely high raptor diversity, as well as centers of raptor endemism, are important conservation sites for plants and other animals, too.

Principal Threats to Raptors. Habitat loss remains the principal threat to tropical raptors. Many natural ecosystems in the region are being converted to human-dominated landscapes (Myers 1984). A recent global analysis of human habitat disturbance (Hannah et al. 1994), for example, suggests that the Indomalayan and Afrotropical realms are the two most disturbed biogeographical realms (*sensu* Udvardy 1975) on earth. Many biogeographical provinces, including the Cuban and Greater Antillean provinces in the Neotropics, the Malagasy woodland-savanna province in the Afrotropics, and the Java and Philippines province in the Indomalayan Realm, are overwhelmingly dominated by human landscapes (Hannah et al. 1994). Many disturbed provinces harbor endemic and at-risk species of raptors. Because many tropical habitats are only now being threatened by human disturbance (Hannah et al. 1994), habitat loss will remain a principal concern for some time.

Overall, 68% of all Threatened and Near Threatened tropical raptors are forest-dependent species. Many of these species require enormous tracts of contiguous forest (Thiollay 1989a, 1993), and are thus particularly vulnerable to habitat loss (Diamond and Lovejoy 1985, Meyburg and Chancellor 1989, 1994, and references therein). All but one of Australia's 15 Threatened raptors are forest dwellers (Baker-Gabb 1994).

Almost half (28 of 59 species) of all Threatened and Near Threatened tropical raptors are restricted to islands. Current levels of habitat degradation on tropical islands (Hannah et al. 1994), together with the recent history of human-induced avian extinctions at such sites (Moors 1985, Temple 1986, Wotzkow 1994), suggests that these species, too, are at high risk.

Gregarious and nomadic, open-habitat species, including those that depend upon superabundant prey associated with seasonally fluctuating wetlands (e.g., Snail Kites [*Rostrhamus sociabilis*]), and upon swarming locusts (e.g., Montagu's [*Circus pygargus*] and Pallid Harriers [*C. macrourus*], Swainson's Hawks, Western [*Falco vespertinus*] and Eastern Red-footed Falcons [*F. amurensis*], and Lesser Kestrels [*F. naumanni*]), also appear to be particularly vulnerable to habitat loss and degradation. Because members of these species operate over enormous ecological neighborhoods, local habitat loss can significantly affect regional, and even continental populations of these raptors (Bucher 1992). The social nature of these species, together with the fact that they frequently feed on prey that are considered agricultural pests, means that large numbers can be poisoned by a single pesticide application (Thiollay 1989b, del Hoyo et al. 1994, Woodbridge et al. 1995). Even when individuals are not poisoned, large-scale efforts to remove insect pests, including swarming locusts from tropical regions, can threaten these species by significantly reducing prey availability (Thiollay 1989b).

Overall, the increasing use of agricultural pesticides in many tropical countries (Goulston 1996) suggests that this threat, which has long been a concern in temperate agriculturalized countries (Hickey 1969, Cooke et al. 1982), is likely to increase. Tropical raptors also are threatened by the use of pesticides to control insect vectors of human diseases (Thiollay 1989b).

Although direct persecution as a threat to tropical raptors appears to be decreasing overall (Thiollay 1994), shooting remains a threat in certain countries (van Balen 1994, Bildstein et al. 1995). Social species such as vultures, and species that flock on migration or that roost communally, as well as those that are considered to be agricultural or aquacultural pests, are especially vulnerable (Thiollay 1989b). Given the region's increasing dependence upon aquaculture as a source of human protein (World Resources Institute 1996), persecution of piscivorous raptors is likely to increase (FAO 1989 and references therein).

Regional Differences. The current geographic distribution of tropical raptors is the result of complex interactions among climatic, geomorphologic, and ecological processes operating across numerous temporal and spatial scales (Sankovski and Pridnia 1995). In the Indomalayan and Australotropical regions, for example, raptor diversity is enhanced because of numerous island endemics in Indonesia (16 species) and New Guinea (14 species), respectively (Table 4). In the Afrotropics, on the other hand, where species diversity is bolstered in part by island endemics from Madagascar, much of the region's diversity results from the high number of migrants from the Western and Eastern Pa-

learctic (Newton 1995) (Table 5). In the Neotropics, diversity appears to result from geographic features and evolutionary processes particular to the region (e.g., forest refugia and centers of endemism, Haffer 1974 and Cracraft 1985). As a result, while the Neotropics have fewer endemic species (7) than any other region, they have significantly more endemic genera (26) (Table 4).

The Neotropics, and to a lesser extent the Afrotropics (particularly when only continental Africa is considered), have proportionately fewer at-risk species than do the Indomalayan and Australotropics. This difference appears to be attributable, mainly, to two factors: the greater number of island species in the Indomalayan Region and the greater incidence of disturbed ecosystems there (Hannah et al. 1994).

Final Thoughts and Suggestions. Many conservation biologists have suggested focusing conservation efforts on megadiversity countries (Mittermeier 1988), biodiversity "hot spots" (Myers 1988), specific habitats types (Wilson 1988 and references therein), or endemic bird areas (Bibby et al. 1992). Thiollay (1994), for example, uses this approach in identifying four priority areas of tropical forest raptor diversity, which together contain 40% of all tropical forest raptor species. All four areas, however, occur in only two tropical regions (the Indomalayan and Australotropical), and focusing on these sites will do little to protect the very different raptor communities of other regions.

Recently, several conservation biologists have suggested that when choices need to be made on which species to protect, efforts should focus on species with the greatest "phylogenetic diversity" (e.g., those most distantly related to other existing taxa, Forey et al. 1994). Eleven tropical raptors belong to genera in which all members of the genus are Threatened or Near Threatened. The Neotropics have five such species (*Harpyhaliaetus solitarius, H. coronatus, Morphnus guianensis, Harpia harpyja,* and *Spizastur melanoleucus*), the Afrotropics have one (*Eutriorchis astur*), the Indomalayan Region has three (*Ichthyophaga humilis, I. ichthyaetus,* and *Pithecophaga jefferyi*), and the Australotropics have two (*Lophoictinia isura* and *Harpyopsis novaeguineae*). Ten of these species are largely or entirely sedentary, eight are large eagles (>1500 g), six are forest-dependent species, and three are island forms. These species, especially, deserve focused conservation efforts.

One of the greatest challenges facing conservationists interested in protecting tropical raptors is our ignorance of the biology of many of these species. This is true not only of secretive forest-dwelling, range-restricted endemics (Meyburg and Chancellor 1994, and references therein), but also for wide-ranging migratory species whose ecology outside of the tropics is relatively well studied (Senner and Fuller 1989, Newton 1995). Indeed, while we appear to have good information on species distributions, we lack reasonable population estimates for many species of tropical raptors (del Hoyo et al. 1994), as well as information on factors limiting their distribution and abundance. We also know relatively little about the extent to which tropical residents interact with migrants overwintering in the region (but see Kirk and Gosler 1994).

We strongly recommend the expansion of fieldwork in tropical areas. Initiatives to gather information on species' ecology, distributions, and abundances (Burnham et al. 1994) and Hawk Mountain Sanctuary's *Hawks Aloft Worldwide,* which uses the spectacle of long-distance migration to strengthen local conservation activities along major migratory corridors in the tropics (Bildstein et al. 1995), together with meetings and publications that focus on tropical raptors (Meyburg and Chancellor 1989, 1994), should be continued and expanded.

Because the fate of tropical raptors ultimately rests in the hands of the human inhabitants of these areas, individuals and organizations interested in protecting tropical raptors need to encourage and support training opportunities for conservationists and biologists living in the region.

ACKNOWLEDGMENTS

We thank the hundreds of raptor biologists, conservationists, and field-workers who contributed data essential to this manuscript. We especially thank the contributors and compilers of del Hoyo et al. (1994), including R.O. Bierregaard, W.S. Clark, S.J.S. Debus, A. Elliot, D.C. Houston, J. del Hoyo, A.C. Kemp, L.F. Kiff, B.-U. Meyburg, P.D. Olsen, J. Orta, A.F. Poole, J. Sargatal, J.-M. Thiollay, and C.M. White. We also thank the dozens of participants of IUCN raptor CAMP workshops in Badajoz, Spain, Asunción, Paraguay, and Duluth, MN U.S.A., the taxon and geographic editors associated with that effort, and the 10 conservation organizations working together on the project (BirdLife International, Fonds d'Intervention pour les Rapaces, The Hawk and Owl Trust, Hawk Mountain Sanctuary, The National Birds of Prey Centre, The Peregrine Fund, The Raptor Conservation Group, The Raptor Research Foundation, The World Working Group for Birds of Prey and Owls, IUCN-

SSC Conservation Breeding Specialist Group). Also, we thank the more than 400 individuals who have contributed data to Hawk Mountain Sanctuary's *Hawks Aloft Worldwide* initiative.

We thank Rick Watson for inviting us to participate in the symposium on tropical raptors, and Rick Watson, Marc Bechard, and two anonymous referees, for editing and improving our ms. Eric Atkinson provided statistical advice and analyses. This is Hawk Mountain Sanctuary contribution number 54.

LITERATURE CITED

AMADON, D. AND J. BULL. 1988. Hawks and owls of the world: a distributional and taxonomic list. *Proc. West. Found. Vertebr. Zool.* 3:295–357.

BAILEY, R.G. 1996. Ecosystem geography. Springer, New York, NY U.S.A.

BAKER-GABB, D.J. 1994. Threatened raptors of Australia's tropical forests. Pages 241–244 *in* B.-U. Meyburg and R.D. Chancellor [EDS.], Raptor conservation today. World Working Group for Birds of Prey and Owls, London, U.K.

BIBBY, C.J., N.J. COLLAR, M.J. CROSBY, M.F. HEATH, CH. IMBODEN, T.H. JOHNSON, A.J. LONG, A.J. SATTERSFIELD AND S.J. THIRGOOD. 1992. Putting biodiversity on the map: priority areas for global conservation. ICBP, Cambridge, U.K.

BILDSTEIN, K.L., J.J. BRETT, L.J. GOODRICH AND C. VIVERETTE. 1995. Hawks Aloft Worldwide: a network to protect the world's migrating birds of prey and the habitats essential to their migrations. Pages 504–16 *in* D.A. Saunders, J.L. Craig and E.M. Mattishe [EDS.], Nature conservation. Surrey Beaty & Sons, Chipping Norton, N.S.W., Australia.

BROWN, L. AND D. AMADON. 1968. Eagles, hawks and falcons of the world. McGraw-Hill, New York, NY U.S.A.

BUCHER, E.H. 1992. The causes of extinction of the Passenger Pigeon. *Curr. Ornithol.* 9:1–36.

BURNHAM, W.A., D.F. WHITACRE AND J.P. JENNY [EDS.]. 1994. The Maya Project: use of raptors as tools for conservation and ecological monitoring of biological diversity. Pages 257–264 *in* B.-U. Meyburg and R.D. Chancellor [EDS.], Raptor conservation today. World Working Group for Birds of Prey and Owls, London, U.K.

COLLAR, N.J., M.J. CROSBY AND A.J. SATTERSFIELD. 1994. Birds to watch 2: the world list of threatened birds. BirdLife International, Cambridge, U.K.

COOKE, A.S., A.A. BELL AND M.B. HAAS. 1982. Predatory birds, pesticides, and pollution. Institute of Terrestrial Ecology, Huntingdon, U.K.

CRACRAFT, J. 1985. Historical biogeography and patterns of differentiation within the South American avifauna: areas of endemism. *Ornithol. Monogr.* 36:49–84.

DEL HOYO, J., A. ELLIOT AND J. SARGATAL [EDS.]. 1994. Handbook of the birds of the world, Vol. 2. Lynx Edicions, Barcelona, Spain.

DESHMUKH, I. 1986. Ecology and tropical biology. Blackwell Scientific, Palo Alto, CA U.S.A.

DIAMOND, A.W. AND T.E. LOVEJOY [EDS.]. 1985. Conservation of tropical forest birds. ICBP, Tech. Publ. No. 4, Cambridge, U.K.

FAO. 1989. Report of the EIFAC working party on prevention and control of bird predation in aquaculture and fisheries operations. Food and Agriculture Organization of the United Nations, Rome, Italy.

FOREY, P.L., C.J. HUMPHRIES AND R.I. VANE-WRIGHT [EDS.]. 1994. Systematics and conservation evaluation. Clarendon Press, Oxford, U.K.

GENTRY, A.H. 1986. Endemism in tropical vs. temperate plant communities. Pages 153–181 *in* M.E. Soulé [ED.], Conservation biology. Sinauer, Sunderland, MA U.S.A.

GOULSTON, G. 1996. Crop protection in Latin America. PJB Publications, Ltd., London, U.K.

GREEN, G.M. AND R.W. SUSSMAN. 1990. Deforestation history of the eastern rainforests of Madagascar from satellite images. *Science* 248:212–215.

GRIFFITHS, C.S. 1994. Monophyly of the Falconiformes based on syringeal morphology. *Auk* 111:787–805.

HAFFER, J. 1974. Avian speciation in tropical South America. Publ. Nuttall Ornithol. Club, No. 14. Nuttall Ornithological Club, Cambridge, MA U.S.A.

HANNAH, L., D. LOHSE, C. HUTCHINSON, J.L. CARR AND A. LANKERANI. 1994. A preliminary inventory of human disturbance of world ecosystems. *Ambio* 23:246–250.

HICKEY, J.J. [ED.] 1969. Peregrine Falcon populations: their biology and decline. Univ. of Wisconsin, Madison, WI U.S.A.

JONES, C.G. 1981. The Mauritius Kestrel. Its biology and conservation. *Hawk Trust Annu. Rep.* 10:18–20.

KENNEDY, R.S. 1983. Can Filipinos learn to love this bird? *Int. Wildl.* 13(4):26–33.

———. 1986. Raptors in the tropics—the next 50 years. *Raptor Res. Rep.* 5:17–25.

KERLINGER, P. 1989. Flight strategies of migrating hawks. Univ. Chicago Press, Chicago, IL U.S.A.

KIRK, D.A. AND A.G. GOSLER. 1994. Body condition varies with migration and competition in migrant and resident South American vultures. *Auk* 111:933–944.

MCNEELY, J.A., K.R. MILLER, W.V. REID, R.A. MITTERMEIER AND T.B. WERNER. 1988. Conserving the world's biological diversity. IUCN, Gland, Switzerland.

MEYBURG, B.-U. AND R.D. CHANCELLOR. 1989. Raptors in the modern world. World Working Group for Birds of Prey and Owls, London, U.K.

——— AND ———. 1994. Raptor conservation today. World Working Group for Birds of Prey and Owls, London, U.K.

——— AND S. VAN BALEN. 1994. Raptors on Sulawesi (Indonesia): the influence of rainforest destruction and human density on their populations. Pages 269–276 *in* B.-U. Meyburg and R.D. Chancellor [EDS.], Raptor

conservation today. World Working Group for Birds of Prey and Owls, London, U.K.

MITTERMEIER, R.A. 1988. Primate diversity and the tropical forest: case studies from Brazil and Madagascar and the importance of megadiversity countries. Pages 145–154 *in* E.O. Wilson [ED.], Biodiversity. National Academy, Washington, DC U.S.A.

MOORS, P.J. 1985. Conservation of island birds. I.C.B.P., Tech. Publ. No. 3, Cambridge, U.K.

MYERS, N. 1984. The primary source. Norton, New York, NY U.S.A.

———. 1988. Threatened biotas: hot spots in tropical forests. *The Environmentalist* 10:243–256.

NEWTON, I. 1995. Relationships between breeding and wintering ranges in Palaearctic-African migrants. *Ibis* 137:241–249.

——— AND R.D. CHANCELLOR. 1985. Conservation studies on raptors. ICBP, Tech. Publ. No. 5, Cambridge, U.K.

SANKOVSKI, A. AND M. PRIDNIA. 1995. A comparison of the southern Appalachian (U.S.A.) and southwestern Caucasus (Russia) forests: influences of historical events and present environment. *J. Biogeogr.* 22:1073–1081.

SENNER, S.E. AND M.R. FULLER. 1989. Status and conservation of North American raptors migrating in the Neotropics. Pages 53–58 *in* B.-U. Meyburg and R.D. Chancellor [EDS.], Raptors in the modern world. World Working Group for Birds of Prey and Owls, London, U.K.

SIBLEY, C.G. AND B.L. MONROE, JR. 1990. Distribution and taxonomy of birds of the world. Yale Univ. Press, New Haven, CT U.S.A.

TEMPLE, S.A. [ED.]. 1986. Endangered birds. Univ. Wisconsin Press, Madison, WI U.S.A.

THIOLLAY, J.-M. 1985a. Falconiformes of tropical rainforests: a review. Pages 155–165 *in* I. Newton and R.D. Chancellor [EDS.], Conservation studies on raptors. ICBP, Cambridge, U.K.

———. 1985b. The West African forest avifauna: a review. Pages 171–186 *in* I. Newton and R.D. Chancellor [EDS.], Conservation studies on raptors. ICBP, Cambridge, U.K.

———. 1989a. Area requirements for the conservation of rainforest raptors and game birds in French Guiana. *Conserv. Biol.* 3:128–137.

———. 1989b. Distribution and ecology of Palearctic birds of prey wintering in West and Central Africa. Pages 99–107 *in* B.-U. Meyburg and R.D. Chancellor [EDS.], Raptors in the modern world. World Working Group for Birds of Prey and Owls, London, U.K.

———. 1992. Influence of selective logging on bird species diversity in a Guianan rainforest. *Conserv. Biol.* 6: 47–63.

———. 1993. Response of a raptor community to shrinking area and degradation of tropical rainforest in the south west Ghâts (India). *Ecogeography* 16:97–110.

———. 1994. A world review of tropical forest raptors: current trends, research objectives and conservation strategy. Pages 231–239 *in* B.-U. Meyburg and R.D. Chancellor [EDS.], Raptor conservation today. World Working Group for Birds of Prey and Owls, London, U.K.

THIRGOOD, S.J. AND M.F. HEATH. 1994. Global patterns of endemism and the conservation of biodiversity. Pages 207–227 *in* P.L. Forey, C.J. Humphries and R.I. Vane-Wright [EDS.], Systematics and conservation evaluation, Clarendon Press, Oxford, U.K.

UDVARDY, M.D.F. 1975. A classification of the biogeographical provinces of the world. IUCN, Morges, Switzerland.

VAN BALEN, S. 1994. The status and conservation of birds of prey in the Sondaic and Wallacean regions of Indonesia. Pages 245–254 *in* B.-U. Meyburg and R.D. Chancellor [EDS.], Raptor conservation today. World Working Group for Birds of Prey and Owls, London, U.K.

WATSON, R.T. AND R. LEWIS. 1994. Raptor studies in Madagascar's rainforest. Pages 283–290 *in* B.-U. Meyburg and R.D. Chancellor [EDS.], Raptor conservation today. World Working Group for Birds of Prey and Owls, London, U.K.

WILSON, E.O. [ED.]. 1988. Biodiversity. National Academy Press, Washington, DC U.S.A.

WOODBRIDGE, B., K.K. FINLEY AND S.T. SEAGER. 1995. An investigation of the Swainson's Hawk in Argentina. *J. Raptor Res.* 29:202–204.

WORLD RESOURCES INSTITUTE. 1996. World resources, 1996–97. World Resources Institute, New York, NY U.S.A.

WOTZKOW, C. 1994. Status, distribution, current research and conservation of forest birds of prey in Cuba. Pages 291–299 *in* B.-U. Meyburg and R.D. Chancellor [EDS.], Raptor conservation today. World Working Group for Birds of Prey and Owls, London, U.K.

ZAR, J.H. 1984. Biostatistical analysis. Second Ed. Prentice Hall, Englewood Cliffs, NJ U.S.A.

Received 16 October 1996; accepted 10 November 1997

Appendix 1. Conservation and distribution status of the world's tropical raptors.

SPECIES	IUCN CONSERVATION STATUS	ENDEMIC	FOREST DEPENDENT	ISLAND DEPENDENT	TROPICAL DISTRIBUTION
Neotropics					
Coragyps atratus	Nt[a]	No	No	No	Mainly
Cathartes aura	Nt	No	No	No	Mainly
Cathartes burrovianus	Nt	No	No	No	Mainly
Cathartes melambrotus	Nt	No	Yes	No	Wholly
Sarcoramphus papa	Nt	No	No	No	Mainly
Pandion haliaetus[b]	Nt	No	No	No	Mainly
Leptodon cayanensis	Nt	No	Yes	No	Mainly
Chondrohierax uncinatus	Nt	No	Yes	No	Mainly
Elanoides forficatus	Nt	No	Yes	No	Mainly
Gampsonyx swainsonii	Nt	No	No	No	Mainly
Elanus leucurus	Nt	No	No	No	Mainly
Rostrhamus sociabilis	Nt	No	No	No	Mainly
Rostrhamus hamatus	Nt	No	Yes	No	Wholly
Harpagus bidentatus	Nt	No	No	No	Mainly
Harpagus diodon	Nt	No	Yes	No	Mainly
Ictinia plumbea	Nt	No	No	No	Mainly
Circus buffoni	Nt	No	No	No	Mainly
Accipiter poliogaster	Near tThreatened	No	Yes	No	Mainly
Accipiter superciliosus	Nt	No	Yes	No	Mainly
Accipiter collaris	Near threatened	No	Yes	No	Wholly
Accipiter gundlachi	Endangered	Yes	No	Yes	Wholly
Accipiter bicolor	Nt	No	No	No	Mainly
Geranospiza caerulescens	Nt	No	No	No	Mainly
Leucopternis schistacea	Nt	No	Yes	No	Wholly
Leucopternis plumbea	Near threatened	No	Yes	No	Wholly
Leucopternis princeps	Nt	No	Yes	No	Wholly
Leucopternis melanops	Nt	No	Yes	No	Wholly
Leucopternis kuhli	Nt	No	Yes	No	Wholly
Leucopternis lacernulata	Vulnerable	Yes	Yes	No	Mainly
Leucopternis semiplumbea	Near threatened	No	Yes	No	Wholly
Leucopternis albicollis	Nt	No	Yes	No	Wholly
Leucopternis occidentalis	Endangered	Yes	Yes	No	Wholly
Leucopternis polionota	Near threatened	No	Yes	No	Mainly
Asturina nitida	Nt	No	No	No	Mainly
Buteogallus aequinoctialis	Nt	No	Yes	No	Mainly
Buteogallus subtilis	Nt	No	Yes	No	Wholly
Buteogallus anthracinus	Nt	No	Yes	No	Mainly
Buteogallus urubitinga	Nt	No	No	No	Mainly
Buteogallus meridionalis	Nt	No	No	No	Mainly
Parabuteo unicinctus	Nt	No	No	No	Mainly
Busarellus nigricollis	Nt	No	No	No	Mainly
Geranoaetus melanoleucus	Nt	No	No	No	Mainly
Harpyhaliaetus solitarius	Near threatened	No	Yes	No	Mainly
Harpyhaliaetus coronatus	Vulnerable	No	No	No	Mainly
Buteo magnirostris	Nt	No	No	No	Mainly
Buteo leucorrhous	Nt	No	Yes	No	Mainly
Buteo ridgwayi	Endangered	Yes	No	Yes	Wholly
Buteo platypterus	Nt	No	Yes	No	Mainly
Buteo brachyurus	Nt	No	No	No	Mainly
Buteo galapagoensis	Vulnerable	Yes	No	Yes	Wholly
Buteo albicaudatus	Nt	No	No	No	Mainly

Appendix 1. Continued.

SPECIES	IUCN CONSERVATION STATUS	ENDEMIC	FOREST DEPENDENT	ISLAND DEPENDENT	TROPICAL DISTRIBUTION
Buteo poecilochrous	Nt	No	No	No	Mainly
Buteo albonotatus	Nt	No	No	No	Mainly
Morphnus guianensis	Near threatened	No	Yes	No	Mainly
Harpia harpyja	Near threatened	No	Yes	No	Mainly
Spizastur melanoleucus	Near threatened	No	No	No	Mainly
Spizaetus ornatus	Nt	No	Yes	No	Mainly
Spizaetus tyrannus	Nt	No	Yes	No	Mainly
Spizaetus isidori	Near threatened	No	Yes	No	Mainly
Daptrius ater	Nt	No	Yes	No	Wholly
Daptrius americanus	Nt	No	Yes	No	Mainly
Phalcoboenus carunculatus	Nt	Yes	No	No	Wholly
Polyborus plancus	Nt	No	No	No	Mainly
Milvago chimachima	Nt	No	No	No	Mainly
Herpetotheres cachinnans	Nt	No	No	No	Mainly
Micrastur ruficollis	Nt	No	Yes	No	Mainly
Micrastur gilvicollis	Nt	No	Yes	No	Wholly
Micrastur mirandollei	Nt	No	Yes	No	Wholly
Micrastur semitorquatus	Nt	No	Yes	No	Mainly
Micrastur buckleyi	Nt	Yes	Yes	No	Wholly
Falco femoralis	Nt	No	No	No	Mainly
Falco rufigularis	Nt	No	Yes	No	Mainly
Falco deiroleucus	Near threatened	No	Yes	No	Mainly
Afrotropics					
Pandion haliaetus[b]	Nt	No	No	No	Mainly
Aviceda cuculoides	Nt	No	Yes	No	Mainly
Aviceda madagascariensis	Nt	Yes	Yes	Yes	Mainly
Pernis apivorus	Nt	No	No	No	Mainly
Macheiramphus alcinus[b]	Nt	No	Yes	No	Mainly
Elanus caeruleus[b]	Nt	No	No	No	Mainly
Chelictinia riocourii	Nt	No	No	No	Wholly
Milvus migrans[b]	Nt	No	No	No	Mainly
Haliaeetus vocifer	Nt	No	No	No	Mainly
Haliaeetus vociferoides	Critically endangered	Yes	No	Yes	Wholly
Aegypius tracheliotus	Nt	No	No	No	Mainly
Aegypius occipitalis	Nt	No	No	No	Mainly
Necrosyrtes monachus	Nt	No	No	No	Mainly
Gyps rueppellii	Nt	No	No	No	Wholly
Gyps africanus	Nt	No	No	No	Mainly
Neophron percnopterus[b]	Nt	No	No	No	Mainly
Gypohierax angolensis	Nt	No	Yes	No	Mainly
Circaetus gallicus[b]	Nt	No	No	No	Mainly
Circaetus cinereus	Nt	No	No	No	Mainly
Circaetus fasciolatus	Near threatened	No	Yes	No	Mainly
Circaetus cinerascens	Nt	No	Yes	No	Wholly
Terathopius ecaudatus	Nt	No	No	No	Mainly
Dryotriorchis spectabilis	Nt	No	Yes	No	Wholly
Eutriorchis astur	Critically endangered	Yes	Yes	Yes	Wholly
Polyboroides typus	Nt	No	No	No	Mainly
Polyboroides radiatus	Nt	Yes	Yes	Yes	Mainly
Melierax poliopterus	Nt	No	No	No	Wholly
Melierax metabates	Nt	No	Yes	No	Mainly

Appendix 1. Continued.

SPECIES	IUCN CONSERVATION STATUS	ENDEMIC	FOREST DEPENDENT	ISLAND DEPENDENT	TROPICAL DISTRIBUTION
Melierax canorus	Nt	No	No	No	Mainly
Melierax gabar	Nt	No	No	No	Mainly
Kaupifalco monogrammicus	Nt	No	Yes	No	Mainly
Butastur rufipennis	Nt	No	No	No	Wholly
Circus macrourus[b]	Near threatened	No	No	No	Mainly
Circus pygargus[b]	Nt	No	No	No	Mainly
Circus aeruginosus[b]	Nt	No	No	No	Mainly
Circus ranivorus	Nt	No	No	No	Mainly
Circus maillardi	Near threatened	Yes	No	Yes	Mainly
Accipiter tachiro	Nt	No	Yes	No	Mainly
Accipiter castanilius	Nt	No	Yes	No	Wholly
Accipiter brevipes	Nt	No	No	No	Mainly
Accipiter badius[b]	Nt	No	No	No	Mainly
Accipiter francesii	Nt	Yes	Yes	Yes	Mainly
Accipiter erythropus	Nt	No	Yes	No	Wholly
Accipiter minullus	Nt	No	No	No	Mainly
Accipiter madagascariensis	Near threatened	Yes	Yes	Yes	Mainly
Accipiter ovampensis	Nt	No	Yes	No	Mainly
Accipiter rufiventris	Nt	No	No	No	Mainly
Accipiter melanoleucus	Nt	No	Yes	No	Mainly
Accipiter henstii	Near threatened	Yes	No	Yes	Wholly
Urotriorchis macrourus	Nt	No	No	No	Wholly
Buteo oreophilus	Nt	No	Yes	No	Mainly
Buteo brachypterus	Nt	Yes	Yes	Yes	Mainly
Buteo auguralis	Nt	No	Yes	No	Wholly
Buteo augur	Nt	No	No	No	Mainly
Aquila pomarina[b]	Nt	No	No	No	Mainly
Aquila rapax[b]	Nt	No	No	No	Mainly
Aquila verreauxii	Nt	No	No	No	Mainly
Hieraaetus wahlbergi	Nt	No	No	No	Mainly
Hieraaetus fasciatus[b]	Nt	No	No	No	Mainly
Hieraaetus spilogaster	Nt	No	No	No	Mainly
Hieraaetus pennatus[b]	Nt	No	No	No	Mainly
Hieraaetus ayresii	Nt	No	No	No	Mainly
Hieraaetus bellicosus	Nt	No	No	No	Mainly
Spizaetus occipitalis	Nt	No	No	No	Mainly
Spizaetus africanus	Nt	No	Yes	No	Wholly
Spizaetus coronatus	Nt	No	Yes	No	Mainly
Sagittarius serpentarius	Nt	No	No	No	Mainly
Polihierax semitorquatus	Nt	No	No	No	Mainly
Falco naumanni[b]	Vulnerable	No	No	No	Mainly
Falco newtoni	Nt	Yes	No	Yes	Mainly
Falco punctatus	Endangered	Yes	Yes	Yes	Wholly
Falco alopex	Nt	No	No	No	Wholly
Falco ardosiaceus	Nt	No	No	No	Wholly
Falco dickinsoni	Nt	No	No	No	Mainly
Falco zoniventris	Nt	Yes	No	Yes	Mainly
Falco chicquera[b]	Near threatened	No	No	No	Mainly
Falco concolor	Nt	No	No	No	Mainly
Falco cuvieri	Nt	No	No	No	Mainly
Falco biarmicus	Nt	No	No	No	Mainly
Falco fasciinucha	Vulnerable	No	No	No	Mainly

Appendix 1. Continued.

SPECIES	IUCN CONSERVATION STATUS	ENDEMIC	FOREST DEPENDENT	ISLAND DEPENDENT	TROPICAL DISTRIBUTION
Indomalayan					
Pandion haliaetus[b]	Nt	No	No	No	Mainly
Aviceda jerdoni	Near threatened	No	Yes	No	Mainly
Aviceda subcristata[b]	Nt	No	No	Yes	Mainly
Aviceda leuphotes	Nt	No	Yes	No	Mainly
Pernis ptilorhynchus	Nt	No	No	No	Mainly
Pernis celebensis	Nt	Yes	Yes	Yes	Wholly
Macheirhamphus alcinus[b]	Nt	No	Yes	No	Mainly
Elanus caeruleus[b]	Nt	No	No	No	Mainly
Milvus migrans[b]	Nt	No	No	No	Mainly
Haliastur indus[b]	Nt	No	No	No	Mainly
Haliaeetus leucogaster[b]	Nt	No	No	No	Mainly
Ichthyophaga humilis	Near threatened	No	No	No	Mainly
Ichthyophaga ichthyaetus	Near threatened	No	Yes	No	Mainly
Aegypius calvus	Near threatened	No	No	No	Mainly
Gyps indicus	Near threatened	No	No	No	Mainly
Gyps bengalensis	Near threatened	No	No	No	Mainly
Neophron percnopterus[b]	Nt	No	No	No	Mainly
Circaetus gallicus[b]	Nt	No	No	No	Mainly
Spilornis cheela	Nt	No	No	No	Mainly
Spilornis kinabaluensis	Data deficient	Yes	Yes	Yes	Wholly
Spilornis minimus	Near threatened	Yes	Yes	Yes	Wholly
Spilornis elgini	Near threatened	Yes	No	Yes	Wholly
Butastur teesa	Nt	No	No	No	Mainly
Butastur liventer	Near threatened	No	No	No	Wholly
Butastur indicus[b]	Nt	No	Yes	No	Mainly
Circus macrourus[b]	Near threatened	No	No	No	Mainly
Circus melanoleucos	Nt	No	No	No	Mainly
Circus pygargus[b]	Nt	No	No	No	Mainly
Circus aeruginosus[b]	Nt	No	No	No	Mainly
Accipiter trivirgatus	Nt	No	Yes	No	Mainly
Accipiter griseiceps	Nt	Yes	Yes	Yes	Wholly
Accipiter badius[b]	Nt	No	No	No	Mainly
Accipiter butleri	Near threatened	Yes	Yes	Yes	Wholly
Accipiter soloensis[b]	Nt	No	Yes	No	Mainly
Accipiter trinotatus	Nt	Yes	Yes	Yes	Wholly
Accipiter fasciatus[b]	Nt	No	No	No	Mainly
Accipiter novaehollandiae[b]	Nt	No	Yes	No	Mainly
Accipiter virgatus	Nt	No	Yes	No	Mainly
Accipiter nanus	Near threatened	Yes	Yes	Yes	Wholly
Accipiter erythrauchen[b]	Nt	Yes	Yes	Yes	Wholly
Accipiter rhodogaster	Nt	Yes	Yes	Yes	Wholly
Pithecophaga jefferyi	Critically endangered	Yes	Yes	Yes	Wholly
Ictinaetus malayensis	Nt	No	Yes	No	Mainly
Aquila pomarina[b]	Nt	No	No	No	Mainly
Aquila rapax[b]	Nt	No	No	No	Mainly
Hieraaetus fasciatus[b]	Nt	No	No	No	Mainly
Hieraaetus pennatus[b]	Nt	No	No	No	Mainly
Hieraaetus kienerii	Nt	No	Yes	No	Mainly
Spizaetus cirrhatus	Nt	No	No	No	Mainly
Spizaetus bartelsi	Endangered	Yes	Yes	Yes	Wholly
Spizaetus lanceolatus	Near threatened	Yes	Yes	Yes	Wholly

Appendix 1. Continued.

SPECIES	IUCN CONSERVATION STATUS	ENDEMIC	FOREST DEPENDENT	ISLAND DEPENDENT	TROPICAL DISTRIBUTION
Spizaetus philippensis	Vulnerable	Yes	Yes	Yes	Wholly
Spizaetus alboniger	Nt	No	Yes	No	Wholly
Spizaetus nanus	Vulnerable	No	Yes	No	Wholly
Polihierax insignis	Near threatened	No	No	No	Wholly
Microhierax caerulescens	Nt	No	No	No	Mainly
Microhierax latifrons	Near threatened	Yes	No	Yes	Wholly
Microhierax erythrogenys	Nt	Yes	No	Yes	Wholly
Falco naumanni[b]	Vulnerable	No	No	No	Mainly
Falco araea	Vulnerable	Yes	No	Yes	Wholly
Falco moluccensis	Nt	Yes	No	Yes	Wholly
Falco chicquera[b]	Near threatened	No	No	No	Mainly
Falco severus[b]	Nt	No	Yes	No	Mainly
Falco jugger	Nt	No	No	No	Mainly
Australotropical					
Pandion haliaetus[b]	Nt	No	No	No	Mainly
Aviceda subcristata[b]	Nt	No	No	Yes	Mainly
Henicopernis longicauda	Nt	Yes	Yes	Yes	Wholly
Henicopernis infuscatus	Near threatened	Yes	Yes	Yes	Wholly
Macheirhamphus alcinus[b]	Nt	No	Yes	No	Mainly
Elanus caeruleus[b]	Nt	No	No	No	Mainly
Lophoictinia isura	Vulnerable	Yes	No	No	Mainly
Hamirostra melanosternon	Nt	Yes	No	No	Mainly
Milvus migrans[b]	Nt	No	No	No	Mainly
Haliastur indus[b]	Nt	No	No	No	Mainly
Haliaeetus leucogaster[b]	Nt	No	No	No	Mainly
Haliaeetus sanfordi	Vulnerable	Yes	Yes	Yes	Wholly
Butastur indicus[b]	Nt	No	Yes	No	Mainly
Accipiter soloensis[b]	Nt	No	Yes	No	Mainly
Accipiter fasciatus[b]	Nt	No	No	No	Mainly
Accipiter novaehollandiae[b]	Nt	No	Yes	No	Mainly
Accipiter melanochlamys	Nt	Yes	Yes	Yes	Wholly
Accipiter albogularis	Nt	Yes	Yes	Yes	Wholly
Accipiter rufitorques	Nt	Yes	No	Yes	Wholly
Accipiter haplochrous	Nt	Yes	Yes	Yes	Wholly
Accipiter henicogrammus	Nt	Yes	Yes	Yes	Wholly
Accipiter luteoschistaceus	Near threatened	Yes	Yes	Yes	Wholly
Accipiter imitator	Endangered	Yes	Yes	Yes	Wholly
Accipiter poliocephalus	Nt	Yes	No	Yes	Wholly
Accipiter princeps	Near threatened	Yes	Yes	Yes	Wholly
Accipiter brachyurus	Vulnerable	Yes	Yes	Yes	Wholly
Accipiter erythrauchen[b]	Nt	Yes	Yes	Yes	Wholly
Accipiter meyerianus	Nt	No	Yes	Yes	Wholly
Accipiter buergersi	Data deficient	Yes	Yes	Yes	Wholly
Accipiter radiatus	Endangered	Yes	No	No	Mainly
Accipiter doriae	Near threatened	Yes	Yes	Yes	Wholly
Buteo solitarius	Near threatened	Yes	No	Yes	Wholly
Harpyopsis novaeguineae	Vulnerable	Yes	Yes	Yes	Wholly
Aquila gurneyi	Near threatened	Yes	Yes	Yes	Wholly
Falco severus[b]	Nt	No	Yes	No	Mainly

[a] Not threatened.

[b] Occurs in more than one tropical region.