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Conservation Biology of the World's Migratory Raptors: status and strategies

Keith L. Bildstein, Jorje Zalles, Jennifer Ottinger and Kyle McCarty

ABSTRACT

At least 162 (55%) and possibly as many as 193 (67%) of the world's 294 species of raptors migrate. Among known migratory raptors, 19 species (6% of all raptors) are complete migrants, 100 (34%) are partial migrants, and 43 (15%) are local, irruptive, or altitudinal migrants. Africa and Asia have 76 and 68 species of migratory raptors, respectively. Australia has 22 species, Europe 38, Central and South America 39, North America 41, and the Pacific Islands 34. The geography of raptor migration is better studied in the Northern than in the Southern Hemisphere, particularly in North America, Europe, and the Middle East. Relatively little is known about raptor migration in Asia and Africa.

Twenty-eight (37%) of the world's 75 Near Threatened, Vulnerable, Endangered, and Critically Endangered raptors are known or suspected migrants. Principal threats to known or suspected migratory raptors include habitat loss (97 species), environmental contaminants (40 species), and direct persecution (59 species).

Migratory raptors are secretive, wide-ranging birds that operate over enormous ecological neighborhoods. Their protection is neither simple nor easy. Global raptor conservation depends upon a practical mix of intercontinental networks, longterm databases, and local community support. The development and widespread use of prismatic binoculars and modern field guides earlier this century provided raptor enthusiasts with the tools needed to begin documenting the geography of raptor migration, as well as to monitor populations along important migration corridors. Programs at well-established migration watchsites, including Hawk Mountain Sanctuary's *Hawks Aloft Worldwide* (*HAWW*), offer useful models for recently activated and incipient watchsites, particularly in areas where raptor migration is little studied.

INTRODUCTION

Diurnal birds of prey (Falconiformes) represent a diverse group of highly mobile, wide-ranging, area-sensitive predators, whose populations occur across a broad range of habitats on six continents (Brown & Amadon 1968). Each year, millions of these birds travel long distances— in many instances across and among entire continents—en route to their breeding and wintering grounds. Although raptors often migrate across broad fronts (Bednarz & Kerlinger 1988), individuals of many species congregate along established corridors on migration, particularly along specific geographic features

including mountain chains, coastal plains, isthmuses, and peninsulas (Bildstein 1998). Considerable potential exists for using these concentrated movements to monitor local, regional, and continental populations, as well as to introduce local inhabitants to these normally secretive and dispersed birds (Broun 1949, Bildstein 1998, Bildstein *et al.* 1995).

Long-distance raptor migration represents one of the most spectacular movements of land-based predators on earth (Bildstein & Zalles 1995). The charismatic and evocative nature of the birds, together with their trophic status as area-sensitive predators, make them useful flagship species for broader conservation issues. Hawk Mountain Sanctuary, the world's first refuge for birds of prey (Broun 1949), maintains the longest and most complete record of raptor migration in the world (Bildstein 1998). The Sanctuary has used the spectacle of raptor migration to introduce more than a million Americans to these birds and their habitat needs since 1934. In 1987, Hawk Mountain launched *Hawks Aloft Worldwide* (*HAWW*), a cooperative global conservation initiative designed to export aspects of the Sanctuary's practical and effective conservation efforts elsewhere, and to amass, analyze, and distribute information on the movements of the world's migratory raptors (Senner & Brett 1989, Bildstein *et al.* 1995, Bildstein & Zalles 1995).

As of mid-1998, *Hawks Aloft Worldwide* had identified 384 raptor-migration watchsites in 87 countries on six continents.

Here, we summarize the results of these efforts, documenting the distribution of migratory raptors, together with that of active and incipient raptor-migration watchsites. We then use these data to highlight opportunities for increased conservation efforts in Africa, where the geography of raptor migration has yet to be studied in detail.

THE GEOGRAPHY OF RAPTOR MIGRATION

Raptor migration is complex and confusing. Most migratory raptors are partial rather than complete migrants (*sensu* Kerlinger 1989), and it is not always possible to determine the extent to which raptors migrate into and out of an area, particularly in regions where migration occurs across a broad front. Nevertheless, it appears that populations of at least 48 of 99 species of New World, and 120 of 201 species of Old World raptors migrate on a regular or irregular basis (Table 1). In the New World, all 36 species of Nearctic breeders are known or suspected migrants, as are 39 of 86 Neotropical breeders, and 30 of 62 Austral breeders (Table 2). In the Old World, 22 Australian, 60 African, 66 Asian, 19 Pacific Islands, and 38 European breeders are suspected or confirmed migrants (Table 3). The continental distribution of known complete and partial migrants is depicted in Figure 1.

Figure 1. Continental distribution of known complete and partial migratory raptors. The Pacific Islands, including New Guinea, are considered separately from Asia and Australia.

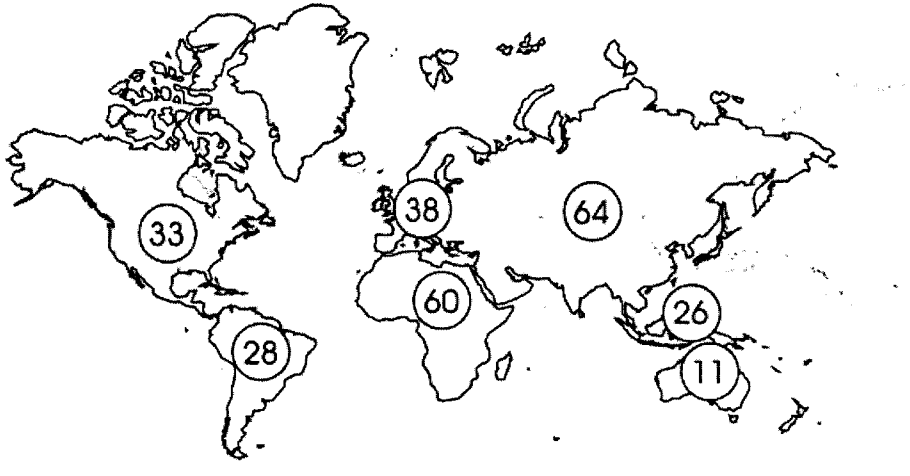


Table 1. Continental distribution of the world's complete, partial, irruptive, and local migrant raptors[a].

Species[b]	*Continental distribution*[c] *AUS*	*AFR*	*NAM*	*SAM*	*ASI*	*PIS*	*EUR*
Complete migrants							
Osprey *Pandion haliaetus*	+	+	+	+	+	+	+
Western Honey Buzzard *Pernis apivorus*		+			+		+
Eastern Honey Buzzard *P. ptilorhynchus*					+	+	
Mississippi Kite *Ictinia mississippiensis*			+	+			
Short-toed Eagle *Circaetus gallicus*		+			+		+
Gray-faced Buzzard *Butastur indicus*					+	+	
Montagu's Harrier *Circus pygargus*			+		+		+
Gray Frog Hawk *Accipiter soloensis*					+	+	
Broad-winged Hawk *Buteo platypterus*			+	+			
Swainson's Hawk *B. swainsoni*			+	+			
Rough-legged Hawk *B. lagopus*			+		+		+
Lesser Spotted Eagle *Aquila pomarina*		+			+		+
Greater Spotted Eagle *A. clanga*[d]		+			+		+
Lesser Kestrel *Falco naumanni*[d]		+			+		+
Western Red-footed Falcon *F. vespertinus*		+			+		+
Eastern Red-footed Falcon *F. amurensis*		+			+		
Northern Hobby *F. subbuteo*		+			+		+
Eleonora's Falcon *F. eleonorae*		+			+		+
Sooty Falcon *F. concolor*		+			+		
Partial migrants							
Black Vulture *Coragyps atratus*			+	+			
Turkey Vulture *Cathartes aura*			+	+			
African Cuckoo Hawk *Aviceda cuculoides*		+					
Asian Baza *A. jerdoni*					+	+	
Crested Baza *A. subcristata*					+	+	
Black Baza *A. leuphotes*					+	+	
Swallow-tailed Kite *Elanoides forficatus*			+	+			
White-tailed Kite *E. leucurus*			+	+			
Black-shouldered Kite *Elanus caeruleus*		+			+	+	+
African Swallow-tailed Kite *Chelictinia ricourii*		+					
Snail Kite *Rostrhamus sociabilis*			+	+			
Plumbeous Kite *Ictinia plumbea*			+	+			
Red Kite *Milvus milvus*		+			+		+
Black Kite *M. migrans*	+	+			+	+	+
Whistling Kite *Haliastur sphenurus*	+					+	
Brahminy Kite *H. indus*	+				+	+	
Pallas' Fish Eagle *Haliaeetus leucoryphus*[d]					+		
White-tailed Eagle *H. albicilla*			+		+		+
Bald Eagle *H. leucocephalus*			+				
Steller's Sea-Eagle *H. pelagicus*[d]					+		
Lesser Fishing Eagle *Icthyophaga humilis*					+	+	
Cinereous Vulture *Aegypius monachus*		+			+		+
Lappet-faced Vulture *A. tracheliotus*		+			+		
Eurasian Griffon *Gyps fulvus*		+			+		+
Ruppell's Griffon *G. rueppellii*		+					
Asian White-backed Vulture *G. bengalensis*					+		
African White-backed Vulture *G. africanus*		+					
Egyptian Vulture *Neophron percnopterus*		+			+		+
Bearded Vulture *Gypaetus barbatus*		+			+		+
Palmnut Vulture *Gypohierax angolensis*		+					
African Harrier Hawk *Polyboroides typus*		+					
Madagascar Harrier Hawk *P. radiatus*		+					
Eastern Chanting Goshawk *Melierax poliopterus*		+					
Dark Chanting Goshawk *Melierax metabates*		+			+		
Gabar Goshawk *M. gabar*		+			+		
Grasshopper Buzzard *Butastur rufipennis*		+					
White-eyed Buzzard *B. teesa*					+		
Spotted Harrier *Circus assimilis*	+					+	

Species[b]	AUS	AFR	NAM	SAM	ASI	PIS	EUR
Northern Harrier *C. cyaneus*		+	+	+	+	+	+
Cinereous Harrier *C. cinereus*				+			
Pallid Harrier *C. macrourus*		+			+		+
Pied Harrier *C. melanoleucus*					+	+	
Western Marsh Harrier *C. aeruginosus*		+			+		+
Eastern Marsh Harrier *C. spilonotus*					+	+	
Swamp Harrier *C. approximans*	+					+	
African Marsh Harrier *C. ranivorus*		+					
Long-winged Harrier *C. buffoni*				+			
Gray-bellied Hawk *Accipiter poliogaster*				+			
Levant Sparrowhawk *A. brevipes*		+			+		+
Shikra *A. badius*		+			+		
Japanese Sparrowhawk *A. gularis*					+	+	
Besra *A. virgatus*					+	+	
Ovambo Sparrowhawk *A. ovampensis*		+					
Eurasian Sparrowhawk *A. nisus*		+			+		+
Sharp-shinned Hawk *A. striatus*			+	+			
Cooper's Hawk *A. cooperii*			+				
Bicolored Hawk *A. bicolor*			+	+			
Northern Goshawk *A. gentilis*		+	+		+		+
Gray Hawk *Asturina nitida*			+	+			
Common Black Hawk *Buteogallus anthracinus*			+	+			
Savanna Hawk *B. meridionalis*				+			
Harris' Hawk *Parabuteo unicinctus*			+	+			
Red-shouldered Hawk *Buteo lineatus*			+				
White-tailed Hawk *B. albicaudatus*			+	+			
Red-backed Hawk *B. polyosoma*				+			
Zone-tailed Hawk *B. albonotatus*			+	+			
Red-tailed Hawk *B. jamaicensis*			+				
Eurasian Buzzard *B. buteo*		+			+		+
Mountain Buzzard *B. oreophilus*		+					
Long-legged Buzzard *B. rufinus*		+			+		+
Upland Buzzard *B. hemilasius*					+		
Ferruginous Hawk *B. regalis*			+				
Red-necked Buzzard *B. auguralis*		+					
Steppe Eagle *Aquila nipalensis*		+			+		+
Imperial Eagle *A. heliaca*[d]		+			+		+
Golden Eagle *A. chrysaetos*		+	+		+		+
Black Eagle *A. verreauxi*		+					
Wahlberg's Eagle *Hieraaetus wahlbergi*		+					
Bonelli's Eagle *Hieraaetus fasciatus*		+			+	+	+
Booted Eagle *H. pennatus*		+			+		+
Martial Eagle *H. bellicosus*		+					
Chimango Caracara *Milvago chimango*				+			
American Kestrel *Falco sparverius*			+	+			
Old World Kestrel *F. tinnunculus*		+			+		+
Australian Kestrel *F. cenchroides*	+					+	
Fox Kestrel *F. alopex*		+					
Gray Kestrel *F. ardosiaceus*		+					
Red-headed Falcon *F. chicquera*		+			+		
Aplomado Falcon *F. femoralis*			+	+			
Merlin *F. columbarius*			+	+	+	+	+
Oriental Hobby *F. severus*					+	+	
Australian Hobby *F. longipennis*	+					+	
New Zealand Hobby *F. novaeseelandiae*	+						
Brown Falcon *F. berigora*	+					+	
Prairie Falcon *F. mexicanus*			+				
Lanner Falcon *F. biarmicus*		+			+		+
Saker Falcon *F. cherrug*		+			+		+
Gyrfalcon *F. rusticolus*			+		+		+
Peregrine Falcon *F. peregrinus*	+	+	+	+	+	+	+
Barbary Falcon *F. pelegrinoides*		+			+		

Species[b]	*AUS*	*AFR*	*NAM*	*SAM*	*ASI*	*PIS*	*EUR*
Local and irruptive migrants							
Savanna Vulture *Cathartes burrovianus*			+	+			
California Condor *Gymnogyps californianus*[d]			+				
Andean Condor *Vultur gryphus*				+			
Black-winged Kite *Elanus notatus*	+						
Letter-winged Kite *E. scriptus*	+						
Hook-billed Kite *Chondrohierax uncinatus*			+	+			
Rufous-thighed Kite *Harpagus diodon*				+			
Square-tailed Kite *Lophoictinia isura*	+						
Black-breasted Buzzard *Hamirostra melanosternon*	+						
White-bellied Sea-Eagle *Haliaeetus leucogaster*	+				+	+	
African Fish Eagle *H. vocifer*		+					
Hooded Vulture *Necrosyrtes monachus*		+					
Himalayan Griffon *Gyps himalayensis*					+		
Cape Griffon *G. coprotheres*		+					
Brown Snake Eagle *Circaetus cinereus*		+					
Banded Snake Eagle *C. cinerascens*		+					
Bateleur *Terathopius ecaudatus*		+					
Crested Serpent Eagle *Spilornis cheela*					+	+	
Brown Goshawk *Accipiter fasciatus*	+					+	
Australasian Collared Sparrowhawk *A. cirrhocephalus*	+					+	
Rufous-breasted Sparrowhawk *A. rufiventris*		+					
Black and White Goshawk *A. melanoleucus*		+					
Great Black Hawk *Buteogallus urubitinga*			+	+			
Black-collared Hawk *Busarellus nigricollis*			+	+			
Short-tailed Hawk *Buteo brachyurus*			+	+			
Puna Hawk *B. poecilochrous*				+			
Hawaiian Hawk *B. solitarius*						+	
Rufous-tailed Hawk *B. ventralis*				+			
Madagascar Buzzard *B. brachypterus*		+					
Jackal Buzzard *B. rufofuscus*		+					
Harpy Eagle *Harpia harpyja*			+	+			
Tawny Eagle *Aquila rapax*		+					
Wedge-tailed Eagle *Aquila audax*	+					+	
Little Eagle *Hieraaetus morphnoides*	+					+	
Ayres' Hawk Eagle *H. ayresii*		+					
Mountain Hawk Eagle *Spizaetus nipalensis*					+	+	
Secretarybird *Sagittarius serpentarius*		+					
Crested Caracara *Polyborus plancus*			+	+			
African Pygmy Falcon *Polihierax semitorquatus*		+					
White-eyed Kestrel *Falco rupiculoides*		+					
African Hobby *F. cuvierii*		+					
Gray Falcon *F. hypoleucos*	+						
Black Falcon *F. subniger*	+						
Continental totals	**22**	**76**	**41**	**39**	**68**	**35**	**38**
Continental totals (without locals and irruptives)	**11**	**60**	**33**	**28**	**64**	**27**	**38**

[a]Complete migrants are species in which more than 90% of all individuals leave the breeding range during the nonbreeding season. Partial migrants are those in which 90% or fewer of all individuals leave the breeding range. Irruptive and local migrants are species whose movements are correlated with less predictable environmental fluctuations, and whose migratory habits are less regular than those of complete or partial migrants. (Based primarily on Kerlinger 1989 as updated in del Hoyo *et al.* 1994.)

[b]Taxonomic status and distribution are based primarily on Amadon and Bull 1988.

[c]AUS = Australia and New Zealand, AFR = Africa, NAM = North America, SAM = South America, ASI = Asia, PIS = Pacific Islands, EUR = Europe.

[d]Species listed in *Birds to watch 2: the world list of threatened birds* (Collar *et al.* 1994). See Table 4 for details.

Table 2. Migratory populations of Western Hemisphere raptors.

Type migrant	*Breeding population* *Nearctic*	*Tropical*	*Austral*
Complete migrants			
Osprey *Pandion haliaetus*	+[a]		
Mississippi Kite *Ictinia mississippiensis*	+		
Broad-winged Hawk *Buteo platypterus*	+		
Swainson's Hawk *B. swainsoni*	+		
Rough-legged Hawk *B. lagopus*	+		
Partial migrants			
Black Vulture *Coragyps atratus*	+	+	—
Turkey Vulture *Cathartes aura*	+	+	+
Swallow-tailed Kite *Elanoides forficatus*	+	+	+
White-tailed Kite *Elanus leucurus*	?	?	+
Snail Kite *Rostrhamus sociabilis*	+	+	+
Plumbeous Kite *Ictinia plumbea*	+	+	+
Bald Eagle *Haliaeetus leucocephalus*	+		
Northern Harrier *Circus cyaneus*	+		
Cinereous Harrier *C. cinereus*		+	+
Long-winged Harrier *C. buffoni*		+	+
Gray-bellied Hawk *Accipiter poliogaster*		+	+
Sharp-shinned Hawk *A. striatus*	+	—	+
Cooper's Hawk *A. cooperii*	+		
Bicolored Hawk *A. bicolor*			+
Northern Goshawk *A. gentilis*	+		
Gray Hawk *Asturina nitida*	+	?	
Common Black Hawk *Buteogallus anthracinus*	+	?	
Savanna Hawk *B. meridionalis*		+	+
Harris' Hawk *Parabuteo unicinctus*	+	—	—
Red-shouldered Hawk *Buteo lineatus*	+		
White-tailed Hawk *B. albicaudatus*	?	—	+
Red-backed Hawk *B. polyosoma*			+
Zone-tailed Hawk *B. albonotatus*	+	?	?
Red-tailed Hawk *B. jamaicensis*	+		
Ferruginous Hawk *Buteo regalis*	+		
Golden Eagle *Aquila chrysaetos*	+		
Chimango Caracara *Milvago chimango*		+	+
American Kestrel *Falco sparverius*	+	—	+
Aplomado Falcon *F. femoralis*	+	+	+
Merlin *F. columbarius*	+		
Prairie Falcon *F. mexicanus*	+		
Gyrfalcon *F. rusticolus*	+		
Peregrine Falcon *F. peregrinus*	+	+	+
Local and irruptive migrants			
Savanna Vulture *Cathartes burrovianus*		+	+
Forest Vulture *C. melambrotus*		+	
California Condor *Gymnogyps californianus*	+		
Andean Condor *Vultur gryphus*		+	+
King Vulture *Sarcoramphus papa*		+	?
Hook-billed Kite *Chondrohierax uncinatus*	+	—	—
Rufous-thighed Kite *Harpagus diodon*		?	+
Great Black Hawk *Buteogallus urubitinga*	+	?	?
Black-collared Hawk *Busarellus nigricollis*		?	+
Black-chested Eagle *Geranoaetus melanoleucus*		?	?
White-rumped Hawk *Buteo leucorrhous*		+	?
Short-tailed Hawk *B. brachyurus*	+	—	—
Puna Hawk *B. poecilochrous*		+	?
Rufous-tailed Hawk *B. ventralis*			?
Harpy Eagle *Harpia harpyja*		+	
Striated Caracara *Phalcoboenus australis*			?
Crested Caracara *Polyborus plancus*	+	+	+
Bat Falcon *Falco rufigularis*		+	
Orange-breasted Falcon *F. deiroleucus*		+	
Total number of known (suspected) migrants	**34 (2)**	**22 (8)**	**22 (8)**

[a]+ = known migratory population; ? = suspected migratory population; — = no known migratory population.

Table 3. Migratory populations of Old World raptors.

Species	*Breeding population* AUS	AFR	ASI	PIS	EUR
Complete migrants					
Osprey *Pandion haliaetus*	+	+	+	+	+
Western Honey Buzzard *Pernis apivorus*			+		+
Eastern Honey Buzzard *P. ptilorhynchus*			+	?	
Short-toed Eagle *Circaetus gallicus*		+	+		+
Gray-faced Buzzard *Butastur indicus*			+		
Montagu's Harrier *Circus pygargus*		+	+		+
Gray Frog Hawk *Accipiter soloensis*			+		
Rough-legged Hawk *Buteo lagopus*			+		+
Lesser Spotted Eagle *Aquila pomarina*			+		+
Greater Spotted Eagle *A. clanga*			+		+
Lesser Kestrel *Falco naumanni*		?	+		+
Western Red-footed Falcon *F. vespertinus*		+	+		+
Eastern Red-footed Falcon *F. amurensis*			+		
Eleonora's Falcon *F. eleonorae*		+	+		+
Sooty Falcon *F. concolor*		+	+		
Northern Hobby *F. subbuteo*		+	+		+
Partial migrants					
African Cuckoo Hawk *Aviceda cuculoides*		+			
Asian Baza *A. jerdoni*			+	+	
Crested Baza *A. subcristata*			+		
Black Baza *A. leuphotes*			+		
Black-shouldered Kite *Elanus caeruleus*		+	+	+	+
African Swallow-tailed Kite *Chelictinia ricourii*		+			
Red Kite *Milvus milvus*		+	+		+
Black Kite *M. migrans*	+	+	+	?	+
Whistling Kite *Haliastur sphenurus*	+				
Brahminy Kite *H. indus*	+		+	?	
Pallas' Fish Eagle *Haliaeetus leucoryphus*			+		
White-tailed Sea Eagle *H. albicilla*			+		+
Steller's Sea Eagle *H. pelagicus*			+		
Lesser Fishing Eagle *Ichthyophaga humilis*			+	?	
Cinereous Vulture *Aegypius monachus*			+		+
Lappet-faced Vulture *A. tracheliotus*		+	+		
Eurasian Griffon *Gyps fulvus*		?	+		+
Ruppell's Griffon *G. rueppellii*		+			
Asian White-backed Vulture *G. bengalensis*			+		
African White-backed Vulture *G. africanus*		+			
Egyptian Vulture *Neophron percnopterus*		+	+		+
Bearded Vulture *Gypaetus barbatus*		?	?		+
Palmnut Vulture *Gypohierax angolensis*		+			
African Harrier Hawk *Polyboroides typus*		+			
Madagascar Harrier Hawk *P. radiatus*		+			
Eastern Chanting Goshawk *Melierax poliopterus*		+			
Dark Chanting Goshawk *M. metabates*		+			
Gabar Goshawk *M. gabar*		+			
Grasshopper Buzzard *Butastur rufipennis*		+			
White-eyed Buzzard *B. teesa*			+		
Spotted Harrier *Circus assimilis*	+			+	
Black Harrier *C. maurus*		+			
Northern Harrier *C. cyaneus*			+		+
Pallid Harrier *C. macrourus*			+		+
Pied Harrier *C. melanoleucus*			+	+	
Western Marsh Harrier *C. aeruginosus*			+		+
Eastern Marsh Harrier *C. spilonotus*			+		
Swamp Harrier *C. approximans*	+				
African Marsh Harrier *C. ranivorus*		+			
Levant Sparrowhawk *Accipiter brevipes*			+		+
Shikra *A. badius*		+	+		
Japanese Sparrowhawk *A. gularis*			+		
Besra *A. virgatus*			+		
Ovambo Sparrowhawk *A. ovampensis*		+			

Species	Breeding population AUS	AFR	ASI	PIS	EUR
Eurasian Sparrowhawk *A. nisus*			+		+
Northern Goshawk *A. gentilis*			+		+
Eurasian Buzzard *Buteo buteo*			+		+
Mountain Buzzard *B. oreophilus*		+			
Long-legged Buzzard *B. rufinus*		?	+		+
Upland Buzzard *B. hemilasius*			+		
Red-necked Buzzard *B. auguralis*		+			
Asian Black Eagle *Ictinaetus malayensis*			+		
Steppe Eagle *Aquila nipalensis*			+		+
Imperial Eagle *A. heliaca*			+		+
Golden Eagle *A. chrysaetos*			+		+
Black Eagle *A. verreauxii*		+			
Wahlberg's Eagle *Hieraaetus wahlbergi*		+			
Bonelli's Eagle *H. fasciatus*		?	?		+
Booted Eagle *H. pennatus*		+	+		+
Rufous-bellied Eagle *H. kienerii*			+	+	
Martial Eagle *H. bellicosus*		+			
Old World Kestrel *Falco tinnunculus*		?	+		+
Australian Kestrel *F. cenchroides*	+			+	
Fox Kestrel *F. alopex*		+			
Gray Kestrel *F. ardosiaceus*		+			
Red-headed Falcon *F. chicquera*		+	+		
Merlin *F. columbarius*			+		+
Oriental Hobby *F. severus*			+	+	
Australian Hobby *F. longipennis*	+				
New Zealand Hobby *F. novaeseelandiae*	+				
Brown Falcon *F. berigora*	+				
Lanner Falcon *F. biarmicus*		+	+		+
Saker Falcon *F. cherrug*			+		+
Gyrfalcon *F. rusticolus*			+		+
Peregrine Falcon *F. peregrinus*	?	+	+	?	+
Barbary Falcon *F. pelegrinoides*		+	+		
Local or irruptive migrants					
Black-winged Kite *Elanus notatus*	+				
Letter-winged Kite *E. scriptus*	+				
Square-tailed Kite *Lophoictinia isura*	+				
Black-breasted Buzzard *Hamirostra melanosternon*	+				
White-bellied Sea Eagle *Haliaeetus leucogaster*	+		?	?	
African Fish Eagle *H. vocifer*		+			
Red-headed Vulture *Aegypius (Sarcogyps) calvus*			+		
Hooded Vulture *Necrosyrtes monachus*		+			
Long-billed Griffon *Gyps indicus*			+		
Himalayan Griffon *G. himalayensis*			+		
Cape Griffon *G. coprotheres*		+			
Brown Snake Eagle *Circaetus cinereus*		+			
East African Snake Eagle *C. fasciolatus*		+			
Banded Snake Eagle *C. cinerascens*		+			
Bateleur *Terathopius ecaudatus*		+			
Crested Serpent Eagle *Spilornis cheela*			+	?	
Pale Chanting Goshawk *Melierax canorus*		+			
Lizard Buzzard *Kaupifalco monogrammicus*		+			
Malagasy Marsh Harrier *Circus maillardi*		+			
Asian Crested Goshawk *Accipiter trivirgatus*			+	+	
Little Sparrowhawk *A. minullus*		+			
Brown Goshawk *A. fasciatus*	+			?	
Australasian Collared Sparrowhawk *A. cirrhocephalus*	+			?	
Rufous-breasted Sparrowhawk *A. rufiventris*		+			
Black and White Goshawk *A. melanoleucus*		+			
Hawaiian Hawk *Buteo solitarius*				+	
Madagascar Buzzard *B. brachypterus*		+			
Augur Buzzard *Buteo augur*		+			
Jackal Buzzard *B. rufofuscus*		+			
Tawny Eagle *Aquila rapax*		+			

Species	*Breeding population* AUS	AFR	ASI	PIS	EUR
Wedge-tailed Eagle *A. audax*	+			?	
Little Eagle *Hieraaetus morphnoides*	+			?	
Ayres' Hawk Eagle *H. ayresii*		+			
Long-crested Eagle *Spizaetus occipitalis*		+			
Crested Hawk Eagle *S. cirrhatus*			+	?	
Mountain Hawk Eagle *S. nipalensis*			+		
Secretarybird *Sagittarius serpentarius*		+			
African Pygmy Falcon *Polihierax semitorquatus*		+			
White-eyed Kestrel *Falco rupiculoides*		+			
African Hobby *F. cuvierii*		+			
Gray Falcon *F. hypoleucos*	+				
Black Falcon *F. subniger*	+				
Laggar Falcon *F. jugger*			+		
Total number of known (suspected) migrants	**21(1)**	**62(6)**	**70(3)**	**10(12)**	**38(0)**

Key

Species

Complete migrants	species in which >90% of all individuals leave the breeding range during the nonbreeding season
Partial migrants	species in which £90% of all individuals leave the breeding range
Irruptive or local migrants	species whose movements are associated with less predictable environmental fluctuations, and whose migratory habits are less regular than those of complete or partial migrants (based primarily on Kerlinger 1989, as updated in del Hoyo *et al.* 1994 and this volume)

Continental distribution

AUS	Australia and New Zealand
AFR	Africa
ASI	Asia
PIS	Pacific Islands
EUR	Europe

Breeding population

+	known migratory population
?	suspected migratory population

In the Western Hemisphere, raptor migration is best understood in Canada and the United States. Although considerable effort is underway in Middle America (i.e., Mexico south to Panama), migration in South America is yet to be studied in detail (but see Davis 1989, Zuquim Antas 1994, Woodbridge *et al.* 1995).

In the Old World, raptor migration is well studied in Europe, particularly in southern Sweden (Rudebeck 1950, 1951), the Pyrenees, southernmost Iberia (Finlayson 1992), and Bulgaria (Ruskov *et al.* unpubl. ms.); and in the Middle East, particularly Israel (Shirihai 1996). Except for Japan (Brazil 1991, Brazil & Hanawa 1991) and Taiwan (Severinghaus 1991), the geography of raptor migration is little studied in Asia (McClure 1998). Much remains to be learned regarding the passage of European and Asian raptors into and out of, as well as within Africa, particularly West Africa (Brown *et al.* 1982).

HAWW AND RAPTOR CONSERVATION

Fifty percent of all migratory raptors are threatened by habitat loss, 21% by environmental contaminants, and 31% by direct persecution. Twenty-two percent are threatened by two of these factors, 7% by all three. Seventy percent of all Asian, 79% of all Pacific Island, 67% of all African, 82% of all European, 53% of all Central and South American, and 59% of all North American raptors are threatened by one or more of these factors. Overall, world populations of 10 migratory species—5% of all suspected or known migratory raptors—are listed as Critically Endangered or Vulnerable by the international conservation community (Collar *et al.* 1994). Another 9% (18 species) are listed as Near-threatened (Table 4).

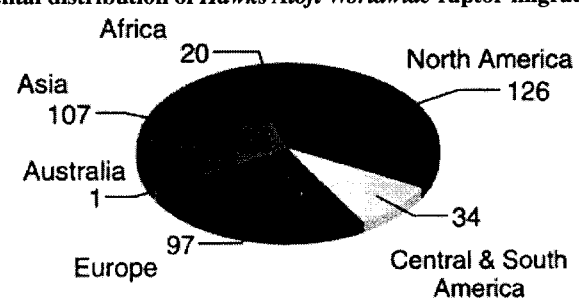
Table 4. Critically Endangered, Endangered, Threatened, Vulnerable, and Near-threatened species of suspected and known migratory raptors from *Birds to watch 2: the world list of threatened birds* (Collar *et al.* 1994).

Species	*Type migrant*	*Continental distribution*
Critically Endangered		
Gymnogyps californianus	Irregular, irruptive migrant	North America
Vulnerable		
Lophoictinia isura	Irregular, irruptive migrant	Australia
Haliaeetus leucoryphus	Partial migrant	Asia
Haliaeetus pelagicus	Partial migrant	Asia
Gyps coprotheres	Irregular, irruptive migrant	Africa
Harpyhaliaetus coronatus[a]	Irregular, irruptive migrant	Central and South America
Aquila clanga	Complete migrant	Africa, Asia, Europe
Aquila heliaca	Partial migrant	Africa, Asia, Europe
Falco naumanni	Complete migrant	Africa, Asia, Europe
Falco hypoleucos	Irregular, irruptive migrant	Australia
Near-threatened		
Aviceda jerdoni	Partial migrant	Asia
Haliaeetus albicilla	Partial migrant	Asia, Europe, North America
Icthyophaga humilis	Partial migrant	Asia
Gyps bengalensis	Partial migrant	Asia
Gyps indicus[a]	Irregular, irruptive migrant	Asia
Gyps calvus[a]	Irregular, irruptive migrant	Asia
Aegypius monachus	Partial migrant	Africa, Asia, Europe
Circaetus fasciolatus[a]	Irregular, irruptive migrant	Africa
Circus maurus[a]	Irregular, irruptive migrant	Africa
Circus macrourus	Partial migrant	Africa, Asia, Europe
Accipiter poliogaster	Partial migrant	South America
Harpyhaliaetus solitarius[a]	Irregular, irruptive migrant	Central and South America
Buteo solitarius	Irregular, irruptive migrant	Asia
Buteo ventralis	Irregular, irruptive migrant	South America
Harpia harpyja	Irregular, irruptive migrant	Central and South America
Phalcoboenus australis[a]	Irregular, irruptive migrant	South America
Falco chicquera	Partial migrant	Africa, Asia
Falco novaeseelandiae	Partial migrant	Australia

[a]Suspected, not confirmed migrant.

Hawks Aloft Worldwide has identified 384 raptor migration watchsites in 87 countries on six continents. The distribution of raptor migration watchsites is closely tied both to the distribution of migratory raptors and to the distribution of the conservationists who study them. In part because of differences in land mass, and in part because of differences in conservation effort, the Northern Hemisphere is home to 90% of all *HAWW* watchsites. Europe and North America, continents with long traditions in migration-watchsite activity (Broun 1949, Rudebeck 1950, 1951) have 97 and 126 watchsites, respectively. Africa and Central and South America have considerably fewer watchsites (Figure 2). Africa, an important wintering area for many Asian and European raptors (Newton 1995), is particularly underrepresented in this regard.

Figure 2. Continental distribution of *Hawks Aloft Worldwide* raptor-migration watchsites.



Although two-thirds of all *HAWW* watchsites are on protected lands, percentages vary considerably among continents, from a low of 45% in Africa, to a high of 74% in North America. More watchsites are active in autumn than in spring. Overall, 8 African, 33 Asian, 19 European, 12 Central and South American, and 37 North American watchsites report more than 10,000 raptors, annually (Figure 3); 16 watchsites report more than 100,00 raptors, annually. With an autumn average of more than two million raptors, and a spring average of 600,000 individuals, the Veracruz Coastal Plain watchsite in Gulf Coast Veracruz, Mexico, ranks as the world's greatest active watchsite. Elat, Israel, with 830,000 migrants in spring and >40,000 migrants in autumn ranks as the most numerically significant Old World site.

Active raptor-migration watchsites can function as centres of environmental education, as well as important sources of information regarding the status of local, regional, and sometimes, continental populations of raptors (Bildstein 1998, Bildstein *et al.* 1995).

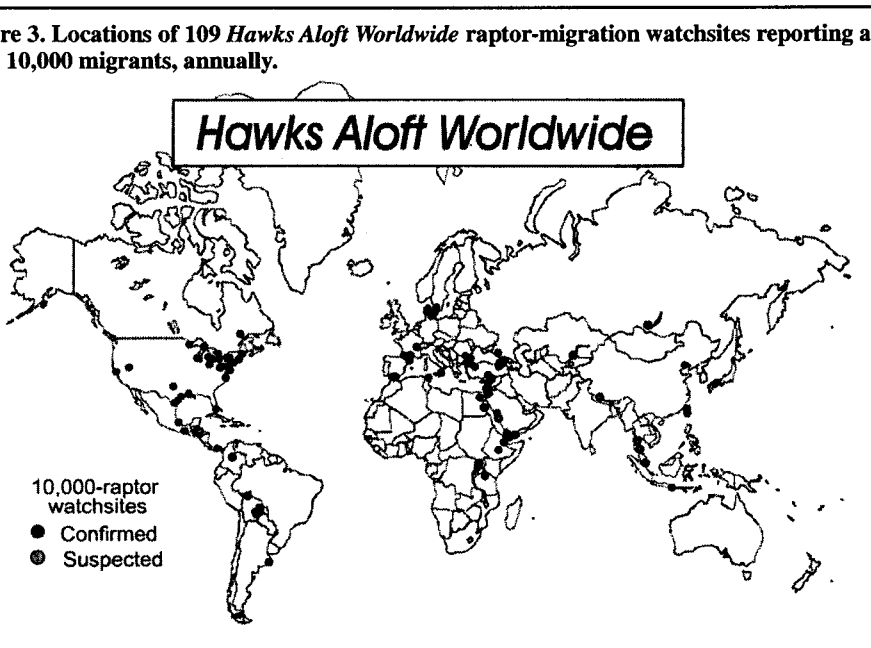
HAWK AND RAPTOR CONSERVATION IN AFRICA

Africa may be the most important wintering area for migratory raptors anywhere. The continent hosts 34 species of endemic, *intra*continental migrants, together with significant populations of 34 European and 42 Asian breeders, several of which travel from as far as Scandinavia, Siberia, and Amurland to over-winter in Africa's grasslands, savannas, and wet and dry forests. Four African countries—Kenya, Ethiopia, Sudan, and Tanzania—rank among the world's top 10 in numbers of species of raptors overall; while 9—Kenya, Ethiopia, Sudan, Uganda, South Africa, Tanzania, Zaire, Eritrea, and Mozambique—rank among the top 10 in terms of numbers of species of *migratory* raptors. In spite of such diversity, the geography of raptor migration is little studied in the Africa, especially in comparison with what is known about raptor migration in Europe and North America.

Leslie Brown's treatment (Brown 1971) remains the best overview of the geography of raptor migration in Africa, while Brown *et al.* 1982 and Mundy *et al.* 1992, provide the best species treatments, overall. Taken as a whole, these three references serve as an essential primer to raptor migration on the continent. Below we use these sources, together with seminal regional references and information provided by *Hawks Aloft Worldwide* cooperators to sketch a synoptic overview of the geography of raptor migration in the region and to suggest ways in which activities at raptor-migration watchsites can increase our understanding of the phenomenon.

Although some migrants, including many harriers (*Circus* spp.) and small falcons (*Falco* spp.),

Figure 3. Locations of 109 *Hawks Aloft Worldwide* raptor-migration watchsites reporting at least 10,000 migrants, annually.



enter North Africa across a broad front via the Mediterranean Sea; and while Eastern Red-footed Falcons *Falco amurensis* enter equatorial East Africa via the Indian Ocean; populations of most migrants enter the continent at well-established bottlenecks that minimize the extent of water crossings. East to west, principal points of arrival and departure include: (1) The northeastern coast of Djibouti along the **Bab-el-Mandeb Straits**, <30 km from Yemen in southern Arabia, and the shortest crossing point between Asia and Africa south of Sinai. More than 240,000 raptors, including 98,000 Common Buzzards *Buteo buteo* and >76,000 Steppe Eagles *Aquila nipalensis* have been recorded in a single autumn at the site (Welch & Welch 1988). (2) **Suez,** in northeastern Egypt at the southern end of the isthmus linking the Sinai Peninsula to mainland Africa. Autumn and spring counts of migrants in the area reveal totals of 134,000 and 125,000 raptors, respectively (Bijlsma 1983). (3) Coastal Tunisia, in and around **Cap Bon**. Spring reports from the site indicate movements of at least 10,000 raptors, presumably en route to Sicily (Steinbacher 1958, Thiollay 1975a). (4) Cape Spartel on **the Strait of Gibraltar**, 12-km south of southernmost Iberia. Autumn and spring reports along the Spanish coast suggest movements of more than 100,000 migrants (Finlayson 1992) (Table 5; Figure 4).

Within Africa, movements of most raptors are decidedly less well understood. In West Africa, particularly in the Sahara and Sahel, most Palaearctic migrants appear to move north-south across a broad front (Moreau 1961, 1972; Brown 1971; Thiollay 1989). There also appear to be significant coastal movements of Peregrine Falcons *Falco peregrinus* in the region (Gatter 1987). Except for Western Honey Buzzards *Pernis apivorus*, which appear to overwinter in the region's humid tropical forests, most Palaearctic migrants in the region concentrate in the more arid Sahel, directly south of the Sahara; whereas the region's Afrotropical migrants tend to spend the wet season (July-September) in the Sahel, and the dry season (December-February) farther south in the more humid savannas of the Guinea Belt (Thiollay 1989). Seasonally flooded wetlands associated with Lake Chad in extreme northern Cameroon may be an important wintering area for Palaearctic migrants (Thiollay 1978). West African wetlands appear to be important wintering areas for *Pandion haliaetus* from northwestern Europe (Österlöf 1977). African Fishing Eagles *Haliaeetus vocifer* undertake sporadic movements in the Niger Inundation Zone and other seasonal wetlands in the region (Thiollay 1977). *HAWW* watchsites in this part of Africa include Hassi Marroket, Algeria, and Bougouni and Niger Inundation Zone, Mali (Table 5, Figure 4).

In East Africa, most Palaearctic migrants travel north-south along the Western and Eastern Rift Valleys. In Egypt, where many raptors enter Africa via the Sinai Peninsula, movements are especially pronounced along the Eastern Desert on the Red Sea. Southeast of Egypt, raptors entering northern Djibouti via the Bab-el-Mandeb Straits continue inland en route to the Ethiopian highlands and the Eastern Rift Valley. Farther south, Western Honey Buzzards, Black Kites *Milvus migrans*, Common Buzzards *Buteo buteo*, and Wahlberg's Eagle *Hieraaetus wahlbergi* migrate along the Western Rift Valley in Rwanda (Vande Weghe 1978) and, presumably, Burundi; while reports from Kenya suggest that large numbers of Steppe Eagles and Lesser Kestrels *Falco naumanni* (the latter, at least in spring) use the Eastern Rift Valley corridor (Curry-Lindahl 1981, Brown *et al.* 1982, and Lewis & Pomeroy 1989). By the time Palaearctic migrants reach South Africa, most movements, except for concentrations along the Drakensbergs and, possibly, the Waterburgs and the Lebombo Range on the border with Mozambique, appear to occur across a broad front (Newman 1977, Broekhuysen 1971, Schmitt *et al.* 1980). *Hawks Aloft Worldwide* watchsites in the region include Bur Safaga, Egypt; Lake Langano, Ethiopia; Lewa Downs and Tsavo, Kenya; Akagera, Rwanda; Mti Mwili and Lake Manyara, Tanzania; Murchison Falls-Budongo Forest and Kibale Forest, Uganda; Lundazi and Chizongwe Hill, Zambia; and Lake Chivero and Mvurwi, Zimbabwe (Table 5, Figure 4).

Table 5. *Hawks Aloft Worldwide* raptor-migration watchsites in Africa.

Name and country[a]	*Season(s)*[b]	*Numbers of:* Species	Endangered species[c]	Individuals
Hassi Marroket, northcentral Algeria	Autumn (Aug.-Oct.)	10	0	?
Bab-el-Mandeb Straits, northern Djibouti	Spring (Mar.)	7	1	1,000s
	Autumn (Oct.-Nov.)	27	3	240,000
Suez, northeastern Egypt	Spring (Feb.-May)	30	4	>125,000
	Autumn (Sep.-Nov.)	33	5	134,000
Bur Safaga, eastern Egypt	Spring (Mar.)	12	2	>>6000
Lake Lagano, central Ethiopia	Spring (Mar.-Apr.)	14	3	?
	Autumn (Sep.-Oct.)	10	3	10,000
Lewa Downs, central Kenya	Autumn (Nov.)	3	0	>>4,000
Tsavo, southeastern Kenya	Austral Summer (Dec.-Mar.)	24	3	?
Bougouni, southwestern Mali	Spring (Apr.-Jun)	12	0	?
	Autumn (Oct.-Nov.)	12	0	?
Niger Inundation Zone, central Mali	Autumn-Spring (Oct.-May)	14	2	?
Akagera, eastern Rwanda	Austral spring (Aug.-Nov.)	13	2	?
	Austral autumn (Feb.-Apr.)	13	2	1000s
Mti Mwili, northcentral Tanzania	Austral autumn (Mar.)	3	2	145,000
Lake Manyara, northcentral Tanzania	Austral autumn (Feb.-Mar.)	5	2	?
Cap Bon, northeastern Tunisia	Spring (Feb-Jun.)	22	2	>10,000
Murchison Falls-Budongo Forest,	Spring (Mar.)	4(+2?)	1?	10,000s
northwestern Uganda	Autumn (Jul.)	4	0	?
Kibale Forest, western Uganda	Spring (Mar.)	1	0	100s
	Autumn (Jul.-Aug.)	1	0	100s
Lundazi, eastern Zambia	Austral spring (Sep.-Nov.)	11	2	?
	Austral autumn (Jan.-Mar.)	11	2	100s
Chizongwe Hill, eastern Zambia	Austral summer (Aug.-Apr.	8	?	1000s
Lake Chivero, northcentral Zimbabwe	Austral summer (Aug.-Apr.)	15	2	1000s
Mvurwi, northcentral Zimbabwe	Austral summer (Aug.-Apr.)	4	0	10,000

[a]Sites are listed alphabetical by country.

[b]Seasons are based on a site's position north or south of the Equator. Boreal spring and summer are listed as spring and autumn.

[c]Includes all Critically Endangered, Endangered, Threatened, Vulnerable, and Near-threatened species listed in Collar *et al.* 1994.

Thoughts and suggestions regarding the conservation of migratory raptors in Africa

Four of 10 globally Vulnerable species of migratory raptors, and 5 of 18 Near-threatened species, occur in Africa (Table 4). Six of the nine species are intercontinental visitors whose migratory geography and conservation status is better studied outside of the continent than within (*HAWW* unpubl. data). Two or more of these species have been counted at 15 of 20 incipient or currently-active *HAWW* migration watchsites in Africa (Table 5). Monitoring the movements and numbers of these birds at these watchsites—particularly if it were done in conjunction with counts at important watchsites in the Middle East—would provide conservationists with important new information regarding the distribution, status, and potential threats to these birds in Africa.

Even without the 9-million-km^2 Sahara Desert, 30-million-km^2 Africa forms the driest and most open of the world's three mainly tropical continents (Brown 1965, Sayer *et al.* 1992). The wet and

dry savannas and grasslands of Africa support some of the highest land-based herbivore biomasses anywhere (Frank *et al.* 1998). Although vertebrates comprise some of this biomass, much of the total consists of invertebrates, including termite alates and migratory locusts (*Schistocerca gregaria*) (cf. Brown 1965). Many Palaearctic and Afrotropical migrants, including many harriers, eagles, and falcons, depend upon these ephemeral insects for much of their "winter" food (Brown 1971, Brown *et al.* 1982). This relatively concentrated, albeit geographically episodic resource, together with the nomadic behaviour of many insect-dependent migratory raptors in Africa, probably explains how these intercontinental migrants manage to overwinter in areas in Africa that are several times smaller than their European and Asian breeding ranges (cf. Newton 1995).

Figure 4. Locations of 20 African *Hawks Aloft Worldwide* raptor-migration watchsites. The sites include: Hassi Marroket, Algeria; Bab-el-Mandeb Straits, Djibouti; Suez and Bur Safaga, Egypt; Lake Langano, Ethiopia; Lewa Downs and Tsavo, Kenya; Sarir, Libya; Bougouni and Niger Inundation Zone, Mali; Akagera, Rwanda; Mti Mwili and Lake Manyara, Tanzania; Cap Bon, Tunisia; Murchison Falls-Budongo Forest and Kibale Forest, Uganda; Lundazi and Chizongwe Hill, Zambia; and Lake Chivero (McIlwaine) and Mvurwi, Zimbabwe.

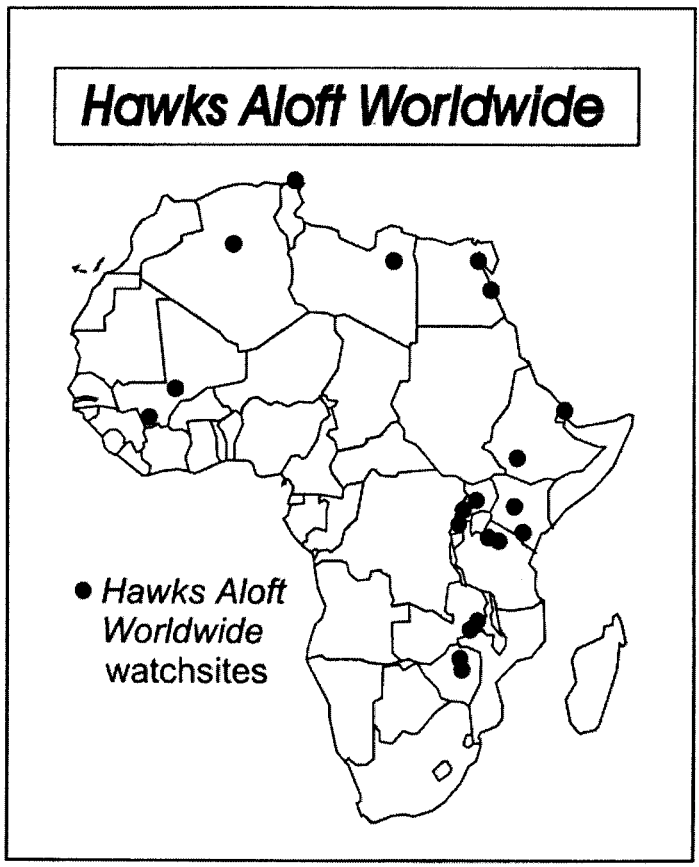


Table 6. Points of inquiry for students of African raptor migration.

1. Where do Western Honey Buzzards *Pernis apivorus* go once they reach Africa? Most appear to enter Africa via Cape Spartel, Morocco, and, to a lesser degree, northeastern Egypt (Brown 1971). Nowhere, however, are they known to be common Africa, except, perhaps in Zimbabwe, and the presumed centre of their wintering range in the Miombo (*Brachystegia*) woodland belt south of the Equator, and the continent's equatorial moist forests (Brown 1971). The species is a rare migrant in most of West Africa (Thiollay 1975b), which largely disappears once it enters the continent (Brown *et al.* 1982). The degree to which its migratory movements on the continent changes among years remains unclear.

2. What are the migratory movements of the three subspecies of Black Kites *Milvus migrans migrans*, *M. m. parasitus*, and *M. m. aegyptius* in Africa? How do the three subspecies interact there? Detailed radio-telemetry studies of this, one of the most conspicuous raptors of tropical Africa, are long overdue.

3. Where do European populations of Egyptian Vultures *Neophron percnopterus* go once they reach Africa; and how long do first-year birds stay on the continent? The extent to which European and Asian birds in juvenal plumage over-summer in Africa remains an understudied topic (Mundy *et al.* 1992).

4. Where do populations of Levant Sparrowhawks *Accipiter brevipes* and European Sparrowhawks *A. nisus* go once they reach Africa? Presumably both species overwinter in grassy woodlands South of the Sahara Desert and north and east of the continent's equatorial forests, but the distributions of both species, not to mention their wintering ecology, remain understudied (Brown *et al.* 1982).

5. Where do Lesser *Aquila pomarina* and Greater Spotted Eagles *A. clanga* go once they reach Africa? The former, which has been reported southbound in Kenya in November, appears to winter in the region's Miombo (*Brachystegia*) woodlands; while the latter, which may be largely nomadic in winter, appears to remain mainly in northeastern Africa. Unfortunately, the movements of both appear to be masked somewhat by those of the far more numerous Steppe Eagle *A. nipalensis* (Brown 1971, Brown *et al.* 1982).

6. How do Eastern Red-footed Falcons *Falco amurensis* reach Africa in autumn? Whether the species does so across the Arabian Peninsula, or via the Indian Ocean from southwestern India, is not yet known (Ash & Miskell 1989, Brown *et al.* 1982). Equally importantly, how do the birds return to their breeding areas in spring (Steyn 1982).

Unfortunately, many of the natural grasslands and savannas that host these arthropods include some of the most endangered terrestrial ecosystems on the planet (Hannah *et al.* 1994, Frank *et al.* 1998). Africa's human population is increasing at an estimated 2.9% annually, with a doubling rate of 24 years (Sayer *et al.* 1992). As the primary productivity of African grasslands and savannas shifts from natural grazers to row-crop agriculture and cattle and wild-game ranching (Frank *et al.* 1998) to feed growing human populations, populations of migratory raptors, particularly insect-dependent species such as Lesser Kestrels, Lesser Spotted Eagles and Steppe Eagles; and semiendemics (*sensu* Gomez de Silva Garza 1996) such as Levant Sparrowhawks, are likely to decline (cf. Brown 1971), particularly if chemical pesticides toxic to raptors are used to control insects and birds in the region (cf. Woodbridge *et al.* 1995, Keith & Bruggers 1998). Counts at African migration watchsites offer the potential of acting as an early warning system for such declines.

Many African migration watchsites occur in areas of high avian diversity and endemism (Thirgood & Heath 1994, Newton 1995). Because such areas often overlap areas of high diversity and endemism for other vertebrate groups (Thirgood & Heath 1994), and because raptors are excellent bioindicators (Bildstein & Zalles 1995), migration counts at these sites also offer the promise of monitoring the

ecological health of globally significant centres of biological diversity, as well as populations of migrating raptors.

Although field work in as vast a continent as Africa is both difficult and expensive, Africa offers raptor biologists and conservationists exciting opportunities for meaningful study (Table 6). We strongly recommend the expansion of field studies of migratory raptors in continental Africa. The region's highly diverse but largely understudied fauna, all but ensure considerable and immediate progress for those working in this area. International, continental, and regional initiatives that use the spectacle of long-distance raptor migration to strengthen local conservation activities along major migration corridors, together with meetings that focus on African raptors such as this one, should be continued and expanded.

The fate of African migratory raptors, including many Asian and European breeders, almost certainly rests in the hands of the human inhabitants of Africa's rural landscapes. In 1971, Leslie Brown lamented that "Rural Africans, who have the best opportunities for observing [raptor] migration note these movements, but neither comprehend them nor record them." Unfortunately, this statement remains largely true today. Community supported and locally operated raptor-migration watchsites along major migration corridors offer the promise of practical and effective raptor conservation, as well as considerable ecotourism revenue (Kerlinger & Brett 1994, Bildstein & Zalles 1995). Training opportunities for conservationists and ecotourism operators working the region, including internships at established watchsites elsewhere, designed to strengthen monitoring activity at these sites, should be encouraged and supported (Bildstein & Zalles 1995, Caldecott *et al.* 1996). Given what remains to be discovered and protected, the benefits of such efforts most certainly outweigh their costs.

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Keith L. Bildstein, Jorje Zalles, Jennifer Ottinger and Kyle McCarty
Hawk Mountain Sanctuary
1700 Hawk Mountain Road
Kempton, Pensylvania 19529
USA