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RAPTOR RESEARCH

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STRATEGY OF RAPTOR CONSERVATION IN THE USSR

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Nearly three decades have passed since the first volume of the fundamental handbook *Birds of the Soviet Union* (Dement'ev and Gladkov 1951) was published. Environmental changes since then have caused some changes in raptor populations and breeding ranges. The most important environmental factors affecting raptor populations are (1) modifications of habitats due to use and development of large tracts of land mostly in the north and east USSR; (2) growing influence of disturbance, in particular due to recreation, tourism, and other visitors to nature; (3) contamination by pesticides, mostly at wintering grounds (little influence by pesticides has been found for birds of prey on nesting grounds in the USSR); (4) electrocution of raptors (especially eagles) at towers for electro-transmission lines which form an expanding net and attract birds in the forestless southern regions; (5) changes in food resources for some species; (6) increase (up to the mid-sixties) and then definite decrease of hunting pressure upon birds of prey; (7) general improvement of nature conservation in the Soviet Union.

However, not all environmental changes caused by man are detrimental to populations of all raptors. Many modifications such as agriculture, hay-making, and clear-cutting in dense forests create a mosaic environment more suitable (especially for feeding) than is a homogeneous habitat. Therefore a strategy of raptor conservation must be based on thorough analysis of a wide range of recent environmental and man-made factors which influence populations of birds of prey. To identify the most dangerous factors and devise plans to mitigate them, various economic and conservation aspects have been studied regarding various species of birds of prey. It should be stressed that an estimation of an economic value is strictly confined to numerous or common raptors. Rare and endangered species are not liable to economic evaluation because of their limited numbers.

Special investigations revealed the main cause of raptor population decreases in the 1950s and 1960s was excessive shooting of birds of prey during the "struggle against vermin predators" as part of game management. By comparing raptor significance to agriculture, forestry, and game management, reliable arguments in favor of raptors were obtained (e.g., Galushin 1970). On the basis of these data, in 1964 a new hunting regulation was approved in the Russian Federation and later in other Union Republics. This legislation banned mass destruction of raptors. By this act, the legislative status of raptors in the USSR was brought to conform with the real economic and ecological value of the birds. In following years this legislation was further improved. In particular, new regulations adopted in the 1970s contained some provisions for penalties (e.g., in Byelorussia a fine for destruction of a Golden Eagle (*Aquila chrysaetos*) or White-tailed Sea Eagle (*Haliaeetus albicilla*) is rather high; up to 300 roubles, approximately $450), as well as special measures for protection. At present all species of falconiforms and strigiforms are granted protection in the Soviet Union.

One of the most important ways for conserving wildlife is creation of nature reserves which effectively protect raptor habitats. As of September 1979 there were 133 nature reserves (100,000 km^2) in all landscape zones of the Soviet Union. Of these more than 30 reserves were set up during the last ten years, with plans for the establishment of about 25 more in the next decade. At the same time national parks, nature parks, and temporary or seasonal reserves have been set up to provide additional habitat for wildlife protection. Nests of rare raptors are also protected. Within the reserves and in some local areas, ornithologists, ecologists, students, teachers, school children, bird watchers, members of local societies for nature conservation, and officers of forest and game management services are involved in location and protection of nests. In some districts (Vitebsk, Moscow, and others) rather effective campaigns are organized annually for locating and protecting nests of rare species.

Examples of local measures to improve raptor habitats include feeding of wintering eagles and nesting vultures, setting up artificial nesting platforms and boxes, and attempting to develop methods to prevent the death of large raptors at electrotransmission towers. These efforts are the result of activity by a few local enthusiasts; thus, their effect is limited and not well known. Our immediate task is to widely publicize such efforts and to introduce effective measures for improving raptor habitats on a national scale. There are few attempts to analyze and control contamination of birds (including raptors) and their habitats by pesticides.

At present two projects for captive breeding of birds of prey are being developed. One of them is located in Kirgizia; another will be established near Oka State Reserve in the Ryazan district of Russia. Within the framework of the USSR-USA Agreement on Cooperation in the Field of Environmental Protection, there is room for fruitful cooperation and further progress on methods of captive breeding.

Ornithologists and ecologists are doing their best to publicize information about the ecology of birds of prey, to create support for their protection, to prevent occasional killing of raptors and destruction of nests, and to reduce factors of disturbance, especially on nesting grounds. Mass media is used extensively for this purpose (e.g., magazines, newspapers, radio, TV, films).

An especially important source for identification of rare and endangered plants and animals is the *Red Data Book of the USSR* (Boradin 1978). Included in this book are 14 species of falconiforms: the Lammergeier (*Gypaetus barbatus*), Gyrfalcon (*Falco rusticolus*), and Barbary Falcon (*Falco pelegrinoides*) are designated endangered species; Steller's Sea Eagle (*Haliaeetus pelagicus*), White-tailed Sea Eagle (*Haliaeetus albicilla*), Pallas' Sea Eagle (*H. leucoryphus*), Himalayan Griffon (*Gyps himalayensis*), Golden Eagle (*Aquila chrysaetos*), Imperial Eagle (*Aquila heliaca*), Tawny Eagle (*A. rapax*), Short-toed Eagle (*Circaetus gallicus*), Osprey (*Pandion haliaetus*), Peregrine Falcon (*Falco peregrinus*), and the Saker Falcon (*F. cherrug*) are designated as rare species. Similar regional Red Data Books have been published (Kazakhstan, Moldavia) or are under preparation in the Union Republics.

Effectiveness of raptor conservation proved to be different for various ecological groups of raptors. Repeated surveys on the same areas over 10, 15, or 20 years of study, as well as a summary of many studies in various regions of the USSR, show trends of stabilization for the Buzzard (*Buteo buteo*), Honey Buzzard (*Pernis apivorus*), Hen Harrier (*Circus cyaneus*), Sparrowhawk (*Accipiter nisus*) and Hobby (*Falco subbuteo*). To some extent local increases of some common species are reported: Black Kite (*Milvus migrans*), Upland Buzzard (*Buteo hemilasius*), Montagu's (*Circus pygargus*), Pallid (*C. macrourus*), Pied (*C. melanoleucus*), and Marsh (*C. aeruginosus*) Harriers, European Kestrel (*Falco tinnunculus*), Merlin (*F. columbarius*), and Red-footed Falcon (*F. vespertinus*). Relaxation of pressure from direct persecution by man has proven favorable to populations of species listed above and perhaps to some other species. There is reason to believe their populations will continue increasing until reaching a stable level at which the ecological capacity of the habitat is attained.

Legislative protection is not as effective for many other falconiforms. Among these, practically all are large and rare birds of prey: Peregrine Falcon, Golden Eagle, Tawny Eagle, White-tailed Sea Eagle, Pallas' Sea Eagle, Lammergeier, vultures, griffons, Short-toed Eagle, and Osprey. This group is still under negative pressure from many factors. Most important among them are probably habitat changes, disturbance by people (tourists in particular), occasional shooting, nest destruction, pesticides encountered mostly at wintering places, and shortages of food.

To summarize, a strategy of raptor conservation began with the achievement of fundamental changes and further improvements in the legislative status of raptors. It proved to be effective for stabilizing or increasing about half the falconiform species in the USSR. Populations of these species make up about 80–90 percent of the total number of falconiforms in the country. This situation encourages scientific and conservation organizations (like the Institute for Conservation of Wildlife and many others) to concentrate their efforts for conservation and management on rare species of birds of prey in our country.

Acknowledgments

We wish to thank F. P. Ward and M. R. Fuller, colleagues in the USSR–USA Agreement on Cooperation in the Field of Environmental Protection, for reviewing this manuscript.

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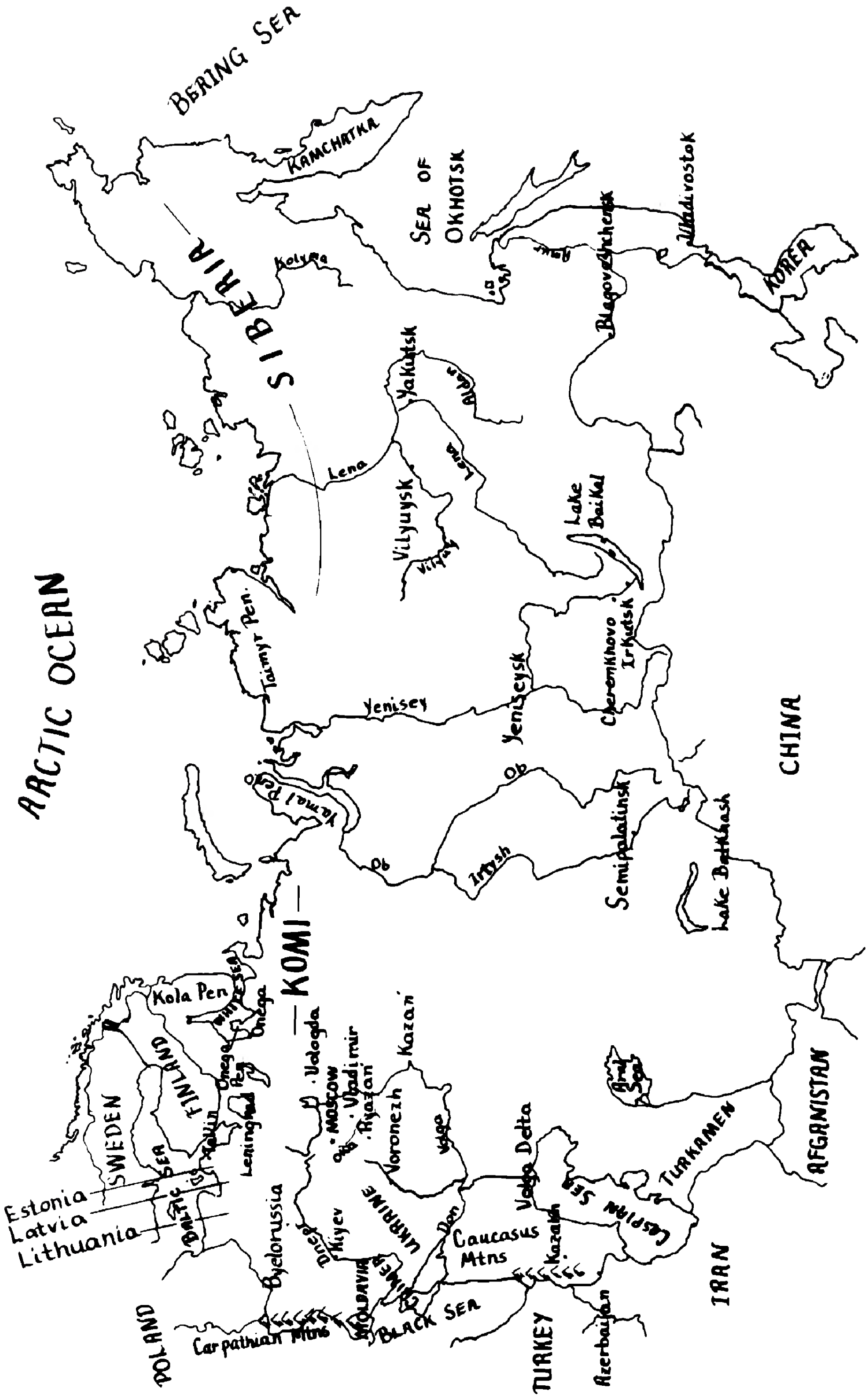
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CHANGES IN POPULATION STATUS AND NEST RANGE DISTRIBUTION OF FALCONIFORMS IN THE USSR SINCE 1950

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Introduction

A starting point to measure changes in nesting ranges of birds of prey during the last thirty years is volume 1 of *Birds of the Soviet Union* (Dement'ev and Gladkov 1951). Recent alteration of range configurations for most species is a result of more complete surveys of bird fauna in some regions (especially in the north and east). However, for some raptor species there are data to suggest real increases or decreases of nesting ranges. To estimate changes in populations, data from permanent or repeated surveys over 10–20 years on the same areas were collected (e.g., Galushin 1971).

Population estimates and range changes given below should be considered as preliminary. They are calculated for large regions on the basis of publications and accounts by many ornithologists: A. S. Malchevski and Yu. B. Pukinski (Leningrad district); I. A. Niefeldt (Karelia); E. V. Kumari and T. Randla (Estonia), G. R. Kasparson and J. Viksne (Latvia); A. M. Dorofeev, B. Z. Golodushko, V. V. Ivanovski (Byelorussia); V. M. Zubarovski, Yu. V. Kostin (Ukraine); Yu. V. Averin, I. M. Ganya (Moldavia); B. O. Geilikman, A. V. Abuladze, A. K. Unanyan (Caucasus); G. A. Krivonosov (Volga delta); V. A. Popov, S. G. Priklonski (Volga-Kama region); N. N. Danilov (Yamal); V. E. Flint, A. A. Kistchinski, Yu. V. Labutin, A. A. Vinokurov (northern Siberia); N. S. Pankin (middle Amur Valley); E. G. Lobkov (Kamchatka); A. K. Rustamov, A. N. Sukhinin (Turkmenia); I. A. Dolgushin, S. N. Varshavski, E. I. Gavrilov, G. V. Lindeman (Kazakhstan); V. M. Galushin (European center of the USSR, northern Vologda district, Onega peninsula); and many others.

Species Accounts

Osprey (*Pandion haliaetus*). In contrast with the data of Dement'ev and Gladkov (1951), there are doubts about its nesting south of the Caucasus. New nest records are needed to provide evidence of nesting in that area. In the southern part of the range, populations declined up to the beginning of the 1970s. At present some local populations continue to decrease, while others (mostly in the North) are more or less stable. Approximate numbers in various regions: European center of the USSR (about 270,000 km^2 around Moscow)—not more than 50 nesting pairs; Leningrad district, Estonia, and Latvia (altogether about 200,000 km^2)—approximately 50 pairs; Onega peninsula at White Sea (about 20,000 km^2)—approximately 120 pairs; Lower Volga—not less than 100 pairs; it is absent in the Crimea and Northern Caucasus. *Red Data Book of the USSR* status: rare.

Honey Buzzard (*Pernis apivorus*). Nests have been located north of previously known range limits (European USSR, south to western edge of Caspian Sea, east to Semipaletinsk, northwest to Ob' River). In recent years populations have been stable or slightly increasing. European center of the USSR—more than 4,000 pairs; Estonia—more than 100 pairs; northern Vologda district (approximately 10,000 km^2)—about 400 pairs. Crested Honey Buzzard (*Pernis ptilorhyncus* = race of *P. apivorus* in Brown and Amadon 1968). New nest records have been obtained west and northwest of previous limits of the range (eastern Siberia).

Red Kite (*Milvus milvus*). Nesting in Latvia and Lithuania is doubtful. No data are known of nesting in Caucasus. Data on numbers are scarce. The general range was from Estonia and Byelorussia south and west (Dement'ev and Gladkov 1951).

Black Kite (*Milvus migrans*). Recent northern range limits are a little north and northeast of previously known limits (south of the White Sea in the west, and south of the area just north of the junction of the Vilyuy, Lena, and Aldan Rivers in Siberia). It is the second most numerous raptor species (after Buzzard). European center of the USSR—about 7,000 pairs (some 30 percent of total raptor numbers); Estonia—20–30 pairs. Along valleys of large rivers the number is decreasing owing to disturbance by tourists, campers, and others.

Hen Harrier (*Circus cyaneus*). Both northern and southern range limits moved to the north (formerly north of Vilyuy River to mouth of Kolyma River in Siberia). In the European part of the USSR it occurs up to the coast of the Arctic Ocean. It is absent in the Crimea, Caucasus, and southwest of the Carpathian Mountains. Number fluctuates annually; however, some increase in isolated areas cannot be excluded.

Pallid Harrier (*Circus macrourus*). Some moving of range limits to the northwest (formerly south of near 55° north and east to Cheremkhovo) is possible, as well as a total increase in the population.

Montagu's Harrier (*Circus pygargus*). Northern range limits extended up to about 60°, i.e., 300–500 km north of Moscow and the junction of the Irtysh and Ob' Rivers in Siberia. Although the number fluctuates annually depending on food resources, it is possible some increase in the population has occurred in the last 5–10 years.

Pied Harrier (*Circus melanoleucus*). New breeding records are known north as well as northwest of the previously known range limits (Amur Region). Number fluctuates, but some total increase cannot be excluded for recent years.

Marsh Harrier (*Circus aeruginosus*). Number decreased before the end of the 1960s. Presently populations are relatively stable.

Goshawk (*Accipiter gentilis*). Populations declined noticeably before the end of the 1960s. At the present time populations are more or less stable. European center of the USSR—approximately 1,600 pairs.

Sparrowhawk (*Accipiter nisus*). Presently known northern range limits are about 100–200 km north of previously known range (south of a line from the mouth of Kolyma River in the northeast to the White Sea in the west). In the 1970s populations began to grow after a serious decline in the 1960s. European center of the USSR—more than 4,000 pairs; Estonia—about 800 pairs; northern Vologda district—some 600 pairs.

Lesser Sparrowhawk = Japanese Lesser Sparrowhawk (*Accipiter gularis*). New nesting records north of the formerly known range (southeast corner USSR). Numbers relatively stable.

Levant Sparrowhawk (*Accipiter brevipes*). One of the lesser-known species. Scarcity of reliable data on nesting is mostly due to difficulties with field identification. The nesting range is likely to have decreased everywhere (south of Voronezh), but south of Caucasus Mountains the species is not rare and even occurs in some parks and gardens.

Shikra (*Accipiter badius*). In Middle Asia it sometimes nests in towns and villages. Numbers relatively stable. (General range in USSR, southern Ukraine, and Caucasus Mountains).

Grey Frog Hawk (*Accipiter soloensis*). The first nesting was recorded in the USSR (near Vladivostok City, southeast corner USSR) in 1974.

Rough-legged Buzzard (*Buteo lagopus*). Number fluctuates in various areas annually. General range is south to approximately 61° N., but the species does not occur in all of this range. Reliable signs of decreases have not been noted.

Upland Buzzard (*Buteo hemilasius*). Near Blagoveshchensk City at Middle Amur River nesting is recorded 400–500 km northeast of former range limits. A summer record is noted also in southern Yakutia. Extension of the range is probable. Number is generally stable despite annual fluctuations.

Long-legged Buzzard (*Buteo rufinus*). Western limits of principal range retreated to the east; at present range limits are drawn through central areas north of the Caucasus Mountains. Single pairs nest in southeast Ukraine and Lower Don River. To the east of Volga the density is high in some areas.

Common Buzzard (*Buteo buteo*). Near northern limits of range, nests are found 200–300 km north and northeast of previously known limits (south of a line from Yakutsk to Yeniseysk and the White Sea). Some expansion to the northeast is likely to occur. The density is relatively high everywhere; usually it makes up 60 percent of the total number of birds of prey. In the middle 1960s numbers became stable; during recent years numbers have increased slowly in some places. European center of the USSR—up to 18,000 pairs; Estonia—more than 1,000 pairs; northern Vologda district—more than 1,000 pairs.

Grey-faced Buzzard Eagle (*Butastur indicus*). Changes in the nesting range (southeast corner USSR) or numbers are not known.

Short-toed (or Serpent) Eagle (*Circaetus gallicus*). Exceptionally rare in the European part of the range. However, in Middle Asia common and in some places numerous. *Red Data Book of the USSR* status: rare.

Booted Eagle (*Hieraaetus pennatus*). Some expansion of nesting range to the northwest, north, and northeast. Uncommon everywhere. Moldavia (about 35,000 km^2)—about 30 pairs. Data on nesting in southern Siberia are very scarce.

Bonelli's (or African Hawk) Eagle (*Hieraaetus fasciatus*). No reliable observations of nesting within the USSR for several decades.

Tawny (or Steppe) Eagle (*Aquila rapax*). Western limits of nesting range retreated to 800–1,000 km to the east for the last 20–30 years, namely, from Moldavia to central areas north of the Caucasus Mountains. Isolated pairs nest in Ukraine near Lower Dnepr' River (Askania Nova). Within a principal part of present range (southwest Siberia), it is common and even numerous in some places. *Red Data Book of the USSR* status: rare.

Greater Spotted Eagle (*Aquila clanga*). Some changes in the northwest part of range (as far north as 65° N across Siberia, active nests in Karelia) as well as in the eastern part (at Baikal Lake and even further east). In southern parts of range populations are decreasing. Leningrad district, Estonia and Latvia together—about 30–40 pairs; northern Byelorussia (about 40,000 km^2)—20–30 pairs; Moldavia—12–15 pairs.

Lesser Spotted Eagle (*Aquila pomarina*). Eastern range limits are not clear because in the field it is practically impossible to distinguish from *A. clanga*. Estonia and Latvia (together about 110,000 km^2)—more than 100 pairs, and the population is relatively stable; Moldavia—approximately 20 pairs.

Imperial Eagle (*Aquila heliaca*). Northern limits (Ukraine) retreated 200–300 km to the south. In the western part of range number is decreasing; in the eastern part (to Lake Baikal area), more or less common. *Red Data Book of the USSR* status: rare.

Golden Eagle (*Aquila chrysaetos*). Southern range limits (approximately 50°N) in the European part of USSR retreated 300–500 km to the north, but it is difficult to draw them precisely owing to exceptional scarcity of the species there. At present it is not likely to nest south of a line from Kiev to Moscow to Kazan. It is very rare almost everywhere except in some regions (northern taiga, northeastern Siberia, southern ridges). Onega peninsula—approximately 30 pairs; northern Byelorussia—8 pairs; Estonia—12 pairs; Latvia—2 pairs; Moldavia—1 pair. In most parts of range, populations are still decreasing. *Red Data Book of the USSR* status: rare.

Pallas' Sea Eagle (*Haliaeetus leucoryphus*). Last reliable records of nesting were obtained 20–30 years ago. Occurrence of young birds suggests species is breeding in the USSR, but the range is spotty (Kazakh and south). *Red Data Book of USSR* status: rare.

White-tailed Sea Eagle (*Haliaeetus albicilla*). The range (all across northern USSR up to 75°N) in the south consists of some narrow belts along large rivers. Nesting in the Crimea, southern Ukraine, and northern Caucasus is not noted. Numbers were definitely decreasing up to the beginning of the 1970s. At present in some parts of the range this decline continues; in other areas populations are relatively stable. Southern Yamal (about 30,000 km^2)—40–60 pairs; Volga delta—about 150 pairs; Oka Valley within Ryazan district (approximately 500 km^2)—2 pairs; Estonia—10–12 pairs; Latvia (65,000 km^2)—1–2 pairs; Moldavia—5 pairs. *Red Data Book of the USSR* status: rare.

Lammergeier (or Bearded Vulture) (*Gypaetus barbatus*). Populations are likely continuing to decline. Caucasus—about 10 pairs; in Middle Asia it occurs rarely. *Red Data Book of the USSR* status: endangered.

Egyptian Vulture (*Neophron percnopterus*). Number is decreasing. The range is spotty: Moldavia—about 5 pairs; Crimea—2–3 pairs; Caucasus—no less than 30 pairs; in Middle Asia numbers not known.

Griffon Vulture (*Gyps fulvus*). Populations are declining everywhere because of disturbance at nesting sites and lack of food. Crimea—about 10 pairs; Caucasus—probably less than 100 pairs; in Middle Asian mountains numbers not known.

Himalayan Griffon (*Gyps himalayensis*). Nesting records are practically absent. *Red Data Book of the USSR* status: rare.

Black Vulture (*Aegypius monachus*). Number decreases steadily. The range is spotty. Disappeared from Moldavis; Crimea—about 5 pairs; Caucasus—50–80 pairs. *Red Data Book of the USSR* status: rare.

Gyrfalcon (Falco rusticolus). Exceptionally rare in the European part of the USSR. Number is probably continuing to decrease although some former nesting territories are being used on the eastern Kola Peninsula during recent years. In eastern Siberia it occurs infrequently: southern Yamal—15–20 pairs. *Red Data Book of the USSR* status: endangered.

Saker Falcon (*Falco cherrug*). Some nesting records are obtained north of formerly known range limits (approximately 60°N across Siberia). In the western part of the range it is rare (Moldavia—about 20 pairs) but in some eastern regions, numerous. *Red Data Book of the USSR* status: rare.

Lanner Falcon (*Falco biarmicus*). The only active nest of the species in the USSR was found in the summer of 1949 in southeastern Azerbaijan.

Peregrine Falcon (*Falco peregrinus*). Exceptionally rare everywhere but on the tundra. Within the forest zone nesting records are isolated; it does not nest in the forest-steppe or steppe. It probably remains in the Crimea and Caucasus. By the beginning of the 1970s Peregrines disappeared from Estonia and Latvia. Population decreases occurred everywhere. During the last 2–3 years in some isolated areas (for instance, the Taimyr Peninsula) a trend of reoccupation of some deserted territories has begun. Central Taimyr (500 km^2)—8 pairs; Yamal (some 120,000 km^2)—100–200 pairs. *Red Data Book of the USSR* status: rare.

Barbary Falcon (*Falco pelegrinoides*, treated as subspecies of *F. peregrinus* by Brown and Amadon 1968). Extremely rare in Middle Asian mountains where approximately 50 pairs nest.

Hobby (*Falco subbuteo*). Numbers began to stabilize at the end of the 1960s. At present, numbers increasing in some regions. European center of the USSR—some 2,500 pairs; Estonia—about 500 pairs; northern Vologda district—not less than 600 pairs.

Merlin (*Falco columbarius*). Populations are stable or slightly increasing. A rather high density in the forest-tundra zone along railways as well as near settlements where crow nests are abundant. In the vicinity of the railway station at Sivaya Maska (northeastern Komi ASSR), there are up to 5–6 pairs per 10 km^2. It is scarce in the forest zone and Kazakhstan steppe region.

Kestrel (*Falco tinnuculus*). Nests are observed 200–500 km north and northeast of formerly known range limits (south of approximately 60°). Some true range expansion is likely beyond the normal fluctuations which occur in accordance with food supply. In the forest zone it is rather scarce and sporadic. In the forest-steppe, common. Populations declined up to the beginning of the 1970s, but at present there are some signs of population stability. Kestrels often nest in parks and suburban forests. European center of the USSR—about 3,500 pairs.

Lesser Kestrel (*Falco naumanni*). Northern limits are likely to have moved 100–200 km to the south (from former range line across southern Poland to 49° N in the Ukraine, to 55° N in central Siberia). At the same time there are some nesting records west of previously drawn range limits into Europe.

American Kestrel (*Falco sparverius*). New species in avifauna for the USSR. The only known case was collected in the summer of 1963 near Talin (Estonia). It is possible that the bird was freed from a cage.

Red-footed Falcon (*Falco vespertinus*). Range limits expanded a little to the northwest, north, east, and southeast. (Former range limits approximately from the White Sea west to Vilyuysk in the north, and from the north shores of the Black and Caspian Seas west to Irkutsk). Distribution is sporadic. Number fluctuates annually. In some areas slight increases are likely occurring.

Amur Red-footed Falcon (*Falco amurensis*) (treated as subspecies of *F. vespertinus* by Brown and Amadon 1968). There are nesting records north and west of previously known range limits (from the southern tip of Lake Baikal west toward the Amur River). It is numerous in some areas.

Discussion

Analysis of the above sketches shows an absence of a general trend in population and range changes common to all raptor species. In contrast, 15–20 years ago a decline in populations of the great majority of raptor species was obvious. The main event which prevented a further decrease of raptor populations was legislation approved in the mid-1960s which banned mass destruction of raptors and provided full protection for all species of falconiforms and strigiforms. However, the effectiveness of this important legislative measure turned out to be different for various groups of falconiforms.

Stability and population increases have occurred in some common raptor populations: Buzzard, Honey Buzzard, Hen Harrier, Sparrowhawk, Hobby; in isolated areas a trend toward stability has been noted for populations of Black Kite; Crested Honey Buzzard; Montagu's, Pallid, Pied, and Marsh Harriers; Long-legged Buzzard, Upland Buzzard, Rough-legged Buzzard; Lesser Sparrowhawk; Shikra; Goshawk; Merlin; Kestrel; Red-footed Falcon; and Amur Red-footed Falcon. For these species persecution by man was probably the main cause of population declines. Therefore, removal of this pressure allowed populations to stabilize and even increase in areas where suitable habitat was available and where raptor populations were not unduly influenced by other limiting factors.

The group of raptors whose populations are increasing includes those species which normally are the most numerous. For instance, at a study area in Vladimir district (175 km west of Moscow) the total number of all nesting raptors increased an average of 18 percent between 1973 and 1975 compared to the level in 1963–1965. This total increase was due mostly to greater abundance of common species such as Buzzard, Kestrel, Sparrowhawk, and Honey Buzzard. A similar situation was noted in the western part of the Moscow district, i.e., a 50 percent increase in raptor numbers of that area was primarily due to larger populations of Kestrels and Sparrowhawks. In the Oka Nature Reserve and its vicinity (Ryazan district) the total number of birds of prey in 1977 turned out to be practically the same as 20 years ago (there was an increase of about 5 percent). High stability is evidence of suitability of these raptor populations to the ecological capacity of habitats on the reserve as well as protection of the entire complex. It is important to note that all three rare species, the White-tailed Sea Eagle, Short-toed Eagle, and Osprey have remained nesting there over the last 20 years.

Unfortunately, quite an opposite situation is observed in populations of many large raptors outside the reserves. The populations of the Peregrine Falcon, Golden Eagle, Tawny Eagle, Imperial Eagle, Spotted Eagle, White-tailed Sea Eagle, Pallas' Sea Eagle, Lammergeier, Egyptian Vulture, Griffon Vulture, Black Vulture, Short-toed Eagle, Osprey, and others, as a rule, have continued to decline. For these species not only direct persecution but some other negative factors influence population stability: reduction of nesting habitats, disturbance, pesticide influence (mostly at wintering places), shortage of food, etc. Additionally, populations of some raptor species probably became so reduced that their management demands special measures, such as protection of individual nests, setting up of artificial platforms, feeding, and captive breeding.

For some rare species (Pallas' Sea Eagle, Himalayan Vulture, Bonelli's Eagle, Levant Sparrowhawk, Red Kite, Barbary Falcon, and Gyrfalcon) we lack reliable facts to appraise properly recent trends and the real status of their populations. Fourteen species of falconiforms are listed in the *Red Data Book of the USSR* as rare or endangered. However, recent data are likely to produce some changes in the status of species listed in the second edition of the *Red Data Book of the USSR*. There seem to be sufficient grounds to include, for example, Levant Sparrowhawk and Bonelli's Eagle, and exclude

Tawny Eagle and Saker Falcon populations which are estimated to include thousands of nesting pairs.

Summary

In the USSR some expansion of the nesting range of ten species is indicated: Kestrel; Red-footed Falcon; Hen, Pallid, Montagu's and Pied Harriers; Black Kite; Buzzard, Upland Buzzard; and Booted Eagle.

Shrinking of ranges is more or less proven for 12 species: Lanner and Peregrine Falcon; Red Kite; Griffon and Black Vulture; White-tailed and Sea Eagle; Pallas's Sea Eagle; Levant Sparrowhawk; Long-legged Buzzard; Golden, Imperial, and Tawny Eagle.

For some species new records gave a more precise picture of previously known limits of nesting range: Osprey, Honey and Crested Honey Buzzard, Sparrowhawk, Lesser Sparrowhawk, Spotted Eagle, Saker Falcon, Lesser Kestrel, and Amur Red-footed Falcon.

Either range limits of other falconiforms have not changed, or we do not have enough comparative data to measure such changes.

Acknowledgments

We wish to thank all those who have contributed population, nesting, and ecological data. M. R. Fuller and F. P. Ward, my colleagues in the USSR–U.S. Agreement on Cooperation in the Field of Environmental Protection reviewed this paper. J. Partelow prepared the map.

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CRITERIA FOR GOLDEN EAGLE, FERRUGINOUS HAWK, AND PRAIRIE FALCON NEST SITE PROTECTION*

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Abstract

Establishment of buffer zones around raptor nest sites has become an important management tool in areas undergoing energy development or increasing recreational pressure. We conducted a survey of field researchers who had distributed Golden Eagle, Ferruginous Hawk, and Prairie Falcon during their research. Bases for and limitations of the use of buffer zones to protect nesting raptors are discussed.

Introduction

Energy development and other human activities can diminish raptor populations by altering habitat and by disturbing nesting activities. Disturbance of nesting raptors can result in complete desertion of nests, eggs, or young. Temporary departure by adults can cause overheating, chilling, or desiccation of eggs or young, predation on eggs or young, or missed feedings. Three studies of the Golden Eagle (*Aquila chrysaëtos*) found that 46, 71, and 85 percent of nesting failures were due to human disturbance (Boeker and Ray 1971, Camenzind 1969, D'Ostilio 1954). The effects of such disturbance range from loss of a year's reproduction to long-term loss of the nest site if the disturbance is chronic. Raptor researchers found that by disturbing birds they can jeopardize the reproductive activity being studied (Fyfe and Olendorff 1976).

Concern over disturbance has resulted in the establishment of spatial or temporal buffers (restriction of activity within an area or period of time) between some energy developments and raptor nest sites. Geothermal development proposals for sites in Utah and Idaho resulted in recommendations for buffers by federal agencies (ERDA 1977, Fisher 1978, USGS 1977). Buffer zones were established to protect raptor nest sites along the Trans-Alaska pipeline (Olendorff and Zeedyk 1978) and were recommended for the proposed Mackenzie gas pipeline (Jacobson 1974). These recommendations were based primarily on the experience of the individuals involved because of the absence of a body of literature on responses of the birds to these disturbances or any consensus of the raptor research community concerning control of disturbance. This study summarizes and expands the bases for such decisions relative to the Golden Eagle, Ferruginous Hawk (*Buteo regalis*), and Prairie Falcon (*Falco mexicanus*).

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Methods

Raptor field research usually involves some disturbance and often allows observation of the effects of other sources of disturbance. Unfortunately, these observations are not routinely reported. To get information, a survey form (table 1, shown with results) was sent to 74 appropriate raptor researchers; a second copy was sent to nonrespondents 2 months later. Questions were framed in terms of the level of disturbance that would elicit a reaction from 20 percent of nesting birds. This criterion was used to avoid the high variance associated with estimates of the reaction of a hypothetical, most sensitive bird. Because the Golden Eagle, Ferruginous Hawk, and Prairie Falcon are not classified as threatened or endangered, protection need not be absolute. These species were chosen because they are the most sensitive raptor species with which western developments will frequently conflict.

Because some survey returns indicated that the use of buffer zones is controversial, a workshop on raptor disturbance was conducted at the 1978 Raptor Research Foundation meeting. While the large attendance and short duration of this workshop prevented the formulation of a consensus, the issues were clearly defined and are discussed below.

Results

Twenty-four surveys were completed and returned with numerical information; 6 additional respondents provided only comments. Numerical results are summarized in table 1. Since the distribution of responses to each question was positively skewed, the median provides the best measure of central tendency. The median is also more useful than the mean because it represents a central or typical response rather than the average magnitude of responses. Median reaction distances were lowest for the Prairie Falcon and highest for the Ferruginous Hawk, but most of the differences between species were not statistically significant.

Factors other than distance and stage in the breeding cycle that were thought to be important in determining the response to a particular disturbance by more than one respondent were existence of a clear line of sight, security of the nest, history of disturbance to which the birds have been exposed, elevation of the disturbance relative to the nest, and whether the birds were the focus of attention. Recommended buffer zones for these species found in the literature or received in response to the surveys are presented in table 2.

Discussion

The objection to nest-site protection most frequently raised at the workshop was that the entire habitat must be protected. If this were necessary, raptors would be absent from areas supporting any human activity. The habitat factors requiring protection are those that limit the population size or that may become limiting as a result of development. Olendorff and Stoddard (1974) found that nest-site availability apparently limits raptor poulations in northeastern Colorado and southeastern Washington. Edwards (1969) found that Golden Eagle density was limited by nest-site availability in western Utah, and Boeker and Ray (1971) found the same to be true for the Southwest in general. Smith and Murphy (1978) attribute the low nesting density of Ferruginous Hawks primarily to nest-site limitations. This is likely to be the case in much of the arid and semiarid west when a sufficiently large area is considered because prey habitat is abundant relative to nesting habitat. Golden Eagles and Prairie Falcons typically require cliff

Table 2. Recommended Buffer Zones for Golden Eagle, Ferruginous Hawk, or Prairie Falcon Nest Sites.

Distance	Species	Development type	Restriction	Source
1 km (0.6 mile)	Golden Eagle Prairie Falcon	Geothermal drilling	No drilling	ERDA 1977
0.5 mile (0.8 km) all year and 1 mile (1.6 km) March 1–July 15	Ferruginous Hawk	Geothermal drilling	No surface disturbance	Fisher 1978
1 mile (1.6 km)	All eagles	Pipeline		Olendorff and Zeedyk 1978
2 miles (3.2 km) all year	Golden Eagle	Pipeline	No construction	Jacobson 1974
2 miles (3.2 km) March 1–Sept. 1	Golden Eagle	Pipeline	No ground activity	Jacobson 1974
0.25–0.5 mile (0.4–0.8 km)	Golden Eagle	General		M. R. Fuller[a]
200–500 m	All three species	General		N. Woffinden[a]
0.5 mile (0.8 km)	Grassland raptors	General		R. P. Howard[a]
1 mile (1.6 km) line of sight	Golden Eagle	General		R. P. Howard[a]

[a]Suggestions received in response to the raptor disturbance survey.

sites. Ferruginous Hawks are more versatile, but most require a tree or rock outcropping. This use of elevated nest sites contrasts sharply with the open-land hunting habit of these species. The importance of nest sites is confirmed by Fyfe and Armbruster's (1976) and Anderson and Follet's (1978) success in increasing the productivity of Prairie Falcons and Ferruginous Hawks, respectively, by nest-site creation and manipulation (see also Howard and Hilliard 1980, White 1974).

Nest-site protection is only advantageous if the prey base remains adequate following development. Many types of development such as oil, gas, and geothermal exploitation, pipeline and road construction, and development of campgrounds and interpretive facilities on public lands remove vegetation from small areas. If important prey concentrations such as ground squirrel colonies are avoided, raptors should be able to coexist with these developments provided nesting sites are undisturbed. The responses to survey question 5 indicate that development should be kept at least 400 m from such prey concentrations.

Another objection to nest-site protection was that disturbance might occur because of the establishment of buffer zones. This disturbance could be caused by irate supporters of the development that would be restricted or by nest robbers, varmint shooters, amateur naturalists, or photographers who are attracted to identified nest sites. The location of nest sites should be revealed only to those who are directly involved in facility siting. Developers should be reminded that the nest site, not the individual birds, is being protected. Shooting the birds would not eliminate the need to restrict development near the site.

General suggestions for buffer zone sizes can be made on the basis of survey responses. To avoid thermal stress to eggs or young, activities such as geological, biological, or soil surveys that are performed intermittently by a few individuals should be kept at least 500 m from active nest sites or limited to a few minutes and periods of moderate temperature. Construction and similar noisy, extended activities should be kept at least 1 km from nest sites to avoid nest abandonment. At this distance, nesting birds are also out of rifle range and are relatively inconspicuous to users of new roads or other facilities. These suggested distances lie within the range of buffer zone sizes listed in table 2. They are not absolute and should be modified by knowledgeable individuals to fit the circumstances of the project and nest site. Knowledgeable advice is also necessary to determine if buffer zones are the appropriate management tool for the circumstances.

Temporal buffers may supplement or be used in place of spatial buffers. Temporal buffers should include all nesting activities but must at least extend from the time of arrival of the adult birds in the nesting area through the first few weeks of nestling development (see Call 1978 for average dates). After this time young are increasingly able to thermoregulate, and adults are reluctant to abandon them. Activity close to the nest (within flushing distance) must wait until fledging is completed and young are independent of the nest area. The use of temporal buffers depends on the ability to schedule activities on an annual basis.

A second alternative to spatial buffers around existing nest sites is the construction of artificial nesting sites. This technique was reviewed by Olendorff and Stoddard (1974) as a method to introduce raptors into unused grassland. The disadvantages of artificial sites as a mitigation technique are that they may not always prove acceptable to the displaced species, they may attract the "wrong" species, and they are typically more conspicuous than natural sites.

Further support for raptor preservation must be provided by field research. One approach is to experimentally disturb nesting birds (White et al. 1979). This type of research is limited by the ability to realistically simulate development activities and by the small number of pairs available. The most valuable information will come from the monitoring of responses to real developments and observation of the distribution of active nests relative to ongoing human activities. These observations should appear more frequently in the literature.

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Table 1. Responses to the raptor disturbance survey (distances in meters).

Question	Golden Eagle			Ferruginous Hawk			Prairie Falcon		
	Med	Range	n	Med	Range	n	Med	Range	n
1. At what distance would an individual or small group of people approaching a nest cause 20% of sitting birds of each species listed to flush from the nest during the following periods?									
a. laying	160	15-1073	16	275	91-1609	17	166	15-1609	14
b. incubation	100	15-805	17	274	5-805	18	91	15-402	15
c. rearing young	333	15-1609	16	337	75-1609	18	250	15-610	15
2. At what distance would extended activities involving several persons and approximately 90 dBA noise, e.g., drilling or earth moving, cause abandonment of the nest by 20% of individuals of each species during the following periods?									
a. nest construction	550	250-4023	16	902	300-3218	15	366	61-1609	13
b. laying	478	250-4023	16	600	105-3218	16	400	61-1609	15
c. incubation	402	150-1609	15	451	100-1609	16	366	30-1295	15
d. rearing young	383	100-1609	16	333	30-1609	16	274	30-805	15
3. At what distance would a noisy									

species listed to flush from a nest during the following periods?									
a. laying	183	30-2414	15	402	91-3218	16	191	30-1609	14
b. incubation	187	30-2414	16	366	25-1609	15	126	25-805	14
c. rearing young	350	30-2414	15	384	75-1609	14	183	30-805	14
4. At what distance would frequent (1 per hour) noisy off-road vehicles cause abandonment of the nest by 20% of the individuals of each species during the following periods?									
a. nest construction	457	91-5632	15	500	91-3218	14	274	91-1407	11
b. laying	457	91-2414	15	451	75-1609	14	201	46-1609	13
c. incubation	402	91-2414	15	383	75-1609	14	200	46-805	13
d. rearing young	200	50-2414	15	250	25-1609	14	200	30-805	13
5. Within what distance of an activity involving several people and large equipment would at least 80% of the members of each species hunt and kill prey?	400	30-3218	15	402	30-3218	17	320	30-1609	13
6. What factors, other than distance and stage in the breeding cycle, do you believe are important in determining the probability that a particular activity will cause a bird of the above species to temporarily or permanently abandon a nest site?					(See text)				

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MARSH HAWK RETRIEVES YOUNG TO THE NEST

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Abstract

Semialtricial Harrier chicks frequently crawl from the nest into surrounding vegetation. A Marsh Hawk female was seen to retrieve 3 of her chicks to the nest. Records of raptors, including Harriers, eating dead chicks or feeding them to siblings are frequent. When a raptor encounters its chicks away from the nest, how does it distinguish them from prey? A breakdown in behavior between parents and their chicks has been suggested as a possible cause of kronism or progenicide in Herring Gulls and Double-crested Cormorants. Attack or predatory responses may be inhibited and retrieving behavior evoked by the color and doddering movements of Harrier chicks.

Introduction

Nice (1962) listed Harriers (*Circus* sp.) as having semialtricial young. Brown (1976) reported that chicks of the three British species of breeding Harriers may leave the nest at an early age and move temporarily into the surrounding vegetation. Brown and Amadon (1968) in their account of *Circus cyaneus* stated that from 2 weeks onward, the young creep out of the nest and hide in the vegetation near it, returning when the female arrives with food. Frances Hamerstrom (in litt.) wrote that North American Marsh Hawk (*Circus cyaneus hudsonius*) chicks commonly crawled away from the nest into the grass, but she presumed that they returned by themselves.

Von Frisch (1966) described how a female Montagu's Harrier (*Circus pygargus*) picked up a 3-day-old chick by the neck and carried it back to the nest from which it had crawled. He was able to film this behavior the next day after placing a chick 70 cm from the nest.

Observations

On 9 June 1979, I placed a blind at a nest of a Marsh Hawk near Anten Mills (44°29′N, 79°50′W), Simcoe County, Ontario. On 16 June at 0915, I entered the blind to watch and photograph the birds. One chick was at least 10 days old, having hatched before 7 June, a second had hatched by 9 June, and 3 more by 14 June. The youngest were therefore less than 7 days old. Their first pale cinnamon coat of down had either faded or had molted, and they had lost the dark eye ring present at hatching. They were still feeble and with many pauses crawled from the nest into the shade of the surrounding vegetation. At 1042 the female landed on a cedar about 1 m above the ground, and at 1048 she settled on the nest. Almost immediately 2 of the chicks crawled back to the nest and pushed under her. After 15 minutes, she stood up, moved about 60 cm and, with her beak, picked up a chick by the down and perhaps skin of the upper neck, turned and carried it to the nest and dropped it. About 20 minutes later she again left the nest and picked up a chick (figure 1) about 45 cm away, turned back to the nest and dropped it. The movements were slow and deliberate taking about 20 seconds from first grasping the chick to dropping it in the nest. At 1143 she again moved about 30 cm behind the nest, picked up the fifth chick by a leg, turned and dropped it into the nest. All three chicks which she carried protested this treatment with chittering calls, but subsequent examination did not reveal any injury. All survived until at least 1 July, but by 9 July they had been killed by an unknown predator.

Discussion

Parental carrying of young to a nest or den is very common in mammals particularly among carnivores and rodents. Instances of birds carrying young have been rarely witnessed except among some waders. In raptors von Frisch (1966) cites Holstein's report in Makatsch (1959, not seen) of a Goshawk (*Accipiter gentilis*) which carried its young to another nest after disturbance.

Raptors seize their mammal and bird prey with their feet before the beak is used to kill and often decapitate it. The Harriers discussed here picked up their chicks with their beaks which suggests a pattern not derived from hunting behavior. Its basis may have stemmed from nest-building behavior, for Brown and Amadon (1968) have reported that the Hen Harrier (*Circus c. cyaneus*) brings nest material to the nest in both the beak and feet.

The question arises, How does a parent raptor distinguish its poorly developed chicks from prey when it encounters them away from the nest? Such a question seldom arises in arboreal or cliff nesters, but is a valid question for ground-nesting species such as the Harriers. This question is particularly pertinent in the light of Brown and Amadon's (1968) generalized statement that an adult female (raptor), finding a dead chick in the nest, is likely to feed the carcass to the remaining young or possibly eat it herself. Balfour and Macdonald (1970) specifically reported a case of an adult female Hen Harrier which carried off a dead chick, brought it back decapitated, and fed it to the brood.

Brown (1976) also states that the Sparrowhawk (*Accipiter nisus*) is to a degree a cannibal on its own young. He does not, however, discuss the circumstances.

The mechanisms involved in preventing predators from killing and eating their own young occasionally break down. Parsons (1971) reported 15 cases of kronism among 747 pairs of Herring Gull (*Larus argentatus*) in which parents killed and ate one of their brood. He also describes extensive cannibalism in this colony in which certain pairs preyed upon the young of other pairs. He suggested that kronism may be due to a breakdown in the behavior between adults and their chicks rather than to a response to food shortage. This suggests the existence of, and breakdown of, an inhibiting mechanism.

Siegel-Causey (1980) recorded that out of 56 Double-crested Cormorant (*Phalacrocorax auritus*) chicks which died in the colony he studied, 16 were killed by parental attack. They were, however, not eaten; some were incorporated in the nest material. He speculated that parental inexperience and aberrant chick behavior may have been responsible.

A description of a mechanism which inhibits attack by a parent on her chicks has been documented by Schleidt et al. (1960) in domestic Turkeys (*Meleagris gallopavo*). They found that the peeping calls of newly hatched chicks appeared to inhibit attack by normal hens which attacked silent golden hamsters placed near the nest. Artificially deafened hens attacked chicks and hamsters indiscriminately.

Many raptors vigorously defend the vicinity of the nest from intruders. It seems likely that attack behavior by parent Harriers was either inhibited by the appearance of the chick or was not released because the movements and behavior of the chick were not appropriate.

Marsh Hawks prey on a variety of mammals and birds, including the juvenile young of precocial species such as pheasants and domestic poultry (Breckenridge 1935), which are similar in size to Marsh Hawk chicks at the age when they first crawl from the nest. However, the cryptic coloration of these species is very different from the pale, unspotted down plumages of Harrier chicks.

Räber (1950) found in simulation experiments with Tawny Owls (*Strix aluco*) that dummies of small mammals were not seized unless they had legs and moved in a particular manner. The total configuration of mammal prey was important in releasing Tawny Owl predatory behavior. It is possible that a similar mechanism is present in Harriers.

Small Harrier chicks seem to have heads too heavy for their necks, they shuffle on their tarsi, and their movements can best be described as doddering and quite unlike the movements of potential prey. There is a possibility that the color of Harrier chicks and/or their characteristic movements may release the retrieving behavior observed. This behavior in Harriers, when their chicks are small, is certainly adaptive and probably normal. It has seldom been observed because the period during which it takes place is short, and Harriers are not easy to watch at the nest.

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Figure 1. A Marsh Hawk carrying her chick back to the nest.

KESTREL ROBBING BARN OWL

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At approximately 10:30 hours on 30 January 1971, while walking along a lane close to Loch Ken, Dumfries, F. Oates and I saw a male Kestrel (*Falco tinnunculus*) sitting on the apex of a chicken coop in the centre of a small field. It was uttering a very excited chatter: "Kee-kee-kee." Suddenly, a Barn Owl (*Tyto alba*) flew out of the coop carrying a small rodent toward an old barn. The Kestrel gave chase and attacked the owl from behind; it grabbed the rodent and appeared to be "back-pedalling" frantically, trying to take it from the owl. The latter continued flying, dragging behind it the Kestrel, which was still hanging on to the rodent when the owl disappeared into the barn. Neither bird was seen for half an hour; then the Kestrel was seen preening in the top of a tree. In the afternoon, we revisited the area and again saw the Barn Owl quartering the same field, at times only 4 m from us. It dropped into the grass twice, but did not appear to catch anything; on a third occasion it caught a large rodent and mantled it in the grass. Within seconds, the Kestrel arrived apparently from nowhere, and landed on the owl's back. The two rolled over in the grass, fighting for the prey; the falcon managed to take it and flew off over the valley. The Barn Owl lay in the grass for about a minute, with its beak open and wings spread, and then resumed hunting. When it next caught a small rodent, it swallowed it almost immediately.

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MOBBING RESPONSES OF SOME PASSERINES TO THE CALLS AND LOCATION OF THE SCREECH OWL

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Abstract

Tests using 12 nest/roost locations of the Screech Owl (*Otus asio*) and 12 non-nest/non-roost locations in a five-county area of Piedmont North Carolina showed that passerine birds recognize the call of Screech Owls, associate an owl's call with its likely location, and remember the location. Passerines mobbed a speaker playing recordings of Screech Owl calls in non-nest/non-roost locations, but playbacks of calls stimulated orientation not to the speaker but to the nest/roost in known owl locations. In all nest/roost locations, the first bird to respond oriented to the owl cavity. The results suggest that a function of mobbing is to gain information about the predator. Mobbing may have evolved from the fight-flight conflict during encounters with predators into a social display communicating presence and location of a predator.

Introduction

Passerines often mob predators in the wild (Dodsworth 1910, Lorenz 1938, Rand 1941), and owls are the most frequent object of this behavior (Hinde 1966). Bangs (1930), Bent (1938), and Pearson et al. (1959) observed that the Screech Owl is often the focus of mobbing by song birds in North America, especially during the nesting season. The Screech Owl is an opportunistic predator, often taking passerines as a main source of food for its young (Allen 1924, Stewart 1969). Since the nesting season of the Screech Owl coincides with the migration of song birds, the owl has a ready supply of food for its offspring (VanCamp and Henny 1975). This is probably the reason Screech Owls are frequently mobbed.

Visual characters that release mobbing in birds have been studied by Hartley (1950), Hinde (1954), Kruuk (1976), and Smith and Graves (1978). Hamerstrom (1957) found that a fed hawk was mobbed less than a hungry one, suggesting that even subtle visual cues of the physiological state of a predator may have an effect on mobbing song birds.

Auditory cues of predators have been largely ignored in studies of mobbing behavior. Miller (1952) mentioned that prey animals can recognize predators by auditory cues alone. He found that whistled imitations of different predator calls evoked mobbing in passerines.

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While censusing birds with a recording of Screech Owl calls, we observed passerines mobbing a tree cavity located a considerable distance from the source of sound. Here we present results of our tests of the hypotheses that passerines can (1) recognize specific predatory species by calls alone, (2) associate a predator's call with its likely location, and (3) remember the location of the predator. If these hypotheses are true, our understanding of the functions of mobbing in birds could be greatly enhanced. The ability of prey to remember a past location of a predator might give a better understanding of how mobbing behavior has evolved.

Material and Methods

Our study was conducted in a five-county (Lincoln, Catawba, Iredell, Mecklenburg, and Union) area of Piedmont North Carolina. Tests were conducted during daylight from August 1976 to May 1977 in order to obtain data on migrating passerines, permanent residents, winter residents, and nesting birds.

A recording of an Eastern Screech Owl, taken from Wetmore (1965), was duplicated off a master reel onto a cassette tape. Five minutes of continuous Screech Owl calls were given at an average rate of 19 calls per minute. The calls were a series of quavering notes of two types. The first were descending in pitch and the second were a series of monotone notes (Robbins et al. 1966).

A portable cassette player was used for playback. The volume output of the speaker was set uniformly at 87 dB at 1 m using a Sound Level Meter, Model 101-A, manufactured by Advanced Acoustical Research Corporation. At several locations the Sound Level Meter was used to check for uniformity of sound level in the field, and no significant variation was found. To assure that the observer did not affect the behavior of mobbing birds, a portable blind (see LeCroy 1975) was used. A pair of binoculars (7 × 35) aided in the identification of the mobbing passerines.

Our study consisted of 24 tests conducted in two situations. The first was at known nests or roosts of Screech Owls designated "P" ("P" = Screech Owl present). The second situation, which served as the control, was where Screech Owls did not nest or roost. Non-owl areas were designated "O" ("O" = no Screech Owls present). All "P" and "O" tests were matched according to similar habitat, season, time, and weather conditions.

A roost location was one in which an adult Screech Owl perched during daylight hours. Screech Owls use old nest cavities as roosting sites during fall and winter (VanCamp and Henny 1975). Where we had no knowledge of nesting in the location, it was defined as a roosting site. A known nest location was defined as a cavity in which active nesting was observed. A cavity that was used as a nest site by a pair of Screech Owls and later abandoned was defined as a nest location.

Nests were reported to us or found by using the call-back method. At nest locations, owls apparently cannot resist calling back to recordings regardless of the time of day. The call-back method was productive since Screech Owls tend to be highly territorial except during December and January (Hough 1960). If calling was heard, we searched the area for a cavity tree. Roost sites were found by hearing owls call from a location and finding the owl at that location on more than two consecutive occasions.

Tests were conducted in 12 "P" locations. After defining an area as "P", we waited at least 24 hours before performing the test. The cassette recorder was placed on the ground 15 m from the nest or roost tree in a direction that afforded the passerines a perching place less than 5 m from the speaker. The blind was equidistant from the speaker and the roost in an area that provided good visual coverage of both locations.

After setting up test equipment, we conducted a five-minute precount of passerines in the area from inside the blind. After starting the tape, a one-minute silent period allowed time to return to the blind. During the five minutes of Screech Owl playback, the following data were recorded: (1) the orientation and species of the first bird (initial response), (2) the number and species of birds orienting to the nest or roost, (3) the number and species of birds orienting to the speaker, and (4) the number and species of birds whose orientation could not be determined. A bird was considered to be orienting to the nest or roost if it perched in the nest or roost tree or within a 5 m radius of it. Birds that perched within a 5 m radius of the recorder were listed as orienting to the speaker. Birds that passed through the test area or failed to perch within a 5 m radius of either location were counted as undetermined orienters.

Twelve "O" locations were selected by driving along rural roads in the study area, picking good bird habitat, and using the call-back method to check for Screech Owls. If there was no owl response, the area was defined as an "O" location. At least 24 hours elapsed before testing began. At each site, a prominent tree was selected the "O" location. The cassette recorder was placed 15 m from the tree in a direction that afforded passerines a place to perch that was less than 5 m from the speaker. Test procedures at "O" locations were identical to those used at "P" locations.

A score, based on the ratio of passerines orienting to the speaker to the total number of mobbing passerines × 10, was assigned to each "P" and "O" location. A score of 10 means all mobbing passerines oriented to the speaker. A score of 0 means mobbing passerines oriented to the nest or roost. In computing the score for "P" locations, birds with undetermined orientation were counted as orienting to the speaker. The Mann-Whitney U Test (Siegel 1956) was used to analyze the data.

Results

Ninety-two percent of the passerines (see table 1) that responded to tests in "P" locations oriented to the nest or roost tree (table 2). The first individual to respond during each test oriented to the tree cavity rather than the source of sound. In "O" locations, all responding passerines oriented to the speaker with initial responders heading directly toward the sound source (table 3). Mobbing orientation of passerines in "P" and "O" locations differed significantly ($P<0.01$). In seven "O" locations the test tree contained a suitable cavity (table 3). When comparing only those seven "O" locations with "P" locations, they were still significant ($P<0.01$).

The 12 "P" locations included two abandoned nests, two roost sites, three inactive nests, and five active nests (table 2). During tests at both abandoned Screech Owl nests, passerines still oriented to the nest during mobbing when induced by the tape presentation. The two abandoned nests were active earlier in the 1976 nesting season. They were abandoned after the death of one of the paired adults. Testing was conducted three months after the last sighting of a Screech Owl at one location, and five months after the cavity was abandoned at the second.

The three inactive nests were 1976 nests of Screech Owls that were used as fall and winter roost cavities. Screech Owls were present in cavities of two inactive nests during the tests. A Screech Owl called from one cavity during the last minute of the five-minute recording. While tests were conducted at the five active Screech Owl nests, the owls were present in the cavities. They were not flushed from the area by the mobbing activity of the passerines.

Table 1. Passerine Species Responding to Tests in "P" and "O" Locations

Great Crested Flycatcher (*Myiarchus crinitis*)	Cedar Waxwing (*Bombycilla cedrorum*)
Eastern Phoebe (*Sayornis phoebe*)	White-eyed Vireo (*Vireo griseus*)
Eastern Wood Pewee (*Contopus virens*)	Red-eyed Vireo (*Vireo olivaceus*)
Blue Jay (*Cyanocitta cristata*)	Black and White Warbler (*Mniotilta varia*)
Carolina Chickadee (*Parus carolinensis*)	Magnolia Warbler (*Dendroica magnolia*)
Tufted Titmouse (*Parus bicolor*)	Yellow-rumped Warbler (*Dendroica coronata*)
Red-breasted Nuthatch (*Sitta canadensis*)	Pine Warbler (*Dendroica pinus*)
Brown-headed Nuthatch (*Sitta pusilla*)	Prairie Warbler (*Dendroica discolor*)
Brown Creeper (*Certhia familiaris*)	Ovenbird (*Seiurus aurocapillus*)
Winter Wren (*Troglodytes troglodytes*)	Common Yellowthroat (*Geothlypis trichas*)
Carolina Wren (*Thryothorus ludovicianus*)	House Sparrow (*Passer domesticus*)
Mockingbird (*Mimus polyglottos*)	Orchard Oriole (*Icterus spurius*)
Gray Catbird (*Dumetella carolinensis*)	Summer Tanager (*Piranga rubra*)
Brown Thrasher (*Toxostoma rufum*)	Cardinal (*Cardinalis cardinalis*)
American Robin (*Turdus migratorius*)	Indigo Bunting (*Passerina cyanea*)
Wood Thrush (*Hylocichla mustelina*)	Purple Finch (*Carpodacus purpureus*)
Hermit Thrush (*Catharus guttatus*)	American Goldfinch (*Carduelis tristis*)
Veery (*Catharus fuscescens*)	Rufous-sided Towhee (*Pipilo erythrophthalmus*)
Eastern Bluebird (*Sialia sialis*)	Dark-eyed Junco (*Junco hyemalis*)
Blue-gray Gnatcatcher (*Polioptila caerulea*)	Chipping Sparrow (*Spizella passerina*)
Golden-crowned Kinglet (*Regulus satrapa*)	Field Sparrow (*Spizella pusilla*)
Ruby-crowned Kinglet (*Regulus calendula*)	White-throated Sparrow (*Zonotrichia albicollis*)

1

Table 2. Results of Tests in 12 Known Nest or Roost Sites ("P" Locations)

Test Month	Type Site[1]	Initial Response[2]	No. of Birds Orienting to Speaker	No. of Birds Orienting to Tree	No. of Birds of Undetermined Orientation[3]	Score[4]
Aug	Inactive	T	0	21	2	1
Sep	Roost	T	0	6	2	3
Oct	Abandoned	T	0	4	3	4
Oct	Abandoned	T	0	6	1	1
Nov	Roost	T	0	7	1	1
Dec	Inactive	T	0	5	0	0
Dec	Inactive	T	0	7	0	0
Apr	Active	T	0	11	0	0
Apr	Active	T	0	15	0	0
Apr	Active	T	0	3	0	0
May	Active	T	0	9	0	0
May	Active	T	0	8	0	0

[1] "Active," "inactive," and "abandoned" refer to nests.
[2] T = To the nest or roost tree.
[3] Birds of undetermined orientation were counted as orienting to speaker.
[4] See Materials and Methods for explanation of score.

Discussion

The dramatic difference in mobbing response at "O" and "P" locations occurred because of the pairing of the predator's call with the location of the predator's nest or roost. Orientation to the speaker in every "O" location was released only by the playback of the predator's call. Although sound was the only stimulus required to produce

Table 3. Results of Tests in 12 "O" Locations

Test Month	Initial Response[1]	No. of Birds Orienting to Speaker	No. of Birds Orienting to Tree	No. of Birds of Undetermined Orientation	Score[2]
Aug	S	5	0	0	10
Sep	S	8	0	0	10
Oct	S	8	0	0	10
Oct	S	10*	0	0	10
Nov	S	31	0	0	10
Dec	S	12*	0	0	10
Dec	S	4*	0	0	10
Apr	S	6*	0	0	10
Apr	S	5*	0	0	10
Apr	S	16	0	0	10
May	S	7*	0	0	10
May	S	11*	0	0	10

[1]S = To the speaker.
[2]See Materials and Methods for explanation of score.
*The test was conducted with the simulated nest or roost tree having a cavity.

mobbing in "P" locations, the apparent goal of the mobbing passerines was a known predator's nest or roost even when it was no longer being used by the owl. This behavior supports the hypothesis that passerines can recognize Screech Owls by calls alone and can associate a Screech Owl's call with its likely location. Our data also indicate that the location of a predator's nest or roost even after abandonment is remembered by some passerines. This agrees with Nice and TerPelkwyk (1941) who observed visual recognition of predators by Song Sparrows (*Melospiza melodia*) and that the sparrows seemed to remember the predators' locations for several months.

Our results support Kruuk's (1976) hypothesis that one function of approaching a predator may be to collect information about a potential enemy. We suggest that by remembering the location of specific predators, passerines would be better able to avoid them.

A prey species has four possible strategies in face of a predator threat: to "do nothing" or freeze, to flee, to attack, or to approach. Birds which literally or seemingly did nothing would be selected against unless their behavior or morphology gave them an advantage in not being recognized as prey. One effective behavioral strategy for prey found near a hunting predator might be to call and immediately freeze (Ficken and Witkin 1977). Perhaps some prey are able to analyze the body language of a predator and thereby anticipate the predator's intentions, thus gaining a selective advantage. Doing nothing in the presence of a disinterested, non-hunting predator should provide no obvious selective disadvantage. Many species observed in our study had protective coloration, yet, although it would cost the least energy, none exhibited a "do nothing" strategy.

Birds are known to flee for cover and freeze when predators fly over (Marler and Hamilton 1966). By fleeing from non-attacking predators, passerines would gain little or no information about the predator (e.g., species characteristics, location, motivational state, etc.) and would be less likely to pass on such information to offspring. Thus they and their offspring might be selected against in subsequent encounters owing to the lack of important recognition cues and experience. Fleeing passerines may also reduce their survival by losing nest and roost cavities to predators who are also competitors for these sites.

Attack (involving physical contact with a predator) would be selected for if prey species drove the intruding predator from the area. Removal might be accomplished providing the prey was larger or more aggressive than the predator or a good bluffer. However, small passerines, individually attacking an intruding owl, might fall easy prey, while collective attack—mobbing—might be successful in removal of the predator. However, because of the risks involved, attacks toward a predator during mobbing would be expected to be uncommon.

Risk is also involved in approaching a predator. Subtle behavioral cues and rapid changes of circumstances perceived during mobbing might, however, be used to full advantage by a prudent passerine to minimize risk during mobbing. But what selective advantages would be gained from such a risk? Single approaching birds would probably not be very successful in removing potential nesting competitors such as the Screech Owl who were also predators. Successful removal could be achieved by being large and aggressive or by attracting other passerines so that by numbers alone there would be an appearance of large size. Flocks of birds are known to compress in size to give the appearance of large size or to make it more difficult for predators to single out individuals (Tinbergen 1951). The effect of a larger, more aggressive species might discourage predation and produce conflict behavior in the predators or actual flight, depending on the situation. Thus Cully and Ligon (1976) and Shedd (1978) state that mobbing functions to reduce danger to breeding birds and their young or to permanent residents by moving predators away from the area. We ask, "To where?" It seems reasonable that predators have territories that are sympatric with passerines. It is not likely that passerines could remove an avian predator such as an owl from an area in which the owl is also foraging or nesting. We are unaware of any studies documenting the frequency at which predators are even temporarily removed or foiled in their predatory behavior owing to mobbing by passerines. While permanent removal seems unlikely, temporary removal of a predator would be advantageous since the likelihood of predation is lessened. Even if the predator is not chased off, mobbing may function as a communicative device, signaling to community members the location of a predator (Hinde 1966).

In every test conducted in a "P" location, initial response was to orient within the 5 m radius of the cavity tree. Under the null hypothesis, the first bird to react to the owl call had an equal chance of orienting to the sound source. That the first individual in each case did not, shows that the initial orientation was toward a known location of a predator. The behavior of this first experienced individual seemed to indicate to other birds the learned probable location of the predator. In the Black-capped Chickadee (*Parus atricapillus*) certain experienced adults may be especially important in alerting group members to nearby predators (Ficken and Witkin 1977).

In several of the tests some of the mobbing passerines were clearly naive. Yet in every test at a "P" location, no bird chose to orient to the source of the sound. Such a response of a naive passerine socially facilitated by the first individual's behavior, would be adaptive, because the participant presumably received important information about a predator by mobbing toward a known Screech Owl cavity.

Ficken and Witkin (1977) suggested that young and inexperienced birds that associated with experienced adults seemed to benefit from signals given by experienced adults when predators were near. Curio et al. (1978) showed cultural transmission to be one function of mobbing in captive European Blackbirds (*Turdus merula*). We suggest that approach during mobbing would be selected for primarily because of the learning involved. The social event of mobbing gives a group of potential prey species experience with a predator and its location, making predation in that particular area more difficult.

The evidence presented in our study lends support to an explanation of the evolution of mobbing behavior. Never have we observed that the act of mobbing an owl results in the removal of the owl from the area. Therefore, it seems highly unlikely that the main function of mobbing behavior is to remove the owl. Passerines are highly territorial and often aggressively display against intruders of other species (Orians and Wilson 1964). The evolution of displacement behavior into an adaptive communicative display was proposed by Tinbergen (1952) as an explanation for the social displays of many gull species. Marler (1956) hypothesized that mobbing in Chaffinches (*Fringilla coelebs*) resulted from the conflict between approach and avoidance behavior stimulated by the presence of a predator. We suggest that mobbing may have evolved from the fight-flight conflict during territorial encounters with predators. This conflict behavior may have become adaptive in predator avoidance and evolved as a device to communicate via a social display that not only can confuse a predator, but can give community members an opportunity to learn about it.

While mobbing may produce fringe benefits such as distracting or confusing a predator or temporarily removing it from the area, there is accumulating evidence that knowledge of who a predator is and where it is most likely to be found gives potential prey a greater selective advantage.

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INCIDENTAL TRAPPING OF AMERICAN KESTRELS IN BLACKBIRD DECOY TRAPS

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Introduction

Since 1962 several versions of the decoy trap have been designed and tested to enable farmers and researchers to trap large numbers of pest birds, such as the Starling (*Sturnus vulgaris*) and various blackbird species (see review by Meanley 1971). According to Ballard (1964), Stiles (1966), and Meanley (1971), the decoy trap is highly selective, taking few nontarget species. No mention is made of any incidental trapping of raptors in decoy traps of any design, but recent observations by the junior author indicate that such trapping may occur more frequently than previously reported, at least with the American Kestrel (*Falco sparverius*).

Observations and Discussion

Between 16 August 1978 and 1 September 1979, four decoy traps virtually identical to the "New York Starling Trap" (U.S. Dept. of Interior, unpubl. report 1962) were set by three farmers near farm buildings in 2 x 2.5 km of farmland habitat in southwestern Quebec to trap blackbirds foraging nearby. During this period, nine American Kestrels, sexes not recorded, were trapped incidentally in these traps. On another occasion, one kestrel was observed perched on a branch next to a decoy trap feeding on a Red-winged Blackbird (*Agelaius phoeniceus*) caught between the two layers of cage netting. It is not known whether some were repeat captures, as only one kestrel was banded. Trap-shyness may not be significant, as apparently kestrels can be retrapped with Bal-chatri traps (Berger and Mueller 1959) in the same area in the same season (E. Henckel, pers. comm.). It is also not known if this phenomenon is widespread, although a kestrel was trapped and released unharmed in July 1979 from a decoy trap set 40 km away from the others.

At least three kestrels had badly cut ceres. Seven kestrels were known to be released, but at least one bird was killed by the trap operator. On at least three occasions, some or all of the decoy blackbirds, usually five to a trap, were killed and partially eaten by the kestrels. This problem is not limited entirely to kestrels, as a female Sharp-shinned Hawk (*Accipiter striatus*) was caught and released unharmed from a decoy trap in this area in May 1980. All five decoy birds were dead, and some were eaten.

It is doubtful if decoy traps are a significant source of mortality for kestrels, but this apparent willingness to enter decoy traps to feed upon the occupants and indirectly scaring away potential victims constitutes a distinct disadvantage of using decoy traps to capture pest blackbirds. It is difficult to estimate the extent of use of these traps in North America, but at least three farmers experiencing crop losses to blackbirds in the Beauharnois district of Quebec are using them.

This foraging behavior of kestrels is indicative of their opportunistic nature. Earlier, Hodgdon (1975) reported a male kestrel decapitating a Purple Finch (*Carpodacus purpureus*) through the wire mesh of the trap holding the finch.

The decoy trap or perhaps a smaller, more manageable version could prove useful for trapping small raptors either on breeding territory or at hawk-trapping stations during migration. These traps would not require constant vigilance. However, frequent checking of the trap contents should lessen constant bait replacement and/or damage to ceres or feathers of the raptors.

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ANNOUNCEMENT

1981 RAPTOR RESEARCH FOUNDATION CONFERENCE AND INTERNATIONAL BALD EAGLE/OSPREY SYMPOSIUM

At the Sheraton Mt.-Royal Hotel in Montreal, an international symposium on the biology and management of the Bald Eagle and Osprey will be held on October 28 and 29, 1981, followed immediately by the annual meeting and conference of the Raptor Research Foundation, Inc. from October 30 to November 2. The scientific program will be accompanied by workshops, evening films and an exhibit of both recent and rare paintings of birds of prey. For further information, contact:

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THE RAPTOR RESEARCH FOUNDATION, INC.
OFFICERS

Address all matters dealing with membership status, dues, publication sales, or other financial transactions to the Treasurer. See inside front cover.

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