

NORTHERN HARRIER

TAXONOMY

Scientific name: *Circus cyaneus* (Linnaeus, 1766)

Common name: Northern Harrier

Family: Accipitridae

Taxonomic comments: Old World population regarded as a separate subspecies, *Circus cyaneus cyaneus*. New World subspecies *C. c. hudsonius* (MacWhirter and Bildstein 1996). South American Cinereous Harrier (*C. c. cinereus*) sometimes considered a conspecific with *C. cyaneus* (AOU 1983), but is smaller than the Northern Harrier (MacWhirter and Bildstein 1996). Previously known by the common name Marsh Hawk in North America.



Photo by Chris Young

DESCRIPTION

Basic description: A medium-sized, slender raptor.

General description:

Members of the genus *Circus* are slim, medium-sized hawks with long, broad wings and long legs and tails; characteristic facial ruff gives them an owl-like appearance (Brown and Amadon 1968). Sexually dimorphic in both color and size. Adult male is pale gray above and white below with reddish or brownish spots on underparts, wingtips edged with black; males up to three to four years have brown markings dorsally (Bildstein 1988). Adult female is dark brown above and buff below, with some streaking on underparts (Bildstein 1988). Females are approximately 50% heavier and 12.5% larger than the males (MacWhirter and Bildstein 1996). Both sexes have barred tail; adults and immatures have a distinctive white rump patch. Immature harriers are similar in color to adult females, but with cinnamon-colored breast and darker brown back and wings (Bent 1937, Brown and Amadon 1968). Eggs change from pale blue when laid to white within a few days; brown markings may occur (Hamerstrom 1969).

Length (cm): 44-61 (Bildstein 1988).

Weight (g): 367.4 (mean male weight; Hamerstrom 1986), 529.9 (mean female weight; Bildstein 1988).

Reproduction:

Arrival on breeding grounds in northeastern North America from mid-March to early April; eggs laid between mid-April and late June (Bent 1937, Hall 1983, Laughlin and Kibbe 1985). In western North America, nesting begins in mid-March in southern latitudes and mid-May or early June in northern regions; nesting cycle ends in July or August (Wheeler 2003).

The nest site is selected by the male or female. In a New Brunswick study, males initiated nest construction 95% of the time (n = 19); males built platforms, which stimulated females to finish the nest (MacWhirter and Bildstein 1996). Nest is constructed on ground and composed of dead grasses, weeds, and small twigs (Urner 1925, Bent 1937, Hecht 1951). Clutch size 4-6 eggs (Bent 1937, Hamerstrom 1969, Duebbert and Lokemoen 1977); egg laying period approximately 9 days with eggs laid at two-day intervals (Hamerstrom 1969). Incubation is typically 30 to 32 days, but may vary between 28 and 36 days. Incubation begins the day the last egg is laid or the day following; as a result, hatch is asynchronous and there are size differences among brood mates (MacWhirter and Bildstein 1996). The nestling period varies from 30 to 41 days (Urner 1925, Hamerstrom 1969, England 1989), but nestlings may leave the nest and wander nearby when they are two weeks old (MacWhirter 1994). Young take first flights at 27 to 35 days (MacWhirter and Bildstein 1996).

Incubation and feeding of young is conducted exclusively by the female (Hamerstrom 1969, MacWhirter and Bildstein 1996). Male provides all food to female during incubation and virtually all food until nestlings reach 10 to 14 days old (Martin 1987, Simmons et al. 1987, Sutherland 1987). When nestlings are about two weeks old, the female leaves the nest more frequently to hunt (Hecht 1951, Schipper 1973). Juveniles stay near the nest and are dependent on their parents for food for an additional three to four weeks after fledging (Breckenridge 1935, Hamerstrom 1969).

The frequency of renesting after nest failure appears low; renesting documented in New Brunswick, Michigan (Craighead and Craighead 1956), and the Dakotas (Duebbert and Lokemoen 1977). Both sexes may breed in their first year (Watson 1977); however, in several studies, more females bred in their first year than males (Hamerstrom et al. 1985, England 1989). Harriers do not appear to mate for life (Hamerstrom 1969), and polygyny is well documented (Breckenridge 1935, Hecht 1951, Clark 1972, Balfour and Cadbury 1979, Hamerstrom et al. 1985, Simmons et al. 1986a, England 1989).

Ecology:

During winter, Northern Harriers often aggregate in communal roosts in areas of high prey density (Evans 1982, Palmer 1988, MacWhirter and Bildstein 1996). Density and distribution may be affected by prey abundance during the winter; numbers observed at winter roosts increased when meadow vole abundance was high (Weller et al. 1955, Craighead and Craighead 1956). Bildstein (1979) also observed that placement of roost sites was partially related to prey density in the surrounding areas and roost sites were commonly situated in the center of the birds' hunting areas.

Hunting ranges vary both spatially and temporally. In the breeding season, hunting range sizes have been associated with habitat, prey availability, distribution of nest sites, and breeding cycle stage (Craighead and Craighead 1956, Balfour and MacDonald 1970, Balfour and Cadbury 1979, Serrentino 1992). Two midwestern studies documented hunting range sizes for pairs between 2.6 and 5.5 km² (Breckenridge 1935, Craighead and Craighead 1956). Males generally had larger hunting ranges than females (Hecht 1951, Schipper 1977, Watson 1977). Hunting range sizes from 9.7 to 17.7 km² were observed

for males in Idaho (Martin 1987), whereas hunting range sizes between 0.8 and 5.4 km² were reported for females in New Hampshire (Serrentino 1987).

Breeding densities between 0.8 and 8.2 females per 10 km² have been documented in North America (Hamerstrom et al. 1985, Toland 1985). Breeding density and distribution have been correlated with prey abundance (Hamerstrom 1979, Serrentino 1992), the occurrence of polygyny (Balfour and Cadbury 1979, Simmons et al. 1986a), nest site fidelity (Sealy 1967, Balfour and Cadbury 1979), and habitat quality (Picozzi 1984, Simmons and Smith 1985). In North Dakota, breeding harriers were found only in grassland patches greater than 100 hectares, and were encountered in large patches more often than expected (Johnson and Igl 2001). Number of nesting Northern Harriers increased with meadow vole (*Microtus pennsylvanicus*) abundance in populations that primarily preyed on voles (Hamerstrom 1969, Clark 1972, Hamerstrom 1979, Simmons et al. 1986b). High prey densities have also been associated with increased breeding success (Hamerstrom et al. 1985, Simmons et al. 1986b).

Cold or rainy weather may negatively affect breeding success by delaying onset of egg-laying (Watson 1977, Schipper 1979), causing adults to desert a nest, or causing death of nestlings from exposure (Follen 1986). Raptors are also susceptible to a number of bacterial and viral diseases, but little is known about the effects of these on wild populations (Newton 1979). External and internal parasites have been documented on wild Northern Harriers (Peters 1936, Scharf 1966, Hamerstrom 1969, Anderson and Freeman 1969, Pence 1973).

Average life span in the wild is approximately seven years (Brown and Amadon 1968); longest life span of a banded, free-ranging individual was 16 years, five months (Clapp et al. 1982).

Migration:

Generally arrives in northern breeding areas between March and May (Haugh 1972, Swem 1985). Southward migration occurs August to November (MacWhirter and Bildstein 1996). Appear on Caribbean islands in October and southern Central America in mid-October (MacWhirter and Bildstein 1996). Northern breeders may migrate farther south than do some more sedentary populations breeding at lower latitudes (Palmer 1988). Distances over 1500 km have been documented (MacWhirter and Bildstein 1996).

Most Northern Harriers migrate alone. Individuals have been observed traveling along both coastal and inland ridges at numerous sites in eastern North America (Nagy 1977, Bildstein et al. 1984, Dunne and Sutton 1986, Heintzelman 1986).

Food:

During summer, eats small and medium-sized mammals (especially rodents), small and medium-sized birds (especially passerines), reptiles, insects, and amphibians (MacWhirter and Bildstein 1996). In northeastern United States, young are fed small mammals and birds (Serrentino 1992). During winter, feeds almost exclusively on voles in northern portion of range (MacWhirter and Bildstein 1996); percentage of passerines

in diet greater in southern portion of range; also feeds on mice, shrews, rabbits, and rats. Hunts over open land or marshes; usually flies low to ground when hunting (MacWhirter and Bildstein 1996).

Phenology:

Northward migration typically occurs March to May (Haugh 1972, Swem 1985), southward migration August to November (MacWhirter and Bildstein 1996). Individuals hunt throughout the day, but mostly in early morning and late afternoon (Evans 1982).

Habitat:

Breeding: Occupies a variety of open habitats, typically with herbaceous cover and occasionally intermixed with woody species. Predominantly breeds in moist-open areas such as freshwater, saltwater and brackish marshes, wet meadows, lightly grazed pastures, abandoned fields, bogs, moorlands, tundra, and alpine meadows. Also commonly breeds in dry uplands including, mesic grasslands, drained marshlands, croplands, riparian woodlands, prairies, cold desert shrub-steppe, tundra, and alpine meadows (Serrentino 1992, Macwhirter and Bildstein 1996). Prairie regions planted with non-native, tall grasses are favored hunting and nesting areas (Wheeler 2003). Individuals perch on ground, stumps, or posts. Nests are constructed on the ground, near low shrubs, in tall weeds or reeds, occasionally in bogs, on top of low brush above water, on knoll of dry ground, on higher shrubby ground near water, or on dry marsh vegetation. Nests were frequently placed in dense vegetation (Duebbert and Lokemoen 1977, Hamerstrom and Kopeny 1981, Toland 1985, Serrentino 1987). Larger and deeper nests were often built in wet or flood-prone areas (Urner 1925, Sealy 1967). In several studies, birds used the same nest site, field, or general area for several years (Sealy 1967, Balfour and Cadbury 1979, Serrentino 1987, England 1989).

Non-breeding: Inhabits open areas with a high proportion of herbaceous growth. Habitat includes deserts, coastal sand dunes, pasturelands, croplands, dry plains, upland and lowland grasslands, old fields, estuaries, open habitat flood plains, and salt and freshwater marshes. The highest concentrations are found in areas with low vegetation, especially the semiarid scrub-steppe (cold desert) habitats of the Great Basin and grasslands of the southern Great Plains (Serrentino 1992, MacWhirter and Bildstein 1996). May roost in flocks on the ground in open habitats such as croplands, abandoned fields, and salt marshes (Weller et al. 1955, Mumford and Danner 1974, Bildstein 1979, Evans 1982, Bosakowski 1983).

There is little data on habitat use during migration. Observations in open wetlands and uplands have been documented during the migration period (MacWhirter and Bildstein 1996).

Hunting: Hunts over open areas (MacWhirter and Bildstein 1996). Hunting habitat is associated by several variables, including proximity to nest site (Schipper 1977, Martin 1987, Serrentino 1987), sex and age of the bird (Schipper et al. 1975, Bildstein 1978, Marquiss 1980), prey abundance and availability (Schipper et al. 1975), vegetative structure (Schipper et al. 1975, Temeles 1986), and competition (Temeles 1986). During

the breeding season, females often hunt in areas adjacent to the nest site (Schipper 1977, Martin 1987, Serrentino 1987). Males hunt farther from the nest; as a result they frequently encounter different habitat types than females. Northern Harriers utilized idle and abandoned fallow fields with vegetative cover more than expected with males preferring more open habitats than females (MacWhirter and Bildstein 1996). In an Ohio study, females were observed significantly more often than males in fallow fields where small mammals were common. The same study found males preferred corn stubble where avian prey were more common (Bildstein 1978).

STATUS

Global rank: G5 (22Nov1996)

Global rank reasons:

Range is extensive; secure, but declines primarily due to habitat loss and degradation have occurred in several areas.

State rank: S3N, S4B (28Jun2006)

State rank reasons:

Alaska range is widespread, but distribution is patchy within the state; information about population size and trends is unreliable and more information is needed. Potential threats include habitat degradation, predation and disturbance while nesting, and exposure to environmental contaminants, but research on the impacts of these forces in Alaska is needed.

DISTRIBUTION AND ABUNDANCE

Range:

Global range:

Breeding: Breeding range is large but often discontinuous. In North America, from northern Alaska to northern Saskatchewan and southern Quebec; south to northern Baja California, southern Texas, southern Missouri, West Virginia, southeastern Virginia, and North Carolina (and formerly Florida). In Eurasia, from British Isles, Scandinavia, northern Russia and Siberia south to Mediterranean region, southern Russia, Turkestan, Amurland, Ussuriland, Sakhalin, and the Kurile Islands (AOU 1983). Rarely and erratically breeds south of the North American breeding range (MacWhirter and Bildstein 1996).

Non-breeding: In North America, from southern Canada south through the United States, Central America, and the Antilles to northern Colombia, Venezuela, and Barbados; casual or accidental in Hawaii (AOU 1983, MacWhirter and Bildstein 1996). In North America, highest number of harriers winter in the Great Basin and central and southern Great Plains (Root 1988). The coastal areas of New York, New Jersey, Delaware, Maryland, and Virginia support the highest number of wintering birds in the Northeast. In Eurasia, occur from British Isles, southern Scandinavia, and southern Japan south to northwestern Africa, Asia Minor, India, Burma, eastern China, and the Ryukyu Islands (AOU 1983).

State range:

Breeding: Breeding has been documented throughout the state except in the Aleutian Islands and tundra habitats of far western Alaska. Widely distributed, but uncommon throughout interior and southcoastal Alaska during the summer (Kessel and Gibson 1978). The species appears to be most abundant in the marshes and estuaries of Southcentral Alaska and becomes progressively less common to the west and north (USFWS 2000). In western Alaska, common in the coastal plain and west of the Yukon River drainage (Irving 1960, Kessel and Gibson 1978, Salter et al. 1980, Garner and Reynolds 1986); rare in the Kuskokwim River drainage, on the Anvik River, and the Utukok River (White and Boyce 1978, Dotson and Mindell 1979, Mindell 1981). Northern Harriers nest on the North Slope at low densities, predominantly in the tundra-wetland complexes (Ted Swem pers. comm.). A number of Northern Harriers have been documented between Fairbanks and Denali National Park (Dixon 1938, Gabrielson 1944); considered a rare breeder within the park (Dixon 1938). The species has also been documented on the Northern Foothills of the Brooks Range (Pitelka 1974).

Non-breeding: Regularly winters on Kodiak Island and irregularly in southeastern Alaska (Wheeler 2003). Northern Harriers are rare and irregular inhabitants of the Aleutian Islands during any season (Byrd et al. 1974). They have been sighted on rare occasions during the winter with one sighting on Amchitka Island (Kenyon 1961) and one on Adak Island (Byrd et al. 1974).

Abundance:

Global abundance:

Global population estimated at 1,300,000 birds, of which 455,000 (about 35%) occur in the U.S. and Canada (Rich et al. 2004). Number of breeding pairs in Canada was estimated at 20,000 to 50,000 in the early 1990s (Kirk et al. 1995).

State abundance:

An adequate statewide abundance estimate is lacking; generally considered uncommon (Gabrielson and Lincoln 1959). Spring migration counts recorded 560 individuals between 2 and 7 May, 1975 on the Copper River Delta (Kessel and Gibson 1978); 856 were recorded at the Sitkagi Bluffs near Yakutat from 21 April to 9 May, 1982 (with 213 in a single day; Swem 1982a); 212 were sighted during fall migration counts near the Malaspina Glacier (Swem 1982b). At Dry Lake, southeast of Fairbanks, southeast-bound harriers make up about 35.3% of raptors seen (average annual counts were 432 in 1987 to 1988 and 802 in 1991 to 1994; McIntyre and Ambrose 1999). Northern Harriers use additional routes during migration and these counts along the southern coast and in Fairbanks likely represent only a fraction of the total population (USFWS 2000).

Trends:

Global trend:

Although population trends vary regionally, global population appears to be declining, presumably due to habitat loss (MacWhirter and Bildstein 1996). The North American

Breeding Bird Survey (BBS) is not the best survey method for this generally sparse raptor; where data are credible, trends are mixed.

Short term trend: In Montana and South Dakota declining trends were estimated by the BBS for 1980 to 2004 (-1.0 and -2.9%/year, respectively) while in North Dakota and the Central Valley, CA, increasing trends were estimated for the same time period (3.8 and 3.1%/year, respectively; Sauer et al. 2005). For 1980 to 2004, BBS trend estimates were declining for the U.S., Canada, and survey-wide (-0.3, -3.0 and -1.1%/year, respectively; Sauer et al. 2005).

Long term trend: Declines have occurred where large wetlands and moist grasslands have been lost. Historic accounts described the harrier as abundant and widely distributed (Baird et al. 1860, Bendire 1895, Coues 1892, Bent 1937); declines in breeding harriers have since been observed in parts of North America through the late twentieth century (Arbib 1973, Evans 1982, Robbins et al. 1986, Serrentino and England 1989, Serrentino 1992). In the Northeast, breeding birds may have been extirpated in Connecticut, are restricted primarily to offshore islands in Massachusetts and Rhode Island, and remain as small and scattered populations in Vermont and New Hampshire. BBS data displayed a significant negative trend (-3.0%/year, $P < 0.00$, $n = 269$) for Canada from 1966 to 2004; for the same time period BBS data indicated a non-significant negative trend (-0.3%/year, $P < 0.60$, $n = 660$) for U.S. routes and for combined U.S. and Canadian routes (-1.1%/year, $P < 0.02$, $n = 929$; Sauer et al. 2005). Analyses of migratory trends showed no clear trend for northeastern North America from 1972 to 1987 (Titus and Fuller 1990). Brown (1973) analyzed Christmas Bird Count data from 45 states between 1952 and 1971; harriers showed a downward trend from 1952 to 1966 and an increase from 1966 to 1969; this increase however, was primarily attributed to populations in California.

State trend:

Undetermined. A positive trend of 10.8%/year ($P < 0.03$) was observed in North American Breeding Bird Survey data for 1980 to 2004 in Alaska (Sauer et al. 2005); however, this trend is based on seven survey routes and may be unreliable.

EXISTING PROTECTION

Global protection:

Protected by the Migratory Bird Treaty Act of 1918. Listed as Endangered in Illinois, Iowa, Indiana, Missouri, New Jersey, Connecticut, and Rhode Island; Threatened in Tennessee, New Hampshire, Massachusetts, and New York; species of Special Concern in Vermont, Michigan, and Wisconsin (MacWhirter and Bildstein 1996). Listed as a species of management concern in the U.S. Fish and Wildlife Service's "Migratory Nongame Birds of Management Concern in the United States: the 1995 list".

State protection:

Habitat protected in state and national parks and national wildlife refuges where the species is known to breed; these include Bering Land Bridge, Lake Clark, Katmai, Denali, Kenai Fjords, Yukon-Charley, and Wrangel-St. Elias National Parks and Innoko,

Kanuti, Koyukuk/Nowitna, Tetlin, Yukon Delta, and Yukon Flats National Wildlife Refuges (Igl 1996).

CHALLENGES

Global challenges:

Habitat degradation: Population decline primarily attributed to habitat loss. Destruction of wetlands and conversion of native grasslands to monotypic farmlands have been major sources of habitat loss (Evans 1982). The majority of southern California habitat has been lost to urbanization. In the northeastern U.S., declines are attributed primarily to habitat loss from reforestation, wetland filling, and urban and industrial development in coastal areas (Serrentino 1992). Increases in intensive sheep grazing have been implicated in declining populations of Orkney Island, Scotland (Amar and Redpath 2005).

Disease: Rosen and Morse (1959) documented the death of Northern Harriers from the ingestion of mice contaminated with the fowl cholera bacterium, *Pasteurella multocida*. During an outbreak of cholera among waterfowl in California, both mountain voles (*Microtus montanus*) and *Peromyscus* spp. had ingested portions of dead birds.

Contaminants: The effects of a variety of organochlorines on raptors have been well documented in North America (Hamerstrom 1969) and Europe (Bijleveld 1974); effects include eggshell thinning, reproductive failure, and death (Newton 1979). On Long Island, New York, high levels of DDE were found in one harrier egg from an abandoned nest (Foehrenbach et al. 1970), although no evidence of eggshell thinning was observed. In North America, a mean decrease of 15% in eggshell thickness was noted between 1947 and 1969 (Anderson and Hickey 1974). Declines in both breeding and migrating harriers and the occurrence of behavioral changes coincided with the heavy use of DDT at a Wisconsin study site and elsewhere in North America. Pesticide use in Vermont (Laughlin and Kibbe 1985), Connecticut (Dowhan and Craig 1976), and New Jersey (Dunne 1984) has been implicated in population declines. A variety of biocides (DDE, dieldrin, PCBs) have been found in Northern Harrier eggs collected during the 1980s on Long Island, New York.

Predation and human disturbance: Because harriers nest on the ground, eggs and young are vulnerable to destruction by humans and natural causes. A number of mammalian and avian predators (e.g., skunks *Mephitis* spp., mink *Mustela vison*, raccoons *Procyon lotor*, dogs, and other raptor species) prey upon eggs and young, and nests have been trampled by deer (*Odocoileus virginianus*) and livestock (Craighead and Craighead 1956, Hamerstrom 1969, Toland 1985, England 1989). Predation of harrier young has occurred when predators followed humans to nests (Watson 1977, Toland 1985).

Farming activities such as mowing and harrowing may cause nest abandonment by adults (Hamerstrom 1969, Follen 1986) and destruction of nests and young (Craighead and Craighead 1956, Hamerstrom 1969, Thomas 1987). During the first half of the 1900s, mortality from shooting was common (Craighead and Craighead 1956); however, death from shooting is no longer a serious threat in North America (Bildstein 1988). In Great

Britain, Watson (1977) reported that human-related mortality remained one of the most frequent causes of death for the hen harrier. Deaths also resulted from starvation and collisions with automobiles and overhead wires.

State challenges:

Most breeding habitat in Alaska is generally intact; however, resource development in tundra habitats (e.g., from oil, gas, and mining exploration and extraction), road construction, other human disturbance, and increased competitors and predators associated with human garbage (e.g., foxes, ravens) may degrade habitat quality and/or availability (ADFG 2005).

Because Northern Harriers nest on the ground, eggs and nestlings are vulnerable to predation by terrestrial mammals such as coyotes (*Canis latrans*), foxes (*Vulpes* spp.), and domestic dogs. Avian predators include the Common Raven (*Corvus corax*), American Crow (*Corvus. brachyrhynchos*), and Great Horned Owl (*Bubo virginianus*). Harriers are also sensitive to human disturbance during nesting and have abandoned nests following human interference (MacWhirter and Bildstein 1996).

Other potential threats include illegal shooting by waterfowl hunters, reduction in diversity or quantity of prey, disruption of intra- and interspecific relationships, and exposure to environmental contaminants. For example, lead poisoning from eating dead and wounded waterfowl was a source of mortality until the 1991 national ban on lead shot (Schempf and Fuller 1981, Wheeler 2003).

RESEARCH AND INVENTORY NEEDS

Global research needs:

Determine the extent of breeding range (MacWhirter and Bildstein 1996). Research tolerance to disturbances, especially for populations located in coastal areas with high human densities (Serrentino and England 1989). Investigate the relationship between wintering distribution and abundance and the decline of breeding birds in coastal Massachusetts, Rhode Island, and Connecticut. Determine the effect of saltmarsh ditching on populations and their primary prey (Serrentino and England 1989). Collect data on hunting habitat and roost site selection in various habitats such as saltmarshes, freshwater wetlands, agricultural habitats, and maritime heaths. Conduct analyses of pellets and prey remains found at roost sites to determine the prey selection of nonbreeding harriers. Determine the causes of breeding failure and mortality in young and adults. Monitor the current levels of biocides and compare with the results of previous studies. Conduct studies on the techniques used to maintain early successional habitats; compare treatments and the cost-effectiveness of each treatment.

State research needs:

Study the impacts of resource development including petroleum exploration and mining activities on tundra habitats and prey populations. Also, see Global research needs.

Global inventory needs:

Monitor populations in areas where declines have been reported or where their status is unknown. Monitor populations at a minimum of every other year; annual monitoring may be required in areas where severe declines have occurred (Serrentino and England 1989). Expand surveys of suitable habitat to look for previously unknown populations. Area selection should be based on analyses of aerial photographs, investigations of historical breeding sites, results of Breeding Bird Atlases and Christmas Bird Counts, contacts with local birders, and element distributional modeling.

Data on density and fledgling production should be collected. Previously used or historic nesting sites should be checked for evidence of breeding activity since harriers may occupy the same site for several years. Total number of nests or females should be used to determine density and breeding success, and not the number of pairs due to their polygynous nature. Distinguish between cyclical trends that follow vole populations and longer term declines (Serrentino and England 1989).

Wintering populations should also be monitored. Surveys of suitable hunting habitats should be conducted by experienced observers. Data collected on surveys should include: (1) the number of birds observed, sex and age (juvenile vs. adult); (2) weather variables, since flight activity is affected by weather conditions (Bildstein 1978); and (3) hunting habitat and roost site selection (Serrentino 1992).

State inventory needs:

Adequate information on population status is lacking. A statewide effort to determine abundance, distribution, habitat use, and variables associated with breeding success and survival is needed (McIntyre pers. comm.) Identify and begin to monitor major migration corridors. Migration counts are currently not reliable enough to estimate trends because migration corridors are not well defined, usage patterns may be too diffuse, access and identification of suitable corridors is difficult, and sufficient, qualified personnel to operate monitoring sites are difficult to find. Each of these issues needs to be addressed to improve quality of migration count data and trend estimates (ADFG 2005).

CONSERVATION AND MANAGEMENT NEEDS

Global conservation and management needs:

Protection of favorable habitat and nest sites is critical; nests should not be disturbed during the early part of the nesting cycle, especially prior to hatching. Wetland preservation aimed primarily at waterfowl and habitat management programs for prairie chickens are beneficial to this species (Evans 1982).

State conservation and management needs:

Continue existing ADFG and CDC efforts to examine dead birds for West Nile Virus in order to detect the virus if/when it appears in Alaska (ADFG 2005). Development of a statewide raptor database would promote data coordination and dissemination throughout

Northern Harrier

Alaska. Use newly acquired information on distribution and abundance to identify conservation areas and focus management efforts on factors associated with increased breeding success and survival (McIntyre pers. comm.).

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Northern Harrier

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