-Draft- Rough-legged Hawk Species Account

The North American Raptor Monitoring Strategy

Strategies for Monitoring Rough-legged Hawk (*Buteo lagopus*) Populations in North America

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Introduction

Rough-legged hawks (*Buteo lagopus*)

The rough-legged hawk (RLHA) is a circumpolar Holarctic species that normally breeds between Latitudes 61° N and 76° N – in the arctic and subarctic regions of North America and Eurasia (Brown and Amadon 1968, Palmer 1988, Johnsgard 1990). Rough-legged hawks arrive and breed in large numbers where rodents are abundant. In such peak rodent years, the rough-legs lay larger clutches and raise larger broods than in years with fewer prey. They nest high up on ledges on steep cliffs, columnar rocks, escarpments, the faces of rock outcrops, and eroded riverbanks, and to a lesser extent on hillocks of rock or dirt, trees, and even man-made structures (e.g. cairns). When nesting in forested regions, the rough-legged is generally found where an abundance of open ground is nearby. RLHA shares nesting habitat with the earlier nesting gyrfalcons, golden eagles, and ravens as well as the concurrent nesting peregrine falcon and in its southern range the red-tailed hawk (Brown and Amadon 1968, Palmer 1988).

Rough-legged hawks arrive and breed in large numbers when rodents are seasonally abundant. In peak rodent years roughlegs lay larger clutches and raise larger broods than in years with fewer prey. When rodents are scarce, roughlegs may even move to areas more abundant with prey (Whitaker et al. 1996). Although breeding densities of RLHA have been shown to fluctuate synchronously with prey populations (Poole and Bromley 1988, Virkkala 1992, Goudie et al. 1994), they appear to be non-cyclic (Mindell and White 1988). The population fluctuation in roughlegs have been summarized as being pseudoperiodic or random rather than cyclic (Mindell and White 1988, Palmer 1988). For breeding populations, those in the higharctic seem to fluctuate the most, while those in taiga zones appear to be more stable.

The southward migration of the rough-legged hawk begins in late August or early September, and reaches a peak in temperate latitudes in mid- late October. In migration the rough-legged hawk occurs almost anywhere away from extensive forest and densely settled areas. It crosses wide inland and marine waters. Occurrence and degree of migration appears to vary with climate and food supply. It is gregarious on migration, often travelling in large flocks; but small groups or individuals are not uncommon. The birds settle on their wintering grounds from November to March. Northbound migration take place in the US from late March through early April. Depending on snow-melt, they arrive at their breeding grounds, often already paired, from late April to May.

Rough-legged hawks winters principally south of the coniferous forest zone with upper limits variable. Recorded southern limits include all southern US-Mexican border states, with some being recorded in Sonora, the US Gulf of Mexico coast, and sightings in Florida.

In North America, the RLHA wintering range includes most of the U.S. and parts of southern Canada (Palmer 1988). Although it is widely distributed in winter, it is usually found in open habitat resembling the tundra in which it nests, such as prairies, plains, coastal marshes, and cleared areas including agricultural fields and airports (Johnsgard 1990). During winter the rough-legged hawk is more common in areas with short growing seasons and low precipitation, and reaches its highest densities in the northern U.S., Great Basin area, and the western short-grass prairies (Bock and Lepthien 1976). The RLHA and RTHA overlap in much of the U.S. during winter, with the RTHA preferring more woodland and edge mix, while the RLHA prefers the more open areas where trees are few or absent.

Because of fluctuating populations, movement in response to prey, and the fact that breeding and nesting takes place at remote locations in the arctic, attempting to monitor rough-legged hawk populations is a daunting challenge. Few Breeding Bird Surveys occur in the breeding zone of the rough-legged hawk. The majority of Christmas Bird Counts occur in or around urban areas, whereas rough-legged hawks tend to avoid developed areas ( ). Migration count numbers of rough-legs are frequently so low at migration count sites, that many papers reporting trends on other raptors at these sites, indicate that no analyses can be run on rough-legged hawks ( ). Little is known on the breeding-wintering links and interrelationships, making interpretation of migration data analyses speculative as to estimation of what populations of rough-leggeds.

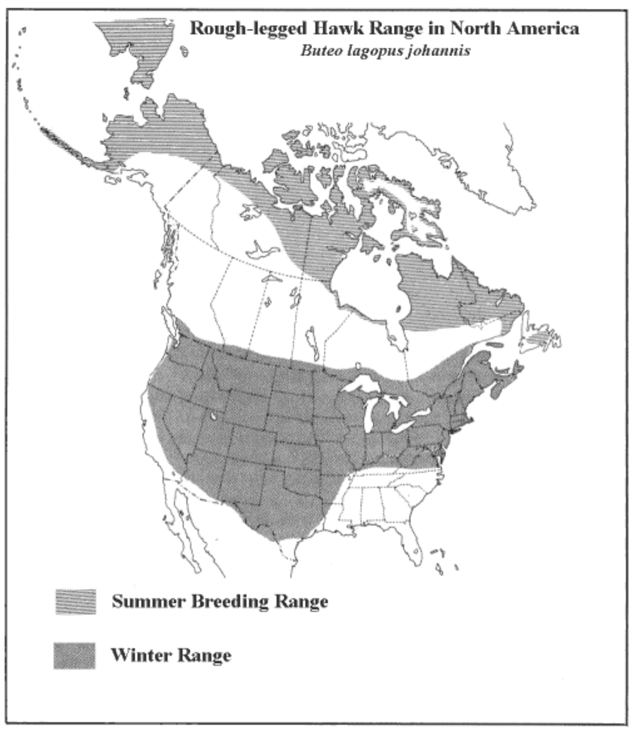
In this account we evaluate existing datasets and methodologies and identify a standardized, population monitoring approach specifically tailored for Rough-legged hawk populations throughout North America.

Species Characteristics

Subspecies and Subpopulations.

There are two subspecies of the rough-legged hawk. *Buteo lagopus kamtschatkensis* Dementiev breeds throughout northern Siberia to Kamchatka, Ussuriland, and the Kurile Islands, south to Lake Bailkal; and from northwestern Alaska (east along Arctic coast to Chipp River) south to St. Michael. The Alaskan population is in large part intermediate toward B. l. s.johannis (see Cade, 1955 Condor 57:339-344)

Buteo lagopus s.johánnis Gmelin breeds from the Aleautian Islands, the interior of Alaska, Yukon, northern Mackenzie, Prince Patrick Island, Victoria Island, Melville Peninsula, southwestern Baffin Island, and northern Labrador south to Manitoba, southeastern Quebec, and Newfoundland. *Buteo lagopus johánnis* is the subspecies, inhabiting North America (Fig. 1).



Annual Activity Budget

Implications of Life History for Surveys

NOTE TO CONTRIBUTORS: Biology, behavior, ecology, etc., used under the topics below must be DIRECTLY relevant to monitoring!

It is difficult to monitor populations of rough-legged hawk because the species breeds in the Arctic region. Numbers of breeding birds fluctuate greatly from year to year (Mindell et al 1987, Mindell and White 1998, Brown and Amadon 1968). The number of rough-legged hawks that winters in an area is also variable and depends on the prey populations, snow cover and temperature (Whitaker et al. 1996). Rough-legged hawk numbers have been shown to fluctuate widely (Baker and Brooks 1981, Mindell and White 1987, Palmer 1988, Virkkala 1992, Swem 1996, Potapov 1997), and fluctuations in the number of wintering juveniles are often attributed to changes in reproductive success prior to the subsequent winter (Bent 1937, Brown and Amadon 1968). However, a variety of local and regional factors such as prey availability, weather, and/or the presence of conspecifics may also influence the distribution and density of wintering birds (Watson 1984,). Two conditions that influence hawk density are prey density and prey vulnerability as a result of biotic and abiotic factors (Craighead and Craighead 1956).

When microtine populations are low, rough-legged hawks appear to be able to switch to a diet heavy in passerines with some ground squirrels (Poole and Bromley 1988). Carrion may also be utilized especially with increased snow depths (>12cm) (Watson 1984).

Also have tendency to dirft throughout the winter (Craighead and Craighead 1956, Watson 1984) probably reflect the individual abilities of the birds to adjust to reduced rodent availability throughout winter. Galushin (1974) speculated that raptors can be nomadic to compensate for food specialization, or faithful to an area but flexible with food habits. He contended that the differences between the two strategies extended not only to the population, but to the individual as well. Watson (1984) showed individual rough-legged hawks in the same wintering population exhibited different survival strategies. Tend to move to road with heavy snowfall (Bildstein 1978, Schnell 1967, Watson 1984).

Local increases in numbers of hawks during years of peak prey abundance are often too great to be attributed solely to locally high production and survival (Newton 1976). Cyclic nomadism has typically been the mechanisms used to explain instantaneous tracking of prey abundance by breeding populations of RLHA (e.g. Galushin 1974, Newton 1976). Exhibit behavior of many nomadic species, being flexible in their nesting selection dependent upon prey abundance, and having long prenesting periods to allow time to assess prey availability and, if necessary, relocate (Galushin 1974). RLHA begin to lay eggs one to two months after returning to northern breeding areas (Johnsgard 1960). Galushin (1974) also suggests that during years of low prey density on traditional breeding grounds, nomadic birds of prey may exploit habitat at the periphery or outside of the species traditional range. Watson (1984) results indicate that rough-legged hawks were not nomadic to the degree of wandering indiscriminately from breeding areas, but that they follow a general flight corridor from Canada to southwestern Montana and they passed onto winter ranges which afforded the best chance of survival.

Most of the main survey techniques do not cover the remote regions where RLHA nest.

Studies indicate that there is a differential winter distribution of rough-legged hawks, with on the average, female adult and juveniles winter farther north than do males (Olson and Arsenault 2000).

Population Monitoring

Evaluate usefulness of various survey methodologies to adequately monitor status and trend(s) of Rough-legged hawk populations in North America. This includes effectiveness of conventional means, (e.g., Breeding Bird Survey, Christmas Bird Counts) as well as species-specific studies conducted to date.

EVALUATE APPROPRIATE EXAMPLE (S) OF SPECIES SPECIFIC SURVEY(S) AND RESULTS IN THE SECTIONS BELOW. THE EVALUTIONS SHOULD BE BASED ON THE FOLLOWING GENERAL CRITERIA:

GEOGRAPHIC (SPECIES' RANGE IN N. AM.) COVERAGE AT TWO BASIC SPATIAL SCALES: 1) THE N. AMERICAN CONTINENT AS FAR SOUTH AS THE SUBTROPICAL FORESTS OF MEXICO, AND 2) THE N. AMERICAN MIGRATORY BIRD FLYWAYS. IF THERE ARE SURVEYS DONE AT A MORE LOCAL (i.e., SMALLER SPATIAL SCALE) SCALE THAT LIKELY COULD BE APPLIED AT THE BROADER SCALES, EVALUATE THEM AND PRESENT YOUR RECOMMENDATIONS.

COVERAGE BY SEASON;

ADEQUATE DATA TO TEST FOR A TREND AND ACHIEVE THE POWER CRITERIA SPECIFIED.

IDENTIFY SHORTCOMINGS, THEN THE SURVEY METHODS, SAMPLING ALLOCATION NEEDED TO PROVIDE A REPRESENTATIVE SAMPLE FOR GEOGRAPHIC AND SEASONAL SURVEYS THAT MEET THE STATISTICAL CRITERIA TO BE APPLIED:

Ensure the ability to detect a 50% reduction in the count or index over a 25-year period with alpha = 0.10 and beta = 0.20. Gould and Lewis (1997) provide discussion material about the use of such criteria as applied to the counts of migrant raptors, and that material is a useful focus for further consideration.

Population Trends Taken From Literature

1) Trends
    a) According to line transect data, the Finnish population decreased significantly from the 1950's to the 1970's (V@is@nen 1983 from Saurola 1985).
    b) 1959 banner year, with major flight reported for Ontario (Spiers & Spiers 1960)

Sampling Adequacy

1) Definition of trend
    a) Unit of measure / response variable

A SIGNIFICANT CHANGE IN THE COUNT PER YEAR; ULTIMATELY COMPARED TO A SIGNIFICANT CHANGE IN THE COUNT BASED ON ABOVE STATISTICAL CONSIDERATION.

    b) Time frame

STATE TIME FRAMES OF EXISTING DATA BASES

c) Extent of change

STATE AMOUNT OF CHANGE, THE TREND, REVEALED BY THE EXISTING DATA AND ANALYSES

2) Power analyses

DETERMINE POWER OF EXISTING DATA AND TESTS AND COMPARE TO OUR STATISTICAL CRITERIA

3) Sample size considerations

BREEDING SEASON SURVEYS

Breeding Season Distribution, Timing, and Habitat

1) *Breeding season distribution by subspecies*
   a) State/provincial Atlases
   b) Literature
      i) Long-term data on breeding densities and productivity from the Northwest Territories suggest that populations are stable (para. From Kirk and Hyslop 1998).
2) *Specific, breeding season schedule*
   a) Starting & ending dates – isocline map, and or tables, but convey differences in timing associated with latitude, elevation, etc.
      i) Incubation and fledgling periods of 31 and 31-40 days (Johnsgard 1990)
      ii) Egg laying
         (1) in Labrador occur from mid to late May (Whitaker et al 1996).
         (2) Labrador May 2 – June 23, with half June 4-10
         (3) Alaska & Artic Canada – May 19-July 13, with half May 30-Jun 20 (Palmer 1988)
         (4) In the forest zone SW Alaska, avg dates ranged June 10-21 (Mindell 1983), which would indicate clutches end of the 1st week of May.
   b) Daily activity budget - Incubation, hunting, nest defense, intra-pair interaction, etc.
   c) Breeding season irruptions / fluctuations
      i) In May, when RLHA arrive there are two main factors affecting the number of territorial pairs in a given area: Small mammal diversity and number of large predators, specifically snowy owls. (snowy owls arrive much earlier and get best prey habitat)
      ii) Maximum densities of RLHA occurred in years with a rapid decrease in rodent diversity, when one (or some) of the species is rapidly increasing in numbers and spreading into a variety of habitats (Potapov 1997)
      iii) Even during years with low rodent densities, most of the territories are occupied early in the spring but few birds lay eggs or stay long on the territory (Saurola 1985)
      iv) May have alternate nesting breeding grounds during years of low prey abundance (Whitaker et al 1996).
      v) Agree with hypothesis that RLHA nomadically search for nesting territories and exploit areas near the limits of their breeding range during years of low prey abundance in Labrador (Whitaker et al 1996).

- vi) In a 12 year study in Finland, Korpimaki (1994) found significant positive correlations between breeding densities and two nomadic raptor species and local small mammal densities during the previous fall.
- vii) Mindell and White (1988) found no indication of regular or cyclic fluctuations of RLHA in the Colville River area in Alaska. They state they know of no supporting breeding season data supporting regular cycles.
- viii) Palmer 1988, says although fluctuate, doesn't imply that it is cyclic – denoting predictable periodicity, it appears more random fluctuations (Garsd and Howard 1981)
- ix) Pielou (1974) classified RLHA as a group of tundra species with a four-year cycle whose fluctuations are linked to cycles in herbivorous prey species, as has Andrewartha and Birch (1954) based on a study by Speirs (1939) of bird watchers in winter in Toronto with data from 1917-1938.
- x) The RLHA are not restricted to small mammal prey, which tends to reduce any one-to-one correspondence between vole and roughleg fluctuations. On the Colville River in 1971, breeding RLHA were relatively abundant despite low microtine populations (White and Cade 1971)
- xi) Pasanen and Sulkava (1971) found RLHA nesting density in Finland to be independent of small mammal stocks.
- xii) However, in Norway, Hagen (1969) found the highs and lows of RLHA corresponded with the highs and lows of vole numbers

d) Breeding Densities – in literature. Drastic declines may be due to concurrent lows in multiple prey species or of extremely harsh weather. These population fluctuations appear to be in most cases, localized and regionally independent of each other. (Palmer 1988)

- i) Annual % change of avg number of breeding pairs has varied from +92 to –77 (n=5yrs) on the Seward Penin.
- ii) From +70 to –49 on the Sagavanirktok River (n=4)
- iii) +39 to –60 on the Colville River AL. (n=11)
- iv) +30 to –27 on the Kuskokwim (n=5) (mixed forest & tundra) All above from (Palmer 88)
  - (1) The Kuskokwim area fluctuated least. Annual % change from the avg was rel low, ranging from +20 to –20, for a Finnish study located in a mixes forest and tundra setting as well (Pasanen and Sulkava 1971) . These two taiga zones generally experience less prolonged severe winters and springs than the arctic regions. The observed population fluctuations of these 2 areas are more similar to other stable raptor species populations (Newton 1979)

FOCUS ON: what time(s) are birds most readily detected?

3) Problems

a) Nest surveys

- i) RLHA appears to move from year to year, e.g. Goudie et al. (1994) when doing helicopter surveys of breeding cliff-nesting raptors in Labrador that RLHA were the most common species in both 1987 and 1989, but were completely absent in 1988.

4) *Habitat associations*

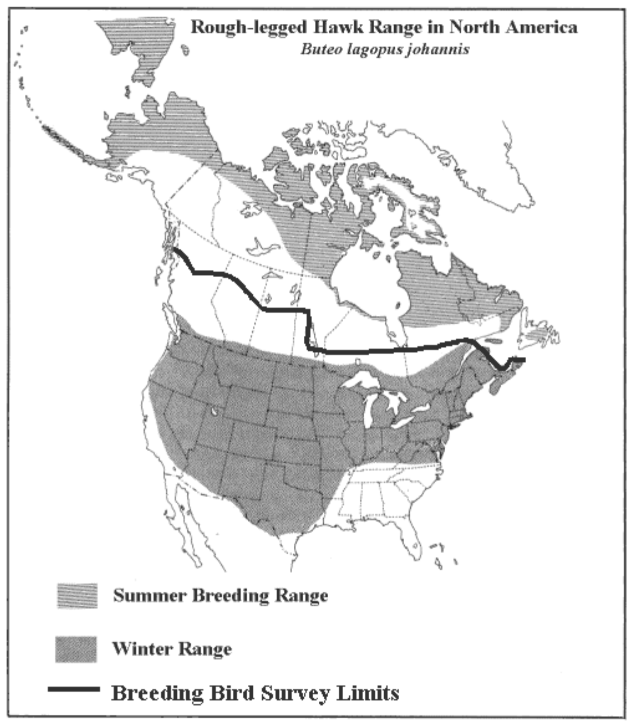
5) *Breeding Season Survey* –relative probabilities of detectability, and other factors affecting surveys, based on habitats and behaviors throughout breeding season.

a) Behavior during low prey year
   i) Birds will not breed and therefore less permanent in their territories, tend to spend the day elsewhere. So visit at night since territorial birds tend to spend the night at a precipice in the center of their territory (Potapov 1997)
b) *Breeding Densities*
   i) *2-3pairs/100km^2 up to 5-8pairs/100km^2 (Saurola 1985)*

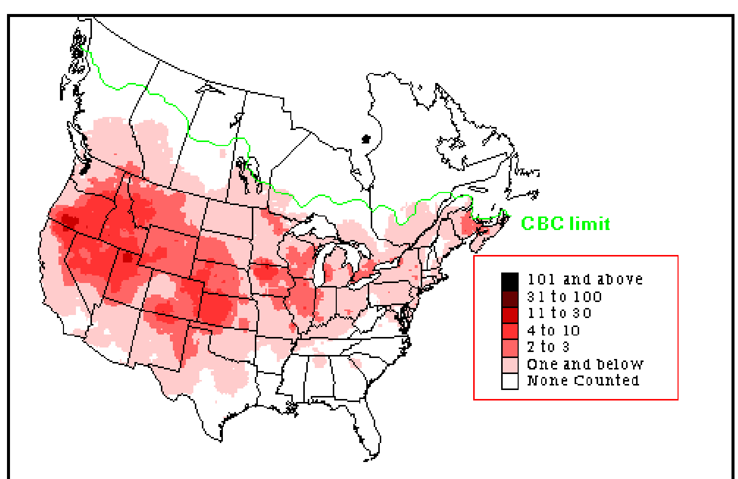
SUMMARIZE HOW TOPICS ABOVE AFFECT ABILITY TO SURVEY AND THUS, MONITOR THE SUBSPECIES, THROUGH THEIR GEOGRAPHIC RANGES, DURING THE BREEDING SEASON.

Breeding Bird Survey

1) National trends
   a) Data from BBS homepage – breeds almost entirely north of most BBS routes
      i) A total of 96 birds were inventoried from 1966-1999
         (1) Alaska - 68
         (2) British Columbia - 1
         (3) Manitoba - 4
         (4) Newfoundland – 8
         (5) Quebec - 2
         (6) Saskatchewan - 3
         (7) Yukon Territories – 10
   b) Data from Literature
      i)
   c) Maps



2) Regional trends
   a) Political boundaries
   b) Subspecies
3) Statistical Adequacy
   a) Sample sizes
      i) Abundance (mean number recorded/route) < 1.0 can be a positive bias associated with the analysis, and both de & increasing trend estimates should be suspect (Sauer et al. 1991, Kirk & Hyslop 1998)
      ii) For a valid trend analysis should have a minimum number of 50 routes on a regional level.
   b) Beta level (% change detectable)
   c) Power
4) Overall effectiveness



a) Literature comments
b) Sources of error / problems
   i) BBS timing
      (1) The mid-June surveys are too late for detection of raptors when they are most conspicuous – courtship display flights for many species occur in Mar or Apr)
      (2) rough-legged hawk breeding phenology – looks OK, incubation and nestling phases
   ii) Species identification error
   iii) Lacking coverage – few BBS in RLHA breeding area
      (1) BBS routes concentrated in Southern Canada, and very few in Boreal or Arctic regions
      (2) Statistical summary

5) Final recommendation

Nest Surveys

1) Breeding population size
   a) Counts vs. estimates
      i) Human Tolerance / Disturbance
         (1) Defense against humans intruders varies from lax to vigorous, with physical contact not uncommon (Palmer 1988)
         (2) Swem (1996) long term study indicated that RLHA are tolerant of single, relatively short disturbances near their nests late in incubation or early in brood rearing and that disturbances do not significantly affect nest success, brood size, or reoccupancy of the nesting territory in the following year.
      ii) Breeding Densities – in general, breeding raptors tend to be regularly spaced where nest sites are widespread but more clumped in areas where nest sites are concentrated (Newton 1979). The ability of raptors to concentrate on unevenly distributed nest sites is limited, however, by the extent that pairs will tolerate others nesting nearby.
         (1) Alternate nests are constructed. However, favored sites of successive pairs are apparently used repeatedly (Palmer 1988).
         (2) In Hudson Bay region of NW Quebec, Brodeur et al 1994 found 1pair/201 km^2 with 70 empty buteo nests. Nests not homogenous in area, most near coastline
         (3) Poole and Bromley (1988) 1pair/62.5 km^2 to 1pr/333.3 km^2 in a 4 yr study.
         (4) In West Alaska, spacing of nests is not regular and in clusters (6-10 pairs), as is with GOEA & GYRF, where numerous sites appeared to be available (Palmer 1980, Weir in Ladd & Schempf) . Spacing appears to be related to occupation of traditional sites plus rodent numbers.
         (5) On Seward Penninsula, AL, pairs increased from 35 in 1968 to 82 in 1970; In 1972 plummeted to 10 pairs and only 2 young fledged (Swartz et al., in Murphy et al. 1973) Need to get reference and paper… in Palmer on pg 170
         (6) In forests and bogs of Finland 1963-66 1nest(pair)/30-50km^2 , and hunting territories during hatching were 5-7 sq km increased to 10 sq km during nestling. (Pasanen 1972)
         (7) In forested SW Alaska, distance between nests were < 3 km (1.9mi) and down to .8 km (.5mi) – they must have overlapped (Mindell and Dotson)

(8) Inconsistent spacing of nests, it appeared random and patchy (Poole and Bromley 1988) possibly due to the patchy microtine distribution.

(9) Swem (1996) in his 10 year study of the Colville River in Northern Alaska found that the number of pairs occupying breeding territories varied from 40-103 (avg. **0** = 81.8, CV=26.1%)

iii) Population Size

(1) Pasanen and Sulkava (1971) n= 4 yrs population size varied (CV) 16.4% in Finland

(2) Mindell (1983) on the Kuskokwim River in interior Alaska n=4 yrs, 24%

(3) Swartz et al. (1975) 60.5% on the Seward Peninsula, n=5 yrs

(4) Poole and Bromley (1988) 63.5% in the NW Territories, n=4yrs

(5) Hagen (1969) found in 2 study areas in Norway 72.2% (n=8yrs), and 84.6% (n=6yrs)

(6) 26.8% in 12 earlier surveys conducted on the Colville River between 1952and 1984 (Kessel and Cade 1958, White and Cade 1975, Dittrick and Swem 1981, Swem et al. 1982, Dittrick and Moorehead 1983, Swem 1996)

(7) 26% Swem (1996) in his 10 year study of the Colville River in Northern Alaska

iv) Clutch size

(1) In N Alaska, 2-5 eggs, mean 3.23 (Kessel et al 1953)

(2) On SE Victoria Is. 4-6 eggs (Parmelee et al. 1967)

(3) In '63 Perry River region NW Keewatin 4-6, mean 5. (Aleksiuk 1964) and in '65 there was 2-5 mean 3.3. (Sealy 1966)

(4) Mindell (1983) avg for 4 years 5/11, 5/16, 5/21, 5/22

(5) Swem (1996 Colville, AK) found clutch size varied from 1 to 6 and avg 3.03 eggs for all 10 years combined. Clutch size varied significantly among years with annual means varying from 2.25 to 3.86.

v) Brood size

(1) Swem (1996 Colville, AK) varied from 1 to 5 and averaged 2.75. Mean brood size varied from 1.7-3.5 young per nest. Varied significantly among years.

vi) Viable Egg Dates – in general, raptors tend to nest earlier in year when prey is more abundant (Newton 1979), and Hagen (1969) found this to be true for rough-legged hawks in Norway.

(1) Labrador May 2 – June 23, with half June 4-10

(2) Alaska & Artic Canada – May 19-July 13, with half May 30-Jun 20 (Palmer 1988)

(3) In the forest zone SW Alaska, avg dates ranged June 10-21 (Mindell 1983), which would indicate clutches end of the 1st week of May.

(4) Poole and Bromley 1988, arrive in early to mid May and laid eggs in early June, with fledglings in early August.

(5) Kuyt 1980 in Poole & Bromley, very similar – mean date initiation of egg laying June 9

(6) Swem (1996 Colville, AK) found median egg laying dates varied (significantly among years) from May 17-27 (514 nests). Median laying dates negatively correlated with average daily minimum temp in the 20 days prior to egg laying. In 8 out of 10 years, **50%** of pairs initiated laying within 5 days or less.

(7) Mindell (1983;SouthWestern Alaska) avg HATCHING for 4 years 5/22, 6/10, 6/20, 6/21

vii) Other nest characteristics

(1) Late arriver, after gyrfalcon, golden eagle, raven; same as peregrine falcon. They arrive later, initiated nesting later, used smaller cliffs with less overhang, took smaller prey, and had relatively shorter reproductive periods (Poole and Bromley 1988- central Arctic study 400km north of NW Territories)

(2) Nest Orientation

(a) Approximately oriented (mean aspect=) 160E (Poole and Bromley 1988)

(b) Nest face predominantly north or east Kuyt (1980) in southcentral NW Territories

(c) Approx 70% faces S, SE or SW; 26.5% face N or NE

(3) Stick nests built by themselves

(4) Cliff height 12.6"5.3

(5) Nest height

(a) Poole and Bromley 1988 = 7.4"3.2

(b) Brodeur et al 1994 6-90 m , mean = 19"15.4

(6) Overhang 20.5%

(7) Mean internest distance

(a) Mean (" SD) internest distance (n in parenthesis) for RLHA = 7.7"5.8 (range was 3.6"3.6 and 11.8"12.7) (Poole and Bromley 1988)

(b) Brodeur et al 1994 mean nearest neighbor distance was 4.95 km (SD=3.82). Min distance between 2 nests was 250m and another eight nests were less than 1km apart.

(c) Swem (1996) in the upriver of Umiat study area found that pairs nested as close as 200 m only six time and < 500 m apart only 21 times (roughly 890 nests examined) over 10 years. In the downriver study area distance avg 1.06-1.16 km apart. Overall, occupied territories spaced avg .8 to 1.16 km apart.

(d) Mindell (1983) results varied from avg distance between nests 2.6-4.9 km in the Kuskokwim area; and 2.5-12.9 km (2.5 Canyon Creek, 5.8 Chiroskey, 8.9 on Gagaryah, 12.9 Old Woman); 4.9 in Oskawalik River.

viii) Hatching Success

(1) High in Perry River with 85.7% nest success

(2) Swem (1996 Colville, AK) success varied from 34-84%

ix) Life expectancy

(1) N America, life span was 20.7 months – oldest 18 years 1 month (Keran 1981)

(2) Avg life span 26.1 months – oldest band reported 17 yrs 2 months

x) Techniques / suggestions /findings

(1) When pairs had nests, one or both adults were invariably present and their vocalizations and/or circling above the nest made them obvious. Swem (1996 Colville, AK)

b) Statistical adequacy

i) Sample sizes

ii) Beta level (% change detectable)

iii) Power

2) Reoccupancy and reproductive success

   a) Data needed for baseline
   b) Resurvey methodology - feasibility of repeated studies
   c) Results –
3) Demographic modelling
   a) Productivity data
   b) Mortality data
   c) Examples if available
4) Conclusions, all breeding season surveys
   a) Population trend with available data
   b) Statistical Adequacy
      i) Area of inference
      ii) Sample sizes
      iii) Beta level (% change detectable)
      iv) Power
5) Overall effectiveness
   a) Literature comments
   b) Sources of error / problems
   c) Statistical summary
   d) Final recommendation

MIGRATION SEASON SURVEYS

Migration Season Distribution, Timing, and Habitat

1) *Migration routes and timing*
   a) Literature – text accounts and/or additional maps
   b) Observations
   c) Band recoveries
   d) Telemetry
2) *Habitat associations*
3) *Human disturbance – historical*
   a) *Brewster (1925 from Palmer 1988) wrote that the Conn. River valley was a principal migration route through Mass. But that the birds were either slain or drive away by 1880. They were easily approached by a gunner in a horse-propelled vehicle.*
   b) *Migration Season Surveys* –relative probabilities of detectability, and other factors affecting surveys, based on habitats and behaviors throughout migration.

SUMMARY OF HOW EACH TOPIC ABOVE AFFECTS ABILITY TO SURVEY AND THUS, MONITOR THE SUBSPECIES, THROUGH THEIR GEOGRAPHIC RANGES DURING MIGRATION SEASONS.

Migration Counts

1) Distribution
   a) Observations & counts
      i) One of the most feasible but many limitations. It may be able to indicate long term trends?
      ii) Many years of data need to detect non-cyclic long-term trends in birds that fluctuate with prey

iii) Roughlegs may not follow ridges as most others due, may use more open spaces (need Ref??) Origin of wintering hawks has not been determined. Some speculation is that Newton (1979) generally thinks that hawks that breed further west tend to winter further west, and northernmost populations tend to winter furthest south. Fleming (1981) speculated that hawks in Columbia Basin migrated from northwest Alaska on the basis of similarity in the degree of melanism (Cade 1955).
iv) Data usually expressed as total numbers of birds observed per year, or as numbers of birds observed per hour of effort (Hackman and Henny 1971) with little or no adjustment for temporal variation in the volume of migration. This data is deceptive because the volume of migration varies seasonally. Total numbers or measures of hourly movement depend on when the samples were taken. A common bias of hawk-count data in recent years is that coverage has increased greatly, especially in the early and late portions of the migration season when volume is low. When such data is compared with numbers per hour of earlier years, erroneous declines appear (Titus et al. 1989). (from Bednarz et al. 1990)
v) Marathon, Ontario on North Shore of Lake Superior, rugged hills support unbroken boreal forest, RLHA most abundant with 409 counted, 41.4% of all. (Escott 1983)

b) Peak Migration Dates
   i) Marathon, Ontario – October 13-31 (Escott 1983)
c) Early & Late Dates areas
   i) Early
      (1) Marathon – Sept 20 (Escott 1983)
   ii) Late
      (1) Marathon – Nov 18 (Escott 1983)
d) Flight Behavior
   i) Height
      (1) Moderate - (Escott 1983)
   ii) Peak Numbers
      (1) Noon - (Escott 1983)
e) Band recoveries
   i) Total banded 4424 (From 1955 up to April 2000)
   ii) Total recovered 213 (From 1936 to Feb '99)

2) National population trends
   a) Plot stations relative to species distribution
      i) Best Locations
         (1) Pacific Continental Flyway
            (a) Chelan Ridge (4 yrs)
         (2) Western Mountain Continental Flyway
            (a) Mount Lorette, Alberta, Canada (9 yrs)
            (b) Windy Point, Alberta, Canada (17 yrs)
            (c) Bridger Mountain, Montana, USA (10 yrs)
         (3) Central Continental Flyway
            (a) Hawk Ridge, Minnesota, USA ( )
            (b) Cranberry Marsh, Ontario, Canada ( )
         (4) Eastern Continental Flyway
            (a) Hawk Mountain, Pennsylvania, USA (63 yrs)

(b) Waggoner's Gap, Pennsylvania, USA (18 yrs)
(c) The Pinnacle, New York, USA (5 yrs)
(d) Franklin Mountain, New York, USA (12 yrs)

b) Present data from select stations

3) Regional population trends
- a) Political boundaries
- b) Subspecies
- c) Literature
  - i) Hawk Mtn (Bednarz et al. 1990)
    - (1) Declining numbers from 1971-1986
    - (2) Because annual mean counts of RLHA low (**0** = 8.7; n=50yrs) suggest that population changes in this species would not be detected at Hawk Mtn. Unless of great magnitude.
  - ii) Six sites by (Titus and Fuller 1990)
    - (1) Found nonsignificant (P>0.10) slopes for counts at 6 of 6 sites.
    - (2) Suggests using different survey methods for monitoring RLHA that has low counts (<20/yr/site) or irruptive species like RLHA.
  - iii) Kirk and Hyslop (1998) migration analyses suggested that populations were stable, but with a significant negative trend at Hawk Ridge
    - (1) Annual percent change of –8.7 at Hawk Ridge at p<0.05 calculated by logistic multiple regression

4) Statistical Adequacy
- a) Area of inference
- b) Sample size
- c) Beta level (% change detectable)
- d) Power

5) Overall effectiveness
- a) Literature comments
  - i) Suggested methods
    - (1) To standardize data (Bednarz et al. 1990)
      - (a) sum all counts over all years for each species,
      - (b) defined sample period, removing portion off of each side of sample – 1-2% off of total. Sample period same for all years
      - (c) Trends were determined by standard linear regression (log transformation made no difference)
      - (d) Used hawks/10 hrs of observation
- b) Sources of error / problems
  - i) Lack of standardization
    - (1) Changes in techniques (mainly taken from Titus and Fuller 1990).
      - (a) RESULTS - Found strong agreement between single-site, pooled-sites, simple regression & nonparametric.
      - (b) Linear regression – to test for species specific trends in hawk counts at single sites over time, evaluating the slope of the regression line using the F-statistic.
      - (c) Multiple regression and or partial correlation
        - (i) Route-regression trend analysis (Geissler and Noon 1981, Geissler and Sauer 1990) to estimate trends among count sites. Trend was estimated for

each site separately with an overall trend being estimated as a weighted mean of the trends at individual sites. This method can use unbalance data, i.e. count sites that had different total years of data. Evaluated trend by its mean annual percent increase or decrease, and the significance of trends was tested using a t-statistic. The variance among sites was estimated by bootstrapping the count-site slopes (Geissler and Sauer 1990). Considered trends to be significant at P < 0.10.

(ii) Route regression – weighted approach has appeal in that sites with greater counts of a given species and more years can be weighted more in the analysis (Geissler and Sauer 1990). A limitation is that data are often not available from a large number of sites.

(iii) No correlation of CV and mean counts for species indicates that statistically more significant trends in not more or less likely to be detected simply due to the magnitude of the counts. (Titus and Fuller 1990, Titus et al. 1989)

(d) Pooled site analyses

(i) Used non-parametric rank trend analysis, weights each site equally, regardless of the magnitude of the count

(ii) Pooling sites increases the precision in otherwise variable data (Harris 1986) and when trends are being estimated over short time frames.

(e) Non-parametric

(i) Rank-trend analysis (Titus et al. 1990)

(2) Changes in observation times

(3) Changes in number of observers

ii) Different seasonal monitoring times – those that extend into dec probably pick up more roughlegs.

iii) Unknown source population and/or destination

(1) Counts at different sites may be sampling birds from different geographic populations from unknown regions (Titus & Fuller 1990). Cannot really pool data because of this.

iv) Subspecies identification

v) Variation in Observers ability to detect and identify

vi) Observer fatigue

vii) Visibility bias

(1) Influence of weather

viii) Low sample size

ix) Differential distribution by sex

c) Statistical summary

i) How do we know that the corrected migration numbers reflect real population change?

(1) Best example is data from a count site in the Great Lakes (Kirk et al. 1995), where a significant positive correlation between trends derived from migration counts and from Ontario BBS for 11 raptor species.

(2) Strong correlation between the Grimsby raptor trends and those calculated for six other sites in eastern N.A. by Titus and Fuller (1990).

d) Final recommendations

WINTER SEASON SURVEYS

Winter Season Distribution, Timing, and Habitat

1) *Winter season distribution*
    a) Literature – text accounts and/or additional maps
    b) Observations
    c) Band recoveries
    d) Telemetry
2) *Habitat associations*
3) *Winter Season Surveys* –relative probabilities of detectability, and other factors affecting surveys, based on habitats and behaviors throughout winter.
    a) *Regionally independent breeding fluctuations could be expected to* lead to the same for some winter populations. The tendency of wintering roughlegs to concentrate in areas of high prey abundance also contributes to annually fluctuating winter densities.
    b) *Site fidelity*

SUMMARY OF HOW EACH TOPIC ABOVE AFFECTS ABILITY TO SURVEY AND THUS, MONITOR THE SUBSPECIES, THROUGH THEIR GEOGRAPHIC RANGES, DURING THE WINTER SEASON.

If a species has substantial range outside the N. Am. continent, note this. If it is known that important issues relevant to a species status occur outside the N. Am. continent, note these and relevant monitoring considerations for that area (e.g., the contaminants threat to the majority of adult Swainson's hawk, which spend the austral summer in central Argentina).

Christmas Bird Count

1) National trends – largest and oldest wildlife survey in the world. A recent survey by Peterjohn and Sauer 1994 see Kirk et al. 1995, that demonstrated a correlation between CBC and BBS trends, suggesting that CBC can provide useful trend data.
    a) Data sources
    b) Maps
2) Regional trends
    a) Titus et al. (1989) found no trends in counts for RLHA in the NE US for CBC data from 1962-1983 in 11 NE states
    b) Kirk et al. 1995, give an annual percentage change from CBC of -.01 for the years 1995-1988, with a total number of circles of 1551.
    c) Johnsgard (1990) estimated 49,600 rough-legged hawks wintered in coterminous 48 states during 1986
    d) Bock and Lepthien (1976) considered the species to be the second most common buteo of the US during winter.
3) Statistical Adequacy
    a) Sample sizes
    b) Beta level (% change detectable)
    c) Power
4) Overall effectiveness
    a) Literature comments
    b) Sources of error / problems
        i) Low detection rates

   ii) Unstandardized in both coverage and observer numbers
  c) Statistical summary
  d) Final recommendation

Other Surveys

1) Roadside counts
  a) Intro
   i) Road transects have often been used to obtain density indices to study regional abundance, seasonal changes in populations, population trends or habitat selection
   ii) Craighead & Craighead (1956) showed that road transects could be useful to estimate raptor populations whenever a previous pilot study is made relating "real" population sizes to the abundance indices provided by road transects.
   iii) Millsap & LeFranc (1988) tested the accuracy of several census techniques based on road transects by using static models of perches raptors and concluded that unadjusted counts provided the most precise results. However, the extent of their analysis is limited because flying raptors are often observed flying as well.
  b) Sources of error/ problems
   i) Differential detectability of species; also depends on the habitat being sampled.
    (1) RLHA not a problem – usually a hunter in open area rarely using forested areas
  c) Methods
   i) Unadjusted counts: an index of relative density (IRD), defined as number of birds seen per 100km of transect
   ii) Strip counts: all observations of isolated birds were assigned to six strips 100m side at each side of the transect. Max distance of observation was estimated to be a little over 1 km. Observations > 600 m eliminated. Data was analyzed with program DISTANCE (ViZuela 1997)
    (1) Caution when sampling species that may be attracted by roads, where they may be finding prey or using power poles to perch, because a basic premise of DISTANCE method is that the spatial distribution of individuals is independent of the transect. (Buckland et al. 1993)
2) Feeder Watch
3) Roost Counts
  a) Schnell (1969) found in Dekalb, Illinois that many rough-legs commonly use communal roosting sites. 1 to 2 hours before sunset, but left again. The first birds to roost came in about 15 minutes before sunset. Most arrived 5 to 15 min after sunset.Movements toward and away from the roost continued for 10 to 20 minutes, but by sunset the birds that had landed remained there. Approach is low steady and deliberate. Almost all birds leave before sunrise, often 20-30 minutes before. Counts vary daily from 0 to 15.
4) Etc.

Interview of 54 experts (Saurola 1985) to estimate Finnish birds of prey. Used to estimate the maximum number of breeding pairs in a hypothetical year when small rodents reach their peak numbers.

SUMMARY

1) Overview

   a) Literature comments – Analyses that emphasize vigorous standardization (e.g. Bednarz et al. 1990) or consider sources of variation (e.g. Hussell 1985) may be more reliable than others.
      i) Kirk et al. 1995 estimated the population size or the current best estimate of number of breeding pairs in Canada to be between 10,000 and 25,000.
   b) Existing methods
      i) Comparison of result from different techniques important because each data set has its own limitations. Unfortunately, because few RLHA are counted by BBS and CBC, they are of limited value for monitoring RLHA populations. Since BBS and CBC do not extend far into Canada, they are useful for evaluating RLHA.
   c) Existing databases
2) Final survey recommendation
   a) Monitoring method(s) chosen
   b) Justification
   c) Feasibility
   d) New data and methodologies needed
3) Action plan & General recommendations

Does recommended method(s) work for other species in the range of the species addressed in this account?

Appendices
Tables
Figures

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