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Breeding Season Irruptions of Rough-legged Hawks (*Buteo lagopus*) on Insular Newfoundland

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ABSTRACT. Rough-legged hawks (*Buteo lagopus* Pontoppidan), a species typically associated with more northerly regions, occurred in unusually high numbers on insular Newfoundland in the summers of 1988 and 1993, and some pairs nested in noncoastal areas on the island in 1993. We suggest that the island is an alternative breeding ground for the species during years of low prey abundance on the Labrador Peninsula. Our observations concur with hypotheses that rough-legged hawks nomadically search for nesting territories and exploit areas near the limits of their breeding range during such years. Forest clear-cuts were used for foraging by pairs nesting in interior Newfoundland during 1993, which suggests that forest harvesting may have opened new alternative habitats for rough-legged hawks.

Key words: rough-legged hawk, *Buteo lagopus* Pontoppidan, breeding distribution, clear-cut, irruption, nomadism, Newfoundland, predator–prey cycles

RÉSUMÉ. Un nombre inhabituellement élevé de buses pattues (*Buteo lagopus* Pontoppidan), une espèce typiquement associée aux régions nordiques, a été observé sur l'île de Terre-Neuve durant les étés de 1988 et 1993, et quelques couples y ont niché dans les régions non côtières en 1993. Ces observations suggèrent que l'île est une aire de nidification alternative pour l'espèce pendant les années où les proies se font rares sur la péninsule du Labrador. Nos observations concourent à l'hypothèse voulant que les buses pattues utilisent différents territoires de nidification et exploitent les régions à proximité des limites de leur aire de nidification pendant les années où les proies se font rares. Les couples nichant dans les régions non côtières de Terre-Neuve en 1993 se sont régulièrement alimentés dans les coupes à blanc, ce qui suggère que l'exploitation forestière pourrait avoir offert de nouveaux habitats alternatifs pour les buses pattues.

Mots clés: distribution de la nidification, buse pattue, *Buteo lagopus* Pontoppidan, coupe à blanc, irruption, nomadisme, Terre-Neuve, cycles prédateur-proie

INTRODUCTION

The rough-legged hawk (*Buteo lagopus*) is a Holarctic species that normally breeds in areas of tundra to a southern limit around the tree line (Johnsgard, 1990). Populations of its primary prey, small rodents, exhibit three- to five-year population cycles (Krebs and Myers, 1974) that are generally synchronous over areas of thousands of square kilometers (Elton, 1942; Chitty, 1950; Kalela, 1962; Andersson and Jonasson, 1986). Breeding densities of rough-legged hawks have been shown to fluctuate synchronously with prey populations (e.g., Todd, 1963; Poole and Bromley, 1988; Virkkala, 1992; Goudie et al., 1994), and 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). Andersson (1980) demonstrated that cyclic food production favors nomadism in birds, as individuals seek out areas of high prey density in which to establish nesting territories. Cyclic prey availability and nomadism have typically been the mechanisms used to explain instantaneous tracking of prey abundance by breeding populations of rough-legged hawks (e.g., Galushin, 1974; Newton, 1976). Other species of Low Arctic raptors having similar diets and numerically similar breeding density responses to prey abundance, such as northern hawk-owl (*Surnia ulula*), long-eared owl (*Asio otus* Linnaeus), and short-eared owl (*Asio flammeus*), have been shown to immigrate into areas of high prey abundance to nest (Korpimäki and Norrdahl, 1991; Virkkala, 1992).

Nest-site fidelity and nomadism among rough-legged hawks have not been widely investigated, though Galushin (1974) reported that the average distance between natal or nesting sites and subsequent breeding areas for individuals banded in Eurasia was large (1955 ± 1079 km; mean ± SD). This fact suggests that individuals are highly flexible with respect to location of breeding territories, a trait which would presumably be associated with nomadism. After arrival on the breeding grounds, nomadic species have long prenesting periods to allow time to assess prey availability and, if necessary, relocate (Galushin,1974). This appears to be true for rough-legged hawks in North America, which begin to lay eggs one to two months after returning to northern breeding areas (Todd, 1963; Johnsgard, 1990). In addition, rough-legged hawks may be able to visually detect scent marks of

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small mammals, which reflect ambiant ultraviolet light (Viitala et al., 1995). This ability would allow rapid assessment of local prey availability and facilitate selection of breeding territories. Galushin (1974) also suggested 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 breeding range. This appeared to be the case in Norway in 1962, when rough-legged hawks nested to the south of typical breeding grounds (Mysterud, 1964 cited in Galushin, 1974).

Newfoundland lies at the southeastern limit of the breeding range for rough-legged hawks in North America. The species has traditionally been rare on insular Newfoundland (Peters and Burleigh, 1951), and the majority of sightings have been limited to coastal areas (Montevecchi, unpubl. data). Here we provide evidence from several sources that document breeding season invasions of rough-legged hawks on insular Newfoundland in 1988 and 1993. We hypothesize that during years of low prey abundance on portions of the nearby Labrador Peninsula, many rough-legged hawks move southward to insular Newfoundland in search of breeding territories that support a higher abundance of prey.

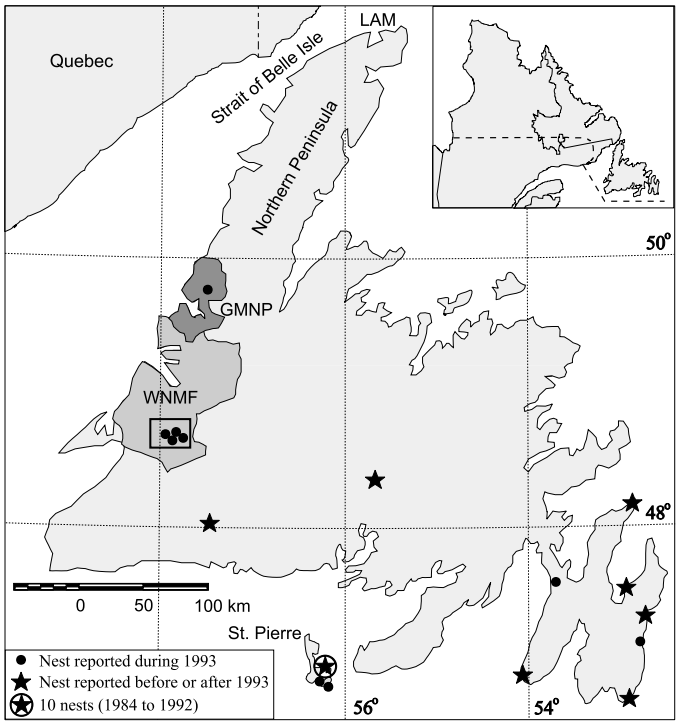

FIG. 1. The southeastern Labrador Peninsula and insular Newfoundland, including the Western Newfoundland Model Forest (WNMF), L'Anse aux Meadows (LAM), and Gros Morne National Park (GMNP). The black rectangle indicates the 1993–94 study area. Stars indicate nest sites reported before and after 1993; black dots indicate nest sites reported during 1993. From 1984 to 1992, ten nest records were reported for the French islands of St. Pierre and nearby Grand Columbier (R. Etcheberry, pers. comm. 1995). The inset depicts the Labrador Peninsula, and the dashed line indicates the southern limit of the breeding range of rough-legged hawks (adapted from Godfrey, 1986).

METHODS

A two-year study of woodland birds of prey was conducted in the Western Newfoundland Model Forest (WNMF; Fig. 1) during 1993 and 1994. The study area, located in the Western Newfoundland Ecoregion (Damman, 1983), is situated 30–60 km inland. Regional vegetation is dominated by balsam fir (*Abies balsamea* (L.) Miller) forests interspersed with extensive areas of open ground (e.g., bogs and clear-cuts). Topography in the area is rugged (Damman, 1983), with frequent rock faces and high ground that typically supports rock–barren tundra vegetation communities. Forests in the area are intensively managed; clear-cutting and precommercial thinning are the most common silvicultural practices.

Field research began in late May each year and continued until mid-August. Raptor surveys were carried out along routes that followed woodland access roads through clear-cut, second-growth (40–60 years), and old-growth (80+ years) forests. Vocalization broadcast surveys were conducted following the methods of Mosher et al. (1990). Broadcast stations were placed at 800 m intervals along survey routes. Vocalization recordings of sharp-shinned hawk (*Accipiter striatus*), northern goshawk (*A. gentilis*), merlin (*Falco columbarius*), boreal owl (*Aegolius funereus*), great horned owl (*Bubo virginianus*), and northern hawk-owl were broadcast during surveys. Rough-legged hawk vocalizations were not broadcast, as we did not expect to find this species, which is not typically associated with woodland habitat, in the study area.

Observers throughout the province currently report bird sightings to W.A. Montevecchi. Detailed records have been maintained since such reports were initiated by L. Tuck in the 1950s, and these records provide a crude index of the seasonal abundance of rough-legged hawks on insular Newfoundland. We used the number of rough-legged hawks reported on the island between 1 April and 31 August each year as an index of breeding season abundance. Numbers reported between 1 November and 31 March were used as an index of the abundance of overwintering hawks, after the departure of fall migrants.

RESULTS

Surprisingly, rough-legged hawks were the most frequently observed bird of prey in 1993 (Table 1). In total, seven pairs and four solitary individuals were sighted, not including nestlings and fledglings (total = 18 individuals). Sightings occurred along cliff faces and in clear-cuts. On eight occasions individuals were seen perched in trees, hovering, slow soaring or carrying prey in clear-cuts.

Four occupied rough-legged hawk nests were located on cliffs in 1993. The mean distance (± SD) between neighbouring nests was 5.6 ± 2.2 km. In the three nests located during incubation, hatching occurred between 18 June and 25 June. At least two young were present in each of four nests during the two weeks prior to fledging (25 July to 8 August). However, exact brood counts could not be obtained because

TABLE 1. Counts of adult birds of prey in the Western Newfoundland Model Forest in 1993 and 1994.[1]

Species		1993	1994
Sharp-shinned Hawk	*Accipiter striatus* Vieillot	6	8
Northern Goshawk	*Accipiter gentilis* Linnaeus	0	1
Rough-legged Hawk	*Buteo lagopus* Pontoppidan	18	0
Boreal Owl	*Aegolius funereus* Linnaeus	5	1
Great Horned Owl	*Bubo virginianus* Gmelin	2	4
Northern Hawk-owl	*Surnia ulula* Linnaeus	5	7
Merlin	*Falco columbarius* Linnaeus	14	16
American Kestrel	*Falco sparverius* Linnaeus	8	4

[1] Numbers include individuals seen outside of survey routes but within the study area.

the nests were inaccessible. Nests were vacated during the second week of August, and two young were observed near each of two of these nests after fledging.

In 1994, field work was carried out at a similar intensity, and all of the 1993 routes were resurveyed. No rough-legged hawks were seen in the study area in 1994, and all four nests located in 1993 were vacant. Counts of other species of raptors were generally similar in both years (Table 1), indicating that observed differences in counts of rough-legged hawks between the two years reflected a change in abundance, not survey efficiency. Also, no rough-legged hawks were sighted during a separate avian study carried out in the region in the summer of 1995 (Whitaker, unpubl. data).

A graphical analysis of sightings reported over the past 20 years (from November 1975 to August 1995) indicated that rough-legged hawks are generally uncommon on insular Newfoundland (Fig. 2). Winter counts of the species on the island were low, averaging (± SD) 3.0 ± 3.6 hawks reported. Numbers of individual rough-legged hawks reported during breeding seasons from 1975 to 1995 are typically higher, though in the same range as the winter reports (Fig. 2), except during the breeding seasons of 1988 and 1993, when 58 and 49 individuals were reported, respectively. The average (± SD) number of individuals reported each breeding season, excluding 1988 and 1993, was 6.4 ± 5.1. It seems unlikely that the near tenfold increases observed in 1988 and 1993 could be attributed to either chance or observer effort. Following the peaks in numbers of reports in the breeding seasons of 1988 and 1993, counts immediately returned to typical levels, and remained there in subsequent breeding seasons (Fig. 2). Excluding the nests located in 1993, 15 of the 17 nest records for rough-legged hawks on insular Newfoundland (1959–94) are from coastal cliff sites; the other two nests were located inland in the extensive Maritime Barrens Ecoregion in southern Newfoundland (Damman, 1983; Fig. 1).

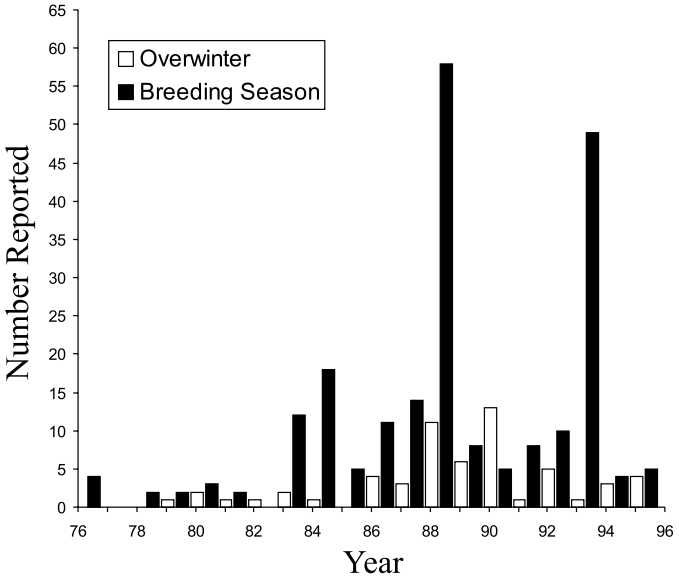

FIG. 2. Numbers of rough-legged hawk sightings on insular Newfoundland reported annually from 1975 to 1995. Sightings are grouped according to those reported during the breeding season (1 April to 31 August) and those reported during winter (1 November to 31 March).

DISCUSSION

Movements of several species of nomadic, small mammal-dependent raptors occur only during the lowest phase of the rodent cycle (Korpimäki, 1984). Invasions southward from Labrador, limited to years of extremely low prey density, would explain why the observed increases in breeding and summering rough-legged hawks on insular Newfoundland persisted for only one season in each case. Moreover, the separation of these invasions by five years is consistent with the hypothesis that numbers of rough-legged hawks seen in Newfoundland are related to the three- to five-year cycles of small mammal abundance on the Labrador Peninsula (Elton, 1942).

Extensive helicopter surveys of breeding cliff-nesting raptors were conducted in Labrador from 1987 to 1989 (Goudie et al., 1994). Rough-legged hawks were the most common species in both 1987 (23 adults, 6 nests) and 1989 (72 adults, 29 nests), but were absent in 1988 (Goudie et al., 1994). Thus, there appears to have been an inverse correlation between the numbers of rough-legged hawks seen in Labrador and those seen in Newfoundland during breeding seasons from 1987 to 1989. Goudie et al. (1994) attributed these fluctuations to changes in small mammal populations, which had collapsed in Labrador in 1988, but increased by 1989.

A study in the fall of 1987 indicated that small mammal populations were extremely low throughout much of Labrador and the northeastern portions of Quebec in comparison to those of 1985 and 1986 (Fudge and Associates, 1989). This fact suggests that prey availability would have been extremely low when rough-legged hawks arrived on breeding grounds on the Labrador Peninsula in the spring of 1988. In a 12-year study in Finland, significant positive correlations were found between breeding densities of two species of nomadic raptors and local small mammal densities during the previous fall (Korpimäki, 1994). Observations from Labrador in 1987–88 concur with this type of pattern. Few data are available on small mammal populations in Labrador during the 1990s. Trapping was carried out periodically between 1985 and 1993 to census post-breeding (late August to

September) populations at a site in barren habitat in southern Labrador. No small mammals were captured in the fall of 1992, in contrast to results from previous years and from the fall of 1993 (J. Brazil, Newfoundland and Labrador Wildlife Division, pers. comm. 1995). This information suggests that populations of rough-legged hawk prey may have been low in portions of Labrador during the autumn preceding the spring and summer rough-legged hawk irruption observed on insular Newfoundland in 1993.

Information on small mammal populations in Newfoundland is unavailable for 1988. Populations were high in western Newfoundland in 1993 (Nichols, 1995; Sturtevant, 1996), and this fact was associated with successful breeding by rough-legged hawks. While we do not suggest that high prey populations in Newfoundland lead to local breeding-season irruptions of rough-legged hawks, they may facilitate successful breeding on the island. The low species diversity of small mammals on insular Newfoundland, as well as their relatively low density and biomass (Pruitt, 1972), may keep the indigenous breeding population of rough-legged hawks small.

Rough-legged hawks were observed hunting in clear-cuts. Clear-cutting, the standard forest harvesting practice in Newfoundland, has generated large patches of open habitat in woodland areas and has increased the breeding and foraging habitat available to rough-legged hawks. Other open ground raptors, such as northern hawk-owls and American kestrels (*Falco sparverius*), may also benefit from forestry clear-cutting practices. Kestrels, which were seen in clear-cuts in the Western Newfoundland Model Forest, have become more common and appear to be expanding their range on insular Newfoundland in recent decades (Montevecchi and Tuck, 1987).

During May 1993, abnormally high numbers of rough-legged hawks were observed flying south at L'Anse aux Meadows at the tip of Newfoundland's Northern Peninsula, just across the Strait of Belle Isle from Labrador (B. Mactavish, Jacques Whitford Consultants, St. John's, pers. comm. 1994), and in both 1988 and 1993, most rough-legged hawks were seen on the Northern Peninsula, many in clear-cuts (Mactavish, 1993; Montevecchi, unpubl. data). In addition, the first nesting record for rough-legged hawks in Gros Morne National Park, located at the base of the Northern Peninsula, was recorded during 1993 (H. Deichmann, Gros Morne National Park, pers. comm. 1995; Fig. 1). Presumably hawks moving from the Labrador Peninsula onto insular Newfoundland in search of breeding territories would do so at the Strait of Belle Isle and travel down the Northern Peninsula (Fig. 1). The strait is the shortest possible crossing (approximately 15 km) from mainland North America to insular Newfoundland.

On the basis of incubation and fledging periods of 31 and 31–40 days, respectively (Johnsgard, 1990), we estimate that egg laying by rough-legged hawks occurred from mid to late May in our study area in 1993. Similar calculations were made for the Labrador Peninsula, using information provided in Todd (1963) and Brodeur et al. (1994). Results indicated that laying dates in Newfoundland did not differ from those on the Labrador Peninsula. Thus, observations in Newfoundland concur with Galushin's (1974) suggestion that breeding in nontraditional regions does not delay nesting activity.

We offer the following scenario, which we believe explains what precipitated the invasions of rough-legged hawks observed on insular Newfoundland during the breeding seasons of 1988 and 1993. During March and April, rough-legged hawks return from wintering grounds in southern Canada and the United States to breeding grounds on the Labrador Peninsula (Todd, 1963) and elsewhere in northern Canada (Godfrey, 1986). In years when prey populations are adequate, they establish nesting territories. If, however, an extensive crash in local prey populations has occurred, some hawks move southward to insular Newfoundland where, if prey abundance is sufficient, they nest. Relatively high numbers of rough-legged hawks on insular Newfoundland may be a reliable indicator of low prey availability on the Labrador Peninsula.

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