RED-NECKED PHALAROPE ASSESSMENT

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MAINE DEPARTMENT OF INLAND FISHERIES AND WILDLIFE
WILDLIFE DIVISION
WILDLIFE RESOURCE ASSESSMENT SECTION
BIRD GROUP

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INTRODUCTION

Since 1968, the Maine Department of Inland Fisheries and Wildlife (MDIFW) has aggressively pursued development and refinement of wildlife species assessments and implementation of cost-effective comprehensive programs that support selected goals and objectives for the next 15 years. Assessments are based upon available information and the judgments of professional wildlife biologists responsible for individual species or groups of species. Precise data may not always be available or are too limited for meaningful statistical analysis; however, many trends and indications are sometimes clear and deserve management consideration.

The assessment has been organized to group information in a user-meaningful way. The Natural History section discusses biological characteristics of the species that are important to its management. The Management section contains history of regulations and regulatory authority, past management, past goals and objectives, and current management. The Habitat and Population sections address historic, current, and projected conditions for the species. The Use and Demand section addresses past, current, and projected use and demand of the species and its habitat. A Summary and Conclusions sections summarizes the major points of the assessment.

NATURAL HISTORY

Description

Two of the 3 species composing Phalaropodidae (Red-necked Phalarope [*Phalaropus lobatus*] and Red Phalarope [*P. fulicarius*]) are the most aquatic of all shorebirds (Charadriiformes) (Terres 1980, Hicklin 1987). The Red-necked and Red Phalaropes are the only truly oceanic shorebirds, possessing salt glands. Their dense breast and belly feathers and a layer of down that traps air enables phalaropes to float high on the water. Phalaropes rest and sleep while afloat (Terres 1980).

Red-necked Phalaropes have a sandpiper-like appearance, especially when running on shore; however, they are usually observed swimming. Their call is a sharp "kit" or "whit," similar to a Sanderling and with a lower pitch than a Red Phalarope (Peterson 1980, Hayman et al. 1986).

Red-necked Phalaropes are the smallest of the 3 phalarope species (Hayman et al. 1986, Schamel and Tracy 1989, Paulson 1993), 18-20 cm in length (Hayman et al. 1986, Peterson 1980) and weighing 28-50 g (Palmer 1967). Females are approximately 20% larger than males (Peterson 1980, Schamel and Tracy 1989, Paulson 1993). Wing lengths for females average 5% longer than males (wing length: F=109-118 mm, M=102-114 mm) (Hayman et al. 1986). Red-necked Phalaropes have short, dark legs (tarsus: 19-22 mm) and dark feet (Terres 1980, Hayman et al. 1986). Their toes are extensively webbed at the bases with scalloped lateral flanges (Terres 1980, Paulson 1993), adapting phalaropes for wading and swimming (Peterson 1980). They have a straight, needle-like, black bill, 19-23 mm in length (Hayman et al. 1986).

In all seasons, Red-necked Phalaropes have a white bar down their dark wing, white sides, and a dark rump (Terres 1980, Hayman et al. 1986). In flight, they resemble Sanderlings but with darker backs and a shorter white wing stripe. The Red-necked Phalarope flies with a flicking, twisting action (Peterson 1980, Hayman et al. 1986).

The breeding plumage of female Red-necked Phalaropes is more colorful than that of males. The female is generally slate-gray above with rufous-buff edging on the feathers along the back and scapulars. There is a distinctive chestnut-red patch on the sides and base of the neck and a distinctive white spot above the eye. Chin, throat, and underparts are white. The breeding plumage of male Red-necked Phalaropes is similar in pattern to females but duller (Hayman et al. 1986). Most birds attain full breeding plumage their first year (Paulson 1993).

Adults molt into nonbreeding plumage July to early August, before they begin their fall migration (Hayman et al. 1986, Paulson 1993). In their nonbreeding plumage, both sexes have slate-colored backs that are heavily streaked above, with entirely white underparts. The head is mostly white with a dark patch through the eyes (Hayman et al. 1986). More detailed descriptions of age- and sex-specific plumages and molting patterns are presented in Hayman et al. (1986) and Paulson (1993).

The Red Phalarope has a winter plumage similar to the Red-necked Phalarope. These 2 species occur together in large flocks on the ocean during fall staging in the lower Bay of Fundy (Brown and Gaskin 1988). The Red-necked Phalarope can be distinguished by its more slender, black bill and more heavily striped back (Peterson 1980, Hayman et al. 1986, Paulson 1993). The bill of the Red Phalarope may be

yellowish at its base (Peterson 1980). In comparison to the Red Phalarope, the Red-necked Phalarope has a faster wing beat and a more erratic flight with rapid twists and turns (Hayman et al. 1986).

Distribution

The Red-necked Phalarope has a circumboreal breeding range. In North America these phalaropes nest in low Arctic latitudes from west and northern Alaska, south to southern Alaska, Aleutian Islands, southern Yukon, and east to Greenland and the coast of Labrador. In eastern Canada, Red-necked Phalaropes breed south to about 54°N and to 60°N in Greenland. Red Phalaropes nest in the high Arctic latitudes, discontinuously around the Arctic circle (Terres 1980, Orr et al. 1982, Richards 1988).

Both Red-necked and Red Phalaropes winter at sea in the Southern Hemisphere (Knight 1908, Peterson 1980, Schamel and Tracy 1989, Paulson 1993). Red-necked Phalaropes, generally found closer to shore than Red Phalaropes, are abundant off Peru, western Africa, southern Arabia and Moluccas, and in the Indian Ocean and South China Sea (Terres 1980, Brown and Gaskin 1988). Their preference of wintering areas may be influenced by an available, predictable food supply and the distance migrants travel from breeding grounds (Brown and Gaskin 1988).

Breeding Biology

Phalaropes reverse the normal parental roles of the sexes. The female is larger and more brightly colored than the male; she initiates courtship. A high level of androgen produced in the ovary results in the brilliant plumage of female phalaropes

and probably contributes to their aggressive behavior. The mating system has been described as monogamous, or serially polyandrous (after completing a clutch, the female may sequentially mate with other males) (Terres 1980, Hayman et al. 1986, Reynolds 1987, Schamel and Tracy 1989).

In successive years, approximately 50% of the Red-necked Phalaropes return to the same nesting locations, occasionally mating with the same partners. They are not territorial in nesting behavior; however, mates may be defended. This behavior reinforces the bond between mated birds. Home ranges vary 1-10 acres, with overlap (Reynolds et al. 1986, Schamel and Tracy 1989).

Nests are on the ground, near water. Males, and to a limited extent females, scratch out a small depression in the moist tundra and line it with grasses, dead leaves, and lichen. Males add to the lining during egg-laying and early incubation (Höhn 1968, Terres 1980, Schamel and Tracy 1989).

Egg-laying occurs late May through June (Bent 1927, Terres 1980). The eggs are olive, blotched or rarely dotted with dark brown. The average clutch size is 4 eggs, with one egg laid/day. Some females have been reported to produce up to 4 sets of eggs in the same nesting season (Terres 1980, Schamel and Tracy 1989). Females leave the nesting ground when they have completed egg-laying for the season. They take no part in incubation or care of young (Hayman et al. 1986).

Incubation begins after the third egg is laid and lasts 18-23 days. The male develops 2 brood patches and incubates the eggs alone (Terres 1980, Schamel and Tracy 1989). In western and northern Alaska, Schamel and Tracy (1991) reported a high hatching success rate, >80%. After hatching, males may remain with and care for

the chicks up to 14 days before beginning their southern migration. The young then feed themselves, grow rapidly, and are able to fly when 18-21 days old; they then begin migrating south (Schamel and Tracy 1989).

Because males incubate and rear young alone, females are able to rapidly produce multiple sets of eggs, have multiple mates, or quickly replace destroyed eggs. Thus, phalaropes demonstrate a unique reproductive strategy for coping with problems associated with nesting in arctic regions, including unpredictable weather and occasional high losses of eggs to predators. Predators on the nesting ground include foxes, weasels, jaegers, gulls, and owls (Schamel and Tracy 1989).

Survival and Longevity

Red-necked Phalaropes have a longevity of at least 10 years (Clapp et al. 1982, Schamel and Tracy 1989). Survival rates for this species are lacking. However, the range of vital rates determined for shorebird species give an indication of rates applicable to Red-necked Phalarope population dynamics. Average annual survival rates for adult shorebirds range 70-94%. Survival rates for young of the year of many shorebird species range 20-30% (Evans and Pienkowski 1984). Fledgling success for shorebirds range 40-50% (Baker and Baker 1973).

Feeding

During the summer when Red-necked Phalaropes are at their inland breeding grounds, their diet consists primarily of freshwater insects (adult and larval; i.e. crane flies, mosquitoes, and midges), tiny crustaceans, mollusks, and other invertebrates.

The birds swim or walk in shallow water at pond and stream edges, picking food from the water surface, exposed boulders and ledges, or vegetation. When feeding in deeper water, phalaropes sometimes swim rapidly in small circles, creating a vortex. Food items raise from the water depths, and birds peck for food from the center circle (Peterson 1980, Terres 1980, Hayman et al. 1986, Brown and Gaskin 1988, Schamel and Tracy 1989).

When at sea, phalaropes feed on zooplankton (e.g., primarily copepods; also krill, arrow worms, amphipods, small crustaceans) while swimming rapidly in zigzag lines or circles (Terres 1980, Schamel and Tracy 1989, Rubega and Obst 1993). Red-necked Phalaropes typically catch prey with quick downward, nearly vertical pecks of their bill, generally immersing only the bill tip. Foraging appears aimed at individual prey. Occasionally, these birds are seen dabbling, submerging their whole head and neck (Bent 1927, Terres 1980, Brown and Gaskin 1988, Paulson 1993). Towards late summer, seaweed mats floating inshore may provide a source of insect larvae and pupae for migrating phalaropes (Bent 1927, Paulson 1993). Brown and Gaskin (1988) speculated that these oceanic sources of insects may allow phalaropes, especially the inexperienced young of the year, make the transition between different types of prey available in freshwater pools versus the open ocean.

Occasionally, Red and Red-necked Phalaropes have been observed associating with other animals (e.g., grey whales, seals, and Oldsquaw ducks), which apparently stir up food from ocean depths while feeding. These phalaropes also have been seen gleaning parasites from the backs of whales (Ryder 1957, Harrison 1979, Schamel and Tracy 1989).

During autumn migration (Jul-Sep), the outer Bay of Fundy is an important feeding area for Red-necked and Red Phalaropes. This area comprises a large inlet, approximately 150 km long and 50 km wide, northeast from the Gulf of Maine. Ocean circulation in the Bay of Fundy region is dominated by strong tidal currents. These currents create considerable turbulence as they pass over submerged ledges, forcing cool bottom water to the surface. Zones of upwelling and sinking are clearly marked at the surface by lines or patches of water called "streaks." Upwelling or divergence streaks are surrounded by areas of ruffled water and usually are free of floating debris. Sinking or convergence streaks accumulate mats of seaweed, driftwood, and other flotsam along the line where the cooler water sinks below the warmer. Streak positions are more or less constant for any given state of the tide (Brown and Gaskin 1988).

These tidally-induced upwellings have an important influence on the distribution of copepod-sized zooplankton near the surface. In the Bay of Fundy, tidal upwellings force zooplankton to the surface, within the birds' reach. Under normal conditions, planktonic crustaceans remain at depths below the surface during the day and migrate to the surface at night. In tidal upwellings, copepod swarms are brought to the surface during the daytime (Brown and Gaskin 1988).

With its dynamic oceanography and high productivity, the Quoddy region has been an important migratory staging area for Red-necked Phalaropes. Large quantities of food, easily accessible at the surface, provide the necessary energy to build up fat reserves needed to migrate south (Mercier and Gaskin 1985). Adults arrive at this staging ground with fat reserves reduced to 10% of fresh weight, likely due to the combined energy demands of breeding, long flight, and molt. Juveniles, arriving in

September, reach the Quoddy staging ground with their fat reserves largely built up (35.8%) (Mercier 1985).

During August 1981-82, Mercier and Gaskin (1985) determined that *C. finmarchicus* was the prey available in the greatest density ($\bar{x}$ density=117 *C. finmarchicus*/m^2) with the highest caloric value/gm dry weight (6.0 Kcal) in the Quoddy region. Phalaropes consistently were found in areas with maximum *C. finmarchicus* concentrations; these copepods were brought to the surface (top 20 cm of water column) by oceanic upwellings. Red-necked Phalaropes fed almost exclusively on this species, which composed 88.6% of the total number of prey items in the stomach. Smaller copepods, seeds, and insects made up the remainder with a size limit of 6 mm for ingested prey.

Phalaropes have evolved a strategy to cope with constant downstream displacement from their preferred feeding grounds. While feeding, phalaropes drift downstream until they reach an area where zooplankton, no longer under the influence of strong upwellings, begin to sink or disperse. Phalaropes then rise off the water as a unit and fly back to approximately their original position, drifting with the current until another "fly up" is necessary (Mercier and Gaskin 1985). McCollough and May (1980) observed this behavior in Cobscook Bay as phalaropes repeatedly flew to the head of a tidal streak and drifted with the current for up to 1 km.

Red-necked Phalaropes have concentrated towards the New Brunswick shore of the Quoddy region, with high copepod biomass and a species community dominated by large *C. finmarchicus* (in the final 2 copepod stages prior to adult molt). Red Phalaropes have occurred mainly on the Nova Scotia side of the Bay, possibly because

copepod biomass and the dominant species were smaller. The Red-necked Phalarope bill (thin and needle-like, tapering to a point) may be adapted for catching large, faster swimming copepods. The broader bill of the Red Phalarope (with wide flexible margins, papillae inside the tip) may be more suitable for smaller, slower prey (Brown and Gaskin 1988).

The exploitation of marine convergences and upwellings by Red-necked and Red Phalaropes is not confined to the Fundy region. These phalaropes are numerous in convergence streaks off Peru. Small scale associations have been described for Red-necked Phalarope in Kandalaksha Bay, NW Russia, off British Columbia, and Chile (Brown and Gaskin 1988).

Phalaropes feeding at sea require some mechanism to concentrate prey at the ocean surface. It is likely that the entire pelagic phase of the phalaropes' feeding ecology is determined by the predictable phenomenon of upwellings, convergences, and other oceanographic phenomena that concentrate zooplankton at the surface. Red-necked Phalaropes appear to prefer coastal upwellings, whereas Red Phalaropes occur at offshore convergences (Brown and Gaskin 1988).

However, not every upwelling or convergence is used by phalaropes. Possibly there is a variation in the quantity of zooplankton in convergences, with plankton concentrated in some frontal areas and not in others. What causes this proposed variation is not understood (Brown and Gaskin 1988).

Quality of food also must be important to phalaropes. In addition to data from Bay of Fundy studies (Mercier and Gaskin 1985, Brown and Gaskin 1988), data indicate that Red-necked Phalaropes winter off the west coast of South America in areas where

dominant copepods are large. More information is needed on the physical and biological oceanographic characteristics that influence the pelagic distribution of phalaropes and their potential prey (Brown and Gaskin 1988).

Migration and Wintering

During 8-9 months of the year, Red-necked Phalaropes are totally pelagic: roosting, feeding, migrating, and wintering at sea. They spend only the breeding season on land (Mercier and Gaskin 1985).

While migrating, Red-necked Phalaropes are abundant along the Pacific and Atlantic coasts, often offshore. They occur inland in the west from British Columbia and Alberta, south to northern Arizona. This species rarely occurs in interior eastern U.S. (Terres 1980).

Beginning in March and peaking in May, Red-necked Phalaropes migrate north in flocks off the Atlantic and Pacific coasts of North America (Bent 1927, Terres 1980, Paulson 1993). Bent (1927) described a large northward migration through the interior of North America in May, passing through Saskatchewan. Spring migrants have been abundant in offshore and inshore waters of the Maine-New Brunswick boundary, especially in the Bay of Fundy during April and May (Knight 1908, Palmer 1949, Terres 1980). Red-necked Phalaropes have been recorded as spring migrants in Hancock, Washington, and Knox Counties. Rarely, inland stragglers may occur in Maine, with one reported observation in Milo (Knight 1908). Palmer (1949) reported the majority of migrating Red-necked Phalaropes occur in Maine offshore and inshore near West Quoddy Head, 21 May to 11 June. Birds begin arriving in nesting areas May-June

(Bent 1927, Höhn 1968, Terres 1980), with females arriving before males (Reynolds et al. 1986, Paulson 1993).

Autumn migration of phalaropes in eastern North America extends July-September (Brown and Gaskin 1988). Females are the first to leave the breeding grounds, beginning in late June. Males that have successfully reared chicks begin migrating south in late July, with the remaining birds (primarily juveniles) leaving in August and early September (Mercier 1985, Hayman et al. 1986, Paulson 1993).

The Red-necked Phalarope population of western and central Canada migrates primarily southwest towards the Pacific coast (Hayman et al. 1986), with an unknown number passing through the continental interior. However, a significant portion of the North American population has staged annually in the Quoddy region of New Brunswick and Maine, migrating overland from the eastern Arctic (Bent 1927, Mercier and Gaskin 1985). Massive numbers of Red-necked Phalaropes, ranging from thousands up to 2 million birds, have concentrated in the Bay of Fundy region July-September (Palmer 1949; Finch 1972; Vickery 1978, 1979; Terres 1980; Vickery 1981; Mercier and Gaskin 1985; Duncan 1989).

The lower Bay of Fundy has been an important feeding area for migrating Red-necked Phalaropes (and Red Phalaropes) in late summer and early autumn. Brown and Gaskin (1988) speculated that most birds breeding in Greenland and the eastern Canadian Arctic used this area as an important staging area to feed and accumulate fat reserves during fall migration. The first Red-necked Phalaropes, primarily females, reach the Bay of Fundy area in mid-July. Males arrive in August. Juveniles generally arrive in early September (Mercier 1985, Brown and Gaskin 1988). Numbers of

phalaropes staging in this region decline throughout September. Rarely do birds remain in the New Brunswick/Maine region through October and November (Palmer 1949, McCollough and May 1980).

Principal concentrations of Red-necked Phalaropes have occurred on the New Brunswick coast in channels south and east of Deer Island, over ledges south of Grand Manan, and adjacent parts of northeast Maine. The Red Phalarope has been more common on the Nova Scotia side of the Bay of Fundy, mainly off Brier Island. Red Phalaropes also have been the dominant species in the Gulf of Maine along the ferry route from Yarmouth, Nova Scotia to Bar Harbor, Maine (Brown and Gaskin 1988).

The major wintering areas of the huge flocks passing through the Bay of Fundy in the fall are unknown (Bent 1927, Hayman et al. 1986). These flocks are presumed to winter off the coast of Peru (Mercier and Gaskin 1985). Because the distance from the Bay of Fundy to Peru (approx. 6,000 km) exceeds the estimated nonstop flight capacities of the Red-necked Phalarope, this species likely makes other feeding stops enroute to their winter area, possibly off Panama (Mercier 1985). Wintering Red-necked Phalaropes have been located in frontal habitat on portions of the southeastern U.S. Continental Shelf (Haney 1985).

Infrequently, Red-necked Phalaropes have been sighted during late winter in Maine (Knight 1908, Palmer 1949). Knight (1908) reported several dozen Red-necked Phalaropes between Castine and Belfast in February, 1900.

MANAGEMENT

Regulatory Authority

Shorebirds are protected by both federal and state legislation. The Migratory Bird Treaty Act of 1918, a federal statute, provides protection from illegal take and harassment. Two federal laws provide some protection for shorebird habitat. Section 404 of the Clean Water Act of 1977, administered jointly by the Army Corps of Engineers (permit authority) and the Environmental Protection Agency (EPA), prohibits projects that violate water quality standards or involve toxic discharges; avoidance, minimization, and mitigation of unavoidable impacts are required. The Coastal Zone Management Act of 1972 establishes federal assistance to coastal states for coastal resource protection programs (Senner and Howe 1984).

In Maine, shorebird nesting, feeding, and staging habitat may be designated as Significant Wildlife Habitat under the Natural Resources Protection Act (NRPA) of 1988. This legislation recognizes Significant Wildlife Habitat as a state natural resource to be protected. The Maine Department of Inland Fisheries and Wildlife (MDIFW) is responsible for defining and mapping shorebird areas for protection under this law.

The Red-necked Phalarope is classified as a Species of Special Concern by MDIFW. Maine's Endangered Species Act of 1975 protects Endangered and Threatened wildlife species from take or harassment. A 1988 Amendment to the Act enables the Commissioner of Inland Fisheries and Wildlife to designate "Essential Habitat", critical for conserving Endangered and Threatened species, and to promulgate and enforce guidelines to protect these species.

Past Goals and Objectives

The Maine Department of Inland Fisheries and Wildlife has not established specific goals and objectives for Red-necked Phalarope management. The broad goal to maintain current abundance and distribution of coastal wildlife was adopted in the Coast of Maine Wildlife Management Area plan and is generally applied to Maine's shorebird resource (Woodward and Hutchinson 1986, Woodward et al. 1991).

Past and Current Management

To date, a strategic management plan and management system have not been drafted by MDIFW for the Red-necked Phalarope. General principles of shorebird management and protection in Maine may not address the specific situation of this shorebird, which is virtually pelagic when occurring in Maine. Monitoring recent population trends has been sporadic, with no concerted effort aimed at determining locations and sizes of Red-necked Phalarope concentrations. Available data on Red-necked Phalarope distribution are based on observations by individuals (e.g., C. D. Duncan, Inst. Field Ornithol.; N. Famous), ecotourism logs, and occasional observations noted by the Canadian Wildlife Service.

HABITAT ASSESSMENT

Past Habitat

The habitats of the Red-necked Phalarope primarily include oceans, bays, lakes, ponds, and tundra (Peterson 1980). Nesting occurs in freshwater marshes and bogs in the low arctic, from sea-level to $\geq$ 1300 m, often at considerable distances from the sea. In comparison, the Red Phalarope is rarely >64 km from the coast (Höhn 1968, Hayman et al. 1986, Schamel and Tracy 1989). During migration, the Red-necked Phalarope is primarily found on open sea and infrequently on inland lakes, reservoirs, sewage ponds, and coastal marshes (Hayman et al. 1986).

During fall migration, the Red-necked Phalarope has been abundant in Maine waters. Thousands of birds have flocked off Quoddy Head, feeding in eddies off Cobscook Bay, the St. Croix River, and Passamaquoddy Bay between Deer Island and Campobello Island (Palmer 1949). As recently as 1977, habitat for Red-necked Phalaropes in Maine was described as static (Jurek and Leach 1977).

In the Fundy Bay area, Brown and Gaskin (1988) observed that flocks near Deer Island consisted almost exclusively of Red-necked Phalaropes. Red Phalaropes were more common on the Nova Scotia side of the Bay of Fundy, mainly off Brier Island, where nearly 90-100% of the phalaropes were Red Phalaropes. Red Phalaropes occurred in the thousands (5,000 - 15,000) on the east and southeast sides of Grand Manan during the early 1980s (Norman Famous, pers. commun.). Red-necked Phalaropes typically concentrated in areas with high concentrations of *C. finmarchicus* (Brown and Gaskin 1988).

Current Habitat

Currently, the distribution of habitat for Red-necked Phalaropes in the Quoddy region is unknown. The number of phalaropes feeding in the Passamaquoddy Bay region of Maine began to decline in 1986, and by 1989 the species was virtually absent during fall staging, with <100 phalaropes observed (C.D. Duncan, Inst. Field Ornithol., pers. commun.). The disappearance of large flocks of phalaropes during fall staging is hypothesized to be the result of a change in the distribution of food (Morrison et al. 1994). Plankton tows conducted by Canadian Wildlife Service in the early 1990s during late summer indicated density of plankton at the water surface <1% of densities in the 1970s. Copepods were still present at greater depths, but unavailable to feeding phalaropes (Goad 1992). These same surface waters had high densities of plankton in October, nearly 2 months after peak fall migration of phalaropes (Duncan 1991).

Habitat Projection

The occurrence of Red-necked Phalaropes in the Passamaquoddy Bay region of Maine is dependent on a predictable fall food supply of zooplankton, brought to the surface by tidal upwellings. A major shift in the distribution of plankton food sources in the Passamaquoddy Bay region during July through September may be one cause for the decline in phalarope abundance in this region. Currently, Red-necked Phalaropes are common during spring and fall migration along southern Brier Island (Nova Scotia) and southwestern Nova Scotia. They are present in lower numbers throughout the upwelling areas southeast and east of Grand Manan (Norman Famous, pers.

commun.). More study is required to determine if a shift in plankton availability has occurred and whether associated factors, if they can be identified, are short- or long-term influences on the marine environment that may determine the future presence of phalaropes in this region.

POPULATION ASSESSMENT

Past Populations

Reliable estimates of the Nearctic population of Red-necked Phalaropes are unavailable. Historical concentrations of this species in the Quoddy region during late summer have been noted as early as 1833 by J. J. Audubon, who estimated flocks from several hundred thousand to 2-3 million. The occurrence of these flocks had been so regular and large that Passamaquoddy Bay/Head Harbor Passage had been highlighted as a key area for observing this species in Maine from mid-August to mid-September (McCollough and May 1980, Pierson and Pierson 1981, Brown and Gaskin 1988). As recently as the late 1970s, the Red-necked Phalarope was listed as common in Maine (Jurek and Leach 1977).

Waters around Eastport and Lubec, Maine and Campobello and Deer Islands, New Brunswick have been identified as the largest fall staging area in the Atlantic for this species, July-August. Estimates of birds using this area range hundreds of thousands to 2 million birds (McCollough and May 1980, Duncan 1989). During aerial surveys conducted in the early 1980s, A. E. Hutchinson (Me. Dep. Inland Fish. and Wildl., unpubl. data) estimated phalarope flocks in the range of 250,000 birds.

In 1982, Mercier and Gaskin (1985) estimated approximately one million birds passing through the Quoddy region during the 2.5 month staging period. During their study, peak numbers occurred in August for both 1981 and 1982. Population estimates for 1981 and 1982 ranged 35,000-145,000 birds and 132,000-770,000 birds. During the August peak, phalaropes were concentrated within a 20 km^2 area around Casco Island,

Indian Island, and Campobello Island, with densities reaching 5,000-20,000 phalaropes/km^2.

Other large, less-regularly occurring, concentrations of phalaropes during fall migration were located off Mount Desert Rock and near Machias Seal Island (N. Famous, pers. commun. to P. O. Corr, Me. Dep. Inland Fish. and Wildl.).

Current Population

The large concentrations of Red-necked Phalaropes that were common around Eastport and Lubec, Maine and Campobello and Deer Islands, New Brunswick have not been observed since about 1986. Since that date, flock sizes have declined at least an order of magnitude annually until 1989, when they became virtually absent from this area (Table 1). Currently, Red-necked Phalaropes, when observed in this area, occur in flock sizes <100 birds; most days the species is entirely absent from this area (C. D. Duncan, Inst. Field Ornithol., pers. commun. to A. E. Hutchinson, Me. Dep. Inland Fish. and Wildl.).

This regional population decline was abrupt and large. A proposed shift in the availability of marine zooplankton may have resulted in a redistribution of Red-necked Phalaropes in the Quoddy region, perhaps to a number of secondary areas (Morrison et al. 1994).

Table 1. Population size of Red-necked Phalarope (*Phalaropus lobatus*) during fall staging in Quoddy region, Maine and New Brunswick.

Year	Estimated population	Source
1982	1,000,000	(Mercier and Gaskin 1985)
1985	20,000	(Duncan, pers. obs. 1985)
1986	8,000	(Duncan 1989)
1987	2,000 (maximum)	(Duncan 1989)
1988	200 (often absent)	(Duncan 1989)
1989	largest flock<100 (often absent)	(Duncan 1990)
1990	absent	(Duncan 1991)
1991	absent	(Duncan 1992)

The nearest extant population of Red-necked Phalaropes is southwest of Grand Manan in the upwellings off Old Proprietor Shoal and Gannet Rock, and waters off Grand Manan near Three Islands and Yellow Murre Ledges. Reports of declining phalarope numbers starting in the late 1980s in the Old Proprietor Shoal - Gannet Rock area and declines in the Grand Manan Basin area may suggest the decline has occurred both in the Passamaquoddy Bay area and staging areas east and southeast of Grand Manan (N. Famous, pers. commun. to P. O. Corr, Me. Dep. Inland Fish. and Wildl.). Red-necked Phalaropes continue to be observed around Mount Desert Island, but in low numbers. A maximum of 124 phalaropes were reported off Mount Desert Island in mid-August, 1990 (Duncan 1991). On 28 August 1989, $\leq$164 phalaropes were observed near Mount Desert Rock (Duncan 1990). A mixed flock of approximately 1,100 phalaropes was observed near Mount Desert Rock on 2 September 1990 (R. D. Applegate, Me. Dep. Inland Fish. and Wildl., unpubl. data).

Red-necked Phalaropes have been observed in large numbers off the coast of southern Nova Scotia during spring and fall migration, 1991-92 (French 1991, Goad 1992). Approximately 5,000 phalaropes (approx. 70% were *P. lobatus*) were observed off Brier Island, Nova Scotia during summer 1990 (French 1991, Gulf of Maine Counc. Mar. Environ. 1991).

During spring 1991, a large migration of Red-necked Phalaropes was reported off George's Bank, further east than the usual migration route (Gulf of Maine Counc. Mar. Environ. 1991).

The Red-necked Phalarope population is considered stable (but uncertain) in Pacific and Central Canada and declining in Eastern regions (Morrison et al. 1994).

Population Projections

Suitable staging areas must be available to assure continued presence of Red-necked Phalaropes in coastal waters of Maine. Currently, more study is required to determine if a change in marine plankton availability has occurred in the Quoddy region and if so, the associated effect on the Red-necked Phalarope population during migration. Thus, data are insufficient to project future population trends for Red-necked Phalaropes in Maine.

Limiting Factors

There is a potential concern for Red-necked Phalaropes at their nesting grounds. As human development expands over coastal arctic regions, foxes may be attracted to these artificial food sources in developed areas. Increased concentration of foxes near phalarope nesting grounds could result in high predation losses of nests (Schamel and Tracy 1989).

While at sea during migration and wintering, Red-necked Phalaropes are vulnerable to predation (e.g., from jaegers) (Schamel and Tracy 1989) and accidental deaths from gale winds (Palmer 1967). Oil from ships is a hazard to pelagic phalaropes. Spilled oil tends to concentrate in the same marine habitats that are used heavily by phalaropes (convergence lines, tide rips, lagoons) (Schamel and Tracy 1989).

Destruction of their marine invertebrate food sources would be critical to phalaropes, whether from oil spillage or other environmental changes. Occasionally,

mass mortality of phalaropes has occurred at sea due to starvation (Schamel and Tracy 1989). The disappearance of enormous numbers of Red-necked Phalaropes staging in the Quoddy and Bay of Fundy region after breeding has lead to speculation. It is possible that the distribution of food sources has shifted, causing a shift in phalarope distribution but no change in actual numbers. There are no recent census numbers to estimate population size.

USE AND DEMAND ASSESSMENT

The demand to conserve rare fauna and the ecosystems they depend upon, especially species listed as Threatened or Endangered, is declared in Maine's Endangered Species Act. Accordingly, MDIFW is entrusted with preserving the diversity of wildlife in the state.

Red-necked Phalaropes contribute to the biological diversity of Maine, and their presence adds to the ecological value of Maine's marine ecosystem. Protecting and gaining ecological understanding of species (e.g., Red-necked Phalarope) is essential to effective ecosystem management and to preserving Maine's natural heritage.

As the popularity of photography, nature study and appreciation, and awareness of Maine's wildlife resource grows, the demand for observation and photographic use of rare species (e.g., Red-necked Phalarope) will increase.

Boyle et al. (1990) estimated 90% of the state's adult population participate in nonconsumptive use of wildlife. Members of thirty-five percent of households in Maine made trips annually to view wildlife and >80% valued the opportunity to view wildlife in Maine.

This high public demand for nonconsumptive use of wildlife is of considerable value to Maine's economy. A minimum estimate of the nonconsumptive value of wildlife in Maine is $55.4 million annually (Boyle et al. 1990), comparable to the economic contribution of hunting by residents.

Increasing numbers of citizens desire to preserve the greatest diversity of species possible, at state, national, and global levels (Kellert 1980). This desire is

based on increasing public perception of scientific, utilitarian, and cultural values of biological diversity, as well as ethical arguments for conserving plant and animal species. At the state level, public support for preserving wildlife diversity in Maine is present and reflected in state legislation protecting Endangered and Threatened wildlife and their habitats.

SUMMARY AND CONCLUSIONS

During spring and fall migration, Red-necked Phalaropes historically have concentrated in the Quoddy region of New Brunswick and Maine. As recently as 1982, fall staging populations in the Quoddy region were estimated at ≥1,000,000 birds during July-September. Beginning in 1986, a significant decline in the numbers of Red-necked Phalaropes in the Quoddy region and coastal Maine occurred. This severe reduction in fall staging numbers off coastal Maine has continued to the present.

The distribution of Red-necked Phalaropes is limited by a predictable food supply of plankton during the fall staging period. Oceanic upwellings make pelagic plankton available to surface-feeding phalaropes. Productive staging areas are critical for these migrating birds, enabling them to accumulate the critical fat reserves required to migrate to wintering areas, believed to be off the Peru coast.

Currently, limited data suggest a shift may have occurred in the distribution of marine plankton within Maine and Canadian waters, perhaps leading to an associated change in the migration pattern and corresponding feeding areas of Red-necked Phalaropes during fall. The cause and extent of this hypothesized regional population shift needs to be identified. Fall staging may be the most effective period for censusing this population because birds are not concentrated during nesting, and wintering areas are poorly defined (Duncan 1989).

There has been no concerted effort at estimating distribution and size of phalarope concentrations off the Maine coast. Areas that should be systematically monitored to assess regional population trends include waters off Mount Desert Island;

Mount Desert Rock; Machias Seal Island; ledges south of Grand Manan, N.B. including Old Proprietor Shoal, Three Islands, and Yellow Murre Ledges; the Quoddy region; southwestern Nova Scotia and Brier I, Nova Scotia.

The Red-necked Phalarope is classified as a Species of Special Concern in Maine. The ecology of the Red-necked Phalarope could be an indicator of the dynamic nature of one of the most productive habitats in Maine. There are implications for possible widespread, long-term effects that would affect the ecology and management of many species relying on this pelagic environment.

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