

**RED PHALAROPE**  
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**FOOD HABITS**

Red Phalarope food habits are not well known. Sample sizes are small in all available studies so that the following conclusions must be considered preliminary. What is known indicates that a variety and continually changing complex of prey items are of importance to this species. However, in the future, more in-depth knowledge of phalarope-prey relationships may reveal key prey species that are critical for reproductive success or survival in given areas and at certain times of the year.

During the breeding season the nesting birds are chiefly insectivorous, depending on freshwater and terres-

trial food sources (Fig. 1). In June, during arrival, egg laying, and much of the incubation period, the birds are highly dependent on the aquatic dipteran fly larvae of chironomids (midges) and *Prionocera* (crane-flies). Other important components of the June diet in some areas are oligochaetes (freshwater and terrestrial worms), molluscs (snails), Plecoptera larvae (stone-flies) *Pedicia* larvae (crane-flies), Coleoptera adults (beetles), and, in late June, chironomid adults. In July, which includes periods of incubation, brooding, and adult departure, chironomid adults, *Prionocera* larvae, and tipulid adults (crane-flies) are the most important prey. Chironomid adults are the most frequently eaten prey at this time, but the much larger size of the *Prionocera* larvae make them very important also. Other July prey in some areas include ostracods (seed shrimps), Corixidae adults (water boatmen), Coleoptera adults, and Araneae (spiders). Eight chicks examined during July at Barrow were feeding mainly on adult chironomids, tipulids, and Trichoptera (caddis-flies). Freshwater crustaceans

seem to be little used during the breeding season, perhaps because they are not easily captured until August, when falling water levels concentrate them.

During the breeding season at Barrow, Red Phalaropes feed visually along the edges of marsh water, from saturated ground out to wading depth water (< 5 cm). Areas of shallow, temporary marsh water are probably of critical importance as feeding habitat. In this habitat, chironomid larvae are very abundant and active early in June. Phalarope arrival on the breeding grounds may be tied to the availability of this food source. *Prionocera* larvae are also found primarily at pond margins and are available in low numbers throughout the summer. Red Phalaropes often feed communally in small groups, with feeding locations changing frequently through the season, suggesting a food supply that is patchy in both space and time.

Other than the one to two months spent on the arctic tundra, Red Phalaropes depend on marine food sources. Even during the breeding season, marine foods may be used if they are available

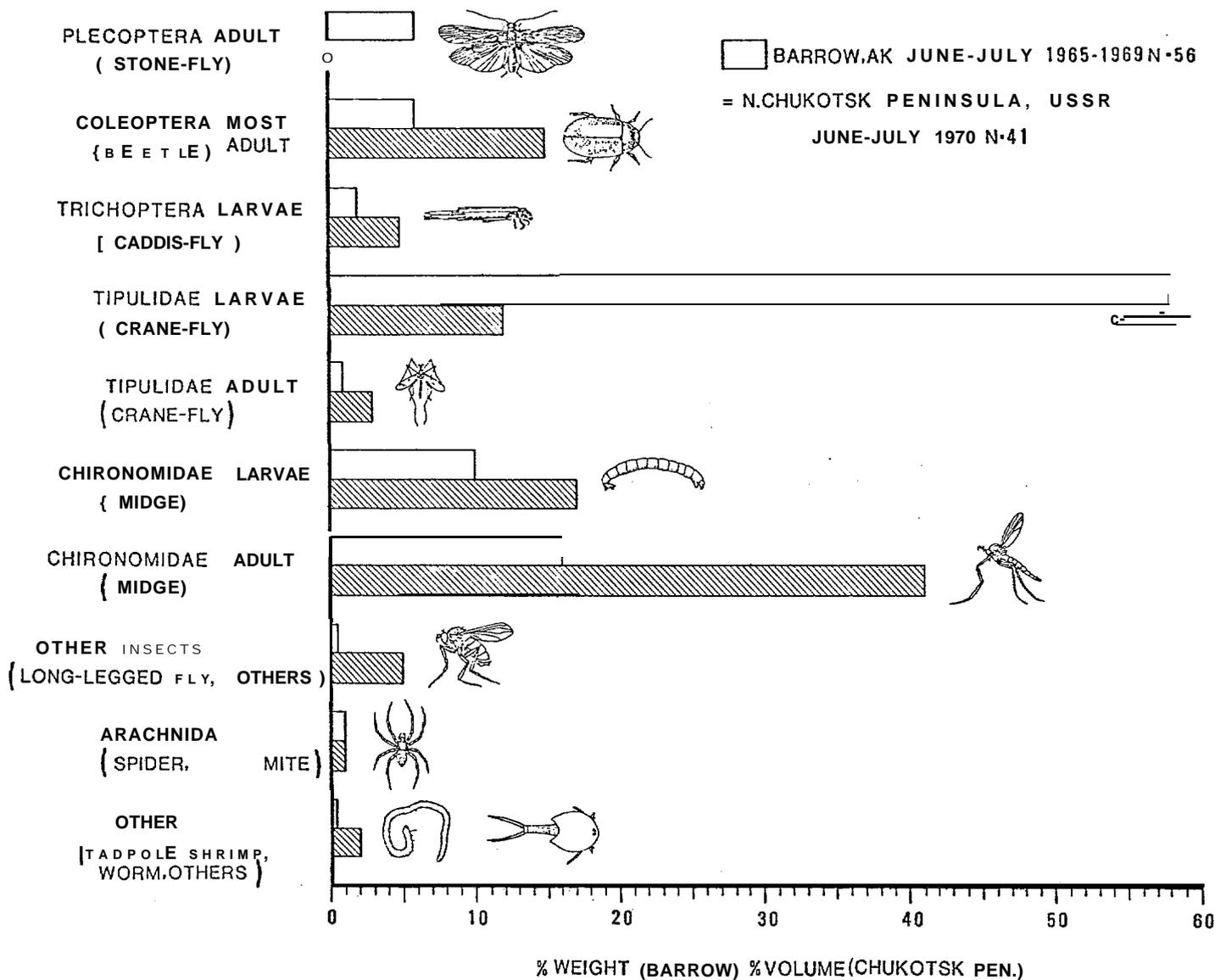


Figure 1: Food habits (stomach analyses) of Red Phalaropes in coastal marshes during the breeding season.

near nesting habitat. When adult females leave the nesting grounds in late June and early July they, apparently move well out to sea; nothing is known about their diet at this time. When adult males depart in mid to late July from Barrow, they make limited use of intertidal prey, feeding on emerging adult dipteran flies near lagoons and brackish pools.

Juvenile Red Phalaropes concentrate in very nearshore marine habitats (< 200 m of barrier islands and exposed coastlines) during August in the Alaskan Beaufort Sea. Copepods and amphipods, both marine crustaceans, are the most heavily used prey (Fig. 2). Other important prey items include small jellyfish,

adult marine dipterans (flies), decapod larvae (euphausiids, crabs, etc.), mysids, chaetognaths (arrow worms), and pteropods molluscs (sea butterflies). The birds seem to take relatively large, slow-moving, conspicuous prey, selecting for large copepods and amphipods and against barnacle cyprids, very small copepods, mysids and chaetognaths. Recorded prey sizes range from 1 to 10 mm.

The major very nearshore Beaufort feeding habitats are in shallow water (< 1 m deep) along spits, barrier islands and bars. Currents contacting these land protrusions may concentrate zooplankton or cause blooms, but these processes

are poorly understood. Red Phalaropes often feed near grounded sea ice, apparently feeding on the under-ice amphipod *Apherusa*. In August in the Beaufort Sea, juvenile Red Phalaropes can also be found feeding up to 60 km from the coast. They are concentrated in areas of well broken; drifting pack ice, where ice-associated plankton and fish provide a major food source for many surface-feeding bird species.

Phalaropes at sea are visual surface feeders, feeding while wading or swimming. When swimming they are noted for sometimes spinning rapidly in small circles, pecking food items out of the center of the circle. This behavior may

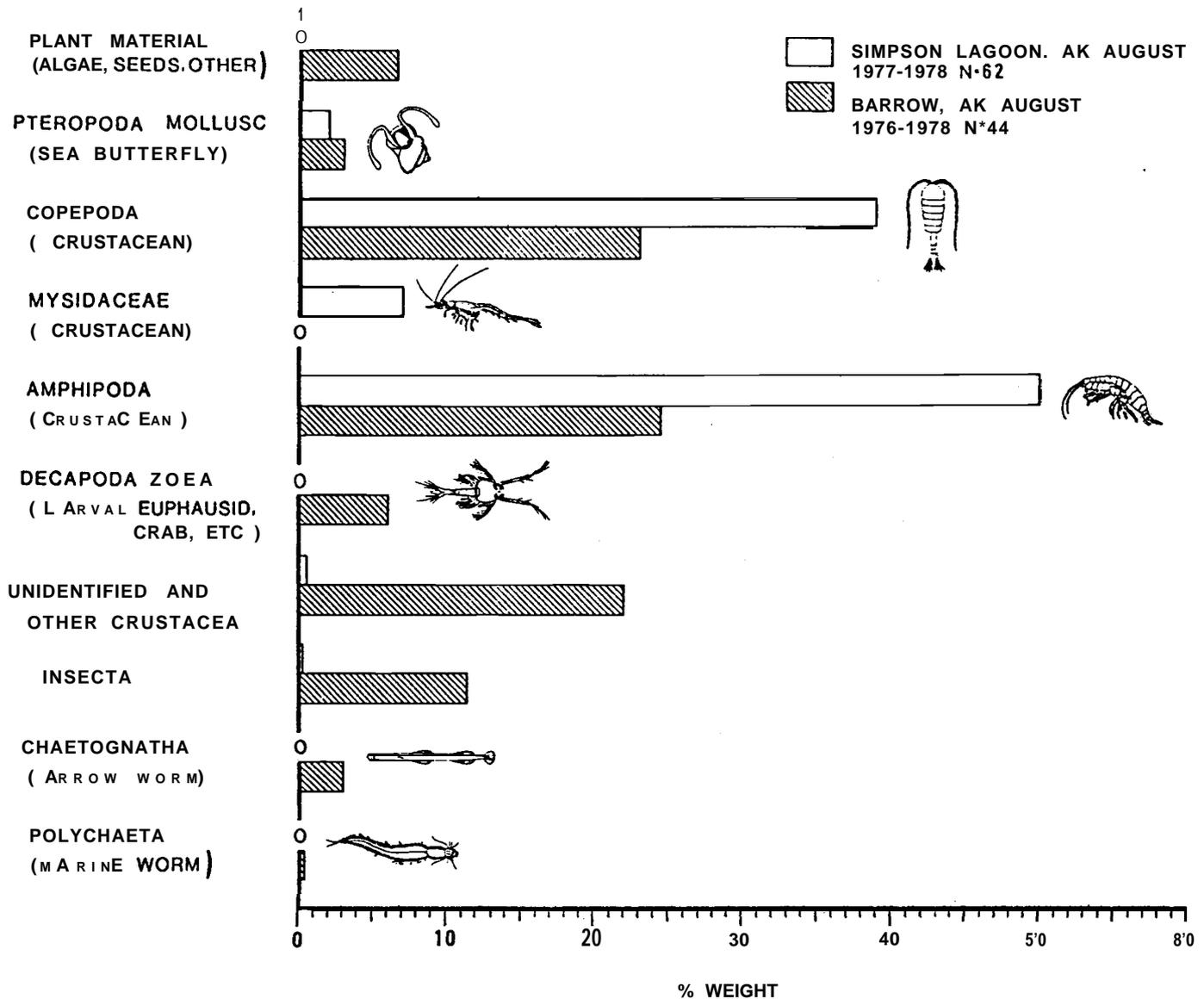


Figure 2: Food habits (stomach analyses) of Red Phalaropes in littoral zones and lagoons during August staging of juveniles.

help raise, concentrate, and trap prey.

Studies in very nearshore Beaufort Sea locations have revealed order of magnitude inter-year variations in the densities of various prey species and in total zooplankton densities. Phalaropes have responded with large inter-year variations in diet and with large variations in densities and distributions of feeding birds. Variations in prey availability may be related to the proximity of the sea ice edge. Usually in late July the nearshore sea ice of the Beaufort Sea undergoes rapid decomposition, releasing under-ice zooplankton and phytoplankton. The released phytoplankton may serve as a food source for non-ice associated zoo-

plankton. Although the mechanism is not clear, during years of early ice break-up and movement well away from shore, August nearshore zooplankton densities seem to be very low.

Juvenile phalaropes staging along the Beaufort coast accumulate fat throughout August. This accumulation is probably very important to their survival during fall migration and the subsequent winter. Arctic zooplankton probably provide a very high-energy food source. Arctic copepods accumulate wax in their bodies through the summer, later using the wax as an energy source during the winter and during reproduction. Arctic amphipods, decapods, chaetognaths, and

jellyfish also contain high-energy wax, obtained through the food chain or produced internally.

Almost nothing is known of the offshore pelagic food habits of Red Phalaropes during fall migration, winter, and spring migration. They use prey available in the pelagic zooplankton, probably including crustaceans (especially copepods), small jellyfish, and the eggs and larvae of fish and squid. The pelagic distribution of Red Phalaropes indicates that they are highly dependent on ocean fronts to concentrate prey so the prey can be efficiently utilized. "Fronts" are narrow bands of water where temperature and/or salinity changes abruptly, as

different bodies of water come in contact. Phalaropes are also known for their associations with whales.

A few adults have been observed feeding on copepods, amphipods, jellyfish and insects in littoral habitats in Alaska during spring migration. However, most spring migrants pass offshore and nothing is known of their diet. A few birds have been observed using open leads in the pack ice, feeding on the under-ice amphipod *Apherusa*. In the spring, sea ice in the Chukchi Sea decomposes simultaneously at the pack front and deep within the pack, releasing the standing stock of under-ice plankton. However, it is unknown how important ice-associated plankton are as a spring food source for Red Phalaropes.

### *Nesting Chronology*

Red Phalaropes arrive on their nesting grounds from mid-May through late June. The later arrival dates are generally found in the northern portion of their breeding range. They are thought to reach their nesting grounds via sea migration routes. Some birds are paired on arrival in tundra nesting habitat; others form pairs soon after arrival. In some locations, females arrive shortly before males. Arrival and nesting generally begin earlier in years with early snow melt than in years when snow melt is late. Inter- and intra-year variations from two Alaskan sites are illustrated in Figure 3.

Egg laying often begins less than a week after the first arriving birds are seen and continues for about three weeks (Fig. 3). The total length of the egg-laying period is the same in both the southern and northern portions of their range. Females depart from tundra-nesting areas within a week after the end of egg laying. They are joined by males that have lost their nests, forming flocks of several to several hundred birds. Molt from breeding to winter plumage begins with molt of body feathers by females in late June - early July. Males begin molt soon after females. Both sexes postpone molt of flight feathers until November, when they are on the wintering grounds.

Incubation of the eggs is performed solely by the male and usually lasts 18-19 days (Fig. 3). Incubating males at Barrow fed only 6% of each day, as compared with 70% prior to incubation. The energetic demands of incubation and the reduction in foraging time leads to a 0.4/day weight loss in these birds in northern portions of their range. Males in more southerly areas are able to maintain their body weight during incubation.

Like incubation, young-rearing duties are assumed by the male alone. He performs three main services for his young by (1) leading them to habitats where food is abundant, (2) brooding (warming) them when they are cold, and (3) warning them of the presence of predators. The male remains with the young for 12 to 14 days, after which time they apparently no longer require brooding. Chicks are able to fly at the age of 18 to 21 days. Soon after gaining flight capabilities, they drift toward the coast where they may remain momentarily (south of Point Hope, Alaska) or for several weeks (northern Chukchi and Beaufort coasts).

### *Reproductive Behavior*

Red Phalaropes exhibit sex-role reversal. Females are about 20% larger than males, have brighter breeding plumage, and are often more aggressive. Males incubate the eggs and care for the young without the aid of a female. Red Phalaropes have a flexible, opportunistic mating system that may best be termed "facultative serial polygamy." They are often monogamous, but the females are capable of producing multiple clutches if the opportunity arises. Double clutching may be facilitated by small egg size in relation to female body size. The egg-laying interval within a clutch is about 24 hours. The interval between completion of one clutch and initiation of another clutch can be as short as 3 to 5 days. Females can lay as many as three clutches in one season. Multiple clutches may result from reneesting with the same mate or from serial polyandry (one female laying clutches for more than one male). Extra males become available to polyandrous females through (1) occasional local

populations with excess males, (2) asynchronous arrival of males, and (3) reneesting by males who have lost their clutches. Some reneesting males may obtain replacement clutches from a female other than the one that laid their first clutch, making them serially polygynous, although they can only bring off one successful nest in a season. The importance of polyandry and reneesting to the reproductive fitness of individuals is not well known, as very little research has been conducted on individually marked birds. However, it is known that predation on eggs, and thus the potential for reneesting, can be very high (see "Productivity" section).

Reproductive behavioral displays have been the *most* studied aspect of Red Phalarope biology. Red Phalarope pair bonds seem to be very flexible in their formation, termination, and duration. Pair formation may be initiated by either sex and can be very rapid, taking only a few hours. Pair formation is characterized by (1) aerial chases, (2) the initiating bird attempting to remain close to and persistently following the potential mate, (3) the initiating bird attempting to drive away conspecifics of the same sex, (4) some aggression between the potential pair members, usually by the potential mate towards the initiating bird when the latter approaches too closely, and (5) a gradual acceptance of the initiating bird by the potential mate. Once pair formation is complete, the pair is maintained and synchronized through aggression, copulatory behavior, nest site searching behaviors, and vocalizations. Red Phalaropes are not territorial. Aggression is used to protect the pair bond and to maintain individual distance. After the pair is formed, both members are aggressive towards intruding conspecifics, especially towards unpaired birds who are still attempting to initiate pair formation. Pairs may continue associating during the post-laying period. Pair termination seems to be caused by (1) the female finding a new mate (although the bond with the first mate seems to be easily reformed later if necessary), (2) the male becoming aggressive towards his mate late in the season, when replace-

ment laying is no longer possible, or (3) completed work on distribution and a general waning of sexual activity as the migration.]  
 season progresses.

**PRODUCTIVITY**

[We have decided to postpone the tions in nesting densities. The magnitude estimate of population size until we have of this variation correlates with latitude.

Reported nesting densities in the best habitats in given areas range from 8 to 70 nests/km<sup>2</sup>. Red Phalaropes are known for their large inter-year varia-

and probably with environmental variability. On a south to north gradient, reports show a two-fold variation at Cape Espenberg (36-72 nests/km<sup>2</sup>), a five-fold variation at Barrow (8-43 nests/km<sup>2</sup>), and a 14-fold variation at Bathurst Island (0-14 nests/km<sup>2</sup>). Data from Barrow (9 years) indicate that

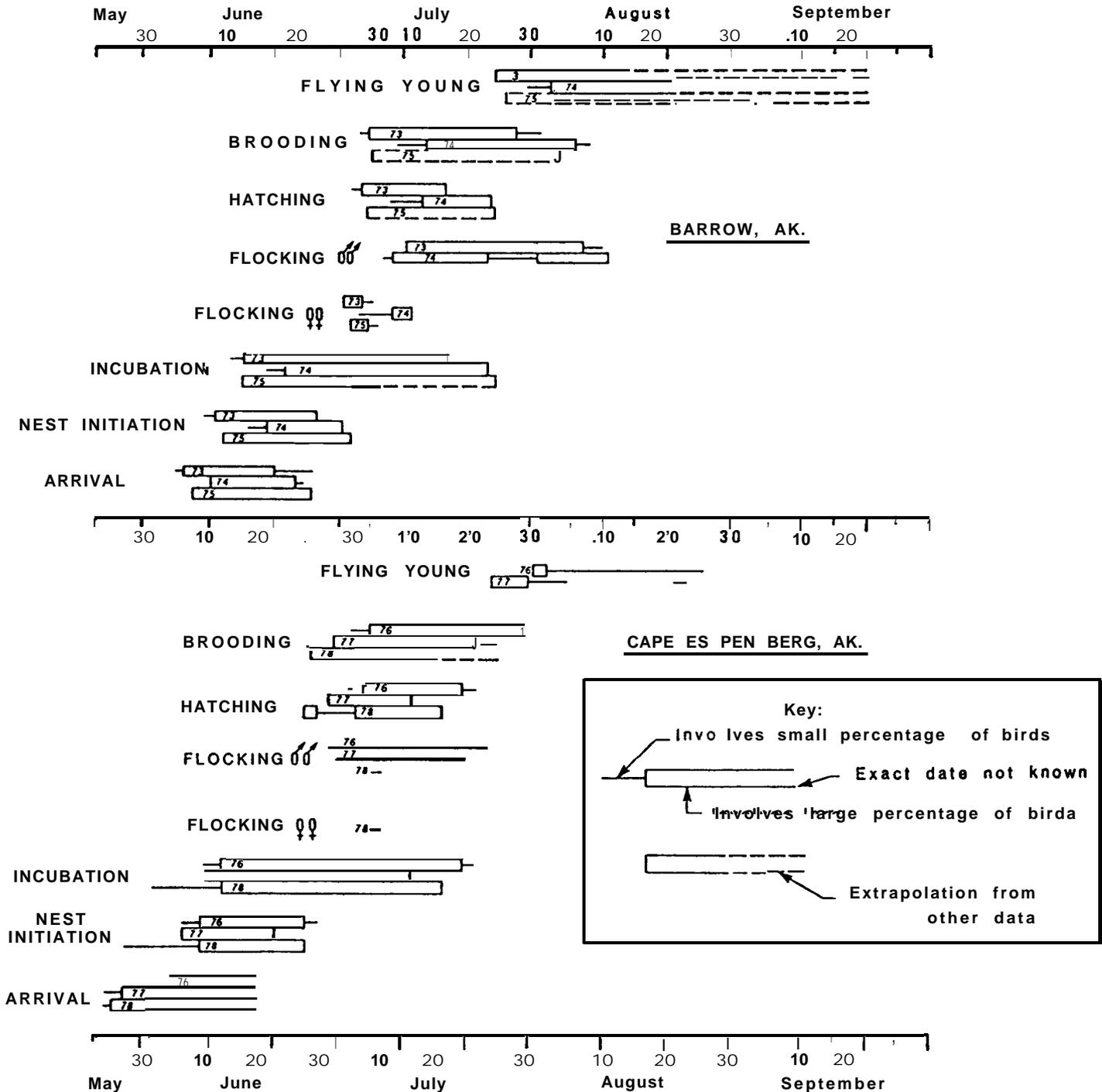


Figure 3: Red Phalarope breeding phenology.

inter-year variations in nesting densities are strongly correlated ( $r = 0.97$ ,  $p < 0.001$ ) with inter-year variations in regional phenology as estimated by snow-melt data from Barrow and Barter Island. The same trend was evident at Espenberg ( $r = 0.86$ ,  $0.1 < p < 0.2$ ), but the correlation is not statistically significant, probably because of a small sample size (4 years) and major flooding during one year. Red Phalarope nesting densities are highest at Barrow and Cape Espenberg when regional phenology is late, and lowest when regional phenology is early. We hypothesize that this results from the packing of breeding phalaropes into the earliest available habitat during late years. In early years larger areas of suitable habitat are sufficiently free of snow and ice when the phalaropes arrive, and the birds settle at lower densities over larger areas. Phalaropes are dependent on marshy, lowland feeding habitats, and these habitats are among the last in a given area to become available in the spring, making it more likely that phenology and habitat availability can affect breeding densities. Water levels during arrival also seem to have a small effect on breeding densities. Higher than normal water levels decreased breeding densities at both Barrow and Cape Espenberg, probably by affecting prey availability during the arrival and egg-laying periods. At Barrow high-water levels decreased nesting densities about 15% below that predicted from a given year's snow-melt phenology. Although our hypothesis predicts higher nesting densities in some areas in regionally late years, nesting is sometimes entirely precluded, especially at high latitudes, if phenology is too late. There is some evidence that nesting densities may also sometimes be affected by a large percentage of nonbreeding adults in the population. The cause of nonbreeding is unknown. Our model explaining the large inter-year variations in Red Phalarope nesting densities is summarized visually in Figure 4.

A small percentage of adult Red Phalaropes return to the same nesting area in successive years. The return rate of adults ranges from 5 to 15%. Males have a greater tendency to return than do females. Chicks show a very low return

rate (< 1%) to hatching sites. In contrast, about 45% of adult Northern Phalaropes return to the same nesting areas, and 3-10% of the chicks return to hatching sites.

Red Phalaropes usually lay four eggs per nest. Scientists have reported mean population clutch sizes ranging from 3.40 to 4.00. Clutch sizes tend to be largest during phenologically "normal" years and smallest during late or very early years. Population clutch size shows no relation to latitude of the nesting area. Hatching success is extremely variable, ranging from 11 to 100%. In the northern portion of the Red Phalarope range, foxes are clearly the key egg predator; hatching success is inversely related to fox activity. At lower latitudes, fox predation on phalarope eggs is buffered by a greater abundance of nesting waterfowl. In northern Alaska and northern Canada, where waterfowl nesting density is low, phalarope nesting success ranged from 11 to 25% during years of high fox activity. In contrast, phalarope nesting success in a year of high fox activity was 66% at Cape Espen-

berg in western Alaska, where waterfowl nesting density is high. When fox activity is low, hatching success ranges from 80-100% (all areas). Jaegers can also be important egg predators, particularly in the southern part of the phalarope nesting range. A small percentage of eggs (0-13%) may be lost to desertion of the nest. Desertion may result from poor physical condition of the male, disturbance at the nest site, incomplete incubation drive, disorientation during mid-summer snowstorms, or male mortality.

Quantitative data on chick mortality are nonexistent. All investigators have noted that phalarope chicks conceal themselves extremely effectively. This factor increases the difficulty of studying chicks, as well as increasing their probability of survival. Most likely, typical chick survival rates range from 25 to 75%, depending on predator activity and weather.

Few data exist on adult mortality. Foxes and predatory birds kill a small percentage of birds on the breeding grounds. Power lines at Barrow kill some

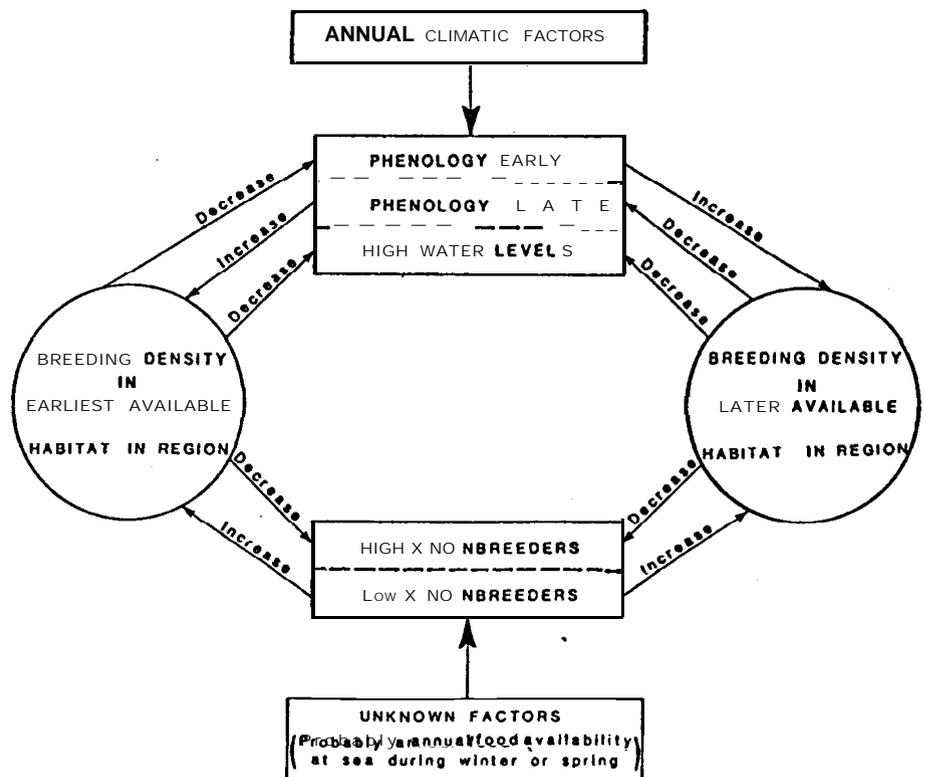


Figure 4: Model of factors influencing inter-year variations in breeding densities.

adults annually. Predatory birds have been seen capturing phalaropes at sea, and fish probably take a few, opportunistically. Large numbers of phalaropes may also starve at sea during some years. Mass mortality of emaciated phalaropes has been reported from southern California. Mass mortality of phalaropes in less populated areas or further out at sea likely occurs, but is unnoticed or unreported-

Chicks grow rapidly and are able to fly at 18 to 21 days of age. Young Red Phalaropes grow faster than at least four other sympatric species (Northern Phalarope, Dunlin, Semipalmated Sand-Piper, Western Sandpiper). Available data suggest that chicks also grow faster further north than in the southerly portions of their range. This is probably due to a compression of hatching dates of the main chick prey items (flies), which increase available food for a brief period. Rapid growth of phalarope chicks is probably advantageous in far north breeding areas, where the growing season, and therefore food availability, is abbreviated.

At least some Red Phalarope yearling males are sexually mature. Data from Northern Phalaropes suggest that females probably postpone sexual maturity until at least two years old. Data on longevity are almost nonexistent. We know that some birds live for at least three years and Northern Phalarope data suggest that some probably live for eight years.

#### MANAGEMENT

[A comprehensive statement of management of this species is not possible until phalarope distribution and migration has been reviewed. The following paragraphs summarize our current management concerns. Some ideas expressed below may be modified in the final, complete account.]

Phalaropes are the most marine oriented of the shorebirds, spending up to 11 months of each year at sea. They pass most of their time swimming and feeding in both littoral and pelagic habitats. Thus, they are potentially highly susceptible to oil contamination. The



most critical areas and times of susceptibility in Alaska are summarized below. Spring migration lasts from early May through early or mid-June. At this time phalaropes are most concentrated around Unimak Pass and close to the Bering Sea islands (the Pribilofs, St. Matthews, St. Lawrence, and the Diomedes). They may also be concentrated in leads in the sea ice of the Bering, Chukchi, and Beaufort Seas. Red Phalaropes nest, feed, and rear their young in low-lying coastal tundra from late May through late July. Preferred habitat consists of wet marsh with shallow ponds and temporarily flooded tundra. The most critical breeding habitats are those areas where these birds nest relatively densely during phenologically late years. During such years, phalaropes apparently nest at fewer locations and at greater densities than in other years. No catalog of these areas exists; it may be possible to predict such

habitats from remote sensing imagery. During fall migration, from early July to late September, concentrations of phalaropes again occur along the Bering Sea islands and at ocean convergence fronts in the Beaufort, Chukchi, and Bering Seas. Concentrations of staging juvenile phalaropes occur from late July to mid-September in lagoons and near spits and barrier islands in the Beaufort and northern Chukchi Seas. An oil spill at this time at even a single location could affect a large number of juvenile phalaropes as they move through the area.

Very little is known about the behavior of phalaropes towards oil slicks. Preliminary experimental evidence suggests that phalaropes learn very quickly to avoid small patches of oiled water. Their response to a large oil spill is unknown. Also, the effects of small amounts of oil gathered on the plumage during the avoidance learning process is

unknown.

Phalaropes are almost entirely dependent on aquatic food sources. Larval and adult aquatic Chironomidae (midges) and Tipulidae (crane flies) from shallow and/or ephemeral ponds are the most important foods during the breeding season. Fall staging birds feed primarily on marine copepods amphipods, and other small, slowing-moving zooplankton. These fall foods are thought to be critical for fat deposition and subsequent survival during migration. Oil spills in either coastal freshwater or marine habitats could seriously affect prey populations. Currents and land forms that concentrate prey may also trap and concentrate oil.

Support facilities related to oil development will have some impacts on phalaropes, mostly detrimental. Evidence suggests that foxes attracted to garbage associated with oil camps can seriously depress phalarope production through increased predation on eggs and young in the vicinity of these camps. There will be a direct loss of nesting and foraging habitat due to construction of roads, buildings, and storage facilities. Dust and disturbances near roads have been shown to decrease shorebird use of habitat along roadways, causing further losses in the amount of habitat available. Construction-related changes in drainage patterns produce habitat changes which may or may not be favorable for phalaropes. An expanding powerline network will, from past experiences at Barrow, certainly result in increased mortality, especially of juveniles but also of adult phalaropes. Gravel docks appear to affect prey abundance in an unknown but similar way to natural spits, and concentrations of phalaropes are attracted to the vicinity of docks in the Beaufort Sea. This attraction may increase their susceptibility to chronic oil pollution in these areas.

Direct human utilization of Red Phalaropes is very low, and not a significant factor affecting their distribution or abundance. In the past, phalaropes were apparently considered a food delicacy by Alaskan Natives. A small amount of subsistence and recreational hunting for this bird undoubtedly con-

tinues. However, the species is not managed as a game bird. They are protected under the Migratory Bird Treaty Act, 16 U.S.C. 701-711.

The major threat to Red Phalaropes outside Alaska is probably also oil-related development. Oil development is occurring in many areas of its circumpolar breeding range. Ocean transport of oil in both the Pacific and Atlantic Oceans could threaten pollution of the ocean "fronts" where phalaropes concentrate to feed during the arctic winter. Pollution in such areas could lead to drastic numerical declines of these birds. Besides the threat from oil, at least one scientist in Europe has suspected that organochloride contamination caused some premature breakage of eggs during incubation. However, there is little evidence of this problem to date.

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#### EXPERTS

R. G. B. Brown, Canadian Wildlife Service, Bedford Institute of Oceanography, P. O. Box 1006, Dartmouth, Nova Scotia, Canada B2Y 4A2. Phone: (902) 426-3870. Pelagic distribution, migration, pelagic marine foods--especially in Atlantic "Ocean."

Peter G. Connors, Bodega Marine Laboratory, University of California, Bo-

- daga, CA 94923. Phone: (707) 875-3511. Use of Alaskan intertidal, migration, marine foods, effects of oil development.
- George J. Divoky, Point Reyes Bird Observatory, 4990 State Route 1, Stinson Beach, CA 94970. Phone: (415) 868-1434. Alaskan pelagic distribution and migration.
- Jim Erckmann, Department of Zoology, University of Washington, Seattle, WA. Phone: (206) 543-1658.
- S. R. Johnson, LGL Ltd., 10110- 124th Street, Edmonton, Alberta, Canada. Phone: (403) 488-4832. Use of Beaufort Sea lagoons, migration, marine foods.
- A. A. Kistchinski, Institute of Evolutionary Morphology and Ecology of Animals, Leninski prospekt 33, Moscow B-71, U.S.S.R. Red Phalarope in the U.S.S.R.
- Harold F. Mayfield, 9235 River Road, Waterville, Ohio 43566. Canadian breeding biology.
- J. Pete Myers, Museum of Vertebrate Zoology, University of California, Berkeley, CA 94720. Phone: (415) 642-2893. Alaskan breeding biology, nesting densities and spacing.
- Frank A. Pitelka, Museum of Vertebrate Zoology, University of California, Berkeley, CA 94720. Phone: (415) 642-2893. Alaskan Breeding biology, nesting densities.
- Douglas Schamel, Institute of Arctic Biology, University of Alaska, Fairbanks, AK 99701. Phone (907) 479-7542. All aspects.
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