NOTES ON WINTER FEEDING BEHAVIOR AND MOLT IN WILSON'S PHALAROPES

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WILSON'S Phalaropes, *Steganopus tricolor*, migrate in late summer from the prairie regions of North America to their wintering grounds in the highlands of Peru and the inland and coastal waters of Chile, Bolivia, Paraguay, Uruguay, and Argentina (Holmes 1939, Meyer de Schauensee 1970). Reports on these birds from their wintering habitat are few. This paper describes numbers, feeding behavior, and molt of Wilson's Phalaropes wintering in a freshwater marsh in central Argentina. Fieldwork in Argentina was conducted by the senior author. The junior author analyzed molt patterns of birds collected there and added data he collected in North Dakota in 1968 and 1969.

The senior author worked from 10 October 1972 through 10 January 1973 on the marshes of the San Jose Estancia near Murphy in the province of Santa Fe. These marshes cover about 2 square miles and contain expanses of open water with a maximum depth of 1.5 m after rainy periods. Water levels drop during the austral summer from evaporation. The borders of the marsh and other shallow water areas contained stands of tules, *Scripus californicus*. The marsh was surveyed at least once a week during the observation period to determine the number of birds present. Censuses were conducted on horseback to facilitate the close approach necessary for accurate counting. Observations on feeding behavior were made for at least 3 h each week at various times of the day. Birds were collected between 16 November and 15 January for molt studies.

The entire marsh was censused at irregular intervals throughout the period. The number of phalaropes on the marsh fluctuated between 150 and 700 during the first month. Following a low count of 75 on 20 November, numbers began increasing steadily to between 600 and 800 by the end of the spring. A rapid increase to 1700 birds between 6 and 16 January could have resulted from the addition of migrants on their way north. Although these are the largest numbers of Wilson's Phalaropes reported from Argentina, the species does not occur annually in such numbers. E. Otto Höhn (pers. comm.), who spent the 1973 autumn season in the same region, saw Wilson's Phalaropes on only five dates between 20 September and 17 October with a peak of about 50 on 1 October. Water levels were much higher in 1973 and phalaropes were only seen in puddles and flooded grassy areas. Fig. 1 shows temporal changes in abundance.

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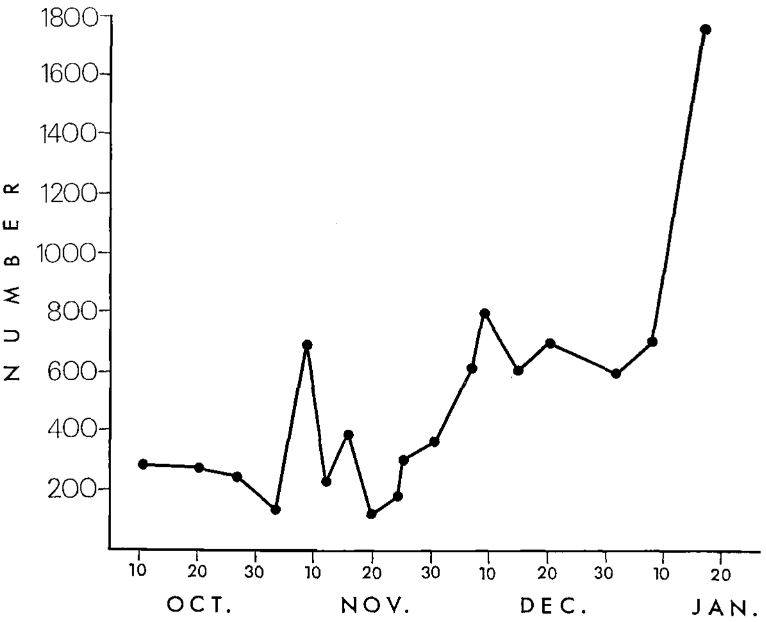

Fig. 1. Temporal changes in Wilson's Phalarope abundance on the marsh, 10 October 1972 through 10 January 1973.

FEEDING BEHAVIOR

Feeding behavior studies consisted of recording the following data: time of day, wind and weather conditions, size of flock, location of flock in the marsh, depth of the water, method of feeding, minimum distance between individuals, and behavior of the flock as a unit. Five methods of feeding were distinguished and named: pecking, swishing, bill-pushing, tipping-up, and spinning. Each is described briefly below and summarized in Table 1.

Pecking consists of rapid jabs at the water with the bill by wading or swimming birds. Birds feeding in this manner pecked at the water 11–42 times per 15 sec ($\overline{X} = 22.2$, SD = 5.2). Siegfried and Batt (1972) found that Wilson's Phalaropes pecking in groups pecked at the rate of 6.3 pecks per 15 sec. The reason for this difference in pecking rates was not apparent. Pecking was seen throughout the marsh, although it was more common near its borders. It was employed frequently by both lone birds and groups, but such groups lacked cohesion and individuals remained far apart and evenly spaced.

Swishing is performed by moving the bill rapidly to the left and right in the manner of avocets, *Recurvirostra* spp. This behavior was noted in

TABLE 1
FEEDING METHODS IN RELATION TO ENVIRONMENTAL AND SOCIAL PARAMETERS

Method	Water depth	Group size	Minimum individual distance (body lengths)	Configuration of birds in flock
Pecking	0–2 m	1–25	5	Scattered, evenly spaced
Swishing	Belly height	1–25	4	Scattered, evenly spaced
Bill-pushing	$\leqslant\frac{1}{2}$ m	1–100	3	Scattered, irregularly spaced
Tipping-up	$\geqslant\frac{1}{2}$ m	1–100	3	Scattered, irregularly spaced
Spinning	$\geqslant 1$ m	40–100	1	Tightly packed, evenly spaced

small flocks of wading birds near the edge of the marsh and occurred in conjunction with other feeding methods. Birds feeding in this way showed distinct flock organization and all members waded in roughly the same direction. When the feeding flock approached a stand of tules the birds would fly to the next pool.

Bill-pushing consists of dipping the opened bill in the water and swimming forward, removing the bill, moving the mandibles as if manipulating prey, and putting the bill back in the water. This behavior occurred in small, loosely organized flocks of wading or swimming birds.

Tipping-up consists of dipping the whole head and part of the neck into the water, tipping the body upright and exposing the legs. The bird paddles along in this position, coming up at short intervals and then repeating the process. This behavior usually occurred in flocks but was also performed by solitary birds. The amount of time the phalaropes spent with their heads submerged in one bout was significantly higher when feeding in a flock than when feeding solitarily ($t = 3.67$, $N = 69$, $P < 0.001$). The mean submergence time when in a flock of 30 or more birds was 1.2 sec (SD = 0.3, range = 0.8–2.6 sec) compared to 0.7 sec (SD = 0.3, range = 0.4–1.8 sec) for birds feeding solitarily. Therefore birds feeding by tipping-up in a flock spent more time feeding than lone birds. No significant difference was found between the amount of time a phalarope had its bill submerged while bill-pushing and the amount of time the head was submerged while tipping-up ($t = 1.1$, $N = 89$).

Spinning, described by Höhn (1967, 1971) and others, also occurred. In spinning, the bird twirls in one spot and pecks at the water surface.

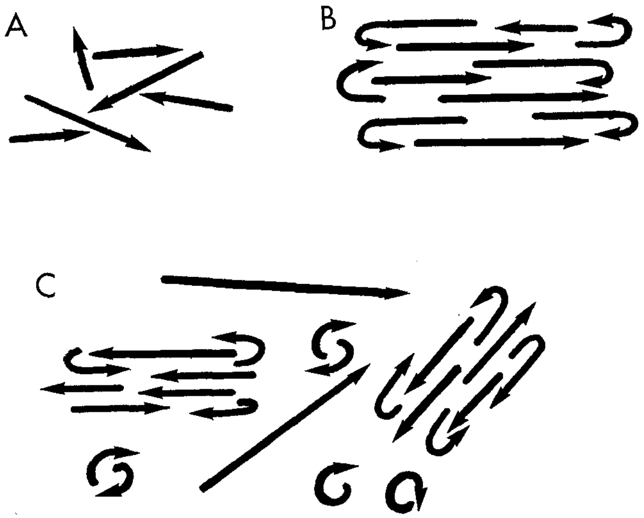

Fig. 2. Patterns of movement of individual Wilson's Phalaropes in flocks. A, flocks of less than 20; B, flocks of 20 to 60; C, flocks of more than 60.

This behavior was usually seen in large, tightly packed flocks (40-700, $\bar{X} = 280$). Spinning was rarely performed by birds in small flocks, and then only when the flock configuration was changing rapidly (see below).

Höhn (pers. comm.) noted an additional feeding method in which swimming phalaropes extended the head and neck upwards in a snapping motion to catch low-flying insects.

The patterns of movement of individuals in swimming flocks and the organization of flocks as a whole were examined. The pattern of movement of individuals can appear organized or highly disorganized. Flocks of from 20 to 60 individuals are organized in that most birds swim parallel to one another (Fig. 2B). Upon reaching the end of the group each bird makes a 180° turn and swims in the opposite direction. Few birds ever cut across the group. Birds in these flocks fed primarily by bill-pushing and tipping-up.

Phalaropes continually enter and leave the group and, when the group exceeds about 60 birds, the movement of the group no longer fits into one pattern. A series of smaller patterns often develops (Fig. 2C); individuals no longer swim from one end of the whole group to the other. Under these conditions some birds cut across the original axis of movement and others feed in only one small space within the group. In some cases individuals swim in circles of decreasing size until they are practically spinning. The number of birds spinning seemed to increase as the flock size increased. All swimming flocks of more than 150 fed only by spinning.

When a group becomes smaller than about 20 birds the organization also decreases as individuals begin swimming in all directions (Fig. 2A). Interestingly, in flocks that decrease to 3–8 individuals, some birds start to swim in circles again, although it rarely develops into spinning.

As solitary birds as well as flocks of various sizes could be found feeding in the same place on the same day, flock size and density appears to be at least partially independent of patterns of food abundance and distribution. This suggests that the methods of feeding employed are functions of at least two variables: (a) size and density of the flock and (b) depth of the marsh. For a summary of feeding behavior and related parameters see Table 1.

LEG COLOR AND MOLT

On three dates between 16 November 1972 and 15 January 1973 Burger collected 16 Wilson's Phalaropes in Argentina. On the basis of wear in the old primaries, two of these were determined to be adults and four to be immatures (juvenal primaries are dark and only slightly worn; old adult primaries are light brown and show heavy wear). No reliable criteria for aging the remaining 10 birds were found. All birds showed active molt in the remiges and rectrices but molt on other parts of the body, with the exception of the wing coverts, was generally lacking. Leg color tended to darken through the period. The following discussion reports details of the progression of leg color change and feather replacement; and, by including data from birds Howe collected in North Dakota between June and August of 1968 and 1969, we present a tentative construction of the prebasic molt schedules of adults and immatures.

Leg color.—Murphy (1936: 999) pointed out that Wilson's Phalarope specimens Beck collected in Argentina in September and October 1914 had yellow or yellowish green legs and feet. Palmer (*in* Stout 1967) refers to the leg color of this species in basic plumage as "muted yellow." In the present study one adult and one immature female were collected on 16 November; both had distinctly bright yellow legs. Only 2 of the 14 birds collected on 7 and 15 January had completely yellow legs; the others varied from yellow-gray to steel gray. As early as the first week of July males and females collected from postbreeding flocks in North Dakota were beginning to undergo a change in toe color from black to yellow. Apparently adults experience a gradual yellowing of the legs and feet very soon after breeding (even before the onset of the prebasic molt) and by November have legs as bright yellow as those of immatures. By January the legs of both age classes have darkened considerably but are not yet the black typical of spring birds. The adaptiveness of seasonality in leg color in this species is not clear.

Molt patterns.—Little information is available on the timing of the molt cycle in Wilson's Phalarope or on differences related to age and sex. Palmer (*in* Stout 1967) described the plumages of adults, juvenals, and immatures, concluding that all birds undergo prebasic body molt before migrating south in the late summer, and immatures retain the juvenal wing and tail in first basic plumage and at least the juvenal wing in first alternate plumage. All the immatures collected in this study showed extensive molt in both remiges and rectrices. This conforms to the pattern found in Red Phalaropes (*Phalaropus fulicarius*), Northern Phalaropes (*Lobipes lobatus*), and all Eurasian Charadrii that migrate long distances (Stresemann 1963).

The small sample of known age birds does not permit a quantitative comparison of the timing of primary molt of immatures and adults, but the data suggest no major differences. By lumping all birds for each of the three collection dates, the mean number of new, fully grown primaries was determined to be 4.0 on 16 November ($N = 2$), 8.0 on 7 January ($N = 8$), and 8.2 on 15 January ($N = 6$). When males and females were treated separately (January birds only), no significant difference was obtained ($t = 0.23$, $df = 12$). As Wilson's Phalaropes have 10 major primaries and a rudimentary 11th, birds are nearing completion of primary molt by mid-January. One female taken on 15 January had completely renewed all primaries. If Wilson's Phalaropes follow the pattern of Dunlin (*Calidris alpina*), in which the first six primaries are molted in rapid succession and the rest follow at longer intervals (Holmes 1966), molt of the primaries probably begins on the wintering grounds in late October.

Wilson's Phalaropes have 14 secondaries, the proximal 4 being elongated with much weaker shafts. The general pattern of secondary molt that emerges is a sequential replacement of secondaries through 9 or 10 (distal to proximal) beginning during the first half of primary molt and ending synchronously with primary molt. Most of the proximal secondaries follow a less defined pattern. In about one-third of the winter birds examined a sequential replacement of secondaries 9 through 11 or 10 through 12 began shortly after the onset of molt in the distal secondaries. In the remainder of the birds no distinct pattern was evident. Many adults in North Dakota replace at least some of the proximal secondaries before migrating south: 1 of 33 adult males collected on 12 July and 7 of 15 collected on 22 July were molting some of the proximal secondaries. It is not known whether some juveniles follow the same pattern. The overall sequence of secondary replacement resembles that of Dunlins from northern Alaska, but in Dunlins the entire process is compressed into a 6-week period concurrent with replacement of primaries 8 through 10 (Holmes 1966).

Two additional features of molt in the remiges warrant comment. The number of new primaries growing at any one time differed significantly between males and females ($t = 4.68$, $df = 13$, $P < 0.001$). The mean number of growing primaries for males over the entire period was 1.25 and for females was 2.0. As the molt of individual birds could not be followed, it could not be determined whether this difference is indicative of more rapid renewal of the entire complement of primaries or slower growth of individual feathers in females. No sexual difference was found for secondary replacement ($t = 0.06$, $df = 12$).

The number of entering secondaries may be directly related to the number of entering primaries. Males with one growing primary averaged 2.5 growing secondaries, whereas those with two growing primaries averaged 4.0 growing secondaries; this difference was significant ($t = -2.50$, $df = 6$, $P < 0.05$). This relationship could reflect a similar response of primary and secondary molt to a common stimulus, such as energy reserves, or possibly might indicate a contigency of the growth of a particular remex on that of another. Too few data were available to examine females for this relationship.

Molt of the rectrices was evident in all winter specimens and most adult summer specimens. In summer birds the two central feathers were typically the first to be replaced. These were often followed by the outermost but replacement of the remaining rectrices showed no consistent pattern. Tail molt in the females took place 3 weeks earlier than in males on the average, three of eight females in postbreeding flocks showing molt activity as early as the first week of June. This schedule corresponded with the temporal difference in postbreeding flocking between males and females. On 3 July two females retained an average of 6.5 old rectrices while seven males averaged 11.3. Likewise on 12 July 3 females retained only 3.7 old rectrices and 30 males 9.2. The latest adult males collected were on 22 July when 15 males averaged 7.0 old rectrices.

These data indicate that tails of many adults are largely renewed before the birds migrate south and suggest the possibility that rectrix molt seen in winter adults might be an additional replacement rather than a resumption of molt begun in the summer. This possibility is also suggested by the molting of the central rectrices of the adult female collected 16 November and the adult male 7 January, but further clarification is required. Immature birds apparently do not begin to lose the juvenal tail until wing molt begins, probably in late October. In known

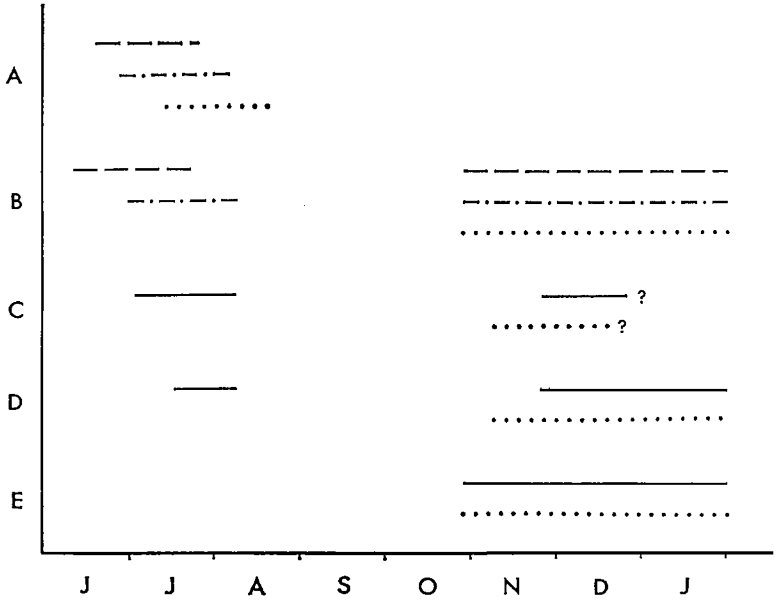

Fig. 3. Prebasic molt schedule of adult and young Wilson's Phalaropes. Symbols: long dashes = adult females; alternating dashes and dots = adult males; unbroken line = adults of both sexes; and dots = immatures. A, body feathers; B, rectrices; C, median or lesser wing coverts (see text); D, proximal four secondaries; and E, primaries and distal 10 secondaries.

immatures on 15 January, a female had four worn rectrices and a male none. Unfortunately at this stage juvenal rectrices are not reliably distinguishable from adult rectrices. In fresh juvenal rectrices the black of the central portion of the vane tapers distally to a point, but this character is rapidly obscured by wear. In all molting birds lumped, individuals averaged 2.42 growing rectrices (summer: $\overline{X} = 2.36$, SD = 2.35, N = 11, winter: $\overline{X} = 2.46$, SD = 1.34, N = 13).

Molt of the body feathers and wing feathers was not quantified. All birds undergo prebasic body molt during July and August, females preceding males and males in many cases preceding juvenals. Back feathers are the first to renew and are joined rapidly by molt in all other body tracts. Scapulars are among the last body feathers to molt. Some winter specimens retain a few juvenal or alternate scapulars or back feathers or show a few very new feathers, probably indicating recent replacement of these old feathers. The gray basic body feathers undergo browning with age.

Summer molt of the scapulars is followed by or occurs simultaneously with molt of the median secondary coverts in adult birds; 13 of 28 adult males on 12 July and 11 of 15 on 22 July showed molt of the median secondary coverts. A comparison of the single November adult and immature females showed that the adult retained the old brown primary and lesser secondary coverts but had previously acquired gray median secondary coverts. The immature retained all juvenal wing coverts but was beginning to molt the median secondary coverts. By January all birds had acquired gray lesser and median primary and secondary coverts and could no longer be aged on this basis. Greater coverts followed the usual pattern of simultaneous replacement with the corresponding remex in all birds.

These data indicate that, despite some differences in the molt schedules of adults and immatures, both age classes undergo a complete prebasic molt that is probably completed in January. Most birds cannot be aged reliably thereafter on the basis of the characters discussed here. New information is needed to clarify the precise timing of the molt and such questions as whether adults undergo two "prebasic" tail molts. A tentative prebasic molt schedule is outlined in Fig. 3.

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