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Foraging, scavenging, and other behavior of swallows on the ground.—Swallows are aerial foragers that occasionally take prey from on the ground. To our knowledge, 6 species of swallows have been reported feeding on the ground in North America (Barn Swallows [*Hirundo rustica*], Bent 1942, Jackson and Weber 1975, Weber 1980; Cliff Swallows [*H. pyrrhonota*], Bank Swallows [*Riparia riparia*], Jackson and Weber 1975, Weber 1980; Tree Swallows [*Tachycineta bicolor*], Bent 1942, Erskine 1984; Purple Martins [*Progne subis*], Bent 1942; Northern Rough-winged Swallows [*Stelgidopteryx serripennis*], Wolinski 1980, Sealy 1982). Also, Erskine (1984) documented what he believed was ground foraging by Violet-green Swallows (*T. thalassina*). All of these sightings were isolated accounts that, for the most part, involved relatively few individuals. The importance and nature of this foraging behavior is poorly understood. We report ground foraging in 3 species of swallows in Manitoba, including large numbers of migrating Tree Swallows, and describe scavenging from artificial food patches and other nonforaging behavior of swallows that occurred on the ground.

Methods.—We observed swallows on the ground near the southern shore of Lake Manitoba and northern edge of Delta Marsh, Manitoba. From mid-July to late August 1985, several thousand migrating Tree and Bank swallows staged here. About 25 pairs of Barn Swallows nested on the study site, and approximately 100 Cliff Swallows were present in August.

We observed the swallows opportunistically from distances of 10–50 m. Upon encoun-

tering them on the ground we determined the species composition of the flock and estimated the number of individuals in it. Flocks seldom remained intact for more than a few minutes. Tree Swallows were classed as adults or subadults; second-year females and hatching-year birds were not distinguished (see Hussell 1983).

The tendency for swallows to scavenge prey was tested using insects (chiefly midges [*Chironomidae*] with some moths [*Noctuidae*]) that we collected with an ultraviolet light trap and froze. We created food patches by placing several hundred thawed insects on the ground within an area of 0.25 m^2. Also, we created a strand line of dead insects 10 m long and 1.5 m from the waterline of Lake Manitoba. Natural densities of arthropods along roadways were measured by counting within randomly placed quadrats. Weather data were obtained from the Environment Canada Meteorological Station located on the study area.

Observations.—Between 13 July and 22 August we observed 21 flocks of swallows for a total of 15 h. Swallows used 2 areas regularly: a smooth dirt roadway (Site 1) and a dirt and gravel roadway and adjacent mowed grass (Site 2, grass height approximately 5 cm). At both sites, swallows roosted diurnally on overhead wires, on rooftops, and in willows (*Salix interior*).

From 13 to 22 July, 6 observations were made of Tree Swallow flocks on the ground. Flocks were composed of 36 ± 29% adults [SD] (N = 17 counts) and the mean flock size was 48 ± 17 individuals (N = 17 counts).

In this area, massive emergences of chironomids occur frequently throughout the summer (Busby and Sealy 1979, Briskie 1985). Occasionally in 1985, large numbers of chironomids were grounded, apparently due to cool overnight temperatures (average minimum daily temperature for July was 10.8°C). On two such occasions (20 and 21 July) we observed flocks of Tree Swallows feeding on chironomids on the ground (Table 1). Some individuals also picked up and dropped leaves, twigs, grass, or pebbles. Individuals remained on the ground for several minutes at a time. Such foraging activity, however, was interrupted frequently by brief, but sudden flights of the flock. The chironomid emergence of 26 July was followed by warmer overnight temperatures, and the density of chironomids on the ground decreased. No swallows were observed foraging on the ground in this case (Table 1).

Tree and Barn swallows also scavenged dead chironomids from food patches. Only one individual fed from a patch at one time, and Tree Swallows were displaced by conspecifics when feeding in patches on 3 occasions. Bank Swallows did not take food items, although they walked through patches several times and picked up grass from amongst the dead insects.

Barn, Tree, and Cliff swallows scavenged dead chironomids from the strand line on cool mornings (Table 1). They usually landed a few cm from the strand line where they picked up and ingested insects. Birds fed at the strand line until they were disturbed by two Ring-billed Gulls (*Larus delawarensis*) that also fed on the chironomids.

From 23 July to 14 August, 7 observations were made of mixed-species swallow flocks on the ground. The mean flock size was 225 ± 168 individuals (N = 17 counts) and compositions ranged from primarily Tree Swallows in late July to primarily Bank Swallows in mid-August. These flocks, together with the four monospecific Tree Swallow flocks observed from 13 to 22 July, involved individuals engaged in a variety of behavioral patterns. Some activity appeared to be related to maintenance. Sunning postures involving lateral tilting (see Barlow et al. 1963) were assumed by Tree, Bank, and Cliff swallows. Bank Swallows dust bathed, and all species preened when on the ground. The most common behavior observed, however, was the repetitive picking up and dropping of pebbles, grass, leaves, and twigs. Individuals picked up and dropped items as many as 17 consecutive times before turning to other objects. Dried blades of grass were often picked up and carried 5–6 m before being dropped and picked up again. All species and age classes participated in this

TABLE 1

SUMMARY OF RESPONSES OF SWALLOWS TO CHIRONOMIDS OCCURRING ON THE GROUND IN NATURAL CONCENTRATIONS AND IN ARTIFICIAL FOOD PATCHES AND STRAND LINES, 19 JULY TO 1 AUGUST 1985

Date[a]	Time	Site[b]	Overnight min. temp (°C)	Temp. at start of observations (°C)	Flock composition[c]	Chironomid/m[d]	Aerial insects	Ground foraging
July 19	09:00	2	10.0	15.0	37 TRSW	Chironomid patch[d]	Yes	Yes
20	08:00	1	7.5		90 TRSW	47 ± 51 (N = 20)	No	Yes
						5.2 ± 3.6 (N = 10)		
21	08:00	1	8.0		105 TRSW	14 ± 10 (N = 10)	No	Yes
						2.7 ± 3.8 (N = 20)	No	Yes
21	14:00	1	8.0	20.5	100 TRSW	Chironomid patch	Yes	Yes
24	10:00	2	14.0		80 TRSW, 70 BKSW	Chironomid patch	Yes	Yes
26	08:00	1	12.5		none	0.5 ± 1.4 (N = 15)	Yes	No
31	08:00	Beach	7.5	16	none	Strand line	Yes	No
August 1	06:30	Beach	7.5	8.5	8 BASW, 4 TRSW, 1 CLSW	Strand line	No	Yes

[a] Overnight chironomid emergences occurred on 18–19 and 25–26 July.
[b] Site 1 = smooth dirt roadway; Site 2 = dirt and gravel roadway and adjacent mowed grass; Beach = shore of Lake Manitoba.
[c] TRSW = Tree Swallow; BKSW = Bank Swallow; BASW = Barn Swallow; CLSW = Cliff Swallow.
[d] In patches chironomid densities were several hundred per m^2. Strand line was 10–15 chironomids thick and 10 m long. Densities given for 20 and 21 July are listed for shaded and unshaded regions of driveway; density for 26 July is for shaded driveway.

behavior, which occurred on grass and dirt substrates and continued in one instance for at least 35 min.

Intra- and interspecific aggressive interactions were observed frequently in mixed and monospecific flocks of swallows on the ground. These interactions usually involved displacements and threats with the opened bill. Mountings, usually lasting less than 5 sec and resembling copulation attempts, were observed amongst Tree Swallows. In 75 min of observation of 2 Tree Swallow flocks and one mixed flock, we recorded 33 mountings of subadults by adults, 6 mountings of adults by other adults, and 7 mountings of subadults by subadults.

Discussion.—Locally abundant food on the ground apparently was created in July 1985 by the massive evening emergences of chironomids followed by cool overnight temperatures. Weber (1980) observed Bank, Barn, and Cliff swallows feeding on mayflies that had settled in large numbers on pavement in Alabama. His observations also were made during early morning in late July but, unlike in our study, he noted that mayflies also swarmed over grass and were thus available as aerial prey. Weber also noted that swallows handled these large insects with difficulty. We found that swallows experienced similar difficulties handling noctuid moths. Although lepidopteran larvae are sometimes taken, they are generally unimportant in the diet of swallows (Bent 1942).

Tree, Barn, and Violet-green swallows occasionally land on beaches during migration (Bent 1942, Gullion 1947, Kilham 1980). Apart from providing rest sites, beaches can provide temporarily abundant food. Wolinski (1980) observed Northern Rough-winged Swallows landing on a lakeshore to feed on fly larvae on dead fish. Sealy (1982) saw this species scavenging dead midges that had washed up on the shore of our study site. Erskine (1984) reported 15 Tree Swallows apparently foraging among decaying vegetation at the strand line of a lakeshore. Slud (1964) reported Gray-breasted Martins (*P. chalybea*) foraging on a seashore in Costa Rica.

Wolinski (1980) and Sealy (1982) attributed ground foraging by Northern Rough-winged Swallows to opportunistic use of a temporarily available, abundant food supply. Erskine (1984) noted that Tree and Violet-green swallows apparently foraged on the ground when insects in the air were scarce. He hypothesized that Tree and Violet-green swallows return earlier in the spring than do other swallows in North America, possibly because they winter north of the Mexico-U.S. border. Thus they spend more time in cooler climates and may benefit the most by exploiting several sources of food. Tree Swallows exhibit greater plasticity in their diet than other North American swallows and have been known to eat seeds and fruits during cool weather (Bent 1942). Interestingly, only Tree Swallows readily foraged and scavenged on the ground in our study area. The apparent absence of this behavior in Bank Swallows circumstantially supports Erskine's hypothesis. However, this requires further study since we also observed ground foraging and scavenging in Barn and Cliff swallows. Also, Weber (1980) saw Bank Swallows taking mayflies on the ground, and this species has been observed taking maggots from on the ground in England (Clegg 1977).

Erskine (1984) suggested that observations of foraging by swallows in early spring or during cold weather would probably provide more records of ground foraging. Our observations suggest that ground foraging also occurs during the postbreeding period, possibly in response to diurnal temperature changes as well as periods of sustained inclement weather. Brown (1976) noted that Purple Martins in Texas cannot forage for aerial prey when temperatures are below 6°C. Ricklefs (1971) noted that the foraging rates of adult Mangrove Swallows (*T. albilinea*) were sensitive to temperature and that foraging activity increased shortly after dawn and before dusk.

The repetitive picking up and dropping of inedible objects has been observed in young Bank, Tree, and Cliff swallows (Bent 1942). Weber (1980) noted that Bank Swallows often

pecked at cigarette butts and feathers and suggested that juveniles may not discriminate consistently between food and nonfood items. Chapman (in Bent 1942) suggested that when young Bank Swallows picked up bits of dried grass they prematurely exhibited nest-building instincts. Bank Swallows occasionally, and Cliff and Barn swallows regularly, gather nest material from the ground (Bent 1942, Peart 1976). Our observations reveal that adult and young swallows exhibit this behavior. Ashmole and Tovar (1968), Dunn (1972), and Feare (1975) observed juvenile terns picking up inedible objects from the sea surface. These authors considered such "playing" to be part of learning to forage.

Aggressive interactions have been reported amongst breeding (Emlen 1952, Harris 1979, Butler 1982) and nonbreeding (Bent 1942, Barlow et al. 1963) swallows on the ground. We could not be certain whether the mountings we observed were primarily copulation attempts or acts of aggression or dominance (see D'Agostino et al. 1982). Female Cliff Swallows are susceptible to "rape" attempts when they are gathering mud for their nests (Emlen 1952, Butler 1982). Hoogland and Sherman (1976) also found that male Bank Swallows attempted extrapair copulations on the ground. Brewster (in Bent 1942) described attempted copulations amongst young Cliff, Tree, and Bank swallows that were on the ground picking up and dropping plant material. Chapman (in Bent 1942) similarly observed young Bank Swallows mounting and ascribed this behavior to procreative instincts. Barlow et al. (1963) reported mounting attempts of nonbreeding Cliff Swallows that were sunning on the ground. Emlen (1952) described aggressive interactions amongst Cliff Swallows that resembled brief and incomplete copulations. In our study, most mountings were by adults on subadults. Many of the subadult Tree Swallows could have been second-year females which, when perched on the ground, resembled birds in a soliciting posture. This may have released a stereotyped mounting behavior in adult males similar to that described by Barlow et al. (1963).

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December records of seabirds off North Carolina.—Little published information is available concerning offshore winter seabird fauna of the southeastern United States. The only overview of the local seasonal variation in seabirds is that by Lee and Booth (1979). Their summaries were based mostly on North Carolina field studies done from late spring through early fall, and provide little new information on the winter distribution of marine birds. Clapp et al. (1982, 1983) compiled records of all marine birds for the southeastern States, but offshore information was generally unavailable for the winter. During the last few winters I conducted 11 offshore survey trips into shelf and shelf-edge waters off North Carolina during December. All trips departed from Oregon Inlet, North Carolina (29 December 1977; 5 and 30 December 1978; 3 and 28 December 1982; 12, 20, 28, and 29 December 1984; 5 and 22 December 1985). Survey routes typically extended 35 to 55 miles offshore, transecting inshore, shelf, shelf-edge, and Gulf Stream waters.