

Glaucous-winged and Mew gulls spent most of their time sitting on the water or the rocky shore. They pecked the exposed dorsal surface of the spawning salmon, but we could not confirm feeding. Bonaparte's Gulls and Red-legged Kittiwakes flew almost continuously and dived frequently. Bonaparte's Gulls appeared to be "pursuit diving," and the kittiwakes, "dipping" (terms from Ashmole, pp. 223-286 in *Avian Biology*, D. A. Farner and J. R. King, eds., Academic Press, New York, New York, 1971). Close observation showed that kittiwakes generally dived between salmon and ate something from the stream bottom, presumably salmon eggs. On at least 2 occasions, kittiwakes pecked at the exposed dorsal surface of salmon spawning in the stream. Although dead salmon were abundant on sand banks, we never saw gulls or kittiwakes eat any of them.

Adult and juvenile kittiwakes foraged similarly. No pattern of dominance, aggression, or indication of feeding hierarchy was detected. Juveniles foraged next to, and independent of, adults.

Red-legged Kittiwakes are commonly found near the Pribilof Islands during the breeding season; they are rare, post-breeding visitors to the northeastern Bering Sea and Aleutian Islands. There are a few accidental records in southeastern Alaska and the Yukon River (Kessel and Gibson, *Stud. Av. Biol.* 1:48-49, 1978), but they are usually seen at sea, if at all. They have only been reported to feed on small fish and cephalopoda in the waters south of the Pribilofs (Hunt, pp. 196-382 in *Environmental assessment of the Alaskan continental shelf*, Vol. 2, Natl. Ocean. Atmos. Admin. Environ. Res. Lab., Boulder, Colorado, 1977).

Bonaparte's and Mew gulls are common visitors to southeastern Alaska in fall, and the Glaucous-winged Gull breeds there—it probably is not unusual to find these 3 gulls foraging together (Bent, *U.S. Natl. Mus. Bull.* 113:65-73, 1921). Our observations are significant in that range extensions in both location and time are established for the Red-legged Kittiwake, and the post-breeding feeding habits in southeastern Alaska are described for the first time.

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Ground-feeding methods and niche separation in thrushes.—Recent papers by Clark (*Wilson Bull.* 83:66-73, 1971) and Henty (*Wilson Bull.* 88:497-499, 1976) have described a foraging method used by a number of species of birds, consisting of lateral sweeps of the bill to move aside loose material. They termed it "bill-sweeping" and reported its occurrence in several thrushes (*Turdus*), namely the White-necked Thrush (*Turdus albicollis*), European Blackbird (*T. merula*), American Robin (*T. migratorius*) and Songthrush (*T. philomelos*). I have recently observed such behavior, together with other foraging methods, in 2 additional species, the Fieldfare (*T. pilaris*) and European Redwing (*T. iliacus*) and incidentally in the European Blackbird. The intention of this note is to relate bill-sweeping to other principal foraging techniques used by thrushes when feeding on the ground, and to comment on niche separation in the genus.

Observations were made between October 1975 and February 1976 on wild birds in Cambridgeshire, England, using a hide or vehicle stationed at the edge of a field. Birds regularly approached to within 20 m, and sometimes to within 10 m of a concealed observer, providing detailed views of their searching and handling techniques.

TABLE I
RELATIVE USE OF FOOD CATEGORIES BY FIELDFARES AND REDWINGS

	Fieldfare N (%)	Redwing N (%)
Surface items (all <10 mm long)	266 (43.7)	176 (66.9)
Soil items	342 (56.3)	87 (33.1)
Soil items >10 mm long	154 (45.0)	19 (21.8)

The 2 main species were wintering together on areas of cattle-grazed permanent pasture. For most of the winter this was their preferred habitat, in which they collected invertebrate food. Foods taken comprised 2 major categories: (1) "soil items," including earthworms, centipedes, slugs and larvae of beetles and craneflies (Tipulidae), which required extraction from soil or grass tufts; and (2) "surface items," exposed on the soil or vegetation, and comprising mainly flies, beetles and spiders, for which handling was minimal. This division was based on the difference in technique required for the capture of prey items in each category.

Similar methods were used by both Fieldfares and Redwings when taking prey from a given category. In both species searching for both categories consisted of running along the ground in short bursts, usually of 1-5 paces or hops, halting after each run, and apparently scanning the ground in the immediate vicinity. If a potential food item was spotted, a few paces might be taken towards it. In the case of a surface item the bird usually pecked immediately at it (although there might be a brief hesitation) during which the bird might cock its head to one side before the peck. Occasionally, more than 1 peck was made. With a soil item, the behavior was similar to the bill-sweeping described by Clark (1971), although he found bill-sweeping used "to move aside twigs, leaves, dry soil, or snow" and did not mention use on relatively hard-packed substrates such as the damp soil with dense roots found on the present study area. On hard substrates the behavior is more appropriately termed digging, as described by Heppner (Condor 67:247-256, 1967) for American Robins hunting earthworms. As in robins, a Redwing or Fieldfare would stop near potential prey, hesitate, often cocking the head to one side, sometimes take a short step backwards or to one side, then stab downwards. Often several pecks were made, when the first few did not usually secure the food. Instead the downward stab was followed by a head flick, often causing soil to be thrown to one side. The flick might be more or less pronounced, and occasionally was not lateral.

The major difference between the bill-sweeping described by Clark (1971) and Henty (1976) and digging as described by Heppner (1967) and the present paper is that the former is a search technique while the latter is a "pursuit" technique used after a potential prey has been spotted. However, the two are seemingly related.

Bill-sweeping was also used by Fieldfares and Redwings to move aside loose material. Redwings occasionally fed in dead leaves in the manner described by Henty (1976), walking through the litter with almost continuous, rapid, lateral head movements. Redwings used a similar method when searching cattle dung for dipteran larvae, except the bird stood still by a pat while searching. When Redwings foraged in cowpats in this way, the technique was intermediate in action between bill-sweeping and digging, and was used for both search and "pursuit." Fieldfares searched litter much less frequently than Redwings, and were never observed feeding at cowpats.

The 2 species differ in size—the Fieldfare weighing 120–140 g and the Redwing 60–80 g. These differences were reflected in differences in diet. I recorded the numbers of surface and soil items taken by thrushes in many large flocks over the whole winter (Table 1). In order to avoid bias due to observations containing different numbers of items captured I calculated the proportion of surface items taken during each feeding record. A Mann-Whitney *U*-test on the difference of this proportion between the species was highly significant ($P < 0.001$). The Redwings took more surface items than soil items and the Fieldfares took more soil items than surface.

Digging required more time and energy than picking items from the grass. However, soil items were generally larger than surface items (Table 1); also Fieldfares took larger soil items than did Redwings (Table 1, Mann-Whitney *U*-test, $P < 0.01$).

Thus, the 2 species subdivided the habitat primarily on spatial and behavioral differences; differences in prey size were to some extent consequential upon these, supporting Hespeneheide (pp. 158–180 in *Ecology and Evolution of Communities*, M. L. Cody and J. M. Diamond, eds., Belknap Press, Harvard, Cambridge, Massachusetts, 1975). However, prey size differences were also evident within a foraging zone, indicating either that each species had prey-size preferences or that some undetected difference in foraging technique was involved (such as depth of digging).

In late February and March, when the availability of larger insects on the surface and vegetation increased (Tye, unpubl.), the Fieldfare took proportionately more surface items (75.4%) than in winter (43.7%, October to mid-February) and more closely resembled the Redwing in feeding techniques, suggesting that prey-size preferences may have been important in determining the Fieldfare's feeding behavior.

Litter-feeding was most common when the ground was frozen or snow-covered. At such times most Fieldfares left the study area completely, and the remaining few fed on small clear patches of pasture or garden lawns. In contrast, Redwings moved into hedge-bottoms and gardens and switched to litter-feeding. Prey items found in litter resembled surface items of the open pasture, mostly small arthropods and slugs. Large items were uncommon in the litter which may explain why Fieldfares did not often feed there.

The European Blackbird apparently used the same techniques as the Fieldfare and Redwing, if not in the same proportions. The Blackbird tended to bill-sweep in a strict sense more than the Fieldfare, especially in litter, and to dig more than the Redwing, and was probably intermediate in its use of soil and surface items on pastures. It is also intermediate in size (ca 90–120 g).

Therefore, when feeding on the ground, the *Turdus* species studied so far all seem to use the same range of related feeding techniques. Within a habitat they achieve niche separation by the differential use of these techniques, and therefore of the foraging zones for which each technique is appropriate. Further niche separation may also be achieved by prey-size preferences within a foraging zone. The behavioral, spatial and prey size differences may be related to body size.

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