I.10 Birds and Wildlife as Grasshopper Predators

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In the early years of this country's agriculture, birds were considered the first line of defense against insect damage. The first laws to protect birds were proposed in 1877 (U.S. Entomological Commission 1878). The act establishing the U.S. Department of Agriculture (USDA) in 1862 made reference to "the introduction and protection of insectivorous birds" (McAtee 1953). A Section of Economic Ornithology and Mammalogy was formed in USDA's Division of Entomology in 1885, and it was expanded into a Division of Food Habits Research in 1921. Much of the wildlife food-habits work was summarized in a book by Martin et al. (1951) in which the authors reported almost universal predation on grasshoppers by insectivorous and omnivorous birds, mammals, and reptiles.

It is interesting that most of the early studies in economic ornithology were not done by ornithologists (people studying birds) but rather by entomologists (those studying insects). For example, S. A. Forbes, an entomologist, founded the field of economic ornithology more than 100 years ago and defined many of the principles of integrated pest management (IPM) as we know them today (Metcalf 1980). The results of examination of more than 40,000 bird stomachs were reviewed by W. L. McAtee (1953). More than 200 species of birds were found to prey on grasshoppers (fig. I.10–1).

Figure I.10–1—More than 200 species of birds are known to feed on grasshoppers. Even seed-eating species, such as this Savannah sparrow, depend on insects for high-protein food during the breeding season. (Photograph by C. K. Miller, of the Nature Conservancy, Clear Lake, SD; used by permission.)

Some of the larger species, such as kestrels (sparrow hawks) (fig. I.10–2), gulls, and meadowlarks, could capture in excess of 100 grasshoppers per day. Swainson's hawks are known to gather in flocks of several hundred to feed on grasshoppers when they become abundant (Wakeland 1958). More recently Johnson et al. (1987) observed large flocks of these hawks capturing about 100 grasshoppers per bird per day in Idaho.

It is not surprising that grasshoppers are so important as food for wildlife because they (1) have high energy value and contain 50–70 percent crude protein (Ueckert et al. 1972, DeFoliart 1975), (2) are widely distributed and available in most western habitats, and (3) are large enough to easily exceed the energy cost of capture by foraging birds and wildlife. Grasshoppers are especially important for successful raising of young by the majority

Figure I.10–2—Research on kestrels has shown their high rate of predation on grasshoppers and their compatibility with grasshopper IPM control materials, such as dimilin, *Beauveria bassiana,* and Sevin 4-Oil ®. (Photograph by B. E. Petersen; used by permission.

of bird species (McEwen 1987) and for many mammals as well. Nestlings and chicks must go through a period of rapid development and growth to survive and perpetuate their species. Even many species that, as adults, eat mostly seeds and plant materials are completely insectivorous in early life (fig. I.10–3). Grasshoppers are highly preferred for feeding young of many kinds of songbirds, upland shore birds, game birds (quail, grouse, pheasants, and turkeys), and even certain hawks and owls (McAtee 1935, 1953).

Grasshoppers are beneficial to a healthy, vigorous, grassland ecosystem when they are at low to moderate (noneconomic) densities. This family of insects preceded today's rangeland plant species and vertebrate animal life by millions of years (Carpenter 1953). Grasshoppers developed in the rangeland ecosystem during a long period of coevolution with other flora and fauna. Grasshoppers' ecologic role (Van Hook 1971) of providing food for wildlife, stimulating plant growth, creating plant litter for the soil, and cycling elements and nutrients was developed as a functional part of the whole ecosystem. Land managers should view grasshoppers as pests only when the insects increase to densities that are clearly damaging to the rangeland plant cover and ecosystem.

Figure I.10–3—Lark bunting with grasshopper captured to feed nestlings. Grasshoppers are a preferred food for young wildlife because of the high protein content and nutritional value. (Photograph by Lowell C. McEwen; used by permission. The shot was taken on the GHIPM Project's grasshopper spray area in Bighorn County, Wyoming.)

Although there is much evidence that birds and wildlife prey on grasshoppers, little research has been done to learn whether wildlife predators actually reduce grasshopper populations or prevent outbreaks. A few recent experiments determined the reduction in grasshopper densities attributed to birds on rangeland. Results show that bird predation commonly reduces grasshopper densities on rangeland by 30–50 percent (Joern 1986, Fowler et al. 1991, Bock et al. 1992). But predation is not so effective in some habitats (Belovsky et al. 1990). Studies of bird predation on other insect pest species also have found that birds significantly reduce pest numbers (McFarlane 1976, Takekawa et al. 1982, Crawford and Jennings 1989, Marquis and Whelan 1994).

Capture of grasshoppers for food by mammals has not received much attention as a suppressing force on grasshopper populations. Small mammals, such as shrews, ground squirrels, deer mice, and grasshopper mice, and larger species, including skunks, foxes, and young coyotes, all eat grasshoppers when available (Martin et al. 1951). Many reptiles and amphibians do the same (fig. I.10–4).

Most investigators agree that predation is more important before, rather than after, insect pests reach the outbreak stage. Bird and mammal predation on grasshoppers is considered a stabilizing force on grasshopper populations. Wildlife predation acts as a preventive factor to grasshopper outbreaks, rather than a means of quick reduction after a buildup to high pest densities. However, instances have been recorded (Wakeland 1958) of flocks of birds saving valuable forage from destruction by grasshopper outbreaks. Perhaps the best known example is the arrival of gulls to save crops in Utah from Mormon crickets (Forbush 1907).

The recognition of the value of birds in combating insect pests has led to efforts not only to protect insectivorous species but also to increase their numbers by providing nest boxes and improving habitat. Nest boxes have been successfully used for hundreds of years on a large scale in Europe to attract birds that control forest insect pests (Takekawa et al. 1982). In the United States, forest management effects on bird populations and relationships to insect outbreaks were reviewed by Thomas (1979) and Crawford and Jennings (1989). A study of insectivorous

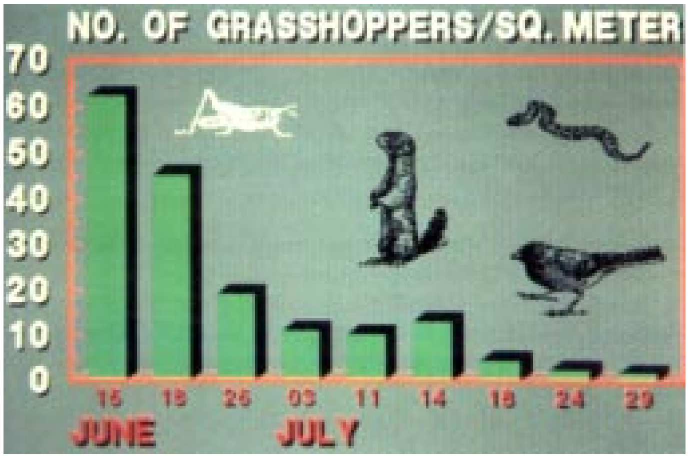

Figure I.10–4—Over the summer, relatively low grasshopper densities on a rangeland area can be diminished further by natural biological factors, including bird, mammal, and reptile predation. But wildlife predation is effective only when grasshopper densities are low (noneconomic) and should be viewed as a preventive force against grasshopper outbreaks, not as a total control measure after outbreaks have occurred.

birds feeding on the insect pests of white oak *(Quercus alba)* concluded that bird predation reduced insect numbers by 50 percent and resulted in one-third greater growth of the oaks (Marquis and Whelan 1994).

Control of locusts that had been a chronic problem on 8,200 acres of grassland in China was achieved by using birds. This was done by creating nesting habitat, planting small shrubs, and digging water seeps to increase the number of insectivorous birds (Anonymous 1988, Yu 1988). Control was successful over many years. Predation on grasshoppers by birds was found in food-habit studies of rangeland birds foraging at edges of Montana wheat fields (McEwen et al. 1986).

Bird densities on the semiarid western rangelands of the United States are generally lower than in other ecosystems that receive higher precipitation. However, numbers of highly insectivorous birds, such as meadowlarks and grasshopper sparrows, can be increased by improving range condition and increasing perennial grass and forb cover. The wildlife associated with healthy stands of native grasses, forbs, and shrubs can contribute greatly to prevention of grasshopper outbreaks (McEwen 1982, McEwen 1987). Figure I.10–1 shows an example of grasshopper suppression by wildlife.

An investigation of bird numbers and range grasshopper densities on the North Dakota Grasshopper Integrated Pest Management Project Demonstration Area indicated a significant negative relationship (George and McEwen 1992). This relationship was a strong indication of possible effects of avian predation on grasshopper densities.

Although bird population densities vary on rangeland, most studies show a normal population range of 1 to 3 birds/acre in the late spring to summer breeding season. Models of predation (McEwen 1987) by birds at these densities show a grasshopper reduction potential of at least 50 percent. In a recent review of the role of birds in controlling insect pests, Kirk et al. (1996) developed a model that indicates even greater potential for regulation of grasshoppers–based on bird numbers, capture rates, and energetics.

Wildlife populations are an important biological control factor in natural suppression of rangeland grasshoppers. Management practices that improve range condition and habitat for insectivorous and omnivorous wildlife can dampen or prevent extreme grasshopper population fluctuations and help reduce damage to vegetation.

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