VII.10 Ongoing Environmental Concerns

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NOTE: Acephate is no longer approved by EPA for rangeland grasshopper control.

Perhaps the greatest continuing environmental concern in a Grasshopper Integrated Pest Management (GHIPM) program is providing safeguards and protection for threatened and endangered (T and E) plant and animal species. These problems complicate grasshopper control programs and make them more costly but must be dealt with in a straightforward manner. Plenty of lead time should be allowed to identify species and habitats and to work out solutions with agencies responsible for T and E species' protection and management.

Recognition of the fact that individual vertebrate animals can vary greatly in their sensitivity to a given toxic chemical should help all workers understand that toxic exposure of the T and E species must be kept to a minimum. Toxic hazard is minor for mature animals lightly exposed to the current GHIPM pesticides—carbaryl, malathion, and acephate—but is probably more of a factor for young animals (chicks, nestlings, amphibians, and larval fish). Any toxic mortality would be of concern because species differ in their lower threshold of numbers of animals necessary for maintaining a viable population. Those limits are not known precisely for each species, but land managers should try hard not to cause unnecessary losses with toxic chemicals.

In the larger picture, it would seem that concern for geographic variants that have been given T and E status should not be on the same level as for T and E species that are the sole remaining population or individuals. Technically and legally, however, there is no distinction at this time.

T and E species can be protected in several ways in a rangeland grasshopper cooperative control program. Nonspray buffer zones are one of the main tools (see chapter III.8). Width and size of buffer zones will vary with the T and E species and on the outcome of consultation with managing agencies. Carbaryl bait treatments or other dry baits, including biological control agents such as *Nosema locustae* and *Beauveria bassiana*, can be used safely much closer to the T and E species habitat or even with no buffer zone in some cases.

Baits and biologicals add expense and sometimes cause equipment problems when used but should be recognized and accepted as important and necessary components of many successful programs. The degree of grasshopper reduction will probably be less than where liquid insecticide spray is applied, but the higher densities of grasshoppers remaining after the treatment often will be beneficial to the T and E species.

Another possible option for protecting T and E species is the timing of the grasshopper control program. This aspect can be explored for T and E insects and pollinators of T and E plants (also see chapter III.5). If the T and E insects are in the adult stage for a relatively brief period, then pest managers may conduct treatments safely before or after the adult stage.

For aquatic species, there are significant differences in toxicity among the three chemicals. Acephate is much less toxic to fish than carbaryl or malathion (Johnson and Finley 1980) and is referred to in other publications as practically nontoxic to fish. Acephate is highly effective against grasshoppers at the low application rate of 1.5 oz/acre (0.105 kg/ha) (U.S. Department of Agriculture 1987). Although acephate has been little used in cooperative control programs, it could be an excellent alternative to other pesticides where T and E fish are of concern. Another safety factor for fish would be to use dry bait treatments because less chemical is used per unit area and there is much less potential for drift into aquatic habitat. The entire problem of T and E species protection in GHIPM programs could benefit from further research.

Indirect Effects on T and E Species

The question of indirect effects of grasshopper control programs, primarily reduction or loss of the food base for birds, now comes up more frequently than potential toxic effects. Colorado State University (CSU)-led studies have shown that when grasshopper availability is reduced, birds generally switch to other insects or invertebrates for food and maintain their nesting success and populations (Miller 1993, Miller and McEwen 1995, Miller et al. 1994, George et al. 1995, Fair et al. 1995). Regarding the concern for peregrine prey effects, CSU investigators have shown that total bird population numbers do not decline following a grasshopper control program, even though some individual species might decrease (George et al. 1995). Since peregrines prey on such a wide variety of avian species (DeWeese et al.

1986, Hunter et al. 1988), the decline of one or two species should have no significant effect on their prey base. Use of dry baits, such as carbaryl bait, also could be a safeguard since the baits are selective formulations and consequently leave many unaffected insects for avian food (Adams et al. 1994).

Nevertheless, each T and E species must be examined individually for potential response to GHIPM treatments. The situation is such that T and E species and their habitats cannot be dealt with routinely by generalized procedures. Each T and E situation must be treated as a unique "case history," although as knowledge is acquired, some will be more standardized than others.

New Chemicals and Biologicals

New materials for range grasshopper control, such as Dimilin® (diflubenzuron) and *Beauveria bassiana*, will require close monitoring until their environmental safety is determined. The two materials appear quite safe for terrestrial vertebrates, but final determinations cannot be made until the materials are applied in large-scale operational control programs. Aquatic effects are especially of concern as well as Acridid (grasshopper) specificity and effects on nontarget invertebrates. Any other candidate chemicals and biologicals that are considered for GHIPM must also be closely examined for environmental effects before being approved for large-scale use.

Species of Concern

State and Federal wildlife agencies in recent years have endorsed a philosophy of giving attention to declining species **before** they reach T and E status. If a declining species can be managed for recovery before listing, management efforts are simplified. Declining species may be designated as "species of concern." Some examples are the long-billed curlew *(Numenius americanus)*, the western burrowing owl *(Athene cunicularia)*, and the ferruginous hawk *(Buteo regalis)*. The curlews and burrowing owls use grasshoppers heavily, especially as a source of protein and nutrients important for breeding and for feeding their young. The golden eagle *(Aquila chrysaetos)* is another species of concern in some areas of the West and is a protected species. There is a need to conduct a study of the response of nesting golden eagles to malathion spray as was done with Sevin® 4-Oil. One or more of several species of concern are apt to be present in GHIPM treatment areas and should be treated as T and E species if necessary in the opinion of the biologists and land managers involved.

Gallinaceous birds, such as prairie chickens and sharptailed grouse *(Tympanuchus* spp.), sage grouse *(Centrocercus urophasianus)*, chukars *(Alectoris chukar)*, and wild turkeys *(Meleagris gallopavo)*, also often are considered species of concern. The effects of grasshopper control on the growth and survival of the young chicks and poults is the primary question. More study is needed on the effects of GHIPM programs on species of concern.

Function of Wildlife in a GHIPM System

Scientists and land managers have made a lot of progress in showing the role and benefits of wildlife, especially birds, as important contributors to regulation of grasshopper densities (Joern 1986, Fowler et al. 1991, Bock et al. 1992). However, the overall ecology of native wild vertebrates in preventing insect pest outbreaks is virtually unexplored. The interrelationships of range condition, vegetative cover types, native plants *vs.* introduced species for reseeding (such as crested wheatgrass, *Agropyron cristatum)*, and associated wildlife populations need much more investigation. Large expanses of crested wheatgrass become devoid of almost all the breeding avian species (Reynolds and Trost 1980). In the northern Great Plains, grasshopper outbreaks frequently originate in crested wheatgrass, where grasshopper densities are usually higher than on native grass range (Hirsch et al. 1988 unpubl., Kemp and Onsager 1994 unpubl.). This fact should not be surprising because the lack of birds as grasshopper predators is coupled with >40 percent bare ground (compared to <5 percent in native grassland (Dormaar et al. 1995), which is favored by many grasshoppers for egg-laying.

Range condition criteria are currently undergoing review and revision (Task Group on Unity in Concepts and Terminology 1995). Land managers need to relate range wildlife habitat use and populations to condition classes and to grasshopper population fluctuations. Improving range condition is a long, slow process, but range in good condition with a full complement of native wildlife can reduce grasshopper population fluctuations in the central and northern Great Plains (McEwen 1987). Improving the condition of degenerated sagebrush *(Artemisia* spp.) range found farther west is more difficult than improving other range types, but it should be a long-term goal (McEwen and DeWeese 1987). New range management practices (Biondini and Manske 1996; Onsager, in press) should be examined for wildlife responses.

The status and function of wild vertebrates in relation to range condition also need more investigation. Basic knowledge of range wildlife ecology connects with the efforts to improve the vegetative cover on western rangelands. Preventing the extinction of animal and plant species is the goal of conservation biology and will be a benefit of better range condition. This will also be an important factor contributing to grasshopper management in an IPM system.

References Cited

Adams, J. S.; Knight, R. L.; McEwen, L. C.; George, T. L. 1994. Survival and growth of nestling vesper sparrows exposed to experimental food reductions. The Condor 96: 739–748.

Biondini, M. E.; Manske, L. L. 1996. Grazing frequency and ecosystem processes in a northern mixed prairie. Ecological Applications 6: 239–256.

Bock, C. E.; Bock, J. H.; Grant, M. C. 1992. Effects of bird predation on grasshopper densities in an Arizona grassland. Ecology 73: 1706–1717.

DeWeese, L. R.; McEwen, L. C.; Hensler, G. L.; Petersen, B. E. 1986. Organochlorine contaminants in Passeriformes and other avian prey of the peregrine falcon in the Western United States. Environmental Toxicology and Chemistry 5: 675–693.

Dormaar, J. H.; Naeth, M. A.; Williams, W. D.; Chanasyk, D. S. 1995. Effect of native prairie, crested wheatgrass *(Agropyron cristatum)* (L.)(Gaertn.) and Russian wildrye *(Elymus junceus* Fisch.) on soil chemical properties. Journal of Range Management 48: 258–263.

Fair, J. M.; Kennedy, P. L.; McEwen, L. C. 1995. Effects of carbaryl grasshopper control on nesting killdeer in North Dakota. Environmental Toxicology and Chemistry 14: 881–890.

Fowler, A. C.; Knight, R. L.; George, T. L.; McEwen, L. C. 1991. Effects of avian predation on grasshopper populations in North Dakota grasslands. Ecology 72(5): 1775–1781.

George, T. L.; McEwen, L. C.; Petersen, B. E. 1995. Effects of grasshopper control programs on bird populations in western rangelands. Journal of Range Management 48: 336–342.

Hunter, R. E.; Crawford, J. A.; Ambrose, R. E. 1988. Prey selection by peregrine falcons during the nestling stage. Journal of Wildlife Management 52: 730–736.

Joern, A. 1986. Experimental study of avian predation on coexisting grasshopper populations (Orthoptera: acrididae) in a sandhills grassland. Oikos 46: 243–249.

Johnson, W. W.; Finley, M. T. 1980. Handbook of acute toxicity of chemicals to fish and aquatic invertebrates. Publ. 137. Washington, DC: U.S. Department of the Interior, U.S. Fish and Wildlife Service. 98 p.

McEwen, L. C. 1987. Function of insectivorous birds in a shortgrass IPM system. In: Capinera, J. L., ed. Integrated pest management on rangeland: a shortgrass prairie perspective. Boulder, CO: Westview Press: 324–333.

McEwen, L. C.; DeWeese, L. R. 1987. Wildlife and pest control in the sagebrush ecosystem: ecology and management considerations. In: Onsager, J. A., ed. Integrated pest management on rangeland: State of the art in the sagebrush ecosystem. Bull. ARS–50. Washington, DC: U.S. Department of Agriculture, Agricultural Research Service: 76–85.

Miller, C. K. 1993. Responses of nesting savannah sparrows to fluctuations in grasshopper densities in interior Alaska. M.S. thesis. Ft. Collins, CO: Colorado State University. 24 p.

Miller, C. K; Knight, R. L.; McEwen, L. C. 1994. Responses of nesting savannah sparrows to fluctuations in grasshopper densities in interior Alaska. Auk 111: 960–967.

Miller, C. K.; McEwen, L. C. 1995. Diet of nesting savannah sparrows in interior Alaska. Journal of Field Ornithology 66: 152–158.

Onsager, J. A. [In press.] Suppression of grasshoppers in the Great Plains through grazing management. Journal of Range Management. [Accepted for publication December 1, 1999.]

Reynolds, T. D.; Trost, C. H. 1980. The response of native vertebrate populations to crested wheatgrass planting and grazing by sheep. Journal of Range Management 31: 122–125.

Task Group on Unity in Concepts and Terminology. 1995. New concepts for assessment of rangeland condition. Journal of Range Management 48: 271–282.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service. 1987. Rangeland Grasshopper Cooperative Management Program: final environmental impact statement. Washington, DC: U.S. Department of Agriculture, Animal and Plant Health Inspection Service. 221 p.

References Cited–Unpublished

Hirsch, D. C.; Reuter, K. C.; Foster, R. N. 1988. Comparison of grasshopper population characteristics in relation to grassland types in western North Dakota in 1987. In: Cooperative Grasshopper Integrated Pest Management Project, 1988 annual report. Boise ID, U.S. Department of Agriculture, Animal and Plant Health Inspection Service: 244–252.

Kemp, W. P.; Onsager, J. A. 1994. Grasshopper population response to modification of vegetation by grazing. In: Cooperative Grasshopper Integrated Pest Management Project, 1994 annual report. Boise, ID: U.S. Department of Agriculture, Animal and Plant Health Inspection Service: 93–98.