III.8 Buffer Zones: Their Purpose and Significance in Grasshopper Control Programs

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

A buffer zone is a distance or space around an environmentally sensitive area that acts as a deterrent to harm and/or disturbance of that area and its plant and animal life. For Federal cooperative grasshopper control or suppression operations, buffer zones are strips or areas of land left untreated and free of grasshopper suppression chemicals or materials.

Such zones, also called buffers, are pesticide-free areas established to protect (1) species listed or proposed as threatened or endangered (T and E) under the Federal Endangered Species Act, (2) designated or proposed critical habitats of T and E species, (3) aquatic sites (water or wetlands) of all types, and (4) other areas such as residences, parks, campgrounds, schools, cropland, apiaries and insectaries, and habitat for other sensitive species. Before any lands are treated in large-scale U.S. Department of Agriculture (USDA)-sponsored cooperative grasshopper management programs, land management agencies meet with USDA's Animal and Plant Health Inspection Service (APHIS) to consider all aspects of an operational plan to protect the T and E species and sensitive sites in the proposed treatment area.

Land-management agencies typically include the U.S. Department of the Interior's Bureau of Land Management and U.S. Fish and Wildlife Service (FWS) and USDA's Forest Service. An APHIS-prepared biological assessment opens the required consultations, and agencies discuss and negotiate buffer-zone requirements until agreement is reached among APHIS and the affected land-management agencies. At times, discussions and negotiations also involve State agencies.

The agencies determine buffer-zone specifics using existing Federal guidelines, the most recent information, and the best judgment of their personnel. The written agreement reached is expressed in detail in the FWS biological opinion for the site-specific environmental assessment. In practice, optimal treatment of a control block also depends on the experience of the project manager and the skill and experience of the spray pilots or ground applicators and on their observance of buffer boundaries and wind and weather conditions.

Generalized Buffer Zone Requirements

There are two general types of insecticide used for grasshopper control: liquid ultralow-volume (ULV) chemical sprays and insecticide-impregnated wheat-bran flakes. Requirements for use are more stringent for liquid ULV sprays than for bait application because ULV sprays are less selective in action, are more prone to drift, and contain more active ingredient (AI).

For treating grasshoppers in large-scale rangeland programs, APHIS not only follows chemical labeling recommendations but at times adds more restrictions based on environmental concerns. APHIS and other agencies base their current recommendations and mitigation (softening of effects) on guidelines contained in the Rangeland Grasshopper Cooperative Management Program and the Final Environmental Impact Statement (EIS) (U.S. Department of Agriculture, Animal and Plant Health Inspection Service 1987). APHIS also relies on changes agreed to by the FWS and content of the biological opinion. In addition, APHIS considers information that has come from its Grasshopper Integrated Pest Management (GHIPM) Project, which began in 1987.

Protecting areas of water on rangeland is important in grasshopper control programs. Present EIS guidelines state that liquid ULV sprays should not be applied within 500 feet (152 m) of aquatic habitat (reservoirs, lakes, ponds, seasonal pools, springs, streams, rivers, swamps, bogs, marshes, and potholes) or where leaching or surface runoff is likely, or when precipitation seems imminent. In recent years, there has been unresolved discussion about the definition of wetlands, and whether or not dry intermittent creek beds, wet meadows, and seasonally dry potholes qualify under the definition.

Aquatic habitat buffers also apply to areas treated with some baits. When chemical baits are used, the width of the no-treatment zones around aquatic habitats is 200 feet (61 m). When baits are used, buffer zones are smaller, and more of the area harboring grasshoppers can be treated. Bran baits containing the biological control agent *Nosema locustae* can be used without buffer zones. Some pest managers believe that being able to treat a larger proportion of the area lengthens the time period before the site is reinfested.

Baits do have limitations: damp or wet weather hampers use, not all grasshopper species will eat dry baits, baits are more expensive to apply than liquid ULV sprays, and baits provide a lower level of control of susceptible species compared to liquid sprays (see chapter II.12). However, baits do make it possible to reduce the size of buffer zones, obtain some suppression of grasshoppers that otherwise would be untreated using ULV sprays, and minimize insecticide effects on nontarget species.

After no-treatment and no-spray zones for sensitive areas are identified and mapped, the APHIS State plant health director or the authorized APHIS representative should verify the treatment locations in a pretreatment reconnaissance flight with the spray pilot(s). Boundaries should be clearly and adequately marked, preferably with large peices of fluorescent orange material. There should be confirmation of the no-treatment sites. Records and maps also should be signed by APHIS representatives and pilots and dated after the pretreatment flights. The pilots(s) must clearly understand locations and boundaries of buffer zones.

When called for during chemical spray operations, spray-deposit dye cards should be placed within the buffer zones to detect drift or inadvertent treatment of no-spray sites. Lack of spray deposit will verify that buffer zones did prevent exposure to sensitive areas being protected. With bran baits, cards containing adhesive or small pans placed in the buffer zones will detect inadvertent treatment.

Aircraft utilizing an electronic guidance system (Loran C or Global Positioning System) will aid greatly in identifying buffer zones and increasing the accuracy of applying sprays or baits (fig. III.8–1). When acceptable electronic guidance is available and used, ground flagging to mark the areas can be reduced or eliminated. Some guidance systems also are combined with a printed record of the flight showing exact locations of areas treated. A printed record adds to accountability and quality assurance. In the future, Federal agencies may require detailed printed records of insecticide applications in treatment areas.

APHIS has found that only rarely is part of a treatment block treated a second year in a row. Typically, APHIS may treat a block of land only once every several years.

Figure III.8–1—In the era before global positioning systems, agricultural pilots had to turn the nozzles of their spray equipment on and off manually. Pilots did this when they spotted “flagmen” who stood on the ground at the edge of spray plots or buffer areas. It was virtually impossible to adjust the on/off decision in light of near-ground wind, so insecticide drift was common. Naturally, flagmen were exposed to toxicants just like the target pests! Now, however, computerized equipment on the spray planes can automatically starts and stops the flow of pesticides using sophisticated mapping and geostationary satellite coordinates.

Buffer Zones for Endangered Plants

Buffer zones for T and E plants are important, not because of a direct effect of insecticides on plants but to protect any insect pollinators that might be necessary for reproduction of the plants. The only insecticides (malathion, acephate, and carbaryl) registered and approved by APHIS for use in grasshopper control on Federal lands are not known to be toxic to plants at the rates used. The insecticides are toxic to some flower-visiting insects, however.

Is it common for T and E plants to need insect pollinators? The T and E plant species studied during the GHIPM Project demonstrated a dependency on insects, particularly native bee species, to move pollen from one flower to another (chapter III.5). Reproductive success of 24 of 26 plant species studied during the project is greatly increased by the presence of native bees. Grasshopper control efforts must be designed to prevent or minimize insecticide exposure to active pollinators of T and E plants.

The question of adequate buffer-zone size is extremely complex. How can pest managers define "adequate size" in a T and E context? The answer to this question depends on several factors including:

- The distance bee pollinators move between their nesting sites and flower populations,
- The distances over which bees forage for food from flowers, and
- The distances bees must move to gather other needs such as mud, leaf pieces, resin, etc., that are important for nest construction.

The brief answer to questions of adequate size is that scientists and pest managers really do not know what is adequate. One way to determine the size of buffer zones is to base the size on the protection needed; however, determining the protection needed often can be difficult. Some studies to determine at least partial answers to the question of size have not been successful (chapter III.5).

For the most part, bees appear to act in ways that increase their foraging efficiency. When possible, bees nest close to the flowers they visit for pollen and nectar. Sometimes bees cannot do so because the proper nest sites are absent. Sometimes bees also forage farther than usual because flower density is low or because other resources are not available at nesting sites.

Studies noted in chapter III.5 did show that many species of bees are capable of flying several miles to return to their nests. Whether bees do this routinely is not known. Without a complete knowledge of insect pollinator behavior, the common (and some scientists believe the safest) approach is a conservative one. A buffer zone of 3 miles' (4.8 km) radius usually is employed around T and E plant populations when using liquid insecticides.

The 3-mile buffer zone can be reduced or eliminated if information shows that the species in question is a self-pollinator or reproduces asexually or if the spray is not a potential problem to the pollinator species. Obviously, if no pollinators are needed, there is no effect on the T and E plants from the use of insecticides.

When using the common formulation of 2 percent carbaryl bran bait or other dry baits to treat grasshoppers, it is unlikely that the control program would need any buffer zone (chapter III.4) even with bees present. Because they do not eat bran baits, bees are not directly exposed to the insecticide.

Change in Peregrine Falcon Buffer Zones

The former standard buffer for peregrine falcon *(Falco peregrinus)* aeries (nests), hack sites (release of young peregrines after acclimation and supplemental feeding), and other release or habitat sites was a 10-mile no-treatment or drift radius (for aerial applications). It is now possible to establish buffer zones that are less arbitrary and correspond to the foraging area of the birds–often a long, narrow strip such as a valley or canyon. The foraging areas must be determined by a review team including one representative each from APHIS, FWS, the State conservation agency, and the land manager (or landowner if private land).

Aerial insecticide treatments then can be applied to within 1 mile (1.6 km) of the nest or release site. The boundaries of known foraging areas have a 500-ft (152-m) no-treatment zone. Bait applications with ground equipment can be made to within 0.5 mile (0.8 km) of a nest or release site and within 200 feet (61 m) of foraging areas. Reduced peregrine falcon buffer zones have not been widely used yet in grasshopper control programs, so the zones' use and effect should be part of the project monitoring plan.

Examples of Effective Uses of Buffer Zones

Piping plovers *(Charadrius melodus)*, an endangered species, nest on the sandy shoreline of Lake Sakakawea adjacent to grasshopper control areas in North Dakota. In 1989, a "hot spot" carbaryl bait treatment (2 lb/acre of 2 percent carbaryl bran bait–0.04 lb/acre AI) was applied to land immediately adjacent to a breeding pair of piping plovers with two small chicks and their no-treatment buffer zone (200 ft) near the nest site. Periodic posttreatment observations verified normal development and behavior of the chicks and adults (McEwen and Fowler unpubl.).

In 1991, a 19,200-acre (7,770-ha) area was sprayed with Sevin® 4-Oil at the standard IPM rate. APHIS sprayed liquid Sevin in the block–excluding a 0.5-mile (0.8-km) strip along the lake shore that was treated with carbaryl bait (2 lb/acre–2 percent actual ingredient). APHIS applied the bait and left a 200-ft (61-m) untreated strip at the water line. Observations on the nesting plovers indicated no effect, and breeding piping plovers were found at the same site in the following year (McEwen unpubl.).

This piping plover site is an especially difficult treatment situation because it is near reseeded crested wheatgrass *(Agropyron cristatum)*. Large areas of nearby native range have been reseeded to crested wheatgrass. The plant's clumpy growth form, with bare ground between plants, tends to promote high pest grasshopper densities. Many grasshopper species prefer bare ground for laying eggs. Also, large expanses of crested wheatgrass lose nearly all the bird species associated with native grasses (Reynolds and Trost 1980) that would be preying on the grasshoppers. Part of the loss of breeding birds is based on poor nesting habitat associated with crested wheatgrass.

The authors also have used and evaluated buffer zones around other aquatic sites in western North Dakota. These zones were in relation to large-scale Sevin 4-Oil treatments in 1991 and 1993 adjacent to the Little Missouri River. The standard aquatic buffer zones of 500 ft (152 m) were in place. In both years, carbaryl was detected in the river.

In 1991, a drought year, the maximum concentration of carbaryl detected was 0.085 parts per million (p/m); in 1993, a wetter year, it was 0.013 p/m. These low concentrations were found 1–2 hours after treatment and then rapidly declined (Beyers et al. 1995). Samples at 48 hours contained less than 0.0005 p/m, well below the concentrations generally known to begin affecting other invertebrates (0.002–1.90 p/m) and fish (1.95–39 p/m) (Johnson and Finley 1980). The only biological effect was an increase in the number of Ephemeroptera (mayflies) in the immediate (1–3 hr) postspray drift samples in 1991.

Natural events had greater impact on the aquatic invertebrates in the river in 1991 than did the insecticide. Monitoring of brain acetylcholinesterase (AChE) activity in flathead chubs *(Platygobio gracilis)* collected from the treatment area showed no inhibition, indicating no adverse carbaryl effects. Measurement of AChE activity is a method of detecting toxic effects of pesticides. It was concluded that the light drift of Sevin 4-Oil into the Little Missouri River was biologically insignificant (Beyers et al. 1995).

A study of golden eagle *(Aquila chrysaetos)* response to Sevin 4- Oil treatments around active nests was initiated in 1993 and is still underway (1995) in North Dakota. Nest areas were treated in June 1993 and 1994 when the young eagles were 4–7 weeks of age. Each young eagle was captured at fledging (10–11 weeks of age) so field crews could take biological measurements and blood samples and attach radio transmitters for postfledging observations. Telemetry is used to determine movements, behavior, survival, and dispersal from the natal (hatching) areas. Preliminary results indicate no differences in survival, movements, and dispersal between young golden eagles from sprayed and unsprayed territories.

Eagles from treated nests tended to be less active in afternoon and evening time periods and preened more (Bednarski and McEwen 1994, Bednarski unpubl.). Fledglings from treated areas had slightly higher (*P* = 0.11) blood plasma cholinesterase activity, a normal "rebound" or overcompensation effect commonly seen in birds after a light exposure to an inhibiting pesticide (Taira 1994), Taira and McEwen unpubl.). Territory maintenance, nesting activity, and productivity of the mature pairs of golden eagles in the sprayed and untreated areas are being followed 1 and 2 years after treatment.

Preliminary findings suggest that buffer zones of 500 ft (152 m) or possibly 200 ft (61 m) around the actual nest site will be adequate for protection when treating with Sevin 4-Oil. Further studies may show that buffer zones could be even smaller or possibly eliminated. The large foraging area (± 50 mi^2 or 129 km^2) characterizing an average territory of a breeding pair of golden eagles need not be of concern. A small area (± 5 acres or 2 ha) around each nest easily could be left untreated, without the human disturbance caused when placing flags, by using an electronic guidance system. The human disturbance of people on foot in the immediate vicinity of the nest should be avoided and could cause more problems than the treatment itself. Again, restrictions of the biological assessment and biological opinion will control program design and operation.

Although the effects of carbaryl on nesting golden eagles have been examined during the GHIPM Project, there has been no study of the effects of malathion on golden eagles. A study utilizing malathion also should be done because it was found that another raptor species, the American kestrel *(Falco sparverius)*, is very sensitive to malathion toxicity in the nestling stage (Schleve et al. 1993 unpubl., McEwen et al. 1994 unpubl.).

Potential Consequences of Buffer Zones

Treatment-free buffer zones may appear to be an obvious way to protect sensitive areas. Although liberal use and size of zones may seem safest, unneeded or exaggerated protection may reduce the effectiveness (efficacy) of grasshopper control programs. Buffers have varying impacts on treatment program efficacy, depending on the specific goals of the program (minimum economic level of control or maximum control) and where in the cycle the current grasshopper population exists. While designed to protect nontargets, buffer zones also can provide protection for pests the program seeks to control.

One concern with buffers occurs when the grasshopper population is expected to be about the same or greater in the following year. When the control effort is crisis in nature, maximum control of damaging grasshoppers is the goal. Untreated zones in a treated block may contribute to extending or expanding the problem by harboring grasshoppers, especially when grasshopper populations are cycling upward. In some cases, a large number or size of buffer zones can result in an immediate loss in the integrity of the spray block (less efficacy of treatment). These zones may result in the need for additional treatments and may expose larger tracts of land to pesticide treatments later. Fewer long-term control problems should result from untreated buffer zones when the grasshopper population is expected to decline.

Regardless of the grasshopper population cycle, blocks with large numbers of irregular buffer zones may result in increased treatment difficulties during the actual spray operation. The increased difficulty may be reflected in an increased cost of the application contract. Increased cost may result from marking each zone on the ground to ensure its identify from the aircraft applying the treatment. Marking is required if accurate electronic guidance is not available to the applicator. Additionally, costs associated with environmental monitoring (if required) of the buffer zones also may substantial. Together, these additional costs may be very significant. Coupled with leaving enough of the problem grasshopper population in the buffer zones possibly to reinfest treated areas, these additional costs could reduce the length of the economic benefit of the treatment. There even may be cases where the total buffer-zone acreage or the associated additional costs are so high as to negate the value of a particular treatment.

Buffers around water are the most frequently encountered treatment-free areas within a spray block. However, it is not unusual for grasshoppers to exist at high densities near rivers, streams, lakes, or ponds. In some cases, these areas around water harbor the highest densities of grasshoppers in the entire proposed treatment area. The entire grasshopper population, including that in buffer zones, must be considered for the most economically, biologically sound program to result.

One area of concern for use of buffers is in small, isolated infestations identified as historic hot-spots. In such areas, buffers that prevent effective treatment could be a threat to the concept of treating localized areas before grasshoppers can spread to larger acreages. Large numbers of uncontrolled grasshoppers in buffers–within areas where preventative hot-spot treatment is the foundation of an areawide program–could prevent full implementation of the concept and seriously jeopardize the overall program.

In many cases, a specifically customized treatment may provide the protection needed for a sensitive area while addressing most of the pest population. An example of a customized treatment would be the use of ground-applied bait adjacent to waterways, with an application direction away from the water. If performed properly, such a treatment could be conducted within a few feet of the water. Conscientious consideration–on a case-by-case basis by all participants–should provide an economically, biologically, and environmentally acceptable treatment solution in almost all situations.

Additional research and more knowledge may, in the future, justify modifications to buffer zones and the agreements between Federal agencies and land managers. Until the knowledge is available to call for modifications, the guidelines set forth in the 1987 EIS and guidelines specified for T and E species will dictate how buffer zones are established for grasshopper control programs.

Conclusions

Buffer zones play a vital role in protecting the environment during grasshopper control programs on public lands. APHIS and land-management agencies regularly share information about T and E species, aquatic areas, and sensitive areas necessary to provide effective buffer zones. Currently, APHIS uses the guidelines contained in the 1987 EIS when conducting treatment programs for rangeland grasshopper control and suppression. As noted in the EIS, buffer zones may be subject to revision as new information comes to light.

APHIS bases its treatment programs on sound biological knowledge. At no time does APHIS intentionally jeopardize nontarget species in a treatment block. Buffer zones reflect the desire to provide protection as needed. Customized treatment programs could help resolve difficult situations, especially when grasshopper populations are building and presence of buffers within treatment areas could lead to reinfestation.

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