EFFECT OF ARTIFICIAL PERCHES AND NESTS IN ATTRACTING RAPTORS TO ORCHARDS

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ABSTRACT: Artificial perches and nest boxes were placed in three Pacific Northwest orchards to assess their effectiveness in attracting birds of prey to reduce vole populations. The data indicated that birds could be attracted under some conditions, but vole populations were not significantly affected. Additional factors such as vegetative biomass and human activity may limit their usefulness in reducing rodent populations under intensive agricultural conditions.

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INTRODUCTION

Vole (Microtus spp.) damage to high-yielding agricultural crops has been and will continue to be a critical problem to producers throughout the world. Their action, through feeding, burrowing, and nesting, accounts for millions of dollar in losses to orchards each year (Laidlaw 1981, Askham 1987, 1988). The development of alternative animal damage control strategies is an important part of horticulture and the management of production fruit orchards. The problem of animal damage control, particularly of rodents, becomes very complex when the combinations of production factors such as nutrient balances, moisture regimes, insects, and diseases are encountered in the production schedule. These conditions, if not managed properly, can produce resident vole populations up to and in some cases exceeding those encountered under natural conditions (Godfrey and Askham 1988).

Methods for controlling Microtus populations can be divided into three categories: mechanical, chemical, and biological. In the most advanced management regimes, a combination of the first two are generally recommended (Byers 1985). With a lack of data, the third is rarely considered.

Biological control, for the purpose of this paper, is defined as the nonchemical management of pest species (Isaacs et al. 1987). One form of biological control is predation. The importance of predation in population dynamics, however, has been a source of controversy for many years. Researchers such as Pearson (1966, 1971), Pitelka (1973), and Baker and Brooks (1982) believe that predation is an important factor in rodent population cycling. But, as Krebs and Myers (1974) ask, "Is this sufficient to regulate vole and lemming populations?" There are strong contentions that avian predators do not hunt intensively enough during a long enough period of time to determine population trends because they leave the area when prey abundances are low. In citing Pearson, Krebs and Myers continue by stating that "predators do not stop the increase of a breeding microtine population." Instead, predation may be responsible for the amplitude of microtine cycles continued pressure when the microtine populations are low. "Predation," Pearson continues, "can also influence the periodicity of the cycle by prolonging the period of low numbers" (p. 341). Krebs (1964) believes that predation cannot account for the changes in mortality and dramatic decline of certain species.

One of the factors which influence predation success is the prey's access to cover. Baker and Brooks (1982) concluded that "the influence of avian predation on vole numbers is affected strongly by cover" and the role of cover "should be considered in relation to other factors involved in population declines" (p. 299). Two additional factors influencing raptor predation success are perching and nesting sites. According to Reinert (1984), the importance of perches for hunting, resting, and feeding, as well as other activities (Forren 1981), has been documented by several investigators. In many areas, the erection of man-made perches, he contends, has served as a passive raptor management tool. To determine if additional perches would enhance raptor use of an area, Reinert erected two types of perches. The results indicated that five species of raptors readily used both types of perches with no significant preferential difference between the two.

In other studies, Wilmers (1982), Forren (1981), Christensen (1972), and Hall et al. (1981) placed perches on trees and poles close to or in several rodent-infested sites. Like Reinert, each found that these additions attracted raptors, but the data on their effectiveness in reducing rodent populations remain unclear.

The theories and concepts developed from studies such as these of predation on microtine populations are particularly useful when assessing some of the biological control alternatives available to production agriculture. As with many of these studies, however, data have been developed with limited population numbers, even in years of high productivity. Microtus population densities rarely exceed 120 animals/a (300/ha) and most research, if not all, is conducted on arid or semi-arid habitats. The question then becomes one of whether or not these concepts and theories apply with higher densities than are encountered in more productive habitats. Specifically, would the addition of artificial perches and nest boxes attract birds of prey to a commercial apple orchard and, if so, could the relative abundance of voles residing in the orchards be reduced?

MATERIALS AND METHODS

Three orchards were used as study sites in the Greater Wenatchee area in northcentral Washington State. Each was selected on the following criteria: 1) had a relatively high vole population, 2) were mature orchards with at least a 6-year history of vole activity and damage, 3) contained at least 20 acres (8 ha) in which one perch per acre and four nesting boxes could be placed, 4) had an observation point from which the entire site could be viewed, 5) were within a 2-mile radius of the control orchard with the same aspect and habitat type, and 6) were 20 to 25 years old.

The first site, adjacent to the east bank of the Columbia River near Orondo, was divided into 10-acre (4.05 ha) blocks. Eighteen perches, placed one acre (.4 ha) apart, four kestrel boxes (1 per 5 acres), and one barn owl nest box were dispersed throughout the study area. On the second site adjacent to the Wenatchee River near Dryden, 20 perches, 4 kestrel boxes, and 2 barn owl nesting boxes were established with the same spacing as on the first site. Nineteen perches and five nesting boxes were also located on a third site near Cashmere in a similar fashion.

The artificial perches were built from 25-ft (7.6-m) tall, 5-in (12.7-cm) diameter lodgepole pine (Pinus contorta) and placed 3 to 5 ft (1 to 1.5 m) in the ground. Extensions to increase the perches' overall height to approximately 30 ft (27 m) were made from 6-ft (1.8-m), 1.5-in (3.8-cm) diameter doweling and topped with a 1-in (2.5-cm) round dowel cross-bar perch. Metal collection trays that could be raised and lowered were mounted beneath each perching unit.

American kestrel (Falco sparverius) and barn owl (Tyto alba) nest boxes were used for the study (USDA 1984, 1985). Each was placed on a 30-ft pole approximately 1 acre apart. All were lined with 2 in (5 cm) of Douglas-fir (Pseudotsuga menziesii) bark and periodically checked for occupancy and fitness.

Two permanent one-half acre (0.2-ha) prey assessment plots were established within each 20-acre site and all fallen apples from the prior year removed. Twenty-five sampling points were established beneath the tree canopy over active Montane vole (Microtus montanus) burrow openings and runways. Sliced apples were placed under each 12 in (30 cm) bituminous impregnated building paper squares each month and evaluated 24 hours later to determine relative population activity (Byers 1975, Askham 1987, 1988).

Predator use of the study sites was divided into two sections: inferred and direct. Inferred observations were made from monthly pellet collections. Direct observations were subdivided into two categories: diurnal and nocturnal. Diurnal observations ranging from 30 minutes to 5 hours each were used to record perch use, hunting activity, and flight behavior. General weather conditions including temperature, wind, and precipitation were recorded as well as on-site orchard activity such as pruning, planting, spraying, and vehicle movement. Raptor activity adjacent to the study sites was noted as well.

Nocturnal observations were limited to one 2-h period each month for each site between dusk and 2:00 a.m. Pre-recorded Pygmy, Saw-whet, Screech, Long-eared, and Great-horned owl calls were broadcast from a central orchard location and the response and location noted.

Each orchard's habitat was subdivided into two categories: trees and understory vegetation. Average tree heights within each treatment block were determined to the nearest foot (0.3 m) during May after the trees filled with new leaves. Distances between trees within rows and between rows was also measured to the nearest foot.

Understory vegetation was measured every 2 weeks from March through May by randomly placing nine 1-ft^2 (30-cm^2) rings beneath and between the tree canopies (18 plots/orchard). The total height, wet and dry biomass (including leaf litter and thatch), was measured within each frame.

RESULTS

None of the nine owl nesting boxes placed in and adjacent to the orchards was used during the project. Only 13% of the kestrel boxes were occupied by the target species. Starlings (Sturnus vulgaris) occupied 26%; Red-shafted flickers (Colaptes cafer), Brewer's blackbirds (Euphagus cvanocephalus) tree swallows (Iridioprocne bicolor), and honeybees each occupied 10%; the rest (21%) remained unoccupied but contained vestiges of grass clippings.

Only five birds were successfully fledged from one nest on the Dryden site. Five unincubated eggs in an abandoned box were found on the Cashmere site at the end of the study. Another nest with three dead 1-week-old birds and one addled egg was found in the Orondo orchard. Data from the USDA toxicology laboratory in Wenatchee indicated that the birds contained substantial amounts of PP'DDE and T-nonachlor (141 and 13.3 ppb, respectively).

During 236 hours of field observations between December 1 and May 30, a great variety of bird activity and perch use was observed. Although Red-tailed hawks (Buteo jamaicensis) and Northern shrikes (Lanius excubitor) were seen in each of the areas, no perch use was recorded until February. Two months later these birds were replaced by American kestrels. Only during February did Great-horned owls (Bubo virginianus) and Saw-whet owls (Aegolius acadicus) respond to repeated electronic calls. None were seen using the perches. From these data approximately 200 hours (h) of perch use was calculated for February, 320 h in March, 2570 h in April, and 2390 h in May (Fig. 1).

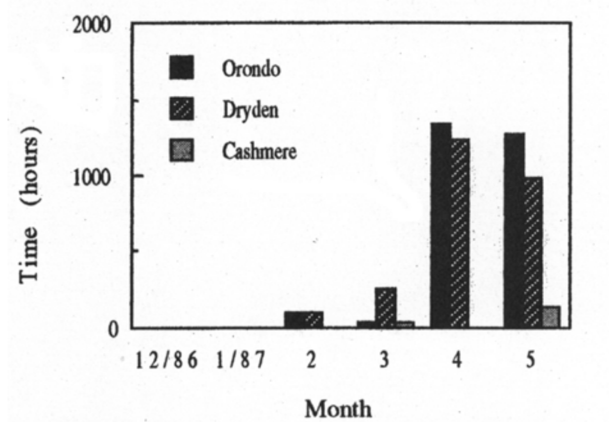

Figure 1. Estimated perch use by raptors for three Pacific Northwest orchards.

Pellet counts, however, indicated that raptors were active in the orchards throughout the entire sampling period (Fig. 2). From these samples, mammal remains were found to be the most common source of prey, followed by invertebrates, reptiles, and avians. Over half (55%) contained a multitude of prey. No attempt was made to correlate the number of pellets with the number of visual sightings.

Four species of small mammals were found in the orchards: Northern pocket gophers (Thomomys talpoides), White-footed deer mice (Peromyscus maniculatus). Shrews (Sorex spp.) and Montane voles. Gopher populations varied from less than one to six per acre. Deer mice and shrew populations were insignificant (Godfrey and Askham 1988). Vole populations ranged from 150 to 1500/a depending on habitat and prior years' management practices (Askham 1988).

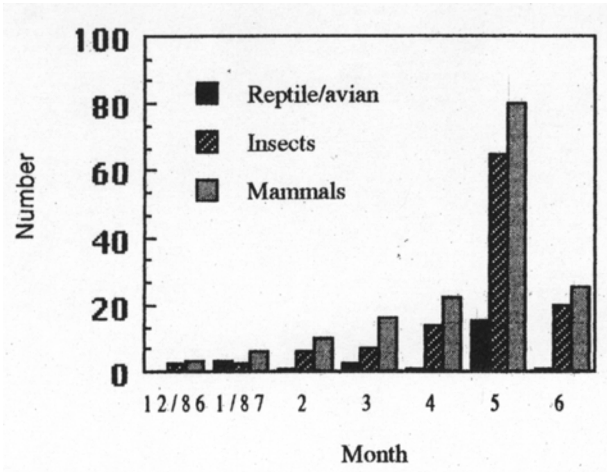

Figure 2. Mammal, reptile, avian and insect remains found in raptor pellets collected in three Pacific Northwest Orchards.

Data from all the control plots showed that vole activity decreased slightly (3.5%) between December and January, increased through April (21.75%), and then declined in May (11.25%) (Fig. 3). These data closely corresponded with those obtained in prior studies (Godfrey and Askham 1988). Data from the Orondo orchard, which had the second greatest amount of raptor activity, showed a similar progression of events but with slightly lower numbers (2 to 28%). Between January and May, vole activity was consistently less than in the control plots. Vole activity in the Cashmere orchard, which had the least amount of raptor activity, uncharacteristically oscillated between 8 and 15% below to 6 and 45% above the controls each month. The Dryden site, which had the highest amount of kestrel use, generally had more vole activity than the other two and the controls (3 to 33%).

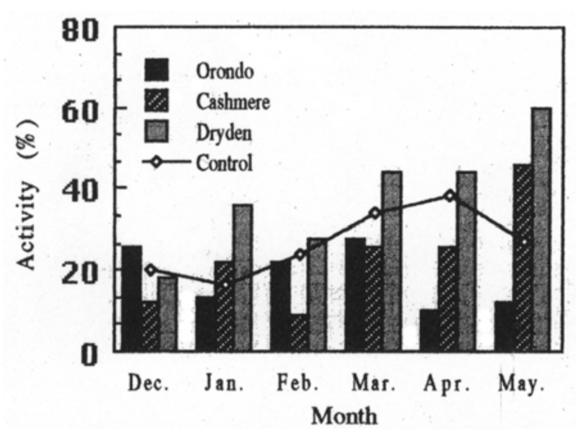

Figure 3. Vole activity in three Pacific Northwest orchards with raptor boxes and perches.

During the summers, the orchards in northcentral Washington State are a lush, green oasis surrounded by desert. The abundance of water from the nearby Columbia River, copious amounts of fertilizers, and lush plantings of various grasses assure that they will remain green all summer. By late October, the orchards have changed and the floors are covered by a dense matting of dead grasses, weeds, tree prunings, fallen leaves, and apples. The trees are bare. During December, snow begins to fall and continues for the next 3 months. Temperatures vary from +50 to -30°F. (+10 to -34°C); snow accumulations are often followed by short periods of mild weather. In the lower elevations, primarily along the river, the accumulated snows periodically melt to expose the orchard floors. By March, most of the snow is gone, the buds on the trees begin to swell, and grasses begin to appear through the matted orchard floor cover. By April, the trees are in full bloom and leaf.

The abundance of large trees such as Ponderosa pines (<u>Pinus</u> <u>ponderosa</u>), Cottonwood, and poplars (<u>Populus</u> spp.) varied between sites. At the Orondo site, approximately 171 pine and 71 poplars were found growing within 1/2 mi from the site. Within 1/4 mi, 8 pines and 42 poplars had been established. At Dryden, over 172 pines and 48 poplars were within 1/2 mi. Only 13 pines were identified within a 1/4 mi radius of the orchard. Several hundred pines flourished along the steep hillsides adjacent to the borders of the Cashmere orchard; only 18 were growing within 1/4 mi of the orchard center.

Tree spacing and height within the orchards of the region were fairly consistent. Most were 12 to 18 ft (4 to 5 m) tall, 15-to-20-year-old trees planted on 10-ft (3-m) centers in 12-ft. (3.6-m) rows. Younger interplantings of 3-to-5-year-old individual or groups of trees were common.

A statistical evaluation of the differences between vegetation biomass within the three treatment orchards was not significant. In general, the biomass within the rows was about 25% greater than that between the rows. The greatest amount of dry biomass, 28 oz/ft^2 (800 g/m^2), within the rows was recorded at the beginning of the growing season (March), decreased by about 50% by the end of April, and then increased through the end of the study. Vegetation height, however, increased steadily until the middle of May when mowings were initiated (Fig. 4).

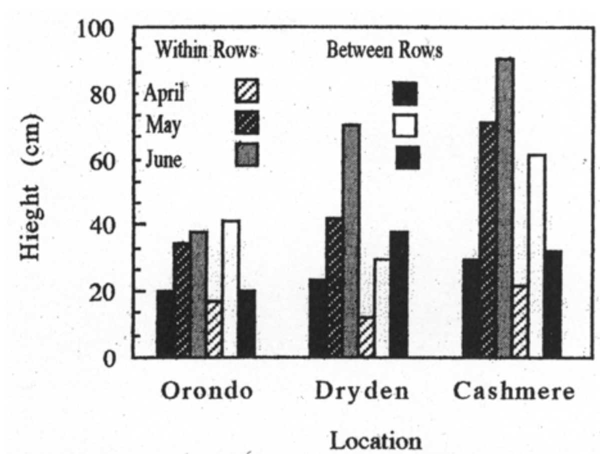

Figure 4. Vegetation height for three Pacific Northwest orchards.

Human activity within each treatment site varied. In general, winter activity within the orchards was limited to pruning and dormancy spraying. By early March, management activity increased as the weather improved. By

April, growers were in the orchards at least once and sometimes three times a week with their mowing, spraying, and final pruning.

At Orondo, light traffic was limited along 2 mi of oiled and 3 mi of graveled roads to and between the 14 homes, barns, and storage and packing sheds within a 1/2 mi. (0.8 km.) radius of the treatment site boundaries. Only 2 homes, 8 farm buildings, 1 mi of oiled road and 1-1/2 mi of graveled roads serviced the orchards within a 1/4 mi (0.4 km) radius of the treatment site. Only across the river about 1/4 mi could light-to-heavy traffic be seen along the 1 mi (1.6 km) of four-lane highway.

Human activity was more prevalent at the Dryden site than the other two. Automobiles and heavy trucks, as well as passenger and freight train traffic, could be seen or heard in the orchard from the mile of State Route 2 and railroad adjacent to the orchard's southern boundary. Light-to-moderate traffic frequently used the 2 mi of paved county roads and 3 mi of graveled roads within 1/4 mi of the orchard. Additional activity was generated in and around the 46 homes and farm buildings within a 1/2 mi radius of the orchard's center.

Although there were no major highways adjacent or close to the Cashmere site, there were many more homes, buildings, and local roads. Within a 1/2 mi radius of the orchard, 56 buildings and 4 mi of road received relatively heavy use from the inhabitants. Within a 1/4 mi radius, 27 buildings and 1 mi of paved roads serviced the local inhabitants.

The Orondo orchard suffered fewer intrusions. It bordered the Columbia River, was bisected by only one dirt road, and had only one small cluster of farm buildings at one edge.

DISCUSSION

Hawks, owls, kestrels, and shrikes were attracted to all of the research sites. More birds, however, appear to have been attracted to the orchards where nest boxes and perches were placed. This tends to support the work of Reinert (1984), Wilmers (1982), Forren (1981), Christensen (1972), and Hall et al. (1981). As the season progressed from winter through spring, use patterns changed. Hawks, owls, and shrikes, prominent during December through February, were gradually replaced by kestrels during March and April until they were the dominant predators by May and June. Although the total number of birds observed appeared to decline in May, there was little change after day length and observation frequency were adjusted.

Vegetative biomass and height under 16 in (40 cm) did not appear to be a limiting factor for attracting raptors during this study. Total biomass between the tree rows where the birds do most of their hunting remained fairly constant. Biomass within rows, however, declined and then increased. As expected, vegetation height increased within and between the rows until the latter was mowed during May. Yet this did not appear to have any bearing on the total amount of calculated predator use of the perches.

The question now is whether or not there were any changes in the numbers of targeted prey populations. From the variety of prey found in the predators' pellets, it can be concluded that voles, although a primary part of their diet, were not the only species hunted. As expected, vole activity in the control plots gradually increased through April and then declined in May, a common phenomenon in the Pacific Northwest. On the Cashmere site, where raptor activity was minimal, vole activity continued to increase at a higher rate than in the control plots throughout the entire period. Activity on the Cashmere site fluctuated between December and February before increasing in March, April, and May. Only on the Orondo site did vole activity decrease during the highest levels of raptor use. Yet this use was not significantly greater than the Dryden site. Although these observations tended to support Pearson's (1971) and Pitelka's (1973) findings, they also supported Kreb's (1964) conclusions: some populations may be affected but others will not.

Several additional observations outside the stated objectives of this study were also made. No correlations could be found between the presence or absence of tall trees in and around the orchards and the number of raptors drawn to each site. The number of tall trees appeared to be fairly consistent within a given radius (1/4 mi) around each site. However, where houses and roads were most heavily used such as at the Cashmere site, only a few birds were seen on the perches. When activity was light, as at the Orondo site, raptor use was heavy. From these limited observations and in hindsight, the study could have been designed to place more emphasis on these particular aspects.

SUMMARY

This study assessed the impact of adding artificial raptor perches and nests to reduce vole populations in three northcentral Washington orchards. The results of the research showed that the perches enhanced raptor use on two sites but the nests did not. It was found that more birds were attracted to the Orondo and Dryden sites than the Cashmere site. The data further indicated that the orchards were used very little during the winter (December and January) when only Saw-whet, Great-homed owls, and Red-tailed hawks were sighted. By February and March, use increased until early spring when these birds were replaced by American kestrels.

The inventory of vegetative biomass showed little change during the growing season. Vegetation height, as expected, increased but did not appear to be a limiting factor primarily because the number of animal remains found in discarded pellets continued to increase throughout the season. Vole populations may have been affected by attracting the raptors to some of the sites, but in others the data are not clear. Assuredly, more work will be done to resolve the issue. The rather limited acceptance of nesting boxes also indicated that additional work needs to be done with their placement in different habitats and environments. It may be possible, too, that more time, possibly several years, is needed to determine if or when they become attractive nesting sites. Moreover, additional work needs to be done on the effect of human habitation and activity. Although not of initial interest in the study, the data indicated that they may play an important role in the success or failure of attracting birds to a specific site.

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