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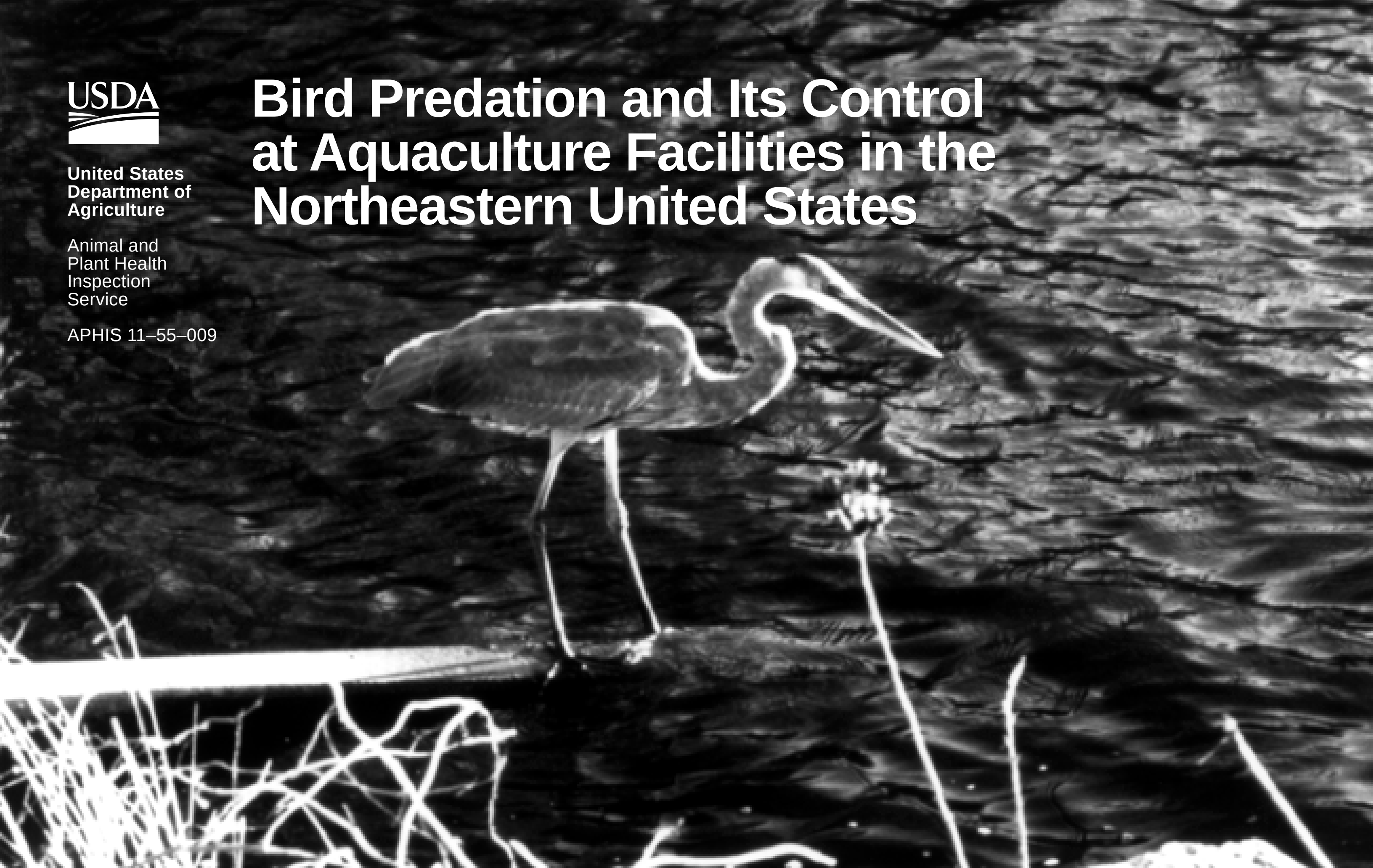
Bird Predation and Its Control at Aquaculture Facilities in the Northeastern United States



Cover photo: The great blue heron is believed to inflict the most damage to the aquaculture industry in the Northeast.

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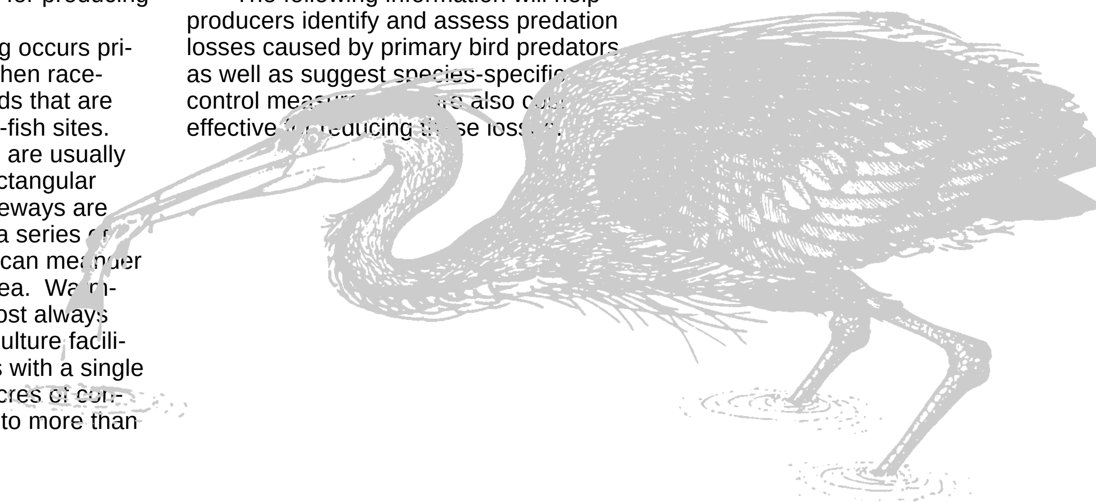
Bird Predation and Its Control at Aquaculture Facilities in the Northeastern United States

The northeastern aquaculture industry, centered in Pennsylvania and New York, consists primarily of trout production, but local facilities also produce a number of warm-water species, including bait fish, catfish, and goldfish. There are several different culturing methods for producing these fish.

Although trout culturing occurs primarily in concrete and earthen raceways, it also occurs in ponds that are sometimes used for pay-to-fish sites. Narrow concrete raceways are usually set in rows over a small rectangular area, whereas earthen raceways are more linear and resemble a series of interconnected ponds that can meander over a large geographic area. Warm-water fish species are almost always produced in ponds. Aquaculture facilities vary in size from farms with a single 0.1-acre pond to several acres of concrete or earthen raceways to more than 100 acres of ponds.

The diversity of northeastern aquaculture and the adaptability of bird species to exploit this resource has led to correspondingly diverse bird-predation problems. Several integrated approaches are needed to alleviate these problems.

The following information will help producers identify and assess predation losses caused by primary bird predators as well as suggest species-specific control measures that are also cost-effective for reducing these losses.



Assessing Predation Losses

It is important to assess fish losses to birds before implementing control measures. Several approaches to assessing predation losses exist, but they vary with the number of birds, foraging rates, and size classes of the fish consumed. The formula in table 1 shows how to estimate yearly fish consumption by a particular bird predator by using species-specific information on bird feeding rates.

By using information on the sizes of fish consumed by each species of bird and on the value of these fish, the annual economic loss to bird predation can be estimated. For accurate estimates, the information used in this formula must be carefully obtained and applied. With most species, bird numbers vary considerably both throughout the day and throughout a given season. Therefore, several counts must be taken daily during the damage season.

Table 1—Estimating yearly fish consumption by bird predators

Average number of birds seen per hour

×

Bird feeding rate (fish taken per hour)

×

Hours birds are present per day

×

Days birds are present per year

=

Fish consumed per year

Primary Bird Predators at Northeast Aquaculture Facilities

Great Blue Heron

The great blue heron (cover), one of the most common and most numerous species at northeastern aquaculture facilities, is considered to inflict the most damage to the industry. It is readily distinguished from other species of heron by its larger size (4-foot body length) and its slate blue coloration, which is more mottled in juvenile birds. Adult birds have a white head; juveniles do not have this coloration. The blue heron occurs in varying numbers throughout the year and forages at aquaculture facilities primarily at dawn and dusk. Night foraging is rare.

While present at trout-rearing facilities, each heron consumes on average 2.2 live trout per hour. Average prey is 9 inches long, but trout up to 14 inches in length may be consumed. At warm-water facilities, great blue herons consume smaller, but proportionally more, fish. At these facilities, herons are thought to consume about 0.5 pound of fish per day.

Other Herons

The black-crowned night heron is not widely occurring but can be numerous at northeastern aquaculture facilities. These herons have a chunky body and a short neck; they are about 2 feet long, with black back and head and white stomach. The black-crowned night heron typically arrives at dusk to start feeding and may continue to feed through the night. At western aquaculture facilities, where they are a more common problem, it has been estimated that black-crowned night herons consume 1.2 live trout per hour apiece, and they consume trout averaging 7.5 inches in length. However, more limited data from the Northeast suggest that trout averaging 6 inches in length are the preferred prey size of the black-crowned night heron. Because of their nocturnal foraging habits, it may be difficult to determine the presence and the extent of predation of this species.

The green-backed heron (fig. 1) is the only other commonly occurring heron species that frequents northeastern aquaculture facilities. One of the smallest herons, it has a chunky body, and short neck and averages 1.5 feet in length. It has a dark-olive back and streaked breast with relatively short bright-orange or yellow legs. Because it is primarily a solitary bird, it usually occurs at very low densities and is typically seen from dawn to dusk. Observations at northeastern aquaculture facilities suggest that the green-backed heron eats about 3 live fish per hour, and they average 4 inches in length.

Common Grackle

The common grackle, a frequent predator at northeastern aquaculture facilities, exerts an impact primarily in the spring months, when large breeding colonies form and small trout fingerlings initially are placed in outside raceways. After fingerlings exceed 5 inches in length, grackles shift their diet to invertebrates and grains and sometimes leave the hatchery altogether.

The common grackle is one of the largest members of the blackbird family and measures approximately 16 inches long. Males are slightly larger than females and are iridescent black. Females have brownish plumage. During daylight hours, grackles sometimes forage in large flocks. At northeastern trout-rearing facilities during the spring, grackles consume about 3 live trout per hour at an average length of 3 inches. At warm-water facilities, grackles are sometimes present but have not been observed to consume fish.

Mallard

The mallard is a common species of waterfowl that frequents northeastern aquaculture facilities. However, the predation problems it poses occur in isolated situations. Where predation situations do occur, mallards achieve extremely high densities throughout the day and have adapted to feed in trout raceways stocked with high densities of smaller fish. In these situations, mallards generally consume 4 fish per hour, with the fish averaging 4, but sometimes reaching 6, inches in length. In other

Figure 1—The green-backed heron is one of the smallest herons and a common predator in the Northeast.

situations, mallards may feed on only aquatic vegetation or fish feed, so careful observations are essential to determine whether losses of fish are occurring.

Belted Kingfisher

The belted kingfisher (fig. 2) is seen at many northeastern aquaculture facilities throughout the year. However, the typically low densities at which it occurs and the smaller fish it consumes lessen its potential impact on the industry. Approximately 1 foot long, the belted kingfisher is easily recognized by the white band separating the dark head from the gray body. An efficient predator of small fish, the belted kingfisher forages throughout the day by plunging directly into the water to capture fish near the surface and then rapidly flies off with its prey. It consumes fish averaging 3 inches in length at a rate of almost 2 fish per hour.

Figure 2—The belted kingfisher, an efficient predator of small fish, brings its prey back to the nest.

Osprey

An efficient predator of larger, more valuable fish, the osprey achieves only low to moderate densities during the spring and fall migratory periods. Commonly called the fish hawk, the osprey resembles a large hawk with a 2-foot-long body and a wingspan of 4.5 to 6 feet. However, white on breast and head distinguishes it from other birds of prey. Although it may appear for only a few weeks of the year, its impact can be substantial in terms of the size of the fish it consumes. Ospreys take about 2 fish per hour that average 12 inches long and can consume fish up to 24 inches long.

Economics of Bird Predation

Although a recent survey of northeastern aquaculture facilities indicated that about 80 percent were experiencing some form of bird-predation problem, the extent of the problem varied considerably. Generally, larger facilities experienced more severe problems with regard to the number of predators involved; in two instances, annual losses of about $500,000 were documented. However, annual losses ranging from several hundred to several thousand dollars were more typical.

As many as 75 great blue herons have been documented at 1 trout-rearing facility in Pennsylvania, where they were estimated to consume roughly $300 worth of trout per day. Smaller numbers of these predators, typically one or two great blue herons, may proportionally represent a serious economic concern to trout producers. Although not limited to trout-rearing facilities, heron predation is poorly documented at warm-water production facilities in the Northeast.

Elsewhere in the United States, mixed flocks of around 100 herons and egrets were estimated to have consumed at least $1,800 worth of golden shiners at an Arkansas minnow farm over a 3-month period. Similarly, at Mississippi catfish farms, heron populations averaging 1 bird per 15-acre pond were estimated to inflict losses worth $182 per pond per year.

Mallards and common grackles have also been reported to cause significant economic losses at trout-rearing facilities in Pennsylvania, averaging $725 and $969 per raceway pool, respectively, per year.

Although managers considering the costs of bird predation should focus primarily on the value of the fish consumed, other costs need to be examined, too. These costs include bird-related fish scarring that cause these fish either to die or to be unusable (fig. 3). Birds also have the potential to spread disease at the facility, resulting in more costs. Although estimates range up to 773,530 fish lost per year at Pennsylvania hatcheries, few estimates consider all forms of loss. In controlled experiments comparing raceway pools with and without exclusion, losses of trout primarily due to great blue herons ranged from 9.1 to 39.4 percent over a 3- to 4-month period. On average, another 2 percent of the fish inventoried from the unprotected pools had puncture holes from heron spearing. In one instance, a higher incidence of “strawberry” disease was also reported from unprotected pools.

Figure 3—This trout has suffered the spearing typical of heron predation.

Prevention and Control of Bird Predation

In the Northeastern United States, the diversity of culturing practices and avian predators dictates the need for a variety of damage prevention and control techniques used singly or in combination to prevent predation. The following methods have been recommended for predation problems in the Northeast and in most cases have been observed in use in either the Northeast or elsewhere.

Fish Husbandry

Although changes in the design of fish culturing facilities and fish management are often recommended for reducing predation losses from birds, the diversity of situations where predation problems are observed raises doubt about the overall utility of this approach. Recommendations for changes in facility design to reduce heron predation include deepening ponds and earthen raceways to a minimum of 3 feet and maintaining steep banks on ponds and raceways to reduce wading activity. Similarly, for concrete raceways, a minimum depth of 3 feet is recommended, but the water level should be at least 2 feet below the top of the perimeter walls.

Even if these changes are accomplished, the large repertoire of feeding behavior exhibited by the great blue heron, including jumping into deep water to take fish, makes the prospect for their overall effectiveness doubtful.

Possible modifications of fish-management strategies offer more possibilities for at least a partial reduction in fish predation. Where grackles are a problem, a delay in moving the fingerlings outside in the spring would clearly be beneficial. If such a delay is not practical, temporarily covering the fish with netting is an alternative. Studies have shown that birds are more likely to feed in ponds that are heavily stocked with fish. Thus, reducing the amount of stock may lessen the attractiveness of ponds to depredating birds. However, reducing stock may be contrary to the goals of fish production.

Observations of herons feeding at catfish ponds and other warm-water aquaculture situations suggest that predation increases when fish are attracted to the surface with floating feed. Although floating feed helps the producer monitor fish health, the value of this practice should be weighed against its potential for increasing predation. Similarly, low concentrations of dissolved oxygen in these ponds force fish to the surface, making them more vulnerable to predation. Regular monitoring and more timely aeration of ponds could be helpful.

Exclusion

Exclusion—the complete enclosure of ponds or raceways with screens or nets—is sometimes, but not always, a practical means of preventing predation. Pond culture, particularly with pay-to-fish sites, does not lend itself to exclusion, but certain raceway configurations may be better suited to using exclusion.

Exclusion systems vary from simple, temporary netting applied directly over individual raceway pools to elaborate permanent systems that completely enclose the entire facility. Although total facility exclusion may be the only completely effective method for preventing predation by most species of birds, temporary exclusion, if properly installed, may be a more cost-effective alternative. Because of its cost, total facility exclusion is best suited for situations where bird sightings and economic analysis demonstrate a significant long-term problem caused by a number of predator species. In some situations, excluding birds from selected raceways may be more cost-effective if integrated with other control measures. For example, selectively covering raceways containing 3- to 5-inch fish could prevent predation by grackles, kingfishers, and mallards; other methods could be used to protect larger fish.

Care must be taken when selecting and designing both temporary and permanent exclusion systems. Failure to do so can result in systems that are ineffective, cumbersome to work around, and a hazard to either the birds or the fish enclosed.

Selection of proper materials is of critical importance. Use small (1- to 2-inch mesh) wire or net to exclude all birds, but avoid finely textured netting that may entangle birds on contact. Although relatively inexpensive polypropylene netting is available for this use, the usable lifespan of this netting is 3–5 years. Framing for temporary covers used on concrete raceways should be strong and durable but also lightweight so it can be easily moved. Although wood is typically used, framing consisting of 1.5-inch polyvinyl chloride (PVC) pipe makes these covers easier to move.

To be completely effective, temporary netting or screens must totally cover raceway pools and must be properly supported. Birds, particularly herons and mallards, will quickly find any gaps in the system and breach the barrier. Center supports of the netting suspended over earthen raceways are important to prevent heron predation. The weight of herons walking on unsupported netting has been observed to cause the net to sag and allow herons to spear fish through holes that they develop in the netting. Nets sagging into the water also present a hazard to fish.

An important consideration in the design of exclusion systems is the ability to perform routine fish maintenance and harvest operations. Where this is a prime consideration, more elaborate, permanent exclusion systems that allow personnel and equipment to work under the exclusion system may be preferable. With permanent systems, particular attention must be given to winter weather conditions. If ice forms on netting, the whole exclusion system can collapse. That has happened in Pennsylvania. To avoid this problem, consider designing the system so workers can remove netting before impending storms.

Other Barrier Systems

Other barrier systems include overhead wires and perimeter fencing, both of which have been shown to be selectively effective for excluding certain species of birds. These systems are not effective against smaller birds like grackles and kingfishers but may be more cost effective than exclusion systems for preventing predation by larger birds.

Overhead Wire Systems—Overhead wire systems (fig. 4), consisting of monofilament and stainless steel wire, can be a durable, all-weather alternative to netting for excluding aerial avian predators such as gulls, ospreys, and cormorants from both ponds and raceways. However, when combined with perimeter fencing or netting, a durable, all-weather, cost-effective system can be created to deter herons as well. For example, the Limestone Springs hatchery in Pennsylvania has successfully excluded both great blue herons and black-crowned night herons by using a perimeter chain-link fence to support an overhead monofilament line system spaced at 6-inch intervals. Wire spacing of 10 inches may be adequate. To prevent these birds from landing on the chain-link fence and dropping through

Figure 4—Overhead wires can make a durable, all-weather exclusion system. Attaching such a system to a tall fence makes it easy for facility personnel to work underneath.

the wires, an electric fence was installed along the top of the chain-link fence.

Where a chain-link fence is cost prohibitive, some barrier such as netting at the sides and ends is recommended for preventing both herons and aerial predators from entering to enhance the barrier's effectiveness and to minimize bird injury, streamers or other materials should be hung from lines to make them more visible.

Perimeter Fencing and Netting— Perimeter fencing and netting systems can deter herons and other wading birds from visiting both ponds and raceways. The most effective system evaluated uses two-strand electric fencing (fig. 5). At earthen raceways and ponds the wires are suspended 12 and 16 inches above the water from fenceposts positioned in the water approximately 1 foot from the water's edge. On concrete raceways, fenceposts are positioned in holes drilled in the center of the raceway walls.

Figure 5—Perimeter fencing and netting systems can deter herons and other wading birds from visiting both ponds and raceways.

The use of nonlethal levels of electric current to shock birds quickly trains them to avoid the area. In some cases, however, herons can learn to avoid the fence by flying directly into the center of the pond or raceway. This happens most often when pond or raceway depth is shallow or raceway flow is low.

Although the cost of this system is low, regular maintenance is required to prevent the electric fence from grounding out. More elaborate nonelectrified perimeter fences and wires also have been shown to provide some protection from heron predation. However, perimeter netting suspended horizontally or diagonally over the water surface is minimally effective. At best, perimeter systems do not deter all herons unless additional protection is provided by an overhead wire system or netting.

Frightening the Predators

Techniques to frighten predators rely on visual and/or auditory stimuli to produce fear and thus discourage birds from remaining in the area. Although most northeastern aquaculture producers have consistently rated frightening as relatively ineffective, it may be useful where barrier systems and other techniques are impractical. To be effective, frightening procedures must be actively and aggressively pursued in a carefully planned program. If possible, the regime should start before birds establish a regular feeding pattern at the site.

Many devices are commercially available for scaring birds, including pyrotechnics, gas-operated exploders, electronic noisemakers, bird distress calls, stationary and pop-up effigies, eyespot balloons, raptor models, strobe or flashing lights, reflective tapes, and water-spray devices.

Although use of one technique may produce positive results in the short term, longer term results are best achieved by using a combination of methods and by alternating the devices used. Effectiveness of these devices can also be enhanced if they are activated upon arrival of the avian predator. Motion sensors or infrared beams can be used to detect the predator and activate many of these devices, thus increasing their effectiveness.

Pyrotechnic Devices—Pyrotechnic devices are effective against most birds. They are fired with a breech-opening, open-bore 12-gauge shotgun or a specially designed pistol. Shell crackers are shotgun shells that contain a firecracker that is projected 50 to 100 yards before exploding. This produces two loud noises, one when the gun is fired and another when the firecracker explodes. Because wads from the shell may stick in the gun, it is important to check the barrel after each shot. Other pyrotechnic devices called screamer sirens and bird bombs are fired from a 15-mm pistol launcher using .22-caliber blanks. Although the range of these projectiles is only 35 to 75 yards, they are less expensive and more convenient to use.

Automatic Exploder—The automatic exploder is effective in deterring most birds if combined with other techniques. Propane or acetylene gas is used to operate this small cannon, which is equipped with an electronic timing device. The cannon emits loud explosions at adjustable intervals and can be heard over areas of up to 5 acres. For best results, exploders should be elevated above vegetation and moved to different locations every 1 or 2 days.

Alarm or Distress Calls—Broadcasting recordings of alarm or distress calls has been shown to be effective in frightening black-crowned night herons but not great blue herons. For best results, distress calls should be broadcast as birds begin to arrive, and the time interval between broadcasts should be as long as possible.

Lights—Strobe lights, barricade lights and revolving beacons have been used to frighten birds. Of these, strobe lights appear to be the most effective in frightening night-feeding birds, particularly the black-crowned night heron.

Water-Spray Devices—Water spray from strategically placed rotating sprinklers can deter birds from feeding. In some cases, water aeration systems can be modified for this purpose. Best results are obtained when sufficient water pressure is used and sprinklers are operated on an on–off cycle.

Human Effigies—Human effigies or scarecrows rely on the innate fear most birds have of humans. For this reason, effigies that best simulate human appearance or that exhibit movement usually are more effective. Successful use of effigies at aquaculture facilities has been demonstrated when effigies are periodically replaced with humans firing live ammunition or pyrotechnics.

Dogs—The use of dogs to deter birds at northeastern aquaculture facilities has met with variable success, depending on the motivation, training, and temperament of the dog. Physical characteristics of the facility, such as total size and layout, also influence effectiveness. For example, dogs obtained from animal shelters proved marginally effective in reducing predation at a large State facility in New York.

Harassment Patrols—Harassment patrols by persons on foot or in vehicles are widely used for frightening birds at aquaculture facilities, particularly larger facilities. Such patrols typically involve the use of pyrotechnic devices. The effectiveness of the technique is largely related to the fear response birds have to human presence. However, this technique can become highly labor intensive because of the need for patrols throughout the day and night. For this reason, human effigies, automatic exploders, and other devices are needed to supplement these patrols when personnel cannot be present.

Lethal Control

Lethal control, usually by shooting, is the selective killing of birds involved in predation problems. Although most wildlife-damage-management professionals consider lethal control appropriate and necessary as a last resort in certain situations, its use remains controversial. In the Northeast, lethal control appears to be most appropriate and necessary as part of an integrated program to control significant and widespread problems caused by great blue herons. Lethal control of grackles also seems appropriate, but it may not be practical because of the large number of individuals usually involved. Lethal control seems to be practical only when there are a limited number of individuals that need to be removed. Typically, lethal control is recommended only to reinforce or supplement nonlethal techniques by removing a few individuals.

Another situation when lethal control might be used is to remove a limited number of herons that remain at aquaculture facilities during the winter months after temporary removal of netting.

Lethal control, involving either trapping or shooting birds, is illegal without a permit from the U.S. Fish and Wildlife Service. State permits also may be required. An exception to this requirement applies to the common grackle, which under Federal provisions can be killed without an advance permit when birds are in the act of causing depredation. However, State permits for grackle control may be required. Inquiries about obtaining a permit should be made through the appropriate Animal Damage Control (ADC) office of the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS).

Capture and Release Techniques

Although not a practical solution in many cases, capturing and relocating certain birds may be a viable alternative to lethal control in specific situations. This technique involves capturing birds alive, transporting them some distance, and releasing them. It might be useful in controlling mallard populations. The chemical immobilization agent alpha-chloralose can be used to capture large numbers of mallards. Use of alpha-chloralose is restricted to ADC personnel for removing waterfowl from nuisance and damage situations. But the translocation of waterfowl may be regulated or prohibited by specific State wildlife agencies. Contact the appropriate ADC office concerning possible use of this procedure.

When tracking control costs, aquaculture facility managers need to consider not only the prorated cost, including maintenance of the device or system over time, but also the additional cost of performing fish-maintenance procedures with these devices or systems in place. For temporary exclusion systems, the labor cost of the latter has been documented to exceed the cost of buying, installing, and maintaining the system itself. At northeastern aquaculture facilities, 82 percent of producers reported spending $500 or less for controlling birds annually, possibly reflecting the large number of smaller facilities sampled. In contrast, large State and private trout hatcheries in Pennsylvania have recently spent from $42,000 to $261,000 to erect total-facility exclusion systems.

The cost effectiveness of control measures should be considered at each facility before implementation. To accurately examine cost effectiveness, some knowledge of the cost of the control measure and its expected effectiveness is needed. This knowledge, combined with knowledge about the cost of predation, can be used to perform a cost–benefit analysis with the following formula:

Cost–benefit ratio = Control cost ÷ Percentage effectiveness (decimal fraction) ÷ Predation cost

If this cost–benefit ratio is greater than 1, the cost of implementing control will exceed the savings realized from using it. In contrast, a ratio of less than 0.1 clearly suggests that the control measure will be beneficial. For example, the cost of a chain-link fence and overhead wire system erected at one trout hatchery was $19,340 to cover a rearing area of approximately 22,000 square feet. Over the expected 20-year lifespan of this system, the annual prorated cost including maintenance is $1,728. During its first year of use, this system was 100-percent effective in reducing losses from great blue herons and black-crowned night herons, resulting in actual savings of $459,453. The cost–benefit ratio of the system in this situation is 0.04, but it is strongly influenced by the extremely large predation cost and the expected long life of this system. Considering its durability, this system has been projected to be more cost effective than similarly priced total-facility exclusion with netting, and it may be applicable to other situations where predation costs due to herons are high.

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