AGRICULTURAL BIRD CONTROL, THE EVOLUTION OF THE TOOLS OF THE TRADE

MICHAEL R. TABER, Wildlife Control Technology, Inc., 2501 N. Sunnyside Ave., Fresno, CA 93727, USA

Abstract: Agricultural bird control has been going on for years. Trapping, shooting, hazing, baiting and exclusion all have a historical place in the ongoing struggle between man and bird. While individual techniques have come and gone due to cost, effectiveness and regulation, the standard need for crop protection remains a constant from California to New York, in everything from premium varietal wine grapes to sunflowers.

Key words: avicides, baiting, cedar waxwing, crow, exclusion, finch, hazing, horned lark, lethal control, robin, scrub jay, starling, trapping

INTRODUCTION
This paper will discuss techniques, successes and failures and the present day pursuits of solutions for agricultural bird control. It will discuss what works, what doesn’t and how to balance the cost of lost crop with the cost of bird control products and techniques.

DISCUSSION
In 1866 W. Ross King of Ontario, Canada, reported that at one time he had watched a May flight of passenger pigeons (Ectopistes migratorius) move northward from the U.S. that was at least 300 miles long and 1 mile wide, and continued for 14 hours. This flight was estimated to contain 3 billion, 717 million birds (Schorger 1955). It has been estimated at the time of discovery of North America, the population of passenger pigeons was between 3 and 5 billion and that it formed 25-40% of the total bird population of what is now the U.S. The land that these birds roaming over was almost a billion acres of forest that produced vast quantities of beechnuts, acorns and other favored passenger pigeon foods. Those same forests were soon converted almost entirely into either timber products or farmland. The beech-oak-maple forests provided support for passenger pigeon nests which sometimes numbered over 100 in a single tree. As impressive a number as this seems, even more impressive is the number of birds that would come to night roosts in these trees in the fall and winter. Passenger pigeons would fly about the countryside during the day to feed and then return to roost in the trees at night. When masses of them settled in trees, often in groups that settled on top of each other, the weight of their numbers broke off trees 2 feet in diameter and large limbs that, crashing to the ground, killed hundreds of pigeons, and left the forest as though swept by a tornado (Audubon, 1870).

The passenger pigeon declined swiftly from 1871 to 1880; in 1874, at one nesting colony in Michigan, 25,000 pigeons were killed daily for the market for 28 days by professional netters, or about 700,000 in

a month. It was this kind of harvest, combined with the destruction of habitat due to species overpopulation in nesting and roosting areas, as well as cutting off of the forest for agriculture (Terres 1980) that doomed passenger pigeons. The last passenger pigeon, named Martha, died September 1, 1914 at the Cincinnati Zoological Garden.

Some sources lead us to believe that overzealous hunters wiped out the species. However, the historical account of population dynamics, habitat loss, market hunting, and natural selection, shows us that the passenger pigeon was a victim of many circumstances. Would the passenger pigeon be around today, given the loss of habitat? What about avian disease associated with bird densities of "3-5 billion"? Professional netters took many species of birds other than passenger pigeons such as horned larks (*Eremophila aslpestris*) and several species of waterfowl, among others.

Why bring up the passenger pigeon in a paper discussing agricultural bird control? This example embodies much that has been feared about bird control. The Federal Migratory Bird Treaty Act was signed in 1918, 4 years after the last passenger pigeon died. Undoubtedly, the then recent case of species extinction was a factor in the decision to protect and regulate the take of birds. The demise of the passenger pigeon was an environmental benchmark of what could go wrong if a bird species was pursued beyond its capacity to adapt. The passenger pigeon was not a victim of over hunting specifically. It was a combination of market hunting, habitat loss, crop protection (timber was a crop in the late 1800's) and a species that was unable to adapt.

Obviously, it would be difficult to categorize a control effort that contributed to the extinction of a species as a success, although a grape grower in New York today may argue that extinction of several bird species seems very appealing in September and October, prior to the harvest of Cabernet Sauvignon wine grapes, which are worth over $2,000.00 per ton. Agricultural bird control takes several forms and has several extremes. On Long Island in New York, if a grape grower doesn’t protect his crop with netting, he doesn’t have anything to harvest, as the migratory bird pressure is so severe. A blueberry grower in Arkansas or Florida can time his harvest by the arrival and presence of cedar waxwings (*Bombycilla cedrorum*). The distinct high pitched call and the impressive flock size of these birds are indicators of doom to a “U-Pick” blueberry grower who will not have any berries to pick unless aggressive control measures are taken quickly. But what measures of control do we take? How has this process evolved beyond the seemingly irresponsible trade of one resource for another, a bird to protect a crop?

From 1929 to 1936, S.E. Piper and J.A. Neff conducted studies in California on control measures for Horned Larks in various row crops. In one study, Piper and Neff examined the effectiveness of treating plant seeds with strychnine, various seed baits such as lambs-quarter and pigweed seed, lettuce seed and various chick feeds (Neff 1937). The bait was spread using commercially available seeders, towed behind a vehicle so that the seed fell exactly in the depression of the vehicle tracks, as this was the most readily accepted bait placement by the now surprisingly wary Horned Larks. At a rate of eight pounds of bait per mile of track, Neff concluded that localized flocks of horned larks could be controlled. However, the study also concluded that horned larks quickly developed a bait aversion and adapted to the treatment programs. In time, they were able to distinguish between treated lettuce seed
and untreated lettuce seed based on seed location, texture and possibly even color.

What the Neff study points out is that this kind of lethal control, while effective short term, is no different than non-lethal control, in that birds adapted to the techniques applied and still managed to damage the crop being protected. As indiscriminate as broadcast baiting of strychnine treated seeds seems, surprisingly few non-target species were affected by this program. However, that did not prevent this technique and strychnine from being banned years later for bird control use.

In addition to broadcast baiting of strychnine treated lettuce seed, Neff (1937) studied and promoted several other lesser known techniques at the time, such as strychnine treated seed in bait troughs for house finch (*Carpodacus mexicanus*) control in strawberries, peaches and figs. Techniques for the control of red-winged blackbirds (*Agelaius phoeniceus*) were examined and categorized into several steps or levels. These differing control measures had different effects, depending on the species, time of year, technique and availability of alternate food sources. In a portion of the report entitled “Herding off by Gunfire” (Neff 1937) it was noted that rifles are far more effective than shotguns, since it is the “spat” of the bullet striking into the standing rice near the feeding flocks of birds or its whine in the air that causes the alarm, rather than the report of the gun. Many growers, it was noted, notch the point of the bullets to intensify the whistling sound. The report concluded that this method succeeded only in moving birds from one field to the next and then to another, degenerating into a vicious circle, and the grower who cannot afford as many herdsmen and as much ammunition as the rest suffers the major part of the loss.

The same report concluded that scare crows, flags, and other non-lethal scare techniques were ineffective without the support of shooting. Even in fields where both shooting and visual cues were used, it was stated that in the absence of an actual threat, birds soon lose fear of any of these items.

Another technique reviewed was large scale habitat modification. Cattail control or elimination, marsh burning, destruction of willow thickets and cottonwood trees and various cultural methods and crop rotations were explored at length. None of these techniques yielded results beyond existing practices.

In 1937 Dr. Mary M. Erickson reported on an interesting annual or biennial event designed to protect crops such as pistachios, cherries and almonds from western scrub jays (*Aphelocoma californica*). She reported that jay shoots had been held in Calaveras County for many years. Two persons reported that hunts had taken place about once a year during the 11 and 14 years they had lived in the vicinity. Two old-time residents said that occasional shoots had been held, for 30 or 40 years, previously. Recent shoots were held once or twice a year, usually in the fall, sometimes in the spring, but the time of year and the number are irregular. The last shoot had been held on October 20, 1935, when, according to a local newspaper, 1368 jays were killed. The shoots, at least in recent years, had been conducted as contests between two teams, and after the count there has been a dinner, or as this year (1937), a barbecue in which wives and friends shared, at the expense of the losing side. In the shoot that she witnessed, 398 California jays (western scrub jays), 214 stellars jays (*Cyanocitta stelleri*), 1 red-tailed hawk (*Buteo jamaicensis*), 1 Cooper’s hawk (*Accipiter cooperii*) and 3 sparrow hawks (American kestrel-*Falco sparverius*) were brought in (Bent 1946).
The conclusion from these shoots was that the resident population of western scrub jays in that area, which was estimated at 11,636 birds or one jay for every 5.5 acres, was unaffected by lethal control. The resulting studies concluded that not more than 5% of the breeding population of jays was eliminated during the spring shoots and that the 5% reduction in numbers, even if accomplished every year, should have no effect on the year-to-year population of jays. The report stated that it is well known that every suitable habitat is filled up to its capacity to support the species, and that the removal of a few individuals makes it just so much easier for others to survive or to drift in from outside.

Aircraft have been used world-wide to herd birds of many species. Attempts have been made in Arizona to herd horned larks (Martin 1981, Boudreau as cited by Martin). While experimenting with biosonic sound systems (actual bird calls) attached to the underside of fixed wing aircraft, ground observers noticed that the horned larks moved in front of the aircraft, circled around and returned to almost the same spot where they were feeding previous to the aircraft flying towards them. Pest control advisors who have tried herding with aircraft or helicopters have had no success in keeping the birds off the seedlings.

The conclusion of these programs has been the same throughout the years: short term effectiveness, limited results, some target aversion to crops, and limited damage prior to harvest. Results to be sure, but solutions? Not anything really worth noting.

What is worth noting is that agricultural bird pests are highly adaptable. Most agricultural pest bird populations, in the face of habitat destruction and lethal control measures, still rebounded and continued to prosper. The creativity, thought process and manpower dedicated by individuals such as Piper and Neff is both fascinating and amazing. Still, the results are what everyone is interested in. And at this point in the history of agricultural bird control, the problem was too large, the field too vast and the resource of the controller too limited. Despite open regulations which allowed far more lethal control with far less regulation than modern day growers’ deal with, the problem of crop depredation remained.

The chemical control era ushered in the use of Mesurol® (methiocarb), a taste repellent, which could be applied directly to fruit. This product was designed to keep birds from damaging various crops, but not have an adverse affect on the fruit itself, and it was successful. Use of Mesurol was widespread throughout the country, until traces of it started showing up in wine. Mesurol is still registered for use in the U.S. as snail bait, but is no longer registered for fruit application for bird control. Other repellents such as Sevana which claimed to be 100% organic and mineral, were tried and either failed due to lack of efficacy or were ultimately removed from EPA registration lists. At one time Avitrol, Starlicide, and Ornitrol were all produced by the same company with registrations for use as agricultural bird repellents and toxicants or chemosterilants. Avitrol and Starlicide are still registered with EPA but the ornitrol contraception registration was dropped by the registrant.

Presently, both anthraquinone (studied heavily in the mid to late 1950’s) and methyl anthranilate are registered for application to fruit prior to harvest. Although both chemicals have shown promise in laboratory testing and in some specific field applications such as sunflower, sweet corn and cherries (Askham 2000), neither has been widely accepted. Chemical control is increasingly less desirable due to perceived concerns regarding fruit quality,
worker safety, water run-off and quality issues, and finally efficacy. Mesurol and Sevana succeeded in an era that has suffered from what some call a well deserved, and others a historically revised reputation as a time of chemical misuse and abuse. Subsequent regulations and a change in grower perception have made it difficult for legitimate chemicals of today to succeed or even be tested in the manner they were 20-50 years ago.

Given that chemical control and lethal control have been extensively tested, documented, regulated and ultimately in most cases, relegated to non usable or unacceptable formulations or techniques, hazing and exclusion remain the only two viable options for agricultural bird control.

In 1986 Richard Dolbeer published a study entitled “Reflecting tapes repel blackbirds from millet, sunflowers and sweet corn.” In this study, Dolbeer concluded that reflective tape could provide a simple and safe means of repelling certain species of birds from high value crops or from other sites where birds are not desired, especially if used in conjunction with other management techniques (Dolbeer 1986). This statement, “a simple and safe means of repelling certain species of birds” more than most, captures what is desired when considering a hazing technique. Just give us something that is simple, safe and works most of the time on the target birds we want to keep away from our crops. However, this statement also contains the most common disclaimer used when describing every bird hazing product developed to this point, “if used in conjunction with other management techniques.”

Other management techniques include noisemakers such as firearms, propane cannons, rebroadcast bird calls, loud music, ultrasonics, unintelligible noise and pyrotechnics. Some of these techniques, such as ultrasonics and loud music, have no biological basis whatsoever, but have been marketed simply as a “silver bullet” technique. Ultrasonics operate on the premise that noise, broadcast at a frequency mostly either above or below human hearing ranges, will repel birds. The human hearing range is 20 to 20,000 Hz. (Spear 1966), while several bird species hearing ranges from 60 to 15,000 Hz. (Brand and Kellogg 1939, Edwards 1943). Ultrasonic frequencies are those exceeding 20,000 Hz or cycles per second. As birds generally hear below ultrasonic frequencies, it is difficult to see how this technology applies. Even if such sounds were heard by birds and caused a frightening response, they might not be practical for use, especially over large areas because ultrasonic frequencies diminish much more rapidly than audible sounds with increasing distance from their source (Spear 1966).

Unintelligible noise makers, such as the AV Alarm, created by Dr. Larry Steward in 1966, are based on the premise that loud noise, of any content, will repel birds. AVA units operate in the frequency range of 2000 to 5,500 Hz. The sound level at full volume, from three feet, is between 114-188 decibels. Clearly, this level of sound has the potential to frighten bird species away from an area, especially if timed to greet them upon their arrival. However, the AV Alarm, while widely accepted at one time, achieved inconsistent control at best. It was consistently irritating to neighbors and passersby though, and this has kept it from being used possibly to its fullest potential.

Rebroadcast bird calls are of two types: predator calls such as the sharp-shinned hawk (Accipiter striatus), and distress calls. The rebroadcast of a predator call is fairly self explanatory. However, the distress call premise warrants further discussion. There are two major hypotheses proposed to explain why an adult bird facing imminent predation should emit distress.
calls. The startle-the-predator hypothesis and the request-aid hypothesis (Conover, 1994) state respectively that the distress call either startles the predator into releasing the caller or solicits the aid of kin or other birds to help the caller escape. Distress calls have proven to be effective with species such as the European starling (Sturnus vulgaris) and the American robin (Turdus migratorius) among other species. Both these species are well documented agricultural pests and for this reason distress calls have been able to maintain their viability as a control measure. Recent progress in technology has packaged this technique into more durable and affordable offerings for growers. Well marketed throughout the U.S. and Canada, distress calls have earned a place as a reputable control technique.

Firearms need little discussion beyond what has already been covered. The opportunity to provide a spontaneous loud noise accompanied by a possible lethal dose of lead pellets has been too appealing for growers to pass up for several years. Most noise making devices try to mimic firearms. However, propane cannons and pyrotechnics whether used in combination with effigies or not, are missing a few key elements required for success. Neither offers lethal consequences. Even though it has been discussed at length in this paper, that lethal control is ineffective for agricultural pest birds, it is still true that a dead bird no longer poses a depredating threat to a crop. Birds easily habituate to propane cannons that are left in the same location for more than two days, or have a consistent firing pattern and firing times. Crop canopy, such as almonds or cherries, almost completely muffles the report of a propane cannon. The only solution to this is to elevate the cannon 14 to 18 feet in the air so that the sound can be effectively dispersed throughout the area. Most growers find this approach impractical and in some cases even dangerous due to the cannon vibrating itself off its “perch” and crashing to the ground. Propane cannons also are common targets of scorn from non-farming neighbors. The British Columbia Ministry of Agriculture, Food and Fisheries released a report in 2001 which exhaustively researched and discussed guidelines for spacing, timing, acreage, firing times and directions for propane cannons. These guidelines were adopted and enforced by the Minister of Agriculture in British Columbia in 2002. As a result, blueberry growers in the Fraser Valley of British Columbia now have restricted firing times, intervals and directions of fire, as well as a limit to the number of cannons they may place in a field.

Pyrotechnics have been a bird control staple for several years. The advantage offered by a pyrotechnic device is that it delivers a loud noise and concussion, along with some visual cue, directly into a group of passing birds. Pyrotechnics have remained largely unimproved over the last several years. They are relatively safe to use, are easy to transport and have effective ranges. Most importantly though, pyrotechnics are completely random in the timing of their application. A human operator is required for these products and that is often the missing key with other hazing techniques. The difficulty in using pyrotechnics is also that a human operator is required. This means that if you are not in the field, you do not get control. Another emerging challenge with pyrotechnics is increased regulation. In the wake of terrorist attacks in the U.S., the federal regulatory agency (Bureau of Alcohol Tobacco and Firearms-BATF) has considerably increased its scrutiny of these products. Now users must fill out various forms, control the distribution of pyrotechnics within their farming operation, have approved storage magazines, and so on. In addition, there are presently only a handful of distributors in
the U.S. and Canada that have survived the BATF licensing and paperwork requirements in order to be able to continue to sell pyrotechnics.

Physical barriers or crop exclusion are the most effective techniques for agricultural bird control today. The principal of a physical barrier is nothing new or revolutionary. The application of screens, netting, fences, plastic film and other barriers has always been the challenge. Some crops such as grapes or blueberries lend themselves to being netted, as the row height is fairly low and the crop is accessible by hand. Other crops such as cherries or almonds present a unique challenge because netting each tree is not cost-effective, and to net an orchard requires a net support system that is at least 14-feet off the ground. Row crops like strawberries or lettuce are also challenging because of required daily worker access and irrigation techniques that make netting more of an obstruction than it is worth.

In Mexico, elaborate net support systems employ steel poles, 3/16-inch aircraft cable and ¼-inch mesh net to shield valuable apple crops from not only bird damage but also potentially devastating hail storms. These designs, when compared to the cost per acre of growing apples and the potential profit from a good harvest, are not cost-effective. However, when complete crop loss is factored in due to weather and bird damage combined, bird/hail netting is a must for these growers to succeed.

In the San Joaquin Valley of California, thousands of acres each year produce varieties of table grapes and raisin grapes. In addition, several thousand tons of grapes are shipped from this region to the more notable premium wine growing regions of the state. These grapes provide a “juice base” for the premium wines, with the necessary premium grapes added to meet the federal regulation for labeling a wine as being produced in a much more marketable area such as the Sonoma Valley. It seems that a consumer in Wisconsin would rather buy a bottle of wine labeled with grapes grown along the Russian River in the Sonoma Valley, then somewhere near the old Tulare Lake Basin outside Oildale, also in California. The price variance between grape varieties is astounding. Flame Seedless grapes, a popular table grape variety purchased at most grocery stores, sell for $75.00 per ton, grown in the San Joaquin Valley. Pinot Noir wine grapes, a popular premium red wine grape grown in the Sonoma Valley, sell for $1,856.84 per ton (CDFA 2002). Both of these grape varieties, grown in the regions mentioned, suffer significant bird damage. However, the economics of $75.00 per ton vs. $1,856.84 per ton make it an easy decision for the grower to decide which variety to net.

As a result of these economic factors, few California raisin or table grape varieties are netted. The notable exception being hybrid “globe” varieties of grapes, that as a single fruit item could be confused with a small plum, and are in high demand in Asian markets. However, as mentioned previously in this paper, a wine grape grower in a high bird pressure region such as Long Island, New York, must net everything, or lose everything. Premium varietal grapes have been protected in most regions of North America, for years, acceptably, using several of the techniques discussed in this paper. However, in the mid 1990’s the market for premium varietal grapes changed dramatically and so did the use of bird netting in the vineyard.

When one takes into consideration that it costs approximately $500.00 per acre for netting, excluding labor, and that an acre contains 3-5 tons of roughly $1,850.00 per ton of wine grapes, the economics are not too hard. This is what happened in the mid
1990’s throughout the U.S. and Canada. The premium varietal wine market matured to a point where growers would do whatever it takes to protect a crop that ranged from $1,000.00 per ton to over $4,000.00 per ton. Agricultural bird control techniques have always had to maintain a balance between what works and what the grower could afford to implement and still make a profit after harvest. In the wine grape “boom” of the mid 90’s (which has been closely followed in some cases by the wine grape “bust” of 2001-2002) the grower could afford quite a bit. This era spawned the creation of mechanical net application and retrieval devices such as The NetMaster (Taber and Martin 1998) which applied and retrieved net with a speed and efficiency not seen before. Finally, the biggest hurdle faced for grape growers, the economical application and retrieval of a crop cover, had been cleared. While successful still today, the NetMaster fails to address other crops such as cherries, peaches or apples. In addition, nut crops such as pistachios and almonds receive tremendous damage from American crows (Corvus brachyrhynchos) and western scrub jays. Growers of these crops still remain largely dependent on every technique but netting, due to the challenge of applying net to trees.

Netting is, to this point, the best control technique available to growers today. The control offered by bird net, which is widely distributed throughout the U.S. and Canada, is as close to 100% protection as anyone could hope for. Bird net is priced competitively, as more suppliers emerge every year to capture their part of the market. Hopefully, bird net will benefit from the same type of study, documentation and experimentation that other bird control techniques have. Certainly, if the same amount of effort is put into bird net that the likes of Piper and Neff put into strychnine baiting for lettuce protection, then growers of many crops should benefit from the evolution of netting as an agricultural control technique.

CONCLUSION

In the continuing battle between man and bird to see who harvests the most of the crop, the biological and environmental impact of all the control techniques presented in this paper have been studied and documented at length. Conclusions range from the loss of effective repellents such as Mesurol, the complete failure of applied technology like ultrasonics, and the realization of a grower that he can not kill every bird he can see, so he must install netting to physically prevent crop loss. The only bird species that potentially suffered irreparable damage as a target of agricultural bird control was the passenger pigeon, and even in this case, the lack of the bird’s ability to adapt to changes in its environment was certainly more of a contributing factor to its demise than any other single cause.

Rarely has economics played as pivotal a role as it does today in the decision of which bird control technique to apply. In addition, regulation both at the state and federal level, has never been as narrow and focused on growers as it is today. Public perception also plays a large role, as in many cases, public perception is the first step in regulation. While today’s grower does not have the perceived luxury of the open regulations of the 1930’s, he can benefit from the years of efficacy studies. These studies, results and conclusions, document step by step, agricultural bird control and the evolution of the tools of the trade.

LITERATURE CITED

Askham, L.R. 2000. Efficacy of the aerial application on methyl anthranilate in reducing bird damage to sweet corn,


MARTIN, L.R. PERSONAL COMMUNICATION BOUDREAU 1981. Bird damage crop protection techniques for seedling crops. Division of Wildlife and Fisheries Biology, University of California, Davis, CA, USA.

NEFF, J.A. 1937. Procedure and methods in controlling birds injurious to crops in California. Part II. California State Department of Agriculture, Sacramento, CA, USA.


