Bird Hazing Manual

Techniques and Strategies for Dispersing Birds from Spill Sites

W. Paul Gorenzel
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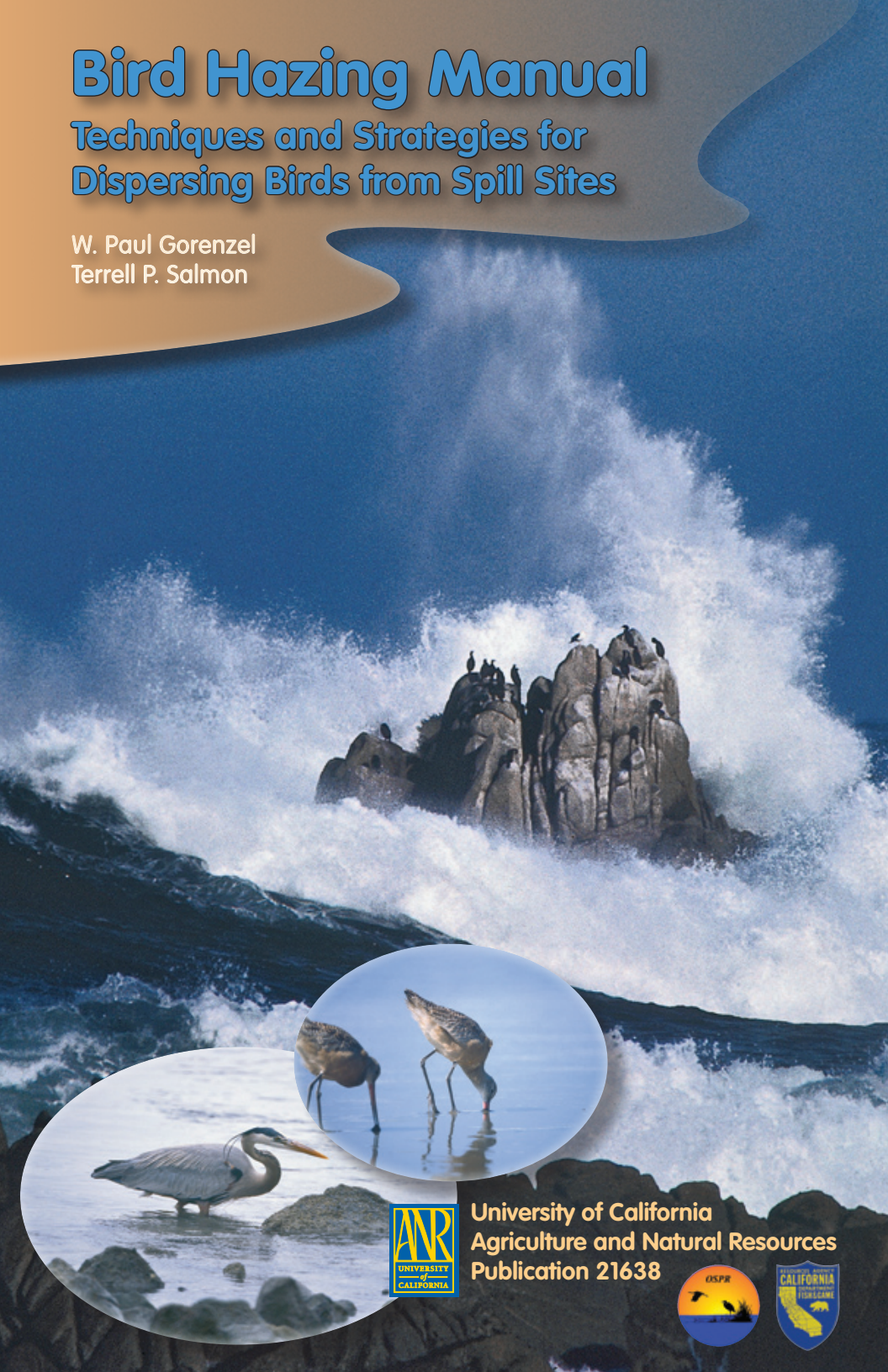

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Section A

Initial Considerations: Assessing Habitats, Bird Populations, and Spill Factors

Initial Considerations

Stretching over 1,000 miles with a great diversity of habitats ranging from rocky, wave-swept shores to relatively calm bays with mud flats and wetlands, the coastline of California presents a challenge for dispersing birds from sites of oil spills, a practice termed "bird hazing." At the very beginning of any hazing effort, the hazer must determine answers to many questions that influence the direction of the hazing program.

What Is the Current Location and Predicted Extent of the Spill?

The current location of the spill is the first step in determining resources that have been impacted and that may need hazing to protect wildlife. The predicted extent or movement of a spill identifies areas that could be impacted in the short term and that might require hazing. The size and extent of the spill is also helpful in making an initial determination of equipment and personnel needs for adequate coverage.

What Is the Habitat(s) at the Spill Site?

Are there any important wildlife areas that are or could be impacted? Wildlife favor certain locations over others. High-use areas threatened or impacted by a spill are priority targets for hazing. Important areas include marshes, sheltered bays, tidal mud flats, and offshore rocks and islands that could be used for feeding, nesting, roosting, and loafing.

Are Alternative Sites Available?

Where birds may go when hazed is an important consideration. If other attractive sites for birds are also contaminated, it may also be necessary to deploy deterrent devices in those areas. For this reason it is important to recognize important habitats and locations used by birds within the region affected by the oil spill. It is generally easier to move birds from a particular site if other sites are equally attractive. In some cases it may be possible to make uncontaminated areas more attractive to birds by temporarily limiting access by people, boats, or other activities.

What Species of Birds Are Present and in What Numbers?

The species present in the area will in part determine the types of hazing equipment that can be used. Certain hazing techniques are very effective in deterring certain species but could be completely ineffective and sometimes counterproductive with other species. Waterfowl, and hunted species in general, can be dispersed from an area with propane cannons and pyrotechnics. However, diving birds such as grebes or loons will dive and swim away from the danger source, surface, and dive again if the threat remains. This behavior can make it difficult to herd the birds away from the oil spill and may add to a buildup of oil on the birds. Therefore, hazing with pyrotechnics, for example, may not be the best deterrent for diving birds close to the spill area. Another example is the use of biosonics. Distress or alarm calls are available for only a limited number of species and are usually species-specific, although closely related species may respond (e.g., gull species). Other species may not respond at all.

What Is the Phenological Status of the Birds?

The phenological status of birds may affect hazing success. Migration and breeding are strongly influenced by season. Migrants in general are easier to disperse from most sites than are breeding birds from a nesting colony. On the other hand, shorebirds may be difficult to disperse from a traditional migratory stopover area. Molting is also a factor, as some birds (e.g., ducks, geese) cannot fly at certain stages in their molt. Flightless birds may take to the water when hazed, which may not be the desired response if the water is contaminated.

Are the Hazing Techniques Safe to Use?

Some spill materials may be flammable or produce flammable gases. Propane cannons, pyrotechnics, and CAPA rockets are explosive devices. Phoenix Wailers or Breco Bird Scarers use batteries that may produce a weak spark. These devices should not be used in the presence of flammable substances or oxidizers that could endanger workers. These devices also produce loud noises and are a threat for ear or eye injury to workers. Workers using certain hazing equipment must be trained in the safe and proper use of that equipment and must use eye and ear protection when appropriate. Other workers in the vicinity of such devices should also use ear protection or remain a safe distance away.

Will Weather Conditions Impact Hazing?

Weather can have an impact on safety, equipment selection and operation, hazing effectiveness, and spill movement. High winds or waves, fog, or other inclement conditions can be hazardous to personnel and may prevent the use of boats and aircraft to haze birds. Hazing during such conditions may be limited to land-based operations. High winds can prevent propane cannons from firing. Pyrotechnics fired into oncoming high winds could be blown back to the operator. Moderate winds may be a problem for kites and balloons, which can be blown down or away, or if attached to poles, become entangled. Mylar tape frequently breaks in high

winds. The possibility of equipment failure may require more personnel and frequent checks to ensure proper operation. In fog and wind the effective range of propane cannons, pyrotechnics, and visual deterrents is reduced. Birds may also be more difficult to disperse from sheltered areas during bad weather conditions. High winds or waves can affect the speed and direction of spill movement and be a consideration in identifying locations in danger of contamination.

Is Hazing Feasible?

Hazing becomes impractical for areas larger than 7 to 10 miles long or diameter due to equipment and manpower requirements. Ideally the hazing effort should be equal and continuous in all contaminated areas to prevent birds from being hazed into an area where they might be in danger. This may be difficult to achieve on a large spill event. Also, birds hazed into a contaminated area may attract other birds, which is unacceptable.

Sources of Local Information

The sheer magnitude and diversity of the coastline makes it impossible for any one person to know ahead of time the answers to the above questions for every potential spill site. The following sources of information can be useful for the initial assessment of habitats and bird populations.

ESI Atlas

The Environmental Sensitivity Index (ESI) Atlas for California is available in a four-CD set available from the National Oceanic and Atmospheric Administration (NOAA) (fig. 1). The four CDs (Southern California, Central California, Northern California, and San Francisco Bay) contain a series of maps, each depicting a segment of the coastline. Each map illustrates the shoreline habitat type (e.g., exposed rocky cliffs, mixed sand and gravel beaches, riprap, exposed tidal flats, salt marshes); biological resources (e.g., bird, mammal, fish, shellfish, and plant species) known to occur in the area; and human-use resources (e.g., aquaculture sites, marinas, boat ramps, parks, wildlife refuges, marine sanctuaries). Additional information is provided in tables for the biological resources. For example, for birds the species present are listed along with the months present and the periods for nesting, laying, hatching, and fledging (fig. 2) .

Although wildlife populations are dynamic and dates of occurrence can vary from year to year, the ESI maps are helpful in providing an initial picture of the species that could occur at a site. Aside from any limited human developments, the habitat types shown on the maps are unlikely to change and are thus most useful.

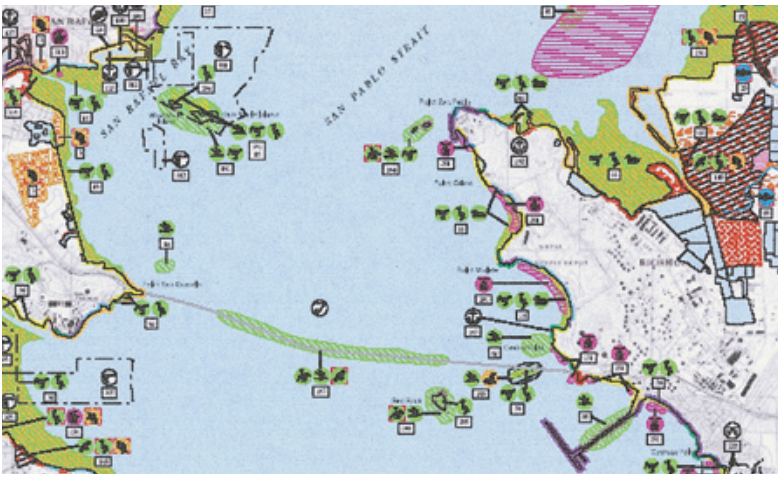


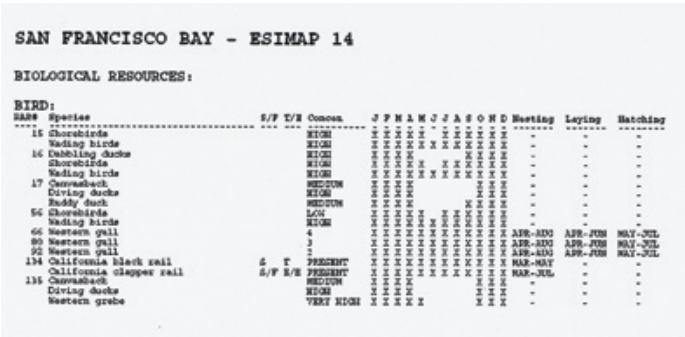
Figure 1. A portion of an ESI map of the north end of San Francisco Bay near the San Pablo Strait. *Source:* Courtesy NOAA.

The entire set of maps should be printed out and filed according to geographic region for easy retrieval. Some maps of important wildlife areas (e.g., Humboldt Bay, San Pablo Bay) should be pasted together as necessary to give a complete picture of the shoreline and the resources that could be impacted. ESI maps should be consulted in the office prior to leaving for the spill site. Hard copies of the ESI maps should be taken to the spill site and used for planning. The appropriate CD should also be taken to the site to be available in the event additional maps are required.

The ESI CDs may be ordered by e-mail (library@noaa.gov) or at the NOAA Web site, www.response.restoration.noaa.gov.

Area Contingency Plan (ACP)

An area contingency plan (ACP) is a response plan for a specific, environmentally sensitive site (e.g., a specific marsh or a specific island). Each ACP includes a description of the sensitive site features, specific response strategies for the site, a site map, and information on economic, cultural, and archeological concerns. Although an ACP is primarily concerned with the initial spill cleanup strategies, there is much information of use for hazing personnel. Useful information includes descriptions of hazards and restrictions (e.g., shallow water, submerged rocks); species present (e.g., nesting birds, endangered species); concerns and advice to



SAN FRANCISCO BAY - ESIMAP 14

BIOLOGICAL RESOURCES:

BIRD:

RAR#	Species	S/F	T/E	Concen.	J	F	M	A	M	J	J	A	S	O	N	D	Nesting	Laying	Hatching
15	Shorebirds			HIGH	X	X	X	X	X	-	X	X	X	X	X	X	-	-	-
	Wading birds			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
16	Dabbling ducks			HIGH	X	X	X	X	X				X	X	X	X	-	-	-
	Shorebirds			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
	Wading birds			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
17	Canvasback			MEDIUM	X	X	X	X	X						X	X	-	-	-
	Diving ducks			HIGH	X	X	X	X	X						X	X	-	-	-
	Ruddy duck			MEDIUM	X	X	X	X	X				X	X	X	X	-	-	-
56	Shorebirds			LOW	X	X	X	X	X	-	X	X	X	X	X	X	-	-	-
	Wading birds			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
66	Western gull			4	X	X	X	X	X	X	X	X	X	X	X	X	APR-AUG	APR-JUN	MAY-JUL
80	Western gull			3	X	X	X	X	X	X	X	X	X	X	X	X	APR-AUG	APR-JUN	MAY-JUL
92	Western gull			3	X	X	X	X	X	X	X	X	X	X	X	X	APR-AUG	APR-JUN	MAY-JUL
134	California black rail	S	T	PRESENT	X	X	X	X	X	X	X	X	X	X	X	X	MAR-MAY	-	-
	California clapper rail	S/F	E/E	PRESENT	X	X	X	X	X	X	X	X	X	X	X	X	MAR-JUL	-	-
135	Canvasback			MEDIUM	X	X	X	X	X						X	X	-	-	-
	Diving ducks			HIGH	X	X	X	X	X						X	X	-	-	-
	Western grebe			VERY HIGH	X	X	X	X	X						X	X	-	-	-

Figure 2. A portion of the data table of bird species at risk for ESI map 14 (fig. 1). The RAR numbers in the left column relate to locations on the map. *Source:* Courtesy NOAA.

responders (e.g., large heron rookery, keep disturbance to a minimum); directions to site (e.g., water access only, location of nearest launch ramp); and communications limitations (e.g., cell phones don't work, use radios). Numerous ACPs have been formulated for three port areas (San Francisco, Los Angeles–Long Beach, San Diego) and six geographical sections of the California coast, from Del Norte County to San Diego County. ACPs for these areas may be viewed at the Office of Spill Prevention and Response (OSPR) Web site, http://www.dfg.ca.gov/Ospr/. As with the ESI maps, the ACP(s) should be reviewed in the office prior to leaving for the spill site and again at the Incident Command Post with Wildlife Branch personnel.

Wildlife Reconnaissance Group

In the Incident Command System, the Wildlife Reconnaissance group is part of the Wildlife Branch. The reconnaissance group consists of three units: the aerial survey unit, the boat unit, and the shoreline survey unit. Personnel in these units are among the first responders to a spill. Information from these surveys can be very helpful to hazing personnel. An aerial survey provides a broad overview of the shoreline features and bird concentrations and helps target areas for deployment. The boat and shoreline surveys provide a more detailed view of the spill and the resources at risk. Unlike the ESI maps that tell you what could be present, boat and shoreline surveys provide "real-time" data as to what is actually present. Boat and shoreline surveys identify the species and numbers present in the spill area, important shoreline habitats, marine mammal haul-out areas, and seasonal features such as rookeries. Upon arrival at the Incident Command Post, hazing personnel should consult with Wildlife Branch personnel on the status and findings from the surveys.

Local Expertise

As noted above, no one individual can have complete knowledge of the entire coastline and the wildlife species

at risk at any given site. Individuals knowledgeable about local wildlife and conditions should be consulted. Potential sources of information include local wardens and OSPR personnel, park or refuge personnel, and local birding experts or residents. Aircraft pilots and other airborne observers should be able to provide helpful information about bird concentrations and sites that have been oiled or are at risk.

Section B
Bird Dispersal and Deterrence

Common Bird Dispersal and Deterrent Practices

Most bird dispersal and deterrent techniques have been developed to prevent damage to a crop or a structure. For such situations, general approaches to control damage could include the use of

- auditory or sound-making devices
- visual scaring devices
- exclusion
- habitat modification
- chemical repellents
- removal (trapping)
- killing

Given that the objective of bird "control" at a spill is to save birds by preventing them from becoming oiled or contaminated, techniques such as killing or trapping are counterproductive and have little or no application. Habitat modification and chemical repellents could be used under special circumstances, but in general they would seldom if ever be used at a spill. Exclusion attempts to physically prevent a bird from occupying a particular location; exclusion with netting or lines is neither appropriate nor feasible on open shorelines but could have an application at contaminated bodies of water such as settling or evaporation ponds.

The primary tools for hazing birds during a spill are auditory devices, such as pyrotechnics and propane cannons, and visual scaring devices, such as mylar tape and lasers. Techniques that incorporate both visual and auditory aspects, such as firing pyrotechnics while patrolling on an ATV, are even more effective.

The key elements in any strategy to haze birds are timing, organization, variation, and persistence. Timing refers to response time, the time from call-out to arrival on scene. A rapid deployment of hazing tools is obviously desirable and could save many birds. A rapid response depends in great part on good organization, which begins with planning in the office and acquiring sufficient kinds and quantities of hazing equipment. Variation, the use of a variety of hazing techniques, whether in combination or in rotation, and frequently changing the type, timing, and location of the equipment, helps prevent or delay the onset of habituation, discussed below. Persistence refers to the motivation and perseverance of the hazing personnel. To be successful, the hazing operation must be diligently applied, and at the same time it must be dynamic, creative, and mobile in response to the changing location and nature of a spill.

Habituation

Habituation is a type of learning in which an animal stops responding to a stimulus in the absence of any reward or punishment. In the context of bird hazing, habituation is the process in which birds no longer react to sights and sounds that were originally frightening.

Normally, birds react warily to new sights and sounds in their environment. For example, juvenile crows feeding on the side of a road react to approaching cars by flying off. Adult crows, on the other hand, simply jump back a few feet or do not react at all. Over time, the flight reaction is suppressed to the point where older birds practically ignore moving cars. Habituation allows animals to discard a normally useful response because it is inappropriate, time or energy consuming in certain contexts. Habituation is usually very stimulus-specific. A bird that is habituated to vehicles moving rapidly by will fly off if a vehicle slows or stops. Thus, its habituation or nonresponse is displayed only to rapidly

moving vehicles, while the appropriate flight response is retained and used for encounters with vehicles that are not moving rapidly.

Habituation eventually occurs with all scaring techniques, especially if the same technique is applied continually over a period of time and if the technique is not reinforced with actual danger, such as killing birds. However, killing birds at an oil spill to reinforce the efficacy of hazing is not acceptable from a public relations standpoint. Thus, variation of techniques and the introduction of a human presence are the primary means of slowing or preventing habituation. Variation can be achieved by changing the location, appearance, and types of hazing devices and by using combinations of devices. These factors should be changed frequently and in a random way, not a fixed pattern. Adding a human presence, for example, by shooting off pyrotechnics or rapidly approaching by boat or ATV, is a necessary and effective component to delay habituation. Variation in the hazing program is analogous to the vehicle-bird scenario described above. Changing the devices, etc., is similar to the vehicle slowing down, stopping, or veering toward the bird: they are new stimuli that produce the desired result, namely flight.

Section C

Bird Dispersal: Auditory Techniques

Pyrotechnics

Pyrotechnics include a variety of devices that frighten birds by producing loud bangs or whistling noises, and in some cases, bright flashes of light. Pyrotechnics are considered a standard hazing technique and are widely used. Most of the commonly used pyrotechnics are projectiles launched from a pistol or shotgun.

Bird Bombs, Screamers, and Screamer Banger Rockets

Description

Bird bombs, screamers, and screamer banger rockets are pyrotechnic cartridges fired from a modified starter pistol using a .22-caliber blank. Bird bombs, sometimes called bangers, travel approximately 50 to 75 feet before exploding (fig. 3). They are effective when range is not a factor.

Figure 3. Pistol launcher with bird bomb (left), .22-caliber blanks, and screamer (right). *Photo:* J. P. Clark, CDFA.

Figure 4. A screamer banger rocket includes a collar to hold the banger over the screamer rocket and wooden stabilizers to control the trajectory. *Photo:* W. P. Gorenzel.

Screamers, sometimes called whistlers, do not explode but make screaming and whistling noises as they travel and leave a visible trail of smoke. The range of screamers is about 150 to 200 feet. The screamer banger rocket combines the bird bomb (banger) and a screamer into one unit (fig. 4). The rocket travels about 300 to 350 feet, making a screaming noise followed by the report from the banger.

Operation and deployment

Bombs, screamers, and screamer banger rockets are fired to disperse birds when it is safe to do so. The pistol is normally held at a 45° angle at arm's length and fired in the direction

Figure 5. Launcher with bird bomb held at 45° angle. Note eye and ear protection. *Photo:* J. P. Clark.

of the target birds, but in high winds it should be fired downwind or crosswind (fig. 5). These pyrotechnics should also be fired away from personnel and any flammable vegetation or spill materials. Although a screamer generally goes where aimed, the flight path can sometimes be erratic. The possibility of an errant screamer makes consideration for the safety of nearby workers important. Bombs, screamers, and screamer rockets can be used alone, but they help to delay habituation when used with other techniques, and they also introduce a human presence. To delay habituation, use the minimum number of rounds necessary to disperse birds. Eye and ear protection is required, and operators should be properly trained.

Advantages

- Relatively inexpensive.
- Readily available for purchase from agricultural pest control suppliers.
- Can be used day or night.
- Can be used as a land- or water-based hazing technique.
- Can be directed close to birds.
- Can be used to influence the direction of dispersal.
- Can be used to supplement other devices (e.g., mylar tape).
- Highly portable; easily transported and applied in a variety of locations.

Disadvantages

- Fire hazard; smoldering debris can ignite dry vegetation and volatile spill materials.
- Labor intensive.
- Storage of large quantities requires a magazine.
- Potential safety hazard to operators and bystanders.
- Short duration of effect in most cases.
- May be difficult to load .22-caliber blanks in inclement weather conditions.

Shell Crackers

Description

These shotgun-launched projectiles are very effective against most species. They are an important tool in most integrated hazing strategies. Shell crackers contain a firecracker and are fired from a 12-gauge shotgun (fig. 6). They explode with a loud bang and a flash about 300 feet from the operator.

Operation and deployment

Single-barrel shotguns that break and load at the breech are recommended for firing shell crackers. The barrel should have an improved cylinder choke to avoid possible jamming or premature ignition in the barrel. Break-action shotguns facilitate inspection and cleaning of the barrel. For safety, the shotgun should be inspected after every shot for possible lodging of wadding in the barrel. Quality shotguns should never be used to fire shell crackers, as the burning fuse is extremely corrosive to the barrel. Modified- or full-choke barrels are not recommended. Pump shotguns can be used but should be loaded with only one shell cracker at a time. Loading more than one shell cracker at a time could cause

Figure 6. Shell crackers are fired from a 12-gauge shotgun. *Photo:* W. P. Gorenzel.

premature firing of the second shell during ejection of the first shell. Run a cleaning rod with a bore brush through the barrel after the end of a shooting session.

Shell crackers should never be fired into a strong wind or in the direction of other personnel. The shotgun should be fired from the hip while held at a 45º angle above the horizon. Recoil is minimal due to the light charge in each shell cracker. If the shell cracker does not explode, do not look down either end of the shotgun barrel, as a shell cracker in the barrel may explode in your face. Point the shotgun in a safe direction and wait at least 3 minutes before inspecting the breech. Eye and ear protection are required with the use of shell crackers, and operators should be properly trained.

Use the minimum number of rounds necessary to disperse birds and delay habituation. Shots that explode in the air are more effective than those that explode near the ground. Typically the first shot will flush birds, while a closely followed second shot will cause them to disperse.

Advantages

- Relatively inexpensive.
- Longer range and louder bang than bird bombs and screamers.
- Can be used day or night.
- Can be used as a land- or water-based hazing technique.
- Can be directed close to birds.
- Can be used to influence the direction of dispersal.
- Can be used to supplement other devices (e.g., mylar tape).
- Highly portable; easily transported and applied in a variety of locations.

Disadvantages

- Fire hazard; smoldering debris could ignite dry vegetation and volatile spill materials.
- Labor intensive.
- Storage of large quantities requires a magazine.
- Potential safety hazard to operators and bystanders.
- Short duration of effect in most cases.

CAPA Launcher and Rockets

Description

The CAPA launcher is a 4-caliber Very-type, hand-held flare gun fitted with a removable liner in the barrel (fig. 7). The liner permits the use of 18 mm "bird scaring cartridges," essentially small rockets that travel up to 1,000 feet before detonating with a loud report of 150 decibels. The CAPA launcher is best used when range is an issue, such as for high-flying birds, birds on broad expanses of open water, and birds in hard-to-get-to places. Due to expense and limited quantities of rockets on hand, the CAPA launcher should be used only after first using shorter-range pyrotechnics and determining that they do not give the desired results.

Operation and deployment

The CAPA launcher and rockets are used and fired in much the same manner as bird bombs and screamers. The launcher is held at arm's length and fired in the general direction of the target birds. According to the manufacturer, when fired at a 45º angle, the rocket reaches a height of approximately 600 feet, then arches back to the ground and explodes at a height of about 300 feet. The distance traveled downrange will be about 700 feet. If fired at a 30º angle, the rocket will travel

Figure 7. The CAPA launcher, a modified flare gun that fires a small rocket up to 1,000 feet. *Photo:* W. P. Gorenzel.

nearly 1,000 feet downrange before exploding at a height of about 100 feet above ground. There have been no reports of misfires or premature detonation of the CAPA rockets. As with other pyrotechnics, eye and ear protection is required and operators should be properly trained.

Advantages

- Longest range of any pyrotechnic.
- Loud report.
- Can be used day or night.
- Can be used as a land- or water-based hazing technique.
- Can be directed close to birds.
- Can be used to influence the direction of dispersal.
- Highly portable; easily transported and applied in a variety of locations.

Disadvantages

- Expensive (more than $10/cartridge) compared to other pyrotechnics, but cost is likely to be inconsequential compared to other spill costs.
- Labor intensive.
- Storage of large quantities requires a magazine.
- Potential safety hazard to bystanders.
- Short duration of effect in most cases.

Propane Cannons

Description

Propane cannons are an effective and relatively inexpensive piece of equipment for shore-based hazing (fig. 8). They produce a loud, directional blast by slowly filling a bellows with propane gas from an LPG tank, then rapidly transferring the gas to a firing chamber for ignition by a spark. The interval between detonations can be varied from 30 seconds to 30 minutes. After deployment these devices operate automatically. Some cannons fire at random intervals or twice in rapid succession. Other models mount on an elevated

Figure 8. A propane cannon deployed at the Suisun Slough Pipeline Spill in Solano County, California, in 2004. *Photo:* W. P. Gorenzel.

stand and rotate with each blast. Each blast then seems to come from a different direction, a feature intended to delay habituation. Some cannons have a sliding barrel that permits reduction in the noise level, a useful feature for populated areas. Models with a photocell to start or stop operation and radio-controlled remote activation are also available. Propane cannons are most useful as part of an integrated hazing scheme where they are moved frequently and interchanged with a variety of other devices.

Operation and deployment

Placement of cannons is not determined by any rigid formula or rule that they should be a set distance apart. Cannons should be placed where birds congregate, including shoreline areas, creek mouths, and mud flats, and in areas where oil may accumulate. Cannons could be mounted on rafts or other floating platforms for use in open-water areas, subject to weather and wave conditions.

The effective range of a cannon depends on the species, weather conditions, and ambient noise levels. In some cases cannons can be placed to take advantage of the prevailing

winds to carry the sound. Cannons have been effective over distances of more than 2,000 feet. For most situations, it is likely a minimum spacing of 600 to 700 feet between cannons will be sufficient, but cannons may be placed closer together as local conditions dictate. As a baseline estimate of the number of cannons required, a spill that is ½ mile long along shore could require 4 or 5 cannons. A spill 2 miles long could require 16 to 20 cannons. Cannons should be checked daily and moved every 2 to 3 days.

A standard refillable 20-pound propane gas tank produces about 12,000 explosions. A 20-pound bottle of propane would need replacement every 2 weeks at a firing rate of 13 explosions an hour, or one explosion every 4 minutes. In windy conditions the rear portion of the cannon, which houses the ignitor, should be protected from the wind by a large piece of plywood or other barrier. When they ignite, older cannons may produce a flash of 4 or 5 feet, creating a potential fire hazard. Dry vegetation should be cleared from the immediate vicinity, and the barrel should not point at the propane tank.

Because of the loud report and the danger to a person in front of the barrel, at least two warning signs should be posted near each propane cannon. The signs should warn of loud explosions and the need for ear protection.

Advantages

- Inexpensive to operate once deployed.
- Requires little maintenance.
- Widely available for purchase from agricultural pest control suppliers or may be rented by the month from some vendors.
- Portable; easily moved.
- Effective day and night.

Disadvantages

- Birds, especially gulls, may habituate to cannons in 1 to 3 days.
- Periodic cannon blasts, especially at night, may provoke complaints from nearby residents.
- Fire hazard; cannot be used near flammable spill materials.

- Must be moved frequently.
- Must be supplemented with other hazing devices.
- Effective range reduced significantly in fog and wind.

Broadcast Calls and Sounds

A variety of devices are available that broadcast sounds in the audible range of birds. Depending on the device, broadcasts may consist of electronically synthesized sounds, novel sounds (e.g., dog barking, sirens, gunfire, music, human screams), alarm or distress calls, or predator calls (e.g., raptor calls). The broadcasts are intended to alarm or stress the target birds and either cause or predispose them to leave the area. Broadcast equipment ranges from simple, portable tape players to sophisticated programmable units designed to float with an oil slick in the water.

Biosonics: Distress and Alarm Calls

Description

Biosonics is the use of an animal's natural vocalizations to influence the behavior of that species. Many species of animals have a vocabulary that conveys meaning to other individuals of their own species. An animal's language, which may range from body postures and movements to vocalizations, is used to communicate information about social rank, courtship, territory, food sources, predators, and other subjects. Indeed, an animal's very survival depends on its ability to understand what is being said and to respond appropriately. Because of the biological relevance of alarm and distress calls, habituation to calls takes longer than to synthesized or novel sounds.

Biosonics depends on animals reacting to particular calls in a predictable and favorable manner. Most often alarm or distress calls are used to make an animal leave an area. Alarm, or warning, calls are given in response to a potential predator; distress calls are given when a bird is attacked or restrained. Biosonics have been most successful with flocking birds. Distress calls have been used to disperse crows and starlings from night roosts and gulls from airports, marinas, and outdoor restaurants.

Operation and deployment

Recordings of alarm and distress calls are available for gulls, terns, herons, and double-crested cormorants. Usually birds respond only to their own species´ calls and sometimes only to calls from their own region. Gulls are an exception as they sometimes respond to the calls of other gull species, particularly those that associate with them in mixed flocks. However, because calls can vary by location, it is best to use recordings of distress calls obtained close to the area where they will be used.

Calls may be broadcast from portable broadcast units or commercially available setups with speakers mounted atop a vehicle's roof. Since calls should be broadcast at the most effective time and location, a portable or mobile broadcast unit is desirable. For maximum effectiveness and to minimize habituation, the calls should be broadcast sparingly and only when the birds are present. In other words, a human operator is required for optimal results.

Arguably, the greatest body of knowledge regarding the application of broadcast calls relates to gulls. Broadcast calls have been widely used to disperse gulls from airports, landfills, and various waterside locations. The initial behavior of gulls to a distress call is flight toward the source of the sound, then to circle over the source of the sound, perhaps to visually confirm the danger. When the broadcast ends the gulls slowly fly away. While the gulls are circling overhead, use pyrotechnics to reinforce the effect of the calls and hasten the departure of the birds. Broadcast calls should not be played continuously, but rather in an on-off rotation: 15 seconds on, 15 to 20 seconds off for 2 or 3 minutes. The timing is not critical, but an on-off pattern will normally cause gulls to respond.

Advantages

- May be used day or night.
- Slower habituation compared to most other auditory or visual hazing techniques.
- Broadcasts are effective at lower sound levels, therefore are less disturbing for nearby residents than pyrotechnics or cannons.

Disadvantages

- Species specific.
- Not all species give alarm or distress calls.
- Recordings for many species are not available.
- Labor intensive; an operator is required.

Phoenix Wailer

Description

The Canadian-built Phoenix Wailer (PW) is a relatively new electronic sound-generating device that broadcasts a programmable variety of sounds at up to 130 dB through four speakers (one facing each direction) (fig. 9). Four optional additional speakers may be deployed with the terrestrial version of the PW. The Marine Phoenix Wailer (MPW) is a self-contained waterproof unit that rides above the water's surface on four floats attached to long legs. Power is supplied by a marine deep-cycle 12-volt battery. A strobe light option is also available.

Wailers can broadcast up to 94 electronically produced noises, including some in the ultrasonic range (> 20,000 Hz). The Wailer Mk III can also broadcast sixteen additional natural bird calls (alarm calls, distress calls, and predator calls). At

Figure 9. The Marine Phoenix Wailer floats on the water and broadcasts alarm and distress calls. *Photo:* D. A. Whisson.

the time of purchase the calls can be individually selected and custom-programmed to match species likely to occur in the buyer's region. Sounds and calls can be broadcast in a random order at an adjustable sound level. The time between broadcasts is adjustable from 30 seconds to 32 minutes, and the duration of each broadcast can vary from 16 to 64 seconds. The unit can be set to turn on or off automatically using a timer or a photocell.

The variety of sounds produced and the random nature of the broadcasts are intended to minimize habituation. The electronically produced sounds initially induce a startle response, but as the sounds have no meaning to the birds, habituation will probably occur rapidly. The ultrasonic broadcasts are unlikely to be effective. Most birds do not hear in the ultrasonic range, and no birds have been shown to avoid or fly away from ultrasonic sounds. Habituation to broadcasts of natural alarm and distress calls takes longer than it does with electronic and ultrasonic sounds.

The MPW has been reported to be effective on sea ducks within a 1,600-foot radius.

Operation and deployment

The MPW is best suited for calm to moderate water situations such as in sheltered bays and small lakes. Rough water conditions and waves may cause the unit to capsize. Due to its size, the MPW is stored and transported disassembled to the staging area. Assembly of the MPW is best accomplished by two people. The unit can be assembled onshore and placed on a boat for transport offshore. Towing or pushing the MPW through the water is not recommended; it is a slow and difficult process as the floats tend to dive underwater. A second option, if a large enough boat is available, is to assemble the MPW on deck and deploy it where desired. The MPW can be anchored or moored to be stationary, or can be allowed to float freely with the spill materials or be slowed with a sea anchor. If floats are not attached, the MPW could be set up as a ground-based device. If so used, signs should be posted nearby warning of loud noises and the need for ear protection.

At least two 12-volt batteries should be available for each MPW used; one for use during operations, and one being charged at all times. Batteries should initially be checked every day. A readout on the control panel indicates battery charge. The battery should be recharged before the charge falls below 75 percent. If the MPW is used on a 24-hour basis, the batteries will need to be changed more often.

Advantages

- Can operate day or night.
- Can drift with contaminated waters.
- Natural alarm and distress calls delay habituation.
- Drifting with contaminated waters lessens chances of hazing birds into the contaminated waters.
- Drifting delays habituation because new groups of birds may be regularly encountered.
- Inexpensive to operate.
- One of only two devices specifically designed for deployment in the water.

Disadvantages

- Expensive to purchase.
- Not easily deployed.
- A special-order item.
- If free floating, must be checked two or three times daily to ensure that it stays with the oil slick.

Other Broadcast Devices

The following devices are not in the OSPR inventory and are unlikely to be deployed by OSPR personnel. They are briefly described here for informational purposes.

BirdGard and Av Alarm

These are small, electronic sound-generating devices. The older-design Av Alarm produces a variety of synthetic, electronic noises and is no longer commercially available, although units may still be in service, primarily in agricultural settings. The newer BirdGard broadcasts real alarm and distress calls. BirdGard units can be custom-programmed at the factory with up to four

calls of the desired species (assuming they are available). BirdGard units also offer features designed to reduce habituation, including random intervals between broadcasts and the ability to turn a particular call or calls on or off as needed. A marine sound chip includes calls from six species of gulls and the double-crested cormorant. A 12-volt deep-cycle battery provides power. These units require little maintenance other than battery checks; an optional solar panel is available for power. Multispeaker units with twenty speakers are claimed to be effective over 40 acres. These devices could be used as part of a ground-based hazing scheme, provided the units were programmed with the appropriate calls. They are most effective if they are moved frequently and reinforced with pyrotechnics. BirdGard units are readily available and may be rented from some vendors.

Breco Bird Scarer

Very similar to the Marine Phoenix Wailer, the Breco Bird Scarer broadcasts random frightening sounds at up to 130 dB through four speakers, one facing in each direction, for up to 72 hours of continuous operation with a lithium battery (fig. 10). The unit is designed to drift with an oil spill. The completely sealed buoy design allows deployment from ship or helicopter in rough as well as calm seas. The Canadian Wildlife Service recommends this device. This is the only unmanned hazing device available for offshore or open-water use. Deployment of several of these devices at a spacing of 4,600 feet might be effective for hazing marine ducks such as scoters from relatively large open-water areas. Initial tests by OSPR did not replicate the results from the Canadian test of this device. The Breco devices are expensive, at about $10,000 each.

Figure 10. The Breco Bird Scarer is designed to float with a spill in all water conditions. *Photo:* D. A. Whisson.

Section D

Bird Dispersal and Deterrent Techniques: Visual Techniques

Visual deterrents such as scarecrows have been used for centuries in an attempt to control bird damage to agriculture. The primary problem with most visual deterrents is rapid habituation, and for this reason most of these techniques are considered to be ineffective to marginally effective at best in agriculture or other locations such as airports where control for long periods (weeks or months) is desired. However, most oil spills are short-lived events, and long-term control is not necessary. Thus, a visual deterrent that is considered ineffective for agriculture may still have a role at a spill. A visual deterrent, even if effective for only 3 to 5 days, should be considered successful. Visual deterrents provide temporary control at specific locations and "buy" time in the early phases of a spill when the need is great for personnel to be deploying equipment at other locations.

Visual deterrents attempt to frighten birds by presenting a stimulus that the birds associate with danger (e.g., a predator) or that is novel and startles them. In some cases unfamiliarity will cause birds to avoid an object. Avoidance of new objects, called novel object response, varies among species. Visual deterrents are most effective with migratory or transient birds rather than with resident birds. Resident birds would have more opportunity to be exposed to and thus habituate to the visual deterrents. The effect of visual deterrents can be reinforced with pyrotechnics and human presence. At the first signs of habituation to a visual deterrent, another hazing technique should be initiated.

Figure 11. Mylar tape moves in the wind and flashes brightly. *Photo:* J. P. Clark.

Mylar Tape

Description

Mylar tape is a reflective tape that is usually silver on one side and red on the other (fig. 11). It is available in rolls of 250 feet and widths of ½, 1, and 6 inches. The tape moves in the wind and flashes when it reflects sunlight. Depending on wind speed, the tape may also produce a low-volume humming or crackling noise when it moves. Birds exhibit a startle response to the bright flashes and may avoid the taped areas because of their natural caution toward unfamiliar objects. The contribution of the auditory component of the mylar tape is probably minimal. Species do not respond equally to mylar tape. Some may initially respond well while others show no response. However, even for those with good initial response, habituation will occur fairly rapidly because there is no real danger associated with the flashing tape.

Operation and deployment

For spill events mylar tape is the primary visual deterrent because it can be readied beforehand and rapidly deployed.

Mylar tape is usually deployed by tying a strip to a free-standing stake, hanging it from a wire strung between two stakes, or stringing it directly between 2 stakes.

For the free-standing setup, simply tie two 4-foot strips of tape to the top of a stake that is at least 6 feet tall. No special knot or attachment method is required to tie the mylar to the stake as the tape flies freely in the wind and produces no stress on the knot. A couple of overhand knots are sufficient to secure the tape to a stake. Tests have shown this setup is durable with no problems of breakage at the knot or tape wrapping around the stake. Breakage will occur at the loose end of the tape, and over time the length of the tape may shorten noticeably.

Various materials can be used as stakes, including PVC pipe. Bamboo poles are excellent stakes. They are relatively inexpensive, light, and easily transported, carried, and deployed in the field. Bamboo poles with mylar strips can be prepared ahead of time, then gathered in bundles of 10 to 20 for easy handling in the field.

Hanging mylar tape from a wire strung between two stakes is a variation of the free-standing setup. A sturdy wire is attached to two stakes or other points of attachment. At intervals of 15 to 25 feet along the wire, 4 to 6 pieces of 3- to 4-foot-long mylar tape are tied to the wire, creating bundles of reflective streamers. The loosely hanging bundles of tape move and flash in the wind, creating a denser pattern of flashes than a typical free-standing setup. The use of the wire lessens any problems of breakage. This setup uses fewer stakes than the free-standing setup but requires more tape.

A third setup is simply stringing 25 to 50 feet of mylar tape between two stakes. This requires more maintenance than the other setups because the mylar tape can break in winds greater than 20 miles per hour. In addition, a special attachment method must be used, because the tape will frequently break at or near the point of attachment if a simple overhand knot is used. To lessen breakage, attach a short piece of strapping tape to the end of the bird tape. Stick the

loose end of the strapping tape back onto itself and the mylar tape, leaving an open loop in the strapping tape. Tie a cord or string around one of the stakes leaving 6 to 8 inches of free cord on each end. Run one of the loose ends of cord through the loop in the strapping tape, then tie up the loose cord ends to one another. Follow the same process at the other end of the mylar tape. Before tying the cord ends, twist the mylar 3 or 4 times. The tape should have some sag. The twists and the sag allow the mylar to move and revolve in the wind.

Mylar tape is best deployed along shorelines, mudflats, and breakwaters where birds tend to congregate and feed, loaf, or roost. Individual stakes with tape should be placed at intervals of 50 to 75 feet along shorelines or other linear locations. Place stakes in a gird pattern for mudflats, marshes, or fields. Stakes are easily pushed into sand or mud substrates. For hard soil, use a short piece of rebar and a hand sledge to make a hole in the ground for the stake. The diameter of the rebar should be the same or slightly greater than the diameter of the stake to ease insertion of the stake. For riprap breakwaters, stakes can be wedged in cracks and openings between the rocks.

For tidal mudflats, the stakes should be tall enough that the strips of tape remain out of the water for free movement during high tide. Mylar bundles attached to wire across small bodies of water are effective for ducks and shorebirds.

Advantages

- Inexpensive.
- Readily available.
- Very portable and easily deployed.
- Stakes can be "armed" with mylar tape ahead of time.
- Can be deployed near populated areas where noise is of concern.

Disadvantages

- Habituation.
- Not effective at night.
- Not effective in windless conditions.

Scarecrows

Description

Scarecrows or human effigies are intended to mimic a human "predator" as closely as possible (fig. 12). Because birds react by flying away from a perceived rather than a real danger, habituation is likely to occur rapidly unless other hazing techniques are employed in combination. They are best used where short-term and local response is sufficient.

Figure 12. A scarecrow may be effective in the short term, but it is time-consuming to construct. *Photo:* W. P. Gorenzel.

Mechanical pop-up scarecrows are also available. One model consists of an inflatable human-shaped bag connected to a compressor and fan. It inflates every 5 minutes or so, produces a siren-like noise, and is illuminated at night.

Operation and deployment

Scarecrows can be constructed from readily available materials such as white or colored coveralls (typically worn by spill workers) stuffed with newspapers. Scarecrows should be brightly colored to attract attention and have some movement in the wind to give at least a minimal appearance of being alive. Realistic facial features and human shape are thought to increase effectiveness.

There is no set rule regarding the number of scarecrows to deploy per unit of area. In part this will depend on the number available and the site characteristics. One scarecrow every 100 to 200 yards along a breakwater or shoreline may be sufficient. Recommendations from crop and airport situations are 1 scarecrow per 10 to 14 acres. Scarecrows have also been deployed on floating platforms. Scarecrows must be moved every 2 to 3 days and reinforced with other hazing techniques. It is helpful to establish the human form and presence as a danger by creating a disturbance (e.g., firing pyrotechnics) prior to deploying scarecrows.

Construction is a disadvantage of scarecrows. Because time is of the essence, scarecrows would not be deployed in the initial phases of a hazing response unless they had been constructed beforehand. If not constructed beforehand, other more effective and efficient techniques should be deployed first. Old clothes and other materials for scarecrows can be stockpiled in preparation for a spill.

Advantages

- Inexpensive.
- Materials readily available, easy to construct.
- Easily deployed and moved as needed.
- Can be deployed near populated areas where noise is of concern.
- Can be deployed on land or water.

Disadvantages

- Not effective at night unless equipped with lights.
- Rapid habituation by birds.
- Limited area of effectiveness.
- Must be moved frequently.
- Time-consuming to construct.

Flags

Description

Flags, like mylar tape, are one of the simplest and most inexpensive visual deterrents. Flags consist of a sheet of black or white plastic attached to a lath. They have been effective in controlling ducks and geese in croplands. The birds respond to these novel objects by avoiding the areas where they have been deployed.

Operation and deployment

Flags can be constructed ahead of time and stored for future deployment. Flags may also be easily and quickly assembled on site. To assemble, staple a plastic garbage bag (white or black) to a 4-foot lath. Dimensions of the flag are not critical and have varied from 2 feet by 3 feet to 2.5 feet by 5 feet in previous tests. Small flags may not be as effective as larger flags. Light plastic should be used; heavy plastic will not move easily in the wind. The stakes should be driven into the ground at a slight angle to aid movement in light winds. Flags should be placed every 100 to 200 feet on land and can be placed on buoys or other floating platforms. Flags should be reinforced as needed with pyrotechnics and human presence.

Advantages

- Inexpensive.
- Materials readily available, easy to construct.
- Easily deployed and moved as needed.
- Can be deployed near populated areas where noise is of concern.

Figure 13. Reflective mylar balloons inflated with helium are susceptible to damage by winds greater than 15 miles per hour. *Photo:* W. P. Gorenzel.

Disadvantages

- Not effective at night.
- Habituation.

Balloons

Description

Included in this group are eyespot balloons, weather balloons, and balloons with a reflective coating (e.g., mylar tape). Balloons are filled with helium and are tethered with a line to keep them positioned over the desired area (fig. 13). To some degree birds may avoid all balloons due to the novel object response. Balloons with a reflective coating may elicit a startle response from birds as the balloons move in the wind and produce flashes of light. Eyespot balloons add another factor, in that the eyespots are intended to resemble the eyes of a predator, thus creating a perceived danger. Kites resembling hawks or eagles have been suspended from balloons to heighten the perceived danger from a predator.

Operation and deployment

The OSPR inventory includes several hundred balloons, each about 18 inches in diameter with a silver reflective coating. These balloons would have limited initial use in a spill event and should be deployed only after other hazing equipment is in place or as a replacement when birds become habituated to an existing hazing installation.

At present, helium for the balloons is available from two large tanks. The tanks are heavy and not easily portable in the field, thus the balloons must be filled at the vehicle or trailer used to transport the tanks. After inflating a balloon a 2- to 3-foot length of twine is attached to the balloon. The balloons should be deployed like mylar tape, with the free end of the twine tied to the top of a free-standing bamboo stake. The balloons and stakes should be deployed in a grid pattern or along the shoreline at intervals of 50 to 75 feet. Balloons should not be attached to the stakes at the transport vehicle. Attempting to carry a handful of stakes with balloons attached results in a tangled, twisted mess of balloons and twine. The balloons should be tied to the stake after the stake is in place. Two people, one carrying the stakes, the other the balloons, are most efficient for deployment. If stakes are not available, the balloons could be tethered to and held in position using rocks, short vegetation, or other available items. The balloons could be tethered to longer lengths of twine for greater altitude, however at some point the weight of the line will be greater than the lifting power of the balloon. Monofilament fishing line reduces the weight and may be used instead.

Helium balloons have undesirable properties. The balloons currently in the OSPR inventory will be noticeably deflated after 2 days. In recent durability tests, none of the balloons retained any lift after 4 days. With no means of reinflating the balloons in the field, the old balloons should be replaced as needed with new balloons. The tests also showed that many balloons tore apart with wind speeds greater than 15 miles per hour. It has been suggested that balloons should be slightly underinflated, as full inflation creates stress from wind resistance.

Advantages

- Inexpensive.
- Readily available.
- Can be deployed near populated areas where noise is of concern.

Disadvantages

- Difficult to deploy.
- Not effective at night.
- Short-lived, deflate within a few days.
- Will not stay aloft in high winds.
- Habituation.

Lasers

Description

Lasers are a new bird control device that can be used at night or other low-light conditions. Lasers project a highly concentrated beam of red light that startles birds. Hand-held lasers (comparable in size to a flashlight or pistol) are light, portable, silent, and do not pose a fire hazard (fig. 14). They represent a valuable tool for dispersing birds at night, from

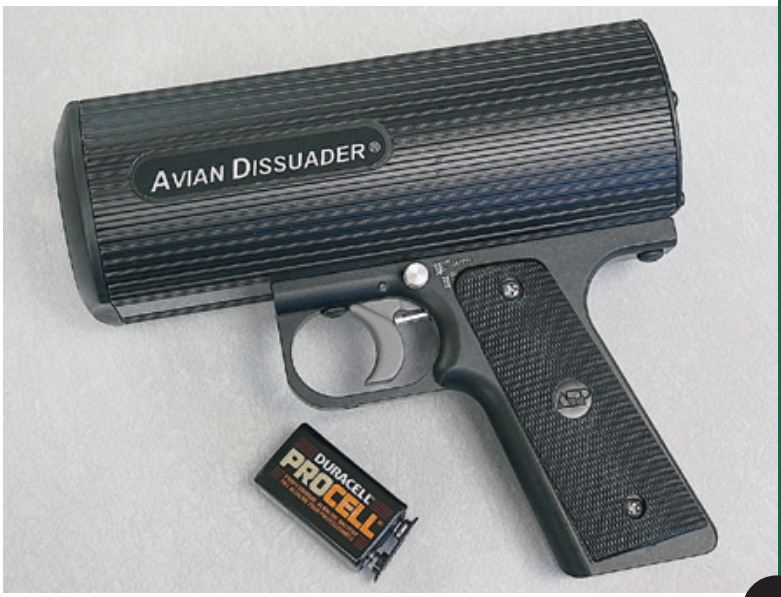


Figure 14. A hand-held laser is useful for dispersing certain bird species at night or in low-light conditions. *Photo:* W. P. Gorenzel.

roosts for example, when other techniques cannot be used or are nonfunctional.

Operation and deployment

Three types of lasers are commercially available. The Desman laser, made in France, resembles a hunting rifle with a scope. It requires a separate battery pack that must be carried along with the laser. The Desman laser has a range of about 1 mile and at about $7,700 is expensive and consequently rare.

A less expensive and more common laser is the Avian Dissuader, which resembles a flashlight with a pistol grip. The beam diameter has a range of 500 yards. The Dissuader weighs 2.6 pounds and is powered by a 9-volt alkaline battery.

A new and relatively inexpensive laser has recently become available. The green laser is essentially a high-powered version of the small penlight lasers commonly used for slide presentations. These devices are only slightly larger than a typical penlight laser and depending on the model, may be powered by either AA or C batteries. The units are light, compact, and easily carried in a pocket. The green laser is very bright, with a beam that is easily visible in dark conditions. The range is claimed to be 20,000 feet.

Lasers are used by simply aiming in the general direction of the target birds and "firing." The laser beam will be projected as long as the trigger is held down. The narrow beam is swept back and forth over the area and produces a visible spot when it hits a solid surface. Birds react both to the approaching beam and when they are "hit." No ocular or other injury to the birds has been reported from these lasers. In one test (Glahn et al. 2000) with captive double-crested cormorants, three birds were directly exposed to a laser beam at distances of 33 meters, 13 meters, and 1 meter. A subsequent histological examination by a veterinary pathologist revealed no retinal degeneration or necrosis. In addition, cormorants at a night roost subjected to laser treatment did not display any strange or unusual behavior, suggesting no ocular damage.

The Desman laser, the Avian Dissuader, and green lasers

are classified as Class IIIB lasers. For humans, ocular injury appears to result only from intentional staring at the laser light close to the diffuser (the muzzle). Thus as a general safety precaution, Desman recommends that the laser not be pointed at people within a nominal ocular hazard distance of 43 feet. As a general practice, a laser should be treated as a firearm and the operator should maintain proper muzzle control (e.g., barrel typically pointed up or down). The barrel should never be pointed at a person and care should be taken when selecting a target so that no people are in the line of fire.

Although tests are still required for many species, cormorants and Canada geese have shown extreme avoidance to laser beams in field trials. Other species that react to laser beams include wading birds, gulls, crows, and vultures. Tests on flightless geese indicated they could be herded in a desired direction with the laser beam. Although unconfirmed at this time, it may be possible to herd birds away from a spill with a laser beam.

Advantages

- Effective at night.
- Silent operation, good for locations where noise is a concern.
- Can be used in situations were flammable spill materials may prevent use of pyrotechnics.

Disadvantages

- Not effective during the day.
- Expensive, about $1,000 each for Avian Dissuader.

Lights

Description

Included in this group are flashing, rotating, strobe, barricade, and search lights. Bright lights at night, at least at some locations, may represent a novel stimulus for birds, which may elicit an avoidance response. Lights have been used with poor to partial success on herons, gulls, and waterfowl. Birds

habituate or learn to avoid bright lights. In one test, black-crowned night herons landed at an aquaculture facility with their backs to the light or landed in shadowed areas to avoid the bright light.

Operation and deployment

The OSPR inventory includes 1-million-candlepower, handheld spotlights powered by internal batteries or by an adapter connected to a vehicle's 12-volt battery. Perhaps the best use of the handheld spotlight is to illuminate birds at night along shorelines, roost sites, or in open water. If the birds take flight, no further action is required. If the birds fail to take flight upon illumination, a subsequent action such as firing of pyrotechnics or a laser treatment should be applied.

If revolving or strobe lights are available, they can be set up along a shoreline or breakwater, or on floating platforms such as booms around a spill. It is thought that flashing or revolving lights are more effective than a steady-shining searchlight.

Lights in general should not be considered as one of the primary hazing tools. Aside from using light to locate and target birds at night, it is probably best used in combination with cannons, pyrotechnics, and other noise-making devices. In foggy or rainy weather lights may attract birds. In such conditions, it is not recommended to use lights to deter birds from contaminated locations. Instead, they might be used to lure birds to safe areas.

Maintenance

The OSPR spotlights each have a rechargeable battery. A fully-charged battery provides about 40 to 50 minutes of continuous light. The actual operating time depends on usage: continuous usage decreases operating time, and intermittent usage increases operating time. If operating time decreases significantly, a replacement battery is required.

Always keep the battery fully charged when not in use. A fully charged battery can be stored for up to 6 months without a recharge. Storage for more than 6 months without

recharging can damage the battery. It takes 8 to 10 hours to recharge the battery from 110-VAC outlets and 2 to 4 hours from 12-VDC current. Recharge each unit as soon as possible after each usage. Do not completely discharge the battery before recharging. A deep discharge decreases battery life.

Advantages

- Relatively inexpensive.
- One of the few tools available for nighttime use.

Disadvantages

- Generally limited effectiveness.
- Habituation.
- Light may attract birds during rainy or foggy conditions.
- Not effective during daylight hours.

Section E

Bird Dispersal: Combination Visual and Auditory Techniques

Aircraft, boats, and all-terrain vehicles (ATVs) provide visual and auditory hazing components. In addition, from a bird's point of view, given the typically fast approach of these machines, they represent a real danger that elicits escape behavior (e.g., flight or diving underwater).

◆ All Terrain Vehicles (ATVs)

Description

ATVs are typically 4-wheeled machines with racks for carrying equipment. Although ATVs are relatively easy to operate, personnel must receive training from a certified trainer before operating an ATV. Appropriate safety gear and clothing, including a helmet, must be worn when operating an ATV. Three-wheeled ATVs, although no longer manufactured, may still be in service. They are not recommended for hazing activities because they are unstable and easily tip over.

Operation and deployment

There are no ATVs in the OSPR Bird Hazing Group inventory, so they must be obtained from other sources within OSPR or from another agency. A listing of OSPR, Department of Fish and Game, and other government-owned hazing equipment can be found in appendix IIIb in the Wildlife Response Plan for California. A request for an ATV should be entered using ICS form 210-OS (Status Change). If an ATV can be secured, inquire as to the availability of a helmet and fuel can. A ramp to load and unload the ATV from a pickup truck should also be available. Bungee cords, tie-downs, or rope should also be available to secure hazing equipment to the racks for transport.

During the original land survey of the spill site, make notes regarding the suitability of the terrain for ATV use. If the

terrain is suitable, an ATV could be used in three ways. First, an ATV could be used to transport hazing equipment from the staging area or the primary vehicle or trailer carrying the equipment to the actual site of deployment. Second, after the primary phase of setting up propane cannons, mylar tape, etc., the ATV could be used for roving patrols, with the operator patrolling an area of shoreline and firing off pyrotechnics as needed. Patrols could be scheduled to coincide with tide changes and other factors that would influence daily movement patterns and habitat use by birds. Patrols on ATVs or other vehicles introduce the human element and reinforce the effectiveness of the hazing equipment already in place. Third, an ATV could be used to check the status of equipment already deployed.

Advantages

- Increases operator mobility and area of coverage.
- Can be used to transport equipment to site of deployment.
- Introduces human presence.
- Enhances effectiveness of other hazing techniques such as propane cannons.

Disadvantages:

- Not quickly available for Bird Hazing Group use.
- Terrain (e.g., steep slopes, deep muck) may limit operation and access.
- Limited mostly to daytime use.

◆ Aircraft

Description

Aircraft can be highly effective at dispersing birds from large areas. Types of aircraft that potentially could be used include fixed-wing airplanes, ultralight recreational aircraft, and helicopters. Birds are thought to respond to the fast approach and loud noise of the aircraft. Due to high noise levels and extreme maneuverability, helicopters are considered to be most effective for hazing birds. It has also been suggested that to a bird, the appearance of a "forward-looking" helicopter resembles a predator about to attack.

Operation and deployment

In the early stages of a spill, a fixed-wing aircraft flying at altitudes high enough not to frighten birds is useful for reconnaissance purposes. Once the contaminated spill areas have been identified, lower-altitude overflights intended to disperse the birds away from the spill area could be initiated.

Reactions of birds to aircraft vary by species and situation. Some birds, such as most ducks and geese on loafing or feeding areas, readily take flight upon the approach of a plane. However, upon the departure of a plane, waterfowl commonly return to the original area within a short time. Nesting and brooding birds are generally unresponsive to overflights by planes. Birds such as loons or alcids typically dive rather than fly upon the approach of an aircraft. Other birds may take cover rather than leave the area; blackbirds in a marsh is an example of this behavior.

The capabilities of a helicopter to hover, fly slowly at low altitudes, and to maneuver with ease relative to an airplane, make it most effective at hazing and herding birds. To a large degree the direction in which birds flush can be controlled better with a helicopter than a fixed-wing aircraft.

Ultralight aircraft could be used to haze birds at a spill. However, the availability of licensed pilots willing to operate such craft at a spill is problematic. Additionally, the sensitivity of ultralight aircraft to wind conditions would limit or prohibit operation at many locations along the coast.

Advantages

- Coverage of large areas in a short period of time.
- Provides coverage of remote and hard-to-get-to sites.
- Requires limited manpower.
- Effective for many species.

Disadvantages

- Not quickly available for Bird Hazing Group use.
- Weather conditions (wind, fog) may limit or prevent use.
- Requires skilled personnel (a pilot) to operate.
- Expensive compared to most hazing methods.
- Limited mostly to daylight hours.

◆ Boats

Description

Airboats, rigid-hulled boats and inflatable craft powered by outboard motors can be effective in dispersing water birds. The fast approach of a boat and the noise of the motor frighten most birds and cause them to take wing. Boats can also serve as a platform on the open water for firing pyrotechnics.

Operation and deployment

One boat, a shallow-draft 12-foot aluminum boat with a small outboard motor, is available in the OSPR Bird Hazing Group inventory. This boat is best suited for near-shore duty on relatively calm waters of lakes, marshes, or sheltered bays. The boat and motor are light enough to easily be taken off the truck-mounted rack, set up, and set afloat by one person.

If an additional or different boat is needed, it can be obtained from other sources within OSPR or from another agency. A listing of OSPR, Department of Fish and Game, and other government-owned hazing equipment can be found in Appendix IIIb in the Wildlife Response Plan for California. Several wildlife refuges in California have an airboat or other boats that might be available in the event of a spill. A request for a boat (or any other materials or equipment) should be entered using ICS form 210-OS (Status Change).

In requesting a boat consider the conditions under which operations will be conducted. If the waters are relatively calm or sheltered, or if shallow draft is required, an airboat might be appropriate. If rougher water is expected, then a boat of sufficient size and design (with high bow and freeboard) should be requested. Specify that the boat should be equipped with gas tank(s), motor, anchor, oars, running lights, and personal flotation devices (PFDs). In general, an aluminum boat with high gunwales, a 16-foot minimum length, and a 25-horsepower motor is sufficient. Finally, request that a properly trained operator be provided to operate the boat, freeing the hazer to concentrate on the task at hand.

Boats are useful for flushing birds that do not respond to hazing from shore. Typically the appearance and fast approach of a motorboat causes most ducks and geese to flush immediately. However, the

flushing distance depends on the degree of habituation to boats. Birds in areas frequented by boats, such as San Francisco Bay, allow a closer approach by a boat before reacting. Boats are less effective for certain diving birds such as grebes or loons that are likely to dive repeatedly and not take wing. Coots are also unlikely to take wing but will dive or head for cover (e.g., cattails or bulrush), if it is available. With careful consideration of the initial approach toward birds, boats can be used to influence the direction of the flushing birds or to herd flightless birds away from the spill or toward safe or boomed areas.

Boats can also be used for reconnaissance, to identify wildlife loafing, roosting, and feeding areas. A boat is not only useful for the initial reconnaissance, but also to later scout out areas ahead of the advancing spill and identify locations for deployment of equipment and personnel. Boats can be used to transport materials and personnel. Boats can also be used in routine checks of deployed equipment. An anchored boat could serve as the floating platform for a propane cannon.

Advantages

- Increases operator mobility and area of coverage.
- Can be used to transport equipment to site of deployment.
- Introduces human presence.
- Can serve as a platform for deployment of pyrotechnics and propane cannons.
- Enhances effectiveness of other hazing techniques such as propane cannons.
- Provides access to hard-to-get-to sites.

Disadvantages

- Water and weather conditions may limit or prevent use.
- Hazards from oil or other spill materials may prevent use of boats.
- Uses more limited after dark.

◆ Model Airplanes

Description

Radio-controlled model aircraft have been used to harass birds at airports, landfills, and aquaculture facilities. Some have been painted to resemble a raptor, and others are available that mimic the shape of a falcon.

Although not discussed here, radio-controlled model boats, which require less experience to operate than model aircraft, may be useful in some situations.

Operation and deployment

The use of model aircraft is limited by the need for volunteers from outside OSPR to provide the aircraft and piloting. For this reason model airplanes would not routinely be considered for use at spills but rather as a technique that might be feasible if a volunteer becomes available.

Model airplanes are effective on a broad range of species. Birds tend not to habituate to a model airplane that approaches rapidly. A predator-like appearance is thought to enhance effectiveness. Model airplanes are highly maneuverable and can be flown to direct the dispersal of birds. The range of model airplanes is limited only by fuel and line of sight. A circling model airplane will prevent birds from returning and landing in an area. Model airplanes would probably be most effective for areas such as small wetlands, a lagoon, a small lake, a jetty, or a breakwater.

However, despite several favorable features, model aircraft have several limitations. The effect of hazing by model aircraft is not long lasting. Birds often return shortly after flight ceases and the operator leaves. Model airplanes are reportedly ineffective against geese resting on bodies of water. They probably would also be ineffective on grebes and loons.

Advantages

- Effective on a wide range of species.
- Habituation occurs slowly.
- Can be used on birds flying at high altitudes.

Disadvantages

- Skilled operator is required.
- Dependence on volunteers to provide and operate model aircraft.
- Cannot be used in heavy winds, rain, or snow.
- Model aircraft easily damaged or destroyed from collision with birds or other objects.
- Limited to daylight hours.

Section F
Bird Deterrents: Exclusion

Exclusion is the use of various devices that physically prevent access to a specific location. In bird control, exclusion is most commonly used to prevent birds from perching or nesting on buildings or other structures. Exclusion is also used to prevent birds from feeding on crops. For example, netting is used to exclude birds from vineyards and fish hatcheries.

In general, exclusion has little application to spills because it is impractical or impossible to apply to large areas. Exclusion as a technique is also rather static, in that once set up, it is not easily moved to a new location in response to the mobile nature of an oil spill on open water. However, exclusion may occasionally have application on small areas, particularly permanently contaminated impoundments or at perching locations (e.g., a piling or buoy) over contaminated water.

Overhead Lines

Description

Overhead lines are wire or monofilament lines strung in a grid or parallel pattern over the area from which birds are to be excluded (fig. 15). The spacing between the wires can vary from inches to 25 feet or more. The reasons for the effectiveness of overhead lines are not well understood. At the wider spacings, there is obviously enough room for most birds to fly between the wires. It has been suggested that the wires interfere with the bird's flight pattern, or that the thin, hard-to-see line startles birds. Overhead lines in most cases do not physically exclude birds, instead they may represent a psychological barrier for some species of birds.

Operation and deployment

Overhead lines could be used over contaminated impoundments or channels to restrict access by gulls and

Figure 15. Overhead lines are a "psychological" barrier for certain bird species. Photo: Courtesy USDA Wildlife Services.

waterfowl. Overhead lines might also be used at a traditional nesting site. The lines should be 0.5 millimeters or less in diameter, making them difficult for birds to see. Stainless steel wire is the most durable. The wires usually are strung parallel to and about 3 feet above the water's surface, although successful repellency has been reported at much greater heights. The spacing between the lines depends on the species to be repelled. The following spacings have been reported effective: 20 feet for Canada geese, 11 to 13 feet for ducks, 2 to 20 feet for ring-billed gulls, and 1 to 40 feet for herring gulls. Overhead lines are most effective on gulls. In one instance .015-millimeter stainless steel wire spaced 80 feet apart, 8 to 10 feet above the water, and stretching up to 1,000 feet prevented gulls from landing on a reservoir in southern California.

Advantages

- Once installed, little maintenance is required.
- Does not require human presence to be effective.
- Less expensive than a complete exclosure.

Disadvantages

- Generally not practical for large areas.
- Mortality can occur if birds fly into lines.
- Labor intensive to install.
- Not a mobile technique.

Netting

Description

Netting is widely used to protect crops and prevent access by birds to nest and perch sites on buildings. Netting is the only sure method for total exclusion. The most common netting made for bird control is made of polyethylene plastic, is lightweight, and is resistant to deterioration by sunlight. It typically comes in rolls 14 or 17 feet wide with up to 1,000 feet per roll. A typical mesh size is ¾ inch. Netting of both smaller and larger mesh sizes and net weights are available.

Operation and deployment

Netting generally suffers the same disadvantages as overhead lines. It is impractical for large areas and is virtually immovable once installed. In some situations netting might be practical over a narrow channel or a small impoundment, particularly if the waters are permanently contaminated. It might be used to prevent access for perching birds on a bridge, tower, or other structure located near oiled waters. Netting supported by an elevated framework could be used to prevent birds from landing at a nesting area.

Advantages

- If properly installed, provides 100 percent exclusion.
- Netting readily available.

Disadvantages

- Generally not practical for large areas.
- Some birds may become entangled in the netting.
- Labor intensive to install.
- Subject to damage from wind and snow.
- Not easily or even possible to move after installation.

Plastic Balls

Description

Plastic balls, usually about 4 inches in diameter and dark colored, are an alternative to overhead lines and netting (fig. 16). They are marketed under the trade name Bird Balls. It is thought that birds do not recognize a body of water covered with floating plastic balls as a potential landing site. Although

Figure 16. Plastic balls are best used on small bodies of water. *Photo:* W. P. Gorenzel.

the balls would shift aside if a bird attempted to land, the balls conceal the water and birds fly elsewhere.

Operation and deployment

Plastic balls are best employed on small, enclosed bodies of water. They are not suitable for locations with currents, tidal flows, or along the open coast. Plastic balls are effective for impoundments with fluctuating water levels, as the balls rise and fall with the water. Plastic balls are installed simply by emptying bags of balls onto the water. The balls float and naturally assume an equal distribution. A sufficient quantity of balls must be deployed to totally cover the water surface, taking into account any increase in surface area resulting from water fluctuation. Balls are not affected by most winds or snow and do not tear or break like netting or lines.

Advantages

- Very easy installation.
- Low maintenance.
- Balls automatically adjust to fluctuating liquid levels.

Disadvantages

- Generally not practical for large areas.
- Effective only on bodies of standing water.
- Considerably more expensive than netting or overhead lines.

Spikes and Coils

Description

These devices are intended to prevent birds from landing on specific areas. Two types of devices are available. The first employs sharp-pointed objects to create an unattractive and potentially dangerous landing site, which birds avoid (fig. 17). The most common product in this category is porcupine wire, typically marketed as Nixalite. Nixalite consists of a narrow stainless steel strip from which emanates an array of

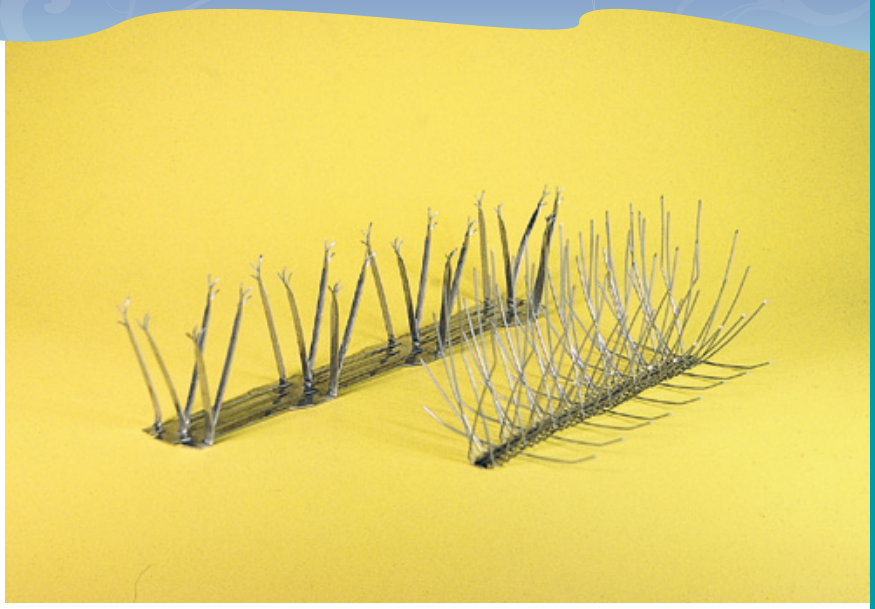


Figure 17. Strips of sharp-pointed metal prongs prevent birds from landing. *Photo:* R. E. Marsh.

needlelike wires approximately 3 to 4 inches long. Variations of the basic porcupine wire design are also available from several manufacturers. Nails or spikes driven through a board are a simple yet effective homemade version of porcupine wire.

The second type of device uses flexible wire in the form of springs or coils to create an unnatural moving substrate for birds to land on (fig. 18). It works on the premise that birds prefer a solid landing site. The most common product of this type is Bird Coil. This product resembles a slinky toy and is available in 25-foot lengths in diameters of either 4 or 5 inches.

Operation and deployment

These devices are typically used to prevent nuisance birds such as pigeons from landing on buildings, billboards, or lampposts. These devices would have limited use at an oil spill. They could be installed to prevent birds from perching on structures in or near contaminated waters, such as pilings, buoys, docks, lamp posts, towers, or waterfront buildings. Care

must be taken with the porcupine wires, which are sharp and can cause injury.

Advantages

- Human presence not required.
- Low maintenance.

Disadvantages

- Relatively expensive.
- Unless all potential perches are treated, birds may simply move to an unprotected site.
- Difficult or impractical to install on some structures (e.g., underside of bridges).

Figure 18. Springs and coils can be used as shown here on solar panels or on buoys or pilings to prevent perching. *Photo:* W. P. Gorenzel..

Section G

Suggested Hazing Techniques

This section suggests hazing techniques that may be appropriate for the different groups of birds (table 1) or in selected locations (tables 2 and 3). (See section H for profiles of the bird groups.)

The tables in this section are works in progress. For some groups of birds, such as the shorebirds or marine birds, there is little or no information available to suggest any particular hazing technique or how effective it might be. As more tests and research are conducted in the future and as more field experience is gained at spills, the tables will become more complete and accurate.

Table 1. Hazing techniques that may be effective for selected groups of birds

Technique	Diving birds	Gulls and terns	Waterfowl	Wading birds	Shorebirds	Marine birds
pyrotechnics	X	X	XX	XX	X	X
cannons	?	X	X	X	?	?
biosonics	?	XX*	?	?	?	?
wailer	X	?	X	?	?	X
mylar tape	NA	X	X	X	X	?
scarecrow	NA	X	X	X	X	X†
flags	NA	X	XX‡	X	X	?
balloons	NA	X	X	X	X	?
lasers	XX§	XX*	XX#	X	X	X
lights	?	?	?	?	?	?
ATV	?	X	X	X	X	?
aircraft	X	?	X	?	?	X
boats	X	?	X	?	?	X
model airplanes	NA	X	X	X	X	?
overhead lines	NA	XX*	X	X	?	?
netting	X	X	X	X	NA	NA
plastic balls	X	X	X	X	NA	NA
spikes, coils	XX**	XX**	X	?	NA	NA

Key:
NA = not advised, not effective
X = may or may not be effective
XX = known to be effective
? = effect unknown
Notes:
*Effective on gulls.
†Possible at seabird colonies.
‡Best on Canada geese, snow geese, and dabbling ducks on land.
§Effective on double-crested cormorants.
#Effective on Canada geese and probably other waterfowl as well.
**To deter perching on structures by gulls, cormorants, and brown pelicans.

Some explanation about the tables will be helpful. In table G.1 an X indicates that a hazing technique could be used for the particular group of birds, given the general habitats and behaviors of the birds. For example, a Marine Phoenix Wailer could be deployed in a bay used by diving ducks. However, an X does not necessarily indicate that the hazing technique will be effective. XX indicates that a particular technique is known to be effective, based on past experience, published accounts, or research. Footnotes for table 1 indicate which particular species the hazing technique has been successfully employed against. NA indicates that a particular technique is not advised or should not be used. A question mark indicates that not enough information is available to make either a positive or negative recommendation, and thus the technique could theoretically be tried.

In tables 2 and 3, ratings of effectiveness are suggested based on the characteristics of the different locations (marsh, coastal bay, offshore waters, and seabird colonies) and the birds likely to be found at these locations. Some ratings are qualitative as little or no information is available.

Hazing at a seabird colony (table 3) is controversial and merits discussion based on Koski et al. (1993). If no action were taken, it is highly probable that a large spill near a seabird colony would eventually kill a significant number of adult birds when they land in the contaminated waters near the colony. If hazing were attempted, it could affect only adult birds, thus the goal is to minimize the number of adult birds that become oiled. Hazing could result in the loss of eggs and young for a breeding season. However, as many seabirds are long-lived, the loss of eggs and young for one season should have less impact than the loss of breeding adults.

The effectiveness of hazing at a seabird colony depends on the species and the stage of the nesting cycle. Some species are highly sensitive to disturbance and might easily be induced to abandon a colony. Others may be less sensitive and be very difficult or impossible to disperse if eggs or young are present. It is likely that regardless of the species, the initial

Table 2. Effectiveness of selected hazing techniques for spills at inland marshes and coastal bays

Technique	Marsh		Coastal bay	
	Day	Night	Day	Night
bird bombs, screamers	good	good	fair	fair
shell crackers	good	good	good	good
CAPA rockets	very good	untried	very good	untried
propane cannons	good	good	good	good
biosonics	good, species dependent	unknown	good, species dependent	unknown
Phoenix Wailer	fair	fair	fair	fair
mylar tape	fair	none	fair	none
scarecrows	fair to poor	none	fair to poor	none
flags, balloons	fair	none	fair	none
lasers	none	good to very good	none	good to very good
lights	none	poor to fair	none	poor to fair
ATV	good	unsafe	good along shorelines	unsafe
fixed-wing aircraft	fair	unsafe	good	unsafe
helicopter	good	unsafe	very good	unsafe
boats	good	good	good, weather dependent	fair, weather dependent
model airplane	good	none	fair	none
overhead lines	impractical	impractical	impractical	impractical
netting	impractical	impractical	impractical	impractical
plastic balls	possible	possible	none	none
spikes, coils	good on perches	good on perches	good on perches	good on perches

Table 3. Effectiveness of selected hazing techniques for spills in offshore waters and seabird colonies

Technique	Offshore waters		Seabird colonies	
	Day	Night	Day	Night
bird bombs, screamers	fair, limited range	fair, limited range	fair	fair
shell crackers	good	good	fair	fair
CAPA rockets	good, long range	untried	untried	untried
propane cannons	unlikely, hard to deploy	unlikely, hard to deploy	good	good
biosonics	impractical	impractical	untried	untried
Phoenix Wailer	not seaworthy	not seaworthy	possible on land	possible on land
mylar tape	none	none	poor to fair	none
scarecrows	none	none	poor to fair	none
flags, balloons	none	none	poor to fair	none
lasers	none	unknown, but possibly very good	none	unknown, but possibly very good
lights	none	poor to fair	none	poor to fair
ATV	none	none	possible	unsafe
fixed-wing aircraft	weather dependent	unsafe	unlikely	unsafe
helicopter	good, weather dependent	unsafe	possible	unsafe
boats	good, weather dependent	fair, weather dependent	good, weather dependent	fair, weather dependent
model airplane	none	none	possible	none
overhead lines	none	none	possible	untried
netting	none	none	possible	possible
plastic balls	none	none	none	none
spikes, coils	none	none	possible	possible

reaction to hazing would be to land in the water near the colony. This could result in additional mortality. Intense hazing from the water is necessary to prevent these landings.

The decision to haze at or near a seabird colony is not one to be made by hazing personnel alone. Hazing should be undertaken only after consultation with the appropriate wildlife authorities and the deployment of sufficient resources for a water-based hazing program.

Section H
Bird Profiles

This section provides a brief introduction and description of the birds likely to occur along the coasts, bays, and inland waterways of California that could be subject to an oil spill. Rather than provide detailed descriptions for individual species, the birds have been grouped, usually according to family relationships but sometimes according to behavioral characteristics (e.g., diving birds). Many bird field guides are available and should be consulted for more detailed information.

Diving Birds

Cormorants

Description

Cormorants are from 28 to 34 inches long with mostly dark plumage; the sexes are colored alike (fig. 19). The neck is long and snakelike, and they fly with the neck kinked. The beak has a hooked tip; the tail is long and stiff, and the feet are set well back on the body. The back appears to be hunched when

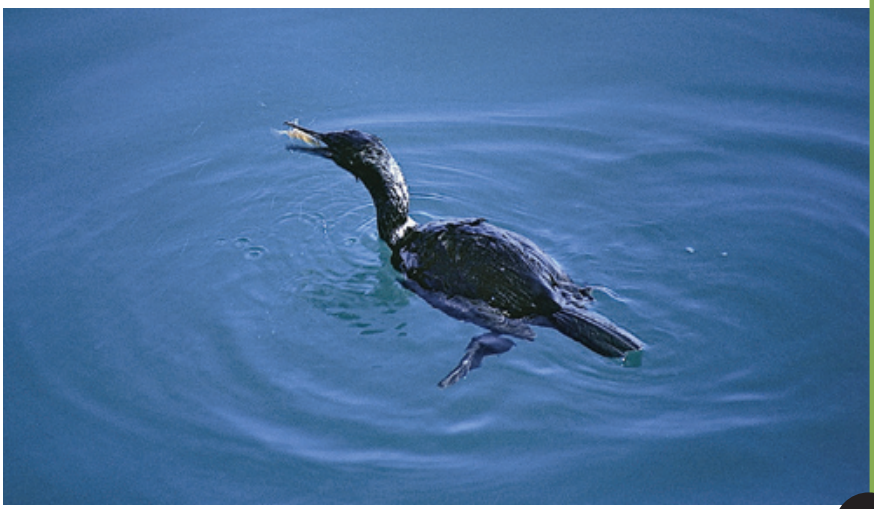


Figure 19. Pelagic cormorant. *Photo:* W. P. Gorenzel.

perched on rocks or pilings. Cormorants often swim with their body nearly submerged, but with the neck erect and the bill pointed at an upward angle. They dive from the water's surface to feed. Birds at rest often spread their wings and hold them out, presumably to dry wet feathers. Three species are found in California: double-crested cormorant *(Phalacrocorax auritus)*, Brandt's cormorant *(P. penicillatus)*, and pelagic cormorant *(P. pelagicus)*.

Distribution and habitat

Cormorants are year-long residents along the entire coast of California. Brandt's and pelagic cormorants are found primarily in near-shore marine waters. Double-crested cormorants are found along the entire coast, on inland lakes and rivers, and in fresh, salt, and estuarine waters.

Migration and seasonal abundance

Coastal cormorants may disperse northward after nesting, then move southward along the coast, with population increases noted in winter south from San Luis Obispo County. Migrants from more northerly ranges swell resident populations. Double-crested cormorants vacate mountain and northeastern plateau regions for the winter, probably migrating west and south to lowlands and coastal areas.

Breeding

Most cormorants nest in colonies on cliffs and rocky areas of headlands and offshore islands. Double-crested cormorants also nest inland on islands or in tall trees. More than 70 percent of the Brandt's cormorant Pacific Coast population breeds along the Central California coast.

Hazing

Cormorants typically take flight and leave the area when hazed, unless they are at a breeding colony. Pyrotechnics elicit flight, as will a direct approach by a motorboat. Double-crested cormorants respond well to laser light, allowing the possibility of moving birds from roosting areas at night. Nesting cormorants are highly susceptible to disturbance.

Pelicans

Description

Pelicans are unmistakable birds that have an enormous pouched bill, a large head and body, and short legs (fig. 20). Two pelican species are found in California: the American white pelican *(Pelecanus erythrorhynchos)* and the brown pelican *(P. occidentalis)*. The brown pelican is smaller, with a

Figure 20. Adult brown pelican. *Photo:* D. W. Anderson.

wingspan of 6½ to 7½ feet, compared to the white pelican at 8 to 9½ feet. The brown pelican dives head first from the air into the water to feed on fish. The white pelican feeds from the surface by dipping its bill into the water and scooping up fish; they sometimes feed cooperatively, with small flocks swimming in a coordinated manner to drive fish into shallows where they are easily caught.

Distribution and habitat

Brown pelicans are found in estuarine, marine subtidal, and pelagic waters along the California coast. White pelicans are found on inland lakes during the breeding season and in the Central Valley and San Francisco Bay and Delta areas during the nonbreeding period.

Migration and seasonal abundance

The brown pelican is common along the Southern California coast all year but is most abundant from March to August. In Northern California, it is fairly common from June to November, but rare from December to May. Migrant flocks of white pelicans may pass overhead during nearly any month but are seen mainly in spring and fall, especially in Southern California. White pelicans are common on San Francisco Bay salt ponds and are uncommon to common on large lakes and estuaries in the Central Valley from August to December.

Breeding

The brown pelican breeds in colonies on the Channel Islands from March through early August. A small nesting colony can be found inland at the Salton Sea. In California the white pelican nests only on large lakes in Klamath Basin from April to August.

Hazing

Feeding and loafing pelican flocks can be dispersed with pyrotechnics or by approach on foot, on an ATV, or in a motorboat. Flocks overhead will respond to pyrotechnics and fly slowly away. Evasive flight in response to pyrotechnics appears to be in slow motion with little change in wing speed,

compared to a noticeable increase in speed for most other flying birds when exposed to pyrotechnics.

Pelicans are highly sensitive to disturbance at a breeding colony. Disturbance of a breeding colony may result in greatly reduced reproductive success and has been known to cause complete abandonment of the site. The potential consequences of hazing near a colony must be given thorough consideration; consult with wildlife officials.

Loons

Description

Loons are medium- to large-bodied birds that capture prey by diving and pursuing it underwater (fig. 21). Loons have longer bodies than ducks and straight, pointed bills. The legs are set far back on the body. They usually swim with the bill pointed above horizontal. Three species commonly occur in California: common loon *(Gavia immer)*, Pacific loon *(G. pacifica)*, and red-throated loon *(G. stellata)*.

Distribution and habitat

During the nesting season loons are found widely throughout Canada and Alaska. Their winter habitat is mostly along coastal waters and inshore areas over shoals, and in sheltered bays, inlets, and channels.

Figure 21. Adult common loon in breeding plumage. *Photo:* W. P. Gorenzel.

Migration and seasonal abundance

Very few loons are present in California during the breeding season. The wintering population departs inland for breeding grounds in April to May. After nesting, most of the population shifts from freshwater inland breeding locations to coastal marine wintering locations, arriving in September to November. Some birds use inland freshwater sites throughout the winter.

Breeding

Nearly the entire California loon population nests outside of the state. A few birds may nest in mountain lakes, but breeding in-state is rare.

Hazing

Oil spills are a threat because loons dive rather than fly to escape oil slicks. By most accounts, loons do not respond well to hazing. Their primary response is to repeatedly dive rather than fly away. Herding from a boat can be attempted but most likely will prove futile, with the birds diving and staying in the general area.

Grebes

Description

Grebes are diving and swimming birds that may be mistaken for small ducks (fig. 22). They are somewhat similar in appearance to loons, although smaller; their slender, pointed bill especially resembles that of a loon. The legs are placed far back on the body, restricting most of their activities to the water. They are active underwater divers but weak fliers. Six species occur in California: pied-billed grebe *(Podilymbus podiceps)*, horned grebe *(Podiceps auritus)*, red-necked grebe *(P. grisegena)*, eared grebe *(P. nigricollis)*, western grebe *(Aechmophorus occidentalis)*, and Clark's grebe *(A. clarkii)*.

Figure 22. Two western grebes and a Clark's grebe (top). *Photo:* W. P. Gorenzel.

Distribution and habitat

Grebes are a diverse group, but in general they nest in freshwater locations in and outside of California. Most winter in coastal waters and inland bays; some winter on inland lakes.

Migration and seasonal abundance

Grebes are uncommon along the coast in summer. After nesting, all species except the pied-billed grebe make a major movement to coastal regions. Mono Lake is an important fall stopover for the eared grebe, and the Salton Sea is their major wintering area.

Breeding

The pied-billed grebe is a solitary nester primarily in freshwater marshes. Eared, western, and Clark's grebes are colonial nesters on inland lakes and marshes. All build floating nests. Horned and red-necked grebes do not nest in California.

Hazing

Grebes typically dive in reaction to people and approaching boats rather than take flight. Based on those observations, hazing with a boat and pyrotechnics will probably not cause

grebes to take flight. It may be possible to slowly herd grebes in the desired direction with a boat. The effectiveness of using a laser at night is unknown.

Coots

Description

The American coot *(Fulica americana)* resembles a chicken in size and shape (fig. 23). About the size of a duck, it has a dark head and plumage and a white bill with a frontal shield. Often called a mud hen or marsh hen, coots are highly aquatic, feeding on surface vegetation or diving for submergent vegetation.

Distribution and habitat

Coots are resident throughout most of California below 7,100 feet. They are found in fresh and saline emergent wetlands during the breeding season. In the winter they can be found on a wide variety of water bodies, including bay tidal flats and salt marshes.

Migration and seasonal abundance

Coots breeding in colder locations migrate in September and October to locations where water remains unfrozen. Inland populations may move to the coast for the winter. They are

Figure 23. American coots. *Photo:* W. P. Gorenzel.

gregarious in the nonbreeding season; large flocks are common on wintering areas.

Breeding

Coots nest almost exclusively in freshwater marshes in floating nests, usually in dense stands of cattails or bulrush.

Hazing

Although coots may take flight, their typical response to danger is to beat their wings and run across the surface of the water toward dense vegetation to hide. Coots typically will not take off and fly away like ducks. If they do take wing, it will generally be only a relatively short flight to open water to create more distance from the perceived danger or to another open pool shielded from the danger by vegetation.

Gulls and Terns

Gulls

Description

Gulls are medium to large, typically gray and white seabirds, usually with black wing tips, a gray mantle, and a hooked beak (fig. 24). Immature gulls usually have brown plumage, which

Figure 24. The western gull breeds on the Farallon and Channel Islands. *Photo:* W. P. Gorenzel.

gradually changes in stages to adult plumage after several years. Gulls are conspicuous and gregarious; they roost together on land or water and breed together in small or large colonies. They are omnivorous and scavenge on the water or land. Ten species regularly occur in California. Among the most common are the western gull *(Larus occidentalis)*, herring gull *(L. argentatus)*, California gull *(L. californicus)*, ring-billed gull *(L. delawarensis)*, and Heermann's gull *(L. heermanni)*.

Distribution and habitat

Gulls are widespread; most are found on or over near-shore salt waters or bays, but some can be found inland around freshwater lakes, rivers, and marshes. They are often attracted to manmade sources of food such as landfills, dams, restaurants, marinas, hatcheries, and aquaculture facilities.

Migration and seasonal abundance

Gull migration varies according to species, but in general gulls are most abundant along the coast after breeding. Inland-nesting species, such as ring-billed gulls and California gulls, move to the coast and low-lying areas. Some species, such as western gulls, are abundant and resident year-round along the California coastline. Heermann's gull moves southward to breed, then northward to the California coast after breeding; it is most common from June through November.

Breeding

Gulls breed in colonies; some, such as the western gull, breed along cliffs and islands off the California coast. Other gulls nest inland: ring-billed gull nests on lakes in the Great Basin and Canada, and California gull nests at Mono Lake and other lakes in the west. Heermann's gulls nest to the south of California.

Hazing

Gulls respond to pyrotechnics, patrols, and broadcast distress calls. They respond to a distress call first by approaching the source of the call, circling overhead, then flying away when the broadcast call stops. Pyrotechnics fired when the birds are circling overhead hastens dispersal when the call stops.

Terns

Description

Most terns are smaller and more slender than gulls and have a sharp-pointed straight bill (fig. 25). They have long, pointed wings with a deeply forked tail. In flight, terns seldom soar like gulls, but fly with an almost constant beating of the wings. Most terns are white with a black cap, which recedes after breeding. Most plunge-dive headfirst into water for fish, often from a hovering position. They are highly sociable. Eight species occur in California. Common species include the gull-sized Caspian tern *(Sterna caspia)*, royal tern *(S. maxima)*, Forster's tern *(S. forsteri)*, and the endangered least tern *(S. antillarum)*.

Distribution and habitat

Most terns are found along seacoasts; some can be found at interior lakes and marshes during the breeding season.

Migration and seasonal abundance

Common terns (*S. hirundo*) migrate northward along the California coastline in April, then southward from August

Figure 25. Royal tern, most common along the Southern California coast from October to February. *Photo:* W. P. Gorenzel.

through October. Terns breeding along the coastline and bays are usually present at or near colonies from April through August, then depart. Postbreeding, least terns leave California, while some Caspian and royal terns remain to winter along the Southern California coast.

Breeding

Terns nest in colonies, usually on the ground using a shallow, sandy scrape for a nest. The marsh-nesting Forster's tern builds a floating nest from rushes and cattails. The gull-billed tern (*S. nilotica*) nests at Salton Sea from March to September.

Hazing

Hazing terns at or near established colonies that have nesting birds or young may cause abandonment or death of chicks. Hazing at an active colony should not be undertaken without consultation with wildlife officials. Hazing feeding areas is possible but difficult due to the terns' wide-ranging foraging habits. Hazing is probably best done from a boat. Long-range CAPA rockets may be most useful for directing tern movements over large expanses of water.

Waterfowl

Geese

Description

Geese are larger than ducks but smaller than swans, long-necked, conspicuous, and easily recognized (fig. 26). They feed by tipping up in the water or grazing on upland areas and are usually found in flocks that may have hundreds of birds. Geese call loudly in flight. Common inland species include Canada goose *(Branta canadensis)*, snow goose *(Chen caerulescens)*, Ross's goose *(C. rossii)*, and greater white fronted goose *(Anser albifrons)*. The brant *(B. bernicla)* is similar in appearance to the Canada goose but is darker and smaller in stature.

Figure 26. Canada goose. *Photo:* W. P. Gorenzel.

Distribution and habitat

Geese may be found in most areas of California except for dense forests, high mountains, and dry deserts. They use a wide variety of habitats, from water bodies (marshes, lakes, rivers, wetlands, urban ponds) to uplands (grasslands, meadows, croplands, pastures, golf courses). The brant is almost exclusively coastal, with flocks in bays and marshes that have eelgrass beds.

Migration and seasonal abundance

Brant are common winter residents from October to May along the California coast, primarily in Humboldt, Tomales, Morro, and San Diego Bays, San Diego River mouth, and Drake's Estero. Canada geese are resident in many areas, but numbers increase with arrival of migrants in October to November. Other geese are migrants, wintering primarily in the Central Valley, arriving in October to November, then departing by March or April.

Breeding

Only the Canada goose breeds in California, with local nesting

likely wherever they occur. They breed on the northeastern plateau and in lakes of the northern Sierra Nevada and Cascades; they nest from February to June on the coastal slope and from March to June in northeastern California. All other species breed far north in Canada, Alaska, and Siberia.

Hazing

As hunted birds, geese respond well to the flash and bang of pyrotechnics and propane cannons. Flags made from black or white plastic attached to lath have been effective in preventing snow goose damage to croplands. It may be possible to lure geese to an area using decoys. Canada geese respond well to laser light. In one trial, 14,000 geese were dispersed from a lake in Pennsylvania using lasers. It is likely that other species of geese will also react well to lasers.

Ducks

Description

Ducks comprise a diverse family, with 27 species in California that can be separated into two groups. Dabbling ducks rarely dive, but instead feed by dabbling their bills in water or by

Figure 27. The mallard is probably the most common and widespread dabbling duck in California. *Photo:* W. P. Gorenzel.

Figure 28. Male surf scoters, a diving duck commonly found on coastal bays during winter. *Photo:* L. Spears.

tipping up. They are capable of taking flight directly from the water, without running. Common dabbling ducks include the mallard *(Anas platyrhynchos)* (fig. 27), northern pintail *(A. acuta)*, American wigeon *(A. americana)*, northern shoveler *(A. clypeata)*, cinnamon teal *(A. cyanoptera)*, and green-winged teal *(A. crecca)*.

Diving ducks normally dive underwater to feed on fish, crustaceans, mollusks, invertebrates, or vegetation. They usually must run along the water's surface before taking off. In season, common diving ducks include the canvasback *(Aythya valisineria)*, greater scaup *(A. marila)*, lesser scaup *(A. affinis)*, surf scoter *(Melanitta perspicillata)* (fig. 28), black scoter *(M. nigra)*, white-winged scoter *(M. fusca)*, bufflehead *(Bucephala albeola)*, ruddy duck *(Oxyura Jamaicensis),* and common merganser *(Mergus merganser)*.

Distribution and habitat

Ducks may occur almost anywhere in California wherever a suitable body of water occurs. Dabbling ducks generally use freshwater locations, while diving ducks use fresh and saltwater habitats. Some diving ducks (e.g., scoters) are almost exclusively found on saltwater.

Migration and seasonal abundance

Duck populations increase dramatically in fall and winter with the arrival of migrants from outside California. The Central Valley and the northeastern plateau in particular are important wintering areas for dabbling ducks and for some diving ducks. Diving ducks, virtually absent during the summer along the coast, return to wintering areas in estuarine and near-shore marine waters. Bays such as San Francisco Bay and San Pablo Bay are important wintering areas for scaup, scoters, canvasback, and ruddy ducks. In winter these ducks often gather in large groups called rafts.

Breeding

Many of the dabbling ducks nest in California along with some of the diving ducks, however greater numbers nest out of state. Most diving ducks breed outside of California.

Hazing

Like geese, ducks are hunted birds and respond well to pyrotechnics and propane cannons. Propane cannons could be set out along the shoreline; a propane cannon set on an anchored boat increases coverage. A Marine Phoenix Wailer anchored offshore in open water also increases coverage and introduces new and different frightening sounds. Ducks will take flight in response to approaching danger (e.g., a human on foot, an ATV, or a boat). Roving patrols can be very effective. Boats and long-range pyrotechnics can be used to herd and direct flocks. On very large bodies of water, a helicopter is effective in moving birds.

Wading Birds

Herons and Egrets

Description

Long-legged, long-necked wading birds, usually associated with water, herons and egrets wade along shores of ponds, lakes, bays, and streams hunting for fish, frogs, and other foods (fig. 29). They sometimes spear food with their sharp, pointed

bill. They fly with their legs straight back and neck tucked back into an S-shape. Egrets are snow white. Bitterns are similar to herons and egrets, but differ from them in having shorter legs and neck, heavier body, and cryptic plumage, and they live in dense, concealing wetland vegetation. Eight species of herons and egrets occur in California: American bittern *(Botaurus lentiginosus)*, least bittern *(Ixobrychus exilis)*, great blue heron *(Ardea herodias)*, great egret *(A. alba)*, snowy egret *(Egretta thula)*, cattle egret *(Bubulcus ibis)*, green heron *(Butorides virescens)*, and black-crowned night-heron *(Nycticorax nycticorax)*.

Figure 29. Great blue heron, fairly common throughout most of California. *Photo:* W. P. Gorenzel.

Distribution and habitat

Herons and egrets are widespread throughout California, especially the great blue heron. Most are associated with freshwater habitats, but the great blue heron, great egrets and snowy egrets also use shallow estuaries and saline emergent wetlands. Bitterns are usually found in fresh emergent wetlands, where they are adept at using their cryptic plumage to conceal themselves in dense cattails and sedges. Herons and egrets tend to keep to the open edges of wetlands, shores, and rivers. Cattle egrets are found in pastures, irrigated croplands, and herbaceous uplands, rarely using aquatic habitats.

Migration and seasonal abundance

Most species of herons and egrets found in California are resident or migrate only locally out of high mountains or the northeastern plateau in winter. Populations in low-lying regions may increase in winter with the arrival of migrants. Least bittern migrates south to Mexico in winter.

Breeding

Most herons and egrets nest in colonies, with nests typically built off the ground in trees. Mixed colonies are common. Bitterns and green herons are usually solitary nesters.

Hazing

Herons and egrets can be dispersed from foraging areas using pyrotechnics and roving patrols. The task will be easier if alternative foraging areas are present. During the nesting season, dispersal from foraging areas near a colony may be difficult. It is unlikely that hazing will cause bitterns to leave a marsh that has been contaminated from a spill. Bitterns will seek concealment in the dense marsh vegetation rather than fly away.

Figure 30. Sanderlings, found on sandy beaches, chase retreating waves, then race back in front of incoming waves. *Photo:* W. P. Gorenzel.

Shorebirds

Description

Shorebirds are a very diverse group with at least 31 species occurring in California. In general shorebirds are small to medium-size birds with relatively long legs and thin and sometimes long bills. They forage mainly for worms, aquatic insects, small mollusks, and crustaceans. They are often found in flocks that may contain hundreds of birds. Species that could occur in potential oil spill locations in California include the snowy plover *(Charadrius alexandrinus)*, black oystercatcher *(Haematopus bachmani)*, black-necked stilt *(Himantopus mexicanus)*, American avocet *(Recurvirostra americana)*, willet *(Catoptrophorus semipalmatus)*, marbled godwit *(Limosa fedoa)*, turnstones (*Arenaria* spp.), sanderling *(Calidris alba)* (fig. 30), and various small sandpipers (*Calidris* spp.) collectively known as "peeps."

Distribution and habitat

Most shorebirds live along shorelines that are underwater much of the time and become exposed rocks, mud flats or sandy shores at low tide. Shorebirds are found along the entire coastline of California and in shallow fresh and saline wetlands.

Migration and seasonal abundance

Many shorebirds are long-distance migrants, nesting far to the north and either wintering in California or continuing further south. Populations are greatest in late summer into winter with the influx of migrants. Coastal bays with tidal mud flats or salt ponds, such as San Francisco Bay, are important wintering areas. Mono Lake is a major migratory stopover for Wilson's phalaropes *(Phalaropus tricolor)*.

Breeding

Most shorebirds breed outside of California, some as far north as the high Arctic. Avocets and stilts breed in the Central Valley and the northeastern plateau.

Hazing

Little is known about hazing shorebirds. They do not damage crops or cause significant problems, thus there has been little reason to haze them. Shorebirds take flight in response to pyrotechnics but may not leave the immediate vicinity, instead just circling and landing nearby. Persistent firing of pyrotechnics and chasing may be required to disperse shorebirds. It is probably not possible to force nesting shorebirds to leave the area.

Alcids

Description

Alcids are seabirds that come ashore only to nest. They spend most of their life at sea. Small to medium-size birds, they are ducklike in appearance but have a short neck, chunky body, and short tail. Plumage is mostly black and white, resembling a small penguin. Their wings beat very rapidly in flight. Skillful swimmers and divers, they use their wings to "fly" underwater; a group often flies and swim in a column. They do not form large flocks, but may aggregate at abundant food sources. Eight species occur in California: common murre *(Uria aalge)*, pigeon guillemot *(Cepphus columba)* (fig. 31), marbled murrelet *(Brachyramphus marmoratus)*, Xantus' murrelet *(Synthliboramphus hypoleucus)*, ancient murrelet *(S. antiquus)*, Cassin's auklet *(Ptychoramphus aleuticus)*, rhinoceros auklet *(Cerorhinca monocerata)*, and tufted puffin *(Fratercula cirrhata)*.

Figure 31. Pigeon guillemot, found from the Oregon border south to the Channel Islands. *Photo:* L. Spears.

Distribution and habitat

Alcids use near-shore and offshore waters along the coast. Most species are found from about Santa Barbara County northward. Some occur in more southerly waters.

Migration and seasonal abundance

Most abundant along the coastline during breeding season; they move offshore or disperse along the coast after nesting.

Breeding

Alcids nest on offshore islands (e.g., Farallon Islands, Channel Islands) or on cliffs and talus slopes along the coast. Most nest colonially on ledges or in crevices and burrows. The marbled murrelet is only alcid to nest inland, in dense, mature forests.

Hazing

Little is known about hazing alcids. As with shorebirds, there has been little reason to haze them. In the open waters of the ocean, hazing may be very difficult; a boat or a helicopter would be required. Hazing at a colony site should not be undertaken without first consulting with wildlife officials or other experts.

Section I
Evaluating Hazing Efforts

Need for Record Keeping

Oil or other spills are relatively uncommon events. Hazing birds at a spill is even less common. Most agencies involved with spill response have no organized hazing programs, thus hazing has not been widely applied at spills. In addition, there is little in the published literature about hazing at spills. This lack of organized hazing and the paucity of pertinent literature results in a skimpy base of knowledge to apply at spills.

Fortunately, many of the species that could be found at a spill are species that cause damage to crops or create other types of problems requiring management action. For example, birds such as herons, double-crested cormorants, and white pelicans cause damage at aquaculture facilities; these species could be impacted by a spill because of their use of water habitats. A wide variety of hazing devices and strategies have been used, tested, and researched in an attempt to lessen the damage caused by such species. Information about hazing these and other species in damage situations is available in the literature and among the practitioners of wildlife damage management. This body of knowledge serves as the starting point for hazing at spill events. However, certain species or groups of birds that may be present at a spill and require hazing do not damage crops or create problems and for the most part have never been hazed. This status particularly applies to shorebirds and marine birds such as the alcids, which are common along the coastline during migration or when nesting in colonies on offshore islands.

Given our incomplete knowledge about which hazing techniques to use for many species, the response of different species to hazing, and the effectiveness of specific techniques, the need for accurate record keeping is apparent. Daily records of hazing activities at a spill permit evaluation of hazing effectiveness and help formulate future hazing strategies.

At the very least, pertinent information must be jotted down as soon as possible in the field on a small notepad, and then transferred later to a standard form. Information to record includes

- observer's initials
- date
- location
- time of animal observation
- species identification
- estimated number present
- details of animal behavior or activity (e.g., loafing, feeding, flying)
- hazing device implemented (e.g., fired bird bombs, shot shell crackers, deployed propane cannons, deployed bamboo stakes with mylar)
- number of items deployed or fired (e.g., 3 cannons, 5 bird bombs)
- response (none, immediately took flight, flew away, circled back, etc.)

GPS readings should be taken to establish the location of propane cannons and other fixed devices (e.g., bamboo stakes, balloons). Give the GPS readings to the GIS specialist for inclusion on daily field maps.

Sample Form

Daily Log

Initials: _____ Date: _____

Time of observation: _____ Location: _____

Species: _____ Number present: _____

Behavior: _____

Hazing device: _____

Number used: _____ GPS way point(s): _____

Response: _____

Time of observation: _____ Location: _____

Species: _____ Number present: _____

Behavior: _____

Hazing device: _____

Number used: _____ GPS way point(s): _____

Response: _____

Time of observation: _____ Location: _____

Species: _____ Number present: _____

Behavior: _____

Hazing device: _____

Number used: _____ GPS way point(s): _____

Response: _____

Time of observation: _____ Location: _____

Species: _____ Number present: _____

Behavior: _____

Hazing device: _____

Number used: _____ GPS way point(s): _____

Response: _____

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Section J

Format of a Hazing Program

Since July 2000, OSPR has contracted with the University of California, Davis, (UCD) to manage the state's hazing program, respond to spill events if hazing is required, and to provide other hazing-related products. Activities undertaken to accomplish these objectives relate to three general topics: preparedness, training, and research.

Using the UCD Wildlife Hazing Group (HG) as an example, this section examines these three components to provide a generic structure for a hazing program.

Preparedness

HG is on call 24 hours a day and must be capable of responding to a spill as quickly as possible. Several factors have been addressed to meet the need for quick response.

Centralization

Prior to the creation of HG, hazing equipment (e.g., propane cannons) was stored in several locations around California. The materials available at any one location were not sufficient for a sustained hazing effort, and no personnel were officially designated to undertake the hazing function at a spill. After the creation of HG, all hazing equipment was collected and stored at a central location at UCD. Assigned personnel in HG at UCD are responsible for the equipment and are on call to respond for a spill. However, in a state as large as California, strategically located satellite storage locations along with a designated group member would have great value in reducing response time. For example, an HG member in San Diego with a basic "starter kit" of pyrotechnics and cannons could quickly go to the scene of a spill in Southern California,

Figure 32. A cargo trailer loaded with hazing materials reduces response time. *Photo:* W. P. Gorenzel.

well ahead of the cargo trailer and HG members arriving from UCD. This reorganization and expansion of HG is currently underway.

Transportation

HG has a 1.5 by 2.4 meter (5 by 8 foot) enclosed cargo trailer to transport hazing materials to a spill (fig. 32). The trailer has been outfitted with shelves and tie-down points to maximize storage capacity and properly secure cargo. To reduce response time the trailer has been prepacked with hazing equipment, tools, and personal protective equipment. At the time of call-out, other items such as the magazine for pyrotechnics, helium tanks for the mylar balloons, and shotgun(s), which are not stored in the trailer, can quickly be loaded in predesignated spaces.

HG has an assigned vehicle for towing the cargo trailer. An assigned vehicle reduces response time by eliminating the need to locate a rental vehicle capable of towing the trailer. The vehicle can also be provisioned ahead of time with several small but useful items (e.g., maps, flashlight or spotlight, binoculars, laser).

In some cases, the use of a rental vehicle to transport additional materials would be necessary. For example, the Marine Phoenix Wailer is not suitable for all spill situations, but if needed, it would require a second vehicle for transport.

Magazine

As required by California Fire Code, pyrotechnics are stored in a portable magazine (fig. 33). The magazine meets the U.S. Bureau of Alcohol, Tobacco, and Firearms requirements for both a Type II indoor storage magazine and Type III day box. The magazine has wheels and can be quickly moved from the

Figure 33. A magazine permits safe storage and legal transport of pyrotechnics. *Photo:* W. P. Gorenzel.

storage area into the trailer for safe and legal transport to the staging area of the spill.

Inventory

HG has acquired a sizeable inventory (table 4) of hazing and other support materials (e.g., personal protective equipment, tools, batteries, magazine) (fig. 34). The quantity of hazing materials available allows HG to arrive on scene at a spill and promptly begin and maintain hazing activities, without the need to request additional supplies.

Table 4. Bird hazing supplies in the Hazing Group inventory

Item	Quantity
bird bombs	1,600
screamers	1,400
rocket bangers	200
pistol-type launchers	11
.22-caliber blanks	3,200
shell crackers	300
shotgun	1
CAPA exploders	50
CAPA launchers	1
seal bombs	70
propane cannons	17
mylar balloons	500
helium tanks (3.8 m, 3 each)	2
bamboo stakes with mylar tape	400
Marine Phoenix Wailers	2

Figure 34. Bird bombs, screamers, shell crackers, CAPA rockets, .22-caliber blanks, and launchers stored in a portable magazine. *Photo:* W. P. Gorenzel.

Miscellaneous Items

Other items intended to improve response time include the "arming" of 700 bamboo stakes with two 1-meter strips of mylar tape. These stakes have been bundled into packets of ten for easy handling and rapid deployment in the field.

Several official forms have been copied and completed to the extent possible, including shipping papers required by the California Department of Transportation, two ICS forms, the Assignment List, and the Status Change forms.

A list of vendors selling hazing supplies, primarily in California, has been prepared (see Section L). The list would be available to logistics section supply unit personnel at the incident command post as an aid to processing any requests for additional hazing materials.

A collection of maps for the entire coastline of California has been printed and assembled. As noted in Section A, these maps could serve as important references in the initial hazing response planning prior to arrival on-scene.

Training

Training is an essential component of any bird hazing program. Personnel should receive training on safety issues relating to oil spills, spill site command operations, use of hazing equipment, and hazing strategies.

HAZWOPER

Due to the unique and potentially hazardous environment of a spill, all personnel responding to a spill, including HG members, must receive Hazardous Waste Operations and Emergency Response (HAZWOPER) training and certification. HAZWOPER training includes recognition, identification, and characteristics of hazardous materials; emergency response; site safety plans; air monitoring instrumentation; safe work practices; respiratory protection; protective clothing; and decontamination procedures. HG personnel must complete the 24-hour HAZWOPER course in order to be permitted access to a spill. An 8-hour refresher course is required annually to maintain certification.

Incident Command System (ICS)

HG personnel should attend a training session on the ICS at least once annually. The ICS is used to manage an emergency incident such as an oil spill. The basic course is intended to acquaint personnel with the ICS structure and terminology.

Hazing Equipment

Personnel must be trained in the safe and proper use of bird hazing equipment, particularly pyrotechnics. This training, which should include both classroom lecture, discussion, and hands-on firing of the various pyrotechnics in the field, may be conducted by a knowledgeable HG member. Pyrotechnics training is also sometimes available at conferences such as Bird Strike (see Section M).

Hazing Strategies

This manual, in addition to describing the hazing materials in the HG inventory, also provides information on hazing strategies (e.g., factors to consider regarding each spill event and how, when, and where to apply the various techniques).

Drills

To reinforce the ICS training, HG personnel are required to attend or participate in drills and exercises. Drills, which may be unannounced, simulate various spill scenarios. Most drills are desktop exercises intended to address response options and decisions and to familiarize personnel with their duties and responsibilities and the functioning of the ICS.

Research

Research is used primarily as a means to evaluate wildlife hazing techniques that may be applied to spills and the species likely to occur at spill locations. This evaluation is accomplished mainly by reviewing the literature and maintaining a library on wildlife hazing. Field research should also be conducted if funding becomes available.

One product of the literature review has been an annotated bibliography on bird hazing techniques and strategies applicable to oil spill response (Gorenzel et al. 2003). Bird hazing and deterrent techniques are widely employed to disperse and exclude birds from croplands, aquaculture facilities, and airports, and reports in the literature are commonly available. However, due to the relative rarity of large oil spills and coordinated bird hazing, published research or even accounts of the efficacy of these bird hazing techniques at spills are uncommon. Thus, the primary sources of information are studies at inland or terrestrial sites, lakes, rivers, wetlands, and toxic containment ponds that discuss techniques that could be applied at a spill or species that could occur at a spill. In addition, literature on bird response to disturbance (e.g., waterfowl response to recreational

boating) provides useful information. Boats, for example, are a useful hazing tool in themselves and also serve as a platform for launching pyrotechnics. Knowledge of the responses of different species to boats in a hazing situation can be inferred from observed responses in recreational or other settings.

In reviewing research, one should keep in mind similarities and differences in the goals of bird hazing at an oil spill versus other locations. For example, an airport and a coastal bay could be large areas encompassing hundreds of hectares. Ideally, hazing techniques at both locations should have a large area of effectiveness. However, at an airport, even though short-term effectiveness is required, long-term deterrence is more important. Habituation (failure to respond) over time to hazing techniques used at airports is of great concern. On the other hand, a spill event is relatively short-lived and transient in location, resulting in less concern about habituation. Thus, techniques that may not be recommended at an airport may be suitable for short-term use at a spill site.

The use of mylar tape is a good example of a technique that may not be valued for long-term control but merits consideration for short-term control. Mylar tape is commonly used in vineyards in California to deter bird pests, primarily European starlings *(Sturnus vulgaris)*, house finch *(Carpodacus mexicanus)*, and American robins *(Turdus migratorius)*. It is generally thought that mylar tape may initially be effective, but that birds habituate to it within a few days. Mylar tape thus would not normally be considered effective for long-term bird control in a vineyard. However, the short-term effectiveness of mylar tape would be useful at an oil spill. In the initial response to a spill, bamboo poles with mylar streamers could be deployed rapidly along shorelines, mud flats, and other locations used by birds. Although it may be effective for only a short time (e.g., 1 to 3 days), the mylar would "buy time" at the initial phases of hazing operations when personnel might be in short supply and large areas require coverage. When habituation occurs, another hazing technique could be introduced to replace or reinforce the mylar.

Section K

Suppliers of Bird Hazing Materials

Suppliers Grouped by Region

Item	Central Coast	South Coast	Inland	Out of State
propane cannons	2, 3	4, 6	7, 8	12
bird bombs, screamers	2, 3	6	7, 8	12
launcher pistols	1, 2, 3	6	7, 8	12
shell crackers	2	—	8	12
CAPA rockets, launchers	—	—	—	12
eye/ear safety gear	1,2, 3	6	7	12
mylar tape	1, 2, 3	4, 6	7, 8	12
lasers	—	—	—	12, 13
balloons	2, 3	4	8	12
predator models, kites	1, 2, 3	6	—	—
effigies	—	—	—	12
Bird Gard or other broadcast units	2	4	—	9, 11, 12
Breco Bird Scarer	—	—	—	10
Phoenix Wailer	—	4	—	11
bamboo stakes	2	5	—	—
netting supplies	1, 2, 3	4	8	—

Note: There are no suppliers in the North Coast region. Numbers represent suppliers in the information table on pages 94–95.

Supplier Information

Supplier no.	Supplier	Contact info
	Central Coast	
1	Farm Supply Company 224 Tank Farm Rd. San Luis Obispo, CA 94106	Phone: 805-543-3751 Web site: www.farmsupplycompany.com
2	Sutton Agricultural Enterprises 746 Vertin Ave. Salinas, CA 93901	Phone: 831-422-9693 or 866-280-6229 Fax: 800-482-4240 or 831-422-4201 E-mail: info@suttonag.com Web site: www.suttonag.com
3	Vegetable Growers Supply 40602 El Camino Greenfield, CA 93972	Phone: 831-674-8416 Fax: 831-674-8418 Web site: www.veggrow.com
	South Coast	
4	Bird Barrier America, Inc. 20925 Chico St. Carson, CA 90746	Phone: 800-503-5444 Fax: 310-527-8005 Web site: www.birdbarrier.com
5	Butler Bamboo 3514 Westminster Ave. Santa Ana, CA 92703	Phone: 714-554-0600 or 800-666-0606 Fax: 714-554-0606 Web site: www.butlerbamboo.com
6	Vegetable Growers Supply 121 Cooper Rd. Oxnard, CA 93030-5401	Phone: 805-486-5909 Fax: 805-486-5917 Web site: www.veggrow.com
	Inland	
7	Vegetable Growers Supply 280 N. Dogwood Rd. El Centro, CA 92243	Phone: 760-352-2133 Fax: 760-352-2154 Web site: www.veggrow.com
8	Wildlife Control Technology 2501 N. Sunnyside Fresno, CA 93727	Phone: 800-235-0262 Fax: 559-490-2260 E-mail: sales@wildlife-control.com Web site: www.wildlife-control.com

Supplier no.	Supplier	Contact info
Out of State		
9	Bird Gard LLC 254 W. Adams Ave., PO Box 1690 Sisters, OR 97759	Phone: 541-549-0205 or 888-332-2328 Fax: 541-549-5286 E-mail: info@birdgard.com Web site: www.birdgard.com
10	Hyde Marine 28045 Ranney Parkway Cleveland, OH 44145	Phone: 440-871-8000 Fax: 440-871-8104 E-mail: sales@hydemarine.com Web site: www.hydeweb.com
11	Phoenix Agritech (Canada) PO Box 10 Truro, Nova Scotia, Canada B2N5B6	Phone: 902-662-2444 Fax: 902-662-2888 E-mail: info@phoenixagritech.com Web site: www.phoenixagritech.com
12	Reed-Joseph International Co. Box 894 or 800 Main St. Greenville, Mississippi 38702	Phone: 800-647-5554 Fax: 662-335-8850 E-mail: sales@reedjoseph.com Web site: www.reedjoseph.com
13	SEA Technology 1 Sun Plaza, 100 Sun Ave., Suite 500 Albuquerque, NM 87109	Phone: 505-884-2300 or 800 732-1452 Fax: 505-346-0635 E-mail: info@shopseatech.com Web site: www.shopseatech.com

Note: There are no vendors in the North Coast region.

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Section L

Sources of Information

This section provides references, as well as conferences and Web sites, that contain additional information about hazing techniques and general strategies described in the previous sections of this manual.

References

The references below were selected from an annotated bibliography (Gorenzel et al. 2003) of bird hazing publications applicable to oil spills.

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Conferences

The three conferences listed below are the major conferences in North America concerned with wildlife damage control. While there are very few papers given specifically relating to hazing at spill events, there are many papers describing techniques that could be used at spills or about species that could be found at a spill.

Bird Strike

This conference is held every year in a different location in the United States or Canada. It is the most specialized of the conferences listed here, focusing on wildlife control, particularly bird control, at airports. The similarities between airports and spills include the large area of coverage and the species present (e.g., gulls), and bird control techniques and strategies for airports can often be applied to spills. Typically Bird Strike is three and one-half days long and often includes a pyrotechnics training workshop. See the conference Web site, http://www.birdstrikecanada.com.

Vertebrate Pest Conference

This conference, known as the VPC, is typically held in California in March of every even-numbered year. The VPC, first held in 1962, has grown to be one of the largest and most respected of the wildlife damage conferences. Presentations at the VPC cover all aspects of wildlife control, including birds, rodents, rabbits, and predators. The papers, which are published in the conference proceedings, represent a comprehensive collection of some of the best information on vertebrate pest problems. While primarily concerned with problems in the United States, many papers are from other countries. The VPC lasts for three days plus an all-day field trip. See the conference Web site, http://www.vpconference.org.

Wildlife Damage Management Conference

This conference is the successor to the Eastern Wildlife Damage Control Conference and the Great Plains Wildlife Damage Control Workshop. It is held in the spring of every odd-numbered year. The conference location changes every time, and it may be held in any state from the Great Plains eastward. Subject matter typically relates to wildlife issues from those regions. The conference features two days of speakers plus an all-day field trip. A conference proceedings is published. See the conference Web site, http://wildlifedamagegroup.unl.edu.

Web Sites

Bird Strike Committee USA, http://www.birdstrike.org/birds.htm

Internet Center for Wildlife Damage Management, http://icwdm.org/

USDA APHIS National Wildlife Research Center, http://www.aphis.usda.gov/ws/nwrc/

USDA APHIS Wildlife Services, http://www.aphis.usda.gov/ws/index.html

Vertebrate Pest Conference, http://www.vpconference.org/

Wildlife Damage Management Conference, http://wildlifedamagegroup.unl.edu

Metric Conversions

English	Conversion factor for English to metric	Conversion factor for metric to English	Metric
inch (in)	2.54	0.394	centimeter (cm)
foot (ft)	0.3048	3.28	meter (m)
yard (yd)	0.914	1.09	meter (m)
mile (mi)	1.61	0.62	kilometer (km)
acre (ac)	0.4047	2.47	hectare (ha)
gallon (gal)	3.785	0.26	liter (l)
pound (lb)	0.454	2.205	kilogram (kg)
ton (T)	0.907	1.1	metric ton (t)
pound per square inch (psi)	6.89	0.145	kilopascal (kPa)
Fahrenheit (°F)	°C = (°F – 32) ÷ 1.8	°F = (°C x 1.8) + 32	Celsius (°C)

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