MANAGING HUMAN–BLACK BEAR CONFLICTS

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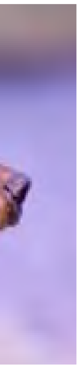



HUMAN-WILDLIFE CONFLICTS MONOGRAPH

NUMBER 1

ACKNOWLEDGMENTS

We thank the Mississippi State University College of Forest Resources, Forest and Wildlife Research Center, Mississippi Agriculture and Forest Experiment Station and Extension Service for support of this publication. C. Costello, D. Etter, and T. Hiller provided valuable comments for manuscript improvement. The Missouri Department of Conservation provided images and instructions for constructing barrel traps.

This publication should be cited as:
Belant, J. L., S. L. Simek, and Ben C. West. 2011. Managing human-black bear conflicts. Human-wildlife Conflicts Monograph 1:1-77.

ISBN# 0-9742415-1-2
Published by The Center for Human-Wildlife Conflict Resolution
Mississippi State University, Mississippi

Editing by Tom Knecht, Words by Tom
Design and Layout by Kathy Jacobs Design & Marketing, www.kathyjacobs.com

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Photo by Stacy Ulmer

Human–black bear conflicts probably have occurred since humans first inhabited North America

PREFACE

This publication was prepared to assist natural resource professionals and others interested in managing conflicts with the American black bear (*Ursus americanus*). However, we expect that it will be read by a wide variety of people, including wildlife biologists, land managers, farmers, hunters, policymakers, academicians, and others. Given this diversity of readership, developing this guide was a balance between (1) offering detailed information supported by the scientific literature and (2) summarizing as simply as possible what is known about managing black bear-human interactions. Our goal was to produce a publication detailed enough to be useful to those with a practical interest in black bear management but succinct enough for those interested in a comprehensive review of resources in management and techniques.

Human-black bear conflicts probably have occurred since humans first inhabited North America (Garshelis 1989). Since that time, problems between humans and black bears have evolved in a variety of ways. However, the black bear also has substantial ecological, aesthetic, and economic value (Jonker et al. 1998, Belant et al. 2005). Conover (2002) opines that a vast majority of wildlife species in North America provide a net benefit to society — that the problems wildlife often create for humans are overshadowed by the many benefits they provide. It seems clear that the black bear is one of these species, as the magnitude of the benefits these bears provide to ecosystems and society is immense and far surpasses the problems they sometimes create. From that perspective, we developed this summary to help individuals minimize problems between humans and black bears while also retaining or enhancing the positive value of bears.

The body of scientific work regarding black bears is impressive, particularly in the arenas of natural history, biology, ecology, and population dynamics. Pelton (2000), Larivière (2001), and, more recently, Feldhamer et al. (2003) have compiled excellent summaries for individuals wanting an exhaustive review of scientific literature pertaining to the biology and ecology of black bears. No such effort has been undertaken with regard to the management of black bear–human conflicts, however, and information about these topics remains scattered among scientific journals, Extension Service publications, and unpublished reports. The intent of this summary is to synthesize much of this published and unpublished literature, with an emphasis on peer-reviewed scientific literature.

Although much is known about the species, many questions remain about the effective management of conflicts with black bears, and managers must often be creative and adaptive in implementing techniques. Our hope is that their efforts will be conducted in an adaptive management framework and communicated so that others can learn from their experiences.

Because we intend this as a technical guide for management, we have included anecdotal information from the field as well as references to the scientific literature. Many of the management options we discuss have been largely untested by rigorous scientific investigation, and we expect researchers to continue testing and refining these and other techniques. In the meantime, we recognize that management is both an art and a science, and both sources of information can be useful in managing black bear–human conflicts.

National Park Service, Harlen Kredit 1976

The American black bear (*Ursus americanus*) is the most widely distributed bear in North America.

BIOLOGY & NATURAL HISTORY

GEOGRAPHIC RANGE

The American black bear (*Ursus americanus*) is the most widely distributed bear in North America (Hall 1981). Historically, black bears occurred throughout the forested areas of Canada, the United States, and Mexico. The black bear still occurs throughout Canada except on Prince Edward Island, where it was extirpated in 1937 (Vaughan and Pelton 1995). Currently, black bears are present in at least 40 states within the United States. Their present distribution is disjunct across portions of the mid-Atlantic and southeastern United States, with populations concentrated in the Appalachian Mountains and coastal regions. The current distribution in Mexico is apparently limited to the Sierra Madre Occidental and Sierra Madre Oriental ranges, possibly extending south to the Mexican states of Sinaloa and San Luis Potosí (Leopold 1959, Hall 1981, Larivière 2001).

PHYSICAL CHARACTERISTICS

The black bear is a large, stocky carnivore with plantigrade feet, short tail, small round ears, and small eyes (Larivière 2001). Its color is generally uniform except for a brown muzzle and occasional white marking or "blaze" on the chest, with blazes occurring on up to 25% of individuals in some populations (Rounds 1987, Ternent 2005). Color variations including brown, cinnamon, grayish-blue, and blonde are found mostly in western

Illustration courtesy of British Columbia Ministry of Environment

Approximate current distribution of American black bears in North America. Green areas are those where black bears are currently present.

Photo courtesy of Stacey Urner

Black bear fur is generally black with a brown muzzle.

Photo courtesy of National Park Service, Bryan Harry 1964

Although the dominant fur color is black, black bear pelage can also be brown, cinnamon, grayish-blue, or blonde, especially in the western United States.

Photo courtesy of Jerrold L. Belant

Black bears deposit characteristic scat that is a reliable sign of their presence in an area.

North America (Baker 1983). Black color morphs are most common in areas containing boreal forest and in the eastern United States. The proportion of black color morphs decreases latitudinally in the Rocky Mountains and southwestern United States (Rounds 1987). A white color morph occurs on the Kermode Islands of coastal British Columbia (Klinka and Reimchen 2009).

Average adult black bears stand less than 2.9 feet (0.9 meter) tall at the shoulder and are about 2.9 to 5.0 feet (0.9 to 1.5 meters) in body length. Black bears exhibit sexual size dimorphism with males typically 20% longer and 10 to 70% heavier than females (Larivière 2001). Adult female black bears weigh from 90 to 300 pounds (41 to 136 kilograms), and adult males weigh from 132 to 485 pounds (60 to 220 kilograms). All bears tend to gain weight in fall and lose weight during the winter period of inactivity (Ternent 2005). Despite losing up to 30% of their fall body weight in the winter, most bears emerge from dens in Spring in relatively good condition (Gerstell 1939, Alt 1980, Belant et al. 2006). Some bears continue to lose weight during spring before soft mast ripens, a period sometimes termed the negative foraging period (Poelker and Hartwell 1973, Noyce and Garshelis 1998).

BREEDING AND REPRODUCTION

Although female black bears reach sexual maturity from 2 to 8 years of age (Poelker and Hartwell 1973, Rogers 1987a, Etter et al. 2002), females usually are sexually mature at 3 to 5 years of age (Pelton 1982). They have, however, reportedly bred at 2 years of age in portions of their range as far north as Michigan (Etter et al. 2002). Females often breed earlier and have above-average litter sizes in portions of their geographic range with abundant food. For example, bears from southern Michigan in areas containing hard mast tree species including oaks (*Quercus* spp.) and agricultural production areas breed at an earlier age (2 to 3 years) compared to sows from other Midwestern states with fewer food resources (Bunnell

Illustration courtesy of Boren 1999

Illustration of front (left) and hind (right) tracks of black bear. Front tracks can range from about 3.5 to 4.5 inches (8 to 11.5 cm) long (excluding rear pad) and 3 to 6 inches (7.5 to 15 cm) wide. Hind tracks are 5.5 to 8.75 inches (14 to 22 cm) long and 3.5 to 6 inches (9 to 15 cm) wide. The rear pad of the front foot does not always register and claw marks are not always present.

Photo courtesy of Evelyn Interis, Mississippi State University

Bald cypress used as den by a black bear. Trees are commonly used for dens by black bears, especially in bottomland hardwood forests of the southeastern United States. Note entrance to den cavity below top whorl of branches.

Photo courtesy of Jerrold L. Belant

Black bears will den in a variety of locations including tree dens, under fallen trees or in brush piles, in excavations, and on open ground.

Photo courtesy of U.S. Forest Service

Female black bear with cubs in ground den constructed under overturned tree.

Photo courtesy of U.S. Fish and Wildlife Service

Black bear cubs are generally born in late January or early February with eyes closed and fully furred. Litter sizes can range from 1to 5 cubs.

and Tait 1981, Rogers 1987a, Etter et al. 2002). Males are sexually mature at 2 years of age but typically do not participate in breeding until 4 to 5 years of age (Ternent 2005).

Breeding season for black bears occurs during summer, the peak being from mid-June to mid-July (Alt 1982, 1989), but it can extend until September (Larivière 2001). Multiple matings are practiced by both males and females (Schenk and Kovacs 1995). Females exhibit delayed implantation (Wimsatt 1963), with the ova being fertilized almost immediately after copulation but development of the embryo being suspended at the blastocyst stage. In Pennsylvania, implantation typically occurs between mid-November and early December (Kordek and Lindzey 1980) with gestation lasting 60 to 70 days (Kolenosky and Strathearn 1987, Hellgren et al. 1990). Delayed implantation postpones any nutritional investment until after the critical fall foraging period (Ternent 2005). If a fall food shortage results in a reduction in fat reserves, the blastocysts can be absorbed with little energy cost to the female. A reduction in nutritional investment in a poor food year allows the female to breed again the following summer if nutritional resources are more favorable (Ternent 2005).

Cubs are born fully furred and with eyes closed, typically in January while females are in the den. Black bear litter sizes range from one to five (Kasworm and Thier 1994, Doan-Crider and Hellgren 1996, McDonald and Fuller 2001), with sex ratios of cubs generally 50:50 (Elowe and Dodge 1989). Cubs weigh 0.62 to 0.99 pound (280 to 450 grams) at birth, but because of the high fat content in their mother's milk, they grow quickly (Ternent 2005). By the time the female and cubs exit the den (generally from mid-March to late April); the cubs weigh between 5.1 and 8.8 pounds (2.3 and 4 kilograms). By the end of their first summer, cubs typically weigh 51 to 60 pounds (23 to 27 kilograms).

Cubs stay with their mother for about a year and a half, denning together the winter after birth and separating in late May to July the following spring. The interbirth interval for adult females ranges from 1 to 4 years; females in eastern North America generally breed every 2 years, whereas for those in the western portion of their range, breeding intervals are often at least 3 years (Bunnell and Tait 1981, Etter et al. 2002). Variability in age at first reproduction, litter size, and interbirth interval has been attributed to variability of fall food, particularly hard mast (Rogers 1976, Elowe and Dodge 1989, Kasbohm et al. 1996).

Photo courtesy of Alan Vernon

When available, salmon and other fish can be an important seasonal food for black bears. Digestibility of fish is much higher than fruits or herbaceous vegetation.

Photo courtesy of Stan Kirkland, Florida Fish and Wildlife Conservation Commission

Black bear foraging for acorns in a live oak tree, Carrabelle, Florida, USA. Hard mast is an important component of black bear diet during autumn.

DIET

Black bears are omnivorous and opportunistic feeders, often referred to as food driven; they consume both plant and animal matter, but about 75% of their diet consists of vegetation (Ternent 2005). Although omnivorous, black bears are predators, too. Black bears scavenge and will attempt to forage on items that smell like a food source. Bears must attain a year's worth of energy and nutrition within a relatively short period (6 to 8 months) before hibernation.

In early spring, bears frequent wetlands, feeding on plants such as skunk cabbage, sedges, and grasses (Ternent 2005). Numerous fruits and berries are important during summer and fall, including blueberry (*Vaccinium* spp.), elderberry (*Sambucus* spp.), blackberry and raspberry (*Rubus* spp.), Juneberry (*Amelanchier* spp.), palmetto fruits (*Serenoa* spp.), pokeberry (*Phytolacca* spp.), wild grape (*Vitis* spp.), black and chokecherry (*Prunus* spp.), and hawthorn (*Crataegus* spp.). In the Southeast, bears forage on bromelia (*Bromeliaceae* spp.), the heart saw palmetto (*Serenoa* spp.), and cabbage palm (*Arecaceae* spp.). Hard mast from oak (*Quercus* spp.), American beech (*Fagus grandifolia*), hickory (*Carya* spp.), and hazelnut (*Corylus* spp.) become important in the fall as bears accumulate significant fat reserves for the winter. Spawning salmon (*Onchorrynchus* spp.) in some coastal areas can also be an important dietary component during summer and autumn (Jacoby et al. 1999, Belant et al. 2006).

Blackberries and other soft mast are important summer foods for black bears.

Bears feed heavily in the fall and can gain as much as 1 to 2 pounds (450 to 900 grams) per day. Bears are capable of nearly doubling their body weight during autumn, particularly when hard mast or salmon is abundant (Virginia Department of Game and Inland Fisheries 2002, Belant et al. 2006). When fall foods are scarce, bears tend to den earlier.

Most animal matter consumed by bears includes colonial insects and larvae such as ants, bees, beetles, and other insects (Pelton 1982). However, bears can and do prey on many small- to medium-sized animals including mice, squirrels, woodchucks (*Marmota monax*), beaver (*Castor canadensis*), amphibians, and reptiles. Under certain conditions bears may hunt for newborn white-tailed deer fawns (*Odocoileus virginianus*) (Kunkel and Mech 1994, Ballard et al. 1999). In north-central Minnesota, 86% of fawn deaths from birth to 12 weeks of age were caused by predators, and bears accounted for 29 to 36% of the kills (Powell 2004). Bears in Pennsylvania accounted for 25% of fawn mortalities to 34 weeks of age (Vreeland 2002). Black bears can also be an important predator of moose calves (Franzmann et al. 1980, Schwartz and Franzmann 1991). Although not fully understood, occurrences of infanticide have been reported in black bear populations (LeCount 1987, Miller 1999, Garrison et al. 2005). Bears scavenge on carrion of wild animals and livestock when available (Graber and White 1983, Pelton 2000).

Human-related foods consumed by black bears include agricultural crops (such as oats, wheat, corn, apples, peaches, and cherries), honey, bird feed, garbage, and hunter-placed bait (Landers et al. 1979, Stubblefield 1993, Pelton 2000, Clark et al. 2002, Organ and Ellingwood 2000, Hristienko and McDonald 2007). Pet foods and some livestock foods are often consumed by bears, especially when readily available or in years when natural food availability is low (Manville 1983, Gray et al. 2004). Because black bears are opportunistic foragers, they will investigate any readily available resource for potential consumption. Most anything that has a food smell or odor has the potential to attract black bears. Some common attractants are barbeque grills and smokers, ripe or rotting fruits and vegetables unpicked or on the ground, and poultry or livestock, especially when livestock produce young. Other lesser known attractants include compost piles, soaps and laundry detergent, and citronella and petroleum products.

HOME RANGE, MOVEMENTS, AND ACTIVITY

The size of bear home ranges typically varies by the sex and age of the individual. The home range size of females is linked to habitat quality, whereas male home range size may be a function of the availability of estrous females (Rogers 1987, Powell et al. 1997). In addition, an array of other factors can influence home range size, including things such as reproductive status, social status, population density, food availability, and presence of potential predators, including humans (Lindzey and Meslow 1977, Rudis and Tansey 1995, Powell et al. 1997, Garshelis 2000). For example, the home range size of a mature female is influenced by whether she has cubs. Females with newborn cubs have smaller home ranges that gradually increase as the cubs mature (Ternent 2005). Annual male home ranges are generally larger than those of females (Powell et al. 1997, Carter et al. 2010, Koehler and Pierce 2003) and are thought to increase the potential for breeding opportunities.

> Movements and activity of black bears vary in response to food supply.

Black bear home range sizes vary greatly across their geographic range. For example, mean home range sizes for three black bear populations in Washington were about 31.6 square miles (82 square kilometers) for males and 7.7 square miles (20 square kilometers) for females (Koehler and Pierce 2003). In northeastern Florida, average home range size for adult males was 64.5 square miles (167 square kilometers) and for adult females was 10.8 square miles (28 square kilometers) (Wooding and Hardisky 1994).

In central Florida home ranges varied from 40.9 square miles (106 square kilometers) for adult males and 14.7 square miles (38 square kilometers) for adult females (McCown et al. 2001). The average adult male home range size of 44.4 square miles (115 square kilometers) in Arkansas was almost 10 times larger than adult female home range size of 4.6 square miles (12 square kilometers) (Smith and Pelton 1990). In that Arkansas study, subadult male home ranges were even larger than those for adults of the same sex, with subadult male home ranges encompassing 57.1 square miles (148 square kilometers) and subadult female home ranges covering 3.5 square miles (9 square kilometers) (Smith and Pelton 1990).

In Michigan, mean annual home range sizes for males and females were among the largest reported for the species (Carter et al. 2010). Females in the northern Lower Peninsula had an average home range size of about 34.4 square miles (89.2 square kilometers), and males had an average home range size of about 179.5 square miles (465 square kilometers). Home ranges of female bears generally overlap, but overlap of mature male home ranges is less common. The home range for a single adult male may encompass several female home ranges.

Movements and activity of black bears vary in response to food supply. Black bears can travel long distances to exploit concentrated food sources such as soft and hard mast, human refuse, and agricultural crops (Garshelis and Pelton 1981, Rogers 1987b). Rogers (1987a) noted black bears foraging more than 4 miles (5.6 kilometers) from their regular home range during autumn to gain access to hard mast. Daily activity generally increases from den emergence until late summer or early fall when natural food availability is greatest. Activity then declines until bears enter dens, which varies from October to December (Larivière et al 1994, DeBruyn 1997), except in extreme southern portions of their range, where bears occasionally do not den (Smith 1985, Oli et al. 1997). Average daily movements are greater for males than females, with subadults traveling greater distances than adults. Average daily movements for males and females in Idaho were 1.7 miles and 1.4 miles (2.7 kilometers and 2.2 kilometers), respectively (Amstrup and Beecham 1976).

Black bears are most active at dusk and dawn. Nocturnal activity is uncommon but sometimes occurs if bears are avoiding areas of high human activity, including campgrounds, urban areas, roadways, and garbage dumps (Waddell and Brown 1984, Ayres et al. 1986, McCutcheon 1990, Ternent 2005). Alt et al. (1980) noted two major patterns of black bear movements throughout the year. Monthly movements of adult males and females were synchronized and highest during the breeding season; movements of females with cubs increased from spring through summer and peaked in fall as cubs matured.

Young males (generally 1 to 3 years old) disperse from their natal home range before establishing a new territory, whereas young females are less likely to disperse and sometimes occupy areas that include portions of their mother's home range (Ternent 2005, Costello 2010). Dispersal generally occurs during

June (Rogers 1987a, Schwartz and Franzmann 1992). Typically, almost 100% of subadult males disperse from their natal home range, whereas more than 95% of females do not (Elowe and Dodge 1989, Schwartz and Franzmann 1992). In the northern Lower Peninsula of Michigan, 32% of radio-collared yearling females dispersed from their natal home range and 95% of radio-collared yearling males dispersed from their natal home range (Etter et al. 2002). Male bears dispersed an average of 14 miles (22.5 kilometers) in Pennsylvania (Alt 1977, 1978). Black bears in Minnesota dispersed distances of 7.5 to 136.7 miles (12 to 220 kilometers) (Rogers 1987a). Male bears in New Mexico dispersed 13.7 to 38.5 miles (22 to 62 kilometers) from their natal range, whereas females established home ranges 0 to 4.4 miles (0 to 7 kilometers) from their natal home range (Costello 2010).

SURVIVAL AND MORTALITY

Black bears are relatively long-lived (Keay 1995), with highest survival rates found in adults, followed by subadults and cubs (Elowe and Dodge 1989). In Michigan, wild black bears have been known to live 28 years (Michigan Department of Natural Resources, unpublished data). Annual survival for yearling and older bears in Michigan's northern Lower Peninsula was 78%; hunting accounted for nearly 60% of annual mortalities (Etter et al. 2002). Other estimates of annual adult survival for males and females were 88% and from 84% to 96% in Florida, 73% and 79% in Montana, and 59% and 87% in North Carolina and Virginia (Alt 1984, Hellgren and Vaughan 1989, Kasworm and Thier 1994, Wooding and Hardisky 1994, Hostetler et al. 2009).

Overall, cub survival is lower than that of adults. Cub survival in Massachusetts was 59% overall (Elowe and Dodge 1989), whereas cub survival in Florida was 46% (Garrison et al. 2005) and in the Lower Peninsula of Michigan was 75%; all within the range reported by other studies (Kasbohm et al. 1996, DeBruyn 1997, McLaughlin 1998). However, cub survival varies annually and has been linked to the availability of natural foods, particularly soft and hard mast (Jonkel and Cowan 1971, Rogers 1976, Young and Ruff 1982) and flooding of dens (Alt 1984). In addition, cub mortality occurs at a higher rate in a female's first litter than in subsequent litters (McLaughlin 1998). Although the mechanism is unknown, mortality of male cubs may be higher than for females (for example, see Elowe and Dodge 1989).

Adult black bears have few natural predators; however, smaller or subadult bears may be killed by bobcats (*Lynx rufus*) (LeCount 1987); coyotes (*Canis latrans*) (Boyer 1949); brown bears (*Ursus arctos*) (Schwartz and Franzmann 1991), wolves (*Canis lupus*) (Rogers and Mech 1981; Michigan Department of Natural Resources, unpublished data), or other black bears (Garshelis and Pelton 1981, Alt and Gruttadauria 1984).

> Human-related mortality is the primary source of mortality for black bears in Michigan and across North America.

Human-related mortality (caused by hunting and vehicle collisions) is the primary source of mortality for black bears in Michigan (Etter et al. 2002) and across North America (Bunnell and Tait 1981, Schwartz and Franzmann 1992, Kasworm and Thier 1994). Mortality rates for males are typically greater than for females (Hamilton 1978, Bunnell and Tait 1981, Hellgren and Vaughan 1989) and are associated with greater vulnerability of males (particularly yearlings) to human and natural mortality factors (Bunnell and Tait 1981, Rogers 1987a). In addition, male bears appear more prone to taking bait than do females (Garshelis and Noyce 2006), resulting in greater vulnerability to harvesting where baiting is legal.

Annual mortality of black bears resulting from vehicle collisions in the eastern United States ranges as high as 8% (Simek et al. 2005). In Florida, the number of bears killed each year by motorists increased from 2 in 1979 to 111 in 2000 (Eason 2001). Collisions between motor vehicles and bears account for 14% of bear mortalities in the Lower Peninsula of Michigan (Etter et al. 2002). The frequency of those collisions increases with increased bear density, human populations, and traffic volume. However, other factors (such as habitat and natural food availability) likely contribute to localized and seasonal variation in such collisions. In Florida, bear mortalities from vehicle collisions were twice as prevalent during fall than in other seasons (Gilbert and Wooding 1996, Simek et al. 2005).

Parasites and disease are not considered a major source of mortality for black bears. Intestinal parasites such as roundworms and tapeworms are common in bears, but they rarely interrupt digestion or affect nutrition (Quinn 1981). The tissue parasites *Toxoplasma gondii* and *Trichinella spiralis* are found in black bears but are not thought to cause mortality (Schad et al. 1986, Briscoe et al. 1993, Dubey et al. 1995).

HABITAT

Black bears are more typically found in forest-dominated areas (Stirling and Derocher 1990, Miller et al. 1997). Black bears require a diversity of habitats that contain seasonally available food, den sites, and security areas. In Michigan, bears tend to use a mixture of vegetation cover types, including deciduous lowland forests and coniferous swamps, mature and early-succession upland forests, and, to some extent, forest openings containing grasses and forbs (Etter et al. 2002). Forested swamps and regenerating clear-cuts can provide much of the escape and resting cover bears require. Mature upland forests provide hard mast (such as acorns, beechnuts, hickory nuts, and hazelnuts), whereas early succession forests provide soft mast (berries) and diverse herbaceous ground flora. Forest openings are important for food resources such as emerging grasses, herbaceous vegetation, insects, and soft mast. Mountainous regions of western North America provide good habitat because of the vegetation diversity provided by the elevation gradient. However, black bear population growth rates are generally higher in eastern North America where a wider variety of food resources occur, including hard mast (Kolenosky and Strathearn 1987).

Black bears are also becoming more common in suburban and exurban areas throughout their range.

As black bears continue to expand into areas from which they were previously extirpated, it has become clear that they can inhabit and thrive in highly fragmented landscapes, provided that some forested areas exist, especially along riparian areas (Carter 2007). Black bears are also becoming more common in suburban and exurban areas throughout their range (McConnell et al. 1997, Lyons 2005, Wolgast et al. 2005, Beckman and Lackey 2008). Some consequences of human activity, including the availability of abundant food from row crops, orchards, apiaries, bird feeders, and human refuse, increase the suitability of these areas for bears.

BEHAVIOR

General

Behavior varies among individual bears, even within the same population. However, black bears are typically shy, solitary animals that will congregate around food resources (including various sex and age classes), pair up or compete during mating season (in male-female or male-male associations), or travel in family groups (comprising a female and dependent young). Variation in behavior may be affected by genetics, experience (that is, learned attributes), and physical condition, such as whether the bear is injured, malnourished, or diseased (Swenson et al. 1999, Stirling and Derocher 1990). Their visual acuity and hearing are comparable to that of humans, and research indicates that they have color vision (Bacon and Burghardt 1976). Bears use their acute sense of smell to gather information from their surroundings.

Bears are known to claw, bite, or rub on trees; however, the exact motivation for these behaviors is unknown. Bears communicate using vocalizations and body posturing (for example, see Tate and Pelton 1983, Alt 1984, Boone et al. 2003). Adult bears and cubs may bawl or moan when distressed, and nursing cubs may make humming sounds. Adult females make several different sounds when communicating with their offspring, including a low, deep swallowing noise. Bears often make a low moaning sound and use defensive gestures when they are uncomfortable.

Bears that exhibit aggressive behavior are typically habituated to human presence, often display dominance over humans, and are potential threats to human safety.

Often, bears lift their heads, shift their ears forward, and even stand on their hind legs when attempting to better understand their surroundings. These are not aggressive or defensive behaviors. The bear may move its head back and forth while standing. Bears searching for an escape route may lower their ears and look from side to side. Bears commonly attempt to avoid conflict by climbing trees, particularly bears not habituated to humans.

Defensive bear behaviors include maintaining eye contact, shifting ears back, protruding the lower lip, huffing, blowing, popping their jaws (called a bite snap), slapping the ground (either bipedally or quadripedally), and bluff charging, a quick approach that typically stops short of making contact (Tate and Pelton 1983). Bears exhibiting defensive behavior may be repeat offenders but may still be deterred with nonlethal management techniques.

Aggressive behavior includes all defensive acts combined with charging as well as charging accompanied by low moaning vocalizations (Tate and Pelton 1983). A bear may be aggressive when it is focused on a food resource and has had no negative consequences from humans. Bears that exhibit aggressive behavior are typically habituated to human presence, often display dominance over humans, and are potential threats to human safety. Predatory black bear behavior is described as ears forward, body and head held in the same plane, a stalking or running approach to humans, and often making no noise (Tate and Pelton 1983). Predatory behavior toward humans by black bears is rare, and evidence suggests food stress and food conditioning as common causes (Herrero and Fleck 1990, Herrero et al 2011).

Conflict Behavior

When bears come into conflict with humans, it is usually because anthropogenic attractants are available. Both human and black bear behavior is responsible for human–black bear conflicts (Conover 2008). Several factors lead to these conflicts and result in nuisance bear behavior.

Because of their large body size, bears require considerable energy, which must be obtained through various foods, and will they seek easily accessible food resources (Rode and Robbins 2000, McLellan 2011). Although omnivores, black bears have a simple carnivore digestive system and a maximal body size that can be sustained on a primarily vegetative diet (Farley and Robbins 1995). Therefore, bears must consume large quantities of food to gain the caloric intake needed to sustain their body mass, and to successfully reproduce and rear young (Farley and Robbins 1995). In addition, lactation costs increase the energetic demands of females with nursing young (Farley and Robbins 1995).

In urban environments, bears can encounter an increased abundance of food that can influence

Photo courtesy of Patricia Underwood, Florida Fish and Wildlife Conservation Commission

A black bear drinks from the swimming pool at an Ormond Beach, Florida, home in summer 2006.

Photo courtesy of National Park Service

Food improperly stored or left unattended attracts black bear and frequently results in property damage.

Photo courtesy of West Sound Wildlife Shelter

Black bear preparing to raid a bird feeder.

Photo courtesy of Stephanie Simek, Florida Fish and Wildlife Conservation Commission

Black bear opening a garbage container to find food. Successful individuals are much more likely to return, increasing the potential for property damage.

demographic parameters. For example, in Nevada, urban adult female bears had earlier age of first reproduction, and the age-specific fecundity was higher compared to wildland female bears (Beckmann and Lackey 2008). Starvation of cubs, young bears, and even older bears in wildlands is not uncommon (Rogers 1976, Rogers 1983, Costello 1992). Dispersing juveniles attempting to establish new home ranges and foraging independently seek easily accessible food resources, which can lead to human–bear conflicts.

In some areas human encroachment into black bear habitat, seasonality of natural and anthropogenic food resources, peaks in human activity coinciding with low food availability, the abundance of food resources readily available for bears in urban areas, and habituation to a food resource (natural or anthropogenic) are cited as causes of human-black bear conflicts (Rogers 1976, Conover 2008). Black bears naturally avoid humans but can become habituated to areas occupied by humans when no negative reinforcement is associated with attaining the food resource or being in the presence of humans (Conover 2002).

Photo courtesy of Colorado Division of Wildlife

The occurrence of black bear-human conflicts appears to be increasing both in frequency and magnitude.

BLACK BEAR DAMAGE

Black bear damage varies seasonally and appears to be related to the abundance of natural foods, previous experience, and behavior. The damage is often a consequence of bears receiving anthropogenic food rewards; research has shown that black bears in conflict with humans had higher levels of trans-fatty acids, which are found in many processed foods, than did bears not involved in conflicts (Thiemann et al. 2008). Common food attractants are listed in the Appendix. Black bear-human conflicts are highly diverse, but most can be categorized as property damage or risks to human health and safety. Damage caused by black bears is often localized and, while seemingly minor on a large scale, can be significant to individual landowners (Vaughan and Scanlon 1990).

In a survey of farmers about compensation programs for wildlife damage in North America, the black bear was reported as the second most common species causing damage (Wagner et al. 1997). The occurrence of black bear–human conflicts appears to be increasing both in frequency and magnitude (Conover and Decker 1991, Conover 1998, Beckmann et al. 2004). For example, complaints increased more than threefold in Oregon from 1985 to 1989 and from 1993 to 1997. Similarly, in Washington complaints increased from 208 in 1985 to an average of 627 annually from 1996 to 1999 (Witmer and Whittaker 2001). During a recent 5-year period, state wildlife agencies in the United States estimated a 45% increase in expenditures to control bear damage, a 22% increase

Photo courtesy of Florida Fish and Wildlife Conservation Commission

Property damage to a trailer home caused by a black bear.

Photo courtesy of Florida Fish and Wildlife Conservation Commission

Vehicle damage caused by collision with a black bear.

Photo courtesy of Florida Fish and Wildlife Conservation Commission

Fence damage caused by a black bear.

in personnel hours to resolve black bear complaints, and a 19% increase in the total number of complaints (International Association of Fish and Wildlife Agencies 2004). Witmer and Whittaker (2001) described a series of factors that could influence the increase in reported black bear–human conflicts that include (1) increasing human population, (2) increasing black bear population, (3) increased human activity in areas of black bear occurrence and new generations of people less knowledgeable about black bears, (4) changes in land use and intensity of use, (5) alterations in habitat and food sources or availability of food, (6) changes in both short- and long-term weather patterns, (7) changes in bear harvest seasons and methods of harvesting, (8) increased public awareness and media coverage of human-bear conflicts, and (9) implementation of improved methods for reporting incidents.

PROPERTY DAMAGE

Black bear damage to personal property is varied and can be extensive. Black bears readily raid garbage cans, knock over barbeque grills, pull down bird feeders, break into houses or vehicles, and threaten pets or livestock (Frawley 2009). The most common form of property damage in Michigan (22%) was bird feeders (Frawley 2009). In a survey of 62 hunting clubs in the Mississippi Alluvial Valley, the items most frequently reported as damaged or accessed were deer hunting stands, buildings, garbage containers, and wildlife food plots (White et al. 1995). The average estimated cost of damage per incident in that survey was $40. Of 1,439 bear complaints reported in Wisconsin during 1995, 12% were categorized as property damage (Kohn et al. 1996). The number of black bear property damage complaints in New Jersey increased from 33 in 1995 to 160 in 2008 (Northeast Wildlife DNA Laboratory 2010).

A considerable amount of information on property damage is available in surveys and reports from national parks. In Glacier National Park, Montana, black bears were responsible for about 23 cases of human property damage annually in the 1960s but declined to 1.2 incidents of damage per year during the 1980s and 1990s (Gniadek and Kendall 1998). The authors attributed the reduction in property damage to changing human behavior through regulation and education — for example, improved practices for storing garbage and food. Similarly, in Denali National Park and Preserve, Alaska, the frequency of property damage caused by black bears and brown bears decreased from about 15 per 100,000 visitors in 1979 to about 6 per 100,000 visitors in 1994 (Schirokauer and Boyd 1998). In Yosemite National Park alone, black bears reportedly broke into 1,111 vehicles from 2001 to 2007, of which more than 40% had evidence of food available that would attract bears (Breck et al. 2009).

There was also variation in break-ins by vehicle type, with minivans selected and sedans avoided. The difference may be related to the relative ease with which bears can enter minivans or a higher probability of food being present in minivans (Breck et al. 2009). The differences seen in the number of human-bear conflicts between national parks is instructive and reflects their history and commitment to managing anthropogenic food attractants and making them unavailable to bears.

Photo courtesy of Jim Peaco, National Park Service

Black bear eating apples at base of tree. Black bears can cause significant damage to orchards when fruit is mature.

AGRICULTURAL CROPS

Bears can cause damage to a variety of crops, particularly grain and fruit (Garshelis 1989, Hygnstrom 1995). Bear damage to crops typically coincides with maturation of grains or fruits. In one study, for example, black bear damage to corn and oats in Minnesota first occurred during August and September (Garshelis et al. 1999). Farmers reported field corn as the crop most often damaged by bears, followed by oats and sweet corn. Wheat and corn were the primary spring and summer foods, and corn and soybeans were important fall foods of black bears in North Carolina (Maddrey 1995). Crops typically damaged by black bears in Wisconsin included corn, oats, wheat, apples, and various vegetables (Hygnstrom and Hauge 1989). In one Minnesota county, black bears damaged an estimated 783 combined acres (317 hectares) of field corn, oats, and sweet corn, representing 11.2% of the total area of these crops (Garshelis et al. 1999). Black bears eat the entire corn cob and prefer corn in the milk stage. Large areas of broken stalks knocked to the ground are indicative of black bear damage (Hygnstrom 1994). Overall damage is comparatively small but can be significant to the individual farmer. Wisconsin farmers reported 288 instances of black bears damaging agricultural crops in 1995 (Kohn et al. 1996).

Costs of bear damage to agriculture can be extensive. In Wisconsin, overall estimates of bear damage were $353,117 each year during the period from 1985 to 1990 (Stowell and Willging 1992). Although estimated costs of damage were not separated by type of damage, 65% of complaints were of damage to corn. More recently, 11 states or provinces experiencing black bear damage had damage compensation programs for landowners (Wagner et al. 1997).

Photo courtesy of Tom Harrison

Corn damage caused by black bear during single feeding.

Photo courtesy of Tom Harrison

Aerial view of damaged caused by repeated black bear foraging events. Large areas of broken corn stalks show where bears have fed in cornfields. Bears will eat the entire cob and prefer corn in the milk stage.

APIARIES

Honey is an important commodity in the United States; in 2009, the nation's 2.5 million bee colonies produced more than 143 million pounds (>65 million kilograms) of honey, representing an economic value greater than $208 million (National Agricultural Statistics Service 2009). Black bears cause more damage to apiaries than any other wildlife species in North America (Huygens and Hayashi 1999). No regional or nationwide estimates of damage are available, but local damage incurred by individual beekeepers can be substantial (Maehr and Brady 1982, Jonker et al. 1998). Twelve states and provinces have had compensation programs for black bear damage to beekeeping equipment (Wagner et al. 1997).

Bear damage to apiaries can occur throughout the time of year when bears are active and bee colonies are vulnerable. However, the damage occurs most frequently during the spring and summer in peak pollination periods (Jonker et al. 1998). Most beekeepers do not experience more than one damage incident per year. Slightly over half of honey producers experienced damage from black bears on one occasion annually and 98% experienced less than five incidents per year. Estimates of damage for loss of bees and honey from single damage occurrences were almost always less than $1,000 per year, according to 98% of respondents in a study by Jonker et al. in 1998. Annual losses incurred by beekeepers due to bear damage in Florida exceeded $100,000 during the early 1980s (Maehr and Brady 1982).

Photo courtesy of Jayson Plaxico, Kentucky Department of Fish and Wildlife Resources

Black bear damage to apiary. Black bears cause more damage to apiaries than any other wildlife species in North America.

Photo courtesy of Washington Forest Protection Service

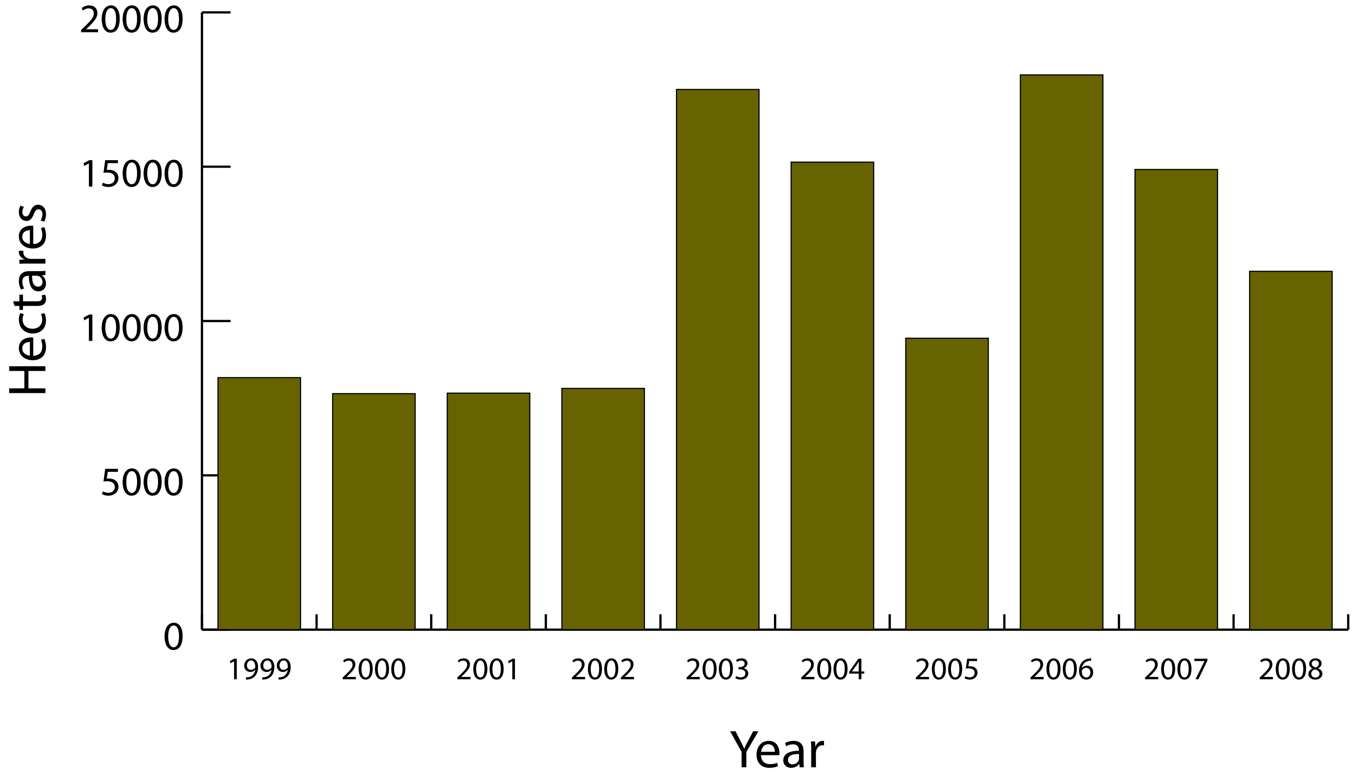
A young Douglas-fir tree damaged by black bears peeling the bark to feed on the inner cambium layer.

Photo courtesy of Washington Forest Protection Service

Black bear damage to Douglas-fir in western Oregon. Peeling the bark reduces tree growth and vigor or may cause mortality.

Photo courtesy of Jim Peaco, National Park Service

Black bear damage to red cedar in western Oregon.



Modified from Nelson et al. 2009

Ten-year trend in extent of forest damage by black bears for western Oregon counties tracking damage as estimated by aerial surveys with ground verification.

DAMAGE TO FOREST RESOURCES

Primarily a problem in the Pacific Northwest of the United States and in coastal British Columbia, black bear damage to timber can be locally significant and of regional importance. A single foraging black bear can girdle 60 to 70 conifer trees each day during spring (Ziegltrum 2004) and completely destroy a young, thinned Douglas-fir plantation in 6 years (Ziegltrum 1994). In Oregon, black bears damage almost 30,000 acres (12,000 hectares) of timber annually (Nelson et al. 2009). Economic losses associated with this damage in Oregon alone is estimated to exceed $11 million annually (Nolte and Dykzeul 2002). Damage to trees is generally most severe shortly after bears emerge from winter dens when food availability is limited. During early spring, trees produce carbohydrates, including sugars, and bears use their claws to strip the bark from trees to eat the newly formed cambium (sapwood) underneath. Foraging usually occurs at the lower 3 to 4.5 feet (1 to 1.5 meters) of the tree, although bears have removed strips of bark up toup to 16 feet (5 meters) in length. Feeding often results in girdling of the tree and eventual mortality.

Female black bears generally cause greater damage to trees than do male black bears. In Washington, Collins et al. (2002) reported that 69% of observed tree damage instances, 86% of the damage intensity, and 89% of the total damage could be attributed to female black bears. Causes for greater damage by females are unknown but may be related to the high nutritional content of cambium, which may be needed by adult females to support lactation (Stewart 1997). Also, males may be too large to efficiently forage on cambium and maintain a net energy balance or gain (Partridge et al. 2001).

Evidence of black bear foraging includes scattered pieces of bark at the base of the tree and vertical tooth marks in the tree trunk. Black bears will also "mark" or "rub" trees, generally biting or clawing trees at a level from 4.5 to 6.5 feet (1.5 to 2 meters) above ground before and after breeding season. Tufts of bear hair can often be found attached to tree bark. Marked trees can generally be found in most areas where black bears occur, but bears rarely cause more than minor damage.

Tree species damaged varies by location and may reflect a combination of species availability and selection. Bears select for Douglas-fir (*Pseudotsuga menziesii*) trees from 15 to 30 years old in many areas, whereas they select for redwoods in northern California, western red cedar (*Thuja plicata*) in British Columbia, and western larch (*Larix occidentalis*) in many interior forests. Individual trees that are higher in sugar content are preferred, whereas trees with higher terpene levels, a toxic plant secondary compound, are avoided (Kimball et al. 1998*b*). Also, trees appear more vulnerable after precommercial thinning and fertilization (Kimball et al. 1998*c*, Mason and Adams 1989, Nelson 1989).

Numerous other tree species have been damaged by black bears, including silver fir (*Abies alba*), balsam fir (*A. balsamea*), grand fir (*A. grandis*), subalpine fir (*A. lasiocarpa*), noble fir (*A. procera*), bigleaf maple (*Acer macrophyllum*), red alder (*Alnus rubra*), Port Orford cedar (*Chamaecyparis lawsoniana*), Engelmann spruce (*Picea engelmannii*), and white spruce (*Picea glauca*) (see Nolte et al. 2003).

LIVESTOCK

Livestock predations by black bears can be locally severe but overall are considered less extensive than those by more common predators such as coyotes (*Canis latrans*) (Horstman and Gunson 1982, National Agricultural Statistics Service 2000 and 2006). Cattle and sheep are the most common victims of black bear predation, although swine, goat, and fowl predations have also been reported (Jorgenson et al. 1978, Jorgenson 1983). In 2005, an estimated 2,800 cattle valued at $1.45 million were killed by black and grizzly bears, and in 1999 an estimated 7,800 sheep and lambs valued at $555,000 were killed (National Agricultural Statistics Service 2000, 2006). Damage compensation payments to farmers in Wisconsin suffering cattle and sheep losses were approximately equal (Hygnstrom and Hauge 1989), suggesting a larger number of sheep predations because of their lower economic value per animal. During 1974 to 1979 in Alberta, 541 black bear predation events on livestock were verified and approved for compensation to be paid (Horstman and Gunson 1982). In that study cattle represented 81% of verified claims followed by sheep and swine (9% each). Most (71%) of the cattle predations were calves. In the western United States, bear predation of sheep is more frequent when sheep are on summer range. In Massachusetts, livestock are most often affected from May through October, with greatest bear-livestock conflicts occurring during parturition (Jonker et al. 1998).

Livestock depredations by black bears can be locally severe but overall are considered less extensive than those by more common predators such as coyotes.

There is apparent variation among sex and age classes of bears that kill livestock. Horstman and Gunson (1982) found that most livestock predation events, including cattle, were by mature male black bears. Male black bears were also implicated in a majority of sheep depredations in Virginia (Davenport 1953, Armistad et al. 1994). In Oregon, 85% of black bears taken in response to livestock predation events were male (Armistad et al. 1994). For bears in general, larger individuals tend to prey on larger livestock (such as cattle), whereas subadult bears are more typical predators on smaller livestock such as sheep. Female bears are generally underrepresented in livestock predation events (Mattson 1990).

Black bears generally kill livestock by biting the neck or shoulders or by knocking the animal down with their paws. For smaller livestock (such as sheep and swine), it is more common for bears to kill multiple animals in one predation event; the inverse is true for cattle (Horstman and Gunson 1982). Claw marks may be evident on the neck, back, and shoulders of larger prey. Carcasses may be torn and mutilated (Dolbeer et al. 1994). The udders of adult females are typically consumed and the prey is generally opened ventrally, with heart and liver consumed (Dolbeer et al. 1994). Because of considerable variation in size of bears, spacing between paired canine tooth wounds can range from about 1.4 to 2.5 inches (3.8 to 6.4 centimeters). The intestines may be dispersed at the site and the prey partially skinned while being fed upon. Smaller livestock, including sheep and goats, may be almost entirely consumed, with only the rumen, skin, and larger bones remaining. Bear feces and rest sites are often found at or near kill sites. Bears that kill livestock in open areas may move the carcass to areas with greater cover before feeding (Dolbeer et al. 1994).

Black bears also scavenge on livestock carcasses when available (Jorgenson et al. 1978, Greer 1987); bear scavenging can easily be misinterpreted as predation (Knight and Judd 1983). Consequently, when investigating potential predation events, multiple lines of evidence, such as observations of hemorrhaging at bite wounds, position of the carcass, presence of blood on soil or vegetation, and evidence of a struggle should be documented before attributing livestock mortality to predation by bear.

DISEASE THREATS TO HUMANS AND LIVESTOCK

Overall, the threat of disease to humans and livestock as a consequence of black bears is low. Black bears do, however, harbor various parasites that have the potential for transfer to humans. Of greatest importance are several tick species that serve as vectors of zoonotic pathogens. Black bears have been documented to serve as hosts for these ticks. Yabsley et al. (2009) documented two recognized zoonotic tick-borne pathogens: *Ehrlichia chaffeensis* and *Rickettsia parkerii*. *Ehrlichia chaffeensis* is the agent of human monocytotropic ehrlichiosis, which is an emerging zoonotic infection in the eastern United States (Yabsley et al. 2005). *Rickettsia parkerii* is the causative agent of *R. parkeri rickettsiosis* and has been recently recognized as a zoonotic species (Sumner et al. 2007). Black bears may serve as a reservoir host for granulocytic ehrlichiae, which can result in human granulocytic ehrlichiosis (HGE), and for *Borrelia burgdorferi,* which can cause Lyme's disease; both are transmitted by infected ticks such as *Ixodes scapularis*, (Schultz et al. 2002).

Overall, the threat of disease to humans and livestock as a consequence of black bears is low.

Wildlife has been frequently considered a potential source of *Cryptosporidium* spp. infection in humans, which can cause diarrhea and respiratory disease (Xiao et al. 2000) through ingestion of oocysts (Laakkonen et al. 1994, Sturdee et al. 1999). Xiao et al. (2000) identified a host-specific strain of *C. parvum* in a black bear that was genetically similar to the *C. parvum* in dogs, a strain that has also been found in some AIDS patients (Pieniazek et al. 1999). *Trichinella nativa* was recently reported from black bears in New York and New Hampshire, resulting in a single suspected case of trichinellosis from an individual eating undercooked black bear meat (Hill et al. 2005).

Bovine tuberculosis has been detected in bears in northeastern Lower Michigan, an area where bovine tuberculosis (TB) has been observed in white-tailed deer (O'Brien et al. 2006). From 1996 to 2003, 3.3% of bears (7 of 214) tested from that area were positive for bovine TB (O'Brien et al. 2006). Bears likely contracted this disease while feeding on carrion or deer gut piles left behind by hunters. Bears that tested positive for bovine TB do not show physical signs of the disease, such as lesions in the lungs. Bears likely serve only as a dead-end host and not as a source of infection for other animals or humans (O'Brien et al. 2006).

BEAR ATTACKS ON HUMANS

Black bears are large carnivores, and the predominant human health and safety issue for humans is the threat of physical injury during an attack. Across North America, black bear attacks on humans periodically result in injury, sometimes serious, and have occasionally resulted in human fatalities (Herrero 2002). There have been few formal studies of nonfatal injuries of humans by bears outside of protected areas such as parks (Middaugh 1987, Miller and Tutterow 1999), and those studies have relied largely on newspaper accounts for information.

Photo courtesy of Miller, National Park Service

Feeding black bears from vehicles was a popular tourist activity in many national parks. Implementation and enforcement of wildlife feeding regulations has greatly curtailed this activity.

> Overall, human injuries from black bears are few when considering the abundance of bears and the number of human-bear encounters that occur each year.

Overall, human injuries from black bears are few when considering the abundance of bears and the number of human-bear encounters that occur each year. Instances of predatory attacks by black bears on humans are even rarer but tend to result in serious injury or death (Herrero and Higgins 1995, Herrero 2002). In Alaska from 1986 to 1996 black bear attacks resulted in an average of 0.33 injuries per year and only one fatality during the entire period, in contrast to 2.75 injuries and 0.42 deaths per year resulting from brown bear attacks (Miller and Tutterow 1999). The number of serious injuries and fatalities inflicted on humans by black bears in British Columbia was 14 and 8, respectively, from 1960 to 1997 (Herrero and Higgins 1999). During this same period in British Columbia, there were 41 serious injuries and 8 fatalities inflicted on humans by grizzly bears. Overall, grizzly bears in British Columbia inflicted twice as many human injuries and fatalities as black bears even though black bears were estimated 12 times more abundant than grizzly bears (Herrero and Higgins 1999).

Several studies have been conducted in an attempt to understand the reasons motivating bear attacks on humans, including those involving black bears (Middaugh 1987, Herrero and Fleck 1990, Herrero and Higgins 1995, Miller and Tutterow 1999, Herrero 2002). Human injuries from black bears usually result from aggressive, defensive, or nuisance bear behavior (Gore et al. 2006). For example, bears in national parks appeared to have learned that aggressive behavior can result in food rewards from people (Herrero 2002). The very rare predatory attacks on humans also represent aggressive bear behavior. Human injury resulting from bear defensive behavior occasionally occur when people come between a female and her cubs. Most human injuries from black bears occur predominantly to individuals that are in the frontcountry of parks or near developed areas. In addition, most human injuries from black bears occur to individuals or two people rather than larger groups (Herrero and Higgins 1999, Herrero 2002).

Photo courtesy of Stacey Urner

Black bear damage varies seasonally and appears to be related to the abundance of natural foods, previous experience, and behavior.

DAMAGE MANAGEMENT TECHNIQUES

An important first step in managing black bear damage is to characterize the types of damage and quantify the frequency, timing, and economic costs of damage events. Understanding timing and relative severity of damage will allow managers to better focus limited resources to maximize the benefits of control programs. However, a minority of states and provinces in black bear range have formalized systems incorporating electronic databases to document human-bear conflicts (Hristienko and McDonald 2007).

Although several methods can be used to control black bear damage, individuals with experience in wildlife damage management recognize that many options within the standard suite of damage management techniques are either unsuitable or ineffective for bears. Fortunately, as human-bear conflicts have increased in the United States (Leigh and Chamberlain 2008), the technology and tools used to address these problems have likewise advanced (see, for example, Breck et al. 2002, 2006). As a result, several effective tools and techniques now exist. Each damage situation is unique, and techniques that are effective for addressing a particular situation in one location may not be effective for the same situation in another location.

With the exception of harvest management and depredation permits, most strategies to manage damage caused by black bears involve nonlethal techniques. The efficacy and feasibility of each of these methods depends on the specific area, available labor and funding, and management objectives. Certainly, most successful efforts to control black bears involve a combination of techniques, often in an integrated management strategy. In all cases, managers and biologists must consider their management objectives when deciding which strategies to pursue and which techniques to employ.

Understanding aspects of black bear ecology, including diet, habitat use, and movements, can increase effectiveness of control measures. In addition, knowledge of black bear population characteristics, particularly abundance, sex, and age characteristics, can be used to refine management programs to focus on individual bears that are more likely to cause damage.

LEGAL CONSIDERATIONS

Individuals interested in managing black bears must understand relevant local, state, and federal laws and regulations before taking action. Black bears are legally protected in every state where they occur. Also, the Louisiana black bear (*U. americanus luteolus*) receives federal protection because of its threatened status (Cotton 2008). Many municipal jurisdictions also have additional ordinances regarding certain activities (such as discharging firearms) that could otherwise be considered useful to manage black bear-human conflicts. This complexity makes it impossible to describe in general terms which management options can and cannot be legally used in a given situation. Moreover, any attempt to outline guidance on legal methods of control would be quickly outdated by changing laws and regulations in the various legal jurisdictions. Readers should contact the appropriate state conservation agency or state Extension Service with questions about nuisance black bear management. It is also important to stay abreast of any changes in regulations to ensure that ongoing management actions remain legal.

Despite the diverse and changing regulations governing bear management, some helpful generalizations about the management of human-bear interactions can be drawn. Generally, state wildlife agencies have jurisdiction over black bears, although occasionally such authority is held at least in part by the federal government. These agencies do, however, recognize nuisance situations resulting from human-bear interactions and associated damage. Consequently, most states offer advice on ways of alleviating nuisance situations, including education on bear ecology and behavior. In addition, some states offer damage compensation or the temporary loan of equipment (such as portable electric fences) to assist landowners. Again, interested readers should contact their state conservation agency or Extension Service for details specific to their locale.

LETHAL CONTROL

Regulated Hunting

Traditionally, population management of black bears has relied heavily on harvesting by hunters (Miller 1999, Pelton 2000). However, most harvests do not exceed 15% of the estimated population, a level of mortality that should result in stable populations over time (Miller 1999). Consequently, current harvest levels in many jurisdictions may reduce population growth but not reduce overall populations. Furthermore, bear abundance may not be strongly correlated with bear damage. In certain instances, however, hunting could be used to address localized bear damage, particularly to agricultural crops and apiaries. Many wildlife management agencies direct hunters to areas with high incidents of bear damage, and in some instances hunters are put in direct contact with landowners experiencing excessive damage. Legal harvesting of bears causing damage may be preferred over shooting, as discussed later, because public attitudes are generally more supportive of hunting as a means for removal of black bears (Peyton et al. 2001).

If hunting is to be considered as a technique for managing bear damage, attention should be given to black bear population characteristics. For example, the bear hunting season occurs during fall in most states and provinces, whereas damage to apiaries is most frequent in summer (Jonker et al. 1998). Thus hunting may not be an effective technique for reducing bear damage to apiaries. Other examples can be cited to illustrate this principle:

- Adult female black bears are more likely to damage conifer trees than males, causing greater damage overall (Stewart 1997, Collins et al. 2002). If the objective is to reduce tree damage, bear harvesting, which typically is male biased, will not target the appropriate sex and age class of bears. (Collins et al. 2002).
- Adult male black bears are more likely to take baits than are subadult males or females of either age class (Garshelis and Noyce 2006). Thus, management strategies involving bait to capture or divert bears from problem areas can elicit a greater response from adult males than other sex or age groups. Subadult bears are often the most frequent age class involved in human-bear conflicts (Waddell and Brown 1984). Control efforts designed to target this age class may therefore be more effective.

Shooting

Shooting — from the perspective of wildlife damage management, not recreational hunting — can be an effective technique for controlling black bear damage, but it is generally used as a last resort. As is the case for any management effort involving shooting and removal of wildlife, it is essential to understand local laws and regulations governing the management of black bears before starting a shooting program.

A number of techniques may be used within the context of a shooting program. Techniques that maximize the potential for shooting offending individuals are obviously desirable. The most effective is to shoot those animals when they are observed causing damage — for example, bears damaging apiaries or fruit trees. However, some types of damage are less spatially restricted (for example, livestock in pastures). In these cases, using baits to attract and shoot bears is a common approach that can be effective. Predator calling is another potentially useful technique (Blair 1981). Baiting and predator calling are both most effective when done at or near the location of damage, and success is increased if the shooter is wearing camouflage, is downwind of the area from which the bear is anticipated to approach, and is in an elevated stand (Hygnstrom 1994). Blair (1981) summarizes predator calling techniques, including those for black bears. Well-trained dogs of appropriate breeds can also be used effectively in shooting programs, where legal, to locate bears.

Toxicants and Fumigants

At present, there are no toxicants or fumigants registered for use on black bears (Hygnstrom 1994).

NONLETHAL TECHNIQUES

Removal of Bear Attractants

Proper food storage and waste management is the single most effective technique for reducing most black bear–human conflicts (Spencer et al. 2007). Simple practices such as removing food from a bird feeder for several weeks; storing garbage, cooking grills, and pet food in buildings or wildlife-resistant containers; or installing electric fencing can reduce opportunities for human-bear contact and thus resolve many human-bear conflicts. Bears that acquire anthropogenic food are more likely to associate this food with human development and are more likely to become nuisances, requiring management actions (Beckman and Berger 2003). Black bear–human conflicts often increase during periods when natural foods are less available and bears seek alternate food (Costello et al. 2001).

Effective food storage policies and practices, such as those implemented in recent decades by the National Park Service, may also improve the efficacy of other bear deterrent techniques (Clark et al. 2002). For example, repellents and fencing may become much more effective when the motivation of food is removed. In response to human injuries resulting from interactions with black and grizzly bears, national parks in both the United States and Canada have implemented some of the most comprehensive and effective food and garbage management practices in North America.

> Proper food storage and waste management is the single most effective technique for reducing most black bear–human conflicts.

As a result of these practices, the human injury rates by both species have dropped dramatically, with fewer bears requiring capture and relocation or euthanasia (Dalle-Molle and Van Horn 1989, Gunther 1994, Gniadek and Kendall 1998, Herrero 2002). Consequently, where at one time most human injuries inflicted by black bears in national parks resulted from the bear's being accustomed to anthropogenic food, in more recent times only 10 to 15% of injuries are related to food (Herrero and Higgins 1999).

Although not well quantified in scientific literature, similar food storage and waste management approaches should be equally effective for rural and suburban residents. Public education, along with implementation and enforcement of policies and ordinances that restrict bears from accessing anthropogenic foods, may be the most effective long-term and sustainable approach to reducing human-bear conflicts (Beckman et al. 2004).

Backpackers in areas occupied by bears often use bear-resistant food containers (Dalle-Molle et al. 1986). Many national parks in the North America, particularly those containing grizzly bears, require their use in backcountry areas (for example, see Schirokauer and Boyd 1998). The typical design is a hard plastic cylinder with a lid with one or two screws that can be tightened to secure it. They are highly effective when used properly and have reduced bear access to anthropogenic food in backcountry areas by up to 95% (Dalle-Molle and Van Horn 1989, Schirokauer and Boyd 1998). In 55 instances of bears attempting to obtain food from bear-resistant containers, only 12 were successful (Schirokauer and Boyd 1998). These occurrences were a consequence of improperly secured or defective lids and overfilling of the containers. Also, these instances of obtaining food were from older model food containers; no instances of bears obtaining food from newer models have been reported (Schirokauer and Boyd 1998). A variety of bear-resistant garbage cans and dumpsters are now available and are highly effective in excluding bears when properly used and maintained.

Free-range Darting

Darting bears that are free-ranging (that is, are not restrained by a trap or enclosure) can be difficult and requires personnel skilled and proficient with darting equipment. There are some situations in which free-range darting may be appropriate. The use of transmitter darts and practice with equipment is advised (Kaczensky et al. 2002). Outlining possible outcome scenarios before free-range darting a bear is good practice to minimize injury and reduce the likelihood of mortality. Mortalities from drowning and vehicle collisions have occurred after free-range darting (McDonald 2004). Bears, if able, will attempt to run from the location once darted. Identifying an escape route for the bear, void of traffic areas, bodies of water, large crowds, or other hazards, minimizes the potential for injury or death. If necessary, have traffic stopped or use barricades to maintain safe escape routes.

Safe, practical darting distances will depend on equipment and shooter proficiency. Bears will often climb trees when threatened. If a darted bear climbs a tree, once the tranquilizing chemicals take effect it could fall and sustain injuries or die. Crash pads and nets are used to cushion a bear's fall; it is not advisable to use trampolines because of the risk of injury to the

Photo courtesy of National Park Service

Brown color morph black bear attempting to obtain food at bear-resistant garbage can, Glacier Bay National Park, Alaska.

Photo courtesy of BearSaver

Bear-resistant trash container commonly used at drive-in campgrounds and rest areas.

Photo courtesy of Jim Heaphy

Example of bear-resistant food container commonly used when camping or backpacking in bear country. The lid can be removed using a coin or key to turn the two screws that secure it to the body of the container.

Photo courtesy of Steffen Sledz

Example of pole used to suspend food above reach of black bears. Note also bear-resistant food storage container in background.

bear. Occasionally, a treed bear will become immobilized while in the tree, requiring the bear to be lowered safely to the ground. In a Massachusetts study, three bears, when given an opportunity, descended from trees once perceived threats — such as people, dogs, and vehicles — were removed (McDonald 2004).

Trapping

Trapping is not in itself a damage management technique but may be used in combination with other damage management techniques. Although generally associated with nonlethal techniques including relocation or harassment, trapping can also be used in conjunction with lethal control techniques (such as shooting or lethal injection). Selecting a capture technique depends on resources available, the location, human and bear densities, legal restrictions, and skill of personnel (McDonald 2004).

Culvert and Barrel Traps

Live trapping of bears in culvert or barrel traps is a highly effective and efficient technique. There are many variations in trap design, but all induce individual bears to enter a cylinder or cage structure and pull on bait or step on a treadle, which activates the trigger mechanism and closes the door. Barrel traps can be made from materials ranging in diameter from 50-gallon (189 liters) barrels to larger road culverts. To reduce bear injuries, culvert and barrel traps must be long enough to ensure that the bear is entirely within the trap when the door closes. Also, traps should be placed in shaded areas to prevent a captured animal from overheating. Because of their large size and weight, culvert traps are often mounted to trailers that can be

Photo courtesy of National Park Service and Florida Fish and Wildlife Conservation Commission

Culvert traps used to capture grizzly (top) or black bears (bottom). Culvert traps are much larger than barrel traps and are typically attached to a trailer frame for transport behind vehicles.

Photo courtesy of Stephanie Simek, Florida Fish and Wildlife Conservation Commission

Example of a culvert trap with an open trailer frame to allow the trap to be lowered to the ground at the capture site.

pulled behind vehicles. In contrast, barrel traps can easily be carried by two people and can be stacked onto a pickup truck or trailer.

Trigger styles vary but involve one of two methods: either the bear pulls the bait located at the back of the trap, releasing the door, or steps on a trap pan that activates the door. Detailed instructions for constructing a portable barrel trap are included in the Appendix along with the design plans for the Cambrian trap (a cage-style culvert). Bears up to 353 pounds (160 kilograms) have been captured in traps made from barrels. For best results, managers should endeavor to set two or more culvert traps at bear damage sites, as multiple bears could be causing the damage. Trappers should be aware that adult females captured may have dependent cubs nearby. Culvert and barrel traps are strongly recommended in areas of high human activity, especially suburban areas, as their design reduces potential for human contact with bears. Posting warning signs on the trap and in the vicinity will further ensure human safety.

Photo courtesy of Jerrold L. Belant

Barrel-style live trap used to capture black bears. Note trap is placed in shade to minimize temperature in trap, and warning sign is attached to door.

Photo courtesy of Wildlife Control Supplies

Aldrich (left panel) and Fremont (right panel) foot snares for the live capture of black bears. Biologists typically attach shock-absorbing springs and in-line swivels on the cables to reduce injury.

Foot Snares

Snares are commonly used to capture black bears for research projects but are also useful when resolving nuisance situations. In addition, foot snares are legal for bear harvesting in Maine. Many design modifications have been made since snares were first used; the Aldrich foot snare, however, has become the most popular. Captured bears can be immobilized and either relocated away from the damage site or euthanized. As with culvert and barrel traps, be sure to place warning signs along all routes where humans may approach. Based on the amount of free cable, a captured black bear may have considerable range of movement because it is restrained only by one foot. Before setting a snare, remove vegetation and low tree limbs that can entangle the snare cable and cause injury to a captured bear. Once a bear has been captured, the bear will further remove vegetation, and the ground will be disturbed throughout the entire area the bear can reach. Under no circumstances should a bear be approached within this disturbed area until fully immobilized.

Several different sets can be made using foot snares (such as trail, cubby, and open sets) (Hygnstrom 1994), with the cubby set being one of the more common. Detailed instructions for setting a cubby snare set are provided in the Appendix. Johnson and Pelton (1980) describe many of the important factors to be considered when setting snares to minimize injury to bears. In addition to the swivel at the end of the snare loop, foot snares should always be

Photo courtesy of Stephanie Simek, Mississippi State University

Black bear captured in foot snare. The surrounding area and base tree were cleared of small shrubs, saplings, and low limbs to avoid entanglement. Note the shock-absorbing spring (to the left of the tree base) also used to reduce injury.

Photo courtesy of Jared Laufenberg

An Aldrich foot snare set for live capture of black bear. Loop size of cable is about 30 cm. The spring arm is positioned toward or slightly off center of the tree forming the base of the cubby. Twigs and plant material provide support for camouflage material (top panel). Note that snare is not camouflaged to illustrate various components; including shock-absorbing spring (bottom panel).

equipped with an in-line shock-absorbing spring to reduce injury to the animal. Typically, the spring is attached to the cable between the snare loop and the anchor or drag (Johnson and Pelton 1980, Lemieux and Czetwertynski 2006). Activation of snares by nontarget animals can be reduced by elevating the snare and placing it within a plastic "cubby" or by increasing the tension required to activate the snare (Reagan et al. 2002, Lemieux and Czetwertynski 2006). An advantage of foot snares over culvert and barrel traps is that they are lightweight and portable, allowing use in locations where barrel traps are impractical, such as backcountry campsites. A disadvantage is that captured black bears and some nontarget captures cannot be released until immobilized, and thus there is a risk that the animal may be approached by humans not associated with the capture effort.

Trapping Baits

Numerous baits can be used effectively with culvert traps or foot snares to capture black bears. Baits that have been used successfully include sardines, cat food, canned tuna, bacon, meat scraps, vehicle-killed wild animals, pastries, candies, molasses, honey, fruits, and vegetables (Hygnstrom 1994, Lyons 2005). Bait preference of black bears can vary by area. In one area of the Upper Peninsula of Michigan, bears generally avoided doughnuts, but bacon seemed preferred; in another study area about 56 miles (90 kilometers) southwest, doughnuts were more effective. Generally, fresh baits that can be smelled from a distance are more effective at attracting bears to traps. Johnson and Pelton (1980) reported higher capture success at snare sites that were prebaited, allowing investigators to eliminate unproductive potential trap sites and focus their trapping efforts in areas with higher probability of success.

Harassment

Although patterns of bear responses to harassment (aversive conditioning) can be generalized, the reactions of individual bears are unpredictable. Many types and combinations of harassment techniques are used for managing nuisance black bears; however, few formalized investigations of their effectiveness have been conducted. Various human actions directed toward black bears can sometimes resolve the nuisance situation, but generally they have only short-term benefits. Additional research is needed to evaluate the efficacy of various harassment tools in improving management efforts.

Noisemakers, Pyrotechnics, and Other Projectiles

In unplanned human-bear encounters, making loud noises (for example, banging pots and pans or yelling), raising your arms over your head to make yourself appear larger, and throwing objects at the bear will sometimes cause it to leave the area. More formalized techniques used in nuisance bear management programs include firing projectiles such as pyrotechnics, bean bags, plastic buckshot, and rubber slugs from 12-gauge shotguns. Use of projectiles and other deterrents, such as dogs, on nuisance black bears can be more effective but do not provide a permanent solution if the attractant remains present (Beckman et al. 2004). The same bear may not return to the offending site, but another bear may be lured by the attractant.

Clark et al. (2002) demonstrated moderate success in reducing repeat nuisance bear problems simply by capturing and handling bears (that is, immobilizing and marking them) and then releasing them on site. However, incorporating harassment techniques with capturing and handling can improve effectiveness. For example, nuisance bears captured and harassed using a combination of yelling, pyrotechnics, rubber buckshot, and dogs took an average of about three times longer (57 days) to return to the capture site than did nuisance bears captured and released on site but not otherwise harassed (18 days) (Northeast Wildlife DNA Laboratory 2010). In Louisiana, 91% of the bears returned to nuisance activity within 5 months of the harassment treatment (Leigh and Chamberlain 2008).

Repellents

Primary repellents

Primary repellents are characterized as those that disrupt a predator’s action using various mechanisms such as neophobia, irritation, or pain (Mason et al. 2001). Stimuli used as primary repellents may be chemical, auditory, or visual, and they disrupt an animal’s typical behavior. For example, a light could disrupt a predator’s foraging activity at night. Several primary repellents have been evaluated for black bears.

Bear or red pepper spray is a repellent commonly used by people for protection from bears. The active ingredient is capsaicinoids, which result in debilitating but nonlethal responses that can include apnea, coughing, sneezing, and temporary blindness (Miller 2001). In general, efficacy of bear spray in deterring black bears is quite high. Rogers (1984) reported that bear spray use on free-ranging black bears was effective. Herrero and Higgins (1998) reported that black bears respond in a variety of ways to pepper spray, but that human injuries were prevented 100% of the time. Smith et al. (2008) stated 90% efficacy of bear deterrent spray on black bears in Alaska. The latter study included 7 of 20 incidents where bears had acted aggressively toward people, exemplifying the efficacy of this repellent. The aggressive behavior displayed was stopped after spraying on all seven occasions, although repeated spraying was sometimes required. Notably, none of these studies reported aggressive behavior by black bears after spraying. Paradoxically, bear spray residue has been documented as an attractant to bears; thus, caution is recommended to ensure residues are removed if the spray is used in areas where humans are often present (Smith 1998).

Frightening devices can be a useful tool to manage human-bear conflicts. A motion-activated sound and light device (Breck et al. 2002) was effective in reducing consumption rates of deer carcasses by free-ranging black bears (Shivik et al. 2003) and may have practical application for protecting apiaries, orchards, or small areas such as those containing infant livestock (Shivik and Martin 2001, Breck et al. 2002). Activation of this device triggered a strobe light and loud sounds with 30 different recorded sounds to reduce habituation (Shivik et al. 2003). Propane exploders have also been used in instances of minor nuisance black bear damage (Stowell and Willging 1992), but their effectiveness in reducing damage has not been assessed.

Secondary Repellents

The effectiveness of secondary repellents is based on animal learning. The aversive stimuli cause a negative experience — which may include pain or discomfort — and ultimately result in avoidance. Aversive conditioning occurs after an association between a behavior and the negative outcome is established by the animal (Shivik and Martin 2001). For example, a bear that receives a negative stimulus from a rubber bullet may associate the negative experience with the shooter as opposed to the area where the shooting occurred.

Efficacy of aversive conditioning varies among methods employed. Although no overall ranking or relative efficacy is available, several studies have compared effectiveness of multiple techniques. In Sequoia National Park, efficacy in deterring bears from developed areas was highest for rubber slugs, followed closely by pepper spray and by physically chasing bears from the areas. Throwing rocks or using slingshots were least effective (Mazur 2010). Firing rubber buckshot, with or without the accompanying use of dogs, was considered equally effective in reducing nuisance bear activity (Clark et al. 2002). However, in other studies, rubber and plastic bullets did not deter bears from apiaries and garbage (Dorrance and Roy 1978, McCarthy and Seavoy 1994). Aversive conditioning appears most successful when used on bears that have not consumed human food or have consumed it only rarely (Mazur 2010). In addition, aversive conditioning is more successful the more rapidly bears receive the negative stimuli after obtaining human food, presumably to increase the likelihood that the bear associates the negative stimulus with the item being protected.

Aversive conditioning appears most successful when used on bears that have not consumed human food or have consumed it only rarely.

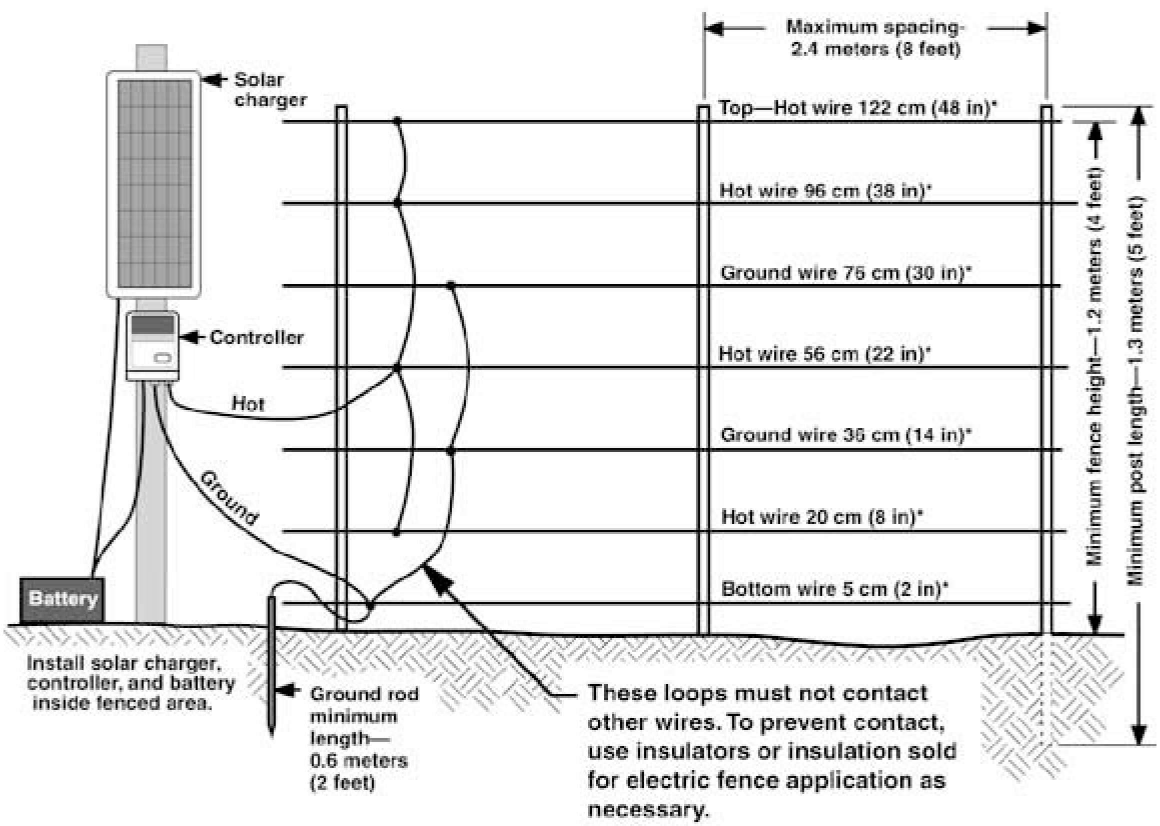
Several chemicals have also been evaluated as secondary repellents for black bears. Ternent and Garshelis (1999) tested the effectiveness of thiabendazole (an anthelmintic drug used to treat animal and human gastrointestinal worm infestations) in promoting conditioned taste aversion in black bears. Free-ranging black bears that consumed military meals-ready-to-eat (MREs) coated with thiabendazole avoided other MREs with this compound in later trials. Two of the bears that were presented MREs with thiabendazole the following year tasted but did not consume them (Ternent and Garshelis 1999). Lithium chloride has also been demonstrated to deter black bears from feeding on honey (Colvin 1975). A bittering agent and chemically hot compound reduced bear damage to western larch by 50% on test plots in Idaho (Witmer and Pipas 1999 *in* Witmer et al. 2000).

Exclusion

Fences

Fences can be an effective option for reducing black bear damage. Depending on the type of fence and area to be protected, material and labor costs can be substantial, so an economic assessment should be made before construction. Because black bears are excellent climbers and possess great physical strength, virtually all fences constructed to reduce black bear damage are electrified. For example, a nonelectrified fence designed to exclude elk did not exclude black bears as indicated by track plots (VerCauteren et al. 2007). There have been few rigorous designs to assess the efficacy of electric fences to reduce damage; nevertheless, they are generally considered effective (Maehr 1984, Huygens and Hayashi 1999, Sanford and Ellis 2006) and have been used for more than 70 years (Storer et al. 1938). Huygens and Hayashi (1999) assessed the efficacy of electric fences for deterring Asiatic black bears (*U. thibetanus*) from apiaries and crop fields. They documented bear activity near fenced areas but no depredations occurred. In a survey of Massachusetts agricultural producers, Jonker et al. (1998) reported that electric fences were the most effective control technique for reducing black bear depredation of bees at apiaries. Electric fencing has also reportedly had some efficacy in reducing black bear predation of livestock (Jonker et al. 1998).

Fence designs vary but typically consist of alternating charged and grounded wires spaced 5 to 8 inches (15 to 25 centimeters) apart. Overall height of fences range from about 4.9 to 5.9 feet, (1.5 to 1.8 meters), although heights exceeding 4.9 feet (1.5 meters) may be unnecessary (Carraway no date). Fences can be either permanent or temporary, depending on the area being protected and the time that the resource is vulnerable to predation. Features of electric fence design considered to be critical include proper maintenance, design, and protection of system components (Carraway no date). Maintenance includes removal of vegetation growing under or around the fence, ensuring that the battery is kept charged, and periodically checking the wire voltage



Electric fence design with alternating charged and ground wires developed by U.S. Department of Agriculture.

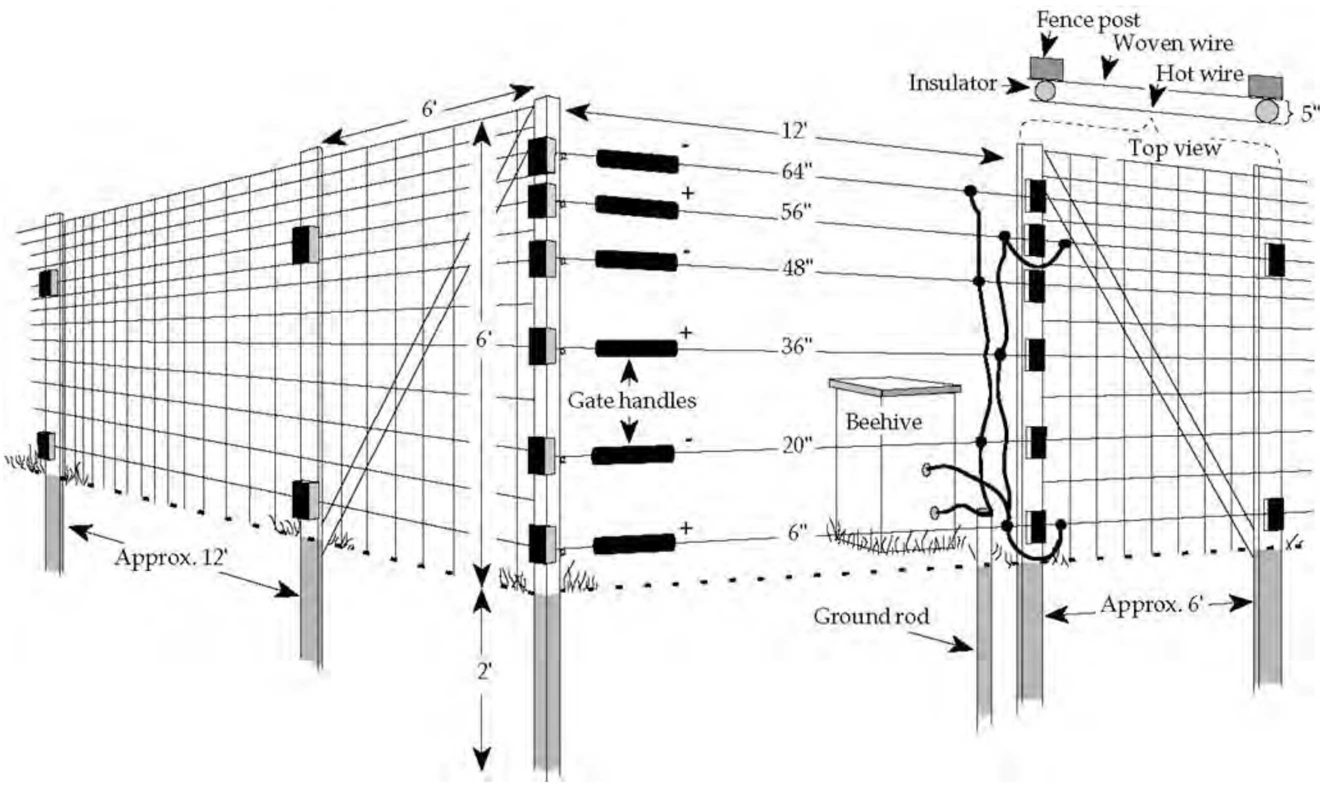


Illustration courtesy of University of Wisconsin Extension; Hygnstrom and Craven 1986

Example of an electrified welded wire fence design with electric gate panel used to deter black bears. Note there are several designs and instructional videos for installation available on the Internet.

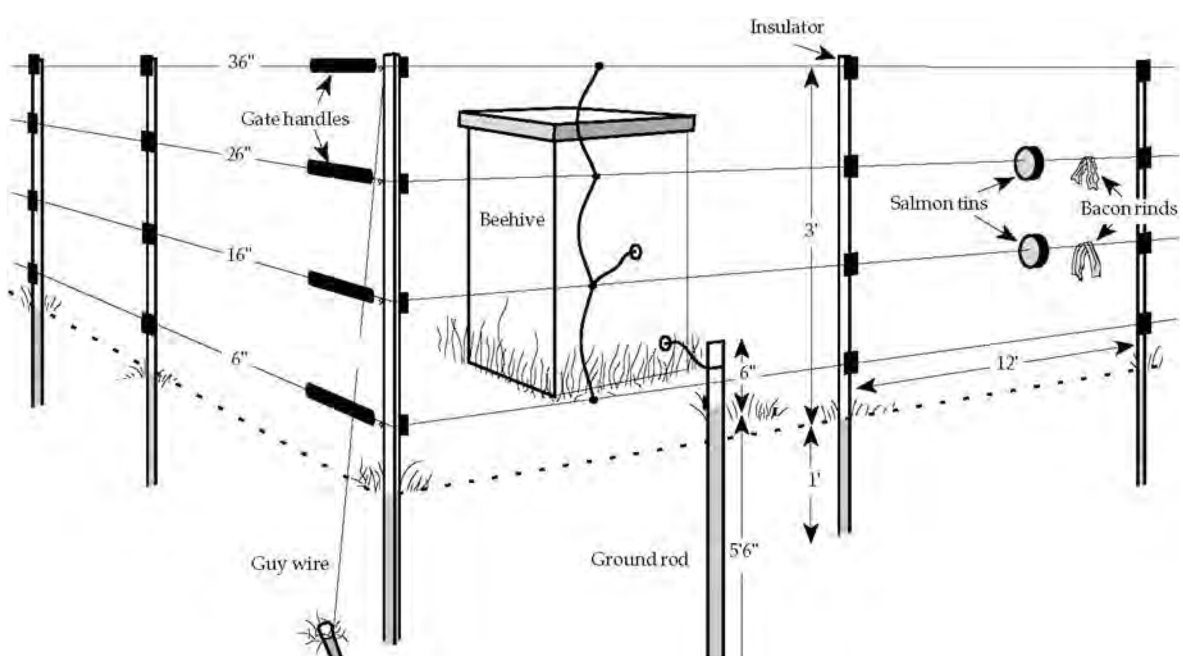


Illustration courtesy of University of Wisconsin Extension; Hygnstrom and Craven 1986

Electric wire fence design used to deter black bears. Note that some authors recommend attaching baits to the hot wires for bears to consume.

Photo courtesy of North Carolina Wildlife Resources Division

Portable electric fence used to deter black bears from apiaries.

Photos courtesy of Florida Fish and Wildlife Conservation Commission

Wildlife underpasses have been successfully designed and installed on highways to reduce vehicle collisions with black bears and other wildlife species.

using a voltmeter. Depending on climate and habitat, these tasks can be substantial undertakings. In the Southeast, for example, vegetation can grow quickly and render an electric fence inoperable; keeping vegetation away from the fence in such situations can require considerable time and effort.

Important features of fence design include strand spacing, energizer type, and appropriate grounding (Carraway 2009). For permanent and temporary fences, wire strand spacing should not exceed 8 and 12 inches (20.3 and 30.5 cm), respectively. For both types of fence, the bottom wire should not be more than 8 inches (20.3 centimeters) above ground. The fence should be charged to at least 4,000 to 5,000 volts, with higher voltages likely to be preferable (Breck et al. 2006). The energizer should be well grounded by connecting it to a 0.5- to 0.7-inch- (1.2- to 1.8- centimeter-) diameter steel rod driven 6 feet (1.8 meters) into the ground. Place the energizer and battery inside the fence to protect it from damage by animals. Also, be sure the fence is separated from the resource being protected (for example, a bee hive) by at least 3 feet (0.9 meter) to ensure that bears cannot reach through the fence to gain access (Carraway 2009). It is important to construct electric fences before damage occurs whenever possible. Sanford and Ellis (2006) state that electric fences are much less effective at protecting apiaries if bears have already caused damage at the site.

To reduce black bear–vehicle collisions, nonelectric fences have been used in conjunction with wildlife underpasses to reduce road crossings by bears (Waters 1998, Foster and Humphrey 1995, Roof 1996). Highway underpasses for wildlife provide benefits for many other species in addition to black bears (Foster and Humphrey 1995, Clevenger and Waltho 2005).

Other Exclusion Techniques

Another electrified device developed to discourage nuisance bear activity is the Nuisance Bear Controller, or NBC (Breck et al. 2006). The device is powered by 12-volt direct current and is activated by depressing a metal plate that completes the electrical circuit. The NBC emits 10,000 to 13,000 volts but only when the trigger plate is moved. This device has been used effectively at apiaries and bird feeders; 0 of 10 bird feeders were robbed or destroyed by black bears during a 5-month trial (Breck et al. 2006). Advantages of this unit include comparatively low cost (less than $200), adaptability, and versatility. Most important, the device activates only when contacted. Although not a replacement for electric fencing, the NBC provides an additional tool for managers to protect concentrated attractants from black bears.

Elevated caches have been long been used by people in remote areas to keep food out of reach of bears. More recently, elevated platforms have been used to reduce black bear access to apiaries (Flanigan 1989) and have been used in several states as a management technique (Stowell and Willging 1992, Carraway 2010). Carraway (2010) considered platforms a very effective deterrent for bears but noted that they are expensive and difficult to construct. Platforms are recommended for use only in areas where beehives will be placed for many years (Carraway 2010). Raised platform use in Florida has largely been discontinued because of cost and maintenance issues; as a result, they are no longer recommended (Maehr 1984).

Livestock Protection Dogs

Livestock protection dogs (LPDs), or guard dogs, have been used for centuries to protect livestock from predation. The first documented use of LPDs was in Europe and portions of Asia to reduce predation of sheep and goats from wolves (*Canis lupus*) and brown bears (Gehring et al. 2010). Few empirical data are available specifically pertaining to means for reducing bear use of areas containing livestock, although several studies suggest LPDs can protect livestock from bears (Green and Woodruff 1989, Hansen and Smith 1999, Andelt and Hopper 2000).

Livestock protection dogs (LPDs), or guard dogs, have been used for centuries to protect livestock from predation.

Many breeds of dogs have been used for protecting livestock including Akbash, Great Pyrenees, Komondor, Anatolian, Maremmas, and various hybrids (Coppinger 1983, 1988; Green and Woodruff 1988, 1989; Andelt 1992, 1999). Data on the relative effectiveness of specific breeds for reducing black bear predations of livestock are unavailable; however, Green and Woodruff (1989) reported that Akbash and Great Pyrenees deterred black bear predation on sheep.

Variation in husbandry practices may also influence the effectiveness of LPDs. For example, Andelt and Hopper (2000) suggested that LPDs were more effective in reducing ewe and lamb predations by black bears when sheep were on open range than in fenced pastures. In contrast, Hansen and Smith (1999) found that brown bear predation on sheep was lower in fenced pastures than on open range. Results of the latter study, however, may have been confounded by the low number of study sites evaluated. Efficacy of livestock protection dogs may increase across a period of years through improved performance of the dogs and their long-term presence; in one study, the proportion of sheep killed by all predators decreased as the number of years that LPDs were used increased (Andelt and Hopper 2000). Of 160 producers surveyed in Colorado, 84% rated the performance of LPDs in reducing predations (by coyotes, black bears, and mountain lions [*Felis* *concolor*]) as excellent or good (Andelt and Hopper 2000). Similar effectiveness of LPDs in reducing predation by other species has been reported (Linhart et al. 1979; Ribeiro and Petrucci-Fonseca 2004, 2005).

Shivik (2006) proposed that three measures of efficacy (biological efficiency, economic efficiency, and psychological assuagement) are important when evaluating the effectiveness of nonlethal control techniques. Gehring et al. (2010) evaluated LPDs within the context of these measures and concluded that they had considerable potential as a nonlethal method of protecting livestock from predation. Biological effectiveness was rated as high because LPDs can protect multiple species of livestock from various wildlife species. Once the initial costs of acquisition and training are completed, costs of using an LPD are relatively low, so economic efficiency also was high, exceeding $1,000 per year (Landry et al. 2005, VerCauteren et al. 2008). Finally, psychological assuagement for humans appeared to be improved because the LPDs were companions of livestock producers and worked 24 hours a day, 7 days a week (Gehring et al. 2010).

Photo courtesy of Kurt VerCauteren, USDA National Wildlife Research Center

Livestock protection dogs can be effective in reducing predations by black bears and other predators.

Photo courtesy of Kurt VerCauteren, USDA National Wildlife Research Center

Great Pyrenees pup with calves. Training livestock protection dogs begins at an early age and is essential for effectiveness in deterring predators.

Animal Husbandry Practices

A number of animal husbandry practices can be employed to reduce black bear predation. Because black bears often avoid people, herders can be an effective method to protect livestock (Linnell et al. 1996). Night penning can be effective in reducing losses to bears and other carnivores (Robel et al. 1981). Keeping ewes inside a shed during parturition can reduce lamb losses (Shivik 2004). Altering the timing of traditional parturition, such as fall lambing, can also be effective (Robel et al. 1981). Maintaining records of pastures or range areas having higher predation rates and reducing grazing in those areas may be effective. As black bears and other carnivores tend to scavenge, sanitation is a critical component of animal husbandry. Eliminating food resources such as carcasses and maintaining sanitary conditions around livestock operations could reduce the severity of black bear predations, as has been suggested for other carnivores (Robel et al. 1981). Jonker et al. (1998) reported that livestock owners in Massachusetts were most successful in reducing predations by keeping livestock close to occupied buildings and by keeping animals about to give birth in or near a shelter such as a barn.

Habitat Considerations

Knowledge of black bear habitat use can be applied to reducing conflicts in some circumstances. For example, Clark et al. (2005) noted that apiaries located away from riparian corridors and unimproved roads may reduce nuisance black bear activity. Also, in their study, apiaries were generally placed in habitats that were less frequently used by bears, which may also reduce their attractiveness. Quantifying high-quality habitat near roads could be used to identify potential areas for wildlife underpasses or warning signs for motorists (McCown and Eason 2001, Clevenger and Waltho 2005). For example, black bear use of wildlife underpasses increased when located closer to water drainages that served as travel corridors (Clevenger and Waltho 2005).

A number of silvicultural practices can be employed to reduce reforestation damage by black bears. Those practices include delaying the thinning of stands, maintaining a higher stand density, avoiding fertilization of reforested plots, and planting trees less vulnerable to damage (Schmidt and Gourley 1992, Kimball et al. 1998*b*). Kimball et al. (1998*a*) found that pruning the lower branches of trees may reduce the probability of future damage. In addition, using genetic strains of conifer species that are less susceptible to damage has been suggested (Kimball et al. 1999). Reducing the availability of stalking cover near pastures may reduce livestock predations (Pearson and Caroline 1981).

Diversionary Feeding

Diversionary or supplemental feeding has been used to reduce human–black bear conflicts. In particular, supplemental feeding is used in the Pacific Northwest, especially Oregon and Washington, to reduce black bear damage to timber (Ziegltrum 1994, 2004, 2006; Ziegltrum and Nolte 2001). Supplemental feeding programs currently being used not only reduce tree damage but are economically viable over a range of forest stand ages and amounts of black bear damage (Ziegltrum 2006). Shivik (2004) suggested that it may be beneficial to increase game availability or place carcasses or other alternate food in areas near livestock to reduce predation. However, he cautioned that even well-fed carnivores may still harass or kill livestock and that multiple years of diversionary feeding could

Photo courtesy of USDA Animal Science Image Gallery

Keeping ewes inside a shed during lambing can reduce risk of predation by black bears.

Photo courtesy of University of North Dakota Extension Service

Black bears and other predators of livestock also scavenge. Proper disposal of carcasses is necessary to reduce their attractiveness.

actually increase carnivore abundance and consequently increase the potential for conflict.

Translocation

Translocation is the intentional capture and transport of animals from one location to another and is a common technique to introduce, reintroduce, or augment existing wildlife populations. Translocation of black bears was once a very common technique used by many state and federal agencies for removing nuisance individuals from problem areas (Clark et al. 2002). However, black bears have a strong homing instinct (Rogers 1986) and consequently relocation is generally used less frequently today for reducing human-bear conflicts. Translocation can be effective with young or inexperienced bears (such as first-time offenders) or in areas where the bear population numbers are low. In a study comparing the effectiveness of deterrents on nuisance black bears in Nevada, Beckman et al. (2004) found that bears relocated up to about 46.6 mi (75 km) after capture returned to the urban area where captured within 1 year 92% of the time. Of these, slightly more than half returned to the urban area where first captured within 30 days. The distance bears were relocated from the capture site did not influence timing of return. Rogers (1986) documented that 81% of bears relocated less than 39.8 miles (<64 kilometers) and 20% of bears relocated 136 miles (>219 kilometers) returned.

Photo courtesy of Canter, National Park Service, 1966

Translocation was once a common method of nuisance bear management. Although translocation is used less frequently today because of the strong homing instinct in bears, economic costs, and liability concerns, it remains an appropriate management option in areas where there are few bears or other extenuating circumstances.

A higher proportion of females (70%) returned than males (54%), but this may have been influenced by a number of subadult males in the sample.

In Florida, almost half (46%) of translocated nuisance bears caused problems after release and 32% of bears returned to their capture area (Annis 2007). In contrast, Armistead et al. (1994) concluded preventive relocation of black bears reduced frequency of sheep depredations. Several factors in addition to potential reductions in nuisance activities must be considered before relocation is attempted. These include the potential of transferring the nuisance bear to a new location where it could cause similar problems, liability issues of damage that may arise because of relocation, and ecological effects of relocating a bear to an area already occupied by other bears. In general, translocation is warranted when the animal is so valuable that euthanasia or other management options cannot be considered, when the population where relocation occurs is below carrying capacity, and when public relations takes precedence over other factors (Conover 2002).

Contraception

Contraception has been investigated as a means of black bear population control to reduce abundance in problem areas, but at present there are no contraceptives registered for black bears. Nevertheless, Witmer and Whittaker (2001) opined that fertility control has promise for management of human–bear conflicts and should be developed through ongoing research. Problems with fertility control for black bears include lengthy and expensive program implementation as bears would need to be captured and are long lived. Also, nuisance bears that are treated would presumably continue to cause problems (Hristienko and McDonald 2007).

HUMAN ATTITUDES AND PERCEPTIONS

Although human-wildlife conflict management has traditionally emphasized the management of wildlife, there is increasing recognition that the human aspects of conflict are equally important. In addition, many techniques (such as aversive conditioning, translocation, and lethal control) used to manage human–black bear conflicts are only temporarily effective (Linnell et al. 1997, Beckman et al. 2004), further supporting the need to better understand human aspects of bear-human conflicts. Integration of human attitudes and perceptions in management strategies will first require improved understanding of human behavior, which in turn would allow prediction of human behaviors that could be modified through education and awareness to reduce bear conflicts. When such understanding occurs, it is clear that human-bear conflicts can be alleviated through education and better regulations (see Gniadek and Kendall 1998, Gore et al. 2006).

Although certain segments of the public, especially those directly involved in negative human-bear interactions, may be intolerant of black bears, most people recognize the many positive benefits of black bears and want them to persist. For example, in Massachusetts, Jonker et al. (1998) found a significant relationship between an agricultural producer's economic dependence on a commodity that was subject to depredation and that producer's tolerance of black bears as a nuisance species. However, in the same study 73% of agricultural producers considered bears an inconvenience but also a tolerable part of their environment and 82% believed that black bears have aesthetic, ecological, or economic value.

Collaborations between social scientists and biologists are undoubtedly necessary to improve our understanding of human dimensions of wildlife management and provide more effective solutions for resolving human-bear conflicts (Baruch-Mordo et al. 2009). To this end, more research is needed to investigate ways of changing human behavior to improve human–black bear coexistence. In addition, evaluations of existing bear education and conflict management programs should be conducted using an adaptive management framework with performance metrics developed to capture human perceptions, knowledge, and behavior, as well as ecological factors including weather and land use patterns (Gore et al. 2006).

Photo courtesy of Florida Fish and Wildlife Conservation Commission

Human-wildlife conflicts are complex, and a myriad of ecological, biological, social, legal, and economic factors are involved.

SUMMARY

Bears are and will continue to be a challenging problem for wildlife managers, landowners, farmers, conservationists, and others. Because of restoration efforts, more stringent harvesting regulations, and a changing landscape and culture, bears have increased their range and population in many parts of North America. Combined with an ever-growing human population, these increases will undoubtedly lead to continued conflicts with humans. In response, wildlife professionals have dedicated substantial effort to better managing the problems caused by humans and black bears, as demonstrated by recent research efforts and extensive information transfer through conferences, workshops, scientific publications, and Extension Service publications.

As Conover (2002) noted, human-wildlife conflicts are complex, and a myriad of ecological, biological, social, legal, and economic factors are involved. As a result, few wildlife problems have single or simple solutions. Instead, most successful wildlife damage management strategies employ a diversity of tactics in a comprehensive, integrated approach. Without doubt, this principle applies to black bears. As with most human-wildlife conflicts (Conover 2002), an integrated approach employing multiple techniques to reduce black bear conflicts with humans is likely the most effective. Black bears may quickly learn to avoid individual control techniques but are less likely to adapt to multiple techniques used in combination. Understanding population characteristics, aspects of spatial ecology such as dispersal, and diet and habitat use is critical for selecting effective techniques, timing control programs, locating optimal control sites, and evaluating the effectiveness of control measures.

Successful black bear management strategies will undoubtedly depend upon persistent, adaptive, and integrated management programs that incorporate sound biological and ecological information. These strategies alone, however, will be insufficient without incorporating stakeholder involvement and education, which are paramount to managing black bear problems. The problems associated with black bears can be defined only within the context of human perceptions, experiences, and values. For that reason, an integrated management approach, in addition to addressing the biological and ecological aspects of black bears, must seek to engage stakeholders via comprehensive education and communication programs. We hope this publication will be a valuable tool in that crucial task.

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APPENDIX

Common Food Attractants

The items listed below are known to attract bears into residential areas and pose a risk for human–black bear conflict. Removing or securing attractants is the best method to prevent conflicts with black bears.

- Food or food containers
- Cooking utensils that have food smells
- Trash and recycling containers
- Pet and livestock feed
- Bird feeders
- Compost piles
- Beehives, poultry, or livestock
- Gardens, berry patches or bushes, orchards, or fruit trees
- Barbeque grills, meat smokers, and turkey or fish fryers
- Citronella and petroleum products
- Carcasses and scraps from cleaning fish or harvested animals
- Salt licks, mineral blocks, and deer feed
- Fertilizers (for example, fish oil)

Steel Drum Bear Trap Plans

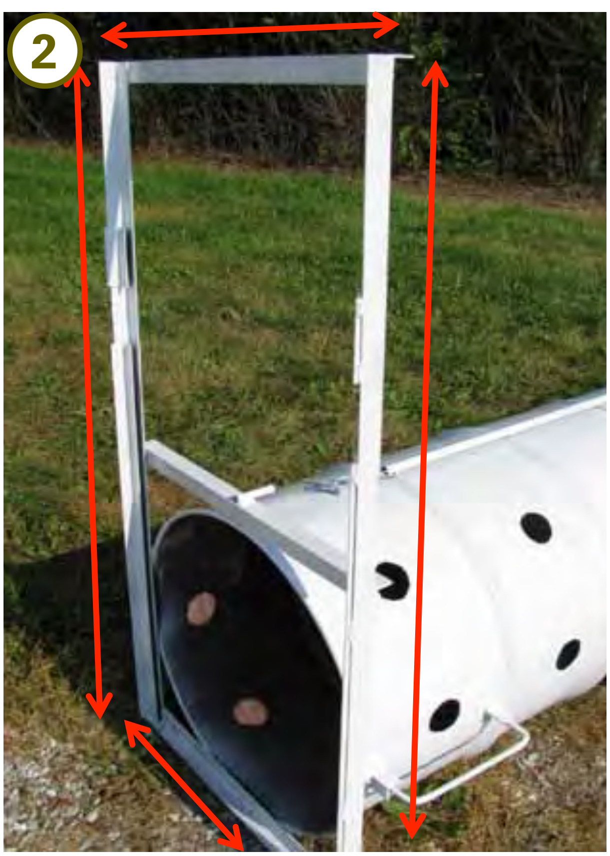
List of Materials (Per Trap)

- Angle iron
  - (3 pieces) 1¼" x 1¼" x 1/8" each 2' long
  - (2 pieces) 1¼" x 1¼" x 1/8" each 50" long
  - (2 pieces) 1" x 1" x 1/8" each 32" long
  - (2 pieces) 1" x 1" x 1/8" each 4" long
  - (1 piece) 1" x 1" x 1/8" 16" long (reinforcement for door)

- Galvanized conduit (cut to fit size of trap)
- 90 degree elbow for conduit
- 1/8" Aircraft cable (cut to fit size of trap)
- 1/8" Cable clamps (2 per trap)
- Plate steel (approx.12 ga. thickness)
  - 23½"x 24" (2 pieces) one for the door and one for the rear of trap
- Small pipe (1 piece) (to hold trip pin on frame)
  - ½" outside diameter
  - 2½" long
- Small rod (1 piece) (used as pin to hold door)
  - 3/16" to ¼" thickness
  - 3½" to 4" long
- 1½"x1½" piece of plate steel (to be welded to pin for door)
  (can be cut from plate that will be used for the rear of trap)
- 3" Door hinges (2 hinges per trap)
- 50-Gallon steel drums
  - (2½ barrels per trap)

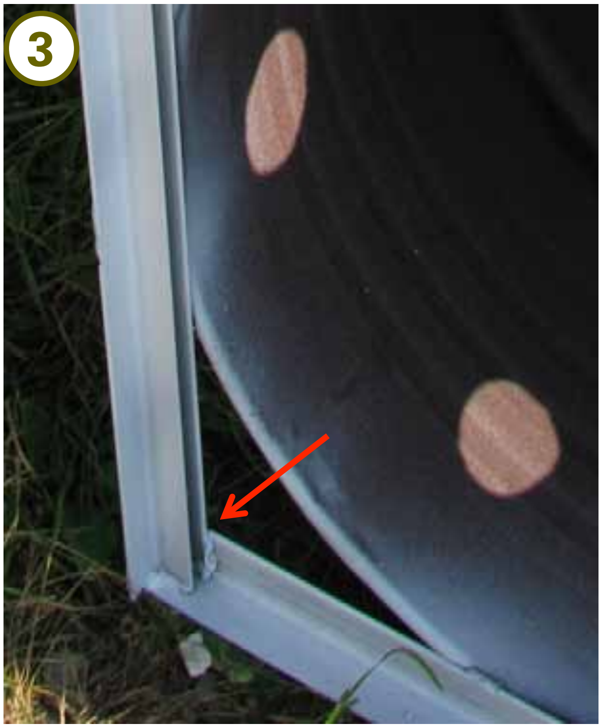
Door Frame

- 3 pieces (2' long)
  of 1¼"x 1¼"x 1/8" make up the horizontal pieces of door frame.
- 2 pieces (50"long)
  of 1¼"x 1¼"x 1/8" make up the vertical pieces.
- 2 pieces (32" long)
  of 1"x 1"x 1/8" make up the channel the door will slide in.
- 2 pieces (4" long)
  of 1"x 1"x 1/8" will be welded 4" above the other channel pieces to keep door from falling while it is held in open position .

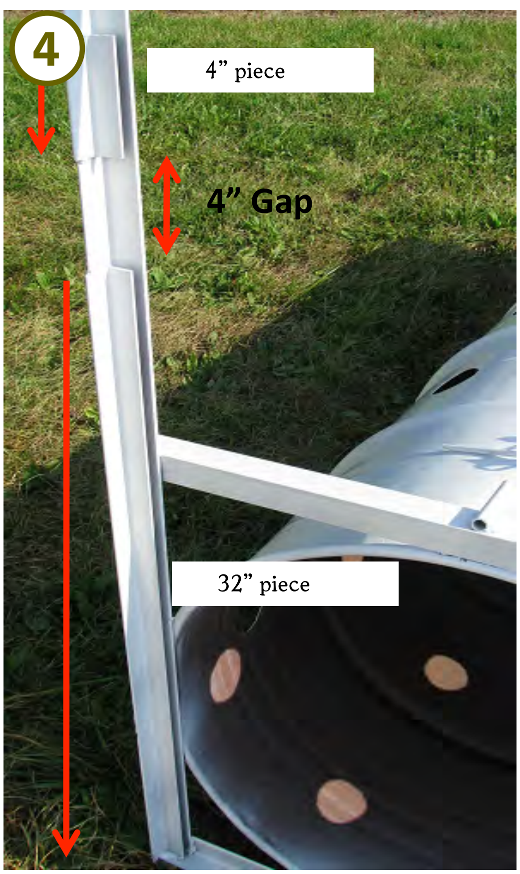


Assembly Procedure

- Weld the 50" pieces to the 2' pieces to make rectangular frame
- Weld top and bottom 2' pieces behind the 50" pieces



· 50” pieces should sit in front of the bottom 2’ piece to prevent door from binding on it.



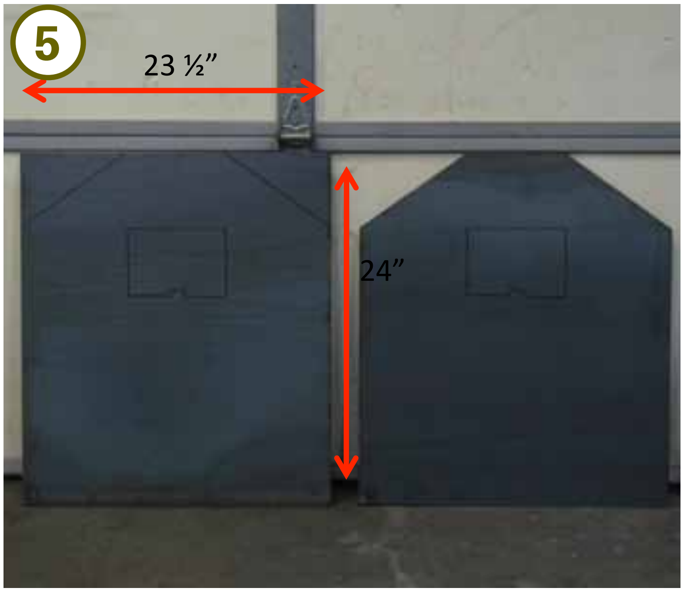
· Weld 32” pieces to the 50” pieces leaving a 3/8” gap between the two pieces.

· This forms a channel for the door to slide in.

· Leave a 4” gap above the 32” piece.

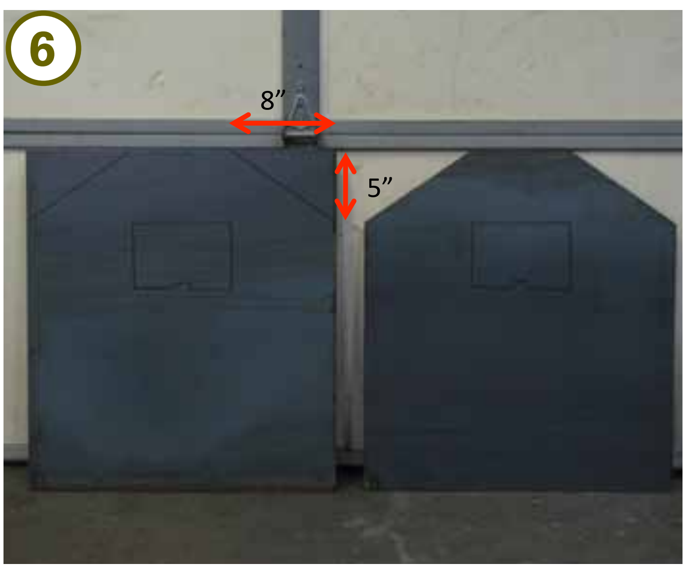
· Weld the 4” piece above the 32” piece.

· Leave a 3/8” gap between the 4” piece and the 50” piece for the door to sit in.



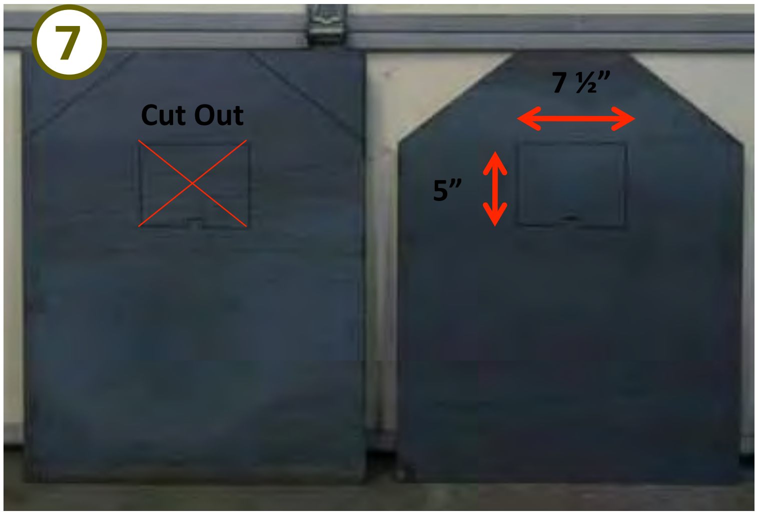
Back Plate of Trap

- 12 ga. plate steel
- 23½” wide
- 24” high



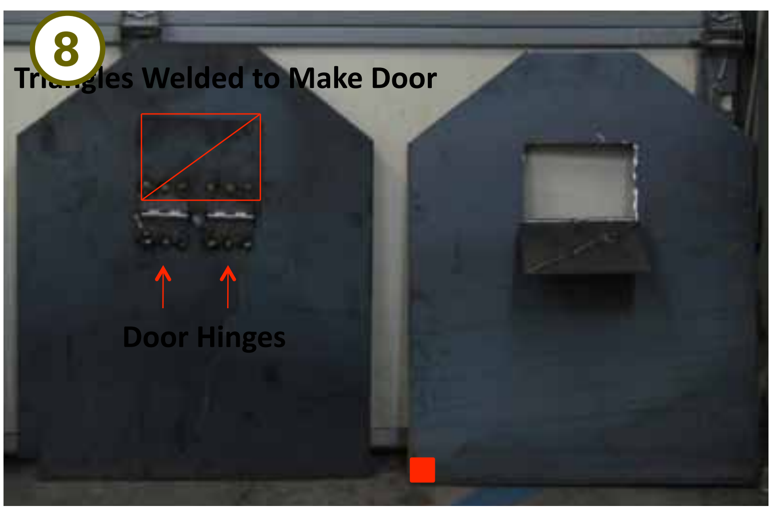
Preparation of Back Plate

- Measure 8” across and 5” down.
- Connect the two points to make a triangle on each side.
- Cut along the line.
- These two triangle pieces will be welded together to make the back door.



Back Door Cut Out

- Make outline for back door 7½” wide x 5” high.
- Cut out with torch.



Back Door

- Take triangles from top of plate and weld them together to make a rectangle which will become the back door.
- Weld two hinges to the door plate.
- Weld the door hinges below the open hole on the back plate.
- Small square can be cut out of bottom of plate to be welded on the pin to hold door.

9

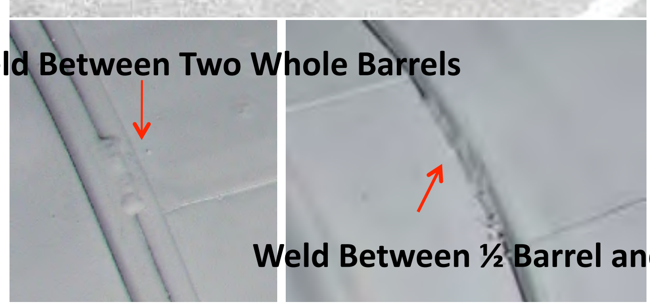
Door Pin

- Cut small rod to 3½” to 4”.
- Weld to 1½” x 1½” plate steel.
- Drill hole in plate steel to attach 1/8” cable.

Use a grinder to make a slight slope on one side of the pin and a file to make a light notch on the other side of the pin.

The door sits well on the sloped side.
(The notch is there for the door to sit on to keep smaller mammals from tripping the trap.)

10



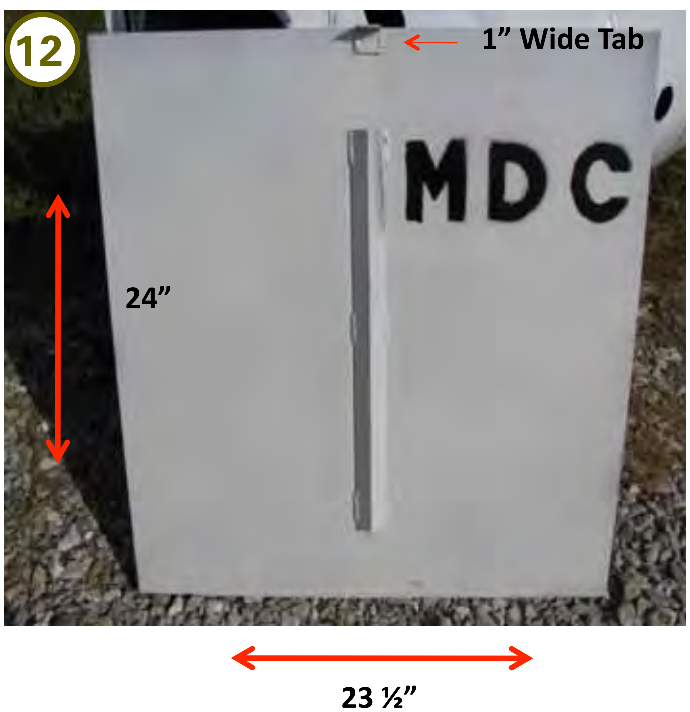
Steel Drum Preparation

- 2½ drums are used for each trap.
- One drum is cut completely in half using a torch.
- The ends of each drum are cut out with a torch.

- The drums are then welded together to make one complete tube for the trap.

Welding Door Frame to Barrels

- Weld door frame to barrels.
- Next weld middle 2' piece across barrel so it is resting on the barrel .
- Weld small 2½" pipe to center of this 2' piece.
- The back plate can be welded to the barrels after the front frame is welded on.



Back Door

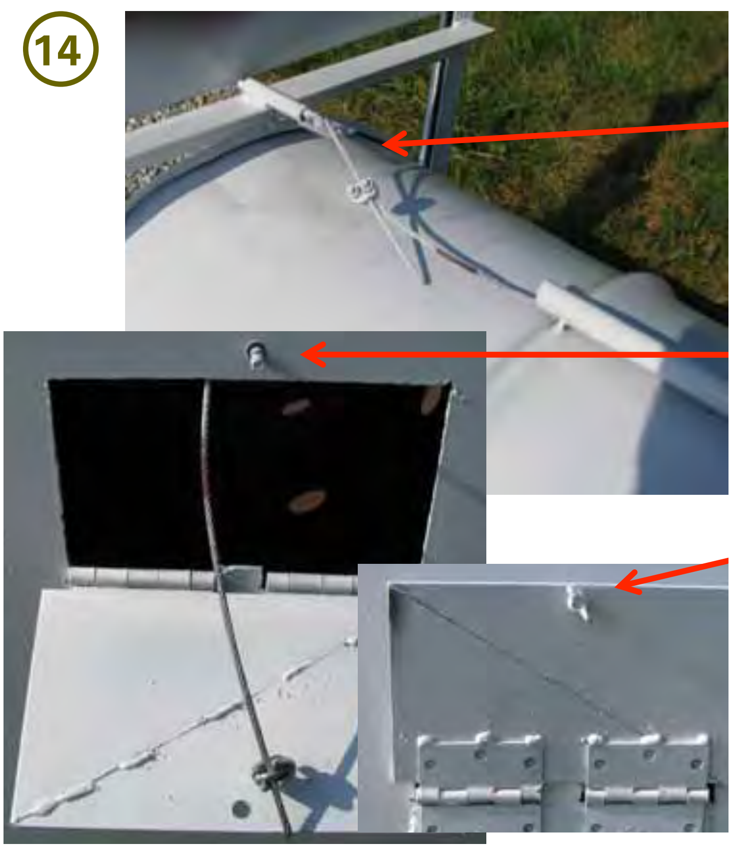
- Door should be 23½" wide and 24" high.
- Weld 16" piece of angle iron to center of the door .
- This will add stability and weight to the door so it falls fast and will not buckle.
- Add a tab to the top of the door so it can be picked up easily.

13

Conduit and Handles

- A hole should be cut in the top of the barrel.
- Conduit should be welded to the 90-degree elbow .
- Elbow should be welded over the small hole.
- Conduit should be cut to fit each trap as barrels may be different lengths which will create different overall trap lengths.
- Handles can be made from scrap iron.
- Make handles large enough for T-posts to be driven in to stabilize the traps.

14



Connect Cable and Pin

- Connect cable to pin and secure with one of the cable clamps.
- The pin sits in the pipe and the door sits on the pin.

- Drill a hole through the back plate and door, then weld bolt inside of the back plate.

- Use a wing nut to keep the back door closed while in use.
- Use the other cable clamp to secure the bait holder in the trap.

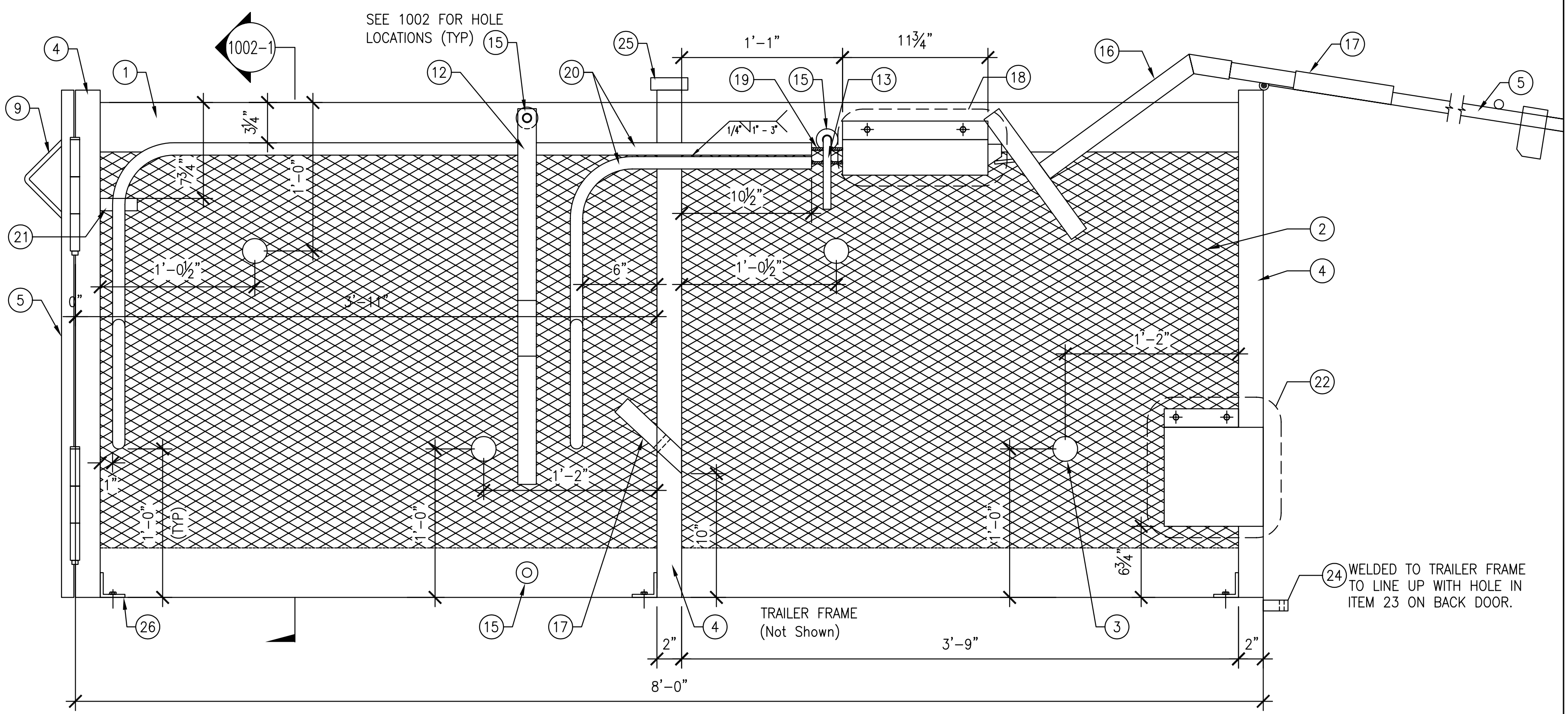
15

Trap

- Holes can be cut where needed for a jab stick and ventilation if necessary.
- The door is tripped by pulling the cable from inside.

Cambrian Design Trap for Adult Bears

Detailed construction plans for the Cambrian design trap for adult bears appear on the next four page. This is a "cage-style" culvert and differs from the standard barrel style trap. Note that there are two Cambrian designs; one for cubs and one for adult bears. Design plans provided by Ontario Ministry of Natural Resources.



SIDE ELEVATION

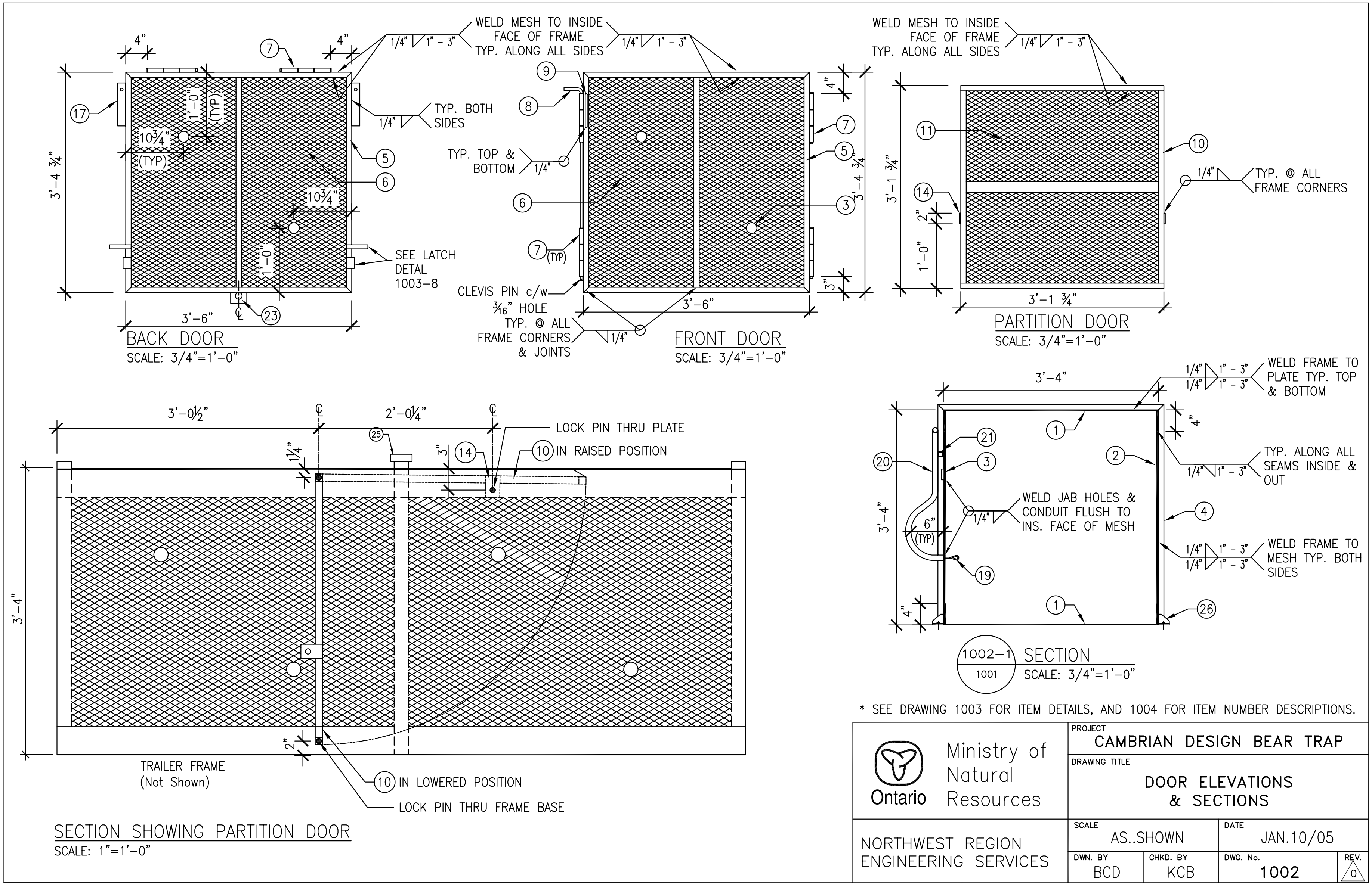
SCALE: 1½"=1'-0"

* SEE DRAWING 1003 FOR ITEM DETAILS, AND 1004 FOR ITEM NUMBER DESCRIPTIONS.

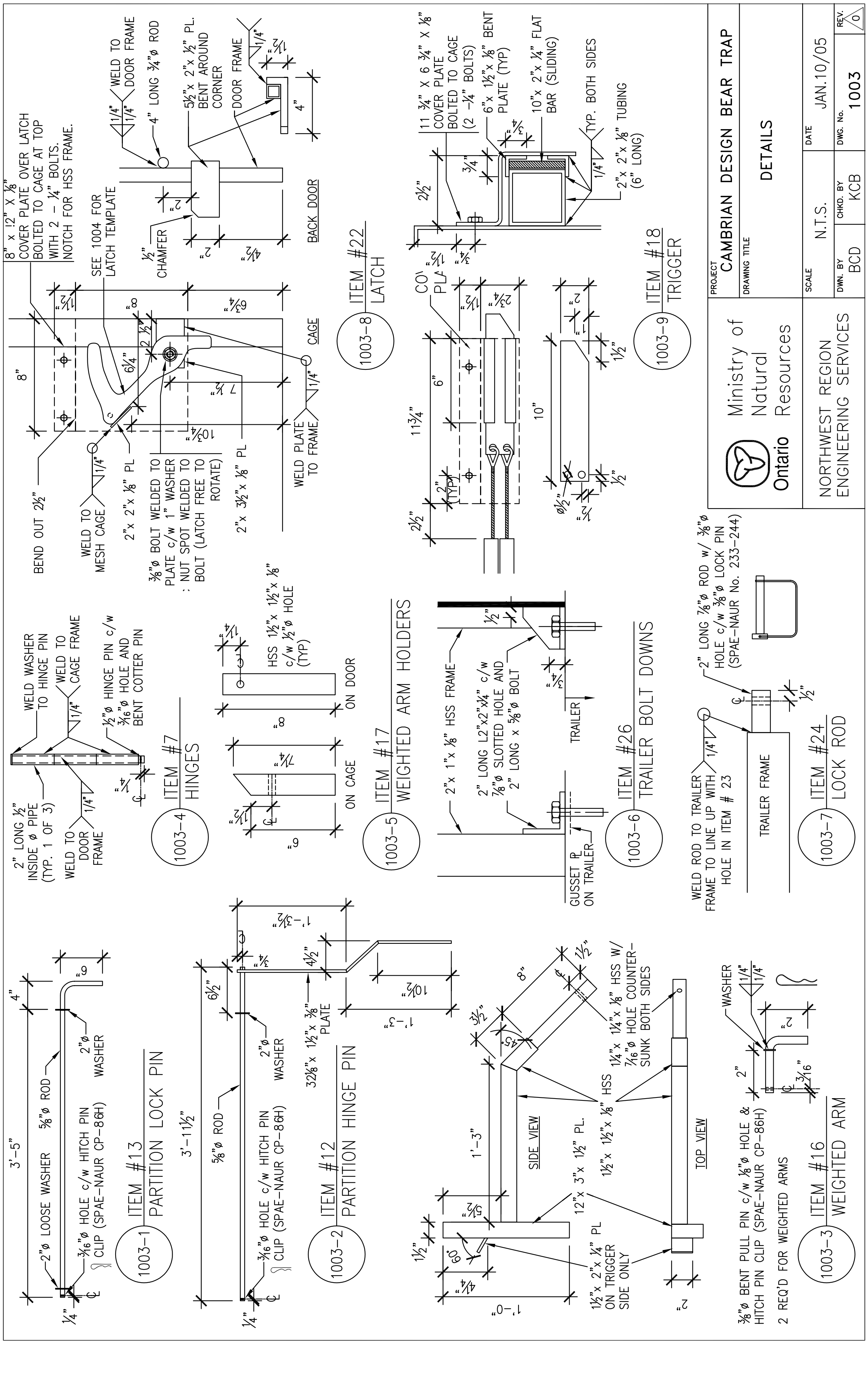
NOTES:

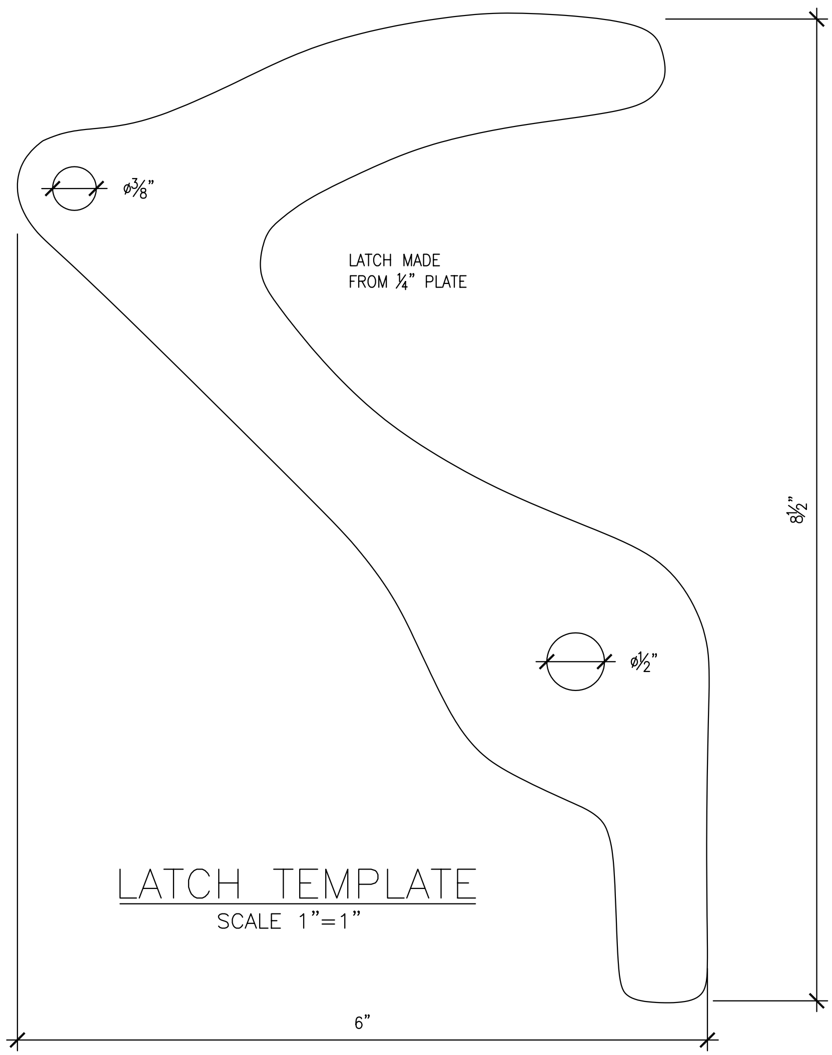
1. FLAT EXPANDED MESH USED TO MINIMIZE INJURIES TO THE BEARS CLAWS OR TEETH. DO NOT SUBSTITUTE ANY OTHER MESH.
2. CAGE BODY TO BE CONSTRUCTED OF TWO 4' X 8' SHEETS OF STEEL PLATE,(14 GAUGE TOP, 12 GAUGE BOTTOM), AND TWO 39"x 8' SHEETS OF ½" #13 F FLAT EXPANDED METAL SHEET.
3. UNLESS NOTED OTHERWISE ALL WELDS SHALL BE 1/4" FILLET WELDS.
4. ALL WELDING SHALL CONFORM TO CSA W59-M AND BE PERFORMED BY WELDERS CURRENTLY QUALIFIED UNDER CSA W59-M.

Ontario Ministry of Natural Resources	PROJECT: CAMBRIAN DESIGN BEAR TRAP	
	DRAWING TITLE: SIDE ELEVATION	
NORTHWEST REGION ENGINEERING SERVICES	SCALE: AS SHOWN	DATE: JAN.10/05
	DWN. BY: BCD / CHKD. BY: KCB	DWG. No.: 1001 / REV.: 0



WELD MESH TO INSIDE FACE OF FRAME TYP. ALONG ALL SIDES
TYP. BOTH SIDES
SEE LATCH DETAL 1003-8
BACK DOOR
SCALE: 3/4"=1'-0"
TYP. TOP & BOTTOM
CLEVIS PIN c/w 3/16" HOLE
TYP. @ ALL FRAME CORNERS & JOINTS
FRONT DOOR
SCALE: 3/4"=1'-0"
TYP. @ ALL FRAME CORNERS
PARTITION DOOR
SCALE: 3/4"=1'-0"
LOCK PIN THRU PLATE
IN RAISED POSITION
IN LOWERED POSITION
LOCK PIN THRU FRAME BASE
TRAILER FRAME (Not Shown)
SECTION SHOWING PARTITION DOOR
SCALE: 1"=1'-0"
WELD FRAME TO PLATE TYP. TOP & BOTTOM
TYP. ALONG ALL SEAMS INSIDE & OUT
WELD JAB HOLES & CONDUIT FLUSH TO INS. FACE OF MESH
WELD FRAME TO MESH TYP. BOTH SIDES
SECTION
SCALE: 3/4"=1'-0"
* SEE DRAWING 1003 FOR ITEM DETAILS, AND 1004 FOR ITEM NUMBER DESCRIPTIONS.
Ontario Ministry of Natural Resources
NORTHWEST REGION ENGINEERING SERVICES
PROJECT CAMBRIAN DESIGN BEAR TRAP
DRAWING TITLE DOOR ELEVATIONS & SECTIONS
SCALE AS..SHOWN
DATE JAN.10/05
DWN. BY BCD
CHKD. BY KCB
DWG. No. 1002
REV. 0


1003-1 ITEM #13 PARTITION LOCK PIN
3'-5"
2"ø LOOSE WASHER
5/8"ø ROD
2"ø WASHER
3/16"ø HOLE c/w HITCH PIN CLIP (SPAE-NAUR CP-86H)
1003-2 ITEM #12 PARTITION HINGE PIN
3'-11½"
5/8"ø ROD
2"ø WASHER
3/16"ø HOLE c/w HITCH PIN CLIP (SPAE-NAUR CP-86H)
3 2/8" x 1½" x 3/8" PLATE
1'-3½"
1'-3"
10½"
1003-3 ITEM #16 WEIGHTED ARM
SIDE VIEW
TOP VIEW
HSS 1½" x 1½" x 1/8"
1¼" x 1¼" x 1/8" HSS W/ 7/16"ø HOLE COUNTER-SUNK BOTH SIDES
12" x 3" x 1½" PL.
1½" x 2" x ¼" PL ON TRIGGER SIDE ONLY
1'-0"
WASHER
3/8"ø BENT PULL PIN c/w 1/8"ø HOLE & HITCH PIN CLIP (SPAE-NAUR CP-86H)
2 REQ'D FOR WEIGHTED ARMS
1003-4 ITEM #7 HINGES
2" LONG ½" INSIDE ø PIPE (TYP. 1 OF 3)
WELD TO DOOR FRAME
WELD WASHER TO HINGE PIN
WELD TO CAGE FRAME
½"ø HINGE PIN c/w 3/16"ø HOLE AND BENT COTTER PIN
1003-5 ITEM #17 WEIGHTED ARM HOLDERS
HSS 1½" x 1½" x 1/8" c/w ½"ø HOLE (TYP)
ON CAGE
ON DOOR
1003-6 ITEM #26 TRAILER BOLT DOWNS
2" x 1" x 1/8" HSS FRAME
2" LONG L2"x2"x¼" c/w 7/8"ø SLOTTED HOLE AND 2" LONG x 5/8"ø BOLT
GUSSET P ON TRAILER
TRAILER
1003-7 ITEM #24 LOCK ROD
WELD ROD TO TRAILER FRAME TO LINE UP WITH HOLE IN ITEM # 23
TRAILER FRAME
2" LONG 7/8"ø ROD w/ 3/8"ø HOLE c/w 3/8"ø LOCK PIN (SPAE-NAUR No. 233-244)
1003-8 ITEM #22 LATCH
BEND OUT 2½"
WELD TO MESH CAGE
2" x 2" x 1/8" PL
3/8"ø BOLT WELDED TO PLATE c/w 1" WASHER ; NUT SPOT WELDED TO BOLT (LATCH FREE TO ROTATE)
2" x 3½" x 1/8" PL
WELD PLATE TO FRAME
CAGE
8" x 12" X 1/8" COVER PLATE OVER LATCH BOLTED TO CAGE AT TOP WITH 2 - ¼" BOLTS. NOTCH FOR HSS FRAME.
SEE 1004 FOR LATCH TEMPLATE
½" CHAMFER
WELD TO DOOR FRAME
4" LONG ¾"ø ROD
5½" x 2" x ½" PL. BENT AROUND CORNER
DOOR FRAME
BACK DOOR
1003-9 ITEM #18 TRIGGER
11 ¾" X 6 ¾" X 1/8" COVER PLATE BOLTED TO CAGE (2 -¼" BOLTS)
6" x 1½" x 1/8" BENT PLATE (TYP)
10" x 2" x ¼" FLAT BAR (SLIDING)
TYP. BOTH SIDES
2" x 2" x 1/8" TUBING (6" LONG)
Ministry of Natural Resources
Ontario
NORTHWEST REGION ENGINEERING SERVICES
PROJECT CAMBRIAN DESIGN BEAR TRAP
DRAWING TITLE DETAILS
SCALE N.T.S.
DATE JAN.10/05
DWN. BY BCD
CHKD. BY KCB
DWG. No. 1003
REV. 0



LATCH TEMPLATE

SCALE 1"=1"

No.	ITEM	DESCRIPTION	QTY.
1	CAGE TOP AND BOTTOM	4'x 8' STEEL PLATE w/ 4" BENDS ALONG EACH LENGTH. 14 GAUGE TOP PLATE, 12 GAUGE BOTTOM.	2
2	CAGE SIDES	39"x 8'-0" PIECE OF 1/2" #13 F FLAT EXPANDED MESH	2
3	JAB HOLES	1/2" LONG x 2"ø PIPE	12
4	CAGE FRAMES	3 SIDED 40"x 40" (INS.) FRAME MADE FROM 2"x 1"x 1/8" HSS	3
5	FRONT & BACK DOOR FRAMES	40 3/4"Hx 42"W (OUT.) FRAME w/ VERTICAL CENTER SUPPORT MADE FROM 1"x 1"x 1/8" HSS	2
6	FRONT & BACK DOOR MESH	40 1/4"W x 42"H PIECE OF 1/2" #13 F FLAT EXPANDED MESH	2
7	PIPE HINGES	SEE DETIAL 1003-4	6
8	HINGE LOCK ROD	1/2"ø ROD (APPROX 3'-2" LONG) w/ 3" BEND AT TOP (TO FIT LOSELY IN HINGES c/w 1/8" HOLE & CLEVIS PIN)	1
9	DOOR HANDLE	9" LONG x 3/8"ø ROD w/ BEND AT MIDPOINT	1
10	PARTITION DOOR FRAME	37 3/4"x 37 3/4" (OUT.) 1"x 1"x 1/8" HSS FRAME w/ HORIZONTAL 1"x 2"x 1/8" HSS CENTER SUPPORT	1
11	PARTITION DOOR MESH	37 3/4"x 37 3/4" PIECE OF 1/2" #13 F FLAT EXPANDED MESH	1
12	PARTITION HINGE PIN	SEE DETAIL 1003-2	1
13	PARTITION LOCK PIN	SEE DETAIL 1003-1	1
14	PARTITION DOOR SIDE PLATE	3"x 2"x 1/4" PLATE w/ 3/4"ø HOLE (℄ OF HOLE 1" FROM END)	2
15	PARTITION PIN HOLES	3/4"ø HOLE w/ 2"ø WASHER AROUND HOLE WELDED TO CAGE	6
16	WEIGHTED ARM	SEE DETAIL 1003-3	2
17	WEIGHTED ARM HOLDERS	SEE DETAIL 1003-5	4
18	TRIGGER	SEE DETAIL 1003-9	1
19	TRIGGER CABLE	3/16" BRAIDED STEEL CABLE WITH EYELET EACH END (1 PIECE APPROX. 7'-9" LG, 1 PIECE APPROX. 4'-7" LG)	2
20	TRIGGER SLEEVE	1"ø STEEL PIPE (1 PIECE APPROX. 7'-3" LG, 1 PIECE APPROX. 4'-1" LG)	2
21	SHIM	3" LONG 1"x 1"x 1/8" HSS	1
22	LATCH	SEE DETAIL 1003-8	2
23	LOCK PLATE	3"x 2"x 1/4" PLATE w/ 1 1/4" ø HOLE	1
24	LOCK ROD	SEE DETAIL 1003-7	1
25	LIFTING HANDLES	3" LONG x 1"ø PIPE WELDED TO TOP CORNERS OF CENTER CAGE FRAME	2
26	TRAILER BOLT DOWNS	SEE DETAIL 1003-6	6

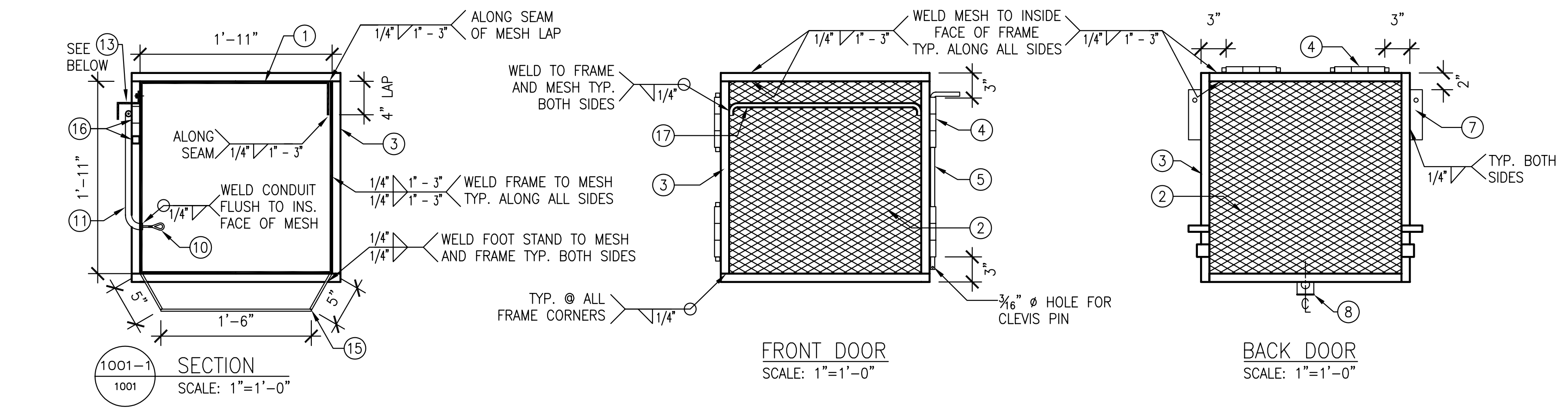
Ontario Ministry of Natural Resources

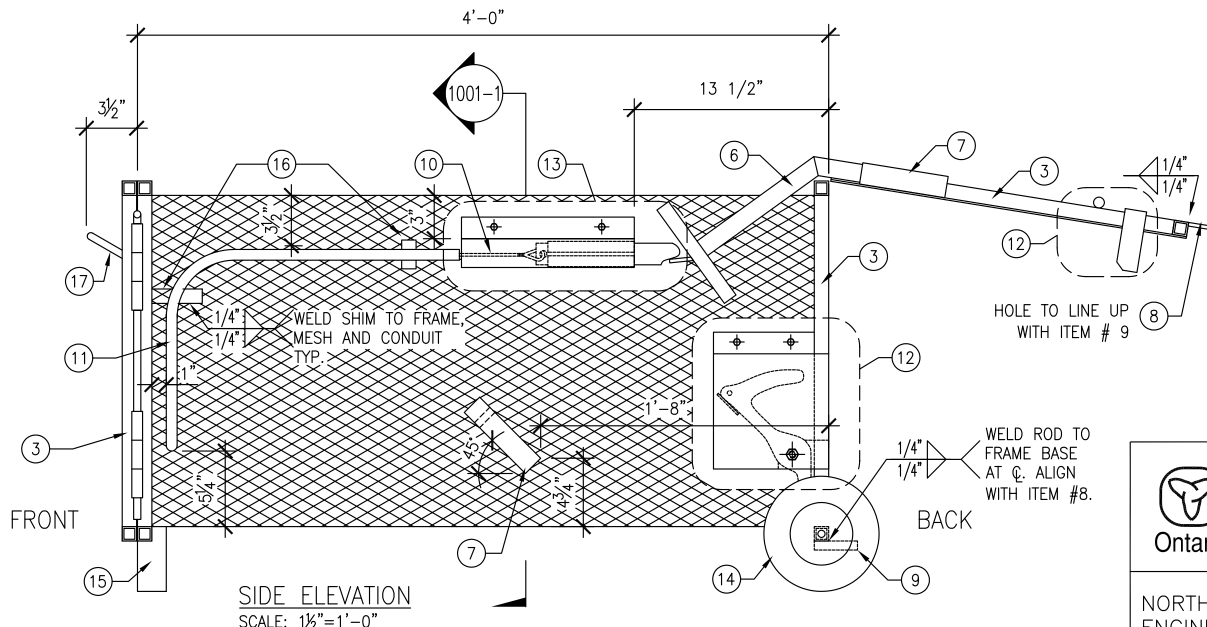
NORTHWEST REGION ENGINEERING SERVICES

PROJECT: CAMBRIAN DESIGN BEAR TRAP			
DRAWING TITLE: LATCH TEMPLATE & ITEM No. DESCRIPTIONS			
SCALE: 1"=1"		DATE: JAN.10/05	
DWN. BY: BCD	CHKD. BY: KCB	DWG. No.: 1004	REV.: 0

Cambrian Design Trap for Cub Bears

Detailed construction plans for the Cambrian design cub trap for bears appear on the next three pages. This is a "cage-style" culvert and differs from the standard barrel style trap. Design plans provided by Ontario Ministry of Natural Resources.



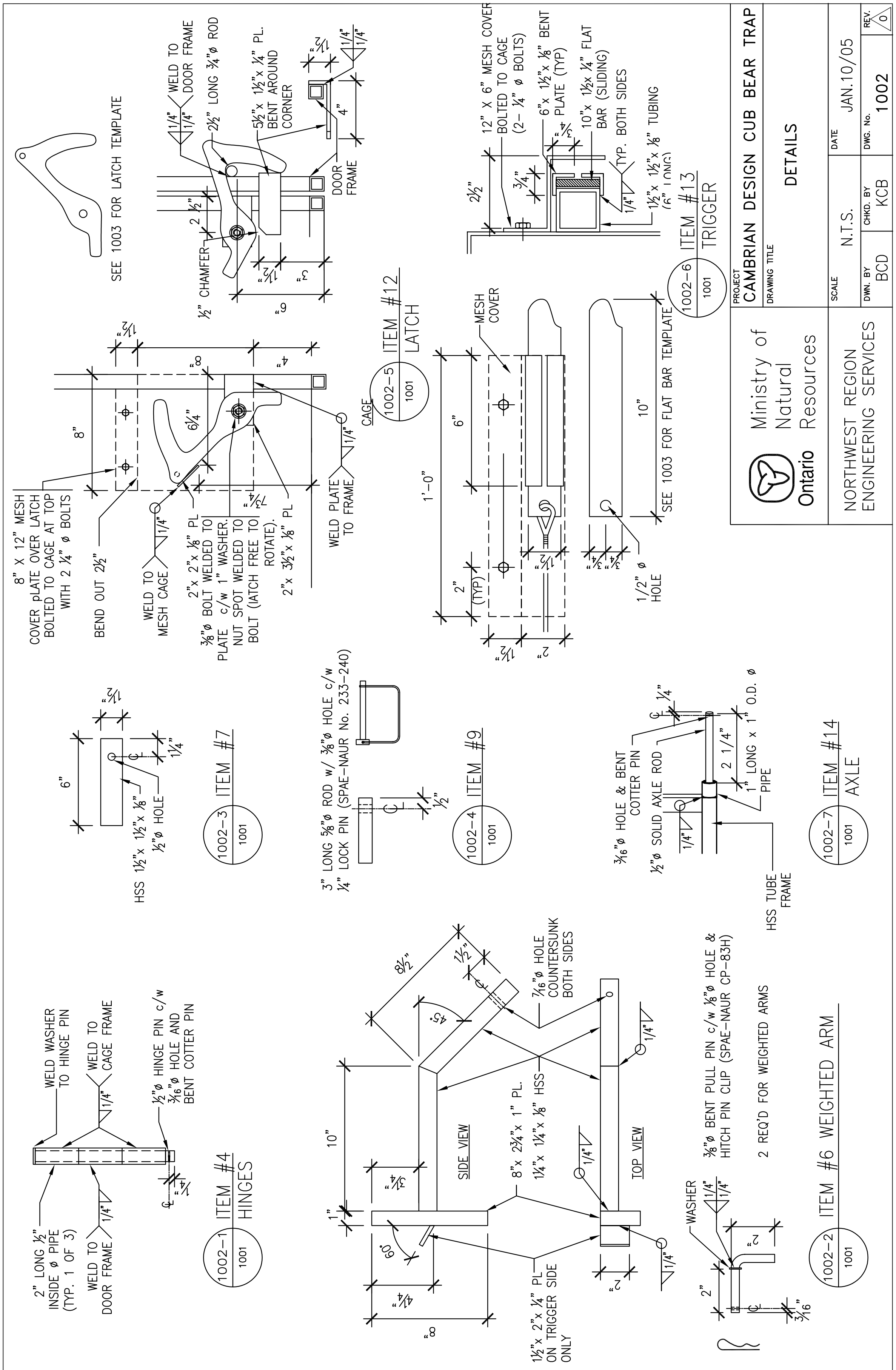


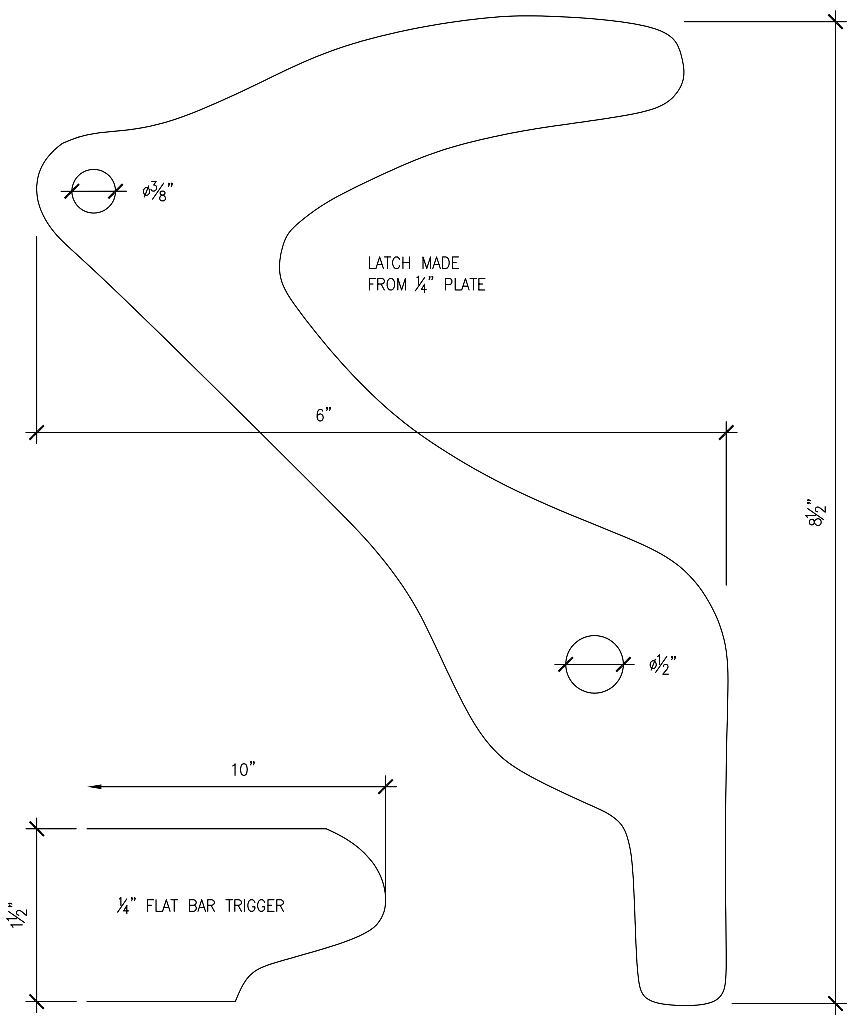
* SEE DRAWING 1002 FOR ITEM DETAILS, AND 1003 FOR ITEM NUMBER DESCRIPTIONS.

NOTES:

1. FLAT EXPANDED MESH USED TO MINIMIZE INJURIES TO THE BEARS CLAWS OR TEETH. DO NOT SUBSTITUTE ANY OTHER MESH.
2. CAGE BODY TO BE CONSTRUCTED BY A SINGLE 4' X 8' SHEET OF ½" #13 F FLAT EXPANDED METAL SHEET.
3. UNLESS NOTED OTHERWISE ALL WELDS SHALL BE 1/4" FILLET WELDS.
4. ALL WELDING SHALL CONFORM TO CSA W59-M AND BE PERFORMED BY WELDERS CURRENTLY QUALIFIED UNDER CSA W59-M.

Ontario Ministry of Natural Resources	PROJECT: CAMBRIAN DESIGN CUB BEAR TRAP	
	DRAWING TITLE: SECTION & ELEVATIONS	
NORTHWEST REGION ENGINEERING SERVICES	SCALE: AS SHOWN	DATE: JAN.10/05
	DWN. BY: BCD; CHKD. BY: KCB	DWG. No.: 1001; REV.: 0


CAMBRIAN DESIGN CUB BEAR TRAP
DETAILS
Ministry of Natural Resources
Ontario
NORTHWEST REGION ENGINEERING SERVICES
SCALE N.T.S.
DATE JAN.10/05
DWN. BY BCD
CHKD. BY KCB
DWG. No. 1002
REV. 0
1002-1 1001 ITEM #4 HINGES
2" LONG ½" INSIDE ø PIPE (TYP. 1 OF 3)
WELD TO DOOR FRAME
WELD WASHER TO HINGE PIN
WELD TO CAGE FRAME
½"ø HINGE PIN c/w 3⁄16"ø HOLE AND BENT COTTER PIN
1002-2 1001 ITEM #6 WEIGHTED ARM
SIDE VIEW
TOP VIEW
8"x 2¾"x 1" PL.
1¼"x 1¼"x ⅛" HSS
1½"x 2"x ¼" PL ON TRIGGER SIDE ONLY
7⁄16"ø HOLE COUNTERSUNK BOTH SIDES
⅜"ø BENT PULL PIN c/w ⅛"ø HOLE & HITCH PIN CLIP (SPAE-NAUR CP-83H)
2 REQ'D FOR WEIGHTED ARMS
WASHER
1002-3 1001 ITEM #7
HSS 1½"x 1½"x ⅛"
½"ø HOLE
1002-4 1001 ITEM #9
3" LONG ⅝"ø ROD w/ ⅜"ø HOLE c/w ¼" LOCK PIN (SPAE-NAUR No. 233-240)
1002-7 1001 ITEM #14 AXLE
3⁄16"ø HOLE & BENT COTTER PIN
½"ø SOLID AXLE ROD
1" LONG x 1" O.D. ø PIPE
HSS TUBE FRAME
8" X 12" MESH COVER pLATE OVER LATCH BOLTED TO CAGE AT TOP WITH 2 ¼" ø BOLTS
BEND OUT 2½"
WELD TO MESH CAGE
2"x 2"x ⅛" PL
⅜"ø BOLT WELDED TO PLATE c/w 1" WASHER. NUT SPOT WELDED TO BOLT (lATCH FREE TO ROTATE).
2"x 3½"x ⅛" PL
WELD PLATE TO FRAME
CAGE
1002-5 1001 ITEM #12 LATCH
SEE 1003 FOR LATCH TEMPLATE
WELD TO DOOR FRAME
2½" LONG ¾"ø ROD
5½"x 1½"x ¼" PL. BENT AROUND CORNER
DOOR FRAME
½" CHAMFER
MESH COVER
1/2" ø HOLE
SEE 1003 FOR FLAT BAR TEMPLATE
1002-6 1001 ITEM #13 TRIGGER
12" X 6" MESH COVER BOLTED TO CAGE (2- ¼" ø BOLTS)
6"x 1½"x ⅛" BENT PLATE (TYP)
10"x 1½x ¼" FLAT BAR (SLIDING)
TYP. BOTH SIDES
1½"x 1½"x ⅛" TUBING (6" LONG)



No.	ITEM DESCRIPTION	QTY.
1	4'x 8' SHEET OF ½" #13 F FLAT EXPANDED MESH BENT AT CORNERS	1
2	2'-1"x 2'-1" PIECE OF ½" #13 F FLAT EXPANDED MESH	2
3	1'-11"x 1'-11" (INSIDE) FRAME MADE FROM 1"x 1"x ⅛" SQUARE TUBING	4 (32' OF TUBING)
4	½"ø PIPE HINGES c/w HINGE PINS -SEE DETAIL 1002-1	6
5	½" ø ROUND BAR BENT AT TOP (TO FIT LOSELY IN HINGES -MACHINED IF NECCESSARY)	APPROX. 2'-0" OF BAR
6	WEIGHTED ARM -SEE DETAIL 1002-2	2
7	1½"x 1½"x ⅛" SQUARE TUBING SEE DETIAL 1002-3	4
8	2"x 1½" ¼" PLATE WITH 1"ø HOLE	1
9	3" LONG x ⅝"ø ROD SEE DETAIL 1002-4	1
10	3/16" BRAIDED STEEL CABLE WITH EYELET AND SLEEVE	APPROX. 3'-10"
11	¾" ELECTRICAL CONDUIT (SLEEVE FOR TRIGGER CABLE)	APPROX. 3'-0"
12	LATCH -SEE DETAIL 1002-5	2
13	TRIGGER -SEE DETAIL 1002-6	1
14	8" RUBBER TIRE -SEE 1002-7 FOR AXLE DETAIL	2
15	¼"x 2" BENT FLAT BAR FOOT STAND	1
16	2" PIECE & 3½" PIECE 1"x 1"x ⅛" SQUARE TUBING (AS SHIMS)	2
17	1/2" ROD (AS HANDLE)	APPROX. 2'-7"

Ontario Ministry of Natural Resources

NORTHWEST REGION
ENGINEERING SERVICES

PROJECT
CAMBRIAN DESIGN CUB BEAR TRAP

DRAWING TITLE
LATCH & TRIGGER TEMPLATES
& ITEM No. DESCRIPTIONS

SCALE 1"=1"
DATE JAN.10/05
DWN. BY BCD
CHKD. BY KCB
DWG. No. 1003
REV. 0

Creating a Snare Cubby Set

To create a cubby set, dig a hole about 4.7 to 6 inches (12 to 15 cm) in diameter and about 4 inches (10 cm) deep within 2.9 to 3.9 feet (0.9 to 1.2 m) of the base of a large tree. Attach the end of the cable around the base of the tree or attach to a large metal drag (see, for example, Lemieux and Czetwertynski 2006). In some areas, two cables may be used to anchor the snare, with each cable attached to an anchor tree in opposite directions (Scheick et al. 2009). Dig a trench from one side of the hole large enough to accommodate the entire snare spring.

After setting the snare, push the pointed stabilizing pins of the snare into the ground, allowing the spring throw arm (make sure the safety latch is on) to rest in the trench with the trigger centered over the hole. Place the snare loop over the perimeter of the hole and place the cable on the spring arm hook, ensuring the snare lock is forward of the hook so the snare loop will close when activated. Anchor the snare cable leading to the tree with anchor pins or tent stakes.

Cover the spring arm and snare cable leading to the tree or drag with dirt and vegetation. Lay small sticks from the perimeter of the hole to the trigger to provide a solid platform for the bear to step on and for placing vegetation to camouflage the trigger. Attach the bait to the base of the tree and spray lure, if desired, on the tree trunk about 6.5 to 8 feet (2 to 2.5 m) above ground.

Build a cubby of small to midsize logs or tree branches such that the bear can only readily enter the cubby through the opening with the snare. Logs and branches should be positioned so that they are able to move freely once a bear is captured. Be sure that the spring arm can move freely if activated and is not restricted by logs or branches. Also, other than the tree the snare is attached to, be sure that all woody vegetation is removed within the immediate vicinity to avoid entanglement of the bear. Upright, rooted saplings or shrubs should be cut to below ground level to avoid entanglement.

Photo courtesy of Jared Laufenburg

An Aldrich foot snare being set for black bear. Structures, such as PVC pipe, can assist in maintaining the walls of the snare hole. Note that the wall support needs to accommodate the snare trigger.

Photo courtesy of Jared Laufenburg

A view of a snare trail set just before adding camouflaging. Various materials can be used to cover the trigger (e.g., screen mesh, leaves, moss, etc.) as long as the material is flexible, has the capability to collapse under the weight of an animal, and does not entangle the snare cable.

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Support for this project was provided by

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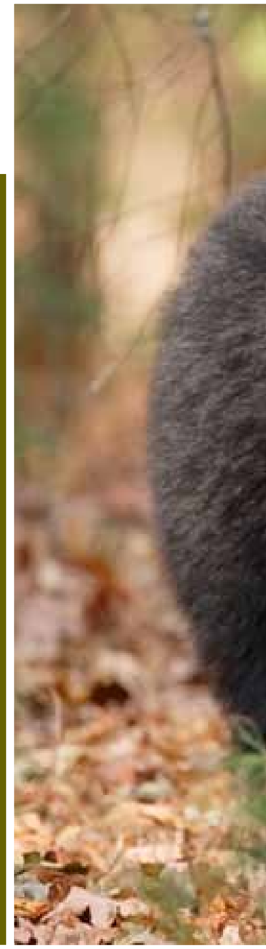

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ISBN# 0-xxxxx-x-x