REPORT OF THE
DEPARTMENT OF GAME AND INLAND FISHERIES

Black Bear Damage Programs

TO THE GOVERNOR AND
THE GENERAL ASSEMBLY OF VIRGINIA

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TABLE OF CONTENTS

Tables and Figures

EXECUTIVE SUMMARY

As part of the 2004-06 biennium budget bill, the Virginia Department of Game and Inland Fisheries (VDGIF) was directed to report on the black bear damage programs in other states and to review the policies of federal land-management agencies that may impact Virginia's ability to manage black bear populations and associated damage.

A questionnaire was sent to 19 eastern and mid-western states to evaluate policies and programs that address problem bear issues in other states. Damage management options used in other states were evaluated for their effectiveness, level of effort, and the overall importance to bear damage management programs.

Most bear damage management options used by other state management agencies were considered to be less than adequate for managing nuisance bear problems and none were considered to be completely effective. The only options considered to be relatively effective and important were exclusion devices, regulated hunting, and public education. Despite being the techniques that required the greatest effort, exclusion devices and public education were still among the most commonly used approaches. Although commonly promoted by agricultural producers, compensation for damage was only used by 32% of the surveyed states, considered to be relatively ineffective, and was among the options requiring the greatest amount of effort.

No single management option is best for managing human-bear conflicts and an integrated approach, using multiple management options, is necessary to manage the diversity of nuisance bear problems. The VDGIF has employed most of the nuisance management options to address bear problems in Virginia. The VDGIF has been very proactive in the implementation of regulated hunting to manage bear problems, but added emphasis on the other more effective approaches (e.g., public education, exclusion devices) could improve the overall nuisance bear concerns.

Federal land-management agencies, especially the George Washington/Jefferson National Forest, Shenandoah National Park, and the Great Dismal Swamp Wildlife National Wildlife Refuge, manage a variety of properties in Virginia that could have an impact on bear management issues. The diverse missions of these various federal agencies can create unique problems for managing black bear populations and associated damage. Very few constraints accompany VDGIF bear population management programs (i.e., hunting seasons) on US Forest Service lands in Virginia. Despite clear expectations that National Wildlife Refuges have hunting as a primary recreational focus, the administrative realities of implementing bear hunting seasons on the Great Dismal Swamp National Wildlife Refuge has been very problematic. Harvesting bears, or any wildlife, on National Park Service lands to meet regional population or damage management objectives would be especially challenging for Shenandoah National Park. Maintaining the cooperative relationships that VDGIF currently has with its federal land-management partners will be vital in achieving the respective goals of all the agencies.

INTRODUCTION

As part of the 2004-06 biennium budget bill (House Bill 1500, Chapter 951, Item 393), the Virginia Department of Game and Inland Fisheries (VDGIF) was directed to report on the black bear damage programs in other states and to review the policies of federal land-management agencies that may impact Virginia's ability to manage black bear populations and associated damage. The specific directive was:

"The Department of Game and Inland Fisheries shall report on the Black Bear Damage Programs in other states, which may have application to Virginia's Black Bear Management Program. The Department is further directed to review the policies of federal land management agencies within the Commonwealth that may impact Virginia's ability to manage the resident Black Bear population and associated damage. This information shall be made available to the General Assembly by December 1, 2005."

This report summarizes the findings from these reviews.

BACKGROUND

VDGIF has managed bears and bear problems since the agency's inception in 1916. Successful bear management programs have resulted in increasing populations in Virginia and throughout the eastern United States. For black bears in Virginia, harvest trends (Fig. 1) correspond to these increasing population trends. Although Virginia's highest bear populations are found primarily around the Great Dismal Swamp National Wildlife Refuge in southeastern Virginia, along the Blue Ridge Mountains, and in the Allegheny Mountains, bears may occur in most any region of the state. The only areas of the state without recent bear observations include the middle peninsula, lower peninsula, and eastern shore counties.

With the profusion of bear populations, black bear management throughout the United States has become increasingly complex. Contentious issues often surround bear hunting, human-bear problems, bear habitat conservation, and trade in bear parts. Many Virginians are interested in observing, photographing, hunting, or just knowing bears exist in the Commonwealth. Unfortunately, bears sometimes damage agricultural crops or residential property. Highway accidents involving black bears have increased in recent years. Diverse values and opinions associated with black bears provide unique management challenges for the Virginia Department of Game and Inland Fisheries.

The VDGIF Board of Directors adopted the first Virginia Black Bear Management Plan in 2002. The Plan serves as a blueprint for bear management through 2010. The Plan describes Virginia's bear management program history, current status, management options, and future program goals. Based on significant stakeholder input, these goals reflect the diverse values and desires of all Virginia's citizens; goal areas address (1) bear populations and habitats, (2) bear-related recreation, and (3) human-bear problems.

Bear Populations And Habitats. The VDGIF mission of managing "wildlife…to maintain optimum populations… to serve the needs of the Commonwealth" depends on ensuring the viability of suitable habitats for bears and knowledge about public desires for bear population objectives. The Bear Management Plan identifies specific population viability and cultural carrying capacity (CCC) objectives (i.e., the maximum number of bears in an area that is acceptable to humans) across the state. The CCC for bears (Fig. 2) balances positive demands (e.g., recreational hunting, viewing) with negative concerns (e.g., agricultural damage, vehicle collisions). Bear population objectives involve a combination of social, economic, political, and biological perspectives. Due to its efficacy, cost-effectiveness, tradition, and recreational value, the Black Bear Management Plan identifies hunting (where appropriate) as the primary population control option for bears.

Bear-Related Recreation. Bear hunting for recreation, food, clothing, weapons, and ornaments has had a long tradition in Virginia. Today, bear hunting in Virginia results in approximately $17.3 million annually being spent on food, lodging, equipment, and transportation. Also, black bears are second only to eagles and hawks as the animals Virginians are most interested in taking a trip to see. Regulated hunting is the principle population management method and also may reduce human-bear conflicts. However, regulated hunting of black bears has become a controversial social issue and may not be acceptable in some urban or suburban situations.

Human-Bear Problems. The bear population size in a given area will impact the prevalence of human-bear problems. Generally as black bear populations increase and bears encounter humans more frequently, human-bear problems also increase. As black bear populations decrease, human-bear problems generally decrease. Areas with no hunting serve as refuges or sanctuaries for bears and exacerbate human-bear problems in nearby areas. Damage caused by black bears is diverse and includes destruction of beehives, foraging at garbage dumps, destroying crops (sweet corn, fruit trees), feeding on grain at livestock feeders, damage to trees, harassing campers, and killing of livestock. In developed areas, problems often center on damage to wooden structures and bird feeders, scavenging garbage cans and pet food, automobile accidents, and simple public sightings. With its combination of rural and urban environments in close proximity to bear habitat, any of these problems can occur almost anywhere in Virginia.

Since 2000, the VDGIF has documented an average of 310 bear complaints each year. Damage to trash (28%), bird feeders (20%), property (14%), corn (13%), livestock (7%), and apiaries (5%) constitute nearly 90% of all complaints. More than 56% of these complaints were made in 8 of the 10 counties in close proximity to Shenandoah National Park where hunting is prohibited. A minimum average of 17 bear-vehicle collisions occur annually. These issues represent a minimum known number of bear problems.

While hunting can control bear population levels, it will not eliminate bear damage. Other damage management techniques are only partially successful. More effective and practical methods need to be developed to manage nuisance bear problems in the future. An evaluation of the effectiveness of different nuisance bear management options was a high priority in the Virginia Black Bear Management Plan.

BLACK BEAR DAMAGE PROGRAMS IN OTHER STATES

Methods

A questionnaire was developed and sent to 19 eastern and mid-western states to evaluate policies and programs that address problem bear issues in other states. This system of obtaining comparative information by canvassing wildlife professionals in other states is commonly used among wildlife agencies. The 19 surveyed states included Arkansas, Connecticut, Georgia, Florida, Maine, Massachusetts, Maryland, Michigan, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, South Carolina, Tennessee, Vermont, West Virginia, and Wisconsin. Except for Florida all these states have increasing or stable bear populations.

The questionnaire, and subsequent telephone conversations with all of the state bear biologists, focused on (1) comparing the use, relative effectiveness, and level of effort among 12 problem bear management options, (2) evaluating bear damage compensation programs, and (3) appraising other agency services that are used to address problem bears and their damage. The 12 black bear damage management options that were evaluated included:

- Public education
- Regulated hunting
- Exclusion devices
- Capture and relocation
- Capture and aversive conditioning
- Capturing and euthanize
- Kill permit
- Bear feeding control regulations
- Repellants and other forms of aversive conditioning
- Compensation funds and damage payments
- Off-season hunting opportunities
- Fertility control

The damage management options were evaluated by each state for its effectiveness, level of effort, and the overall importance to their bear damage management programs. More specific details were obtained for some of the options (e.g., capture and aversive conditioning, public education, compensation funds).

Results and Discussion

Overall survey results. The most commonly used bear damage management options used among the 19 surveyed state management agencies were public education (100%), regulated hunting (89%), and exclusion devices (89%) (Table 1). Other commonly used approaches involved capture and relocation (84%), capture and aversive conditioning (84%), and capturing and euthanizing (74%). The least commonly used techniques were fertility control (0%), off-season hunting opportunities (11%), and compensation funds (32%).

Corresponding to most commonly used options by state agencies, the most effective (Fig. 3) and important (Fig. 4) approaches to managing nuisance bears were exclusion devices, regulated hunting, and public education. The least effective and important options were fertility control, off-season hunting opportunities, and compensation funds.

The level of effort required to implement each option was considered to be greatest for public education, exclusion devices, and compensation funds (Fig. 5). Off-season hunting programs and capture and euthanizing took the least effort.

Options used in Virginia. Virginia's programs to address negative human-bear interactions have evolved since the VDGIF was created in 1916. The current damage management programs supported by the VDGIF are the product of changing bear populations, citizen expectations, emerging techniques, and budgetary constraints. Recognizing that an integrated approach is necessary for bear damage management and no single option has been viewed as adequate for all situations, a very wide array of damage management options and programs have been adapted for use in Virginia. In some form, at least 10 of the 12 surveyed options are already being used to manage nuisance bear problems in Virginia.

Damage Management Options

The following sections explain each damage management option, provide the survey results about use and effectiveness in other states, and describe the use in Virginia.

Public Education. A strong information and education program will be key to managing nuisance problems, raising public tolerance for bears, and increasing the public knowledge about bear ecology and resource issues. A knowledgeable public will be important for an effective, science-based bear management program. Helping citizens to coexist with bears, information outreach is important to educate the public about bear biology, living in bear country, damage prevention measures, and damage management options. It is also important to provide information and education to foster public support and understanding of agency programs. Educational information can be offered in many forms including popular publications, presentations, media contacts, telephone calls, emails, brochures, websites, and television productions.

Survey results. All state wildlife agencies used education as a component of human-bear problem management (Table 1) and it was considered the most important option (Fig. 4) with high effectiveness (Fig. 3). However, public education also required the greatest amount of effort compared to the other options (Fig. 5).

Use in Virginia. Several educational brochures are available through printed formats and the web. These brochures provide information about coexisting with bears and fencing options. As well as providing technical advice over the telephone, periodic seminars and articles are also provided by VDGIF staff. Containing an abundance of general information about bears, the Virginia Black Bear Management Plan can also be found on the VDGIF website. The Virginia Black Bear Management Plan also states that "education should be an important component of human-bear problem management".

Regulated Hunting. Regulated hunting has been the method of choice for managing wildlife populations since 1910. With regulated hunting, specific population levels are achieved by adjusting season length, season timing, and legal methods of take to manipulate the magnitude, sex composition, and age composition of the harvest. Information from hunting harvests provides wildlife managers with important data to assess bear population status.

Usually as an additive form of mortality, hunting is the major limiting factor in most black bear populations. Depending on harvest levels, black bear populations can increase, decrease, or remain the same in the presence of hunting. Bear populations have been observed to decrease due to heavy hunting pressure.

Regulated hunting has the potential to reduce human-bear problems. Lower bear densities help reduce human-bear interactions. In Washington, hunting to control black bear population levels has been used to reduce bear damage to commercial forest stands. However, hunting may not always have the desired effect on bear damage concerns. Liberalized hunting regulations failed to reduce bear population levels and crop damage in agricultural areas of Minnesota's black bear range; more liberal hunting regulations would be required to have a population and damage impact.

Bear hunting seasons that do not coincide with damage periods (as occurs in Virginia) keep hunters from targeting the specific bears involved in problems at other times of the year. The establishment of a September bear hunting season in Wisconsin increased the recreational harvest of bears that were causing damage problems and decreased the average number of nuisance bears destroyed per year using kill permits from 110 to 19. Adjusting the hunting season structure to coincide with bear damage periods may afford greater opportunities to remove problem bears from the population.

Regulated hunting of black bear populations has become a controversial social issue. Perhaps the most contentious issues involve fair chase and the ethics of certain methods of harvest, especially hunting bears over bait, hunting with dogs, or hunting in the spring. Physical effects of hunting on bears, possible environmental side-effects of providing access to hunters, and the expense of regulating various hunting methods also have been questioned by critics of bear hunting. Additionally, regulated hunting may not be acceptable or feasible near urban areas due to concerns for human safety. Hunting may be ineffective at controlling bear populations and human-bear problems near large sanctuaries (e.g., Shenandoah National Park).

Survey results. Regulated hunting was used by 17 states (89%) to help manage problem bears (Table 1). The average black bear harvest among these states was 1,279 bears per year (range = 35 in South Carolina, and 3,837 in Maine). Virginia's average harvest has been 1,089, ranking it 9th among the hunting states. Connecticut and Florida do not provide bear hunting opportunities. Two states (Maryland and New Jersey) have been able to provide bear hunting as a management option only in the last three years. Regulated hunting was considered one of the most effective (Fig. 3) and important (Fig. 4) options used by state agencies to manage problem bears. Relative to other options, hunting took less effort than other effective management options (Fig. 5).

Use in Virginia. As the principle population management tool, diverse recreational hunting opportunities are available statewide. In response to concerns about bear population growth and damage concerns, the VDGIF has recently expanded hunting seasons for bears and provides one of the more liberal hunting bear hunting seasons in the eastern United States. In Virginia, some 15,000 hunters spent 91,000 hunter-days hunting black bears every year. Ranking it 9th among the hunting states in the survey, Virginia's average bear harvest has averaged 1,089 over the last 5 years.

Exclusion Devices. Exclusion devices are physical barriers that prevent access of bears to human property, food, or commodities. Exclusion devices include electric fencing, bear poles, and bear-resistant containers. Electric fencing around apiaries is extremely effective in preventing hive damage or destruction. Electric fencing also can be used around other agricultural commodities, but the cost of fencing sometimes limits the practical use to smaller areas. Bear poles and bear-resistant containers are effective at keeping bears out of garbage and stored foods. Fencing, bear-resistant containers, and garbage incinerators have been used to address broad-scale solid waste management associated with industrial development in some states.

Exclusion devices can eliminate individual and site-specific bear problems. As a nonlethal management technique, social acceptability is also high. Reflected in the high effort rating (Fig. 5), major limitations to exclusion devices in some situations could be cost and practicality. Bear-resistant containers and bear poles are likely cost effective for camping, backpacking, and other recreational activities in bear habitat. However, electric fencing around large fields of agricultural crops may become cost prohibitive and/or difficult to maintain. Costs to construct electric netting around apiaries may be as little as $300.

Bear-exclusion costs associated with broad-scale solid waste management can be highly variable depending upon the specific needs of each area. Mandatory animal-resistant garbage containers have reduced bear problems in the city of Gatlinburg, TN adjacent to Great Smoky Mountains National Park.

Survey results. Exclusion devices were commonly used by states (89%) to help manage problem bears (Table 1). Exclusion was considered to be the most effective damage control option (Fig. 3). As a result, and despite the relatively high amount of effort involved (Fig. 5), exclusion was very important to agency bear damage management programs (Fig. 4).

Many states (n= 8) said they loaned electric fencing as complete packages (fence, posts, insulators and charger) or just the charger and allow the landowner to provide the other materials. Pennsylvania and Maryland indicated they would provide free electric fencing materials. However, Pennsylvania limits this provision to the fencing (no solar powered chargers) and only to apiaries with a minimum of 10 hives; the fence must meet design standards and be properly maintained. Furthermore, if the fencing need is for less than 10 years, a charge for the materials is prorated at a 10% per year depreciation rate. Florida also reported that they would occasionally loan bear resistant/proof trash containers and provide plans to build similar containers.

Use in Virginia. Although the VDGIF may occasionally assist landowners with electric fence construction and materials, most support of exclusion devices is provided via technical advice and I&E materials.

Capture and Relocation. Translocations (i.e., capture and relocation) of nuisance bears have implications for human-bear problems. According to a 1994 study in eastern North America, 24 of 28 states/provinces used translocation to manage nuisance bear problems. Translocation has been shown to be effective at reducing nuisance activity and is especially useful for bears in urban areas. However, translocation fails to address the situation that led to the nuisance behavior and the relocated nuisance animal may become a problem elsewhere. Translocated nuisance bears can cause problems while attempting to return home; human-induced mortality (i.e., vehicle collisions, regulated hunting) increases with the additional bear movements during the first few months following translocation. Since about 1980, 4.7% of translocated nuisance bears in Virginia continued nuisance activity.

Translocation appears to receive wide public acceptance as a wildlife damage control technique, but selection of suitable release sites for black bears may be problematic. Translocation has proven to be labor intensive and expensive.

Survey results. Relocating captured problem bears, used by 84% of the states (Table 1), was considered somewhat less than adequately effective by states that used it (Fig. 3), and relatively important to overall bear damage programs (Fig. 4). Out of 12 other damage management options, capture and relocation ranked 4th in effort (Fig. 5). Some smaller or more populated states (e.g., New Jersey, Maryland) have fewer remote habitats and fewer options for release areas.

Use in Virginia. Historically, problem bears in Virginia were trapped and relocated to remote areas 60 to 100 miles from the trap site. Approximately 50 bears were relocated per year with less than 4% of these relocated bears causing additional problems. However, relocation of most nuisance bears has become an impractical management option with expanding bear populations, fewer suitable release sites, and tighter budgets. Not only is relocation a costly approach, citizens in other localities are not interested in somebody else's nuisance bears. Therefore, nuisance management options in Virginia have evolved toward managing bears in place (i.e., at the nuisance site) and discouraging relocation. Even so, albeit less frequently, relocation is still sometimes necessary for problem bears in urban areas.

Capture and Aversive Conditioning (AC). Aversive conditioning is the process where bears learn to alter certain problem behaviors through negative reinforcement of that behavior. It has become an increasingly important technique used by many wildlife management agencies for human-bear problems. It is designed to alleviate problems by altering behavior of the bear rather than removing the individual from the area or the population. Aversive conditioning techniques include the use of pepper spray (Capsaicin), emetic compounds, electric shocks (e.g. cattle prods), rubber bullets, or live-trapping/handling/release at the capture site.

In practice, the perceived effectiveness of aversive conditioning for reducing human-bear problems has had mixed results. The effectiveness of aversive conditioning at altering a bear's problem behavior may be affected by a bear's previous experiences associated with that

behavior. According to a nationwide survey conducted by VDGIF staff in 1997, black bear project leaders generally felt that aversive conditioning was, at best, only about 50% effective.

The public acceptability of aversive conditioning may be controversial. Strong negative reinforcement techniques may be viewed as cruel because they cause pain, discomfort, or illness.

Survey results. Aversive conditioning was used by 84% of the states. Compared to other options, aversive conditioning was less than adequate and mid-range in the perceived effectiveness (Fig. 3) and effort (Fig. 5). On average, it was the 5th most important technique importance (Fig. 4). Georgia provided a unique form of aversive conditioning in the form of lithium chloride, an emetic that is sometimes used to lace damaged beehives; ingestion by nuisance bears causes vomiting.

Use in Virginia. Depending on the specific circumstances, VDGIF staff may trap, aversively condition, and release the problem bear near the nuisance site. Rather than removing the individual from the area, aversive conditioning is designed to (and may) alter behavior through negative reinforcement. Aversive conditioning in Virginia generally entails capturing, immobilizing, ear tagging, tattooing, removing a tooth and releasing. Occasionally some biologists will utilize rubber buckshot as an additional disincentive to the bear.

Capture and Euthanize. Capture and euthanization can effectively target and remove specific bears involved in human-bear problems, eliminating future problems with that individual. In practice, capture and euthanization has generally occurred only in relatively rare situations where the bear is an immediate threat to human safety or has repeatedly been involved in human-bear problems. However, as a lethal control measure, capture and euthanization may be less socially acceptable than other non-lethal options. On an individual bear basis, can be cost effective; however, capture and euthanization can be expensive and labor intensive as a technique for population-wide management.

Survey results. Although the majority of states (74%) also used capture and euthanization (Table 1), it was generally not considered to be as important (Fig. 4) or effective (Fig. 3) as many other damage management options. Probably because of its relatively rare use in unique human-bear problems, it was considered a low-effort option (Fig. 5). While somewhat unimportant to the overall nuisance bear management, this is clearly an option most agencies need to use under some circumstances.

Use in Virginia. Capture and euthanizing is not popular with the public and has rarely been used in the past in Virginia. However, in recent years VDGIF staff has killed bears that exhibited bold and aggressive behavior or entered a home. During the period 1975 – 2000 a total of about 10-12 bears were destroyed. Since 2000, as bear numbers and complaints have increased, the number of bears destroyed by VDGIF staff has averaged about 4-6 per year.

Kill Permits. Kill permit programs generally are designed to alleviate site-specific, human-wildlife problems, particularly damage to agricultural commodities. Wildlife agencies have not used kill permits to manage black bear population levels; these programs for site-specific problems generally do not occur on a large enough scale to affect overall black bear populations.

In addition to effectively removing specific bears involved in human-bear problems, access to kill permits also might increase farmer tolerance for damage by giving them a sense of control over the damage situation.

Kill permit programs have some limitations. Kill permits may not be practical for some urban areas where the discharge of firearms could lead to public safety concerns. Substantial time investments may be required to remove specific animals. Persons issued kill permits would incur expenses in the time and equipment needed to remove bears. The kill permit option generally involves administrative costs to distribute permits and monitor use.

As a lethal control measure, kill permit programs may not be socially acceptable. Animal welfare groups often support nonlethal means for managing wildlife populations. Perceiving a loss in recreational opportunities, hunters sometimes object to bear removal from the population via kill permits. However, a 1997 study reported that controversy surrounding Wisconsin's kill permit program came from a vocal minority; hunters and farmers accepted the use of kill permits for reducing crop damage.

Survey results. Slightly more than half the states (58%) offer some form of kill permit to address problem bear issues (Table 1). Probably because of its site-specific potential, kill permits were ranked mid-range in effectiveness (slightly less than adequate) when compared to the other damage management options (Fig. 3). Because the public assumes most of the effort, the agency effort was relatively low (Fig. 5) with a relatively low overall importance to damage programs (Fig. 4).

Use in Virginia. As provided by Virginia State Statue §29.1-529, VDGIF game wardens issue permits any time of year to landowners who suffer agricultural damage from bears. Virginia has provided the option of kill permits since about 1950. Until the late 1990s very few permits were issued and very few bears were killed; increasing bear populations and a de-emphasis on relocation of problem animals, have resulted in an increase in the use of kill permits by the public. During the 4-year period, 2000-2004, a yearly average of 142 bear kill permits were issued to kill an average of 42 bears.

Bear Feeding Control Regulations. Often through strategically located feeding stations, supplemental feeding augments natural food supplies by providing additional food sources to bear populations. Black bears utilizing high-energy, human foods grow faster and mature earlier than bears utilizing only natural foods. Improved fertility through earlier sexual maturation, increased litter sizes, and fewer skips in the reproductive cycle appears to be common for black bears with supplemented diets.

Most human-bear problems often arise from bears exploiting human-related food resources. Supplementally fed bears (both intentionally and not intentionally fed) often are responsible for increased nuisance problems. Eliminating bear access to human-related foods, particularly in areas of high human use (e.g., parks, campgrounds), helps reduce human-bear problems. Bears in areas where regular feeding is taking place become food conditioned and habituated to humans. Bears lacking fear of humans may become dangerous; close encounters between habituated bears and humans are more likely to occur resulting in severe property damage.

Regulations controlling the supplemental access to human foods have decreased the human-bear problems in many areas (e.g., Gatlinburg, TN; Juneau, AK).

Proponents suggest that supplemental feeding may reduce competition for human-related food resources and minimize other human-bear problems. Bear damage to coniferous trees in Washington was reduced through a supplemental feeding program.

Survey results. About half of the states surveyed (53%) indicated that they restricted the feeding of bears with feeding regulations (Table 1). These regulations were not considered especially effective (Fig. 3). However, the associated effort was also relatively low (Fig. 5) and the overall importance to bear damage management programs was mid-range (Fig. 4). Most states that controlled supplemental feeding felt it was an important option.

Use in Virginia. Supplemental feeding of bears was banned in Virginia on USFS and VDGIF lands in 1999. Additional regulations enacted in 2003 expanded bear-feeding prohibition to all lands (4 VAC 15-40-282). Even inadvertent and unintentional food sources (e.g., bird feeders, trash, pet foods) would become illegal when complaints are received. Written warnings would be issued by wardens and summons written for non-compliance.

Repellents. Repellents are nonphysical deterrents that keep bears from entering certain areas or prevent the close approach by bears. They can be chemical compounds, loud noises, or guard animals. Their use is typically restricted to unique circumstances (e.g., confrontations on a trail, livestock problems).

Certain chemical compounds may prevent the close approach of bears. When sprayed directly in a bear's eyes, Capsaicin can be effective at repelling captive and free-ranging black bears. However objects or sites sprayed with Capsaicin did not repel bears but attracted bears to the object or site. Capsaicin is applicable only in situations of close human-bear contact and probably doesn't have broad application for reducing most forms of human-bear problem. Male human urine or ammonia mixed with bait was effective (67% of the time) at keeping bears from bait sites. Karelian bear dogs and sheep dogs have proven effective in keeping bears from frequenting areas or livestock guarded by these animals.

As a nonlethal form of control, repellents appear to be socially acceptable. Repellents also are relatively cost effective and readily available.

Survey results. Less than half the states (42%) utilized repellents to address problem bears (Table 1). For the circumstances under which repellents are used, they were considered to be relatively effective (Fig. 3) and required moderate effort (Fig. 5). Repellents were also rather low in importance to bear management programs (Fig. 4). Some states (32%) reported that they provided shell crackers, which are pyrotechnics that emit loud aerial noises when shot from a shotgun. New York loans propane canons that may have effective short-term results. Some states (21%) also provide rubber buckshot/slugs to discourage the bear from returning.

Use in Virginia. Other than providing technical advice, no VDGIF program provides much active support of repellent options.

Compensation Funds. Damage compensation programs for black bears provide landowners with financial compensation for damage caused by bears. Success of these reimbursement programs have had mixed results. While damage compensation programs may satisfy those receiving damage, they do not address the problem causing the damage. Without addressing the causal factors, damage is likely to persist and compensation programs may be self-perpetuating. Other limitations of reimbursement programs involve the assessment of damage, determination of the damage payment, program equitability, and adequate funding.

Costs associated with damage compensation programs would vary according to program guidelines. Costs associated with small-scale, single-species programs restricted to only reimbursements for the most significant damage may be affordable. However, expanded, large-scale programs aimed at reimbursing individuals for any damage incurred by any species become cost prohibitive.

The acceptability of damage compensation programs is unclear. Some private organizations (e.g., Great Bear Foundation, Defenders of Wildlife) are willing to establish compensation funds for damage caused by some species. However, studies have shown that farmers in the United States generally have preferred other nuisance management options to damage compensation. Surveys of the Virginia Chapter of The Nature Conservancy, Virginia State Beekeepers Association, and Virginia Bear Hunters Association reported that 47.4%, 66.5%, and 60.7% of their members, respectively, agreed that agricultural producers should be compensated for damage caused by black bears. Under Wisconsin's Wildlife Damage Compensation Program (1930-1979), landowners were dissatisfied with damage assessments and damage payments.

Survey results. Only about 1/3 (32%) of the surveyed states use damage compensation funds as part of their nuisance bear management program (Table 1). Maryland, West Virginia, Wisconsin, Vermont, Pennsylvania and New Hampshire provided some form of compensation funds for bear damage. Even among the states that used compensation, effectiveness was considered to be very low (Fig. 3) while expending a great deal of effort (Fig. 5). Overall, compensation is not a very important option among states for managing human-bear conflicts (Fig. 4). Table 2 shows the average annual compensation activity in these states. In addition to compensating for bear damage ($104,266/year), Wisconsin annually also distributes more than $3,000,000 in damage claims for many species (e.g., deer, bear, goose, turkey).

A wide diversity of approaches and conditions are tied to the existing damage compensation programs. For example, to place some responsibility with landowners, Pennsylvania's compensation program is restricted to damaged apiaries within 300 yards of the owner's residence; a second claim will not be honored unless a Commission-approved electric fence had been constructed. Pennsylvania will also pay for some livestock damage.

Use in Virginia. Since 1942, counties in Virginia have had the option to administer a damage stamp program to compensate landowners for damage caused by deer or bear. Local county governments administer the damage stamp system in counties that choose this option. To fund these programs, deer and bear hunters are required to purchase "Damage Stamps" to hunt in participating counties. Mostly concerned with deer damage, interest in this program peaked in

the late 1970s with 18 counties participating. Probably reflecting the same ineffectiveness expressed by other state management agencies (Fig. 3), county participation this compensation option has significantly declined due to concerns over insufficient funds and allocation of payments. Today, only Smyth County continues to participate in the damage stamp program in Virginia.

Off-Season Hunting. Special hunting seasons may help target nuisance bear problems that do not coincide with the traditional fall hunting periods. Shifting the harvest of nuisance bears to special recreational hunting opportunities can target nuisance periods, be more cost effective than other bear removal options, and help address the concerns about "wasting" bears taken by kill permits.

Survey results. Only 2 states (11%) provide some form of off-season hunting to manage problem bears (Table 1). Neither of the participating states (Minnesota and Wisconsin) felt that off-season hunting programs were effective (Fig. 3) or important (Fig. 4) options to manage problem bear issues. A positive aspect is that these off-season hunting options took relatively little effort (Fig. 5).

Use in Virginia. Virginia offers this option through the Bear Population Option Program (BPOP). BPOP is a site-specific bear management tool that allows landowners experiencing bear damage to use hunters to kill (or chase) bears outside traditional hunting seasons and during the period of the year when damage occurs. During 2003, 3 landowner's harvested 5 bears under BPOP permits. Two BPOP permits were issued in 2004 and so far 3 have been issued in 2005. A hunting license is required and the bear must be registered at a bear check station; however, bears harvested on a BPOP permit do not count against the yearly bag limit for bears. The bag limit on bears in Virginia is one per season, but an additional bear may be killed on a BPOP permit.

Fertility Control. Chemical contraception by steroids, estrogens, and progestins has been studied since the 1960s. Although studies have identified successful methods of inhibiting reproduction, they have not led to the development of a viable wildlife management technique. Therefore, chemical contraception currently is impractical for broad-scale population and damage control. The concept of immunocontraception (vaccines that stimulate the body's immune system to stop production of antibodies, hormones, or proteins essential for reproduction) is a recent technology that might lead to a viable wildlife management technique. However, current immunocontraceptive technology is practical only for laboratory studies, pen studies, and limited field applications.

Most of the fertility control research and applications have been directed at the management of deer populations. Insufficient research exists with respect to the use and effectiveness of fertility control agents on black bears. Until the efficacy, health impacts, behavioral changes, method of administration, and costs are determined, fertility control will not be a viable option for black bear population management.

Survey results. Reflecting the lack of development in the technique, no state indicated the use of utilized fertility control as an option for managing problem bears (Table 1). As such, it was the least important option (Fig. 4).

Use in Virginia. As a concept still in the research and development stage, this is not a management option used anywhere in Virginia.

Conclusions

No damage management option was considered to be completely effective by other state management agencies (Fig. 3); in fact, most available techniques were considered to be less than adequate for managing nuisance bear problems. The only options considered to be relatively effective and important (Fig. 4) were exclusion devices, regulated hunting, and public education. Despite being the techniques that required the greatest effort (Fig. 5), exclusion devices and public education were still among the most commonly used approaches (Table 1). Although commonly promoted by agricultural producers, compensation for damage was only used by 32% of the surveyed states (Table 1), considered to be relatively ineffective (Fig. 3), and was among the options requiring the greatest amount of effort (Fig. 5).

It is obvious that no single management approach is best for managing human-bear conflicts in every circumstance; most options have useful applications in specific situations. Therefore an integrated approach, using multiple management options, is necessary to manage the diversity of nuisance bear problems. Selection of the appropriate management option(s) will be determined by public concerns, extent of damage, type of conflict/damage, black bear biology, public safety, animal welfare, available control methods, and agency resources.

The VDGIF has employed most of the nuisance management options to address bear problems in Virginia. Having a diversity of techniques helps address the variety of nuisance situations that involve bears. Relative to the effective techniques identified in the survey of other state agencies (Fig. 3), Virginia has been very proactive in the implementation of regulated hunting to manage bear problems. However, added VDGIF emphasis on the other effective approaches (public education and exclusion devices) would likely improve the overall nuisance concerns by Virginia citizens. Among the more expensive options (i.e., those that required high effort, Fig. 5), additional agency resources or shift in priorities would be necessary to enhance these education and exclusion capabilities for nuisance bear management.

POLICIES OF FEDERAL LAND-MANAGEMENT AGENCIES

The primary bear-management issues in Virginia address population regulation of black bears and human-bear problems.

> Population Regulation. Population objectives for black bears are designed to increase, decrease, or stabilize population levels in a given area. These specific population objectives can be achieved through a variety of appropriate management strategies. The

Virginia Black Bear Management Plan Bear identifies growth or stability as the population objectives for various areas of the Commonwealth (Fig. 2). "Where it is necessary to control … bear population numbers," the Plan further recognizes that "regulated hunting will be the primary population management option."

Human-Bear Problem Management. The bear population size in a given area will impact the prevalence of human-bear problems. Generally as black bear populations increase and bears encounter humans more frequently, human-bear problems also increase. As black bear populations decrease, human-bear problems generally decrease. Although general population management for bears will help with nuisance concerns, other management options (e.g., exclusion devices, education) will still be necessary to more specifically address human-bear problems.

Federal agencies manage a variety of properties in Virginia, including National Parks, National Wildlife Refuges, National Forests, military bases, research facilities, and impoundments. The US Forest Service (USFS), National Park Service (NPS), and the US Fish & Wildlife Service (USFWS) manage the vast majority of Federal land containing viable black bear populations. Based on land area, the specific properties that likely have the greatest impact on bear management issues in Virginia are the George Washington/Jefferson National Forest of the USFS, Shenandoah National Park of the NPS, and the Great Dismal Swamp Wildlife National Wildlife Refuge of the USFWS.

Because almost all human-bear problems in Virginia occur on private property, Federal land-management policies should have little impact on many options specifically designed to alleviate nuisance bear issues for private landowners (e.g., education, exclusion devices). However, Federal policies that affect population management capabilities could impact the attainment of regional population objectives (Fig. 2) and the nuisance problems associated with high bear populations. Because regulated hunting is the most important option to manage bear population levels and is among the most effective strategies to manage bear damage (Fig. 3), the following review of Federal policies that impact Virginia's ability to manage bears will focus on influences that affect population management options (specifically as these influences relate to regulated hunting).

George Washington/Jefferson National Forest

The largest land manager in Virginia is the US Forest Service. At approximately 1.7 million acres (2660 mi^2), the George Washington/Jefferson National Forest (GW/Jeff) extends from Frederick County in the northwest mountains for more than 300 miles to Lee County in the far southwest. The majority of Virginia's black bears are probably found on the GW/Jeff or adjoining private lands.

Through Congressional approval of the Weeks Act in 1911, Virginia's National Forests were established to protect and reform deforested landscapes. Totaling 13,450 acres, the first land purchase for National Forests in Virginia occurred in the Mt. Rogers area in 1911 and later became part of the Unaka National Forest in 1920. Established in 1916, the Natural Bridge National Forest was Virginia's first National Forest. The Jefferson National Forest was created

in 1936 by combining lands from the Natural Bridge and Unaka National Forests. Later renamed the George Washington National Forest, Shenandoah National Forest was created in 1917.

In 1938, the Virginia Game Commission and the U.S. Forest Service executed a formal agreement to fund additional wildlife habitat and management work on National Forests within the state. A required purchase by hunters and fisherman, the National Forest Permit continues to support cooperative wildlife management on US Forest Service lands in Virginia today.

Today's mission of the US Forest Service is to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations. Under the National Forest Management Act, the Forest Service is charged with providing for a diversity of plant and animal communities consistent with overall multiple-use objectives. Within these charges, a wildlife goal of the 2004 Jefferson National Forest Land and Resource Management Plan is to "maintain and restore natural communities in amounts, arrangements, and conditions capable of supporting native and desired non-native species. Provide quality wildlife-based recreational opportunities to the public, including hunting, fishing, and wildlife viewing." An area of emphasis is to provide "optimal habitat for black bears."

Relative to bear management, the George Washington/Jefferson National Forest has population and recreation goals that are very similar to the VDGIF. With hunting recreation as a stated goal of the George Washington/Jefferson National Forest, the full influence of bear hunting as a population management and damage management tool can be achieved on Forest Service lands. The common goals (especially the support for recreational hunting) and cooperative relationship between the VDGIF and the George Washington/Jefferson National Forest have been keys to effective management of bear populations on and around US Forest Service property in Virginia.

Shenandoah National Park

The creation of Shenandoah National Park (SNP) in 1936 provided needed protection for bears and bear habitat. Shenandoah National Park runs along the Blue Ridge Mountains for about 70 miles from Front Royal south to Waynesboro. Comprising 197,411 acres (308 mi^2) of mixed hardwood/pine forest types in older age classes, SNP is home to one of the densest black bear populations in North America.

The absence of harvest with the associated high bear populations probably have the greatest impact on the population and damage management programs around SNP. With no hunting or harvest allowed, SNP has largely served as a protected sanctuary for black bears in the area. Research has shown that many bears, especially males, on SNP have home ranges that do extend into the surrounding private lands. However some females, which have much smaller home ranges than males, may spend their entire lives within the boundary of the Park. Bear sanctuaries (like SNP) have been used effectively by some states (e.g., North Carolina, West Virginia) to protect core populations of breeding females to increase or maintain high bear population levels.

As a consequence of these locally high bear populations, more than 56% of all nuisance complaints in Virginia occur in 8 of the 10 counties near Shenandoah National Park. Vehicle collisions with bears around SNP also have become increasingly problematic.

In order to provide some relief for nuisance concerns, to stop bear population growth, and to meet the bear population objectives around the Park (Fig. 2), the VDGIF recently liberalized bear hunting seasons near SNP. While the bear harvest has increased, it remains doubtful that hunters harvest enough females from the refugia of SNP to have the fully desired impact on population growth.

The National Park Service was created in 1916 to "to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." Except for recreational fishing, the harvesting of wildlife is generally not a feature of National Park Service management programs. Even so, procedures do exist that allow animals to be harvested under special circumstances. According to the National Park Service Management Policies (2001), "the Service will not intervene in natural biological or physical processes, except:

- When directed by Congress;
- In some emergencies in which human life and property are at stake;
- To restore natural ecosystem functioning that has been disrupted by past or ongoing human activities; or
- When a park plan has identified the intervention as necessary to protect other park resources or facilities."

The Park Service Management Policies further clarify that "biological … processes altered in the past by human activities may need to be actively managed to restore them to a natural condition or to maintain the closest approximation of the natural condition in situations in which a truly natural system is no longer attainable. Prescribed burning and the control of ungulates when predators have been extirpated are two examples." The Policies even indicate that "public harvesting of designated species of … animals … may be allowed in park units when hunting … or other harvesting is specifically authorized by statute or regulation and not subsequently prohibited by regulation."

The Code of Federal Regulations (36 CRF Chapter 1, Part 2, Section 2.2) also addresses the circumstances under which hunting is allowed in National Parks. "Hunting shall be allowed in park areas where such activity is specifically mandated by Federal statutory law. Hunting may be allowed in park areas where such activity is specifically authorized as a discretionary activity under Federal statutory law if the superintendent determines that such activity is consistent with public safety and enjoyment, and sound resource management principles. Such hunting shall be allowed pursuant to special regulations."

Harvest or hunting on National Park lands could be a management option, but many stipulations exist about the associated justification, monitoring, and management requirements. Even though harvest of bears from SNP would probably help address bear population objectives and damage issues for the VDGIF, Park Service experiences would suggest that the administrative realization of this type of removal would very difficult. In addition, SNP objectives would have to be balanced with VDGIF bear management needs.

While the joint effort to address Virginia's bear management issues has been relatively small, a good working relationship exists between the SNP and VDGIF. A Memorandum of Understanding between the Shenandoah National Park and the Virginia Department of Game & Inland Fisheries strengthens this relationship. Among many points, this Memorandum recognizes a need:

- To coordinate efforts to attain the respective wildlife management objectives.
- To manage wildlife populations in and adjacent to the Park.
- To recognize that management of wildlife resources in or adjacent to the Park may differ between agencies.
- To cooperate with the development of activities designed to reduce damage to private property.

The Virginia Black Bear Management Plan also recognized the need to cooperatively work with Shenandoah National Park to achieve management objectives. A Plan strategy suggests a need to "cooperate with Shenandoah National Park … to meet the CCC objectives of adjacent land ownerships through implementation of appropriate population management programs (e.g., habitat management, hunting, other options)." The Plan also recognizes that some site-specific damage issues will be difficult to address by managing populations with hunting regulations. In particular, unique management approaches would be necessary to mitigate agricultural damage associated with large refuge areas like SNP.

Great Dismal Swamp National Wildlife Refuge

Over the past two centuries, humans have significantly altered the landscape around the Great Dismal Swamp in southeast Virginia. Encroachment by agricultural practices, commercial development, and residential growth has destroyed much of the former habitat for bears. The establishment of the Great Dismal Swamp National Wildlife Refuge (GDSNWR) through the Dismal Swamp Act in 1974 has helped protect valuable habitat for Virginia's eastern bear population. Located within the city limits of Chesapeake and Suffolk, the GDSNWR contains about 111,000 acres (174 mi^2), in both Virginia and North Carolina. The GDSNWR is one of 13 different individual refuges of the National Wildlife System in Virginia, but is the only refuge with significant populations of black bears.

Since the creation of the GDSNWR, no hunting for bears has been permitted and the GDSNWR has served as a sanctuary for black bears that has facilitated population growth. Research in the 1980s estimated the bear population on the GDSNWR to be about 300 bears. Continuing urban growth around the GDSNWR has not only resulted in an increasing isolation of the bears in the region, but it also has increased the incidence of problem bear complaints, agricultural damage, and bear/vehicle collisions.

The National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 (NWRSIA) proclaims that "the mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." A major goal of the Refuge System is "to foster understanding and

instill appreciation of … wildlife … and … conservation, by providing the public with safe, high quality, and compatible wildlife-dependent public use." The NWRSIA further specifies six priority wildlife-dependent uses (hunting, fishing, wildlife observation and photography, and environmental education and interpretation) by the public for recreation on National Wildlife Refuges. "To the maximum extent possible, issues dealing with hunting … regulations should be consistent with state rules and regulations. In addition, issues dealing with management of fish and wildlife habitat should be consistent with state fish and wildlife conservation plans and policies." Today, the refuge system offers hunters a diversity of hunting experiences on more than 300 of the 535 National Wildlife Refuges throughout the Untied States.

While there is a clear expectation that National Wildlife Refuge hunting programs should be consistent with state agency regulations and plans, bear hunting has not yet been permitted by the US Fish & Wildlife Service on the GDSNWR. Hunting for other game species, including deer, has been permitted on the Refuge. To assist the VDGIF with meeting bear population management and nuisance goals around the Refuge, the USFWS staff at the GDSNWR has worked toward implementing a bear-hunting season for about the last 10 years. During this period, GDSNWR staff has addressed National Environmental Protection Act (NEPA) requirements, administrative challenges, and threats of litigation related to bear hunting proposals. Several proposed hunts have been cancelled (most recently for fall, 2005); optimistic efforts are under way to initiate a bear hunt for the 2006 hunting season.

As with Shenandoah National Park, the Virginia Black Bear Management Plan also recognized the need to cooperatively work with the GDSNWR to achieve management objectives. Per the Black Bear Management Plan, VDGIF staff has been actively cooperating with the GDSNWR "to meet the CCC objectives of adjacent land ownerships through implementation of appropriate population management programs (e.g., habitat management, hunting, other options)." When finally implemented through joint GDSNWR and VDGIF efforts, bear hunting on the GDSNWR will be a significant step toward managing bear populations and damage in the region.

Summary

Recreational hunting is the key management tool for managing bear populations throughout Virginia. The diverse missions of the various federal land-management agencies in Virginia can create unique problems for managing black bear populations and associated damage. Very few constraints accompany bear population management programs (i.e., hunting seasons) on US Forest Service lands in Virginia. Despite clear expectations that National Wildlife Refuges have hunting as a primary recreational focus, the administrative realities of implementing bear hunting seasons on the Great Dismal Swamp National Wildlife Refuge has been very problematic. Harvesting bears, or any wildlife, on National Park Service lands to meet regional population or damage management objectives would be especially challenging for Shenandoah National Park. While mechanisms exist to harvest/hunt wildlife to meet unique management needs, the different focus and mission of the National Park Service guaranties that implementation of harvest management options would be administratively difficult and extremely unlikely. Maintaining the cooperative relationships that VDGIF currently has with its federal land-management partners will be vital in achieving the respective goals of all the agencies.

Table 1. Prevalence of bear damage management options used by state wildlife agencies (n=19) [1] in the eastern and mid-western US.

Bear Damage Management Options	States Using this Option	
	%	N
Public Education	100	19
Regulated Hunting	89	17
Exclusion Devices	89	17
Capture and Relocation	84	16
Capture and Aversive Condition (AC)	84	16
Capture and Euthanize (C/E)	74	14
Kill Permits	58	11
Bear Feeding Control Regulations	53	10
Repellents & other Aversive Conditioning	42	8
Compensation Funds	32	6
Off-Season Hunting	11	2
Fertility Control	0	0

[1] The surveyed states are Arkansas, Connecticut, Georgia, Florida, Maine, Massachusetts, Maryland, Michigan, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, South Carolina, Tennessee, Vermont, West Virginia, and Wisconsin.

Table 2. Annual average payments and claims for bear damage compensation (5-year average)

	Annual Payments	No. of Claims	Avg. Payment / Claim
Wisconsin	$104,266	74	$1,409
West Virginia	$75,201	159	$473
Pennsylvania	$12,182	56	$218
New Hampshire	$9,500	30	$317
Vermont	$4,819	19	$254
Maryland	$4,000	15	$267
		Average	$595

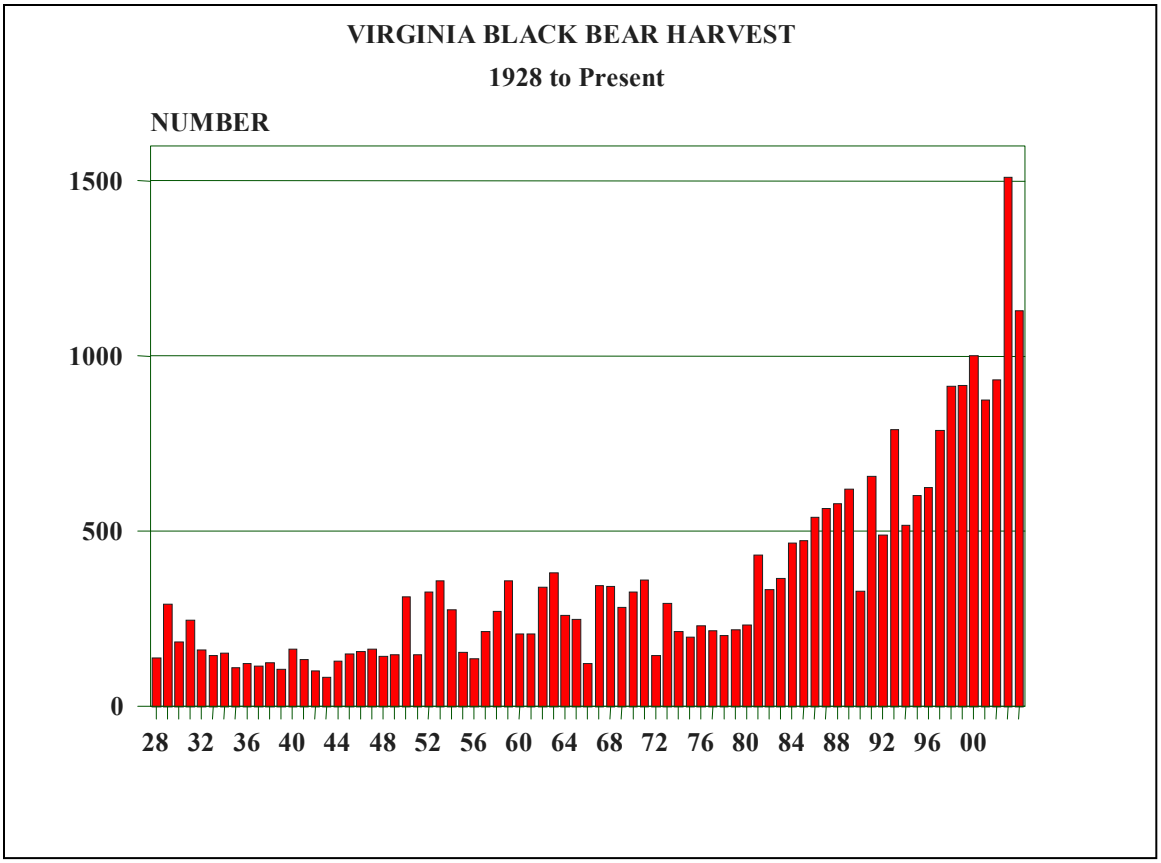

Figure 1. Statewide black bear harvest in Virginia (1928 - 2004).

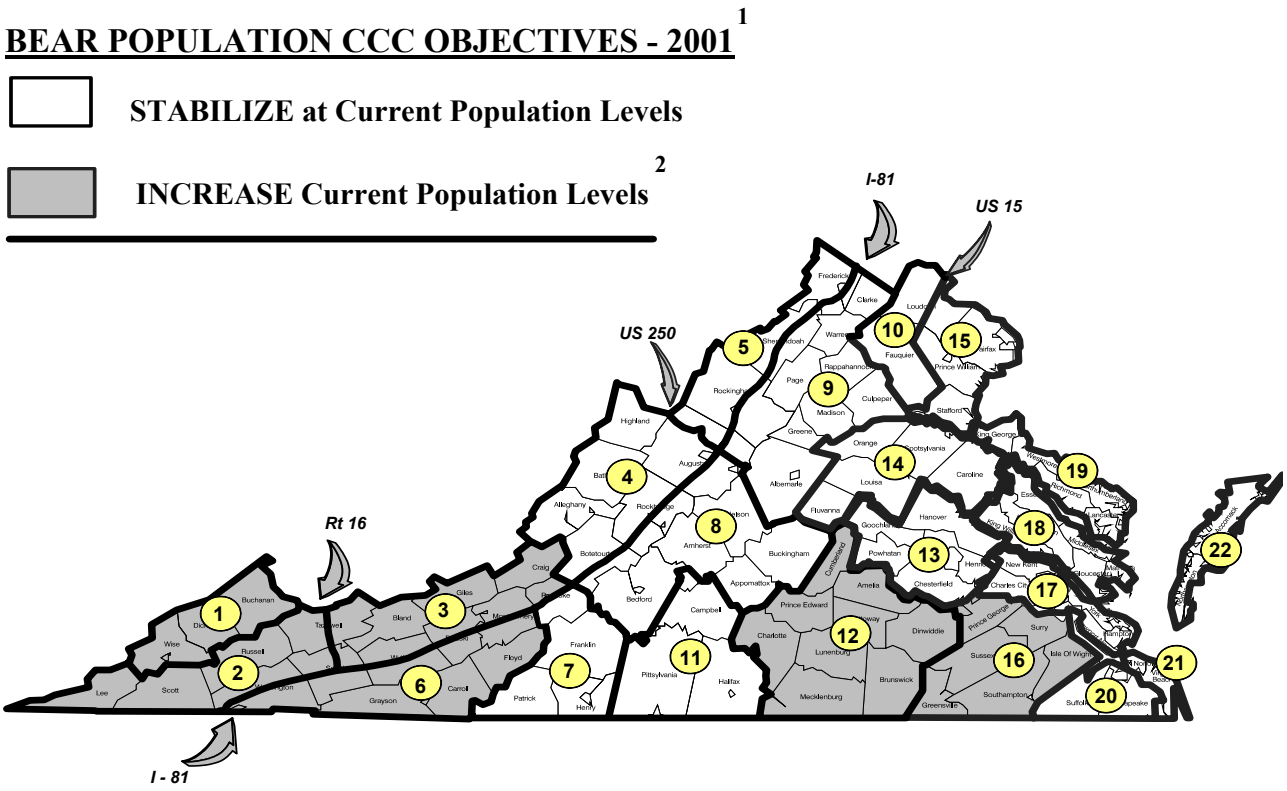

Figure 2. Population management objectives for black bears in Virginia.

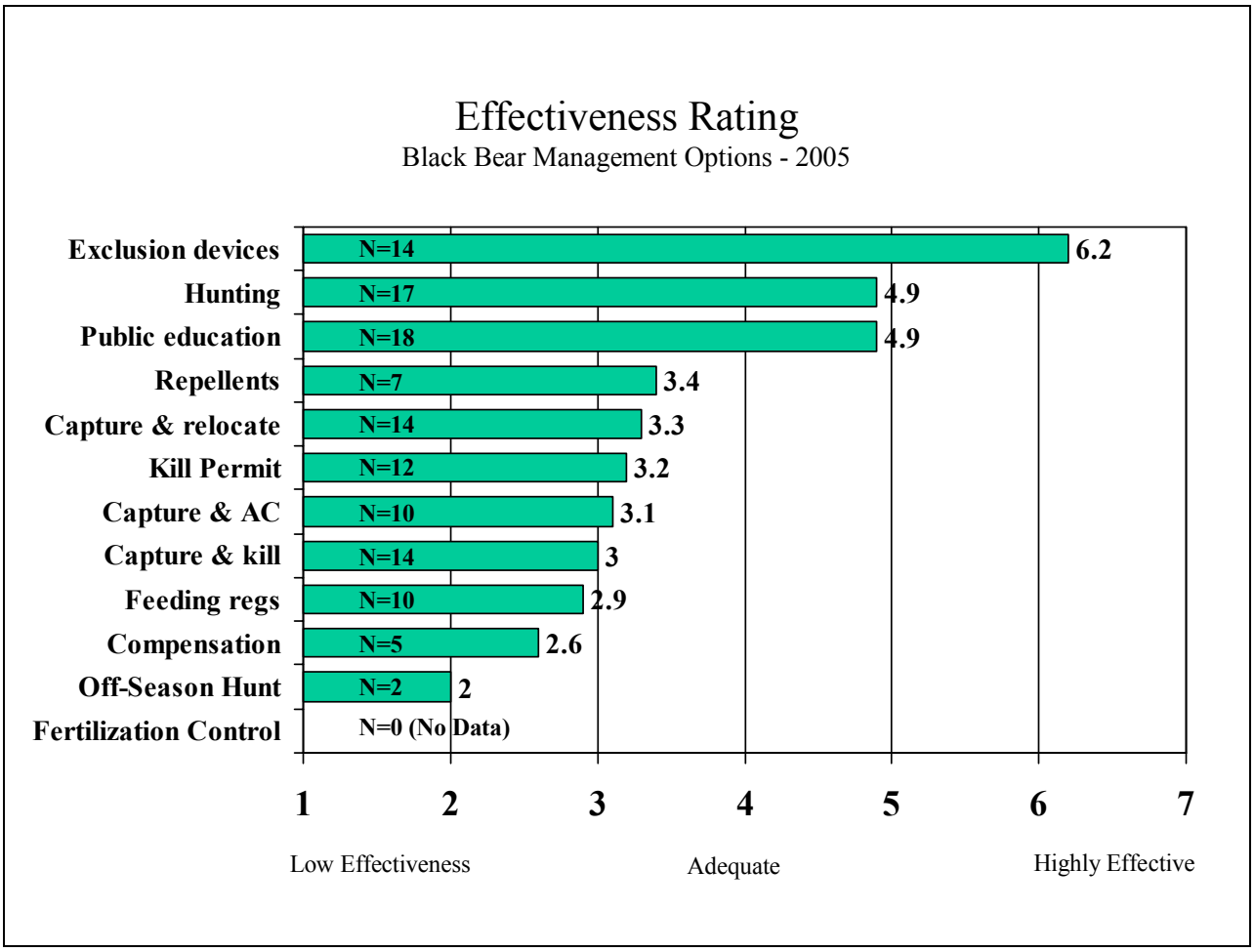

Figure 3. Effectiveness ratings by state wildlife agencies in the eastern and mid-western US that used different bear damage management options (N = the number of states that used the option and responded to the survey question).

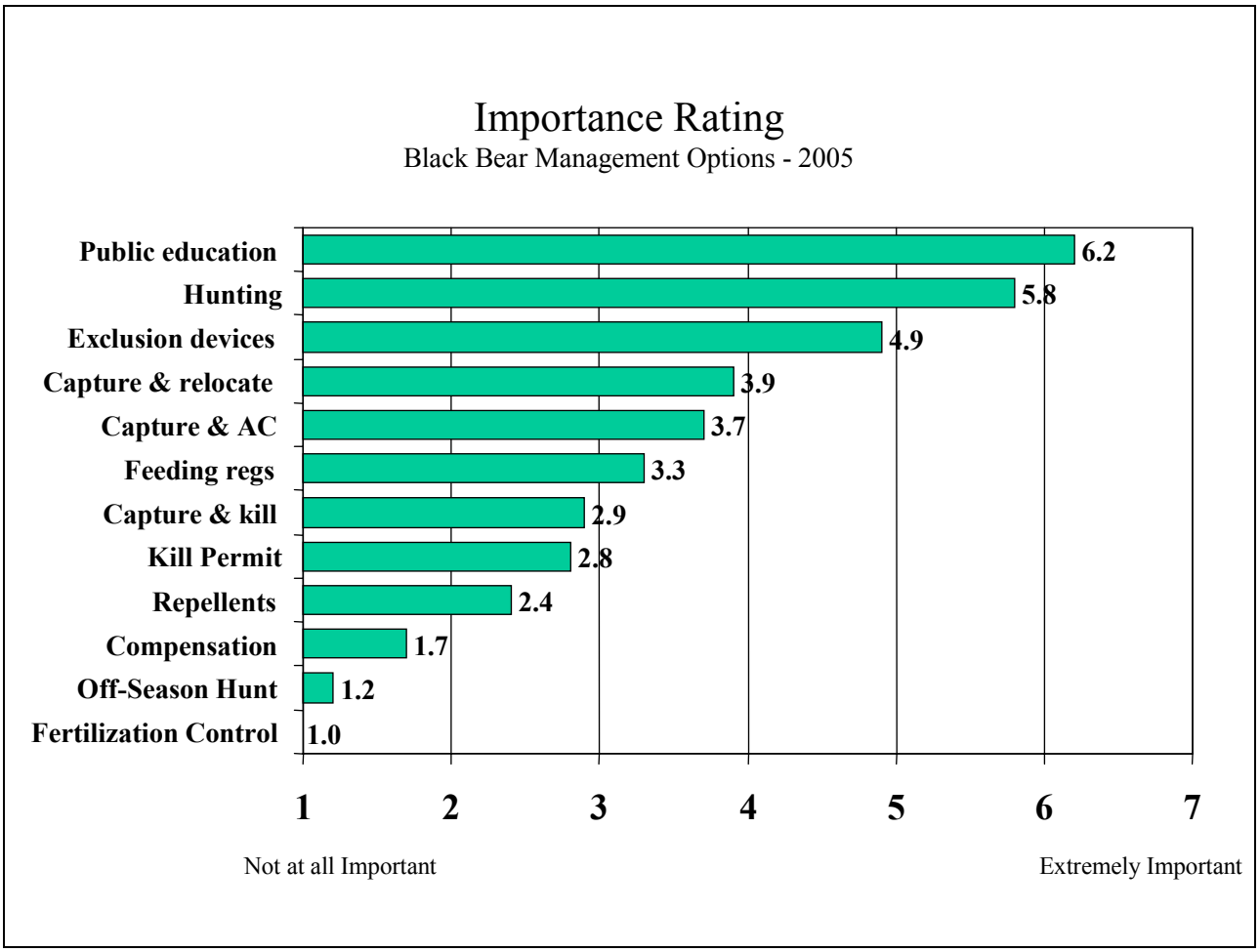

Figure 4. Importance ratings by state wildlife agencies in the eastern and mid-western US for different bear damage management options (all 19 states provided importance ratings, regardless of whether they used the technique or not).

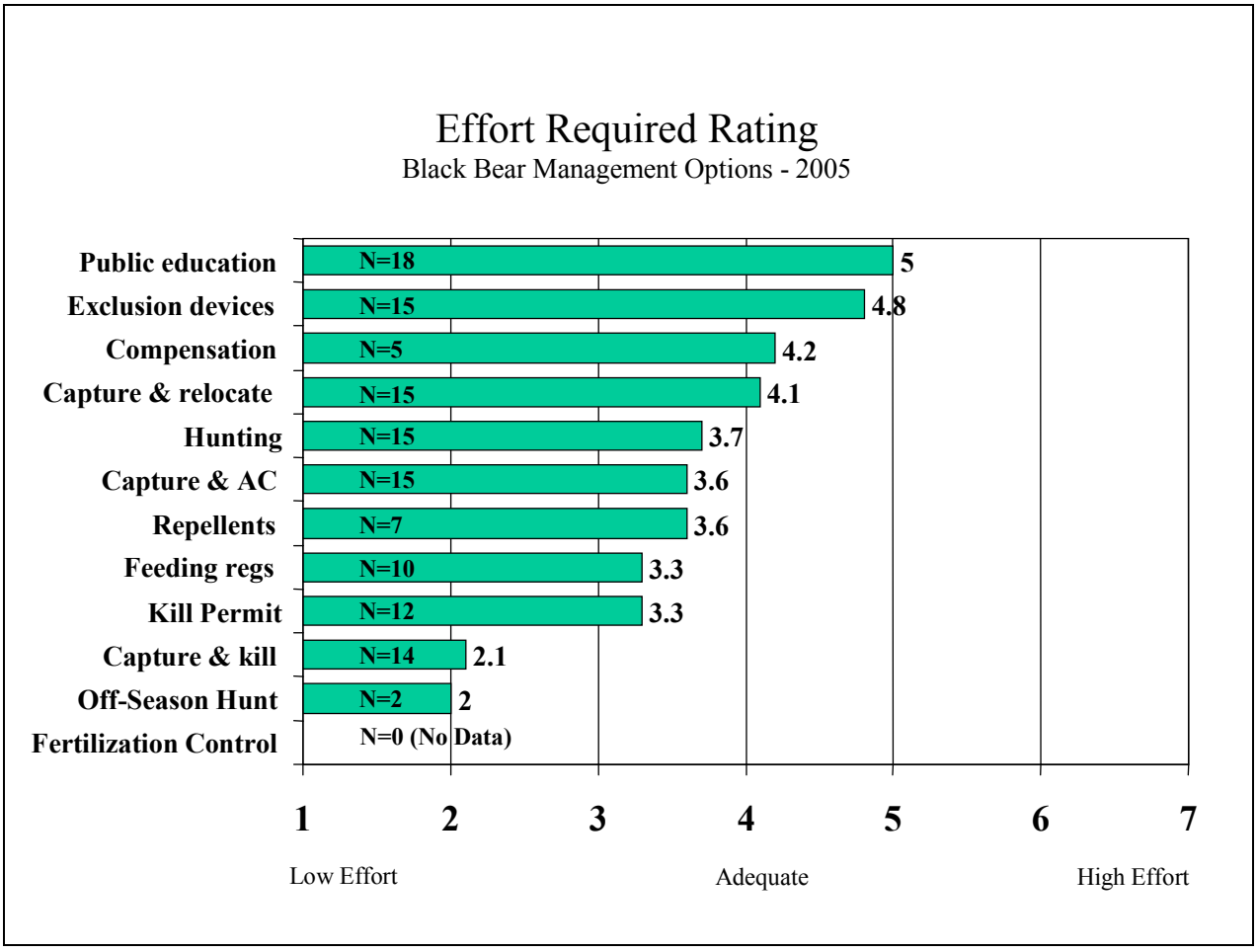

Figure 5. Effort ratings by state wildlife agencies in the eastern and mid-western US that used different bear damage management options (N = the number of states that used the option and responded to the survey question).