Black Bear Conservation Plan for California

April 2024

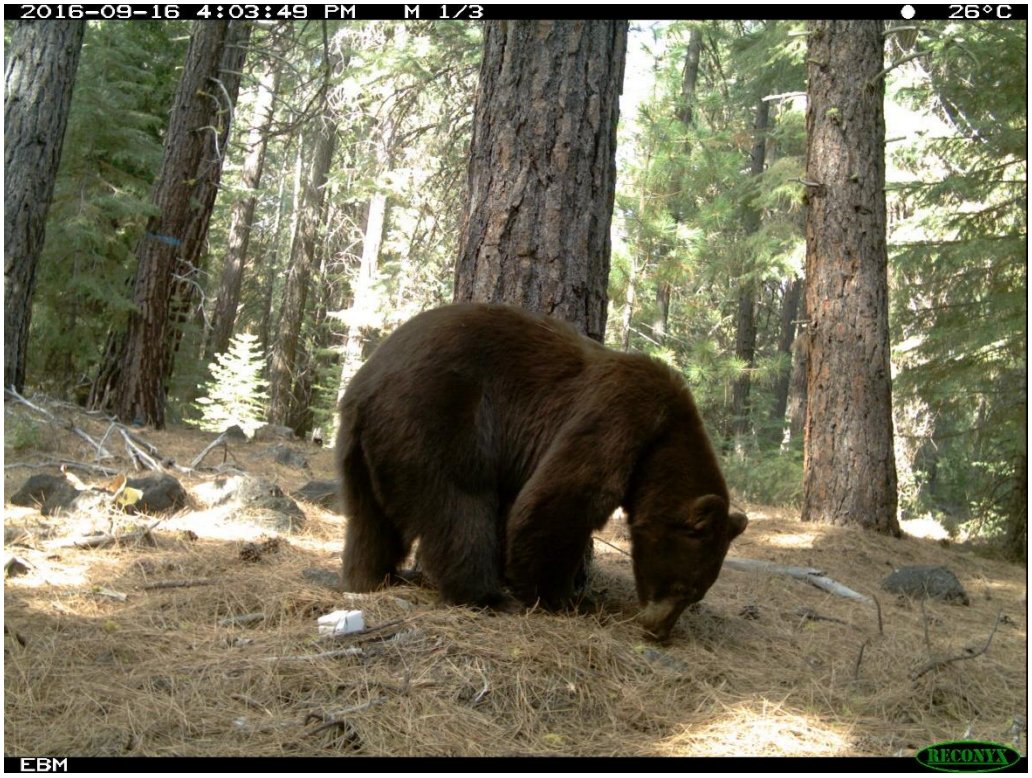

Photo: CDFW Ecoregional Biodiversity Monitoring Project, Northern Region. Camera traps are one of the science tools used to monitor black bear populations throughout California, and this information is used to guide black bear conservation.

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Table of Contents

List of Figures

List of Tables

Chapter 1. Introduction

The American black bear (*Ursus americanus*) is an iconic species that garners a high degree of public interest in California, as it does across North America (Graber and White 1983, Klip 2012). The relationship between black bears and people is complex, however, and public attitudes and opinions concerning black bears are diverse (Siemer et al. 2023). Black bears are highly valued for various reasons. For example, black bears are culturally significant to many Native American Tribes, are a favored game species to many hunters, are sought after for viewing and photography opportunities, and are widely recognized for their intrinsic value and ecological role as an omnivorous predator. Black bears can also be a source of conflict when they use areas of high human activity (i.e., they become habituated to people), seek out anthropogenic food sources and cause property damage (i.e., they become food-conditioned), prey upon livestock, contribute to reducing ungulate populations (Monteith et al. 2014, Wittmer et al. 2014) below desired management thresholds, or threaten public safety through aggressive or predatory behavior (Hopkins et al. 2010). Given the diverse array of values surrounding black bears, a comprehensive statewide plan guiding their conservation is necessary.

It is difficult to define the differences between wildlife conservation and management, however, the former terminology is broader than the latter, such that conservation can include management. Further, Fish and Game Code (FGC) 1801 declares wildlife "conservation" a policy for California. For these reasons, this document is referred to as a "conservation plan" which considers both passive and active management strategies for maintaining black bear populations throughout California while mitigating sources of human-black bear conflict (HBC).

The previous black bear "management plan" of the California Department of Fish and Wildlife (CDFW) was developed more than two decades ago (CDFW 1998) when black bear population size estimates were based on less contemporary methods than what is currently available. Until recently the CDFW applied an indirect population modeling approach using age information inferred from tooth samples collected annually by hunters (Fraser 1976). While annual age data remains an important source of information, this modeling approach has long been recognized to be error prone, especially when there are changes in hunter effort and other analytical assumptions (Harris and Metzgar 1987). At an April 2022 meeting of the Fish and Game Commission ("Commission"), the CDFW presented preliminary results of an updated, more accurate, integrated population modeling approach to make better use of black bear age data and other data sources

(CDFW 2022b) and committed to revise its management plan to include details about improved black bear population monitoring.

CDFW is the state trustee agency responsible for the conservation of wildlife and their habitats (FGC 1802). It is charged with implementing and enforcing regulations set by the Commission, as well as providing biological data and expertise to inform Commission decision-making on a wide variety of issues affecting wildlife. The Commission enacts wildlife regulations in a manner that considers information on populations, habitat, food availability, and animal welfare (FGC 200-203). Issues of regulation include recreational harvest, use of protected areas, permitting of wildlife rehabilitation facilities, and listing of species under the California Endangered Species Act, among others. State policy set by the legislature recognizes a balance between protecting wildlife for their intrinsic and ecological values; providing for beneficial and recreational uses including regulated hunting; and mitigating economic, human safety, and public health damages caused by wildlife (FGC 1801). An essential concept recognized in this policy is that wildlife is a renewable resource and that, through regulated management, abundant and thriving populations can be perpetuated.

Through California Executive Order B-10-11(2011), state policy reaffirmed that California Native American Tribes have sovereign authority over their territories and activities, and thus cross-jurisdictional issues require effective government-to-government consultation between state agencies and Tribes. The policy of the CDFW is to notify and consult with Tribes regarding proposed activities affecting fish, wildlife, and plant resources and other Tribal interests, and to encourage collaborative relationships resulting in co-management of resources, such as black bears (CDFW 2014).

Black bears are classified as a game mammal in California (FGC 3950) such that regulated hunting of the species includes licensing, fees, harvest season and area, and other restrictions (14 CCR 365, 366, 367.5, FGC 4750-4763). The CDFW also manages black bears associated with HBC, which may include issuing lethal depredation permits when non-lethal efforts to address problems prove ineffective (FGC 4181, CDFW 2022a). The current decision-making process for addressing HBC and other related issues such as animal welfare is described in a policy developed by CDFW (2022a).

Regulated hunting has been a central component of wildlife conservation in California and throughout North America for over a century (Geist et al. 2001, Organ et al. 2012). For example, CDFW conservation activities that benefit both game and non-game species alike (e.g., population monitoring, research, land acquisition, habitat improvement, law

enforcement etc.) are substantially funded by revenues generated from hunting license fees and from taxes on firearms and ammunition pursuant to the Pittman–Robertson Federal Aid in Wildlife Restoration Act of 1937. Additionally, partnerships between CDFW and hunting-focused non-government organizations (NGOs) play important roles in habitat creation and protection that benefit a wide variety of species. Specific to black bears, hunters also provide CDFW with tooth samples from harvested animals. Age estimates from these samples constitute a key source of scientific data that is critical to efficient estimation and monitoring of black bear populations throughout California.

Changing societal views towards hunting highlight the need for wildlife managers to ensure they are adequately considering the perspectives of non-hunters (Peterson and Nelson 2017). Wildlife managers have also been criticized for undervaluing the perspectives and contributions of Native Americans—both those that hunt and those that do not—to wildlife conservation (e.g., Hessami et al. 2021). Recognizing these concerns, the Commission has a policy statement addressing justice, equity, diversity, and inclusion that acknowledges prejudices and barriers experienced by historically marginalized and underserved communities regarding access to nature and regulatory decision-making processes (FGC 2022). This policy commits the Commission to a set of actions for correcting these inequities. The CDFW shares this goal; it will seek to broaden input beyond traditional constituencies while continuing to value hunting as an important tradition and management tool.

In consideration of the background and history summarized above, CDFW's goals for black bear conservation apply to both black bears and people:

Black Bear Conservation Goals:

1. Conserve black bear populations that are abundant, disease-resilient, and genetically diverse statewide and regionally, and conserve and enhance their habitats.

2. Provide opportunities for black bear hunting, viewing, and public education; minimize human-black bear conflict; consider animal welfare in black bear conservation; and be inclusive of all Californians in black bear conservation decisions.

CDFW's approach to achieving these goals includes monitoring black bear populations and using these data in an adaptive and structured decision-making process to inform conservation actions and policies about hunting, other human interactions with black

bears, and responses to climate change, land use, and other conservation stressors. This black bear conservation plan includes background on black bear biology (Chapter 2) and the ecological and social framework for black bear conservation (Chapter 3), describes the monitoring and modeling approach for tracking black bear populations (Chapters 4 and 5), explains how this information will be applied in decision making (Chapter 6), and lists the resources and next steps needed to successfully implement the plan (Chapter 7). Specific recommendations about hunting rules (e.g., tag quotas, season dates. methods of take) for black bears will not be made in this plan. However, the information in this plan and the implementation thereof will inform future regulations to establish or adjust hunting seasons for black bears (FGC 302). Additionally, those rule changes generally require changes to Title 14 regulations by the Commission or statutory changes to Fish and Game Code by the California Legislature.

Chapter 2. Black Bear Biology and Ecology

2.1 Physical Characteristics

Black bears are large, heavily built carnivores. Adult females typically weigh between 45 and 90 kg, and adult males typically weigh between 70 and 160 kg, with some individuals exceeding 220 kg (Lariviere 2001). Bears in excess of 300 kg have been found in places where anthropogenic food sources are abundant. Pelage color is generally uniform and varies from cinnamon, tan, brown, or black. White patches may occasionally occur on the chest (Lariviere 2001).

2.2 Denning

Black bears typically hibernate during the winter months in response to a seasonal shortage of food. In contrast to other winter-hibernating mammals that reduce their metabolic rate by >90% and body temperature to near 0^0 C (e.g., rodents), black bears only reduce their metabolic rate by 20-50% and maintain a near normal body temperature, which allows them to quickly react to danger (Hellgren 1998, Stenvinkel et al. 2013). Other hibernating mammals are slow to arouse because they must gradually warm themselves.

During hibernation, black bears remain inactive without eating, drinking, urinating, or defecating. This too differs from other hibernating mammals, which must arouse every 4-10 days to feed, defecate, and urinate (Folk et al. 1976, Hellgren 1998). Hibernating animals recycle waste products (e.g., urea), preserve muscle and bone mass, and do not acquire bed sores—adaptations that are of interest to medical practitioners seeking to improve human health in areas such as heart and kidney disease, muscle wasting, obesity, osteoporosis, etc. (Stenvinkel et al. 2013, Berg von Linde et al. 2015). Under the constraints of hibernation, adult female black bears also experience the physiological demands of gestation, parturition, and lactation, which other hibernating mammals do not experience.

Most black bears in California hibernate each year, but if sufficient food resources are available some black bears, particularly males, may remain active all winter (Graber 1989). Black bear dens are often in tree cavities, rock or brush piles, underground burrows, or open-ground beds (Lariviere 2001). In California, other common documented den sites are talus slopes and cavities in downed logs or at the base of trees (Graber 1982, Koch 1983, Braden 1991, Stafford 1995). Occasionally, black bears sometimes den in anthropogenic structures (e.g., crawl spaces and under decks, Schafer et al. 2018).

2.3 Reproduction

Litters of 1-4 cubs are born during January-February. Mothers and cubs typically emerge from their dens during April-May. Cubs remain with their mothers through the following winter, and then separate prior to the breeding season (e.g., June-July). In total cubs remain with their mothers for approximately 16 months (Lariviere 2001).

Reproductive success in female black bears is related to abundance and availability of quality food (Elowe and Dodge 1989, Costello et al. 2003). As adult female nutrition increases, reproductive parameters likely change in the following order: litter size increases, age of first reproduction decreases, yearling survival increases, cub survival increases, and interbirth interval decreases (Noyce and Garshelis 1994).

Adult females generally breed every other year but may breed in consecutive years if a litter is lost. Reproductive parameters of black bears in California are generally unknown outside of Yosemite National Park, where Graber (1982) and Keay (1990) reported mean litter sizes ranging from 1.6 to 2.0, a mean age of first reproduction of 4.2 years, and a mean interbirth interval of 2.5 years.

2.4 Mortality

Mortality rates for black bears are relatively high during the first few years of life (18-47%; Kolenosky 1990) and common causes of death include cannibalism, starvation, and abandonment (LeCount 1987, Elowe and Dodge 1989). Once adulthood is reached, mortality rates decrease substantially, in part because adult black bears have few natural predators and are relatively unaffected by parasites and disease (Rogers 1983). Anthropogenic causes of mortality (e.g., hunting, vehicle collisions, management removals) are the dominant causes of mortality for adult animals in both areas where harvest is allowed and where it is not, but overall rates of mortality are generally low and sustainable (Gantchoff et al. 2020). Adult female mortality rates are usually lower than those of adult males. Estimates of black bear survival rates and causes of mortality in California have not been reported in recent years.

2.5 Food Habits

Black bears are omnivores, and their teeth are adapted for feeding on both plant and animal matter. They are highly opportunistic and will eat nearly anything edible. Black bear food habits vary widely with season and location. In general, following emergence from winter dens in spring, black bears forage on green grasses and forbs, insects, and carrion.

Black bears shift to eating berries when they become available (Graber 1982, Grenfell and Brody 1983) and focus on mast crops such as acorns (*Quercus* spp.) in the fall. Where present, manzanita berries (*Arctostaphylos* spp.) are an important food resource during late summer and fall (Kelleyhouse 1980), as are sugar pine (*Pinus lambertiana*) seeds (Mazur et al. 2013). While the diet of black bears is mostly comprised of vegetation, they may prey upon newborn ungulates in the spring (Zager and Beecham 2006, Monteith et al. 2014) and scavenge the kills of mountain lions (*Puma concolor*) year-round, including during the winter (Elbroch et al. 2015, Allen et al. 2021). The opportunistic foraging behavior of black bears often brings them into conflict with people, as black bears will damage property such as homes and storage sheds while seeking out human food and garbage, damage agricultural crops, and occasionally kill livestock, primarily chickens (CDFW unpublished data).

Chapter 3. Conservation Framework

The framework for black bear conservation in California includes a mix of ecological and social factors. This chapter summarizes background information relevant to the conservation goals introduced in Chapter 1.

3.1 Population Abundance

It is a goal of the California Department of Fish and Wildlife (CDFW) to conserve abundant black bear populations because of their ecological role among the carnivore species that inhabit California. Common, abundant species tend to have large, widespread ranges (Lawton 1993), and there tend to be a few common species versus many rare species within any ecological community of animals or plants (Preston 1948, Fig. 1).

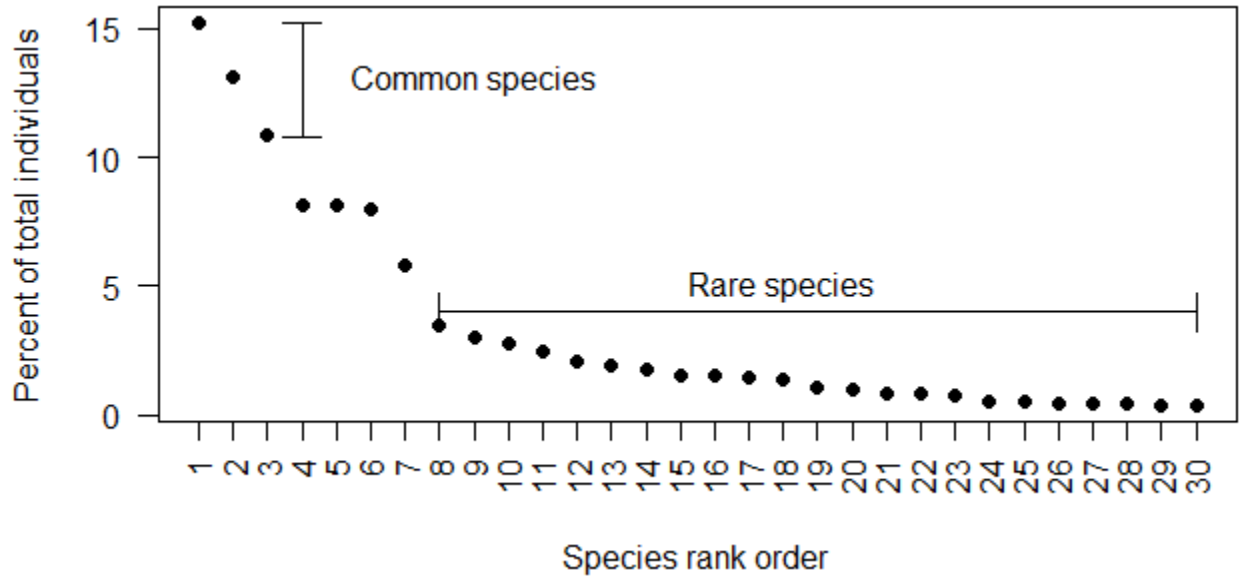


Figure 1. Commonness and rareness of wildlife species. As illustrated in this simulated example, ecological theory and empirical data demonstrate that that there are usually a few common, abundant species versus many rare, less abundant species. In California, black bears are an example of a common, abundant species.

Black bears are widespread and common throughout most forested habitats of California; they are one of the most commonly occurring large mammal species in California forests (Furnas et al. 2022). Occupancy modeling is a statistical approach for analyzing the proportion of locations a species occurs at to assess its relative abundance with respect to other species (MacKenzie et al. 2006). The geographical range of black bears in California cover 39% of the state's land area and the average probability of bear occurrence at any

point within this range for a month sampling period is estimated at 63% based on occupancy analysis of detections from camera surveys at 2,954 locations (Fig. 2, Furnas et al. 2022). In comparison, examples of less widespread and common carnivores in California include Pacific fisher (*Pekania pennanti*, range=29%, occupancy<20%) and red fox (*Vulpes vulpes*, range=16%, occupancy<1%) (CDFW unpublished data).

Black bear densities, however, are not evenly distributed throughout the species' range in California. Roughly half of the statewide black bear population resides in the North Coast and Cascade regions (see Fig. 8 for regional locations). Studies indicate that black bear densities have ranged from 38 to 96 black bears per 100 km^2 (Piekielek and Burton 1975, Kelleyhouse 1977, California Department of Fish and Game 1993) in these regions. About 40% of the black bear population inhabits the Northern and Southern Sierra regions. Density is less than in the North Coast and Cascades regions, with estimates of 19 to 38 black bears per 100 km^2 (Sitton 1982, Grenfell and Brody 1983, Koch 1983). Fusaro et al. (2017) reported that density within the town of Mammoth Lakes (38 black bears per 100 km^2) was 3 times greater than in a nearby wildland study area, Slinkard Wildlife Management Area. The remainder of the black bear population inhabits other areas of the state including the South Coast region, where densities are probably less than 10 black bears per 100 km^2 (Stubblefield 1992, Novick et al.1981, Moss 1972). The highest reported recent black bear densities from California are 133 black bears per 100 km^2 on the west side of the Hoopa Valley Reservation (Matthews et al. 2008) and 84 bears per 100 km^2 in the Lake Tahoe basin (Owens-Ramos et al. 2022). These densities are among the highest recorded for black bears across their range, with the densest known population inhabiting southeastern Alaska (155 black bears per 100 km^2; Peacock et al. 2011).

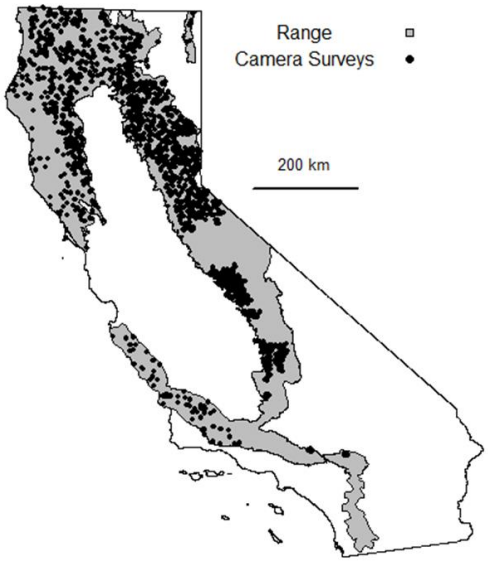


Figure 2. Locations of ~ 3,000 camera trap surveys, 2009-2022, throughout black bear range in California.

Common species, such as black bears in California, have substantial effects on the broader ecological community such that the conservation of common species should be considered alongside concerns about rare species (Gaston and Fuller 2007). The abundance of black bears in California is likely driven by their diverse, omnivorous diet and ability to use many different habitat types and seral stages as a generalist species, and their adaptability to varied environmental conditions over time (Garshelis et al. 2020b). Due to their abundance and ecological role, black bears may serve as a potential indicator species for guiding wider conservation efforts as demonstrated by their foraging ecology (Steenweg et al. 2023), use of large woody debris (Mitchell and Powell 2003), association with wildfire (Furnas et al. 2022), and habitat associations with many other species (Cox et al. 1994, Simberloff 1999). For all of these reasons, it is important that black bears remain abundant throughout their range in California.

Sustained and systematic monitoring of black bear abundance at statewide and regional scales is essential to effective conservation of black bears and other wildlife in California. Quantifying a desired population abundance of black bears is subjective and beyond the scope of this conservation plan, because it depends on both the ecological status of black bears and the needs of human society in a state of nearly 40 million inhabitants in 2023. On one hand, ecological considerations can be used to estimate the biological carrying capacity of how many black bears available habitats can support, although this number would be expected to fluctuate up and down from year to year with environmental cycles (McClelland et al. 2021). On the other hand, the needs and desires of people may define a

smaller, social carrying capacity of how many black bears human society is willing to tolerate on the landscape (Decker and Purdy 1998, Cleary et al. 2021). As part of its mission, CDFW is charged with balancing these potentially conflicting goals. As such, CDFW intends to meet an ecological goal of maintaining abundant black bear populations by ensuring that black bears remain common and widely distributed within secure, well-connected habitats, and are not experiencing any long-term population declines of conservation concern pursuant to either Fish and Game Code (FGC) 1801 or the California Endangered Species Act.

3.2 Habitat

Black bears occupy most mountain ranges in California outside of the Mojave and Sonoran deserts, and most of the 145,000 km^2 of forested habitat that is biologically suitable for them (Fig. 3). Black bears continue to occupy the distribution first mapped by Grinnell (1937), but expanded populations now also exist in areas where black bears were formerly rare or absent, such as the Central Coast and the San Bernardino and San Gabriel mountains of southern California. Range expansion in southern California is the result of a translocation of black bears from Yosemite National Park to the San Bernardino mountains in the 1930s, which resulted in a persistent population (Brown et al. 2009).

More recently, black bears appear to have expanded into other areas of California where they were previously rare or absent, such as the Warner Mountains in Modoc County and the Mayacamas Mountains of Sonoma and Napa Counties (Fusaro et al. 2017, CDFW unpublished data). Range expansion has continued outside of California as well. In the 1980s black bears originating in California began recolonizing habitat in the Carson Front of Nevada, where black bears had been absent for >80 years (Lackey et al. 2013, Malaney et al. 2018, Sultaire et al. 2023).

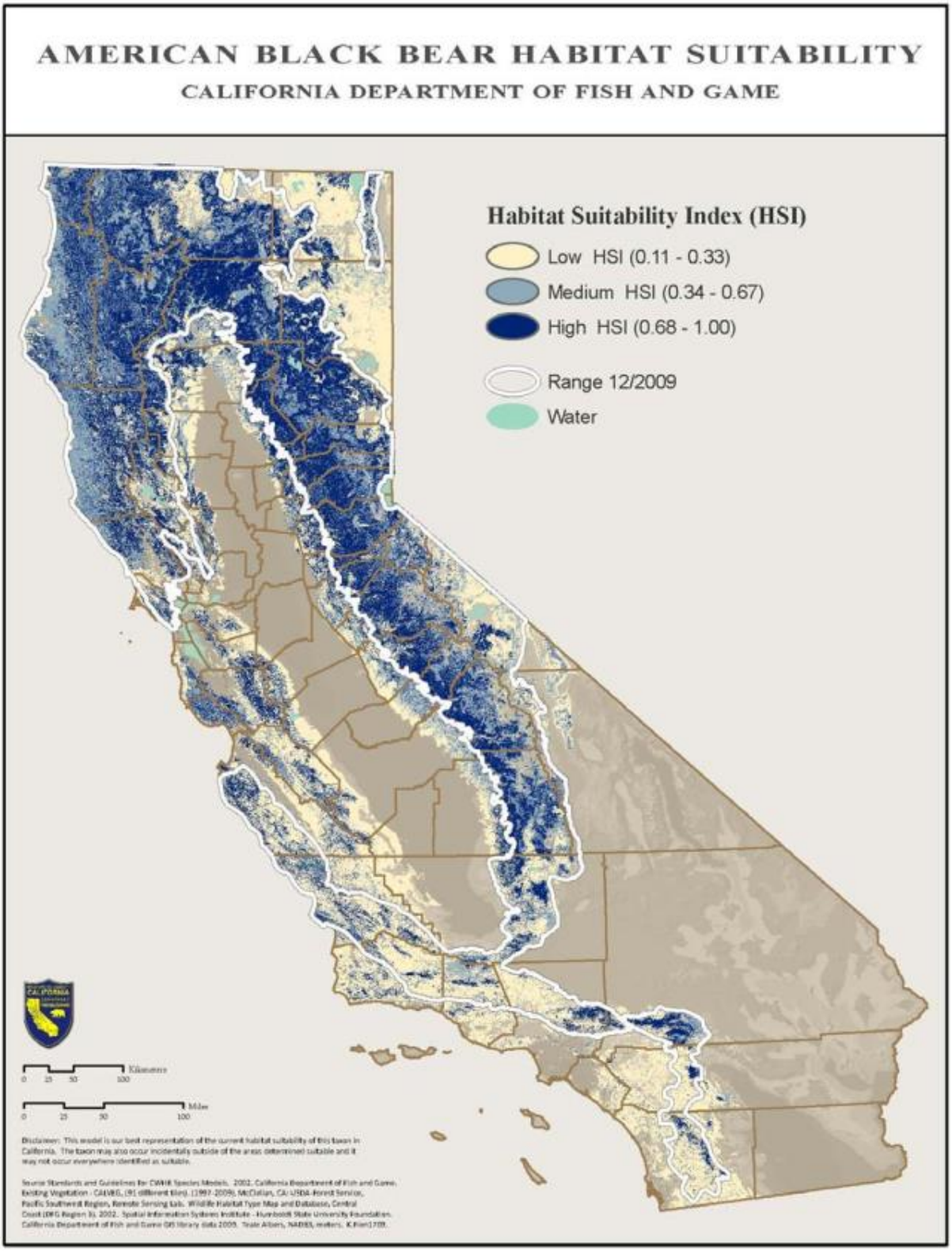


Figure 3. Black bear distribution and habitat suitability in California.

Over half of the suitable black bear habitat in California is in public ownership, managed primarily by the US Forest Service and National Park Service. Approximately 10% of California's black bear habitat is managed as either wilderness or designated park. These areas represent large blocks of undeveloped habitat and core areas within their habitat where black bears encounter few humans. The abundance of black bear habitat in public ownership where development is restricted provides an important buffer against habitat loss. Because black bears are highly adaptable to living in human-modified environments, human development along the wildland-urban interface in areas such as the Lake Tahoe Basin is more of a concern for management of human-black bear conflict (HBC) than it is for habitat loss and/or fragmentation negatively impacting black bear populations. However, habitat enhancement using fire management and other methods may serve to mitigate HBC (see Section 3.9).

3.3 Genetic Diversity and Connectivity

Overall, black bear populations appear to be genetically diverse throughout California. Brown et al. (2009) identified 3-4 genetic clusters in a study of 504 black bears from across California collected by hunters and researchers. The occupation of black bears in the Central Coast region was hypothesized to have occurred relatively recently following a release from competition with extirpated grizzly bears (*Ursus arctos*), and a range expansion of black bears from the southern Sierra Nevada and Tehachapi mountains, rather than from Southern California (Sherman and Ernest 2015).

Black bears in Northwestern California had the highest levels of genetic diversity, probably as a result of connectivity with black bear populations in Oregon and throughout the Pacific Northwest. Similarly, there was evidence of high genetic diversity and gene flow among the interconnecting populations in Northern California and the Sierra Nevada mountains. Black bears in the Southern California and Central Coast regions were geographically isolated from larger populations to the north, but still maintained a similar level of genetic diversity as other North American black bear populations (Brown et al. 2009, Clarke et al. 2001, Paetkau et al. 1998, Paetkau and Strobek 1994).

More recently, Sherman and Ernest (2015) studied the genetic diversity of black bears in San Luis Obispo and Monterey Counties. Genetic diversity was lower than in other populations in California but because the area had only recently been colonized by black bears expanding from elsewhere, the authors concluded that management intervention was not warranted.

3.4 Disease

Black bears are susceptible to many infectious and non-infectious diseases, most of which do not significantly impact black bear populations. While there is no evidence that disease is an important factor in California black bear population dynamics or population health, there are some diseases of concern to monitor. These include emerging diseases like sarcoptic mange (Niedringhaus et al. 2019) with an unknown risk to California's black bear populations, zoonotic diseases that could affect people like trichinellosis (Schellenberg et al. 2003), or diseases that could increase the likelihood of HBC like idiopathic encephalitis (Alex et al. 2020). As such, disease, and health in general, is important for black bear conservation at both the level of the individual black bear and the population.

CDFW veterinarians investigate potential diseases in black bears opportunistically through mortality investigations and actively through specific disease surveillance projects or programs. Disease and mortality investigations consist of either a full necropsy with postmortem workup and ancillary testing, or through targeted sample collection and testing, depending on the situation. Currently, CDFW maintains an active research and surveillance program for encephalitis in black bears. This emerging condition in California and Nevada black bears potentially has more than one cause. It tends to affect young black bears, often orphaned cubs of the year or yearlings. Clinical signs range from mild changes in behavior and mentation that often mimic habituation, to overt neurologic changes including head tilt, ataxia, tremors, and seizures. The disease is often seen in black bears involved in conflict situations. CDFW also supports active surveillance of *Yersinia pestis* in carnivores by providing samples from black bears and other carnivores to the California Department of Public Health for serologic surveillance. Moreover, CDFW continues both active and opportunistic surveillance for pesticides like anticoagulant rodenticides, organophosphates, carbamates, and bromethalin in black bears. Pesticides can be direct sources of mortality for black bears and public health risks to hunters as some can accumulate in consumable portions like meat and fat.

In addition to ongoing mortality investigations and active surveillance projects in black bears, there have been and continue to be several serology-based surveillance projects. These projects utilize archived serum collected either from hunter harvest, depredation, or management actions and measure antibody prevalence to various pathogens in one or more of California's black bear populations. These projects confirm that California's black bears are variably exposed to multiple different pathogens including, but not limited to, *Toxoplasma gondii*, *Borrelia burgdorferi*, *Anaplasma phagocytophilum*, *Trichinella spiralis*,

canine distemper virus, canine adenovirus type 1, *Yersinia pestis*, *Trypanosoma cruzi*, and *Francisella tularensis* (Mortenson 1998, Stephenson et al. 2015, CDFW unpublished data). While serologic surveillance for antibodies is an important tool for disease and pathogen surveillance, it is only informative about exposure to pathogens—not the presence or absence of disease associated with pathogens.

CDFW continues to perform mortality investigations to support Law Enforcement and HBC programs, and to investigate abnormal mortalities. Common causes of death include trauma (thermal burns, gunshot, vehicle strike, or conspecific aggression being the most common), infections (viral, fungal, bacterial, and parasitic), and neoplasia or cancer. Infections are more commonly diagnosed in young black bears, especially cubs and yearlings. Idiopathic encephalitis, canine adenovirus type 1, and generalized dermatophytosis have been the most commonly diagnosed infections in recent years (CDFW unpublished data). Generalized dermatophytosis is often indistinguishable from sarcoptic mange and may be either a primary disease or secondary to some other infection (e.g. *Ursicoptes* sp. or *Sarcoptes* sp. mite infestation) or immunosuppression (Clothier et al. 2022). Trauma, particularly from vehicle strikes or gunshot wounds (e.g., sustained due to depredation or other conflict behavior, or from poaching) or infections secondary to trauma are more commonly seen in prime age adult black bears. With increasingly severe wildfire activity associated with climate change, black bears with thermal burns from wildfires are being seen more commonly, affecting young and old black bears alike. Neoplasias are more commonly diagnosed in old black bears, and older sows may be particularly susceptible to mammary gland tumors (CDFW unpublished data).

3.5 Animal Welfare

Animal welfare for black bears is defined in CDFW Bulletin Number 2022-01 Black Bear Policy in California: Public Safety, Depredation, Conflict, and Animal Welfare as "the physical, psychological, social, and environmental well-being of an animal." It is CDFW's responsibility to consider animal welfare whenever managing black bears. In implementing this policy, CDFW follows Bulletin Number 2018-02 Department of Fish and Wildlife Animal Welfare Policy, which states that:

- Research, surveys, and experiments involving free-ranging and captive invertebrates, reptiles, amphibians, fishes, birds, and mammals shall consider:
    - Whether the use of animals is necessary;

    - The number of animals needed to obtain valid scientific data; and
    - Methods to avoid or minimize pain, discomfort, and distress consistent with sound research design and practice.
- Animals shall be housed under conditions that are species-appropriate in environments that are safe and secure for animals and staff.
- Methods of euthanasia shall be consistent with current recommendations of the American Veterinary Medical Association (AVMA) Panel on Euthanasia, unless alternatives have been justified and approved by the appropriate CDFW Program (Wildlife Branch, Fisheries Branch, or Marine Region).

One prominent example of how animal welfare concerns are addressed with black bears is the care and rehabilitation of injured and orphaned black bears. In the absence of being taken into captivity, most of these black bears would die. While these deaths will not result in changes to black bear population health, the experiences of the black bears themselves prior to their death would be unpleasant and there is substantial demand from the public for wildlife managers to intervene in these situations (Beecham et al. 2016). Options include non-intervention; humane euthanasia; reuniting black bears with their biological mothers; fostering black bears to wild, adoptive females; transporting black bears to a permanent captive facility; and transporting black bears to a rehabilitation facility for eventual release (Beecham et al. 2015). CDFW veterinarians work with regional staff to identify individual black bears that have been injured or orphaned and determine appropriate interventions.

Animal welfare is also an important consideration in wildlife field research. Examples include decisions regarding whether to externally mark (e.g., ear tags) or remotely monitor (e.g., GPS collars) black bears, types of traps to be used, types of chemical immobilization drugs to use, etc. In these cases, actions taken by researchers to better understand black bear ecology have the possibility of causing distress, pain, or behavioral changes to black bears. Thus, it is important that the negative impacts are weighed against the benefits. Consequently, prior to initiating any research or monitoring program for black bears, capture plans are developed and reviewed by CDFW veterinarians.

3.6 Regulated Hunting

Hunting regulations (e.g., the setting of seasons and methods of take, bag limits, etc.) in the United States are the product of municipal, state, and federal laws that began as early

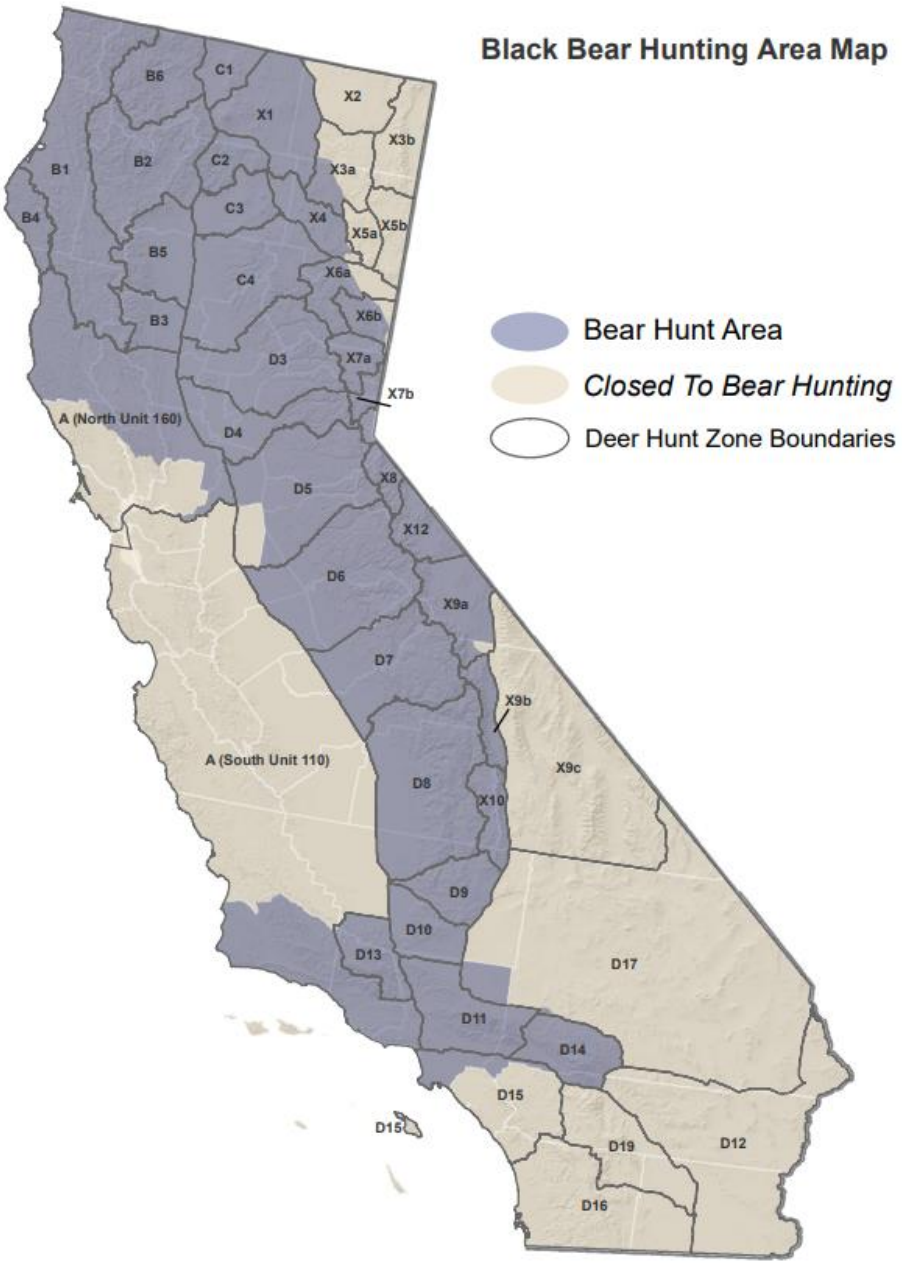
as 1646, when the colony of Rhode Island established a season for white-tailed deer (*Odocoileus virginianus*) hunting and enforced penalties for hunting out of season (Organ et al. 2012). However, expectations regarding how, when, and why wildlife was harvested were implemented by indigenous people for thousands of years prior to the arrival of Europeans (Eichler and Baumeister 2018).

Outside of National Park Service lands like Yosemite and Sequoia and Kings Canyon National Parks, where the hunting and trapping of any species has been prohibited since the late 1800s, the first formal regulations governing black bear hunting in California were enacted in 1948, when black bears became classified as game animals. A license became required for hunting and trapping, and a bag limit of two black bears per hunter was established. Over time, regulations have generally become increasingly restrictive, both to ensure black bear harvests are sustainable and to reflect changing public attitudes. For example, recreational trapping was prohibited in 1961, the bag limit was reduced to one in 1968, harvest of cubs or females with cubs was prohibited in 1972, a quota limiting the number of black bears harvested annually was initiated in 1990, and the use of dogs to hunt black bears was prohibited in 2013.

Since 1957, successful black bear hunters have been required to submit report cards that describe sex and age class of harvested black bears, along with the location and date of harvest. Beginning in 1982, report cards became required of all tag holders, regardless of success, and hunters were required to bring harvested black bears to the CDFW for tag validation and removal of a premolar tooth, which is used to determine the black bear's age in years. As discussed in Chapter 4, these samples are the key source of data utilized by CDFW for estimating and monitoring black bear populations and their vital rates. As demonstrated in California and elsewhere, the public (including hunters who provide age information on bears) can contribute to conservation through scientific data collection that supports population monitoring efforts (Cretois et al. 2020, El Bizri et al 2020, Candler et al. 2022).

While black bears are widespread in California, hunting is not permitted in all areas that black bears inhabit and is limited in others (Fig. 4). For example, approximately 19% of occupied medium-high quality black bear habitat (hereafter, black bear habitat) is comprised of National Parks in which black bear hunting is prohibited (4%) or is outside of the black bear hunt zone (15%), such as the Warner Mountains in Modoc County. In addition, 8% of black bear habitat within the hunt zone is comprised of roadless wilderness areas where harvest is likely minimal because of logistical difficulties or the challenge of packing out the meat, head, and hide. Collectively, these 36,751 km^2 (27% of all black bear

habitat) likely function as sanctuaries that provide a reservoir of adult females with relatively high survival rates that produce dispersing offspring and contribute to hunted populations (Beringer et al. 1998). However, protection from hunting may not necessarily result in greater survival, and consequently, population growth rates. For example, in unhunted black bear populations near carrying capacity, cub and yearling survival may decrease in association with density dependent natural causes of death, such as starvation, intraspecific competition, and predation (Schwartz et al. 2006, Obbard and Howe 2008, Czetwertynski et al. 2007). These populations may also have high rates of HBC (Fusaro et al. 2017).



548

549 Figure 4. California black bear hunting map.

550 Regardless of the difference in population dynamics in hunted vs unhunted populations,
551 researchers generally agree that hunting is a mostly additive form of mortality in black
552 bears. (Gantchoff et al. 2020) This, combined with their low reproductive rates, indicates
553 that unless management objectives call for population reduction, harvest should be
554 conservative to prevent overexploitation. Under optimal survival and reproductive rates,

the maximum sustainable annual hunting mortality rate for black bears has been estimated to be 15.9% (Miller 1990), although Pennsylvania, Virginia, and Wisconsin have reported increasing black bear populations with harvest rates >20% (Hristienko and McDonald 2007).

Based on current best estimates of black bear populations statewide and regionally, hunters harvest less than 7% annually of the bears present in any region of the state, and under 3% overall (see Section 4.2). This harvest rate is considerably lower than the maximum sustainable harvest rates discussed above and is also lower than recent harvest rates in nearby states such as Oregon (ODFW 2022) and Washington (WDFW 2022). In some regions, the actual harvest rate may be as low as 1% of the black bear population. Most harvest occurs in Northern California where bear densities are highest (i.e., Shasta, Trinity, Siskiyou, and Mendocino Counties), which typically accounts for 35-40% of the overall state harvest (CDFW 2021, CDFW unpublished data).

Over the last 10 years (2012-2022), an average of 28,024 black bear tags were sold annually which, when including the cost of a hunting license, generated $27.2 million in revenue, ranging from $1.9 to $3.2 million per year. It should be noted that many of these licenses are purchased by hunters who hunt other species or purchase other tags (e.g., deer tags). Still, black bear tags alone generated $13.4 million in revenue, ranging from $1.2 million to $1.6 million per year. Additionally, pursuant to the Pitman Robertson Act of 1937, a federal tax on firearms and ammunitions sales allocates between $10 and $30 million per year to game species conservation in California. CDFW uses a portion of these funds to staff its conservation and hunting programs for black bears and other game species. For example, over the last 10 years (2012-2022), CDFW used $4.3 million of these state and federal funds for staff working on black bear conservation and for a variety of black bear research projects including some of the local density studies listed in Section 4.2 that CDFW is integrating into its updated population monitoring approach.

Since at least the 19th century sportsman's associations have promoted hunter ethics in North America. This includes concepts of fair chase, appreciation of nature, humane killing methods that avoid unnecessary pain and suffering, and avoiding waste of harvested animals (Organ et al. 1998). CDFW promotes ethical hunter behavior through hunter education programs, which hunters are required to take prior to obtaining hunting licenses.

California's first hunter education law was enacted in 1954. Classes are offered throughout the State by more than 1,000 certified volunteer instructors, often CDFW game wardens. Along with curricula focusing on understanding firearm equipment, shooting and

hunting skills, and safety, there is additional content on being a responsible and ethical hunter. Students discuss (and perhaps even debate) the concept of fair chase, which is defined by law, regional differences in ethical standards (e.g., hunting seasons and methods of take vary by US state) and learn how and why hunting laws are passed. Hunting ethics, which generally covers behavior that has to do with issues of fairness, respect, and responsibility not covered by laws are also discussed. Students learn that not everyone will agree on what is considered ethical hunting and thus it is important for each individual to develop their own personal code of conduct. To aid in this development, discussions might include questions the law does not address such as (1) at what distance should a shot be taken, considering the distance, hunter skill level, and personal convictions regarding whether the shot is a fair one? (2) is shooting birds on the ground, on water, or in trees acceptable? or (3) how much should one share with strangers about the locations of quality hunting locations on social media (i.e., hotspotting)? Collectively, discussions about hunting ethics can be summarized by the statement, “Just because you can, does not mean you should.”

Beyond basic hunter education courses, the CDFW promotes ethical hunter behavior through advanced hunting clinics that are specific to the game being targeted (e.g., turkey, upland game, waterfowl, and big game). Topics covered in each clinic include type of firearm, ammunition, importance of sighting in the firearm, gauging distance, scouting, tracking, field dressing, shoot-don't shoot scenarios, hunter ethics, landowner-hunter relationships, conservation, and safety. The goal of this series of hunting clinics is to develop ethical, conservation-minded, successful hunters through education, taking the hunter a step beyond the basic hunter education course.

Examples of regulations that have attempted to address ethical hunter behavior with respect to black bears include prohibition of (1) the use of traps (FGC § 3011), (2) the use of bait (14 CCR § 365), and (3) the harvest of cubs and females accompanied by cubs (14 CCR § 365). Many regulations are in place that describe requirements for firearms and archery equipment that promote humane harvest and fair chase (e.g., centerfire rifle cartridges are required, shotguns may hold no more than 3 shells, there are draw weight requirements for bows, etc.) (14 CCR § 353 and 354). Other examples of regulations promoting fair chase include hunting and shooting hours restrictions (14 CCR § 352), prohibition on taking big game with the aid of artificial light (14 CCR § 353), and regulations related to the use of motorized equipment while hunting (FGC 3003.5, CCR 251). To avoid needless waste, hunters are prohibited from leaving any portion of meat normally eaten by people in the field (FGC § 4304). Because the sale of black bear parts is considered both

unethical and unlawful, the possession of >1 black bear gall bladder is considered “prima facie evidence that the bear gall bladders are possessed for sale” (FGC § 4758).

Cultural, societal, and demographic changes have resulted in a declining participation in hunting and fishing in California since the 1970s. Recognizing the importance of sustaining interest in the hunting tradition, CDFW began state-wide participation in the federal Recruitment, Retention and Reactivation (R3) program in 2017, with the aim of increasing statewide hunting and fishing participation by collaborating with diverse stakeholders to transform barriers into opportunities (CDFW 2019). Stakeholders cooperating with the CDFW in this program include Tribes, non-governmental organizations, clubs, media, industry, educators, and members of the public. An important component of the R3 program is to address barriers to participation, focusing beyond traditional hunter education and community outreach efforts that have existed for decades, by becoming socially relevant and creating spaces where both traditional hunting and fishing identities are celebrated, and new identities, inclusiveness, and difference are embraced.

3.7 Viewing

Black bear viewing has long been a popular activity with visitors to National Parks in California, such as Yosemite and Sequoia and Kings Canyon. As described by Graber and White (1983) in a study of black bear food habits in Yosemite, “The sight or sound of a 100 to 200 kg beast poking around one’s camp in the gloom of night has provided a thrill tinged with varying degrees of terror to generations of tourists.” Black bear viewing has been associated with terms such as ecotourism or sustainable tourism, which is often considered an important way to increase tourism through encouraging the public to visit local environments and natural surroundings with a focus on environmental education and ecological conservation (Stronza et al. 2019, Streimikiene et al. 2021). Most black bear viewing in California likely occurs in largely undeveloped National Parks, but some semi-urban areas such as Lake Tahoe and Mammoth Lakes, are popular destinations for black bear viewing as well (Klip 2012).

In contrast to hunting, black bear viewing is considered a non-consumptive activity. However, as with hunting, black bear viewing can have negative consequences for both black bears and people if not managed appropriately. Black bears inhabiting areas popular for black bear viewing have frequent benign encounters with people, which can cause them to become habituated to human presence and show no overt reaction to people (Penteriani et al. 2017). Habituated black bears are often a significant management concern because they are at an increased risk of becoming food-conditioned, either

through being directly fed by people or by finding human food themselves (Hopkins et al. 2010). While food-conditioning is common both inside and outside of protected areas, habituation is probably more common in parks and other areas where hunting (i.e., a form of negative conditioning) is restricted (McCullough 1982).

3.8 Black Bear Interactions with other Wildlife

Black bear predation on neonate ungulates is a significant influence on ungulate population dynamics in some areas of North America (Linnell et al. 1995, Bowyer et al. 1998, Zager and Beecham 2006). Within California, Monteith et al. (2014) found neonate mule deer (*Odocoileus hemionus*) born west of the Sierra Crest, where black bear densities are higher than east of the Sierra crest, were >6 times more likely to die of black bear predation than any other cause. High rates of black bear predation were thought to limit deer abundance in this area by causing a reduction in the proportion of deer that migrate to summer range, as deer trade off obtaining superior nutritional benefits to avoid predation (Monteith et al. 2014). Black bear predation is also a common cause of mortality for black-tailed deer (Odocoileus hemionus columbianus) fawns in the Mendocino National Forest (Wittmer et al. 2014).

Black bears are suspected of being a potential predator of desert tortoises (*Gopherus agassizii*) (Lovich et al. 2014), which are listed as threatened under the California Endangered Species Act. While even a single black bear could have negative effects on small populations, such interactions are likely extremely rare because black bears and desert tortoises have very different habitat preferences.

Within the Mendocino National Forest, black bears frequently displace mountain lions from their kills, a behavior called kleptoparasitism. Elbroch et al. (2015) found black bears at 77% of mountain lion kills, and black bears displaced mountain lions from them 72% of the time. Black bear kleptoparasitism caused mountain lions to increase their kill rates substantially to recoup energetic losses to black bears (Elbroch et al. 2015, Allen et al. 2021) and mountain lion ungulate kill rates in this system were the highest reported for the species across their range (Allen et al. 2021, Cristescu et al. 2022). Collectively, high rates of predation on fawns and kleptoparasitism of mountain lion kills by black bears have likely contributed to a declining deer population in this area (Wittmer et al. 2014, Marescot et al. 2015).

Black bear interactions with wolves (*Canis lupus*) can be lethal or kleptoparasitic. Packs are known to displace bears from carcasses or predate on bears themselves (Ballard et al.

2003). In areas without wolves, black bears may exhibit a release of predation and/or competition (Frey et al. 2022), In California, these interactions are understudied, and impacts on survival and prey selection are yet to be quantified.

More indirectly, black bears interact with other wildlife by dispersing seeds that they consume. Black bears often swallow fruits whole, and the seeds remain intact once excreted. Given their large home ranges, black bears can be even more effective than birds in seed dispersal (Harrer and Levi 2018), and the movement of seeds contributes to the maintenance of food and cover for many wildlife species. Some plant species even germinate better after being digested and deposited in black bear scats than if they do not go through this process (Rogers and Applegate 1983, Auger et al. 2002). Secondary seed dispersers, such as small mammals, can become involved in multiple ways. Small mammals can experience nutritional benefits by obtaining concentrated food sources. Black bear scats can contain thousands of seeds containing enough energy to meet the daily calorie requirements of >90 mice (Shakeri et al. 2018). Additionally, while long-distance seed dispersal by black bears is important for plant propagation, some species may not germinate well within scats because of high predation rates, competition, or an inadequate temperature and moisture environment. Small mammals can disperse seeds a second time from black bear scats and then bury them in safer locations, making the combined effect of black bears and small mammals for seed dispersal greater than each species would have alone (Enders and Vander Wall 2011).

3.9 Human-Black Bear Conflict

With a population of almost 40 million people, conflicts between people and black bears are common and management of these conflicts is a significant priority for CDFW. HBC appears to have been increasing for decades due to increasing spatial overlap between people and black bears (i.e., increased human development and recreation in black bear habitat, expansion of black bear distribution). The vast majority of HBC involves the intersection of black bears and attractants, such as food, garbage, and livestock.

Records of HBC are managed by CDFW staff. More standardized statewide recordkeeping began in 2017, when a Wildlife Incident Reporting (WIR) system was created that both CDFW staff and the public can submit reports to (Fig. 5).

During 2017-2022, excluding reports of black bear sightings in which no conflict occurred, there were 6,049 HBC reports submitted through the WIR. In descending order of frequency, reports were of depredation and property damage (57%), nuisance behavior

(30%), and potential human conflicts (13%). Reports of HBC were stable during 2017-2020, averaging 674/yr, and then increased sharply by 160% during 2021 and 2022 to an average of 1,678/yr. Hotspots of HBC reports included the Lake Tahoe Basin and the foothills of the San Gabriel Mountains.

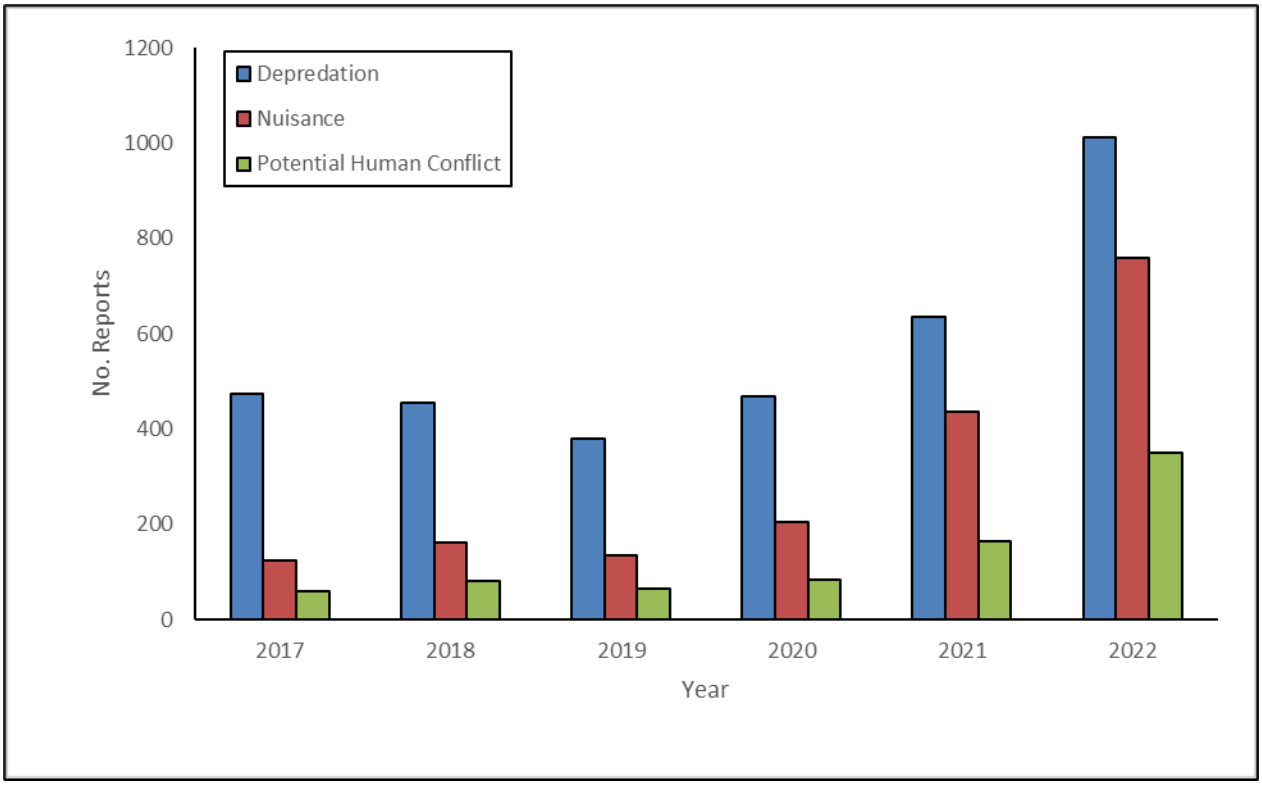


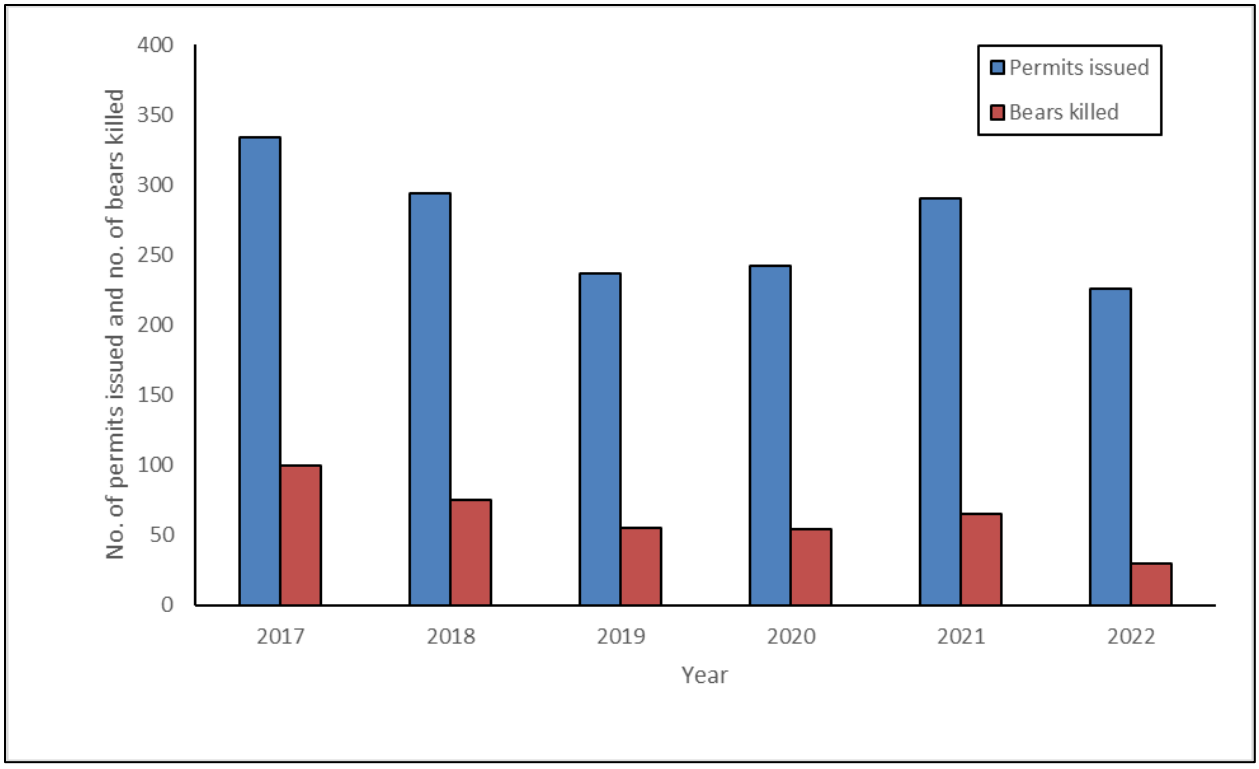
Figure 5. Number of human-black bear conflict reports submitted to the Wildlife Incident Reporting (WIR) system (2017-2022).

While documenting the frequency, location, and severity of HBC is commonly used by management agencies to track trends through time and evaluate the effectiveness of management strategies, caution is warranted in interpreting the data. Trends in reports may not accurately reflect actual trends in HBC. For example, the degree to which HBC increases during 2021 and 2022 reflect an increase in HBC or an increase in reporting is unclear, but it is likely that an increase in reporting was an important factor during 2022 at least. In February of that year the CDFW began implementing Department Bulletin Number 2022-01 Black Bear Policy in California: Public Safety, Depredation, Conflict, and Animal Welfare, which increased staff awareness of the WIR system by requiring its use for all incidents requiring a response by CDFW.

Additionally, public reporting behavior can be biased in different ways. Howe et al. (2010) thought that increases in HBC reports in Ontario, Canada were more likely the result of public dissatisfaction with a controversial decision to end the spring black bear hunt, rather than actual increases in HBC. Similarly, Wilbur et al. (2018) found that in Colorado, the people most displeased with management had the highest HBC reporting rates. Other factors that were predictive of a resident's decision to report HBCs included their prior experience with black bears and attitudes related to tolerance of black bears. Recognizing these potential biases is important because public attitudes are often geographically clustered, meaning that spatial patterns of HBC reports may not reflect actual HBC (Wilbur et al. 2018).

California is currently a member of BearWise (https://bearwise.org/), a program developed and managed by biologists from multiple state natural resource agencies to provide consistent information and messaging about coexisting with black bears. It promotes education and preventative action as the most effective tools for reducing HBC. Informational resources on black bear biology, behavior, and conflict prevention can be found on the BearWise website.

CDFW staff provide assistance to landowners experiencing HBC in the form of education and advice on corrective actions to prevent re-occurrence (e.g., hazing; eliminating unnatural food or attractants by removing trash and bear-proofing food storage areas; enclosing animal pens; installing fencing or electric fencing, motion lights and sprinklers, noise machines, guard animals; or securing and blocking access to crawl spaces or other potential denning sites). Depredation permits may also be issued (Fig. 6), typically after other non-lethal management options have been exhausted in accordance with the black bear policy.



765

766 Figure 6. Number of CDFW issued black bear depredation permits issued and numbers of black bears killed
767 (2017-2022).

768 During 2017-2022, there was a declining trend in both the number of black bear
769 depredation permits issued and the numbers of black bears killed under the permits. The
770 number of black bears killed under depredation permits has decreased annually from 100
771 in 2017 to 30 in 2022. Moreover, there has also been an annual increase in the percentage
772 of permits issued that do not result in black bears being killed, from 70.1% in 2017 to
773 86.7% in 2022. Though these trends may partly reflect changes in human attitudes toward
774 black bears, there was also a significant policy shift in 2022 that is likely influencing recent
775 patterns in depredation permit issuance and outcomes. CDFW's black bear policy (CDFW
776 2022a) prioritizes non-lethal conflict mitigation measures before issuing permits for lethal
777 take when possible. Permits for hazing bears have been issued, although these are still
778 classified as depredation permits.

779 Key predictors of HBC include the availability of both natural foods and anthropogenic
780 foods, proximity of black bear habitat to humans, and black bear abundance and density
781 (Garshelis et al. 2020a). CDFW does not support diversionary feeding practices, and
782 modifying the availability of natural foods is generally infeasible because periods of
783 scarcity are driven by uncontrollable weather events such as drought, wildfires, late spring

784 frosts, etc. However, maintaining a diversity of habitat types through prescribed fire and
785 other sylvicultural practices may be beneficial (Weaver 2000). Limiting future development
786 in black bear habitat is possible, but substantially reducing existing development is not.

787 Hunting black bears at a rate high enough to reduce their growth rates and abundance
788 across a large spatial scale can be effective for reducing HBC (Garshelis et al. 2020a). In
789 California, however, hunting levels over the past decade have been low (e.g., less than 3%
790 annually of the statewide population), and there is substantial public opposition to
791 increasing black bear harvest to a level that would be effective in controlling populations
792 (CDFW 2022b). Thus, encouraging the public to minimize black bear access to human
793 foods has been the primary tool used to manage HBC recently, in conjunction with non-
794 lethal methods designed to temporarily remove animals from conflict situations (e.g.,
795 hazing), and targeted lethal removal of individuals involved in conflicts by CDFW or through
796 the issuance of depredation permits. CDFW's black bear policy (CDFW 2022a) will govern
797 the CDFW response to HBC.

798 Reducing black bear access to human food can be effective for reducing HBC (Johnson et
799 al. 2018), but black bear resistant containers and associated infrastructure are often cost-
800 prohibitive for individuals and municipalities alike (McCarthy and Seavoy 1994). Even when
801 present, black bear resistant containers are often not used correctly (Lewis et al. 2015).
802 Therefore, planning and coordination at the local and state scales will be critical for
803 reducing HBC linked to anthropogenic food sources. Research from North America
804 suggests that availability of anthropogenic food sources may increase bear reproductive
805 and recruitment rates, thereby contributing to increased bear population density on the
806 wider landscape (McLean and Pelton 1990, Gould et al. 2021). Alternatively, there is also
807 evidence that low survival rates in urban environments due to HBC outweigh any increases
808 in fecundity and lead to an "ecological trap" in which wildland bears disperse into urban
809 environments and reduce overall bear density through source-sink dynamics (Beckmann
810 and Lackey 2008, Baruch-Mordo et al. 2014). This information suggests that reducing
811 access to anthropogenic food sources may reduce both HBC and local black bear
812 densities by reducing either recruitment or immigration rates.

813 Black bears can have large home ranges and often travel long distances to locate seasonal
814 food sources. Consequently, they frequently cross roads where they are susceptible to
815 vehicle collisions. An average of 111 black bears were reported killed on California roads
816 annually during 2016-2020 (University of California 2021). While reporting rates of black
817 bear-vehicle collisions are probably higher than they are for species that are more
818 commonly killed on roads, such as birds and small mammals (Paul et al. 2014) and black

bear carcasses are more likely to be detected by highway workers, it is unknown how these incidental reports compare to the true number of black bears killed, which is likely higher, as there is no formal reporting structure to document black bear-vehicle collisions. In addition, age and sex information are not collected from road-killed black bears, which further limits the ability of these data for informing the impacts of vehicle collisions on black bear populations. At a population-level scale, vehicle collisions have not been reported to be influential in population dynamics, but at local scales vehicle collisions can have pronounced effects (Brandenburg 1995, Laufenberg et al. 2018).

While further study of the impacts that vehicle collisions have on black bear populations may be warranted, black bear-vehicle collisions are a management concern nonetheless for several reasons. First, they pose a substantial safety risk to people. Between 4-10% of vehicle collisions with large mammals result in human injury (US Department of Transportation 2008). Second, they are financially costly. The average cost of a collision with a deer, including vehicle repair, medical bills, towing and law enforcement, monetary value of the animal and carcass disposal is estimated at $6,700 (US Department of Transportation 2008). Finally, black bear-vehicle collisions generate concern about animal welfare (see Section 5.4), particularly when cubs become orphaned or when animals experience prolonged suffering prior to death or severe injury without death.

3.10 Climate Change, Wildfire, Drought, and Land Use

The global climate is changing at a faster pace than previously anticipated (Smith et al. 2015, Xu et al. 2018) and scientists expect cumulatively deleterious impacts to wildlife (Pimm et al. 2014, Ceballos et al. 2017, Spooner et al. 2018). In California, climate change is expected to 1) alter vegetation composition of wildlife habitats forcing species to either shift their geographical ranges or otherwise adapt, 2) increase wildfire extent and severity, 3) increase variation in precipitation leading to both extended droughts and periods of severe flooding, 4) create phenological mismatches between wildlife species and their habitat and foraging resources, and 5) exacerbate land use impacts and other anthropogenic stressors on biodiversity (Parmesan 2007, Mann and Gleick 2015, Williams et al. 2019, Huang and Swain 2022).

Wildfires and droughts can impact black bear habitat by altering vegetation structure and/or composition, which black bears rely on for cover, denning, and food. In the short-term following wildfires, black bears may continue to use all areas of a burn, even those burned with high severity (Crabb et al. 2022). Conversely, black bears may avoid burned areas until vegetation recovery occurs (Bard and Cain 2020), and reduced food availability

may result in low cub recruitment (Cunningham and Ballard 2004). Either way, wildfires with substantial areas of high burn severity have not been found to be catastrophic for black bears (Crabb et al. 2022, Koel et al. 2019). In the long term, wildfires generally have positive effects and mosaics of burn ages and intensities produce diverse habitat conditions that provide black bears with necessary cover and forage resources (Young and Beecham 1986, Stratman and Pelton 2007, Crabb et al. 2022).

In particular, low severity fire can diversify food resources for omnivorous mammals such as black bears and thereby possibly mitigate HBC (Weaver 2000, Crabb et al. 2022). These fires can also create logs and other structural features for denning while maintaining forest cover. Overall, research from California shows that low severity burning at an average annual rate of 2% across forested landscapes benefits black bears and other carnivore species (Furnas et al. 2022). The current rate of low severity fire is much lower than this threshold, and it is also lower compared to the mixed severity fire regime that shaped the structure and heterogeneity of California forest over millennia prior to climate change, fire suppression and other anthropogenic impacts (Taylor and Skinner 2003, Millar et al. 2007). Nonetheless, even in an era of increasing megafires, there is still more low severity than high severity fire in California forests (Fig. 7). As demonstrated by California Native American Tribes and others, prescribed burning can be an effective management tool and surrogate for naturally occurring wildfire that benefits black bears and other wildlife (Connor et al. 2022, Furnas et al. 2022).

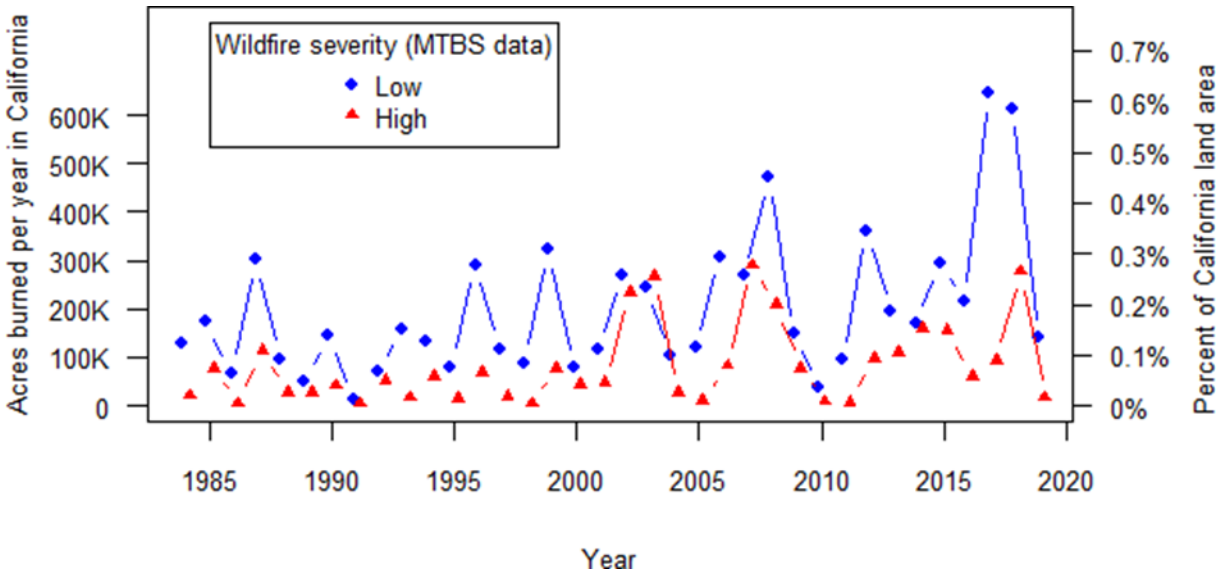


Figure 7. Low and high burn severity amounts in California through time based on analysis of the Monitoring Trends in Burn Severity database (MTBS, methods described in Eidenshink et al. 2007).

Climate change in conjunction with the availability of human food sources is expected to reduce the average duration of bear hibernation thereby extending the active bear season and potentially exacerbating HBC in some places (Johnson et al. 2017). In systems with little human development, natural food shortages, often associated with droughts, may cause declines in reproduction (Rogers 1976, Elowe and Dodge 1989) but generally do not impact adult survival (Kasbohm et al. 1996, Clark et al. 2005). In these circumstances, food shortages have limited effects on black bear populations (Laufenberg et al. 2018). In developed areas however, natural food shortages may induce black bears to shift their foraging to human foods, increasing their exposure to human-caused mortality (Baruch-Mordo et al. 2014, Laufenberg et al. 2018). For one black bear population near Durango, Colorado, a natural food shortage was associated with the most severe black bear population decline ever documented over a 1-year period, which was suspected to be the result of much higher-than-normal human-caused mortality rates, primarily vehicle collisions (Laufenberg et al. 2018). Although black bear populations are likely to be resilient to climate change due to their remarkable adaptability to changing environmental conditions (Garshelis et al. 2020b), they may face declines due to interactions between climate change and forest management -induced food shortages and anthropogenic pressures (Baruch-Mordo et al. 2014, Laufenberg et al. 2018, Rettler et al. 2021).

3.11 Tribal Authority and Perspectives

Since time immemorial California has been home to a great diversity of Native American Tribes. Although these Tribes vary considerably in terms of language and culture, they share a strong ecological, cultural, and spiritual connection to the land (Rawls 1984). This includes a long history of using fire and other tools to manage habitats for the plant and wildlife resources which supported Tribal peoples in California (Anderson 2005).

European settlement of California severely impacted Tribal populations, their cultures and livelihoods, and their tenure over the land (Rawls 1984, Starr 2005). Yet, approximately 180 distinct Tribes remain active in the state today. Many are providing leadership in wildlife science, conservation, and management (Matthews et al. 2008, Ramos 2022, Connor et al. 2022). This includes a Tribal management plan for black bears (Higley et al. 2006). Black bears are an especially important animal to many California Tribes to which many people ascribe kinship. For example, an annual ceremonial “bear dance” honoring this bond is still practiced by some Tribes. Based on comments provided at the listening sessions described below, the names for black bear in various California Tribal languages include *Virusur*, *Cher'ere*, *Wah’ima,* and *Sa:ts’* among many others.

In Executive Order B-10-11 and reaffirmed in Executive Order N-15-19, the State of California recognizes the sovereign authority of California Tribes over their ancestral territories and activities. Additional actions by the California Natural Resources Agency (CNRA) to integrate the historical knowledge of Tribes support efforts to further incorporate tribal perspectives in scientific and policy discussions. Further, it is the policy of CDFW to notify, consult, and promote collaboration and co-management with Tribes on proposed activities affecting black bears and other wildlife species (CDFW 2014). In June 2022, the CDFW notified all California Tribes of our intention to revise this black bear conservation plan and requested their input via consultation. After further notification, two online listening sessions were held with Tribes in May 2023. In total, the CDFW received and heard comments, interests, and views pertaining to black bears from eight Tribes including the Barbareno/Ventureno Band of Mission Indians, the Hoopa Tribe, the Karuk Tribe, the Morongo Band of Mission Indians, the Pit River Tribe, the Resighini Rancheria, the Rincon Band of Luiseño Indians, and the Yurok Tribe, which are summarize below (Table 1).

924 Table 1. Summary of black bear comments, interests, and views expressed by California Tribes.

1. California Native American Tribes are diverse, representing a variety of perspectives with respect to black bear conservation and management, however, overall black bears and humans are viewed as intrinsically connected spiritually, culturally, and ecologically.
2. Tribes expressed concerns about the ecological health of habitats supporting black bears and other species and provided recommendations for using prescribed fire to restore those habitats.
3. Tribes expressed concerns about the need for improved human infrastructure for enabling successful non-lethal responses to human-black bear conflict. This included discussion of the affordability and availability of secure garbage containers.
4. Tribes noted the need for clarifying the applicability of Tribal ordinances to non-Tribal persons who hunt on Tribal lands.
5. Tribes noted a desire to streamline a process facilitating Tribes to recover black bears that are killed in collisions with vehicles. This included discussion that black bears are important culturally and spiritually to many California Tribes.
6. There is a diversity of views among Tribes pertaining to the ethics of black bear hunting, but sport and subsistence hunting of black bears is not common among California Tribes. There is greater (but not widespread) support for killing black bears, in some circumstances, as part of management to mitigate human-black bear conflict.
7. One Tribe expressed concern about bear hunting in southern California mountain ranges that overlap their ancestral territories. They requested that CDFW prohibit hunting in any areas where population density is low.
8. There is interest in combining CDFW wildlife research activities with Tribal youth environmental education programs.
9. There is also interest in increased collaboration and co-management regarding conservation and management of black bears and other wildlife species. This included discussion about the value of supporting, sustaining, and expanding the capacity of Tribal wildlife research and management departments, and developing agreements for data sharing. It also included discussion of interest in developing approaches for increasing opportunities for Tribal hunting and subsistence use of game species, but this interest was focused on species other than black bears.

3.12 Rulemaking Process

The California State Legislature has delegated a variety of powers to the Fish and Game Commission ("Commission"). These powers are delegated within California Statutes that comprise Fish and Game Code (FGC). The FGC establishes the basis of fish, wildlife, and native plant management and protection in California, and can only be established and modified by the State Legislature. The FGC more specifically establishes the Commission's authority in fish and wildlife rules, regulations, and policy making, whereas CDFW is designated as the trustee for fish and wildlife resources. CDFW is charged with implementing and enforcing regulations set forth by the Commission, as well as providing biological data and expertise to inform the Commission's decision-making process. Under administrative law, the California Code of Regulations (CCR) codifies general and permanent rules and regulations to be enacted by the agency responsible for implementation. The Commission and CDFW work within CCR Title 14- Natural Resources. Regulations routinely addressed under Title 14 include general harvest regulations including harvest quota, season dates, and hunt zone boundaries. Management features can be adopted, amended, or repealed via the Administrative Procedures Act (APA) rulemaking process. The APA is a requirement by law that allows for the public to participate in the adoption of state regulations to ensure that the regulations proposed are clear, necessary, and legally valid.

CDFW provides recommendations for adopting, amending, or repealing regulations based on inventory and monitoring of resources, as well as both biological and social conditions. To change hunting regulations for any species, an additional parallel document is required through the California Environmental Quality Act (CEQA). CEQA requires all public agencies to evaluate the environmental impacts of projects, including regulation changes which may have potential to significantly affect the environment. CDFW has prepared Environmental Documents for each harvested species, including black bear, on behalf of the Commission. This document serves as a guide for periodic harvest adjustment recommendations within the APA process.

The APA process for enacting new Title 14 regulations generally requires a 12-18 month timeline composed of several public meetings (Table 2). The process generally begins with 2 initial discussion meetings at public meetings of the Wildlife Resources Committee (WRC) which is chaired by one member of the Commission. An initial scoping meeting of the WRC is typically held in May to discuss general rulemaking needs and is followed by a recommendation meeting of the WRC in September to approve or reject moving the rulemaking under consideration forward to present to the Commission. If a rulemaking is

approved to move forward by the WRC, the proposed regulation change is presented to the Commission at a public notice hearing in December. A public comment period follows this meeting. In February, a public discussion hearing is held, where the details of the proposed changes are discussed by the Commission and the general public and comments are responded to by CDFW staff. Adoption hearings would then be held in April, where final recommendations are presented by CDFW staff – formed in part by public comments and inquiry and discussion with the Commission. The regulatory framework is a public process that provides multiple opportunities for the public to engage with the Commission and CDFW to manage our shared resources effectively. The Commission has final approval authority to adopt, amend, repeal, or reject proposals set forth by CDFW or the general public. If a new regulation is approved, CDFW is responsible for implementation. Generally, this occurs in the fall when hunting seasons open.

Table 2. Administrative process and general timeline for adopting Title 14 regulations affecting black bear hunting and conservation.

Action	Government authority	Timeframe
Initial scoping	Wildlife Resources	May, year 1
Recommendation to proceed	Wildlife Resources	September, year 1
Notice hearing	Fish and Game Commission	December, year 1
Public discussion	Fish and Game Commission	February, year 2
Adoption vote	Fish and Game Commission	April, year 2
Implementation	CDFW	June-November, year 2

Chapter 4. Population Monitoring

4.1 Black Bear Conservation Regions

Due to California's geographical size and ecological diversity, black bear populations throughout the state may differ in terms of abundance, genetic diversity, and disease vulnerability. Therefore, the California Department of Fish and Wildlife (CDFW) intends to monitor black bear populations separately within nine Bear Conservation Regions (BCRs) representative of these potential differences.

Black bear hunting generally runs concurrent with the deer hunting seasons, and the area open to black bear hunting is largely delineated by deer hunt zones. For these reasons CDFW is adopting BCRs conforming to groups of deer zones (Fig. 8). These BCRs also generally conform to different ecological regions and CDFW administrative regions.

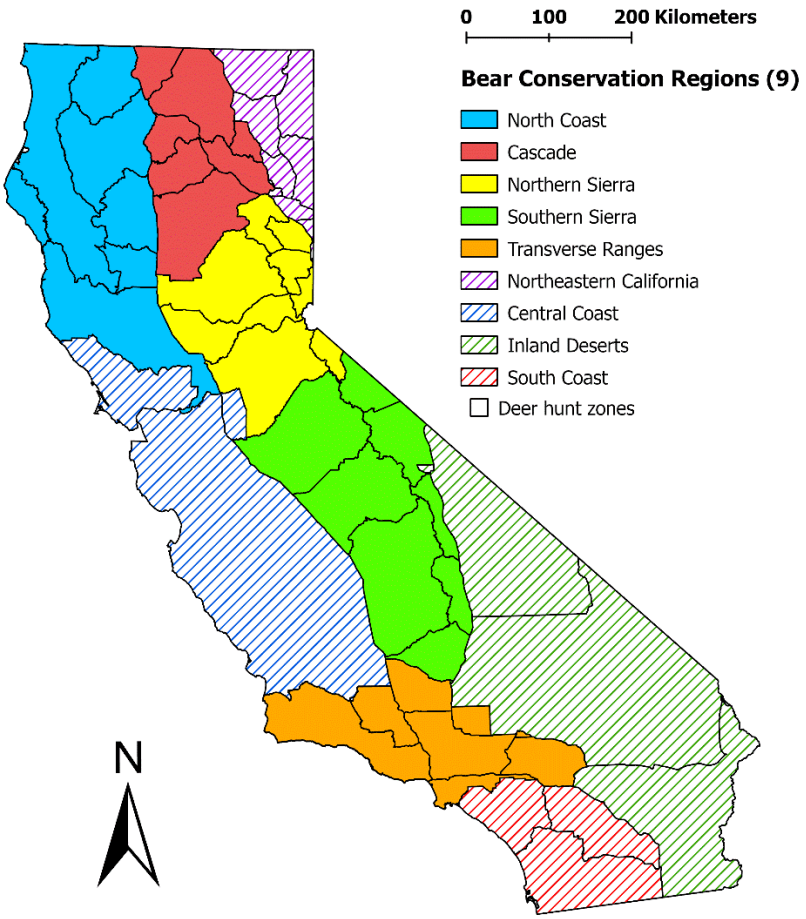


Figure 8. Bear Conservation Regions (BCRs) within which population trends would be monitored and harvest limits set. Solid patterns represent BCRs where hunting currently occurs, and dashed patterns represent BCRs where there is currently no hunting.

The 56,931-km^2 **North Coast** BCR lies mostly in CDFW Region 1, overlaps the Northern California Coastal Ranges and Klamath Mountains ecoregions, and includes deer zones B1—B6, and portions of the A North Unit.

The 29,640-km^2 **Cascade** BCR lies mostly in CDFW Region 1, overlaps the Southern Cascades ecoregion, and includes deer zones C1—C4, X1, X4, and portions of X3a.

The 34,463-km^2 **Northern Sierra** BCR lies mostly in CDFW Region 2, overlaps the Sierra Nevada ecoregion, and includes deer zones D3—D5, X7a, X7b, X8, and portions of X6a and X6b.

The 53,437-km^2 **Southern Sierra** BCR lies mostly in CDFW Regions 4 and 6, overlaps the Sierra Nevada ecoregion, and includes deer zones D6—D9, X9a, X9b, X10, and X12.

The 32,046-km^2 **Transverse Ranges** BCR lies mostly in CDFW Regions 5 and 6, overlaps the Transverse Ranges ecoregion, and includes deer zones D10, D11, D13, D14, and portions of D15, D17, and the A South Unit.

The 16,165-km^2 **Northeastern California** BCR lies entirely in CDFW Region 1, overlaps the Modoc Plateau ecoregion, and includes deer zones X2, portions of X3a, X3b, portions of X4, X5a, X5b, and portions of X6a and X6b.

The 68,284-km^2 **Central Coast** BCR lies mostly in CDFW Regions 3 and 4, overlaps the Central California Coast and Great Valley ecoregions, and includes portions of the A North Unit and A South Unit.

The 93,355-km^2 **Inland Deserts** BCR lies mostly in CDFW Region 6, overlaps the Mojave Desert and Sonoran Desert ecoregions, and includes deer zones D12, D17, and X9c.

The 24,746-km^2 **South Coast** BCR lies in CDFW Regions 5 and 6, overlaps the Southern California Coast and Southern California Mountains and Valleys ecoregions, and includes deer zones D16 and D19 and portions of D15.

Although CDFW will be monitoring black bear populations at the BCR scale, regulatory changes (Title 14 CCR) approved by the Fish and Game Commission would be required to modify the statewide annual harvest limit (e.g., currently 1,700 black bears) so that separate limits apply within each BCR. CDFW will also monitor bear populations in unhunted areas to inform conservation in these areas and to understand any potential range expansion.

4.2 Integrated Population Model

Black bear age and sex structure (i.e., percent of black bears by each year of age for each sex, Fig. 9) is a key source of data that CDFW uses to monitor black bear populations in California. CDFW can use this information to evaluate the effects of hunting and other factors on the statewide black bear population. For over two decades, hunters have provided tooth samples from harvested black bears. CDFW sends these teeth to a laboratory that counts annual rings visible in each tooth to determine the age of each

harvested bear. For many years, CDFW used these data in a mathematical model that estimated the total statewide black bear population size each year by comparing the age structures of males and females to the total number of harvested black bears (Fraser 1976). As males are more frequently harvested than females, there is a greater proportion of them in the younger age classes of harvested bears. This effect dissipates with older bears, so the sex ratio approaches 1:1 at a given age (Fig. 9). The age at which this occurs was then used as a parameter for estimating the total population size. However, a key accuracy assumption of the model was violated when hunter effort and success changed in 2013, when the use of dogs to hunt black bears was discontinued (Harris and Metzgar 1987, CDFW 2022b).

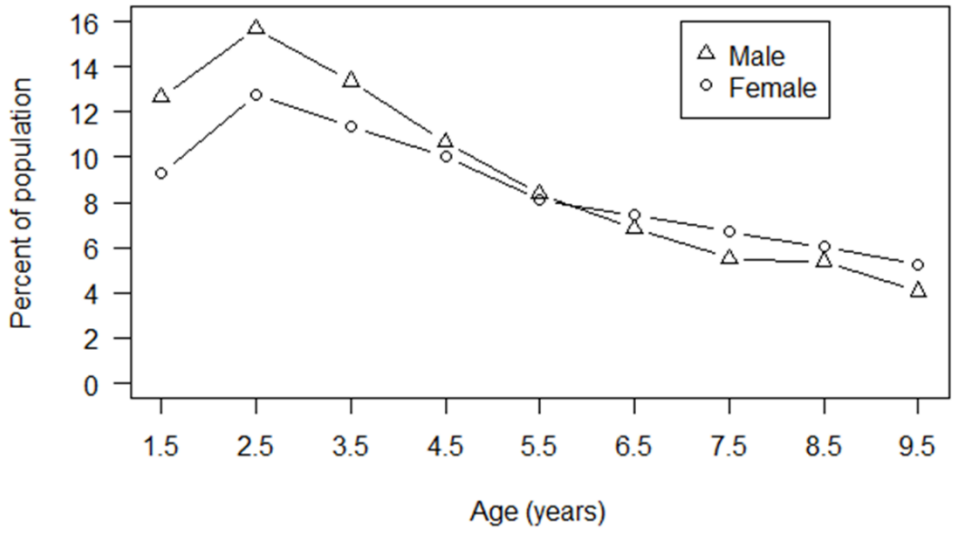


Figure 9. An example of age structure data for black bears in California. Hunters provide a tooth from each harvested bear (n~1,300 each year) from which the age can be estimated by a laboratory.

Integrated population models (IPM) are a powerful tool to efficiently combine different types of available information (e.g., population surveys, age and sex structure, survival, and reproductive rates) to better monitor population sizes and trends and understand the drivers of trends (Arnold et al. 2018, Zipkin and Saunders 2018). Recent advances in computing speed and Bayesian algorithms to solve complex problems have led to the increased application of IPMs and other types of advanced hierarchical models in wildlife ecology (Schaub and Kery 2012, Kery and Royle 2021). In particular, Bayesian models facilitate incorporating multiple sources of data including through the use of “informative priors”. Put in other words, final estimates combine inferences from the data being modeled and prior information from other studies. In 2022, CDFW began the process of adapting a black bear IPM originally developed in Wisconsin for use in California (Allen et

al. 2018a). The new IPM for California black bears combines the age and sex structure information from tooth sampling with additional information on vital rates (e.g., reproduction and survival) and other factors (e.g., non-reporting rate for hunter harvest). For the time being, most of the information included in the IPM on vital rates comes from published studies throughout North America. It includes some California information on hunting season adult survival which is expected to be higher in California than in Wisconsin where the bear IPM was first applied. The California black bear IPM also includes local information on the harvest non-reporting rate based on available data for deer. CDFW does not currently have the non-reporting rate for black bears but will be prioritizing the collection of that data. In the meantime, CDFW is using the deer non-reporting rate due to the substantial overlap between California's deer and black bear hunters.

CDFW also used information from local black bear density studies and species distribution modeling from camera traps to calculate informative priors on the initial value of black bear population size in each BCR (Figure 10). The IPM then applies an algorithm called Markov chain Monte Carlo (MCMC) to compute statistical probabilities which it uses to estimate the most likely final values (i.e., posterior distributions) of the population sizes and other model parameters, given the totality of information considered in the model. To get these priors, CDFW used a special type of occupancy model (Royle and Nichols 2003) to estimate how relative abundance varies spatially with covariates (e.g., elevation and forest cover) across the state at thousands of camera trap locations. CDFW then calibrated the camera modeling against black bear densities independently estimated from eight local studies that used various methods ranging from counts of GPS collared bears to spatial capture-recapture modeling (Kelleyhouse 1977, Piekielek and Burton 1975, Matthews et al. 2008, Fusaro et al. 2017, Owen-Ramos et al. 2022, CDFW unpublished data).

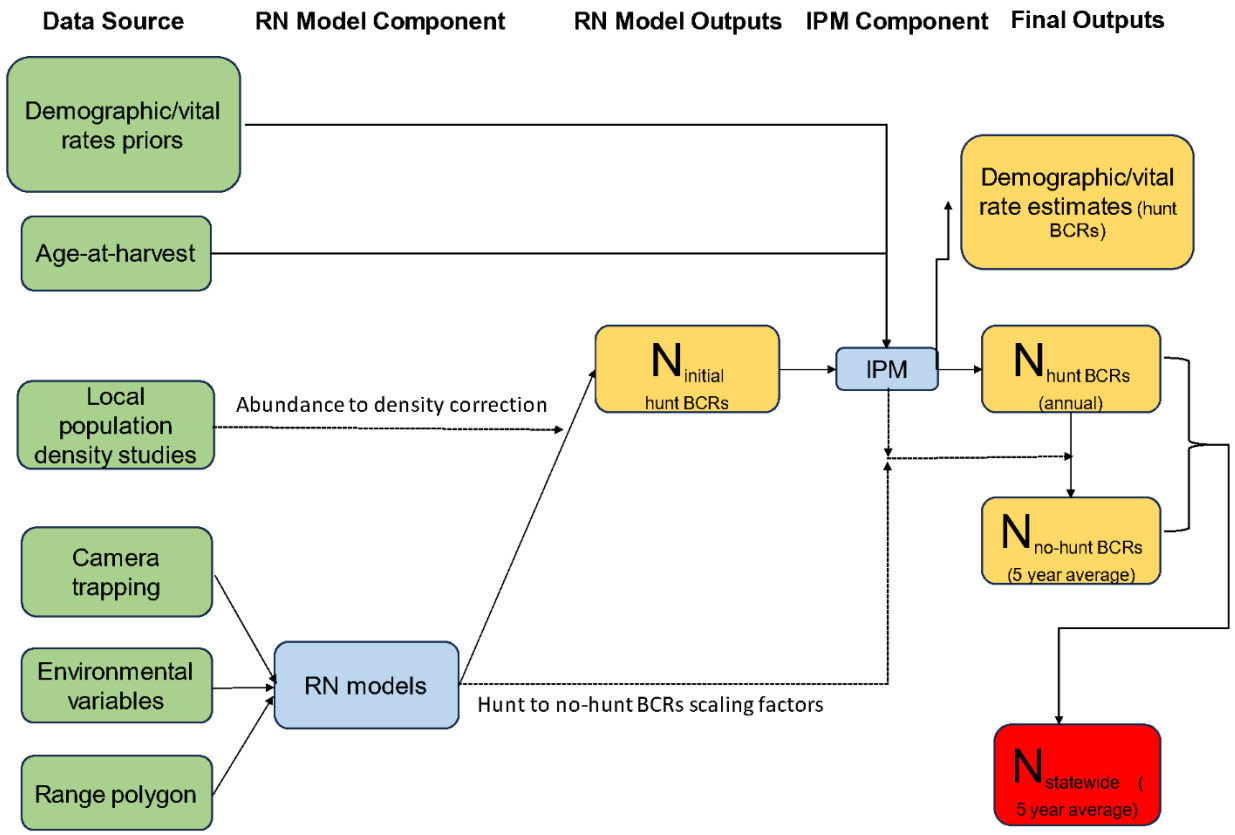


Figure 10. A flowchart showing the components and framework of the IPM. Solid lines indicate a direct input or output. Dashed lines indicate modifying or scaling effects. RN refers to the Royle-Nichols occupancy models that are used to predict black bear abundance using camera trap data. IPM refers to the integrated population model which estimates black bear population size and structure. N refers to population size.

Using the IPM with currently available data, CDFW estimates a total statewide black bear population (5-year average, 2019–2023) of 65,405 (90%CI: 49,549–80,935, Table 3). It is expected that the accuracy and precision of population estimates will improve further as CDFW begins to regularly collect local information on vital rates. Nevertheless, CDFW considers the current estimate reliable because it is based on multiple sources of information and a modeling framework that has been shown to be robust to inaccuracies about vital rates (Allen et al. 2018a).

Table 3. Current best estimates of black bear population size for all of California and Bear Conservation Regions within the state. The estimates below represent a 5-year average for 2019-2023.

Bear Conservation Region	Population estimate (90% CI)	Hunter harvest	Harvest rate
Hunt:			
North Coast	20,335 (12,221–28,627)	447	1.6%–3.7%
Cascade	16,059 (9,897–22,031)	217	1.0%–2.2%
Northern Sierra	15,420 (9,473–21,038)	279	1.3%–2.9%
Southern Sierra	8,173 (5,116–11,115)	259	2.3%–5.1%
Transverse Ranges	2,473 (1,024–3,793)	61	1.6%–6.0%
No-hunt*:			
Northeastern California	1,308 (802–1,812)	N/A	N/A
Central Coast	942 (501–1,373)	N/A	N/A
Inland Deserts	143 (83–201)	N/A	N/A
South Coast	551 (218–885)	N/A	N/A
Statewide	65,405 (49,549–80,935)	1,262	1.6%–2.5%

*Population estimates in no-hunt Bear Conservation Regions are currently based on spatial predictions from the camera trap-based Royle-Nichols occupancy model (Royle and Nichols 2003) scaled to results from an age-at-harvest (AAH)-based integrated population model (IPM). Thus, estimates in no-hunt BCRs should be interpreted cautiously.

The IPM also provides strong evidence that black bear populations have been stable in all BCRs over the past decade (Fig. 10). There is no evidence of any statistically credible ($P>0.1$) population declines or increases at the BCR scale during 2014-2023. One caveat is that the current modeling approach allows CDFW to extrapolate black bear population size in the no-hunt BCRs using occupancy modeling of camera trap surveys, but the lack of age distribution data outside of hunted regions currently precludes evaluation of population trend in the no-hunt BCRs. This issue could be rectified through the analysis of additional camera trap data and expansion of the age distribution and vital rates monitoring from areas where no hunting currently occurs.

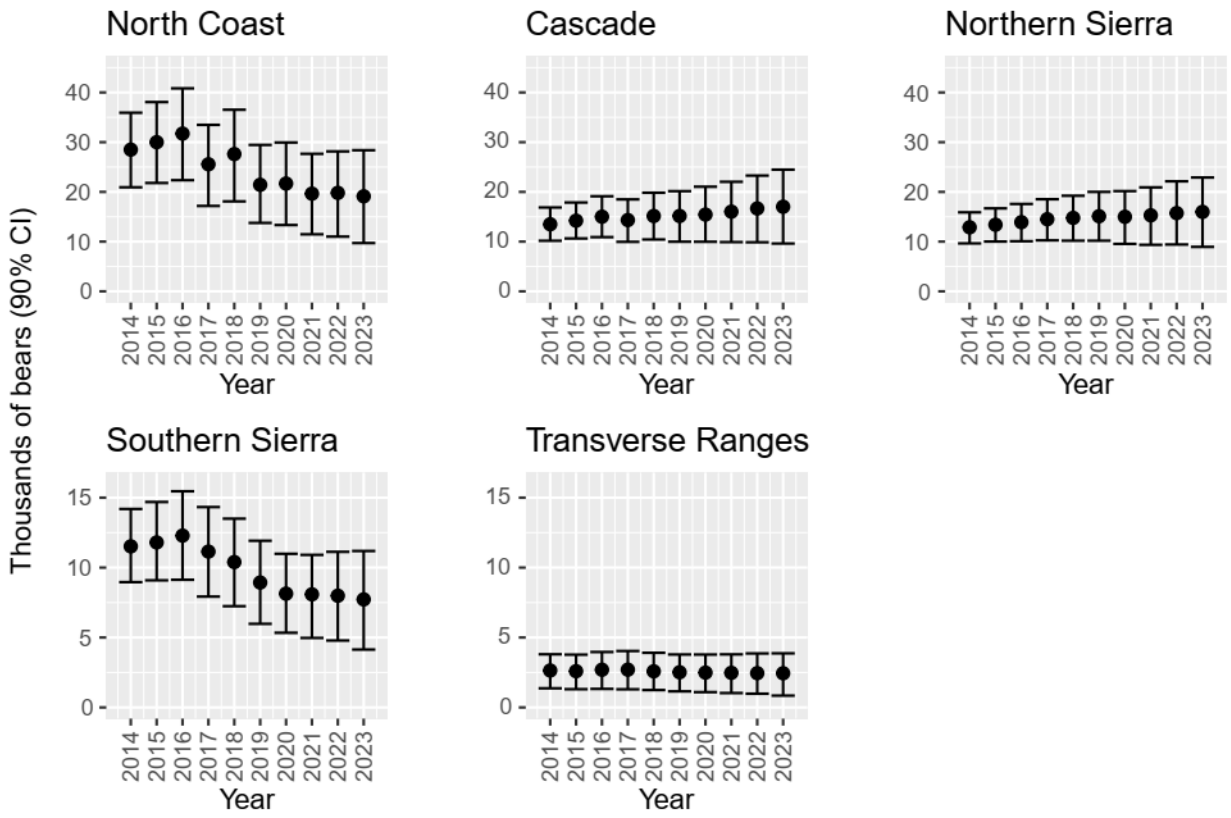


Figure 11. Evidence of lack of significant population trends in all California Bear Conservation Regions (BCRs) where hunting occurs based on the integrated population model (IPM).

Based on the age distributions and other sources of data included in the IPM, the model is estimating a hunting season survival rate that is higher and more precise than the prior information CDFW included in the modeling (Fig. 11). The updated posterior estimate makes sense considering that there is less hunting pressure in California than in other regions of North America. The current modeling approach, however, highlights the need for 10–15 local study areas throughout California to monitor black bear vital rates and other information, to complement the age and sex structure data used in the IPM. The locations of these study areas should be chosen to represent the range of black bear habitats across California and within BCRs. Vital rates within study areas could be monitored through a combination of GPS telemetry collars, den checks, camera grids, hair snares, fecal DNA, and other methods. Reproductive rates could also be estimated outside of these study areas using the thousands of camera traps surveyed in California each year, through analyzing how the number of cubs per adult female photographed changes each month. Additionally, CDFW will explore options for gathering information about pregnancy status inferred from the same tooth samples used to estimate ages of harvested bears. Thinner

tooth cementum annuli rings are often a signal of pregnancy in female bears, but methodological uncertainties will need to be formally addressed if the data are included in the IPM (Allen et al. 2017).

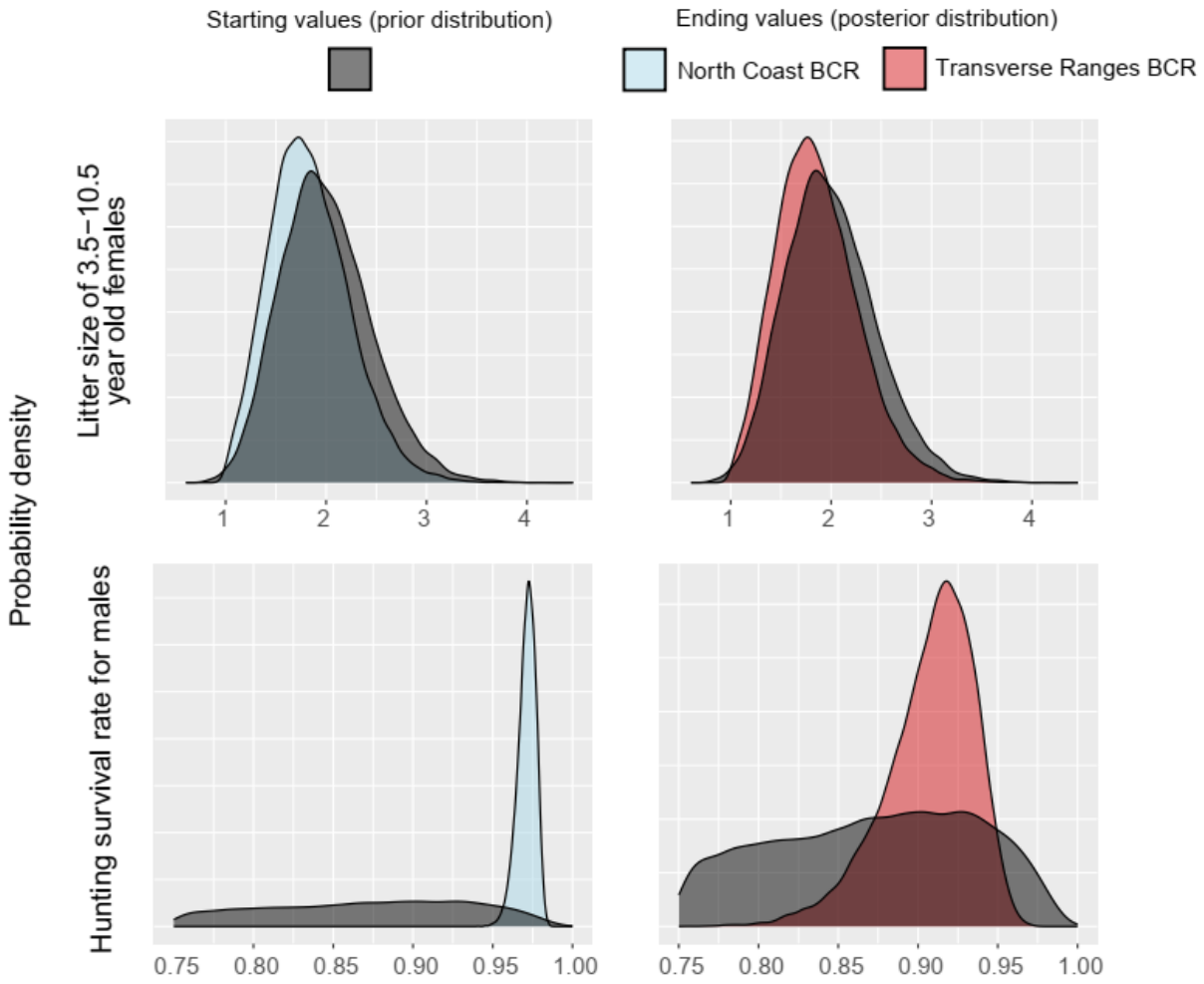


Figure 12. Plots of the prior and estimated posterior distributions of two key vital rates in the IPM for the year 2016 and in the North Coast and Transverse Ranges Bear Conservation Regions (BCRs). The plot of the predicted litter size of females aged 3.5-10.5 shows minimal departure from the informed prior distribution. The plot of estimated hunting survival rates for males shows a relatively high predicted survival rate in both BCRs and a large departure from the informed prior distribution, though lower rates in the Transverse Ranges compared to the North Coast.

Another source of potential bias in the IPM is that the age structure data are based on the ages of harvested black bears. While the age structure of harvested bears may not be fully representative of the age structure in the total population, the IPM can account for different harvest rates faced by different sex and age classes by estimating age, sex, and

year-specific hunting season survival rates (Allen et al. 2018a). Following the recommendations of Allen et al. (2018b), CDFW made additional adjustments to priors included in the IPM to offset the effects of expected age distribution bias in the black bear harvest. Additionally, CDFW will develop independent methods to sample the ages of non-harvested black bears. CDFW will compare the age distributions of harvested and non-harvested black bears, and use this comparison to adjust the IPM, if necessary (e.g., double sampling, Cochran 1977). CDFW expects that this adjustment would require a substantially smaller sample of non-hunted black bears with respect to the large amount of age data provided by hunters.

Spatial capture-recapture (SCR) modeling using field collection of genetic samples is a powerful method for robustly estimating bear abundance (Royle et al. 2013). CDFW does not need to rely on this method for black bears as much as for other species (Furnas et al. 2018), because of the age distribution data available for both sexes used in the IPM. CDFW did use SCR from local genetic studies (e.g., Owen-Ramos et al. 2022) for providing prior information on bear densities used in the IPM. To improve precision and accuracy of the IPM, CDFW will periodically conduct additional genetic surveys among the 10-15 local study areas for updating local densities used as priors in the IPM.

CDFW will develop a black bear population monitoring plan following completion of this conservation plan. It will provide greater detail on the data inputs and structure of the IPM, and protocols, timelines, and logistics for collecting all the necessary data statewide and within local study areas. This will be crucial to make sure appropriate data are being collected for use in the IPM.

4.3 Other Population Indicators and Harvest Metrics

Monitoring how black bear population size varies by BCR and year (i.e., using the IPM) is the primary scientific information CDFW needs to conserve the species throughout the state and ensure regulated hunting is sustainable. Vital rates (e.g., recruitment and survival) are key inputs into the IPM which will also provide CDFW with the ability to better understand the potential causes of any population trend. Some of the methods to estimate vital rates will involve deploying GPS collars on adult black bears, using GPS data to locate and monitor dens, and using camera traps to estimate litter size and cub recruitment.

In combination with population and vital rates estimates, CDFW will use other metrics to inform its adaptive management of black bears as described in Chapter 6. These metrics include those CDFW has previously used in the absence of robust population estimates: 1)

the average (or median) age of female bears ascertained from the age distribution data used in the IPM, and 2) the percentage of harvested bears that are females ascertained from harvest success reporting required of hunters (CDFW 1998). When possible, CDFW staff will confirm reported bear sex when handling bears to extract teeth. This approach of using harvest-based metrics to guide sustainable levels of hunter harvest has been used by many other state wildlife agencies throughout North America (IDFG 1999, WGFD 2007, NYDEC 2014, Allen et al. 2018a, Allen et al. 2018b).

CDFW maintains a database of harvest statistics of annual black bear tags sold and the mandatory reporting information on harvest locations and dates. Besides using this information to inform population monitoring, the information is used to assess factors affecting hunter success at the BCR scale.

Chapter 5. Other Data for Informing Conservation and Management

5.1 Genetic Diversity and Connectivity

Brown et al. (2009) found that genetic diversity among California black bears is substantial and similar to that of other states (Brown et al. 2009, Clarke et al. 2001, Paetkau et al. 1998, Paetkau and Strobek 1994). However, given the age of this study, these estimates require an update. The California Department of Fish and Wildlife (CDFW) is currently collaborating with the University of California, Santa Cruz to conduct a statewide genomic study to address issues of genetic diversity, population structure, and adaptive differentiation. This study will serve as a baseline assessment that can be used to evaluate genetic diversity in subsequent years. Given the substantial genetic diversity, minimal population structure, and high connectivity among California black bears, there are currently few conservation concerns regarding genetics. Given the time lag between when a population may experience anthropogenically induced reductions in size and/or connectivity versus when the genetic effects of such events become detectable, statewide efforts to re-estimate genetic diversity should every 10-20 years. On that schedule, CDFW scientists should estimate standardized measures of genetic diversity (e.g., heterozygosity, allelic richness, etc.), as well as re-evaluate genetic population structure. Both can provide insights regarding whether anthropogenic activities have significantly fragmented available habitat or reduced population size. To facilitate these updates, CDFW will continue to build and maintain a DNA archive for black bears throughout the state.

5.2 Movement Ecology and Connectivity

California Assembly Bill 2344 (Safe Roads and Wildlife Protection Act) was enacted in 2022 and provides new authority and funding to support the evaluation of wildlife connectivity across roads, and other barriers, to benefit wildlife populations and reduce vehicle collisions. In part in response to these priorities, CDFW will include detail in a black bear monitoring plan (see Section 4.4) to guide how most efficiently to place GPS collars on black bears to better understand their spatial ecology and vulnerability to road collisions. For example, autocorrelated kernel density estimators can be used to estimate bear home range sizes and understand factors associated with differences in those ranges (Fleming et al. 2015), and GPS collar data will also allow for detailed analyses of black bear movement and habitat selection through methods such as Brownian bridge movement models and

integrated step selection functions (Koehler and Pierce 2003, Thurfjell et al. 2014). Results from these analyses will allow for better predictions of where black bear road crossings are the most likely, which will help inform mitigation efforts like the installation of wildlife road crossings (Zeller et al. 2020).

A secondary purpose of the GPS collars will be to estimate survival rates, and how they change over space and time. As noted in Section 4.2, vital rates are a key source of information included in the IPM to monitor black bear populations.

Additionally, in 2022, the CDFW initiated a project to document the space use of black bears involved in human-black bear conflict (HBC) and cubs released from rehabilitation facilities. Over the next 3-5 years, fine-scale habitat use data (i.e., hourly detections) will be collected from up to 250 black bears fitted with GPS collars. Collars fitted to adults will last for 2 years and collars fitted to yearlings or small juveniles will last for 9 months to accommodate increase in body size. This data can be used to inform habitat selection in relation to environmental factors (e.g., forest cover, riparian areas, fires, droughts, etc.), improve understanding of black bear road crossings, and evaluate the ability of non-lethal management tools for altering conflict behavior.

CDFW and other researchers are increasingly placing cameras at wildlife crossings below or above roads to document and evaluate the effectiveness of these structures for facilitating wildlife connectivity (Ng et al. 2004, Caldwell and Klip 2020). Cameras in these settings provide information on the species using connectors, the times of day they are more likely to use these structures, and interactions among species, for instance whether prey species such as deer are at greater risk of ambush by predators such as mountain lions. These data could help inform an expanded assessment of the importance of underpasses and overpasses to reduce vehicle collisions with black bears and the degree to which black bears alter the behavior of other species using these structures.

Roadkill data is also relevant to mitigating traffic collisions and other aspects of wildlife conservation and management (Schwartz et al. 2020). The California Department of Transportation maintains a wildlife roadkill database including species, date, road number, and mile marker location. Further, the UC Davis Road Ecology Center compiles some of these data and other sources of citizen science wildlife roadkill observations in another database (Shilling and Waetjen 2015, http://wildlifecrossing.net/california).

5.3 Disease

Collecting biologic samples and associated metadata (age, sex, date, location, etc.), whether for archive or immediate analysis, is an important tool to inform managers about the health, disease status, and HBC involvement of individual animals within the context of populations. If sample collections are from a large and diverse enough subset of one or more populations, results either from a point in time or, better yet, across time can collectively provide significant information on health and disease status of populations. Trends in results could indicate changes in population health. CDFW and its partners maintain multiple tissue sample archives including serum, whole blood, hair, formalin-fixed paraffin embedded tissues, and various fresh tissues collected from black bear mortality investigations, management actions, and hunter harvests. CDFW will continue to collect and archive these samples so they will be available for future use. The value of maintaining this archive is that if a health or disease related issue does emerge, samples are available that could be used to assess over space and time, giving managers a better understanding of any potential impacts.

5.4 Animal Welfare

One of the primary animal welfare concerns of the CDFW is the disposition of orphaned black bear cubs. Up to 30 cubs are assessed for care annually by CDFW veterinarians for placement in one of currently four permitted rehabilitation facilities in the state. Monitoring of these bears following release from rehabilitation facilities with GPS collars began in 2022 and will continue for the next 3-5 years. Information on short-term (i.e., 9-month) survival, causes of mortality, and conflict behavior of the animals will be compared to that of wild bears to evaluate and/or improve practices for management of orphaned cubs.

5.5 Human Interactions with Black Bears

CDFW will continue to maintain and use its Wildlife Incident Reporting (WIR) database to monitor HBC trends. The public can submit reports online directly to the WIR, or a CDFW staff member can enter a report on the public's behalf. The report consists of the date the incident occurred, the species of wildlife involved, the address of the property, the approximate GPS coordinates, and a brief description of the incident.

CDFW's black bear policy defines different types (categories) of bear incidents requiring a response:

1) **Conflict bear:** A catch-all term for any bear that requires response due to its behavior or situation, including animal welfare bears, habituated bears, and "no harm/no foul" bears which may require assistance returning to nearby habitat.

2) **Depredation bear:** A bear that is threatening to, damaging, or destroying property for which a revocable depredation permit has been requested and can be issued in accordance with the Fish and Game Code.

3) **Public safety bear:** A bear demonstrating aggressive action that has resulted in physical contact with a human; or a bear exhibiting an immediate threat to public health and safety.

Once a WIR report has been submitted, it is reviewed by a CDFW staff member. If the incident warrants further investigation or action, the staff member will follow up with the reporting party and often perform a site visit to inspect the situation firsthand. For black bears, this may involve providing outreach on coexistence. If the incident is a depredation incident, the depredation permit process may be initiated per the steps in the Black Bear Depredation Policy (CDFW 2022a).

Human dimension studies on the quality of human interactions with wildlife including black bears are led by a CDFW social scientist. These studies will focus on both the general public, particularly those living in black bear habitat, and California's black bear hunters. Specifically, understanding the factors influencing effective implementation by the public of preventative measures to reduce human black bear conflict will be important for effective conservation (Baruch-Mordo et al. 2011). Further research on how the California public values black bears will be necessary to better estimate and manage social tolerance levels for the species in different settings and help set conservation goals accordingly (Vaske et al. 2022, Delie et al. 2023). Additionally, understanding the experiences of California's black bear hunters will be useful for predicting hunter effort and evaluating the role of hunter harvest in black bear management and conservation. Such work can help identify the behavior of hunters and the barriers and limitations hunters face. Hunter satisfaction surveys are the easiest surveys for CDFW to perform because CDFW has the contact information of hunters purchasing a black bear tag or hunting license. For most surveys of the general public, CDFW would need to purchase a survey panel or sample to have a scientifically robust sample.

CDFW is beginning to explore methods for analyzing social media posts about wildlife to widen its understanding of human-wildlife interactions beyond hunting. For example,

CDFW has worked with data science interns at the University of San Francisco to extract and analyze posts about black bears from X (formerly known as Twitter) throughout California during 2010-2022. A preliminary analysis of emotional sentiment using data science methods suggests that the predominant sentiments towards black bears were ambivalence (38%), fear (24%), and joy (19%) and that there were seasonal shifts in the relative frequency of these sentiments (Fig. 12, Ai 2023). CDFW will attempt to improve upon this analytical approach including expansion to other social media platforms.

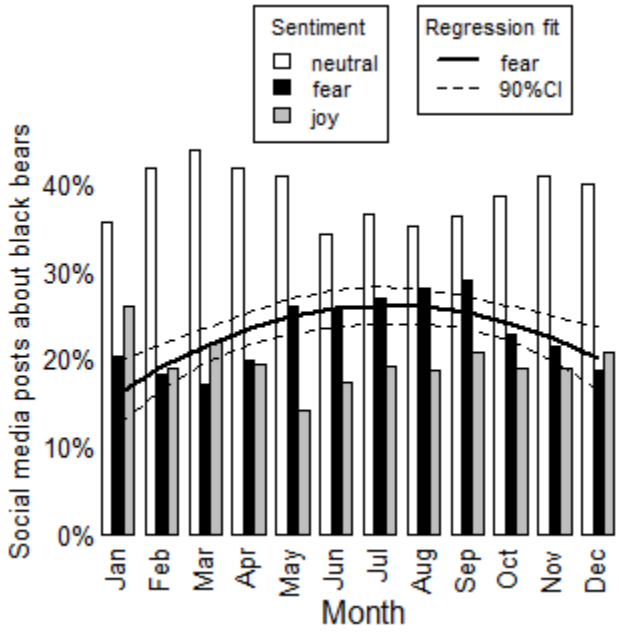


Figure 13. Analysis of emotional sentiments expressed within black bear social media posts from California during 2010-2022. Data science methods were applied to remove non-wildlife related tweets (e.g., Black Bear Diner) and to infer emotional content of phrases and sentences. Results suggest negative sentiments peaked during summer when human wildlife conflict incidents are more prevalent (Ai 2023).

Chapter 6. Adaptive Management

6.1 Conserving Abundant Black Bear Populations and their Habitats

An ability to estimate and monitor bear population abundances statewide and regionally constitutes the foundation of the California Department of Fish and Wildlife's (CDFW) approach to meeting its conservation goals for black bears. CDFW intends to apply population information within an adaptive management framework for guiding, supporting, and communicating decisions affecting hunting, human-black bear conflict (HBC), and other conservation actions for black bears (Walters 1986, Fig 13). This adaptive approach will provide CDFW with the flexibility to adjust its approach to black bear conservation based on the most up-to-date data and evidence.

As detailed in Chapter 4, CDFW will monitor black bear population totals and their trends within each Bear Conservation Region (BCR). Consistent with the goal to maintain abundant bear populations, if there is a conservation concern about a population decline or low population, CDFW will use the integrated population model (IPM) to follow up with an evaluation of vital rates, associations with specific stressors (e.g., harvest, habitat, climate, food availability, fire, etc.), and related conservation metrics (e.g., genetic diversity, disease). If concern remains, CDFW would apply the IPM to simulate expected future conditions and provide a population viability analysis to help quantify the conservation risk (Penman et al. 2022). CDFW would rely on findings from these analyses and assessments to inform any recommendations to the Fish and Game Commission ("Commission") about regulatory changes including (but not limited to) hunting levels, methods, and seasons. CDFW would also use its findings to inform other potential conservation responses, including initiating new research and collaborating with external partners (federal and state agencies, tribes, non-government organizations, private landowners) on developing conservation approaches which could include forest and fire management strategies for improving black bear habitat.

Whereas there is a goal to maintain abundant black bear populations, high black bear densities can exacerbate HBC, adversely impact other wildlife species, and increase incidence of bear diseases (see Chapter 3 for greater detail). If there is a concern about black bear overpopulation within a BCR, CDFW would conduct similar analyses as described in the previous paragraph. CDFW would use this information to help assess whether and how overabundance contributes to the concern as it pertains to its conservation goals for black bears. CDFW would then evaluate and appropriately

implement management actions for addressing the concern. These actions include application of educational and public outreach approaches included in CDFW's policy for addressing HBC (CDFW 2022a) and working with local municipalities and other groups to provide expanded access to secure waste disposal and other infrastructure that reduces the availability of anthropogenic food sources to black bears (Johnson et al. 2018). CDFW will use its IPM-based population monitoring approach to evaluate whether reduced levels of HBC lead to reductions in recruitment and population size. Specifically, CDFW will coordinate vital rates monitoring among groups of black bears representative of different levels of HBC. This will help CDFW assess whether reducing attractant-based HBC leads to either lower regional population size via reduced recruitment or lower local density via reduced immigration. CDFW would also evaluate the application of non-lethal strategies for managing the potential effects of black bear predation on ungulates and other species of management or conservation concern. For example, relocation of black bears off elk (*Cervus elaphus*) calving grounds has been used to improve calf recruitment (Yarkovich et al. 2011).

As there is anecdotal information suggesting black bears have recently expanded their range in some areas of California (Section 3.2) effecting a potential for increased hunting opportunity and increased HBC, CDFW will prioritize analysis of occurrence (e.g., cameras) and movement (e.g., GPS collars) monitoring in these areas. If necessary, CDFW will create additional BCRs to reflect the changing distribution of black bear populations.

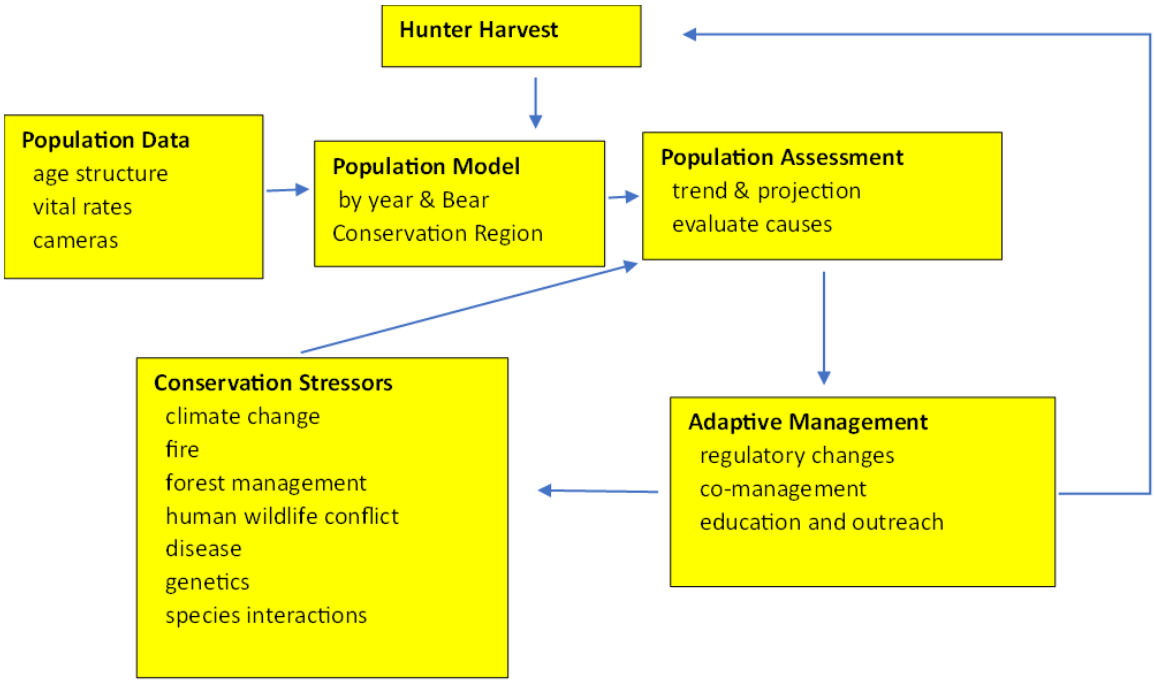


Figure 14. Adaptive management steps for using population data, and other information, to inform conservation actions for black bears in California.

6.2 Conserving Genetically Diverse Black Bear Populations

By monitoring and reassessing black bear genetic diversity every 10 to 20 years (Section 5.1), CDFW will be able to determine if anthropogenic activities have significantly fragmented habitat and limited gene flow. Should such situations occur, CDFW will use other existing and future data sources (e.g., from GPS collared individuals, road-kill surveys, etc.) to identify locations where mitigation projects to improve connectivity (e.g., highway crossing structures, habitat corridor protection and enhancement) could occur.

6.3 Conserving Disease-Resilient Black Bear Populations

Black bear populations currently appear to be stable and disease-resilient in California. CDFW will continue to opportunistically surveil black bears for emerging health or disease concerns through mortality investigations and routine sample collections from management actions or conflict black bears. In particular, CDFW will research idiopathic encephalitis in black bears, which can substantially alter black bear behavior and has been suggested to exacerbate HBC (Sinnott et al. 2022)

6.4 Providing Black Bear Hunting Opportunities

Consistent with Fish and Game Code (FGC) Section 1801, CDFW will analyze and assess black bear population data, and other sources of information including data on hunter opportunity and success, to inform any recommendations to the Commission about changes to hunting regulations (e.g., tag limits, seasons, methods of take).

CDFW's primary analytical tool for determining sustainable harvest levels would be the IPM combined with simulation of the future population trajectory under different harvest scenarios.

As CDFW will be monitoring black bear populations at the BCR scale, it makes sense to manage hunting levels, seasons, and methods of take at this scale. Regulatory changes (Title 14 CCR) would be required for this to be possible. This is because current regulations set a 1,700 black bear annual harvest limit at the state level.

CDFW will continue to promote hunter ethics through hunter education activities.

6.5 Managing Human-Black Bear Conflict and Consideration of Animal Welfare

Although concerns about HBC and conserving abundant populations are linked (see Section 6.1), management of HBC is a broader issue that is largely addressed in a separate CDFW (2022) policy document.

This policy places a high priority on animal welfare. Specifically, the policy prioritizes use of non-lethal, corrective actions (e.g., eliminating attractants and adding bear-proofing structures) before authorizing depredation permits for killing conflict bears. The annual number of black bears taken under depredation permits has decreased since 2017 and averages 60 bears per year, which amounts to <0.1% of the state population.

Additionally, CDFW will continue to coordinate with rehabilitation facilities around the state to ensure humane and effective veterinary care for black bears recovered during wildfires and other circumstances. Further, CDFW veterinarians will continue to lead review of capture plans required for research investigations that include the capture and temporary immobilization of black bears to place GPS collars or for other purposes. These capture plans safeguard animal welfare by specifying methods of capture, proper use of immobilization drugs, and monitoring of the physical and psychological health of captured animals.

CDFW will continue to consider animal welfare in its planning activities and regulatory change proposals affecting regulated hunting. Besides conserving abundant, genetically diverse, and disease-resilient bear populations, and consistent with efforts to promote hunter ethics (see section 6.4), CDFW will consider the effects of hunting seasons and methods of take on animal welfare.

6.6 Communication and Outreach About Black Bears

CDFW will produce an annual report on the status of California black bear populations at the BCR scale which it will post on its website by September 15th each year. The report will include estimates and trends for population sizes, vital rates, and harvest statistics. The report will discuss any emerging conservation or management issues and identify areas requiring new, focused research to further investigate those issues.

Additionally, the CDFW Statewide Black Bear Coordinator will regularly lead meetings of a black bear working group (i.e., CDFW regional biologists and subject area experts) to discuss black bear conservation issues and implementation of this plan.

6.7 Co-management of Black Bears with Tribes and other Partners

Consistent with policy (CDFW 2014), CDFW will continue to notify and consult with Tribes regarding any regulatory change proposals affecting black bears. CDFW will also prioritize co-management opportunities with Tribes including actions that address comments summarized in Table 1. Other potential opportunities include funding to help support and sustain Tribal wildlife conservation and research programs and cooperation on population monitoring of black bears.

CDFW will actively seek opportunities to partner with Tribes, federal and state agencies, hunter and animal welfare interest groups, and others to collaborate on 1) research studies, 2) habitat improvement activities (e.g., prescribed fire, forest management, food availability, movement connectivity, climate adaptation), and 3) human infrastructure programs (e.g., increasing access to secure waste disposal, electric fencing, and educational outreach about their proper use) that are likely to benefit stable black bear populations and minimize HBC.

6.8 Periodic Review and Updating of the Black Bear Plan

CDFW will review and update this plan in its entirety every 10 years. CDFW will update individual sections as necessary.

Chapter 7. Research, Resources, and Organizational Support Required for Plan Implementation

7.1 Data Collection

This conservation plan provides a general summary of the types of data that will need to be collected for use in population modeling and other sorts of analyses for informing effective conservation of black bears in California. The California Department of Fish and Wildlife (CDFW) will also need to develop a black bear monitoring plan that details the logistics for sustaining collection of these data over time. Such a plan could take 1-2 years to develop; it would need to include specifics on the locations of the 10-15 regional study areas where recruitment and survival data would be collected and where genetic spatial capture-recapture surveys would occur for validating population estimates from the integrated population model (IPM). The logistical considerations would include equipment, samples sizes, the scheduling of surveys, and the CDFW staff in Regions and Headquarters required to administer this work. CDFW would also need to identify suitable and sufficient sources of funding to cover the anticipated actions.

In the first few years of implementing new and expanded black bear population monitoring efforts, CDFW will need to prioritize research of new survey and analytical methods, especially for vital rates and the most efficient design of genetic spatial capture-recapture studies. Currently, we rely on the use of the teeth from harvested bears as our primary source of information on age distribution. However, the estimation of DNA methylation levels is an emerging and potentially promising alternative method that CDFW will investigate. Higher DNA methylation levels, which can be estimated from blood, hair, and tissue samples, are associated with older age in mammals (Nakamura et al. 2023).

7.2 Data Management

Historically, CDFW and other wildlife agencies have placed greater emphasis on gathering wildlife survey data than on planning for management and analysis of that data once collected (DeWan and Zipkin 2010, Scotson et al. 2017). CDFW will require dedicated staff to manage and quality check these data in a timely manner.

Data storage and workflow management pipelines are also important considerations for ensuring data integrity, security, and ease of use (Brousil et al. 2023). CDFW is currently developing its data science capabilities through contracts to help manage its camera trap data (e.g., Wildlife Insights) and sound recorder surveys for birds and bats (e.g., UC

Berkeley). CDFW will also need to investigate similar approaches for telemetry and genetic spatial capture-recapture data. The effectiveness of data sharing practices will also need to be considered (Urbano and Cagnacci 2021), especially since numerous entities outside of CDFW use camera traps and other survey methods (e.g., roadkill counts) that generate data that would likely be useful to big game species conservation in California. Pooling large data sets for improving statistical modeling will require development of collaborative relationships that are ultimately formalized through data sharing agreements and memorandums of understanding. For example, it is likely that the 10-15 black bear study areas proposed under this conservation plan will require collaboration with Tribes, other state and federal agencies, private landowners, and non-government organizations.

7.3 Data Analysis

Modern computing allows for more robust modeling and stronger scientific inferences by combining data from multiple sources and adjusting for uncertainties and biases in the sampling methods (Kery and Royle 2016). One of the challenges is that these analyses are often highly complex, requiring advanced statistical expertise. CDFW currently has a full time Quantitative Ecologist to guide and advise on population modeling of big game species, but additional modeling support may be required to expedite analytical work for black bears and other big game species in a timely manner in response to conservation decisions that arise during the adaptive management process (Fig. 13).

Computing speed is often a constraint on the efficiency and effectiveness of solving complex statistical models that include spatial data or multiple sources of data (de Valpine et al. 2017, Turek et al. 2021). It may be necessary to work with university researchers to customize software for improving the efficiency, performance, and scalability of the IPM and spatial capture recapture models (e.g., Nimble package for R software). CDFW also may need to invest in additional computing power for use by staff running complex models.

7.4 Collaboration and Co-management

The CDFW Statewide Black Bear Coordinator will lead collaboration and co-management activities, but support from various other functions will be critical to success of these efforts. Co-management of habitat conditions through forest and fire management that require outreach to Tribes, and other state (e.g., CalFire, State Parks) and federal agencies (e.g., US Forest Service, National Parks) are best achieved in consideration with the needs of multiple wildlife and plant species. This highlights the importance of a broader, co-

management approach within CDFW that is coordinated across species, habitats, and programs.

Photo: CDFW Ecoregional Biodiversity Monitoring Project, Northern Region.

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