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**Management of Orphaned Black Bear Cubs in British
Columbia: Jurisdictional Summary, Recommendations
for Best Practices, Summary of Research on Captive-
Rearing Efficacy, and Study Proposal**
for the British Columbia Conservation Foundation



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Efficacy of Orphaned Cub Captive-rearing

Orphaned bears have been captive-reared and released back to the wild for more than three decades, often without a clear understanding of their fates because post-release monitoring is not a common practice. As a result, management agencies lack efficacy data on post-release success rates. To date, there have been few studies on captive-rearing of bears, and most have been limited to bears kept at a single facility. Where studies have been completed, researchers defined primary success of a captive-rearing program where bears released back into the wild survive at rates comparable to wild conspecifics and avoid human-bear conflict post-release. Using this definition of success, I summarize the findings of key studies that look at the efficacy of orphaned cub captive-rearing, and other common concerns with releasing captive-reared bears.

Breck et al. (2008)

Summary: Breck et al. (2008) looked at the role of social learning, asocial learning and inheritance in creating conflict behavior in bears.

In this study, Breck et al (2008) investigated whether two distinct behavioral patterns, non-food-conditioning (NFC) and food-conditioning (FC), observed in populations of black bears partitioned along genetic lineages. They used data from two distinct bear populations where both NFC and FC bears were studied and used behavioral and genetic data to compare genetic relatedness within and between NFC and FC bears. They hypothesized that if behavior between individuals was similar because of genetic inheritance or parent-offspring social learning, they should see simultaneous behavioral and genetic divisions, such as along familial lineages.

They combined genetic data with behavioral data for 116 American black bears from the Lake Tahoe Basin and Yosemite National Park, USA. They categorized individual bears as food-conditioned (FC) or non-food-conditioned (NFC) based on their behavior over a several year period of intensive study at each site. They compared levels of relatedness, based on microsatellite DNA genotyping, within and between these groups and compared behavior between nine mother-offspring pairs determined through genetic analysis of maternity.

Based on four separate analyses of the data there was no evidence that food-conditioning behavior in black bears partitioned along related lineages, indicating that the acquisition of food conditioning behavior was more likely a function of either social learning that occurs independently of close relatives or asocial learning.

Beecham et al. (2015)

Summary: This is one of the first multi-institutional studies, spans multiple continents, countries and captive-rearing practices, and considers the efficacy of captive-rearing on three species of bears. This study also evaluated whether spring, fall or winter releases produced better survival rates for cubs. This study included collared bears in the sample. It showed similar rates of survival and conflicts with people as wild bears. There was no difference between fall and summer released bears when considered on par with their wild counterparts.

Multi-institution studies that look at the effects of captive-rearing on black bear survival and behavior are lacking, particularly in North America. This study was a precedent for multi-institution data analysis among wildlife rehabilitation centers. Beecham et al. (2015) evaluated the potential management and conservation implications of releasing captive-reared bears by documenting post-release survival, cause specific mortality, human conflict activity, movements, and reproduction for 550 American black, brown and Asiatic black bears reared in 12 captive-rearing programs around the world. They defined post-release success in two hierarchical levels: 1) primary success was achieved when captive-reared bears were able to survive in the wild and avoided negative interactions with humans; and 2) secondary success was achieved when bears demonstrated life-history traits similar to wild bears, including post-release movements and reproduction.

All orphaned bears included in this study were accepted into captive-rearing facilities during their first year of life. The cubs were kept in captivity for 2–14 months using a variety of captive-rearing protocols, all accepted under the International Fund for Animal Welfare (2007), which primarily involved minimizing post-weaning human contact during their captivity. Bears were fed natural foods, supplemented with dry dog food and other anthropogenic foods after weaning (Beecham 2006).

Captive-reared bears considered suitable for reintroduction into the wild were released as yearlings (11–23 months) into habitat occupied by the species. Release sites ranged from rural to remote areas with no exceptional levels of protection for released bears. Releases of American black bears took place during the first winter (Nov–Mar) or the second year during spring or summer (Apr–Jul), with a few exceptions (7%) that were kept in captivity until the second fall (Sep–Oct) when they were considered releasable. Bears released in winter were placed into natural or artificial dens or released directly to choose a natural den site.

All released bears were ear-tagged and/or equipped with very high frequency (VHF) or global positioning system (GPS) telemetry collars for post-release monitoring. Monitoring frequency and duration varied among projects because of logistical constraints and funding limitations. Collared bears were monitored until the collar dropped or malfunctioned and provided data on survival, cause-specific mortality, and movements. Ear-tagged bears provided opportunistic data on longevity, movements, and conflict activity.

Approximately 30% of all released bears were not observed post-release and were categorized as unknown fate, 31% were known to have died, and 39% were alive when last observed. The primary causes of mortality for American black bears were sport hunting and road kills. Survival rates varied considerably among states and provinces, ranging from ~ 0.502 in Washington to ~ 0.897 in Utah. Bears released in the 3 northwestern states, with unlimited or controlled entry spring hunting and unlimited fall hunting opportunities (Idaho, Montana, and Washington), had lower survival than states and provinces with controlled entry or no spring hunting and unlimited fall hunting opportunities (New Jersey, New Mexico, Ontario, and Utah).

Of 141 known mortalities, 54% occurred during the first year after release when bears were 1 to 2-year old and at least two bears lived for more than 10 years in the wild. Twenty captive-reared bears produced 21 litters. Age at orphaning, release weight, and the interaction between the two were the variables that best explained first-year mortality in Idaho, Montana, and Washington. Survival was higher for bears orphaned at < 8 months when they were released at heavier weights. However, increasing release weight decreased survival for bears orphaned at 8 months or older. Timing of release

(e.g., fall versus spring/summer) did not affect survival rates in comparison to wild conspecifics. There were no differences in survival between winter released bears <12 months of age and spring and summer releases of yearlings, or when comparing den releases with other hard-release methods.

Black bears showed no homing tendencies toward their rearing facility. The majority of released black bears (94.2%) were not documented to be involved in conflicts. No agonistic behaviors towards humans were reported for any captive-reared bears. Most conflicts were documented during the first year after release. Spring and fall release period and hard versus soft release method did not affect the probability of bears being involved in conflicts. Beecham et al. (2015) did not find any difference in the probability of being involved in a conflict, regardless of whether the cub was born to mothers with a known history of conflict behavior or born to mothers with no known history of conflict behavior. The probability of a bear being involved in a conflict increased with the length of time in captivity and decreased with heavier release weight. Increasing release weight had a larger effect on reducing conflict probability for bears held in captivity for longer periods of time (i.e., >6 months) but was less important when bears were in captivity for shorter periods.

Low release weight and longer periods of captivity increased the probability of post-release conflicts, suggesting that keeping bears in captivity for longer periods to increase their weight prior to release, which results in higher survival, may be an acceptable risk if the probability of conflict with humans is low in the release area. Otherwise, it is advisable to maximize growth rates and reduce the length of time bear are in captivity, to increase survival rates and reduce the potential for human-bear conflicts in the first year post-release.

Binks (2008)

Summary: This is one of the first multi-institutional studies, though all study animals came from and were returned to Ontario. This study compared differences in success rates for captive-reared bears given three captive-rearing practices ranging from more human contact and a less natural setting, to no human contact and a highly natural setting. Bears were collared and tracked for this study. Bears had similar survival rates and rates of conflicts with people, regardless of the captive-rearing setting. This may be particularly true if bears are released into a remote settings. There was no difference in survival between released bears when considered against their wild counterparts.

Binks (2008) provided information about post-release survival and behavior of orphaned and shelter-reared black bear cubs and its implications for conflict bear management and control. Binks (2008) tested the two main hypotheses:

1. Shelter methodology influences the post-release behavior of shelter-reared, juvenile black bears. He predicted that shelters which follow a captive-rearing protocol approximating natural conditions would release bears behaving similarly to wild-reared juveniles, while large protocol departures from natural conditions would most modify behavior in the wild.
2. Deviations from normal behavior negatively affect the post-release physical condition and survival of shelter-reared bears. Binks (2008) predicted that shelter protocols that made little or no attempt to approximate natural conditions would decrease the physical fitness and increase the mortality of the

released bears. Shelter protocols that approximated natural conditions would increase fitness and survival of the released bears.

In the spring of 2002, sixty orphaned and shelter-reared black bear yearlings (30 males, 30 females) from three central Ontario wildlife shelters were radio-collared prior to release. All bears were monitored until emergence from dens in March-April 2003. The three groups of shelter-reared study animals were compared to a control group of wild-reared bears of the same age, opportunistically captured from May through to September of 2002 while mitigating human-bear conflicts. Binks (2008) noted that the sample size for the study was lower than desired to detect the desired difference in effective size for some indices, and stressed this as a limitation of the study. Given the data, post-release movements of shelter-reared and control bears were systematically monitored by radio-telemetry. No differences in post-release dispersal were found among study groups. Study bears were checked in dens during March 2003. A den quality index, which included insulation, elevation, slope and aspect, also showed no differences among shelter and control bear groups. Morphometric parameters used to assess body condition of study bears showed no differences among groups and there were no differences among study bear groups in estimated survival rate.

Blair (2018)

Summary: This is the first major study where a large number of bears were collared and tracked with GPS collars. All study animals came from one facility. This study compared differences in success rates for captively-reared bears with published rates for survival and conflicts from studies in the same release area. There was no difference in survival between released bears when considered against their wild counterparts.

The objectives of this study were to (1) estimate first-year survival, (2) identify key variables affecting survival, (3) determine cause-specific mortality, and (4) assess conflict behavior of bears following captive-rearing and release from a rehabilitation facility, Appalachian Bear Rescue (ABR), in Townsend, Tennessee, USA. Blair (2018) hypothesized that captively-reared bears would survive at similar rates, die from similar causes, and engage in similar conflict behavior to wild conspecifics. He collared 42 black bear cubs and yearlings from ABR with Global Positioning System (GPS) wildlife tracking collars during 2015 and 2016 and released them in either Great Smoky Mountains National Park (GSMNP) or Cherokee National Forest (CNF). Wildlife agencies provided reports of released bears in conflict situations. Blair (2018) used a known-fate method to estimate survival. He treated lost telemetry signals as collar failure on a living bear (optimistic estimate) or as collar destruction related to mortality (pessimistic estimate). Pessimistic and optimistic estimates of overall annual survival of bears were 0.88 and 0.93, respectively. Survival for bears released as cubs was lower than for bears released as yearlings, and the major cause of mortality was vehicular-collisions. Three of 42 bears released from ABR engaged in conflict up to one year post-release. Survival rates, cause-specific mortality, and engagement in post-release conflict of study bears was similar to published reports for wild conspecifics.

Cant (2003)

Summary: This study used phone and written questionnaires to get information from 39 black bear rehabilitation facilities across North America on captive-rearing practices and captive-rearing success rates. This study showed, as reported by rehabilitators, that a variety of captive-rearing practices can be used to rear bears and successfully release them back in to the wild.

Cant (2003) sent out surveys to 39 wildlife rehabilitation centers (9 in Canada and 30 in the United States) to obtain information on how cubs are raised and released. The survey asked questions on captive-rearing considered pertinent to the care of cubs, including feeding, housing, health and sanitation, handling and human exposure, hibernation, releases, funding and expenses, and government relations.

The rehabilitation centers represented an array of wildlife captive-rearing practices, ranging from small, home-based programs taking in fewer than a hundred animals a year to large, fully-staffed facilities receiving several thousand animals, annually. Rehabilitators relied mainly on donations and grants to conduct operations. Rehabilitators cared for a total of 144 cubs a year on average, at a mean cost of \$154 per bear each month.

Given that black bears pose a potential threat to human safety, rehabilitators expressed awareness of the risks associated with handling and human exposure. Participants indicated they were careful to limit contact with cubs and keep caretaker numbers to a minimum. Cubs were also housed in groups to reduce habituation and permit normal social development. Efforts were made to feed natural foods and provide an environment that allowed for hibernation and stimulated natural behaviors such as climbing, playing, and foraging. Although generally free of serious health concerns, cubs received veterinary treatment as needed. Facilitated by government wildlife agencies, cubs were released back into the wild at an average age of 14 months.

Cant's (2003) findings suggested that a variety of methods could be used to successfully raise cubs to release. Cant (2003) concluded from her multi-institution, multiyear study that black bears are suitable captive-rearing candidates. She suggested that rehabilitators can raise and release cubs using non-uniform methods, while achieving high survival rates and weights compared to bears at a similar age in as in the wild.

Clark et al. (2002)

Summary: This study looked at short term survival of a small sample of radio-tracked captively-reared bears, released into the Smoky Mountains. Their results suggest that short-term survival (to 180 days) of captively-reared orphaned bears was high in comparison to wild bears.

The objective of this study was to estimate short-term survival of orphaned American black bears captively-reared and released into the Smoky Mountains. Between January 1998 and July 1998, Clark et al. (2002) released 11 captively-reared orphaned bears (6 males, 5 females) into the Smoky Mountains of Tennessee and North Carolina. Age of bears at time of release ranged from 11 to 18 months old. They monitored released bears via radio-telemetry from January 1998 to October 1998. Although they documented no mortality of bears, the fate of 2 bears in the study was unknown. Maximum survival

(assuming 2 bears of unknown fate survived) to 180 days post-release was 1.00 (95% CI = 0.22-1.00), and minimum survival (assuming 2 bears with unknown fate died) to 120 and 180 days post-release ranged from 0.90 (95% CI = 0.69-1.00) to 0.77 (95% CI = 0.26-1.00), respectively. Their results suggest that short-term survival (to 180 days) of captively-reared orphaned bears was high in comparison to wild bears.

Myers (2016)

Summary: This is the only study to look at personality in bears and the implications of personality on the success of captive-rearing. Meyers used GPS collars to investigate the immediate post-release movements, denning chronology, release-site fidelity, and season-delineated movements, home ranges, and resource use for six, orphaned and captively-reared black bears.

This study demonstrated the first application of captive behavior tests for the investigation into black bear personality, defined by consistency in the individual differences in behavior across time or context. Behavior testing in other species has revealed that many traits exhibited in captivity often translate to wild behavior; however, this had not yet been investigated for black bears. Through open field, novel object, startle object, and focal-animal sampling, Meyers investigate the potential for personality in six black bear cubs. Results indicate consistency in behavior across five metrics for the bold-shy axis, and eight sampling events measuring responses for the activity axis, thus indicating personality. However, analysis to identify correlations to wild activity metrics did not yield strong statistical support.

Meyers used GPS collars, resource selection functions, and generalized linear mixed models, to investigate the immediate post-release movements, denning chronology, release-site fidelity, and season-delineated movements, home ranges, and resource use for six, orphaned and captively-reared black bears. This study was the first application of GPS monitoring and resource selection for captively-reared black bears. Data from this study provided insights into the activity of released captively-reared black bear cubs, highlighted trends among the release cohort, and illustrate the variability of individual behavior. Results indicate species-typical behaviors, with bears denning shortly after their releases, exhibiting elevated movement rates and dispersals during late-summer, preferential selection for certain habitat types based on season, and no utilization of anthropogenic-resources.

Patrascu (Abstract only)

Summary: This abstract summarizes a case study of one Romanian bear that was injured. The study shows the degree to which an animal can be injured, rehabilitated, and still exhibit behavior on par with wild conspecifics.

In August 2012 a six months old male bear cub was found injured and abandoned by its mother. The cub was hit by a train, lost his right foreleg, and was unable to follow his mother. The cub was rescued and transported to an Animal Rescue Centre in Focsani, where it underwent surgery. During his 8-month recovery, he had minimal human contact and was considered wary of people upon release. Once fit for release, the bear was relocated to the orphan bear cub center in Balan. He was fitted with a GPS collar, and then soft-released. He left the rehabilitation center in June 2013 and established his home range in

the Hasmasi Mountains near the center. When compared to two, same-aged, non-disabled wild conspecifics, his home range size and daily movements showed similar habitat use patterns. There was no abnormal behavior in roaming, though the bear was limited in daily distances. The study team continues to monitor the bear to assess its survival rate.

Smith et al. (2016)

Summary: Smith et al. (2016) evaluated the release of captive-reared, orphan black bears in northern New Hampshire. Eleven yearling bears (9 males and 2 female) were outfitted with GPS radio-collars. This study showed that in years where foods crops are poor, captive-reared bears, released that year, are prone to conflicts and mortality. However, rates of conflicts and mortalities were also similarly higher for wild conspecifics.

Smith et al. (2016) release captive-reared, orphan black bears in northern New Hampshire. Eleven bears (9 males and 2 females) were outfitted with GPS radio-collars and released during May and June of 2011 and 2012. Bears released in 2011 had high apparent survival and were not observed or reported in any conflicts. No bears released in 2012 survived, and all were involved in minor human-bear conflicts. In 2011, bears had access to and used abundant natural forages or habitat. In 2012 abundance of soft and hard mast was lower. Conflict behavior, and consequently survival, was inversely related to availability of natural forage. Conflict behaviors reflected the record number (1,108) of conflicts statewide in 2012, 117% higher than those reported in 2011 and 78% higher than the preceding 10-year average. However, the conflicts involving study bears were relatively minor and did not require major management action (e.g., removal) based on New Hampshire's nuisance bear policy. For example, one male pilfered a birdfeeder in early June, but ceased after the feeder was removed. The overall survival (6 of 10) achieved during the 6-month post-release period indicated that most released bears were not overly susceptible to mortality, including hunter harvest during the first fall.

Winslow and Murphy (2018; Post-Release Conflicts with Humans by Captive-Rehabilitated New - Mexico Black Bears)

Summary: Winslow and Murphy (2018) investigated factors that may have influenced post-release conflicts with humans by captive-reared American black bears in New Mexico, USA. They considered the success rates for 215 injured or ill wild bears and orphaned bear cubs that were captive-reared. Age classes were cub (< 1 year), subadult (≥ 1 < 4 years), and adult (≥ 4 years). Their results suggested that the probability of post-release conflicts with humans by captive-reared bears in New Mexico may increase with bear age at the time of intake to a rehabilitation facility. However, the study acknowledges limitations with knowing the conflict history that subadult or adult bears had prior to captive-rearing.

Winslow and Murphy (2018) investigated factors that may have influenced post-release conflicts with humans by captive-reared American black bears in New Mexico, USA. During 2001–2016, 256 injured or ill wild bears and orphaned bear cubs were captive-reared (16 bears/year). They sexed and assigned age class (cub [< 1 year]; subadult [$\geq 1 < 4$ years]; adult [≥ 4 years]). All bears were given a uniquely numbered ear tag prior to being hard-released (i.e., released without an acclimation period) in primary

habitat on US Forest Service lands ≥ 4 km from human settlements after captive-rearing. Cubs were released when 10–14 months of age, whereas subadults and adults were released when deemed recovered. They fit logistic regression models to investigate if duration in captivity, sex, or age class predicted probability of post-release conflicts with humans.

Because of incomplete records or death during captive-rearing, only 215 of the 256 captive-reared bears were released back to the wild. Median duration spent in captivity was 108 days for cubs, 74 days for subadults, and 14 days for adults. Fifty bears (23.25%) were recaptured or euthanized following release because of conflicts with humans. The average number of days until a bear was recaptured or euthanized because of conflicts was 472.17 (95% CI = 245.89–698.44). Among the six regression models they considered, the most parsimonious model included only age class as an important predictor. The probability of conflicts with humans post-release was higher for adults than cubs or subadults.

Their results suggested that the probability of post-release conflicts with humans by captive-reared bears in New Mexico increased with bear age at the time of intake to a rehabilitation facility. However, the study acknowledges limitations with knowing the experiential history with humans that subadults or adults had prior to captive-rearing (i.e., previous conflicts). Consequently, their estimates for conflict rates for subadults and adults might be at least partially reflective of behaviors learned by bears following interactions with humans that occurred prior to captive-rearing. Further, their determination of conflict activity was based on the observation or recapture of ear-tagged bears, and the ear tag loss rate can be high for black bears. Winslow and Murphy (2018) suggest that this means their estimates of conflict probabilities may be negatively bias.

Summary

All 10 studies that I reviewed suggest that cubs released from captive-rearing can survive at rates similar to and are no more prone to conflicts than their wild counterparts. Some studies suggest that captive-rearing practices can vary significantly and still achieve high rates of success. This may, in part, be due to a screening process that happens at rehabilitation facilities prior to admission and prior to release, where cubs that are not considered suitable candidates are not captive-reared or released. Further stringent practices around reduced human contact, and releasing cubs as soon as practicable, likely also contribute to the success of captive-rearing programs. These published accounts are commensurate with the verbal accounts that I have had from numerous facilities and agencies across North America.

However, many studies note that there were issues with sample sizes and researchers were not always able to adequately address their research questions, other than at a very basic level. Most studies had to rely on comparative data from the literature, rather than contemporaneously collared wild bears. Many studies also acknowledge limitations with knowing the previous history of the bears prior to entering the facility, or did not record information on bear behavior and captive-rearing practices. More complex questions relating to the success of captive-rearing would be best addressed using GPS tracked captive-reared and wild bears, across multiple institutions and geographic regions. This might be best achieved by having agencies and rehabilitation facilities across North America coordinate on a study design.