

EXECUTIVE SUMMARY

The small group of bison first introduced to Santa Catalina Island in 1924 increased over the years and is currently managed by periodic roundups to maintain a herd size of 185-250 animals. The fauna of Santa Catalina Island did not historically include large grazing ungulates, which has led to significant recent concern regarding the potential ecological effects of bison on native and endemic plants and animals on the island. In the intervening years since bison were first brought to the island, however, this large ungulate has taken on important cultural and economic significance to island residents. The challenge for future management of bison on Santa Catalina Island will be balancing conservation interests related to the ecological integrity of the island with cultural and economic values. The focus of this study was to undertake detailed research on the ecological effects on bison on Santa Catalina Island and to provide recommendations on possible management options suitable for minimizing potential ecological damage induced by the activities of bison. In the report we detail and summarize the major findings of this study as they relate to island-based ecological restoration activities and potential future management of the bison on Santa Catalina Island at different levels. In the Executive Summary we briefly highlight the major findings of the study and refer readers to the body of the report for more information and justification for our suggestions on management.

Our research was multifaceted, using a combination of observational, comparative and experimental methods to evaluate many different potential effects of bison on Santa Catalina Island. Related to experimental aspects of the research (bison enclosure experiments), it is important to note that failure to *detect* an important ecological effect after a relatively short time frame (2 years for this study) does not mean an effect does not exist. Plant and animal communities are labile, and in ecological studies many years are often required to unequivocally identify important changes resulting from reduced exposure to a disturbance agent (bison grazing and wallowing in the case of this study) that might otherwise be masked by normal climatic or environmental variation. Finally, this study was designed to address the ecological relations that the Santa Catalina Island Conservancy will need to consider when managing bison on the island. As already noted, there are important social, cultural and economic considerations that will be weighed as the Conservancy considers future management directions for bison on Santa Catalina Island, which were not part of our ecological research on the bison on the island. Below we briefly describe the results and implications of the research, including how those results relate to potential changes in bison management. Additional details related to these findings are provided in the **RESULTS** and **DISCUSSION** sections of the report.

Although the introduced bison on Santa Catalina Island appear to be doing well based on long-term population growth and persistence, the animals are significantly smaller than mainland bison, experience relatively low reproductive rates, and appear in relatively poor nutritional condition based on serum chemistry/hematology and frequent observations of open sores (open sores are not typically observed at high frequencies in mainland bison). Taken together these results/observations indicate that the bison on Santa Catalina Island are in general poor health, especially during the relatively frequent drought periods on the island. From a humanitarian perspective, the generally poor body condition of bison on Santa Catalina Island should be considered as the Conservancy discusses management options. For example, bison restricted to a small national monument in Colorado were determined to be in poor nutritional condition based on small body sizes and low reproductive rates relative to bison in other parts of North America. In part, the eventual management decision to remove the bison herd from the Colorado National Monument was a direct result of this finding; officials were concerned that animals suffered from overall poor health.

Bison enclosure experiments indicate that foraging and wallowing is altering plant communities in grassland and riparian habitats more than in island scrub oak woodland/chaparral areas. In bison exposed island scrub oak woodland/chaparral habitats (e.g., Zones 2, 3, 4), however, bison may be altering aboveground canopy structure by rubbing and horning actions. Diets of bison on Santa Catalina Island were composed of a variety of native and non-native grasses and forbs. During dry periods bison altered their diets to include some woody shrubs and cactus, including small amounts of the Channel Island endemic island scrub oak. Santa Catalina Island has a recent history of disturbance by many non-native herbivores (livestock, feral goats, feral pigs, bison) such that island plant communities were already significantly disturbed before substantial numbers of bison were present. Previous research on grazing and herbivory indicates that ecosystems severely damaged by herbivores and grazing (Santa Catalina Island prior to the 1970s) usually require a greater reduction in grazing pressure, or no grazing at all to allow for recovery compared to areas lacking a history of overuse. Once an ecosystem is seriously damaged by herbivores, even low densities of remaining herbivores may prevent recovery. Nevertheless, and based on results from enclosure experiments, one immediate response of plant communities to reduction or removal of bison on the island will be the proliferation of non-native annual grasses currently being grazed by bison.

Importantly, bison are now serving as an important mechanism of dispersal for a variety of non-native grasses and herbaceous forbs, which may undermine ongoing efforts directed at weed management and plant community restoration. Bison hair samples collected from wallows

contained multiple seeds of non-native seeds proportional to the mass of the hair clump. Seeds of non-native plants extracted from hair clumps germinated in both greenhouse and field trials. Thus, bison are actively dispersing seeds of many non-native weedy grasses and forbs across large areas of the island via their wallowing activities. Findings indicated that any future management option that reduces the number of bison below the current 185-250 target will function to reduce dispersal of non-native weedy plants because fewer bison will shed a lower overall mass of hair in fewer wallows across the island.

As part of comparative sampling in Zone 1 (bison absent) and Zone 2 (bison present), we detected no important negative effects of bison on native terrestrial vertebrates (small mammals, amphibians or reptiles). Due to the relatively short duration of our research contract, however, we were unable to perform a true experimental study on the potential effects of bison on small terrestrial vertebrates, which would provide the best method of controlling for site-specific differences that can cause difficulties in drawing inferences from comparative studies. Based on our current results, however, any future reduction in bison numbers on the island would not significantly alter the relative abundance or composition of terrestrial vertebrate communities.

We collected multiple water samples from streams and reservoirs on the island over 12+ months but detected no significant negative effects of bison on any of the measures of water quality evaluated. This part of our study did not include an experimental or comparative approach, however, with samples collected from bison absent areas as a control. Nevertheless, results suggested that any future change in bison management to reduce or remove bison from some or all areas of the island will not result in changes in measures of water quality.

Brown-headed cowbirds and European starlings sometimes occurred among relatively large groups of bison on Santa Catalina Island, but we cannot conclude from our research that the presence of these non-native birds on the island is being positively promoted by the presence of bison. As part of bison group and bison behavioral observations, the presence/absence of brown-headed cowbirds and European starlings was recorded. However, we did not conduct island-wide surveys for either of these species. Because observations of cowbirds and starlings among bison groups were disproportionately distributed near permanent sources of water and/or close to areas of relatively high human use/disturbance, it appears that multiple factors including but not limited to bison are facilitating these species on Santa Catalina Island.

We developed a detailed model to estimate carrying capacities for bison under three different management scenarios (no change from current approach, restricting bison to Zone 2 only, and restricting bison to a smaller area of Zone 2 amenable for maintaining bison viewing opportunities). We also considered the ecological implications of removing all bison from the

island independent of carrying capacity considerations. Our estimates of carrying capacity suggest that *if bison were the only species consuming or otherwise using aboveground plant biomass produced in any given year*, the island area encompassed by Zones 2, 3, and 4 could support absolutely no more than 378 bison. Many species of native vertebrates and invertebrates require forage and plant materials otherwise consumed by bison, however, and when at least as much biomass as that consumed by bison was reserved for use by native organisms, we estimated that only 95 to 189 bison should be allowed to range over Zones 2, 3, and 4. Because there is no reliable information on forage and habitat requirements for the multiple native island organisms in direct or indirect competition with bison for plant materials, however, we recommend that the Conservancy be conservative when reaching decisions on the numbers of bison supportable by different areas of the island. More specifically, we recommend management target numbers of 142 bison under Management Option A, 90 bison under Management Option B, and 13 bison under Management Option C. These recommended target numbers would allow for flexibility in population management because immediate action would not be required when the population is just below or just above a base stocking level. This conservative approach would also reduce risk to island plant communities currently exposed to relatively high numbers of bison, and provide a more acceptable level of protection for the unique natural resources on Santa Catalina. Finally, estimates of biomass production values used in the carrying capacity model were based on the current distribution and extent of grassland habitats on the island. Historically, extensive areas of coastal sage scrub habitat were converted to grassland when livestock were being produced on the island. As restoration of plant communities on Santa Catalina Island proceeds it is likely that the area of grassland habitat on the island will diminish, which will result in reduced grass and forb production and thereby reduce carrying capacities for bison for different regions of the island.

A fourth management option would be the complete removal of bison from Santa Catalina Island. Our results suggest that the complete removal of all bison from the island would significantly improve habitat conditions in grassland and riparian areas. Over the longer term bison removal would also reduce pressure on scrub oak island chaparral habitats, potentially maintaining beneficial habitat conditions for cavity nesting vertebrates. This option would completely eliminate viewing opportunities for island residents and visitors, however, and over the short term would result in the proliferation of exotic grasses and forbs. The buildup of dry plant biomass over several years by reduced grazing pressure would require consideration of a fire management program, potentially including periodic controlled burning to reduce fuel loads in the event of wildfire. A controlled burn schedule would be recommended because unusually

hot fires carried by a heavy understory fuel load would significantly damage island woodland habitats including the island endemic ironwoods and scrub oaks.

From a global conservation and restoration perspective, the ecological integrity of native plant and animal communities on islands is especially important because islands typically include proportionally more unique or endemic species than mainland areas. The Channel Islands of California are estimated to support 26 endemic species and 6 species have so far been identified as occurring only on Santa Catalina Island. Thus, the changes to plant communities on Santa Catalina Island that were identified as being caused by bison in this study should be of important management concern. We therefore recommend that the Santa Catalina Island Conservancy consider a significant reduction in bison numbers on the island and restrict the herd to a smaller area of the island than is currently occupied by the species. Reducing the herd size to around 90 bison and restricting animals to Zone 2 as described under Management Option B would support both of these recommendations. From an ecological perspective, even small numbers of a problematic non-native species occupying an insular ecosystem is cause for concern. Effective conservation often requires balancing multiple conflicting interests, however, and public acceptance of any change in bison management on Santa Catalina Island will be difficult. Nevertheless, the cost of maintaining the status quo on bison management will be significantly reduced ecological integrity of native plant communities on Santa Catalina Island.