

# Wilderness Camp Impacts: Assessment of Human Effects on the Shoreline of Glacier Bay

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**Abstract.** The physical condition of campsites and potential ecological impacts from human use along Glacier Bay's shoreline was assessed to help inform the upcoming Backcountry Management Plan. We modified a standard campsite impact measurement protocol to fit Glacier Bay's unique geologic and biologic conditions. A total of 257 shoreline campsites in 134 survey areas were identified. Seventy-four percent of all campsites contained rock rings, 22 percent trash, 16 percent human trails, and 9 percent supratidal firepits. Fourteen percent of all campsites showed no human impacts, 59 percent were rated as low impacts, 23 percent medium, and 4 percent high. We recommend initiating studies evaluating ecological impacts of human use on species of management concern, examining seasonal closures, expanding camper education, and further monitoring of campsites for human impacts.

## Introduction

The vast majority of backcountry use (not accessible by road) in Glacier Bay National Park occurs in a narrow fringe along the shoreline within Glacier Bay proper. Backcountry visitors usually travel by sea kayak and concentrate most activities including camping, cooking, and hiking in the narrow belt of terrain between the ocean and steep fjord walls or dense upland vegetation. Most visitors come to Glacier Bay to view tidewater glaciers so shoreline areas between the camper drop-off locations and the tidewater glaciers are especially prone to the highest concentrations of people. The shoreline of Glacier Bay also supports important wildlife habitats and productive biological communities. The shoreline serves as a travel corridor, contains important foraging habitat, and provides denning locations for many mammals. Shorelines also serve as haul-out habitat for pupping and molting harbor seals as well as nesting areas for large populations of both colonial nesting birds and solitary nesting species. In addition, marine waters directly adjacent to shorelines often serve as resting areas for molting sea ducks.

The park has committed to preparing a Backcountry Management Plan. To accomplish this task, it is necessary to identify actual and potential social and ecological impacts that result from human recreation in Glacier Bay's backcountry. For the purposes of this study, we define social impacts as physical evidence of human use visible to people when they visit, such as fire pits, trampled vegetation, and trash. Social impacts are usually site specific and are subjective, based on user needs and perspectives. Social impacts can directly contribute to the recreation quality for the backcountry users (Hammitt and Cole, 1998). Ecological impacts are disturbances to the natural landscape or biota of the ecosystem as a result of human recreation (Hammitt and Cole, 1998).

These impacts can range from site-specific impacts, such as a bird egg crushed by a hiking boot, to landscape-wide impacts like the introduction of an invasive plant species.

In this study we attempted to assess the human impacts on the shoreline of Glacier Bay's backcountry by examining site specific human impacts in areas of suspected use. We recorded social impacts and assigned each campsite a rating based on the intensity of these impacts. We also documented potential ecological impacts from campers at these campsites. Although we attempted to assess both social and ecological impacts equally, social impacts were much more apparent and therefore measured, while ecological impacts were difficult to quantify within the scope of this study, and were therefore observed and described as potential impacts.

## Methods

We used ArcView GIS® analysis of an existing camper survey database to determine where sampling efforts should be focused within the bay. Crews walked the beach surrounding high use areas and determined the boundaries of the survey areas using geographic features such as creeks and cliffs. While walking the survey area, crews recorded: sign of humans including footprints, trash, trails, etc; observations and signs of animals including tracks, scat, nests, etc; and campsite locations. Campsites and satellites (smaller sites associated with larger sites) were drawn in a sketch and the following social impact parameters were measured: vegetative damage; size of impacted sites; long-lived impacts such as trailing and supratidal fire pits; and short-lived impacts such as rock rings, intertidal fire pits, trash, human waste, firewood, human structures, and footprints (fig. 1). A final social impact rating was determined for each site by calculating an additive score of these impacts, including the site's vegetative damage

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**Figure 1.** Large campsite with substantial vegetative damage and rock rings in Johns Hopkins Inlet.

rating, size, long-lived impacts, and short-lived impacts. Final social impact ratings were calculated after the field season had commenced as a way to best summarize social impacts. These impact rating categories are: “none, low, medium, and high”. Ecological impacts were not included in final impact ratings.

Potential ecological impacts were also recorded including observations of dominant plant species in the campsite and outside of the campsite (the control), and presence of species of management concern in the survey areas and in the vicinity of the campsites. Species of management concern include invasive or uncommon plants, shore nesting birds, molting birds, black and brown bears, river otters, denning mammals, harbor seals, boreal toads, and spawning salmon.

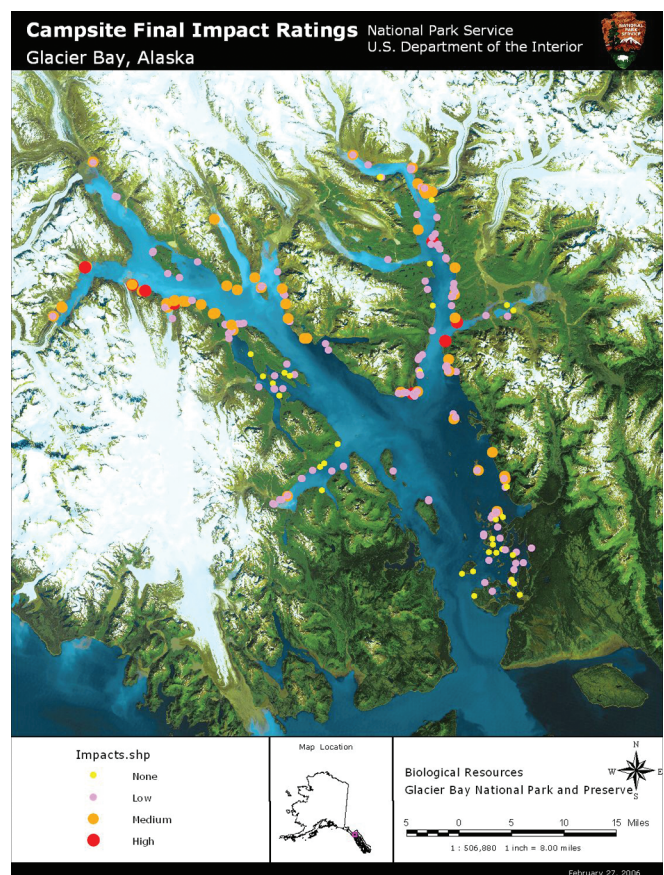
## Results

One hundred and thirty-four areas were surveyed, of which 105 (78 percent) contained one or more established campsites. In 29 survey areas (22 percent) no established campsites were found. Evidence of species of management concern was observed in 134 survey areas (100 percent).

Two hundred and fifty seven campsites were identified, measured and rated. Almost half (48 percent) of the measured sites were given a vegetative damage rating of “none”, indicating no difference between on-site and off-site vegetation. Twenty-five percent were rated “low”, 18 percent rated “moderate”, and only 9 percent rated “substantial” vegetative damage. The majority of the campsites were categorized as small (81 percent) while 19 percent were large. Seventy-four percent of the campsites contained rock rings, 28 percent had footprints, 22 percent had trash, 16 percent had trailing, 9 percent had supratidal fire pits, and 5 percent or fewer sites contained intertidal fire pits, human waste, structures or firewood (table 1). Fourteen percent of the measured sites showed no sign of human impact and thus a final social impact rating of “none”. Fifty-nine percent of the sites received a final social impact rating of “low”, 23 percent “medium”, and 4 percent “high” (fig. 2).

**Table 1.** Percentage of campsites containing human impacts, 2002-2003.

Human Impact	Percentage of Campsites Containing (n=257)
Rock Rings	74% (191)
Footprints	28% (72)
Trash	22% (57)
Trailing	16% (41)
Supratidal Firepits	9% (22)
Intertidal Firepits	5% (14)
Human Waste	5% (12)
Structures	4% (11)
Firewood	3% (8)



**Figure 2.** Map of campsites with final social impact ratings, 2002-2003.

## Discussion and Conclusions

### Social Impacts

The locations of campsites with medium and high final social impact ratings were generally (1) near tidewater glaciers, (2) near camper drop-off locations, (3) along popular travel routes, often between camper drop-off locations and glaciers, and/or (4) in areas of steep terrain that concentrate camping.

Glacier Bay National Park requires a backcountry orientation to all campers in which they are encouraged to leave no trace of camping, and specifically asked to build fires only in the intertidal zone. Despite these requirements most campsites were found contain rock rings and many had trash and supratidal firepits. Rock rings were much more common in the northern portions of the bay than the southern, probably due to higher use and rockier ground substrates that make tent stakes difficult to use. Most trash appeared to be items left unintentionally, but occasionally we found trash that appeared purposefully left in fire pits.

Overall the social impacts on the shoreline of Glacier Bay appear minimal. Approximately 2,000 people camp in the backcountry every year, and because there are no established campsites, campers generally spread out along the shoreline as they find their own places to camp. Campsite locations also continually change over time in Glacier Bay. The land is rising approximately 2.5 cm per year from glacial rebound so the shoreline is in a constant state of renewal. Campsites that were once in beach meadows are now covered with bushes, while areas still submerged by high tides will be soon be dry meadows suitable for camping. Plant succession processes in recently deglaciated areas also cover up vegetative damage from camping. Another contributing factor in the low level of social impacts observed is the way in which people camp in Glacier Bay. Campers are taught during their orientation to cook and eat in the intertidal zone where the next high tide will wash away food remains and smells. This greatly reduces time spent above the intertidal zone, and the overall footprint of the campsite tends to be smaller than if it included both eating and sleeping areas.

### Potential Ecological Impacts

Given the scope of this project we did not attempt to make any conclusions about the number of species or individuals that are impacted by campers. However we did observe several potential ecological impacts in specific locations. For example, we observed an invasive species of dandelion (*Taraxacum spp.*) in many parts of the bay and uncommon orchid species (*Platanthera* and *Cypripedium spp.*) near several camping areas.

We observed thirteen species of birds nesting on the ground in the vicinity of camping areas and rafts of flightless birds in molt near the shore of many camping areas in the

latter part of the summer. Nesting success and survivorship of these birds may be affected due to trampling or disturbance.

We observed signs of bear, river otter, wolf, coyote, mink and wolverine in camping areas. We saw denning marmots in three camping areas, but found no active dens of any other species. We found potential for disturbance of harbor seals from campers on Leland Island, in McBride Inlet, and in the Beardslee Islands. Harbor seals are of special management concern because their numbers have declined drastically since 1992 and because harbor seals often leave their haulouts in the presence of humans.

Finally, we observed boreal toads in several camping areas. Boreal toads and other amphibians are declining in the region and throughout the world although it is unlikely that campers contribute to this decline. We saw spawning salmon in 11 camping areas. Not only are spawning salmon sensitive to disturbance by people walking in the stream bed, but these areas also attract many species of birds and mammals and thus represent a valuable food resource to be protected.

### Management Implications

Social and ecological impacts along the shoreline of Glacier Bay may be minimized by, 1) initiating further studies on distribution, abundance, and human disturbance of species of management concern, 2) considering changes to seasonal human use closures to further protect species of concern, 3) expanding current camper education, including the results of this study, and 4) monitoring long-term camper impacts at a random selection of campsites of varying human use.

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