

# Managing Coastal Recreation Impacts and Visitor Experience Using GIS

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**Abstract**—A campsite monitoring program was initiated in Gwaii Haanas National Park Reserve/Haida Heritage Site to determine baseline levels of visitor impacts. These data were necessary to evaluate visitor management strategies and to act as reference points to measure changes in impacts over time. Using GIS, survey data were integrated with an ecological land classification, archaeological databases and a visitor use database. Analyses showed that although the campsites impacted only 0.0007% of the land base, 53 of the 75 campsites were ranked as either extremely or highly sensitive to human disturbance. The implications of this information to visitor management are discussed.

Gwaii Haanas National Park Reserve/Haida Heritage Site is a 1,475 square kilometer (570 square mile) wilderness area located on the southern end of Haida Gwaii/Queen Charlotte Islands, in British Columbia, Canada (fig. 1). Access to the area is by water or air only, as no roads exist. Gwaii Haanas is cooperatively managed by Parks Canada and the Council of the Haida Nation; two members from each organization form the Archipelago Management Board (AMB), which is responsible for all aspects of planning, management and operation of Gwaii Haanas.

In 1995, the AMB became concerned that it did not have a good understanding of the level of impacts related to camping activities in Gwaii Haanas. Based on this uncertainty, the AMB decided that a proactive strategy had to be developed to ensure that visitor use of the area was not significantly impacting ecological and cultural heritage. The strategy had two facets:

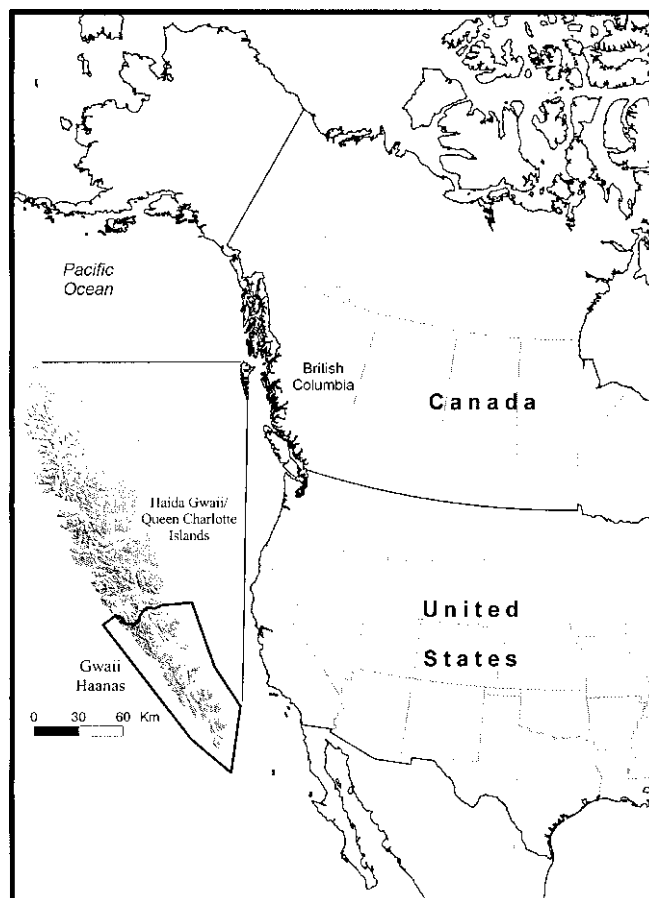
1. Freeze visitor use at current levels until a baseline of visitor impacts could be determined.
2. Initiate a campsite monitoring program to determine the extent of impacts and monitor changes to those impacts over time.

Since that time, the AMB has also initiated the development of a backcountry management plan, and decisions

related to camping activities rely heavily on the results of this monitoring program. This paper summarizes the baseline data collected at 75 sites between 1996 and 1998, which were integrated into Gwaii Haanas' geographic information system (GIS); it also itemizes the recommendations which formed part of the backcountry management plan.

## Camping Behavior in Gwaii Haanas

Although Gwaii Haanas currently has a random camping policy, certain sites have become heavily used, creating visible impacts. Based on research conducted by Vaske and



**Figure 1**—Location of Gwaii Haanas National Park Reserve/Haida Heritage Site.

In: Cole, David N.; McCool, Stephen F.; Borrie, William T.; O'Loughlin, Jennifer, comps. 2000. Wilderness science in a time of change conference—Volume 5: Wilderness ecosystems, threats, and management; 1999 May 23–27; Missoula, MT. Proceedings RMRS-P-15-VOL-5. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

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others (1996), three main types of “visitor experience” areas have been defined in Gwaii Haanas:

1. Access areas: areas that are particularly safe entry and departure points.
2. Attraction sites: areas that offer unique opportunities for education, spiritual introspection and the solitary or shared experience of a special place and living Haida culture.
3. Wild places: the majority of Gwaii Haanas, which can be defined as wilderness.

Most independent visitors and commercial tour guides plan their trips around pick-up and drop-off schedules at access areas, as well as visits to specific attraction sites. Thus, many groups may stay at or near these areas to facilitate access, resulting in multiple use of campsites throughout the summer. In addition, many guides establish standard routes for their tours and camp repeatedly on the same sites. This is particularly the case when large groups are involved, since sites with adequate space for multiple tents are uncommon.

Independent visitors (those who travel without the assistance of a licensed guide) who do pre-trip research or inquire with others familiar with Gwaii Haanas, such as their transport company, may also find out where the most favorable campsites are located. They then plan their travel routes and overnights based on that information. Therefore, some sites are receiving a lot of use based on ‘local knowledge’. In addition, topography dictates that not all areas are viable campsites. Therefore, the random camping policy is more accurately described as an ‘undesigned’ camping policy.

## Methodology

### Development of Ecological Campsite Monitoring Methodology

Dr. Jeffrey Marion and Tracy Farrell of Virginia Technical University developed the ecological monitoring methodology, based on field testing in Gwaii Haanas, peer review and staff input (Marion and Farrell 1996). Modification of existing monitoring techniques by Gwaii Haanas staff tailored the methodology to the Gwaii Haanas environment.

Campsites were identified by field staff based on local knowledge of previous camping activities.

### Development of a Cultural Heritage Monitoring Methodology

Parks Canada staff developed a framework for monitoring cultural heritage at campsites. The methodology was based on the Cultural Resource Management Policy (Parks Canada 1994), the Gwaii Haanas Draft Terrestrial Area Strategic Management Plan (Archipelago Management Board 1996) and standardized archaeological methods. Presentation of the framework at a Parks Canada wilderness conference and a cultural resource management workshop provided review prior to commencement of monitoring.

## Data Collection and Analysis

The methodology for this project requires that each campsite be evaluated a minimum of two times. The initial evaluations of the campsites were conducted in August of 1996, 1997 and 1998. This established the baseline data for the project, which included the campsite’s location, present condition and sensitivity to impact. Subsequent evaluations will be compared to the baseline data to monitor change over time. A multidisciplinary team consisting of Parks Canada wardens, patrol officers and archaeologists performed the initial fieldwork for each individual site.

### Inventory/Impact Parameters

Measurements of physical attributes were taken at each site (fig. 2), a permanent pin was placed at the centre of the site’s primary use area, and photographs and videotape were taken as visual records of current conditions. At many campsites, there were several distinct use-areas (fig. 3), which required that each use-area be surveyed separately. The variable radial transect method was chosen to measure the area of impact. A sighting compass and a Sonin measuring device or metric measuring tape (when rain prevented use of the electronic device) were used to record bearings and distances from a central point to points on the perimeter of each use-area (fig. 4). All sites were georeferenced using the 1:20,000 Gwaii Haanas base map, which employed a spatial referencing system based on a UTM extended zone 9 projection and an NAD 1983 Datum.

Analyses of the data were done to determine the total and the average level of physical impacts at campsites. Median values were used because they provide better estimates of central tendency when the effect of outliers are present, as is the case with most campsite monitoring data (Marion 1994).

### Condition Classes

Campsite condition class ratings were assigned to provide an overall picture of each campsite’s condition (table 1). Again, each use-area was surveyed separately. Because the condition class ratings are category variables, it was not possible to determine a mean or median condition class for each campsite. The use-area with the highest condition class was chosen to represent the campsite as a whole, in order to err on the side of caution when identifying existing impacts, as well as monitoring impact changes.

### Ecological Features

Impacts to ecological features were estimated by overlaying data collected at each campsite with the Gwaii Haanas Ecological Land Classification (Westland Resources Group 1994) database on GIS. Indicators were sensitive ecosystems, erosion-prone terrain, seabird colonies, Peale’s peregrine falcon (*Falco peregrinus pealei*) aeries, bald eagle (*Haliaeetus leucocephalus*) nests, harbor seal (*Phoca vitulina*) and Steller sea-lion (*Eumetopias jubatus*) haul-outs and rookeries and salmon (*Oncorhynchus* sp.) streams.

### Campsite Description Form

Campsite Number: \_\_\_\_\_ Date: \_\_\_\_\_ Inventoried By: \_\_\_\_\_

Located on Map? ☐ Map Code: \_\_\_\_\_

Location Description: \_\_\_\_\_

---

**Primary Pin Reference Information**

| Primary Pin Location Coordinates from (GIS, GPS, Map) | Description | Landmarks | Bearing | Distance (m) |
|-------------------------------------------------------|-------------|-----------|---------|--------------|
| 1. Easting: _____ Northing: _____                     | 1. _____    | _____     | _____   | _____        |
| 2. _____                                              | 2. _____    | _____     | _____   | _____        |
| 3. _____                                              | 3. _____    | _____     | _____   | _____        |

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**Inventory/Impact Parameters**

Substrate of Landing Area (B = bedrock, C = cobble, S = sand, D = dirt/soil) ☐

Shoreline Developments (#) Tables ☐ Benches ☐ Chairs ☐ Floats ☐

Other Campsites Visible (#) ☐

Tree Canopy Cover (1=0% 2=1-5% 3=6-25% 4=26-50% 5=51-75% 6=76-95% 7=96-99% 8=100%) ☐

Overstory Species: Dominant ☐ Codominant ☐ Codominant ☐

Vegetation Groundcover Onsite (M=Moss H=Herbs G=Grasses/sedges O=Organic litter S=Shrubs) ☐

Shoreline Condition Class (m) Class 1: ☐ Class 2: ☐ Class 3: ☐

Trails By Condition Class (m) Class 1: ☐ Class 2: ☐ Class 3: ☐

Fire Sites (#) Campsite: ☐ Beach: ☐ Litter/trash: ☐

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**Exotic Plants**

|                                                                             |                                                                  |                                                                             |                                                                 |
|-----------------------------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------|
| <input type="checkbox"/> <i>Cirsium brevistylus</i><br>Short-Styled Thistle | <input type="checkbox"/> <i>Cirsium vulgare</i><br>Bull Thistle  | <input type="checkbox"/> <i>Cirsium arvense</i><br>Canada Thistle           | <input type="checkbox"/> <i>Aira praecox</i><br>Early Hairgrass |
| <input type="checkbox"/> <i>Digitalis purpurea</i><br>Foxglove              | <input type="checkbox"/> <i>Urtica dioica</i><br>Stinging Nettle | <input type="checkbox"/> <i>Matricaria matricarioides</i><br>Pineapple Weed |                                                                 |

Comments: \_\_\_\_\_

Figure 2—General parameters measured for Gwaii Haanas campsites.

### Campsite Description Form

Campsite Number: \_\_\_\_\_ Date: \_\_\_\_\_ Inventoried By: \_\_\_\_\_

UA #: \_\_\_\_\_ From: \_\_\_\_\_

Bearing Distance (m)

Reference Points: 1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_

Boundary Points: 1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_ 4. \_\_\_\_\_ 5. \_\_\_\_\_ 6. \_\_\_\_\_ 7. \_\_\_\_\_ 8. \_\_\_\_\_

Condition Class (0-5) ☐

On/Off ☐

Vegetative Ground Cover ☐

Unconsolidated Organic Duff ☐

Consolidated Organic Duff ☐

Exposed Primary Substrate ☐

UA #: \_\_\_\_\_ From: \_\_\_\_\_

Bearing Distance (m)

Reference Points: 1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_

Boundary Points: 1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_ 4. \_\_\_\_\_ 5. \_\_\_\_\_ 6. \_\_\_\_\_ 7. \_\_\_\_\_ 8. \_\_\_\_\_

Condition Class (0-5) ☐

On/Off ☐

Vegetative Ground Cover ☐

Unconsolidated Organic Duff ☐

Consolidated Organic Duff ☐

Exposed Primary Substrate ☐

UA #: \_\_\_\_\_ From: \_\_\_\_\_

Bearing Distance (m)

Reference Points: 1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_

Boundary Points: 1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_ 4. \_\_\_\_\_ 5. \_\_\_\_\_ 6. \_\_\_\_\_ 7. \_\_\_\_\_ 8. \_\_\_\_\_

Condition Class (0-5) ☐

On/Off ☐

Vegetative Ground Cover ☐

Unconsolidated Organic Duff ☐

Consolidated Organic Duff ☐

Exposed Primary Substrate ☐

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UA #: \_\_\_\_\_ From: \_\_\_\_\_

Bearing Distance (m)

Reference Points: 1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_

Boundary Points: 1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_ 4. \_\_\_\_\_ 5. \_\_\_\_\_ 6. \_\_\_\_\_ 7. \_\_\_\_\_ 8. \_\_\_\_\_

Condition Class (0-5) ☐

On/Off ☐

Vegetative Ground Cover ☐

Unconsolidated Organic Duff ☐

Consolidated Organic Duff ☐

Exposed Primary Substrate ☐

UA #: \_\_\_\_\_ From: \_\_\_\_\_

Bearing Distance (m)

Reference Points: 1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_

Boundary Points: 1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_ 4. \_\_\_\_\_ 5. \_\_\_\_\_ 6. \_\_\_\_\_ 7. \_\_\_\_\_ 8. \_\_\_\_\_

Condition Class (0-5) ☐

On/Off ☐

Vegetative Ground Cover ☐

Unconsolidated Organic Duff ☐

Consolidated Organic Duff ☐

Exposed Primary Substrate ☐

UA #: \_\_\_\_\_ From: \_\_\_\_\_

Bearing Distance (m)

Reference Points: 1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_

Boundary Points: 1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_ 4. \_\_\_\_\_ 5. \_\_\_\_\_ 6. \_\_\_\_\_ 7. \_\_\_\_\_ 8. \_\_\_\_\_

Condition Class (0-5) ☐

On/Off ☐

Vegetative Ground Cover ☐

Unconsolidated Organic Duff ☐

Consolidated Organic Duff ☐

Exposed Primary Substrate ☐

Coverage Categories (0% 1-5% 6-25% 26-50% 51-75% 76-95% 96-99% 100%)  
Midpoints: 0 3 16 38 63 86 98 100

Figure 4—Use-area parameters measured for Gwaii Haanas campsites.

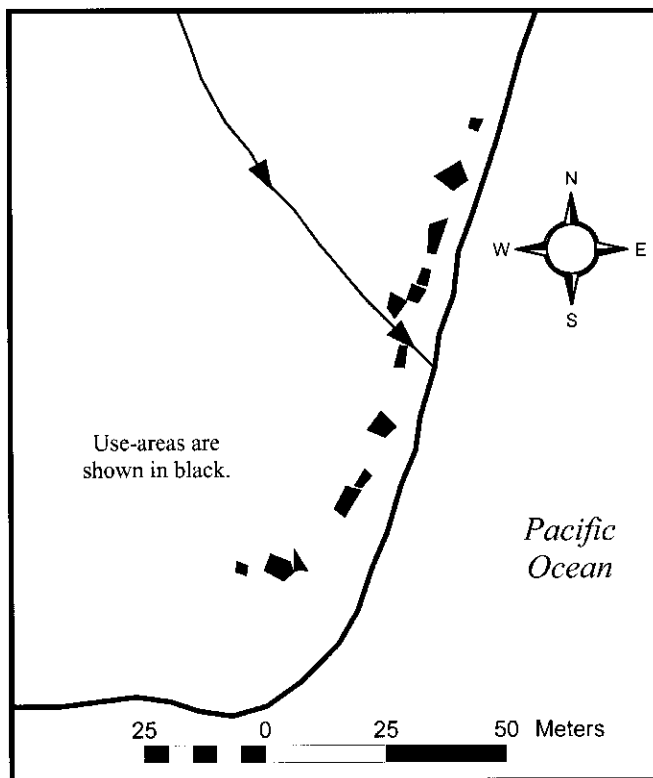


Figure 3—Example of use-areas that compose a single campsite.

Sensitivity to erosion rankings was based on GIS analysis, using the biophysical inventory and ground truthing. Presence of peregrine falcon aeries within 1 km increased a site's sensitivity rating, as falcons aggressively defend nesting areas and may abandon their nests if disturbed. Eagles are more tolerant of disturbance than peregrine falcons, but the extent of their tolerance is unclear. Thus, campsites were identified as being within either 500 m (highly sensitive) or 250 m (extremely sensitive) of an eagle nest. Seal and sea

Table 1—Condition class rating definitions used for the Gwaii Haanas campsite monitoring program.

| Class | Definition                                                                                                                                      |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 0     | Campsite barely distinguishable; no or minimal disturbance of vegetation and/or organic litter. Often an old site that has not seen recent use. |
| 1     | Campsite barely distinguishable; slight loss of vegetation cover and/or minimal disturbance of organic litter.                                  |
| 2     | Campsite obvious; vegetation cover lost and/or organic litter pulverized in primary use areas.                                                  |
| 3     | Vegetation cover lost and/or organic litter pulverized on much of the site; some bare soil exposed in primary use areas.                        |
| 4     | Nearly complete or total loss of vegetation cover and organic litter; bare soil widespread.                                                     |
| 5     | Soil erosion obvious, as indicated by exposed tree roots and rocks and/or gullyng.                                                              |

lion haul-outs were noted if they were in the general vicinity of the campsites. A complete inventory of sensitive seal and sea lion habitat has not yet been completed, but integration of future inventories with campsite information should yield a better understanding of potential impacts to these species. The presence of salmon streams was recorded if they were within or 100 m (extremely sensitive) or 250 m (highly sensitive) of a campsite. The sensitivity was not related to the salmon themselves, but to the presence of black bears (*Ursus americanus carlottae*) feeding on the fish during spawning season.

An overall ranking of ecological sensitivity was also determined to establish priorities for management action. The qualitative categories are provided in table 2.

## Cultural Features

Parks Canada's extensive archaeological databases were available on GIS and facilitated the analysis of cultural heritage site sensitivity. An archaeologist inventoried each campsite, conducted a literature review and provided recommendations to minimize camping impacts. The sensitivity and significance of the archaeology and spirituality of the sites were recorded after consultation with Haida elders.

Cultural heritage features at or near the site were identified, and these included:

- Historic Haida village sites, burial caves, human remains.
- House pits, house beams, habitation sites, campsites.
- Canoe runs, fish weirs, culturally modified trees.
- Fire broken rock, cultural rock mounds.
- Terrestrial and intertidal lithic shell middens.

As with ecological sensitivity, an overall ranking of cultural sensitivity was determined for each site. The same qualitative categories that were used for ecological sensitivity (table 2) were used to rank the overall cultural sensitivity of each campsite.

## Visitor Use Levels

In addition to the ecological and cultural data, visitor use data were used to aid in the overall ranking of the individual campsites. Beginning in 1998, both commercial

operators and independent visitors submitted trip logs, which included maps to identify campsites used on trips. The total number of user-nights was calculated for each campsite, and these data were correlated with levels of impact at specific campsites surveyed in that same year. In the future, it may also be possible to relate impacts to cumulative use over time, but current data are insufficient to do such an analysis.

## Cumulative Impacts

This assessment was done using results from the previous five analyses. The objective was to estimate the overall extent of impacts to ecological features, cultural features, and visitor experience and to identify sites that were extremely or highly sensitive to impacts. Sites that were ranked as extremely or highly sensitive became the priority sites for management action.

An extremely sensitive site was one that triggered one of the following criteria:

- Received an extreme rating for any ecological indicator, for spiritual sensitivity or significance or for archaeological sensitivity or significance; or
- Had a weighted median condition class of 3 or greater, received more than 150 user-nights/year and was located on a sensitive ecosite or had an impact area of greater than 110 m<sup>2</sup> and received more than 150 user-nights/year.

In comparison, the criteria for a highly sensitive site were:

- Received a high rating for spiritual sensitivity or significance or for archaeological sensitivity or significance.
- Had a weighted median condition class of 3 or greater or had a weighted median condition class of 2 and had received more than 100 user-nights.

## Results and Discussion

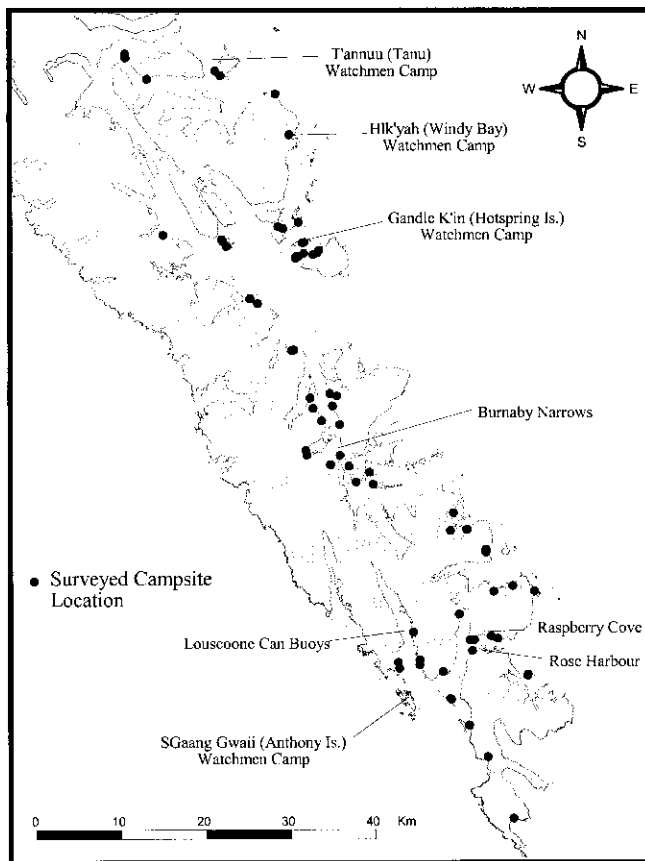
Seventy-five campsites were monitored through the 1996, 1997 and 1998 field seasons (fig. 5). The majority of the campsites were located along the relatively protected east coast, with the remainder in the Houston-Stewart Channel area. The east coast receives the majority of use because its numerous bays and inlets provide more protection from Gwaii Haanas' unpredictable weather. There are not as many suitable camping locations along the west coast of Gwaii Haanas because it is a steep and rocky coastline, with pounding surf and lengthy stretches of water where landing is not possible. Very few user-nights are spent on the west coast, and thus campsite monitoring is currently not being done in that portion of Gwaii Haanas.

## Inventory/Impact Parameter Analysis

Table 3 provides a summary of the cumulative inventory/impact measurements at the 75 campsites measured between 1996 and 1998. The total area in itself (1 ha, or 0.0007%) is not significant relative to the entire land mass of Gwaii Haanas. The median number of use-areas per campsite was five, with a median cumulative impact area of 13.21m<sup>2</sup> (table 4). The use-areas had a median loss of

**Table 2**—Categories of overall ecological sensitivity for Gwaii Haanas campsites.

| Sensitivity category | Definition                                                                                                                                                 |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Extreme              | At least one indicator is rated as extremely sensitive, and site visit verified that there are significant impacts or potential for significant impacts.   |
| High                 | The majority of indicators are rated as highly sensitive, and site visit verified that there are significant impacts or potential for significant impacts. |
| Medium               | The majority of indicators are rated at medium sensitivity, and site visit verified that there are moderate impacts or potential for moderate impacts.     |
| Low                  | The majority of indicators are rated at low sensitivity, and site visit verified that there are minimal impacts or minimal potential for impacts.          |



**Figure 5**—Map of Gwaii Haanas showing 75 surveyed campsites in relation to attraction sites and access areas.

0.72 m<sup>2</sup> of vegetation and resulted in a median of no exposed substrate. The median differences in the percentages of loose (unconsolidated) organic duff and consolidated organic duff were 35% and 0%, respectively. This indicates that there was 35% less loose organic duff (such as twigs and leaves) on the use-areas compared to the immediate vicinity of the use area. This is generally a result of the organic duff material being pushed off to the boundaries, making the use-area clear of any debris. The value of zero for consolidated organic duff indicates that the majority of the sites were still covered with loose material or vegetation, thus preventing the damage to the consolidated duff layer.

**Table 3**—Cumulative inventory/impact parameter measurements of Gwaii Haanas campsites.

| Factor                  | Cumulative total impact |
|-------------------------|-------------------------|
| Number of camping areas | 75                      |
| Number of use-areas     | 453                     |
| Campsite area           | 10352.75 m <sup>2</sup> |
| Vegetation loss         | 2023.65 m <sup>2</sup>  |
| Exposed soil            | 498.91 m <sup>2</sup>   |
| Shoreline disturbance   | 270.62 m <sup>2</sup>   |
| Fire rings              | 83                      |

**Table 4**—Median inventory/impact values calculated for Gwaii Haanas campsite use-areas.

| Criteria                                        | Median value         | Range                         |
|-------------------------------------------------|----------------------|-------------------------------|
| Number of use-areas per campsite                | 5                    | 1 to 23                       |
| Area of use-areas                               | 13.21 m <sup>2</sup> | 2.51 to 255.68 m <sup>2</sup> |
| Area of vegetation loss                         | 0.72 m <sup>2</sup>  | 0 to 214.77 m <sup>2</sup>    |
| Area of exposed 1° substrate                    | 0 m <sup>2</sup>     | 0 to 98 m <sup>2</sup>        |
| Percent difference in loose organic duff        | –35                  | 0 to –98                      |
| Percent difference in consolidated organic duff | 0                    | 0 to –95                      |

In reviewing the cumulative impact of all use-areas per site, an average campsite covered a median area of 106 m<sup>2</sup>, but had no human-caused shoreline disturbance (table 5). The median number of human developments (beach furniture and fire rings) were zero and one, respectively.

## Condition Class Assessment

The use-areas had a median condition class rating of 2, but a substantial proportion had a ranking of 3 (table 6). The median condition class rating of 2 indicates that the campsites were generally obvious—that is, there was some lost vegetation cover and/or pulverized organic litter in the primary use areas.

The condition class descriptors (table 1) were compared to the vision for the Gwaii Haanas draft strategic management plan, which states “... visitors from all over the world begin to arrive. Each one of them shares the sensation of being the first person to set foot here.” Based on this comparison, it was decided that a condition class rating of 0 or 1 meets the plan’s vision for environmental protection and visitor experience. Sites with a condition class rating

**Table 5**—Median criteria values obtained for Gwaii Haanas campsites.

| Criteria                  | Median value          | Range                         |
|---------------------------|-----------------------|-------------------------------|
| Total campsite area       | 106.02 m <sup>2</sup> | 6.53 to 367.06 m <sup>2</sup> |
| Shoreline disturbance     | 0 m                   | 0 to 112 m                    |
| Pieces of beach furniture | 0                     | 0 to 41                       |
| No. fire rings            | 1                     | 0 to 4                        |

**Table 6**—Condition class ratings for all use-areas.

| Condition class | Number of use-areas | Percentage of total use-areas |
|-----------------|---------------------|-------------------------------|
| 0               | 63                  | 13.9                          |
| 1               | 148                 | 32.7                          |
| 2               | 133                 | 29.4                          |
| 3               | 105                 | 23.1                          |
| 4               | 4                   | 0.9                           |
| 5               | 0                   | 0                             |

of 2 are acceptable, but sites with a rating of 3, 4 or 5 require management action.

Approximately 24% of the individual use-areas exceed the acceptable condition class of 2. There were, however, only four use-areas rated at a condition class of 4, where complete loss of vegetation has occurred and bare soil has been exposed on the majority of the site. These use-areas are located in four separate campsites, which are associated with an attraction site. In addition, two sites are access areas where visitors often begin and end their trips. This confirms that campsites near attraction sites and access areas experience more of an impact than average campsites in Gwaii Haanas.

The use-area with the highest condition class was chosen to represent the campsite as a whole. To use a simple evaluation of central tendency would misrepresent the extent of impact as it relates to the management goal, because many, slightly impacted use-areas could mask the presence of one extensively impacted use-area. The measure also would not be very sensitive to changes, as the condition of most use-areas would have to increase in order to register an increase in campsite condition. Choosing the highest condition class provides management with a more sensitive indicator of changes in campsite condition.

The condition classes for the 75 campsites are provided in table 7. Based on this analysis, 52% of the campsites have use-areas that exceed the acceptable impact standards of Condition Class 2 and thus require some level of management action.

## Ecological Assessments

Although the campsites only covered 0.0007% of Gwaii Haanas, this may represent a significant portion of sensitive ecosites. Queries of the Gwaii Haanas biophysical inventory, using GIS, provided information regarding the relationship of campsites to sensitive ecological heritage. Table 8 summarizes the number of campsites that were rated in each category.

Analysis to determine overall ecological sensitivity showed that four (5%) campsites were rated as being extremely sensitive to ecological impact, and 26 (35%) were ranked as being highly sensitive. In addition, four sites that received a overall ranking of "medium" were located in sensitive ecosites with a total area of less 100 ha (considered rare), and thus were given additional consideration.

**Table 7**—Distribution of Gwaii Haanas campsites according to condition class.

| Condition class | Number of campsites | Percentage of campsites |
|-----------------|---------------------|-------------------------|
| 0               | 3                   | 4                       |
| 1               | 18                  | 24                      |
| 2               | 16                  | 21                      |
| 3               | 36                  | 48                      |
| 4               | 3                   | 4                       |
| 5               | 0                   | 0                       |

**Table 8**—Overall ecological sensitivity ratings for Gwaii Haanas campsites.

| Ranking | Number of campsites | Percentage of campsites |
|---------|---------------------|-------------------------|
| Extreme | 4                   | 5                       |
| High    | 26                  | 35                      |
| Medium  | 34                  | 45                      |
| Low     | 11                  | 15                      |

## Cultural Assessment

Archaeological assessments reveal that 77% of the campsites monitored are associated with known cultural heritage. Twenty-six campsites are associated with extremely or highly sensitive cultural heritage (table 9).

## Visitor Use Assessment

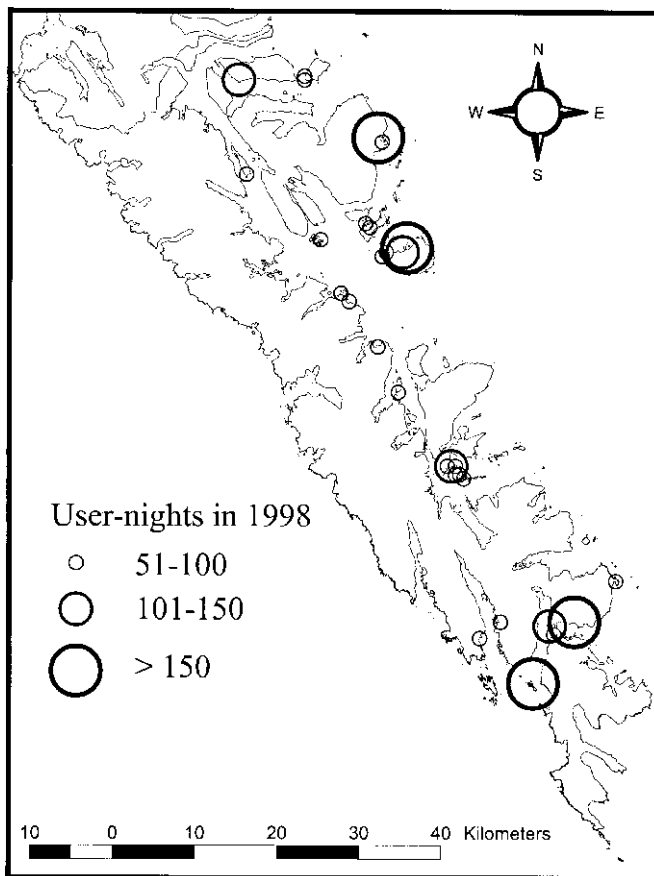
For the purposes of this report, a campsite was considered 'high use' when it received 100 or more user-nights in a season. At this stage of the monitoring program, this number is relatively arbitrary, but it was decided to choose a figure and refine it as more information becomes available to correlate use levels to levels of impact.

In 1997, the median number of user-nights for campsites was 27, with a range of 0 - 472. In 1998, the median increased slightly to 32 user-nights, while the range decreased to 0 - 273. It is important to note that the number of user-nights is a conservative estimate, since only about 40% of independents return trip logs indicating overnight locations. In addition, the trip log maps were small-scale, and thus there are unknown errors related to the accuracy of where people indicated their campsites. If a campsite was mapped within 200 m of a surveyed campsite's primary pin, the user-nights associated with that mapped site were counted under the surveyed site. Clearly, then, the missing independent trip logs could result in an underestimate of user-nights, while the inclusion of user-nights within 200 m of the primary pin could result in an overestimate. These shortcomings are recognized, and work is in progress to refine the collection of campsite locations from users.

There are several campsites that receive substantially higher than average use throughout the season. The user-night distribution pattern for the 1998 season (fig. 6) demonstrates that each of the high-use campsites were closely associated with an attraction site (SGaang Gwaii, Burnaby

**Table 9**—Overall cultural sensitivity ratings for Gwaii Haanas campsites.

| Ranking          | Number of campsites | Percentage of campsites |
|------------------|---------------------|-------------------------|
| Extreme          | 6                   | 8                       |
| High             | 20                  | 27                      |
| Medium           | 23                  | 31                      |
| Low              | 12                  | 16                      |
| To be determined | 14                  | 19                      |



**Figure 6**—Campsites with high use in 1998 typifying concentration of camping activities at certain sites.

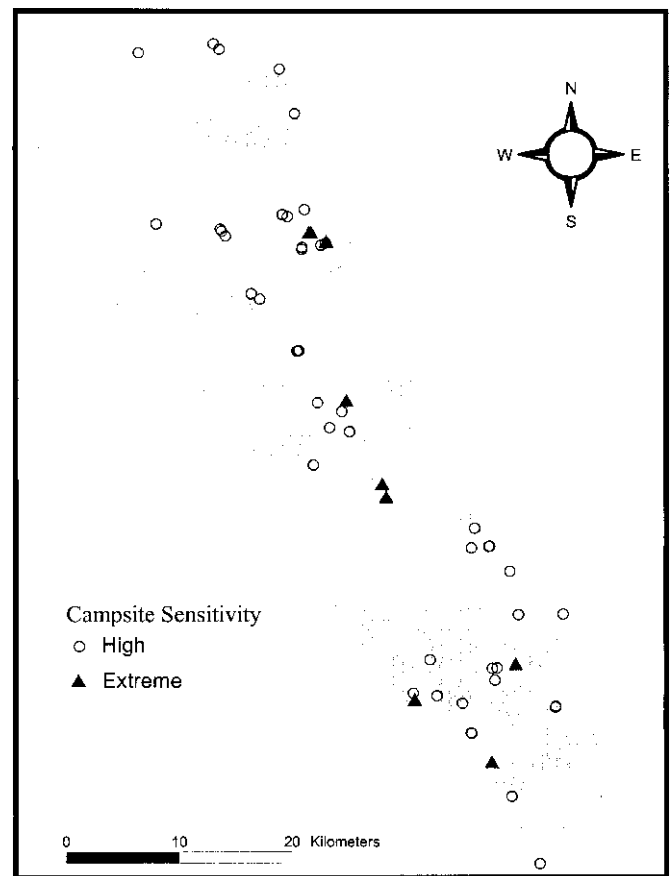
Narrows, Hotspring Island, Windy Bay and T'aanuu) or with an access site (Louscoone Inlet, Rose Harbour, Raspberry Cove).

## Cumulative Impact Assessment

Based on the methodology described earlier, the cumulative impacts from camping in Gwaii Haanas are extreme or high at 52 of the 75 surveyed sites (fig. 7). Although only a small fraction of Gwaii Haanas is being impacted by camping, that activity is concentrated in areas that are either sensitive to use, or at levels where impacts exceed acceptable standards set by management.

## Management Recommendations

Based on the cumulative analysis, management action must be taken at a majority of the surveyed campsites. Because each site has unique characteristics, it is not possible to develop a general management strategy that can be applied equally to all sites. Use levels have already been limited in Gwaii Haanas, and 37 of the campsites of concern are identified as such due to ecological or cultural sensitivity—that is, any use at all is a concern. Therefore, each site must be evaluated separately to determine what management action is appropriate.



**Figure 7**—Surveyed campsites that were ranked as being either extremely or highly sensitive to human disturbance.

There are six general management prescriptions that can be applied to each site:

1. Accept current level of impact.
2. Actively restore the site.
3. Close temporarily (for example, when surface-nesting birds are breeding).
4. Close temporarily until site recovers to acceptable level.
5. Close permanently.
6. Harden site.

Site hardening will be considered a last resort, as it conflicts with the Gwaii Haanas strategic management plan's goal of minimizing infrastructure in this wilderness environment.

In developing prescriptions at each site, consideration must be given to public safety. Management is encouraging people to visit sites such as Sgaang Gwaii and Gandle K'in (Hotspring Island). Travel to these sites involve a committed crossing for kayakers, who do a majority of the camping in Gwaii Haanas. Since winds generally increase during the afternoon, many kayak groups try to travel to attraction sites in the morning or early evening. To minimize travel time, therefore, camping will occur close to the attraction sites. If management forced a reduction of use close to attraction sites (and similarly to access areas), it would potentially be increasing visitors' risk by requiring longer travel times in suboptimal conditions.

The results of the campsite inventory provide management with a better understanding of visitor preferences for choosing campsites. This is also valuable management information, since it provides the AMB with a better understanding of the limitations related to finding appropriate camping areas. The following is a list of general campsite characteristics for Gwaii Haanas.

1. Campsites have a medium gradient gravel beach that allows for relatively easy access to the adjacent flat terrain suitable for camping at all tide levels.

2. Campsites are made up of a number of dispersed/decentralized use-areas linked by trails. This configuration permits camping with forest protection during poor weather and use of open areas for tenting, cooking and group gatherings when weather conditions are favorable. Use-areas are typically round or simple polygon shapes that are just slightly larger than the footprint of a lightweight three-person tent. This is consistent with an area of disturbance of a tent and gear storage.

3. The greatest amount of ground disturbance occurs at kitchen areas and at tent entrances. The kitchen area tends to be a place where groups gather, with a lot of movement occurring during setup, food preparation and cooking. The movement can quickly scuff away delicate surface vegetation, like mosses. This may be of particular concern for larger groups or when longer stays occur in one campsite. As people enter and exit through tent entrances vegetation, can be scuffed away.

4. Visitors tend to camp in locations where distances from landing to camp are as short as possible, since the activities of packing, unpacking and the hauling of gear are repeated many times during a multiday coastal camping trip. Therefore, campsites tend to be developed close to high tide marks.

5. Availability of fresh water is a consideration but not a necessity, as most visitors carry their own water supply. When a water supply is available, campsites are generally as close as possible to that supply.

6. Protection from the elements is a preferred quality in a campsite. It may provide a break from the wind and rain, or a sheltered harbor free of driving surf. Exposure to the weather and sea conditions, in addition to the type of shoreline leading to a campsite, all affect the degree of risk for accessing or departing from a campsite.

7. A beach consisting of sand, gravel or cobble with a gradient that allows for convenient access to the campsite at all tide levels is preferred. If the gradient is too shallow, a visitor would have a long to haul to get their gear and boats to the campsite. Too steep a gradient makes landing difficult. Visitors normally attempt to time arrival and departure from campsites at high tide, thus reducing the distance gear must be hauled from boats to camp. However, depending on travel routes, it may be necessary to do the exact opposite in order to take advantage of favorable tidal currents.

8. Sites that can accommodate larger groups are more limited, and thus impacts are more extensive (a) because of an increase in use-areas and (b) because the limited nature of this type of campsite results in higher reuse.

Considering the public safety issues, visitor behavior patterns and preferred campsite characteristics, it is clear that random camping is not occurring in Gwaii Haanas. It is

also clear that moving to a strict designated camping policy has significant public safety implications and could cause people to push themselves to reach a particular site, rather than stopping whenever they are tired or the weather worsens. The potential for visitor conflicts also increases, since limiting the number of sites would force increased contact among groups.

As the AMB evaluates each campsite that has been given an extreme or high ranking for overall sensitivity, consideration will be given to the realities of topography, weather and visitor behavior. The latter can be modified to some extent through the visitor orientation program (random camping messages have been enforced since this program was initiated in 1996). However, research on visitor behavior in Gwaii Haanas (Vaske and others 1996) indicates that a majority of visitors prefer designated camping to minimize impacts, as opposed to dispersing camping to achieve the same objective. One option may be to accept higher levels of impacts in "zones" surrounding attraction sites and access areas, while keeping the original standard (condition class 2) for the remaining portions of Gwaii Haanas. If this were done, the AMB may consider designating some campsites in these zones and encourage visitors to restrict their camping activities to these areas in order to minimize overall impacts. Outside these zones, visitors would continue to be encouraged to camp in areas where there is no evidence of previous camping activities to keep use levels, and therefore impacts, minimal.

## Summary

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The Gwaii Haanas campsite monitoring program has provided valuable information in assessing the impacts of visitor activities on the ecological and cultural heritage of the area, as well as management's ability to provide a high-quality wilderness experience to its visitors. Although a random camping policy encourages visitors to camp where there is no previous evidence of use, baseline data show that visitors frequently reuse the same sites due to proximity to attraction sites or access areas, or to favorable characteristics of the campsite itself.

The monitoring protocol was developed using both quantitative and qualitative variables in order to provide a comprehensive picture of current conditions. Analysis of these baseline data has been critical to the development of management strategies for visitor use in Gwaii Haanas, and resurveying of these sites in the future will provide information to determine if management objectives are being met. In the analyses presented in this paper, the qualitative factors have played a predominant role. This caused difficulties in analysis, since qualitative factors generally cannot be analyzed statistically. Therefore, there remains significant subjectivity in interpreting the results. Ultimately, however, all management decisions are subjective - the line must be drawn somewhere. The advantages of this monitoring program and its application to the backcountry management program are that:

1. The establishment of indicators and standards set baselines of acceptability; they may be imperfect, but they do play a critical role in "forcing" managers to think about specific methods of evaluating management strategies.



2. As the campsite monitoring program continues, additional information will allow analyses and standards to be refined in accuracy, thus improving the effectiveness of the management actions on which this information is based.

GIS has been a powerful tool in allowing the AMB to understand the intricacies of managing visitor impacts in Gwaii Haanas. The analyses presented here are doubtless a very simplistic description of a complicated interaction of factors, but the process is nevertheless extremely valuable in assisting managers to make the best possible decisions with the information at hand. The powerful analyses also provide opportunities for managers to begin to answer questions that were previously considered unanswerable.

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