

## Vessel Use and Activity in Glacier Bay National Park's Outer Waters

C. Soiseth<sup>1,2</sup>, J. Kroese<sup>3</sup>, R. Liebermann<sup>4</sup> and S. Bookless<sup>5</sup>

### Abstract

Vessel use in Glacier Bay proper is well documented during June through August when vessel entries are limited by permit. However, vessel-use and activity in the park's outer waters are poorly known. We used aerial photography, GPS, and GIS tools to assess the distribution, abundance, and activity of vessels in Glacier Bay's outer waters. Commercial trollers, private cabin cruisers and charter vessels were most commonly sighted. The most frequently observed activity was "fishing." Vessel sightings increased 40 percent during 2002 but declined during 2003 despite increased survey effort. Relative vessel densities in outer waters were 1.5 to 2.5 times greater than in Glacier Bay proper. Commercial troll fishing effort within park waters accounted for an estimated 1-5 percent of harvest in Statistical Area 114. As many as 27 percent of charter vessels observed fishing within the park lacked the required National Park Service business permit.

### Introduction

The type, number, distribution, use, and activity of vessels in Glacier Bay National Park's outer waters is poorly known. The National Park Service (NPS) limits vessel access to the bay proper (north of an east-west line connecting Point Carolus and Point Gustavus; fig. 1) from June 1 through August 31. Vessel entries are limited by daily vessel quotas assigned to distinct vessel classes. Daily and seasonal vessel use is closely tracked and regulated to avoid exceeding these quotas. In contrast, there is no vessel limitation and vessel use statistics are inaccurate for outer waters (outside the bay proper). Moreover, the relative difference in vessel densities, as an indication of use and activity, between outer waters and Glacier Bay proper is unknown. This metric would serve as a useful measure for managers seeking to minimize vessel effects on visitors, wildlife and the marine ecosystem.

Vessels engaged in commercial salmon troll and recreational charter fisheries are known to operate within the park's outer waters. The Alaska Department of Fish and Game (ADF&G) tracks fishing effort and harvest but statistical areas transcend the park boundary. Existing harvest reporting systems do not quantify and report harvest within park boundaries. The amount of commercial troll fishing effort and harvest occurring in Glacier Bay's outer waters as a component of a larger statistical area is therefore unknown.

Recreational charter fishing effort and harvest in park outer waters also requires better documentation. A NPS permit is required when conducting commercial operations in the park. Anecdotal evidence of unpermitted recreational charter

fishing activity in park waters exists. Because permitted charter businesses pay a fee for the privilege of operating within the park, unpermitted charters present a legal and fairness issue. However, the size and scope of this issue remains undocumented.

This paper summarizes aerial survey information on vessel distribution by class and activity in Glacier Bay National Park's outer waters (fig. 1). We investigated abundance and distribution of 16 vessel classes (e.g., cruise ships, tour boats various commercial fishing vessels, charter boats, private cabin cruisers, skiffs and kayaks, etc.) in park outer waters during June through September 2001-2003. We also identified high-use areas for these vessel classes, compared vessel densities in outer waters to Glacier Bay proper, estimated troll harvest contribution from the park portion of ADF&G Statistical Area 114, and assessed unpermitted charter activity. Data from this study will assist managers in understanding vessel activity and fisheries effort and harvest to better evaluate resource risks and manage user-conflicts.

### Methods

Our study area encompassed a portion of Glacier Bay National Park's "outer" waters. Outer waters are delineated by the NPS boundary located mid channel in Excursion Inlet, Icy Passage, North Passage, North Inian Pass and three miles offshore from Cross Sound to Icy Point (fig. 1). Our study area did not extend west of Icy Point due to cost, logistical, and safety considerations.

We employed a randomized, two-stage stratified sampling design to select survey dates (weekday versus weekend) and times (a.m. versus p.m.). We typically sampled up to four weekdays and two weekend days each week. Our temporal sampling frame was between 0700-1900 hr daily from June 15 through September 30, 2001-2003. A total of 27 survey flights were conducted in 2001, 35 in 2002, and 48 in 2003.

Vessel location, vessel class, and activity were recorded during 1.5-hr aerial surveys aboard single-engine, high-

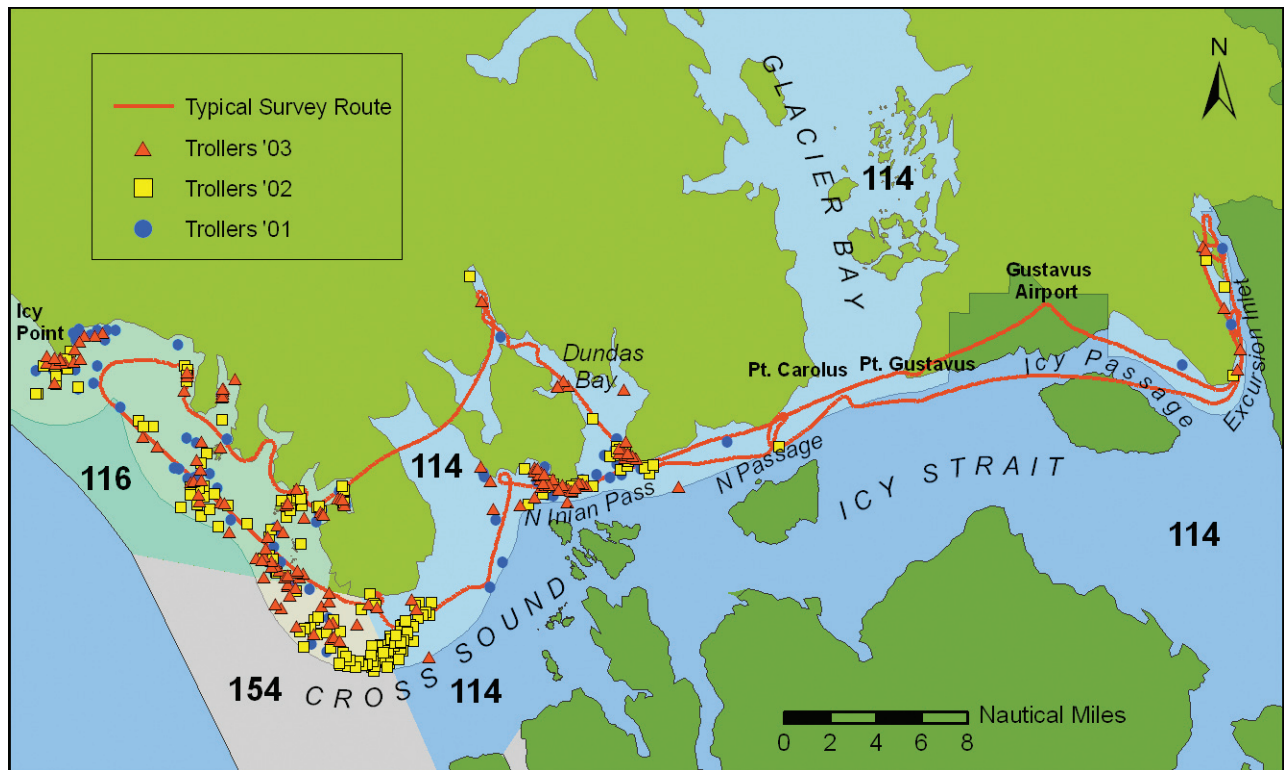
<sup>1</sup> Glacier Bay National Park and Preserve, P.O. Box 140, Gustavus, AK 99826.

<sup>2</sup> Corresponding author: chad\_soiseth@nps.gov, 907 697-2659.

<sup>3</sup> Department of Fisheries, Wildlife and Conservation Biology, University of Minnesota, 1987 Upper Buford Circle, St. Paul, MN 55108.

<sup>4</sup> P.O. Box 1097, Denali National Park, AK 99755.

<sup>5</sup> 395 Middletown Road, South Londonderry, VT 05155.



**Figure 1.** Outer waters vessel activity study area from Exclusion Inlet to Icy Point. The red line indicates a typical aerial survey flight route. Symbols represent cumulative annual troll vessel spatial distribution. The Glacier Bay National Park boundary (mid channel in indicated passages or passes and 3 miles offshore from Cross Sound west) and Department of Fish and Game Statistical Areas (154, 114, and 116) are indicated.

wing configured aircraft (Cessna 176, 206). Survey flights were initiated from the Gustavus airport. We followed a predetermined flight path (fig. 1) and conducted an instantaneous, progressive survey (Pollock and others, 1994) of vessels within the study area. Vessel classes were predefined as cruise ships, tour boats, tug and barge, trollers, longliners, crabbers, seiners, tender/processors, charters, private cabin cruisers, NPS or research vessels, sailboats, skiffs, kayaks, and “other” using existing NPS definitions where applicable (National Park Service, 2003). We classified vessel activity as either adrift, anchored, ashore, fishing or transit. Observed fishing activity was prioritized over other activity.

We tracked our survey route and captured each vessel’s location as a waypoint using a Garmin GPSMAP76 GPS unit. Vessel locations, as assessed by simultaneous vessel and plane based positioning, were accurate to approximately 0.3 km. We used ArcView 3.2 to display vessel distribution and identify high-use areas.

We photographed each vessel to document vessel class and activity and identify individual vessels. We used a Nikon N80 SLR camera and film with 300 mm lens (2001 and 2002) and a Nikon D100 6 mega pixel digital camera and 450 mm lens (2003). We used vessel names or license numbers in

conjunction with individual permit and vessel information from the Commercial Fisheries Entry Commission website ([http://www.cfec.state.ak.us/mnu\\_Pmt\\_Vess\\_Recs.htm](http://www.cfec.state.ak.us/mnu_Pmt_Vess_Recs.htm)) to verify vessel class and identify individual vessels. Individual vessel information will not be used for law enforcement purposes.

## Results

We enumerated 211, 466, and 437 vessel sightings in 2001, 2002, and 2003, respectively. Troll vessels were the most commonly observed vessel class comprising 30-50 percent of all vessel sightings within each year, followed by private cabin cruisers (15 percent), charter vessels (14 percent), and small craft (i.e., skiffs and kayaks; ca. 13 percent).

Overall, about 40 percent of all vessels were engaged in fishing activity. Commercial troll vessels accounted for the majority of fishing activity with a much smaller contribution by charter vessels. Most charter vessel sightings were classified as either fishing (32-62 percent) or in transit (28-38 percent). In contrast, private cabin cruisers were engaged in fishing activity less than 5 percent of the time.

Assuming that the number of vessel sightings observed during an aerial survey provided an unbiased estimate of the mean number of vessels within the park for that day, we expanded the mean daily number of vessel sightings by the total number of days over the June 1 through August 31 (92 d) period. Estimated total outer waters vessel sightings ranged from 900–1,900 (95 percent confidence intervals) over the three seasons (fig. 2). Vessel sightings increased approximately 40 percent between 2001 and 2002, subsequently declining by about 30 percent during 2003. This relationship was significant (ANOVA,  $F=4.46$ ,  $p=0.01$ ) although no significant difference in sightings was evident between 2001 and 2003.

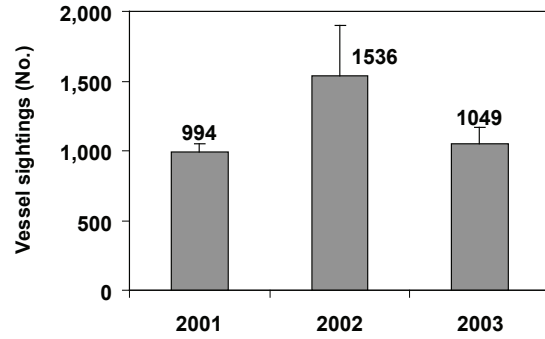
We used a simple arithmetic expansion, based on trolling effort, to estimate the contribution of harvest from surveyed park waters within ADFG Statistical Area 114 (fig. 1). Weekly totals of 13-31,000 salmon (mainly coho salmon, *Oncorhynchus kisutch*) were harvested during selected statistical weeks (fig. 3). We estimate that weekly commercial troll fishery harvest from park waters in Cross Sound and Icy Strait for selected statistical weeks ranged from 270-700 salmon, constituting an estimated 1-5 percent of total salmon harvest for ADFG Statistical Area 114.

Fifty charter vessel sightings were documented during 2002 while more than 80 were documented during 2003. Our ability to confidently identify charter vessels improved during the study, with 64 percent of charter vessels identified during 2002, and 95 percent identified during 2003. Based on NPS permitting records, 34-46 percent of identified charter vessel sightings were operating within park waters without a business permit. Thirty percent of 2002 charter vessel sightings were classified as fishing, while more than 60 percent were engaged in this activity during 2003. Six percent of identified charter vessels observed fishing were unpermitted during 2002 while nearly a third (27 percent) was unpermitted during 2003.

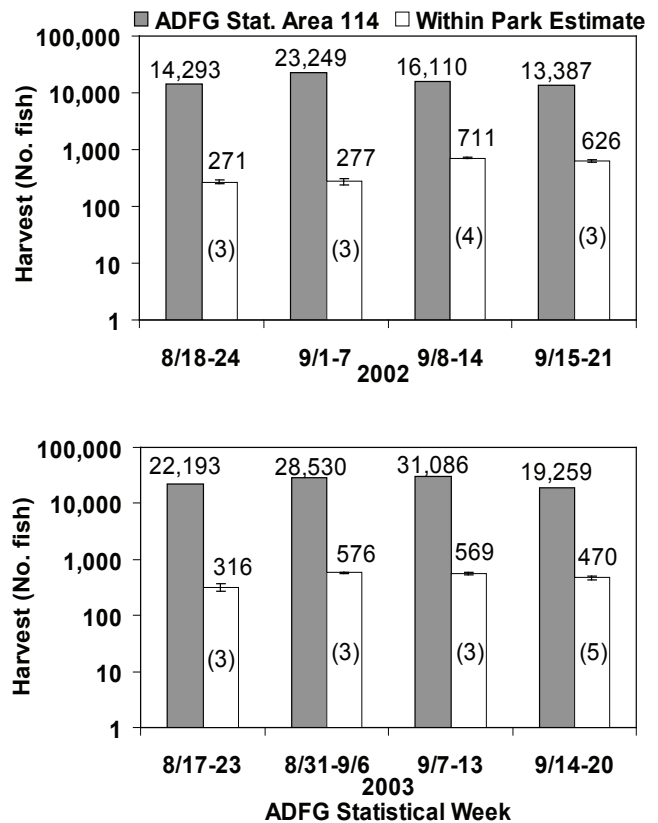
### Discussion and Conclusions

Although survey effort increased from 2001-2003 more vessels were sighted during 2002 than in 2001 or 2003. Higher numbers of tour boat, troller, cabin cruiser, skiff and kayak vessel sightings all contributed to this increase but troll vessels within Statistical Area 154 were undoubtedly the largest contributor (fig. 1). Overall, we documented twice the vessel sightings per flight during peak survey periods in July and early August of 2002 compared with 2001 and 2003. These results highlight the importance of fisheries resources to both commercial and charter fishers since many vessels are locally owned and operated. In addition, this area is important to recreational users. Although our three years of data are inadequate for any trend assessment, we predict that future increased use and resource limitation (e.g., space, fisheries, opportunity for solitude) may well lead to user-conflicts.

The eventual attrition of commercial fishing in Glacier Bay Proper as a result of a federal regulatory phase-out could



**Figure 2.** Estimated seasonal (June 1–Aug. 31) vessel sightings over three survey years. Values are parameter estimates from survey data. Error bars indicate 95 percent confidence intervals. Data were expanded according to Cochran (1977).



**Figure 3.** Estimated commercial troll fishery harvest contribution from park waters within Statistical Area 114. Mean troll vessel sightings from multiple aerial surveys ( $n=3-5$ ) during selected statistical weeks were used to estimate within-park harvest. Statistical weeks lacking adequate sample sizes were omitted. Error bars indicate 95 percent confidence intervals. Total harvest statistics are from ADF&G.

result in increased fishing activity in Glacier Bay National Park's outer waters. As commercial fishing is phased out in Glacier Bay proper over the next 30-40 years, an excess productivity "spillover effect" of large halibut and other commercially or recreationally sought species could further focus fishing effort at the mouth of the Bay (Gasper and others, 2004). In fact, Gasper and others (2004) report that the Gustavus charter fleet currently targets halibut along the terminal moraine near the mouth of Glacier Bay proper.

Next to "fishing," vessels "in transit" were the next most frequently observed activity. Few vessels, other than cruise ships and tugs and barges, remain in transit through park waters. With the exception of a marine disaster (i.e., collision, grounding, fire, or fuel spill), transit associated impacts would include primarily emissions, noise (above and underwater), and cetacean ship strikes.

Vessel densities in our survey area (5.9-12.4 vessels/1,000 acres) were 1.5-2.5 times greater than in Glacier Bay Proper (4.0-4.9 vessels/1,000 acres) during the June through August visitor use period. NPS vessel entry restrictions for Glacier Bay proper have resulted in more opportunities for boater solitude and recreation within Glacier Bay proper compared with unregulated waters in Cross Sound and Icy Strait. Absent new regulations, this disparity in vessel use and crowding will likely increase as local populations and tourism activities increase throughout Southeast Alaska.

Salmonid distribution is structured both in space and time. Troll vessel distribution is presumably determined by the underlying fish distribution, mediated to some extent, by weather and the number of troll vessels competing for fish within a given area. Our estimated troll harvest contribution from park waters of 1-5 percent is one third or less of the harvest contribution estimate of 15 percent for this area previously provided by Taylor and Perry (1990). However, it is not possible to determine whether the spatial distribution of troll fishing effort has shifted since Taylor and Perry's time.

Our estimate of 34-46 percent for unpermitted charter vessels may overestimate this activity. Charters are exempt from the NPS permitting requirement when not operating commercially. Thus, for example, charter vessels in Elfin Cove are not required to be permitted when checking recreational Dungeness crab pots in Dundas Bay as long as they are not operating commercially. The estimated 27 percent or less of charter vessel sightings characterized as fishing may actually provide a more accurate estimate of unpermitted charter activity in park waters.

## Management Implications

Although a variety of vessels transit and use the park's outer waters, very little onshore activity was documented. Potential resource impact concerns include fishery effects, the possibility of a marine disaster, and cetacean ship strikes. This study and Gasper and others (2004) indicate that a very small component of Cross Sound and Icy Strait troll and charter

harvest can be attributed to park waters. Tugs and barges were observed infrequently but nevertheless pose a threat because fuel transport vessels can hold up to a million gallons of fuel. Geographic response strategies must be developed for critical resource areas in close proximity to high probability fuel spill areas.

Additionally, the NPS must resolve the legal and fairness issues associated with unpermitted charter vessels. We recommend a two pronged approach of education and enforcement. The NPS must inform all charter businesses of the permitting requirement and facilitate the permitting process. A more visible NPS presence in outer waters could reduce illegal charter activity provided that the consequences of unpermitted operation are prohibitive, and, the detection probability of unpermitted charter operators is high.

Our work establishes a baseline for vessel distribution and activity in Glacier Bay's outside waters. We hope future managers grappling with increased use, resource limitations, and/or user-conflicts will learn from and build on our approach.

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Desolation Valley, looking north across the head of Lituya Bay. (Photograph by Bill Eichenlaub, National Park Service.)