THE NORTH FACE

Describing Brown Bear Activity Patterns Using Time-Lapse Photography in Katmai National Park and Preserve

By Carissa Turner and Troy Hamon

Introduction

Katmai National Park and Preserve (Katmai), located on the Alaska Peninsula, is home to one of the largest protected populations of brown bears (*Ursus arctos*) in the world (*Sellers et al. 1999*). A recent population survey in 2004 and 2005 estimated 2,183 ± 379 brown bears within the park boundary (*Olson and Putera 2007*). Concentrated food resources along salmon streams and coastal foraging sites result in seasonal aggregations of bears. The spatial and temporal activity of these animals in relation to their habitat has not been well studied, despite extensive general knowledge of these activity patterns in many locations. Documentation of activity patterns is important to park managers: changes to these patterns may reflect changes in food availability or habitat over time, or behavioral responses to development or human activity.

There are several remote backcountry areas in the park that have seasonal aggregations of brown bears. Many of these areas also attract bear viewers and wildlife photographers. Visitation to backcountry bear viewing locations has increased in recent years (*Kim 2008*). Human presence at brown bear foraging areas has the potential to alter bear use (*Olson and Gilbert 1994, Olson et al. 1997, Smith 2002, Smith and Johnson 2004, Nevin and Gilbert 2005*).

Figure 1. Bear viewers at Geographic Harbor, Katmai National Park and Preserve.

NPS photograph

In 2004, Katmai initiated a study using time-lapse photography at the lower Brooks River. The purpose of the study was to analyze bear use in and around the river crossing (a floating boardwalk) and evaluate whether or not repositioning the boardwalk may reduce human-bear interactions (*Hamon et al. 2007*). In 2007, the time-lapse study was expanded to the backcountry as a tool to monitor bear use of remote foraging sites.

Geographic Harbor was the first backcountry site where bear use was monitored using time-lapse photography (*Figure 2*). Bears make use of several foraging resources in the narrow bay: clam beds exposed on the intertidal flats at low tide, high protein sedge meadows, and seasonal salmon runs. Visitors are attracted to Geographic Harbor for bear viewing and photography. The combination of bear and human use at this site provides park researchers with an opportunity to document bear and human activity patterns and changes in bear activity in the presence and absence of people.

Methods

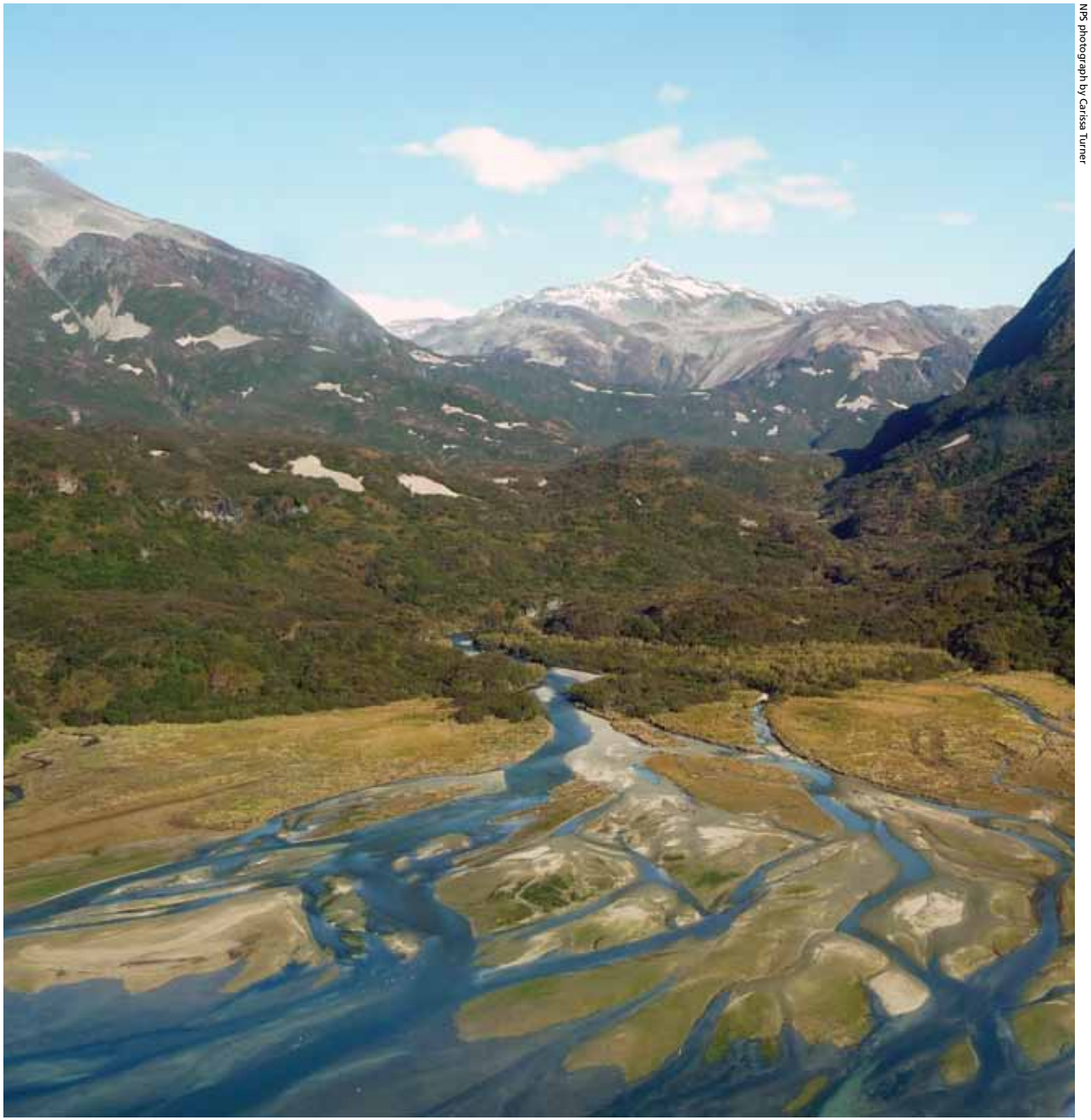
In 2007, 2008 and 2009, cameras with time-lapse controllers were set up on a hillside overlooking Geographic Harbor. The cameras were set to take photos at regular intervals to capture bear activity from June to September. The camera (*Figure 3*) was visited regularly to change memory cards and conduct maintenance as needed.

Data was later collected from each usable photo. Photos were imported into ArcMap® with a standard x/y coordinate reference system. Each bear, person, boat and plane were identified and marked as a point feature (*Figure 4*). A relative tide stage point was also marked. Geodatabases were used to store object identification, spatial (x/y coordinate), and time and date information for each photograph.

Photo object data was analyzed to compare bear numbers in relation to day of year, time of day and tide stage. The number of people in photographs was also compared by day of year and time of day. Primary bear activity and bear viewing time periods were determined through these analyses. In addition, the data was used to compare bear numbers and bear spatial distributions in the presence and absence of people.

Results and Discussion

During the three years of the study, bears were observed in 61% of usable photos and people were observed in 18% of usable photos. Not all photos could be scored due to weather and low light conditions. In some cases, objects in groups (such as close knit visitor groups) were hard to distinguish from each other, so scored data represent minimum estimates when people or bears are clumped.



NPS photograph by Carissa Turner

Figure 2. Geographic Harbor. A view of the outflow of Geographic Creek, sedge meadows and tidal flats at Geographic Harbor.

Bear and Human Activity and Day of Year

Bears were observed as early as June 12 (2008) and as late as October 3 (2009). Over 90% of bear activity occurred between July 23 and September 17, with the peak observed in late August (*Figure 5*). This activity corresponds with Geographic Creek's seasonal salmon runs.

Visitors were observed as early as June 24 (2008) and as late as September 15 (2009) in Geographic Harbor. During the three year study, human activity peaked between August 18 and August 25 (*Figure 6*). Approximately 95% of human activity occurred between August 4 and September 12. Bear viewing accounts for 93% of visitor activity at Geographic Harbor and the Amalik Bay area, according to Katmai's commercial use data. This explains the observed concentrated visitor use during peak bear activity.

Bear and Human Activity and Time of Day

Bears were observed at all times of the day; however, two prominent peaks in bear activity were observed during daylight hours (*Figure 7*). The first peak occurred in the morning (approximately 6:00am to 12:00pm) and the second occurred in the evening (approximately 6:00pm to 10:00pm). In all three years, a decrease in bear activity was observed between these two peak periods.

Visitors were observed as early as 8:50am (August 13, 2009) and as late as 9:51pm (August 22, 2009). There was one peak in visitation during the day, which occurred from 10:00am to 4:00pm (*Figure 8*). Almost 80% of visitation occurred during this timeframe.

Bear use in the presence and absence of visitors

The highest number of bears counted in a photograph was 19, recorded on August 30, 2007 at 7:11am. Similarly high numbers of bears were recorded in 2007 (18), however significantly fewer bears were recorded in 2008. The maximum number of bears in the 2008 photographs was 10 (August 13). Overall, the average number of bears recorded was four in both 2007 and 2009, and two in 2008. The cause for lower bear numbers in 2008 is un-

NPS photograph by Carissa Turner

Figure 3. Camera installation at Katmai Bay. As in Geographic Harbor, two cameras with time-lapse controllers were set up in weather proof housings. The installation was surrounded by an electric fence to prevent damage from wildlife and camouflaged so as not detract from the visitor experience.

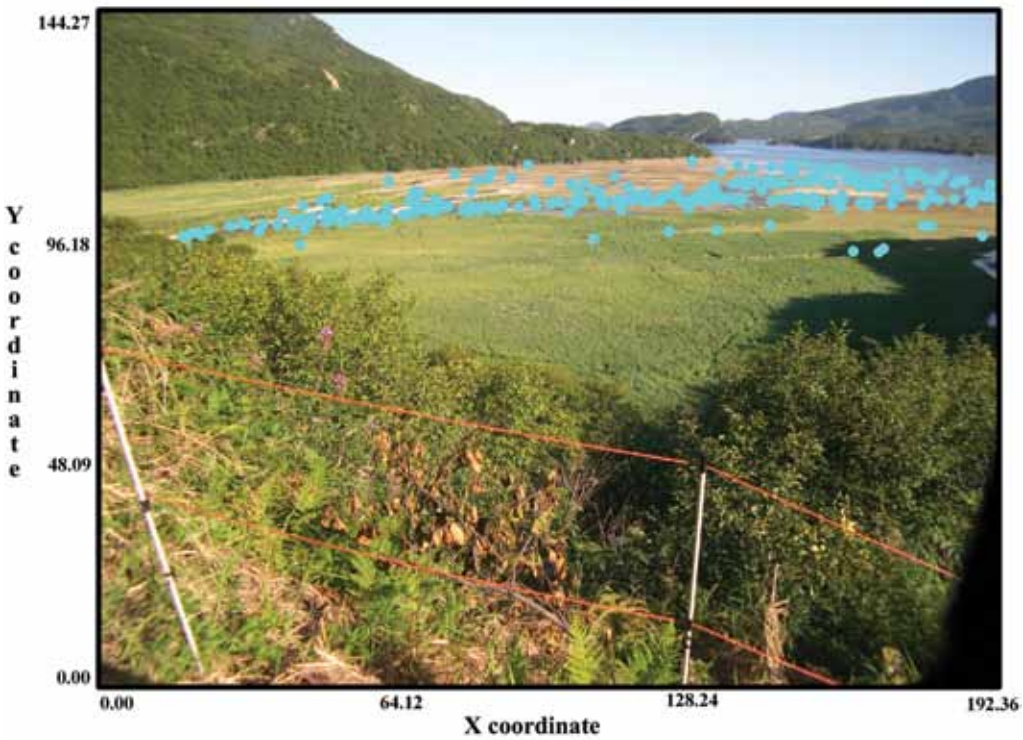


Figure 4. Data collection from photos. Photos were imported into ArcMap® and standardized. The points represent bear activity on August 12, 2007.

known, but may indicate lower food availability at the site.

Visitor numbers ranged from one to 29, with the highest count occurring on August 12, 2009, at 3:50 pm. The number of people in the photographs was similar in all three years. During times of visitation, the average number of people was seven, and the most common number of people counted was six. Average numbers of visitors did not change significantly over the three years, even though bear activity was lower in 2008.

To determine whether or not bear activity changes with human presence, the number of bears can be compared to the number of people in photographs. Figure 9 illustrates this comparison; a general decrease in maximum bear numbers is observed as human numbers increase. Bears are not seen in numbers greater than 8 when there are more than 16 visitors present.

Spatial data was also used to evaluate bear use. X/Y coordinates collected from photographs allow for comparison of bear distribution during time of visitation and times without visitors present. During primary bear use (late July through mid-September), bear activity is focused in Geographic Creek and the river corridor.

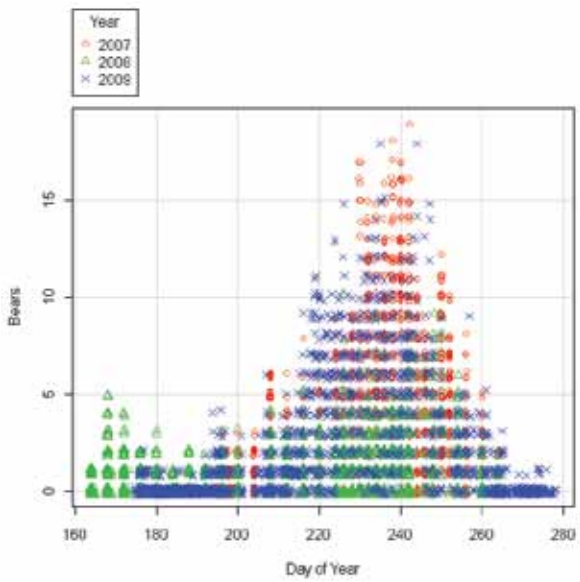
For ideal bear viewing, visitor groups distribute themselves along the banks of Geographic Creek. This has the potential to displace foraging bears, or alter their feeding patterns and locations (*Olson and Gilbert 1994, Olson et al. 1997, Smith 2002, Smith and Johnson 2004, Nevin and Gilbert 2005*).

Management Implications

Time-lapse photography is a relatively cost-effective method for monitoring bear activity at remote foraging sites, and allows for data collection in the absence of people. Katmai is expanding this project to other areas within the park and is currently setting up seasonal cameras at another foraging site that does not attract visitors. This research control site will provide baseline bear activity data for comparison with Geographic Harbor and other sites where visitation is common.

Evidence of changing bear presence and habitat use with changing visitor use levels warrants additional monitoring and research. Long-term data collection and analysis of bear use at remote foraging sites will

Figure 5. Bear use throughout the seasons. This graph compares the number of bears in a photograph in relation to the day of the year. Days are numbered based on the 365/366 day calendar. For example: 220 is August 8 in 2007 and 2009 and August 7 in 2008; 260 is September 17 in 2007 and 2008, but is September 16 during the 2008 leap year.



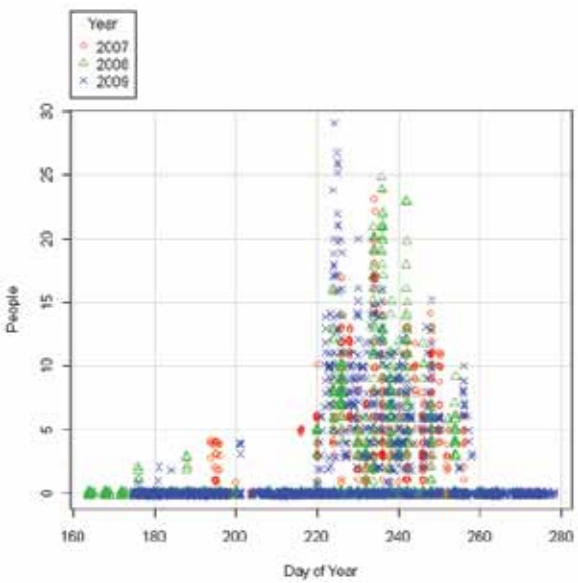


Figure 6. Human use throughout the seasons. This graph compares the number of people within a photo in relation to the day of the year. Days are numbered according to the 365/366 calendar days.

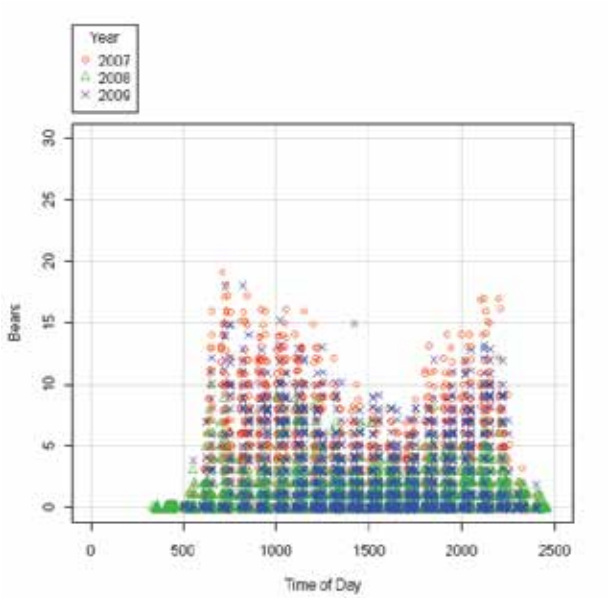


Figure 7. Bear use throughout the day. Two peaks in bear activity occur in the observable 24-hour period.

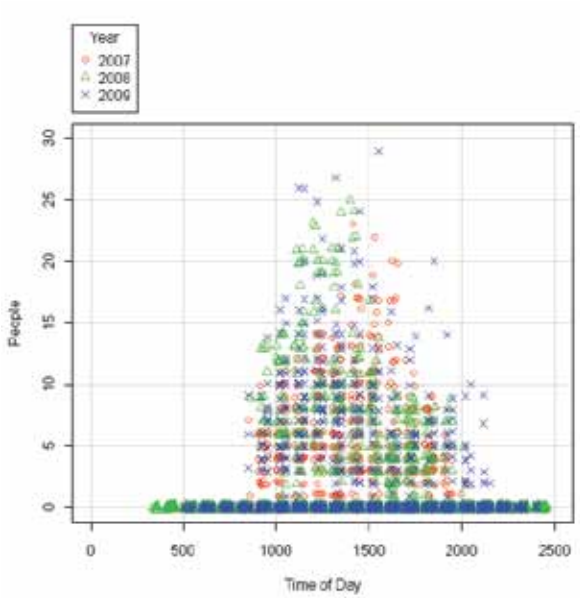


Figure 8. Human use throughout the day. One peak in human activity can be observed over the observable 24-hour period. Due to camping restrictions and remoteness of the site, Geographic Harbor is predominantly a day use area.

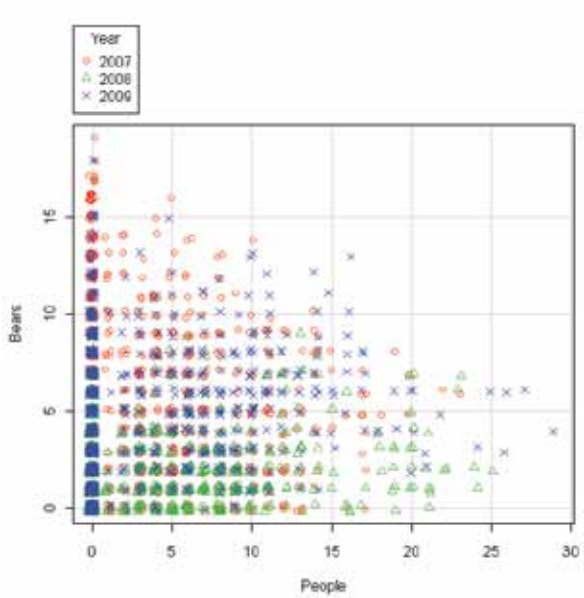


Figure 9. Bear numbers as they relate to human numbers. The number of bears observed within photographs decreases with high visitor numbers.

help Katmai staff to identify natural and human-caused changes in bear activity, and resource management options for mitigating negative impacts to brown bears. By understanding bear use activity patterns at foraging sites and changes in bear numbers and spatial distributions with visitation, park managers and guides will be better able to adapt tourism and management activities to protect natural bear population dynamics and maintain high quality wildlife viewing experiences for the public.

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