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**The Impact of Nighttime Visitation on the Breeding Colonial Waterbirds
Of Alcatraz Island: Preliminary Results**

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Introduction

Alcatraz Island hosts significant wildlife resources of the San Francisco Bay, including substantial breeding populations of 5 colonial waterbirds (Brandt's Cormorants *Phalacrocorax penicillatus*, Pelagic Cormorants *Phalacrocorax penicillatus*, Pigeon Guillemots *Cepphus columba*, Black-crowned Night Herons *Nycticorax nycticorax*, and Western Gulls *Larus occidentalis*) (Hatch 1997). In 1997, the Golden Gate National Recreational Area (GGNRA) introduced a new program (After-Hours Program, AHP) that allows nighttime visitation of the island for the first time in 20 years. Human disturbance is known to have negative impacts on breeding colonial waterbirds (Manuwal 1978, Anderson 1988). In light of the possible threat of additional visitation to the breeding colonial waterbirds of Alcatraz, the GGNRA contracted Point Reyes Bird Observatory (PRBO) to conduct an investigation of the impact of the AHP on these bird species.

Many human impact studies only examine the influence of human disturbance on reproductive parameters of the bird species being studied (Ellison & Cleary 1978, Brown & Morris 1995). Though this is a main component of our study, we also believe documenting visitor behavior is an important component of human disturbance studies (Klein 1993, Burger et al. 1995). Visitor use of different areas of wildlife refuges varies, as does the corresponding level of disturbance in those areas (Klein 1993, Burger et al. 1995). Differing types of visitors also incur differing levels of disturbance to waterbirds (Klein 1993, Burger et al. 1995). Collecting data on visitor behavior during the AHP will highlight the areas of the island experiencing the most intense human disturbance, as well as clarify the impacts that differing types of visitor groups are likely to have on Alcatraz colonial waterbirds.

Our research protocol was designed to address the following questions: 1) Does nighttime visitation affect the behavior and/or reproductive success of breeding colonial waterbirds on Alcatraz? 2) Do differing types of visitor groups (organized vs. unorganized) incur differing levels and/or frequencies of disturbance to colonial waterbirds? 3) Is the intensity of human disturbance similar for all areas on the island, or are disturbance events more frequent and intense in certain areas? The results reported here are the preliminary results of a representative sample of data collected during the pilot year, 1997.

Methods

For this pilot study, we studied the effects of the AHP on nesting Western Gulls and AHP visitor behavior (see below). We monitored gulls nesting within five meters of the main visitor thoroughfare because they experience the highest frequency and intensity of human interaction, and are the most likely to be affected by the nighttime program. Both an After-Hours site (AH) and control site were selected for monitoring. The AH site consists of nests on a section of walkway exposed to day- and nighttime visitation. The control site consists of nests located on a section of walkway which is only open to daytime visitation. Nest contents were monitored twice weekly for both sites. We also examined the effects of

nighttime visitation on the activity budgets of Western Gulls. A sample site of no less than five nests were monitored for both AH and control sites. Gull behavior (Table 1) and nest attendance (presence/absence of each adult) was recorded for each nest at the study site every five minutes from 1830 to 1900. Activity budgets were calculated as a percentage of behavioral observations recorded when adults were present. Occupancy rates were calculated as a percentage of total possible observations ($N = 62/\text{nest}$ assuming two adults are involved in nesting activities).

We examined visitor behavior as it related to group type. We monitored visitor behavior on the walkway, since this was the only time they would disturb colonial birds. When first arriving on the island, visitors are sectioned off into groups of approximately 50, and led on an interpretive walk up to the lighthouse plaza atop Alcatraz. The trail to the lighthouse was divided into subsections of approximately 50 meters each (Figure 1). Areas marked with R's are sections of the walkway which have a significant incline (Ramp), and V's are level sections which are often used as viewing areas (Vista points). An observer joined a random sample of these groups, and recorded 1) the amount of time the group spent in each section of the trail, 2) the behaviors of individuals throughout the walk (Table 2), 3) location of the group on the walkway (Table 3), and 4) any interactions of visitors with waterbirds. After the interpretive walk, visitors are free to roam the open areas of the island. A random sample of these groups was followed by an observer, and the data mentioned above was recorded for these groups as well.

Finally, we examined general patterns of nighttime use of Alcatraz. An observer censused the path from the dock to the lighthouse plaza every twenty minutes, recording the numbers of people in each subsection and their respective behaviors.

Results

Gull Productivity and Activity Budgets

Nighttime activities did not have a significant effect on the number of chicks fledged/pair (Table 4). AHP visitation also did not apparently affect the activity budgets of birds attending active nests (Table 5). However, nests in the After-Hours site had lower occupancy rates than the control site on nights with and without visitation (Table 5).

Behavior of Visitor Groups

Visitor use of the walkway was dependent on the type of group (Table 6). Organized groups (OG's) spent an average of 38 minutes on the walkway, whereas unorganized groups (UG's) spent only 10 minutes (Table 6). The use of subsections of the path was also dependent on groups type (Table 6). OG's spent more than twice as much time in vista areas than on ramps (Table 6). UG's spent virtually no time in vista areas on their brisk walks down the walkway toward the boat (Table 6).

Visitor behavior and location was also dependent on group type (Table 7). People in OG's spend 64% of their time standing, and 35% of their time walking while on the walkway. However, people in UG's stood only 12% of the time, and walked 88% of the time. People in OG's, very large groups, were located both on the path and in areas directly next to boundary rails 99% of the time. People in UG's, however, used the center of the path most often (88%), and occasionally approached boundary rails (12%).

Visitor use of the walkway throughout the entire evening was relatively uniform, with Vista Area 2 and Ramp Area 6 showing slightly higher utilization than other areas (Table 8). However, since the AHP consists of two distinct phases of visitation (OG's in the first half of the evening and UG's in the second half), we analyzed the data accordingly. When the data is broken down this way, some patterns emerge. During the first half of the evening (when visitors are associated with OG's), visitors spent a significant amount of time at the dock and in vista areas (Table 8). They spent little time, however, at the Light House Plaza (LHP) (Table 8). During the second half of the evening (when visitors are associated with UG's), however, visitors spent virtually no time in vista areas, and a significant amount of time at the LHP (Table 8). Ramp Area 4 was the most heavily utilized area during the second half of the evening (Table 8).

Discussion

In 1997, the After Hours Program (AHP) apparently had minimal effects on the breeding success and/or behavior of Western Gulls. Productivity of AH sites and control sites did not differ significantly. Nor did the activity budgets of adults in attendance of nests at AH and control sites. However, occupancy of nests was lower for AH sites on nights with and without visitation than control sites. This may be due to an AH-induced increase in metabolic demands. Gull heart rates increase dramatically (over 200%) in the presence of humans well before any behavioral evidence of disturbance is manifest (Kanwisher et al. 1978, Ball & Amlaner 1980). Metabolic rates resulting from anthropogenically elevated heart rates can increase daily energetic demands by 10% (Regel & Putz 1997). Therefore, gulls experiencing continual disturbance throughout the evening may need to forage more often (or longer) to meet these increased metabolic demands. It is important to note, however, that the gulls exposed to AH visitation were also those exposed to the most visitation during the daytime. This is because daytime visitors often walk only up to the cell house and back down to the boat without visiting other open areas of the island. AH birds, therefore, may be continually stressed throughout each day. This is in contrast to control birds that receive little daytime visitation. Thus, the lower attendance of AH birds when compared to controls may be due to this difference rather than being a result of the AHP. Unfortunately, due to the limited number of sites available for monitoring, selecting appropriate sites to control for this effect was not possible. Differences in daytime visitation of these sites may be the subject of further investigation.

Visitors participating in the AHP demonstrate predictable behavioral patterns. When first arriving on the Alcatraz, visitors are sectioned off into large (>50) organized groups that are led on an interpretive walk. These groups spend an average of 40 minutes on the walkway, and spend the longest periods of time in vista areas (5-7 minutes). They spend the majority of their time (62%) standing while listening to the interpreter. Because of their large numbers, these groups utilize the entirety of the path, and also run up against the rails which enclose the walkway. The wildlife located in the vicinity of vista areas, therefore, are the most likely to be affected by the AHP. A small number (approximately 5) of Western Gulls nest within 5 meters of these areas (Figure 1). However, a colony (N= 24) of Black-crowned Night Herons is located very close to Vista Area 1 (Daphne Hatch, pers. comm.). These birds are known to be sensitive to human disturbance (Tremblay & Ellison 1979). Though Black-crowned Night Herons were not monitored during 1997, the effects of the AHP on these birds needs to be examined in the future.

After being led on the interpretive walk, visitors are free to roam the island. Most go on an audio tour and/or visit the gift shop in the Cell House. These indoor activities last over 30 minutes. After they left the Cell House, most AH visitors either returned to the boat or went to view a movie in a theater located next to the boat landing. These unorganized groups present little or no threat to wildlife. They spent only an average of 10 minutes on the walkway, usually using the center of the path. They rarely lingered in any area, and were never observed to harass wildlife, or attempt to enter closed areas.

The activities of visitors participating in the AHP appear to present little threat to the nesting colonial waterbirds of Alcatraz Island, but additional study is needed to confirm this observation. Overall productivity of Western Gulls did not appear to be affected by nighttime visitation, though some behaviors were modified (i.e. occupancy). The most threatened birds are those which nest in proximity to vista areas of the main walkway up to the Lighthouse Plaza. They experience the closest and longest exposure to the large interpretive groups led to the Cellhouse. After the interpretive group activities end, however, individual tourist groups spend very little time in the vicinity of or interacting with the colonial waterbirds of Alcatraz.

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