Alcatraz Visitor Capacity Standards Related to Disturbance of Brandt's Cormorants

Lara Rachowicz, PhD., Alcatraz Biologist
Bill Merkle, PhD., GOGA Wildlife Ecologist
Alan Hubbard, PhD., Assistant Professor UC Berkeley

Approach:

We established that any island based visitor or water based disturbances that result in Brandt's cormorant sub-colony abandonment would exceed the threshold for management action at the initial visitor capacity workshop for Alcatraz. Based on review, these are appropriate thresholds, as sub-colony abandonment indicates a substantial adverse impact to the nesting population of Brandt's cormorants. The appropriate management action response to disturbances that cause Brandt's cormorant sub-colony abandonment would be determined based on the incident; however, based on the serious nature of the impacts of sub-colony abandonment, management actions would likely be at the more intensive level.

For establishing thresholds for the number of incidents of disturbance to Brandt's cormorants that result in impacts to individual birds during the nesting season, we used disturbance monitoring data on Brandt's cormorants collected by PRBO Conservation Science from 1997-2008. Data was examined in terms of disturbance rates per hour because the island cannot be continuously monitored. We examined patterns of the trends in the rates of water and island based disturbance to Brandt's cormorants over time, as well as the percentage of total disturbances that these types of disturbance accounted for over time.

A more extensive analysis was performed on the PRBO data on disturbances to Brandt's cormorants for the years 2006-2008. Considerable work was done to clean up and code the data for this analysis, precluding using all years of data. In addition, this subset of all the data was used because we were more confident that the data was collected uniformly across these years, and this subset of data may better reflect current trends in patterns of disturbance to Brandt's cormorants. Using an estimate of the mean disturbance rates from years 2006, 2007, and 2008, we assumed the Poisson distribution and derived the cumulative distribution function with 95% confidence intervals for two time intervals (1 monitoring day = 6.5 hours and 1 breeding season/year). We set threshold values such that there was low probability (5%) of observing a greater number of disturbances in one day or averaged over the entire season by chance. Threshold values were converted to rates per hour for consistent presentation. More details of this analysis are included as Appendix 2. Thresholds

determined through this analysis were compared to the range and patterns of variation in the trends of all the data from 1997-2008.

For on-island visitor disturbances, disturbance data from PRBO provides a reasonable baseline to establish thresholds. However, data was collected under current conditions, with the seasonal closure of the Parade Ground and no visitor access to the Laundry Building. The GMP proposes to open both the Parade Ground and Laundry Building to year round access, which could result in greater levels of disturbance to adjacent Brandt's cormorants. Thresholds are established here using data from the time period before these areas are set to be opened, thus, providing a disturbance threshold standard from a potentially more protective environment. Though, the park would like to maintain high habitat quality for Brandt's cormorants, and as such, these disturbance standards should be appropriate. Based on how the data was collected, it is not possible to establish separate disturbance thresholds for the northern compared to the southern portions of the island at this time. Monitoring data from adaptive management for opening access to the Laundry Building and Parade Ground may inform revision of the visitor capacity disturbance thresholds, but this data likely would not be directly comparable because of differences in methodology.

For the water based disturbances, the baseline data was collected without any closures or buoys surrounding the island. This means that these baseline standards do not really reflect what would be expected once a closure is established and buoys are put in place. We would expect that water based disturbances would decrease significantly once these measures were enacted. As such, the standards developed from the baseline data are not appropriate as thresholds for the water based disturbance. We have set a 75% reduction in the baseline disturbance thresholds as a reasonable target. Ideally, thresholds would be developed through monitoring once the closure and buoys are put in place.

Another caveat is that the data used to establish the thresholds was collected from 2006-2008, when Brandt's cormorant populations were growing and/or at high levels, likely indicating good environmental conditions. In 2009, we observed complete breeding failure for Brandt's cormorants, and in 2010, although we are still monitoring, we have observed late nesting of a small number of Brandt's cormorants. It is likely that the non-breeding and poor breeding for Brandt's cormorants that we observed in 2009 and 2010 was related to bad environmental conditions and a low prey base. Breeding Brandt's cormorants may be more susceptible to disturbance when they are stressed by poor environmental conditions.

Results:
As noted above, any water or island based visitor disturbances that cause Brandt's cormorant sub-colony abandonment would exceed the threshold for management action.

For standards related to island based visitor disturbances that affect individual Brandt's cormorants:
From 1997-2008, the annual hourly rate of disturbance ranged from 0 to 0.14 disturbances per hour, with a mean of 0.03 disturbances per hour (Appendix 1). The percentage of all disturbances attributed to on-island visitors ranged from 0-33%, with an average of just over 9% (Appendix 1). Based on analysis of 2006-2008 data, an average of 0.02 disturbances per hour would be the threshold standard for the entire season. In addition as observers note more than one disturbance event, especially major events that cause birds to flush, over a single 6.5 hour monitoring period, additional management efforts could be considered. It is likely that management actions based on exceeding thresholds for a single day would be focused on less intensive management actions such as outreach and signage.

For water based disturbances that affect individual Brandt's cormorants, as noted above the baseline measures do not accurately reflect the environment we would expect once the waters surrounding most of the island are closed and marked with buoys. From 1997-2008, the hourly rate of disturbance from water based sources ranged from 0.02 to 0.50, with an average hourly disturbance rate of 0.20. Water based disturbances ranged from 30%-60% of all disturbances, and averaged 45.7% by year. Water based disturbances accounted for a much greater percentage (average 45.7%) of disturbance to Brandt's cormorants than disturbance from on-island visitors (average 9.1%). Based on analysis of 2006-2008 data, an average of 0.12 disturbances per hour would the threshold for the entire season. Also, if observers noted 3 or more water based disturbances in a monitoring session, additional management efforts should be considered.

A reasonable approach to establishing water based thresholds would be to reduce the baseline thresholds by a certain, large percentage because would expect considerably less water based disturbance to Brandt's cormorants with closure and buoys. For example, a 90% decrease in the average disturbance rate per hour over a season would be 0.01 disturbances per hour, and a single water based disturbance on a monitoring day would trigger additional management consideration. A 75% decrease in the disturbance rate would amount to an hourly disturbance rate of 0.03 over a season, with again a single water based disturbance during a monitoring day triggering possible

management action. The 75% decrease from current baseline levels seems to be the most reasonable as a threshold value, and is what is proposed.

Appendix 1.

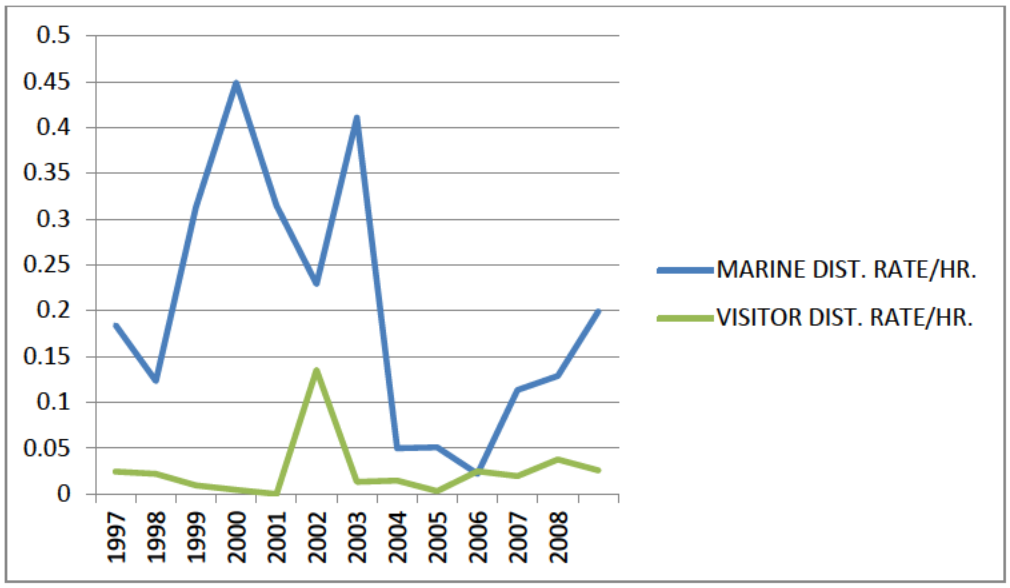


Figure 1. Hourly rates of disturbance by year to Brandt's cormorants from marine (water based) and island based visitors.

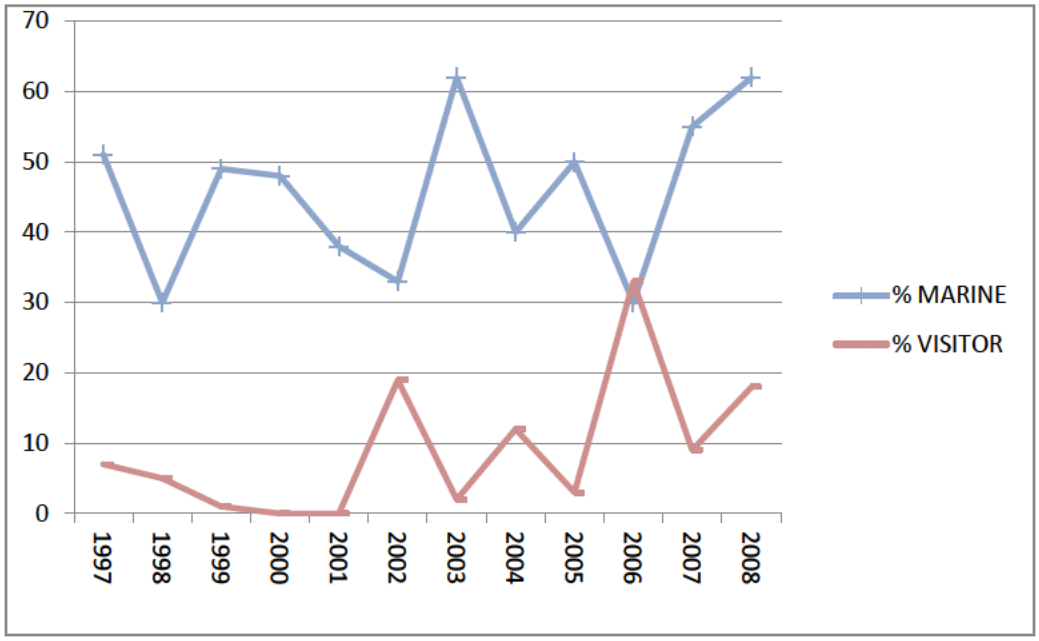


Figure 2. Percentage of total disturbances by year attributable to marine (water based) and island based visitors.

Appendix 2.

Seabird Disturbance as a Potential Indicator Measure of User Capacity at Alcatraz Island

Lara Rachowicz, PhD., Alcatraz Biologist
Bill Merkle, PhD., GOGA Wildlife Ecologist
Alan Hubbard, PhD., Assistant Professor UC Berkeley

Indicator measures are being developed for Golden Gate National Parks' upcoming General Management Plan (GMP). Indicator measures attempt to assess impacts on resources after changes in user capacity. A potential indicator measures for Alcatraz Island is the number of incidents of visitor disturbance to Brandt's Cormorants that result in impacts to individual birds. These visitor induced disturbances will be measured for (1) water-based visitors and (2) island-based visitors.

One approach to developing indicator measures is to use historic Brandt's Cormorant disturbance data and, from that, estimate the probability of having a disturbance rate of a certain magnitude or greater at a future time. This approach estimates the probability that we see x or more events during a future survey day or season. For example, using this approach, imagine the observed disturbance rate for 2015 has a 5% probability. If 2015 has the same underlying rate of disturbance as 2006-08, the observed rate for 2015 has only a 5% probability of occurrence. This might be interpreted that the overall disturbance rate for 2015 is unlikely to be the same as that from 2006-08. Thus, perhaps something has changed that is having an impact on the rate of disturbance to Brandt's Cormorants.

Method: Using an estimate of the mean rate from years 2006, 2007, and 2008, we assumed the Poisson distribution and derived the cumulative distribution function for two time intervals (1 monitoring day and 1 breeding season/year) that were used to estimate the probability of having a number of events/unit time of greater than a certain magnitude. We calculated cumulative distribution functions with 95% confidence intervals for two time intervals, for both water-based and island-based visitors. Data for 2006-08 was available from PRBO Conservation Science, but considerable cleaning and additional coding was necessary.

Results: Figures 1-4 show the cumulative distribution functions for one monitoring day and one year, for marine and on-island visitors. Based on figure 1, there is a low probability (5%) of observing more than 2.5 disturbance events in a typical monitoring day of 6.5 hours. This figure could be used to alert NPS staff when an unlikely number of marine-based disturbance events occurs, thus giving staff a chance to investigate and possibly implement management strategies. Figures 2-4 can be interpreted similarly.

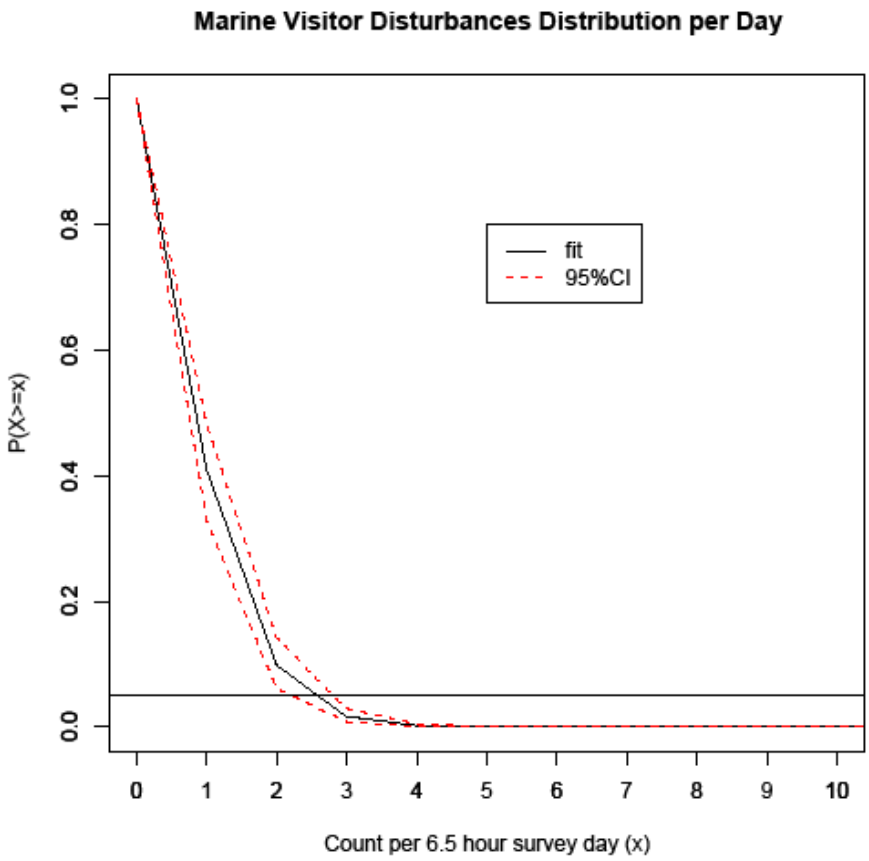

Marine Visitor Disturbances Distribution per Day
P(X>=x)
0.0
0.2
0.4
0.6
0.8
1.0
fit
95%CI
0
1
2
3
4
5
6
7
8
9
10
Count per 6.5 hour survey day (x)

Figure 1.

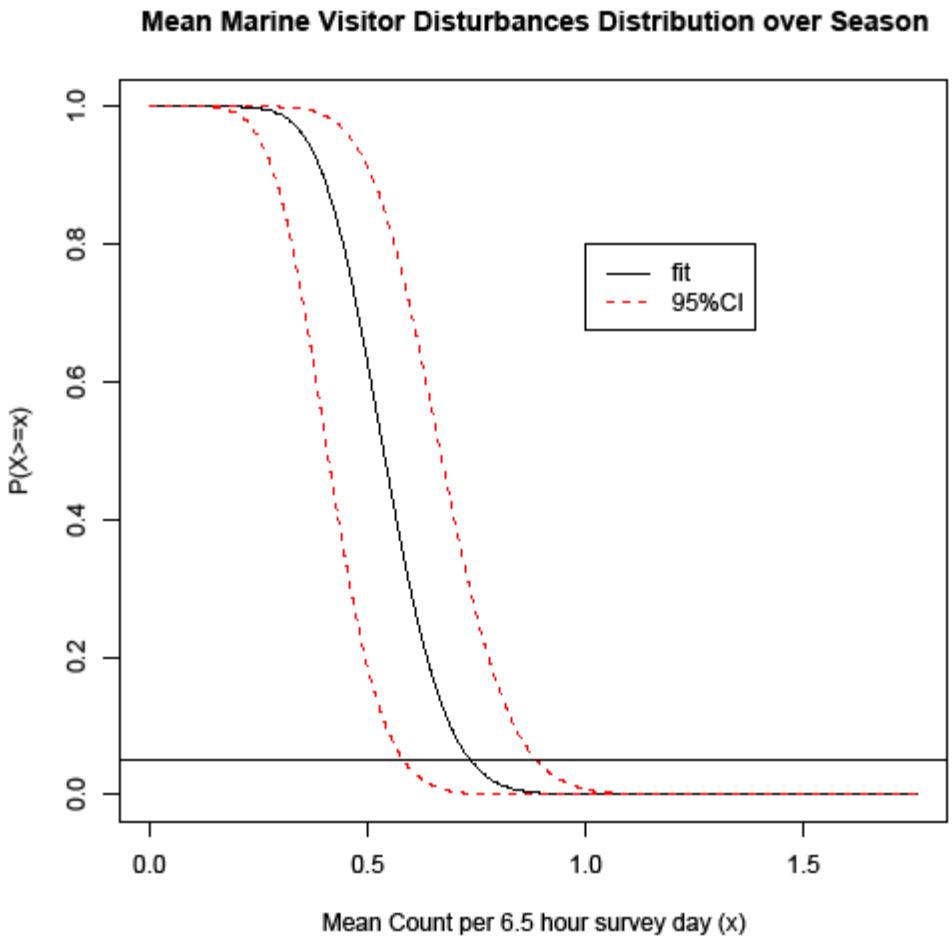

Mean Marine Visitor Disturbances Distribution over Season
P(X>=x)
0.0
0.2
0.4
0.6
0.8
1.0
fit
95%CI
0.0
0.5
1.0
1.5
Mean Count per 6.5 hour survey day (x)

Figure 2.

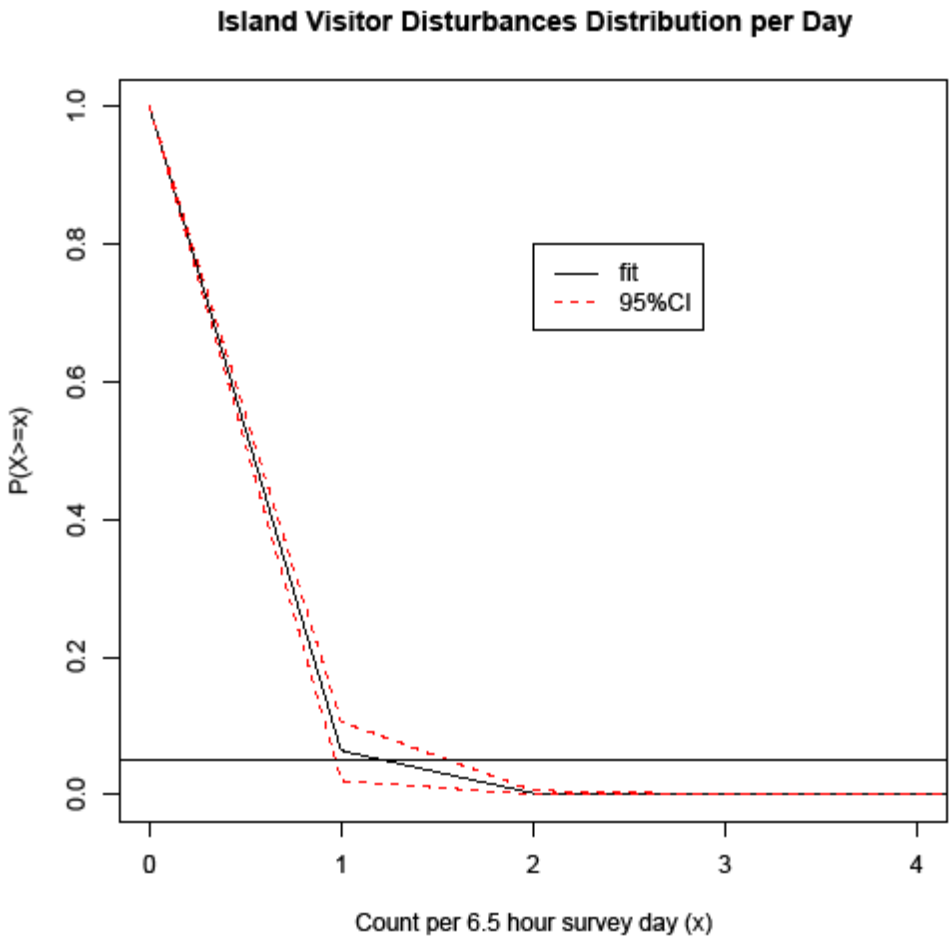
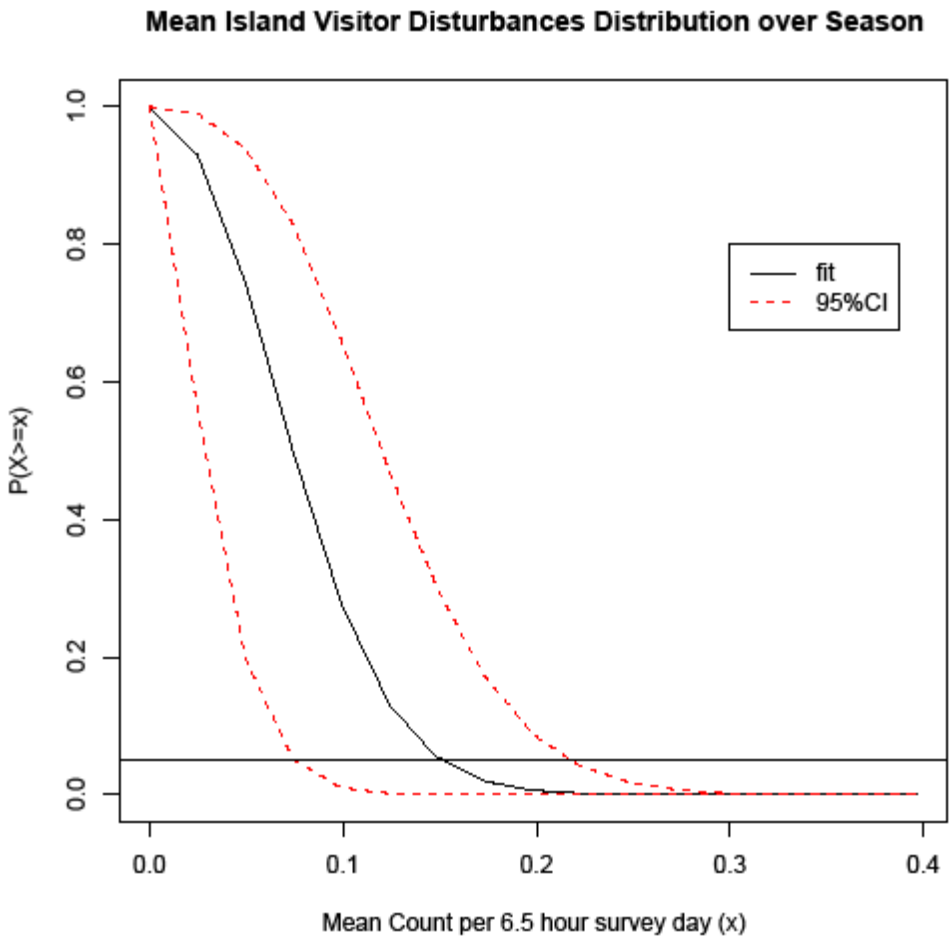

Island Visitor Disturbances Distribution per Day
P(X>=x)
0.0
0.2
0.4
0.6
0.8
1.0
fit
95%CI
0
1
2
3
4
Count per 6.5 hour survey day (x)

Figure 3.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0.0
0.1
0.2
0.3
0.4
Mean Count per 6.5 hour survey day (x)
fit
95%CI

Figure 4.