



Ecological Studies and Interpretation of Seabirds on Alcatraz Island, 2009



Final Report to the Golden Gate National Recreation Area (GGNRA) National Park Service (NPS)

Sara Acosta • Jaime Jahncke • Melissa Pitkin

PRBO Conservation Science
3820 Cypress Drive, #11
Petaluma, CA 94954
(707) 781-2555

William Merkle • Lara Rachowicz

Golden Gate National Recreation Area
Fort Mason, Building 201
San Francisco, CA 94123
(415) 331-2894

TABLE OF CONTENTS

EXECUTIVE SUMMARY	3
INTRODUCTION	4
METHODS	5
RESULTS AND DISCUSSION	8
PUBLIC OUTREACH	13
CONCLUSIONS AND RECOMMENDATIONS	15
ACKNOWLEDGEMENTS	19
LITERATURE CITED	20
FIGURES	
Figure 1. Alcatraz Island seabird breeding areas, survey observation points, and significant structures, 2009.	21
Figure 2. Brandt's Cormorant (BRCO) breeding population size on Alcatraz Island, 1990-2009.	22
Figure 3. Western Gull (WEGU) breeding population size on Alcatraz Island, 1990-2009.	23
Figure 4. Overall Brandt's (BRCO) and Pelagic (PECO) Cormorant productivity on Alcatraz Island, 1995-2009.	24
Figure 5. Pelagic Cormorant breeding population size on Alcatraz Island, 1996-2009.	25
Figure 6. Western Gull productivity at three sub-colonies on Alcatraz Island, 1999-2009.	26
Figure 7. Pigeon Guillemot population size on Alcatraz Island, 1997-2009.	27
TABLES	
Table 1. Brandt's Cormorant population size on Alcatraz Island, 1991-2009.	28
Table 2. Brandt's Cormorant productivity by sub-colony on Alcatraz Island, 1995-2009.	29
Table 3. Brandt's (BRCO), Pelagic Cormorant (PECO), California Gull (CAGU) and Western Gull (WEGU) reproductive phenology on Alcatraz Island, 2009.	30
Table 4. Brandt's (BRCO), Pelagic Cormorant (PECO), Western Gull (WEGU), and California Gull (CAGU) reproductive performance on Alcatraz Island, 2009.	31
Table 5. Pigeon Guillemot reproductive phenology on Alcatraz Island, 2009.	32
Table 6. Frequency and percentage of types of disturbance to Brandt's Cormorants on Alcatraz Island, 1997-2008.	33
Table 7. Summary of Alcatraz Presentations and Outreach in 2009.	34

EXECUTIVE SUMMARY

Alcatraz Island has become a regionally important site for a number of seabird species in the last couple of decades. Population size, breeding phenology, and productivity of most seabirds including Brandt's and Pelagic Cormorants, Western and California Gulls, Pigeon Guillemots, and Black Oystercatchers have been monitored since 1995. Disturbance to wildlife is a concern on Alcatraz, given its status as a heavily-visited part of the Golden Gate National Recreation Area (GGNRA) and its location in the center of the San Francisco Bay. During weekly monitoring, we recorded and cataloged disturbances to seabird populations from March - August, 2009. In an attempt to reduce human caused disturbances to seabirds and raise awareness of seabird natural history, PRBO has been conducting education and outreach programs since 2006. In 2009 we delivered public outreach programs to target audiences including on-island staff, island visitors, personal watercraft operators, and school children, and made recommendations for further outreach centered on Alcatraz seabirds.

Populations of breeding Brandt's and Pelagic Cormorants on Alcatraz were completely absent in 2009, the first breeding failures since the populations were established in the early 1990's. Brandt's Cormorants did poorly throughout central California where many colonies had little to no breeding attempts and many birds were found dead at colonies and local beaches. Western and California Gull populations also decreased, while the Pigeon Guillemot populations remained steady. Overall productivity for birds that bred in 2009 was lower than the long-term average.

Western Gull breeding numbers decreased to 888 nesting pairs in 2009 (nests taken under a depredation permit from USFWS # MB057058-0 are not included in the total count) from 1034 pairs in 2008. Western Gulls fledged an average of 1.3 chicks/pair in 2009, lower than the long-term mean. We confirmed 20 Pigeon Guillemot sites in 2009, a drop from the 32 confirmed sites in 2008, including one nesting new site in the Sallyport building roof. One pair of Black Oystercatchers bred on the Seawall in 2009. One chick survived to fledge, making it the seventh oystercatcher chick to fledge Alcatraz since 1997. We first discovered California Gulls breeding on Alcatraz in 2004. Since then, this small colony behind the rubble piles on the Parade Ground peaked at 23 pairs in 2007, but has since decreased to 14 nests in 2009. They fledged an average of 1.1 chicks fledged/pair in 2009, lower than the mean since the monitoring began.

Due to the absence of breeding cormorants in 2009, only two disturbances of roosting cormorants were documented during approximately 111 hours of observation throughout the breeding season. Disturbances in both cases caused cormorants to flush their roosting sites and were due to aircraft flying over the island.

The National Park Service approved implementation of a project to install windows on the Laundry Building during the seabird breeding season. Had cormorants bred in 2009, additional disturbance monitoring of this project would have taken place. Precautions were taken to minimize noise levels and a visual barrier was created. However these precautions seemed to have some imperfections and could have contributed to even more disturbances to breeding cormorants. In recent years, we have begun to see that cumulative effects of disturbance may cause increased behavioral sensitivity in Brandt's Cormorants. It also potentially takes only one ill-timed disturbance to cause colony failure. Therefore, to continue to reduce disturbances, we

recommend continued park vigilance in restricting human access and construction activities within view of the western cliffs after early February, especially if activities may influence the sensitive Pelagic Cormorant population which is at risk of disappearance from Alcatraz. We also recommend the continued use of the visual barrier on the fence at the Model Industries Building.

We continue to encourage plans to post signs visible to both visitors on the island and to passing boaters that explain proximity restrictions with the threat of law enforcement as well as plans to re-install historical buoys around the island. Alcatraz Island offers a unique opportunity for the public to view seabird breeding activities up close, and this should be highlighted as a focal point of visitor education and outreach. Recent improvements of signage and a new "Birds of Water" display will play a role in improved visitor appreciation and understanding of the seabird colonies at Alcatraz. Interpretive tours around the island, increased staff training regarding awareness and sensitivity of bird colonies, as well as increased public outreach to marine and air traffic operators also will help educate visitors as well as protect breeding seabirds.

Common Raven predation and/or harassment on Pigeon Guillemots were observed in 2008, and raven predation and/or harassment have been observed in recent years on Brandt's Cormorants, Black-crowned Night Herons, Snowy Egrets, Western Gulls, and Black Oystercatchers on Alcatraz. While we have not made direct observations of raven and Pelagic Cormorant interactions, this is also a possibility. Therefore, increased efforts to investigate the potential for the best methods of Common Raven management are also recommended.

INTRODUCTION

Prior to human settlement on Alcatraz Island (37° 49'N, 122° 25'W) in San Francisco Bay, it was home to thousands of nesting seabirds as indicated by the guano covered sandstone. As early human settlement took place, birds left the island and did not return throughout the military and prison history. Over a century later, Alcatraz became part of the Golden Gate National Recreation Area (GGNRA), a unit of the National Park Service (NPS), and birds slowly began to return to reclaim the island. Waterbird species of interest include Brandt's Cormorants (*Phalacrocorax penicillatus*), Pelagic Cormorants (*P. pelagicus*), Western Gulls (*Larus occidentalis*), California Gulls (*Larus californicus*), Pigeon Guillemots (*Cepphus columba*), Black Oystercatchers (*Haematopus bachmani*), Black-crowned Night Herons (*Nycticorax nycticorax*), Snowy Egrets (*Egretta thula*), Great Egrets (*Casmerodius albus*), and Great Blue Herons (*Ardea herodias*). The Brandt's Cormorant colony on Alcatraz is one of the few known estuarine breeding sites for this species. Pigeon Guillemots breed nowhere else in the San Francisco Bay. The Western Gull colony is the largest in the Bay and the Black-crowned Night Heron colony is among the largest in the Bay.

This diversity of species, although protected by the Migratory Bird Treaty Act, National Park Service Management Policies, and NPS-77 Natural Resource Management Guidelines, exists in a delicate balance with the considerable human presence both on and around Alcatraz Island. Colonial waterbird populations on Alcatraz experience substantial disturbance from a number of different sources. About 1.5 million visitors tour the island annually, and associated historic preservation and safety construction projects, public access to breeding areas, gardening

activities which are part of a new historic garden restoration program, and special events may disrupt the breeding efforts of Alcatraz seabirds. Encroachment near the Alcatraz shoreline by large numbers of commercial and/or recreational boaters (e.g. tour boats, fishing boats, kayakers), and uncontrolled aircraft overflights (e.g. media, military, and air tour operators), may have similar effects. In addition, dredging and other projects which disturb and alter the subtidal environment are potentially disruptive to seabird populations, as these activities may remobilize contaminants, increase turbidity, and destroy essential foraging habitat.

In 1993, GGNRA completed a management plan for Alcatraz Island, which included provisions for maintaining breeding populations of colonial waterbirds (LSA Associates and NPS staff 1993). This plan emphasized protection of the island's natural resources, while maintaining opportunities for visitor access, special events, and other island uses. The plan called for natural resource monitoring and the development of protocols to determine baseline information for key wildlife populations. Since 1996, PRBO Conservation Science (formerly Point Reyes Bird Observatory) in conjunction with GGNRA has conducted wildlife studies with the goals of (1) establishing the distribution, abundance, and reproductive performance of waterbird species, (2) assessing the extent and effects of various forms of disturbance, and (3) assisting management personnel in developing appropriate and effective policies to protect waterbird populations. To address protecting natural resources while maintaining visitor and event services, PRBO, with support from the Golden Gate National Parks Conservancy (GGNPC, a non-profit partner that supports and assists the Golden Gate National Parks in research, interpretation, and conservation programs) and GGNRA, has been conducting education and outreach programs since 2006.

This report details results of monitoring and education and outreach efforts during the 2009 breeding season. This report should not be cited without permission from the authors. This is PRBO contribution number 1698.

METHODS

We conducted island- and boat-based surveys from March through August, 2009. Island surveys consisted of censuses and focal nest observations once per week, on Thursdays. In order to minimize disturbance to nesting birds, we made observations using binoculars (8 x 42) and/or a spotting scope (Bausch & Lomb Elite ED 20 - 60x) from concealed or distant locations around the island (Figure 1). Nest boxes and a sample of crevice sites for Pigeon Guillemots that are near known nesting sites and are accessible were monitored manually biweekly when adults were not present. Boat surveys took place 7 times between 28 May and 23 July and concentrated on capturing peak incubation of Western Gulls and Brandt's Cormorants. Pigeon Guillemot activity near nesting sites was also observed and boat surveys in June and July focused on capturing sightings of Pigeon Guillemot fish deliveries to chicks in order to confirm breeding. We circled the island slowly at a distance of at least 100 meters from shore and made observations using binoculars and a Canon EOS Digital Rebel camera with a 300mm zoom lens.

BRANDT'S CORMORANT

In 2009, there were no nesting Brandt's Cormorants on Alcatraz Island and attendance was extremely low. However in each sub-colony visible from the island, we counted the total number of adult and immature Brandt's Cormorants (if any were present) once per week, between 08:00 and 11:00. These included the Southern (except for the Gap – see Figure 1), Northern, Barker Beach, Laundry, and North Foghorn sub-colonies, as well as part of the Model Industries sub-colony. We observed the Gap, South Bricks, Below Rubble Piles, and parts of the Model Industries sub-colony not visible from the island by boat 7 times between 28 May and 23 July. During each survey, we recorded the total number of adults present as well as the number of dead birds seen. No eggs were laid, so no breed monitoring could be conducted this year.

Due to an abnormally high count of dead birds found on the island in mid-April, four accessible, fresh carcasses were collected and sent to the Marine Wildlife Veterinary Care & Research Center in Santa Cruz, California.

PELAGIC CORMORANT

Pelagic Cormorants were censused and monitored similarly and concurrently to Brandt's Cormorants (weekly between 08:00 and 10:00). There were no Pelagic Cormorants nesting on Alcatraz in 2009.

WESTERN GULL

We censused Western Gulls using standard protocols developed for Alcatraz in 1990 (Bell 1990). One all-island nest count was obtained following peak egg-laying (as determined from phenology in study plots). We divided the island into census areas and counted all active nests in each area, determined by seeing eggs or chicks when possible or by counting birds in incubation posture. We walked through accessible parts of the island and counted nests; boat surveys were used to survey inaccessible parts of the island. NPS staff provided a map of depredated nests, and thus those were excluded from our total count for the all-island census.

We assessed Western Gull reproductive performance and phenology by monitoring individual nest contents (number of eggs and/or chicks) weekly in study plots on the Cistern, the Parade Ground, and the Model Industries Plaza, using binoculars and spotting scopes. The Cistern and Model Industries plots were followed by PRBO staff while the Parade Ground was followed by GGNRA staff. Phenology was documented by determining mean dates of egg-laying, hatching, and fledging at monitored nests. Fledging was assumed when chicks were fully-feathered and therefore capable of flight. Reproductive performance was assessed by determining hatching success, fledging success, and total productivity.

CALIFORNIA GULL

California Gulls began breeding behind the Rubble Piles in 2004 (Figure 1). Due to their sensitive location, they have since been monitored by opportunistic access to the colony by PRBO or GGNRA during Black-crowned Night Heron surveys or visited during the Western Gull census.

In 2009, four visits to the colony were made in order to get complete nest contents, including one visit to the colony on 1 June for the all island gull census.

In addition to this visit to the colony, weekly monitoring was possible by access to the top of the Lighthouse (Figure 1) where most nests could be seen using binoculars and a spotting scope. This access allowed us to assess California Gull reproductive performance and phenology for the fourth year in a row on Alcatraz Island. For all other monitoring methods concerning reproductive performance and phenology, refer to Western Gull methods above. The California Gull plot was monitored by GGNRA staff.

PIGEON GUILLEMOT

We monitored Pigeon Guillemots during cormorant surveys and opportunistically, both from the island and by boat. Counts were taken between 08:00 and 11:00 around the perimeter of the island beginning at the dock area and ending at the blind located at the south end of the island (see Figure 1). Guillemots were counted both on the island and in the water, taking care not to double count individuals while moving from one monitoring location to another. We mapped and numbered nest crevices as they were identified throughout the season. Active nest sites were confirmed by observations of chicks or by parental delivery of fish to a crevice, indicating presence of a chick, or by presence of egg/chick remains found post-season. Probable nest sites were defined by regular attendance of adults. These methods have the potential for underestimating breeding numbers, as we may not have documented nests which failed early in the breeding season or if eggs, chicks, or fish deliveries were missed during observations.

In 2006, we installed 30 nest boxes for Pigeon Guillemots at three locations around the island: Powerhouse (PH), North Foghorn (NF), and South Colony (SC) near the blind (Figure 1). These locations are known breeding areas for guillemots. The nest boxes offer protected nesting sites that allowed us to monitor and examine breeding success. The PH site includes 11 nest boxes and 7 natural crevices. Natural crevices were discovered while installing nest boxes at the PH site and provided an accessible addition to our 30 nest box sample size. Therefore, crevices were cleaned out and checked simultaneously during biweekly checks. The NF site has 5 nest boxes, and the SC site has 14 nest boxes. Fledging was defined as chick disappearance from a nest site when at least 35 days old and mostly-feathered.

BLACK OYSTERCATCHER

During each cormorant survey, we recorded the presence and behavior of adult Black Oystercatchers near the Seawall. We noted nest contents (eggs or chicks). We also recorded the locations and behaviors of any oystercatchers seen on or around other areas of the island. Fledging was defined as chick disappearance from the nest site once fully-feathered.

DISTURBANCE MONITORING

During all monitoring activities March through August, we documented disturbances to nesting seabirds. For each disturbance event, we described the event and its observed effects, including the approximate distance of the event from the colony and the number of birds affected. This

report focused on details of events that caused noticeable disruption to cormorant breeding activities, as this species is considered sensitive to disturbance (Ainley and Lewis 1974, Boekelheide et. al. 1990). We classified disturbances as major, moderate, or minor. Major disturbance events caused cormorants to flush from breeding or roosting areas. Moderate disturbances caused agitation in cormorants such as fluffing, growling, threat gestures or standing up off nests. Disturbance was considered minor if cormorants only looked in the direction of the event. Due to the absence of breeding cormorants in 2009, few disturbances were observed and data is not comparable with previous years. Also, maintenance on the Laundry Building adjacent to cormorant nesting areas took place from January to early May which overlaps into the cormorant breeding season. No regular monitoring of disturbances due to construction was conducted due to lack of cormorant attendance.

RESULTS AND DISCUSSION

BRANDT'S CORMORANT

Brandt's Cormorants had a complete breeding failure in 2009, for the first time since the breeding population was established in the early 1990's (Figure 2). The population peaked in 2007 with 1782 nesting pairs. In 2008, the population dropped about 15% to 1515 nesting pairs. See Table 1 for Brandt's Cormorant breeding populations by sub-colony from 1991-2009 and Table 2 for productivity by sub-colony from 1995-2009. A decrease in Brandt's Cormorant breeding population size in 2008 and a large decrease or complete absence of breeding pairs in 2009 occurred throughout several colonies in central California and may be due to a combination of factors, including warmer air temperatures, low prey availability, and disturbances.

Brandt's Cormorants were first seen at the island in March in low numbers, mostly in roosting areas of the island (see Figure 1). Minimal nesting activity (nest building and displaying for mates) was seen in March through May, the usual time period of initiation and peak of breeding activity. On 15 April, 10 Brandt's Cormorants were found dead around the island. Between mid-April and early June, a total of 114 dead cormorants (mostly adults) were found around the island as well as a few other birds that appeared to be sick or weak. This coincided with a large increase of dead Brandt's Cormorants found on local beaches from Point Reyes to Año Nuevo (Shannon Lyday, pers. comm.).

Similar to the decline in breeding population of Brandt's Cormorants at Alcatraz in 2008 and their complete absence in 2009, populations of colonies throughout central California showed declining trends. In 2008, the offshore, Southeast Farallon Island population had decreased by approximately 75% compared to 2007 and had only very few, unsuccessful breeding attempts in 2009 (Warzybok et al. 2008 & 2009). At nearshore Año Nuevo Island, the breeding population also dropped in 2008 and again in 2009 to below 200 nesting pairs (compared to the peak population count in 2007 of 1830 nesting pairs; PRBO and Oikonos unpublished data).

In recent years (2005-2007), productivity of many seabird species in central California was relatively low, while that of cormorants was relatively high. That trend has reversed since 2008

with much lower cormorant productivity. In 2009, both Alcatraz and the Farallon Island Brandt's Cormorant populations had complete breeding failures, an unprecedented event since monitoring began at the Farallones in the early 70's (Warzybok *et al.* 2009) and monitoring began on Alcatraz in the early 90's (Figure 4).

Warm air temperatures may have had a greater influence on seabirds in 2008 than ocean productivity, as many nests failed after an abnormally high air temperature was reached at Alcatraz and at the Farallones (Acosta *et al.* 2008, Warzybok *et al.* 2008). In 2009, several piscivorous seabird species performed poorly in the region and some evidence suggests that ocean productivity played a role (PRBO unpublished data). With the high number of dead birds found at Alcatraz and the central California coast, we collected fresh carcasses at Alcatraz in order to be sent to the Marine Wildlife Veterinary Care & Research Center in Santa Cruz, California. Tests came back similar to others that were collected from local beaches; they were found to be emaciated.

PELAGIC CORMORANT

The Pelagic Cormorant population has been declining at Alcatraz for the last several years. In 2009, although some adults were seen attending nest sites in March and April, there were no breeding attempts (Figure 5). This is the first time since monitoring began in 1996 that Pelagic Cormorants failed to breed. In comparison, the Farallon population although low, had a productivity that was above the long-term mean (Warzybok *et al.* 2009).

Pelagic Cormorant productivity declined sharply starting in 2004 (Figure 4), and breeding attempts decreased notably in 2005 (Figure 5) and have remained low since. Several factors may have negatively affected Pelagic Cormorants breeding on Alcatraz in recent years. First, warm-water marine conditions since the mid 2000s may have adversely affected reproductive success through a mechanism of reduced prey availability (PRBO unpublished data). Second, the growth of the Brandt's Cormorant population may have resulted in some inter-specific competition with Pelagic Cormorants for nest sites in the early 2000's (Saenz *et al.* 2002). Third, in recent years human activity has increased at the north end, including construction activities, visitor access to boundaries of nesting colonies, staff access to the Model Industries building, and special events; all of which could have had adverse effects. Specifically, a fence was erected in February 2003, 30 feet from the edge of the cliff where Pelagic Cormorants breed, which may have disturbed early breeding activity. Staff activity in the Model Industries Building and surrounding plaza during the breeding season increased since then. Additionally, visitor access in 2004 and 2005 was allowed down to this fence throughout the breeding season, including the very sensitive nest-initiation stage. A special event held adjacent to the Pelagic Cormorant colony in early April 2007 may have negatively influenced breeding. Finally, other researchers have noted reduced Pelagic Cormorant populations elsewhere in the California Current related to corvid harassment and nest predation (Paine *et al.* 1990). Increased Common Raven activity on Alcatraz may negatively affect Pelagic Cormorant nesting.

WESTERN GULL

Western Gull breeding numbers have been on the rise since the late 1990's, but have plateaued since 2003 (quadratic regression, $p < 0.01$; $R^2 = 0.89$; $n = 11$). The Western Gull population at its peak in 2008 reached 1034 breeding pairs¹, but has since dropped to 888 breeding pairs in 2009 (Figure 3), not including 126 nests which were removed from public access areas and buildings under the GGNRA depredation permit from the US Fish and Wildlife Service. In 2009, the Alcatraz population decreased by 14%, which was not as high as the 22% decrease in the Western Gull population on the Farallones (Warzybok *et al.* 2009).

The first Western Gull eggs in 2009 were observed on 27 April, and the mean lay date was 11 May (Table 3), extremely consistent with the past several years, 1999-2008. The average hatch date was 11 June. Western Gull hatching success and fledging success was 0.6 and 0.7 respectively (Table 4). Productivity was 1.1 chicks per pair in 2009 (Figure 6), the lowest since 2000 and below the long-term mean of 1.5 chicks per pair since 1999. This was higher than the dense Farallon colony where productivity fell well below the mean (Warzybok *et al.* 2009).

Of the 3 Western Gull sub-colonies monitored, productivity at the cistern sub-colony was much lower for the third year in a row with 0.9 chicks fledged per pair in 2009 compared to 1.2 chicks fledged per pair at the Model Industries and the Parade Ground sub-colonies (Figure 6). Reasons for decreased productivity in the cistern sub-colony are unknown. The Western Gull population, although denser in this area in comparison to the other monitored areas, has remained similar between years, vegetation cover has not changed much, and researchers have been accessing the colony less in recent years due to altered monitoring protocols. Potentially unobserved disturbance to this area is a possibility for decreased productivity. Additionally, construction activities near the cistern in 2008 may have had an effect as well as entrance by staff on 21 May in 2009 for a cultural resources assessment.

CALIFORNIA GULL

We first discovered 5 pairs of California Gulls breeding on Alcatraz in 2004 in a small colony along the walkway south of the Rubble Piles on the Parade Ground. Since then, the population has increased up to 46 birds (23 nests), including an occasional pair attempting to breed outside of the small colony behind the Rubble. In 2009, there were 14 nesting pairs of California Gulls (Figure 3), including one nest that was established apart from the rest of the colony (Figure 1).

Due to their obscured location behind the Rubble Piles, we were not able to obtain exact lay dates. The first California Gull eggs seen were on 27 April. The average hatch date was 9 June (Table 2). Productivity, like in Western Gulls, was 1.1 chicks per pair in 2009, slightly lower than the 1.2 chicks per pair in 2008 and on the decline since 2006 when productivity of California Gulls was 1.7 chicks per pair.

¹ Correction to 2008 data was made in this report (population was previously reported as 1061 breeding pairs). Western Gull breeding pairs is defined by the number of pairs with active nests (nests with eggs and/or chicks) at the time of census.

PIGEON GUILLEMOT

Pigeon Guillemots were first detected in 2009 around Alcatraz on 17 March and attending nest sites on the island by 26 March (Table 5). A high count of 66 adults was recorded on 7 May, equal to the high count in 2008 and the highest since monitoring began in 1997. However, only 20 Pigeon Guillemot nest sites were confirmed in 2009, just below average for the number of confirmed sites since 1997. Additionally, we observed 19 probable nesting sites around the island (Figure 7).

In 2008, a Common Raven was observed eating a fully-feathered Pigeon Guillemot chick at the guillemot's nest site in the Barker Beach sub-colony. In previous years, ravens have been observed harassing adult guillemots attempting to deliver fish to chicks in nest sites. In 2009, on 11 June, one raven was seen in the intertidal areas near several Pigeon Guillemot known sites including some probable and confirmed sites. The raven was in the intertidal area and then proceeded to climb up the rocks under the walkways where adults were making fish deliveries to sites earlier in the day. No eggs or chicks were seen being taken although the raven made at least two visits to the site within a 15 minute period. The full extent of impacts on guillemots is unknown due to the inability to monitor reproductive success in many breeding sites due to accessibility and disturbance issues. However, predation to just one nest in 2009 would affect 5% of the breeding population at Alcatraz. It is possible that each year, more nests are actually impacted and not observed.

Out of 30 nest boxes placed around the island in February 2006, one box under the blind in the Southern sub-colony was used in 2006 and 2007 and again in 2009. In addition to one nest box, one natural crevice at the Power House and one hole in the Sallyport building roof was used for nesting by Pigeon Guillemots. The Power House crevice which was cleared out at the time of nest box placement was used by a pair of Pigeon Guillemots in 2008 and in 2009. Adults were first seen at the nest boxes under the blind on 7 May. One egg was first seen on 9 July and a downy-feathered chick was hatched by 30 July. The chick was last seen fully feathered on 3 September. The natural crevice near the Power House had adults incubating eggs by 21 May and one downy-feathered chick was seen by 8 June. The chick at this site however did not fledge. Despite adult activity at the nest site through July, the chick was not seen again. Although Pigeon Guillemot activity has been seen near the Sallyport roof in recent years, 2009 is the first year we have confirmed a nest site at this location. Activity was first seen at this site on May 28. On July 23, we were able to access the site through the inside of the building and found 1 downy-feathered chick. Weekly checks ensued and the chick was last seen fully-feathered on August 26 and fledged by September 03. We had anticipated greater occupancy in subsequent years after nest box installation once the guillemots became familiar with the new boxes. Nest boxes have been a successful tool for monitoring reproduction of cavity-nesting seabirds in other locations in California, as well as increasing population size (Sydeman et. al. 2000). Nest box occupancy usually increases in the second to third year after installation (Sydeman et. al. 2000), however occupancy has not increased on Alcatraz. Nest box occupancy could increase once marine conditions improve, however, nest box locations may need to be adjusted. Current obstacles to better placement of boxes include accessibility and keeping boxes hidden from sight from visitors via island or boat observations.

BLACK OYSTERCATCHER

A single pair of Black Oystercatchers nested on the Seawall in 2009. Adults were seen at the Seawall and around the island intermittently from 21 May to 6 August. Eggs were laid at an inconspicuous spot on the seawall and not seen until our second boat survey on 1 June. Eggs could not be seen due to their location, but 2 downy-feathered chicks were first seen on 8 June, however only one chick was seen since. The remaining chick was last seen fully-feathered on 6 August. One potential challenge to nest success of the Black Oystercatchers could again be the Common Ravens. On 1 June, one oystercatcher was seen chasing a raven away near the seawall. Raven harassment of Black Oystercatchers has been observed at other central California colonies and may reduce oystercatcher reproductive success (Thayer and Lindquist 2006). Of a potential brood of 3 chicks per year, Black Oystercatchers on Alcatraz have only fledged seven chicks since 1997 (one each in 1997, 2001, 2003, 2004, two in 2006, and one in 2009).

DISTURBANCE MONITORING

With the absence of breeding Brandt's Cormorants at Alcatraz in 2009, there were very few possibilities for disturbances to this species. Only two disturbances were recorded in 2009 and both caused cormorants to flush from roosting areas. One disturbance took place on 14 May when a motorized hang glider with 2 passengers flew over, flushing 20 birds from Little Alcatraz (small rock within 100 yards of the island). Another disturbance was observed on 21 May when a jet flew over the island flushing 4 of 10 roosting birds in the South Colony roosting area.

GGNRA implemented a stabilization project on the Laundry Building during the breeding season. The Laundry Building is directly adjacent to several sub-colonies of Brandt's Cormorants, Pelagic Cormorants, and Western Gulls breeding at the Cistern and Model Industries Plaza. Had cormorants been present on the island in 2009, additional disturbance monitoring would have taken place due to this project. Maintenance to the Laundry Building, adjacent to the cormorant colony location, took place from January to early May. In recent years, we have begun to see that cumulative effects of disturbance may cause increased behavioral sensitivity in Brandt's Cormorants (Acosta *et al.*, 2007). The potential for disturbance from maintenance and construction activities that occur between February and August overlaps with the pre-breeding, incubation, and chick hatching activities of breeding birds. In order to minimize disturbances, park staff ensured many safeguards were observed. This included reducing noise inside the building from various power tools and other equipment by having mats ready to be laid on the floors to minimize noise if items were dropped, constructing small rooms within the building to use loud, electrically powered equipment in, and creating mufflers for loud power tools. Despite noise barriers, in early March, sounds of hammering and use of power tools could be heard from the Model Industries building. No cormorants were present at the time. In addition to noise barriers, a visual barrier was created and placed along the length of the Laundry Building, between the building and the location of the cormorant colony. This visual barrier was constructed by placing scaffolding outside the buildings' windows, then covering it in a white, shrink-wrapped plastic and installation was completed in March. The barrier was constructed with the intention for it to withstand wind and weathering through the end of the seabird breeding season in September. However, by 1 June it was torn and portions of the plastic were flapping in the wind creating a loud noise. The barrier was put in place to reduce disturbances to

seabirds, but instead could have contributed to disturbances if cormorants were present. Pieces of the barrier were also seen littering the island and surrounding waters. In the future, the addition of a visual barrier should be modified to withstand the elements or the inability to create such a barrier could warrant construction or maintenance projects to take place outside of the breeding season.

The visual barrier created in 2009 was not the first instance when one was necessary to reduce disturbances. Just prior to the breeding season in 2008, a permanent visual barrier was installed on the fence between the Model Industries Building and the Laundry Building to provide buffer between breeding birds and visitors and/or researchers. This barrier installed on the fence was created by vinyl slats weaved through an existing chain-link fence between the cormorant colony and the staff/visitor pathway. It proved to be successful in withstanding the wind and weather conditions throughout the year and in reducing the number of disturbances of non-motorized access to the Model Industries Building. Continued care will need to be taken to keep noise levels down as well as to keep gull disturbance at a minimum in this area so as not to alarm adjacent cormorant nesting colonies.

In February of 2009, a new “Birds of Water” exhibit opened at Alcatraz, showcasing the waterbirds of the island and their importance to Alcatraz, the ecosystem, and people. New signage interpreting the waterbirds of Alcatraz was also installed in several locations around the island. These new signs along with interpretative programs delivered by rangers or volunteers as well as the seabird docents will help to keep visitor disturbances at a minimum and increase the opportunity to foster greater seabird awareness. This is crucial, as it takes only one ill-timed disturbance to potentially cause colony failure (Thayer *et al.* 1999). In addition, as the cormorant population fluctuates due to climate and prey variability, it is likely to make breeding cormorants more sensitive to disturbance, and should be considered during future planning exercises related to human access.

PUBLIC OUTREACH PROGRAMS

The following programs were delivered:

International Migratory Bird Day Celebration, June 6, 2009

This was our fourth on-island celebration and public awareness day of Alcatraz seabirds. This celebration had two goals: 1) raise awareness of island visitors to the nesting seabirds while they enjoy and explore the prison, and 2) demonstrate to island staff that island visitors are interested in learning about Alcatraz seabirds. Activities included public viewing stations at five locations on the island, informational booths, games, and slide show in the Band Practice Room of the Cellhouse. In 2009, we made 980 visitor contacts between our headquarters in the Band Practice Room and each of the viewing stations.

Detail of IMBD Celebration Activities-

Public Viewing Stations: Volunteer docents were stationed at each of the key breeding colony sites easily viewed by island visitors. At these areas visitors viewed seabirds through spotting scopes and binoculars provided by PRBO and NPS and learned about the natural history of the birds.

Seabird Education Center: The Band Practice Room in the Cellhouse was opened to visitors and operated as a seabird education center where visitors walked through a photo gallery of the wildlife of Alcatraz, enjoyed a running slideshow of the birds, and received materials about seabirds, including the Monterey Bay Aquarium Seafood Watch card. Other activities included a station where visitors could check out binoculars and participate in a scavenger hunt. Visitors were also able to see for themselves first hand through microscopes evidence of what cormorants were eating and learn how scientists use this information to study their diet on Alcatraz. Booths were staffed by representatives of the Golden Gate Audubon, International Bird Rescue Research Center, and the Seabird Protection Network.

Alcatraz Seabird Docent Program

This is the third year of the Seabird Docent Program on Alcatraz. The docent program has two goals: 1) raise awareness among island visitors of nesting seabirds, and 2) reduce visitor entry into closed areas. The docent program involves a two part training and a commitment to operate the stations at least 10 times during the seabird nesting season. In 2009 the docents spent a total of 278 hours on the island between 30 April and 31 August and reached over 21,000 visitors, over 7 times as many reached than in 2008. A total of 26 docents were trained, most of which were able to come frequently throughout the season. The Alcatraz Seabird Docent Program was a huge success both for spreading awareness about the importance of Alcatraz seabirds, as well as to connect a group of people with the island and the birds inhabiting it.

Detail of 2009 Docent Activities

Docent Trainings: In 2009 we conducted two trainings, one classroom (17 March) and one field (28 March). The classroom training included distributing the resource binder, delivering presentations from the biologists on the natural history of seabirds and presentations from NPS staff on the cultural history of the prison, followed by a Q&A session for docents. The field session occurred on the island, where docents were given an orientation on what a typical day for them would entail.

Docent Resource Binder: We added additional information and updated the Alcatraz Seabird Docent Binder that was used in 2008. The binder contains approximately 30 pages of information helpful to docents in interpreting the natural history of seabirds, as well as some general information about Alcatraz.

On-island Presentations

The goal of our on-island tours and presentations is to train island staff in the natural history and ecology of Alcatraz's seabirds, enabling them to answer questions from island visitors and become connected to the natural resources of the island. Sara Acosta delivered 2 pre-season presentations to on-island staff and other invited guests on 26 March and one end-of-the-season presentations on 5 November on breeding ecology and sensitivity of nesting seabirds. Attendance was good and feedback of its informative impact was positive.

Targeted Outreach to Key User Groups and the Public

This program's goal is to reduce off-island human-caused disturbance to nesting seabirds. Activities include identifying and conducting outreach to boaters and air tour operators, creating outreach materials and websites, delivering presentations, and participating in a central coast working group to reduce seabird disturbance (the Seabird Protection Network, <http://farallones.noaa.gov/ecosystemprotection/seabirds.html>).

To inform our targeted outreach efforts, we summarized disturbance from 1997-2008 (Table 6). From this, we developed a list of Bay Area marine groups to target. We then developed a presentation discussing the natural history of seabirds on Alcatraz, effects of disturbance, and ways to prevent disturbance by humans on foot, in boats, and in aircraft. Formal and informal presentations, meetings, media outreach, and delivery of disturbance reduction information are summarized in the Table 7 and below is a summary of outreach materials created.

Outreach Materials Created (summary)

- Docent binder
- Alcatraz Seabird Ecology and Conservation Presentations for staff and boater outreach
- Student outreach posters – posters created through PRBO's SEA Alcatraz program. The best posters have been chosen as effective outreach tools for 2010.
- Seabirds of Alcatraz website (in progress).

Fewer public outreach presentations were delivered in 2009 due to the fact that the Brandt's Cormorants did not initiate nesting.

CONCLUSIONS AND RECOMMENDATIONS

The Brandt's and Pelagic Cormorant populations on Alcatraz experienced an unprecedented absence and breeding failure in 2009, the small population of California Gulls decreased and the more numerous Western Gull population dropped by 14% in comparison to its peak in 2007. Productivity of both species of gulls dropped to 1.1 chicks fledged per pair, the lowest for Western Gulls since 2000 and the lowest for California Gulls yet recorded. Although productivity for Western Gulls was low, it was higher than that of the Southeast Farallon Islands population. Pigeon Guillemot population was equal to the population in 2008 which was the highest recorded since 1997, but the numbers of confirmed breeding sites was below the long term average since 1997. Brandt's Cormorant colonies across the central coast (Southeast

Farallon Island and Año Nuevo Island) experienced similar failures or overall poor success, and was likely influenced by reduced prey availability. The Pelagic Cormorant population on Alcatraz also failed although the Farallones appeared to have a low population with average breeding success. Pelagic Cormorants may be affected not only by prey availability but also negatively impacted by increased human disturbance near nest sites in recent years, competition for optimal nest sites in relation to Brandt's Cormorant population growth, and potentially harassment from Common Ravens

Since the last major El Niño event in 1998 when Brandt's Cormorants at Alcatraz outperformed those at the Southeast Farallon Islands (Saenz *et al.* 2007), Alcatraz cormorants performed better than those at coastal and pelagic colonies only during favorable marine conditions (high upwelling and low ocean temperatures). But during poor ocean conditions (from 2005-2007), cormorants at Alcatraz performed worse. This held true in 2008 as marine conditions improved; Alcatraz cormorants had higher productivity than other nearby, oceanic colonies. However, in 2009, cormorants in both locations experienced an unprecedented complete breeding failure. Explanations could include differing prey availability near Alcatraz in the Bay's estuarine environment versus in coastal or pelagic waters. Studies of seabird diet and comparisons with research trawl surveys could help explain differences, discern mechanisms, and provide information to assist in management and conservation of these seabirds in central California.

The Pelagic Cormorant breeding population on Alcatraz has been decreasing since the early 2000's and, in 2009 none were present on the island, despite the population at other nearby colonies being present. Productivity has also been alarmingly low since 2004. These factors warrant increased protection if this species is to remain on Alcatraz. To protect against disturbance, human activities around the cliffs should be minimized as much as possible before breeding season, and ceased completely after early February, as mandated in the Alcatraz Final Environmental Impact Statement of 2001 (GGNRA), and continued since then as standard operating procedure. We advise against visitor or staff access near this area during breeding season (mid-February to the end of August). However, should any access be permitted, extreme caution should be exercised by people in this area to help prevent disappearance of Pelagic Cormorants from Alcatraz Island.

Common Ravens have become abundant along the central California coastline due to their ability to take advantage of human development. However this species can be detrimental to breeding waterbirds (Roth *et al.* 1999). Common Raven predation and/or harassment on Pigeon Guillemots was observed in 2008 and in 2009, and has also been observed in recent years on Brandt's Cormorants, Black-crowned Night Herons, Snowy Egrets, Western Gulls, and Black Oystercatchers on Alcatraz. While we have not made direct observations of raven and Pelagic Cormorant interactions, this is also a possibility. Pelagic Cormorant populations in Washington have been reduced due to influence of corvid harassment and nest predation (Paine *et al.* 1990). Therefore, increased efforts to investigate the best methods of Common Raven management are also recommended.

Attempts to oil Common Raven eggs in the one nest on Alcatraz have been made by the GGNRA in the past three years. In 2007, all eggs present in the nest when a biologist scaled the tree were oiled, but one egg hatched. It is possible that this egg was laid after the oiling attempt,

or that a different oiling technique may be more effective. In 2008, raven chicks hatched prior to any oiling attempts and in 2009, ravens likely re-laid after oiling of its eggs occurred. Exploring different oiling techniques (types of oils, coverage, etc.), monitoring early raven breeding phenology, continued checks for potential egg re-lays or removing adult birds from the island could make management attempts more effective.

Pigeon Guillemots were found nesting in the Sallyport building, a building currently not open to the public or staff activities. We recommend that any future maintenance on this building would take place outside of the seabird nesting season between February and mid-September.

Disturbance to seabirds is a consistent problem at Alcatraz Island given its status as a heavily-visited national park and its location in the center of the San Francisco Bay. There is constant air traffic from small planes, helicopters, and various other aircraft as well as marine traffic from kayaks, canoes, and powerboats. Marine traffic could be significantly reduced if historical buoys warning or reminding boaters of the proper distance to keep from Alcatraz were re-installed. Visitor presence on the island can also pose a threat of disturbance to nesting birds. The placement of the visual barrier at the Model Industries and Laundry Building fence helped significantly as there were no records of human disturbance in that area since its placement in 2008. In addition, the signs near closed areas and an increase in seabird interpretation by docents may have helped to reduce or eliminate the visitor disturbances to Brandt's Cormorants in 2008. It will be important to continue and improve the visitor experience in relation to the natural side of Alcatraz in order to keep human disturbances at a minimum. Coordination of both law enforcement and outreach staff in this endeavor is crucial. Special use permits for air-based and marine vessels near the island as well as any special use permits on-island should be carefully coordinated. Regulation may include denying inappropriate permit applications, providing clearer language and better guidance in terms of restrictions in permits, and more effort to ensure adherence to permits once they are granted. For example, monetary fines and forbidding future opportunities may be good incentives for grantees to adhere to specified permit regulations.

We also urge that access to the foghorns for necessary bi-annual service be scheduled before and after the breeding season. This will require continued communication between seabird ecologists and GGNRA Alcatraz biologist, and consistent scheduling and follow-up between natural resources staff and the U.S. Coast Guard and its contractors. Construction and maintenance projects should be held outside of the breeding season, during the months of September through January. If projects must be done during the breeding season, additional disturbance monitoring efforts should be in place for the duration of the event. Also, wildlife sensitivity training for staff and contractors that need access nearby or within colonies of any of the breeding waterbirds is also important.

Summary of recommendations:

Management Recommendations

- Allow no public visitation near the western cliffs or in the Sallyport building after early February, especially if activities may influence seabird pre-breeding or early-nesting behavior.
- Allow no construction activities to be carried out near the western cliffs or in the Sallyport building after early February, especially if activities may influence seabird pre-breeding or early-nesting behavior.
- Keep visual barrier in place at the Model Industries/Laundry Building fence and maintain when necessary outside breeding season.
- Enforce strict regulations in granting special use permits for events and groups and such privileges should be carefully planned in advance to prevent any potential miscommunication and/or disturbance to wildlife.
- Increase warning signage in sensitive areas with threat of law enforcement consequences. Specifically, near the metal detector at the south end of the Laundry Building where many visitors have crossed barricades.
- Secure debris (e.g., trash bags, tarps, etc.) that can blow away in windy conditions from cleaning or construction sites and potentially cause seabird disturbance.
- Schedule police K-9 training units during the seabird non-breeding season, and restrict K-9 units to the main walkways between the Dock and Cellhouse, excluding the sensitive area behind Building 64.
- Continue communication with U.S. Coast Guard personnel and contractors to schedule bi-annual foghorn maintenance before and after the breeding season
- Re-install historical buoys around the island.
- Continue efforts on Common Raven management
- If GGNRA continues to actively participate in seabird monitoring, it should ensure that staff has adequate training and enough time allocated to monitor the agreed upon plots weekly including continued check-ins during the season as changes in monitoring occur.

Research Recommendations

- Continue ongoing monitoring of colony breeding success and human disturbance monitoring
- Increase monitoring of guillemots and other species potentially impacted by Common Raven disturbance
- Incorporate studies of seabird diet which may help to reveal links between seabird reproductive parameters and marine environmental conditions versus human disturbance effects
- Further investigate Western Gull population dynamics on Alcatraz Island and how effects of increased management or reduced habitat would affect this species, including support for Western Gull banding and re-sighting banded birds

Outreach Recommendations

- Continue participation in central California Seabird Protection Network (SPN) to ensure that minimum approach distances are set to benefit Alcatraz seabirds
- Continue to work with GGNRA staff to develop interpretive signs and deliver tours around the island to help protect breeding seabirds as well as educate visitors about wildlife on this unique island
- Continue the on-island docent program for seabird colonies during the nesting season
- Discontinue the island seabird celebration (International Migratory Bird Day) as it has accomplished the goal of demonstrating public interest to GGNRA staff and the visitor education goal is better accomplished through the docent program.
- Incorporate Alcatraz as a key outreach site for existing marine outreach programs (GFNMS Webs Under Waves and SPN for example) since other seabird colony sites are largely inaccessible to humans
- Deliver presentations and outreach materials to marine and air users during and just prior to the nesting season with an emphasis on the early part of the season as colonies are most vulnerable during this time
- Develop and include a seabird protection pledge at the end of all our outreach activities to foster greater buy in of our boating best practices
- Invite boaters and pilots to a guided seabird tour on the island to observe and learn about nesting Brandt's Cormorants
- Continue to investigate the idea of producing a seabird protection map for SF Bay area parks, or work with the SF Bay Joint Venture outreach committee and GGNRA to include sensitive seabird/wildlife areas into a bay-wide map
- Enhance GGNRA website on seabirds of Alcatraz – include outreach products and other informational materials and presentations created through this program.

ACKNOWLEDGEMENTS

This study and associated outreach was made possible by Golden Gate National Recreation Area and Golden Gate National Parks Conservancy in cooperation with PRBO Conservation Science under the Scientific Research and Collecting Permit # GOGA-2005-SCI-0002. We would like to thank NPS Rangers and other employees, as well as Alcatraz Cruises and GGNPC personnel, for their interest, encouragement, and logistical support. Special thanks to Amy Brees and John Cantwell at Alcatraz Island for allowing us access to the Lighthouse for additional monitoring opportunities, Bill Doll and Philip Erwin at San Francisco Maritime National Historic Park (Hyde Street Pier) for help with boat support, Ed Ryken and Eric Brumm, and the Alcatraz Cruises Solitary staff including Captain Jack Edmondson for additional boat support; and finally to Helen Davis (PRBO intern) for her extra efforts and assistance with the outreach program.

LITERATURE CITED

- Acosta, S.M., J.A. Thayer, W. Merkle, and C. Hellwig. 2007. Alcatraz Island Special Event Seabird Disturbance Monitoring Report, 2007. Unpublished report to the National Park Service, Golden Gate National Recreation Area, San Francisco, CA. Point Reyes Bird Observatory, Petaluma, CA.
- Ainley, D. G. and T. J. Lewis. 1974. The history of the Farallon Island marine bird populations, 1854-1972. *Condor* 76: 432-446.
- Bell, D. 1990. Alcatraz Island Western Gull nest survey, 1990. Unpublished report to the National Park Service, Golden Gate National Recreation Area. Museum of Vertebrate Zoology, University of California, Berkeley, CA.
- Bell, D. 1991. Alcatraz Island Western Gull nest survey, 1991. Unpublished report to the National Park Service, Golden Gate National Recreation Area. Museum of Vertebrate Zoology, University of California, Berkeley, CA.
- Boekelheide, R. J., D. G. Ainley, S.H. Morrel, and T.J. Lewis. 1990. Brandt's Cormorant. pp. 163-195 in *Seabirds of the Farallon Islands: Ecology, Dynamics, and Structure of An Upwelling System Community*. (Ainley, D.J. and R.J. Boekelheide, eds.). Stanford University Press, Palo Alto.
- Brown, M. E. 1997. Population monitoring for Western Gulls (*Larus occidentalis*) on Alcatraz Island, California. Unpublished report to the National Park Service, Golden Gate National Recreation Area. Biology Department, University of Dallas, TX.
- LSA Associates and National Park Service Staff. 1993. Alcatraz Development Concept Plan, Environmental Assessment and Finding of No Significant Impact.
- Paine, R.T., J.T. Wootton, and P.D. Boersma. 1990. Direct and indirect effects of Peregrine Falcon predation on seabird abundance. *The Auk* 107: 1-9.
- Roth, J.E., J.P. Kelly, W.J. Sydeman, M.W. Parker, S.G. Allen, 1999. Ecosystem-level management of Common Ravens on the Point Reyes National Seashore. Unpublished report to Point Reyes National Seashore, CA. Point Reyes Bird Observatory, Petaluma, CA.
- Sydeman, W.J., J.A. Thayer, M.M. Hester, K.L. Mills, and S. Wolf, 2000. Nest boxes as a tool for Seabird Population Restoration. Unpublished report to the National Fish and Wildlife Foundation.
- Saenz B.L., Thayer, J.A., Sydeman, W.J., & Hatch, D.A. 2006. An urban success story: breeding seabirds on Alcatraz Island, California, 1990-2002. *Marine Ornithology* 34: 43-49.
- Thayer, J.A. et al. 1999. Baseline Monitoring and Assessment of Effects of Disturbance to Seabird Populations on Alcatraz Island, California, 1988. Unpublished report to the National Park Service, Golden Gate National Recreation Area, United States Department of the Interior, San Francisco, CA. Point Reyes Bird Observatory, Petaluma, CA.
- Thayer, J.A., and K.L. Lindquist. 2006. Long-term studies of seabirds on Año Nuevo Island and Mainland, 2006. Unpublished report to State of California Department of Parks and Recreation, Bay Area District, Año Nuevo State Reserve. Point Reyes Bird Observatory, Petaluma, CA.
- Warzybok, P.M., and R.W. Bradley. 2008. Population size and reproductive performance of seabirds on Southeast Farallon Island, 2008. Unpublished final report to the USFWS Farallon National Wildlife Refuge, CA. Point Reyes Bird Observatory, Petaluma, CA.
- Warzybok, P.M., and R.W. Bradley. 2009. Population size and reproductive performance of seabirds on Southeast Farallon Island, 2008. Unpublished final report to the USFWS Farallon National Wildlife Refuge, CA. Point Reyes Bird Observatory, Petaluma, CA.

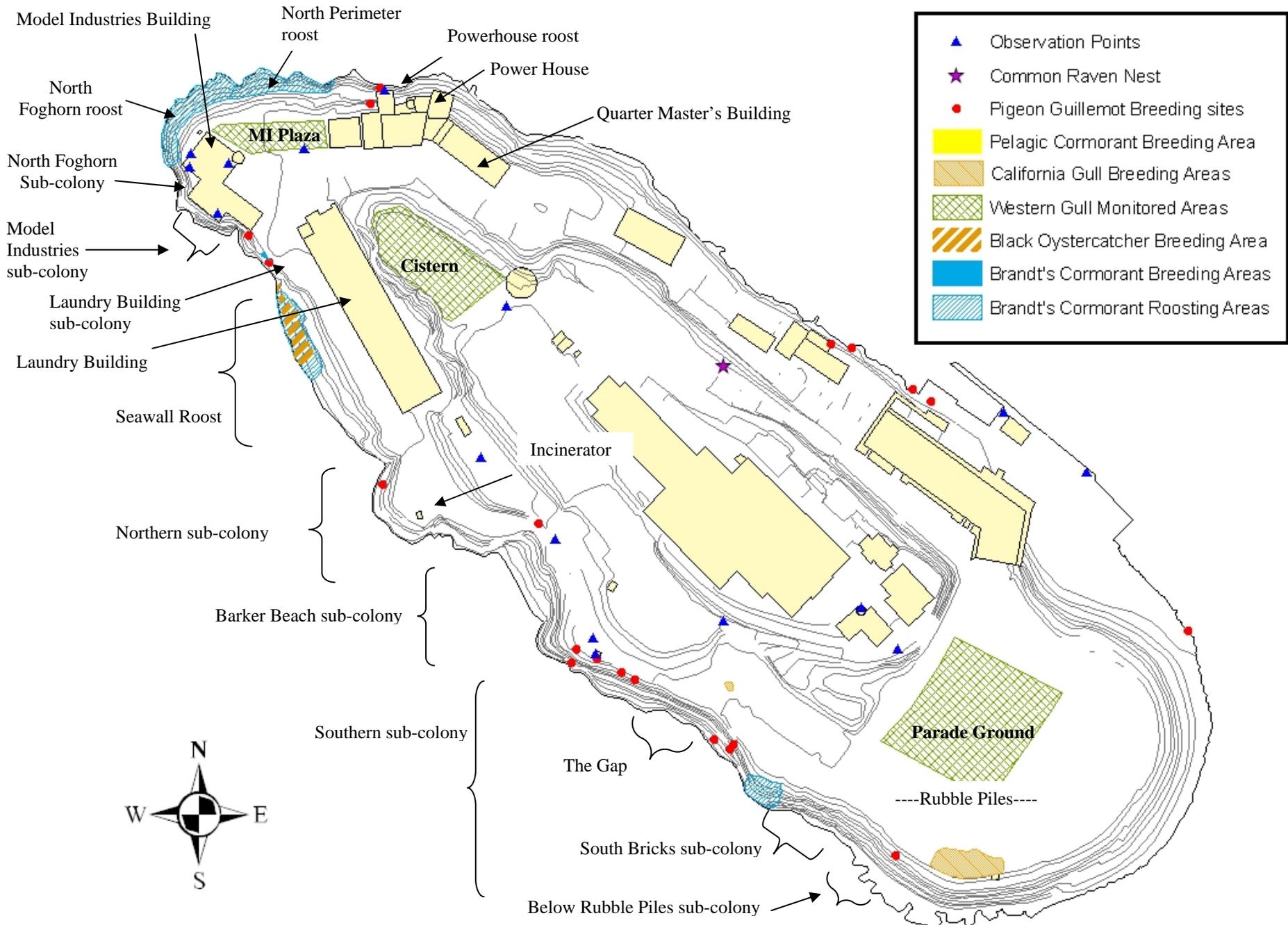


Figure 1. Alcatraz Island seabird breeding areas, survey observation points, and significant structures, 2009.

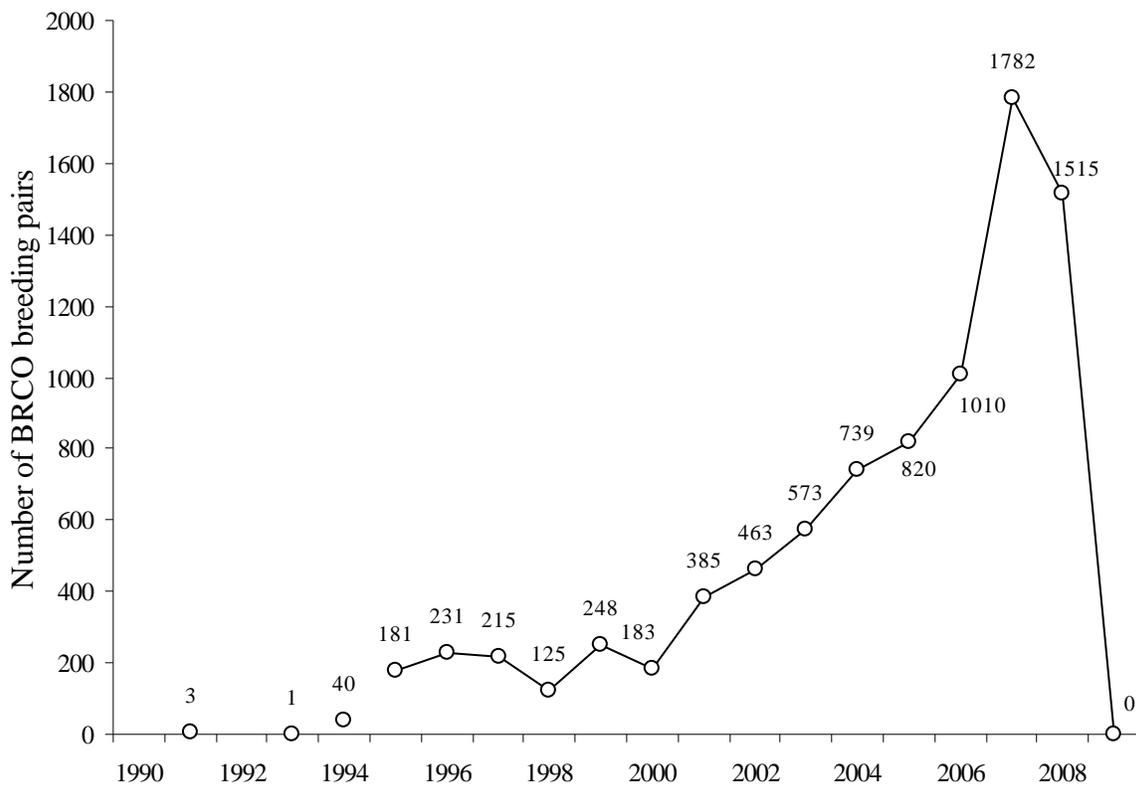


Figure 2. Brandt's Cormorant (BRCO) breeding population size on Alcatraz Island, 1990-2009. Data represent the minimum number of breeding pairs on Alcatraz. Breaks in data indicate a change in observers and/or census methodology. BRCO data in 1991 from R. Farwell/GGNRA, (pers. obs.); in 1993 from D. Hatch/GGNRA (unpubl. data); in 1994 from R. Hothem/USGS and W. Reyes/GGNRA, (pers. obs.). WEGU data in 1990 from Bell (1990); in 1991 from Bell (1991); in 1995 from D. Hatch and A. Fish/GGNRA (unpubl. data); in 1996-1997 from Brown (1997); in 1998 from Brown/Univ. of Dallas (unpubl. data).

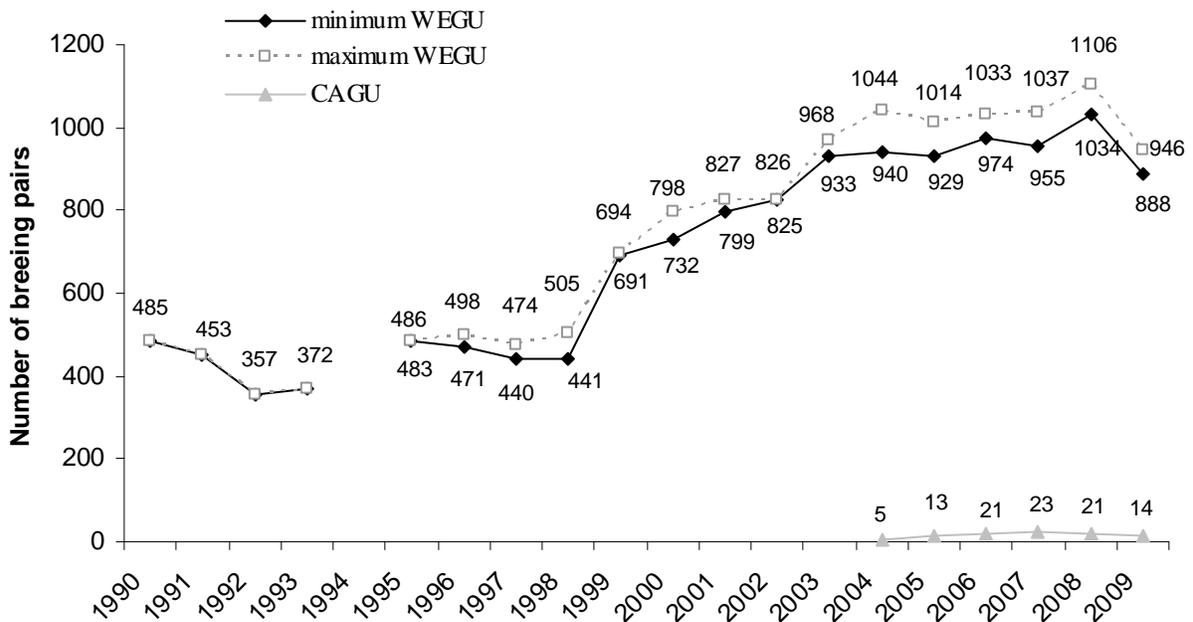


Figure 3. Western Gull (WEGU) and California Gull (CAGU) breeding population size on Alcatraz Island, 1990-2009. Minimum breeding pair data for WEGU represent the number of active nests (nests containing eggs and/or chicks on date of census) on Alcatraz. Maximum breeding pair data represent active nests and inactive nests (nests containing no eggs or chicks, but is being attended by an adult pair). CAGU population is represented by active nests found during the duration of the breeding season. Breaks in data indicate a change in observers and/or census methodology. WEGU data in 1990 from Bell (1990); in 1991 from Bell (1991); in 1995 from Hatch and A. Fish/GGNRA (unpubl. data); in 1996-1997 from Brown (1997); in 1998 from Brown/Univ. of Dallas (unpubl. data).

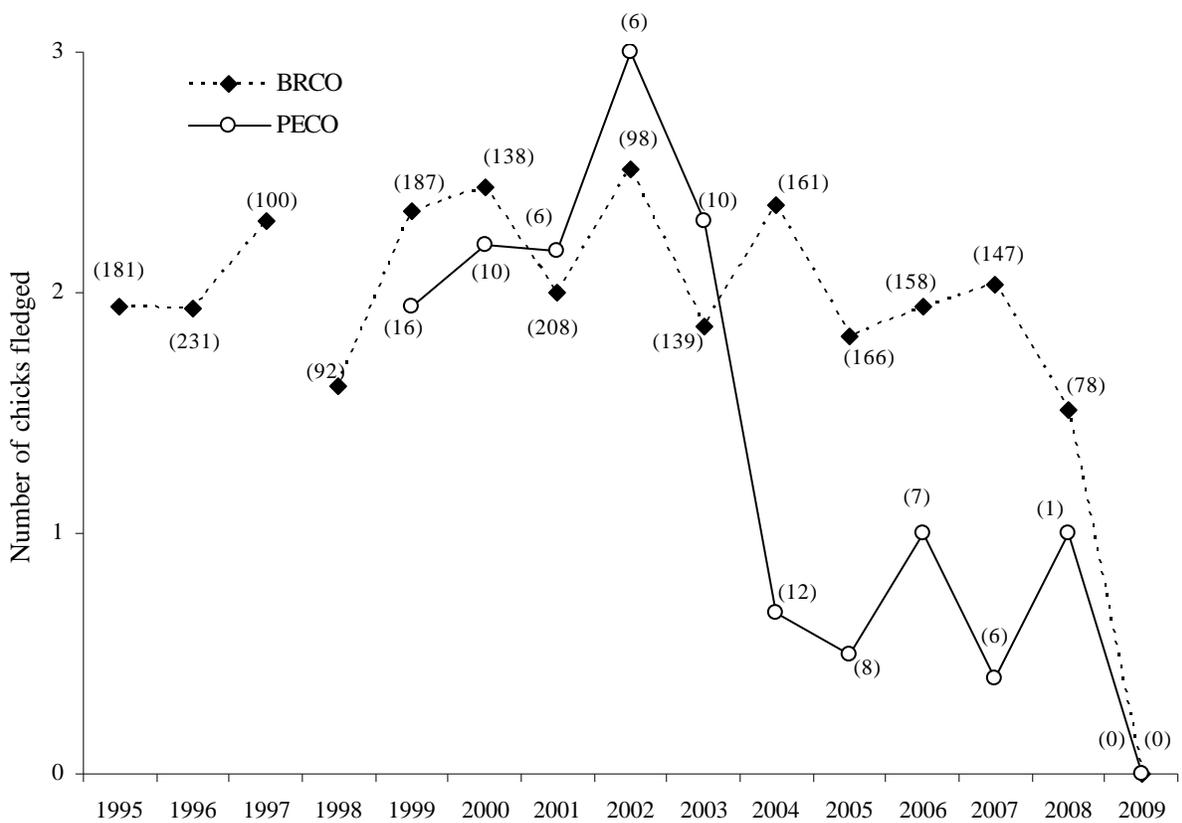


Figure 4. Overall Brandt's (BRCO) and Pelagic (PECO) Cormorant productivity on Alcatraz Island, 1995-2009. Sample size is in parentheses. Productivity in 1995-1997 was calculated from total chick counts. Productivity in 1998-2009 was calculated from number of chicks fledged per pair monitored.

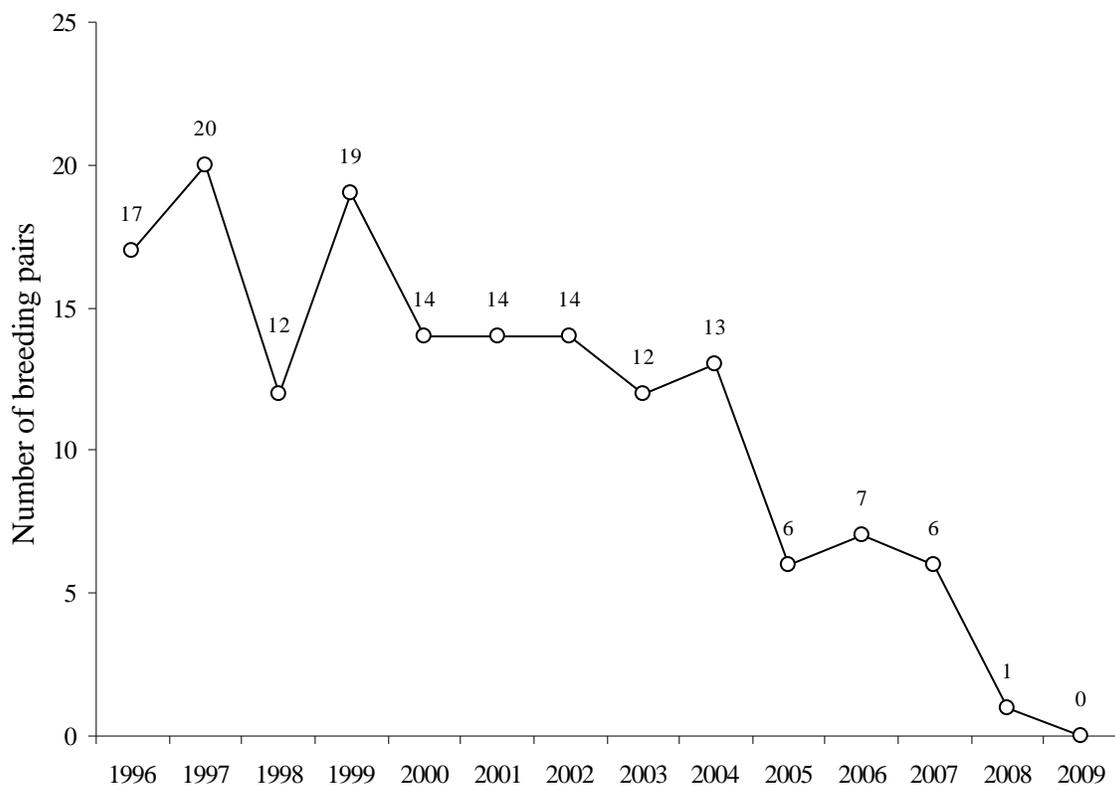


Figure 5. Pelagic Cormorant breeding population size on Alcatraz Island, 1996-2009. Data in 1996 from M. Parker/USFWS aerial surveys.

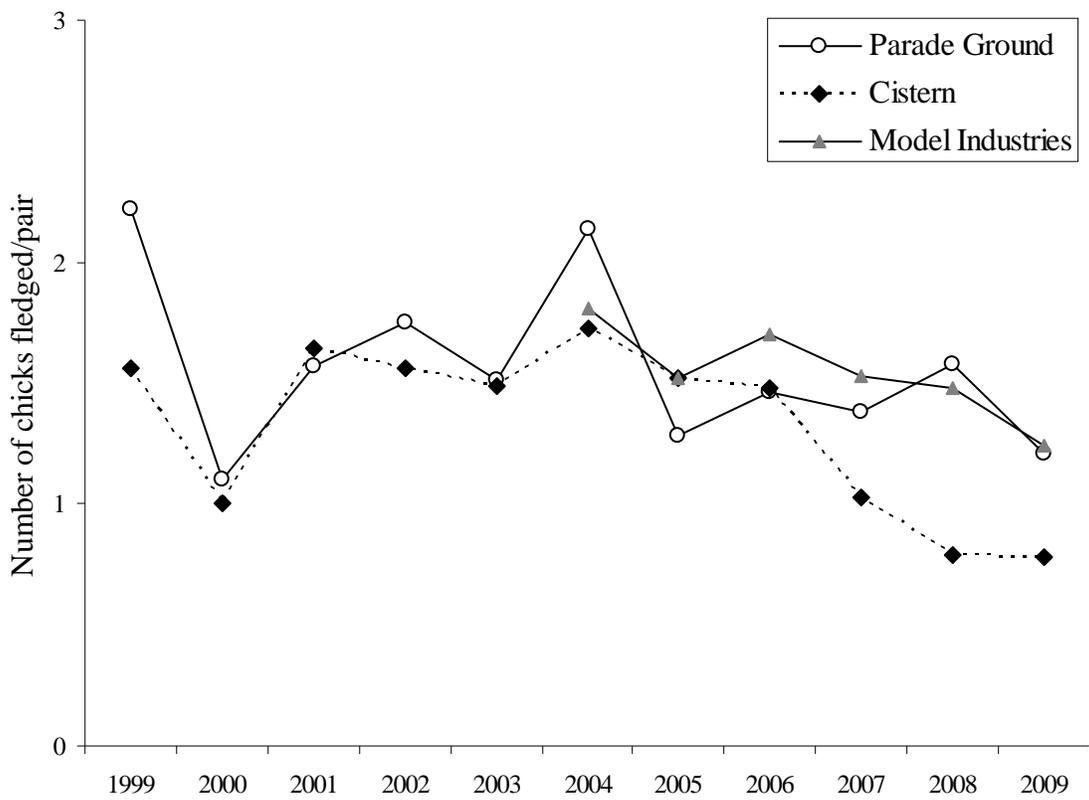


Figure 6. Western Gull productivity at three sub-colonies on Alcatraz Island, 1999-2009.

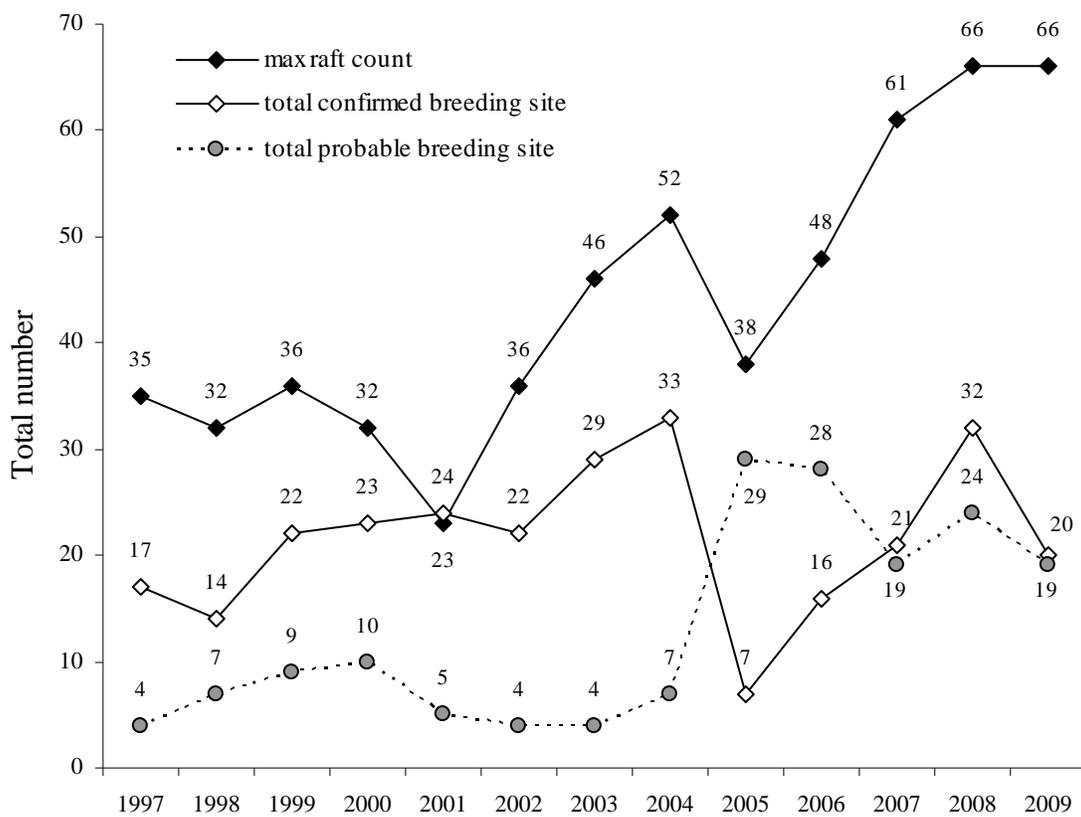


Figure 7. Pigeon Guillemot population size on Alcatraz Island, 1997-2009. “Total Confirmed Breeding Sites” reflects the minimum number of breeding pairs confirmed through observation of chicks, observing fish delivery, or post-season inspections of crevices.

Table I. Brandt's Cormorant population size on Alcatraz Island, 1991-2009.

YEAR	POPULATION ESTIMATES (breeding attempts)											SOURCE
	TOTAL	Model Industries Sub-Colony	North Foghorn Sub-Colony ⁵	Laundry Sub-Colony	Northern Sub-Colony	Barker Beach Sub-Colony	Southern Sub-Colony	Gap Area ⁴	South Bricks Sub-Colony ⁴	Below Rubble Piles Sub-Colony ⁴	East Side of island	
1991	3	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	R. Farwell/GGNRA, pers. obs. ¹
1992	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
1993	≥ 1	no data	no data	no data	no data	no data	≥ 1	no data	no data	no data	no data	D. Hatch/GGNRA, unpubl. data ¹
1994	≥ 40	no data	no data	no data	no data	no data	≥ 40	no data	no data	no data	no data	R. Hothem & W. Reyes, pers. obs. ¹
1995	~ 181	0	0	0	~ 81	0	~ 100	0	0	0	0	D. Hatch/GGNRA, PRBO, unpubl. data ²
1996	≥ 231	0	0	0	105	0	126	no data	no data	0	0	PRBO data ³
1997	215	1	see footnote	11	47	0	125	24	7	0	0	PRBO data ³
1998	125	3	see footnote	7	0	0	102	3	10	0	0	PRBO data ³
1999	248	30	see footnote	17	63	0	118	10	10	0	0	PRBO data ³
2000	183	37	see footnote	19	22	0	93	3	9	0	0	PRBO data ³
2001	385	45	see footnote	19	131	0	145	38	7	0	0	PRBO data ³
2002	463	47	see footnote	25	78	151	137	18	7	0	0	PRBO data ³
2003	584	82	see footnote	0	136	156	146	16	48	0	0	PRBO data ³
2004	752	88	see footnote	85	226	156	104	22	71	0	0	PRBO data ³
2005	820	89	see footnote	123	251	172	37	17	115	16	0	PRBO data ³
2006	1010	74	see footnote	145	369	196	16	0	142	68	0	PRBO data ³
2007	1782	105	86	8	1053	213	113	18	154	73	0	PRBO data ³
2008	1515	41	2	312	728	108	62	23	150	87	2	PRBO data ³
2009	0	0	0	0	0	0	0	0	0	0	0	PRBO data ³

¹ Incidental observation in 1991 or observation during 1993 Western Gull survey or 1994 Black-crowned Night Heron survey.² Carter et al. (1996) reported 218 Brandt's Cormorant nests on Alcatraz in 1995, based on aerial photographic surveys.³ Observation during ground survey in 1996 or ground and boat surveys in 1997-2008.⁴ Visible only during boat surveys, apart from 2004-2007 when the Gap included some nests visible from the blind.⁵ Numbers of North Foghorn sub-colony included in Model Industries sub-colony from 1997-2009.

Table 2. Brandt's Cormorant productivity by sub-colony on Alcatraz Island, 1995-2009.

YEAR	PRODUCTIVITY							METHOD
	Southern Sub-Colony	Northern Sub-Colony	Laundry Sub-Colony	Model Industries Sub-Colony	Barker Beach Sub-Colony	North Foghorn Sub-Colony	TOTAL	
1995 (chicks/site)	2.6 (262/100)	1.1 (89/81)	(0)	(0)	(0)	(0)	1.9 (351/181)	colony-wide, island-based and aerial photographic surveys
1996 (chicks/site)	1.7 (215/126)	2.2 (230/105)	(0)	(0)	(0)	(0)	1.9 (445/231)	colony-wide, island-based surveys
1997 mean ± s.d. (n)	2.4 ± 1.2 (76)	2.0 ± 0.8 (24)	no data	no data	(0)	no data	2.3 ± 1.1 (100)	focal-site analysis
1998 mean ± s.d. (n)	1.6 ± 1.0 (83)	(0)	1.7 ± 0.5 (6)	2.0 ± 0.0 (3)	(0)	included in MI Sub-Colony	1.6 ± 1.0 (92)	focal-site analysis
1999 mean ± s.d. (n)	2.6 ± 1.0 (93)	2.1 ± 1.0 (53)	2.1 ± 1.0 (17)	2.0 ± 0.8 (24)	(0)	included in MI Sub-Colony	2.3 ± 1.0 (187)	focal-site analysis
2000 mean ± s.d. (n)	2.5 ± 1.0 (81)	2.2 ± 1.4 (19)	2.5 ± 1.3 (17)	2.4 ± 0.9 (21)	(0)	included in MI Sub-Colony	2.4 ± 1.1 (138)	focal-site analysis
2001 mean ± s.d. (n)	2.2 ± 1.2 (102)	1.7 ± 1.3 (80)	2.5 ± 1.3 (13)	2.2 ± 1.3 (13)	(0)	included in MI Sub-Colony	2.0 ± 1.3 (208)	focal-site analysis
2002 mean ± s.d. (n)	2.7 ± 0.9 (43)	no data	2.8 ± 0.8 (23)	2.0 ± 1.0 (23)	no data	included in MI Sub-Colony	2.5 ± 1.0 (98)	focal-site analysis
2003 mean ± s.d. (n)	1.9 ± 1.1 (54)	1.2 ± 1.2 (21)	(0)	1.9 ± 1.2 (44)	2.3 ± 0.7 (20)	included in MI Sub-Colony	1.9 ± 1.1 (139)	focal-site analysis
2004 mean ± s.d. (n)	2.5 ± 1.2 (37)	2.5 ± 1.1 (35)	1.5 ± 1.3 (22)	2.6 ± 1.1 (47)	2.4 ± 1.1 (20)	included in MI Sub-Colony	2.4 ± 1.2 (161)	focal-site analysis
2005 mean ± s.d. (n)	2.1 ± 1.0 (12)	1.9 ± 1.2 (69)	1.5 ± 1.2 (26)	2.0 ± 1.1 (41)	1.6 ± 1.0 (18)	included in MI Sub-Colony	1.8 ± 1.1 (166)	focal-site analysis
2006 mean ± s.d. (n)	1.3 ± 1.6 (7)	1.9 ± 1.1 (65)	1.8 ± 1.3 (46)	2.2 ± 1.1 (21)	2.3 ± 1.2 (19)	included in MI Sub-Colony	1.9 ± 1.2 (158)	focal-site analysis
2007 mean ± s.d. (n)	1.9 ± 1.0 (45)	2.4 ± 0.8 (25)	1.9 ± 1.4 (8)	1.8 ± 1.2 (20)	1.9 ± 1.1 (29)	2.4 ± 1.0 (20)	2.0 ± 1.0 (147)	focal-site analysis
2008 mean ± s.d. (n)	1.0 ± 1.1 (18)	1.6 ± 1.2 (22)	2.4 ± 0.9 (21)	no data	.8 ± 1.1 (17)	(0)	1.5 ± 1.2 (78)	focal-site analysis
2009 mean ± s.d. (n)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	focal-site analysis

Table 3. Brandt's (BRCO), Pelagic Cormorant (PECO), California (CAGU) and Western Gull (WEGU) reproductive phenology on Alcatraz Island, 2009. Actual ranges may be wider due to re-lays and hard-to-see nests. Egg-laying data refers to first attempts of a pair at egg-laying, while hatching and fledging data may refer to second breeding attempts if first attempt failed. For BRCO, fledging was assumed when chicks were large enough to wander from their nests, since after that time it was difficult to assign chicks to particular nest sites. For PECO, CAGU and WEGU, fledging was assumed once chicks were fully feathered.

		EGG-LAYING DATE mean \pm s.d. (n) (range)	HATCHING DATE mean \pm s.d. (n) (range)
Brandt's Cormorant	Southern Sub-Colony	did not breed	did not breed
	Barker Beach Sub-Colony	did not breed	did not breed
	Northern Sub-Colony	did not breed	did not breed
	Laundry Building Sub-Colony	did not breed	did not breed
	Model Industries Sub-Colony	did not breed	did not breed
	North Foghorn Sub-Colony	did not breed	did not breed
	ALL SUB-COLONIES	did not breed	did not breed
Pelagic Cormorant		did not breed	did not breed
California Gull		13 May \pm 9 (13) (27 Apr - 1 Jun)	9 Jun \pm 11 (12) (1 Jun - 2 Jul)
Western Gull	Cistern	14 May \pm 7.3(21) (7 May -28 May)	10 Jun \pm 6 (13) (4 Jun - 18 Jun)
	Parade Ground	7 May \pm 6 (19) (27 Apr - 19 May)	9 Jun \pm 5 (8) (4 Jun - 18 Jun)
	Model Industries	13 May \pm 9 (23) (7 May -4 Jun)	8 Jun \pm 12 (9) (4 Jun - 2 Jul)
	ALL SUB-COLONIES	11 May \pm 8 (63) (27 Apr - 4 Jun)	11 Jun \pm 8 (30) (4 Jun - 2 Jul)

Table 4. Brandt's (BRCO), Pelagic Cormorant (PECO), California Gull (CAGU) and Western Gull (WEGU) reproductive performance on Alcatraz Island, 2009. Actual ranges may be wider due to re-lays and hard-to-see nests. Data refer to first attempts only.

		CLUTCH SIZE mean \pm s.d. (n)	BROOD SIZE mean \pm s.d. (n)	HATCHING SUCCESS mean \pm s.d. (n)	FLEDGING SUCCESS mean \pm s.d. (n)
Brandt's Cormorant	Southern Sub-Colony	did not breed	did not breed	did not breed	did not breed
	Barker Beach Sub-Colony	did not breed	did not breed	did not breed	did not breed
	Northern Sub-Colony	did not breed	did not breed	did not breed	did not breed
	Laundry Building Sub-Colony	did not breed	did not breed	did not breed	did not breed
	Model Industries Sub-Colony	did not breed	did not breed	did not breed	did not breed
	North Foghorn Sub-Colony	did not breed	did not breed	did not breed	did not breed
	ALL SUB-COLONIES	did not breed	did not breed	did not breed	did not breed
Pelagic Cormorant		did not breed	did not breed	did not breed	did not breed
California Gull		2.6 \pm 0.5 (13)	1.7 \pm 1.0 (9)	.7 \pm .4 (9)	.8 \pm .4 (6)
Western Gull	Cistern	2.5 \pm 0.8 (28)	1.4 \pm 1.2 (23)	0.7 \pm 0.4 (20)	0.7 \pm 0.4 (16)
	Parade Ground	2.9 \pm 0.4 (21)	1.8 \pm 1.3 (17)	0.6 \pm 0.5 (17)	0.7 \pm 0.3 (12)
	Model Industries	2.4 \pm 0.7 (24)	1.5 \pm 1.1 (23)	0.6 \pm 0.4 (22)	0.8 \pm 0.4 (17)
	ALL SITES	2.5 \pm 0.7 (73)	1.5 \pm 1.2 (63)	0.6 \pm 0.4 (59)	0.7 \pm 0.4 (45)

Table 5. Pigeon Guillemot reproductive phenology on Alcatraz Island, 2009. Adults are censused from April through August, and activity on the water and at nesting areas on the south cliffs is noted until no remaining guillemots are sighted. Crevices cannot be regularly monitored, as many are in cormorant colonies or out of reach. Presence of chicks is confirmed by delivery of fish to the nest site by the parent or by incidental sightings of chicks.

First adults seen rafting on water	First adults seen on cliffs/ at nest sites	First fish delivery seen	Last fish delivery seen
17 Mar	26 Mar	5 Jun	16 Jul

Table 6. Summary table showing frequency (and percentage) of types of disturbances to Brandt's Cormorants on Alcatraz Island, 1997-2008.

Type of Disturbance		Number of disturbances observed											
		1997 (206 hrs)	1998 (227 hrs)	1999 (313 hrs)	2000 (216 hrs)	2001 (251 hrs)	2002 ¹ (96 hrs)	2003 ² (224 hrs)	2004 ² (340 hrs)	2005 (334 hrs)	2006 (363 hrs)	2007 (308 hrs)	2008 (186 hrs)
External:	Marine traffic	38 (51%)	28 (30%)	98 (49%)	97 (48%)	79 (38%)	22 (33%)	92 (62%)	17 (40%)	17 (50%)	8 (30%)	35 (55%)	24 (62%)
	Air traffic	20 (27%)	18 (19%)	59 (29%)	61 (30%)	102 (49%)	23 (34%)	47 (32%)	14 (33%)	13 (38%)	7 (26%)	7 (11%)	4 (10%)
	Other	2 (3%)	4 (4%)	10 (5%)	24 (12%)	9 (4%)	0 (0%)	1 (1%)	4 (9%)	1 (3%)	1 (4%)	3 (5%)	0 (0%)
Island-Based:	Human interference	5 (7%)	5 (5%)	3 (1%)	1 (0%)	0 (0%)	13 (19%)	3 (2%)	5 (12%)	1 (3%)	9 (33%)	6 (9%)	7 (18%)
	Interspecies event	3 (4%)	23 (24%)	26 (13%)	12 (6%)	10 (5%)	7 (10%)	4 (3%)	1 (2%)	2 (6%)	1 (4%)	0 (0%)	3 (8%)
	Other	0 (0%)	1 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (4%)	0 (0%)	0 (0%)
Unknown Cause:		6 (8%)	15 (16%)	5 (2%)	8 (4%)	5 (2%)	2 (3%)	2 (1%)	2 (5%)	0 (0%)	0 (0%)	6 (9%)	1 (3%)
Total:		74	94	201	203	207	67	149	43	34	27	64	39
Frequency of disturbances ³		0.36	0.42	0.65	0.84	0.82	0.70	0.67	0.13	0.10	0.07	0.21	0.21

¹ The total hours observed was reduced in 2002 due to observer inconsistency.² In 2003-2008, includes extra disturbance monitoring on the North End of the island.³ This frequency represents the minimum number of disturbances per hour. Observers could not see the whole island at once, therefore the actual disturbance rate is likely to be higher.

Table 7. Summary of Alcatraz Presentations and Outreach in 2009.

Date	Audience/Outreach method	# People
January – March 2009	Bay Nature Magazine article, Kayaks and breeding birds at Alcatraz+	
Spring 2009	Alcatraz Wildlife Protection reminder in the South End Rowing Club's newsletter, The Southender	
March – April 2009	SEA Alcatraz Program Students, on-island tour	7 classrooms
April 2009	Updated online boat launch sites with PRBO website links and photo of the Alcatraz Protection flyer *	
April – July 2009	Alcatraz Protection Flyer distribution	16 clubs, rental shops, marine user groups and fishers contacted; 13 were receptive
July 8, 2009	Slideshow presentation of Wildlife Protection at Alcatraz Island given to the South End Rowing Club	10-15 board members
April – August 2009	Seabird monthly updates via email to PRBO & Alcatraz staff and volunteers, and updates included in SFAN Natural Resource and Science Monthly & GOGA weekly updates	
October – December 2009	Bay Nature Magazine article, No normal for coastal waters †	
Interviewed in May 2009; article expected online in November 2009	Alcatraz Seabird article online at the Women's International Perspective ±	

+<http://baynature.org/articles/jan-mar-2009/ear-to-the-ground/kayaks-and-breeding-birds-at-alcatraz>

*<http://gotoes.org/put-ins/>

† <http://baynature.org/articles/oct-dec-2009/ear-to-the-ground/no-normal-for-coastal-waters>

± www.thewip.net