Brandt's Cormorant Reproductive Efforts on Gualala Point Island, Sonoma County, and Fish Rocks, Mendocino County, California, 1996 to 2008

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INTRODUCTION

In the summer of 2007, The Sea Ranch Association California Coastal National Monument Stewardship Task Force (hereafter Task Force) initiated a seabird monitoring project in response to a 2006 Independence Day fireworks display near Gualala Point Island, an island within the California Coastal National Monument (CCNM). The Task Force is a primarily volunteer organization, in partnership with the Bureau of Land Management, the US Department of Interior agency that administers the California Coastal National Monument. Concern about potential impacts to nesting seabirds originated from observer reports of large numbers of birds on Gualala Point Island that flushed and flew into the darkness above the island on 2 July 2006 during the First Annual Gualala Festivals Committee Independence Day fireworks display. This monitoring project continued in 2008, and the Task Force intends to continue monitoring Gualala Point Island seabirds into the future.

To gain a broader perspective on the results of the 2007 and 2008 Gualala Point monitoring during the seabird nesting season, the Task Force wanted to assess seabird use on other CCNM islands along the Sonoma and Mendocino county coasts. CCNM monitoring included aerial photography of Gualala Point Island in northern Sonoma County and Fish Rocks in southern Mendocino County. The Task Force photography supplemented annual aerial photography completed by the United States Fish and Wildlife Service (USFWS) and University of California, Santa Cruz, in cooperation with the California Department of Fish and Game, for all of the offshore rocks and islands along the California Coast. These two sets of photographs and the resulting data are the basis for this report.

The purpose of this report is to document how both numbers of seabirds and habitat use by seabirds changes from year to year on Gualala Point Island and Fish Rocks. Brandt's Cormorant (*Phalacrocorax penicillatus*) is the principal species analyzed here.

Biology of the Brandt's Cormorant.

Brandt's Cormorant is a coastal species chiefly confined to nearshore upwelling areas of the California Current System. It breeds from extreme southeastern Alaska (a few pairs) south along the coasts of British Columbia, Washington, Oregon, California, and Baja California. Approximately seventy-five percent of the world population nests in central and northern California based on estimates in Wallace and Wallace (1998).

Brandt's Cormorant is a large dark waterbird with a slender neck, short tail, heavy hooked bill, and a blue gular pouch bordered behind by buff-colored feathering. Breeding adults have long, ephemeral white plumes trailing down their backs. The species is highly colonial, nesting on flat ground or gentle slopes. The species prefers northwesterly or northeasterly exposures (Farallon Islands, Ainley and Boekelheide 1990; Channel Islands, Hunt et al. 1979 in Ainley and Boekelheide 1990). They generally avoid the perpendicular cliffs used by Pelagic Cormorants (*P. pelagicus*). The nest is a mound composed of annual terrestrial vegetation, marine algae, and guano. The male gathers and piles nest material before pair formation, displaying to attract the females. Early-arriving males usually occupy sites centrally located in the colony, acting as a nucleus for colony growth (Boekelheide et al. 1990). Edge-nesting cormorants arrive significantly later (Feldman 1992). Returning males commonly fight or threaten to evict new occupants from their previous nest site; females occasionally fight to regain their previous nest sites (Boekelheide and Ainley 1989).

On the Farallon Islands, new colonies are occupied in years with favorable feeding conditions and many new breeders (Boekelheide et al. 1990). New colonies may develop where large numbers of males actively gather plants for nest material, stimulating some to display in the vicinity. Successful formation of just one pair in suitable habitat quickly results in formation of a colony. However, rate of abandonment and failure in new colonies is apparently higher than in established colonies, and some new colonies do not last long enough to produce chicks.

Brandt's Cormorants usually lay four (range 3-6) light blue/bluish-white eggs. One brood is raised per year (Ainley and Boekelheide 1990).

Both sexes incubate for about 29 days (Ainley and Boekelheide 1990). Nestlings are continually brooded during the first five to ten days of life until they are able to regulate their body temperatures. They begin to develop rapidly at about twenty days of age. Both adults regurgitate food for the young.

Fledging terminates the gradual process of decreasing dependence on parental provisioning, as chicks move from the immediate nest site, wander about the colony, take to the water and begin to forage on their own, and ultimately cease being fed by adults.

Brandt's Cormorants obtain food by surface dives in marine or estuarine waters. Most foraging is in the open ocean and varied marine fishes are captured. Examination of pellets recovered on the Farallon Islands during the five years 1973-1977 (Ainley and Boekelheide 1990) indicated that prey items were caught at or near flat, sandy or muddy seafloor. Adults were found to rely heavily on juvenile rockfishes, bothid and pleuronectid flatfishes, Pacific Tomcod, Plainfin Midshipman, and Spotted Cusk-Eel. Flatfishes comprised a great proportion of the Farallon birds' diet by weight. During years of near-normal water temperature, species diversity in the diet was low, owing to reliance on rockfishes. As numbers of juvenile rockfish were very low in 1976, a warm-water year, diet diversity spiked.

Brandt's Cormorant is the most abundant cormorant species along the outer California coast. Although locations of nesting colonies occur irregularly owing to constraints of substrate requirements, birds involved in nesting range miles from their colonies, such that the species is present along the entire length of the coastline in summer. The largest breeding aggregation is on the Farallon Islands, where 28,000 birds nested in 1979 (Ainley pers. comm. in Sowls et al. 1980). Sowls et al. noted that, during their late 1970s survey period, at least thirteen colonies in California contained more than 1000 birds. Brandt's Cormorants are among the California nesting seabirds which nest in large colonies rather than in loose, dispersed colonies or as discrete pairs.

Similar to some other seabirds given to nesting in large assemblages, Brandt's Cormorants shift their colonies from one site to another over the years (Hunt et al. 1979, Sowls et al. 1980). Several examples serve to illustrate this phenomenon. Two hundred birds nested on Casket Rock in Mendocino County in 1969. No nests were observed there in 1979, but 330 birds nested in 1980 (Sowls et al. 1980). Sowls et al. (1980) noted that similar fluctuations occurred at White Rock, '333 Point', and Arched Rock; they also stated that cormorants may have abandoned Prince I. (Del Norte Co.) in 1977 because of a heavy flea infestation. While Sowls et al. estimated only 200 Brandt's Cormorants in the Pinnacle Point survey segment (#007, Catalog of California Seabird Colonies, 1980) in the course of their 1979-1980 census effort, 1100 birds were counted from shore within that segment at Point Lobos in June 1981 (LeValley and Evens 1981). At well-watched Año Nuevo I., San Mateo County, Brandt's Cormorants bred for the first time in 1993, with 37 nests constructed (Yee et al. 1993).

These birds leave sites of breeding concentrations on the north coast and at the Farallon Islands in early winter, dispersing along the central and southern coast (Osborne 1972, DeSante and Ainley 1980). Band returns indicate that young birds disperse northward following the breeding season; most recoveries were from north of Cape

Mendocino, primarily in Humboldt Bay and along the Oregon coast (Ainley and Boekelheide 1990). Observers along the Oregon coast annually witness considerable northward flight within two miles of shore by flocks of Brandt's Cormorants. Such flocks often contain scores of cormorants, flying in unwavering formation. This evident northward movement is generally first noted in August and continues well into early fall. Some return flight is noted by observers later in the fall (D. Fix, pers. obs.). Brandt's Cormorants are much less numerous on the Humboldt and Del Norte County coasts in late fall and winter than during the warmer months (Harris 1996). A count of 130+ at Point St. George 3 December 1980 was exceptional; it is conceivable these birds may have been late-lingering fall migrants (LeValley and Evens 1981).

Sensitivity to human disturbance during the period of egging on the Farallon Is. from the 1850s to the 1890s impacted Brandt's Cormorant population size at that site. Fewer than 5000 birds nested there in the early twentieth century (Ainley and Lewis 1974, in Ainley and Boekelheide 1990), but the population had increased to 18,000-20,000 birds by 1959, to 22,000 by 1972, and to 28,000 at the time of publication of Catalog of California Seabird Colonies (Sowls et al. 1980). Point Reyes Bird Observatory data indicate a peak of around 24,000 in 1974 when a long term decline manifested through the late 1970's, 1980's and early 1990's bottoming around 3,000 birds in 1993. The strong 1982-83 El Niño event was a low point in the breeding numbers on the Farallones. Since 1993 there has been a gradual increase in numbers breeding on the Farallones, reaching 20,788 by 2007 (Figure 1, Warzybok and Bradley 2007).

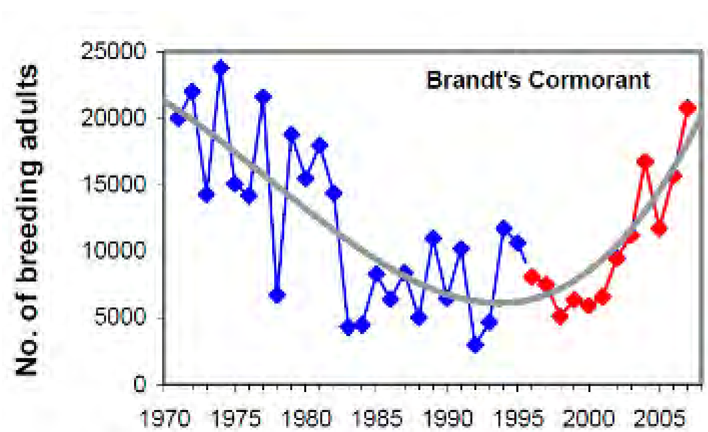

Figure 1. Brandt's Cormorant Numbers from the Farallon Islands (Warzybock and Bradley, 2007). Red lines correspond to the time period of this analysis.

Reproduction in Brandt's Cormorant is reduced and mortality rises during warm-water years, in which cold upwelling is curtailed (Ainley and Boekelheide 1990). This was especially true in 1983, a dramatic El Nino/Southern Oscillation year in the North Pacific (Stenzel et al. 1988, in Ainley and Boekelheide 1990). A resulting crash in fish populations caused widespread nest abandonment, and only ten chicks fledged on the Farallon Islands where typically, 7500-10,000 young are fledged (LeValley and Evens 1983, Boekelheide et al. 1990). Similarly, the ENSO event of 1998 "crushed the breeding of marine cormorants" in Monterey Co., where Brandt's Cormorants completely failed at Point Lobos and only 8+ nestlings survived at Bird Rock off Pebble Beach by 28 June. These two colonies combined for 4677 nesting pairs in the 1989 colony survey conducted by the USFWS (Roberson et al. 1998).

As it is closely tied to nearshore ocean and estuarine waters, Brandt's Cormorant is susceptible to oil pollution. This threat is greatest in the vicinity of breeding colonies, where large numbers of birds assemble for extended periods. This species may be the most vulnerable of all cormorants to localized oil spills because of its tendency to concentrate both at nest colonies and while foraging. Reported deaths from oil spills are infrequent, however, and this species made up only one percent of the recovered birds in the 1971 San Francisco oil spill (Smail et al. 1972 in Sowls et al. 1980). Low recovery may reflect a greater tendency to sink than in other seabird species (Harris pers. comm. to Sowls et al. 1980).

Brandt's Cormorants are vulnerable to disturbance during the breeding season. Adults flush from nests readily when approached by boats, low-flying aircraft, or humans on foot. Temporary desertion allows Western Gulls to prey upon eggs and helpless nestlings (Sowls et al. 1980). During these disturbance events, cormorants may break their own eggs when flushing from the nest (Osborne 1972). Repeated disturbance can cause permanent desertion of a colony (Sowls et al. 1980).

Given Brandt's Cormorants abundance, large size, visible breeding colonies and its importance in the California Current Ecosystem, it is useful indicator species for monitoring and assessing changes in our ocean system (Jones et al. 2008).

Materials and Methods

Two sets of aerial photographs were used for this analysis. In 1996-2007, USFWS, in cooperation with Humboldt State University and the California Department of Fish and Game, photographed Gualala Point Island and Fish Rocks during annual aerial photographic surveys of Common Murre, Brandt's Cormorant, and Double-crested Cormorant colonies in northern and central California. Surveys in 1996-2007 were funded by the *Apex Houston* Trustee Council (McChesney et al. 2007). In 2008, surveys were conducted by University of California, Santa Cruz, in cooperation with USFWS, with funding from California Department of Fish and Game-Office of Spill Prevention and Response (Capitolo et al. 2010). Members of the Task Force visited the San Francisco Bay National Wildlife Refuge Complex headquarters in Newark, California, and scanned archived slides from 1996-2006 surveys for both Gualala Point Island and Fish Rocks. Beginning in 2007, digital photography was used.

Subsequently, a volunteer pilot and a volunteer professional photographer flew additional surveys of Gualala Point Island on 4 June, 5, 7, and 12 July, and 30 August 2007 and then again on 9 June, 2, 5, 9, and 18 July, 1 and 17 August and 5 September 2008, using a protocol comparable to that used by the USFWS. These flights were conducted above 300 m (1000 ft) altitude in a fixed-wing Cessna 172-M aircraft, and digital photographs were taken through an open side window with unobstructed view as requested by the USFWS. Surveys were flown high enough to alleviate disturbance to seabirds from this type of fixed-wing aircraft. Photographs were taken of the entire island, with a focus on the Brandt's Cormorant colony.

Photographs were imported into Adobe Lightroom and scanned for quality and coverage of the nesting colonies. From each aerial survey date, the photographs with the highest quality and most complete coverage of the cormorant colony were the primary photo source used, augmented by additional photos stitched together as needed for complete coverage of all Brandt's Cormorant nests. A new photo layer was created in Adobe Photoshop, and small colored spots were placed on the new layer next to each active nest. An active nest was defined as a visible nest (e.g., nest material present) with an adult. It was sometimes difficult from the quality of photos to count adults on the nest; therefore, numbers of birds were not counted. Individual or pairs of adults at a territory, but with no nest, were also not counted because many individuals will set up territories for a day or two, but progress no further (personal observations and data from the Task Force multiple flights during the season).

Each photo was then reviewed to make sure no nests were missed, and the colored spots were counted. Digital photos with the colored spots are archived at the Refuge Complex headquarters.

Results

Results are presented in Table 1 and Table 2. The annual surveys from 1996 to 2008 are from the USFWS and usually occurred in the last few days of May or the first few days of June. Other more frequent surveys for 2007 and 2008 come from flights undertaken by the Task Force.

Fish Rocks		Gualala Point	
1996	121	1996	95
1997	136	1997	105
1998	30	1998	22
1999	60	1999	62
2000	83	2000	74
2001	109	2001	107
2002	169	2002	141
2003	181	2003	130
2004	233	2004	130
2005	44	2005	20
2006	159	2006	91
2007	262	2007	73
2008	147	2008	78

Table 1. Number of active Brandt's Cormorant (BRCO) nests counted from aerial photographs.

Annual Survey Results

During the period of this study, Brandt's Cormorant nests overall gradually increased from 1998 to 2007. Numbers of active nests at Gualala Point Island and Fish Rocks tracked each other very well (Figure 2). Both 1998 and 2005 were widely documented failures in seabird nesting success in northern California. The El Niño/Southern Oscillation in 1998 reduced reproduction for various seabird species in the California Current system. In 2005, although not an El Niño year, the upwelling system failed and led to reduced availability of krill, an important food source for seabirds or their prey (Jahncke et al., 2008).Cormorant numbers reported in this study also tracked well with seabird numbers on the Farallon Islands (Figures 1 and 3) from 1997 to 2007 and with the number of nests on three other central California colonies at Point Reyes, Devil's Slide and the Castle/Hurricane Rocks complex for the years 1997-2001 (Figure 4, Capitolo et al, 2004). This synchrony suggests that cormorants in the central California system were responding similarly to ocean conditions.

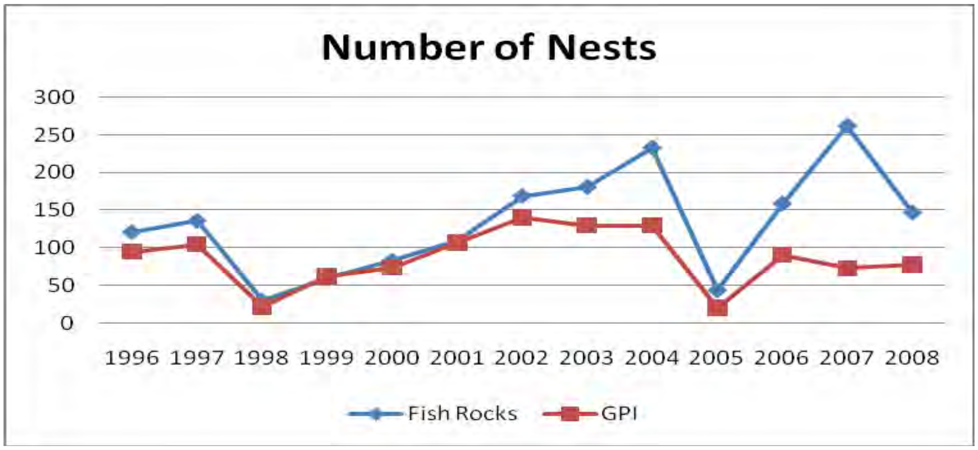

Figure 2. Number of Brandt's Cormorant nests on Fish Rocks and Gualala Point Island counted in late May/early June annual aerial surveys 1996 – 2008.

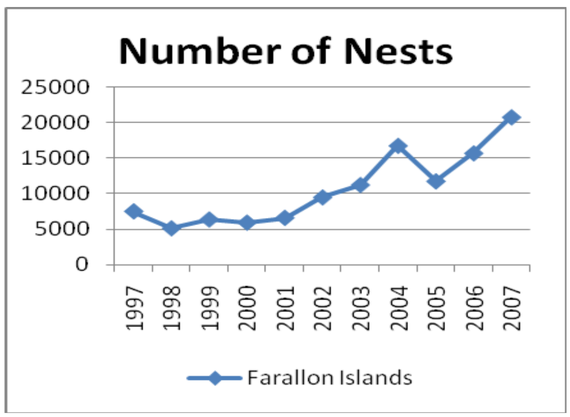

Figure 3. Number of breeding Brandt's Cormorant adults on the Farallon Islands. Breeding Season counts from PRBO Conservation Science (Warzybok and Bradley, 2007).

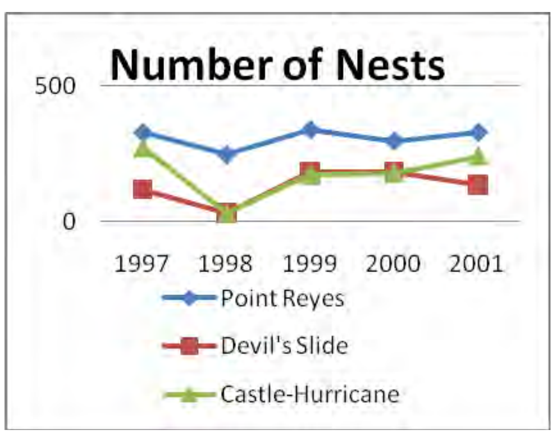

Figure 4. Number of Brandt's Cormorant nests on three nesting colonies in Central California 1997-2001 (from Capitolo et al. 2004).

Annual Variability

Gualala Point Island has received attention because of the 2006 and 2007 fireworks events and because of a marked decrease in numbers nesting on the island since surveys conducted in 1979-80 and in 1989. Breeding cormorant numbers have declined from an estimated 620 nests in 1980 (Sowls et al., 1980) to 237 in 1989 (Carter et al., 1992) to an average of around 100 during the period of the current study. Numbers at Fish Rocks during these earlier surveys were 15 in 1979 and 9 in 1980 (Sowls et al., 1980) and 96 in 1989 (Carter et al., 1992). Present numbers have averaged just over 130 during the period of this study. The reasons for the decline on Gualala Point Island are not clear, but increased human disturbance may have played a role. The long-term monitoring program implemented by the Task Force looks at potential causes for population changes at this site. These data indicate that since 1996 the annual numbers of breeding cormorants at various sites in central and northern California track each other quite well, so deviations unique to a single colony may potentially be significant.

Breeding Season Surveys 2007 – 2008

The second set of aerial photographs conducted by the Task Force during the nesting seasons of 2007 and 2008 are reported in Table 2 and Figure 5. Unfortunately, photographs from only three dates in 2007 cover the Fish Rock nesting colony adequately; therefore, strong comparisons cannot be made between the two island colonies at this time.

Fish Rocks			Gualala Point	
2007	**BRCO**	**COMU**		**BRCO**
5/30/2007	262		5/30/2007	73
6/4/2007	174		6/4/2007	85
7/5/2007	176		7/5/2007	79
7/7/2007			7/7/2007	70
7/12/2007	152	25	7/12/2007	75
8/30/2007	0	0	8/30/2007	0
2008				
6/1/2008			6/1/2008	
6/2/2008			6/2/2008	78
6/9/2008	147	32	6/9/2008	72
7/2/2008	258	91	7/2/2008	122
7/5/2008	261	93	7/5/2008	126
7/9/2008	235	45	7/9/2008	121
7/18/2008	221	93	7/18/2008	113
8/1/2008	218	30	8/1/2008	77
8/17/2008	Chicks very mobile, nests not easily detected		8/17/2008	77
9/5/2008	Most chicks gone, all nests empty.		9/5/2008	0

Table 2. Number of Brandt's Cormorant (BRCO) nests and individual Common Murres (COMU) counted during repeated surveys 2007 and 2008. Incomplete counts are highlighted in yellow.

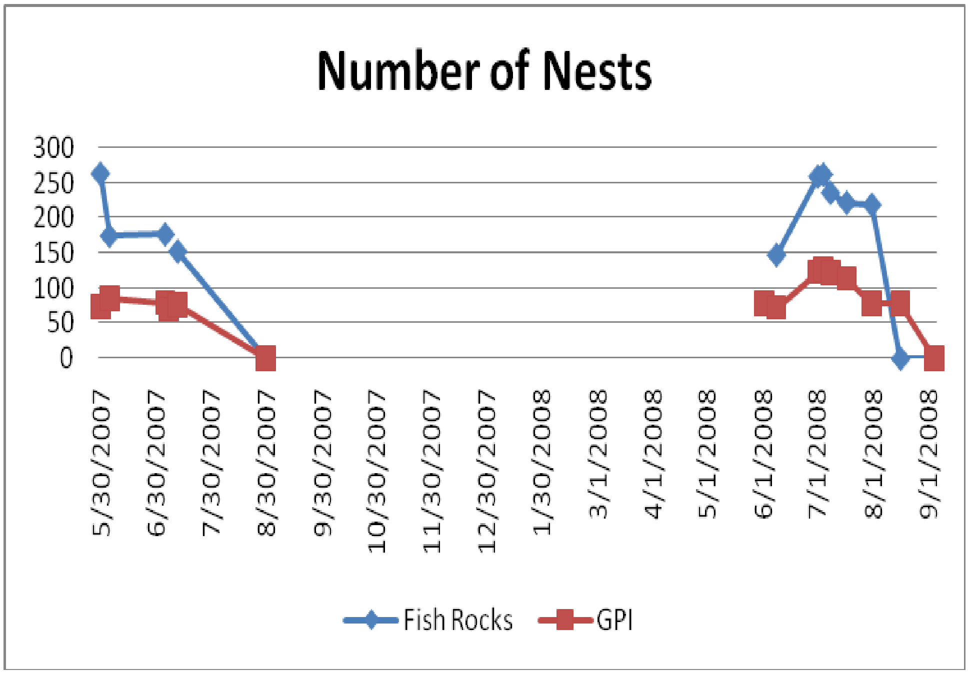

Figure 5. Number of Brandt's Cormorant nests during 2007 and 2008 at Fish Rocks and Gualala Point Island.

Discussion

The number of cormorant nests on Gualala Point Island in 2007 was less than the number in 2006, differing from the trend at Fish Rocks and on the Farallon Islands. This difference appears significant as the other colonies increased in size while the Gualala Point Island colony actually decreased (Table 1, Figure 2). While the decline cannot be attributed to the fireworks event in 2007, as the annual nest counts are taken from surveys done before the July 4 event, it is possible that disturbance from the 2006 fireworks event discouraged birds from returning to nest on Gualala Point Island in 2007.

Another interesting aspect of the colonies at Gualala Point and especially at Fish Rocks is the variation in location of nests from year to year (Appendix 1 -- Figures 6 – 31). As noted in the introduction, Brandt's Cormorants establish and abandon small colonies over a period of years. Also, males begin displaying to attract females, with older more experienced males beginning the process and eventually being the core of a breeding concentration (Wallace and Wallace, 1998). It is interesting to note the distribution of the Fish Rock breeding area and its obvious changes from year to year (Figures 19-31). This suggests that a few individual males choose the central part of a nesting site, and others subsequently congregate around the core males, but that the initiation site varies from year to year. Whether the same males each year choose different micro sites on the island, or different males initiate nesting core sites each year is unknown.

This situation was first noted by Jones et al., (2008) during their monitoring of the cormorants on the three islands in central California and has important implications for colony monitoring, especially for colonies such as Gualala Point Island that are monitored from shore. Viewing a seabird breeding island from shore is problematic if the colony location changes and the shoreline viewing point allows a restricted view of the whole island. Monitoring from shore can still be a very valuable tool, especially in characterizing the timing of different stages of the breeding cycle. At sites where the entire colony cannot be seen from shore, aerial surveys add considerably to the understanding of colony-wide reproductive effort.

Breeding Season 2007-2008

The repeated surveys by the Task Force on Gualala Point Island during the breeding season of 2007 and 2008 have been reported previously (Weigand and McChesney, 2008; LeValley 2009). The more frequent survey data from the Task Force efforts aid in understanding the status of these small islands to Brandt's Cormorant nesting efforts in California. The timing of breeding activity on the two islands is quite similar, so deviations in the reproductive efforts between the two islands could lead to a greater understanding of the factors contributing to breeding success or failure.

The breeding season flights for 2007 on Fish Rocks were limited to only four surveys. Thus, conclusions from a year-to-year comparison are not possible. As many as 262 nests were counted from the 30 May USFWS survey. The first Task Force survey on 4 June unfortunately had incomplete coverage of the island, but at least 174 nests were still active. On 5 July, again with incomplete coverage, at least 184 nests were active. The 7 July survey did not cover the colony, and the 12 July survey had a minimum of 152 nests active. The number of active nests was similar in pattern to those documented at Gualala Point Island, but the lack of complete surveys and the lack of comparative surveys before and after the 4 July fireworks event hamper between-colony comparisons for that event.

In 2008, a heat wave in mid-May caused widespread abandonment of Brandt's Cormorant nests and presumably delayed nest initiation at Gualala Point Island (LeValley 2009). The heat wave apparently affected birds on Fish Rocks as well. On the 9 June aerial survey, only 145 nests were active, but by the 2 July survey 258 nests were active, indicating a late start for numerous pairs. This sequence is consistent with what occurred on Gualala Point Island and suggests that pairs either aborted attempts during the heat wave and then renested later in the summer, or just got a late start. Late clutch initiation dates in June are rare for Brandt's Cormorants, but this apparently was the case on Gualala Point Island and Fish Rocks (this study) and on the Farallon Islands (pers. observation) during 2008. The aerial survey for Fish Rocks on 17 August indicated many potential chicks present on the island, but they were not associated with nests and in the photographs could not be distinguished from the adults. So many cormorants still on the island as late as 17 August indicate a very late nesting season. Colony attendance patterns on the Farallon Island from the 11 years 1973-1983 indicated only two years where cormorants were still present in the colony on 15 August (Boekelheide et al 1990).

Common Murre

At the Fish Rocks colony, numerous Common Murres were present during the nesting season with peaks of 25 in mid-July 2007 and over 90 in July 2008. The resolution of the photographs was not sufficient to determine absolutely the presence of chicks, but it appeared that nesting was taking place and potential chicks were noted. Previous nesting was not reported for this species on any coastal rocks in Mendocino or Sonoma County during the period 1979 – 1995 (Carter et al. 2001).

Recommendations

Monitoring of smaller Brandt's Cormorant colonies can produce valuable information on a variety of important issues. Brandt's Cormorants are excellent indicators of the presence and abundance of forage fish such as juvenile rockfish and anchovies. These data can also help to assess the impact of various disturbance events such as the fireworks displays. They can also be useful for documenting the occurrence and impacts of other disturbance events such as low-flying aircraft or humans on the islands. Population numbers would be extremely valuable in the case of a large-scale disaster such as an oil spill. Regular and comparative surveys on the two islands would allow for assessment of site-specific events versus events that impact Brandt's Cormorants on a broader scale.

Acknowledgments

The Sea Ranch CCNM Stewardship Task Force was the energy behind starting this project. Aerial Photographs were obtained from the USFWS courtesy of Gerry McChesney. In 1996-2007, annual aerial surveys in late May/early June were conducted by USFWS and Humboldt State University; in 2008, this survey was conducted by University of California, Santa Cruz, in cooperation with USFWS. Key personnel for 1996-2008 aerial surveys were Harry Carter, Mike Parker, Phil Capitolo, and Gerry McChesney. All surveys were flown by pilots from the California Department of Fish and Game, Air Services, Sacramento.

Richard Kuehn and Bryant Hichwa scanned the original slides provided USFWS. Jerry Rench (pilot) and Craig Tooley (photography) performed the Task Force aerial monitoring in 2007-2008. In addition, this study could not have happened without the assistance of BLM ecologist James Weigand. This report benefitted from the thoughtful and thorough reviews by Diane Hichwa and James Weigand. Thanks also goes to Mendocino Coast Audubon of Mendocino County, Madrone Audubon Society of Sonoma County, and the Bureau of Land Management for funding the analysis of data and the report.

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Appendix 1.

Distribution of Nest Sites -- Gualala Point Island

Figure 6. Gualala Point Island 1996 Distribution of Nest Sites

Figure 7. Gualala Point Island 1997 Distribution of Nest Sites

Figure 8. Gualala Point Island 1998 Distribution of Nest Sites

Figure 9. Gualala Point Island 1999 Distribution of Nest Sites

Figure 10. Gualala Point Island 2000 Distribution of Nest Sites

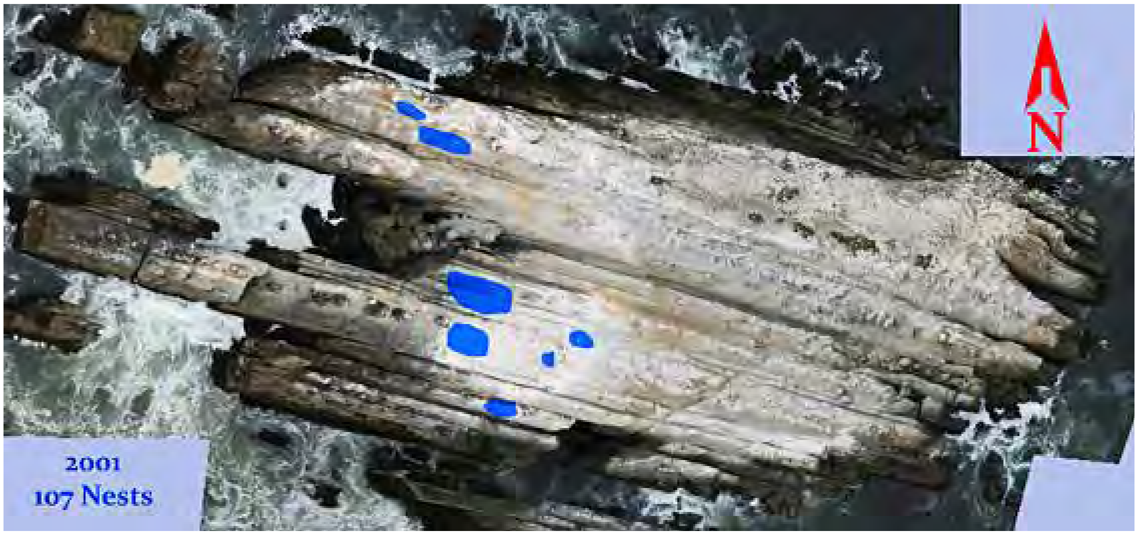

Figure 11. Gualala Point Island 2001 Distribution of Nest Sites

Figure 12. Gualala Point Island 2002 Distribution of Nest Sites

Figure 13. Gualala Point Island 2003 Distribution of Nest Sites

Figure 14. Gualala Point Island 2004 Distribution of Nest Sites

Figure 15 Gualala Point Island 2005 Distribution of Nest Sites

Figure 16. Gualala Point Island 2006 Distribution of Nest Sites

Figure 17. Gualala Point Island 2007 Distribution of Nest Sites

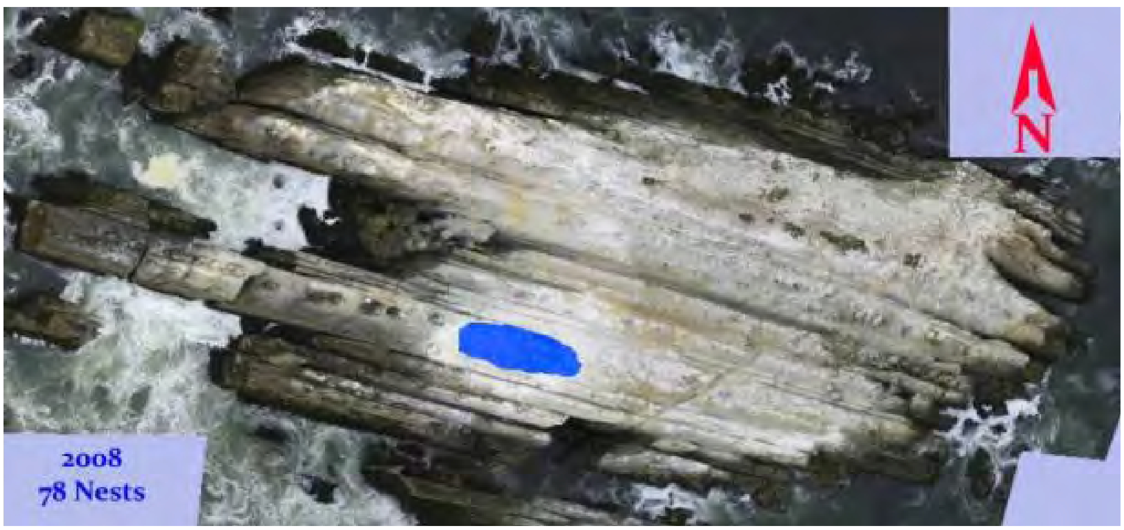

Figure 18. Gualala Point Island 2008 Distribution of Nest Sites

Distribution of Nest Sites -- Fish Rocks

Figure 19. Fish Rocks 1996 Distribution of Nest Sites

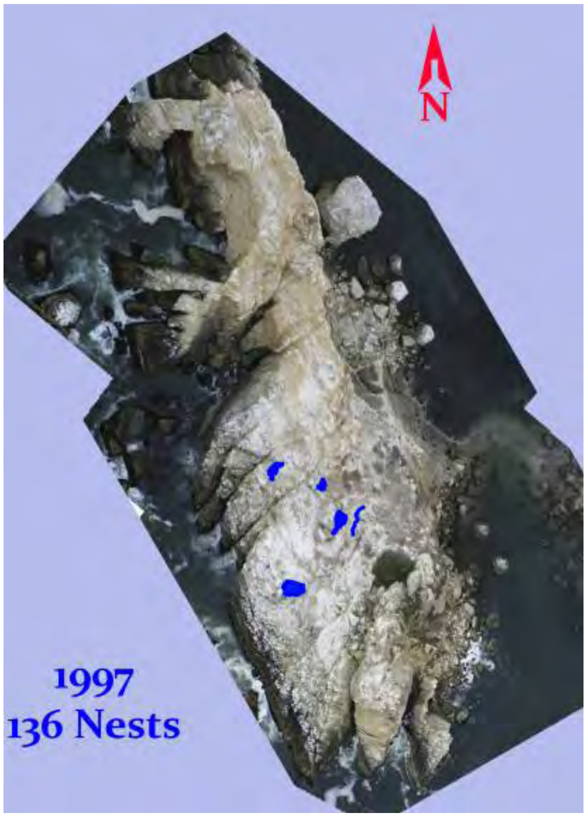

Figure 20. Fish Rocks 1997 Distribution of Nest Sites

Figure 21. Fish Rocks 1998 Distribution of Nest Sites

Figure 22. Fish Rocks 1999 Distribution of Nest Sites

Figure 23. Fish Rocks 2000 Distribution of Nest Sites

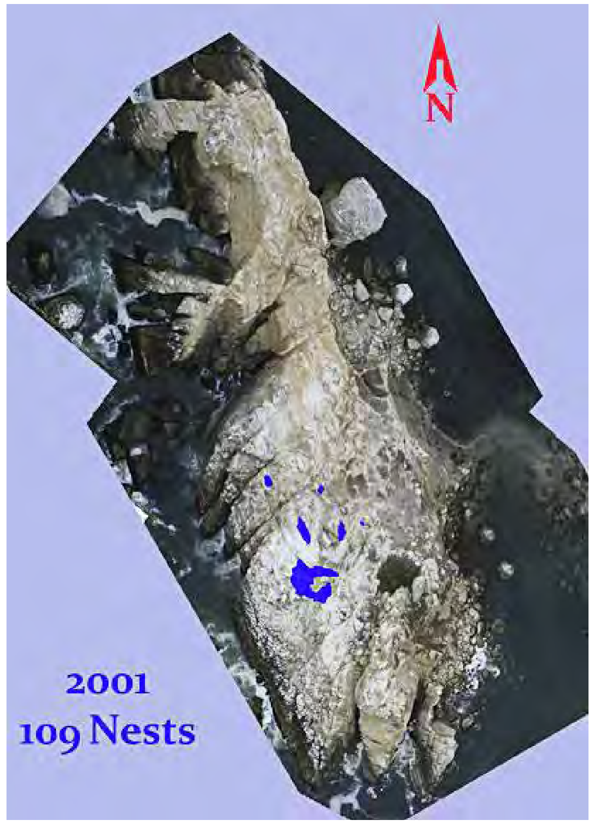

Figure 24. Fish Rocks 2001 Distribution of Nest Sites

Figure 25. Fish Rocks 2002 Distribution of Nest Sites

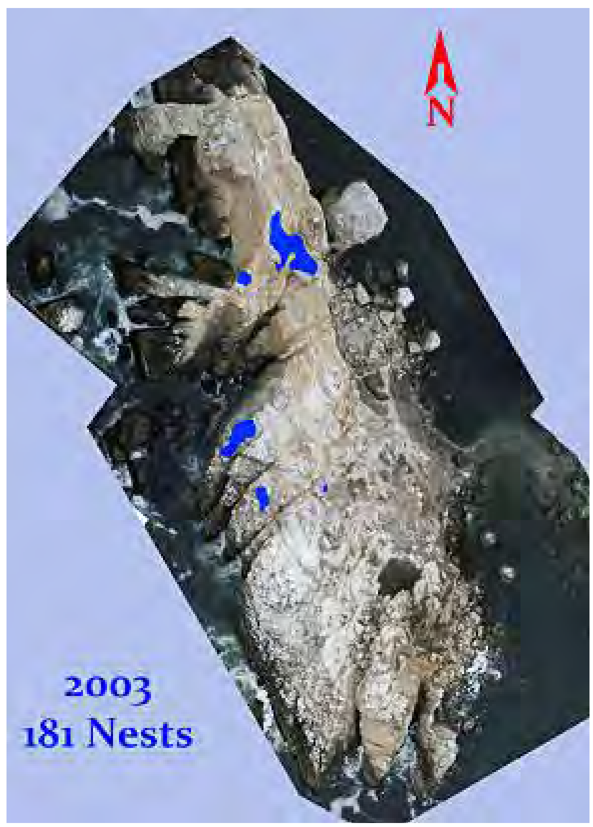

Figure 26. Fish Rocks 2003 Distribution of Nest Sites

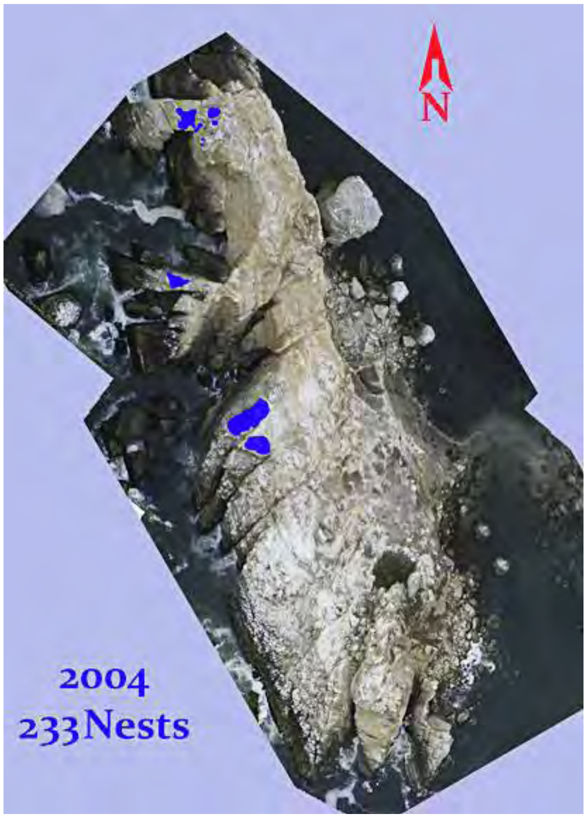

Figure 27. Fish Rocks 2004 Distribution of Nest Sites

Figure 28. Fish Rocks 2005 Distribution of Nest Sites

Figure 29. Fish Rocks 2006 Distribution of Nest Sites

Figure 30. Fish Rocks 2007 Distribution of Nest Sites

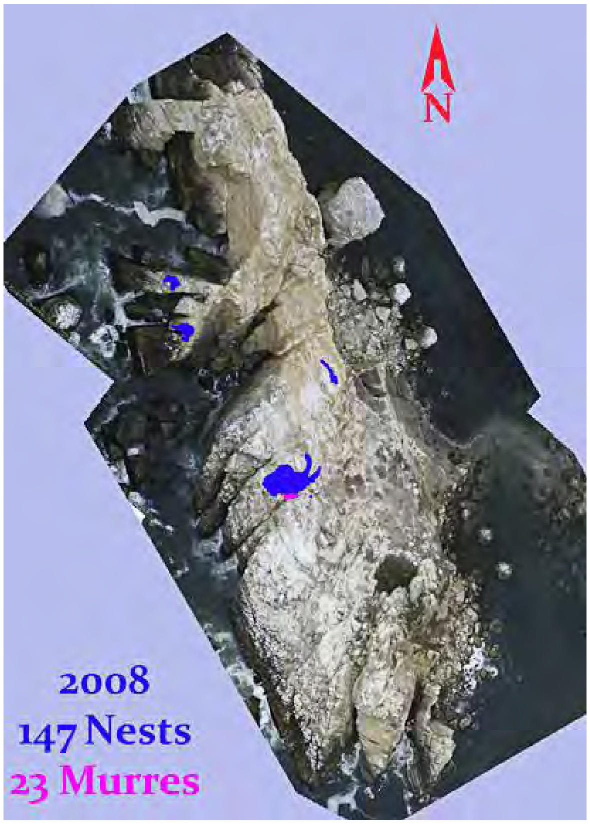

Figure 31. Fish Rocks 2008 Distribution of Nest Sites

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