

**MONITORING OF BIRD ISLAND**  
**ELLWOOD, SANTA BARBARA COUNTY, CALIFORNIA**  
**2005 – 2010**  
**FINAL REPORT**

Prepared for  
the Santa Barbara Audubon Society

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2 March 2011

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<sup>1</sup> This report is based heavily on the structure and content of the 2008 Annual Report for Bird Island, which was prepared by Dave Compton. The majority of the Summary, Introduction and Appendices were taken with Dave's permission from that report verbatim.

## **SUMMARY CONCLUSION – FIVE YEARS OF MONITORING**

The patterns suggested after the first couple years of monitoring of the new Bird Island structures appear to have held strong through all five years of post-construction surveys. Though the pre-construction (baseline) data taken from the old Bird Island pier only span 4 months of time, many of the important indices measured and compared during post-construction years have proven to be significantly different.

Brandt's Cormorants are attracted to the new structures in great numbers, notably during the nesting season, while California Brown Pelicans continue to be less of a presence than they were on the old structure. Other species such as Western and Heerman's Gulls, Rock Pigeons, and European Starlings are also using the new structures far less frequently than they did in 2005. The use of surrounding waters by all birds (including pelicans and cormorants) has not changed significantly following the construction of the new platforms.

The design focus for the new structures was to provide ample space for cormorant nests; this goal has been achieved at the expense of roosting areas for pelicans and other birds during the cormorant nesting season.

## **SUMMARY FOR 2010**

Bird Island monitoring in 2010 continued the process initiated in 2005. The old Bird Island was the remnant of a pier several hundred meters off Ellwood, Santa Barbara County, California, and home to nesting Brandt's Cormorants, roosting California Brown Pelicans (federally listed as endangered until 2009), and several other bird species. The remains of the old pier were removed in the fall of 2005 and replaced with four new structures designed to accommodate the nesting and roosting birds.

Within the text of this report, "cormorant(s)" and "pelican(s)" will refer, respectively, to Brandt's Cormorant and California Brown Pelican, unless otherwise specified.

During January to mid-February 2010, hour-long observational surveys were conducted twice a week to monitor bird activity on the new structures. On 16 February, the breeding season protocol was initiated for the 2010 season. Surveys were conducted every third day under this protocol, through 14 September (with a few exceptions – see Appendix A). Surveys were again conducted under the non-breeding season protocol from 17 September until the end of the year.

As in previous years, Brandt's Cormorants were easily the dominant species on the structures. As five years of data have now been compiled on this breeding population of cormorants, the timing of nesting events that looked to be significant in one year or another have generally blended together to create a range. The cormorants appeared to get an 'early start' to breeding (peak number of active/incubating nests) in 2010 in comparison to 2005-2008, but their timing was consistent with 2009, and so perhaps should not be considered 'early.' In addition, the last active nest in 2010 was observed during the same week as in 2008 – over a month later than any other study year; however,

if the three 2010 late re-nesting attempts are removed from the data set, nesting was completed within a week of the same event in 2005 and 2009, and a few weeks earlier than in 2006 and 2007. Also, the number of cormorant nests counted in 2010 was on par with 2008 numbers, 7% higher than 2009 numbers, approximately 1.5 times higher than 2006 and 2007 numbers, and more than 3 times higher than 2005 numbers. This measure does seem to show a clear increasing trend over a few years from 2005, but fluctuation between 2008 and 2010 seems less significant than the dramatic growth in nest numbers from 2005 to 2008.

While Brandt's Cormorant numbers and breeding activity continued to be high compared to preconstruction days, numbers of roosting Brown Pelicans remained low during the breeding season compared to those recorded on the old Bird Island. During the height of the cormorant breeding season, the cormorants crowded out the pelicans and other roosting species almost completely. Only one Brown Pelican was observed on the structures between 23 April and 19 July. The per-survey average for two species of gulls commonly using the structures, the Western (*Larus occidentalis*) and Heermann's Gulls (*Larus heermanni*), also remained low compared to numbers recorded on the old Bird Island. Two exotic terrestrial species regularly recorded using the old structure, the European Starling and Rock Pigeon, were recorded in very low numbers during the 2010 breeding season compared to those recorded on the old Bird Island. The new structures provide ample open, flat areas, but fewer of the small and narrow perching areas that the old structure provided. As a result, the new structures appear to be particularly well suited to cormorant nesting and less inviting for other species that seem to be crowded out by the cormorants.

## INTRODUCTION

The old Bird Island was the remnant of an old pier and oil well service structure about 260 meters off Ellwood, Santa Barbara County, California (Padre Associates 2004), that supported many roosting birds, including the California Brown Pelican (*Pelecanus occidentalis californicus*) and nesting Brandt's Cormorants (*Phalacrocorax penicillatus*).

The Brown Pelican is a subspecies that has been federally listed as endangered since 1970 (USFWS 2009) and listed in California as endangered since 1971 (CDFG 2009). During the summer and autumn of 2009 respectively, California Department of Fish and Game and the U.S. Department of Interior voted unanimously to delist the California Brown Pelican due to the populations' recovery (CDFG 2010 and USFWS 2010). The population of the subspecies found in southern California, which includes nesting islands in Mexico, is now estimated at more than 11,000 breeding pairs (USFWS 2010). Though the subspecies is no longer considered endangered, it will remain under close observation by conservation biologists nationwide due to continued threats to its breeding habitats. For this reason, this study continues to track the use of Bird Island structures by Brown Pelicans.

The Brandt's Cormorant, although an abundant breeder on the Channel Islands, was not known to breed anywhere else along the mainland coast between Pt. Conception and La Jolla, San Diego County as of the year 2000 (McChesney et al. 2000). However, a new

small breeding location was discovered at Point Hueneme Harbor in Ventura County on 14 May 2007. Eight nests were discovered and photographed on that date, and breeding has taken place at this location each year since its discovery (Capitolo, Davis, Henkel, Tyler, and Carter, 2008).

Cormorants used the old Bird Island for nesting and raising young from late winter until late summer. The remainder of the year, this species, like the Brown Pelican, used the site for roosting. Though the cormorant is not a listed species, this study tracks its use of the Bird Island structure due to its relative importance as a regional breeding site.

The old Bird Island pier was removed in the fall of 2005 and replaced with four new structures (in close proximity to each other) designed to accommodate the roosting and breeding birds. The Santa Barbara Audubon Society began overseeing the monitoring of the old Bird Island during the Spring of 2005 to gather baseline data on bird use of the structures. Baseline data for the old Bird Island were collected for 4 months (spanning the latter portion of the breeding season, and a small portion of the non-breeding season to follow) from 19 May to 19 September 2005. In late September of 2005, the monitoring of the new Bird Island began; post-construction surveys continued through the end of 2010. In 2010, the final year of the project, surveys were conducted under the non-breeding season protocol from 4 January to 13 February, and breeding season surveys were conducted from 16 February through 14 September. Non-breeding season surveys were resumed on 17 September and continued through the end of the year (31 December). For the last five years of surveys (2006–2010), we have charted the use of the structures and used data from this phase (recorded in successive annual reports) to make comparisons with the preconstruction data to measure the success of the project. This document (summarizing the 2010 year) will serve as the final report for this project.

The old structure was very irregularly shaped, with seven large concrete pilings supporting the remains of a metal framework on the northern half and an open, flat area on the southern half. Each of the four new structures consists of a large column supporting three more or less triangular platforms projecting out from the column in different directions and at slightly different heights. Below these three platforms is a circular ledge extending around the column. The structures are arranged in a line extending approximately from east to west, in more or less the same area as the old pier.

Monitoring was conducted under the breeding season protocol from 16 February through 14 September (Table 1). During the cormorant breeding season, we recorded observations relating to the breeding cycle of the cormorants and, every 20 minutes, counted all birds on the structures and in the water in the immediate vicinity of the structures, within approximately 300 meters. (For more detail on the breeding season and non-breeding season protocols, see Appendix B: “Protocol for Monitoring Bird Island.”)

	<i>Initial Survey</i>	<i>Final Survey</i>	<i>Total Surveys</i>
Non-breeding season protocol (prebreeding)	4 January	13 February	13
Breeding season protocol	16 February	14 September	64
Non-breeding season protocol (post-breeding)	17 September	31 December	30

Prior to the breeding season (through 13 February), we conducted two surveys per week, and we again cut the frequency of surveys to this level (about eight per month) beginning on 17 September 2010. Under the non-breeding season protocol, we recorded numbers every ten minutes (six times per hour-long survey) for all species on the structures and for all species resting on the surrounding waters within about 300 meters. Peter Gaede conducted the majority of surveys, in addition to coordinating additional surveyors. Jared Dawson and Laura Wilson both conducted many surveys during the second half of the year, beginning late in the breeding season.

#### IMPORTANT SPECIES USING BIRD ISLAND

The brief accounts below relate natural history information about Brandt’s Cormorant and the California Brown Pelican that is relevant to each species’ status at Bird Island—as a breeder in the case of the cormorant, and as a roosting species in the case of the pelican.

*Brandt’s Cormorant:* This species nests in colonies, mostly on rocky islets and cliffs. The cormorants generally choose flat areas or ledges to place their “large and untidy” nests (Wallace and Wallace 1998). Males gather most of the nesting material, before and after pairing. In a study at the Farallon Islands, the incubation period ranged from 28 to 32 days (Boekelheide et al. 1990). In cases of nest failure, replacement clutches are laid, but pairs are not known to raise multiple broods in a season. After hatching, nestlings are brooded continually for up to 10 days. Adults may leave young unattended as early as 20 days. At this time young, still unable to fly, may leave the nest in the parents’ absence and form tightly gathered groups known as “creches” with young from other, nearby nests. It is not known at what age young are independent from their parents (Wallace and Wallace 1998).

*California Brown Pelican:* The Brown Pelican was listed as endangered by the U.S. Fish and Wildlife Service in 1970 and delisted in December 2009 due to a “dramatic and sustained recovery in numbers” (USFWS 2010). The California Department of Fish and Game further protected the California subspecies by listing it as endangered in 1971, though California also delisted the bird in 2009 (CDFG 2010). The California Brown Pelican breeds in the Gulf of California (in northern Mexico) and the California Bight north to the Channel Islands. The established breeding colony nearest to Bird Island is on Anacapa Island (approximately 45 miles southwest of Bird Island); the only other established colony north of Mexico is on Santa Barbara Island. Also, an aerial survey on 16 May 2006 reported 43 nests on Prince Island, a major seabird breeding site off San Miguel Island (and approximately 45 miles from Bird Island); this was the first recorded nesting in this area since 1939 (CDFG and UCSC 2006). In addition to nesting habitat,

the California Brown Pelican requires “offshore habitat with an adequate food supply” and “appropriate roosting sites for both resident and migratory” individuals. For both breeding and non-breeding pelicans, “offshore rocks and islands, river mouths with sand bars, and many breakwaters, pilings and jetties along the U.S. and Mexican west coasts are important . . . as roosting sites” (Gress and Anderson 1983). At the nesting sites, pelicans in the Bight of California may lay eggs as early as December, with peak egg-laying occurring from February to May (Gress and Anderson 1983), meaning that peak breeding activity extends more or less through August. For nesting birds, roosting sites such as Bird Island, which are far from breeding sites, may be less critical during this time than they are during the non-breeding season, since pelicans are unlikely to fly far from their nesting sites during breeding season. However, non-breeding birds still require roosting sites during the breeding season.

## **RESULTS: 2010 BREEDING SEASON**

### **BRANDT’S CORMORANT**

Measured in terms of active nests, peak nesting activity for Brandt’s Cormorants in 2010 came on 23 April, when 114 active nests were at different stages on the structures<sup>2</sup>. On 9 May, 101 active nests could still be seen. Thereafter, the number of active nests dropped steadily: 94 nests were visible on 20 May; 31 on 6 June; 18 on 20 June; and 4 on 10 July. With the exception of 3 apparent re-nesting attempts that were completed by 1 October (described below), the last active nest appeared abandoned on 22 July.

The first nestlings were visible on 3 May; 8 young were observed in 7 nests on that day. The peak number of nests (35 nests) observed concurrently with young occurred on 23 May. The first clear sign of fledged young came on 13 July, when 2 juveniles were seen flying off of the structures to the water. The last date that adults were observed feeding young was 15 August (Table 2).

Several important breeding events occurred in 2010 compared with previous years. In 2010, the peak number of active nests were observed in the same week of the year as in 2009 (late May), which was about three weeks earlier than in any year prior to 2009; what appeared to be a significantly ‘early start’ for breeding cormorants in 2009 seemed to hold true again this year. In addition, evidence of first fledging (here defined as leaving the nest area, rather than as first flight) occurred in mid-July of this year, which was approximately 3 weeks later than the same event in 2008 or 2009, though consistent with observations in 2005, 2006, and 2007. A relatively early start to breeding and a later fledge date would appear to indicate a longer period between initiation of nest-building and laying of eggs, since incubation times are known to be consistently between 28 and

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<sup>2</sup> These figures reflect the number of nests that could be detected from the observation point, including partial nests in some cases. Before young cormorants are able to fly, they walk out of the nest and join young cormorants from other nests in creches, although for a time they continue to return to the nest where they were hatched, and they remain under parental care (Wallace and Wallace 1998). With unfledged young in the nest at some times, and not at others, it can be difficult to determine the stage of nesting. However, since nests are generally dismantled when nesting is finished (pers. obs.), and even partly dismantled while young are still present, even a partial nest can be an indication of continued breeding activity.

Bird Island Monitoring, 2005-2010

32 days (Boekelheide et al. 1990). This year the cormorants appeared to end their breeding cycle (indicated by dismantled nests) at least 3 weeks earlier than in years prior to 2009, with the exception of 2005, when the last intact nest was noted on 19 July. The last date that intact nests from first-round breeding attempts were observed in 2010 was 22 July, which is consistent with 2005 and 2009 patterns; however the 3 re-nesting attempts in 2010 (see below) make it seem as though nesting as a whole ended much later than it did.

Three potential attempts at re-nesting were observed in 2010. Though most nests were observed to be dismantled or abandoned by 22 July, three new nests were observed on 29 July; one lasted until 28 August and the other two until 1 October. It was impossible to tell whether the adults at these nests had raised young in previous nests (all pairs were observed building new nests, and could not be tracked to prior nest locations). Two young were observed (19 August) in one of the nests (which was considered successful), while the other two nests seemed to be abandoned after several weeks of behavior indicative of incubation, with no nestlings or fledglings observed.

Table 2. Timing of Brandt's Cormorant Breeding Events, 2005 through 2010

<i>Breeding Event</i>	2005		2006		2007		2008		2009		2010	
	<i>date</i>	#	<i>date</i>	#	<i>date</i>	#	<i>date</i>	#	<i>date</i>	#	<i>date</i>	#
Peak number of active nests	19 May	37	20 May	75	30 May	85	23-29 May	123	24-27 April	112	23 April	114
Young first observed in nests	22 May	3	11 April	1	9 May	1	8 April	1	30 April	6	3 May	8
Peak number nests observed with young	9 June	23	10 June	39	6 July	38	23 May	71	27 May	76	23 May	35
Trampolining young first observed <sup>a</sup>	12 July	?	5 July	2	Not noted	-	Not noted	-	Not noted	-	2 July	-
Last date any nests intact	19 July	2	29 Aug	1	13 Aug <sup>b</sup>	7	1 Oct <sup>b</sup>	3	20 July	2	1 Oct <sup>h</sup>	3
First young clearly fledged	21 July	5	18 July	3	20 July	1	25 June	10 <sup>c</sup>	20 June	1	13 July	3
Last feeding witnessed	9 Sep <sup>d</sup>	3	15 Nov <sup>e</sup>	1	7 Sep <sup>f</sup>	1	7 Sep <sup>g</sup>	1	8 July	1	15 Aug	1

<sup>a</sup> Trampolining: jumping up and exercising wings; a prelude to fledging.

<sup>b</sup> This was the last date nest locations were noted. Some structures may have persisted beyond this date.

<sup>c</sup> Multiple birds near the platform bases as early as 13 June 2008 may have been fledglings.

<sup>d</sup> The next latest feeding witnessed took place on 27 July 2005.

<sup>e</sup> The next latest feedings witnessed took place on 18 October 2006 (2); prior to that no feedings had been witnessed since 29 August.

<sup>f</sup> The next latest feedings took place on 24 August 2007 (2).

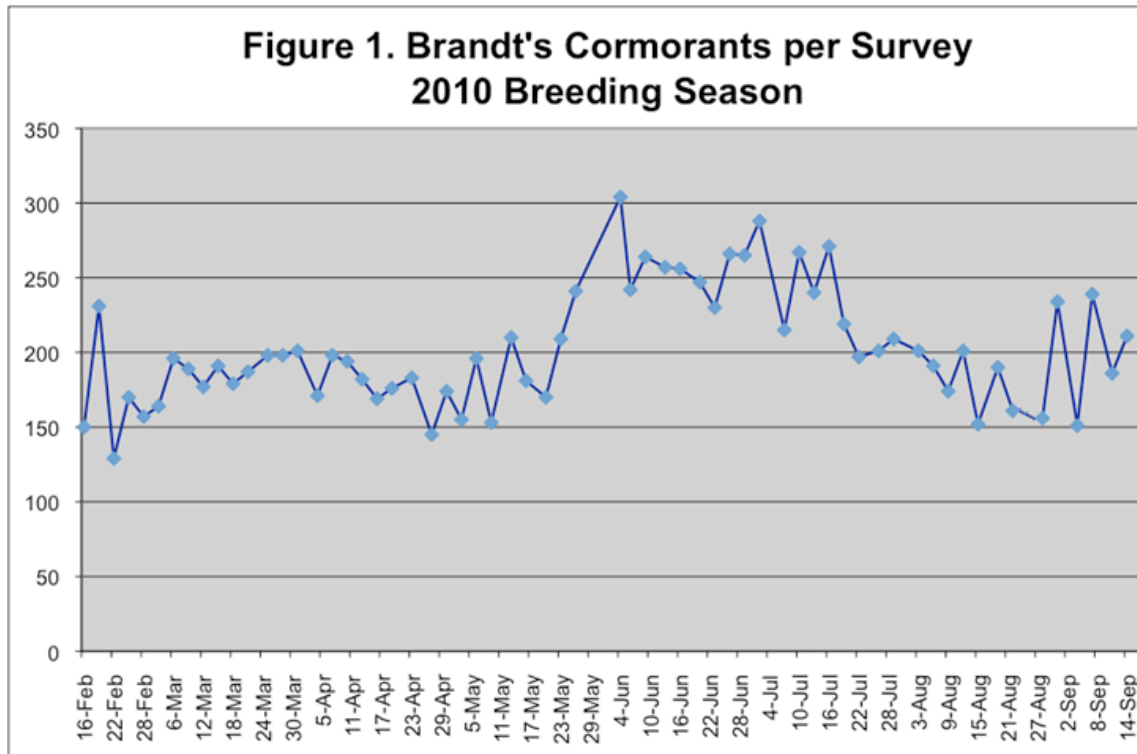
<sup>g</sup> Despite early date of the last feeding witnessed, clearly unfledged young were present through 31 Aug.

<sup>h</sup> Most nests were abandoned by 22 July 2010, but 3 re-nesting attempts yielded one additional successful nest that was abandoned on 1 October 2010.

Throughout the breeding season, the distance between the observation point and the structures – along with the similarity in appearance between adults and large young – made it at times impossible to obtain reliable figures for adults, immature birds (birds not yet of breeding age but hatched in a previous year), and larger young of the year. Thus,

figures below reflect the total number of birds of all ages. Also, while the 114 nests observed across the entire season is an indication of how many breeding pairs were present, it may not accurately reflect the number of after-hatch-year birds, or even adults, that were present, since non-breeding birds may have visited the structures during the breeding season.

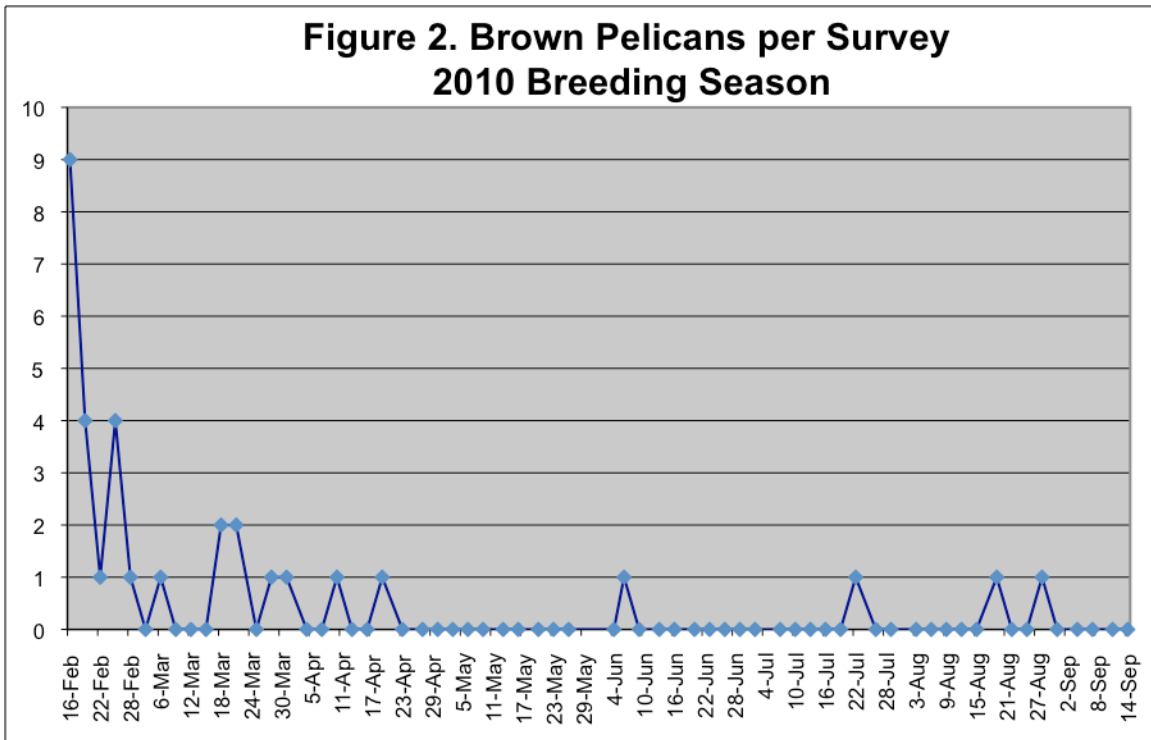
Total individuals<sup>3</sup> recorded during the breeding season in 2010 averaged 198.9 per survey and ranged from 129 on 22 February to 304 on 4 June (Figure 1). In general, numbers were lower in the early part of the breeding season (fewer than 160 were recorded on three occasions in February) before any juveniles were recorded and before all breeding pairs were present. Numbers subsequently rose as the number of nesting pairs peaked and young birds became visible in the nests, with a consistently high number of birds recorded through the month of June and half-way through July (between 240 and 304). Numbers began a downward trend again before the breeding season protocol was suspended, as evidenced by the fact that fewer than 220 cormorants were counted at all except 2 surveys after 16 July; 4 of those surveys found numbers at or below 161 birds. The low totals in February were consistent with numbers in 2007, 2008, and 2009 when the lowest figures were recorded for those years. Also, the dip in numbers in August reflected the trend in 2005 and 2006, when the lowest breeding-season numbers were recorded in those years.



<sup>3</sup> “Total individuals” refers to the high number counted on the structures at any one time during a survey. So if the counts of Brandt’s Cormorants for three different intervals during a one-hour survey were 105, 125, and 115, then the total individuals for that survey was 125. During the non-breeding season, the highest of six totals recorded during an hour was considered the total number of individuals for a survey.

In 2005, when preconstruction surveys were conducted, no surveys were performed before 19 May. Therefore, comparisons with post-construction data (2006–2009) must focus on the period beginning on that date. Overall, the average number of Brandt’s Cormorants using the new Bird Island from 19 May to 14 August<sup>4</sup> was significantly higher in 2006, 2007, 2008, 2009, and 2010 (means of 196, 221, 237, 209, and 224 respectively) than for the old structure in 2005 (mean of 161); statistics are presented in Appendix A.

BROWN PELICAN



Brown Pelicans were present on the platforms in moderate numbers both prior to and during the first two weeks of the 2010 breeding season (with a breeding season high of 9 counted on 16 February; Figure 2). As cormorant nests began to be established in greater numbers, pelicans generally stopped using the platforms; pelican counts varied between 0 and 2 from 28 Feb to 23 April (the day the highest number of active cormorant nests were recorded). From 23 April through the remainder of the breeding season, there were only 4 surveys where a pelican was noted using the platforms. Cormorants were observed on several occasions raising their bills and snapping at pelicans that were attempting to land on the platforms. Each time one of these pelicans was observed, the bird was perched on a vertical piece of metal adjacent to one of the ‘wings’ of the platforms: in essence not taking up any flat space that could potentially be used for nesting by the cormorants.

<sup>4</sup> As detailed in Appendix A, the range of 12 May to 5 August, 2009 was used for comparison to the 2005 data since breeding protocol ended on 5 August in 2009.

In comparison, Brown Pelicans were also absent for months during the 2009 breeding season, when no pelicans were observed from 10 March through 30 May (and then only single birds observed during 6 surveys through 4 August). The 2007 breeding season was similar, with no pelicans observed from 28 April through 4 August. In 2006, pelicans were absent from 1 February to 26 April and were recorded 9 times from 29 April to 17 August. The high for the cormorant breeding season that year was 5 pelicans recorded on 4 June. Brown Pelicans were a consistent presence on the old Bird Island during the cormorant breeding season in 2005, and numbers from mid-May to mid-August (the only months of the breeding season for which data were recorded) frequently reached double digits, even rising above 30 on two occasions. In fact, using only data for mid-May to mid-August for subsequent years, a comparison shows a significant decrease in the average number of Brown Pelicans using Bird Island in the years after construction, 2006, 2007, 2008, 2009, and 2010 (means of 0.40, 0.03, 0.07, 0.21, and 0.14 respectively) compared to 2005 (mean of 10.7), the year prior to construction; statistics are presented in Appendix A. Interestingly, the structure of the old Bird Island (in comparison to the new Bird Island) included many more vertical perching places that could be used by birds such as pelicans without physically disturbing nesting cormorants.

OTHER SPECIES

The low numbers of Brown Pelicans using Bird Island during the breeding season reflect the overall infrequent use of the structures by any species besides Brandt's Cormorant (Table 3a). Besides cormorants, only the Western and Heermann's Gulls occurred regularly on Bird Island during the 2010 breeding season (11 times and 24 times, respectively, in 64 surveys). Only 11 individual Western Gulls and 53 Heermann's Gulls were recorded during this seven-month period.

	2005	2006	2007	2008	2009	2010	2006-2010
Heermann's Gull	2.20	0.23	0.38	0.95	0.95	0.85	0.67
Western Gull	1.93	1.09	0.63	0.58	0.38	0.18	0.57
Rock Pigeon	1.30	0.14	0.02	0.00	0.05	0.00	0.04
European Starling	34.77	0.02	0.12	0.33	0.00	0.48	0.19

	2005	2006	2007	2008	2009	2010	2006-2010
Heermann's Gull	1.50	2.21	3.46	5.33	3.47	3.84	3.66
Western Gull	1.45	0.79	1.22	0.90	2.72	1.33	1.39
Rock Pigeon	0.22	0.42	0.04	0.00	0.00	0.00	0.09
European Starling	34.35	2.83	10.18	1.00	2.62	1.51	3.63

In addition, two terrestrial species that regularly used the old Bird Island in 2005 have been virtually absent in the past five breeding seasons. As many as 214 European Starlings (*Sturnus vulgaris*) came to roost in a single evening during the cormorant

breeding season in 2005. This species was recorded 11 times (out of 30 surveys) during that breeding season. During 2010, only 30 starlings total were observed in the cormorant breeding season; 18 starlings were observed at the very start of breeding season protocol (19 Feb) and on 4 other occasions numbers varied between 1 and 5 starlings. This species was recorded only once each during the breeding seasons of 2006 and 2007 and three times in 2008. The Rock Pigeon (*Columba livia*) was recorded on 30 of 33 breeding season surveys in 2005. This figure fell to five in 2006 and one in 2007, when a single bird was recorded on 1 May. Only three Rock Pigeons were recorded during 2009; one individual on 1 March and two individuals on 28 March. In 2008 and 2010, no Rock Pigeons were recorded during the entire year.

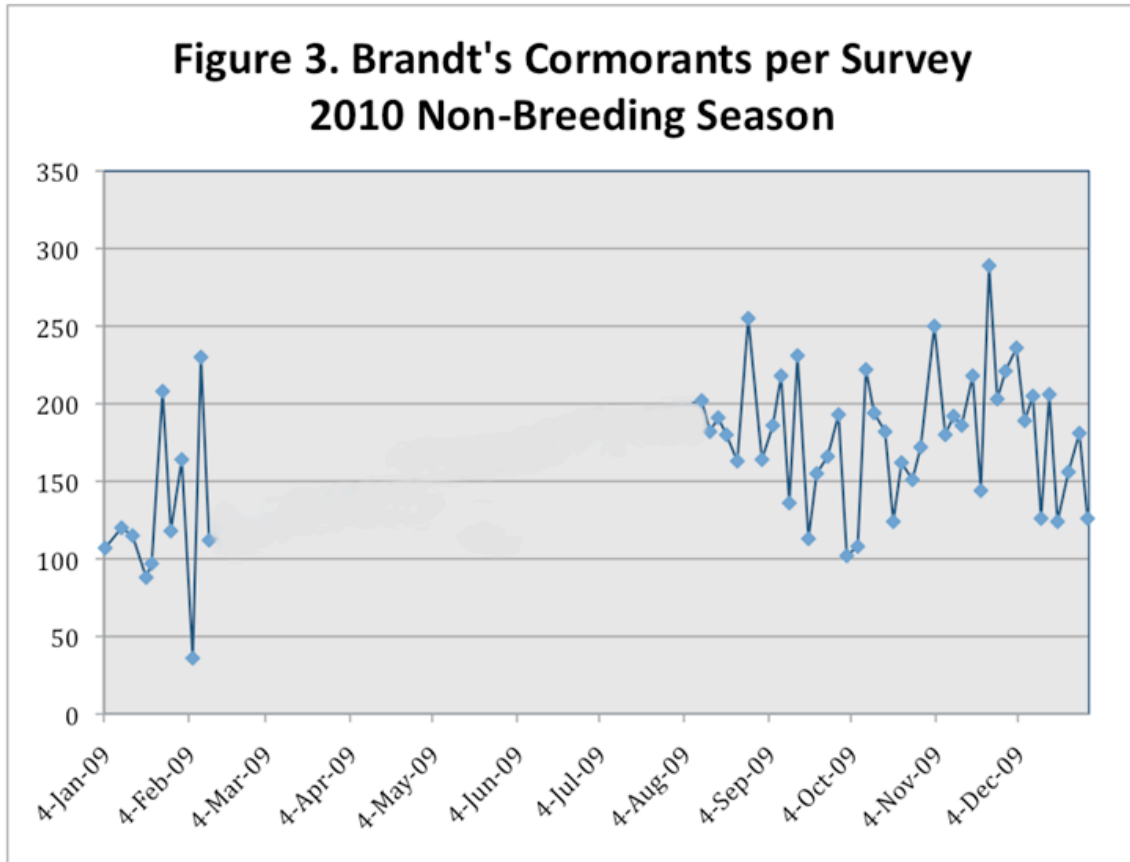
The variety of species using Bird Island during the cormorant breeding season has also decreased since 2005. The number of species observed on the structures in 2010 was equivalent to the low from 2008 of five species. This compares to 12 species in the 2005 breeding season, eight in 2006, nine in 2007, and six in 2009 (Table 4).

	2005	2006	2007	2008	2009	2010
Brown Pelican ( <i>Pelecanus occidentalis</i> )	x	x	x	x	x	x
Brandt's Cormorant ( <i>Phalacrocorax penicillatus</i> )	x	x	x	x	x	x
Double-crested Cormorant ( <i>Phalacrocorax auritus</i> )		x	x		x	
Pelagic Cormorant ( <i>Phalacrocorax pelagicus</i> )	x		x			
Snowy Egret ( <i>Egretta thula</i> )	x					
Little Blue Heron ( <i>Egretta caerulea</i> )	x					
Heermann's Gull ( <i>Larus heermanni</i> )	x	x	x	x	x	x
Western Gull ( <i>Larus occidentalis</i> )	x	x	x	x	x	x
California Gull ( <i>Larus californicus</i> )	x	x	x			
Rock Pigeon ( <i>Columba livia</i> )	x	x	x		x	
Cliff Swallow ( <i>Petrochelidon pyrrhonota</i> )	x					
European Starling ( <i>Sturnus vulgaris</i> )	x	x	x	x		x
blackbird sp. (family Icteridae)	x					

## RESULTS: 2010 NON-BREEDING SEASON

### BRANDT'S CORMORANT

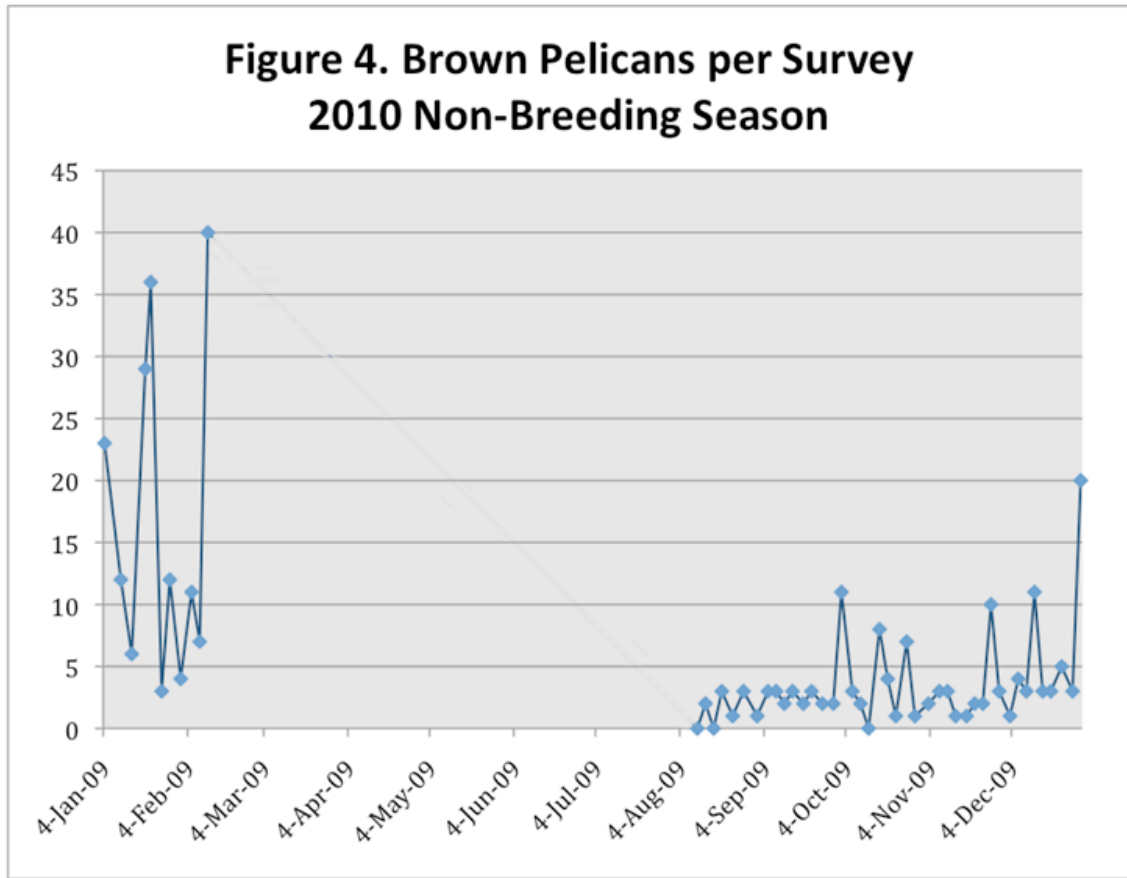
As in the breeding season, Brandt's Cormorant was the dominant species on the structures during periods when the non-breeding season protocol was followed (Fig. 3). The average number of cormorants recorded using Bird Island during these periods was 172.4, compared to 198.9 during the breeding season. The average for the 13 surveys conducted prior to the breeding season, in January and early February (139.6), was lower than the average for the 30 surveys coming after the non-breeding season protocol was reinstated in September (186.6). The overall average for the 2010 non-breeding season falls within a close proximity to the averages of all previous years, including 2005 (Table 5). Comparison with preconstruction data is difficult because only 10 non-breeding surveys, from mid-August to late September, were conducted before demolition in 2005. There is no significant difference in the average number of Brandt's Cormorants observed on Bird Island during the non-breeding period before and after construction (Appendix A).



**BROWN PELICAN**

Compared with the cormorant breeding season, Brown Pelicans were a more regular presence on Bird Island when the non-breeding season protocol was in place; they were recorded during 36 of 43 surveys (Figure 4). The overall average for 2010 was 3.2 pelicans per survey, which was the smallest average recorded during the 6 years of study, though not significantly different than the 3.9 birds recorded in 2007 (Table 5); statistics presented in Appendix A. The 2010 numbers were generally higher during the pre-breeding phase (average of 4.46 per survey) than the post-breeding phase (average of 2.67 per survey). Inadequate data from the non-breeding season for the old Bird Island make it difficult to show whether numbers have changed since construction of the new Bird Island in late 2005 (Appendix A).

Table 5. Brandt's Cormorant and Brown Pelican Numbers per Survey, 2005 Preconstruction through 2010 (averages for breeding and non-breeding seasons)			
	Type and Number of Surveys	Brandt's Cormorant	Brown Pelican
2005	Breeding (29)	160.9	10.7
	Non-breeding (10)	171.5	4.8
2006	Breeding (66)	175.3	0.2
	Non-breeding (45)	158.0	8.6
2007	Breeding (60)	193.0	0.6
	Non-breeding (50)	166.5	3.9
2008	Breeding (64)	203.8	0.1
	Non-breeding (48)	150.9	6.9
2009	Breeding (58)	181.4	0.6
	Non-breeding (53)	158.6	6.2
2010	Breeding (64)	198.9	0.5
	Non-breeding (43)	172.4	3.2



	2005	2006	2007	2008	2009	2010
Brown Pelican ( <i>Pelecanus occidentalis</i> )	x	x	x	x	x	x
Brandt's Cormorant ( <i>Phalacrocorax penicillatus</i> )	x	x	x	x	x	x
Double-crested Cormorant ( <i>Phalacrocorax auritus</i> )		x	x	x		x
Pelagic Cormorant ( <i>Phalacrocorax pelagicus</i> )		x	x			
Peregrine Falcon ( <i>Falco peregrinus</i> )				x		
Great Egret ( <i>Ardea alba</i> )		x				
Snowy Egret ( <i>Egretta thula</i> )	x					
Bonaparte's Gull ( <i>Larus philadelphia</i> )			x			
Heermann's Gull ( <i>Larus heermanni</i> )	x	x	x	x	x	x
Western Gull ( <i>Larus occidentalis</i> )	x	x	x	x	x	x
California Gull ( <i>Larus californicus</i> )		x				
Rock Pigeon ( <i>Columba livia</i> )	x	x	x			
phoebe sp. ( <i>Sayornis</i> sp.)		x				
European Starling ( <i>Sturnus vulgaris</i> )	x	x	x	x	x	x
blackbird sp. (family Icteridae)	x					

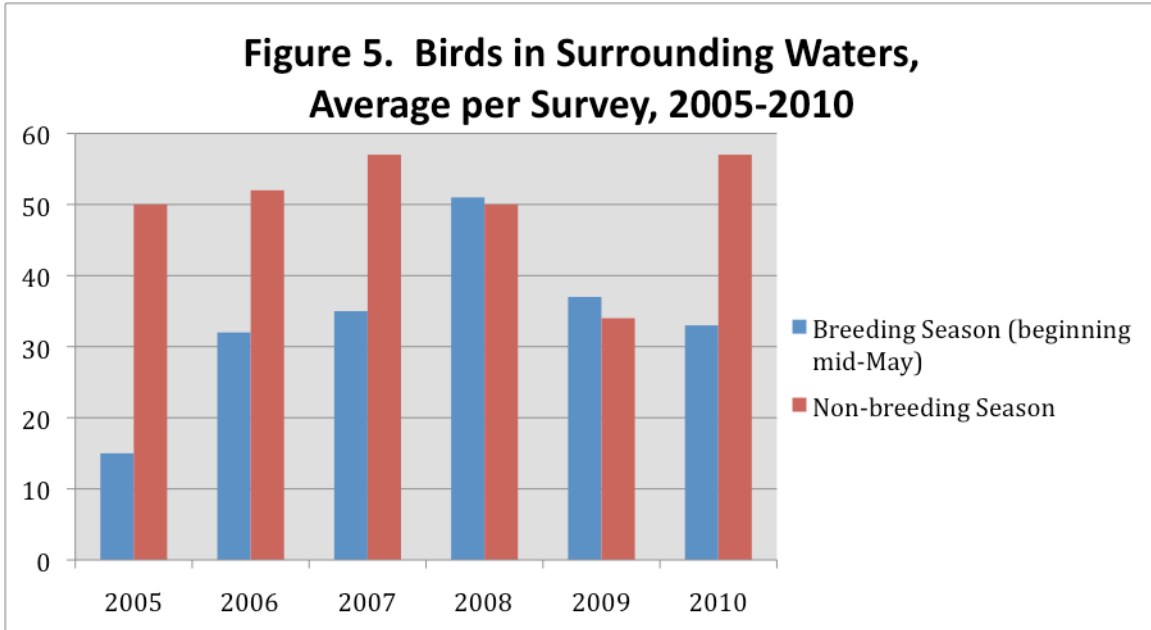
#### OTHER SPECIES

Only six species total were recorded using the structures during the 2010 non-breeding season. Other than the Brown Pelican and Brandt's Cormorant, Heermann's Gull (37 times) and the Western Gull (29 times) were the most often recorded during the non-breeding season (43 surveys total). European Starlings were recorded only three times and a single Double-crested Cormorant was recorded once.

The numbers for European Starlings have been dramatically down since construction of the new Bird Island, both during cormorant breeding and non-breeding seasons (Table 3b). Western Gull numbers have stayed relatively constant during the non-breeding season (Table 3b), but have declined during the breeding season over the period since construction in 2005 (Table 3a). Also, the variety of species (six in 2010) has generally declined since the first full year of non-breeding season surveys (2006); with the exception of a single Double-crested Cormorant sighting, the 2010 count is equal to the 2009 count. The number is also down from 2005, when only 15 non-breeding season surveys were conducted. Table 6 gives a complete list of species recorded on the structures during the non-breeding seasons since the beginning of surveys in 2005.

#### RESULTS: 2010 BIRDS USING SURROUNDING WATERS

The number of all birds resting or feeding in the waters within approximately 300 meters of the structures during the breeding season dropped slightly from 2009; an average of 32.6 birds was recorded per survey in 2010 compared to 36.6 birds in 2009 (Figure 5 and Table 7). In 2006-2010 the breeding season protocol was instituted in February. But surveys in 2005 did not begin until 19 May, so breeding season data in Figure 5 cover only the period from approximately mid-May to mid-August. In the 2010 non-breeding season, numbers (57.1 birds per survey on average) exceeded all past years of data with the exception of 2007, when 57.5 birds were recorded per survey.



Totals recorded for Brandt’s Cormorants during the 2010 breeding season (11.3 per survey; Table 7) were lower than any other post-construction year, though slightly higher than numbers from 2005. The numbers of cormorants observed during the 2010 non-breeding season (13.3 per survey) were lower than most years past, with the exception of 2009. During the breeding season, 2.9 Brown Pelicans were recorded on average per survey, more than were observed in any year other than 2005 (1.8 per survey). In the non-breeding season, the 6.1 per survey average of Brown Pelicans was considerably higher than all past survey years including 2005 (4.0 per survey).

	Brandt’s Cormorant		Brown Pelican		All Species	
	<i>breeding</i>	<i>non-breeding</i>	<i>breeding</i>	<i>non-breeding</i>	<i>breeding</i>	<i>non-breeding</i>
2005	9.4	22.4	1.8	4.0	15.3	49.5
2006	15.0	26.2	0.6	3.0	31.8	52.0
2007	12.3	19.2	0.3	2.8	35.0	57.5
2008	17.5	17.1	0.5	4.2	51.3	49.7
2009	16.9	10.5	1.6	3.5	36.6	33.5
2010	11.3	13.3	2.9	6.1	32.6	57.1

In all, 21 species occurred in the waters around Bird Island in 2010 (Table 8). This was comparable to the numbers found in 2006 (24), 2007 (27), 2008 (26), and 2009 (20) and double the number recorded in 2005 (10). The lower number in 2005, at least in part, reflects the fact that no surveys were conducted that year before 19 May or during the period of the demolition of the old Bird Island and the construction of the new, between 20 September and 13 December. In addition to Brandt’s Cormorant and Brown Pelican, the most numerous and regularly occurring species in 2010 were the Western Gull and

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Western Grebe. A complete list of species occurring in waters near the structures by year is in Table 8.

	2005	2006	2007	2008	2009	2010
Mute Swan ( <i>Cygnus olor</i> )			x			
Brant Goose ( <i>Branta bernicla</i> )					x	
American Wigeon ( <i>Anas americana</i> )				x		x
Mallard ( <i>Anas platyrhynchos</i> )			x	x	x	
Surf Scoter ( <i>Melanitta perspicillata</i> )			x	x	x	
Red-breasted Merganser ( <i>Mergus serrator</i> )		x	x	x	x	x
Red-throated Loon ( <i>Gavia stellata</i> )		x	x	x	x	x
Pacific Loon ( <i>Gavia pacifica</i> )		x	x	x	x	x
Common Loon ( <i>Gavia immer</i> )		x	x	x	x	x
Pied-billed Grebe ( <i>Podilymbus podiceps</i> )		x				
Horned Grebe ( <i>Podiceps auritus</i> )			x	x	x	x
Eared Grebe ( <i>Podiceps nigricollis</i> )		x	x	x		x
Western Grebe ( <i>Aechmophorus occidentalis</i> )	x	x	x	x	x	x
Clark's Grebe ( <i>Aechmophorus clarkii</i> )		x	x	x	x	x
Brown Pelican ( <i>Pelecanus occidentalis</i> )	x	x	x	x	x	x
Brandt's Cormorant ( <i>Phalacrocorax penicillatus</i> )	x	x	x	x	x	x
Double-crested Cormorant ( <i>Phalacrocorax auritus</i> )	x	x		x	x	
Pelagic Cormorant ( <i>Phalacrocorax pelagicus</i> )		x	x	x		
Great Blue Heron ( <i>Ardea herodias</i> )			x		x	x
Great Egret ( <i>Ardea alba</i> )	x	x	x	x	x	x
Snowy Egret ( <i>Egretta thula</i> )		x	x		x	x
American Coot ( <i>Fulica americana</i> )			x			
Red-necked Phalarope ( <i>Phalaropus lobatus</i> )		x	x			
phalarope sp. ( <i>Phalaropus</i> sp.)				x		
Bonaparte's Gull ( <i>Chroicocephalus philadelphia</i> )		x	x			
Heermann's Gull ( <i>Larus heermanni</i> )	x	x	x	x	x	x
Mew Gull ( <i>Larus canus</i> )			x	x		x
Ring-billed Gull ( <i>Larus delawarensis</i> )		x	x	x		
Western Gull ( <i>Larus occidentalis</i> )	x	x	x	x	x	x
California Gull ( <i>Larus californicus</i> )	x	x	x	x	x	x
Herring Gull ( <i>Larus argentatus</i> )				x		
Glaucous-winged Gull ( <i>Larus glaucescens</i> )		x	x	x		
Royal Tern ( <i>Sterna maxima</i> )		x		x		x
Elegant Tern ( <i>Sterna elegans</i> )		x				
Forster's Tern ( <i>Sterna forsteri</i> )		x	x	x	x	x
Common Murre ( <i>Uria aalge</i> )	x					x
Cliff Swallow ( <i>Petrochelidon pyrrhonota</i> )	x					

## DISCUSSION

Comparison of data for the old Bird Island in 2005 and the new Bird Island in 2006 through 2010 suggest that in some ways the new structures have provided new benefits to the birds that use them. More than three times as many Brandt's Cormorant pairs were recorded breeding on the new structures in 2008, 2009, and 2010 as were recorded on the old structure in 2005; the peak number of active nests observed (only 37 in 2005) has increased each year up to 2008 -- to 75 in 2006, 85 in 2007, 125 in 2008 -- with a slight

drop in 2009 to 112 nests and a slight recovery to 114 nests in 2010. The large, flat, open areas on isolated structures offshore seem well suited to nesting by this species. However, evidence compiled from the five years post-construction suggests that, during the breeding season, the old structure provided better opportunities for use by species other than Brandt's Cormorant -- including the formerly endangered California Brown Pelican. On the old structure, there were enough areas poorly suited to cormorant nesting that pelicans could find places to rest without being immediately chased away by territorial cormorants. The large metal frame on the top of the northern half of the pier remnant, for example, provided a good roosting place for pelicans while few cormorants nested on this part of the structure.

The suitability of the new structures for Brandt's Cormorants also appears to have affected the presence of species other than the Brown Pelican. Western and Heerman's Gull numbers have been considerably lower during the breeding season in all years since the platforms were replaced, and the variety of species observed on Bird Island (year-round) has decreased since construction of the new structures. Two common exotic species -- the Rock Pigeon and the European Starling -- have not found the new structures as welcoming as the old one, particularly during the cormorant breeding season. While the new structures appear to provide excellent habitat for breeding cormorants, other species have relatively little space to roost when the structures are crowded with nesting cormorants.

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## APPENDIX A: STATISTICS

T-tests were performed to test the statistical significance of differences in mean numbers of Brandt's Cormorants and Brown Pelicans on the structures in the breeding and non-breeding seasons before and after construction of the new Bird Island. Baseline data for the old Bird Island were collected only from 19 May to 19 September 2005. This included 29 breeding season surveys conducted from 19 May to 14 August and 10 non-breeding season surveys conducted from 18 August to 19 September. Thus only data covering these periods for 2006, 2007, and 2008 were tested.

The breeding season in 2009 was determined to be complete (and thus the breeding protocol was ended) on 5 August (earlier than past years); thus there were only 27 breeding season surveys conducted between 19 May and 5 August 2009. To increase the *n* value for 2009 to 29 to be consistent with all past years, the two previous breeding survey dates (12 May and 15 May) were added to the data set. For the 2009 non-breeding season t-tests, data from 10 surveys immediately following the end of breeding season dates were used (10 August to 11 September).

In 2010, the breeding season protocol ended with the 14 September survey, which allowed for more than enough surveys to select 29 of them to compare to the 2005 breeding season surveys. The breeding season data set hence began on 20 May and ended on 28 August. The 10 non-breeding season surveys began on 31 August and ran until 1 October.

Though the selection of surveys began on approximately the same day in 2010 as in 2005 (20 and 19 May, respectively), one will notice that the period of 29 breeding season surveys for 2010 seems to extend almost two weeks later than it did in 2005. This discrepancy is due to several unintended gaps in the survey protocol, where data were not recorded every 3 days as prescribed. There was a 9-day gap between 26 May and 4 June that was due to a miscommunication between survey biologists. A 5-day gap also occurred due to miscommunication between 2 July and 7 July. Finally, the survey attempted on 25 August was not used in the t-tests because a thick fog prevented the biologist from accurately counting birds on the platforms.

For each species, ten unpaired t-tests were conducted: five for the breeding season data (separate comparisons of 2006, 2007, 2008, 2009 and 2010 data to the baseline data) and similarly, five for the non-breeding season data.

With 29 values in each breeding season group, the differences in bird use for both species in 2005 versus 2006, 2007, 2008, 2009, and 2010 were statistically very significant (tables A.1, A.3). This was not true of the non-breeding season data (tables A.2, A.4). In the non-breeding season, the mean numbers for Brandt's Cormorants in 2006, 2007, 2009, and 2010 were marginally higher than that for 2005, while the mean number for

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2008 was marginally lower. However, the high  $p$  values suggest none of the later groups is significantly different than the 2005 group. By contrast, mean numbers of Brown Pelicans during the non-breeding season were lower in all post-construction years compared with 2005. For all five comparisons,  $p$  values were high, although only marginally so when comparing 2007 or 2010 with 2005 data.

	$n$	mean	standard deviation	$t$	$p$
2005	29	161	40.6	-	-
2006	29	196	43.5	3.17	0.002
2007	29	221	31.0	6.33	<0.001
2008	29	237	49.4	6.38	<0.001
2009	29	209	41.7	4.45	<0.001
2010	29	224	41.2	5.84	<0.001

	$n$	mean	standard deviation	$t$	$p$
2005	10	172	34.5	-	-
2006	10	184	32.6	0.86	0.401
2007	10	176	27.3	0.31	0.761
2008	10	166	37.2	0.31	0.759
2009	10	188	33.7	1.08	0.147
2010	10	189	35.7	1.10	0.285

	$n$	mean	standard deviation	$t$	$p$
2005	29	10.70	11.1	-	-
2006	29	0.38	1.0	-4.98	<0.001
2007	29	0.03	0.2	-5.17	<0.001
2008	29	0.07	0.4	-5.15	<0.001
2009	29	0.21	0.4	-5.08	<0.001
2010	29	0.14	0.4	-5.11	<0.001

	$n$	mean	standard deviation	$t$	$p$
2005	10	4.9	7.4	-	-
2006	10	1.6	4.0	-1.3	0.233
2007	10	0.2	0.4	-2.0	0.061
2008	10	1.3	1.5	-1.5	0.150
2009	10	1.8	5.6	-1.26	0.119
2010	10	0.4	0.8	-1.87	0.078

## APPENDIX B: PROTOCOL FOR MONITORING BIRD ISLAND

The general question to be answered by this project is: Which species roost and nest on the Ellwood pier remnant (or on the structures that will be replacing it), and how does each species' use of the structures (in terms of abundance and breeding activity) vary annually, seasonally, daily, and in different weather conditions?

One species, the Brandt's Cormorant, has been known to nest on the pier remnant. The protocol should give special attention to breeding activity of this species. Separate protocols have been developed for the nonbreeding and breeding seasons of the Brandt's Cormorant.

### *Nonbreeding Season Protocol*

The nonbreeding season will begin when juvenile Brandt's Cormorants are no longer under the care of their parents. In years when cormorants are recorded nesting on the structures, four visits must pass during which no young are seen being fed by adults before the breeding season protocol can be terminated for that year and the nonbreeding season protocol can be implemented. These criteria may be adjusted if other species are found to breed on the structures.

#### NUMBER AND DURATION OF VISITS

Two visits per week (a week being Sunday through Saturday), normally with no more than three and no fewer than two days in between, will be made to the site between the end of one breeding season and the beginning of the next. For example, if the first survey of the week is conducted on Monday, the next survey should be conducted on Thursday or Friday.

Each visit will be one hour in duration.

#### TIMING OF VISITS

Each visit will be made during one of four periods during the course of the day, between sunrise and sunset: *early morning* (Period I), *late morning/early afternoon* (Period II), *early/mid-afternoon* (Period III), and *late afternoon/early evening* (Period IV). During the first week of the season, the first visit will occur during Period I and the second visit will occur during Period II. During the second week, the first visit will occur during Period III and the second visit will occur during Period IV. Then the cycle will be repeated.

The timing of these windows will vary with seasonal changes in the timing of sunrise and sunset, as follows:

- Period I will begin when there is enough light to see the structures and end at the midway point between sunrise and 12:00 standard time or at the midway point between sunrise and 13:00 daylight time.
- Period II will begin at the end of Period I (see above) and end at 12:00 standard time or 13:00 daylight time.

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- Period III will begin at 12:00 standard time or 13:00 daylight time and end at the halfway point between the beginning of the period and sunset.
- Period IV will begin when Period III ends and end when it is too dark to see the structures adequately.

### OBSERVATION POINT

The observation point will be located at a designated spot on the road running along the east side of the hill that is immediately west of the lagoon at the mouth of Bell Creek.

### FORMS AND DATA RECORDING

During each visit, the observer will record information on the species resting on the structures and the surrounding waters. The hour will be divided into 6 ten-minute periods, during which the observer will record on the usage form the four-letter American Ornithologists' Union code for each species and the number of that species resting anywhere on the structures during each period. When possible, numbers of adults vs. immature birds will be noted. (Due to the distance of the structures offshore, the poor light at some times of day, and the difficulty of distinguishing between adults and subadults of some species, including the Brandt's Cormorant, this information may not be recorded for all species).

In addition to recording species and numbers on the structures, the observer will record the same information for species in the water within approximately 300 meters of the structures (keeping in mind that the old structure was approximately 270 meters offshore). For this purpose, the surrounding ocean waters will be divided into four quadrants: East, South, West, and North.

The protocol for the nonbreeding season will be terminated for the season when cormorants begin building nests, *but not earlier than 1 February*. The breeding season protocol will then be implemented.

## ***Breeding Season Protocol***

### NUMBER AND DURATION OF VISITS

One visit every three days will be made during the season when Brandt's Cormorants are breeding.

Each visit will be one hour in duration.

### TIMING OF VISITS

Visits will be made during four different periods over the course of the day. These periods are outlined in the Nonbreeding Season Protocol, under "Timing of Visits." Observers will alternate between visits during Period IV and visits made during each of the other three periods in turn. Therefore, the initial, third, and fifth visits will occur during Period IV, the second visit will occur during Period I, the fourth visit will occur during Period II, and the sixth visit will occur during Period III. The sequence will then be repeated over the next six visits (see Table B1).<sup>5</sup>

Table B1: Sequence of breeding season visits

<i>Visit#</i>	<i>Period</i>
1	IV
2	I
3	IV
4	II
5	IV
6	III
7	begin repeat of sequence

### OBSERVATION POINT

The observation point will be located at a designated spot on the road running along the east side of the hill that is immediately west of the lagoon at the mouth of Bell Creek, the same location used during the nonbreeding season.

### FORMS AND DATA RECORDING

During each visit, the observer will record information on the species resting on the structures and the surrounding waters, as will be done under the nonbreeding season protocol. However, this information will be recorded only three times during the course of the hour. Thus each hour-

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<sup>5</sup> In this protocol, the timing of visits during the non-breeding season was determined due to considerations relating to the quality of light at different times of day and the difficulty of distinguishing between adult Brandt's Cormorants and large nestlings and fledglings and of recording other information relevant to breeding. Because monitoring the breeding activity of this species is a major task being conducted under the breeding season protocol, it is essential to have good light to discern the presence of small nestlings, to distinguish between adults and large young, and to gather other breeding information. The best conditions for viewing the structures from the observation point occur at or just before sunset under clear conditions.

long visit will be divided into three 20-minute periods. Species and numbers on the structures and in the surrounding waters will be recorded at the beginning of each 20-minute period. The remaining time will be used to record information relevant to the breeding of Brandt's Cormorants, as outlined in the following two paragraphs.

When cormorants begin building nests, the location of the nests will be noted on the "Breeding Form," with a circle representing a single nest. Observers will use a series of one- and two-character codes to note various indications of breeding and breeding behaviors, including empty nest, adult near/standing on nest, adult incubating/sitting, adult feeding young, adults switching at nest, (# of) young in nest, nest occupied – unknown age, courtship, and nest building.

During the height of the nesting season, priority should be given to recording the location of each nest and the basic situation at that nest (e.g., incubation, young in nest, nest building). The location of each visible nest and some indication of the stage of nesting (lighting and visual obstructions allowing) should be recorded during every visit in the nesting season.

Protocols developed September 2005