Introduction

Wetlands are vital habitats for birds. More than half of the 800 protected migratory avian species rely on wetlands for their life cycles (Mitsch, 2000). Wetlands provide for every aspect of a bird's life, offering food, retreat, and breeding sites. Because of the many different environments found within a wetland, including freshwater, marsh lands, uplands, and mudflats, both resident and migratory birds are able to utilize the wetlands through niche partitioning. Much of the loss of bird species that has taken place has been the result of development. Habitat loss and pollution result from intense urbanization, and this is especially true for the salt marshes of Southern California. Urbanization and trash from winter's "first flush" have led to the destruction of 90% of coastal wetland habitat, greatly affecting migratory and resident birds.

The contribution of birds to the scientific community is often overlooked by the average person. While millions of people across the world enjoy the aesthetics associated with birds, birds are the crucial indicators of the effects we have on our environments, thus being named "bioindicators". Bird presence alone can be associated with the health or destruction of habitat, and the negative impacts of pollution, invasive species and pesticides in an environment. Birds also function as insect eaters, pollinators and rodent predators (Trulio, 2000). This short list does not begin to explain the importance of birds to our local and worldwide communities.

When discussing the ecological integrity of an environment, specifically in a wetland area, a number of bioindicators may be investigated. We chose to study birds because they are easily monitored, can be surveyed in a number of ways, and have longer life spans than other bioindicators such as amphibians or vascular plants (Adamus, 1995). Surveying birds at ten different sites within the Los Cerritos Wetland (LCW) Complex allowed us to achieve a better understanding of not only the health of each ecosystem, but also the numbers and types of bird species present on any given day. From this information we were able to conclude potential areas for mitigation and provide valuable statistics for those interested in future restoration of these important regions.

The main objective of the biology project was to show that the LCW Complex is an important habitat for birds. Moreover, we wanted to monitor which species were present in the LCW Complex as well as identify where species of special concern, under the Migratory Bird Treaty Act (MBTA), the Endangered Species Act (ESA) and the California Endangered Species Act (CESA), are most likely to be found. We also wanted to compare the species presence and absence of the LCW Complex to nearby bird habitats: Bolsa Chica Wetlands and the Naval Weapons Station-Seal Beach.

Our hypothesis is that the LCW complex, although somewhat degraded, is still a viable habitat for migratory and resident birds. We expected Steam Shovel Slough to have a high biodiversity level and more birds than any other site because it seemed less disturbed. We expected the degraded sites to have the least amount of birds and biodiversity due to high disturbance. Overall, we predicted the LCW Complex to have potential for restoration and/or enhancement.

Research Sites

Los Cerritos Wetlands Complex

This study focused on the Los Cerritos Wetlands Complex that contains sites in both Los Angeles and Orange Counties in Southern California (**see Figures 5.1 and 5.2)**. The complex is located in the cities of Long Beach and Seal Beach. The San Gabriel River is the boundary between the two counties.

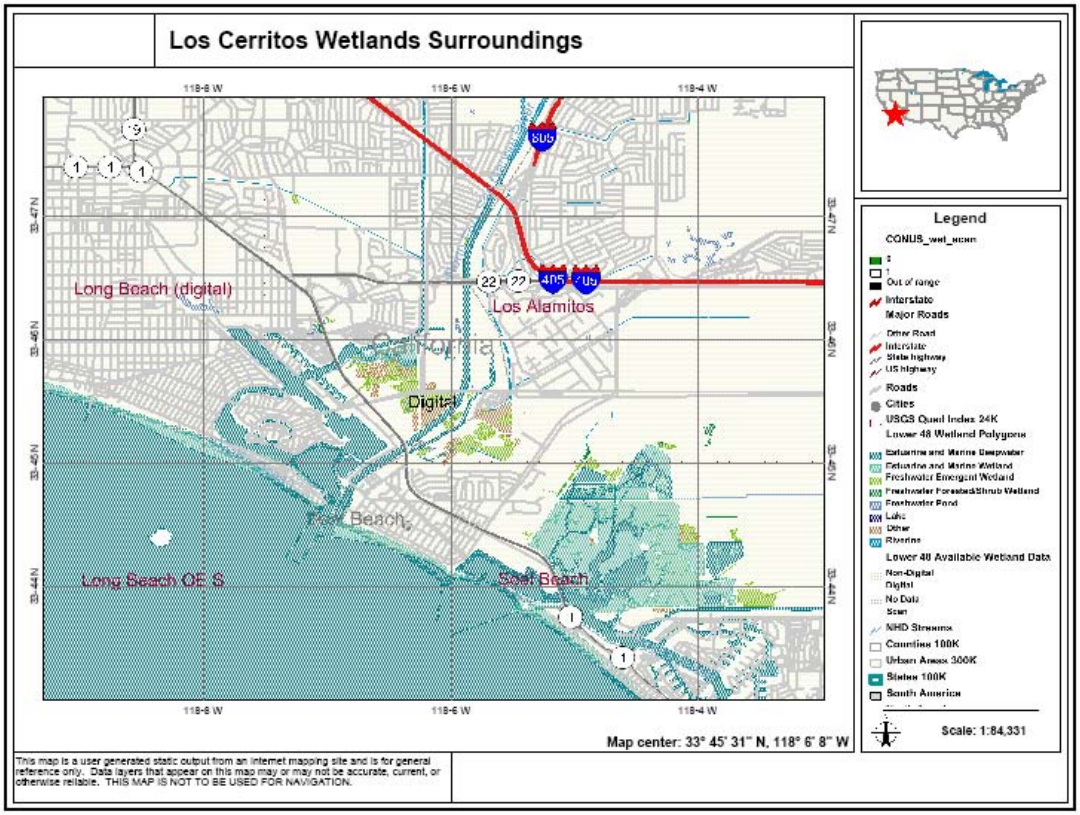


Figure 5.1: The Los Cerritos Complex is located in Los Angeles and Orange Counties in California in the cities of Long Beach and Seal Beach, with the San Gabriel River as the boundary between the two counties.
Source: USFG Online Wetlands Mapper, 2007

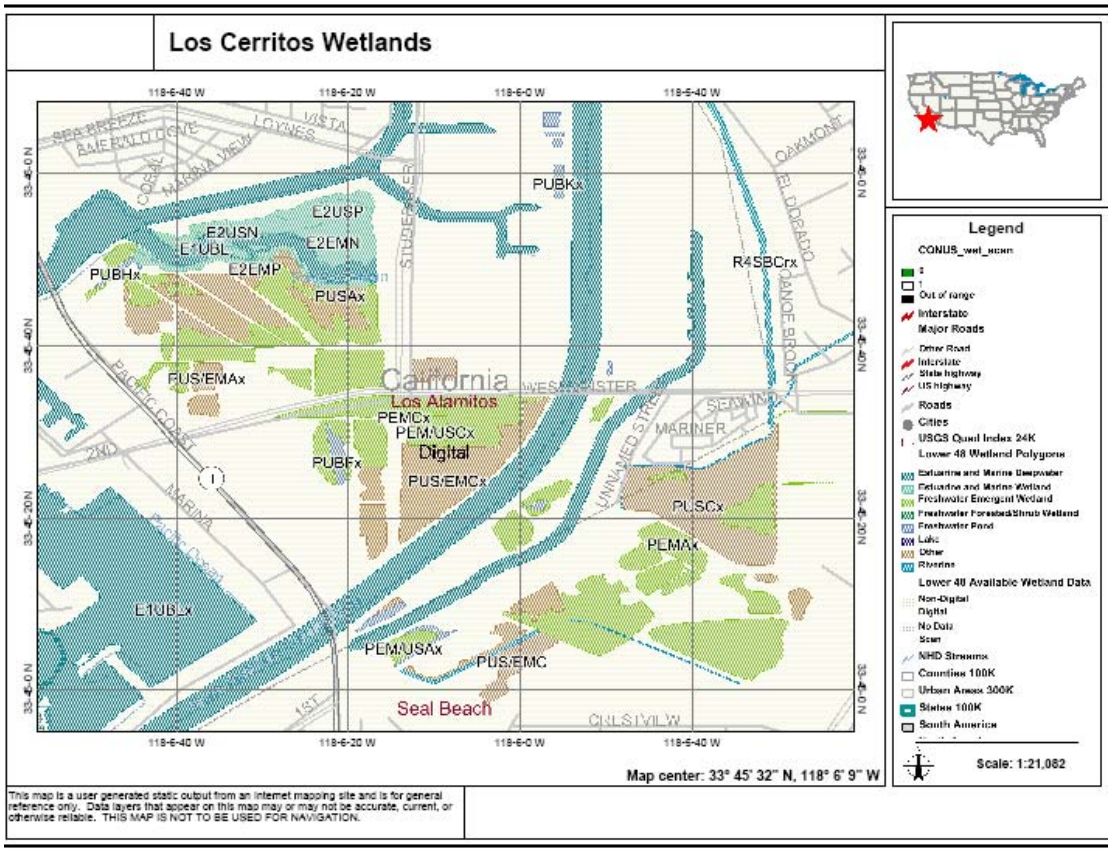


Figure 5.2: Los Cerritos Wetlands with the San Gabriel River (middle), the Los Cerritos Channel (upper left). Source: USFG Online Wetlands Mapper, 2007

There are many sites within the Los Cerritos Wetlands Complex. This study will focus on ten specific sites within the complex due to time and resource limitations in an attempt to comprehensively sample the complex (**see Figure 5.3)**.

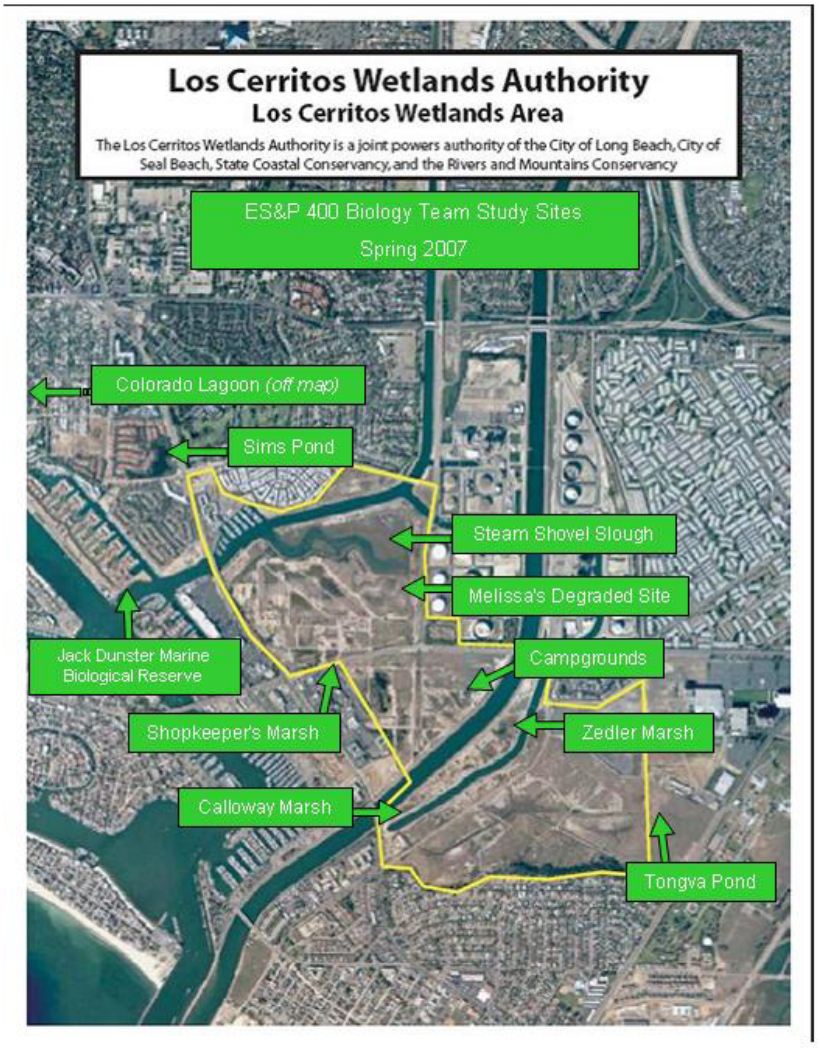


Figure 5.3: The ten study sites of this project located in the LCW Complex.

The ten study sites were selected based their habitat types, the amount of tidal flushing at each site, and specific circumstances such as mitigation sites versus degraded sites. The selected sites consisted of four tidal salt marsh sites, three degraded salt marsh sites, one brackish marsh site, and two freshwater marsh sites. Two of the sites are mitigation sites. Research for each site was conducted at the habitat level and was comprised of avian surveys.

Site 1: Steam Shovel Slough
This site is a tidal salt marsh with full tidal flushing (**Figures 5.4, 5.5, and 5.6**).

Figure 5.4: Southward-facing panoramic view of Steam Shovel Slough with Melissa's Degraded Site towards the upper left and the Los Cerritos Channel on the right.
Photos: Garcia, 2007

Figure 5.5: Steam Shovel Slough with Catalina Island in the background.
Photo: Garcia, 2007

Figure 5.6: Steam Shovel Slough at Alamitos Bay.
Photo: Garcia, 2007

Site 2: Jack Dunster Marine Biological Reserve

This site is a tidal salt marsh with full tidal flushing and is a mitigation site (**Figure 5.7**).

Figure 5.7: Jack Dunster Marine Biological Reserve is a mitigation site adjacent to a housing development and Marine Stadium in Long Beach.
Photo: Garcia, 2007

Site 3: Zedler Marsh
This site is a tidal salt marsh with muted tidal flushing (**Figure 5.8**).

Figure 5.8: Zedler Marsh is adjacent to the San Gabriel River.
Photo: Garcia, 2007

Site 4: Callaway Marsh
This site is a tidal salt marsh with muted tidal flushing (**Figure 5.9**).

Figure 5.9: Callaway Marsh has muted tidal flushing from the San Gabriel River.
Photo: Garcia, 2007

Site 5: Colorado Lagoon
This site is a degraded salt marsh with muted tidal flushing (**Figure 5.10**).

Figure 5.10: Colorado Lagoon is a degraded salt marsh surrounded by housing, a golf course, and a park.
Photo: Garcia, 2005

Site 6: Campgrounds
This site is a degraded salt marsh with no tidal flushing (**Figure 5.11**).

Figure 5.11: Campgrounds is adjacent to the San Gabriel River and a busy street.
Photo: Garcia, 2007

Site 7: Melissa's Degraded
This site is a degraded salt marsh with no tidal flushing (**Figure 5.12**).

Figure 5.12: Melissa's Degraded Site is adjacent to Steam Shovel Slough (exposed soil in the middle center above green algae).
Photo: Garcia, 2007

Site 8: Shopkeeper's Marsh
This site is a brackish marsh (**Figure 5.13**).

Figure 5.13: Shopkeeper's Marsh is divided into two sections, each surrounded by fencing, across from a shopping center.
Photo: Garcia, 2007

Site 9: Sims Pond
This site is a freshwater marsh (**Figure 5.14**).

Figure 5.14: Sims Pond is surrounded by fencing adjacent to a busy street and a housing development.
Photo: Garcia, 2006

Site 10: Tongva Pond
This site is a freshwater marsh and is a mitigation site (**Figures 5.15 and 5.16**).

Figure 5.15: Tongva Pond is located between a new housing development, the undeveloped Hellman Property, and an Orange County Retention Basin.
Photo: Garcia, 2007

Figure 5.16: Oil drilling machinery adjacent to Tongva Pond on the undeveloped Hellman Property.
Photo: Garcia, 2007

Methods

Through observation, we surveyed the above sites to detect, identify, and count the presence of bird species. We utilized statistics to estimate bird abundance, distribution, and species richness. We assumed that all bird species were available to be detected at the time the survey, and observations began 3/25/2007 and ended 4/30/2007. We also used previous data, collected in 2004 and late 2006 through 2007. We relied solely upon visual observation and used birds' songs as a guide with which to direct our attention. Additionally, we only counted birds that we were able to positively identify.

We divided ourselves into three groups and each group was assigned specific sites from which to observe and record data (**see Appendix A**). The data was recorded using the form in **Appendix B.** Included on the form were bird species, number identified, and habitat location (wetlands, uplands, artificial structures or flying). Separate log sheets were used for each observation.

In an attempt to simulate random sampling, the day of week and the time of day were varied. We employed an out-and-back method of surveying the sites. Birds were recorded on the way out; once we reached the end of the site, only new species or obvious increases were recorded. Regardless of whether or not there was a designated path, we took a different route on each visit, taking care not to disturb vegetation. We used binoculars and bird field guides to aid us in identification (**see references**). At the conclusion of our sampling and data collection, we used statistics to analyze our data and formulate our findings.

Statistics

To determine the health of the Los Cerritos Wetlands, we used the Shannon-Weiner Index to measure biodiversity at each site:

(**Equation 1**) $H = -\sum p_i \ln p_i$

with values of i from 1 to S, where S is the total number of species present at each site and p_i is the proportion of S made up of the i^{th} species. Both species richness and individual abundances contribute to biodiversity, therefore to better interpret our index results, we calculated both the maximum biodiversity possible based on total number of species:

(**Equation 2**) $H_{max} = \ln(S)$

and the evenness of species:

(**Equation 3**) $E_H = H / H_{max}$

In order to assess the primary habitats used by birds at each site, we grouped the birds into eight separate category types: diving birds, gulls and terns, herons and egrets, raptors, shorebirds, upland birds, water fowl and Belding's Savannah Sparrow. The Belding Savannah Sparrow is in a category by itself because of its dependence on pickleweed, *Salicornia virginica*. (For a list of the birds in each category, see **Appendix C**).We created pie charts based on the proportions of bird groups at each site.

Data Collection and Analysis

Bird Species

The number of bird species at each site was determined by entering data collected on data sheets into an excel file for each site. The file for each site contained worksheets with data for each day a bird survey was conducted (or information received for Colorado Lagoon and Sims Pond). The birds noted on the data sheets that could not be positively identified were not entered into the excel spreadsheet. A master list of species observed at all sites was created. The percent total of bird species observed was determined by dividing the number of species at each site by the total number of species for the complex. The counts (number of sightings for each bird on each day at each location) were tallied using excel. The number of site visits varied for each site and was noted accordingly. The number of species a person is expected to observe per visit for each site was determined by dividing the number of species observed at a site by the number of times the site was visited. The counts a person is expected to observe per visit for each site was determined in the same manner.

The dominant bird species for each site was determined on a daily basis. A list of the dominant species was compiled and the counts were tallied to determine the species with the most counts for that site. The dominant bird species for each site, and their

respective counts, were then compiled in order to determine the dominant species of the complex.

The number and location of non-native bird species observed for the complex was determined by comparing the master list of species for the complex (**see Appendix D**) with the *Official California Bird Records Committee State Bird List* (dated April 10, 2007). For the non-native birds that were not listed, the native status of each bird was individually researched. Once the non-native species were identified, the presence and absence of each non-native was determined for each site.

Results

There were 106 bird species positively identified at the entire LCW Complex (**see Appendix D**). The number of bird species identified at each site in descending order are as follows (**see Table 5.1**): Sims Pond – 69 species; Steam Shovel Slough – 50 species; Colorado Lagoon and Tongva Pond – 37 species; Jack Dunster Marine Biological Reserve – 34 species; Shopkeeper's Marsh – 30 species; Zedler Marsh – 25 species; Campgrounds – 21 species; Melissa's Degraded Site – 13 species; Callaway Marsh – 12 bird species. **Table 5.1** also contains the percentage of species per site, the counts of birds at each site, the number of site visits for each site, the number of species per visit at each site, and the number of counts per visit at each site.

Table 5.1: Bird species observed, counts, and site visits for LCW Complex and each site.

Bird Species Observed, Percentages, Counts, and Site Visits

Location	Bird Species	% of Total	Sightings	Site Visits	Species / Visit	Counts / Visit
Callaway Marsh	12	11.3%	44	5	2.4	8.8
Campgrounds	21	19.8%	86	8	2.6	10.75
Colorado Lagoon*	37	34.9%	6914	14	2.6	493.9
Jack Dunster	34	32.1%	594	8	4.25	74.25
Melissa's Degraded	13	12.3%	53	8	1.6	6.6
Shopkeeper's Marsh	30	28.3%	376	8	3.75	47
Sims Pond**	69	65.1%	3380	14	4.9	241.4
Steam Shovel Slough	50	47.2%	1198	7	7.1	171.1
Tongva Pond	37	34.9%	410	9	4.1	45.6
Zedler Marsh	25	23.6%	579	9	2.8	64.3
LCW Complex	106	100%	13,634			

**10/2006 to 4/2007*
***1/2004 to 4/2007*

The dominant bird species of the LCW Complex, based on counts, was the American Coot with 3,434 counts (**see Table 5.2**). The dominant bird species for each site is as follows: Callaway Marsh – Mourning Dove; Campgrounds – Cliff Swallow; Colorado Lagoon – American Coot; Jack Dunster – Double-crested Cormorant; Melissa's Degraded – European Starling; Shopkeeper's Marsh – Cinnamon Teal; Sims Pond – Black-crowned Night Heron; Steam Shovel Slough – Semipalmated Plover; Tongva Pond – Mallard; Zedler Marsh – Western Sandpiper.

Table 5.2: Dominant bird species observed at each site in the LCW Complex and their counts.

Dominant Bird Species at Each Site and the Complex

Location	Mourning Dove	Cliff Swallow	American Coot	Double-crested Cormorant	European Starling	Cinnamon Teal	Black-crowned Night Heron	Semipalmated Plover	Mallard	Western Sandpiper
Callaway Marsh	**16**	-	-	-	6	-	-	-	-	-
Campgrounds	2	**25**	-	7	16	-	-	-	-	-
Colorado Lagoon*	-	-	**3278**	144	-	-	5	1	357	22
Jack Dunster	19	45	17	**88**	7	-	-	1	24	5
Melissa's Degraded	12	3	-	1	**19**	-	-	-	-	-
Shopkeeper's Marsh	8	20	5	-	7	**102**	3	-	30	16
Sims Pond**	43	5	129	5	25	143	**953**	-	582	-
Steam Shovel Slough	53	2	-	18	42	-	-	**267**	14	50
Tongva Pond	30	18	5	-	40	19	-	-	**67**	-
Zedler Marsh	3	1	-	6	11	-	-	-	1	**208**
LCW Complex	186	119	**3434**	269	173	264	961	269	1075	301

**10/2006 to 4/2007*

***1/2004 to 4/2007*

Four non-native bird species were observed at the complex (from the 106 total bird species) (**Table 5.3**). The European Starling was the non-native species at most sites (8 sites), followed by the Rock Pigeon (7 sites), the House Sparrow (3 sites), and the Nutmeg Mannikin (1 site).

Table 5.3. Non-native species observed and their locations in the LCW Complex.

Locations of Non-Native Bird Species

Location	European Starling	House Sparrow	Nutmeg Mannikin	Rock Pigeon
Callaway Marsh	X	-	-	X
Campgrounds	-	-	-	X
Jack Dunster	X	X	-	X
Melissa's Degraded	X	-	-	-
Shopkeeper's Marsh	X	-	-	-
Sims Pond	X	X	X	X
Steam Shovel Slough	X	X	-	X
Tongva Pond	X	-	-	X
Zedler Marsh	X	-	-	X

Of the 106 bird species observed at the LCW complex, 98 (91.5%) had protected status under the Migratory Bird Treaty Act (MBTA); three (2.8%) had protected status under the Endangered Species Act (ESA), and three (2.8%) had protected status under the California Endangered Species Act (CESA). Seven species (6.6%) had no protective

status under any act (**Table 5.4 and Appendix D**). The birds protected under the Endangered Species act are the American Coot, the California Least Tern and the California Brown Pelican; birds protected under the CESA are the California Least Tern, the California Brown Pelican and the Belding's Savannah Sparrow.

Table 5.4. Summary of bird species protected under MBTA, ESA, and CESA.

95 MBTA ONLY
1 MBTA & ESA
2 MBTA, ESA, CESA
1 CESA
7 NO PROTECTION
106 SPECIES

The bird species of special concern with state endangered status, federal endangered status, or both that were observed in the complex were Belding's Savannah Sparrow (4 sites), California Brown Pelican (1 site), and California Least Tern (1 site) (**Table 5.5**).

Table 5.5. Observed bird species of special concern and counts in LCW Complex.

Bird Species of Special Concern / Location	Belding's Savannah Sparrow	California Brown Pelican	California Least Tern	Least Bell's Vireo	Snowy Plover
Campgrounds	3	-	-	-	-
Colorado Lagoon	-	30	-	-	-
Melissa's Degraded	3	-	-	-	-
Steam Shovel Slough	36	-	6	-	-
Zedler Marsh	3	-	-	-	-

The presence/absence table (**Appendix E**) allows us to see the presence and absence of each bird species positively identified at each of the ten sites surveyed. Callaway Marsh and Melissa's Degraded had the fewest bird species (12 and 13, respectively). Sims Pond had the highest number of species (69).

According to our Shannon-Weiner Index results from **table 5.6**, Sims Pond had the highest biodiversity value and the greatest number of species, yet had a comparably low evenness value ($H = 3.357$; $H_{max} = 4.19$; $E_H = 0.801$). Conversely, Callaway Marsh ($H = 2.2$; $H_{max} = 2.485$; $E_H = 0.893$) and Melissa's Degraded ($H = 2.335$; $H_{max} = 2.639$; $E_H = 0.885$) both had high evenness values but low biodiversity and species richness

values. Tongva Pond had consistently high values (H = 3.354; H_{max} = 3.611; E_H = 0.929), while the results for Zedler Marsh (H = 2.024; H_{max} = 3.219; E_H = 0.629) and Campgrounds (H = 2.663; H_{max} = 3.091; E_H = 0.861) were consistently low. Although Steam Shovel had a high potential for biodiversity, both its biodiversity and evenness values were low (H = 2.988; H_{max} = 3.401; E_H = 0.748). With the exception of its low evenness value, Colorado Lagoon (H = 2.335; H_{max} = 3.611; E_H = 0.647) had relatively average results for all three values, as did Shopkeeper Marsh (H = 2.988; H_{max} = 3.401; E_H = 0.879) and Jack Dunster (H = 3.079; H_{max} = 3.526; E_H = 0.873).

Table 5.6

Shannon-Weiner Index			
Sites	**H**	**H_{max}**	**E_H**
Callaway Marsh	2.2	2.485	0.893
Campgrounds	2.663	3.091	0.861
Colorado Lagoon	2.335	3.611	0.647
Jack Dunster	3.079	3.526	0.873
Melissa's Degraded	2.335	2.639	0.885
Shopkeeper Marsh	2.988	3.401	0.879
Sims Pond	3.357	4.19	0.801
Steam Shovel Slough	2.957	3.951	0.748
Tongva Pond	3.354	3.611	0.929
Zedler Marsh	2.024	3.219	0.629

Of the ten sites surveyed, only two had all eight categories of birds present: Steam Shovel Slough and Zedler Marsh (**figures 5.17 – 5.26**). At both of these sites, the shorebirds were the majority group (63% and 81%, respectively). However, at most sites upland birds were the dominant group (Melissa's Degraded: 74%; Campgrounds: 76%; Jack Dunster: 42%; Callaway: 79%; and Tongva Pond: 51%). The major group at Colorado Lagoon was water fowl (64%). Water fowl also shared the majority with upland birds at Sims Pond (36% for each group). The most evenly distributed site was Shopkeeper Marsh (shorebirds: 32%; upland birds: 32%; water fowl: 28%), however this site only had four of the eight bird groups present. The most widely distributed bird groups across the complex were the herons and egrets at ten sites, followed by the shorebirds and upland birds at nine sites each. Diving birds, gulls and terns, and water fowl were also found at a majority of the sites (8, 7, and 7, respectively), however the Belding's Savannah Sparrow was only seen at four.

Figure 5.17

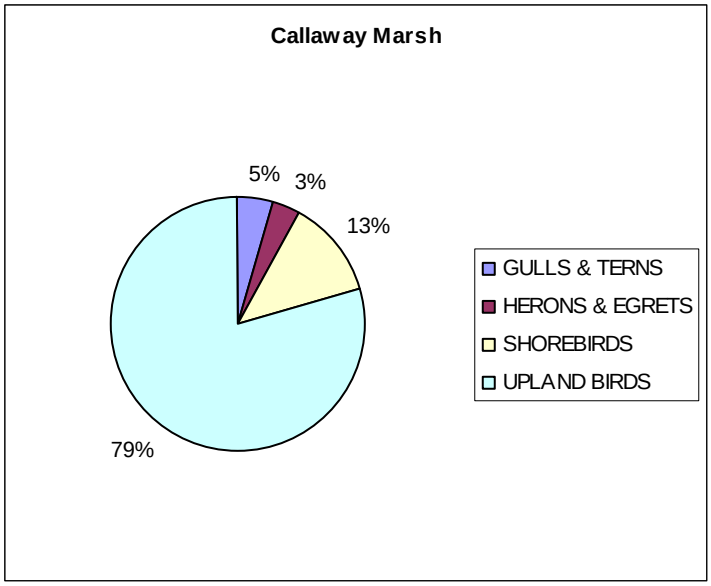


Figure 5.18

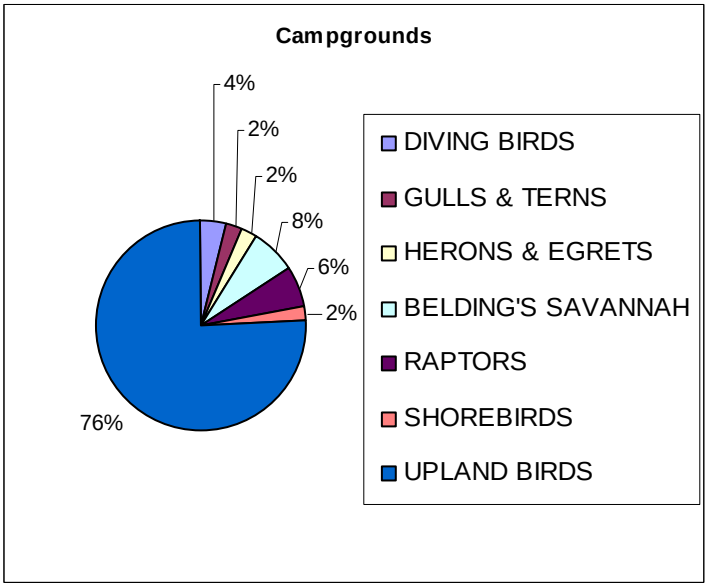


Figure 5.19

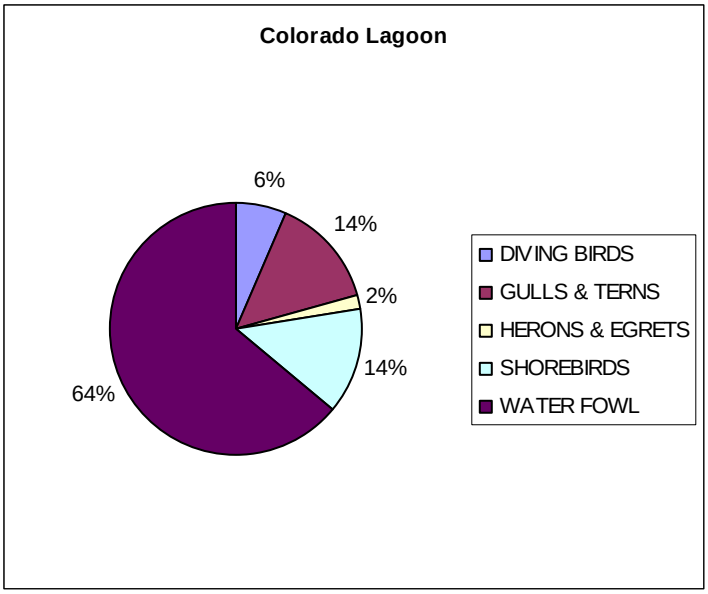


Figure 5.20

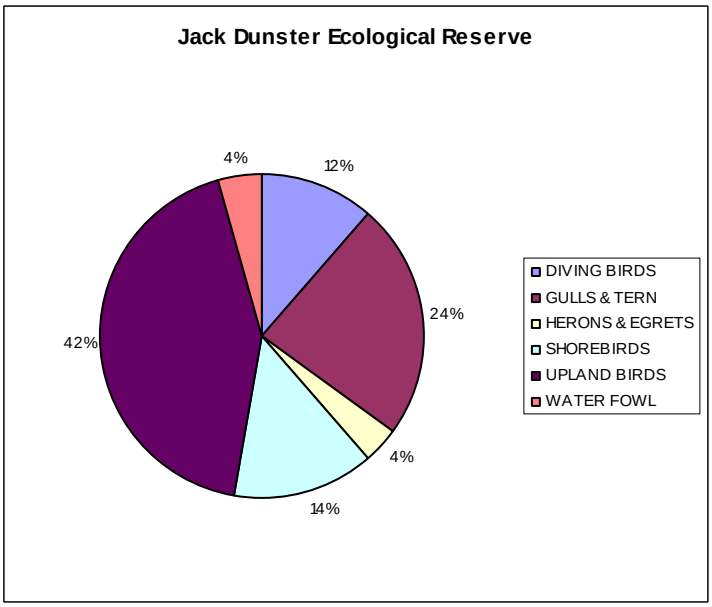


Figure 5.21

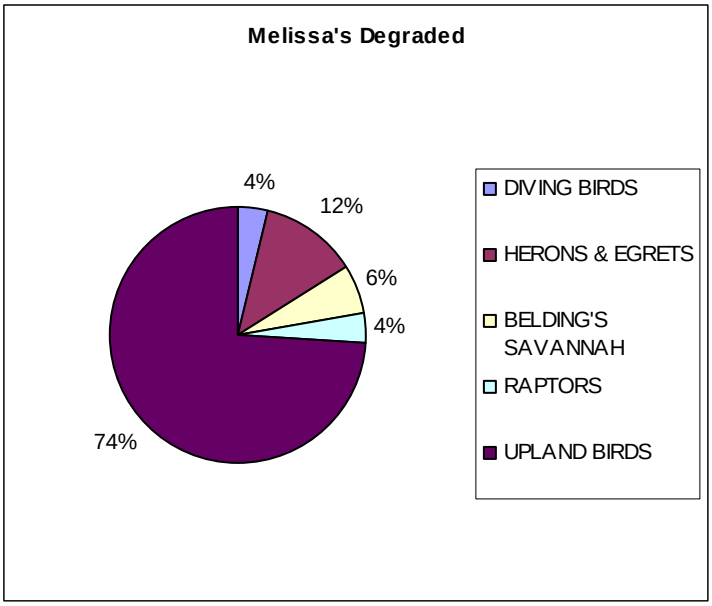


Figure 5.22

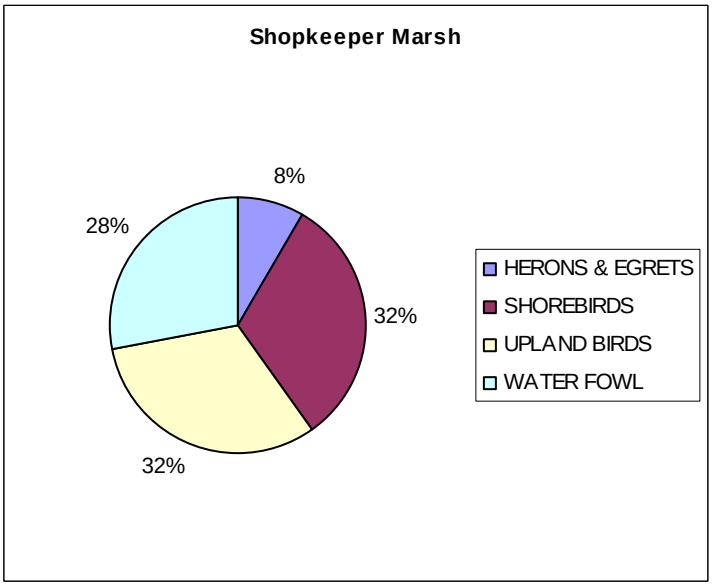


Figure 5.23

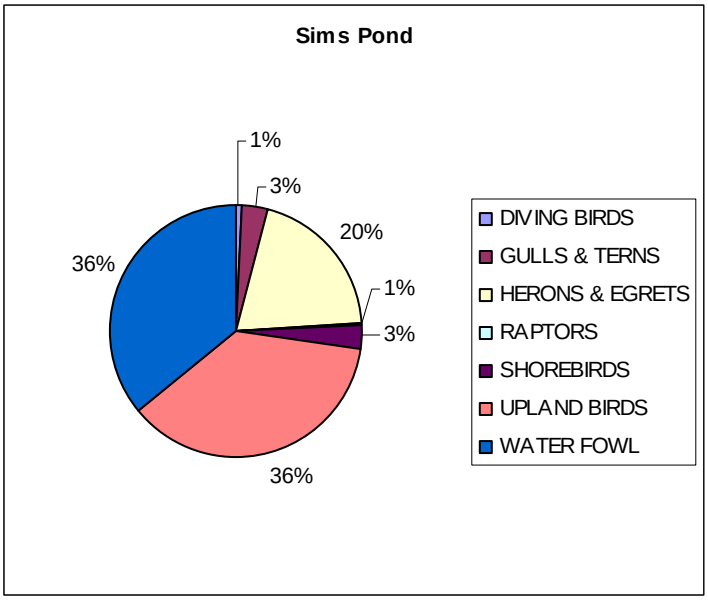


Figure 5.24

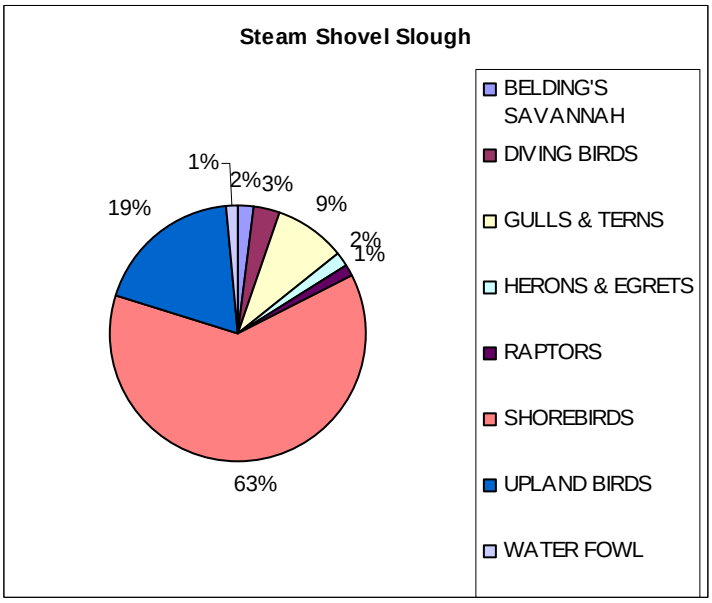


Figure 5.25

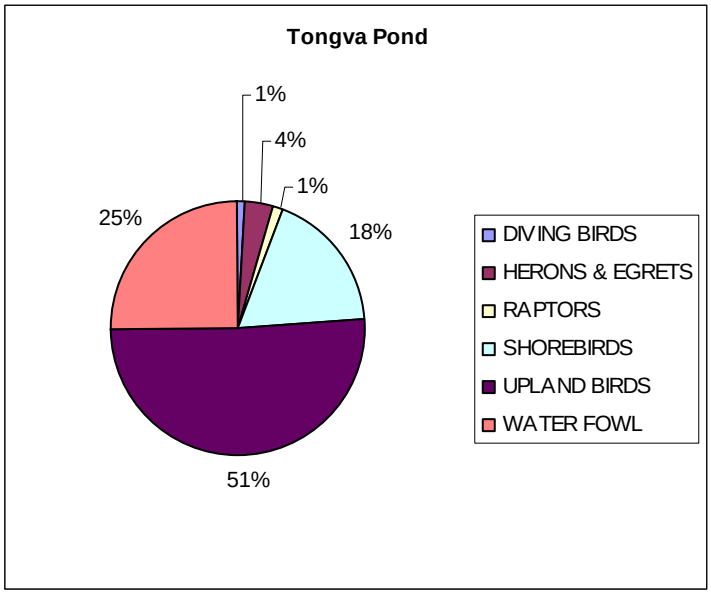
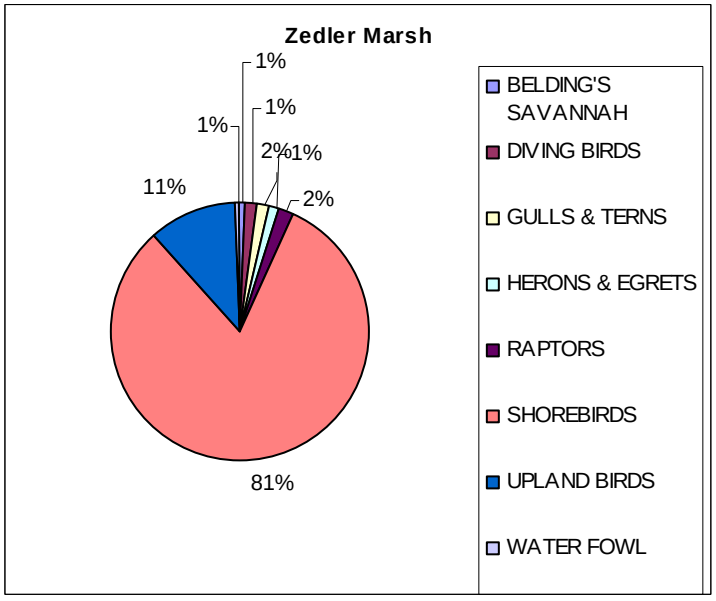


Figure 5.26



Using Minitab, we created histograms in order to graphically depict frequencies (**see Appendix F)**. The histograms are useful for displaying what proportion of species fall into which numerical count categories. The data employed in the histograms was taken from a table of observed counts per species per day. The number of species that share a count are indicated by the number above the bar graph. The number (N) of species present at each site is located in the key to the right of each graph. From the graphs it is possible to determine which sites best approximate a normal curve. This is a graphical depiction of the number of different species, and the average presence of that species, per site plus an indication of any and all outliers.

While observing the sites within the Los Cerritos Wetlands Complex we also found it important to compare our species to those of nearby locations. A table was made for comparing bird species at the Bolsa Chica Wetlands, the Naval Weapons Station Seal Beach and the Los Cerritos Wetlands Complex in order to identify the exact species present or absent at each location. These sites are locations of completed and ongoing restoration projects or are labeled as wildlife refuges.

The Naval Weapons Station Seal Beach is the largest area with more than 5,000 acres, 920 acres of which are a national wildlife refuge (Smith, 2005), while the Bolsa Chica Wetlands are home to nearly 1700 acres (Bolsa Chica Land Trust, 2007). The smallest of the locations is the Los Cerritos Wetlands Complex at nearly 500 acres, and includes ten sites observed. The LCW Complex is clearly the smallest in acreage, but includes strictly wetland areas unlike the Bolsa Chica Wetlands, which includes the mesa, lowlands and wetlands and the naval station, which is home to a wildlife refuge. The LCW Complex possesses less than half of the same birds seen at the two other locations, the majority of which are protected under the ESA or the MBTA, and does so in less than half the acres (**Appendix D**). Another important aspect obtained from the table created was the presence of such birds as the Cassin's Vireo, the Nutmeg Mannikin, and the Feral Duck that were not present at any of the other locations. While these birds are not protected under the MBTA, ESA or CESA they are still important attributes to our complex (**Appendix G**).

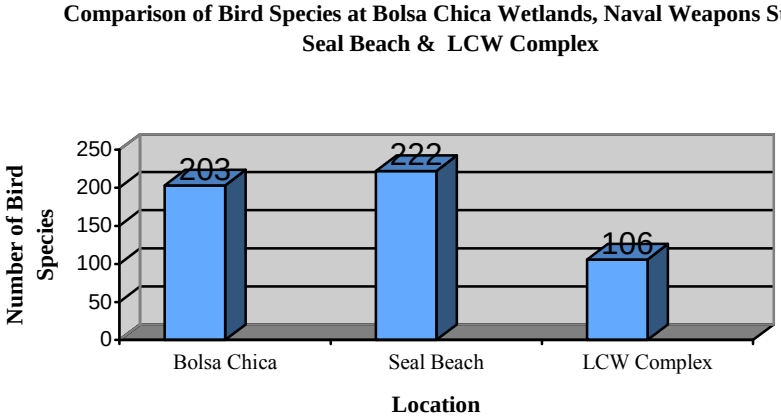


Fig. 5.27: Graphical representation of the total number of species at the Bolsa Chica Wetlands, the Seal Beach Naval Weapons Station and the Los Cerritos Wetlands Complex. The total number of species present between all three locations was 271.

Conclusions

The observation of 106 positively identified bird species at the Los Cerritos Wetlands indicates that the complex is healthy enough to support this number of species. We were limited by the project time frame in that we only had the month of April to collect original data for eight of our ten sites. Our sampling period occurred during an important time in the yearly avian cycle when winter birds are migrating out of the area and breeding pairs are coming in to the area. Despite our limitations, we obtained a year-round perspective of birds at the complex from the Colorado Lagoon and Sims Pond data.

Although there were more birds observed at Colorado Lagoon based on counts, Sims Pond had the highest number of bird species in total, indicating the relatively greater health of this site. In contrast, Callaway Marsh had the lowest number of bird species present followed by Melissa's Degraded indicating that those sites are the least healthy. Steam Shovel Slough consistently contained the greatest number of species per visit, while Melissa's Degraded consistently had the least number of species per visit.

The dominant bird species at each site suggest the uniqueness of habitat and health of each site. At Melissa's Degraded, the dominant species was the non-native European Starling. This is indicative of the level of degradation at this site, as non-native species are generally an indication of poor habitat health. In contrast, the healthy and mitigated sites had native species; Steam Shovel Slough (healthy): Semilpalmated Plover; Jack Dunster (mitigated): Double-crested Cormorant; and Tongva Pond (mitigated): Mallard. The dominant bird species for the entire complex was the American Coot, a native species.

The non-native bird species found in the complex were the European Starling, House Sparrow, Nutmeg Mannikin, and Rock Pigeon. Sims Pond was the only site where all four species were observed suggesting the need for further research at that location. Special concern bird species were observed at Campgrounds, Colorado Lagoon, Melissa's Degraded, Steam Shovel Slough, and Zedler Marsh, indicating that the following endangered birds are present in the complex: Campgrounds – Belding's Savannah Sparrow; Colorado Lagoon – California Brown Pelican; Melissa's Degraded – Belding's Savannah Sparrow; Steam Shovel Slough – Belding's Savannah Sparrow and California Least Tern; and Zedler Marsh – Belding's Savannah Sparrow.

Sims Pond was found to have both the greatest number of species and the highest level of biodiversity based on the Shannon-Weiner Index. This may be attributed to the fact that Sims Pond is a restricted-access reserve that has been restored in recent years. Moreover, Sims Pond is the only site within the Los Cerritos Wetlands with riparian habitat, which provides important niches for different bird species. Indeed, the only variable of relatively low value at this site was species richness, and overall biodiversity would have certainly been nearer maximum biodiversity had individual species abundances been more equitable ($H = 3.357$; $H_{max} = 4.19$; $E_H = 0.801$). Tongva Pond appeared to be the healthiest site, with high biodiversity, species richness, and evenness values. This data indicates the mitigation at this site was successful, and supports further mitigation within the Los Cerritos Wetlands in the future ($H = 3.354$; $H_{max} = 3.611$; $E_H = 0.929$). The other mitigation site, Jack Dunster, had comparably lower values for each area of analysis, though overall these values were average. Possible factors to explain this difference that were not studied include: relative size, levels and affects of

recreation, and the extent of urbanization immediately surrounding each site ($H = 3.079$; $H_{max} = 3.526$; $E_H = 0.873$). Though not a natural site, Shopkeeper's Marsh had relatively average values, suggesting restoration at this site could be successful ($H = 2.988$; $H_{max} = 3.401$; $E_H = 0.879$). Of the remaining sites, Steam Shovel Slough is the least degraded. This may be due to the full tidal flushing that Steam Shovel Slough receives; at the other five sites, tidal flushing is muted or completely absent ($H = 2.988$; $H_{max} = 3.401$; $E_H = 0.748$). Although Zedler Marsh is a restricted-access site, it exhibited some of the lowest values in the analysis. A likely cause is the location of this wetland; it is surrounded by other degraded areas, such as the Campground site which scored similarly low in each of the categories ($H = 2.024$; $H_{max} = 3.219$; $E_H = 0.629$; and, $H = 2.663$; $H_{max} = 3.091$; $E_H = 0.861$, respectively). Though Melissa's Degraded had low biodiversity and species richness values, species evenness was quite high ($H = 2.335$; $H_{max} = 2.639$; $E_H = 0.885$). Similar outcomes, where one of the three results did not appear to be consistent with the other two, occurred for both Colorado Lagoon and Callaway Marsh ($H = 2.335$; $H_{max} = 3.611$; $E_H = 0.647$; and, $H = 2.2$; $H_{max} = 2.485$; $E_H = 0.893$, respectively). Further study is needed to adequately interpret the results at these three sites.

From our pie chart results (**figures 5.17 - 5.26**) we determined that all bird groups were present at Steam Shovel Slough and Zedler Marsh. This is consistent with the wide range of habitats and full tidal flushing available at Steam Shovel Slough. However, Zedler Marsh is more degraded and has only muted tidal flushing; therefore the best explanation for its diversity of bird groups is that it is a restricted-access site. Shopkeeper Marsh had the greatest evenness between groups, however only four of the eight groups were present there. As Shopkeeper Marsh is a comparatively small site, it may be lacking certain habitats that these other bird groups require. Tongva Pond and Sims Pond, both freshwater marshes, shared similar results; both sites were dominated by water fowl and upland bird species. Further, six of the eight species were present at Tongva Pond and seven at Sims Pond, likely due to the fact that Tongva Pond is a mitigation site and Sims Pond is a restored site and restricted-access reserve. Although Jack Dunster is a marine reserve, the major group at this location were upland birds. Future researcher might investigate the affect of marine recreation as a possible explanation for this. There were a significantly large proportion of upland birds at Callaway Marsh, most likely due to garbage that litters the marsh habitat at this location - another possible topic for future studies. Both Melissa's Degraded and Campgrounds are dominated by upland bird species which can be explained by the lack of tidal flushing at these sites. Most of the other groups identified at these sites were observed flying to Steam Shovel Slough, adjacent to Melissa's Degraded, and the San Gabriel River Channel, adjacent to Campgrounds. Colorado Lagoon is a degraded site as well, yet the muted tidal flushing it receives is enough to support a large number of water fowl, the dominate group at this site.

The histograms indicate that Tongva Pond best exemplifies species diversity and richness; it is the closest approximation to normal and has the fewest zero count gaps. Sims Pond had the highest number of species present, but had very low counts. On average, many species are present at Sims Pond, but in relatively low numbers. The histograms also exhibit outliers: Zedler Marsh has one outlier species with a count greater than 60, indicating that Zedler Marsh is dominated by one species found in relatively high numbers.

As we have found in this study, the Los Cerritos Wetlands currently supports a large number of avian species. Though a total of 106 birds were positively identified within the complex, only between 11-65% were present at any given study site. This indicates that, while the Los Cerritos Wetlands are cumulatively healthy and supportive of bird species, many of the individual marshes within the complex are not. Indeed, those sites with the highest levels of biodiversity exhibited the greatest range of habitat, such as Steam Shovel Slough. The restoration and mitigation sites, Tongva Pond, Jack Dunster, and Sims Pond, proved to be successful in our study when compared to some of the more degraded sites, Melissa's Degraded, Campgrounds, and Callaway Marsh. However, the Los Cerritos Wetlands would benefit more from a complex-wide restoration. At other Southern California sites, such as the Bolsa Chica Wetlands and the Naval Weapons Station Seal Beach, species richness is approximately twice that of the Los Cerritos Wetlands. The most significant source of this discrepancy is the connectedness of habitats that is present at the other wetlands, but that is lacking at the LCW. Also, both the Bolsa Chica Wetlands and the Naval Weapons Station Seal Beach cover much greater areas than do the Los Cerritos Wetlands. Therefore, those planning restoration projects in the Los Cerritos Wetlands should consider the following: 1) Investigate the complex as a whole, rather than directing attention towards individual sites; 2) Expand the complex, if possible; 3) Connect sites within the complex by means of wildlife corridors; and, 4) Ensure all wetland habitat types are evenly distributed throughout the complex.

The benefits of a complex-wide restoration would not only affect birds, but also local communities and the entire Southern California coast. A restoration will increase biodiversity and provide healthier habitats for MBTA, ESA and CESA species already inhabiting the area, and would attract new species as well. As with the Bolsa Chica Wetlands, a restoration of this scale will heighten public awareness of the Los Cerritos Wetlands, providing for increased ecotourism, educational opportunities, and will encourage future generations to invest their time in protecting this valuable resource. Finally, a restored Los Cerritos Wetlands will be a tremendous asset to Southern California as we begin to replace the coastal wetlands we have destroyed.

References

Adamus, Paul R. *Bioindicators for Assessing Ecological Integrity of Prairie Wetlands*. September 1995 http://www.epa.gov/owow/wetlands/wqual/ppaindex.html

Bolsa Chica Land Trust. http://www.bolsachicalandtrust.org/bclt.html 2003-2005. 14 May 2007.

California Bird Records Committee; Western Field Ornithologists (WFO). *Review List of the Western Field Ornithologists' California Birds Records Committee*. 10 April 2007. http://www.wfo-cbrc.org/cbrc/ca_list.html

California Department of Fish and Game; Habitat Conservation Planning Branch. *Threatened and Endangered Birds Species Accounts.* http://www.dfg.ca.gov/hcpb/species/t_e_spp/tebird/tebirda.shtml May 2007

Mitsch, William and James Gosselink. *Wetlands*. 3rd Edition. John Wiley & Soncs, Inc. New York. 2000.

Schoenherr, Allan A. *A Natural History of California.*UC Press-Berkeley.1992.

Sibley, David Allen. *The Sibley Field Guide to Birds Of Western North America*. Alfred A. Knopf, Inc, NY. 2003.

Smith, Gregg. *Birds Thriving at Naval Weapons Station Seal Beach*. 21 January 2005. 14 May 2007. http://www.news.navy.mil/search/display.asp?story_id=16696

Trulio, Lynne Ph. D. *Basics of Bird Conservation in the U.S*. January 12, 2000 http://www.epa.gov/owow/birds/basics.html

U.S. Fish and Wildlife Service. *Birds Protected by the Migratory Bird Treaty Act.* http://www.fws.gov/migratorybirds/intrnltr/mbta/mbtintro.html May 2007

Appendix A

Avian Survey Schedule

Date	Day	Site Visited	Time	Observers
3/28/07	Wed	Jack Dunster	8:52am-9:12am	Eric Zahn
3/28/07	Wed	Shopkeeper Marsh	10:40am-10:45am	Eric Zahn
3/30/07	Fri	Campgrounds	10:15am-10:30am	Eric Zahn
3/30/07	Fri	Zedler Marsh	10:52am-11:00am	Eric Zahn
3/30/07	Fri	Jack Dunster	10:25am-11:00am	Mayra Garcia, Maja Roble
3/30/07	Fri	Tongva Pond	12:12pm-12:29pm	Mayra Garcia, Maja Roble
3/30/07	Fri	Shopkeeper Marsh	12:42pm-1:10pm	Mayra Garcia, Maja Roble
3/30/07	Fri	Jack Dunster	1:45pm-2:00pm	Eric Zahn
4/2/07	Mon	Tongva Pond	9:20am-9:55am	Everyone
4/2/07	Mon	Shopkeeper Marsh	10:10am-10:30am	Everyone
4/4/07	Wed	Jack Dunster	12:51pm-1:35pm	Mayra Garcia, Maja Roble
4/4/07	Wed	Shopkeeper Marsh	1:45pm-2:23pm	Mayra Garcia, Maja Roble
4/4/07	Wed	Tongva Pond	2:40pm-3:05pm	Mayra Garcia, Maja Roble
4/5/07	Thurs	Steam Shovel Slough	12:15pm-1:15pm	Christy Norris, Claudia Monge
4/5/07	Thurs	Melissa's Degraded Site	1:15pm-1:24pm	Christy Norris, Claudia Monge
4/5/07	Thurs	Campgrounds	1:48pm-2:07pm	Christy Norris, Claudia Monge
4/6/07	Fri	Jack Dunster	12:41pm-1:12pm	Mayra Garcia, Maja Roble
4/6/07	Fri	Shopkeeper Marsh	1:28pm-1:43pm	Mayra Garcia, Maja Roble
4/6/07	Fri	Tongva Pond	1:55pm-2:34pm	Mayra Garcia, Maja Roble
4/10/07	Tues	Zedler Marsh	7:00am-7:30am	Eric Zahn
4/12/07	Thurs	Zedler Marsh	4:45pm-5:00pm	Eric Zahn
4/12/07	Thurs	Callaway Marsh	5:00pm-5:05pm	Eric Zahn
4/12/07	Thurs	Marketplace Marsh	5:15pm-5:30pm	Eric Zahn
4/13/07	Fri	Zedler Marsh	2:30pm-2:42pm	Eric Zahn
4/13/07	Fri	Callaway Marsh	2:45pm-2:50pm	Eric Zahn
4/13/07	Fri	Tongva Pond	3:30pm-3:45pm	Eric Zahn
4/14/07	Sat	Jack Dunster	4:56pm-5:35pm	Mayra Garcia, Maja Roble
4/14/07	Sat	Shopkeeper Marsh	5:43pm-6:06pm	Mayra Garcia, Maja Roble
4/14/07	Sat	Tongva Pond	6:18pm-6:39pm	Mayra Garcia, Maja Roble
4/16/07	Mon	Steam Shovel Slough	3:40pm-4:55pm	Jennifer Jarvis, Christy Norris
4/17/07	Tue	Zedler Marsh	2:50pm-3:05pm	Eric Zahn
4/17/07	Tue	Callaway Marsh	3:25pm-3:45pm	Eric Zahn
4/17/07	Tue	Steam Shovel Slough	3:34pm-4:50pm	Jennifer Jarvis, Claudia Monge, Christy Norris
4/17/07	Tue	Shopkeeper Marsh	3:55pm-4:10pm	Eric Zahn
4/17/07	Tue	Melissa's Degraded Site	4:50pm-5:02pm	Jennifer Jarvis, Claudia Monge
4/17/07	Tue	Campgrounds	5:20pm-5:42pm	Jennifer Jarvis, Claudia Monge, Christy Norris
4/17/07	Tue	Tongva Pond	3:38pm-4:08pm	Mayra Garcia, Maja Roble
4/17/07	Tue	Shopkeeper Marsh	4:20pm-4:41pm	Mayra Garcia, Maja Roble
4/17/07	Tue	Jack Dunster	4:56pm-5:27pm	Mayra Garcia, Maja Roble
4/19/07	Thurs	Steam Shovel Slough	12:15pm-1:00pm	Eric Zahn
4/19/07	Thurs	Zedler Marsh	1:45pm-2:00pm	Eric Zahn
4/19/07	Thurs	Tongva Pond	1:53pm-2:20pm	Mayra Garcia, Maja Roble
4/19/07	Thurs	Shopkeeper Marsh	2:34pm-2:59pm	Mayra Garcia, Maja Roble
4/19/07	Thurs	Jack Dunster	3:14pm-3:42pm	Mayra Garcia, Maja Roble
4/19/07	Thurs	Steam Shovel Slough	2:22pm-3:36pm	Jennifer Jarvis, Claudia Monge, Christy Norris
4/19/07	Thurs	Melissa's Degraded Site	3:36pm-3:44pm	Jennifer Jarvis, Claudia Monge, Christy Norris
4/19/07	Thurs	Campgrounds	4:03pm-4:25pm	Jennifer Jarvis, Claudia Monge, Christy Norris
4/22/07	Sun	Melissa's Degraded Site	2:30pm-2:50pm	Christy Norris, Claudia Monge
4/22/07	Sun	Campgrounds	3:05pm-3:30pm	Christy Norris, Claudia Monge
4/25/07	Wed	Zedler Marsh	4:45pm-5:00pm	Eric Zahn
4/26/07	Thurs	Steam Shovel Slough	12:00pm-1:00pm	Eric Zahn
4/26/07	Thurs	Zedler Marsh	1:00pm-1:20pm	Eric Zahn
4/26/07	Thurs	Steam Shovel Slough	2:15pm-3:20pm	Jennifer Jarvis, Claudia Monge, Christy Norris
4/26/07	Thurs	Tongva Pond	3:03pm-3:45pm	Mayra Garcia, Maja Roble
4/26/07	Thurs	Melissa's Degraded Site	3:20pm-3:42pm	Jennifer Jarvis, Claudia Monge, Christy Norris
4/28/07	Sat	Steam Shovel Slough	9:15am-11:15am	Christy Norris, Eric Zahn
4/28/07	Sat	Melissa's Degraded Site	11:20am-11:34am	Christy Norris, Eric Zahn
4/28/07	Sat	Campgrounds	11:53am-12:25pm	Christy Norris, Eric Zahn
4/29/07	Sun	Melissa's Degraded Site	10:19am-10:38pm	Jennifer Jarvis, Claudia Monge
4/29/07	Sun	Campgrounds	11:00am-11:21am	Jennifer Jarvis, Claudia Monge
4/30/07	Mon	Zedler Marsh	6:00pm-6:10pm	Eric Zahn

Appendix B

Avian Survey Data Sheet

Environmental Science & Policy 400 • 2007 Biology Team Bird Survey

Date	**Observer**	**Location**	**Start Time**	**End Time**
Weather	**Tide**	**Wind**	**Temperature**	

Species:	Number	Comments
	Habitat:	☐ Wetlands ☐ Uplands ☐ Artificial ☐ Flying
Species:	Number	Comments
	Habitat:	☐ Wetlands ☐ Uplands ☐ Artificial ☐ Flying
Species:	Number	Comments
	Habitat:	☐ Wetlands ☐ Uplands ☐ Artificial ☐ Flying
Species:	Number	Comments
	Habitat:	☐ Wetlands ☐ Uplands ☐ Artificial ☐ Flying
Species:	Number	Comments
	Habitat:	☐ Wetlands ☐ Uplands ☐ Artificial ☐ Flying
Species:	Number	Comments
	Habitat:	☐ Wetlands ☐ Uplands ☐ Artificial ☐ Flying
Species:	Number	Comments
	Habitat:	☐ Wetlands ☐ Uplands ☐ Artificial ☐ Flying
Species:	Number	Comments
	Habitat:	☐ Wetlands ☐ Uplands ☐ Artificial ☐ Flying
Species:	Number	Comments
	Habitat:	☐ Wetlands ☐ Uplands ☐ Artificial ☐ Flying
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Species:	Number	Comments
	Habitat:	☐ Wetlands ☐ Uplands ☐ Artificial ☐ Flying
Species:	Number	Comments
	Habitat:	☐ Wetlands ☐ Uplands ☐ Artificial ☐ Flying
Species:	Number	Comments
	Habitat:	☐ Wetlands ☐ Uplands ☐ Artificial ☐ Flying

Appendix C

Avian Categories

Belding's Savannah Sparrow
Belding's Savannah Sparrow
Diving Birds
Clarks Grebe
Eared Grebe
Horned Grebe
Pied-billed Grebe
Western Grebe
California Brown Pelican
Double-crested Cormorant
Belted Kingfisher
Gulls and Terns
California Gull
Heermann's Gull
Herring Gull
Ring-billed Gull
Western Gull
California Least Tern
Caspian Tern
Elegant Tern
Forster's Tern
Herons and Egrets
Black-crowned Night Heron
Great Blue Heron
Great Egret
Green Heron
Snowy Egret
Raptors
American Kestrel
Coopers Hawk
Osprey
Red-shouldered Hawk
Red-tailed Hawk
Turkey Vulture
Shorebirds
American Avocet
Black-bellied plover
Black-necked Stilt
Killdeer
Semipalmated Plover
Greater Yellowlegs
Least Sandpiper
Long-billed Curlew
Long-billed Dowitcher
Marbled Godwit
Sanderling
Short-billed Dowitcher
Spotted Sandpiper
Western Sandpiper
Whimbrel
Willet

Upland Birds
Mourning Dove
Rock Pigeon
Allen's Hummingbird
Anna's Hummingbird
Downy Woodpecker
Ash-throated Flycatcher
Black Phoebe
Cassin's Kingbird
Western Kingbird
Cassin's Vireo
Loggerhead Shrike
Warbling Vireo
American Crow
Barn Swallow
Cliff Swallow
Northern Rough-winged Swallow
Tree Swallow
Bushtit
Ruby-crowned Kinglet
Northern Mockingbird
American Pipit
Cedar Waxwing
European Starling
Common Yellowthroat
Orange-crowned Warbler
Wilson's Warbler
Yellow Warbler
Yellow-rumped Warbler
California Towhee
Large-billed Savannah Sparrrow
Song Sparrow
White-crowned Sparrow
Brown-headed Cowbird
Common Grackle
Great-tailed Grackle
Hooded Oriole
Red-winged Blackbird
Western Meadowlark
American Goldfinch
House Finch
House Sparrow
Lesser Goldfinch
Nutmeg Manikin
Water Fowl
Pacific Loon
Feral Goose
American Wigeon
Blue-winged Teal
Cinnamon Teal
Feral Duck
Green-winged Teal
Mallard
Northern Pintail
Northern Shoveler
Bufflehead
Gadwall
Greater Scaup
Lesser Scaup
Red-breasted Merganser
Ruddy Duck
American Coot
Common Moorhen

Appendix D

Avian Master List and Protection Status

Protection	Common Name	*Species Name*
MBTA	Pacific Loon	*Gavia pacifica*
MBTA	Clarks Grebe	*Aechmophorus clarkii*
MBTA	Eared Grebe	*Podiceps nigricollis*
MBTA	Horned Grebe	*Podiceps auritus*
MBTA	Pied-billed Grebe	*Podilymbus podiceps*
MBTA	Western Grebe	*Aechmophorus occidentalis*
MBTA, ESA, CESA	California Brown Pelican	*Pelicanus occidentalis*
MBTA	Double-crested Cormorant	*Phalacrocorax auritus*
MBTA	Black-crowned Night Heron	*Nycticorax nycticorax*
MBTA	Great Blue Heron	*Ardea herodias*
MBTA	Great Egret	*Ardea alba*
MBTA	Green Heron	*Butorides virescens*
MBTA	Snowy Egret	*Egretta thula*
	Feral Goose	hybrid
MBTA	American Wigeon	*Anas americana*
MBTA	Blue-winged Teal	*Anas discors*
MBTA	Cinnamon Teal	*Anas cyanoptera*
	Feral Duck	hybrid
MBTA	Green-winged Teal	*Anas crecca*
MBTA	Mallard	*Anas platyrhynchos*
MBTA	Northern Pintail	*Anas acuta*
MBTA	Northern Shoveler	*Anas clypeata*
MBTA	Bufflehead	*Bucephala albeola*
MBTA	Gadwall	*Anas strepera*
MBTA	Greater Scaup	*Aythya marila*
MBTA	Lesser Scaup	*Aythya affinis*
MBTA	Red-breasted Merganser	*Mergus serrator*
MBTA	Ruddy Duck	*Oxyura jamaicensis*
MBTA	American Kestrel	*Falco sparverius*
MBTA	Coopers Hawk	*Accipiter cooperii*
MBTA	Osprey	*Pandion haliaetus*
MBTA	Red-shouldered Hawk	*Buteo lineatus*
MBTA	Red-tailed Hawk	*Buteo jamaicensis*
MBTA	Turkey Vulture	*Cathartes aura*
MBTA, ESA	American Coot	*Fulica americana*
MBTA	Common Moorhen	*Gallinula chloropus*
MBTA	American Avocet	*Recurvirostra americana*
MBTA	Black-bellied plover	*Pluvialis squatarola*
MBTA	Black-necked Stilt	*Himantopus mexicanus*
MBTA	Killdeer	*Charadrius vociferus*
MBTA	Semipalmated Plover	*Charadrus semipalmatus*
MBTA	Greater Yellowlegs	*Tringa melanoleuca*
MBTA	Least Sandpiper	*Calidris minutilla*
MBTA	Long-billed Curlew	*Numenius americanus*
MBTA	Long-billed Dowitcher	*Limnodromus scolopaceus*
MBTA	Marbled Godwit	*Limosa fedoa*
MBTA	Sanderling	*Calidris alba*
MBTA	Short-billed Dowitcher	*Limnodromus griseus*
MBTA	Spotted Sandpiper	*Actitis macularia*
MBTA	Western Sandpiper	*Calidris mauri*
MBTA	Whimbrel	*Numenius phaeopus*
MBTA	Willet	*Catoptrophorus semipalmatus*

Protection	Common Name	*Species Name*
MBTA	California Gull	*Larus californicus*
MBTA	Heermann's Gull	*Larus heermanni*
MBTA	Herring Gull	*Larus argentatus*
MBTA	Ring-billed Gull	*Larus delawarensis*
MBTA	Western Gull	*Larus occidentalis*
MBTA, ESA, CESA	California Least Tern	*Sterna antillarum browni*
MBTA	Caspian Tern	*Sterna caspia*
MBTA	Elegant Tern	*Sterna elegans*
MBTA	Forster's Tern	*Sterna forsteri*
MBTA	Mourning Dove	*Zenaida macroura*
	Rock Pigeon	*Columba livia*
MBTA	Belted Kingfisher	*Ceryle alcyon*
MBTA	Allen's Hummingbird	*Selasphorus sasin*
MBTA	Anna's Hummingbird	*Calypte anna*
MBTA	Downy Woodpecker	*Picoides pubescens*
MBTA	Ash-throated Flycatcher	*Myiarchus cinerascens*
MBTA	Black Phoebe	*Sayornis nigricans*
MBTA	Cassin's Kingbird	*Tyrannus vociferans*
MBTA	Western Kingbird	*Tyrannus verticalis*
	Cassin's Vireo	*Vireo cassinii*
MBTA	Loggerhead Shrike	*Lanius ludovicianus*
MBTA	Warbling Vireo	*Vireo gilvus*
MBTA	American Crow	*Corvus brachyrhynchos*
MBTA	Barn Swallow	*Hirundo rustica*
MBTA	Cliff Swallow	*Petrochelidon pyrrhonota*
MBTA	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
MBTA	Tree Swallow	*Tachycineta bicolor*
MBTA	Bushtit	*Psaltriparus minimus*
MBTA	Ruby-crowned Kinglet	*Regulus calendula*
MBTA	Northern Mockingbird	*Mimus polyglottos*
MBTA	American Pipit	*Anthus rubescens*
MBTA	Cedar Waxwing	*Bombycilla cedrorum*
	European Starling	*Sturnus vulgaris*
MBTA	Common Yellowthroat	*Geothlypis trichas*
MBTA	Orange-crowned Warbler	*Vermivora celata*
MBTA	Wilson's Warbler	*Wilsonia pusilla*
MBTA	Yellow Warbler	*Dendroica petechia*
MBTA	Yellow-rumped Warbler	*Dendroica coronata*
CESA	Belding's Savannah Sparrow	*Passerculus sandwichensis beldingi*
MBTA	California Towhee	*Pipilo crissalis*
MBTA	Song Sparrow	*Melospiza melodia*
MBTA	Upland Savannah Sparrrow	*Passerculus sandwichensis*
MBTA	White-crowned Sparrow	*Zonotrichia leucophyrs*
MBTA	Brown-headed Cowbird	*Molothrus ater*
MBTA	Common Grackle	*Quiscalus quiscula*
MBTA	Great-tailed Grackle	*Quiscalus mexicana*
MBTA	Western Meadowlark	*Sturnella neglecta*
MBTA	Hooded Oriole	*Icterus cucullatus*
MBTA	Red-winged Blackbird	*Agelaius phoeniceus*
MBTA	American Goldfinch	*Carduelis tristis*
MBTA	House Finch	*Carpodacus mexicanus*
	House Sparrow	*Passer domesticus*
MBTA	Lesser Goldfinch	*Carduelis psaltria*
	Nutmeg Mannikin	*Lonchura punctulata*

Appendix E

Presence/Absence Table

Presence or Absence of Bird Species Within LCW Complex

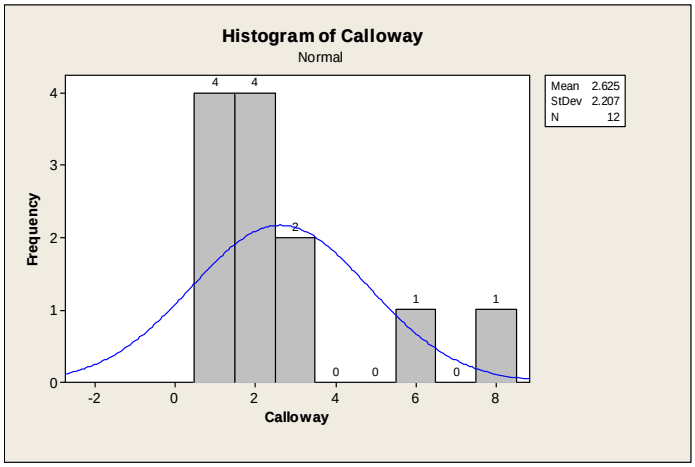
	Callaway	Campgrounds	Colorado Lagoon	Jack Dunster	Melissa's Degraded	Shopkeeper's Marsh	Sims Pond	Steamshovel	Tongva Pond	Zedler
Allen's Hummingbird	0	0	0	1	0	0	1	0	1	0
American Avocet	0	0	0	0	0	1	1	0	1	1
American Coot	0	0	1	1	0	1	1	0	1	0
American Crow	0	1	0	1	0	1	1	1	1	0
American Goldfinch	0	0	0	0	0	0	1	1	1	0
American Kestrel	0	1	0	0	0	0	0	0	0	0
American Pipit	0	0	0	0	0	1	0	0	0	0
American Widgeon	0	0	1	0	0	0	1	0	1	0
Anna's Hummingbird	0	1	0	1	1	1	1	1	1	1
Ash-throated Flycatcher	0	0	0	0	0	0	1	1	0	0
Barn Swallow	0	1	0	0	1	1	1	1	1	0
Belding's Savannah Sparrow	0	1	0	0	1	0	0	1	0	1
Belted Kingfisher	0	0	1	0	0	0	1	1	0	0
Black Phoebe	0	0	0	1	0	1	1	1	1	0
Black-bellied Plover	0	0	1	0	0	0	0	0	0	1
Black-crowned Night Heron	0	0	1	0	0	1	1	0	0	0
Black-necked Stilt	0	0	0	0	0	1	1	0	1	0
Blue-winged Teal	0	0	0	0	0	1	1	0	1	0
Brown-headed Cowbird	0	0	0	0	0	0	0	0	1	0
Bufflehead	0	0	1	0	0	0	0	0	0	0
Bushtit	0	0	0	1	0	0	1	0	1	0
California Brown Pelican	0	0	1	0	0	0	0	0	0	0
California Gull	0	0	1	1	0	0	0	1	0	0
California Least Tern	0	0	0	0	0	0	0	1	0	0
California Towhee	0	0	0	0	0	0	0	1	0	0
Caspian Tern	1	0	0	1	0	0	0	1	0	1
Cassin's Kingbird	0	0	0	0	0	0	1	0	0	0
Cassin's Vireo	0	0	0	0	0	0	1	0	0	0
Cedar Waxwing	0	0	0	0	0	0	1	0	0	0
Cinnamon Teal	0	0	0	0	0	1	1	0	1	0
Clark's Grebe	0	0	1	0	0	0	0	1	0	0
Cliff Swallow	0	1	0	1	1	1	1	1	1	1
Common Grackle	0	0	0	0	0	1	0	0	0	0
Common Moorhen	0	0	0	0	0	0	1	0	0	0
Common Yellowthroat	0	1	0	0	1	1	1	1	1	0
Cooper's Hawk	0	0	0	0	0	0	1	0	0	0
Double-crested Cormorant	0	1	1	1	1	0	1	1	0	1
Downy Woodpecker	0	0	0	0	0	0	1	0	0	0
Eared Grebe	0	0	1	1	0	0	0	1	0	0
Elegant Tern	0	0	0	0	0	0	1	0	0	0
European Starling	1	1	0	1	1	1	1	1	1	1
Feral Duck	0	0	0	0	0	0	1	0	0	0
Feral Goose	0	0	0	0	0	0	1	0	0	0
Forster's Tern	0	1	1	1	0	0	0	1	0	1
Gadwall	0	0	0	0	0	1	1	0	0	0
Great Blue Heron	0	1	1	1	1	1	1	1	1	0
Great Egret	1	0	1	1	0	1	1	1	0	1
Greater Scaup	0	0	1	0	0	0	0	0	0	0
Greater Yellowlegs	0	0	0	0	0	0	1	1	1	0
Green Heron	0	0	1	1	0	1	1	0	0	0
Green-winged Teal	0	0	1	0	0	0	1	0	0	0
Great-tailed Grackle	0	0	0	0	0	0	1	0	0	0
Heerman's Gull	0	0	1	0	0	0	1	0	0	0
Herring Gull	0	0	1	1	0	0	0	0	0	0

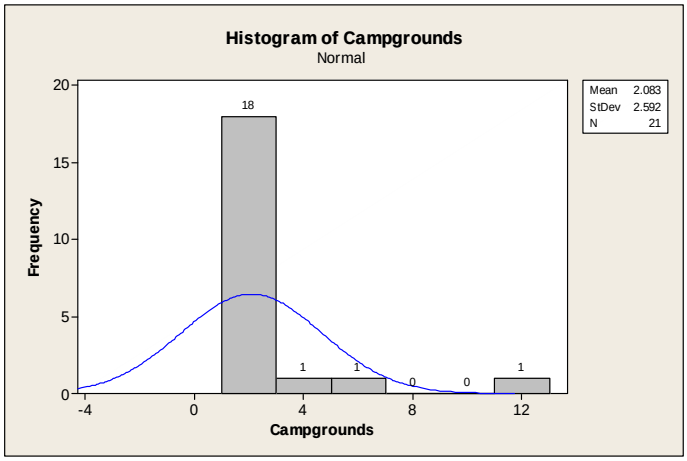
Presence or Absence of Bird Species Within LCW Complex

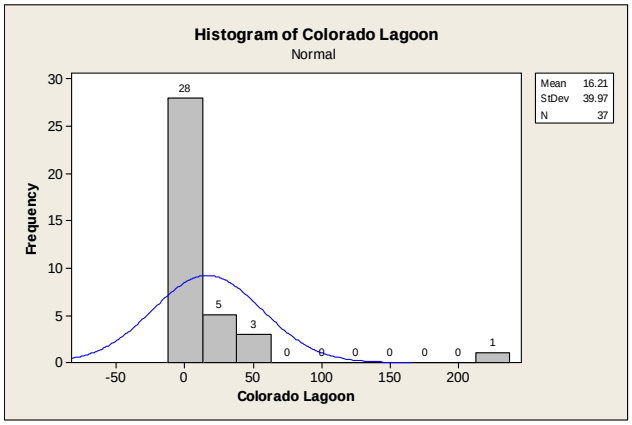
	Callaway	Campgrounds	Colorado Lagoon	Jack Dunster	Melissa's Degraded	Shopkeeper's Marsh	Sims Pond	Steamshovel	Tongva Pond	Zedler
Hooded Oriole	0	0	0	0	0	0	0	0	1	0
Horned Grebe	0	0	0	0	0	0	0	1	0	0
House Finch	1	0	0	1	0	1	1	1	1	1
House Sparrow	0	0	0	1	0	0	1	1	0	0
Killdeer	1	1	1	0	0	1	1	0	1	1
Large-Billed Savannah Sparrrow	1	1	0	0	1	0	0	1	0	0
Least Sandpiper	0	0	1	1	0	0	0	0	1	1
Lesser Goldfinch	0	0	0	1	0	0	1	0	1	0
Lesser Scaup	0	0	1	0	0	0	1	0	0	0
Loggerhead Shrike	0	1	0	0	0	0	0	0	0	0
Long-billed Curlew	0	0	0	0	0	0	0	1	0	1
Long-billed Dowitcher	0	0	1	0	0	1	1	1	1	0
Mallard	0	0	1	1	0	1	1	1	1	1
Marbled Godwit	0	0	1	1	0	1	0	1	0	0
Mourning Dove	1	1	0	1	1	1	1	1	1	1
Northern Mockingbird	0	1	0	0	0	0	1	1	1	1
Northern Pintail	0	0	0	0	0	0	1	0	0	0
Northern Rough-winged Swallow	0	0	0	0	0	0	1	0	0	0
Northern Shoveler	0	0	0	0	0	1	1	0	1	0
Nutmeg Manikin	0	0	0	0	0	0	1	0	0	0
Orange-crowned Warbler	0	0	0	0	0	0	1	0	0	0
Osprey	0	0	0	0	1	0	0	1	0	0
Pacific Loon	0	0	0	0	0	0	0	1	0	0
Pied-billed Grebe	0	0	1	1	0	0	1	1	1	0
Red-breasted Merganser	0	0	1	0	0	0	0	0	0	0
Red-shouldered Hawk	0	0	0	0	0	0	1	0	0	0
Red-tailed Hawk	0	1	0	0	0	0	0	1	1	1
Red-winged Blackbird	1	1	0	0	0	1	1	1	1	1
Ring-billed Gull	0	0	1	1	0	0	1	1	0	0
Rock Pigeon	1	1	0	1	0	0	1	1	1	1
Ruby-crowned Kinglet	0	0	0	0	1	0	1	0	0	0
Ruddy Duck	0	0	1	0	0	0	1	0	1	0
Sanderling	0	0	1	0	0	0	0	0	0	0
Semipalmated Plover	0	0	1	1	0	0	0	1	0	0
Short-billed Dowitcher	0	0	0	0	0	0	0	0	1	1
Snowy Egret	0	0	1	1	0	1	1	1	1	1
Song Sparrow	0	0	0	0	0	0	1	0	0	0
Spotted Sandpiper	0	0	1	1	0	0	1	1	0	0
Tree Swallow	0	0	0	0	0	0	1	0	0	0
Turkey Vulture	0	0	0	0	0	0	0	1	0	0
Warbling Vireo	0	0	0	0	0	0	1	0	0	0
Western Grebe	0	0	1	0	0	0	0	1	0	0
Western Gull	1	0	1	1	0	0	1	1	0	1
Western Kingbird	1	1	0	0	1	0	1	1	1	0
Western Meadowlark	0	1	0	0	0	0	0	0	0	0
Western Sandpiper	0	0	1	1	0	1	0	1	0	1
Whimbrel	0	0	0	1	0	0	0	1	0	0
White-crowned Sparrow	0	0	0	0	0	0	1	1	0	0
Willet	1	0	1	1	0	0	0	1	0	1
Wilson's Warbler	0	0	0	0	0	0	1	0	0	0
Yellow Warbler	0	0	0	0	0	0	1	0	0	0
Yellow-rumped Warbler	0	0	0	0	0	1	1	0	0	0
Species Total	12	21	37	34	13	30	69	50	37	25

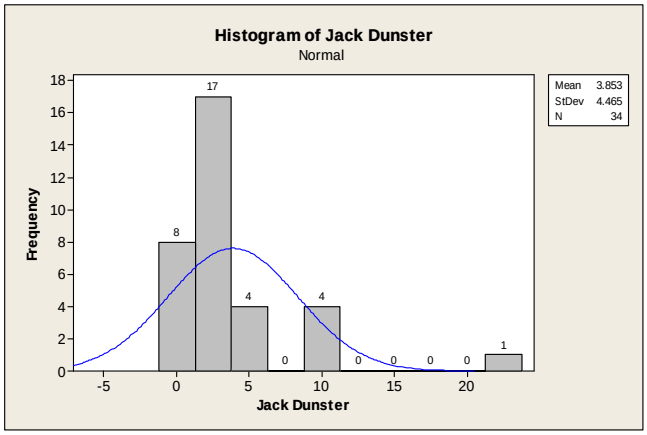
Appendix F

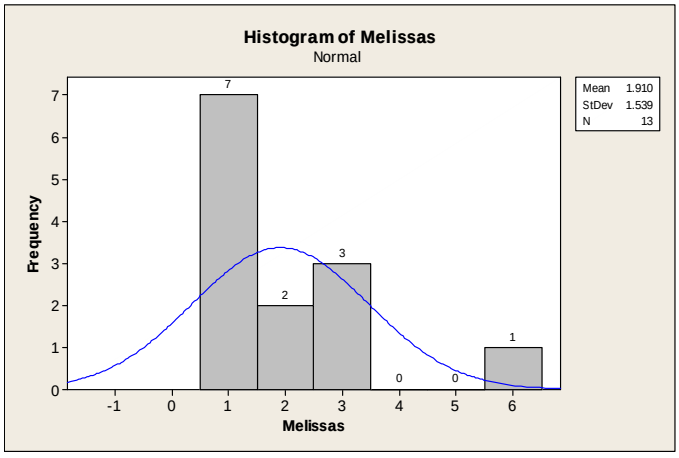
Histograms

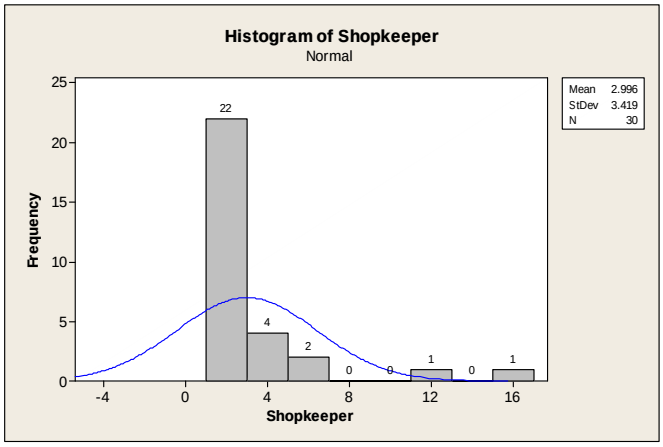

Histogram of Calloway
Normal
Mean 2.625
StDev 2.207
N 12
Frequency
Calloway

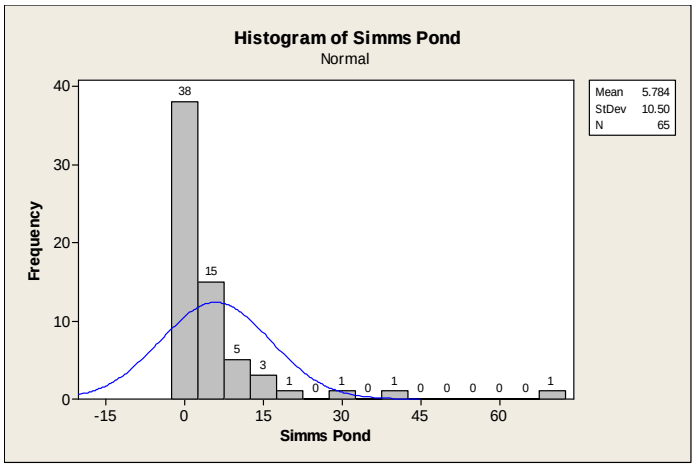

Histogram of Campgrounds
Normal
Mean 2.083
StDev 2.592
N 21
Frequency
Campgrounds

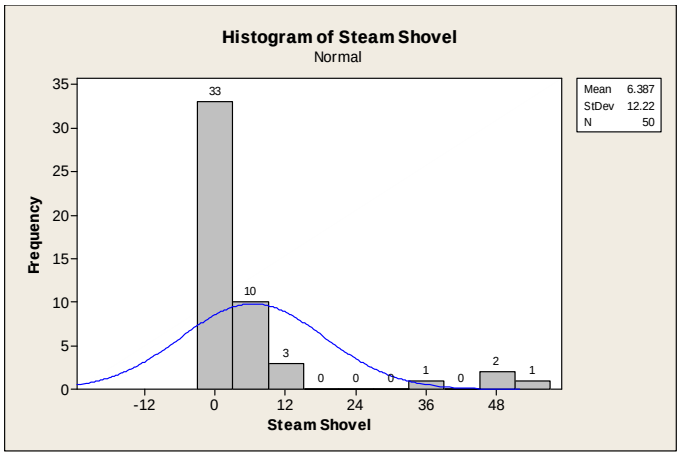

Histogram of Colorado Lagoon
Normal
Mean 16.21
StDev 39.97
N 37
Frequency
Colorado Lagoon

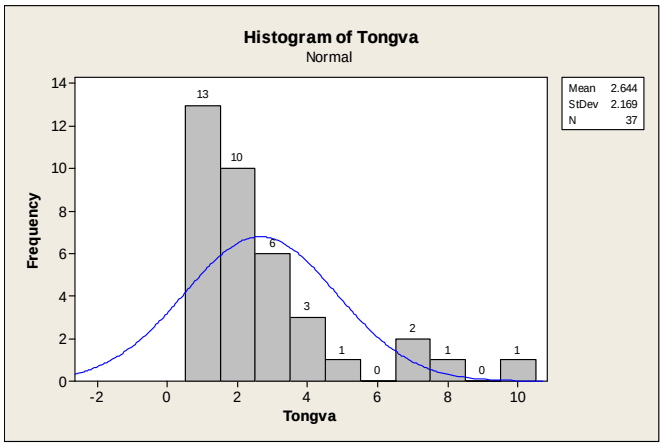

Histogram of Jack Dunster
Normal
Mean 3.853
StDev 4.465
N 34
Frequency
Jack Dunster

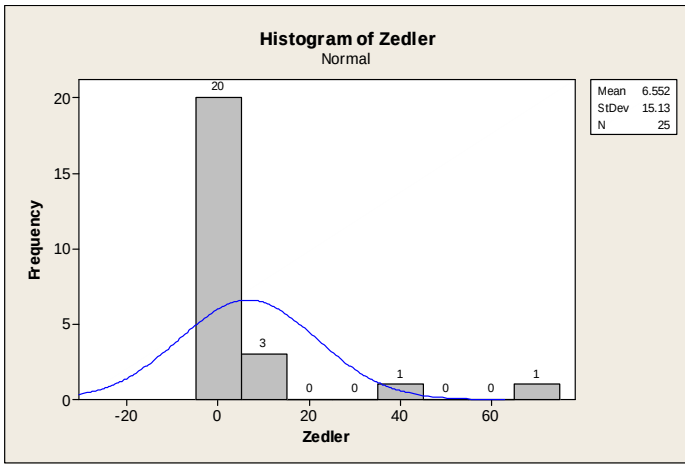

Histogram of Melissas
Normal
Mean 1.910
StDev 1.539
N 13
Frequency
Melissas


Histogram of Shopkeeper
Normal
Mean 2.996
StDev 3.419
N 30
Frequency
Shopkeeper


Histogram of Simms Pond
Normal
Mean 5.784
StDev 10.50
N 65
Frequency
Simms Pond
38
15
5
3
1
0
1
0
1
0
0
0
0
0
1


Histogram of Steam Shovel
Normal
Mean 6.387
StDev 12.22
N 50
Frequency
Steam Shovel
33
10
3
0
0
0
1
0
2
1


Histogram of Tongva
Normal
Mean 2.644
StDev 2.169
N 37
Frequency
Tongva
13
10
6
3
1
0
2
1
0
1


Histogram of Zedler
Normal
Mean 6.552
StDev 15.13
N 25
Frequency
Zedler
20
3
0
0
1
0
0
1

Appendix G

Comparison Table Between the LCW Complex, Bolsa Chica Wetlands and the Naval Weapons Station Seal Beach

	Bolsa Chica	Seal Beach	LCW Complex
Allen's Hummingbird	X	X	X
American Avocet	X	X	X
American Bittern		X	
American Coot	X		X
American Crow	X	X	X
American Goldfinch	X	X	X
American Kestrel	X	X	X
American Pipit	X	X	X
American Robin		X	
American White Pelican	X	X	
American Wigeon	X	X	X
Anna's Hummingbird	X	X	X
Ash-throated Flycatcher	X	X	X
Baird's Sandpiper	X	X	
Bank Swallow	X		
Barn Owl	X	X	
Barn Swallow	X	X	X
Barrow's Goldeneye	X		
Belding's Savannah Sparrow		X	X
Belted Kingfisher	X	X	X
Bewick's Wren	X	X	
Black Oyester Catcher		X	
Black Phoebe	X	X	X
Black Scoter	X		
Black Skimmer	X	X	
Black Storm-Petrel		X	
Black Tern	X	X	
Black Turnstone		X	
Black-bellied Plover	X		X
Black-chinned Hummer		X	
Black-chinned Hummingbird	X		
Black-crowned Night Heron		X	X
Black-headed Grosbeak	X	X	
Black-legged Kittiwake	X	X	
Black-necked Stilt	X	X	X
Black-throated Gray Warbler		X	
Black-vented Shearwater		X	
Blue Grosbeak		X	
Blue-gray Gnatcatcher	X	X	
Blue-winged Teal	X	X	X
Bobolink		X	
Bonaparte's Gull	X	X	
Brandt's Cormorant	X	X	
Brewer's Blackbird	X	X	
Brown Pelican	X	X	
Brown-headed Cowbird	X	X	X
Bufflehead	X	X	X

Bullock's Oriole	X		
Burrowing Owl	X	X	
Bushtit	X	X	X
California Brown Pelican			X
California Gull	X	X	X
California Least Tern			X
California Towhee		X	X
Canada Goose	X	X	
Canvasback	X	X	
Caspian Tern	X	X	X
Cassin's Sparrow	X		
Cassin's Auuklet		X	
Cassin's Kingbird	X	X	X
Cassin's Vireo			**X**
Catcus Wren	X		
Cattle Egret	X	X	
Cedar waxwing	X	X	X
Chipping Sparrow	X		
Chipping Towhee		X	
Cinnamon Teal	X		X
Clapper Rail	X	X	
Clark's Grebe	X	X	X
Cliff Swallow	X	X	X
Coassta's Hummer		X	
Common Goldeneye	X	X	
Common Grackle			**X**
Common Ground-Dove		X	
Common Loon	X	X	
Common Merganser		X	
Common Moorhen			**X**
Common Murre	X	X	
Common Raven	X	X	
Common Snipe	X		
Common Tern	X	X	
Common Yellowthroat	X	X	X
Comon Snipe		X	
Cooper's Hawk	X	X	X
Dark-eyed Junco		X	
Double-crested Cormorant	X	X	X
Downy Woodpecker		X	X
Dunlin	X	X	
Eared Grebe	X	X	X
Elegant Tern	X	X	X
Emperor Goose		X	
Eurasian Wigeon	X	X	
Eurpoean Starling	X	X	X
Feral Duck			**X**
Feral Goose			**X**
Ferruginous Hawk		X	
Forester's Tern	X	X	X

Fox Sparrow	X	X	
Franklin's Gull	X		
Gadwall	X	X	X
Glaucous-winged Gull	X	X	
Golden Eagle		X	
Golden-crowned Sparrow	X	X	
Great Blue Heron	X	X	X
Great Egret	X	X	X
Great Horned Owl	X	X	
Great White-fronted Goose	X		
Greater Scaup	X	X	X
Greater White-fronted Goose	X	X	
Greater Yellowlegs	X	X	X
Great-tailed Grackle			X
Green Heron	X	X	X
Green-winged Teal	X	X	X
Gull-billed Tern	X		
Hammond's Flycatcher		X	
Harlequin Duck	X		
Heerman's Gull	X	X	X
Hermit Thrush	X	X	
Hermit Warbler		X	
Herring Gull	X	X	X
Hooded Oriole	X	X	X
Horned Grebe	X	X	X
Horned Lark	X	X	
House Finch	X	X	X
House Sparrow	X	X	X
House Wren	X	X	
Killdeer	X	X	X
Large-billed Savannah Sparrrow		X	X
Lark Sparrow	X	X	
Laughing Gull	X		
Lawrence's Goldfinch	X	X	
Lazuli Bunting		X	
Least Sandpiper	X	X	X
Least Storm-Petrel		X	
Least Tern	X	X	
Lesser Goldfinch	X	X	X
Lesser Night Hawk		X	
Lesser Scaup	X	X	X
Lesser Yellowlegs	X	X	
Lincoln's Sparrow	X	X	
Little Blue Heron	X	X	
Loggerhead Shrike	X	X	X
Long-billed Curlew	X	X	X
Long-billed Dowitcher	X	X	X
MacGillivray's Warbler	X	X	
Magnificent Frigatebird	X		
Mallard		X	X

Mallard Northern Pintail	X		
Marbled Godwit	X	X	X
Marsh Wren	X	X	
Merlin	X	X	
Mew Gull		X	
Mountain Bluebird	X	X	
Mountian Plover		X	
Mourning Dove	X	X	X
Nashville Warbler	X	X	
Nighthawk	X		
No. Rough-winged Swallow	X	X	
Northern Flicker	X	X	
Northern Fulmar	X	X	
Northern Harrier	X	X	
Northern Mockingbird	X	X	X
Northern Pintail		X	X
Northern Rough-winged Swallow	X		X
Northern Shoveler	X	X	X
Nutmeg Manikin			**X**
Oldsquaw		X	
Orange-crowned Warbler	X	X	X
Osprey	X	X	X
Pacific Golden-Plover	X	X	
Pacific Loon	X	X	X
Pacific-slope Flycatcher	X	X	
Parasitic Jaeger	X	X	
Pectoral Sandpiper	X	X	
Pelagic Cormorant	X	X	
Peregrine Falcon	X	X	
Phainopepla		X	
Pied-billed Grebe	X	X	X
Pine Siskin	X		
Pink-footed Shearwater		X	
Pomarine Jaeger		X	
Prairie Falcon		X	
Purple Marlin	X		
Red-breasted Merganster	X		X
Red Crossbill	X		
Red Knot	X	X	
Red Phalarope	X	X	
Red-breasted Sapsucker	X	X	
Reddish Egret	X	X	
Redhead	X	X	
Red-necked Grebe	X		
Red-necked Phalarope	X	X	
Red-shouldered Hawk	X	X	X
Red-tailed Hawk	X	X	X
Red-throated Loon	X	X	
Red-winged Blackbird	X	X	X

Rhinceros Auklet		X	
Ring-billed Gull		X	X
Ring-necked Duck		X	
Ring-necked Phesant		X	
Rock Pigeon	X	X	X
Rock Wren	X	X	
Ross's Goose	X		
Rough-legged Hawk	X	X	
Royal Tern	X	X	
Ruby-crowned Kinglet	X	X	X
Ruddy Duck	X	X	X
Ruddy Turnstone	X	X	
Rufous Hummer		X	
Sage Thrasher		X	
Sanderling	X	X	X
Sandwich Tern	X		
Savannah Sparrow	X	X	
Say's Phoebe	X		
Screech Owl	X		
Scrub Jay	X		
Semipalmated Plover		X	X
Semipalmated Sandpiper	X		
Sharp-shinned Hawk	X	X	
Short-billed Dowitcher	X	X	X
Short-eared Owl	X	X	
Snow Goose	X	X	
Snowy Egret	X	X	X
Snowy Plover	X	X	
Solitary Sandpiper	X		
Song Sparrow	X	X	X
Sooty Shearwater		X	
Sora	X		
Spotted Dove	X	X	
Spotted Sandpiper	X	X	X
Spotted Towhee		X	
Surf Scoter	X	X	
Surfbird		X	
Swainson's Hawk		X	
Swainson's Thrush		X	
Thayer's Gull	X		
Townsend's Warbler	X	X	
Tree Swallow	X	X	X
Tri-colored Blackbird	X	X	
Tri-colored Heron			
Tropical Kingbird	X		
Tundra Swan		X	
Turkey Vulture	X	X	X
Vaux'x Swift	X		
Violet-green Swallow	X	X	
Virginia Rail	X		

Wandering Tattler	X	X	
Warbling Vireo		X	X
Western Bluebird		X	
Western Grebe	X	X	X
Western Gull	X	X	X
Western Kingbird	X	X	X
Western Meadowlark	X	X	X
Western Sandpiper	X		X
Western Scrub-Jay		X	
Western Tanager	X	X	
Western-Wood-Pewee		X	
Whimbrel	X	X	X
White Faced Ibis		X	
White throated swift		X	
White-crowned Sparrow	X	X	X
White-faced Ibis	X	X	
White-tailed Kite	X	X	
White-throated Swift	X	X	
White-winged Scoter	X	X	
Willet	X	X	X
Wilson's Phalarope	X	X	
Wislon's Warbler	X	X	X
Yellow Warbler	X	X	X
Yellow-headed Blackbird	X	X	
Yellow-rumped Warbler	X	X	X
Total Species	**203**	**222**	**106**