TAMPA PORT AUTHORITY

SOVEREIGN LANDS MANAGEMENT INITIATIVES PROGRAM

AMERICAN OYSTERCATCHER NESTING IN HILLSBOROUGH BAY, FLORIDA: POPULATION TRENDS 1990-2007 AND MANAGEMENT RECOMMENDATIONS

Final Report

Prepared by
Florida Coastal Islands Sanctuaries Program
410 Ware Blvd., Ste. 702
Tampa, FL 33619

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Frontispiece: American Oystercatcher, courtesy of Florida Coastal Islands Sanctuaries Program.

1 EXECUTIVE SUMMARY

Audubon of Florida's Florida Coastal Islands Sanctuaries Program compiled results of field surveys of nesting American Oystercatcher nest sites and nest density in Hillsborough Bay, Florida for an 18-year study period (1990-2007). Hillsborough Bay supports approximately 20% of the nesting American Oystercatcher population in Florida.

Between 1930-1985, 20.08 km of potential oystercatcher nesting habitat were created on dredged material spoil islands in Hillsborough Bay, and 0.89 km of shoreline on the Apollo Beach hammerhead. We identified 135 territories occupied at least once during the study period on Tampa Port Authority Spoil Islands 2D, 3D, Fantasy Island, and Fishhook Spoil Island, the Mosaic Fertilizer, LLC Richard T. Paul Alafia Bank Bird Sanctuary, the TECO jetty, and the Apollo Beach south hammerhead.

Between 1990-2007 the Hillsborough Bay and Apollo Beach hammerhead area (Middle Tampa Bay) supported 58-87 territories annually (mean 71.8, SD 13.60, n=18 yrs) (Table 2; Table 4). Sites on 2D, 3D, Fishhook Spoil Island, TECO jetties, and the Alafia Bank were also occupied consistently (Figures 6-10, Table 4). The two spoil islands managed by the Tampa Port Authority in the northern bay had mean occupied territories of 31.8 (SD 4.64) and 15.6 (SD 1.98) for 2D and 3D, respectively. Combined, these two spoil islands support 68% of the occupied territories bay-wide. Fishhook Spoil Island including the TECO jetty in southern Hillsborough Bay supports 16%, and Mosaic Fertilizer LLC's Richard T. Paul Alafia Bank Bird Sanctuary supports 25% of the oystercatchers nesting in the bay. The mean number of annually occupied territories (i.e., breeding oystercatcher pairs) in Hillsborough Bay was 71.8 (SD 13.60).

Territory density varied among the seven study areas and ranged from 10.4 pairs km^{-1} on Fishhook Spoil Island to 1.6 pairs km^{-1} on Alafia Bank-Bird Island. The mean oystercatcher pair density was 4.8 pairs km^{-1} shoreline (SD 0.42) for suitable habitat. Seasonal monitoring identified breeding pairs, numbers of nests and their locations, and the presence of chicks, but it was not possible in some years to determine the number of fledged young.

Annual productivity was estimated from observations of fledged chicks in some years. In 2007, we tracked the productivity on Spoil Island 2D from the onset of nesting through the fledged young stage. Of 35 nesting pairs or nest attempts, the annual productivity was nine large feathered young and fledged young for an average of 0.26 chicks/nest.

We mapped the locations of historically occupied oystercatcher territories on each site using ArcView 9.3 GIS, then buffered each pair with a 15 m radius circle, which was the minimum inter-territorial distance we determined from observing breeding pairs with immediately adjacent territories, and a 100 m radius circle, which is the distance we observed was adequate to prevent nest disturbance during the nesting season.

Oystercatcher productivity is affected annually by three primary factors: disturbance from recreational boaters and fishermen, nest overwash due to intermittent storm events occurring on high tides and pressure wakes from tugboats and cargo ships, and mammalian or avian predation. Avian predation (e.g., Fish Crows, Great Blue Herons, Black-crowned Night-Herons, and other species) is often facilitated by human disturbance driving incubating or guarding oystercatcher parents off their nests.

The onset of nesting by approximately the third week of March supports advancing the "migratory bird season" from April 1 to March 15 or at the latest March 21 for maintenance dredging and construction activities on the port's facilities.

Future American Oystercatcher management in Hillsborough Bay should focus on reducing human disturbance, revising shipping schedules and speeds to prevent nest overwash, and controlling mammalian predators.

2 INTRODUCTION

The eastern race of the American Oystercatcher *Haematopus palliatus palliatus* is a large, conspicuous shorebird that inhabits coastal islands and salt marshes, and occurs in the largest concentrations along the Atlantic coast of the United States from Massachusetts to Florida, along the Gulf of Mexico coast to Texas, and south to southern Argentina, and along the Pacific coast from Baja California south to central Chile (Nol and Humphrey 1994). The breeding range has expanded since about 1940 and oystercatchers now nest in New England, from where they were extirpated in the mid-1800s, south through the gulf coast (Post and Raynor 1964, Lauro and Burger 1989, Davis et al. 2001). The species winters on the Atlantic and Gulf coasts from North Carolina to southeastern Mexico, and on the west coast from Baja California to South America (Nol and Humphrey 1994).

In the southeastern United States, Christmas Bird Count (CBC) data show oystercatcher populations wintering annually along the Atlantic and Gulf coasts from North Carolina through Alabama and concentrated in the Tampa Bay area (National Audubon Society 2006) (Figure 1).

For the reader's reference, an overview of the species' life history is included in *Section 9* of this report.

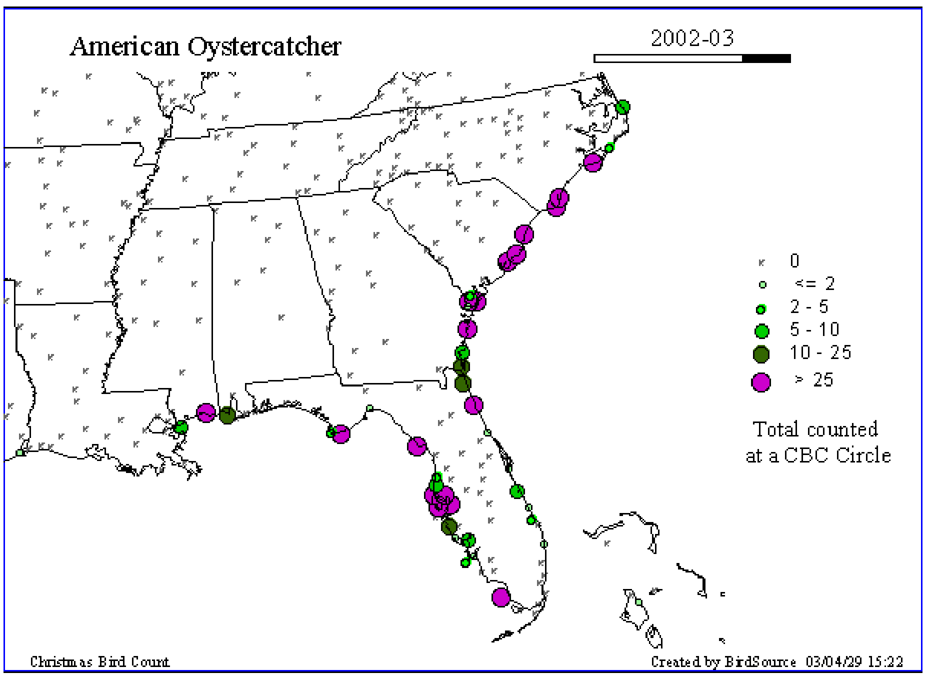

Figure 1. Number of American Oystercatchers counted in each National Audubon Society, Inc. Christmas Bird Count (CBC) circle during the 2002-2003 CBC.

2.1 Management Status of American Oystercatchers

Due to its apparently declining population, the American Oystercatcher is listed as a "Species of High Concern" in the U. S. Shorebird Conservation Plan (Brown et al. 2001). The oystercatcher was placed on the National Audubon Society, Inc.'s 'Watchlist' (NAS 2002), a listing that is compiled by scientists affiliated with 'Partners in Flight', a national avian conservation partnership among U. S. governmental agencies and private organizations that calls attention to birds whose populations are declining and are at risk before they require federal listing, stressing preventative action to increase populations and survival today, over last-minute species rescue attempts in the future. The 'Watchlist' targets bird species with declining populations, limited ranges, and facing threats such as habitat loss on their breeding, migrating, and wintering grounds.

Oystercatchers are one of the rarest and most vulnerable coastal nesting bird species in Florida, and are listed as a “Species of Special Concern” on the Florida Fish and Wildlife Conservation Commission’s List of Endangered, Threatened, and Species of Special Concern (FWC 2006). The state population was estimated at 300-350 pairs statewide in 1991 (Paul and Below 1991), and 400 pairs during a statewide survey in 2001 (Douglass and Clayton 2004). Regional surveys estimate 120 pairs (approximately 30% of the known state nesting population) breed in the Tampa Bay area. About 80 pairs (20% of the population) nest annually on the dredged spoil material islands that were constructed in Hillsborough Bay from the 1920s through the 1980s (Douglass and Clayton 2004, Hodgson, Paul and Rachal 2006).

Throughout its range, conservation threats to oystercatchers include shoreline development that continues to decrease habitat options for all life history requirements, human disturbance from water-based recreation, residential, commercial and industrial development, nest overwash from storm-driven tides and commercial shipping traffic, and anthropogenically facilitated increases in mammalian and herptile predators and toxic contaminants.

Across their range, oystercatchers warrant conservation planning for several reasons:

1. Low population size: The North American east coast population is estimated at 11,000 birds (Brown et al. 2005);
2. Widespread habitat loss: Oystercatchers are restricted to a narrow range of coastal habitats and development of barrier islands and coastal marshes is diminishing their habitat;
3. Threats during the breeding and non-breeding seasons: In addition to direct habitat loss, populations face pressure from recreational disturbance, increases in nest predators, potential contamination of food resources, and alteration of habitat through beach stabilization and renourishment practices.

Within Hillsborough Bay, oystercatchers warrant conservation planning and management because the population represents a high proportion of the total state population, nesting habitat availability is limited and restricted to dredged spoil material islands owned by the Tampa Port Authority and private landowners, and managed by the Audubon of Florida Florida Coastal Islands Sanctuaries Program, and oystercatcher pairs are subject to high disturbance during the nesting season, which adversely affects successful nesting and chick rearing.

2.2 American Oystercatcher Habitat in Hillsborough Bay

American oystercatchers use both coastal shorelines and island beaches as nesting sites. We have incomplete information about where suitable oystercatcher nesting habitat may have existed before the Hillsborough Bay land shoreline was developed, but it is possible some oystercatchers and other beach-nesting shorebirds nested on the beaches before development and associated disturbance made the bay’s shorelines unsuitable habitat.

The original bay had three important island features that may have provided oystercatcher nesting habitat: “Grassy Key”, a large island offshore of the Hillsborough River shoreline where the Davis Islands are now located, and Green Key and Whiskey Stump Key in the southeastern bay. Grassy Key was covered with dredged spoil material in the 1920s as the Davis Islands were built of pumped fill from construction of the Port shipping channels. In the 1960s, the Port Redwing spit was dredged up and the distance from Green Key and Whiskey Stump Key to the mainland shoreline was narrowed to approximately 40 m, which provided easy access for raccoons or other predators across the narrowed channel and made these islands unusable for bird nesting due to disturbance and predation.

The artificial island features now present in Hillsborough Bay were created from dredged spoil material dredged and deposited from the 1920s through the 1980s. In the 1920s, the shipping channel into the Port of Tampa was first deepened and a series of small spoil material islands were formed running parallel to the channel towards the port. These small islands persisted until the 1970s when the U. S. Army Corps of Engineers, in cooperation with the Tampa Port Authority, built Spoil Island 2D over them in 1978, and then built Spoil Island 3D to the southwest in 1982, both as dredged spoil material deposit islands for material dredged during the deepening of the Tampa Shipping Channel.

Of the sites present during our study, the Alafia Bank dredged spoil material islands (Bird Island and Sunken Island) were constructed beginning in 1929 when the lower reach of the Alafia River was straightened to run due west in a shipping channel connecting with the main shipping channel into the Port of Tampa. The Alafia Bank was enlarged progressively as the Alafia shipping channel was widened and deepened and maintenance dredged, and now includes the eastern island (Bird Island) connected by an eroding sand spit to the western island (Sunken Island) built beginning around 1970. Sunken Island was enlarged with the addition of the Sunken Island extension in the early 1980s.

Southeast of spoil islands 2D and 3D, the Tampa Port Authority's Fishhook Spoil Island and a chain of islands now eroded below low tide, except for Pine (or "Beer Can') Island, were built in the mid-1970s, as the Tampa Electric Company (TECO) Big Bend power plant channel was dredged and connected to the main shipping channel in the 1960s, and IMC's phosphate loading facilities were constructed. When the old Gandy Bridge was torn down in 1956, the concrete pilasters were placed to make a jetty continuing south from Fishhook to separate the hot water return flow from the TECO intake. The Apollo Beach hammerhead was filled in the early 1960s, but the dredged spoil material beaches created by the massive dredging project developed slowly for the next 30 years, and its beach provided new suitable oystercatcher nesting habitat until the lots were seawalled and homes were built (Figures 2, 3).

Figure 2. Dredging construction of the Apollo Beach hammerhead c. 1960 (photo courtesy of Gandy Aerial Photography, Inc., from the Sandy Gandy historical archives).

Figure 3. Dredging construction of the Apollo Beach hammerhead c. 1964 (photo courtesy of Gandy Aerial Photography, Inc., from the Sandy Gandy historical archives).

The overall effect of anthropogenic development in Hillsborough Bay has been that most of the possible nesting habitat on the bay shoreline became unusable over time due to human disturbance (including the Gardenville Beach, which was a popular public recreational site in the 1920s). Of the three natural islands that may have had suitable nesting habitat on their shorelines, Grassy Key was buried under dredged fill when the Davis Islands were filled, and the Green Key and Whiskey Stump Key shorelines became unsuitable because of predator pressure. Oystercatchers shifted from formerly used nest sites on natural habitat made unusable by human development to using sites on dredged spoil material islands and the shoreline of the Apollo Beach hammerhead.

In the mid-1980s, at least 35 pairs of oystercatchers were known to nest on Hillsborough Bay spoil islands and 15 pairs or more on islands near the Tampa Bay mouth. In the entire bay system, 60-75 pairs may have been present (Paul and Woolfenden 1985). The number of nesting oystercatcher pairs increased from approximately 35 pairs in the mid-1980s, immediately after the construction of Spoil Islands 2D and 3D, as birds occupied territories on the newly constructed habitat, to approximately 80 pairs on 2D, 3D, and other sites in Hillsborough Bay (Paul and Schnapf 2001, Hodgson, Paul and Rachal 2006).

The purpose of this study is to characterize the breeding population of American oystercatchers in Hillsborough Bay by mapping their territories to determine the nesting distribution and density, and summarizing annual productivity. Audubon's Sovereign Lands Management Initiatives Program grant includes three tasks: 1) Data Compilation; 2) Data Analysis; and 3) Technical Report. This report presents the results of our study and completes Task 3 – Technical Report, pursuant to our grant proposal.

2.3 Study Area

The Florida Coastal Islands Sanctuaries Program has conducted a survey of American oystercatcher nesting annually for approximately 20 years in Hillsborough Bay, a sub-bay of Tampa Bay (Lewis and Estevez 1988; Figure 4).

We studied oystercatchers on seven dredged spoil material deposit islands in Hillsborough Bay: Tampa Port Authority Spoil Island 2D, Fantasy Island, Spoil Island 3D, the Richard T. Paul Alafia Bank Bird Sanctuary (Bird Island and Sunken Island) and, for the purpose of this report, we have included territories diffusely distributed in the Big Bend region on Fishhook Spoil Island, the rock jetty at the Tampa Electric Company (TECO) facility in the Hillsborough Bay segment, and south through the south end of the outer shoreline of the Apollo Beach 'hammerhead' in the Middle Tampa Bay segment of Tampa Bay, Florida (Figure 5).

Island shorelines were composed of sandy dredged spoil material beaches lying waterward of spoil material uplands. In Hillsborough Bay, spoil island shoreline vegetation includes three species of mangroves (*Rhizophora mangle*, *Avicennia germinans*, and *Laguncularia racemosa*), smooth cordgrass *Spartina alterniflora*, halophytic succulents (e.g. *Batis maritima*), saltbush *Baccharis halimifolia*, seagrape *Cocoloba uvifera*, Australian pine *Casuarina* spp., Brazilian pepper *Schinus terebinthifolius*, lead tree *Leucaena leucocephala*, and other species.

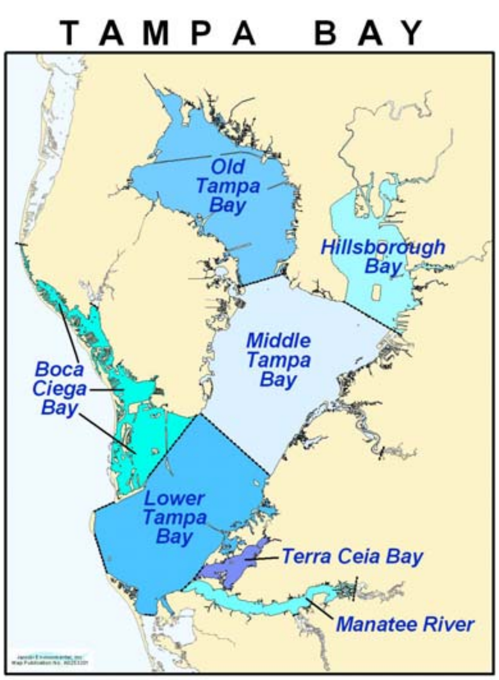

Figure 4. Named segments of Tampa Bay.

Shoreline vegetation varied among islands in relationship to topoedaphic elevation and exposure to fetch on each island. Nesting sites on the Apollo Beach hammerhead area were small patches of shoreline on undeveloped lots among the residential development.

3 METHODS

3.1 Field Surveys

During 1990-2007, an 18-year study period, we located nests by observing incubating adults with binoculars from a motorboat about 30 m offshore. Pair formation initiates generally in March in central Florida and breeding is completed by mid-August. Most nests were easily visible and recurred annually at locations used previously. Our survey intensity varied inter-annually, ranging from one seasonal survey, typically in late April when we expected to have the greatest likelihood of seeing successfully nesting pairs, to continual daily surveys in years when we supported the Tampa Port Authority's Migratory Bird Protection Committee and the Port's dredging contractors when construction work extended past the April 1 construction stop work date adopted by the committee. We recorded numbers of adults, locations of occupied territories or nests on the island shorelines, descriptions of nesting habitat, behaviors, and numbers of chicks.

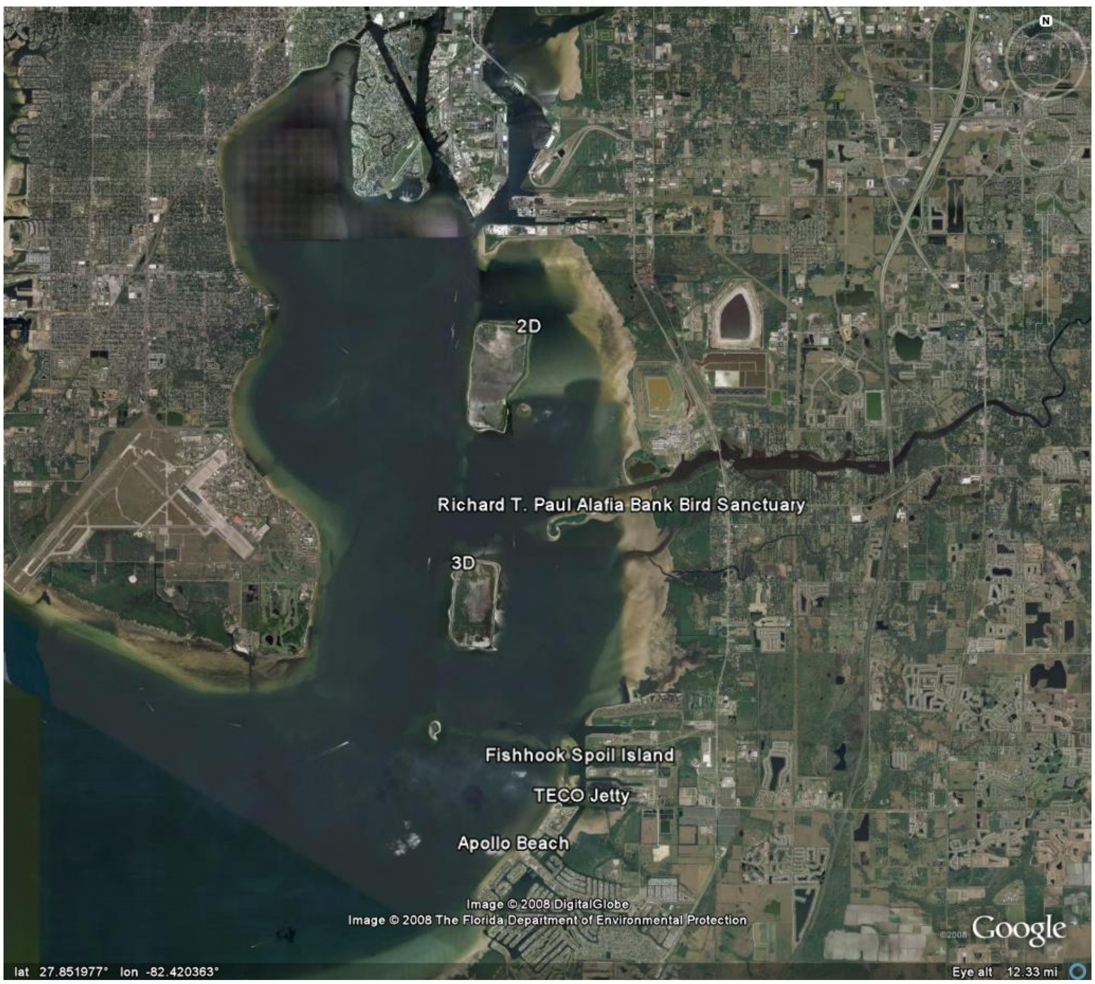

Figure 5. Aerial photograph of Hillsborough Bay showing the Tampa Port Authority's Spoil Island 2D, Fantasy Island, and Spoil Island 3D; the Richard T. Paul Alafia Bank Bird Sanctuary; TECO's Fishhook Spoil Island and jetty; and the coastline south to Apollo Beach (photo derived from Google Earth 2008).

3.2 Data Analysis

We compiled field notes and mapped 135 territories (American oystercatcher pairs defend linear territories along island shorelines where they nest) that were occupied at least once among the study sites during 1990-2007. Spoil Island 2D was not surveyed in 1990; Fishhook Spoil Island was not surveyed in 1990, 1992-94, 1996, 1998, and 2006; and the Apollo Beach hammerhead was not surveyed in 1990-99 and 2005-06.

We divided the number of breeding pairs by the number of kilometers of beach shoreline at mean high water (MHW) to estimate an index of nesting density (nests km^{-1} suitable shoreline) on the seven study sites, using recent aerial photographs (Southwest Florida Water Management District 2006). We excluded shoreline segments that were unsuitable for nesting where they were densely vegetated with mangroves or other encroaching vegetation, had insufficient beach or a sharp escarpment or riprap face above the mean high tide line because of their position relative to the fetch in the bay, or had residential or industrial development and were uninhabitable by oystercatchers. In other studies, productivity is reported as the number of chicks fledged per breeding pair per year. This estimate of productivity assumed the local breeding numbers did not change during a breeding season, based on other studies of marked birds that supported these assumptions (Nol and Humphrey 1994). We calculated productivity similarly for the 2007 data from Spoil Island 2D.

3.3 Animal Welfare Protocols

We did not capture or restrain oystercatchers during our research.

4 RESULTS

Between 1930-1985, 20.08 km of potential oystercatcher nesting habitat were created on dredged material spoil islands in Hillsborough Bay, and 0.89 km of shoreline on the Apollo Beach hammerhead (Table 1, and see Table 3).

Table 1. Construction dates of dredged spoil material deposit islands and in Hillsborough Bay.

Landowner	Study Area	Construction completion date
Tampa Port Authority	2D	1978
Tampa Port Authority	3D	1982
Tampa Port Authority	Fantasy Island	1978
Tampa Port Authority	Pine Island	1969
Tampa Port Authority	Fishhook Spoil Island	1978
Tampa Electric Company	TECO Jetty	1956
Mosaic Fertilizer, LLC	Alafia Bank – Bird Island	1930, and later deposits
Mosaic Fertilizer, LLC	Alafia Bank – Sunken Island	1970, and later deposits
Private landowners	Apollo Beach	c. 1960-65

4.1 Nesting Success

Between 1990-2007 the Hillsborough Bay and Apollo Beach hammerhead area (Middle Tampa Bay) supported 58-87 territories annually (mean 71.8, SD 13.60, n=18 yrs) (Table 2; Table 4). Sites on 2D, 3D, Fishhook Spoil Island, TECO jetties, and the Alafia Bank were also occupied consistently (Figures 6-10, Table 4). The two spoil islands managed by the Tampa Port Authority in the northern bay had mean occupied territories of 31.8 (SD 4.64) and 15.6 (SD 1.98) for 2D and 3D, respectively. Combined, these two spoil islands support 68% of the occupied territories bay-wide, and 10% of the Florida nesting population. Fishhook Spoil Island including the TECO jetty in southern Hillsborough Bay supports 16%, and Mosaic Fertilizer LLC's Richard T. Paul Alafia Bank Bird Sanctuary supports 25% of the oystercatchers nesting in the bay.

Table 2. Mean number of occupied American Oystercatcher territories in seven study areas in Hillsborough Bay 1990-2007.

Study Area	Mean	SD	Minimum (n)	Maximum (n)	Range (n)	Mean Occupancy Frequency (%)
Spoil Island 2D	31.8 [a]	4.64	21	38	17	61.1
Spoil Island 3D	15.6	1.98	12	19	7	59.8
Fantasy Island	0.6	0.51	0	1	1	55.6
Alafia Bank	17.6	2.64	14	22	8	58.5
Fishhook Spoil Island	11.5 [b]	3.45	3	16	13	63.6
Apollo Beach	3.3 [c]	1.75	1	6	5	41.7
Total - ALL Areas	71.8	13.63	33	87	54	59.4

[a] No survey conducted in 1990.
[b] No survey conducted in 1990, 1992-94, 1996, 1998, and 2006
[c] No survey conducted in 1990-99 and 2005-06.

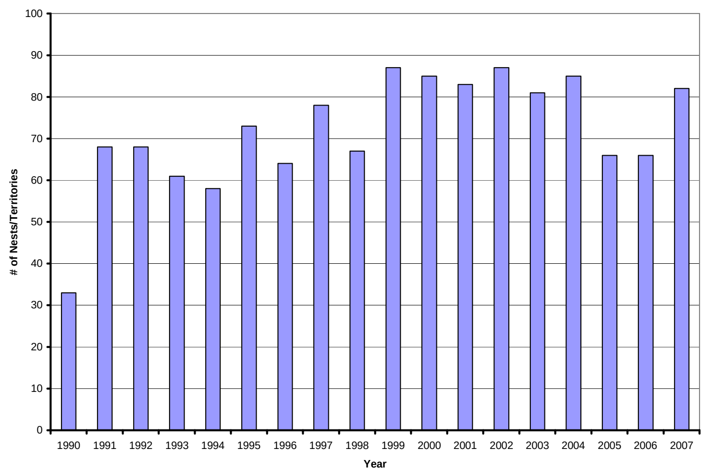

Figure 6. Total occupied American Oystercatcher territories between 1990-2007 in Hillsborough Bay and the Apollo Beach hammerhead area, Tampa Bay.

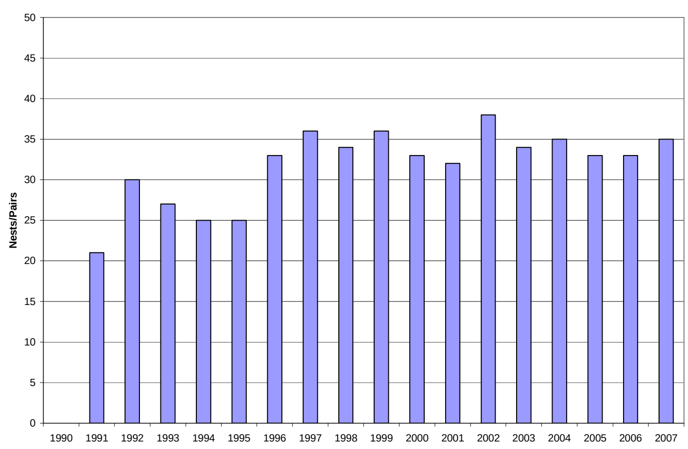

Figure 7. Number of occupied American Oystercatcher territories on Spoil Island 2D (no survey conducted in 1990).

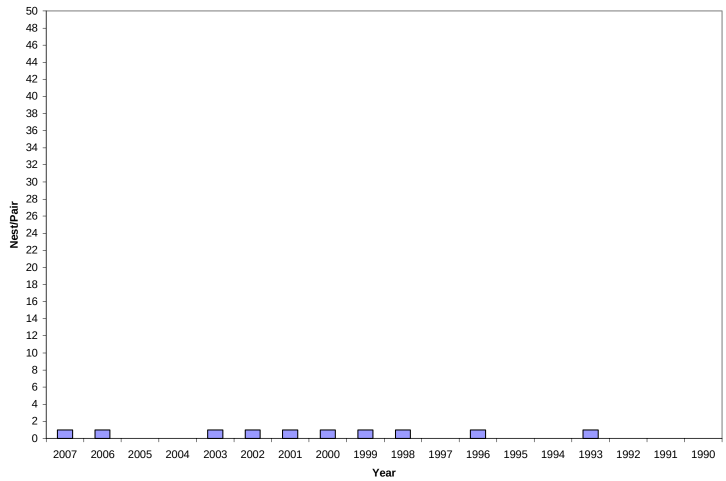

Figure 8. Number of occupied American Oystercatcher territories on Fantasy Island.

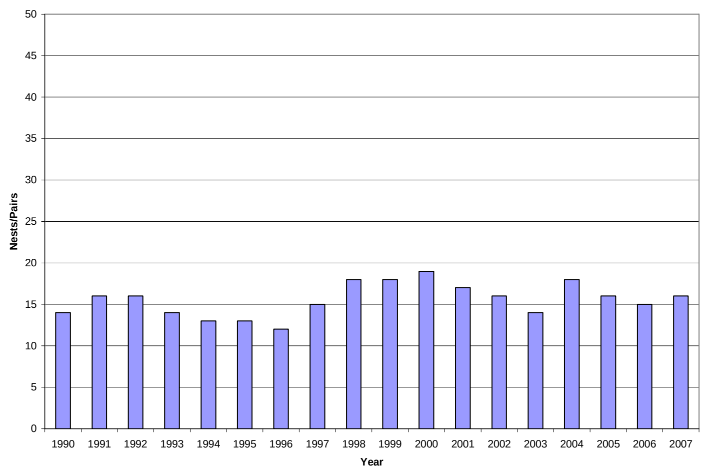

Figure 9. Number of occupied American Oystercatcher territories on Spoil Island 3D.

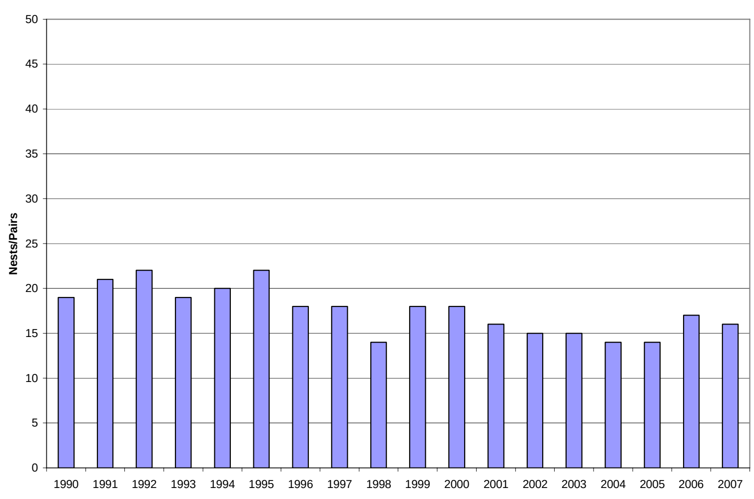

Figure 10. Number of occupied American Oystercatcher territories on the Alafia Bank.

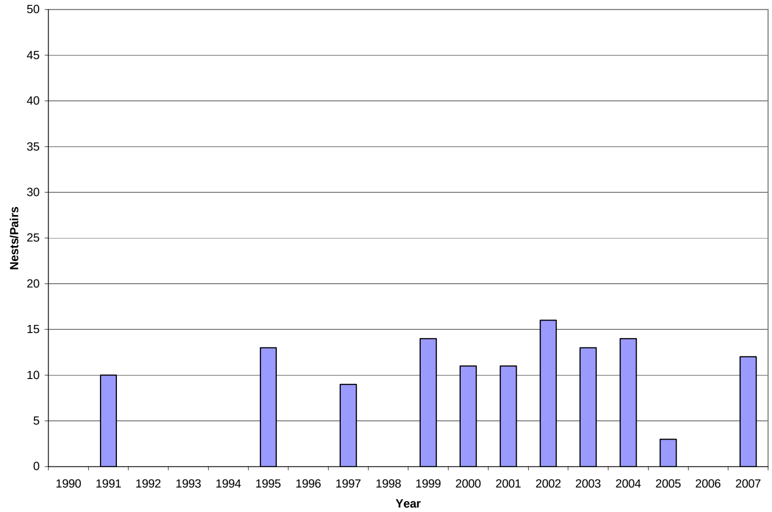

Figure 11. Number of occupied American Oystercatcher territories on Fishhook Spoil Island (no survey conducted in 1990, 1992-94, 1996, 1998, and 2006).

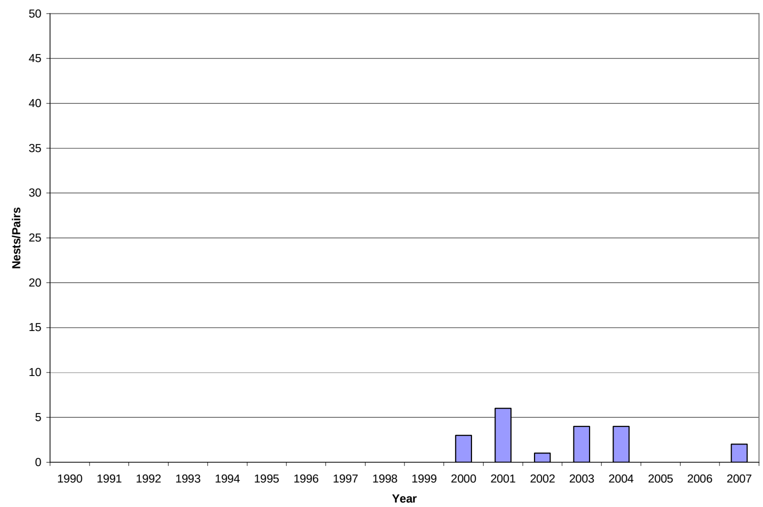

Figure 12. Number of occupied American Oystercatcher territories on the Apollo Beach hammerhead area (no survey conducted in 1990-99 and 2005-06).

4.2 Territory Distribution

We mapped the locations of territories occupied at least once during our study period on each island based on compiled field notes (Table 3; Figures 13-18). Inter-territorial distances varied among territories due to shoreline topography, presence of and type of vegetation, proximity to forage, and debris or features that were present intermittently on the beach. The minimum inter-territorial distance was 13.7 m (rounded to 15 m for planning purposes), based on the nearest neighbor distance of the territories that were immediately adjacent to each other because of the shoreline configuration. Inter-territorial distances varied, and were greater than the minimum distance mapped relative to inanimate objects on the beaches such as debris (e.g. “the blue barrel effect”), rock jetties, or Australian pines on 2D that visually shielded pairs from each other, aspect, sensitivity to fetch, forage availability on or nearby a territory, or unsuitable shoreline habitat.

Figure 13. Locations of American oystercatcher territories in Hillsborough Bay on Spoil Islands 2D, Fantasy Island, 3D, Alafia Bank, Fishhook Spoil Island, and Apollo Beach hammerhead area (photo Southwest Florida Water Management District 2006).

Figure 14. Locations of American oystercatcher territories occupied at least once during the study period on Spoil Island 2D and Fantasy Island.

Figure 15. Locations of American oystercatcher territories occupied at least once during the study period on Spoil Island 3D.

Figure 16. Locations of American oystercatcher territories occupied at least once during the study period on the Alafia Bank Bird Island.

Figure 17. Locations of American oystercatcher territories occupied at least once during the study period on the Alafia Bank Sunken Island.

Figure 18. Locations of American oystercatcher territories occupied at least once during the study period on Fishhook Spoil Island and the TECO jetty.

Figure 19. Locations of American oystercatcher territories occupied at least once during the study period on the Apollo Beach hammerhead.

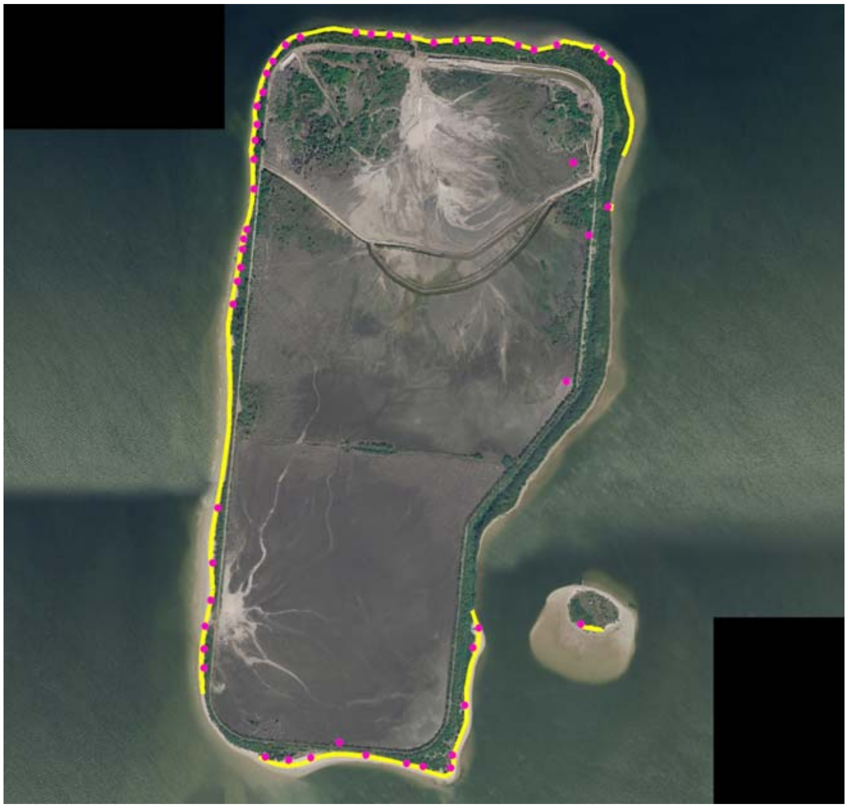

Figure 20. Suitable oystercatcher habitat on Spoil Island 2D and Fantasy Island.

Figure 21. Suitable oystercatcher habitat on Spoil Island 3D.

Figure 22. Suitable oystercatcher habitat on the Alafia Bank Bird Island.

Figure 23. Suitable oystercatcher habitat on the Alafia Bank Sunken Island.

Figure 24. Suitable oystercatcher habitat on Fishhook Spoil Island and the TECO jetty.

Figure 25. Suitable oystercatcher habitat on the Apollo Beach hammerhead and adjacent canal shorelines.

4.3 Territory Density

Territory density varied among the seven study areas and ranged from 10.4 pairs km^{-1} on Fishhook Spoil Island to 1.6 pairs km^{-1} on Alafia Bank-Bird Island (Table 3).

Table 3. Dredged spoil material deposit islands and kilometers of suitable oystercatcher nesting beach in Hillsborough Bay in 2007.

Landowner	Spoil Island	Shoreline perimeter (km)	Usable shoreline (km)	Usable shoreline (%)	Pairs (n)	Pairs km-1 (n)
Tampa Port Authority	2D	6.46	4.62	72	35	7.6
Tampa Port Authority	3D	5.32	4.99	94	16	3.2
Tampa Port Authority	Fantasy Island	0.45	0.09	20	1	11.1
Tampa Port Authority	Pine Island	0.60	0.60	100	0	0
Tampa Port Authority	Fishhook Spoil Island	0.77	0.77	100	8	10.4
TECO	Teco Jetty(e. side)	1.55	1.05	68	2	1.9
TECO	Teco Jetty (w. side)	0.77	0.77	100	2	2.6
Mosaic Fertilizer, LLC	Alafia Bank – Bird Island	1.86	1.22	66	2	1.6
Mosaic Fertilizer, LLC	Alafia Bank – Sunken Island	2.80	2.42	86	14	5.8
Private	Apollo Beach1	0.06	0.06	100	1	16. 7
Private	Apollo Beach2	0.06	0.06	100	1	16. 7
Private	Apollo Beach3	0.17	0.17	100	1	5.8
Private	Apollo Beach4	0.13	0.13	100	1	7.7
Private	Apollo Beach5	0.14	0.14	100	1	7.1
Private	Apollo Beach6	0.12	0.12	100	1	8.3
Private	Apollo Beach7	0.05	0.05	100	1	20.0
Private	Apollo Beach8	0.16	0.16	100	1	6.3

4.4 Annual Productivity

Most of the nesting productivity data we acquired over the study period followed nesting birds for portions of the nesting season on Spoil Island 2D, in association with the Tampa Port Authority's maintenance dredging and construction program. In 2007, we tracked the productivity on Spoil Island 2D from the onset of nesting through the fledged young stage. Of 35 nesting pairs or nest attempts, the annual productivity was nine large feathered young and fledged young for an average of 0.26 chicks/nest.

In 2007, nesting initiated c. March 19 and most young-of-the-year were fledged by July 17, when we stopped monitoring construction activities for the year. Based on this chronology, the first small downy chicks were observed at the end of April (c. April 28), they had grown to large downy chicks in approximately 20 days, the first large feathered young were observed June 11, and the first fledged young were observed July 2. The onset of nesting by approximately the third week of March supports advancing the "migratory bird season" from April 1 to March 15 or at the latest March 21 for maintenance dredging and construction activities on the port's facilities.

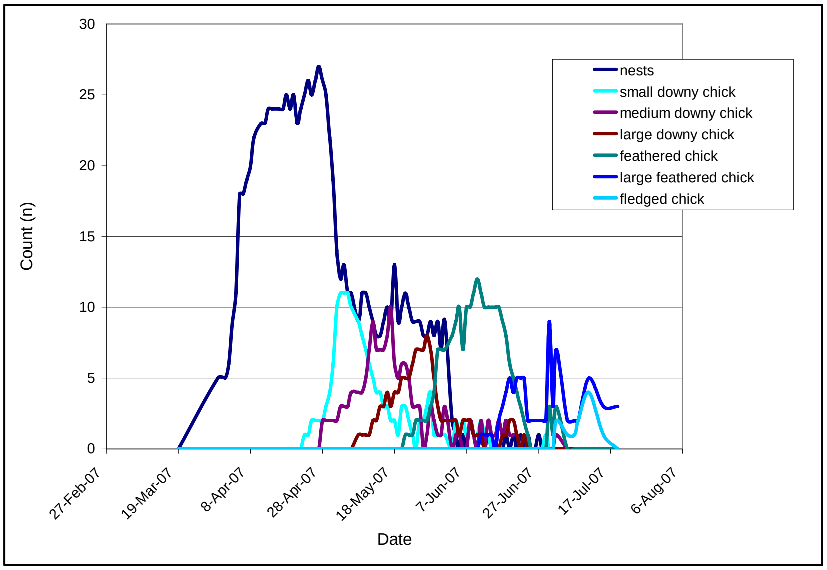

Figure 26. Nesting and fledging chronology in 2007 on Spoil Island 2D.

5 DISCUSSION

American oystercatcher nesting has decreased during the past two decades on larger barrier islands along the central gulf coast (e.g. South St. Petersburg Beach, Madeira Beach, Ft. DeSoto Beach in Pinellas County or Anna Maria Island) due to coastal development, increasing disturbance (boaters, jet skis, campers, etc.), and increasing mammalian predator populations. Smaller islands (<20 ha in particular) are important to the conservation of a diverse group of nesting waterbirds, but small estuarine islands in the range of 2-~40 ha are highly vulnerable to erosion from natural and navigation exacerbated currents, and anticipated effects from the progressive rise in sea levels (Erwin, Hatfield and Wilmers 1995). The smallest islands tend to be lower in elevation and susceptible to washing over by storm tides. Birds also tend to avoid islands large enough to support mammalian predators (e.g., raccoon *Procyon lotor*) year around.

Surveys in the early 1980s enumerated 60-75 oystercatcher pairs in the entire Tampa Bay system, with 35 oystercatcher pairs in Hillsborough Bay and 15 or more pairs on islands near the bay mouth (Paul and Woolfenden 1985). Oystercatchers apparently have very high fidelity to a nesting site, will aggressively defend their territory against other oystercatchers and aerial predators, and attempt to nest in about the same location year after year if conditions are suitable and they are not driven from the site (Hazlitt and Butler 2001). If their first nesting attempt fails, pairs will attempt to re-nest once or twice until mid-July, depending on seasonal conditions. Even though nesting success may be suppressed in one year because of nest failure related to predation, disturbance, or overwash, they will return to the same site the next year if it is still suitable. As nesting habitat becomes unsuitable, pairs will search for new available nesting territories. Occupancy frequency in primary and alternate nesting territories was generally consistent in Hillsborough Bay. The available habitat was occupied during the study period, and pairs persisted in occupying their approximate territories unless habitat conditions changes so much that a site had to be abandoned.

Nesting density is a function of available habitat and site-specific conditions. Oystercatchers can nest in close proximity if there is some visual shielding between territories (Nol and Humphrey 1994, Toland 1999). We found that the densest territories were located on continuous beaches on Spoil Island 2D where habitat was optimal, and on the TECO jetty, where pairs were visually screened and nested within about 20 feet of each other on opposite sides of the jetty mound. The nesting pairs there are blocked from seeing each other by the topography and vegetation on the jetty corner, which allows the pairs to nest more closely together than if they could see each other. We noted intermittently during the years that debris on the beaches or construction rubble also isolated pairs sufficiently to potentially decrease inter-territorial distances. Inter-territorial distances increased where suitable habitat was patchy, pairs were not visually separated from each other, or foraging habitat was not present adjacent to a territory.

McGowan et al. (2005) compared nesting success on remote barrier beaches (0.6 pairs km^{-1} shoreline) with dredged spoil material islands (10.6 pairs km^{-1} shoreline) in the Cape Fear River, North Carolina. On remote barrier beaches density may vary, but is generally highest near prime foraging territories, especially on sand flats near inlets (McGowan et al. 2005). Densities at our study sites reflected highly variable conditions and ranged widely. The Alafia Bank and TECO jetty had low densities (Bird Island - 1.6 pairs km^{-1}, west jetty – 2.6 pairs $km^{-1,}$ and east jetty - 1.9 pair km^{-1}, respectively) but far exceeded densities at North Carolina remote barrier beaches. Spoil Island 2D (7.6 pairs km^{-1}), Fantasy Island (11.1 pairs km^{-1}), Fishhook Spoil Island (10.4 pairs km^{-1}), and Sunken Island (5.8 pairs km^{-1}) had densities ranging around that of the Cape Fear River dredged spoil material islands. Differences on our sites may be related to human or terrestrial predator disturbance or forage availability. The shoreline of Fishhook Spoil Island is frequently disturbed by fishermen and recreational boaters. The Apollo Beach hammerhead area was intermittently occupied and highly sensitive to disturbance, since the nest sites were located on the shorelines of lots where houses had not yet been built and in the small public park on an extended spit. Around the 2007 nesting season, houses were built on the few undeveloped lots that oystercatchers were nesting on in Apollo Beach and those sites will likely be unsuitable for nesting in the future.

Oystercatchers attempting to nest on Pine Island, Fantasy Island and any site on the Apollo Beach shoreline and canal area including the Mira Bay Channel will likely be unsuccessful. Shorelines on the Apollo Beach hammerhead are privately owned and abut residential properties so it is likely that oystercatchers will not nest there successfully in the future. The few oystercatchers that have attempted to nest on residential shorelines in the past were generally positioned on as yet undeveloped lots among the residential development. Fantasy Island and Pine Island are the public use islands in Hillsborough Bay and any oystercatcher pairs that attempt to nest there we presume will fail due to the constant recreational use especially in the spring and summer.

Fishhook Spoil Island appears to have intermittent public use and boater landings, and campfire and camping sites were observed in 2006 and 2007. The island was posted with National Audubon Society signs warning ‘Bird Sanctuary’ and ‘No Trespassing’ in spring 2008. It should also be posted with Tampa Port Authority “No Trespassing” signs, which may be the most influential warning available in Hillsborough Bay.

The South Atlantic Migratory Bird Initiative Implementation Plan sets population targets to maintain or increase populations of high priority species based on current estimates of population levels (Watson and McWilliams 2004). The plan assumes that current estimates of shorebird breeding populations are close to the true values and that ornithologists can anticipate, for oystercatchers, the appropriate population level necessary to ensure long-term species survival.

Effects of human disturbance on nesting colonial waterbirds vary among species, and disturbance activity (Carney and Sydeman 1999). The effects of human disturbance on oystercatchers are partially documented and further research will be useful. If we assume that many of the documented effects on waterbirds affect nesting shorebirds similarly, we can apply those management guidelines logically to the protection of oystercatchers. There are three main categories of human disturbance that affect oystercatchers in Hillsborough Bay: scientific researchers (staff of the Tampa Port Authority, Audubon’s Florida Coastal Islands Sanctuaries Program, or other agencies), ecotourists (e.g., kayakers and wildlife photographers), and recreators (e.g., fishermen, picnickers, campers, and boaters).

Local scientific researchers are collaborating closely to plan for and control disturbance events on 2D and 3D, and our methods have been widely reviewed for their impacts. We identify territories early in the nesting season, and maintain buffers from contractor operations around them. Working with agency partners (the Tampa Port Authority, the U. S. Army Corps of Engineers, the Florida Fish and Wildlife Conservation Commission, other agencies, and contractors) through the Migratory Bird Protection Committee, the group has been able to coordinate construction operations during the spring nesting season to assure that nesting pairs are not affected by spoil island dredging and construction projects.

Ecotourists are a larger problem. There are several local kayak outfitters that commonly guide trips around the Alafia Bank and have not cooperated in staying sufficiently offshore of the beach during the nesting season. Several wildlife photographers are also resistant to staying suggested distances from the oystercatcher beach territories, particularly at the Alafia Bank. The Florida Aquarium boat “Bay Spirit” has a route that encircles the Alafia Bank, enters into the cove on the south side of Sunken Island, then runs between Fantasy Island and 2D. The boat occasionally throws a wake onshore to the Alafia Bank and 2D where there are several oystercatcher territories on the beach. Wildlife photographers have been documented to drive parent oystercatchers off nests, causing predation of eggs or young. In 2006, one wildlife photographer photographed another pair of photographers landing on the Alafia Bank and pushing an adult off the nest, allowing a fish crow to swoop in and steal an egg while the adult was off the nest.

Recreators are a significant disturbance factor in the bay. Both commercial and recreational fishermen approach island shorelines at close distances, either drifting by a location, causing a short-term temporary disturbance or anchoring and remaining stationary for an extended period causing a longer-term disturbance. Drifting boats typically cause an alert reaction and energetic expenditure in the adults, and the incubating oystercatcher may leave its nest unprotected for a lengthy period. This exposes the eggs or young to injury and/or death from predation or temperature extremes. Stationary boats (guided or independent) cause oystercatchers to depart their nests for extended periods. Disruptions from fishermen wading on the beaches are even more significant.

Boaters, picnickers, and campers are a persistent disturbance factor in Hillsborough Bay because Pine Island and Fantasy Island are the only two public island landing locations in the bay. On summer weekend days Pine Island can have dozens of boats anchored around it, and oystercatchers have not nested successfully on the island. Similarly, many boats anchor at the north end of Fantasy Island and although one pair attempts to nest annually on the south side, they have not been successful, so neither of these islands supports successfully nesting oystercatchers.

Although approximately 50,000 free Hillsborough Bay Boaters Guides have been distributed to the public, boaters are still landing on the restricted sandy beaches of 2D, 3D and the Alafia Bank. Audubon hires a Seasonal Warden to patrol these islands on the weekends and holidays during the nesting season (March-August), but the warden cannot be a daily continuous presence on the bay. A greater patrol presence and more intensive level of law enforcement will be necessary to protect nesting oystercatchers and other birds in the bay.

6 MANAGEMENT RECOMMENDATIONS

We have developed a series of management recommendations for protecting breeding American oystercatchers in Hillsborough Bay. These recommendations are consistent with management recommendations throughout the oystercatcher's range in the eastern United States (Schulte, Brown and the American Oystercatcher Working Group 2006):

1. Identify and protect emerging habitats in Hillsborough Bay. Manage emerging sandbars and sandspits around the main oystercatcher activity areas and shorelines of Spoil Islands 2D and 3D, the Alafia Bank, and Fishhook Spoil Island and the TECO jetty in the Big Bend Channel area of Hillsborough Bay.

2. Protect key areas of existing important habitat that are currently vulnerable. The shorelines of Spoil Islands 2D and 3D are posted with “No Trespassing” signs above the mean high water (MHW) tideline, which are placed there to prevent the signs from washing away. Boaters often walk onto the beaches below the MHW line to read the signs because the lettering is small, and also misinterpret the signs' meaning as “No Trespassing beyond this point” instead of “No Trespassing on the beach”. Unfortunately, this means that the trespassers have already affected American oystercatcher nesting sites located waterward of the signs. We recommend installing “No Landing” signs after the 2008 nesting season. The Alafia Bank is similarly posted with large 3x4 foot wooden signs and yellow metal “No Trespassing” sanctuary signs identifying the sanctuary; Bird Island is also designated a FWC “Critical Wildlife Area”.

3. Establish offshore buffers because oystercatchers leave their nests when boaters approach the beach during the nesting season. The FWC recommended buffer distance is 100 m; about 30-50 m may be adequate.

4. Manage existing protected areas to reduce nest predation and disturbance. All jurisdictions should cooperate to reduce the density of meso-carnivores. Heightened management to control mammalian (raccoons, opossum, potentially coyotes, feral cats, and wild pigs) and other predators (iguanas, snakes, or other herptiles) bay-wide must be cooperatively implemented to

minimize the possibility that predators could move among nesting islands. Predation by various avian predators (Laughing Gulls or other gull species, Great Blue Herons, Black-crowned Night-Herons, Fish Crows, and other birds) will occur, but reducing human disturbance will allow parent birds to remain on their nests, and protect their young.

5. Use boater environmental education to reduce disturbance at key nesting (and wintering) areas. Recreational use on Spoil Islands 2D and 3D, Alafia Bank, Fishhook Spoil Island and the TECO jetty should be further limited through an integrated program of signage, education, and enforcement control, with reprinting and additional distribution of the "Hillsborough Bay Boater's Guide" and interagency law enforcement cooperation. Fantasy Island is designated as a recreational island, although it may be possible to protect the oystercatcher that attempts to nest there annually during the nesting season. Regionally, resident and tourist beach users are disrupting beach-nesting bird colonies and causing the loss of eggs and young. These user groups must be more assertively educated and managed by the respective land managers of the colony sites to ensure compliance with the Migratory Bird Treaty Act. Unless disruptions are controlled during the nesting season, many nests will continue to fail. Audubon employs a Seasonal Warden to patrol Hillsborough Bay colonies. Tampa Port Authority, FWC, Hillsborough County Sheriff's Office, and other law enforcement agency patrols and enforcement of wildlife protection laws, supplemented by interagency in-service briefings, should complement this staffing.
6. Protect nesting territories by reducing the potential for wave overwash, especially during spring high tides, from existing tug, cargo and cruise ship vessel traffic and proposed Panamax shipping. Incorporate offshore wave-breaks to control erosion and retain wide beaches usable as on-shore oystercatcher habitat. Use of shoreline riprap should be avoided, and offshore riprap should be positioned so that it does not obscure the oystercatchers' view of the horizon.
7. Closely coordinate cooperative planning for all dredging, survey, and marine construction projects on spoil islands in Hillsborough Bay through the Migratory Bird Protection Committee to protect and reduce disturbance to nesting waterbirds, including oystercatchers.
8. Implement vegetative habitat management as necessary annually to establish bare substrate as suitable habitat for oystercatcher and other beach-nesting birds.
9. Protect freshwater inflows to the estuary to sustain oyster populations near the known oystercatcher nesting territories.
10. Install oysterbar habitat to provide forage adjacent to the known oystercatcher territories.
11. Prosecute trespassers year-around to protect bird nesting, migrating, and wintering use.

There is a large ecological overlap with other nesting species common in the bay. Implementation of these conservation measures for oystercatcher and other beach-nesting species will provide benefits for the bay's entire avian community.

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Data Ownership

The data presented in this report are managed by Audubon of Florida and may not be used for other publications or re-interpreted by others without the express written consent of the Sanctuaries Manager, Florida Coastal Islands Sanctuaries. Audubon of Florida's Florida Coastal Islands Sanctuaries Program is currently preparing a manuscript of this study for publication within the next twenty-four months. The Florida Coastal Islands Sanctuaries Program may be contacted at 410 Ware Blvd., Suite 702, Tampa, FL 33619, telephone 01-813-623-6826, email ahodgson@audubon.org.

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Table 4. Summary of occupied nesting territories between 1990-2007.

Nesting Territory	Location[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Yrs Occupied (n)	Yrs Occupied (%)
1	2D			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	16	94.1
2	2D		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	16	94.1
3	2D		X	X	X	X		X	X		X	X	X	X	X	X	X	X	X	15	88.2
4	2D		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	16	94.1
5	2D		X	X	X	X		X	X	X	X	X		X		X	X	X		13	76.5
6	2D		X		X	X	X	X	X	X	X			X	X	X		X	X	13	76.5
7	2D			X	X	X		X	X	X			X			X	X	X		10	58.8
8	2D		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	16	94.1
9	2D		X			X		X		X	X	X	X	X	X	X	X	X	X	13	76.5
10	2D		X		X	X	X		X	X										6	35.3
11	2D					X				X				X						3	17.6
12	2D			X			X	X	X	X	X	X	X	X	X	X	X	X	X	14	82.4
13	2D			X			X	X			X		X	X		X	X	X	X	10	58.8
14	2D				X			X			X	X	X		X	X	X		X	9	52.9
15	2D					X			X	X	X	X	X	X	X		X	X		10	58.8
16	2D		X		X					X	X	X		X	X	X	X	X	X	11	64.7
17	2D		X					X	X	X	X	X		X	X	X				9	52.9
18	2D				X		X	X	X	X	X	X	X		X	X	X	X	X	13	76.5
19	2D		X	X	X			X	X	X	X		X	X			X		X	11	64.7
20	2D								X		X	X		X	X	X	X	X		8	47.1
21	2D							X	X		X		X		X				X	6	35.3
22	2D		X					X		X		X	X	X			X	X	X	9	52.9
23	2D			X						X	X		X	X		X				6	35.3
24	2D			X						X		X			X	X	X	X	X	8	47.1
25	2D			X	X				X	X		X	X	X	X	X		X		10	58.8
26	2D			X				X			X		X		X	X				6	35.3
27	2D		X	X				X	X			X	X	X			X		X	9	52.9
28	2D			X	X		X	X	X	X	X	X	X	X	X					11	64.7
29	2D			X		X	X		X		X	X		X						7	41.2
30	2D						X	X	X	X		X	X	X			X			8	47.1
31	2D		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	16	94.1
32	2D		X	X					X			X	X	X	X	X	X	X	X	11	64.7
33	2D						X		X	X	X	X			X	X		X		8	47.1
34	2D		X	X	X	X	X	X	X	X	X	X	X	X		X		X	X	15	88.2

Nesting Territory	Location[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Yrs Occupied (n)	Yrs Occupied (%)
35	2D					X	X	X		X	X	X	X	X	X	X			X	11	64.7
36	2D		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	15	88.2
37	2D						X		X					X	X	X	X	X	X	8	47.1
38	2D		X	X	X	X		X	X	X	X	X	X	X	X	X	X			14	82.4
39	2D						X		X			X		X					X	5	29.4
40	2D			X	X	X		X		X	X		X	X		X	X	X	X	12	70.6
41	2D		X	X	X			X	X			X		X	X		X	X	X	11	64.7
42	2D			X	X	X	X	X		X	X			X			X	X		10	58.8
43	2D						X		X		X			X	X	X	X	X	X	9	52.9
44	2D		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	17	100.0
45	2D			X	X	X	X	X	X	X	X	X	X		X	X		X	X	14	82.4
46	2D			X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	15	88.2
47	2D		X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	16	94.1
48	2D			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	16	94.1
49	2D																		X	1	5.9
50	2D									X					X					2	11.8
51	2D																		X	1	5.9
52	2D																		X	1	5.9
53	Fantasy Is.				X			X		X	X	X	X	X	X			X	X	10	55.6
54	RTP/AB		X				X				X	X	X	X		X				7	38.9
55	RTP/AB		X	X	X	X		X	X		X	X	X	X	X					11	61.1
56	RTP/AB			X		X	X	X				X	X	X				X		8	44.4
57	RTP/AB	X	X	X	X				X			X								6	33.3
58	RTP/AB	X	X			X	X	X							X					6	33.3
59	RTP/AB	X		X	X	X	X			X		X	X					X		9	50.0
60	RTP/AB			X		X					X			X	X	X			X	7	38.9
61	RTP/AB		X	X	X	X	X	X	X	X	X	X						X	X	12	66.7
62	RTP/AB									X	X	X	X	X	X		X			7	38.9
63	RTP/AB	X	X	X	X	X	X	X	X	X			X					X		11	61.1
64	RTP/AB		X													X	X	X	X	5	27.8
65	RTP/AB	X	X	X	X		X	X	X		X			X	X	X			X	12	66.7
66	RTP/AB			X		X				X	X	X						X	X	7	38.9
67	RTP/AB		X	X	X		X		X				X			X	X			8	44.4
68	RTP/AB	X		X		X	X		X	X				X						7	38.9
69	RTP/AB	X	X	X	X			X	X		X	X			X		X	X	X	12	66.7
70	RTP/AB	X	X	X	X	X	X	X	X	X	X	X	X	X		X			X	15	83.3

Nesting Territory	Location[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Yrs Occupied (n)	Yrs Occupied (%)
71	RTP/AB			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	16	88.9
72	RTP/AB	X	X	X	X	X	X		X		X				X		X			10	55.6
73	RTP/AB	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	16	88.9
74	RTP/AB	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	17	94.4
75	RTP/AB	X	X	X	X		X	X					X				X	X		9	50.0
76	RTP/AB	X					X		X	X	X					X		X	X	8	44.4
77	RTP/AB		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	16	88.9
78	RTP/AB	X	X	X	X	X	X	X		X	X	X		X	X		X	X	X	15	83.3
79	RTP/AB	X	X		X		X	X			X	X	X	X	X	X		X	X	13	72.2
80	RTP/AB	X	X	X		X	X			X	X					X	X	X		10	55.6
81	RTP/AB	X		X	X	X		X	X			X	X	X	X				X	11	61.1
82	RTP/AB	X	X	X	X	X	X	X	X			X	X		X	X	X	X	X	15	83.3
83	RTP/AB	X	X	X		X	X	X	X	X	X						X			10	55.6
84	3D	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	17	94.4
85	3D		X	X						X		X		X		X				6	33.3
86	3D	X						X					X		X		X		X	6	33.3
87	3D	X	X	X	X	X	X	X	X	X	X	X					X	X		13	72.2
88	3D	X	X				X	X		X	X	X				X				8	44.4
89	3D			X	X				X			X	X	X		X		X	X	9	50.0
90	3D		X		X	X	X		X	X	X				X	X	X		X	11	61.1
91	3D	X	X	X		X	X	X		X	X	X	X	X		X	X		X	14	77.8
92	3D		X	X	X	X			X	X		X	X	X	X		X	X	X	13	72.2
93	3D		X		X	X		X		X	X					X		X	X	9	50.0
94	3D	X						X	X	X	X	X					X	X	X	9	50.0
95	3D	X	X	X		X	X				X	X	X		X					9	50.0
96	3D	X			X	X				X		X	X			X	X	X		9	50.0
97	3D		X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	16	88.9
98	3D			X	X		X		X		X		X	X	X	X	X			10	55.6
99	3D	X	X	X	X	X	X					X	X	X	X	X		X	X	13	72.2
100	3D	X		X	X	X	X	X		X	X			X			X		X	11	61.1
101	3D	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X		15	83.3
102	3D	X		X				X	X	X	X	X	X	X	X	X	X	X		13	72.2
103	3D		X	X	X		X	X	X	X	X	X	X	X	X			X	X	14	77.8
104	3D		X			X			X	X	X	X	X	X	X	X	X	X	X	13	72.2
105	3D	X	X	X					X		X			X	X	X	X			9	50.0
106	3D		X				X			X	X	X	X	X	X	X			X	10	55.6

Nesting Territory	Location[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Yrs Occupied (n)	Yrs Occupied (%)
107	3D								X			X				X	X	X		5	27.8
108	3D	X		X	X								X	X		X		X	X	8	44.4
109	3D			X			X		X	X	X	X	X		X		X		X	10	55.6
110	Fishhook												X	X	X	X			X	5	45.5
111	Fishhook						X					X	X	X					X	5	45.5
112	Fishhook		X				X		X		X		X	X					X	7	63.6
113	Fishhook						X		X		X	X	X	X	X	X			X	9	81.8
114	Fishhook		X								X	X		X		X	X		X	7	63.6
115	Fishhook						X		X			X	X	X	X				X	7	63.6
116	Fishhook		X						X		X	X		X	X	X			X	8	72.7
117	Fishhook										X	X	X	X	X	X			X	7	63.6
118	Fishhook		X				X				X			X	X	X				6	54.5
119	Fishhook						X				X				X	X			X	5	45.5
120	Fishhook		X				X		X		X	X			X	X				7	63.6
121	Fishhook		X						X			X		X		X				5	45.5
122	Fishhook						X				X		X	X	X	X				6	54.5
123	Fishhook						X				X		X	X	X	X			X	7	63.6
124	Fishhook		X				X		X		X	X	X	X	X	X			X	10	90.9
125	Fishhook		X				X		X		X	X		X			X			7	63.6
126	Fishhook		X				X		X		X	X	X	X	X	X	X			10	90.9
127	Fishhook		X				X				X		X	X	X	X			X	8	72.7
128	Apollo Bch												X							1	16.7
129	Apollo Bch											X	X		X	X			X	5	83.3
130	Apollo Bch												X		X				X	3	50.0
131	Apollo Bch												X							1	16.7
132	Apollo Bch												X							1	16.7
133	Apollo Bch														X	X				2	33.3
134	Apollo Bch											X		X		X				3	50.0
135	Apollo Bch											X	X		X	X				4	66.7
Total		33	68	68	61	58	73	64	78	67	87	85	83	87	81	85	66	66	82		

Notes: 1) location codes: 2D – Tampa Port Authority Spoil Island 2D; 3D – Tampa Port Authority Spoil Island 3D; Fantasy Is – Tampa Port Authority Fantasy Island; RTP/AB -- Richard T. Paul Alafia Bank Bird Sanctuary; Fishhook – Tampa Port Authority Fishhook Spoil Island and TECO concrete jetties; Apollo Bch – Apollo Beach hammerhead shoreline.

Table 5. Mean occupied nesting territories on each study site 1990-2007.

Nesting Territory	Location[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Yrs Occupied (n)	Yrs Occupied (%)
1	2D			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	16	94.1
2	2D		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	16	94.1
3	2D		X	X	X	X		X	X		X	X	X	X	X	X	X	X	X	15	88.2
4	2D		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	16	94.1
5	2D		X	X	X	X		X	X	X	X	X		X		X	X	X		13	76.5
6	2D		X		X	X	X	X	X	X	X			X	X	X		X	X	13	76.5
7	2D			X	X	X		X	X	X			X			X	X	X		10	58.8
8	2D		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	16	94.1
9	2D		X			X		X		X	X	X	X	X	X	X	X	X	X	13	76.5
10	2D		X		X	X	X		X	X										6	35.3
11	2D					X				X				X						3	17.6
12	2D			X			X	X	X	X	X	X	X	X	X	X	X	X	X	14	82.4
13	2D			X			X	X			X		X	X		X	X	X	X	10	58.8
14	2D				X			X			X	X	X		X	X	X		X	9	52.9
15	2D					X			X	X	X	X	X	X	X		X	X		10	58.8
16	2D		X		X					X	X	X		X	X	X	X	X	X	11	64.7
17	2D		X					X	X	X	X	X		X	X	X				9	52.9
18	2D				X		X	X	X	X	X	X	X		X	X	X	X	X	13	76.5
19	2D		X	X	X			X	X	X	X		X	X			X		X	11	64.7
20	2D								X		X	X		X	X	X	X	X		8	47.1
21	2D							X	X		X		X		X				X	6	35.3
22	2D		X					X		X		X	X	X			X	X	X	9	52.9
23	2D			X						X	X		X	X		X				6	35.3
24	2D			X						X		X			X	X	X	X	X	8	47.1
25	2D			X	X				X	X		X	X	X	X	X		X		10	58.8
26	2D			X				X			X		X		X	X				6	35.3
27	2D		X	X				X	X			X	X	X			X		X	9	52.9
28	2D			X	X		X	X	X	X	X	X	X	X	X					11	64.7
29	2D			X		X	X		X		X	X		X						7	41.2
30	2D						X	X	X	X		X	X	X			X			8	47.1
31	2D		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	16	94.1

Nesting Territory	Location[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Yrs Occupied (n)	Yrs Occupied (%)
32	2D		X	X					X			X	X	X	X	X	X	X	X	11	64.7
33	2D						X		X	X	X	X			X	X		X		8	47.1
34	2D		X	X	X	X	X	X	X	X	X	X	X	X		X		X	X	15	88.2
35	2D					X	X	X		X	X	X	X	X	X	X			X	11	64.7
36	2D		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	15	88.2
37	2D						X		X					X	X	X	X	X	X	8	47.1
38	2D		X	X	X	X		X	X	X	X	X	X	X	X	X	X			14	82.4
39	2D						X		X			X		X					X	5	29.4
40	2D			X	X	X		X		X	X		X	X		X	X	X	X	12	70.6
41	2D		X	X	X			X	X			X		X	X		X	X	X	11	64.7
42	2D			X	X	X	X	X		X	X			X			X	X		10	58.8
43	2D						X		X		X			X	X	X	X	X	X	9	52.9
44	2D		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	17	100.0
45	2D			X	X	X	X	X	X	X	X	X	X		X	X		X	X	14	82.4
46	2D			X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	15	88.2
47	2D		X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	16	94.1
48	2D			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	16	94.1
49	2D																		X	1	5.9
50	2D									X					X					2	11.8
51	2D																		X	1	5.9
52	2D																		X	1	5.9
53	Fantasy Is.				X			X		X	X	X	X	X	X			X	X	10	55.6
54	RTP/AB		X				X				X	X	X	X		X				7	38.9
55	RTP/AB		X	X	X	X		X	X		X	X	X	X	X					11	61.1
56	RTP/AB			X		X	X	X				X	X	X				X		8	44.4
57	RTP/AB	X	X	X	X				X			X								6	33.3
58	RTP/AB	X	X			X	X	X							X					6	33.3
59	RTP/AB	X		X	X	X	X			X		X	X					X		9	50.0
60	RTP/AB			X		X					X			X	X	X			X	7	38.9
61	RTP/AB		X	X	X	X	X	X	X	X	X	X						X	X	12	66.7
62	RTP/AB									X	X	X	X	X	X		X			7	38.9
63	RTP/AB	X	X	X	X	X	X	X	X	X			X					X		11	61.1

Nesting Territory	Location[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Yrs Occupied (n)	Yrs Occupied (%)
64	RTP/AB		X													X	X	X	X	5	27.8
65	RTP/AB	X	X	X	X		X	X	X		X			X	X	X			X	12	66.7
66	RTP/AB			X		X				X	X	X						X	X	7	38.9
67	RTP/AB		X	X	X		X		X				X			X	X			8	44.4
68	RTP/AB	X		X		X	X		X	X				X						7	38.9
69	RTP/AB	X	X	X	X			X	X		X	X			X		X	X	X	12	66.7
70	RTP/AB	X	X	X	X	X	X	X	X	X	X	X	X	X		X			X	15	83.3
71	RTP/AB			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	16	88.9
72	RTP/AB	X	X	X	X	X	X		X		X				X		X			10	55.6
73	RTP/AB	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	16	88.9
74	RTP/AB	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	17	94.4
75	RTP/AB	X	X	X	X		X	X					X				X	X		9	50.0
76	RTP/AB	X					X		X	X	X					X		X	X	8	44.4
77	RTP/AB		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	16	88.9
78	RTP/AB	X	X	X	X	X	X	X		X	X	X		X	X		X	X	X	15	83.3
79	RTP/AB	X	X		X		X	X			X	X	X	X	X	X		X	X	13	72.2
80	RTP/AB	X	X	X		X	X			X	X					X	X	X		10	55.6
81	RTP/AB	X		X	X	X		X	X			X	X	X	X				X	11	61.1
82	RTP/AB	X	X	X	X	X	X	X	X			X	X		X	X	X	X	X	15	83.3
83	RTP/AB	X	X	X		X	X	X	X	X	X						X			10	55.6
84	3D	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	17	94.4
85	3D		X	X						X		X		X		X				6	33.3
86	3D	X						X					X		X		X		X	6	33.3
87	3D	X	X	X	X	X	X	X	X	X	X	X					X	X		13	72.2
88	3D	X	X				X	X		X	X	X				X				8	44.4
89	3D			X	X				X			X	X	X		X		X	X	9	50.0
90	3D		X		X	X	X		X	X	X				X	X	X		X	11	61.1
91	3D	X	X	X		X	X	X		X	X	X	X	X		X	X		X	14	77.8
92	3D		X	X	X	X			X	X		X	X	X	X		X	X	X	13	72.2
93	3D		X		X	X		X		X	X					X		X	X	9	50.0
94	3D	X						X	X	X	X	X					X	X	X	9	50.0
95	3D	X	X	X		X	X				X	X	X		X					9	50.0

Nesting Territory	Location[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Yrs Occupied (n)	Yrs Occupied (%)
96	3D	X			X	X				X		X	X			X	X	X		9	50.0
97	3D		X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	16	88.9
98	3D			X	X		X		X		X		X	X	X	X	X			10	55.6
99	3D	X	X	X	X	X	X					X	X	X	X	X		X	X	13	72.2
100	3D	X		X	X	X	X	X		X	X			X			X		X	11	61.1
101	3D	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X		15	83.3
102	3D	X		X				X	X	X	X	X	X	X	X	X	X	X		13	72.2
103	3D		X	X	X		X	X	X	X	X	X	X	X	X			X	X	14	77.8
104	3D		X			X			X	X	X	X	X	X	X	X	X	X	X	13	72.2
105	3D	X	X	X					X		X			X	X	X	X			9	50.0
106	3D		X				X			X	X	X	X	X	X	X			X	10	55.6
107	3D								X			X				X	X	X		5	27.8
108	3D	X		X	X								X	X		X		X	X	8	44.4
109	3D			X			X		X	X	X	X	X		X		X		X	10	55.6
110	Fishhook												X	X	X	X			X	5	45.5
111	Fishhook						X					X	X	X					X	5	45.5
112	Fishhook		X				X		X		X		X	X					X	7	63.6
113	Fishhook						X		X		X	X	X	X	X	X			X	9	81.8
114	Fishhook		X								X	X		X		X	X		X	7	63.6
115	Fishhook						X		X			X	X	X	X				X	7	63.6
116	Fishhook		X						X		X	X		X	X	X			X	8	72.7
117	Fishhook										X	X	X	X	X	X			X	7	63.6
118	Fishhook		X				X				X			X	X	X				6	54.5
119	Fishhook						X				X				X	X			X	5	45.5
120	Fishhook		X				X		X		X	X			X	X				7	63.6
121	Fishhook		X						X			X		X		X				5	45.5
122	Fishhook						X				X		X	X	X	X				6	54.5
123	Fishhook						X				X		X	X	X	X			X	7	63.6
124	Fishhook		X				X		X		X	X	X	X	X	X			X	10	90.9
125	Fishhook		X				X		X		X	X		X			X			7	63.6
126	Fishhook		X				X		X		X	X	X	X	X	X	X			10	90.9
127	Fishhook		X				X				X		X	X	X	X			X	8	72.7

Nesting Territory	Location[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Yrs Occupied (n)	Yrs Occupied (%)
128	Apollo Bch												X							1	16.7
129	Apollo Bch											X	X		X	X			X	5	83.3
130	Apollo Bch												X		X				X	3	50.0
131	Apollo Bch												X							1	16.7
132	Apollo Bch												X							1	16.7
133	Apollo Bch														X	X				2	33.3
134	Apollo Bch											X		X		X				3	50.0
135	Apollo Bch											X	X		X	X				4	66.7
Total		33	68	68	61	58	73	64	78	67	87	85	83	87	81	85	66	66	82		

Notes: Means for Fishhook Spoil Island n = 10 survey years; Apollo Beach n = 7 survey years; mean for Spoil Island 2D adjusted for 1990 n=0 pairs.

9 BIOLOGY AND ECOLOGY OF AMERICAN OYSTERCATCHERS

There are many similarities in biology among the several holoarctic oystercatcher species (*Haematopus* spp.), now thought to be races. The following section summarizes important aspects of the biology and ecology of oystercatchers.

9.1 Morphology

American oystercatchers are a relatively large-bodied shorebird with black, brown, and white plumage and a heavy orange-red bill, a wingspan of approximately 23-27.5 cm, weighing approximately 600 gms. Sexual dimorphism is apparent, with females significantly heavier than males (weights respectively: 638 +/- 42 gms females, 567 +/-113 gms males, Nol 1984). Mean whole body mass of unsexed oystercatchers (n=6) was 581 +/- 16.7 gms (Corbat 1990). Females have brighter orange and longer bills than males (Nol 1985). Basal metabolic rate (BMR) was reported (Kersten and Piersma 1987).

9.2 Distribution in the United States

Two races are recognized in North America; the nominate race, *Haematopus palliatus palliatus,* nests on barrier beaches, sandbars, spoil islands, shell islands, and marsh islands along the east coast from Nova Scotia to eastern Mexico. In winter, flocks occur from central New Jersey southward. Smaller populations occur in the Caribbean and coastally south to Argentina and Chile. The western race, *Haematopus palliatus frazari,* is found from Southern California to western Mexico.

In Florida, the breeding range extends in suitable habitat along both coastlines (Bent 1962, Brown et al. 2001). Flocks from more northern areas winter in northeast Florida on the Atlantic coast as far south as Daytona Beach and on the Gulf Coast from Apalachicola Bay on the panhandle south to the Ten Thousand Islands in the Everglades. Most wintering flocks are concentrated near Cedar Key, Tampa Bay, and Nassau Sound, Florida, and Cape Romano, South Carolina. The islands of Cedar Key and the Lower Suwannee River support the highest density of wintering oystercatchers in the state (Brown unpubl. data 2003, P.&D. Leary unpubl. data, National Audubon Society 2002).

9.3 Habitat Use

Breeding habitat includes accreting undeveloped barrier beaches, sandbars, shell rakes, and occasionally salt marsh islands. In recent years, more extensive nesting in salt marsh habitat has been documented (Wilke et al. 2005, Shields and Parnell 1990, Lauro and Burgur 1989, Frohling 1965). Non-traditional habitats include dredge spoil material islands and rooftops in Florida and North Carolina (R. Paul pers. comm., Douglass, Gore and Paul 2001, J. Fussell pers. comm.).

More than half the colonies of all seabirds and wading birds in coastal North Carolina, Florida, and Texas occur on estuarine islands in the Gulf of Mexico and Atlantic coastal areas that have been created by dredged spoil materials as deposition sites from the Intracoastal Waterway (Landin and Soots 1977, Lewis and Lewis 1978, Schreiber and Schreiber 1978). Dredged sandy materials, which were formerly re-deposited on these islands, are now being diverted to other 'beach nourishment' projects and maintenance of the islands as bird nesting sites has declined (Parnell and Shields 1990). On many man-made islands, inadequate maintenance of nesting habitat has precluded their use (probably due to successional vegetation changes). Because of the stochastic suitability over time to nesting waterbirds, it is essential to maintain a network of such islands as alternatives for a dynamic breeding population (Erwin et al. 1981). Thus, maintenance of metapopulations of waterbirds may depend on maintaining a network of small, undisturbed patches whose suitability varies over time (Pickett and Thompson 1978).

Island geometry is important. The recommended perimeter buffer distance of 250 m for great blue heron colonies (Short and Cooper 1985) is often quoted as a guideline to avoid disturbance, but achieving this recommendation assumes that birds are nesting in the center of a circular 20 ha island with a radius of 250 ha.

Shell rakes are another habitat of high importance. In the mid-Atlantic and southeast they are used by nesting and wintering oystercatchers (Wilke et al. 2005, Murphy and Sanders n. d., B. Winn unpubl. data) and serve as roost sites for the majority of wintering flocks (Brown et al. 2005, P. and D. Leary pers. comm.). Shell rakes along the Intracoastal Waterway are generally owned by the U. S. Army Corps of Engineers. In Hillsborough Bay, oystercatchers roost on docks at the Tampa Port Authority (A. Hodgson, A. Paul, and M. Rachal pers. obs.).

9.4 Foraging

Oystercatchers use their laterally compressed bill to feed on bivalves and other marine invertebrates (Sabine et al. 2005, Nol 1989) and, because of their specialized diet, are found in coastal areas that support intertidal shellfish beds ("oyster bars or shell rakes"). They open bivalves by rapid stabbing to sever the adductor muscle that holds the shells together (Nol and Humphrey 1994). Typical prey species reported for various oystercatcher species worldwide have analogous prey probably occurring in Tampa Bay. It is notable that oystercatchers are apparently in competition with humans for edible estuarine species. They also compete with other shorebirds and other birds.

Oystercatchers are proficient at taking one or a few prey types. Food preferences are culturally heritable (Norton-Griffiths 1969) and within and between population diversity in diet specializations has been noted (Norton-Griffiths 1968). Safriel (1985) described diet dimorphism within an island population of European oystercatchers comparing reproductive success of two feeding types, limpet vs. terrestrial feeders on Skokholm Island, Wales, UK. 15% bred near the shore, 85% bred inland, 28% fed their young on limpets, and 72% on terrestrial arthropods. Terrestrial feeders were 3 times more successful in fledging young. Terrestrial-fed young were 4-5% heavier, and limpet-fed young were 7-10% lighter than average (Safriel 1985). Limpet-fed young are prone to gull predation because they are both undernourished and less protected by parents than terrestrial-fed young.

Gull foraging at shoreline oystercatcher territories by shore-breeding gulls (laughing gulls *Larus atricapillus* in Hillsborough Bay), and the continuous removal of grazing herbivores and large filter-feeding bivalves from an intertidal system facilitates the settlement and establishment of persistent beds of sessile species such as barnacles and of macroalgae that degrade the shore as a forage source (Hockey and Bosman 1986). The importance of predator-prey balance was demonstrated by comparing densities of *H. moquini* in areas with and without large limpets. Sites with large limpets had 80 birds km^{-1} coast, whereas, where limpet biomass was 25% of the high density site, oystercatcher density was only 5% of the site with large limpets (Hockey 1983, Hockey and Branch 1984). Hypothetically, oystercatchers regulate their density through territorial behavior to a level constructed by the balance between predation pressure and fecundity of their prey populations.

Oystercatchers are subprecocial, fed by adults until at least six months after fledging due the learning curve associated with prey capture and handling (Hockey 1987).

9.5 Nest Site Selection and Nesting Behavior

Nest sites commonly occur on sandy substrates with varying amounts of shell present. Nests have a rim of shells, wrack, both, or wrack and grass; lined with wrack or shells (Corbat 1990). Wrack is disadvantageous as a nest material since chick legs can become easily entangled in it. Nests were located on wide berm areas, sand flats at the end of beaches, and overwash areas, all with sparse vegetation. Nesting habitat has been described historically as broad sandy beaches above the mean high tide with (1) open ground above mean high tide, (2) an opening where the birds could walk back and forth from beach to nest, (3) a slightly elevated area, and (4) isolation from other large beach-nesting birds, including conspecifics (Bent 1929, Kilham 1979, Rappole 1981, Tompkins 1954). Nests are typically on sandy habitat at the ocean side of a barrier island between the dunes and high tide line, and in the salt marsh on elevated sandy dredged spoil deposits in the marsh or on grass patches on marsh islands (Frohling 1965, Lauro and Burger 1989, Lauro, Nol and Vicari 1992).

American oystercatchers have been observed nesting on the upper drift line of wrack (seagrass and terrestrial grass blades, algae, and detritus) accumulated over cordgrass (*Spartina* spp.) growing in saltmarsh habitat (Shields and Parnell 1990). Nests were depressions on top of a drift line of dead smooth cordgrass (*S. alterniflora*) culms. The wrack line was 2-3 m wide, about 50 m long, with some shrub thicket interspersed in the marsh. Marsh nest sites did not have patches of bare sand or shell (Nol 1989, Corbat 1990). This atypical nesting substrate may be a response to reduced availability of bare sand and shell substrates resulting from increased human use of beaches and reduced spoil island maintenance deposition as more material is deposited to offshore disposal sites.

Oystercatchers used different microhabitat among different areas and even within one area in different years. Birds have recently colonized non-shore habitats and the species' population has increased remarkably (Dare 1966, Douglass, Gore and Paul 2001).

Nesting density varies among locations and habitats. On remote barrier beaches density may vary, but is generally highest near prime foraging territories, especially on sand flats near inlets (McGowan et al. 2005). McGowan et al. (2005) compared nesting success on barrier beaches (0.6 pairs km^{-1} shoreline) with dredged spoil material islands (10.6 pairs km^{-1} shoreline) in the Cape Fear River, North Carolina. While dredged spoil material islands may have higher nesting oystercatcher densities, it is unclear whether the birds on spoils islands are more productive. Hatching success was higher, but overall nesting success was similar, indicating that birds on spoil islands were not successfully raising chicks.

American oystercatchers are typically monogamous shorebirds exhibiting territorial fidelity (Tompkins 1954, Nol 1989). Both sexes exhibit highly synchronized behavior during the time period when females are susceptible to extra-pair copulations; they have stable, highly complementary pair bonds over many years; low divorce rates (approximately 2.5%, Nol pers. obs.); and successful reproduction apparently requires both parents participating in parental care (Nol 1985; also European oystercatchers (Harris 1967)).

During the breeding season (March-August in Hillsborough Bay), oystercatchers are highly territorial, with mostly linear territories ranging in size from a few meters up to nearly a kilometer of beach, depending on local conditions and the presence of neighboring pairs (Cadman 1979, Corbat 1990, Davis et al. 2001, Dinsmore, Collazo and Walters 1998, McGowan et al. 2005). They form pair bonds that last the length of the breeding season (S. Schulte, unpublished data), but birds of a pair may migrate to different locations during the non-breeding season.

In the southern part of the range, many pairs do not migrate and remain together throughout the winter (F. Sanders, pers. comm., B. Winn, pers. comm.). Oystercatchers typically show strong breeding site fidelity; both males and females usually return to the same breeding territory annually (Ens et al. 1992, Nol 1989).

A breeding female lays from two to four eggs in a shallow scrape and incubation lasts approximately 27 days (Baker and Cadman 1980). Clutch sizes are mean 2.8 eggs, mode 3, in first clutches and mean 2.4, mode 2, in replacement clutches. Females tended to initiate at the same time every year. The average egg size correlated with the size of the laying female (Nol, Baker and Cadman 1984). Nests are vulnerable to overwashing and washout, predation, and disturbance. Clutch initiation dates of first clutches are synchronous, and synchrony was most consistent where the largest number of oystercatchers nested. Nesting birds are vocal and aggressive towards neighboring pairs, and participate in long piping displays during the pre-laying period. Egg weight hierarchy occurs among the laid eggs; generally the second egg is heaviest.

Newly hatched chicks are precocial and can move out of the nest within a few hours of hatching (S. Schulte, unpubl. data). Sibling social hierarchy affects fledging success; when a parent arrives with food, the dominant chick rushes to the parent, successively dominant chicks are fed after the first chick is satiated (Groves 1978, Safriel 1981). Unlike other shorebird species, chicks cannot feed themselves immediately after hatching because of their specialized shellfish diet; adult oystercatchers must open shellfish and feed their young until well after fledging (Nol and Humphrey 1994). Chicks take about 35 days to develop flight capability, during which time they are also vulnerable to predation as well as direct and indirect human impacts. Disturbance by humans may lead to increased predation and stress from temperature extremes.

9.6 Egg and Chick Mortality

Nest predation by gulls is a significant mortality factor for oystercatcher chicks. Ghost crab predation on eggs is speculated (Corbat 1990). Other possible predators include diamondback terrapin (*Malaclemys terrapin*), mangrove water snake (*Nerodia fasciata compressicauda*), eastern diamondback rattlesnake (*Crotalus adamanteus*), eastern indigo snake (*Drymarchon corais couperi*), black rat (*Rattus rattus*), and raccoon (*Procyon lotor*). Raccoons, Fish Crows, hawks, and Peregrine Falcons are common predators on shorebird eggs. In Hillsborough Bay, Laughing Gulls, Fish Crows, Peregrine Falcons, and Great Blue Herons have been observed predating oystercatcher chicks (A. F. Paul, A. B. Hodgson, M. Rachal pers. obs.). Other reported factors are stabbing by adjacent adults when chicks wandered into their territory, and starvation.

9.7 Non-breeding Season and Wintering Behavior

After the breeding season, many oystercatchers move off breeding territories and gather in roosting flocks at the edges of marshes and sand flats. In the southeast states some resident pairs remain on breeding territories throughout the year (F. Sanders unpubl. data, B. Winn unpubl. data). Oystercatchers typically roost on sites that are near feeding areas and not connected to the mainland (Brown et al. 2005). In the mid-Atlantic and southeast they commonly use shell rakes (oysterbars) as winter roost sites (Brown et al. 2005, P. and D. Leary pers. obs., Murphy and Sanders n. d.). Other habitat types used by wintering oystercatchers include small sandy islands, inlet beaches and accreting sand spits, edges and interior mudflats on marsh islands and occasionally long docks and jetties.

During the non-breeding season, oystercatchers gather in flocks, typically on remote coastal islands and marshes (Brown et al. 2005). Juveniles and sub-adults may remain in these non-breeding flocks during the summer months (F. Sanders, pers. comm.). Little is known of natal site fidelity and average age of first breeding for American oystercatchers. The similar European oystercatcher (*Haematopus ostralegus*) typically has delayed maturity with first breeding at 3-5 years. American oystercatchers apparently have a similar life history. Two and three year old birds may return to their natal site during the breeding season (McGowan et al. 2005), but most birds probably do not establish a territory and nest until they are at least four years old.

9.8 Lifespan and Diseases

American oystercatchers may live regularly over 10 years and possibly as long as 30 to 40 years (Nol and Humphrey 1994). The similar European oystercatcher can live up to 40 years (Ens et al. 1992). Diseases noted include viral dermatitis (Harris 1967, Safriel 1982); helminth parasites (Goater 1989, Hulscher 1982).

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