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Natural Resource Program Center

Summary of Shorebird Monitoring at Cape Hatteras National Seashore, 2006-2009

Natural Resource Data Series NPS/SECN/NRDS—2009/010

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- This document provides coarse data summaries for piping plover, American oystercatcher, Wilsons plover, and red knot for data collected at Cape Hatteras National Seashore under the long-term monitoring protocol developed by Byrne et al. (2009).

- The following data represent the time period of 1 January 2006 to September 2009.

- Data collected during the wintering period of 2006 -2007 follow the sampling design presented in Byrne et al. 2009b) (i.e., park-wide inference), while data collected since that timeframe were collected following the design presented in Byrne et al. (2009a) (i.e., inference limited to accreted areas).

Background and Objectives (from Byrne et al. 2009a)

Overview

Shorebirds play a vital role in the trophic dynamics of our coastal ecosystems (Moreira 1997, Leguerrier et al. 2003) and are indicators of the conditions of those systems (Morrison 1986). Because many shorebird species are highly specialized predators, the diversity of species present and their duration of stay in a location is often a good indication of the condition of that location.

Shorebirds also contribute to many people's general enjoyment of the outdoors, are the focus for many wildlife watchers, and consequently, have a significant positive impact on state and local economies (Leonard 2008). In a recent study of the economic impact of wildlife watching, Florida ranked 2nd, North Carolina ranked 8th, and Georgia 17th in the number of people involved in wildlife-watching activities, with 4.2, 2,6, and 1.9 million documented participants, respectively (Leonard 2008). Of these states, Florida ranked 2nd, Georgia 4th, and North Carolina 14th in total annual salaries, wages, and business income to the state resulting from wildlife watching activities, at just under two billion, one billion, and a half a billion dollars, respectively (Leonard 2008).

Despite this quantifiable interest, and subsequent positive financial impact, many shorebird populations have exhibited substantial population declines (Donaldson et al. 2000, Brown et al. 2001). Approximately half of all shorebird species are considered at risk (Brown et al 2001), many of which use the National Parks in Southeast Coast Network (SECN) at some time during the year. Among these species are piping plover (*Charadrius melodus*), red knot (*Calidris canutus*), American oystercatcher (*Haematopus palliates*), and Wilson's plover (*Charadrius wilsonia*), henceforth collectively referred to as "focal shorebirds."

Habitat loss and degradation is the primary threat to shorebirds. Many shorebirds often migrate substantial distances between their breeding and wintering ranges, and are dependent upon the availability of adequate resources throughout the migratory range. While shorebirds in SECN parks exhibit short-, medium, and long-range migrations, migrations of any distance require a substantial amount of energy to sustain. Slight perturbations in any part of their respective ranges can have significant negative impacts on survival and reproduction (Davidson and Piersma 2000, Sandberg and Moore 1996, Piersma and Baker 2000, Bêty et al. 2003).

The importance of protected areas, such as National Parks, that provide adequate resources is paramount, as many shorebird species use these areas year-round. Consequently, well-designed and scientifically sound monitoring protocols will further our understanding of shorebird population status and trends, and provide the information necessary to aid land managers in decisions regarding shorebird species.

Because of their high mobility, use of multiple habitat types including dense vegetation, cryptic coloration, and frequently low detectability, shorebirds present many challenges to effective monitoring and abundance estimation. No single technique is completely effective, and several techniques (e.g., air surveys, boat surveys, point counts, driving counts) are typically utilized to collect count data and generate indices of abundance, or occasionally calculate abundance estimates.

Justification for Monitoring

The National Park Service strives to understand, maintain, restore, and protect the natural resources, processes, systems, and values of the parks while providing meaningful and appropriate opportunities to enjoy them. This protocol is designed to inform park managers of the distribution of wintering and migratory shorebirds throughout park units, the habitats in which shorebirds are commonly observed, the times of day/year in which those observations occur, and the presence or absence of local and system drivers that are known or expected to affect shorebirds. However, consistently and systematically collected data on trends in presence, timing, and habitat use for do not exist for wintering and migratory shorebirds that occur in SECN parks.

Specifically, park managers need information regarding areas of active and consistent shorebird use to guide multiple management decisions. The ability to predict areas of use by shorebirds, many of which are protected through one or more statutes or regulations, will allow NPS managers to make decisions regarding seasonal access restrictions and the type and intensity of visitor access. Identification and inventories of habitat types are critical to park managers for managing designated critical habitat, essential habitat, and recovery areas to maintain and enhance their value for the recovery of threatened and endangered species (NPS Natural Resource Management Policies 4.4.1.1 and 4.4.2.3).

Additionally,

- The Recovery Plans for all three piping plover populations highlight the limited current knowledge on migratory and wintering patterns and emphasize the need for more information (USFWS 1988, USFWS 1996, USFWS 2003).

- A standardized systematic monitoring protocol presents an opportunity for across governmental agency and non-governmental organization cooperation and data-sharing as shorebirds migrate and winter across many jurisdictional boundaries and are systematically monitored in many locations (e.g., Cape Cod National Seashore, Great Lakes).

- Data are limited regarding frequency and duration of habitat use by the aforementioned shorebirds and relative abundance of wintering populations.

Measurable Objectives

- Determine the status and trends in migratory and wintering shorebirds in SECN parks using normalized observations.

- Determine the trends in migratory and wintering shorebirds in areas open and closed to vehicles in SECN parks using normalized observations.

- Determine the habitat types used by migratory and wintering shorebirds in SECN parks and if these patterns change over time.

The Byrne et al (2009a) protocol is designed to ensure 90% certainty that we can detect a 20% change in the annual number of shorebirds using normalized observations (i.e., observations / unit of effort) with a 5% chance of obtaining a false-change error (i.e., $\alpha = 0.05$, $\beta = 0.20$). In addition to the monitoring objectives above, the protocol is designed to provide park managers

with scientifically defensible data upon which to make day-to-day management decisions. This protocol is intended to provide information that can be interpreted in conjunction with other data being collected by SECN Vital Signs Monitoring Program (DeVivo et al. 2009) or by the individual parks in which wintering and migratory shorebirds are collected (such as habitat type maps).

Sampling Design

Data from the wintering period of 2006 -2007 followed the design presented in Byrne et al (2009b) (i.e., park-wide inference), while data collected since that timeframe were collected following the design presented in Byrne et al. (2009a) (i.e., inference limited to accreted areas).

Methods

Study Site (from Byrne et al. 2009b)

Cape Hatteras National Seashore is part of the east coast barrier island system. The Seashore consists of 14,326 ha of land and 121 km of beach. The U.S. Fish and Wildlife Service administers Pea Island National Wildlife Refuge within the boundary of the Seashore. The Seashore has recently been designated a Globally Important Bird Area by the American Bird Conservancy because of the importance of the Seashore's habitats to avian breeding, migration, and wintering. Developmental pressures inside and outside the Park, potential modification of geomorphic processes resulting from Hwy 12 and the associated artificial dune, predation, and recreational uses represent the major categories of threat to the integrity of natural resources at CAHA. As is the case in all National Seashores in the Southeast, adjacent property development has resulted in direct loss and fragmentation of habitat upon which numerous park wildlife species were partially dependent. Other threats to natural resources include off-road vehicle use, the introduction of non-native plants and animals, and dredging of channels adjacent to the park.

Definitions of the term "habitat type" follow that proposed by Daubenmire (1968), despite the fact these communities are disturbed to such an extent that, in general, successional processes occur on a limited scale. See Byrne et al (2009a) for descriptions of the shorebird habitat types used in this study and a conceptual representation of habitat type juxtaposition.

Conducting the Line Transect Survey

The technique for quantifying shorebird observations consists of time-constrained transect-based surveys within the entire sampling frame in the allotted time. The survey technique is an adaptation of a line-transect survey with distance-to-bird sampling (Anderson 1979, Buckland et al. 2001). Line transects surveys are generally most effective in open vegetation community types where the target species are mobile and flush easily, occur in low densities, and are easily identified.

Transect length is dependent upon the sampling frame, or the existing infrastructure used as sampling-unit boundaries (e.g., beach miles or kilometers) and is sampled for 30 minutes. It is important to note that sampling units must be of approximately equal size throughout the sampling frame, such that equal amounts of time are spent surveying equal amounts of area.

The observer walks a straight line, as indicated from a location and compass bearing identified in SOP #1 “Season Preparation, Equipment, and Training”, along the beach on a trajectory that parallels the surf zone and maximizes observability across the entire beach. If the entire beach cannot be observed in one pass (i.e., with one transect), another transect, parallel to the initial one, is conducted; this should be determined as part of the season preparation described in SOP #1. If multiple transects are necessary, transects should be > 300m apart (see Byrne et al. 2009a). In situations that require an additional parallel transect(s), the transect closest to the access point is always measured first to prevent the bias associated with traveling through a site, that is planned to be measured, prior to collecting measurements. In sites with multiple transects, all within-site transects are measured consecutively to minimize the likelihood of bird movements and possible double-counting. This is discussed further in SOP #2 “Conducting a Line Transect Survey.”

Data Summaries

Data summaries were generated for piping plover, American oystercatcher, Wilsons plover, and red knot. The data summaries include 1) observations per-unit-of-effort pooled across all locations at CAHA for the identified timeframe, and 2) observations by habitat type pooled across all locations at CAHA for the identified timeframe.

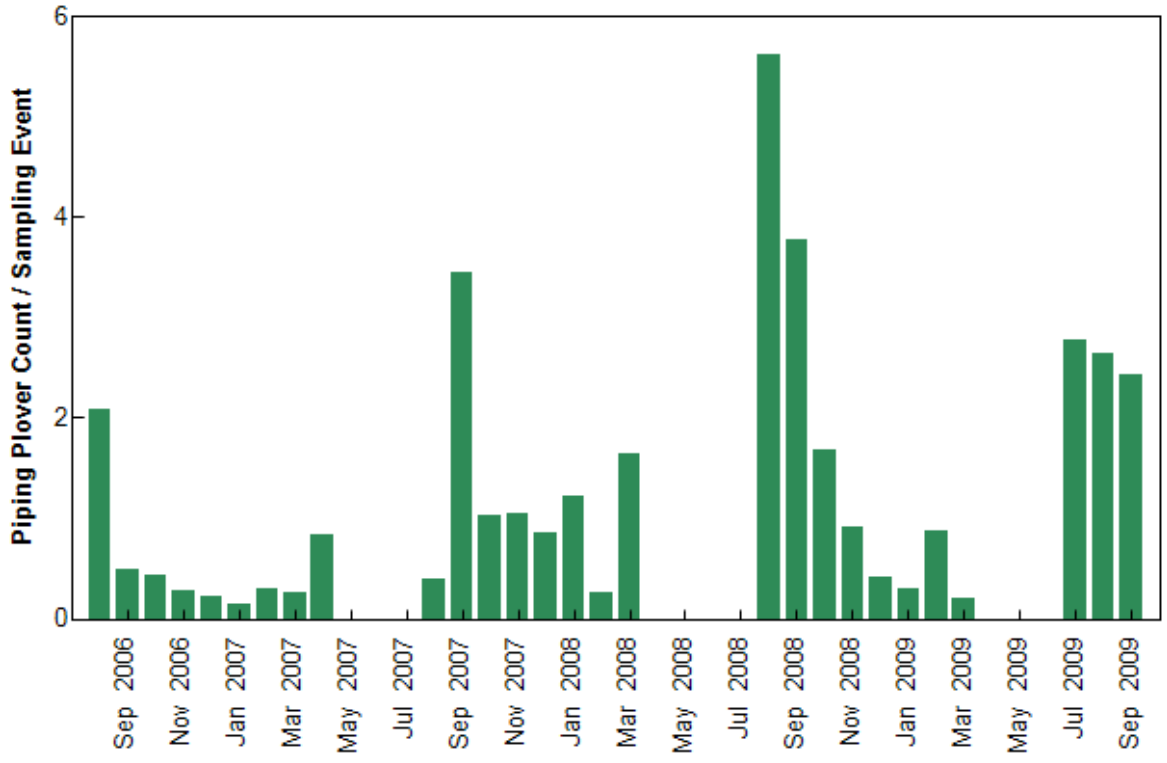

Figure 1. Piping plover observations by unit-of-effort at CAHA from 8/1/2006 to 9/30/2009. The sampling design from July 2006 to April 2007 included all beachfront areas at the park and allowed for park-wide inference; and the sampling design from April 2007 to September 2009 included only the accreted areas at the park and does not allow for parkwide inference.

Table 1. Piping plover observations by unit-of-effort at CAHA from 8/1/2006 to 9/30/2009. Months with no sampling events are not included. The sampling design from July 2006 to April 2007 included all beachfront areas at the park and allowed for park-wide inference; and the sampling design from April 2007 to September 2009 included only the accreted areas at the park and does not allow for parkwide inference.

Month	Number of Events	Count	Normalized Count
8/2006	35	73	2.09
9/2006	50	25	0.50
10/2006	57	25	0.44
11/2006	51	14	0.27
12/2006	44	10	0.23
1/2007	72	10	0.14
2/2007	83	24	0.29
3/2007	69	18	0.26
4/2007	58	49	0.84
8/2007	35	14	0.40
9/2007	53	183	3.45
10/2007	37	38	1.03
11/2007	39	41	1.05
12/2007	26	22	0.85
1/2008	38	46	1.21
2/2008	27	7	0.26
3/2008	25	41	1.64
8/2008	31	174	5.61
9/2008	13	49	3.77
10/2008	32	54	1.69
11/2008	25	23	0.92
12/2008	12	5	0.42
1/2009	37	11	0.30
2/2009	23	20	0.87
3/2009	20	4	0.20
7/2009	13	36	2.77
8/2009	39	103	2.64
9/2009	39	95	2.44

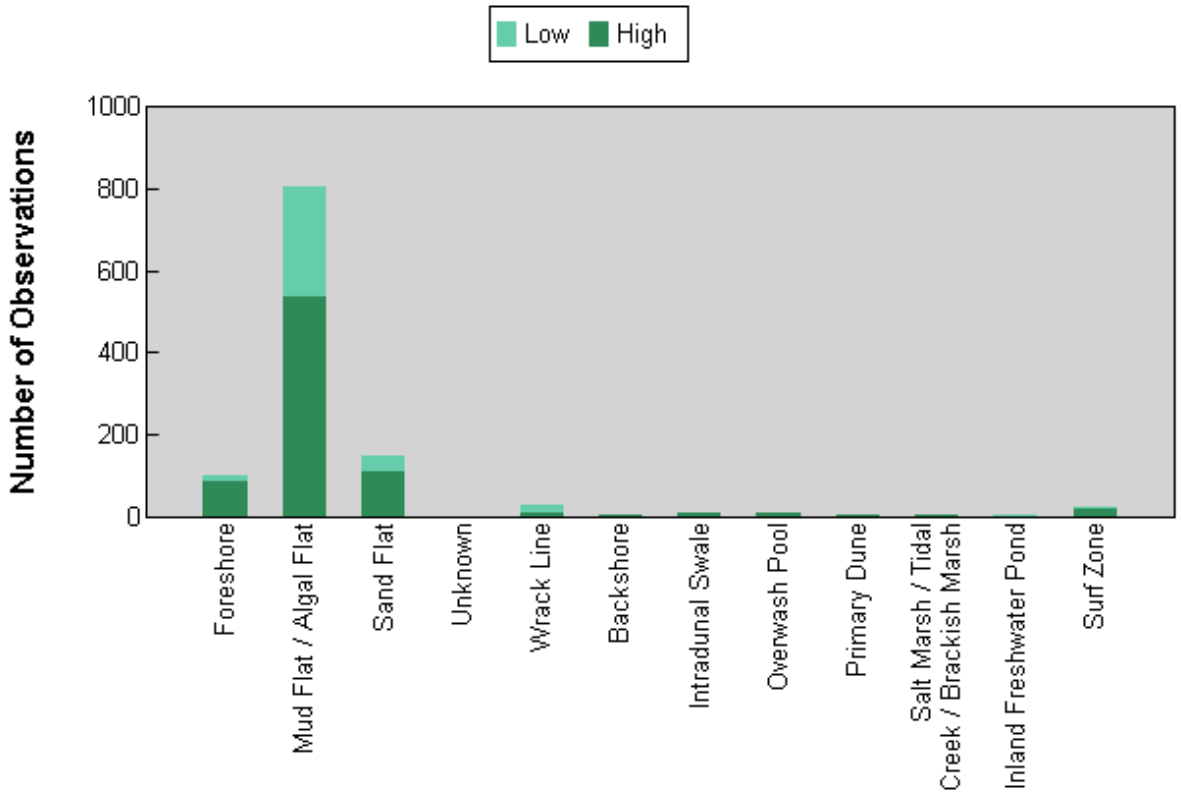

Figure 2. Piping plover observations by habitat type at CAHA from 8/1/2006 to 9/30/2009.

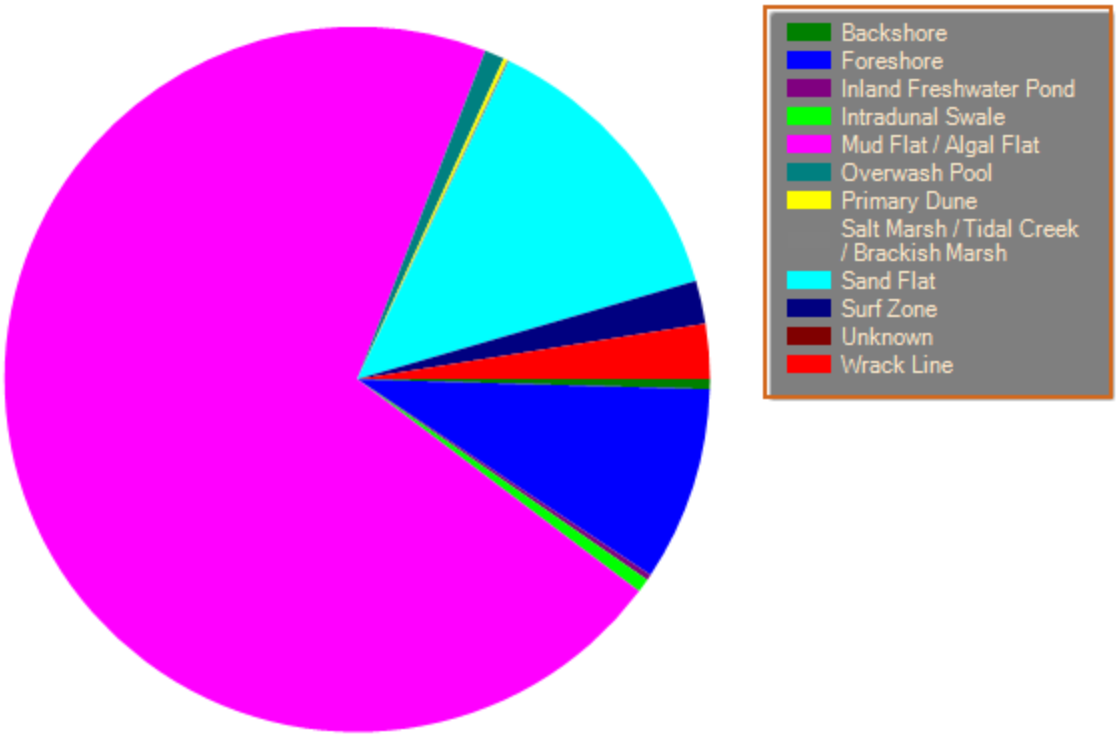

Figure 3. Piping plover observations by habitat type at CAHA from 8/1/2006 to 9/30/2009.

Table 2. Piping plover observations by habitat type at CAHA from 8/1/2006 to 9/30/2009. Not included are months with no sampling events.

Habitats	Count
Backshore	5
Foreshore	99
Inland Freshwater Pond	3
Intradunal Swale	7
Mud Flat / Algal Flat	785
Overwash Pool	10
Primary Dune	2
Salt Marsh / Tidal Creek / Brackish Marsh	1
Sand Flat	149
Surf Zone	22
Unknown	0
Wrack Line	28

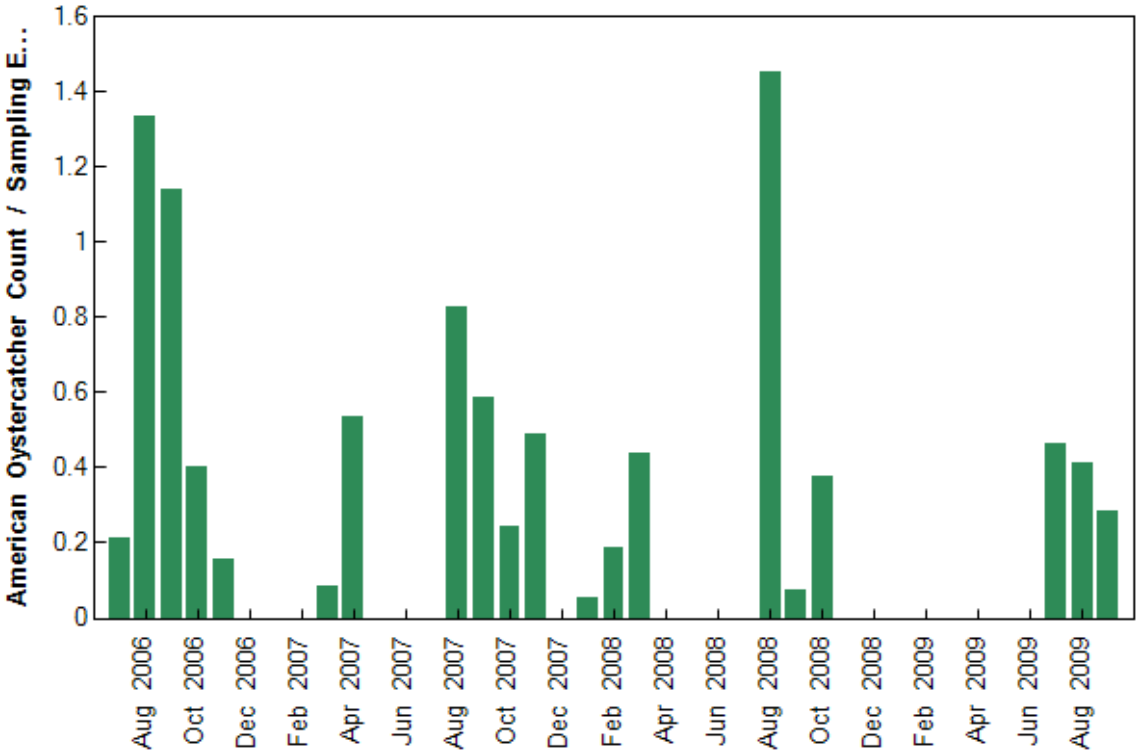

Figure 4. American oystercatcher observations by unit-of-effort at CAHA from 8/1/2006 to 9/30/2009. The sampling design from July 2006 to April 2007 included all beachfront areas at the park and allowed for park-wide inference; and the sampling design from April 2007 to September 2009 included only the accreted areas at the park and does not allow for parkwide inference.

Table 3. American oystercatcher observations by unit-of-effort at CAHA from 8/1/2006 to 9/30/2009. Months with no sampling events are not included. The sampling design from July 2006 to April 2007 included all beachfront areas at the park and allowed for park-wide inference; and the sampling design from April 2007 to September 2009 included only the accreted areas at the park and does not allow for parkwide inference.

Month	Number of Events	Count	Normalized Count
7/2006	14	3	0.21
8/2006	36	48	1.33
9/2006	50	57	1.14
10/2006	57	23	0.40
11/2006	51	8	0.16
12/2006	44	0	0.00
1/2007	73	0	0.00
2/2007	83	0	0.00
3/2007	69	6	0.09
4/2007	58	31	0.53
8/2007	35	29	0.83
9/2007	53	31	0.58
10/2007	37	9	0.24
11/2007	39	19	0.49
12/2007	26	0	0.00
1/2008	38	2	0.05
2/2008	27	5	0.19
3/2008	25	11	0.44
8/2008	31	45	1.45
9/2008	13	1	0.08
10/2008	32	12	0.38
11/2008	25	0	0.00
12/2008	12	0	0.00
1/2009	37	0	0.00
2/2009	23	0	0.00
3/2009	20	0	0.00
7/2009	13	6	0.46
8/2009	39	16	0.41
9/2009	39	11	0.28

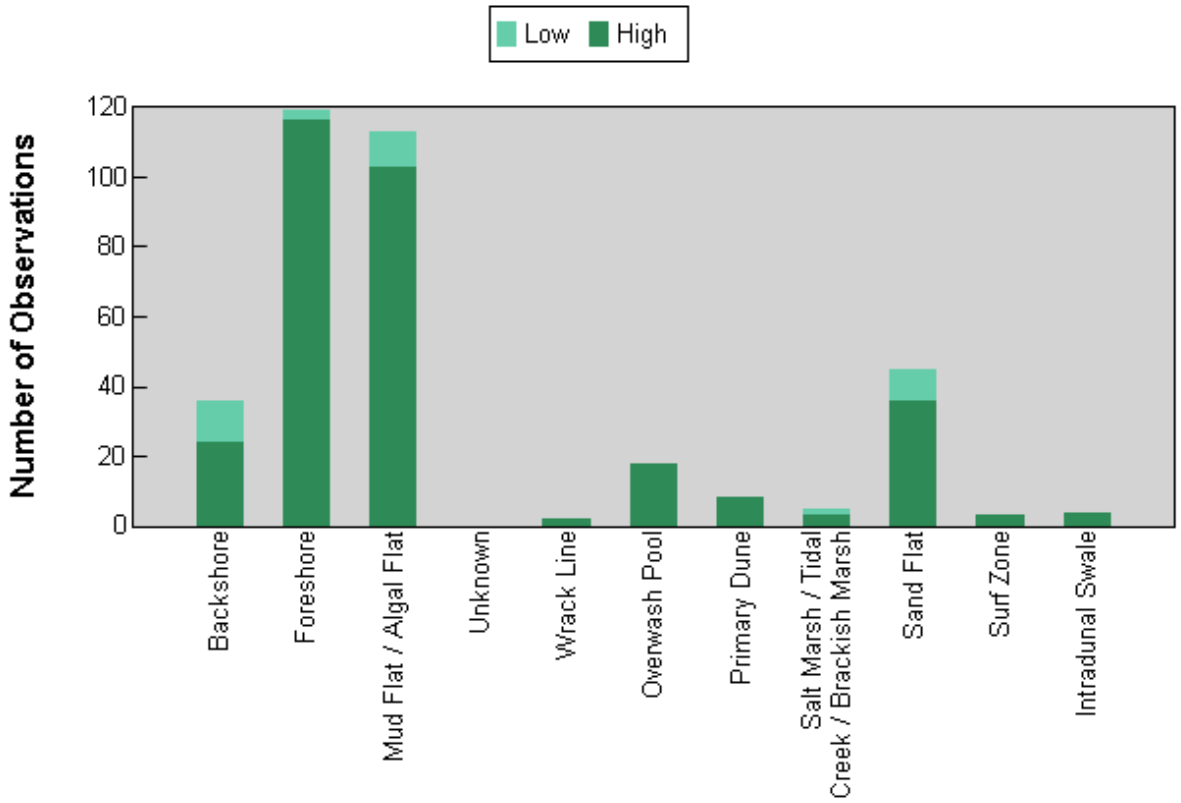

Figure 5. American oystercatcher observations by habitat type at CAHA from 8/1/2006 to 9/30/2009.

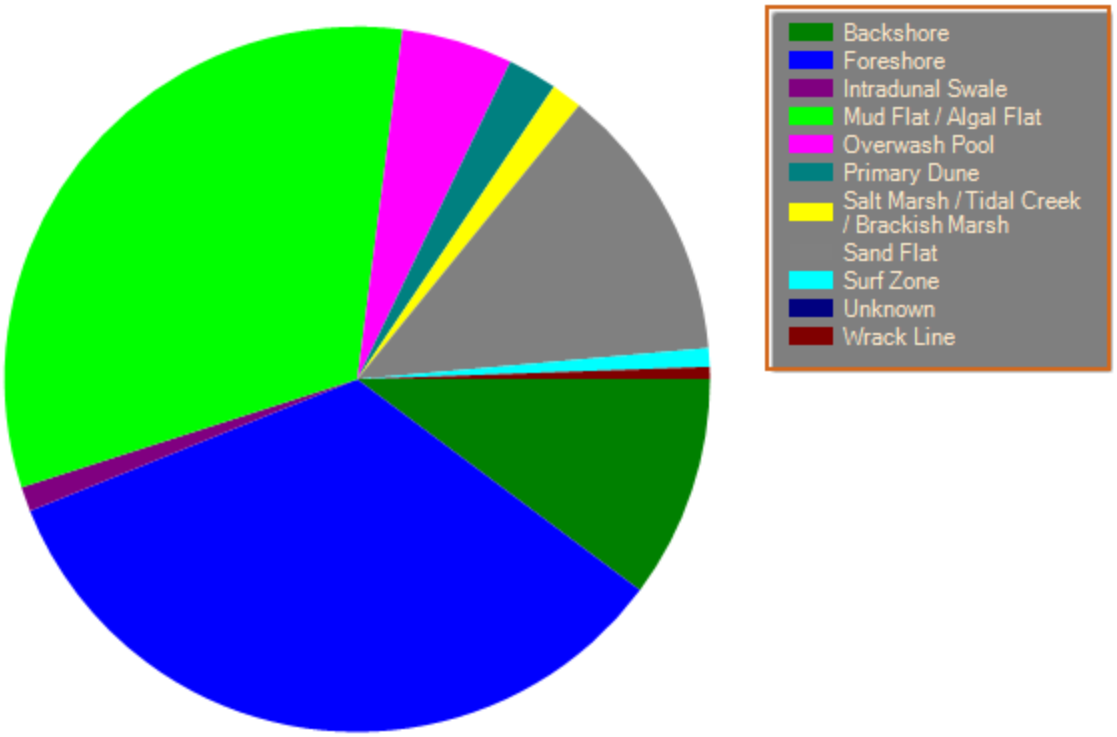

Figure 6. American oystercatcher observations by habitat type at CAHA from 8/1/2006 to 9/30/2009.

Table 4. American oystercatcher observations by habitat type at CAHA from 8/1/2006 to 9/30/2009.

Habitats	Count
Backshore	36
Foreshore	119
Intradunal Swale	4
Mud Flat / Algal Flat	113
Overwash Pool	18
Primary Dune	8
Salt Marsh / Tidal Creek / Brackish Marsh	5
Sand Flat	45
Surf Zone	3
Unknown	0
Wrack Line	2

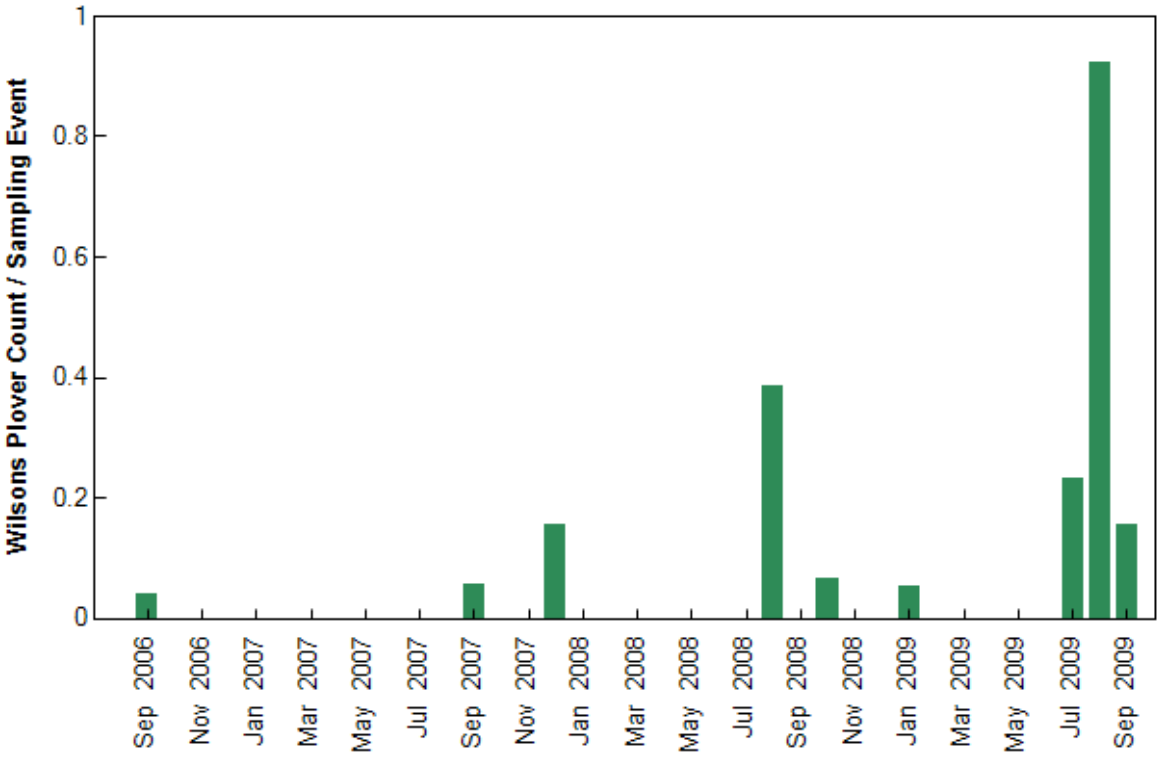

Figure 7. Wilsons plover observations by unit-of-effort at CAHA from 8/1/2006 to 9/30/2009. The sampling design from July 2006 to April 2007 included all beachfront areas at the park and allowed for park-wide inference; and the sampling design from April 2007 to September 2009 included only the accreted areas at the park and does not allow for parkwide inference.

Table 5. Wilsons plover observations by unit-of-effort at CAHA from 8/1/2006 to 9/30/2009. Months with no sampling events are not included. The sampling design from July 2006 to April 2007 included all beachfront areas at the park and allowed for park-wide inference; and the sampling design from April 2007 to September 2009 included only the accreted areas at the park and does not allow for parkwide inference.

Month	Number of Events	Count	Normalized Count
9/2006	50	2	0.04
10/2006	57	0	0.00
11/2006	51	0	0.00
12/2006	44	0	0.00
1/2007	73	0	0.00
2/2007	83	0	0.00
3/2007	69	0	0.00
4/2007	58	0	0.00
8/2007	35	0	0.00
9/2007	53	3	0.06
10/2007	37	0	0.00
11/2007	39	0	0.00
12/2007	26	4	0.15
1/2008	38	0	0.00
2/2008	27	0	0.00
3/2008	25	0	0.00
8/2008	31	12	0.39
9/2008	13	0	0.00
10/2008	31	2	0.06
11/2008	25	0	0.00
12/2008	12	0	0.00
1/2009	37	2	0.05
2/2009	23	0	0.00
3/2009	20	0	0.00
7/2009	13	3	0.23
8/2009	39	36	0.92
9/2009	39	6	0.15

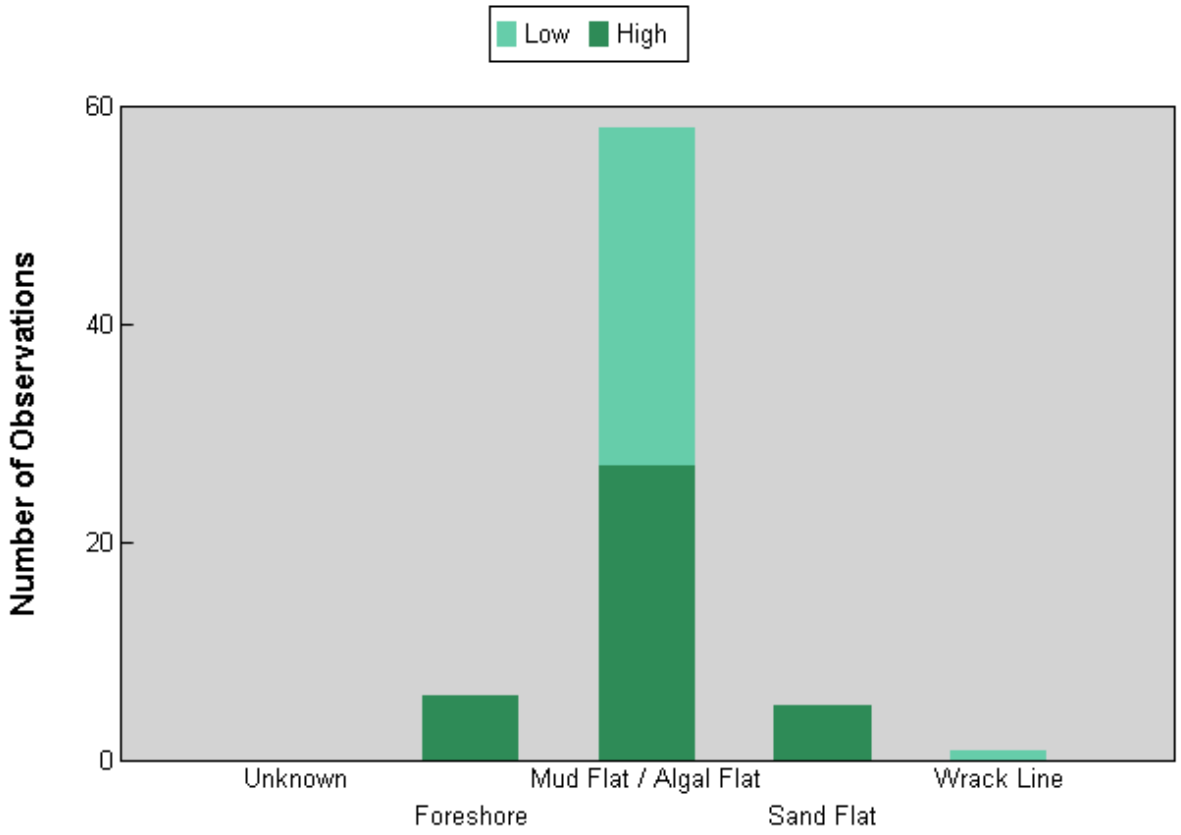

Figure 8. Wilsons plover observations by habitat type at CAHA from 8/1/2006 to 9/30/2009.

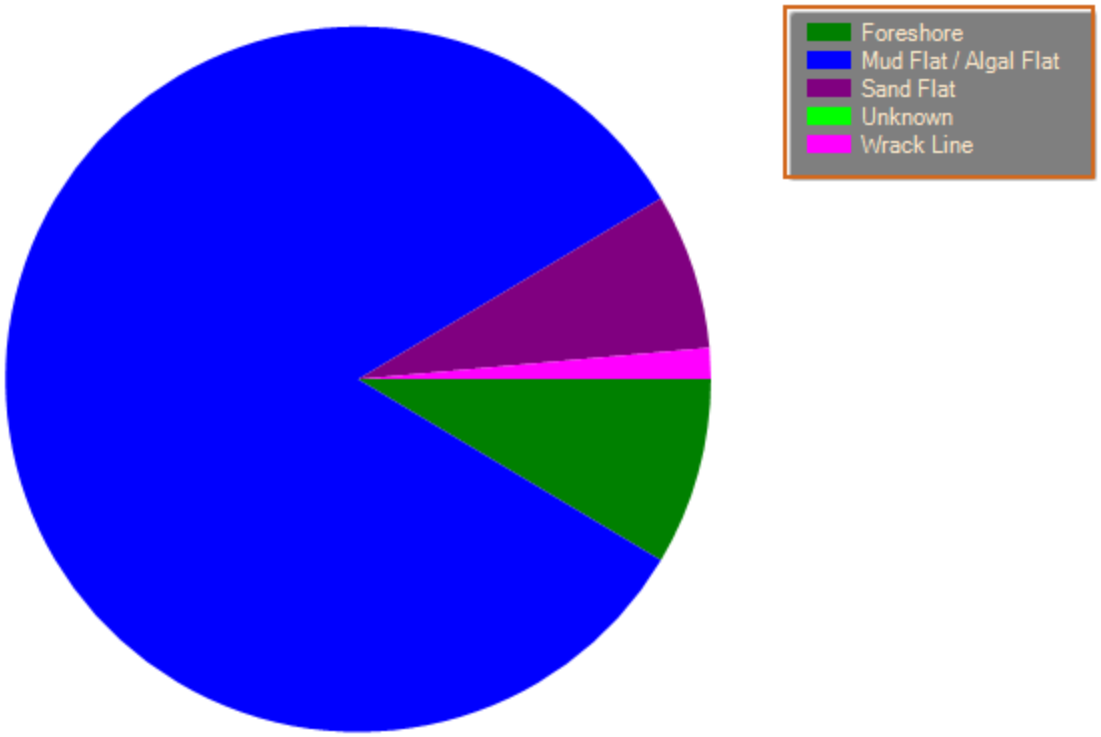

Figure 9. Wilsons plover observations by habitat type at CAHA from 8/1/2006 to 9/30/2009.

Table 6. Wilsons plover observations by habitat type at CAHA from 8/1/2006 to 9/30/2009.

Habitats	Count
Foreshore	6
Mud Flat / Algal Flat	58
Sand Flat	5
Unknown	0
Wrack Line	1

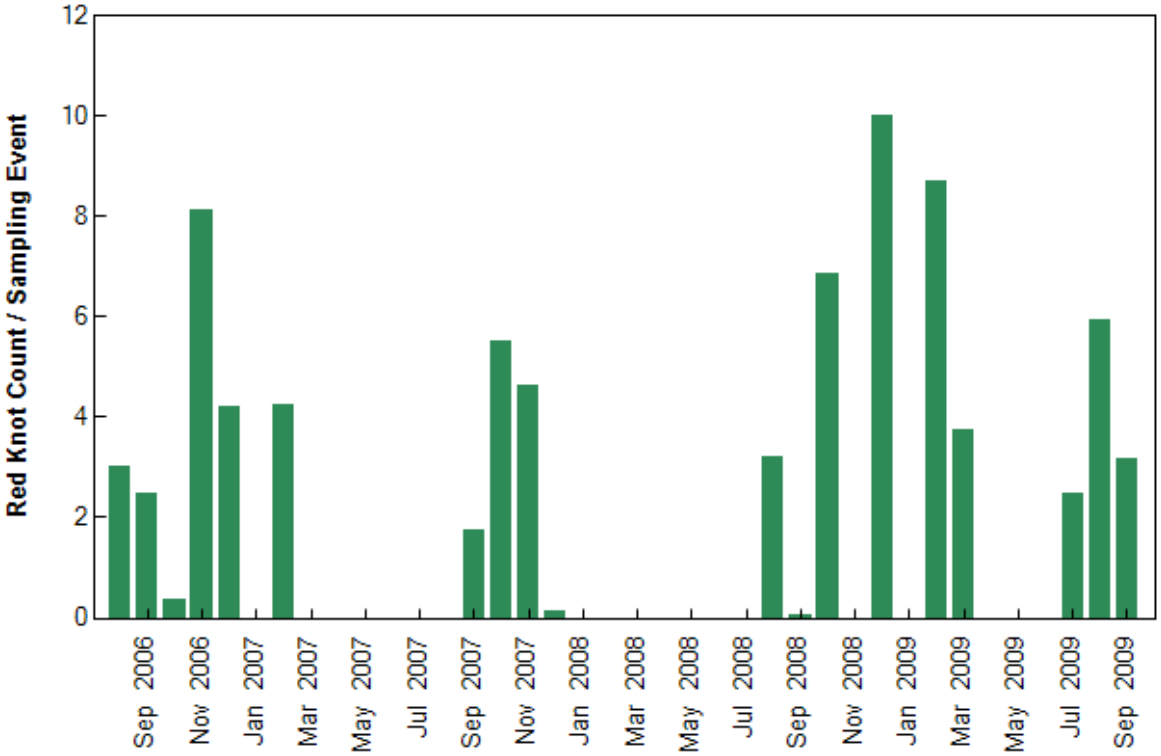

Figure 10. Red knot observations by unit-of-effort at CAHA from 8/1/2006 to 9/30/2009. The sampling design from July 2006 to April 2007 included all beachfront areas at the park and allowed for park-wide inference; and the sampling design from April 2007 to September 2009 included only the accreted areas at the park and does not allow for parkwide inference.

Table 7. Red knot observations by unit-of-effort at CAHA from 8/1/2006 to 9/30/2009. Months with no sampling events are not included. The sampling design from July 2006 to April 2007 included all beachfront areas at the park and allowed for park-wide inference; and the sampling design from April 2007 to September 2009 included only the accreted areas at the park and does not allow for parkwide inference.

Month	Number of Events	Count	Normalized Count
8/2006	36	108	3.00
9/2006	50	124	2.48
10/2006	57	20	0.35
11/2006	51	415	8.14
12/2006	44	185	4.20
1/2007	72	0	0.00
2/2007	83	353	4.25
3/2007	69	0	0.00
4/2007	58	0	0.00
8/2007	35	0	0.00
9/2007	53	93	1.75
10/2007	37	204	5.51
11/2007	39	181	4.64
12/2007	26	4	0.15
1/2008	38	0	0.00
2/2008	27	0	0.00
3/2008	25	0	0.00
8/2008	31	100	3.23
9/2008	13	1	0.08
10/2008	32	219	6.84
11/2008	25	0	0.00
12/2008	12	120	10.00
1/2009	37	0	0.00
2/2009	23	200	8.70
3/2009	20	75	3.75
7/2009	13	32	2.46
8/2009	39	232	5.95
9/2009	39	124	3.18

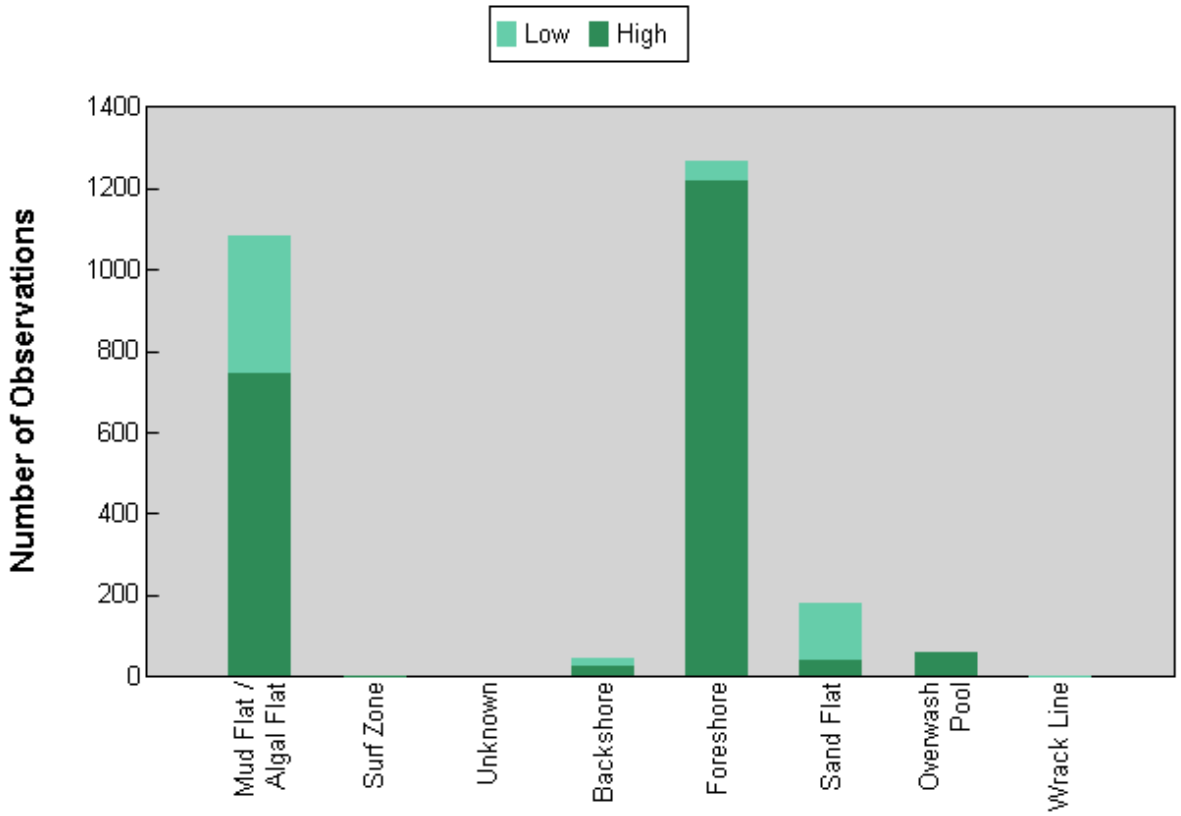

Figure 11. Red knot observations by habitat type at CAHA from 8/1/2006 to 9/30/2009.

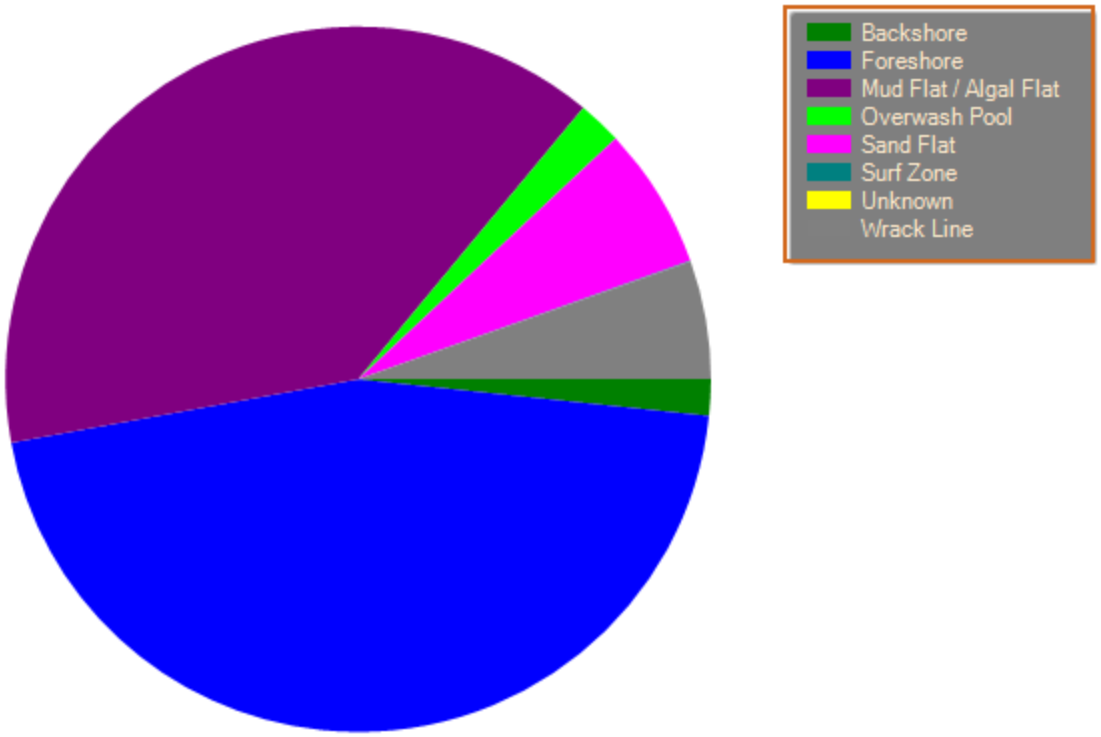

Figure 12. Red knot observations by habitat type at CAHA from 8/1/2006 to 9/30/2009.

Table 8. Red knot observations by habitat type at CAHA from 8/1/2006 to 9/30/2009.

Habitats	Count
Backshore	46
Foreshore	1265
Mud Flat / Algal Flat	1082
Overwash Pool	56
Sand Flat	181
Surf Zone	1
Unknown	0
Wrack Line	151

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