

TRENDS IN CARIBBEAN BROWN PELICAN (*PELECANUS OCCIDENTALIS OCCIDENTALIS*) NEST COUNTS ON ST. MAARTEN, WEST INDIES

ADAM C. BROWN

**ENVIRONMENTAL PROTECTION IN THE CARIBBEAN (EPIC), 200 DR. MLK JR. BLVD. RIVIERA BEACH, FL 33404.
EMAIL: ABROWN@EPICISLANDS.ORG**

*ABSTRACT.--Herein, I look at trends in Caribbean Brown Pelican (*Pelecanus occidentalis occidentalis*), nest counts between 2001-2010 on St. Maarten, West Indies. Two colonies were monitored during the 10-year period: Fort Amsterdam and Pelikan Key. For both colonies, I counted active nests as well as adult birds. Both measures showed a cyclic pattern with peaks of nest abundance in 2001, 2004, and 2006. However, overall I observed an 85% decline in pelican nests on St. Maarten over the 10-year study period. The Fort Amsterdam colony showed a general downward trend between 2001 and 2007 and was then completely abandoned in 2008. Nest counts on Pelikan Key were relatively consistent over the study period with recent declines documented in 2009 and 2010. Potential local-scale factors influencing nest numbers on St. Maarten include development, human disturbance, and introduced mammals.*

Key Words: brown pelican, Caribbean, habitat, disturbance, introduced predators, nesting, St. Maarten.

Brown Pelicans are a long-lived, highly social species (Schreiber and Risebrough 1972). This species has been well studied throughout many portions of its range, particularly the North American populations (Schreiber and Risebrough 1972, Anderson *et al.* 1982, Blus 1982). Well documented population declines of Brown Pelicans linked to exposure to organochlorine pesticides such as DDT led to placement on the U.S. Federal Endangered Species List in 1970 (USFWS 1979, Blus 1982). Subsequently, following a U.S. ban on DDT in 1972, the North American Brown Pelican population increased and United States recently allowed the species to be removed entirely from the Endangered Species List (USFWS 2009). This decision has implications for the Caribbean subspecies, as the delisting itself may or may not reflect the status of the entire Caribbean subpopulation. Unfortunately, little data from the Caribbean, other than populations from Puerto Rico and the U.S. Virgin Islands, appears to have been used in the ruling to de-list the Caribbean sub-species (Collazo and Klaas 1986, USFWS 2009).

The Caribbean Brown Pelican (*Pelecanus occidentalis occidentalis*), hereafter referred to also as pelican and Brown Pelican, occurs throughout the Caribbean basin (Blake 1977, Rafaella *et al.* 1998). This small-bodied subspecies of Brown Pelican is endemic to the Caribbean region and is separated from other Brown Pelican sub-species by its smaller size and darker undersurface when in alternate plumage (Wetmore 1945, Blake 1977). The species ranges throughout the Caribbean and the regional population is currently estimated at approximately 1,200 pairs (Bradley and Norton 2007). Breeding colonies have been recorded in the Bahamas, throughout the Greater Antilles as well as the U.S. Virgin Islands and British Virgin Islands (Halewyn and Norton 1984, Scheiber and Lee 2000, Bradley and Norton 2007). The Lesser Antilles have numerous small colonies on Anguilla, St. Maarten, St. Barthelemy, St. Kitts, Antigua, and the Grenadines (Collier *et al.* 2003, Bradley and Norton 2007). Pelicans have also been recorded breeding on Trinidad, as well as the islands off the Venezuelan coast (Bradley and Norton 2007).

Research into the breeding biology of pelicans in the Caribbean has been focused on the northern Caribbean basin populations, specifically Puerto Rico and the U.S. Virgin Islands (Schreiber *et al.* 1981, Collazo 1985, Collazo *et al.* 1998). Population biology data was collected by Collazo (1985) and Agardy *et al.* (1982) and based on these data, it was determined that pelican populations in Puerto Rico and the U.S. Virgin islands were not affected by the same factors that influenced continental populations (Reimold 1975, Collazo and Klaas 1986). Whereas continental populations of brown pelicans declined mostly due to organochlorine pesticides, human disturbance was considered to have played a large role in the decline of Caribbean pelican populations. In particular, the poaching of eggs and young, as well as pelicans abandoning colonies due to human intruders, were significant factors (Halweyn and Norton 1984). Habitat loss was believed to have played a factor as well, specifically the removal of mangrove forests throughout the region (Halweyn and Norton 1984).

Little data on pelican populations from regions other than U.S. territorial islands have been published. Regional population estimates have been made in numerous publications, but little other breeding data has been made

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available. Incidental breeding data has been collected on St. Maarten pelicans, beginning with the first publication on the nesting of the species on St. Maarten by Voous (1955). During Voous' visits to St. Maarten between 1949 and 1952, he regularly observed breeding pelicans on Pelikan Key during the months of February – August (Voous 1955). Voous and Koelers (1967) estimated 30-50 pairs nesting on Pelikan Key during February 1952. Hoogerwerf (1977) reported only a single nest on Pelikan Key during 1974, from which a single chick fledged in May. A colony of pelicans was observed nesting on Green Key during 1981, where 50 pairs were observed breeding during the month of April (Voous 1983). During 2001, Collier *et al.* (2003) observed pelicans breeding at both Pelikan Key and Fort Amsterdam, the latter being the only known mainland breeding site on St. Maarten.

Herein, I report on ten years of detailed nest counts on Caribbean Brown Pelicans from St. Maarten, Lesser Antilles. These data come from a point within the Caribbean range that is often overlooked and thus provide an important window on the demographics and conservation of the Caribbean Brown Pelican. Further, I discuss potential local-scale factors influencing nest numbers and introduce several conservation strategies that would help stabilize the alarming declines that I observed.

LOCATION AND METHODS

St. Maarten (18° 03' N 63° 03' W; 100 km²; FIG. 1) is located in the northern Lesser Antilles. The island is politically divided with the northern half being governed by the French and the southern half being self governed by the island nation of St. Maarten. The small island is mountainous and surrounded by saline wetlands along the coastal margins, including two substantial lagoons that cover one-fifth of the island. A large portion of the coastline has been developed with hotels and resorts; however, there are some small areas that have been left untouched including five small islets (<2 km²) located in near-shore waters.

From 2001 to 2010, I surveyed each wetland, cliff band, and nearby islet for nesting pelicans. Surveys took place between the months of November and July, each year during the ten year study period. I recorded each pelican observed roosting, foraging, and/or nesting, including the age of each bird and feathering status of each chick. Nests were often a pile of dry brush and therefore hard to differentiate from the immediate habitat. Therefore, I defined an active nest as having either 1) a chick in or just outside of the nest; 2) an adult in incubation posture on the nest; or 3) if the nest was not visible above the brush, two adults had to be next to each other, indicating a pair (Collier *et al.* 2003).

Specifically, our surveys focused on two areas historically known as breeding sites on St. Maarten: the Fort Amsterdam Peninsula (18° 00' 52.05 N 63° 03' 37.44 W), which is a registered National Historic Site, and on Pelikan Key (18° 01' 05.23 N 63° 01' 07.98 W; FIG.1). The habitat that the pelicans nested in on Fort Amsterdam was characterized by dry xerophytic habitat comprised mainly of *Acacia macracantha* and *A. tortuosa*. The loose nests were located on the thorny shrubs. Pelikan Key is a small dry islet located on the windward side of St. Maarten. The pelicans historically nested within the small grassy area atop the islet.

Nesting colonies were observed with both binoculars and a spotting scope from a vantage point that allowed a complete view of each colony and was located distant enough that birds were not disturbed by the presence of observers. At the Pelikan Key colony, nests were observed from Point Blanche, approximately 0.5 km across the water from the colony. At Fort Amsterdam, the colony was monitored from Little Bay, approximately 0.5 km from the colony boundary. When nesting was observed, an additional observation point was located on Fort Amsterdam Peninsula approximately 50m from the colony boundary.

During 2001, the Fort Amsterdam colony had unprecedented high numbers of nesting pelicans. Due to the large numbers of both adult birds and active nests, it became very difficult to determine the true number of nests. Therefore, a breeding correction factor of 0.287 was used to more accurately determine the number of nests (see Collier *et al.* 2003). In years following 2001, there were substantially lower numbers of nesting birds and I was able to determine the number of nests with more certainty. Standard error below is reported as +/-.

RESULTS

Over the 10-year study period, I recorded 341 Brown Pelican nests between Fort Amsterdam and Pelikan Key with a mean nest number of 34.1 +/- 25.9 per year (TABLE 1). Nests were recorded from November to April, with no nests

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observed during surveys from May to July. The highest number of nests observed island-wide was 80 in 2001 while the low number of nests was 9 in 2009 (Table 1). Island-wide increases in observed pelican nests were recorded in 2004 (+40), 2006 (+46), and 2010 (+3). Notably, over the study period there appeared to be a cyclical nesting pattern island-wide with peak nesting years in 2001, 2004, and 2006 and low years in 2002, 2003, 2005, 2009, and 2010 (FIG. 2). However, overall from 2001-2010, island-wide, there was a downward trend in Brown Pelican nest numbers (FIG. 2).

At the Fort Amsterdam pelican colony, nesting was observed from 2001-2007, while no nesting was recorded from 2008-2010. Nests were observed at this colony during the months January – April. A total of 135 nests were observed while the mean nests observed was 13.5 +/- 22.6 (FIG. 3). The peak number of nests was 60 observed in 2001. During 2002 and 2007 there was only a single nest observed and in 2005 only three nests were observed (Table 1). Following colonization in 2001, there were two additional years with increases in observed pelican nests, 2004(+21) and 2006(+32). Overall, there was a downward trend in the number of pelican nests observed at this location (FIG. 3).

At the Pelikan Key colony, nesting was recorded every year from 2001-2010. Nests were observed during the months November – April. A total of 206 nests were observed at this colony with the mean annual number of nests at 20.6 +/- 14.0 (FIG. 4). The peak number of nests was 49 observed in 2007. There were four years where overall nests at this site increased, 2004(+19), 2006(+14), 2007(+19), and 2010(+3). There was an upward trend in the number of observed nests at Pelikan Key likely in part to birds that were displaced from the Fort Amsterdam colony (FIG. 4).

Adult birds were counted in addition to pelican nests. The highest number of adults island-wide, occurred in 2001 where 222 adults were observed. At the Fort Amsterdam nesting colony, the highest number of adults observed was 202 in 2001 while at the Pelikan Key nesting colony the highest number of adults observed was 63 in 2004. Notably, numbers of adults have decreased over the study period with the lowest numbers of adults recorded in 2009 and 2010 (Table 1).

DISCUSSION

The breeding activity of Caribbean Brown Pelicans on St. Maarten has decreased by 85% over the ten-year study period, showing a much more severe decline in nesting than that of the Caribbean population as a whole (61%, Bradley and Norton 2007). The complete abandonment of the Fort Amsterdam colony was the basis behind the severity of the observed decline. Pelican Key, located on a near shore islet, had an overall upward nesting trend, indicating the factors affecting the complete abandonment of the mainland colony were likely isolated to that colony. Additionally, Pelikan Key population numbers were likely inflated by the birds that abandoned the Fort Amsterdam colony. However, the small size of Pelikan Key is a limiting factor in overall population size and the islet was likely unable to support the entire Fort Amsterdam nesting population.

The colony at Fort Amsterdam was located on the main island of St. Maarten, on a peninsula between Great Bay and Little Bay. For a number of reasons, the site is exposed to numerous forms of human disturbance, some of which have increased in recent times. For instance, Great Bay on the east side of the Fort Amsterdam peninsula is the main harbor for the island and activity there includes both freight traffic and cruise ship traffic estimated to carry 6 million people per year. Great Bay also has a number of resorts that are on the immediate coastline. Little Bay, on the west side of the peninsula is also developed and includes a large all-inclusive resort.

The Fort Amsterdam pelican colony's close proximity to resorts has led to regular human disturbances as well. For example, while surveying nesting birds I observed tourists on jet skis come within 10m of the peninsula and flush Caribbean Brown Pelicans from their nests. On another occasion I observed a dive operations boat that moored within 50m of the colony, and observed pelicans being flushed off of their nests by divers coming and going in the boat. On numerous occasions, I observed people walk through the colony to get to the tip of the peninsula to fish.

The Fort Amsterdam peninsula itself contains the remains of a historic fort that is protected and managed as a tourist destination. The attraction of the historic Fort Amsterdam site, which is on top of the peninsula and in close proximity to the pelican colony, has most likely contributed to the decline of and eventual abandonment of the Fort Amsterdam pelican colony. In particular, extensive landscaping in 2007/2008 at the historic site recently removed a

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critical buffer of vegetation between visitors and the colony. The landscape changes and the increasing popularity of this historic site have greatly amplified human disturbance factors such as noise levels, people approaching too closely, and intrusions by unleashed and unsupervised pets. In addition to the habitat removal of the buffer zone around the colony, recent removal of mangrove forests by heavy machinery in an adjacent wetland in preparation for a new resort, has likely added to the disturbance of the nesting colony.

Alteration of habitat near to nesting colonies is detrimental to the birds that nest within that colony. Not only does human disturbance become an issue, but so do effects of development. Specifically, the developments adjacent to the Fort Amsterdam pelican colony provide new, altered habitats that are ideal for the proliferation of introduced mammalian predators, which undoubtedly utilize adjacent areas such as the pelican colony for foraging. In these adjacent developments on St. Maarten, I have observed feral dog (*Canis lupus familiaris*), feral cat (*Felis catus*), and small Indian mongoose (*Herpestes auro-punctatus*), as well as brown rat (*Rattus norvegicus*) and roof rat (*R. rattus*), all of which are well known predators of colonial nesting birds (Brown 2008, Courchamp *et al.* 2003, King 1985). While predation on adults, nests, or chicks was not recorded by observers, it is very likely that predation on pelicans by these introduced predators has played an important role in the eradication of this colony. These same limiting factors are present on other colonies throughout the Caribbean including in the Virgin Islands and Puerto Rico and have similarly limited increased populations at those sites (Schreiber *et al.* 1981, Collazo 1985, Collazo *et al.* 1998)

The oil depot on the island is located approximately 1 km west of the Fort Amsterdam pelican colony. This depot has experienced documented pipeline failure on numerous occasions (Bervoets 2010a, 2010b), however there is little oversight of this industry on St. Maarten, and oil spills are likely more numerous than are reported to the government, public, and media. An oil spill in such close proximity to the colony could have a catastrophic effect to nesting pelicans. Not only could the spill potentially affect the nesting location itself, but the oil sheen could possibly cover pelican foraging areas in close proximity to the colony. While it is unclear what role oil spills played in the demise of the Fort Amsterdam colony, it is well understood how catastrophic to wildlife such spills could be.

Our data on the Caribbean Brown Pelicans of St. Maarten show some alarming patterns, based largely on the recent abandonment of a long-used colony and the apparent inability of offshore islets to provide sufficient refuge. However, an even more problematic realization is that the lack of knowledge on the overall pattern for Caribbean Brown Pelican populations makes it difficult to tie our findings into a coherent overall view. For instance, large fluctuations in regional populations have been reported; however, these may be more an artifact of differing methodology rather than reality, as much of these data were generated using estimates and various approaches to estimating, rather than actual population counts. Therefore, past trends in regional populations have been hard to determine with accuracy. For instance, Halewyn and Norton (1984) reported ~3,100 pairs of pelicans nesting in the region while Schreiber and Lee (2000) estimated ~1,500 breeding pairs, a precipitous 52% population decline over a 16-year period. The most recent data published on regional populations of pelicans is in Bradley and Norton (2007) who estimate ~1,200 pairs, a steep 61% decline since Halewyn and Norton. To complicate matters even further, data collected during 2008-2010 by a regional collaborative research effort, wherein every seabird colony within the Lesser Antilles was surveyed, estimated the Caribbean pelican population at 2,716 pairs, showing a 12% decline since 1984, considerably less than previously reported (Lowrie *et al.* 2011). Although the percentages differ, all three of the more recent studies are consistent in showing that Caribbean Brown Pelican numbers are declining. Finally, these discrepancies in Caribbean Brown Pelican population numbers highlight the importance of collecting fine-grained data on populations and on the status of breeding colonies. Long-term counts of breeding pelicans are critical in assessing the health of regional population.

On a more local level, I recommend a greater prioritization of conservation initiatives on St. Maarten in order to counter some of the disturbances that were recorded during the course of our surveys. For instance, I feel that effective education strategies directed at tourists, service providers, and island residents could help reduce some of the direct disturbances I observed. Even basic measures such as the placement of educational signs to discourage foot traffic, and perhaps buoys to keep recreational watercraft away, would be an improvement. Furthermore, I recommend the placement of protective landscaping to replace what was recently removed at Fort Amsterdam as well as placing predator fencing around the colony and incorporating predator control at the nest site during the nesting season.

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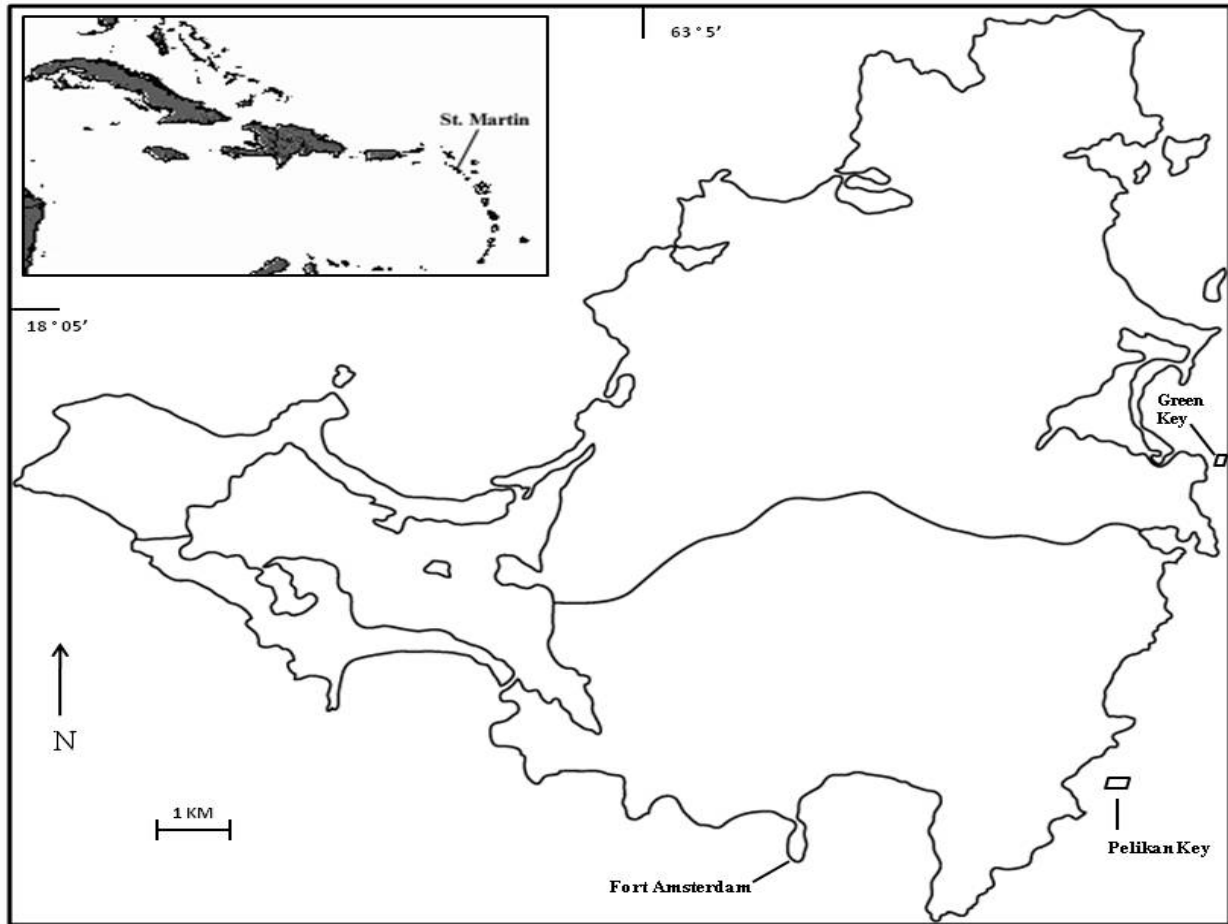
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Table 1. Annual total of Caribbean Brown Pelican nest counts and the adult birds observed attending colonies for the island of St. Maarten, and specifically for the Fort Amsterdam and Pelikan Key colonies from 2001-2010.

Year	St. Maarten		Fort Amsterdam		Pelikan Key	
	Birds	Nests	Birds	Nests	Birds	Nests
2001	222	80	202	60	20	20
2002	48	11	24	1	24	10
2003	47	10	28	7	19	3
2004	110	50	47	28	63	22
2005	38	19	13	3	25	16
2006	109	65	53	35	56	30
2007	64	50	5	1	59	49
2008	61	35	14	0	47	35
2009	23	9	14	0	9	9
2010	30	12	14	0	16	12

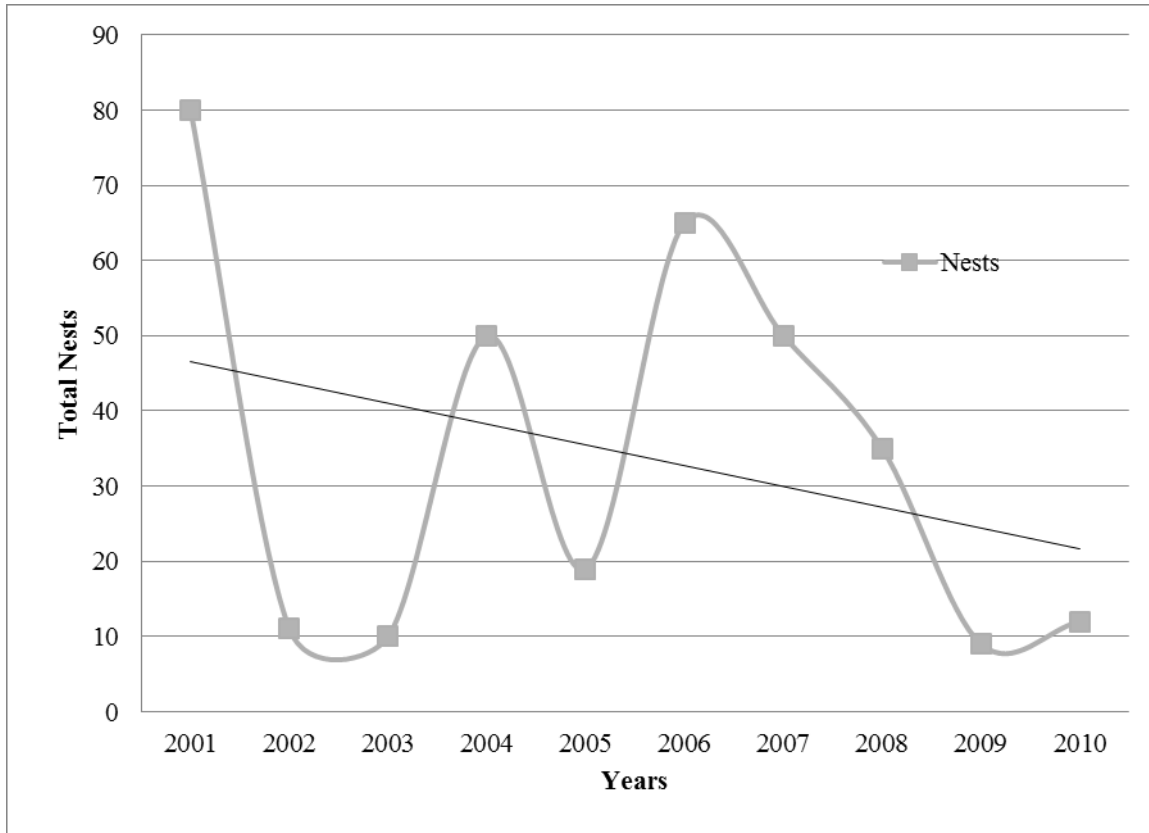
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Figure 1. Map of historic and current Caribbean Brown Pelican colonies at Fort Amsterdam, Pelikan Key, and Green Key on St. Maarten, West Indies.



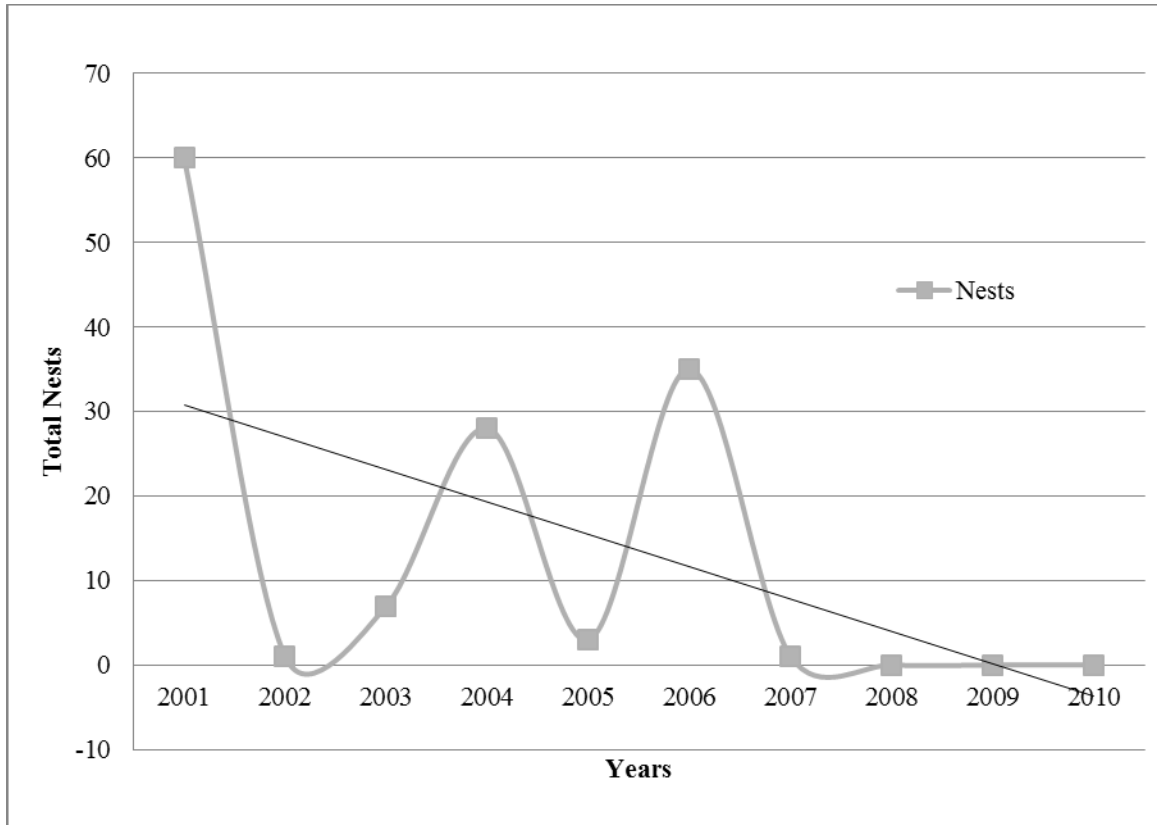
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Figure 2. Caribbean Brown Pelican nest counts and nest trends on St. Maarten, 2001-2010.



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Figure 3. Caribbean Brown Pelican nest counts and nest trends at the Fort Amsterdam colony, St. Maarten, 2001-2010.



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Figure 4. Caribbean Brown Pelican nest counts and nest trends at Pelikan Key, St. Maarten, 2001-2010.

