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Black Skimmer (Rynchops niger) Conservation Management Plan

New York State Department of Environmental Conservation Division of Fish, Wildlife, and Marine Resources

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NYSDEC – New York State Department of Environmental Conservation

NYSOPRHP – New York State Office of Parks, Recreation, and Historic Places

USFWS – United States Fish and Wildlife Service

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MISSION OF THE BUREAU OF WILDLIFE

To provide the people of New York State the opportunity to enjoy all the benefits of the wildlife of the State, now and in the future. This shall be accomplished through scientifically sound management of wildlife species in a manner that is efficient, clearly described, consistent with law, and in harmony with public need.

Goals of the Bureau of Wildlife

Goal 1. Ensure that populations of all wildlife in New York State are the appropriate size to meet all the demands placed on them.

Goal 2. Ensure that we meet the public desire for: information about wildlife and its conservation, use, and enjoyment; understanding the relationships among wildlife, humans, and the environment; and clearly listening to what the public tell us.

Goal 3. Ensure that we provide sustainable uses of New York State's wildlife for an informed public.

Goal 4. Minimize the damage and nuisance caused by wildlife and wildlife uses.

Goal 5. Foster and maintain an organization that efficiently achieves our goals.

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Executive Summary

A migratory beach nesting colonial waterbird, the black skimmer (*Rynchops niger*) is a species of special concern in New York State. A piscivorous (fish eating) species relying almost entirely on coastal resources, skimmers begin to arrive in New York during the last week of April and into early May. The black skimmer is colonial and forms mixed species colonies with both common and/or least terns. Gulls, terns, and skimmers are all closely related in the Laridae family.

Skimmers prefer to nest along New York's barrier beaches but also nest on salt marsh and dredge spoil islands. Recent surveys indicate that these breeding habitats are being lost to coastal development, marsh island subsidence, or are abandoned due to human disturbance or predation pressure from both wild and domestic species. The effects of climate change and sea level rise are also beginning to exert pressures on the resiliency of available habitat.

Historically, black skimmers nested throughout the southern coast of Long Island at multiple locations, many within Great South Bay. At present, skimmers nest primarily in two large colonies, located in Queens (Breezy Point) and Nassau (Nickerson Beach) counties. While the black skimmer population remains somewhat stable between years, recent trends in the loss or abandonment of most of New York's smaller colonies are putting that current level of stability at risk.

The Black Skimmer Conservation Management Plan provides a full ecological perspective covering the major issues influencing successful breeding in the state. The overarching goal is to maintain a self-sustaining population that is secure in perpetuity. This can be ensured by maintaining a five year annual mean minimum number of ten (10) colonies and a five year annual mean minimum population of 550 breeding pairs.

Management, monitoring, research, and outreach tasks are provided to help counteract many of the negative factors influencing skimmer breeding productivity in the state.

Management Actions:

- Enhance existing habitat
- Restore historical nesting areas
- Placement of wrack (dead vegetation) in both natural & artificial ways
- Placement of sand and dredge spoil to counteract beach erosion and marsh island subsidence
- Maintain the integrity of vegetative communities along coastal beaches and salt marsh islands
- Visual and auditory methods to attract skimmers to enhanced or restored areas
- Provide Best Management Practices for local managers to implement on a site specific basis

Monitoring Actions:

- Establish more accurate survey methods using remote sensing technology

Research Actions:

- Banding survey to assess how skimmer move throughout the NY/NJ Bight
- Examine contaminants and toxins in skimmer forage species
- Understand the distribution and abundance of forage species
- Establish a pilot project to assess the viability of creating rooftop habitat

Outreach Actions:

- Inform both residents and visitors how their actions can aid managers
- Promote stewardship though volunteer activities

In these ways the Black Skimmer Conservation Management Plan provides a common sense approach that aims to find a balance between the ecological needs of the black skimmer and the societal needs of New York's residents and visitors.

BLACK SKIMMER (*RYNCHOPS NIGER*) CONSERVATION MANAGEMENT PLAN

INTRODUCTION

The black skimmer, *Rynchops niger niger* is a migratory colonial waterbird that breeds on the beaches and salt marshes in New York State's marine district. The state of New York lists the black skimmer as a Species of Special Concern. Reasons for the special concern status of this species are centered on loss of available habitat and the conflicts of use that arise in the areas that remain. This conservation management plan was developed to provide conservation managers, academic researchers, and other concerned stakeholders with a comprehensive overview of the environmental issues that influence black skimmer ecology. Additionally, this plan provides a series of management, research, and outreach actions that can be taken to foster sustainable nesting colonies of breeding black skimmer along New York's coast.

NEW YORK STATE LEGAL STATUS

Both federal and state laws protect the black skimmer in New York State: the Migratory Bird Treaty Act of 1918, and the New York State Environmental Conservation Law Article 11.

The Migratory Bird Treaty Act established national prohibitions on taking, capturing, possession, and the sale of any migratory bird or any part, nest, or egg of migratory species. The Treaty and supporting legislation were enacted to reverse the damages to a multitude of species which were in decline due to active hunting pressure resulting from the needs of millenary trade and industry (Brinker et al. 2007).

While black skimmers were not directly persecuted for their plumage, they were the subject of frequent egging pressure. Egging is the practice of actively collecting wild bird eggs for consumption as a commercial or subsistence food source. Egging was also outlawed by the Migratory Bird Treaty Act.

Article 11 of New York State Environmental Conservation Law establishes most of the protections for the state's fish and wildlife. Article 11-0103(5) (b) legally defines protected birds, which includes black skimmers. Article 11-0107 prohibits the taking of all protected birds except as authorized by law or regulation. Article 11-0535 authorizes the State to create rules and regulations for species of special concern. The black skimmer is listed as a species of special concern under 6 NYCRR Part 182.5 section (c) (6) (vii). As a result of these legal protections, there is no open hunting season on black skimmers and the species cannot be taken without a permit from the New York State Department of Environmental Conservation.

NATURAL HISTORY

PHYSICAL DESCRIPTION

The skimmer species are in the subfamily of Rynchopinae of the Laridae family which includes gulls and terns. The black skimmer, *Rynchops niger niger* is one of three skimmer species found globally, the other two being the African (*R. albicollis*) and Indian (*R. flavirostris*) skimmer (Burger and Gochfeld 1990). This conservation management plan deals solely with the North American race of black skimmer, *Rynchops niger niger*, specifically those that migrate along the eastern seaboard and not migrants along the western coast.

FIGURE 1: AN ADULT AND JUVENILE SKIMMER. NOTE DIFFERENCES IN COLORATION AND BILL STRUCTURE.

Black skimmers are a medium sized sexually dimorphic species (Schew and Collins 1990). Adults range in size from approximately 15.5 – 19.5 inches (40-50 cm) in length with a wingspan of approximately 14 – 15 inches (35-39 cm). Adult skimmers weigh between 0.5 and 0.8 of a pound (265-365 g) (Gochfeld and Burger 1994).

Adult black skimmers are easily identifiable with predominant black markings on the top half of their bodies and white below. Skimmers have bright reddish orange colored webbed feet. Juvenile skimmers by contrast are mottled brown and black on top with off-white underneath and their feet are a dull pink color (Gochfeld and Burger 1994).

Perhaps the most noticeable feature of the black skimmer is its uniquely shaped bill. The skimmer bill is approximately 2 – 2.5 inches (5-6 cm) long with the lower mandible obviously longer than the upper, often by as much as 2 – 3 cm (Gochfeld and Burger 1994). Colored bright reddish orange at the base and black at the tip, the bill is compressed laterally (Pettingill 1937) and is reminiscent of a knife blade. This unique feature of black skimmers is an evolutionary adaptation to its feeding and foraging behavior (Martin et al. 2007). However, during early juvenile development both upper and lower mandibles are the same length with dusky coloration (Gochfeld and Burger 1994).

Coupled with this strange bill is an atypical eye structure. Adaptations to the structures in the eyes (Rojas et al. 1997) of skimmers allow for nocturnal foraging and easy recognition of captured items before consumption (Martin et al. 2007). Black skimmers are the only known bird species that has a vertical pupil structure which may help to protect the eye from excessive light or glare from the water's surface (Zusi and Bridge 1981).

Black skimmers can live up to twenty (20) years with the predominant age class between five and nine (5 – 9) years with increased survivorship after two (2) years of age (Gochfeld and Burger 1994).

RANGE OF SPECIES

The North American race of black skimmers relies almost entirely on coastal resources (Gochfeld 1978). With a winter range from North Carolina to as far south as Panama, skimmers are primarily located within the Caribbean and Gulf of Mexico during the winter months (Burger and Gochfeld 1990). In the early spring the black skimmer migrates northward along the coast and breeds from Florida to its northernmost breeding habitat in New York and Massachusetts (Gochfeld and Burger 1994).

It is important to note that the location of skimmer nesting and breeding habitat in New York is at northern edge of its range. Predicted climate change along the Atlantic Coast may result in higher temperatures within the geographical breeding range of the black skimmer. As such, breeding habitat along New York's coastline could become all the more valuable as the potential for more skimmers reaching New York increases.

NON-BREEDING BIOLOGY

MIGRATION

During the early spring black skimmers leave their southern wintering grounds and begin to migrate northward along the eastern coast. Black skimmers arrive in New York during the last week of April and into early May (Burger and Gochfeld 1990).

FIGURE 2: BLACK SKIMMER AND JUVENILE GULL-BILLED TERNS LEAVING A STAGING AREA IN CAPE MAY, NJ TO CONTINUE THEIR SOUTHERN MIGRATION.

After nesting and breeding during the summer months, juveniles and adults will often stay and loaf along New York's coast into the fall. Migration back to wintering grounds usually occurs during October and into November however, skimmer have been known to stay in New York as late as December (Burger and Gochfeld 1990).

COLONIALITY

The black skimmer is a colonial species. This means that black skimmers loaf, roost, and nest within close proximity to other black skimmers. The colonial lifestyle provides the benefits of social interaction, social stimulation, information sharing, and increased protection from predators to the entire colony (Burger and Gochfeld 1990). The cumulative anti-predator behavior provided by the colony, reduces the amount of energy an individual needs to devote to anti-predator vigilance (Burger and Gochfeld 1992). As colonies increase in size, social and security benefits are countered with increased competition for mates, resources, and higher levels of disease transmission (Burger and Gochfeld 1990). Larger colonies can also attract more attention from predators due to both the amount of activity and noise generated by the colony (Puis and Leberg 1998).

Black skimmers in New York almost always form mixed-species colonies with nesting least terns (S.Sinkevich, USFWS, Aug 2010, Pers. Comm.) and/or common terns (Gochfeld 1978). It is unclear if skimmers nest with terns because of the anti-predator benefits of having an aggressive neighbor. There is evidence that skimmers would nest exclusively with other skimmers but only when enough suitable locations are available (Puis and Leberg 2002). Terns may also signify quality nesting opportunities within the available habitat (Gochfeld 1978). A mixed species colony increases the overall size of the colony which provides more anti-predator security (Puis and Leberg 1998). Through both nesting and forage habitat partitioning the additional protection comes without increasing competition for mates or resources (Burger and Gochfeld 1990). In this way the benefits of the mixed species colony outweigh the risks of nesting alone in smaller groups.

FIGURE 3: MIXED SPECIES COLONY AT NICKERSON BEACH, NY WITH BLACK SKIMMER AND LEAST TERNS.

As a general progression gulls select nesting habitat first (Burger and Gochfeld 1990). They often choose higher ground with taller, more surrounding vegetation (Burger and Shisler 1978). Terns arrive next and usually select lower elevations with less vegetative cover. Terns are then followed by skimmers which are often centrally located within the overall mixed species colony. Skimmers tend to nest areas with slightly higher elevation and protective vegetation such as searocket (*Cakile edentula*) and beach grass (*Ammophila breviligulata*). Despite arriving approximately a week later to establish breeding territory, skimmers are larger than terns and therefore can squeeze themselves into pre-existing tern colonies (Burger and Gochfeld 1990). Skimmers will often break a larger group of conspecifics into smaller sub-colonies in order to reduce crowding along the foredune (Gochfeld 1979).

The mixed species colonial dynamic requires that management actions designed to benefit black skimmers must by default, consider the other species that utilize and share the same habitat, such as terns and gulls.

Aggression, Antipredator, and Disturbance Behavior

Black skimmers have developed interesting strategies to deal with predators that pass by or enter nesting habitat. The first aspect to skimmer protective strategies involves using their tern neighbors to their benefit. Terns exhibit very aggressive behavior including diving at and mobbing intruders. It has been argued that skimmers nest within proximity to terns for just this reason (Burger and Gochfeld 1992). Terns therefore provide the primary alarm and reaction to most disturbances to the colony. When the terns are unsuccessful and threats from predators persist, black skimmers exhibit their own strategies to protect not only themselves but their eggs and hatchlings as well.

Black skimmers will use a combination of distraction displays, camouflage techniques, mobbing, and striking to confound predators (Burger and Gochfeld 1990). Distraction displays performed by adults are designed to lure a potential predator away from nests, eggs, or hatchlings (Pettingill 1937, Burger and Gochfeld 1992a). Cryptic coloration of eggs and juveniles helps to hide both while the parent makes the distraction. While adults draw the attention of predators, hatchlings often run several feet away and begin to hide (Puis and Leberg 1998). Chicks disguise themselves by kicking sand with their back legs forming a depression. The kicking of sand not only forms a small scrape for the chick to nestle into, the falling sand lands on top of the hatchling and adds to the camouflaged effect (Hays 1970). The longer a potential predator remains in proximity to the colony, the more aggressive behavior is exhibited such as mobbing and striking (Burger and Gochfeld 1992a).

FIGURE 4: AGGRESSIVE BEHAVIOR IN SKIMMER CAN TAKE THE FORM OF AERIAL DISPLAYS.

Skimmer aggression shifts throughout the breeding season. Generally speaking, black skimmers are more aggressive during early breeding when males are defending either mates or territory where nesting will occur (Burger 1981b). During egg incubation skimmers are less aggressive and less likely to come off their nest (Gochfeld and Burger 1994), though skimmers not actively incubating or brooding are known to exhibit aggressive behavior so their mates can continue to incubate (Burger 1981b). Another period when aggressive behavior is more likely occurs just after eggs have hatched but before chicks have fledged (Burger 1981a).

Location of the colony can also play a role in the aggressive behavior of skimmers. Skimmers in colonies closer to the mainland where interactions between humans are more common are often more aggressive than those nesting in more remote areas (Jackson et al. 1982, Puis and Leberg 1998). This is due to the frequency of disturbance events. When skimmer are left alone and disturbed infrequently behavior such as mobbing and diving is reduced (Jackson et al. 1982, Puis and Leberg 1998). Denser colonies can also lead to increases in aggressive behavior as competition increases for mates and resources (Burger 1981a). Marsh island nesting locations offer the most respite from human disturbance.

GENERAL HABITAT CHARACTERISTICS

Black skimmers rely almost entirely on coastal resources (Gochfeld 1978) and their preference for nesting habitat reflects this. Generally speaking black skimmers nest upon beaches, salt marsh islands, dredge spoil islands, and sand bars (Burger and Gochfeld 1990).

Within New York, skimmers nest almost entirely along the beach front on Long Island's barrier islands, by contrast, in New Jersey skimmers nest almost exclusively on dredge and salt marsh islands (Erwin et al. 1981). In both cases however, black skimmers tend to nest within close proximity to forage areas and tend to select locations closer to the main land (Burger and Gochfeld 1990).

Black skimmers prefer to nest on sandy beaches with plenty of shell. The shift to marsh islands appears to be an adaptive response to the disturbance and loss of the beach environment by human development and use (Frohling 1965, Gochfeld 1978, Erwin et al. 1981, Burger 1982b). Black skimmer colonies on barrier beaches are considerably larger than those located on marsh or dredge spoil islands (Erwin et al. 1981). Island habitats are more prone to flooding and may require more anti-predator vigilance because fewer individual birds nest there (Burger and Gochfeld 1990). Both flooding and predation can cause colony site abandonment and many smaller colonies are eventually vacated for these reasons. Selected nesting locations on both beach and marsh island are generally flat with slopes less than ten degrees (< 10°) (Gochfeld 1978).

BARRIER BEACHES


FIGURE 5: BLACK SKIMMER SURROUNDED BY SEA ROCKET (*CAKILE EDENTULA*).

Barrier beach nesting habitat is located primarily within the foredune of the beach. The foredune is characterized by a sparsely vegetated mix of *Ammophila* (ex. beach grasses), *Solidago* (ex. seaside goldenrod), and *Cakile* (ex. Sea rocket) species. Skimmers prefer to nest in beach areas with less than twenty percent (< 20%) vegetative cover (Gochfeld and Burger 1994). Excess cover can camouflage predators, restrict movement especially chicks, and can inhibit nest building (Mazzocchi and Forys 2005). Typically the foredune is slightly higher in elevation then the rest of the beach and begins the transition between the beach and crest of the primary dune.

Selected habitat for beach nesting will most likely have a mix of sand and shell. Beaches with fine grain sand are less preferential as egg pores tend to become clogged which reduces hatching success (Mallach and Leberg 1999). Beaches with greater than ten percent (> 10%) (Golder et al. 2008) but less than twenty percent (< 20%) composition of shell provide optimal beach conditions for nesting skimmers (Mazzochi and Forys 2005).

Salt Marsh and Dredge Spoil Islands

Preferred salt marsh island habitat is characterized by islands that contain at least a twenty percent (> 20%) composition of *Spartina patens/Distichlis* with deposits of wrack (Burger and Gochfeld 1990). Wrack is deposited dead vegetation that is left behind following high tides. Skimmers prefer less vegetation surrounding their nests (Mazzochi and Forys 2005). Wrack deposits that serve as nesting locations for black skimmer are usually wider than two meters (2m) (Burger and Gochfeld 1990). Islands that are primarily *Spartina alterniflora* are more prone to daily inundation due to lower elevation and will not be selected for nesting. Additionally, skimmers prefer islands that are at least 0.25 ha but no larger than 10 ha in size. Location also plays a role in suitable habitat and skimmers tend to select islands within close proximity to the main land (Burger and Gochfeld 1990).

Proximity to Forage Areas

The distance to an active forage area is also a major factor in black skimmer selection of nesting habitat. Since skimmers provision their young it is advantageous to minimize the flight distance to food sources (Tomkins 1951). Increased access to forage areas decreases the energy required to feed not only themselves but their young as well. As such, closer proximity to food sources increases survivorship of hatchlings (Gordon et al. 2000).


FIGURE 6: THE UNIQUE FORAGING STYLE OF SKIMMING THE SURFACE OF THE WATER WAS THE INSPIRATION FOR NAMING THE BLACK SKIMMER.

Forage Areas


FIGURE 7: RIDGES ALONG THE BLACK SKIMMER BEAK MAY REDUCE DRAG THROUGH THE WATER WHILE FORAGING.

Black skimmers forage in shallow tidal waters (Erwin 1977a). These areas are often found in the back of bays and tidal inlets. Foraging usually occurs during low tide or at night (Tomkins 1951). Low tide foraging can either expose or trap fish in smaller pools (Erwin 1977b). During low light hours fish come closer to the surface of the water and can be more easily reached by skimmers (Burger and Gochfeld 1990). Additionally, wind speeds are usually lower at night, reducing surface chop and wave action (Rojas et al. 1997). Calmer waters are more easily navigated by foraging skimmers.

There are two key characteristics of these tidal areas that the black skimmer actively selects when foraging. Skimmers normally forage within two meters (2 m) of land, in water between ten and twenty centimeters (10 – 20 cm) in depth. Forage areas are often described as having a generous mix of land and water transitions with more mudflats than open water (Black and Harris 1983).

Black skimmers can be seen foraging at any time throughout the day but commonly feed at dawn and dusk and are well adapted to night time feeding (Rojas et al. 1997). Interestingly, black skimmers have been documented using inland freshwater resources as forage areas as well (Nicholson 1948).

Foraging Behavior

The foraging behavior exhibited by black skimmers is a unique method that ultimately influenced the naming of the species. Black skimmers literally skim the surface of the water with their bill partially submerged. Upon coming into contact with a potential food item the skimmer reflexively snaps its bill closed capturing the object (Rojas et al. 1997).

When foraging skimmers fly in a straight line for approximately 50 – 100 meters along the surface of the water (Martin et al. 2007). Their head is tilted so that the lower mandible is submerged with the upper mandible above the water's surface. There are ridges along the edge of the lower mandible that may reduce drag (Martin et al. 2007) as the black skimmer slices through the water. Upon contact with a potential food item the lower bill "catches" on the object and the head begins to roll under the body. Skimmers can visually inspect the held object (Martin et al. 2007) and stray vegetation or other non-food items are dropped. Food items captured are either consumed by the individual or are brought back to mates or nestlings.


FIGURE 8: WHEN THE BEAK COMES INTO CONTACT WITH AN OBJECT THE HEAD ROLLS UNDER AND THE MANDIBLES ARE REFLEXIVELY CLOSED SHUT.

Black skimmers normally forage individually however, after fledging, juveniles may accompany a parent while learning how to forage for themselves (Erwin 1977a).

Prey Species

Across their entire range black skimmers are primarily piscivorous and feed on smaller species found within shallower tidal waters. Fish comprising skimmer diets include Atherinidae (silversides), Fundilidae (killifish) (Erwin 1977b), Engraulidae (anchovies), and Clupeidae (herring) (Mariano-Jelicich and Favero 2006). Other species that skimmer feed upon include crustaceans, primarily shrimp (Leavitt 1957), and the occasional cephalopod (Burger and Gochfeld 1994).


FIGURE 9: A SKIMMER RETURNS WITH AN ATLANTIC NEEDLEFISH.

In New York skimmers are most likely to feed on silversides, killifish, menhaden, bluefish, sand lance, and needlefish.

Breeding Biology


FIGURE 10: A MALE PRESENTS A FISH TO A FEMALE TO INITIATE COURTSHIP.

Courtship Displays

Once territory has been established breeding black skimmers follow simple courtship rituals that occur as males present themselves to females. Audio and visual displays are culminated with males offering a fish (Burger and Gochfeld 1990), small stick (Petingill 1937), or leaf (Burger and Gochfeld 1990) to females as an act of fitness. Females receptive to male presentations will accept the offering and usually hold it within her bill during copulation. If the offering was a fish the female will usually consume it after mating. Mating occurs primarily during evening hours after dusk (Burger and Gochfeld 1990).

Nest Description

The black skimmer nest is simply a small scrape or depression on the beach or within a wrack deposit (Burger and Gochfeld 1990). Scrapes are formed by kicking sand or wrack backwards with their feet. During courtship several nests will be created and "tested" (by sitting in it). Selecting a nest from available scrapes made during courtship may be a factor of proximity to other nearby nests (Gochfeld 1978). Nests are usually spaced at least one meter (> 1m) and usually less than two meters (< 2m) apart

(Rounds et al. 2004). Mean nest space distances have however been reported as high as two and a half meters (2.5 m) (Burger 1981b).

Egg-Laying Period

Egg laying by skimmers usually occurs between mid-May and early June, however late arrivals or re-nesting skimmers may be outside of that window. Eggs are usually laid on successive or alternate day intervals and a typical nest contains three to four (3-4) eggs (Pettingill 1937) with two (Gochfeld and Burger 1994) and five egg (Erwin 1977a) nests being rare (Pettingill 1937). Clutch size may be influenced by the availability and nutritional value of food resources (Monticelli et al. 2007, Gochfeld and Burger 1994). During the egg laying period skimmer continue to copulate often without courtship displays (Burger and Gochfel 1990). Adults may wait to initiate incubation until after the second egg has been laid (Burger and Gochfeld 1992b). Egg incubation requires between 21 – 26 days. Both parents share the responsibility (Erwin 1977a, Gochfeld and Burger 1994) and during the day both parents are usually found tending the nest (Burger 1981b). During the evening hours parents can forage by taking turns sitting on the nest (Pettingill 1937).

There are many factors that can influence the success of a nesting attempt but nest initiation date plays a major role in the fate of a nest. As a general rule, pairs that nest earlier in the season are often the more productive (Rounds et al.2004). This may be due to chicks fledging prior to seasonal storms or flooding events and the potential to re-nest if early attempts are unsuccessful. Nest initiation may also be influenced by the timing of spring algal blooms and the availability of prey (Monticelli et al. 2007). Re-nest attempts will usually occur within two weeks' time (Gochfeld 1979).

FIGURE 11: THE BLACK SKIMMER NEST IS LITTLE MORE THAN A DEPRESSION IN THE SAND. CRYPTIC COLORATION HELPS TO CAMOUFLAGE EGGS FROM PREDATORS.

Past research has noted various annual hatching success rates in black skimmer. Hatching success rates in Virginia have been reported as high as 80% (Erwin 1977a) and as low as 45% (Rounds et al. 2004) while areas in New Jersey report 52% (Burger 1982b). Fledging rates are much lower with values of less than one chick per pair often reported (Erwin 1977a, Burger 1982b). There are currently only preliminary estimates for fledging success of black skimmer in New York State (see Conservation Strategy Goal section for more information).

Colony Synchrony

Paired black skimmers within a colony will generally tend to begin breeding at the same time. This is known as breeding or colony synchrony. Synchrony, however, can diminish with increasing colony size (Gochfeld 1979). Larger colonies often receive incoming breeding pairs that were unsuccessful elsewhere or are late arriving migrants (Gochfeld 1979). These additions to a colony will often nest on the edge of the colony and may breed later than the rest of the colony (Gochfeld 1979). Colonies that are not in synchrony will have longer periods of sensitivity when hatchlings or fledglings are at risk due to the staggered starts in egg-laying.

Site Fidelity

Black skimmers exhibit site fidelity at successful breeding locations. This means that once a location hosting black skimmers results in the successful rearing of fledglings then black skimmers will likely return to that location the following year (Burger 1982b). Breeding locations that are successful for extended successive periods are not quickly abandoned (Gochfeld 1978). Larger colonies with a history of successful breeding may see a drop in numbers following a low productivity year but it is often not abandoned outright (Burger and Gochfeld 1990). Once a breeding location is abandoned however, it is unlikely that skimmers will return during the following years (Burger 1982b).

FIGURE 12: ADULT BLACK SKIMMER WITH TWO HATCHLINGS (FORE).

Colonies may be abandoned for any number of reasons including flooding, human disturbance, and predation (Burger et al. 1994). Flooding events however, are often tolerated by breeding skimmers and they will not necessarily abandon a site due to these events. Predation and disturbance pressures are far more likely to result in site abandonment (Burger 1982b). It is interesting to note that skimmer again follow tern behavior and usually abandon a site only after the terns have chosen to do so (Burger and Gochfeld 1990).

Developmental Biology

After hatching, adults brood chicks for approximately one week (Burger 1981b). Chicks older than one week are too large to brood and often die of exposure to either extreme heat or cold (Gochfeld and Burger 1994). During this time hatchlings are vulnerable to heat and are often hunkered down in scrapes or in the shade of nearby vegetation (Pettingill 1937). Hatchlings are provisioned by both parents although males may do the larger share (Burger 1981b). After twenty-eight (28) days hatchlings begin to fledge although males may take up to three (3) days longer (Gochfeld and Burger 1994). The extra time is due to the additional size and mass of the male (Schew and Collins 1990). Upon fledging, chicks are quick to take to wing and can begin foraging for themselves within just a few days of first flight (Burger and Gochfeld 1990).

Skimmers have a greater chance of mortality during the first two years of life (Burger and Gochfeld 1990). Chicks experience competition initially between siblings for food and first hatched chicks have the greatest chance for surviving long enough to fledge (Erwin 1977a). Presence of adequate prey species also influences fledgling success. When more prey is available more hatchlings will be able to survive to fledge (Erwin 1977a). However, once fledged, juveniles remain at risk and the greatest mortality rate of skimmer is during these early years.

Typically, most skimmers reach sexual maturity at two years of age. Occasionally however, females will begin breeding during their first season while some males often wait until year three or four before attempting to breed (Gochfeld and Burger 1994).

Hatchling and Fledgling Behavior

Within hours after hatching, chicks are able to run (Gochfeld 1981). Disturbance during this period can result in chicks running into neighboring territories. Chicks that venture too far from their nest may be attacked by neighbors, especially gulls (Gochfeld 1981). However, skimmers have been documented attacking and killing chicks of other skimmers (Burger and Gochfeld 1990).

FIGURE 13: RETURNING WITH A SMALL HERRING THE COMPETION AMONG SIBLINGS BEGINS.

While flightless, hatchlings rely on their parents to provide their food. Adults do not regurgitate and instead present whole fish for consumption (Pettingill 1937). Siblings compete over food brought back and older chicks have a size advantage. Chicks that hatch first or second have the greatest chance of survival (Gordon et al. 2000) while those hatching third or fourth often do not survive longer than a week (Erwin 1977a). After the first three weeks sexual dimorphism becomes obvious with males considerably larger in mass, bill length, and wing chord than females (Erwin 1977a, Schew and Collins 1990).

Hatchlings fledge at approximately four weeks of age, although smaller and lighter females often take flight before males. First flying attempts are made by running and jumping into the wind (Gochfeld and Burger 1994). Within two days of first flight, juveniles can be seen accompanying adults to forage areas (Gochfeld and Burger 1994). Early juvenile skimming attempts are often unsuccessful and fledglings require supplemental feeding from parents for several weeks after first flight (Erwin 1977a).

Once flight has begun, fledglings no longer run from intruders and instead take to wing (Gochfeld and Burger 1994). Fledglings join adults during loafing periods and will accompany adults during the winter migration (Burger and Gochfeld 1990).

HISTORICAL STATUS ASSESSMENT

During the 1800s, hunting and collection of waterbirds for their plumage left many bird populations decimated. Black skimmers while not specifically valued for their feathers did experience pressures from egging for commercial or subsistence food sources. Terns however, were actively sought for their plumage and, due to the relationship between terns and skimmers additional pressure was placed on skimmer populations (Gochfeld and Burger 1994). By the time the Migratory Bird Treaty Act was ratified in 1918, waterbird populations were no longer plentiful enough to warrant the extra effort required to hunt them (Burger and Gochfeld 1990).

The protections granted to species by the Migratory Bird Treaty Act did afford the opportunity for waterbird populations to begin their slow rebound. The waterbirds we see today are the surviving ancestors of those few isolated colonies that survived the taking pressures of the 1800s. The most notable period of black skimmer population expansion occurred after the enactment of conservation laws between 1930 and 1950 (Burger and Gochfeld 1990).

Early recorded sightings of black skimmer in New York have been noted as far back as 1919 (Griscom and Janvrin 1920). The first breeding record however did not occur until 1934 when an adult was documented provisioning hatchlings at Gilgo State Park along the south shore of Long Island (Vogt 1934).

In the mid-1970s the National Park Service conducted helicopter surveys of colonial waterbirds across Long Island recording 339 pair of black skimmer in 1974 (Brown et al. 2001).

Beginning in 1983 the Long Island Colonial Waterbird and Piping Plover (LICWPP) survey began. The LICWPP covers both Nassau and Suffolk counties of Long Island and includes all five boroughs of New York City. During the first year of the survey only piping plover and least terns were surveyed. In the following year the survey included the plover, all the tern species, and the black skimmer. The survey continued to expand and include more species and added double-crested cormorants, wading birds and gulls in 1985. The last addition in 1986 saw the inclusion of the American oystercatcher (Litwin 1993).

In the years 1987 – 1993 all included species were surveyed every year. In 1994 only terns, skimmer, and plover were counted, and beginning in 1995 surveys of all species occurred every three years but with terns, skimmer, and plover still being surveyed annually (Litwin 1993).

During the early years, the survey was organized by the Seatuck Research Program in partnership with the NYSDEC, The Nature Conservancy, and other organizations. In 1992 the organizational responsibilities for the survey shifted to the NYSDEC and since then the agency has remained the central hub for collecting and reporting LICWPP survey data (Litwin 1993).

CURRENT STATUS ASSESSMENT

POPULATION STATUS AND DISTRIBUTION

While the LICWPP survey provides an essential look at the abundance and distribution of New York's waterbird populations there are a few issues with the survey that makes statistical analysis problematic for black skimmer. During the switch over from Seatuck to NYSDEC some site location boundaries and names were altered.

Survey methods also cause some issues with the use of the data. Specifically, site locations are surveyed twice during the survey window. During these visits the number of individual birds is counted. Individual numbers are converted to breeding pairs using formulas. The formula for black skimmers is: 2 individuals = 1 pair. Reported numbers for a site are an average of the two numbers recorded during the two survey visits. However, if either survey visit was missed or no site activity had begun yet, then one of the numbers being averaged would be zero. This is acceptable and appropriate when a colony or location has been abandoned but in all other cases it skews the data and presents inaccuracies throughout the survey numbers.

Lastly, the window for surveys is based on tern nesting. This means that numbers for skimmers may be chronically low as skimmers initiate nesting after terns do. Despite these black skimmer specific short-comings the LICWPP is a valuable tool in monitoring all waterbird populations along New York's coast.

According to the LICWPP data (collected between 1985 -2013) (see Appendix A) there are a few trends and observations throughout the black skimmer's nesting history along New York's shoreline. New York averages approximately 494 breeding pair of black skimmer annually, with a low in 1999 of 283 pairs and a high of 690 pairs in 2009. New York hosts approximately ten (10) colonies annually with the most colonies occurring in 1997 with twenty (20) and a low of only two (2) colonies in both 2010 and 2011. Looking over the entire LICWPP survey the black skimmer's breeding population has remained fairly stable despite annual shifts. However, the recent trend toward only a few colonies is cause for concern.

There are only three consistent breeding locations that skimmers have been using throughout the survey. There are the two largest colonies at Breezy Point, part of the Rockaways in Queens County and Nickerson Beach (also referred to as Lido Beach) located on Long Beach Island in Nassau County. The third consistent colony location is also on Long Beach Island at Atlantic Beach (also referred to as Silver Point).

The sites are typical of black skimmer beach nesting habitat. These beaches are inhabited by terns and have an established foredune. Breezy Point averages approximately 150 pair with a high survey count of 353 pair in 2001. The Nickerson Beach nesting site averages between 150 and 200 pair annually with much higher counts in recent years. Nickerson's highest survey count occurred in 2009 with 467 pair. The colony located on the western side of Long Beach Island at Atlantic Beach hosted skimmer through the 1990s (53 pair annually) but annual abundance was highly variable. Atlantic Beach had a high of 152 pair in 1999 which declined to a low of 5 pair by 2003. The site rebounded during 2007 and 2008 with survey counts of 90 pair in both years only to drop to again to 11 pair in 2009. The site was not surveyed in either 2010 or 2011 but was surveyed in 2012 (5 pair) and 2013 (26 pair).

The two colonies at Breezy Point and Nickerson Beach comprise the majority of all recently documented nesting skimmers in New York and the importance of these two locations to the black skimmer cannot be understated. The two sites are in close proximity to each other with only seventeen (17) miles between them (the Atlantic Beach site is approximately half way between the two). During both the 2010 and 2011 breeding seasons these two colonies were the only active skimmer colonies in New York State. Atlantic Beach was not surveyed in these years but evidence suggests skimmers were not present.

The LICWPP shows that a few locations were historically being used by black skimmer but most of these colonies were much smaller than those located at Breezy Point and Nickerson Beach. For example, Cartwright Point on Gardiner's Island averaged approximately twenty six (26) pair annually. Other consistent locations included several marsh islands within Great South Bay which often hosted small colonies of around 5 pair or less each. There has been no documented nesting on Cartwright Point or the marsh islands of Great South Bay since 2009.

The LICWPP also reveals the abandonment of other colonies. The locations of Lanes Island (11 pair annually) and Warner's Island East (37 pair annually) both hosted successful colonies for many years. However due to the subsidence of these marsh islands there has been no nesting activity on Warner's Island East since 1992 or on Lanes Island since 2003.

Yearly averages for the number of colonies decreased from fifteen (15) in 2008, to nine (9) in 2009, with only two or three (2-3) from 2010 through 2013. LICWPP survey results for these years (2008-2013) indicated few if any nesting attempts were made outside of the two large beach colonies at Breezy Point and Nickerson Beach. For instance, a stable colony at Sand City (one of the only north shore colonies) which averaged five (5) pair annually (between 1994-2009) was abandoned in 2010 mostly likely due to predation (S.Sinkevich USFWS, Personal Communication, October 2011).

In late October of 2012 super storm Sandy hit New York State. The inundation from the storm surge flooded New York's beaches and marsh islands. Despite the major habitat alterations and loss of many dune systems resulting from the storm, skimmer colonies were largely unharmed. For example, while the foredune vegetation was buried under sand deposited during the storm the dunes themselves were not entirely scoured. As such, at skimmer nesting locations the beach system showed its resiliency and the foredune vegetation re-established in 2013. The dunes will take longer to re-establish.

Due to the inter annual variations in the mean average number of breeding pairs (494) and colony locations (10) over the more than 30 years of the LICWPP the recent trend in black skimmer nesting habitat is difficult to see. Using five (5) year mean averages beginning five years (1989) into the LICWPP the loss of nesting colonies becomes extremely apparent (see Appendix A). These mean averages show a steady annual breeding population above 500 pairs from the 2000-2005 through the 2009-2013 periods. However, the 2005-2009 average was the last above the ten (10) colony target. Since then the annual number of colonies has steadily declined to the latest average of less than four (4) colonies annually.

Target goals for the conservation of black skimmer will be calculated based on these five year mean averages.

THREATS TO SPECIES

Black skimmer populations in New York State are often variable between individual years but generally speaking the population is somewhat stable. However, that population is becoming more and more concentrated within only a few large colonies. While nesting attempts are being made outside of the large colonies there are many factors that can influence the success of these colonies regardless of size (Burger and Gochfeld 1990).

FIGURE 14: BEACHFRONT DEVELOPMENT PRESSURE CAN LIMIT THE AMOUNT OF AVAILABLE NESTING HABITAT FOR ALL WATERBIRDS NOT JUST SKIMMERS.

Some of the threats to black skimmer breeding success are natural, biological, or ecological processes; the majority of them however are anthropogenic. While that may sound dire, the good news is we can alter, manage, and mitigate the anthropogenic ones. Additionally, bringing awareness to larger global processes affords the opportunity to plan and prepare for predicted climatic shifts to New York's environment.

HABITAT LOSS

The loss of available habitat for nesting skimmers is the single largest threat to the continued breeding success of not only the black skimmer but all waterbirds along New York's coast. There have been two types of habitat loss that have influenced black skimmer breeding. The first loss was to beach and sandy habitats due to development pressures (Burger and Gochfeld 1990). The second is a culmination of factors that when combined results in the subsidence of marsh islands (Kolker 2005).

As both the footprint and population of New York City grew the surrounding natural environment shrank. While much of the growth and development around the core of the city grew up, the edge of the city grew out and spread both north into the Hudson River Valley and east onto Long Island. The increased population resulted in development expansion to accommodate both the practical and recreational needs of society. Much of the development occurred along the coast. This encroachment resulted in the direct loss of dunes and narrowed beaches. Dune-less beaches are more vulnerable to erosion from storm driven inundation resulting in flooding of the areas behind the beach. While narrow beaches do not effectively replenish sediments to dunes (Magliocca, McNamara, and Murray, 2011).

In response to this loss of preferable beach habitat skimmers began using salt marsh and dredge spoil islands for nesting (Erwin et al. 1981). However, some of these island habitats have either begun to subside and become more prone to flooding events or slipped below the water's surface entirely (Kolker 2005).

With the increase of human use and development came additional pressures on the environment to adjust. Excess input of nutrients and other organic matter into our waterways derived from our agricultural and sanitary needs has caused our coastal waters to become eutrophic (Bertness et al. 2002). Microbial processes that oxidize organic matter can result in excess hydrogen sulfide (H_2S). The increased acidic conditions are toxic to plants and as they die off, the stability root systems provide to island cohesion is lost to erosion from tidal inundation and wave action (Deegan et al. 2012). Deficiencies in sediment budgets (Hapke et al. 2010), rising seas, nutrient loads, and a diminished capacity for sediment accretion due to the loss of stabilizing vegetation (Kolker 2005) has created a synergistic effect. The synergy of these impacts is not uniform across New York's coastline, bays, and inlets. In some areas, marsh island loss is driven by nutrients, while other areas are more directly influenced by erosion. It is more appropriate to think of these influences as gradients across the landscape.

The overall impact however of this synergy of sediment, chemical, and sea level pressures has resulted in available nesting habitat to becoming limited for waterbird use. Loss of suitable breeding habitat results in an increase to colony density. As density increases so too does competition for mates and resources which in turn decreases the chances of chick survival. Increased mortality to chicks over the years will break the natural cycle of waterbird ecology and eventually populations will decline (Burger and Gochfeld 1990).

HABITAT DEGRADATION

In many instances it isn't the lack of habitat but the quality of the habitat that works against successful waterbird breeding activity. The functionality of many of our salt marsh and dredge spoil islands has been hampered primarily by the engineering practices of our past and the recent proliferation of invasive species.

Salt marshes were used during the 1700s as a source of hay for agriculture or use in construction of rooftops (Bromberg and Bertness 2005). Beginning in the early 1900s the practice of ditching marsh islands to control mosquitoes was conducted extensively (Burger et al. 1979) primarily as a job creation effort (Buchsbaum, 2001). This practice involved creating parallel ditches that connected standing water to the waters of the bays and estuaries. Mosquito ditches reduced standing water and increased hydrologic flow (Burger et al, 1979). The alteration to natural hydrology had a dramatic impact on the vegetative composition on these ditched islands. Areas formerly composed of *Spartina* gave way to less salt tolerant edge species like *Baccharis* and *Iva* (Burger et al, 1979) along the ridges and mounds left behind from ditching. While plant diversity may have increased as a result of mosquito ditching, the process ultimately reduced the amount of habitat available to terns and skimmers (Burger and Shisler 1978). Gulls that nest upon the spoil mounds beside the ditched areas seem to have benefited most from the practice (Burger and Shisler 1978 & 1980).

In contrast, dredge spoil islands are often elevated too high to be conducive to skimmers and waterbird nesting altogether. Elevation restricts marine hydrology and allows the island to undergo succession and form upland vegetative communities. Upland communities are not conducive to skimmer nesting as they can host mammalian predators or attract incompatible avian species (Burger and Gochfeld 1990).

Since elevated areas receive less exposure to higher salt concentrations in the water, different species can establish. While *Baccharis* and *Iva* may be favorable in this regard invasive species can also capitalize on elevated natural systems. *Phragmites australis*, once established, can out-compete native vegetation and create monocultures of wetland meadows. While skimmers have been known to nest near stands of *Phragmites* it is generally undesirable due to its limited habitat value and potential to attract incompatible avian species to nesting habitat (Burger and Gochfeld 1990). Many of these elevated dredge spoil islands do however host other colonial bird species many of which are also species of special concern.

Water Quality

Current water quality conditions including nutrient, contaminant, and toxin levels often result in negative impacts to both fish and wildlife. Excess nutrient inputs can result in increased phytoplankton and algal blooms. These types of events result from excess nutrients in waterways and temporarily increase biomass in the water column. As these species grow, die, and decompose it reduces the levels of dissolved oxygen in the water. Coupled with increasing summer temperatures, the process can reduce dissolved oxygen levels to hypoxic conditions. Hypoxia can cause mass mortality events of aquatic species on a local scale (McInnes and Quigg 2010) including the prey species of foraging skimmers.

Toxins and other contaminants present in prey species can bioaccumulate in the black skimmer. These chemicals have been associated with reductions in breeding success (Burger et al. 1994). Toxic effects can decrease hatching rates, result in deformities, and disrupt neurological behavior (Burger 2002). Toxins can also influence adult skimmers over time leading to weakened immune systems which can increase risk of disease or other ailments (Burger and Gochfeld 1990).

Land Use Conflicts

In addition to the loss of habitat due to human development and population growth, conflicts arise over incompatible uses of the remaining areas. While it is true that some activities are more detrimental than others, the majority of issues that arise can be managed in a way that affords the best of both worlds.

Human activities, even just simply going to the beach to walk a dog, can create disturbances to nesting waterbirds. Research shows that colonies exposed to repeated disturbance will result in lower chick survival and fledgling rates (Dinsmore 2008). As activities become more and more frequent or disturbing, successful breeding may drop off considerably and ultimately result in the abandonment of the colony (Safina and Burger 1983). Leash laws and dog walking restrictions are intended to prevent these events from occurring.

On some beaches in New York the use of motorized vehicles is permitted for municipal vehicles and to allow anglers access to remote sections of the coast. Vehicles are usually equipped with safety gear and adhere to driving guidelines (NYSORVA 2012). Despite the additional precautions, motorized vehicle use near breeding habitat areas will always be in conflict with waterbirds. Driving vehicles in proximity to nesting areas can create a disturbance to the colony or can result in bird strikes especially to chicks which can fall into tire ruts created by the vehicles.

Likewise water craft can also disrupt breeding or foraging behavior. Wakes created by water craft can reduce foraging efficiency of skimming due to the disruption in the surface of the water. While landing on marsh islands is a direct invasion of a nesting area. No wake zones, speed limits and restrictions to entering marsh islands can prevent recreational use of water craft from harming black skimmer as well as other water and shore birds in the area.

Entertainment events can be another source of disturbance to breeding waterbirds. Throughout New York's marine district many music venues, sporting events, and holiday celebrations take place in close proximity to nesting habitat. The noise generated by these types of events can be enough to create disturbance in colonies. If coupled with crowds in proximity to or that trespass in nesting areas the disturbance can be enough to reduce breeding success if not lead to outright colony abandonment. Firework displays in particular can create enough noise in one event it can lead to immediate evacuation from or abandonment of the nesting habitat. This can leave eggs and/or chicks unattended or left behind entirely.

Conflicts can arise when recreational activities occur within close proximity to nesting waterbirds. While many of these issues can be resolved through event planning and resource management vandalism to nesting birds, eggs, and chicks does occur. While these events are uncommon, the damage that can result can devastate a local colony. The management recommendations within this plan are intended to reduce the potential conflicts that can occur between regulating agencies, users of the resource, and the birds themselves.

Competition, Predation, and Disturbance

There are several ways other species can influence the breeding success of black skimmers in New York. Under ideal conditions many of these processes are quite natural and black skimmers have evolved coping mechanisms. Under current conditions, however, competition over resources, predation, and intrusion from other animals can put too much additional pressure on breeding species.

While competition between species is part of natural ecology, under conditions of limited resources it creates elevated levels of aggression (Burger and Gochfeld 1990). This aggression often exhibits itself during periods of colony disturbance when adults and chicks may become separated. Chicks that wander or flee into territory occupied by other species can be attacked by adults or lost (Safina and Burger 1983). Small chicks are the most susceptible and research has shown that the probability of mortality increases with distance from the nest (Safina and Burger 1983). While a skimmer chick may survive an encounter with an adult tern, a gull attack will usually result in death. Under conditions of limited resources even conspecifics may respond negatively to neighboring chick intrusion (Safina and Burger 1983). While the behavior is atypical in skimmers it does help ensure one's own offspring survive.

In addition to competition over resources, skimmers experience predation pressure from both mammals and other avian species. Despite habitat partitioning, great black-backed, herring, and laughing gulls have all been documented as predators on skimmers (Burger 1982b). Gulls can target skimmer chicks while species like the American oystercatcher are known to predate upon eggs (Burger and Gochfeld 1990). Skimmers and terns nesting on islands may select habitat away from gulls which further limits available habitat selection (Erwin et al. 1981) (O'Connell and Beck. 2003).

Egg predation is a common practice among wildlife and the behavior is not limited to avian species. Raccoon, Norway rat, and red fox are primarily egg predators within nesting colonies (Burger and Gochfeld 1990). These species also occur in higher densities near housing and locations were trash collects. Breeding habitat including locations that have been successful for years will be abandoned quickly in response to predation from these species (Erwin et al. 2001). Under current environmental conditions predation within active colonies must be discouraged or controlled as best as possible.

There are even some species that one would not normally associate with reduced breeding success in black skimmers. Red-winged blackbirds (*Agelaius phoeniceus*) have been documented pecking skimmer eggs. The blackbirds are often drawn into close proximity to waterbird nesting habitat due to presence of nearby *Phragmites* stands (Burger and Gochfeld 1990). Other studies warn of introduced species like the European rabbit (*Oryctolagus cuniculus*) which will bury waterbird eggs (Nolfo-Clements and Clements 2011). Behavioral responses by skimmers to species like red-winged blackbirds and European rabbits are often non-aggressive and can result in the loss of several nests within a colony.

Domestic animals can also exhibit or mimic predatory behavior. Harassment of nesting colonies by dogs off leashes or that have gotten away from their owner can have drastic impacts on waterbird species. Even if the intrusion does not involve the actual taking of an animal, the presence of a dog can cause parents to separate from their offspring (Burger and Gochfeld 1990). As discussed earlier any time adults are away from their young, the chance for detrimental or lethal consequences increases.

Domestic and feral cats intruding into nesting habitat can also have damaging impacts (Tschanz et al. 2011). Cats are however, just as likely to attack an adult as a hatchling. Presence of feral cat populations near to nesting colonies will often result in complete site abandonment due to the predation impact even just one cat can have on a colony (Burger and Gochfeld 1990).

There are many instances when the greatest amount of predation behavior is exhibited by a relatively small number of individuals (Hall and Kress 2008). This is true for both wild and domestic species. Direct observation of the waterbird colony through either on site visits or camera traps can lead to the identification of individual predators. Developing a mitigation strategy for two or three nuisance individuals is often easier, less costly, and as effective as population based predator management (Hall and Kress 2008).

Disturbance to the colony can come from any number of sources. This can be as simple as a dog running loose off the leash or the presence of a nearby avian predator. Primarily, most disturbance to nesting black skimmers (and other waterbirds) is anthropogenic in nature. Beach-going, off-road vehicles, music venues, and firework displays can all negatively impact waterbird nesting success. Colonies that experience too much disturbance will see significant drops in hatching success. Disturbance affords predators more opportunity for destruction of eggs and juveniles while adults are off nests. Additionally, heat stress can impact eggs while they are not being incubated. Persistent disruption to the colony will usually result in site abandonment (Safina and Burger 1983).

Climate Change, Storms, and Sea Level Rise

Under current interpretations of global climatic data, it is understood that certain climatic variables have begun to or will change in our local environment (Heath et al. 2009). Initially some predicted changes may sound desirable such as an earlier arrival of spring and extended summer weather. However, these predictions include extreme heat conditions over prolonged periods (Field et al. 2007).

Skimmer nesting success can be greatly influenced by summer heat. Skimmer eggs and hatchlings are especially vulnerable to overheating. As a mechanism for cooling, skimmers will dig scrapes into the hot beach and settle down into the cooler sand below or seek shelter under surrounding vegetation (Pettingill 1937). Under extreme heat conditions these efforts are not always enough to survive (Burger and Gochfeld 1990).

The beach is not the only environment that is affected by increasing temperatures. Water resources also warm up during the spring and summer months. Extended exposure to extreme temperatures can drastically influence shallower areas of bays and inlets. Warmer water does not contain as much dissolved oxygen. Hypoxia occurs when the amount of dissolved oxygen in the water is reduced below two parts per million (2 ppm). Under hypoxic conditions forage fish will either die off in a fish kill or relocate to water that contains enough oxygen for them to respire (Hall and Kress 2008). This can lead to decreased availability of forage species or require longer flights to other forage areas. Reduced prey availability or increased distances to forage areas will directly influence chick survival (Gordon et al. 2000).


FIGURE 15: FLEDGLING BLACK SKIMMER AND ATLANTIC BRANT ON JONES BEACH, NY IN EARLY DECEMBER OF 2013.

There is also the potential for migratory behavior to be influenced by climatic shifts to seasonal conditions. Earlier onset of spring conditions may bring earlier arrivals of migratory waterbirds in the New York area. Along the same vein, extended summer climates may also cause migrants to vacate the area later in the season. Black skimmers are already known to linger in New York late into the fall and on occasion as late as December (Burger and Gochfeld 1990).

It is anticipated that altered seasonal conditions will be coupled with increased frequency and severity of storm events (Erwin et al. 2006, Field et al. 2007). New York's coastline and beaches are quite dynamic and local residents can attest to the drastic annual shifts beaches undergo as sands erode and accrete. Increased frequency or severity of storm events that can directly alter, scour, and erode beach habitat (Field et al. 2007) can prevent the successful nesting of skimmers and other waterbirds. Damage from storm and inclement weather that happen earlier in the season may be mitigated by re-nesting attempts but later arriving storm events may wash out eggs or hatchlings (Burger and Gochfeld 1990). The anticipated increase in frequency and severity may also result in continued storm related pressure throughout the breeding season (Erwin et al. 2006). The potential for storms to occur throughout the entire breeding season could severely limit breeding success in all colonial species.

The storm surge of tidal waters can be devastating to beach and island ground nesting species. Submersion of nesting habitat resulting from rising storm waters can flood out entire colonies (Palestis 2009). Depending on the timing, these events can result in the loss of almost an entire year's breeding productivity (Burger and Gochfeld 1990). While some fledglings may survive severe flooding events, many will be lost. Hatchlings and eggs have very little chance of survival during flooding events (Pettingill 1937). Surge from the 2012 super storm Sandy inundated all the marsh islands and beaches utilized by coastal birds. The late October arrival of Sandy meant that most juvenile skimmers had already fledged. Thus many were capable of staying aloft throughout the storm and avoid the flooded conditions.

While Sandy was a late arriving storm both hurricane Earl (2010) and tropical storm Irene (2011) affected the New York coast earlier in the breeding season (early September and late August respectively). Both of these storms flooded the Nickerson and Breezy Point colonies and negatively impacted chick productivity of black skimmer (T.Schneider Town of Hempstead Conservation & Waterways, Personal Communication, September 2014).

This issue of flooding becomes all the more likely and severe as water levels are anticipated to keep rising. Predicted increases to mean sea level range from ten to ninety centimeters (10-90cm) over a one hundred year (100 yr) period with an average expected increase of 48cm (Erwin et al. 2006). While the natural processes of sediment deposition and accretion will keep some systems in pace with rising sea levels (Kolker 2005), many islands may be washed out or submerged. Rising sea levels can not only result in the loss of available habitat but will also increase density pressures (Erwin et al. 2006) and potentially increase conflicts between humans and wildlife in the areas that remain.

DATA GAPS

There are three essential pieces of information that will provide better understanding of black skimmer ecology in New York State. Each piece revolves around a central question: How productive is black skimmer nesting in our state?

To develop the answer to that question three smaller steps need to be taken. The first is to develop an estimate of annual productivity. This estimate should focus on the number of annual fledglings per nest and not the number of hatchlings per clutch. This estimate should be colony specific with each colony having its own value.

The second step is to understand where our birds are coming from. There is some evidence that the New York population only remains annually stable because it is being supplemented with juveniles that originally fledged in New Jersey (Burger et al. 1994). A banding study would provide data on the New York and New Jersey black skimmer populations and reveal any relationship between the two. The possibility exists that the skimmers nesting in New York and New Jersey may be better managed as a whole.

Lastly, exploring the relationship between annual forage fish species abundance and the yearly total number of black skimmer fledglings will complete the ecological loop of productivity. This would include identifying any contaminants or toxins that may be present within the forage species and the potential for those compounds to influence egg, juvenile, or adult development.

Each of these topics is discussed more fully within the Conservation Strategy sections, Monitoring Tasks and Research Needs.

CONFIDENCE LEVEL

Based on both the LICWPP survey and the body of research conducted by biologists such as Joanna Burger, Michael Gochfeld, and R. Michael Erwin throughout their careers the level of understanding black skimmer ecology is extremely high. As such, it is the role of current managers and biologists to follow the path that they so clearly laid out.

CURRENT CONSERVATION EFFORTS

Current conservation efforts that directly address black skimmer biology or ecology in New York State are limited. The LICWPP survey counts black skimmer and tern pairs on a yearly basis and provides the best estimate of population and distribution for the state. Local beach maintenance in preparation for summer breeding does occur at Nickerson beach. Fencing is placed off season to collect sand and the beach is re-graded keeping the foredune in succession. Lastly, while an indirect benefit, the fencing placed on the beach to delineate piping plover nesting habitat often encompasses black skimmer and tern nesting locations as well. This helps to provide a buffer between nesting birds and beachgoers.

CONSERVATION STRATEGY

This section serves to describe the State's goal, management actions, research needs, monitoring protocols, and outreach techniques that can conserve the black skimmer in New York State.

CONSERVATION STRATEGY GOAL

- *To maintain a self-sustaining population of black skimmer in New York State with multiple colonies of various sizes located throughout the state's marine district.*

The overarching goal for the conservation of New York's black skimmer is to maintain a self-sustaining population that is secure in perpetuity. Skimmer persistence can be ensured by encouraging the establishment of nesting colonies in available habitat along both the north and south shores of Long Island. Neither small nor large colonies are favored by this conservation strategy; instead it is recommended that colonies should be of various sizes. The distribution of colonies is equally important. Colonies should be located throughout the marine district. Larger numbers of colonies all within the same general vicinity is less desirable than slightly fewer colonies widely distributed across the coastline.

The minimum annual mean number of colonies should be at least ten (10). Minimum population levels should be maintained at or exceed 550 breeding pairs annually. Inter-annual colony averages should be calculated across a five (5) year span.

Population viability models (PVAs) can be used to assist conservation managers in determining a minimum population level required to allow a given species to persist in a given environment. For colonial species like the black skimmer it is also important to know the minimum number of colonies required as well. PVAs consider many factors when calculating results. There are a few essential ecological values that must be known for PVA models to reliably predict persistence. These include current population, breeding productivity estimates, and mortality rates. As PVA models get more complex, values for age structure, male/female sex ratios, percent chance of colony abandonment, percent change for new colony formation, and percent chance for stochastic events are factored in. These additional values can help capture the nuances of a particular species and help hone the predictive ability of the model.

Our current data on black skimmer ecology in New York State is not comprehensive enough to accurately model skimmers via a PVA. There are however, certain factors that we do understand and how they either work for or against sustainable black skimmer colonies in New York.

From the LICWPP survey we understand the current abundance and distribution of black skimmers. On average approximately 494 pairs nest in New York annually (1983-2013). Also according to the LICWPP the state historically averaged approximately 10 colonies annually (1983-2013). Since 2009 however, the LICWPP data indicates that only three consistent colonies remain in New York. Research indicates skimmer hatchling productivity rates may be as high as 80% (Virginia) (Erwin 1977a) or as low as 52% (New Jersey) (Burger 1982b). A skimmer productivity estimate was calculated in 2012 for the Breezy Point colony in Queens. The estimate was based on the LICWPP count of 137 breeding pairs and a juvenile count of 116. This equates to a productivity rate of 86%. That is to say, on average each pair successfully fledged 0.86 chicks per nest (S.Sinkevich USFWS, Personal Communication, August 2012). Additionally, research has estimated that annual colony turnover rates are between 25% and 50% (Burger 1982b).

While this information is extremely valuable, it is not enough data to properly inform a PVA model. However, these statistics do provide a glimpse into the future of black skimmer in New York and the species' ability to persist.

The LICWPP survey over the last few years indicates that small colonies being pioneered during the breeding season are abandoned before the end of the breeding season. As a result, breeding activity in New York is being concentrated in two major colonies and a third smaller colony (Breezy Point, Nickerson Beach, and Atlantic Beach respectively). Coupled with recent trends of loss of habitat, active predation pressures, climate change issues, sea level rise, and disturbance in the areas that remain, there is very little room left for error when it comes to black skimmer breeding. Despite an annual stable population and indications of breeding success there are simply too few colonies. To make matters worse these colonies are in close proximity to each other. To put it another way, all of our skimmer eggs are in three baskets. One storm, one predator, or one reckless beach-goer could dramatically change the current status of black skimmer in New York forever.

Conservation Strategy Objectives

- *Increase the number of colonies, both large and small, that sustain successful breeding pairs of black skimmer in New York State throughout multiple continuous seasons.*

- *Expand the geographic range of successful black skimmer colonies irrespective of size along New York's coast.*

- *Maintain or increase the number of successful breeding pairs of black skimmer that nest annually in New York State.*

Management Tasks

This section describes the direct management actions that can be taken conserve black skimmers in New York State. Most of these management actions are intended to be conducted by the New York State Department of Environmental Conservation. There are however some actions that are beyond the capacity of the agency or will require partnership with other governmental agencies, academia, non-profit conservation organizations, or other stakeholders. It will be noted when partnerships or reliance on other entities is required.

Habitat Enhancement

Habitat enhancement actions are recommended in areas that require minimal adjustment to the environmental conditions that are currently present. These actions should be undertaken prior to and in preparation for the arrival of migrating skimmers.

Local site managers and municipal conservation agencies will often perform habitat enhancement actions as part of yearly maintenance actions. Community groups, beach clubs, or other volunteer organizations may also find they can help maintain our coastal habitat by partnering with site managers during the performance of these activities.

Beach Maintenance: Cleaning, Raking, & Re-grading

Both terns and black skimmers primarily use sandy beaches as nesting habitat in New York State. Both species prefer to nest along the seaward side of beach dunes in an area commonly referred to as the foredune (Erwin et al. 1981). This area is a transition zone between the true beach and the vegetated dune. Maintenance activities within the foredune can prepare the beach before skimmers and other waterbirds arrive for the breeding season.

Clean-up activities should be done by hand in breeding habitat and should remove only unnatural debris from the beach, leaving wrack behind. Mechanical beach raking removes both wrack and debris and care should be taken within breeding areas to leave behind wrack whenever possible. All clean-up and raking, especially mechanical methods should be conducted and finished prior to the arrival of migratory waterbirds.

Beach re-grading creates a disturbance to the foredune and does not allow beach or dune vegetative species to undergo succession. Maintaining the foredune in this way prevents the establishment of vegetative species like *Ammophila*, *Cakile*, and *Solidago* which should remain at less than twenty percent (< 20%) cover and provide ideal conditions for waterbird nesting. Annual re-grading can halt the encroachment of the primary dune into beach recreating areas which may help reduce the potential for negative interactions between nesting waterbirds and beach-goers. Additionally, this keeps nests further away from high tide water which will decrease the likelihood of flooding related mortality.

As an example the Town of Hempstead Conservation & Waterways maintains Nickerson beach. They do this by preparing the site during the fall through the placement of snow fence that captures beach sands. During the winter the snow fencing is removed and the collected sand is redistributed within the foredune. This keeps the foredune vegetation in succession and maintains the habitat for colonial breeding (T.Schneider Town of Hempstead Conservation & Waterways, Personal Communication, September 2014).

Re-grading of the beach environment may require both a tidal wetlands and a coastal erosion hazard area (CEHA) permit from NYSDEC. In the presence of threatened or endangered vegetative species such as Seabeach Amaranth (*Amaranthus pumilus*) maintenance activities should be done outside the growing season to allow the plants to repopulate as the breeding season progresses.

Natural and Artificial Wrack Mats

Wrack mats, whether deposited naturally or placed artificially on marsh islands are valuable nesting locations (Frohling 1965). Both terns and skimmers will select wrack deposits as nest sites on salt marsh and dredge spoil islands (Burger and Gochfeld 1990, Palestis 2009). Enhancement or creation of wrack mats on marsh islands can raise nest elevations above mean high water and create extremely valuable habitat for nesting terns and skimmers (Rounds et al. 2004). Research and direct observations have documented that nests that are located on wrack mats can survive most normal flooding events (Palestis 2009).

Skimmers prefer older, wider, and deeper wrack deposits (Burger and Gochfeld 1990). As mats age, they become bleached and lighter in color (Burger and Gochfeld 1992b). Lighter colors match chick and egg coloration and makes hiding easier. Lighter (and therefore older) mats also indicate flood or tidal waters have not reached the mat in years past and signal safer nesting locations (Burger and Gochfeld 1992b). Wider mats place nests further away from high tide levels, while deeper mats provide extra height and further reduce flooding potential (Palestis 2009).

There does appear to be some level of habitat partitioning occurring between terns and skimmers nesting on wrack mats (Burger and Gochfeld 1992b). Despite arriving sooner, terns usually nest closer to the edge of mats and spread into the center. Skimmers despite arriving later fill in from the center outward (Gochfeld and Burger 1994).

Wrack mats should be composed of clean, dead, and appropriate vegetative matter (*Zostera* or *Spartina*). Wrack can be transported and mats created artificially or pulled from the shoreline and raked towards the center of the island. Mats should be placed a minimum of five meters (5 m) from the shoreline edge of the island (Palestris 2009). Mats should be a minimum of forty centimeters (40 cm) in depth and reach a minimum width of two meters (2 m) as black skimmers will not nest on mats narrower than this (Burger and Gochfeld 1990).

Placement of wrack mats on either dredge spoil or salt marsh islands should be done with care and consideration of the surrounding vegetation. Wrack should not be placed in a way that it shades out existing vegetation, especially *Spartina* species, as the vegetative structure stabilizes the island and encourages sedimentation (Kolker 2005, Croft et al. 2006, Ray 2007). Artificial wrack mats can be placed on connected wooden pallets and anchored to prevent drifting or removal during flooding events. The additional elevation provided by the wooden pallets may also be a boon during years when wrack is less available.

Wrack is a limited resource and variations in year-to-year availability will present complications for managers. Combining wrack collection (in non-breeding areas) with beach clean-up events can help to make more wrack available for distribution in nesting habitat. Construction or enhancement of wrack mats should be done prior to spring migrations of both terns and skimmers.

HABITAT RESTORATION

Habitat restoration actions require more site preparation and are by their nature disruptive to the preexisting conditions found on site.

It is anticipated that projects involving habitat restoration and the placement of sediments will be initiated primarily by the United States Army Corps of Engineers (ACOE). Partnerships between regional organizations, municipal or state conservation agencies and the ACOE can help facilitate restoration projects through consultation, funding, and staff. Appendix B provides a list of sources for dredged sediments.

These actions should be undertaken previous to and in preparation for the arrival of migrating black skimmer. A minimum of two months prior to the arrival of terns and black skimmers is recommended to allow islands to stabilize (Golder et al. 2008).

BEACH NOURISHMENT AND DUNE RESTORATION

Beach nourishment and dune restoration is not a new concept in New York State. The first beach nourishment project in New York occurred at Coney Island in 1922. By the late 1940s and early 1950s it was widely accepted that soft stabilization methods provided a functionally better method to protect coastlines than hard structures such as seawalls and jetties (Coburn, 2012).

As a result from the impacts of super storm Sandy on New York’s coastline in 2012 a great deal of attention has been focused on beach nourishment, dune restoration, and shoreline resiliency projects. While most of these projects are intended to protect upland property from storm surges, increase recreational areas, and replenish sand lost to erosion (Coburn, 2012) there also exists opportunities to restore beach habitat for both nesting shorebirds and waterbirds.

The key principles to keep in mind when restoring beach and dune habitats for nesting birds are related to the microhabitats that can be created or disturbed in the process of replenishing sediments. While black skimmer prefer to nest in the slightly elevated foredune other species like piping plover rely on tidal pools for foraging (Grippo, Cooper, and Massey, 2007). It is vital to the ecology of the nesting shorebirds and waterbirds to maintain or establish these microhabitats during the implementation of these projects.

For black skimmer it is important to establish foredune habitat at secure distances from mean high water to avoid inundation from regular wave action. Dune height also plays an important role in the morphology of beach width and slope. Taller dunes do not necessarily equate to better dunes (Magliocca et al. 2011).

Lastly, beach nourishment does disturb the macroinvertebrate communities present. While this effect is temporary, when possible nourishment projects should occur outside of the breeding season. This will help avoid any reductions in foraging efficiency with either shorebirds or waterbirds (Grippo, 2007).

Vegetative Community Restoration

Many salt marsh and dredge spoil islands are not currently conducive to hosting skimmer or tern colonies. These islands often have vegetative communities that include invasive species such as *Phragmites australis* or woody vegetation. While skimmers have been known to nest near stands of *Phragmites* it is often to their detriment. Islands that exhibit primarily upland vegetative communities often host small mammals or other avian species that will disrupt or actively predate upon skimmer or their eggs (Burger and Gochfeld 1990). In some instances removal of invasive species and replanting of these areas with native salt tolerant vegetation can create opportunities for nesting skimmers and terns.

The elevation and hydrology of islands being restored should be a primary concern. Without proper consideration of final elevation and hydrology the potential for natural succession to upland vegetative communities is likely (Ray 2007). Salt marsh or dredge spoil islands should contain a greater than twenty percent (> 20%) composition of *S.patens/Distichlis* (Burger and Gochfeld 1990) and be maintained as early successional habitat (Golder et al. 2008). When managing an island for nesting skimmers, close proximity to or additional planting of seagrass communities can provide essential sources of wrack in future years. Marsh islands that are candidates for vegetative restoration should be at least 0.25ha and no larger than 10ha in size. Additionally, islands should be within close proximity to forage areas such as an inlet or sheltered bay (Burger and Gochfeld 1990, Gordon et al. 2000).

Marsh Island Restoration Using Dredged Sediments

While the vegetative composition of some salt marsh and dredge spoil islands is not favorable to nesting skimmers, other islands are disappearing altogether. The subsidence of New York's salt marsh habitat is a complicated matter. It is being driven by a combination of factors including excessive nutrient input, insufficient accretion of sediments, and phyto-toxic levels of sulfides (Kolker 2005). As the effects of sea level rise continues to grow many of these islands may become lost below mean water levels. However, salt marsh islands can be restored and conserved through the supplemental placement of sediments from dredging operations (Golder et al. 2008, Erwin et al. 2003, Urner 1926).

Dredged sediments placed as either thin layer supplements or used for full scale island restoration can counteract island subsidence to either chemical or climate related impacts (Croft et al. 2006).

Additions of sediment up to twenty centimeters (20 cm) in depth have been shown to have little negative impact on previously existing vegetative communities (LaPeyre et al. 2009, Croft et al. 2006). Supplemental sediment placement can favorably alter soil chemistry by reducing sulfides (Mendelssohn and Kuhn 2003) and increasing nutrients while providing extra elevation for nesting waterbirds (Erwin et al. 2003).

Sediment slurry mixes used for waterbird habitat should consist primarily (> 90%) of coarse and medium grained "beach quality" sand to prevent clogging of egg pores (Golder et al. 2008). If available, shell should be added into the slurry mix before spraying. If this is not possible adding crushed shell to the subsidized area after spraying should be done. The addition of shell helps to reduce the speed at which vegetative growth occurs (Mallach and Leberg 1999) and prolong the expected benefits to waterbird nesting. Final grades after sediment placement should be slight, gradual, and site specific. Minimum grades should be 1:30 (3.33% grade or 1.91°) (Golder et al. 2008) and not exceed 1:10 (10% or 5.74°) (Gochfeld 1978, Mazzochhi and Forys 2005) to allow for drainage and no ponding of water. Steeper gradients encourage erosion or runoff related washouts (Coburn et al. 2001). Final elevations should be a minimum of two meters (> 2m) above mean high water (Mazzocchi and Forys 2005) but not exceed three meters (< 3m) (Golder et al. 2008).

Sediment subsidies in proximity to seagrass beds or mollusk reefs should be conducted with extreme care to avoid excessive turbidity during deposition of dredged materials (Golder et al. 2008, Ray 2007).

Projects that involve the placement of dredged sediments on an island with the intent to encourage skimmer nesting should be no smaller than 0.25ha and no larger than 10ha (Burger and Gochfeld 1990). Resulting vegetative community composition should be maintained as early successional (Golder et al. 2008) and contain a mix of greater than twenty percent (> 20%) *S.patens/Distichlis* cover (Burger and Gochfeld 1990) in addition to any other vegetative communities desired. Islands should be not be diked and sediments may require replacement every three to seven (3-7) years (Golder et al. 2008).

SOCIAL ATTRACTION

Projects designed to supplement existing black skimmer colonies or encourage the formation of new ones may find additional support and opportunities through partnerships with federal, state, and municipal conservation agencies or regional environmental organizations such as Audubon or The Nature Conservancy. Proposals for beach or island resiliency projects being developed in the aftermath of super storm Sandy may provide opportunities for skimmer and other waterbird conservation.

DECOYS

The enhancement and restoration of beach and marsh island habitat for breeding skimmers is a great step in the right direction. Getting the birds to utilize the habitat is a separate matter altogether. The use of decoys can increase the likelihood that migrating skimmers see and select the potential habitat for breeding.

Research conducted over the years has revealed nuances of decoy use. Birds are primarily attracted to decoys because they signal the presence of suitable habitat and mating activity (Kotliar and

Burger 1984). As more birds arrive to use the location, social facilitation increases which in turn draws in more birds (Burger 1988).

Decoy use should be based upon the amount of available habitat on site. When areas are capable of hosting large colonies (i.e., along the beach) then more decoys should be placed sporadically throughout the area. Terns were noted selecting larger decoy arrays for nesting and it is believed that the anti-predator, social facilitation, and information sharing benefits of larger colonies drives this preference (Burger 1988).

Decoys should be placed no closer than 2.5m from one another (Burger 1981b) to encourage skimmers to nest in between. Decoys should be arranged both individually and in mated pairs. Mated pairs should be placed within five centimeters (5 cm) of each other. Pairs should not outnumber individual placements. The presence of both individuals and pairs mimics patterns found in newly formed natural colonies. Paired and single decoys signal breeding has occurred but there are still individuals from which to find a mate (Burger 1988).

Smaller islands require more consideration for the number of decoys to be used. Since space is limiting on smaller islands, too many decoys can leave little room for actual skimmers. Decoys should be placed on the outer edges of wrack mats, *S.patens/distichlis* meadows, foredunes, and otherwise not occupy prime skimmer nesting locations. Use of cut-out decoys may reduce the overall footprint that three dimensional decoys occupy. There is no preference for either type.

Black skimmers nest both after and in close proximity to terns. It may be advisable to use common or least tern decoys to help initiate colony formation. Using both tern and skimmer decoys together may also produce desired results. Decoys should be removed at the first signs of egg-laying at the location.

Audio Calls

While decoys can provide initial visual cues to potential nesting habitat they are often unsuccessful in attracting birds if used alone. Using audio cues in addition to visual stimuli can increase the success of social attraction methods (Kress 1983).

Research indicates that playing courtship calls can encourage nesting perhaps better than visual based decoys can. Experiments utilizing various combinations of decoys and audio have shown that nesting can occur with audio only and results indicate a strong preference for nesting downwind of the broadcasting loudspeaker system (Arnold et al. 2011). Audio calls can be set up using solar panels and timing delays to avoid continuous playback. Recordings should be played between 06:00 and 18:00 hours (Kress 1983).

Using both decoys and audio calls can provide the best methodology for attracting nesting waterbirds. Decoys can signal the birds to potential habitat while the audio calls can keep them there. At smaller locations, audio cues alone may be enough draw skimmers to the site (Arnold et al. 2011).

Predator & Disturbance Control

Predator and disturbance reduction strategies are best performed by federal, state, or municipal conservation agencies.

Symbolic Fencing

The use of fencing is a common practice in conservation management to clearly delineate nesting areas or individual nests that may be located apart from the main colony. Symbolic fencing is primarily used to restrict human access into nesting areas. These barriers, which can be constructed with snow fence, flagged string, or temporary wooden fencing, will often suffice in reducing trespass into nesting areas. In most cases the fifty meter (50m) buffer that is required under USFWS piping plover regulations is more than sufficient and will encapsulate nesting black skimmers (USFWS 1996).

Since there is no required minimum distance for placing symbolic fencing around nesting black skimmer (as there is for piping plovers) some general guidance may help local managers. The perimeter should be far enough around the foredune that it does not restrict colony activity and creates enough space so that normal recreational activity does not cause disturbance. In instances where black skimmer productivity is still being influenced by proximity to a disturbance a larger buffer zone should be implemented.

It is advisable to include signage affixed to the fence itself describing why the barrier has been erected. This simple step can help educate the public as well as discourage curious onlookers from venturing too close to nesting birds.

Removal of Artificial Perches

Perches of all shapes and sizes exist throughout the marine environment. Many of these perches are created by tall naturally occurring woody vegetation. Natural perches are often used by other species for roosting or observing prey. However, there are many perches within the marine district that are the result of the construction of docks, landings, and other artificial structures no longer in use. Removal of these remnants can reduce the potential for avian predators (especially raptors) to perch and watch over nesting waterbirds (Murphy et al. 2003b). Continued presence of avian predators in the vicinity of nesting skimmers will often result in the abandonment of the colony. When planning for the restoration of black skimmer habitat, artificial structures that can serve as perches should be removed before migrating skimmers arrive in New York to breed.

Management of Predators

In many cases restricting the access of predatory species can produce desirable results. Some animals however are either persistent or creative enough to thwart protective measures. In some cases problem animals can be relocated (i.e., stray cats through adoption) however, others species present problems. Animal rights, animal control, and rescue organizations may be able to provide some support for dealing with domestic and feral animals (see Appendix C). When relocation is not possible and the impacts of predation are persistent, lethal control may be necessary to protect waterbirds.

Often, the greatest predation pressure is exerted by only a few individuals (Hall and Kress 2008). The use of lethal methods of control can be extremely effective when used with deliberate thought and precision as compared to landscape scale methods to control a predator population (Blokpoel et al. 1997, Cote and Sutherland 1997). Public sentiments also tend to be more accepting of the careful and precise use of lethal methods (Messmer et al. 1999).

The need to survey shorebird breeding habitat (including existing, historic, and potential reintroduction areas) for the presence of predator species is an essential step in the conservation of the black skimmer. Identification of predators, their abundance, proximity, and access routes to breeding locations should be mapped through the use of GIS. This will provide spatial awareness of the potential for negative interactions in existing colonies, identify factors that could prevent establishment of new colonies, and guide decisions on the use of predator control methods.

Best Management Practices (BMPs)

Best management practices or BMPs are simple actions or changes in local policy that can be easily incorporated into everyday operations. BMPs are designed to help reduce the potential for negative interactions between nesting waterbirds and human uses of nearby locations. BMPs should be implemented as appropriate and as local need dictates.

Protective Archways

When it is necessary for the public to cross through or near waterbird nesting habitat protective archways can be constructed to allow for easier and safer access to natural resources of interest. These protective archways can help minimize the likelihood of being struck by diving birds protecting their offspring. This simple feature protects both humans and birds during these events and should be incorporated into any location where human access is necessarily in proximity to nesting waterbirds.

Construction of protective archways is fairly simple with only a few details to keep in mind. Posts should be spaced at equal intervals approximately ten to twenty feet (10'-20') apart. The farther poles are spaced the more likely birds can navigate the structure. Tying string between the tops of archways can further limit diving behavior. Archways should also include anti-predator devices (such as barbs or prongs placed on top of archway posts) to discourage avian predators from perching on these structures near nesting habitat.

Motorized Beach Vehicles

In New York State the use of motorized vehicles is permitted on some beaches. This is to allow for access to isolated fishing locations, police and emergency services, and for maintenance activities. New York's Vehicle and Traffic Law, Article 48-C establishes the rules and regulations for all terrain vehicle (ATV) use in New York. Suffolk County's Local Law 29-1998 restricts ATV use on public lands and requires written permission for their use on private lands. Additionally, the many towns have enacted their own local ordinances regarding off-road vehicle use not just ATVs (for example, East Hampton (§91-5), Shelter Island (§37-6), and Southampton (§111-32). Off-road vehicle clubs may also implement additional practices that members are encouraged or required to adhere to (LIBBA 2012). This section serves to highlight some of those practices and offer additional suggestions that may help further reduce negative interactions between users of the resource and beach nesting species.

FIGURE 16: A 5 MPH POSTED SPEED LIMIT NEAR A STAGING AREA ON NICKERSON BEACH. SEVERAL FLEDGLINGS ARE LOCATED WITHIN THE TIRE RUTS.

Minimizing the number of vehicle paths or tracks especially within areas of known nesting activity can help to reduce accidental vehicle strikes. Delineation of specific pathways through high pedestrian areas (such as active beaches) or within nesting areas can provide additional measures to reduce accidental destruction of nesting birds or their young. Pathways should not follow the wrack line (USFWS 1996). Speed limits along the beachfront should be strictly enforced especially near active nesting areas.

Areas that see frequent use by motorized vehicles should prevent deep ruts from forming as small birds can become trapped (USFWS 1996). Allowing pathways to migrate within a delineated traffic area instead of driving over the same area again and again can reduce the formation of ruts.

Additional lighting, such as fog lights, can help illuminate the sides of pathways and tire ruts. Many waterbird eggs and juveniles are cryptically colored and evolved to be camouflaged in the beach environment. Additional vehicular lighting can help drivers avoid any hidden, stray, or stuck birds.

Areas experiencing severe impacts from motorized beach vehicles on local nesting waterbird populations can additionally increase fines during the nesting season to help reduce these events. If none of these BMPs seem to prevent the loss of birds within nesting areas then as a last resort motorized beach vehicle access can be restricted within the area of concern. The restriction of motorized beach vehicle access should be done on local, site specific instances where the continued use of these vehicles could result in the abandonment or outright failure of a colony.

Enforcing beach traffic laws is a difficult task. It is the responsibility of the beach property owner to enforce traffic laws on their property. Decisions on speed limits, fine amounts, and access permissions are made by their authority. For example, Nickerson beach traffic laws would be enforced by Nassau County, while at Breezy Point the laws would fall to the private landowners, in this case the Co-Op itself. If protected birds are being taken according to definition in Article 11 of NYS Environmental Conservation Law because traffic laws are not being enforced, the state may find the land owner in violation and take appropriate measures.

Supplemental Feeding & Trash Removal

The supplemental feeding of wild waterbird species, black skimmers included should be discouraged at all times and in all circumstances. Whether from well-meaning beach visitors tossing a piece of lunch, locals that maintain a feeding station, or trash left behind at the end of the day, supplemental feeding can create problems. Food given in this manner is not as nutritional as food gathered through natural means. Loss of key nutrients in this way can lead to slowed growth, impair development of healthy bone structure, which is essential for flight, and lead to cognitive disorders especially in chicks (Kitaysky et al. 2006).

Providing consistent and frequent trash removal services at beach access points in close proximity to nesting waterbird habitat is an easy way to help conservation efforts. Additionally, all trash cans should have lids. Gulls, feral cats, and raccoons are attracted to trash receptacles were discarded food can be scavenged. Locations where trash is not removed on a daily basis will often host larger concentrations of animals due to the additional food availability (Ferreira et al. 2011). Larger concentrations of gulls that occur near habitat preferred by black skimmer and tern species increases the amount of competition for already limited nesting locations. The presence of additional predators increases the likelihood of disturbance. Lastly, larger congregations of animals can lead to increased transmission of disease (Horn et al. 2011, Coleman et al. 1997).

Dog Parks & Beach Restriction Periods

Many beaches along New York's coast have in place restrictions for dogs on the beach. These may be as simple as requiring dogs to be kept on leashes at all times. Some beaches additionally limit dog walking on beaches during certain hours of the day. Other locations ban dogs from the beach entirely. The purpose of this section is not to advocate for any one method over another.

As stated earlier, skimmers arrive in New York towards the end of March and into early April. Active breeding begins in late April and continues through August. It is most critical to reduce disturbance during these times.

While it may be necessary to restrict dogs during the breeding period, it is not as essential during the rest of the year. In instances where dogs should be restricted due to nesting waterbirds, it may be advisable to establish separate areas for dogs to occupy. Dog parks for instance can provide a safe alternative at beaches where waterbird nesting activity is occurring. Providing segregated open space where dogs can socialize and recreate off the leash can help to alleviate the inconvenience of restricted beach access during the breeding season.

Domestic and Feral Cats

Both domestic and feral cats can negatively impact the breeding success of waterbird colonies. Since many cats are active during the evening hours allowing them to prowl near nesting areas at night can have dire consequences. Local residents in proximity to active nesting locations can assist conservation efforts by keeping their domestic cats inside at all times (Coleman et al. 1997). Reducing outdoor activity is especially important during the dusk and dawn hours when adult skimmers may be away from the nest to forage (Burger and Gochfeld 1990).

The presence of feral cats near waterbird nesting locations may result in an abandoned colony. Control of feral cat populations within proximity to active nesting locations is an essential part of ensuring the habitat is suitable for nesting activity. Prey availability is a controlling factor in wild animal populations. Many feral cat colonies can persist when prey is scarce because of supplemental feeding. Natural instincts towards hunting however are not suppressed despite the additional food subsidies (Tschanz et al. 2011, Coleman et al. 1997). Feral cat colonies can therefore have more impact on prey species than natural predators. Feral cats can often suppress natural predator populations due to the increased level of competition during times of limited or reduced prey availability (Tschanz et al. 2011, Coleman et al. 1997). As a result, management and control of feral cat colonies is essential for waterbird conservation.

Trap, neuter, and release (TNR) efforts are not always effective in eliminating the entire colony or do so over an extended period of time (Levy and Crawford 2004). Municipalities, animal shelters, or other organizations conducting TNR need to be aware, that returning feral animals to sensitive habitat is counter-productive. The negative pressure feral cats exert on breeding waterbirds may require more immediate control measures than TNR programs can provide.

The use of geographic information systems (GIS) can help with managing feral cat colonies. Creating mapping databases that track feral cat colonies over the years can be a great tool for both conservation managers and animal care advocates. Overlaying sensitive habitat areas with existing cat colonies can help prioritize areas for management and more effectively monitor feral cat populations. The development of a feral animal GIS database will require input from both conservation and animal care stakeholders and can serve as a catalyst for partnership between citizen advocates and governmental agencies.

Ultimately, the best solution for reducing the impact of feral cat colonies is to prevent them from forming in the first place. Continued advocacy and education of spay and neuter programs should be encouraged by veterinarians, animal shelters, and adoption centers, especially near waterbird nesting locations.

For assistance in dealing with an unwanted pet, please contact your local animal shelter to find the animal a new home (see Appendix C).

Firework Displays and Entertainment Venues

Firework displays and entertainment events are an enjoyable part of summertime in New York and Long Island is no exception. However, the potential for negative interactions between black skimmers (all waterbirds for that matter) and these events is very problematic and better planning for is essential.

While it is not the intent of this conservation guide to prevent legal firework displays or other events from occurring it is important to consider the potential for disturbance these venues can create. Event planners should ensure proper placement of staging areas, locations for the viewing audience, and methods for crowd control. Firework staging areas for instance should be placed a minimum of ¾ of a mile away from known nesting areas. Audiences should not encroach in or linger in close proximity to waterbird colonies.

Illegal fireworks detonated in or near nesting skimmers should be reported at all times. Municipalities can assist conservation efforts of nesting waterbirds by monitoring beach nesting areas for the use of illegal or un-regulated fireworks.

Restoration or enhancement projects that occur near known entertainment venues should exercise extra caution and plan strategies to mitigate both the event itself and the secondary effects of increased visitors viewing the display. A map has been provided which highlights frequent areas for annual firework displays near waterbird nesting habitat (see Appendix E).

Monitoring Tasks

LICWPP Survey

The Long Island Colonial Waterbird and Piping Plover (LICWPP) survey is conducted annually for plovers, terns and skimmers. During the survey two visits are made to numerous island and beach locations throughout New York’s marine district. The survey window for terns and skimmers generally runs from the last week in May through to the end of June (Litwin et al. 1993).

Black skimmers usually attempt first egg-laying between mid-May and mid-June (Burger and Gochfeld 1990). While two visits are made as part of the survey, the first visit can occur before skimmers have actually begun to nest in a particular area. The LICWPP survey averages the counts from both visits made during the window. As a result, locations where skimmers nest later in the season will be underestimated by this survey.

Despite this timing issue, the LICWPP does provide valuable insight into waterbird nesting activity throughout New York. Extending the survey window by two additional weeks and incorporating another count of terns and skimmers seems like a simple solution however adding a change to the current methodology for data collection will further complicate statistical relationships within the data set. It may instead be advisable to re-survey any location that did not initially indicate nesting activity but did during the subsequent survey visit.

Since the LICWPP does not include any measure of breeding success it is perhaps a better solution to add a new survey window entirely. Conducting a survey towards the end of the breeding season after most hatchlings have fledged will allow for the collection of breeding productivity data. An end of season window would minimize disturbance to the colony and reduce the potential for aggressive parental behavior from protecting hatchlings. After fledging, juveniles often accompany adults to loafing areas. During these times skimmers can be easily counted (Burger et al. 1994). Providing the ratio of adults to juveniles can provide valuable information on breeding productivity and provide insight to the sustainability of New York's black skimmer colonies. Since skimmer chicks are sexually dimorphic (Schew and Collins 1990), additional information could be gathered on the ratio of males to females. This additional survey window would be exclusive to black skimmers due to the ability to distinguish adults from juveniles, males from females, and because of the limited number of colony locations.

Lastly, a population trend analysis should be done on all species surveyed under the LICWPP. This analysis should include and identify any patterns associated with breeding abundance, number of colonies per species, shifts in habitat selection, and any nesting habitat that has been lost. Comparing data and trends from the LICWPP with existing bird conservation areas (i.e., Important Bird Areas) can further guide management, planning, and policy decisions throughout the marine district. With predictions of changing climate, sea level rise, and continued human expansion waterbird populations will be a direct indicator of the health of our coastal resources for years to come (Brinker et al. 2007).

PHOTO INTERPRETATION AND TECHNOLOGY

Under current LICWPP survey protocols the counting of birds is done by flushing birds out of their habitat. Counts are made while the birds are airborne. Surveys conducted in this manner can result in either over- or under-estimating of individual birds. Observer error factors heavily into these types of aerial/flushing surveys (Frederick et al. 2002). Flushing does not guarantee all birds take to wing, cannot account for individuals away from nesting habitat, and ultimately perhaps most importantly disturbs the colony.

While this method has served its purpose throughout the years, it is often necessary to flush birds more than once to get accurate counts. With recent advances in optical and electronic technologies, digital cameras can produce high resolution images with no need for processing. Taking high resolution photos after flushing instead of (or in addition to) making airborne count estimates can reduce observer error and provide more accurate numbers for the survey. Photo interpretation of images taken after fledging can additionally be used to make distinctions between juveniles and adults. This additional piece of information can then be archived and a photo record of annual site specific nesting can be created and referenced over time.

Remote Sensing Pilot Survey

As future photographic technology continues to advance opportunities to use cameras near (remote sensing) or perhaps within a colony (webcam decoy for instance) may become feasible. Using photographic technologies to identify colony predators, document re-colonization efforts, or to monitor breeding success can all lead to better decision making in management efforts. The feasibility, practicality, and effectiveness of collecting photographic data to survey black skimmer populations will be investigated.

Using remote sensing techniques the agency will conduct a pilot study using an unmanned aircraft system (UAS). This survey will be conducted with full accord of existing and future Federal Aviation Administration (FAA) regulation and policies governing the use of UAS. Additionally, the United States Fish and Wildlife Service (FWS) will be consulted regarding concerns of endangered species that inhabit the shoreline such as piping plover (*Charadrius melodus*) and red knot (*Calidrus canutus*). This will include maintaining a 200m kite flying buffer around plover nests and ensuring that red knots are not in the area at the time of the survey. Initial test flights will use decoys after black skimmer have begun migrating back south for the winter to avoid any potential disturbance during the breeding season.

If successful, UAS will be incorporated as appropriate throughout the implementation of the conservation management plan and their use will be extrapolated for other waterbird species. The potential for monitoring methods using other camera technologies will additionally be explored if possible.

Beach Stewards

Placement of seasonal beach stewards at skimmer nesting colonies can provide many benefits. It allows for the consistent documentation of the type, timing, persistence, and severity of disturbance events (natural or otherwise) that occur within proximity to colonies. The presence of a steward may deter many anthropogenic sources of disturbance from occurring in the first place. Beach stewards can provide immediate answers to conservation questions raised by residents and vacationers and help educate the users of the resource prior to potentially detrimental behavior. Additionally, beach stewards can record the timing of breeding events such as dates for, nest initiation, first hatch, first fledge, and last fledge.

Research Needs

Habitat Suitability Mapping

One of the best ways to provide insight on where to conduct activities such as habitat restoration is through the mapping of environmental variables. GIS offers a way to locate the existing landscape conditions that are suitable for black skimmer nesting as well as highlight areas where important factors may be impaired or missing altogether.

Many of the relevant environmental variables that are selected by breeding black skimmers have already been identified and are explained within the natural history section of this document. By analyzing existing terrain conditions for spatial patterns including elevation, slope, areal extent, vegetative cover, sand grain size, fish abundance/distribution, proximity to forage areas, nutrients, contaminants, impervious surface, and building density potential opportunities for re-establishing or creating new colonies can be determined.

Habitat suitability maps will be created to help guide governmental agencies, municipalities, and property owners in understanding where habitat conditions are favorable, can be restored, or are not conducive to black skimmer breeding and colony formation.

Before using social attraction methods to initiate a black skimmer colony however other information needs to be factored in. This includes identification of nearby predators natural or domestic, understanding existing land use and potential conflicts, as well as establishing any maintenance or monitoring protocols.

Rooftop Nesting Pilot Study

Black skimmers and terns have been using rooftops as alternate nesting locations along the coast of Florida where beach habitat has become severely limited (Langridge and Hunter 1986). Many of the rooftops being used by waterbirds in Florida were built prior to the 1970s. These rooftops are characteristically flat and constructed with gravel instead of shingles. The first documented rooftop nesting attempt made by black skimmers was in 1975 (Greene and Kale 1976). Rooftop nesting has become a viable alternative for Florida's colonial waterbirds. In 1990, rooftop nest locations accounted for more than half of all least tern nest locations and seven of twelve skimmer colonies in Florida's northwest (Gore 1991). By the year 2000 rooftop nesting of least terns accounted for 75% of all colonies and approximately 83% of the nests (Forys and Borboen-Abrams 2006). In 2003, all black skimmer nesting in southernmost Florida occurred on rooftops (Zambrano and Smith 2003).

Research conducted by biologists in Florida has highlighted the benefits that terns have experienced as a result of nesting on rooftops. Breeding success rates for terns on rooftops is double when compared to beach nesting terns. Reasons for success are attributed to the increased levels of protection rooftops afford nesting birds due to seclusion and limited mammalian predator access (Fisk 1978). While the flooding potential from high tides or storm events is almost eliminated, drainage on flat roofs is a concern (Fisk 1978).

While terns have seen increases in hatching and fledging rates, black skimmers in contrast exhibit lower success rates than when compared to nesting in natural environments (Gore 1987). The primary reason for this lack of success, despite the additional protections seems to be the gravel substrate itself. The gravel is too coarse and too shallow for black skimmer nests (Greene and Kale 1976). Additionally, when an adult skimmer creates a scrape in the shallow stones it can expose the underlying tar paper. When light colored eggs are laid upon the black tar paper they become highly visible and susceptible to avian predators such as crows and grackles (Greene and Kale 1976). Avian predation is responsible for many of the losses of rooftop nests. Providing hiding spots and shelter will be a necessary component of successful rooftop colonies (Voigts 1999, Coburn et al. 2001).

Tar paper also becomes sticky as it heats under summer temperatures. Adult skimmers can accidentally puncture egg shells while rearranging the nest because the eggs have become stuck in the tar (Gore 1987). The weight of incubating adults pressing down upon eggs that rest upon unforgiving gravel or roof surfaces can crack eggs too. Wind may also dislodge eggs in shallow rooftop nests (Gore 1987). While these conditions are not ideal for nesting skimmer there are simple adjustments that can be made to compensate for these identified problems.

Studies conducted in Florida on rooftop nest characteristics revealed that there are only a few reasons why certain rooftops are not selected for nesting. Primary among them was distance to the nearest forage area; shorter distances are favored. Rooftops being used as habitat are often well inland and heights of the selected rooftop (including those in proximity to the nesting rooftop) seem to matter little. The rooftop should be free and clear of adjacent trees and other structures that may allow mammalian access to the rooftop habitat. Minimum roof size (or combination of nearby rooftops) should be approximately 0.02 ha or 200 m^2 (Forys and Borboen-Abrams 2006).

Given the increased levels of rooftop breeding success in terns in Florida, it is recommended that a rooftop nesting habitat pilot study be undertaken in New York. Specifically, at least one rooftop along New York's coast, in close proximity to a forage area (bay or inlet) should be converted to support nesting waterbirds. Substrate should be at least four centimeters (4 cm) in depth comprised of small sized (less than 16 mm) gravel or shell (Coburn et al. 2001). Methods should be explored to minimize wind throw of substrate materials. Finer substrate materials may be more prone to wind scour and layering of substrate materials may provide the best nesting bed while reducing loss to winds.

Fences or other barriers should be constructed along the perimeter to prevent wandering hatchlings from falling from the rooftop. Barriers need be at least six inches (6") tall (Coburn et al. 2001). Additionally, some form of cover should be provided to create shade from direct sunlight and shelter from avian predators. Appropriate materials could include PVC pipes, wooden pallets or boards, masonry blocks, (Fisk 1978) or shallow rooted vegetation could be planted using green roof planting techniques.

Rooftop drainage is an essential part of rooftop nesting. Roofs should include a slight rise or pitch to the surface to minimize standing water potential. All drainage pipes and openings should be screened (Fisk 1978, Coburn et al. 2001). Rain barrels, rain gardens, or other green infrastructure stormwater technology can be used to capture the nutrient rich roof runoff.

Rooftop nesting activity will need to be closely monitored at all times. Non-intrusive observation could be accomplished through remote periscope or camera placement. Cameras capable of broadcasting to the internet may expand the amount of potential viewers and be an excellent way of educating and fostering stewardship in residents and resources users.

Projects located in close proximity to tidal wetlands or Coastal Erosion Hazard Areas (CEHA) may require additional permits or variances and local regulatory agencies will be consulted during the early planning stages of a rooftop habitat pilot.

No current rooftops have been identified however habitat suitability modeling techniques may be able to help locate potential locations for this pilot study. By its very nature this management action will not be able to be conducted solely by NYSDEC staff and will require multiple partnerships including a willing property owner(s) and consulting engineers. Despite the intent of this section, the NYSDEC will always favor natural habitat over artificial supplementation to habitat.

Skimmer Banding Survey

There is some evidence that black skimmer populations in New York are being supplemented by populations in New Jersey. Specifically, black skimmers that hatched and fledged in New Jersey are coming to New York to breed (Burger et al. 1994). There are two hypotheses that should be explored to determine if this observation is valid. First, that New York breeding success rates are lower than New Jerseys productivity rates. Second, that breeding habitat is so limited in New Jersey that young skimmers need to move to New York to find nesting locations. Conducting a black skimmer bird banding survey to study population interactions between the New York and New Jersey populations will help reveal the nuances, disparities, and dynamics of the entire New York/New Jersey breeding area.

When coupled with the additional methods recommended for collecting breeding productivity data these two actions should provide valuable insight into overall black skimmer breeding ecology in the New York/New Jersey nesting habitats. The banding survey will need to be a dual state partnership. Black skimmer chicks would need to be banded in both New York and New Jersey prior to fledging. Banding tags should be color coded and easily readable from a distance to minimize further disturbance. Monitoring for returning birds would need to occur over the course of at least three full breeding seasons (starting the following year) to ensure that banded birds will have reached sexual maturity. Banding tags are not the only method available to monitor the movements of birds. Patagial tags, neck collars, or GPS transmitters could also be utilized as tracking methods.

Due to the limited number of skimmer colonies, extreme care should be exercised during the banding effort. Banding should occur quickly by the fewest number of biologists required to efficiently mark and record identification information. Hatchlings should be banded at approximately three weeks of age just prior to fledging (Burger 1980).

Trophic and Contaminant Surveys

Black skimmer reproduction and chick survival is directly related to the nutrients consumed while residing in New York. Both the quality and availability of forage species influences the probability of chicks fledging (Monticelli et al. 2007). The abundance, size, and nutritional value of forage species is directly related to primary production cycles within the water column (Borstad et al. 2011). Monitoring the flow of energy and nutrients through the food web from primary production to secondary consumers on up to black skimmers is a way to connect multiple ecological processes (Heath et al. 2009). To understand more fully how these separate environmental events interact and influence the whole system, several surveys will be required.

Each step is described individually below. It is important to note that if possible these surveys and assessments should occur in conjunction or overlap as closely as possible temporally. However, not all of trophic and contaminant survey recommendations are within the scope of the Black Skimmer Conservation Management Plan. Both the stable isotope and toxin and contaminant actions should be performed by an external partner such as a federal, state, or local governmental agency, regional non-profit conservation organization, or an academic institution. They have been included to acknowledge the need for this information and to illustrate its potential for use in the management of coastal species.

Distribution and Abundance of Forage Species

Biological surveys conducted throughout state watersheds during the 1930s included an assessment of Long Island's salt water habitats (Daniels 2011). Led by the state's Conservation Department in 1938, the sampling occurred at 238 locations in Nassau, Suffolk, Queens, and Kings Counties. Another biological survey was conducted in 1954 but only included Nassau and Suffolk counties. Remarkable changes in landscape, development, and water quality have taken place since those earlier surveys were completed (Panek 1984). The NYSDEC has been conducting a seine survey since 1985 and collecting physical data along with the survey since 1998. This effort however has been concentrated in western Long Island.

Conducting another assessment of shoreline aquatic resources across Long Island and the five boroughs of New York City would re-establish a baseline for the distribution and abundance of marine and estuarine forage species. If possible, existing surveys should be expanded throughout the marine district. In 2010, a graduate student at Queens College initiated a forage species survey primarily in Nassau and Suffolk counties with some additional sites in and around Jamaica Bay. These data sets, survey analyses, and methodologies can form the foundation of assessing forage quality for black skimmer.

Data collected during these surveys will be compared to the 1938 and 1954 inventories. Changes to or losses of habitat should be cataloged and mapped along with sampling data using GIS software. A GIS database will be developed by the NYSDEC for use by conservation managers in these marine and estuarine environments and incorporated into black skimmer habitat suitability models.

Chlorophyll a, Sea Surface Temperature, and Wind

The use of physical and biotic factors as a general predictor of environmental processes has a long and developed history (Monticelli et al. 2007). Sea surface temperature (SST) for instance is often used to predict ocean productivity (Borstad et al. 2011) while chlorophyll *a* concentration is a direct measure of primary productivity (Monticelli et al. 2007). Comparing historic chlorophyll *a* concentrations with both wind and SST data over the same period (minimum ten years) can reveal patterns or influencing factors that impact the timing of spring algal blooms (Borstad et al. 2011). This information should be analyzed along with local species data such as skimmer productivity and forage fish abundance which can further refine the predictive power of these parameters for New York's marine ecosystem. For instance, the timing of spring algal blooms can be influenced by both SST and winds (Borstad et al. 2011). Early onset of spring blooms will make more food and nutrients available to primary and secondary consumers (zooplankton and finfish respectively). This in turn equates to larger egg masses (Monticelli et al. 2007), higher rates of growth, and increased survivability in forage fish species (Borstad et al. 2011). Abundant supplies of more nutritious forage fish in turn equates to larger clutch sizes, higher rates of chick growth, and increased survival in piscivorous waterbirds (Gordon et al. 2000, Erwin 1977a).

The timing of seasonal wind patterns, date of first algal bloom, abundance and size of forage fish, or the number of chicks fledged could all be used to develop an annual index of harbor and bay productivity. Incorporating commercial and recreational fisheries data into this analysis is a logical progression and should be directly applicable. Using black skimmer productivity information in conjunction with fisheries data will also highlight shifts in harbor health that can be attributed to climate change processes (Heath et al. 2009). Additional connections may be possible using pinniped (seals) abundance data such as count surveys taken at haul out areas.

Much of the satellite imagery required for this analysis is freely available through online resources such as NASA's Earth Observatory website.

Stable Isotope Signatures

The stable isotopes of carbon (^{13}C) (Hobson and Clark 1992a), nitrogen (^{15}N) (Weinstein et al. 2012), and sulfur (^{34}S) (Hobson 2009) have been used to establish linkages between primary production, primary consumers, and secondary consumers. Through the development of isotopic signatures for phytoplankton, benthic algae, macrophytes, and particulate organic matter (POM) (Weinstein et al. 2012, Grimaldo et al. 2009) coupled with species signatures and tissue fractionation rates for consumers (Hobson 2009) (both forage fish species and black skimmers) many details of New York's marine food web can be revealed (Hobson 2009, Hobson and Clark 1992b). Due to the complexity and dynamic nature of marine systems multiple isotopes should be used to develop signatures (Hobson 2009). This is to establish extra isotopic characteristics that can be used to further distinguish locations and species.

Establishing stable isotope signatures for ^{13}C, ^{15}N, and ^{34}S, throughout the marine district will require extensive sampling (Hobson 2009). As a result it may be necessary to develop isotopic signatures in smaller geographic areas such as Jamaica Bay or Great South Bay. Focusing initial attention on these areas can help capture the majority of black skimmer foraging habitat.

Several tissues including blood, muscle, liver, feather (Hobson and Clark 1992a) and egg samples (Hobson 1995) can be used to analyze waterbird isotopic signatures. Turnover and half-life rates of isotopes vary according to the tissue sampled. For instance, in quail liver tissue ^{13}C turnover rates are approximately 2.6 days, while bone collagen has a half-life rate of 173.3 days (Hobson and Clark 1992a). As such the use of a particular tissue can relay information on various time scales of diet. Use of feathers and eggs may prove especially valuable for understanding contaminants in juvenile skimmers. Egg formation (Hobson and Clark 1992a) in females and feather growth (Hobson 2009) of chick primaries will be directly related to the nutritional quality of food derived from local resources (Hobson 1995). Blood and feather samples do not require lethal methods for collection (Hobson and Clark 1992b). Carcasses may become available after severe climatic events or extreme tidal surges and should be collected immediately following the event. When carcasses do become available they can be used to collect hard tissue samples (ex. feathers or claws). Depending on the state of decay of the carcass some soft tissue samples (ex. muscle and liver) may still be viable but care should be taken to thoroughly wash dirt and other contaminating agents clean from the carcass. Tissues in an advanced state of decay or infested with invertebrates should be avoided (C. Herbert, Environment Canada, Sept 2012, Pers. Comm.).

Finfish sampling material for this analysis can be collected in conjunction with or in addition to abundance and distribution sampling (see Distribution and Abundance section above) of marine and estuarine forage fish. Fin clips and scales can often suffice for collecting biologic samples for use in stable isotope analysis (Kelly et al. 2006). As such, lethal collection may not be necessary or tissues can be taken from samples collected for contaminant and toxin analysis (see Contaminant and Toxin Assessments below).

Contaminant and Toxin Assessments

The potential for bioaccumulation of contaminants and toxins within black skimmers nesting along New York's coast is a complicated matter. Certain areas are more toxic than others just as certain substances are more hazardous than others. Understanding both the chemical gradients as they occur across the landscape as well as the effects (and potential for accumulation) of particular chemical substances will have vast management application.

Levels of mercury (Hg), lead (Pb), cadmium (Cd), and chromium (Cr) should be assessed across the entire marine district. Organic compounds such as PCBs, dioxins, and furans also need to be included. Sampling material from the black skimmer should include feathers, eggs, and carcasses when available. Collection of biological samples of finfish should occur (if possible) during the abundance/distribution and stable isotope surveys described above.

Having a better understanding of the distribution, concentration, and potential for bio-accumulation of contaminants in fish that comprise the black skimmer's diet will allow for better understanding and therefore better decision making in marine conservation. Coupling large scale biological sampling with chemical analysis of collected specimens for the presence of contaminants and toxins would complete the nutritional and chemical cycle of black skimmer foraging. Analyzing the bottom-up ecological, nutritional, and chemical parameters of black skimmer predator/prey relationships can isolate the factors that influence both fish and avian communities within New York's marine environment.

Monitoring Sedimentation and Sea Level Rise

Understanding how the separate but connected processes of sedimentation and sea level rise influence the resiliency of New York's salt marsh islands is absolutely vital for future conservation of these resources (Erwin 2006). Complex interplay between eutrophication, natural erosion, sediment budgets and recharge events, levels of sulfides, sea level rise, and vegetative community structures has resulted in much debate over the primary drivers of marsh island subsidence (Kolker 2005). While one set of factors may explain why one island is subsiding, a neighboring island may be relatively stable or disappearing for different reasons altogether.

Monitoring sea level rise and collecting sediment data occurring at the local level can be compiled and analyzed for region-wide trends. Placement of sediment elevation tables (SET), tidal gauges, and other water quality data collectors (surface and bottom temperature, salinity, dissolved oxygen, and chlorophyll *a* levels for example) should be encouraged throughout New York's marine district. Monitoring the sedimentation patterns influencing individual and groups of islands is a crucial step in properly mitigating or reversing any loss of habitat.

Injured Shorebird Reporting System Pilot Study

Injury to black skimmer and other water/shorebirds whether caused by beach vehicles, water craft, or wild and domestic animals is difficult to assess. This is due to many issues but they could include both natural and logistical reasons. A natural cause for instance, may be the removal of a carcass by a predator or scavenger before it is ever noticed by a local site manager. Likewise, logistically there is no requirement for an animal rehabilitator to notify anyone when they receive an injured animal.

As a pilot study the NYSDEC will establish protocols for a more formalized reporting system. This may involve creating a hotline style call-in system for stakeholders or citizens to report injuries as well as requesting wildlife rehabilitators to notify the agency when a water/shorebird has been taken in for care.

Establishing a record of where these events are happening, the sources of injury, and the severity of injuries can be tracked using GIS or other database. This in turn can allow for better site management. For example understanding where vehicle strikes are occurring or when predation pressure is increasing can allow for targeted education efforts to be increased, mitigation solutions enacted, or help focus enforcement efforts.

OUTREACH ACTIONS

BEACH EDUCATION AND MUNICIPAL COORDINATION

On an annual basis the NYSDEC will conduct educational outreach to both municipal organizations that operate in proximity to nesting black skimmer as well as provide educational materials to beachgoers and other recreationalist in the vicinity. This outreach will focus on black skimmer nesting behavior but should be applicable to all nesting birds. It will explain why certain actions are being taken to conserve this species in New York, how those affected can help, and provide a forum for open discourse.

A presentation will be given to municipal operation crews, such as beach maintenance personnel, lifeguards, and others that conduct business along the beach during the breeding season. This will help educate new employees and help refresh returning employees to the needs of the black skimmer. This will also allow the municipal groups an opportunity to voice logistic concerns regarding their operational issues. Conducting annual outreach in this way facilitates a dialogue and allows management actions to adapt to seasonal needs.

The agency will also develop an educational flyer for beachgoers and other recreationalists that may come into contact with breeding black skimmer. The flyer will provide an explanation of the major issues that threaten successful breeding and provide both passive and proactive ways that the public can help with ongoing management efforts.

The flyer will generally be made available at beach and water access locations throughout the marine district but will targeting areas where black skimmer activity occurs.

INTER-AGENCY COORDINATION

The NYSDEC will take the lead to facilitate and formalize inter-agency cooperation between all municipal, federal, and non-profit organizations involved in the management of black skimmer in New York State. This will include encouraging communication between neighboring states such as New Jersey and Connecticut as well. Establishing a link between these organizations will allow for better sharing of methods, data, increase available staff and resources, and provide better management for the black skimmer as a whole.

Beach Clean-up Blog

Over the years many recreationalists, user groups, volunteers, and environmentalists have teamed up together and organized a beach clean-up event. Many of these events take place in locations that are considered local favorites, often see more frequent use, and are generally more accessible to the public. Whether for a day or over the course of the season, beach clean-ups are an inexpensive way to give back to the environment. These activities should be encouraged and if possible formalized.

Internet and social media technologies can be easily used to provide individuals or groups of volunteers with information on the scheduling, planning, or completed beach clean-up projects. Creating a centralized forum for the organization of annual beach clean-up projects along New York's coast can help expand the effectiveness of these efforts. Access to information on the locations where clean-ups have occurred, where future clean-ups will be conducted, and how to join the effort can help bolster volunteers and make these events more successful.

While this effort is beyond the purview of the NYSDEC, the agency does encourage non-profit stakeholders and other concerned citizens to consider this as a marketing strategy for their events. Beach clean-up events benefit more than just black skimmer and other nesting shorebirds. Other beach breeding species such as horseshoe crab can also benefit from this effort. In the long run, we all benefit from clean beaches.

Posting Conservation Signs

Posting signs near locations of sensitive habitat or where management actions are taking place is a common practice in environmental conservation. Signs and the information presented can benefit the management of species in several ways. First, it helps to satisfy the curious nature of people. Providing information that is clearly visible and easily accessible can prevent accidental intrusion into conservation areas and helps to foster stewardship of the resource being protected. Secondly, it is an opportunity to provide contact information to local authorities in case of emergency or to report an observation. Signs can be used to provide notice of local rules and ordinances or alert the public to an immediate threat they should be aware of. In some cases this may include potential legal action for violating the posted notice. Messages contained within conservation signs should be simple, concise, and to the point. Signs should be multi-lingual or use clear symbology.

Lastly, it may also be advisable to post signs welcoming visitors and resource users to the property. Providing a contrast to signs that restrict behavior can remind people that they too are appreciated and welcome to responsibly enjoy the natural setting. The following section provides additional guidance on placing signs for the express benefit of waterbird management.

Post Signs in Advance of Changes

Whether conducting a management action or implementing a local rule, posting signs in advance of the proposed activity or onset of a new ordinance can provide an adjustment period for visitors to the property. Early notification of future changes to locations can help foster stewardship and interest, encourage volunteers to help, or provide adequate time to get accustomed to behavioral changes before laws or regulations begin.

Post Signs with Symbolic Fencing

Symbolic fencing is frequently used to delineate the nesting areas of waterbirds when the purpose is to restrict human access. Symbolic fencing in this regard is little more than a colored or flagged string stretched between fence posts. It is good practice to incorporate signs as part of the fence (ex. on fence posts). Providing easily accessible information as to why the fence was placed can reduce accidental intrusion, foster stewardship, and satisfy the curious. Additionally, as the season progresses symbolic fencing can become weathered, worn, and can break during storms or in high winds. Having signs affixed to fence posts can help to maintain the integrity of the fence during these times. In instances when the primary purpose is to restrict public intrusion, conservation signs posted in close enough proximity can serve as a fence without the need for actually enclosing the area. This method will not suffice to restrict access by domestic or wild animals.

Locating Conservation Signs

It is common practice to place conservation signs within close proximity to the habitat being protected or where management actions are taking place. This is often an effective strategy for relaying information. There are however, many opportunities for providing awareness to conservation efforts that may also prove valuable. Placing additional signs or providing informational flyers where users of the resource frequent can extend the reach of the intended message. For example, providing conservation information at marinas, bait or surf shops, and restaurants with waterfront views can help educate a larger segment of the population than site specific signs alone.

Spay/Neuter, Animal Adoption, and Animal Rescue Signs

Providing information regarding the issues and potential conflicts between domestic and wild animals to pet owners and veterinarians can also benefit conservation efforts. Having information regarding spay/neuter awareness, adoption, and rescue services accessible at pet stores, veterinary offices, animal shelters, as well as beach access points and locations of feral cat colonies serves the environment in two ways. First, it is a proactive method for disseminating information on the ecological impacts of feral or stray animals. Second, having animal adoption service information easily accessible at locations of current or previous cat colonies can serve as a final line of defense for the prevention of animal abandonment.

Black Skimmer Specific Conservation Signs

The agency will explore the need for black skimmer specific signage much like existing signs for piping plover and tern species. This will also be an opportunity to provide contact information for the injured shorebird reporting system pilot study mentioned in the research section of this plan (see page 53). If determined to be of value, the signs will be located at sites with nesting black skimmer as well as any new sites where colonies are being formed either naturally or through the efforts of this management plan.

Distribution of Conservation Management Plan

Electronic copies of the Black Skimmer (*Rynchops niger*) Conservation Management Plan were distributed to local, state, and federal governmental offices as well as many stakeholder organizations throughout New York's marine district during the public comment period (July 16 thru Sept 2, 2014). Additional copies will be made available to the NYSDEC Research Library in Albany, NY. An electronic version of the conservation guide can be downloaded from the Black Skimmer Fact Sheet web page (see below).

BLACK SKIMMER FACT SHEET

The Black Skimmer Fact Sheet is available on the New York State Department of Environmental Conservation web site. The fact sheet provides a brief description of the black skimmer, its life history, distribution, status, and examples of management actions. A link to the full conservation guide is also available for download in a .PDF format. The web address for the fact sheet is:

http://www.dec.ny.gov/animals/79513.html

IMPLEMENTATION OF CONSERVATION ACTIONS

Some of the actions being recommended within the Black Skimmer (*Rynchops niger*) Conservation Management Plan are currently being undertaken by government agencies, site managers, municipal departments, and academic institutions. There are many recommendations however that are not currently being implemented. It is the intent of this document to guide the actions of the NYSDEC and other partners in the conservation of the black skimmer and their nesting habitat in New York State.

The actions described within this document are intended to be accomplished over the next five years. During this time the NYSDEC will dedicate staff resources tasked with the completion of many of the black skimmer conservation actions. Initial focus will revolve around onsite and GIS analysis of skimmer habitat, development of protocols for productivity surveys, and investigating skimmer sighting reports. Additionally, outreach and educational support will be provided to municipal governments, local property owners, and other stakeholders by NYSDEC staff regarding skimmer BMPs and conservation efforts.

There are however certain aspects of the plan that will require coordination between the NYSDEC and external organizations. This can take the form of staff support or regulatory permitting. For example, experimental remote sensing and photographic survey methods (page 43) will need to comply with the USFWS piping plover regulations as well as FAA regulations.

The New York and New Jersey banding survey (page 46) will require a joint partnership between the NYSDEC and the New Jersey Department of Environmental Protection. Additional support for the project will be provided by NYC Audubon, NJ Audubon, and Rutgers University.

Habitat restoration projects (pages 35-36) that involve the placement of sediment either to nourish eroded beaches or stabilize marsh islands for the benefit of black skimmers will require consultation between the NYSDEC, the Army Corp of Engineers, and local municipalities.

The first two sections of the trophic survey (pages 47-48) can be accomplished through NYSDEC staff resources. However collecting stable isotope (page 48) or contaminant and toxin (page 49) data are beyond the current capacity of the state's resources. Local conservation organizations, other governmental agencies, and academic researchers can assist conservation efforts by collecting and sharing this type of data.

The monitoring of sea level rise (page 49) across the marine district is currently being undertaken by several environmental organizations. SET sites have been established for example by both the NYSDEC and NYC Parks Department. SET surveys should be as comprehensive as possible. By the continued placement of SETs in various places along New York's coast and the sharing of results between organizations a better understanding of New York State's resiliency to sea level rise can be gained.

Lastly, the pilot rooftop habitat action (pages 44-45) will require multiple partnerships. It is anticipated that coordination and consultation will need to occur between the NYSDEC, a local property owner, and environmental engineers. Additionally, funds for this project may need to be generated through a competitive grant application.

Over the next five years the NYSDEC intends to be the primary facilitator of the conservation actions outlined within this plan. However, successful completion will require a complete effort by not only the NYSDEC but the many other concerned partners, consultants, and organizations across the state. By working together we can ensure a persistent and stable population of breeding black skimmer in New York for generations to come.

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APPENDICES

APPENDIX A: BLACK SKIMMER BREEDING STATISTICS

TABLE 1: THE NUMBER OF ANNUAL BLACK SKIMMER COLONIES AS RECORDED DURING THE LICWPP. THE MEAN AVERAGE NUMBER OF COLONIES PER YEAR IS APPROXIMATELY TEN (10).

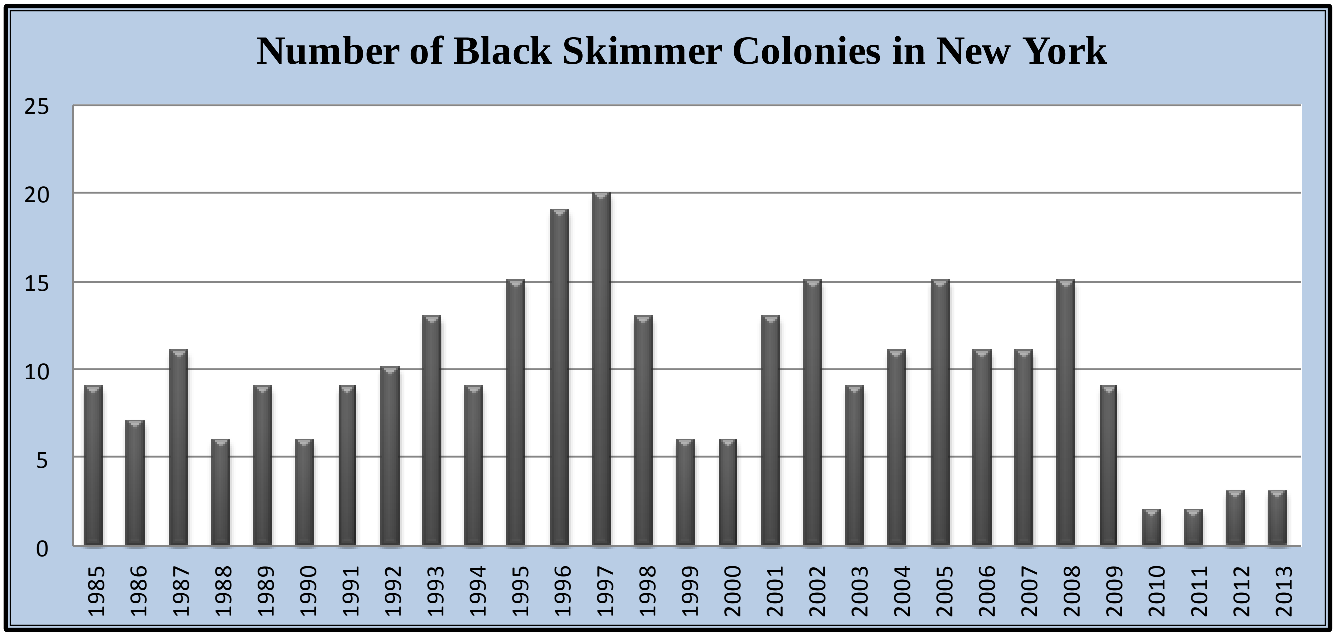


TABLE 2: THE NUMBER OF ANNUAL BREEDING PAIRS OF BLACK SKIMMER AS RECORDED DURING THE LICWPP. THE MEAN AVERAGE NUMBER OF BREEDING PAIRS IS APPROXIMATELY 494.

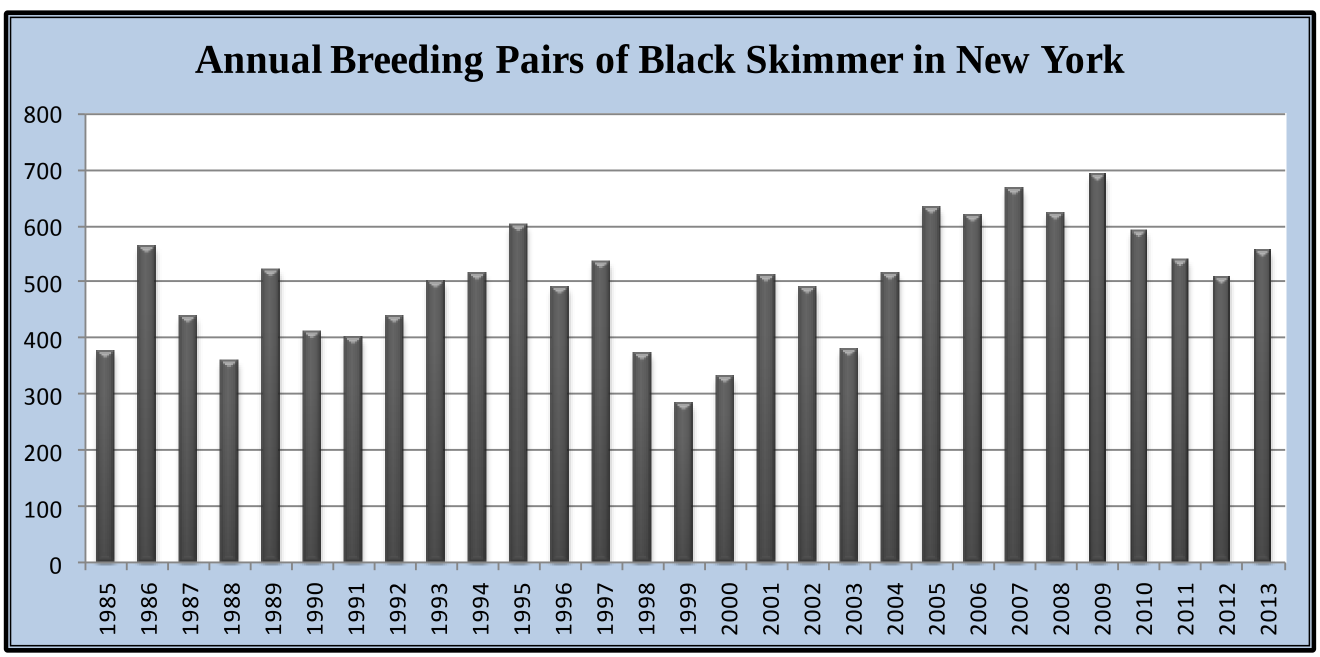


TABLE 3: AVERAGE NUMBER OF BREEDING PAIRS BY COLONY LOCATION ACCORDING TO THE LICWPP FROM DATA COLLECTED FROM 1985-2013.

TABLE 4: FIVE YEAR MEAN AVERAGE NUMBER OF BLACK SKIMMER COLONIES. THE MOST RECENT AVERAGE (2009-2013) IS 3.8 COLONIES PER YEAR.

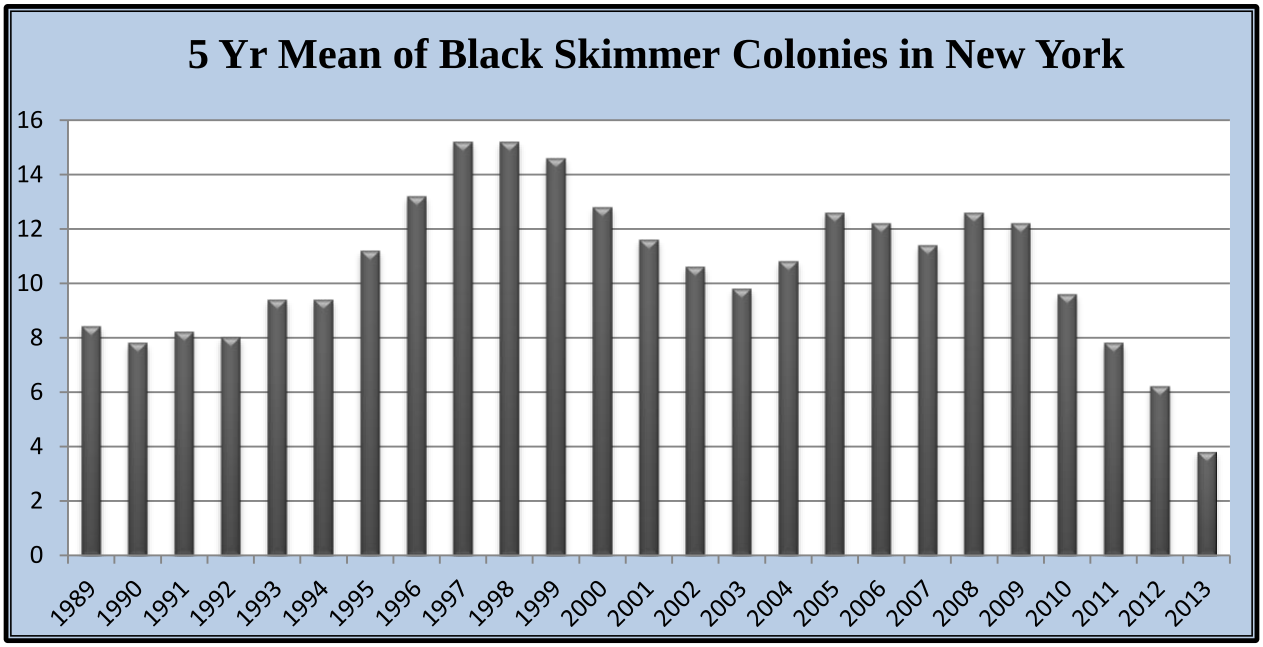
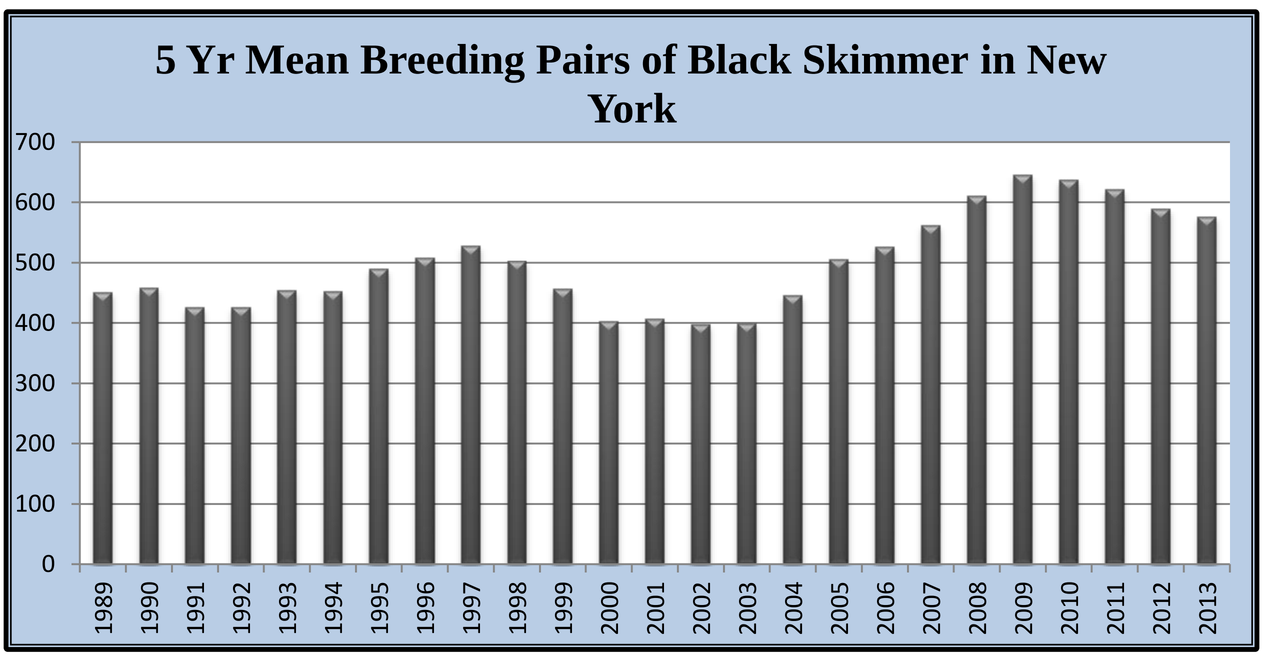


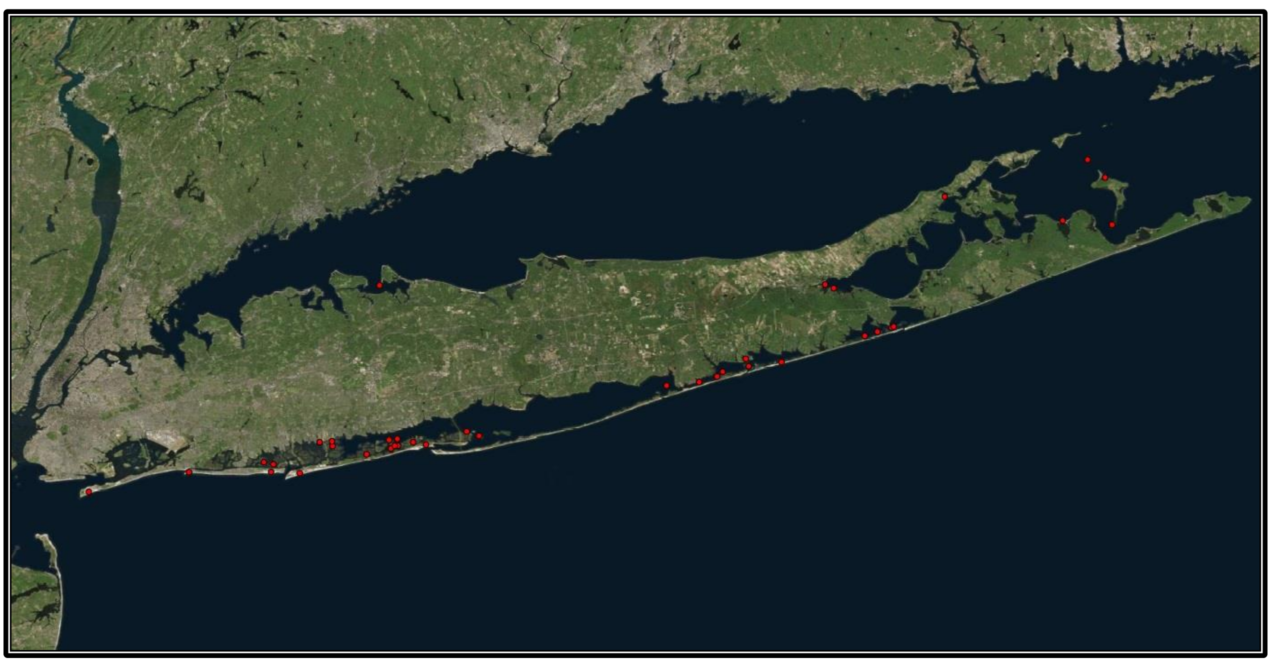
TABLE 5: FIVE YEAR MEAN AVERAGE OF BREEDING PAIRS OF BLACK SKIMMER. THE MOST RECENT AVERAGE (2009-2013) IS 576 BREEDING PAIRS.



APPENDIX B: HISTORIC AND CURRENT BLACK SKIMMER BREEDING LOCATIONS

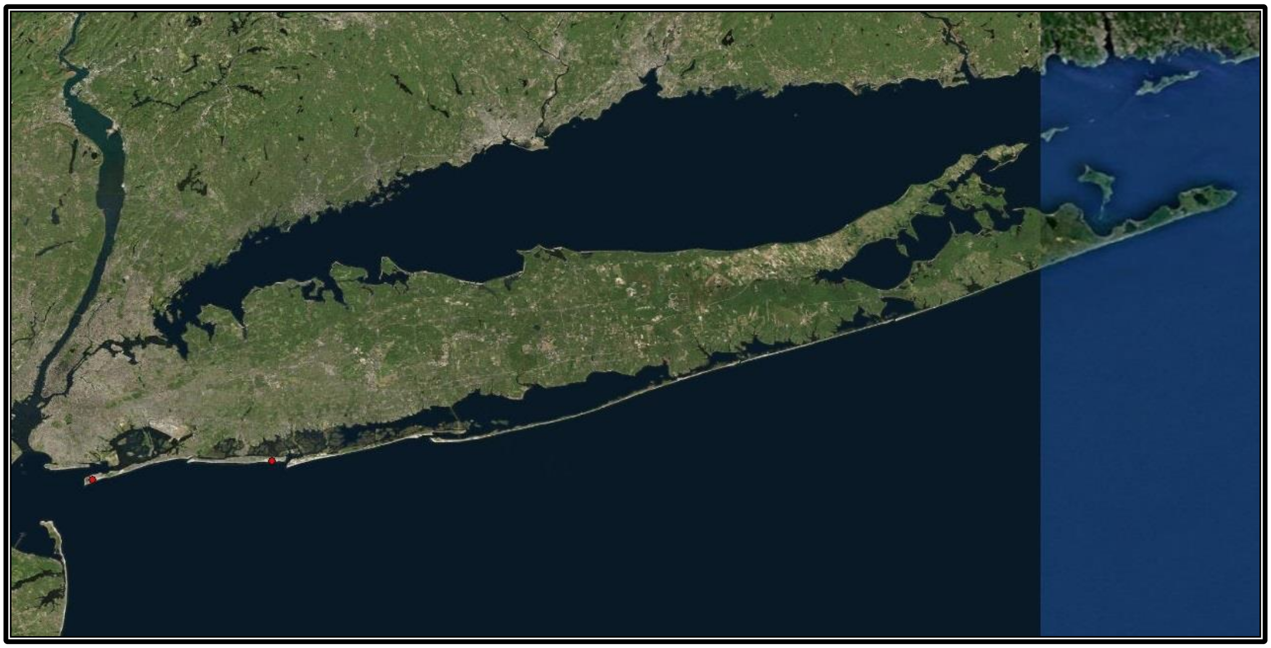
All locations that have been recorded as having black skimmer nesting according to the LICWPP survey, 1983-2014.

All locations that have been recorded as having black skimmer nesting according to the LICWPP survey, 1995-2014.



All locations that have been recorded as having black skimmer nesting according to the LICWPP survey, 2005-2014.

All locations that have been recorded as having black skimmer nesting according to the LICWPP survey, 2013-2014.



Appendix C: U.S. Army Corps Navigational Dredge Channels

TABLE 6: LIST OF SAND QUALITY DREDGE MATERIAL SITES NEAR PREVIOUS OR CURRENTLY EXISTING BLACK SKIMMER COLONIES.

Project	Dredging Cycle	Approx. Quantity	Last Dredged	Proximal Colonies
Lake Montauk Harbor	5 yrs	4,000 CY	2011	
L.I. Intracoastal Waterway	5-6 yrs	150,000 CY	2013-2014	John Boyle, Pattersquash, New Made, Carter's, West Inlet, East Inlet, Tuthill Cove, Westhampton, Sedge, Lanes, & the Warner Islands
Fire Island Inlet & Shore Westerly to Jones Inlet	2 yrs	1,000,000 CY	2013	Fire Island Democrat Point, Jones Beach East, Cedar, the Grouts, Dock, Goose Flat, Thatch, Elder, Tobay Marsh, Cuba Island Group, Line Island Group, Ned's, Oliver's, Jones Beach West, Long Meadow, Cinder Island Group, Parsonage Island Group, & Long Beach - Lido Beach
Jones Inlet	5 yrs	500,000 CY	2013-2014	Cuba Island Group, Jones Beach West, Long Meadow, Cinder Island Group, Parsonage Island Group, & Long Beach - Lido Beach
East Rockaway Inlet	1 yr	300,000 CY	2013	Long Beach Island - Atlantic Beach
Jamaica Bay - Rockaway Inlet	2 yrs	300,000 CY	2013	Breezy Point
Moriches Inlet	5 yrs	250,000 CY	2013	West Hampton Island West, East Inlet, West Inlet, Tuthill Cove, Carter's, New Made, & Pattersquash
Shinnecock Inlet	5 yrs	450,000 CY	2012-2013	The Warner Islands, Lanes, Greater Greenbacks, & Sedge

APPENDIX D: CONTACT INFORMATION

Whether planning conservation actions, reporting observations, or whenever questions arise, it is always advisable to reach out to your local conservation office or animal shelter. For regulatory questions or for wildlife issues contact your local conservation office. They can answer questions regarding permits and regulations or help find you an appropriate animal handler or rehabilitator.

For questions and issues regarding domesticated animals please contact your nearest animal shelter. Feral cat sightings near waterbird nesting habitat should be reported to both your local conservation office and animal rescue service provider.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Region 1 – Serves Nassau and Suffolk Counties

Address: SUNY @ Stony Brook, 50 Circle Road, Stony Brook, NY 11790

Regulatory Inquires: (631) 444-0270

Wildlife Information Services Hotline: (631) 444-0310

The hotline is available Monday & Thursday 9 AM – 4 PM, messages can be left at any time.

Region 2 – Serves Bronx, Kings, New York, Queens, and Richmond Counties

Address: 47-40 21st Street, Long Island City, NY 11101

Regulatory Inquires: (718) 482-4997

Nuisance Animal or Wildlife Inquires: (718) 482-4922

ANIMAL SHELTERS AND ANIMAL RESCUE SERVICES

The contact information provided below is for assistance in dealing with domestic animals. For assistance with wild animals please contact your local state conservation office.

The American Society for the Prevention of Cruelty to Animals (212) 876-7700 http://www.aspca.org/aspca-nyc.aspx	***Animal Care & Control of NYC*** Dial 311 (In New York City Only) **Bronx:** 464 East Fordham Road, Bronx, NY 10458 **Brooklyn:** 2336 Linden Boulevard, Brooklyn, NY 11208 **Manhattan:** 326 East 110th Street, New York, NY 10029 **Queens:** 92-29 Queens Boulevard, Queens, NY 11374 **Staten Island:** 3139 Veterans Road West, Staten Island, NY 10309 http://www.nycacc.org/index.htm

Mayor's Alliance for NYC's Animals (212) 252-2350 244 Fifth Avenue, Suite R290, New York, NY 10001 **www.animalalliancenyc.org**	***NYC Feral Cat Initiative*** (212) 330-0033 244 Fifth Avenue, Suite R290, New York, NY 10001 http://www.nycferalcat.org
Save-A-Pet (631) 473-6333 608 Route 112, Port Jefferson Station, NY 11776 http://www.saveapetli.net	***Town of Brookhaven Animal Shelter & Adoption Center*** (631) 286-4940 300 Horseblock Road, Brookhaven, NY 11719 http://www.brookhaven.org/animalshelter
North Fork Animal Welfare League ***Southold Animal Shelter*** (631) 765-1811 165 Peconic Lane, Peconic, NY 11958 http://www.nfawl.org	***Smithtown Animal Shelter*** (631) 360-7575 410 East Main Street, Smithtown, NY 11787 http://www.smithtowninfo.com/AnimalShelter/

APPENDIX E: FIREWORK DISPLAY LOCATIONS ALONG NEW YORK'S COAST