Florida Field Naturalist 34(1):21-27, 2006.

BEACHED BIRD SURVEYS ON SHELL KEY, PINELLAS COUNTY, FLORIDA

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Abstract.—A twice monthly series of beached bird surveys has been established on Shell Key, Pinellas County, Florida in conjunction with the Tufts University SEANET program. The goal of SEANET is to provide information on potential ecological threats to seabird populations. Beached bird carcasses are also collected to assess the body burden of brevetoxin, the toxin associated with red tides caused by the toxic dinoflagellate, *Karenia brevis*, in the Gulf of Mexico. In this report we summarize the first 10 months of information on seabird mortality and the brevetoxin body burden for species commonly found on Pinellas County beaches.

Evidence for the impact of Harmful Algal Blooms (HABs or red tides) on sea and shorebird populations has been largely anecdotal until recently, when brevetoxin, a potent neurotoxin produced by the red tide dinoflagellate, *Karenia brevis*, was found in tissues of Double-crested Cormorants (*Phalacrocorax auritus*, Kreuder et al., 2002) and in the gastro-intestinal tract of Lesser Scaup (*Aythya affinis*, J. Landsberg, FWRI pers. comm.). Hundreds of Lesser Scaup were found dead in southwest Florida in March 2002. Since red tides in the eastern Gulf of Mexico are an annual occurrence (Steidinger et al. 1998), one would expect impacts on the avian community would be well documented. However, recent reviews by Shumway et al. (2003) and Landsberg (2002) supplement earlier studies by Quick and Hendersen (1974, 1975) and confirm that only a handful of publications exist about avian mortalities in connection with Florida West Coast red tides.

Given the difficulty and expense of conducting avian surveys at sea during a red tide bloom, a beach survey was established as an alternate method to obtain samples for brevetoxin analysis. This beach sur-

vey is part of a larger program called SEANET (Seabird Ecological Assessment Network; www.tufts.edu/vet/seanet) established by Mark Pokras, Rebecca Harris, and Florina Tseng at the Center for Conservation Medicine in the Tufts Cummings School of Veterinary Medicine. Aims of this program, as stated in their brochure, include "establishing links between marine ecological health and human health by monitoring seabird mortality. Numerous threats contribute to mortality, including disease, fisheries operations, organic pollutants, heavy metals, offshore development (potentially wind farms), and oil pollution. These risks to seabirds also threaten the coastal and marine environments used by humans for respite and ecological services, such as food production, waste elimination, and flood protection. Pinpointing areas of concern enables SEANET and our collaborators to focus on specific causes of mortality or ecological degradation, and propose policy and conservation measures to counteract the threats."

Beached bird surveys are an important monitoring tool that has been used throughout the world for decades to detect threats to marine and coastal birds and the larger ecosystems upon which they rely (e.g., Camphuysen and Heubeck 2001). Since HABs are an ecosystem level event in the Gulf of Mexico (Steidinger et al. 1998) and the growth and maintenance of these blooms may be related to increased coastal eutrophication due to estuarine nutrient fluxes (Vargo et al. 2004), establishing this survey was a natural connection for the SEANET program. Although the main focus area of the SEANET program is in the Northeastern states, expansion into the Southeastern U.S. is underway. The beach transect established with the help of the Pinellas County Environmental Management staff at Shell Key in Pinellas County is the first such study.

Methods

Surveys for beached birds of all species were done twice monthly along the western shore of Shell Key Preserve that is located off the coast of Pinellas County, Florida (Fig. 1). The route is approximately 2.6 km long starting at the north end of the island at 27°40.564 N latitude, 82°44.376 W longitude and ending at the south end of the island at 27°39.273 N, 82°44.781 W (see Fig. 1). The average width of the beach is estimated as 30 m, so the total area covered is approximately 0.078 km^2. All surveys follow protocols established by the SEANET Program (Harris et al., in press) and are usually conducted in conjunction with twice monthly nesting and winter bird surveys done by Pinellas County Environmental Management (PCEM) staff and volunteers. Copies of all data forms are sent to Harris for incorporation into the SEANET database. A hand-held Garmin GPS III was used to determine the location of each carcass.

An initial survey was done on 7 March 2004 to determine the transect length. Typically, surveys are done from north to south, but several were done in the opposite direction when PCEM staff provided access to the island.

Live bird identifications and counts (data not presented) were conducted only on the initial transect whereas dead, beached birds were counted during both the southward

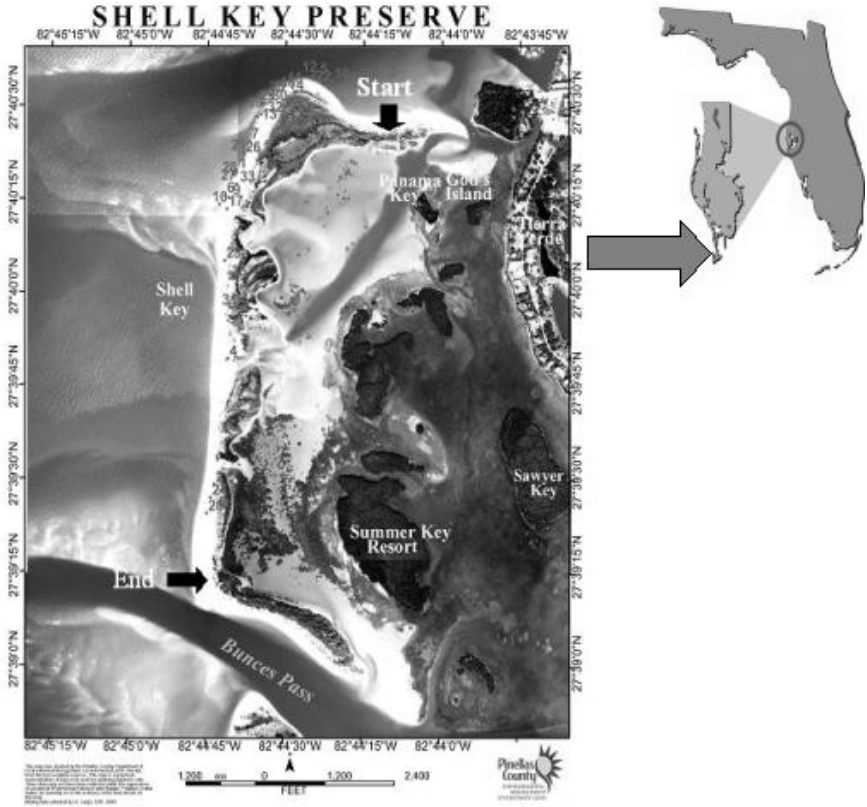

Figure 1. The location of Shell Key Preserve, Pinellas County, Florida. The start and end of the beach transects are noted as are the locations of all beached bird carcasses found during the 2004 beach surveys.

walk and the return trip. Normally the walk south was done along the high tide line while the return trip was done along the edge of vegetation on the upper beach. During nesting season, no intrusions were made into the nesting area so distances from the vegetation often overlap with the initial southern survey. Every effort was made to minimize disturbance of roosting and nesting birds.

Dead bird carcasses that still contained tissues and organs were collected and returned to the Florida Wildlife Conservation Commission, Florida Wildlife Research Laboratory, for necropsy. Organs collected for brevetoxin analysis (Naar et al. 2002) included kidney, liver, and stomach contents with brain and lung tissue archived for future analyses. Feathers were also collected for future analyses that include stable isotopes.

RESULTS AND DISCUSSION

Twelve species are known to nest on Shell Key and include Black Skimmer (*Rhynchops niger*), Least Tern (*Sterna a. antillarum*), Royal Tern (*Sterna maxima*), American Oystercatcher (*Haematopus palliatus*),

Willet (*Catoptrophorus semipalmatus*), Snowy Plover (*Charadrius alexandrinus*), Wilson's Plover (*C. wilsonia*), and Laughing Gull (*Larus atricilla*). A complete description of the Preserve and its Environmental Management Plan can be found at: http://www. co.pinellas.fl.us/bcc/Environment/pagesHTML/envLands/el7000.html

Thirty-five bird carcasses were found on surveys conducted from March 2004 through November 2004 (Table 1). Surveys were not done in September and December. The season average is therefore 2.43 carcasses per survey which, based on an area of approximately 0.078 km^2, extrapolates to 31 birds/km^2. Based on linear distance traveled, the 2004 Shell Key deposition rate was 0.96 birds per km. This rate is considerably higher than 0.21 birds per km on southern Massachusetts's beaches in 2003-2004 (Harris et al., in press), but is in line with the deposition rate of 1.00 bird per km found on Florida's Gulf Coast from 1975-1983 (Simons 1985). In our study Laughing Gulls comprised approximately 63% of the total, with Black Skimmers and Brown Pelicans (*Pelecanus occidentalis*) adding another 11% and 9%, respectively. Numbers of bird carcasses increased during late summer and fall (Fig. 2) largely due to increased numbers of dead Laughing Gulls (Table 1). Eight of the 35 birds, all Laughing Gulls, showed signs of predation as the cause of death. These birds were found during August through November surveys, a time when migrating raptors are common along the southwest Florida coasts. Peregrine Falcons (*Falco peregrinus*), Merlins (*Falco columbarius*), Sharp-shinned and Coopers Hawks (*Accipiter striatus* and *A. cooperii*) and a pair (male and female) of Northern Har-

Table 1. Shell Key Beached Bird Survey, 2004 summary data.

Date	# Beached birds	Species
28 March	1	Green Heron (*Butorides virescens*)
18 April	1	Common Loon (*Gavia immer*)
29 April	2	Black Skimmer
12 May	2	1 Brown Pelican[1], 1 Black Skimmer
25 May	0	
22 June	2	1 Black Skimmer, 1 Laughing Gull
11 July	2	1 Laughing Gull, 1 Royal Tern[1]
21 July	2	1 Laughing Gull, 1 live Laughing Gull (died enroute)
1 August	5	4 Laughing Gulls, 1 Brown Pelican
11 August	3	2 Laughing Gulls, 1 Brown Pelican
22 August	4	2 Laughing Gulls, 2 Royal Terns[1]
3 October	5	5 Laughing Gulls (took third for necropsy[1])
17 October	4	3 Laughing Gulls, 1 unidentified
14 November	2	2 Laughing Gulls

[1]Bird carcass transferred to FWRI for necropsy and brevetoxin analysis.

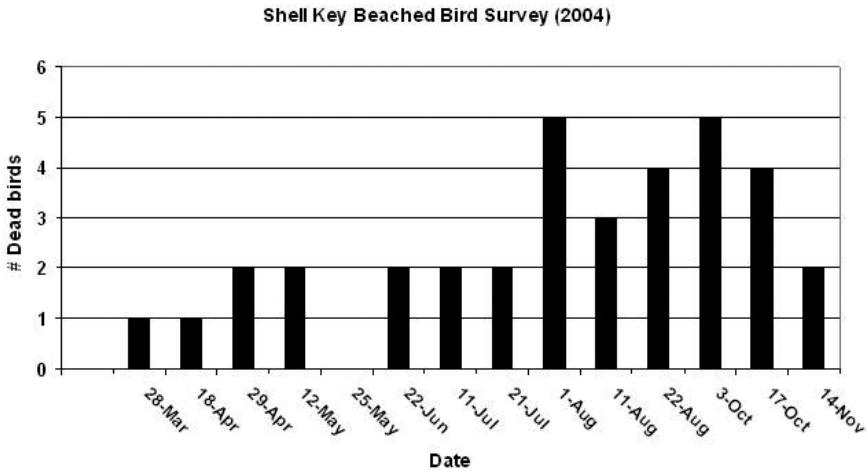

Figure 2. The seasonal distribution of beached bird carcasses found during the 2004 Shell Key Preserve surveys.

riers (*Circus cyaneus*) were seen on Shell Key during the fall months (pers. comm., Shell Key volunteers).

A Laughing Gull found on 22 June and a Brown Pelican found on 11 August were the only two birds with fishing gear problems. The Laughing Gull was captured alive with a hook in its bill and monofilament line entangling its wings. After removing the line and hook it was checked for injury, found to be healthy, and released. The Brown Pelican was in an advanced state of decomposition and was totally entangled in monofilament fishing line.

Six of the 35 bird carcasses were found next to one or more ghost crab (*Ocypode quadrata*) burrows. In each case crab tracks were seen leading directly to the carcass, suggesting that this crab species, which is a scavenger, uses dead birds as a resource. Most carcasses were found along the northwest coast of Shell Key (Fig. 1). The area around this northwest point is a roosting area for many species of birds and is also a nesting zone for Black Skimmers and other species. Tidal currents converge around this point so it may also be a depositional site for carcasses that are carried onto the beach from other areas.

Five carcasses were fresh enough to contain sufficient organs and tissues for brevetoxin analysis. The ELISA method we used detects all forms of brevetoxin and has a limit of detection of approximately 10 ng/g of tissue. Most samples were below the detection limits of the assay (Table 2) but tissues from two Royal Terns and the kidney from one Laughing Gull returned positive results. The positive values in Table 2 should be viewed with caution as the results have not been analytically con-

Table 2. Levels of brevetoxin (PbTx) found in various tissues of bird carcasses collected on Shell Key during the 2004 beach surveys.

Species	Date collected	Tissue	PbTx (ng/g)
Brown Pelican	12 May	Brain, lung, spleen	
		Stomach contents, kidney	All < DL
Royal Tern	11 July	Kidney, liver, testes, heart	All < DL
		Muscle	14.1
		Stomach lining	32.5
		Intestinal lining	26.1
		Lung	33.1
Laughing Gull	21 July	All tissues and stomach	
		Contents	< DL
Royal Tern	22 August	Muscle, viscera	< DL
		Liver	26.3(40.5)[1]
		Stomach lining	14.0
		Kidney	12.5
Laughing Gull	3 October	Intestinal contents, gonads	
		Heart, stomach, muscle, lung	All <DL
		Kidney	16.2

[1]Replicate samples.

firmed, but they can be viewed as minimal values suggesting a baseline body burden. Since we did not have a red tide bloom in the area throughout the 2004 survey period, any body burden of toxin in seabirds would have to result from accumulation in prey based on background levels (1000 cells per liter; Tester and Steidinger 1997) of *Karenia brevis*, or from prey items carrying a long-term body burden of toxin from the 2003 red tides (L. Flewelling, pers. comm.). Since brevetoxin is a lipid soluble toxin (Baden 1983) it could bio-accumulate and persist in fish and other organisms, but its duration or potency in this form is still unknown.

We speculate that if prey items carry a long-term body burden of brevetoxin, then avian migrants, which may also suffer from exposure to other types of phycotoxins (saxitoxin, domoic acid) in their home regions, may become further debilitated upon exposure to local Florida red tides. We plan to continue the SEANET surveys over the foreseeable future, and, if additional volunteers are found, expand the program to other beaches along the Florida Gulf coast.

ACKNOWLEDGMENTS

Sincere thanks to the PCEM staff (Cathy Flegel, Kristen Penney Sommers, and Pam Leasure) for help in establishing the survey and in providing access via County boats. Also thanks to the "Twiners"—the dedicated group of volunteers who check the nesting colonies and repair twine and stakes twice monthly during nesting season; to Joyce King and other volunteers from the St. Petersburg Audubon Society for assistance in identifications and counts during the winter bird surveys; to Captain Alva Sholty, owner

and operator of the Shell Key Shuttle based at the Merry Pier, Pass-A-Grill, Florida for providing transportation to the island without charge; to Barbara Ranck for coordinating monthly schedules; and to Leanne Flewelling, FWRI/FFWCC, for assistance with brevetoxin analyses and comments on the manuscript.

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