OBSERVATIONS ON ESTUARINE BREEDING BIRD RICHNESS IN NEW YORK STATE

John Vanek[1,2], James P. Browne[3,4], and Crystal A. Crown[4]
Town of Hempstead Department of Conservation and Waterways,
Point Lookout, NY, 11569

Identifying and tracking the nesting locations of birds is an important part of the data that New York (NY) birders collect and report. These contributions have led to the completion of two breeding bird atlases spaced 15 years apart (Andrle and Carroll 1988, McGowan and Corwin 2008). The atlases provide a wealth of information, and ultimately enable researchers to track changes in nesting patterns over time. For each atlas (1980-1985 and 2000-2005), 5332 survey blocks covering all of NY were searched for evidence of breeding birds. This evidence included everything from simple presence of a species in suitable breeding habitat, to singing males, and nests with eggs. Depending on the strength of evidence, each species was then assigned breeding status as either "Possible," "Probable," or "Confirmed," based on objective criteria.

As environmental scientists located in a marine district of NY, we were particularly interested in the spatial trends for the bird species that are dependent on estuarine environments. As a first step towards understanding how marine ecosystems support associated bird species, we investigated the changes in the species that require a functioning marine ecosystem to feed and raise their chicks. To do this, we measured breeding bird richness, i.e., the total number of species in a survey block, on Long Island, NY.

We used data from the above-mentioned New York State Breeding Bird Atlases (BBA) and analyzed spatial trends for 22 species of breeding birds characteristic of NY estuarine environments (Table 1). These are species that breed in and around salt marshes and rely heavily on estuarine prey in salt marshes, tidal flats or coastal waters. We excluded species that mostly breed around fresh water or confine their activity to surrounding habitats such as barrier beaches, brackish marshland or high marsh. For example, we excluded the Green Herons (*Butorides virescens*) and Red-winged Blackbirds (*Agelaius phoeniceus*) because they readily breed and forage around freshwater, and are not restricted to the marine environment (McGowan and Corwin 2008). We also excluded Herring Gulls (*Larus argentatus*) and Piping Plovers (*Charadrius melodus*) because the former are scavengers feeding heavily in urban areas far from estuarine areas, and the plover is often dependent on ephemeral pools and

[1,]Department of Biology, Hofstra University, Hempstead, NY, 11549
[2,]Present Address: Cooperative Wildlife Research Laboratory and Department of Zoology, Southern Illinois University, Carbondale IL, 62901
[3] Corresponding author - James.Browne@stonybrook.edu
[4] Department of Ecology and Evolution, Stony Brook University, Room 650 Life Sciences Building, *Stony Brook*, *NY* 11794-5245

Table 1. Species used in the richness analysis, conservation status in New York State, number of Breeding Bird Atlas blocks occupied by atlas year, and the change in blocks between the first and second atlas.

Family	Scientific Name	Common Name	State Status	1985	2000	% Change
Ardeidae	*Ardea alba*	Great Egret		18	26	+44.4
	Botaurus lentiginosus	American Bittern	Special Concern	4	0	-100
	Egretta caerulea	Little Blue Heron		8	12	+50
	E. thula	Snowy Egret		30	22	-26.7
	E. tricolor	Tricolored Heron		7	5	-28.6
	Nyctanassa violacea	Yellow-crowned Night-Heron		18	18	0
	Nycticorax nycticorax	Black-crowned Night-Heron		50	52	4.0
Emberizidae	*Ammodramus caudacutus*	Saltmarsh Sparrow		58	48	-17.2
	A. maritimus	Seaside Sparrow	Special Concern	44	26	-40.9
Laridae	*L. marinus*	Great Black-backed Gull		33	33	0
	Leucophaeus atricilla	Laughing Gull		3	5	+66.7
Pandionidae	*Pandion haliaetus*	Osprey	Special Concern	61	105	+72.1
Rallidae	*Rallus limicola*	Virginia Rail		9	8	-11.1
	R. longirostris	Clapper Rail		36	33	-8.3
Rynchopidae	*Rynchops niger*	Black Skimmer	Special Concern	25	21	-16
Scolopacidae	*Tringa semipalmata*	Willet		36	61	+69.4
Laridae	*Gelochelidon nilotica*	Gull-billed Tern		3	4	+33.3
	Sterna dougallii	Roseate Tern	Endangered	17	10	-41.2
	S. forsteri	Forster's Tern		1	9	+800
	S. hirunda	Common Tern	Threatened	55	56	+1.8
	S. antillarum	Least Tern	Threatened	73	69	-5.5
Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis		24	17	-29.2

wrack along the ocean edge, areas that are not usually dependent on estuarine productivity (Pierotti and Annet 1991; Elias *et al.* 2000).

We re-created the sampling grid used by the atlas, truncated to include only blocks that overlapped any land portion of Kings, Queens, Nassau, or Suffolk Counties. We then visually inspected each BBA map for our target species and noted the locations in which the breeding status was recorded as either "Confirmed" or "Probable." We excluded "Possible" designations due to the inherent uncertainty of the category. These data were visualized in a geographic information system, and we calculated the total number of confirmed and probable breeders for each survey block (richness), as well as the differences between both atlases for each block.

The total number of survey blocks occupied by breeding waterbirds increased from 613 to 640 during the 15 years between atlases. However, this change was not evenly distributed, with some species dramatically increasing, e.g., Osprey (*Pandion haliaetus*), and some species dramatically decreasing (Table 1). In addition, these changes differed by family, with herons, gulls, and terns remaining relatively static; sparrows, skimmers, and ibises decreasing; and shorebirds and raptors increasing (Table 2). The top five blocks for each atlas were different, with a single exception (Table 3). Slightly more blocks gained species than lost species (Fig. 1, p. 295), and the blocks that gained species did so to a greater degree (Table 4). All blocks noted in Tables 2, 3, and 4 are depicted in Figure 2 (p. 296).

There was no clear pattern among species or families for changes in breeding occupancy. For example, of the five species of terns analyzed, Roseate Terns (*Sterna dougallii*) decreased from 17 blocks to 10 blocks, while Forster's Terns (*Sterna forsteri*) increased 800%, from one breeding block to nine. The most precipitous declines were that of the American Bittern (*Botaurus lentiginosus*), which disappeared entirely between the first and second atlases, the Seaside Sparrow (*Ammodramus maritimus*), which decreased by over 40%, and the aforementioned Roseate Tern. All three of these species are of conservation concern (Table 1), and their population trends should be monitored carefully.

The blocks with the highest waterbird richness were located along the marshes of the south shore of Long Island for both atlas periods. In 1980-1985, the top five blocks were all located around Hempstead Bay. In 2000-2005, these expanded to include parts of Moriches Bay. Both bodies of water differ from the other bays by having more salt marsh, very shallow flats, and being highly eutrophic (Barlow *et al.* 1963, Oviatt *et al.* 1989, Swanson *et al.* 2009, Wallace and Gobler 2011), in addition to other factors that may enhance their ability to support upper trophic levels. For example, increases in nutrient availability may positively influence seabird productivity in some other systems (Monticelli *et al.* 2007).

Table 2. Changes in breeding bird occupancy by taxonomic family presented as percent change in number of blocks occupied.

Family	Species	1980-1985	2000-2005	% Change
Ardeidae	7	135	135	0.0
Emberizidae	2	102	74	-27.5
Laridae	2	36	38	+5.6
Pandionidae	1	61	105	+72.1
Rallidae	2	45	41	-8.9
Rynchopidae	1	25	21	-16.0
Scolopacidae	1	36	61	+69.4
Laridae	5	149	148	-0.7
Threskiornithidae	1	24	17	-29.2

Table 3. The top five ranked blocks with the highest breeding bird richness from each atlas, including the change in richness for the corresponding block between the 1980-1985 and 2000-2005 atlases.

Atlas	Block	Rank	Richness	Change
1980-1985	6249B	1	16	-7
	6249A	2,3,4 (tied)	14	+1
	6349A	2,3,4 (tied)	14	-4
	6350D	2,4,4 (tied)	14	-8
	6049D	5	13	+4
2000-2005	6149A	1	19	+7
	6049D	2	17	+4
	6851A	3	17	+10
	6149B	4,5 (tied)	16	+6
	6851B	4,5 (tied)	16	+9

CONCLUSION

Birds are excellent indicators for the general assessment of the health of an ecological system (Landres *et al.* 1988, Montevecchi 1993), and additional environmental factors and more years of detailed survey data will have to be included in future studies. We hope this introductory analysis will prompt interesting questions among birders, citizen scientists, and professional scientists.

Table 4. The five blocks with the greatest richness gains and losses, including the richness of each block noted in the 2000-2005 atlas, and the change between the 1980-1985 and 2000-2005 atlases.

Block	Rank	2000-2005 Richness	Change
6851A	1	17	+10
6851B	2	16	+9
6150B	3, 4, 5 (tied)	7	+7
7152A	3, 4, 5 (tied)	13	+7
7052C	3, 4, 5 (tied)	15	+7
6149A	3, 4, 5 (tied)	19	+7
6350D	1	6	-8
6249B	2	9	-7
6450B	3	1	-6
6551D	4	0	-6
6550B	5 (tied)	2	-5
6449A	5 (tied)	0	-5
6350B	5 (tied)	0	-5
7252D	5 (tied)	3	-5

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Figure 1. Changes in species richness of breeding estuarine birds between the 1985 and 2000 NYS Breeding Bird Atlases. See article pp. 254-259.

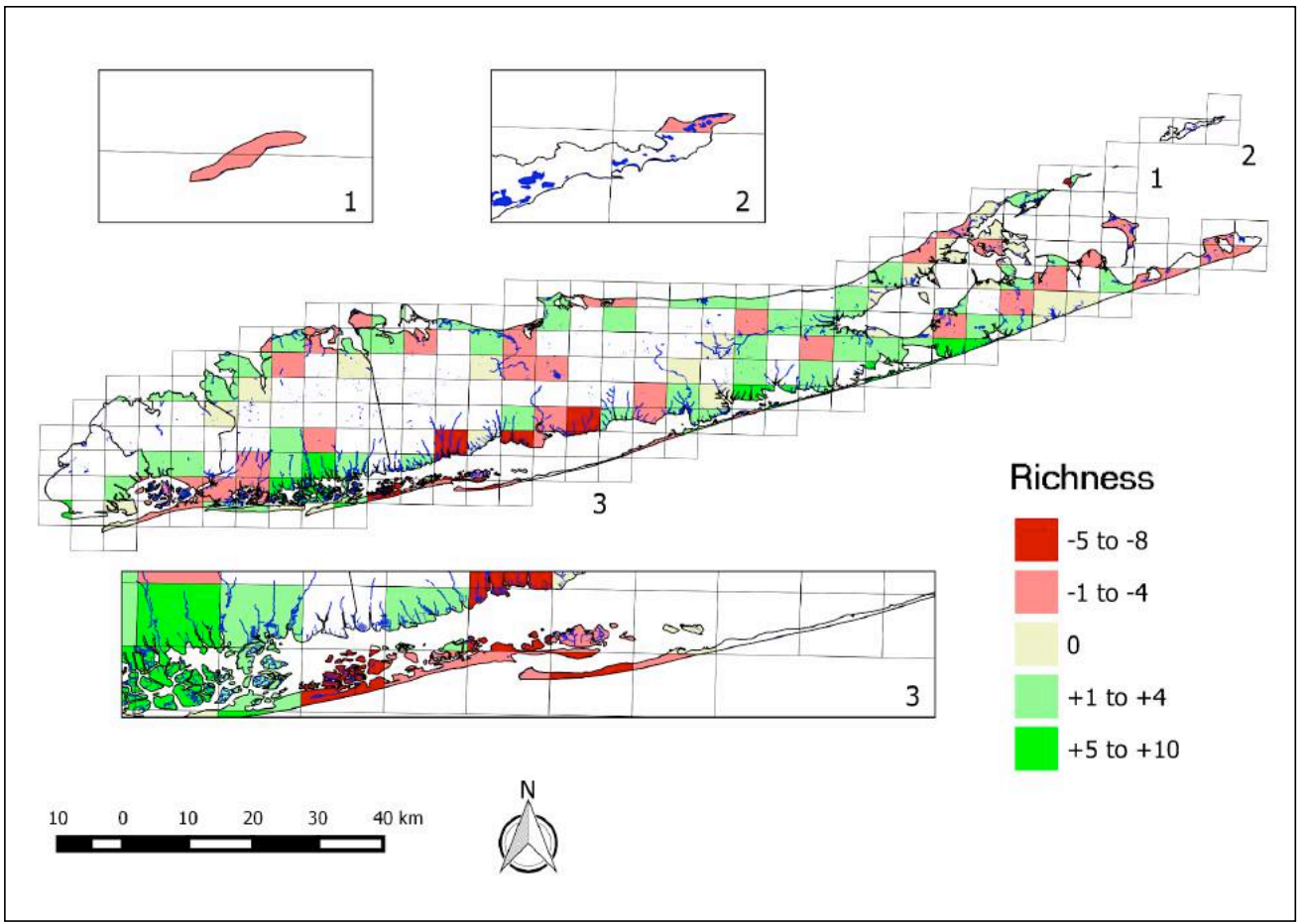

Figure 2. Labeled atlas blocks referenced in Tables 3 and 4, highlighting atlas blocks with the highest breeding bird richness in each year, and those with the highest losses and gains. See article pp. 254-259.