WINTERING RAPTORS AND WATERBIRDS

OF THE GREAT EGG HARBOR RIVER

ATLANTIC COUNTY, NJ

A Ten Year Summary of Observed Status and Trends

2003-2013

Including Key Comparisons to the MULLICA RIVER,
A review of Historical Data, and discussion of Spring and Fall Migration

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Long-term studies sponsored by
The Great Egg Harbor Watershed Association

Submitted to:

The Great Egg Harbor Watershed Association

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On the cover:

A **Northern Harrier** hunting the coastal tidal wetlands in winter. Northern Harriers, known to many as "Marsh Hawks," are a hallmark of the Great Egg Harbor River system -- as a rare breeding species, as abundant migrants, and particularly as wintering birds.

-- Photo by Clay Sutton

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ON THE GREAT EGG HARBOR RIVER

Atlantic County, NJ
2003-2013

A Ten Year Systematic Study
of an Important Avian Wintering Area

EXECUTIVE SUMMARY

In an effort to establish baseline data on winter raptor and waterbird use of the lower Great Egg Harbor River watershed, information that could eventually be used to determine status and possible trends in avian use and populations, a systematic study was begun during the winter of 2003-2004 and continued through winter 2012-2013. For this ten-year period, data was gathered at nine sites (point counts), for forty-five minutes per site, at a rate of approximately every two weeks during the period from the first week of December to the last week of March in order to assess winter populations and distribution of birds, primarily raptors, waterfowl, and other waterbirds.

Substantial bird use of the Great Egg Harbor River system was proven. Ten years of systematic sampling determined winter raptor use of the Great Egg River and estuary to be highly significant in its own right, and easily comparable and on par with the lower Maurice River (the only other southern New Jersey system for which substantial data exists). Waterfowl and waterbird use of the system was found to be considerably higher than indicated by previously published and unpublished historical and anecdotal accounts. This was particularly noteworthy on Great Egg Harbor Bay, where winter Brant, scaup, and diving duck numbers were found in concentrations previously unreported, and in numbers highly significant for the region. As an adjunct study, conducted to offer perspective on the Great Egg findings, comparative studies were conducted on the Mullica River for nine winter seasons as well, studies that demonstrated the Mullica to also be a river that sustains similar and important avian resources in winter.

In this long-term systematic study, Great Egg Harbor River winter raptors and waterfowl were documented in numbers judged to be substantial and regionally significant to New Jersey and in the Mid-Atlantic States. In addition to the core winter survey efforts, systematic counts were undertaken during the spring and fall migration season to expand the temporal scope, and our understanding, of the value of the Great Egg system to migrant raptors and waterbirds, particularly shorebirds. The findings of these preliminary studies corroborate winter results in proving the Great Egg Harbor River and Bay to be an area of high importance to birds at all seasons.

GREAT EGG HARBOR WINTER RAPTORS AND WATERBIRDS

BACKGROUND AND INTRODUCTION

> *"On the winding northern shore of Great Egg Harbor, on the edge of narrow passages of blue sea water, bordered by rushes or silver white sand, there was an old tavern, Beasley's Tavern, still in existence a century and a half later, and it became one of Alexander Wilson's refuges. Inland were slow-moving rivers that poured from swamps through large stands of dwarf pines, the air fragrant with their resinous scent mingled with the odor of the white sand and salt sea. Near Cape May and along the short Tuckahoe River that flowed into Egg Harbor were groves of swamp oaks and deep-shaded cedar swamps, where herons, egrets and bitterns nested.*
>
> *"In the early twilight the night herons flew toward the marshes, uttering their hoarse and hollow cries, and the bird life of the region, once the migrating geese departed, was not so much beautiful as it was eccentric, a florid example of rococo nature, long-legged creatures pacing endlessly along the shore, and shovel-mouthed sea birds scooping up their food over the waves. Wilson was surely a happy individual when he wrote of Great Egg Harbor, something that could confidently be said of him at few times in his life."*
>
> Robert Cantwell, on Alexander Wilson's 1811 journey to Great Egg Harbor
> From *Alexander Wilson: Naturalist and Pioneer,* 1961

The Great Egg Harbor River and Great Egg Harbor Bay have long been known for the abundance of birds found there. The very names of the waterways were derived from the ability of first European settlers, and the Native Americans before them, to easily gather eggs there -- a major source of food during the protracted and bountiful nesting season. So too was Great Egg Harbor famous with some of our early and greatest ornithologists. Alexander Wilson, widely regarded as the father of American ornithology, studied extensively along the Great Egg Harbor River and Bay in the 1820s, and many of his great discoveries were made in the region. In 1812, Wilson's friend and colleague George Ord collected a warbler near Tuckahoe in northern Cape May County that was unknown to science. Wilson "wrote it up," describing it, and named it the Cape May Warbler. (Of interest, it is one of only three North American birds that are named for a specific place: Philadelphia Vireo, Nashville Warbler, & Cape May Warbler; the Baltimore Oriole was *not* named for the City of Baltimore, but for Lord Baltimore, early Governor(s) of Maryland – the colors of the family crest were orange & black). Perhaps only the fact that the entire Southern New Jersey region was well-known to Wilson and other early Philadelphia scientists as the "Cape May Country" kept the bird from being named the "Tuckahoe Warbler."

John James Audubon, easily the best-known of all American naturalists and ornithologists, also collected and painted at Great Egg Harbor in the 1830s. One of the most dramatic plates of his monumental *Birds of America*, Plate 81 depicting the Fish Hawk (Osprey) carrying a Weakfish, was painted on the banks of the Great Egg in 1829. Audubon also recounted his adventures there, with birds and with all of nature, in his famous journal where he offered an early and glowing testimonial to the Great Egg:

> *"To such naturalists as are qualified to observe many different objects at the same time, Great Egg Harbor would probably offer as ample a field as any part of our coast excepting the Florida Keys. Birds of many kinds are abundant, as are fishes and testaceous animals. The forests shelter many beautiful plants, and even on the driest sandbar, you may see insects of the most brilliant tints."*
>
> John James Audubon
> From *Ornithological Biography*, *Volume 3*, 1835

The Great Egg Harbor River and Great Egg Harbor Bay, including its important Tuckahoe River tributary, is one of New Jersey's greatest river and bay systems. The Great Egg easily joins the Mullica River/Wading River complex, the Maurice River, and the Cohansey River in being among the largest and most important river and estuary systems in southern New Jersey. Despite a long history of settlement in the areas surrounding the river, and despite recent and substantial regional growth and development, much of the Great Egg Harbor River remains wild and scenic, and indeed was so designated (as a National Scenic and Recreational River) in 1992 under the National Park Service's Wild and Scenic River program. Many areas of the Great Egg system would yet qualify as pristine under many standards of review. The Great Egg is certainly one of South Jersey's gems -- in scenic vistas, natural resources, wildlife use, and recreation and ecotourism opportunities.

Despite its long and well-established reputation for substantial wildlife populations and avian-use, prior to 2003 surprisingly little systematic ornithological data had been gathered on the Great Egg Harbor or Tuckahoe Rivers. Following Wilson and Audubon's pioneering efforts, Great Egg Harbor to some degree seemed to drop off the ornithological map, always overshadowed somewhat by the nearby Mullica River and adjacent Forsythe National Wildlife Refuge (aka "Brigantine Refuge"). That began to change in the 1980s. After James F. Akers moved from Ohio in 1959, he soon became a strong force in South Jersey birding and conservation. In 1981, his *All Year Birding in Southern New Jersey* was published, the first comprehensive site (and seasonal) guide for the southern half of the state. Jim Aker's guide highlighted his favorite areas in Atlantic County, such as the Tuckahoe and Corbin City impoundments and Estell Manor County Park, and birders soon began to discover and enjoy the wonders and opportunities that the quality Great Egg Harbor habitats offered.

Yet even with increased visitation and coverage, most subsequently published avian-use data remained scattered or anecdotal at best -- chance sightings or non-systematic surveys (such as Christmas Bird Counts). State and federal waterfowl counts documented substantial use, yet

were conducted infrequently (usually only twice a year) with the results not readily unavailable or understandable to the public. In short, available records hinted at exceptional bird use of the area, but unfortunately offered biologists or planners little definitive data or mapping for use in resource management, land use planning, decision-making, or protection strategies.

Compared to the long-term in-depth studies on Cumberland County's Maurice River, and to lesser yet substantial data on the Cohansey River, little was known of raptor (hawk and eagle) and waterbird use of the Great Egg system. In studies dating back to 1987, the Maurice and the Cohansey Rivers have been intensively studied for raptors and waterbirds when compared to the Great Egg Harbor and Tuckahoe River system. Note: herein, "waterbirds" are defined largely as waterfowl (ducks and geese), wading birds (herons, egrets and ibis), other aquatic birds such as gulls, terns and loons, as well as shorebirds (sandpipers and plovers). Raptors for our study purposes include all diurnal birds of prey: eagles, hawks, falcons and vultures.

With this troubling lack of comprehensive or available data in mind, and with over-arching goals of discovery, documentation, awareness, and protection, in winter 2003-2004 a systematic survey of Great Egg Harbor River avian resources was initiated by the Great Egg Harbor Watershed Association. While ornithological findings for that first, single season were significant in their own right, most importantly it was realized that the establishment of a systematic survey methodology, survey route, and data collection protocol could allow for crucial comparisons over time. (Although initial findings provided a good baseline for future studies, there was no way of knowing whether the results were truly representative -- whether they represented an average, "good," or even "bad" year for winter bird-use). Because the first single-season effort did not allow for any assessment of long-term status and trends, winter season studies were then continued to the five year mark, and ultimately maintained to the arbitrary yet important ten year duration. Under the auspices of the Great Egg Harbor Watershed Association, and funded by grants from the National Park Service's Wild and Scenic River program, these winter raptor and waterbird studies continued through winter 2012-2013, generating a highly significant ten seasons of survey data. Ten seasons of study carried out with the same protocols and same observers is an unusual commodity in the documentation of avian resources in the Mid-Atlantic Region or anywhere, and the studies and their findings were soon found to substantially meet the original conservation goals envisioned by the Great Egg Harbor Watershed Association.

GOALS AND OBJECTIVES

Beginning in winter 2003-2004, a winter raptor and waterbird survey was funded and initiated by the Great Egg Harbor Watershed Association. These studies continued for ten winter seasons through winter 2012-2013, and are reported on herein. In the Mid-Atlantic Region, winter is an exceptional time for bird-use, particularly raptor and waterfowl use, of river and coastal wetlands habitats. Vast river and bay systems attract and support both a wide variety and large numbers of winter birds -- birds that have migrated in autumn from regions farther north and west, including high Arctic regions, to feed in milder, ice-free river and estuarine habitats. Winter is a key time of bird-use in southern New Jersey and a crucial time in the life cycle and survival of all Mid-Atlantic Region hawks, eagles, and waterfowl.

Although important avian use of the Great Egg occurs on a year-bound basis, the suspected importance of the area as a key wintering area called for systematic surveys to be conducted during the highly important winter season -- at a time when raptor and waterfowl numbers are at their yearly highest in the region. The goals of this Great Egg Harbor raptor and waterfowl survey, as determined at the outset in concert with the Great Egg Harbor Watershed Association, were as follows:

1. The establishment of an avian data base which, over time, can be used to determine status and trends in bird populations and bird use - such baseline data would be of particular importance as land use changes accelerate in the watershed.

2. The determination of key use areas by birds - possible eventual habitat rankings could be of real value in directing resource protection and acquisition prioritization, as well as specific wildlife management needs.

3. Submission of rare, threatened and endangered species records to the Endangered and Nongame Species Project (ENSP) of the NJDEP Division of Fish, Game and Wildlife (DFGW). By submission of copies of these ongoing reports, including all important mapping, findings of this study will supplement and aid ENSP's Landscape Project, Habitat Rules, Wildlife Incentive Programs, and other Department programs in protecting key Great Egg Harbor region habitats.

4. Bring recognition and publicity to the considerable avian resources of the Great Egg watershed. While there was considerable anecdotal information on the area's bird life, no systematic raptor or waterbird studies had been carried out prior to 2003-2004 on the Great Egg (excepting the DFGW's twice-annual waterfowl counts). The lack of Great Egg data on winter raptors, a hallmark feature of South Jersey river systems, was noteworthy in its absence prior to 2003 – far less was known about the Great Egg Harbor River than was known about the Maurice River, Cohansey River, or even the nearby Mullica River to the north.

5. The key objective of the survey efforts is to discover and provide cornerstone avian resource data to be used in river management and protection. Baseline knowledge -- backed by strong systematic data obtained by employing strict protocols -- can play a crucial role in decision making, land-use planning, and resource management on the great Egg Harbor River. Long-term monitoring, leading to a true understanding of avian status and trends over time (and in relation to a rapidly changing landscape), should play an important part in planning and protection for the Scenic and Recreational Great Egg Harbor River.

These goals and objectives, established by the researchers (authors) in concert with the Great Egg Harbor Watershed Association, of note were highly compatible and complimentary with the Association's overall mission to protect and restore the natural, cultural, and recreational resources of the Great Egg Harbor Watershed; to promote research and action to determine and secure a healthy river system; to expand public awareness, education, and appreciation of the watershed's valuable and unique resources; and to coordinate and/or facilitate permanent preservation of land within the watershed that is of high benefit to wildlife or rare plants.

METHODOLOGY

For ten full winter seasons, from the inaugural 2003-2004 study and continuing through the 2012-2013 season, raptor and waterbird surveys on the Great Egg Harbor River were conducted systematically between the first week of December and the fourth week of March. Seven to ten surveys were conducted each field season (ten year average was 8.2), at roughly the rate of once every two weeks during this winter period. It should be noted that early December sees some late "fall" migration into the South Jersey region, and that March is a time of substantial spring migration build-up, particularly in waterfowl numbers.

Two observers working together, Clay Sutton and James Dowdell, spent 45 minutes apiece at each of nine sampling sites. All raptors and waterbirds were tallied at each site, whether in flight or sitting (perched or on the water). All hawks and eagles were searched for in accordance with Sutton and Sutton (1994 and 1996). Raptors were identified, aged, and sexed in accordance with Dunne, Sibley, and Sutton (1986 and 2012), Clark and Wheeler (1987), Wheeler and Clark (1995), and Ligouri (2005 and 2011). Waterbirds were found and identified in accordance with Sibley (2000), Sutton, *et al.*, (2004), and, additionally, the two authors' many years of extensive field experience (collectively over 80 years….) throughout southern New Jersey and elsewhere.

Additional birds, most often raptors, observed *between* official count sites were recorded if, *and only if*, the observers were confident they had not been previously counted. For example, a low-flying Cooper's Hawk dashing across the road would be added to the count if it had not been observed at the previous site. While the nine sampling sites were generally far enough apart to preclude "double-counting," the observers used extreme care to avoid recounting the same bird or birds. For example, eagles range widely up and down the river; a Bald Eagle roosting at Lake Lenape may range east to Tuckahoe WMA or farther. A "new" eagle would only be counted when direction of flight, age, plumage, observed molt, or circumstance (such as concurrent sightings) would allow the observers to confidently assess that it could not possibly have been counted previously. Due to such constraints, counts of raptors as shown, particularly vultures and eagles, are thought to be conservative.

Waterfowl counts are also largely conservative; unless flushed by hunters, boats, or raptors, many ducks consistently remained out of sight in creek beds or guts. Also many distant ducks were often uncountable, unidentifiable, or unseen due to heat waves, haze, rough water, or distance from the observers. As discussed below, the Great Egg river basin is a very large area, and extremely wide in the lower portions. Counts are representative, but by no means exhaustive or complete. Total birds present are most always certainly higher than those counted and recorded. Note too that the large and important Tuckahoe River tributary was not counted by this methodology (nor was Great Cedar Swamp Creek), excepting for the site in the Tuckahoe Unit of the Tuckahoe WMA. Given that only the lower portion of the Tuckahoe River was counted, and not the upper tidal portion, good numbers of raptors and waterfowl were routinely missed, supporting the premise that overall daily counts shown for the system are conservative. (Adding an Upper Tuckahoe River point count site may have been desirable, but not practical or

even do-able given the short day lengths of mid-winter).

The Great Egg Harbor River is 49 miles long and drains a land area of approximately 304 square miles. The upper portions of the river corridor are largely wooded and do not lend themselves to easy sampling/counting of either raptors or waterfowl (nor are raptors or ducks as generally prevalent or as concentrated/abundant as on the tidal lower river portions of the system). The tidal portion of the Great Egg stretches about 12.6 miles (as measured on the centerline of the river) from the dam at Lake Lenape in Mays Landing to the mouth of the river (on a line connecting the beaches of Ocean City and Longport) where it meets the ocean in Great Egg Harbor Inlet. The 12.6 miles of tidal river and bay were sampled by this study.

The nine count locations, the official "Point Count" methodology sampling sites, are shown on **Map 1**. Some sites did have supplemental count locations (labeled A, B, and C on our field maps, but not on Map 1) to allow for all areas to be seen and thereby most birds counted. For example, the Tuckahoe Wildlife Management Area (WMA) site, Site 9, southeast of Tuckahoe has three impoundment pools, and not all pools can be viewed or counted from the same immediate location. Therefore, the Site 9 count is a composite of tallies taken at three separate locations, but only one final tally is given for the site on the daily and summary data sheets. In this case, the 45 minutes are expended at the three stops put together. Only by using such supplemental viewing locations could all birds, particularly waterbirds, be reasonably and reliably tallied to the greatest extent possible. In order to avoid time-of-day bias in the sampling technique, the route was reversed on each subsequent sampling date, run "upriver" and then "downriver" on alternate sampling days.

The nine sites ultimately settled upon as part of a reasonable, practical, representative, and opportunistic sampling route are as follows, (starting on the lower estuary and working upriver):

1. **Longport Bridge Fishing Pier.** This site allowed counting of the lower portion of Great Egg Harbor Bay and the Rainbow Channel/Rainbow Island area. Observations were made from both sides of the road so that the entire bay could be seen and counted.

2. **John F. Kennedy Park** in Somers Point. Allowed counting of the bay east of the Garden State Parkway Bridge. An alternate site was employed here; the foot of the Route 9 Bridge over Great Egg Harbor bay (north end) allowed the bay west of the bridges to be seen and censused.

3. **Jeffers Landing**, including a supplemental site (looking west) on Job's Point Road.

4. **English Creek Landing**, at Wharf Road. Both Jeffers Landing and English Creek Landing afforded excellent views of the vast and wide estuary where the river meets the bay.

5. **The "Upper" tidal river**. The principal and regular count location was from the Shady

River Marina on Route 559. A supplemental site used rarely (if and when waterfowl -- primarily Canada Geese -- were noted to be present in numbers) was "the bulkhead" in Mays Landing just south of Route 40.

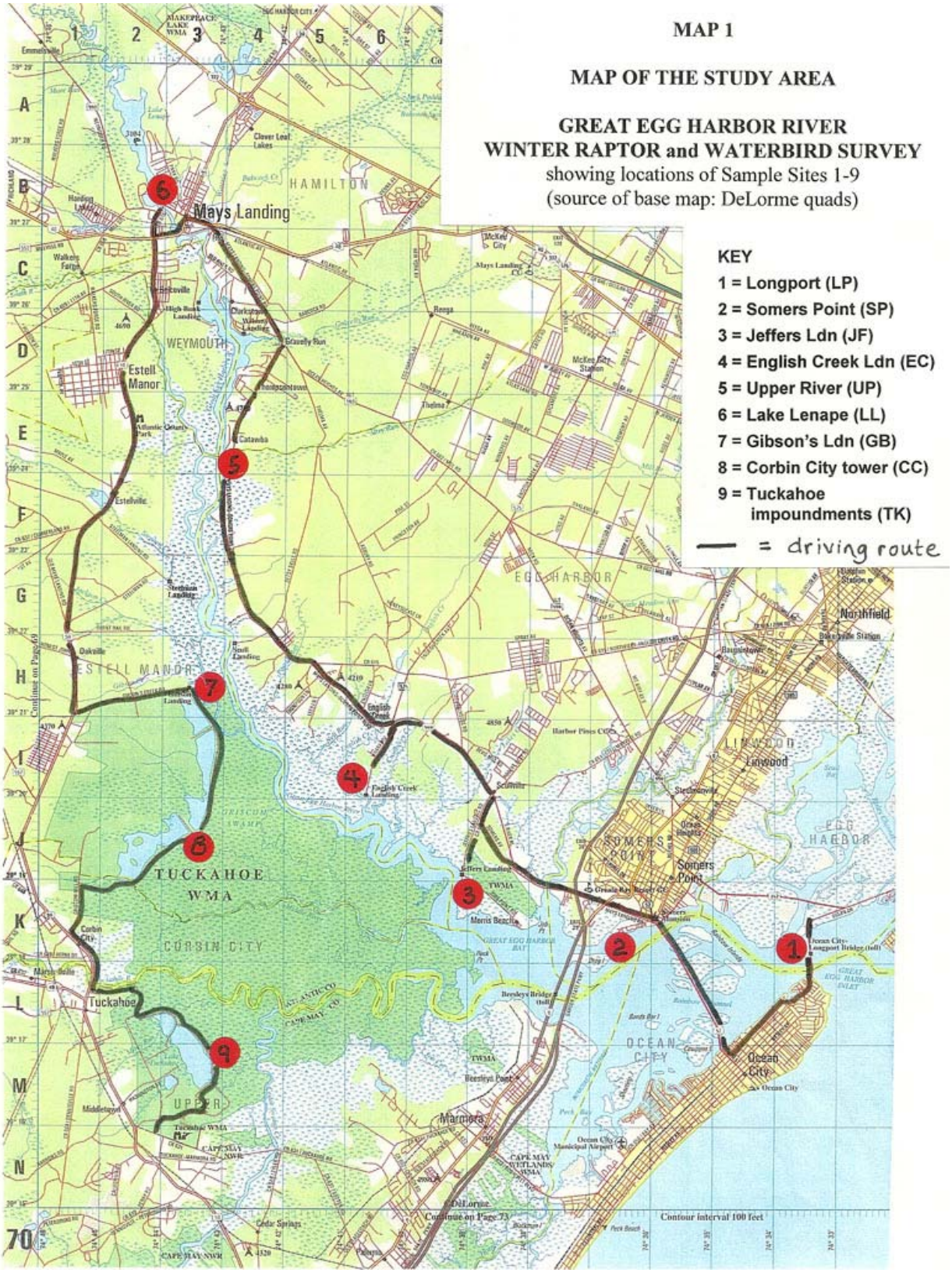
6. **Lake Lenape**. Observations were conducted from the berm adjacent to the dam's spillway in Mays Landing, just off CR 616, which offers an excellent view of the lake.

7. **Gibson Landing**, at the end of Gibson's Creek Road, at the northern end of the Corbin City unit of Tuckahoe WMA.

8. **Corbin City WMA.** The count was taken from the observation tower on the dike (wildlife drive) of the Corbin City unit of the Tuckahoe WMA. Here supplemental observation points were used in order to observe and count all of the various nooks and crannies of the several impoundments.

9. **Tuckahoe WMA**, from the dike (wildlife drive) of the Tuckahoe unit of the Tuckahoe WMA, including three supplemental stops which allowed all three impoundments to be viewed and counted. Particularly Site 9 allowed those raptors and waterfowl using the lower Tuckahoe River tributary to the Great Egg Harbor River basin to be included in survey results. This site was in Cape May County; all others were in Atlantic County.

To the greatest extent practicable, all counts were conducted in good weather. The observers carefully selected sampling days which were sunny and breezy, conditions which readily facilitate raptor hunting and movement along the river. Such conditions particularly allow for the best raptor counts; on cloudy, windless days raptors often spend much of their time perched, and therefore often are out of sight. While the technique used might be considered to be a combination of the time-honored "point count" and "transect" methods, birds recorded during the transits from site to site were infrequent and only included under the caveats expressed above. None-the-less, the route was always virtually the same, decreasing any variability possibly associated with this technique. The transect portion of the study – the driving route – was 44.1 miles in length, stretching from the Longport Bridge north and west to Mays Landing, then down the west side of the river to Tuckahoe WMA. This route is also shown on Map 1. In essence this study used standard point count techniques, yet did attempt to maximize sightings by adding any key observations gained while in transit -- thereby gaining a full picture of the numbers and diversity of the considerable avian resources present.


MAP 1
MAP OF THE STUDY AREA
GREAT EGG HARBOR RIVER
WINTER RAPTOR and WATERBIRD SURVEY
showing locations of Sample Sites 1-9
(source of base map: DeLorme quads)
KEY
1 = Longport (LP)
2 = Somers Point (SP)
3 = Jeffers Ldn (JF)
4 = English Creek Ldn (EC)
5 = Upper River (UP)
6 = Lake Lenape (LL)
7 = Gibson's Ldn (GB)
8 = Corbin City tower (CC)
9 = Tuckahoe impoundments (TK)
= driving route
Mays Landing
HAMILTON
WEYMOUTH
Estell Manor
ESTELL MANOR
TUCKAHOE WMA
CORBIN CITY
Tuckahoe
Marmora
EGG HARBOR
Somers Point
Ocean City
Northfield
Linwood
Contour interval 100 feet

FINDINGS

A total of 82 winter surveys were carried out over the ten winter seasons, beginning in winter 2003-2004 and running through winter 2012-2013, for an average of 8.2 surveys per winter. The results of the ten seasons of winter raptor and waterbird studies on the Great Egg Harbor River are shown in **Table 1**. Table 1 shows the peak numbers for all raptor and waterbird species for each of the ten seasons of study. The all-time high peak winter counts for the ten seasons of study are shown in **Bold Face.**

While average counts are of value in comparing data from year to year, and in part reflect the amount of time over the season which birds spend on the river (as well as the inevitable impacts of both daily and prolonged weather conditions upon count results), the peak count for many species far better reflects the true numbers present. For example, the peak of 1,238 American Black Ducks recorded on February 1, 2004, far better reflects the true number present than that year's seasonal average count of 365. Weather, ice, count conditions, tide, and access can greatly vary and alter the results of any given survey. This is why a minimum of 7-10 surveys per field season are required to confidently assess bird populations present in the system.

Table 2 represents a smaller subset of Table 1, and shows key signature raptor and waterfowl species found on the Great Egg Harbor River. Table 2 shows seasonal peaks and seasonal averages for 22 species for each of the ten winter field seasons. The all-time high peak winter count, or "best count" for each species, is also shown in **Bold Face** in Table 2 (as it was in Table1). Table 2 also shows the five-year average of the yearly peak counts, and the five-year average of the yearly average (mean) counts for key waterfowl and raptor species for *each of the five-year segments* of the ten year study. These numbers shown are a succinct and easy way to view and ascertain changes and trends in waterfowl and raptor populations on the Great Egg Harbor River over time. Finally, Table 2 shows the *overall* ten year averages -- of both peak and average (mean) counts -- for the ten years of study. This overall average allows for a comparison of the Great Egg with other rivers, such as the Mullica River (see below).

Ten intensive seasons of study on the Great Egg Harbor River have documented high concentrations of wintering raptors, wintering waterfowl, and other waterbirds. These populations are deemed significant and substantial for the Atlantic Coastal marshes in all of New Jersey, and in the Mid-Atlantic region. Few areas have reported numbers that rival the Great Egg Harbor River, and fewer still if any can claim the documentation that is now available for the Great Egg Harbor River. This data set for the Great Egg Harbor River clearly establishes it as one of the best studied rivers in New Jersey and in the region (second only to the lengthy studies of Cumberland County's Maurice River) and documents remarkable raptor and waterfowl numbers at a level few other areas or sites can match. Finally, we have gained important awareness and publicity that has brought overdue recognition to the extraordinary avian resources and ecotourism opportunities of the Great Egg Harbor River Watershed.

Table 1

Great Egg Harbor River
Winter Raptor and Waterbird Survey
10-YEAR SUMMARY – PEAK NUMBERS FOR EACH WINTER SEASON

	1	2	3	4	5	6	7	8	9	10
FIELD SEASON	**2003-2004**	**2004-2005**	**2005-2006**	**2006-2007**	**2007-2008**	**2008-2009**	**2009-2010**	**2010-2011**	**2011-2012**	**2012-2013**
	(N = 8)	**(N = 9)**	**(N = 7)**	**(N = 9)**	**(N = 10)**	**(N = 8)**	**(N = 8)**	**(N = 8)**	**(N = 8)**	**(N = 7)**
LOONS to CORMORANTS										
Red-throated Loon	3	7	8	17	22	33	12	22	**44**	18
Common Loon	20	27	21	31	42	**58**	32	25	33	39
Pied-billed Grebe	1	1	2	1	1	1	1	1	**4**	3
Horned Grebe	28	27	10	34	42	**77**	13	37	7	13
Red-necked Grebe	**3**	1		2					2	
Northern Gannet	1		5		**500**	3		2	7	
White Pelican		1								
Double-cr Cormorant	61	**464**	139	91	189	129	129	150	223	126
Great Cormorant	**3**	3	2	2	3	1				
HERONS to VULTURES										
American Bittern		1		1						
Great Blue Heron	22	29	22	29	27	**38**	22	15	16	19
Great Egret	2	21	2	3	28	11	5	15	**31**	30
Snowy Egret					1	1			**2**	
Black-cr Night-Heron			1			1				1
Glossy Ibis									1	
Black Vulture	5	5	**16**	11	12	12	**16**	11	12	12
Turkey Vulture	120	110	106	**132**	106	116	128	96	114	119
WATERFOWL										
Snow Goose	**110**	70		3				1	46	
Canada Goose	764	**906**	474	442	562	573	388	655	458	444
Brant	2425	**5440**	1570	1332	4984	3505	1761	2550	1560	922
"Black Brant"							1			1
Mute Swan	89	84	**126**	92	94	77	79	93	59	87
Tundra Swan	23	38	27	12	24	54	21	**80**	24	14
Wood Duck		**6**	**6**	2	1	2			1	

Peak Counts are **BOLD FACED**
N = number of surveys per field season

Osprey* -- number shows peak spring count (not a wintering species)

Table 1

Great Egg Harbor River
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	1	2	3	4	5	6	7	8	9	10
FIELD SEASON	**2003-2004**	**2004-2005**	**2005-2006**	**2006-2007**	**2007-2008**	**2008-2009**	**2009-2010**	**2010-2011**	**2011-2012**	**2012-2013**
	(N = 8)	**(N = 9)**	**(N = 7)**	**(N = 9)**	**(N = 10)**	**(N = 8)**	**(N = 8)**	**(N = 8)**	**(N = 8)**	**(N = 7)**
Gadwall	27	12	16	42	32	71	40	**162**	64	22
Eurasian Wigeon					1			1	1	1
American Wigeon	20	114	28	35	97	178	111	218	**264**	190
Am. Black Duck	1238	1115	868	813	882	904	941	**1369**	1037	670
Mallard	220	172	203	104	263	130	244	**683**	393	230
Blue-winged Teal	2	**9**	2		8			2	1	
Northern Shoveler			17	6	**37**	2	1	4	14	
Northern Pintail	497	484	644	443	783	761	372	**1294**	1205	560
Green-winged Teal	1032	859	1140	949	**2510**	1763	1002	1264	1424	644
"Common Teal"	1	**3**	1	2	1			2	2	2
Canvasback		**8**			1			1		
Redhead	2			**8**		5				
Ring-necked Duck	12	7	11	**111**	2	12	17	20	15	7
Greater Scaup	301	75	1	**4158**	60	4		6	12	2
Lesser Scaup	20	1	10	**2142**	1	28		320	5	21
Scaup (sp.)	**7050**	4300	750	6555	800	3100	2140	3706	600	35
Common Eider						1	**30**	20	25	
Harlequin Duck							2			
Surf Scoter	2	150	100	1	14	30	**405**	20	2	16
White-winged Scoter		2			1			**3**	3	
Black Scoter		50	60		3	40	**150**	80	20	11
Scoter (sp.)		300	**800**		50	2	120	80	15	7
Long-tailed Duck	120	415	66	184	**484**	94	365	70	76	38
Bufflehead	1168	599	815	703	1088	1280	1079	**1670**	304	322
Com. Goldeneye	**61**	22	56	35	48	49	20	32	14	22
Hooded Merganser	34	138	149	107	138	**192**	146	166	180	56
Com. Merganser	91	**205**	48	181	141	133	122	99	40	18
Red-breasted Merganser	172	**180**	165	178	140	144	124	85	113	103

Peak Counts are **BOLD FACED**
N = number of surveys per field season

Osprey* -- number shows peak spring count (not a wintering species)

Table 1

Great Egg Harbor River
Winter Raptor and Waterbird Survey
10-YEAR SUMMARY – PEAK NUMBERS FOR EACH WINTER SEASON

FIELD SEASON	1 2003-2004 (N = 8)	2 2004-2005 (N = 9)	3 2005-2006 (N = 7)	4 2006-2007 (N = 9)	5 2007-2008 (N = 10)	6 2008-2009 (N = 8)	7 2009-2010 (N = 8)	8 2010-2011 (N = 8)	9 2011-2012 (N = 8)	10 2012-2013 (N = 7)
Ruddy Duck	3	6	**24**	4	6			1	1	1
DIURNAL RAPTORS										
Osprey *	7	**45**	6	15	39	17	23	13	22	19
Bald Eagle	14	11	18	16	18	22	**24**	15	19	17
Northern Harrier	41	**47**	37	38	**47**	37	34	28	29	22
Sharp-shinned Hawk	1	7	5	2	6	**17**	2	2	5	2
Cooper's Hawk	3	**5**	4	2	4	3	**5**	3	2	2
Northern Goshawk	1	1				1				
Red-shouldered Hawk	**4**	3	1	1	2	1	1	1	1	2
Red-tailed Hawk	57	56	59	57	49	49	52	**71**	42	40
Rough-legged Hawk	9	**10**	5	2	4	3	3	3	2	2
Golden Eagle	1	**2**	2	1		1	1	1	1	2
American Kestrel		3	**4**	1			1	**4**	1	
Merlin	1	**2**		**2**				1		
Peregrine Falcon	3	3	4	**6**	4	4	4	5	5	4
GROUSE to SHOREBIRDS										
Ring-necked Pheasant	1		**3**	1	2	1			**3**	
Wild Turkey			12					6	**16**	
Clapper Rail	1		1						1	1
Virginia Rail	2					1			1	
American Coot					**6**			2		
Black-bellied Plover	6	6	11	3	10	**55**	26	19	5	18
Semipalmated Plover				1						**6**
Killdeer	3	3		4	**14**	7	2	2	2	2
Am. Oystercatcher	30	52	54	57	67	57	43	**102**	37	68
Greater Yellowlegs	12	13	36	20	**89**	27	17	28	42	22
Lesser Yellowlegs	1	1	2	1	8			2	**13**	10
Willet ("Western Willet")								1		

Peak Counts are **BOLD FACED**
N = number of surveys per field season

Osprey* -- number shows peak spring count (not a wintering species)

Table 1

Great Egg Harbor River
Winter Raptor and Waterbird Survey
10-YEAR SUMMARY – PEAK NUMBERS FOR EACH WINTER SEASON

	1	2	3	4	5	6	7	8	9	10
FIELD SEASON	**2003-2004**	**2004-2005**	**2005-2006**	**2006-2007**	**2007-2008**	**2008-2009**	**2009-2010**	**2010-2011**	**2011-2012**	**2012-2013**
	(N = 8)	**(N = 9)**	**(N = 7)**	**(N = 9)**	**(N = 10)**	**(N = 8)**	**(N = 8)**	**(N = 8)**	**(N = 8)**	**(N = 7)**
Marbled Godwit			1						**3**	
Ruddy Turnstone	10					**48**	40	1		
Sanderling	75	20	27	40	90	130	**205**	70		26
Western Sandpiper			**3**			2				
Least Sandpiper										1
Pectoral Sandpiper					2					
Purple Sandpiper						30	**80**	1	10	
Dunlin	801	450	686	445	1225	**2460**	1171	483	285	460
Wilson's Snipe	**6**	5	5	2	2	1	1	2	1	4
American Woodcock	1	3		2		1	**4**			3
GULLS to ALCIDS										
Laughing Gull *							27	4	**122**	
Bonaparte's Gull		**400**	1	150		3	1		7	2
Ring-billed Gull	√	√	√	√	√	√	√	√	√	√
Herring Gull	√	√	√	√	√	√	√	√	√	√
Iceland Gull						1				
Great Black-backed Gull	√	√	√	√	√	√	√	√	√	√
Lesser Black-backed Gull								1	1	
Caspian Tern				1						
Sandwich Tern			1							
Forster's Tern		2								
Black Skimmer						**2**	1			
OWLS to KINGFISHERS										
E. Screech Owl			1			1				
Great Horned Owl	**4**		1		1	2	1	1	2	1
Short-eared Owl	6	7	5	0	**10**	0	0	2	0	0
Belted Kingfisher	6	7	**10**	6	5	7	4	4	5	5

Peak Counts are **BOLD FACED**
N = number of surveys per field season

Osprey* -- number shows peak spring count (not a wintering species)

Table 2

Comparison of Winter Raptor and Waterfowl Totals
Great Egg Harbor River
Winter 2003-2004 to Winter 2012-2013

	2003 - 2004		2004 - 2005		2005 - 2006		2006 - 2007		2007 - 2008		2008 - 2009		2009 - 2010	
	PEAK	AVG.	PEAK	AVG.	PEAK	AVG.	PEAK	AVG.	PEAK	AVG.	PEAK	AVG.	PEAK	AVG.
	(N = 8)		(N = 9)		(N = 7)		(N = 9)		(N = 10)		(N = 8)		(N = 8)	
WATERFOWL:														
Canada Goose	764	322	**906**	359	474	267	442	183	562	270	573	213	388	270
Brant	2,425	985	**5,440**	3,125	1,570	893	1,332	856	4984	2484	3505	1920	1761	979
Am. Black Duck	1,238	365	1,115	647	868	481	813	517	882	556	904	582	941	505
Mallard	220	73	172	74	203	82	104	48	263	115	130	63	244	62
Northern Pintail	497	106	484	132	644	212	443	149	783	349	761	339	372	95
Green-winged Teal	1,032	172	859	229	1,140	276	949	298	**2510**	894	1763	650	1002	209
Bufflehead	1,168	467	599	343	815	418	703	345	1088	421	1280	474	1079	391
Red-breasted Merganser	172	86	**180**	92	165	79	178	99	140	78	144	68	124	67
RAPTORS:														
Black Vulture	5	1.5	5	3.2	**16**	6.4	11	4.2	12	3.8	12	4.5	**16**	6
Turkey Vulture	120	61	110	76	106	86	**132**	106	106	83	116	87	128	82
Bald Eagle	14	8.25	11	7.3	18	8.9	16	8.2	18	9.1	22	12.75	**24**	14.63
Northern Harrier	41	31	**47**	36	37	27	38	26	**47**	34	37	31	34	23
Sharp-shinned Hawk	3	0.88	7	1.7	5	2.4	2	0.89	6	1.78	**17**	4.38	2	1.13
Cooper's Hawk	3	1.13	**5**	1.9	4	2	2	1.0	4	1.3	3	1.88	**5**	2.63
Northern Goshawk	1	0.13	1	0.1	0	0	0	0.0	0	0	1	0.13	0	0
Red-shouldered Hawk	**4**	0.9	3	0.63	1	0.43	1	0.33	2	0.33	1	0.5	1	0.13
Red-tailed Hawk	57	40	56	45	59	42	57	41	49	38	49	35	52	33
Rough-legged Hawk	9	3.38	**10**	4.6	5	2.3	2	1.0	4	1.78	3	1.25	3	0.88
Golden Eagle	1	0.38	**2**	0.8	**2**	0.43	1	0.22	0	0	1	0.25	1	0.13
Am. Kestrel	0	0	3	0.3	**4**	0.57	1	0.22	0	0	0	0	1	0.25
Merlin	1	0.11	**2**	0.3	0	0	**2**	0.22	0	0	0	0	0	0
Peregrine Falcon	3	1.38	3	1.6	4	2.7	**6**	1.89	4	1.89	4	2.63	4	2.75

All-time highest counts shown in **BOLD FACE**
N = number of surveys per field season

Table 2

Comparison of Winter Raptor and Waterfowl Totals
Great Egg Harbor River
Winter 2003-2004 to Winter 2012-2013

	2010 - 2011		2011 - 2012		2012 - 2013		1st 5 Year Segment		2nd 5 Year Segment		10 Year Overall	
	PEAK	AVG.	PEAK	AVG.	PEAK	AVG.	2003 - 2008		2008 - 2013		2003 - 2013	
	(N = 8)		(N = 8)		(N = 8)		PEAK	AVG.	PEAK	AVG.	PEAK	AVG.
WATERFOWL:												
Canada Goose	655	377	458	187	444	252	630	280	504	260	567	270
Brant	2550	1173	1560	917	922	538	3150	1669	2060	1105	2605	1387
Am. Black Duck	**1369**	657	1037	484	670	437	983	513	984	533	984	523
Mallard	**683**	245	393	174	230	89	192	78	336	127	264	103
Northern Pintail	**1294**	409	1205	351	560	202	570	190	838	279	704	234
Green-winged Teal	1264	385	1424	602	644	134	1298	374	1219	396	1259	385
Bufflehead	**1670**	571	304	199	322	155	875	399	931	358	903	378
Red-breasted Merganser	85	47	113	53	103	50	167	87	114	57	140	72
RAPTORS:												
Black Vulture	11	4.88	12	6	12	7.14	9.8	3.82	12.6	5.7	11.2	4.76
Turkey Vulture	96	75	114	91	119	87	115	82	115	84	115	83
Bald Eagle	15	9.25	19	11	17	13.43	15.4	8.35	19.4	12.21	17.4	10.28
Northern Harrier	28	22	29	20	22	14	42	31	30	22	36	26
Sharp-shinned Hawk	2	1.25	5	1.25	2	0.86	4.6	1.53	5.6	1.77	5.1	1.65
Cooper's Hawk	3	1.38	2	1.25	2	1.29	3.6	1.47	3	1.69	3.3	1.58
Northern Goshawk	0	0	0	0	0	0	0.4	0.05	0.2	0.03	0.3	0.04
Red-shouldered Hawk	1	0.38	1	0.25	2	0.43	2.2	0.52	1.2	0.34	1.7	0.43
Red-tailed Hawk	**71**	35	42	28	40	31	56	41	51	32	53	37
Rough-legged Hawk	3	1.13	2	0.88	2	1.14	6	2.61	2.6	1.06	4.3	1.83
Golden Eagle	1	0.13	1	0.38	2	0.71	1.2	0.37	1.2	0.32	1.2	0.34
Am. Kestrel	**4**	0.63	1	0.13	0	0	1.6	0.22	1.2	0.2	1.4	0.21
Merlin	1	0.38	0	0	0	0	1	0.13	0.2	0.08	0.6	0.1
Peregrine Falcon	5	2	5	2.5	4	3.43	4	1.89	4.4	2.66	4.2	2.28

All-time highest counts shown in **BOLD FACE**
N = number of surveys per field season

DISCUSSION:

WINTER RAPTORS OF THE GREAT EGG HARBOR

Wintering populations of birds of prey are a characteristic feature of coastal New Jersey woodlands and marshes. These raptor concentrations occur in part as a result of the well-known coastal fall migration of hawks through the region, as migrants pause and "stage" here, and (for many) then choose to remain in the food-rich, quality habitats available throughout southern New Jersey.

The Great Egg Harbor River system hosts large numbers of wintering raptors. Ten years of winter study have documented 15 species of wintering raptors (including vultures) on the Great Egg, with at least 13 species occurring annually. The Great Egg hosts one of the highest assemblages of raptors in New Jersey, with similar numbers unrecorded, or at least unreported, elsewhere in the state excepting the Delaware Bay's Maurice River (see Literature Cited/For Further Reference). Accordingly, wintering raptors are a high ecovalue of the Great Egg Harbor River. Diversity and numbers are excellent, not only for New Jersey, but also for the entire Mid-Atlantic coastal region. Species by species accounts follow, with discussions that mostly address current and overall status (2003-2013) rather than significant trends, as the two five-year segments -- ten years total -- do not yield a lengthy enough time span to allow for an in-depth understanding of true long-term trends. That said, a few trends are indeed obvious, and are discussed below and throughout.

Black Vulture

Black Vultures continue to expand their range and numbers in the Northeast and in New Jersey. They are a southern species well known to rapidly be moving northward. They remain, however, somewhat uncommon away from the Delaware Bayshore and the Cape May peninsula in winter. They are none-the-less daily on the Great Egg at all seasons. A peak daily high or "best count" of 16 was achieved on two occasions, and the ten-year overall daily average was 4.76 birds per survey. When comparing the averages of the two five-year segments, wintering Black Vultures increased by 49 % over the course of this ten year study, reflecting and at the same time proving an observed regional trend.

Turkey Vulture

Turkey Vultures, sometimes called "buzzards" by locals, are a staple of winter on the Great Egg. A peak daily high of 132 and a ten-year daily average of 83 both indicate that vultures are in sight daily in numbers at virtually all survey locations, and that nature's clean-up crew is hard at work on the Great Egg. Of interest, there was virtually no change in numbers when comparing the two five-year segments of the study.

Osprey

Osprey, known to many as "Fish Hawks," migrate to warmer climes in fall, and do not (normally) winter in the Mid-Atlantic; numbers shown in Table 1 are those "spring arrivals" recorded during the last survey of the winter season study period, during the third or fourth week of March. That said, in winter 2007-2008, an Osprey successfully wintered on the Great Egg (as did one on/adjacent to the Mullica River, at Forsythe NWR). Also, although not seen on our surveys, an Osprey was reliably reported on the Great Egg on 18 January 2013. To our knowledge, these are the first winters that this has ever occurred, and -- reflecting warmer winter temperatures, warmer waters, and the availability of fish as prey – wintering Osprey perhaps may be an indicator of climate change.

Bald Eagle

Bald Eagles are today a hallmark of the Great Egg in winter, and even in just ten years of data increasing numbers can easily be seen. Bald Eagles increased by 46 % over the course of this study when comparing the average counts from the two five-year segments. A peak daily high counts of 24 Bald Eagles was achieved during the 2009-2010 study season, and a ten-year average of 10.28 Bald Eagles were recorded per survey. Augmenting true "wintering" birds (mostly immatures) from farther north, a minimum of eight pairs of Bald Eagles today nest in the Great Egg system (including birds from beyond the river's mainstem study area, such as those on the upper Great Egg, the Tuckahoe River, and Great Cedar Swamp Creek). The Great Egg complex is one of the best and most reliable places in Atlantic coastal New Jersey to see Bald Eagles, and only the Mullica River rivals the Great Egg for wintering eagles. Unlike in the not so distant past, Bald Eagles are a daily sight over the Great Egg Harbor River and its tributaries. The upward trend and comeback of Bald Eagles would be even more readily seen had not the final four years of the ten year study been rather mild – with mostly ice-free waters. By far the most eagles are found during bitter cold winters when frozen conditions to our north drive them south – to find an abundance of prey concentrated in the fast moving and therefore open waters of the South Jersey rivers and bays.

Golden Eagle

Whereas Bald Eagles nest in the region, Golden Eagles do not. Golden Eagles recorded in winter in New Jersey are migrants from the far north and west (most East Coast Golden Eagles breed in the James Bay/Hudson Bay region). The Great Egg has proven to be one of the top areas in the East to see wintering Golden Eagles. Two to three individuals are recorded most winters; peaks of two were recorded three times, and the daily average is 0.34 – numbers achieved elsewhere in New Jersey only from the Mullica River (and only rarely from anywhere else in the Mid-Atlantic region). Whereas the Bald Eagle is more of an opportunist and even a scavenger, the Golden Eagle is characterized as a true hunter. Seeing a Golden high up in a gale, quartering the wind over the vastness of Great Egg -- a speck against the gray winter clouds, hunting Black Ducks that it takes on the wing in characteristic rocketing dives or "stoops," -- was an infrequent yet always glowing highlight of these studies for the researchers/authors.

Northern Harrier

The Northern Harrier or "Marsh Hawk" is another popular and conspicuous signature species of the winter marsh. They were recorded in large numbers on the Great Egg, with a best count of 47 (achieved twice) and a ten-year average of 26 recorded per day. The daily average for Harriers declined 29 % when comparing the two five-year segments of the study, possibly as a result of coastal storms and habitat change associated with sea level rise. This is discussed in greater detail below.

Sharp-shinned Hawk

This small forest-dwelling accipiter is secretive in winter, and certainly more numerous than those tallied on any given day. Up to 17 Sharp-shinned Hawks have been recorded in a day, although this number reflects a very late "fall migration" movement (4 December) that coincided with the very first days of the official winter count period that began 1 December. The ten-year average of yearly peak counts is 5.1, and the daily average over the ten years is 1.65 birds per survey. None-the-less, far more of these furtive hawks are present than are usually counted, and counts recorded herein are highly conservative for both Sharp-shinned Hawk and Cooper's Hawks.

Cooper's Hawk

Also retiring in winter, this larger accipiter is only very slightly less numerous than Sharp-shinned Hawk on the Great Egg in winter. The peak is 5 birds in a day (recorded twice), with a ten-year daily average of 1.58 recorded. A 15 % increase is seen when comparing the two five-year segments, once again proving a suspected region-wide trend. Like Osprey and Bald Eagles, Cooper's Hawks have recovered in recent decades from a major decline linked to former the use of DDT.

Northern Goshawk

The Goshawk is a very large accipiter of the northern forests. More irruptive (in response to food shortages) than truly migratory in the Mid-Atlantic, they only rarely reach Southern New Jersey in fall or winter. Goshawks are uncommon to rare anywhere in New Jersey in winter or at any season, and generally secretive as well. A total of three individuals, all immatures (as expected), were recorded during the ten years of survey efforts.

Red-shouldered Hawk

The Red-shoulder is another forest-dwelling raptor that is always no doubt considerably more numerous than those seen and recorded. Most are seen during the coldest winter days when they sit low on sunlit edges – both to warm up and to seek prey attracted and activated by the sun and warmth. A peak of 4 was tallied, and the 10-year average was 0.43 birds per survey, meaning roughly that one was seen about every second survey.

Red-tailed Hawk

Red-tails are by far the most conspicuous of all our wintering hawks, and were present

along the length of the Great Egg in excellent numbers – attracted by the feeding opportunities offered by the bounty of the vast salt marshes and upland edge. Highest numbers were recorded in early winter or late winter when late fall migrants or early spring migrants augmented "local resident" and wintering Red-tailed Hawks. An excellent and extraordinary peak of 71 was carefully counted on 11 February 2011, by far our highest count (second highest was 59) and a number that no doubt included some very early northbound migrants. The ten-year average of 37 is much more indicative of the numbers of Red-tails encountered on a given winter day. Red-tails are a common and welcome part of the Great Egg Harbor landscape at any season, yet a bird that appeared to decline, on average, by 22 % in the second five-year segment of study (see discussion below).

Rough-legged Hawk

Even though it is found in small numbers (low density), the Rough-legged Hawk can be thought of as a flagship species of the Great Egg winter wetlands. Even prior to this study, the Tuckahoe/Corbin City/Great Egg complex was widely known as one of the best places to see Rough-legged Hawks in New Jersey. This survey only confirmed and corroborated this reputation. An excellent peak count of 10 was tallied in winter 2004-2005, and an overall ten-year average of 1.83 was seen per survey. Each winter season, the vast marshes of the lower river attract good but variable numbers of this charismatic winter visitor from the high Arctic regions. The irruptive and nomadic behavior of Rough-legs results in counts that vary considerably from year to year on the Great Egg and elsewhere in the region. That said, there is evidence (when comparing the average of five-year segments) of a 59 % decline in Rough-leg use of the Great Egg, possibly linked to habitat change, sea level rise, and coastal storm events (also see below). It is fairly well-known that many or most Rough-legs remain farther north during warmer winters.

American Kestrel

This small falcon was once a staple in southern New Jersey, gracing pastures, meadows and roadsides alike. Yet during this survey, very few were seen, and even those that were seen represented mostly early spring migrants, not wintering birds. The peak was a mere 4, and the average a dismal 0.21 per survey. The American Kestrel, once common in the general area, has today virtually disappeared as a wintering bird (and nesting bird….) throughout southern New Jersey. (See comments under historical data). To our knowledge, not a single individual truly wintered (spent the entire winter or even a good portion of it) in the study area during the entire ten years of study. This was perhaps the most sobering finding of all, as we realize that this former keystone species has completely vanished in a few short decades.

Merlin

Merlin are northern forest nesters and highly migratory. Most Merlin spend the winter far to the south of New Jersey, yet a few always remain in our area near the northern limit of

their winter range. One to two are present during most winters (peak of 2 on two occasions), yet the ten-year average was only a paltry .10 Merlin recorded per survey. This was a somewhat surprising finding, as Merlin are decidedly more prevalent in southern Cape May County in winter.

Peregrine Falcon

Two pairs of Peregrines nest on the lower Great Egg Harbor River (on a Tuckahoe WMA artificial nest box tower erected and maintained by ENSP, and formerly under the Garden State Parkway Bridge – now relocated to a new nest box on Drag Island due to the reconstruction of the Parkway Bridge). These residents are supplemented in winter by other wintering birds, usually immatures. Peregrine was by far the most common winter falcon on the Great Egg, with a best count of an excellent 6, and a daily average of 2.28. The Peregrine is another former victim of DDT that has recovered exceptionally in recent decades, and an increase (in average) of 41 % can readily be seen when comparing the first and second five-year segments of this study. Although uncommon (low density), Peregrines are fast, powerful and iconic hunters of teal and shorebirds on the expansive wide open marshes of the Great Egg estuary, and always a welcome find during our winter searches.

Short-eared Owl

Crepuscular (active in the dim light of dawn or dusk) if not truly diurnal in its habits, the Short-eared Owl is the one owl which can be in-part censused during daylight hours (and using the methodology of this study). As with Rough-legged Hawk, the Great Egg Harbor River area -- specifically the dikes at Tuckahoe and Corbin City WMA -- have long been known to be one of the best and most reliable places in all of New Jersey to find and enjoy Short-eared Owls. An irruptive species, they were recorded in numbers during 4 of the first 5 winter seasons. A peak count of 10 Short-ears was recorded near sunset at Tuckahoe WMA (winter, 2007-2008). A targeted effort (at dusk) would have undoubtedly revealed a number of additional Short-ears, and it can be conservatively estimated that up to 12-15 Short-eared Owls have wintered on the lower Great Egg in some years. Accordingly, the Great Egg amply maintained its reputation for hosting some of the highest regional numbers of this always exciting wetlands/open country owl species. However, a marked decline in numbers during the second five-year segment is troubling, and may well be linked to the observed loss in Rough-legged Hawk and Northern Harrier, and will be discussed in greater depth below.

DISCUSSION:

WINTER WATERFOWL AND WATERBIRDS OF THE GREAT EGG HARBOR

Great Egg Harbor Bay was found to be an excellent wintering area for waterbirds. Good numbers of Common Loons, Red-throated Loons, and Horned Grebes use the lower bay in winter. Northern Gannets often fish the inlet in notable numbers. The Great Egg Harbor Bay area is unique in southern New Jersey in having a substantial wintering population of Double-crested Cormorants, and a few Great Cormorants are usually present as well. Great Blue Herons commonly winter (and breed), and late winter sees an influx of returning spring migrant herons, egrets, and Glossy Ibis.

Fourteen species of shorebirds were found by core winter survey efforts. Winter is not a time of substantial shorebird use in the mid-Atlantic, yet shorebirds were found to use Great Egg Harbor Bay winter mudflats in some numbers – mostly east of the Garden State Parkway Bridge. Up to 2,460 Dunlin were counted in winter , and up to 102 American Oystercatchers have been tallied during the winter season, an excellent total for a place near the northern limit of this bird's winter range. And, as we will discuss subsequently, targeted seasonal shorebird surveys in spring and fall of the Great Egg Harbor Bay mudflats have documented major migrant shorebird use during migration.

Waterfowl use of the Great Egg Harbor River and Bay system is a signature avian phenomenon -- substantial and highly significant in the region and in New Jersey. Thirty-two species of waterfowl (and two notable subspecies) were found by survey efforts over the ten years of study, and high regional winter concentrations were documented for a number of key species.

Canada Goose

A ten-year average of 270 Canada Geese per survey was achieved for the route, and a peak count of 906 was tallied. While some Canadas were no doubt "local" geese, the high mid-winter counts also include many wild migrant Canada Geese driven to the region by snow and ice conditions farther north. Numbers appear fairly stable over the study period, without the expected increase that one would expect. It is possible however, indeed likely, that a probable substantial increase in local geese is being masked by the well-known decline of wild northern Canada Goose populations.

Brant

Among waterfowl, Brant, a small salt-water goose, is a hallmark species of Great Egg Harbor Bay, attracted to the rich, shallow-water bays and mudflats in vast flocks. The peak count of 5,440 is regionally significant, and better and more accurately reflects Great Egg usage than the more modest ten-year daily average of 1,387. Daily Brant locations (and numbers) vary greatly in winter in response to tide, wind direction, ice conditions, and waterfowl hunting

pressure. There is some evidence of a decline over the course of the study, mainly toward the end, possibly and speculatively linked to increasing coastal storms and damage to shallow waters and mudflats -- and to the Brant's principal food supply, *Ulva* or sea lettuce. Single "Black Brant," the western subspecies (race) were seen on two occasions, always a noteworthy find in New Jersey, and hint at the vast distances some birds travel to reach the Great Egg.

American Black Duck

Likewise, the all-time peak of 1,369 Black Ducks better reflects known use than the considerably lower ten-year average of 523. Black Ducks are a highly representative species of the Atlantic Coastal marshes, and Great Egg populations are judged substantial and significant in New Jersey for this species of special concern. Of interest is that the peaks and averages are virtually identical for the first and second five-year segments, indicating that the population of Black Ducks on the Great Egg is remarkably stable, and not exhibiting the serious declines that have been noted on the Maurice River and elsewhere in recent years.

Mallard

With little of their preferred brackish and fresh water marsh available, Mallards are never abundant on the Great Egg. A good peak of 683 and a more modest ten-year daily average of 103 were found. Mallards were found to be exhibiting a slight but noticeable increase over the course of the long-term study. Most were found in the quality habitat found at Corbin City WMA in late winter and early spring.

Northern Pintail

Pintail are never abundant in early winter, yet become quite numerous by late January and February. Pintails are known for spring "staging" in our region and peak numbers generally occur in early March on their return journey north. An excellent peak of 1,294 was tallied, making the Pintail almost as numerous as Black Duck in the Great Egg system. The ten-year daily average of 234 reflects the relatively brief time that Pintails spend in the region on their journey north, although there is good evidence (in the growing peaks and averages) that with milder winters, Pintails are indeed spending more time in the region (because they are theoretically not going as far south as they did historically). Most of these handsome ducks were found in the slightly brackish Tuckahoe WMA and Corbin City WMA impoundments.

Green-winged Teal

As with Pintails, most teal were also recorded in the Tuckahoe and Corbin City WMA impoundments. The peak count occurred in the fifth season of study, with 2,510 recorded. There is some evidence that teal numbers are increasing; the average grew slightly over time, with a ten year average of 385 seen daily. As with Pintail, Green-winged Teal pause relatively briefly in the region during their rapid spring return migration northward. None-the-less, teal numbers recorded on the Great Egg are quite significant for New Jersey. "Common Teal," the Eurasian race of Green-winged Teal (and a candidate for "splitting" -- becoming a full species), are seen almost annually at Tuckahoe and Corbin City WMAs and in numbers; a high of three were seen in winter 2004-2005. Common Teal are a rare and desirable find for birders, and the Great Egg

is arguably the best spot in New Jersey to reliably spot this handsome Eurasian duck.

Diving Ducks

The vast rafts of diving ducks found on Great Egg Harbor Bay were a delight and a key finding of the study. Anecdotally, the Great Egg Harbor Bay has long been known to support a large concentration of diving ducks in winter, but to our knowledge it had never been quantified prior to these studies. In winter 2003-2004, the bay supported a flock of over 7,050 scaup and high numbers of other divers as well; similar numbers were also present in winter 2006-2007. Only in mild winters are diving ducks absent in numbers as warmer and ice-free waters allow the majority to remain north of our region.

Typically, **Greater Scaup** outnumber **Lesser Scaup** by about a 10:1 ratio in salt water in winter (Walsh, et al, 1999). Therefore Great Egg Harbor Bay scaup are mostly Greater Scaup, yet both species were clearly present. The 2006-2007 flock held over 4,000 Greater Scaup and over 2,000 Lesser Scaup. These are highly significant counts for Southern New Jersey. In New Jersey only Raritan Bay and Sandy Hook (and historically Barnegat Bay) typically have higher counts. The Great Egg Harbor Bay is an important wintering area for scaup during most winters.

Hooded Mergansers are mostly found in the Tuckahoe and Corbin City WMA impoundments, and present in good numbers, with up to 192 counted. **Common Merganser** numbers varied from year to year, with largest numbers present during the coldest winters – when birds are pushed south as rivers and lakes to the north freeze. A peak number of 205 was counted in winter 2004-2005, and only 18 during the extremely mild 2012-2013 winter season. **Red-breasted Mergansers** (peak 180) were more scattered but present in high numbers too.

The 1,168 **Bufflehead** counted on February 1, 2004, were an all-time, all-place winter maximum for New Jersey (Walsh, et al, 1999), and that record was broken with the 1,670 counted on 11 February 2011! Bufflehead are usually widely spread from near Job Point to Great Egg Inlet, an attractive and active icon of Great Egg Harbor Bay in winter. The numbers of this keystone species documented for the lower Great Egg are a major discovery of the study.

Long-tailed Ducks (formerly known as the Old Squaw) are present in remarkable numbers in colder winters in the lower bay and inlet, with an excellent 484 recorded on 31 March 2008 (and 560 on 10 April – outside of the official winter count period/protocol). Great Egg Inlet has also hosted a small flock of (up to 30) **Common Eiders** in recent winters, as Common Eiders increase their numbers and range in New England and southward. In summary, the Great Egg Harbor River and Bay hosts an exceptional array of diving ducks in winter, particularly during harsher winters when greater numbers are pushed south to our region by cold waters and freeze-ups to our north. The waters of the lower Great Egg Harbor River and Bay, and Great Egg Inlet, are important areas for divers in New Jersey by any criteria.

COMPARISONS TO THE MULLICA RIVER

In 2003-2004 (the first year of studies), when evaluating our initial findings on the Great Egg Harbor River, we made many comparisons to the well-studied and comparatively much better-known Maurice River in Cumberland County (see Literature Cited/For Further Reference). While such comparisons yielded perspective and value to the Great Egg findings, we noted then that to a considerable degree we were inevitably comparing "apples and oranges" when comparing and contrasting an Atlantic Coastal river and estuary to a Delaware Bay tributary. An obvious and excellent example of this disparity would be the complete absence of Brant on the Delaware Bayshore, and the complete absence of Snow Geese on the Atlantic coastal marshes (excepting those found at Forsythe NWR).

As a result of this dilemma, and after much discussion, the Great Egg Harbor Watershed Association authorized comparative studies on the nearby Mullica River, also an Atlantic tributary and nearby/adjacent to the Great Egg. In an effort to put the Great Egg's avian resources in true regional perspective, five comparative surveys were carried out in winter 2004-2005 on the Mullica River. These surveys continued through 2012-2013, yielding a full nine seasons of comparative studies. (Due to eventual funding constraints, the final three seasons of Mullica surveys were carried out *pro bono* by the senior author).

The Mullica River study area and sample locations are shown on **Map 2.** The methodology used on the Mullica was designed to be identical to that used on the Great Egg: Nine sample locations were established on the Mullica between Green Bank in the west and on downriver to Great Bay Boulevard near Little Egg Inlet. Each site was visited for 45 minutes each during a given survey. Sampling direction was reversed every other survey to avoid time-of-day bias. The nine sites, numbered and beginning at the mouth of the river and then working upriver, were as follows: Great Bay Boulevard WMA (where the road dead-ends at lower Great Bay/Little Egg Inlet), Graveling Point, the Garden State Parkway Bridge, Swan Bay WMA, Lower Bank, and Green Bank. The major Wading River tributary was monitored at the Wading River Bridge (Route 542), and Bass River was counted at Amasas Landing. Finally, the Leeds Point area, on the south side of Great Bay was monitored from Oyster Creek (Alternate Route 561), and at an alternate overlook at Mott's Creek.

There is some inevitable difference in the geographical scope of the study areas. The Great Egg Harbor River study area, from the head of Lake Lenape east to the Great Egg Harbor inlet constitutes about 12.6 linear miles (direct miles, measured on the center line of the river but *not* accounting for the many winding turns on the river). The Mullica River, on the other hand, is about 15.6 linear miles in length from Green Bank east to the landing at the foot of Great Bay Boulevard (Seven Bridges Road). While it bears noting that the study area on the Mullica is 3 miles longer, no attempt has been made (as yet) to compare width or acreage (or habitat types) of the comparative study areas. This will be carried out in the future as part of planned in-depth comparisons of all major South Jersey rivers. None-the-less, the identical methodologies allow comparisons to be made to the greatest extent currently practicable. The driving route or "transect" (shown on Map 2) route on the Mullica was 42.3 miles, compared to the 44.1 mile route on the Great Egg, making for a fairly ideal comparison.

Nine years of winter raptor, waterfowl, and waterbird surveys of the Mullica River (2004-2013) are shown in **Table 3**. The results of all nine years of surveys are shown, and all time peaks for all species are shown in **Bold Face**. A subset of Table 3 is presented in **Table 4**, which shows peaks and averages for all key species for each of the nine years. Here again, the all-time peak is bold faced, and the nine-year overall average of peak counts and average of average (mean) counts is shown. The comparison between the winter raptor and waterfowl populations of the Great Egg Harbor River and those of the Mullica River is shown in **Table 5**. All-time peak counts, as well as averages (average peaks and average means) for key species are included for each river system. Because the Mullica was sampled less frequently than the principal Great Egg study area, there is perhaps some greater value in comparing peak values rather than average numbers, as more frequent sampling yields truer and more comprehensive averages.

Despite the Mullica's slightly longer length (of the study area), in winter the two rivers show many ornithological similarities, and a few major differences. Vulture populations are remarkably similar, as are numbers of most raptors. Northern Harrier peaks and averages were similar for the Mullica and Great Egg. Sharp-shinned Hawk and Cooper's Hawk numbers were nearly identical, and while the Great Egg tops the Mullica for peak numbers, the Mullica bests the Great Egg (barely) for the average number per survey for these accipiter species. Red-tailed Hawk numbers however were consistently and considerably lower on the Mullica for unknown reasons (this anomaly is born out by historical data too -- see below).

Rough-legged Hawks were seemingly twice as common on the Mullica, yet the Mullica average for Rough-legged is substantially boosted by the amazing peak of 21 individuals seen on 25 January 2005. This outstanding number -- a very high count for New Jersey -- resulted from a major incursion to the region which occurred on and just before the 25 January survey date - as large numbers were pushed into the South Jersey region by major snow falls to the north in upstate New York and the northeastern states. This was a temporary incursion - lasting only about two weeks - but on 25 January we really "hit the peak" of this remarkable movement. We feel we didn't quite hit this key peak time on the Great Egg, although we did record an excellent 10 Rough-legs on the Great Egg a week later, on 2 February 2005. Suffice it to say that both rivers are substantially important for Rough-legged Hawk use in winter, and represent two of the very best places in all of New Jersey to view this iconic northern buteo.

Wintering Bald Eagle numbers (counts that inevitably include nesting birds – as nonmigratory local residents also "winter" on the river) are remarkably similar on both the Great Egg Harbor River and the Mullica River. The Great Egg peak count just bested the Great Egg (24 on the Great Egg and 20 on the Mullica), the average of each season's peak are quite similar (17.4 on the Great Egg vs. 15 on the Mullica), and the average per day are nearly identical (10.28 on the Great Egg versus 10.12 on the Mullica). In short, both rivers are highly important to wintering Bald Eagles and host a high percentage of all Bald Eagles found on the Atlantic Coastal marshes of New Jersey.

Golden Eagles are slightly more prevalent on the Mullica River, no doubt due in no small part to the inducement of the vast, remote, and wild Pinelands Region surrounding the Mullica and Wading Rivers. Also, Goldens – whose principal prey species include Snow Geese and Black Ducks – are clearly attracted each season to the vast concentrations of waterfowl at

Forsythe NWR (see comments below). To Golden Eagles, "Brig" functions as a sumptuous bird feeder. During this survey, what was highly likely the same bonded "pair" of adult Golden Eagles (one male and one female) were seen hunting over Forsythe NWR (seen from the Leed's Point area) on at least three of the first four winters of study. The Great Egg hosts Golden Eagles each winter, but in fewer numbers. The Great Egg peak was 2, and the average was 0.34 per survey. The Mullica Golden Eagle peak was 4; and the average was 0.55. Both rivers are easily two of the very best places to encounter wintering Golden Eagles anywhere in the Mid-Atlantic or Northeastern regions.

While many strong comparisons can be made between the Great Egg and Mullica for raptors, there are some notable contrasts regarding waterfowl. Canada Geese were more numerous on the Mullica, and Snow Geese far more prevalent on the Mullica as well (averages clearly boosted by the large flocks attracted to Forsythe NWR; see below). Brant averaged far fewer on the Mullica (although the Mullica's absolute peak is higher), although whether this is true in the very long-term would remain to be learned. This disparity may be an artifact of physical coverage; the lower Great Egg is far more accessible and visible than the wider, vast, and much less easily viewed lower Mullica basin in the area of lower Great Bay and Little Egg Inlet.

Black Ducks were more numerous on the Great Egg, although not by a wide margin, but Mallards far more common on the Mullica. Inexplicably (based on Mallard status – the two species are usually found together...), Northern Pintails are virtually absent on the Mullica. Similarly, Green-winged Teal were very scarce on the Mullica. Strange contrasts continued for diving ducks. Scaup were less common on the bays of the lower Mullica (perhaps a factor of observability -- see above), and Bufflehead were far less common than on the Great Egg. Conversely, Mullica Red-breasted Mergansers edged the Great Egg numbers, and Hooded Mergansers were far more common on the Mullica River route (although this fact was mainly due to a single sheltered pond on Great Bay Boulevard that, when ice-free, always hosted a huge flock of Hoodeds).

Any discussion of the avian resources of the Mullica River complex and Great Bay must include discussion of Forsythe National Wildlife Refuge (a.k.a. "Brigantine Refuge" to most birders). While not technically within our arbitrary geographical boundaries for the Mullica River adjunct study, it exerts a tremendous influence on the birds of the study area – particularly waterfowl. Just as the quality impoundments at Tuckahoe/Corbin City WMA attract and concentrate ducks and geese on the Great Egg (and as do Heislerville WMA and the Bivalve Estuarine Enhancement Program Site on the Maurice River), Forsythe NWR -- by its sheer size and quality of habitat (vast impoundments) -- attracts and concentrates large numbers of Mullica River region waterfowl. But where Tuckahoe/Corbin can be counted because they are "within" that study area, the impoundments at Forsythe are largely adjacent to Reeds Bay, Little Bay, and Brigantine Inlet - and are not really a part of Great Bay or the Mullica River system. In essence, Tuckahoe/Corbin City WMA are "in bounds," but Forsythe NWR is (just barely....) "out of bounds."

We cannot gainsay the degree to which Forsythe NWR exerts a massive influence on Mullica River waterfowl. Because of the size, excellent management and high quality of the

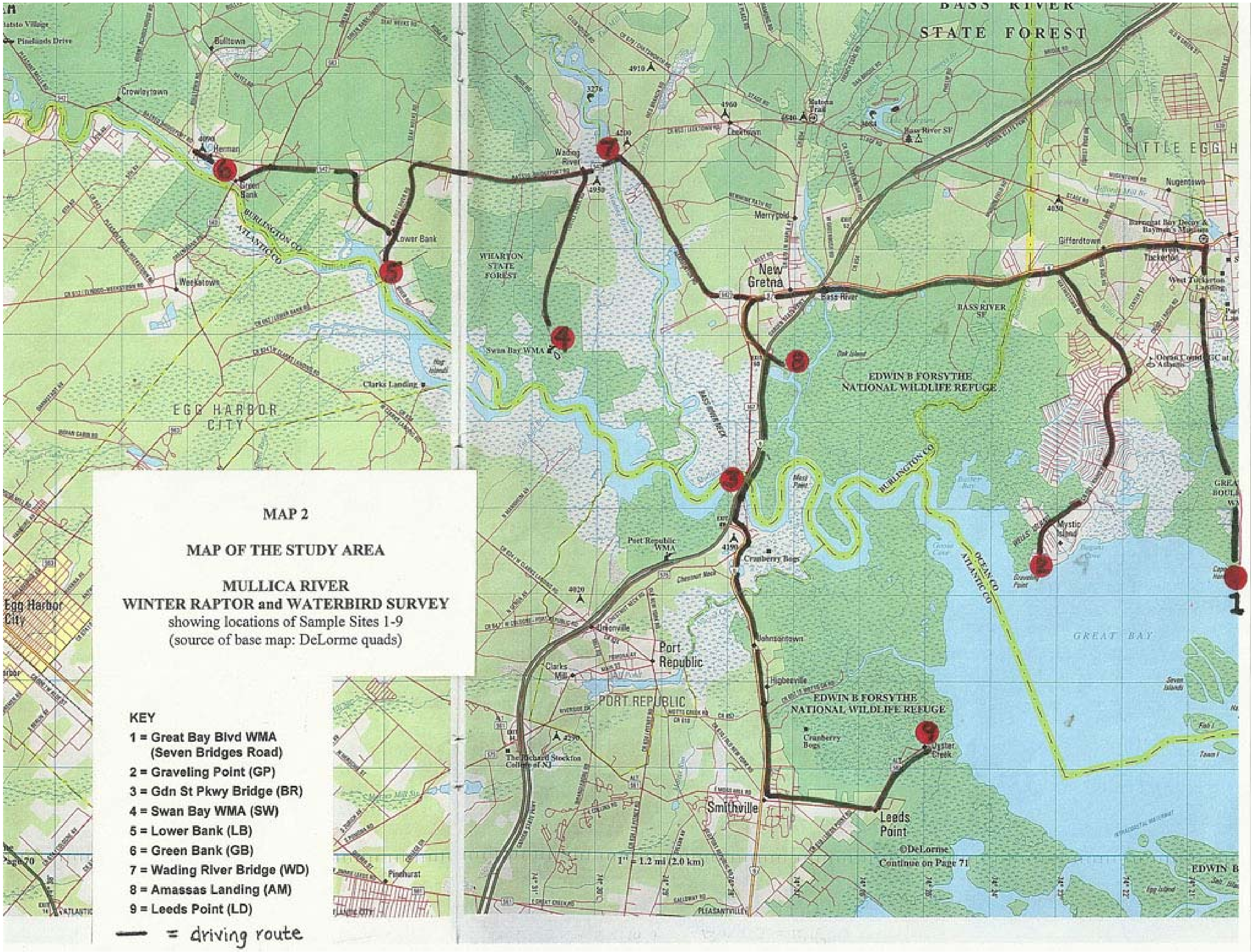
impoundments, as well as the relative safety of waterfowl from hunting pressure, Forsythe clearly pulls in many, many birds from the nearby Mullica River. As one birder aptly put it, "Brigantine simply 'sucks in' most of the area's waterfowl." And while many ducks return to the adjacent Mullica River at night to feed, by day they are safely back at the refuge, sanctuary, and high quality feeding station that is Forsythe NWR.

While one could make a case to include this site and its birds in a Mullica River count, to do so would bias the count to such a degree that comparisons to the Great Egg and/or other rivers would be moot and meaningless. For example, very few Green-winged Teal and Pintail are counted on Mullica point count surveys, but at the same time, just two miles away, perhaps 10,000 teal and 10,000 Pintails are often present at Forsythe. It is a dilemma with no real answer. To count Forsythe NWR birds would be to bias the count beyond comparability (plus it would take 6-8 hours to truly census the Refuge, time simply not available under current survey protocol). But, at the same time, to *not* count Brigantine waterfowl will forever undercount (and so bias) any Mullica survey efforts. Such are the issues with Forsythe NWR, one of the premier waterfowl refuges in the entire country, and the implications when attempting hard comparisons to the Great Egg Harbor River.

In summary, and in fact, the Great Egg Harbor River (and Bay) and the Mullica River (and Great Bay) are very similar for winter raptor and waterfowl populations. They are two wild, scenic, and high quality rivers with high avian ecovalues. If in a few ways the Mullica bests the Great Egg, it must be remembered that the Mullica is of greater length, and particularly wider near the mouth. And, Forsythe NWR exerts intense positive pressure on Mullica waterfowl, drawing in huge numbers in a way that renders some comparisons with the Great Egg to be of little value.

The Mullica River was concurrently studied during this survey because the Mullica was in part better known, understood, and documented – and therefore able to provide a valid comparison – and possible contrast -- for the Great Egg. In this regard, the Great Egg Harbor River and estuary have stacked up quite nicely by comparison. Avian resources are similar and of exceedingly high value on both the Great Egg and the Mullica Rivers, and the documented significant populations of raptors and waterbirds on both rivers warrant high consideration and protection during the planning process for any projects or anticipated changes in these incomparable regions. Both rivers hold and support large numbers of raptors, waterfowl, and waterbirds throughout the seasons, and based on the findings of this ten-year survey, host some of the most significant winter bird populations found in New Jersey and beyond.

After ten years of study on the Great Egg and nine comparison years on the Mullica, few if any regional rivers – save the Delaware Bayshore's Maurice River – can boast of better study, better data, or better understanding. If other Mid-Atlantic region-Atlantic Coastal river systems have equal or greater values, they have either been unreported or undocumented to anywhere near the degree to which these current studies have discovered the values of the Great Egg Harbor River and to a lesser degree (if only in coverage), the Mullica River.



MAP 2

MAP OF THE STUDY AREA

MULLICA RIVER
WINTER RAPTOR and WATERBIRD SURVEY
showing locations of Sample Sites 1-9
(source of base map: DeLorme quads)

Table 3

Mullica River Winter Raptor and Waterbird Survey
9-YEAR SUMMARY – PEAK NUMBERS

	0	1	2	3	4	5	6	7	8	9
FIELD SEASON	**03-04**	**2004-2005**	**2005-2006**	**2006-2007**	**2007-2008**	**2008-2009**	**2009-2010**	**2010-2011**	**2011-2012**	**2012-2013**
	NC	**(N = 5)**	**(N = 6)**	**(N = 6)**	**(N = 8)**	**(N = 4)**	**(N = 4)**	**(N = 3)**	**(N = 3)**	**(N = 2)**
LOONS to CORMORANTS										
Red-throated Loon		18	21	25	15	8	**26**	7	26	13
Common Loon		15	16	16	**26**	12	26	10	15	19
Pied-billed Grebe		1	1	4	6	4	3	1	4	**7**
Horned Grebe		11	12	9	**24**	16	63	8	1	9
Red-necked Grebe			1	1						
Northern Gannet				4	**20**					
Double-cr Cormorant		**220**	5	42	5	2	22	1	3	7
Great Cormorant					1	1				
HERONS to VULTURES										
American Bittern		1	**2**	1					1	
Great Blue Heron		12	21	22	**38**	19	23	14	24	23
Great Egret		**60**	3	3	4	6	7		1	2
Snowy Egret		**6**								
Tri-colored Heron						1				
Black-cr Night-Heron			1		1				**2**	1
Glossy Ibis		1								
Black Vulture		9	8	15	**25**	4	10	18	7	
Turkey Vulture		**119**	114	88	116	80	103	85	103	68
WATERFOWL										
Snow Goose		850	1000	1080	1000	505	**1240**	400	500	300
Cackling Goose									1	
Canada Goose		366	980	**1293**	665	712	795	952	680	372
Brant		1421	1785	1800	3100	1559	1010	270	**6500**	208
Mute Swan		6	8	**19**	4	5	8	5	4	2
Tundra Swan		55	**461**	15	6	4	6	4	26	
Wood Duck		**26**	24		11	1				
Gadwall			**15**	11	4		3	2		
American Wigeon				1	1	1	**2**			
Am. Black Duck		530	**892**	601	870	453	814	557	365	240
Mallard		365	334	489	547	**772**	631	691	294	347
Northern Shoveler		1		1	**10**		2			
Northern Pintail		1	20	30	6	7	4	**100**	20	

Peak Counts are **BOLD FACED**
N = number of surveys per field season

Osprey* -- number shows peak spring count (not a wintering species)

Table 3

Mullica River Winter Raptor and Waterbird Survey
9-YEAR SUMMARY – PEAK NUMBERS

	0	1	2	3	4	5	6	7	8	9
FIELD SEASON	**03-04**	**2004-2005**	**2005-2006**	**2006-2007**	**2007-2008**	**2008-2009**	**2009-2010**	**2010-2011**	**2011-2012**	**2012-2013**
	NC	**(N = 5)**	**(N = 6)**	**(N = 6)**	**(N = 8)**	**(N = 4)**	**(N = 4)**	**(N = 3)**	**(N = 3)**	**(N = 2)**
Green-winged Teal		22	2	21	8	28	8	**200**	25	4
Canvasback			5	2	**32**		5	18		2
Redhead				**24**	20	3				1
Ring-necked Duck		**40**	28	32	30	14	32	15	2	5
Greater Scaup		25	**50**	1	10	20	17	2		50
Lesser Scaup			1	**45**	10	2	36	2		3
Scaup (sp.)		400	700	451	1265	**1900**	700	700	60	94
Common Eider				**3**			1			
Surf Scoter		**52**	47	9	6	1	6	2		
White-winged Scoter					1					
Black Scoter			**2**	1	1					1
Scoter (sp.)		**254**	50	40	35			20	4	
Long-tailed Duck		84	**155**	55	61	46	82	26	35	15
Bufflehead		150	365	446	806	538	**860**	170	48	315
Com. Goldeneye		6	16	25	**74**	8	25	13		12
Hooded Merganser		93	131	208	**649**	439	93	247	119	176
Com. Merganser		**245**	27	43	23	25	16	31		5
Red-breasted Merganser		**410**	98	95	136	111	274	66	48	101
Ruddy Duck			7	2	**54**	16		1		
DIURNAL RAPTORS										
Osprey *		**24**				1	1			2
Bald Eagle		**20**	11	14	17	17	18	12	14	12
Northern Harrier		42	48	37	**58**	41	32	25	34	17
Sharp-shinned Hawk		2	4	3	**5**	5	3	2	2	
Cooper's Hawk		3	**4**	4	4	3	4	2	2	1
Northern Goshawk		1								
Red-shouldered Hawk		**3**			1	2	1	2		1
Red-tailed Hawk		39	42	40	40	46	**48**	30	29	22
Rough-legged Hawk		**21**	12	2	7	6	1	4	5	3
Golden Eagle		2	2	**4**	2	1	1		1	
American Kestrel		**2**				1				
Merlin		**2**	1	1	2	1	1		1	1
Peregrine Falcon		5	4	5	**8**	4	6	4	3	2

Peak Counts are **BOLD FACED**
N = number of surveys per field season

Osprey* -- number shows peak spring count (not a wintering species)

Table 3

Mullica River Winter Raptor and Waterbird Survey
9-YEAR SUMMARY – PEAK NUMBERS

	0	1	2	3	4	5	6	7	8	9
FIELD SEASON	**03-04**	**2004-2005**	**2005-2006**	**2006-2007**	**2007-2008**	**2008-2009**	**2009-2010**	**2010-2011**	**2011-2012**	**2012-2013**
	NC	**(N = 5)**	**(N = 6)**	**(N = 6)**	**(N = 8)**	**(N = 4)**	**(N = 4)**	**(N = 3)**	**(N = 3)**	**(N = 2)**
GROUSE to SHOREBIRDS										
Ring-necked Pheasant		**2**	1							
Clapper Rail			1	1						
Virginia Rail							1			
American Coot			1	**5**	1	4				
Black-bellied Plover		1	2	**11**		7				1
Killdeer		2	1	7	9	**14**	3		2	2
Am.Oystercatcher		**20**		15	2	2	15	8	2	6
Greater Yellowlegs		5	**8**	**8**	6	3			3	3
Lesser Yellowlegs				1	**5**					
Marbled Godwit				8						
Ruddy Turnstone				2						
Red Knot					1					
Sanderling		**100**	25		**100**	12	8	12		6
Purple Sandpiper					10					
Dunlin		30	412	**2500**	1107	427	300	179	250	200
Wilson's Snipe			1	2	**5**	2				1
American Woodcock				**7**		2				
GULLS to ALCIDS										
Laughing Gull		1		3			**5**			
Bonaparte's Gull				**4**	1	1				
Ring-billed Gull		√	√	√	√	√	√	√	√	√
Herring Gull		√	√	√	√	√	√	√	√	√
Lesser Black-backed Gull				**2**		1				
Great Black-backed Gull		√	√	√	√	√	√	√	√	√
Forster's Tern		1								
OWLS to KINGFISHERS										
Barn Owl			1							
Great Horned Owl				1		1		**2**		
Short-eared Owl		2	1		**8**		3	1		
Belted Kingfisher		2	4	4	**7**	6	3	1	2	4

Peak counts are **BOLD FACED**
N = number of surveys per field season

Osprey* -- number shows peak spring count (not a wintering species)

Table 4

Comparison of Winter Raptor and Waterfowl Totals
Mullica River
Winter 2004-2005 to Winter 2012-2013

	2004-2005		2005-2006		2006-2007		2007-2008		2008-2009	
	PEAK	AVG.	PEAK	AVG.	PEAK	AVG.	PEAK	AVG	PEAK	AVG
	(N = 5)		(N = 7)		(N = 6)		(N = 8)		(N = 4)	
WATERFOWL:										
Canada Goose	366	174	980	463	**1,293**	547	665	444	712	553
Brant	1,421	793	1,785	706	1,800	970	3100	1157	1559	879
Am. Black Duck	530	312	**892**	442	601	348	870	478	453	341
Mallard	365	196	334	220	489	356	547	431	**772**	687
Northern Pintail	0	0	20	7	30	10	6	2	7	3
Green-winged Teal	22	8	2	1	21	5	8	2	28	9
Bufflehead	150	67	365	230	446	217	806	345	538	339
Red-breasted Merganser	**410**	116	98	64	95	49	136	73	111	62
RAPTORS										
Black Vulture	9	5.2	8	3.8	15	4.7	**25**	7.4	4	2.25
Turkey Vulture	**119**	70	114	71	88	57	116	74	80	57
Bald Eagle	**20**	10.8	11	8.0	14	8.8	17	9.0	17	12.75
Northern Harrier	42	31	48	38	37	30	**58**	45	41	37
Sharp-shinned Hawk	2	1.2	4	2.2	3	1.5	**5**	2	5	1.75
Cooper's Hawk	3	1.6	**4**	1.3	4	1.5	4	2.25	3	2
Northern Goshawk	1	0.2	**0**	0.0	**0**	0	0	0	0	0
Red-shouldered Hawk	**3**	1	0	0.0	0	0	1	0.13	2	0.5
Red-tailed Hawk	39	31	42	34	40	24	40	28	46	40
Rough-legged Hawk	**21**	10.6	12	6.2	2	1	7	3.8	6	4.25
Golden Eagle	2	0.8	2	1.0	**4**	1.33	2	0.38	1	0.25
Am. Kestrel	**2**	0.8	0	0.0	0	0	0	0	1	0.25
Merlin	**2**	0.4	1	0.17	1	0.33	2	0.38	1	0.5
Peregrine Falcon	5	4	4	3.2	5	2.67	**8**	3.88	4	2.75

All-time highest counts shown in **BOLD FACE**
N = number of surveys per field season

Table 4

Comparison of Winter Raptor and Waterfowl Totals
Mullica River
Winter 2004-2005 to Winter 2012-2013

	2009- 2010		2010- 2011		2011- 2012		2012- 2013		9 Year Overall	
	PEAK	AVG	PEAK	AVG	PEAK	AVG	PEAK	AVG	2004 - 2013	
	(N = 4)		(N = 3)		(N = 3)		(N = 2)		PEAK	AVG.
WATERFOWL:										
Canada Goose	795	473	952	525	680	406	372	262	757	427
Brant	1010	877	270	203	**6500**	3167	208	181	1961	993
Am. Black Duck	814	506	557	450	365	255	240	199	591	370
Mallard	631	287	691	469	294	149	347	289	497	343
Northern Pintail	4	2	**100**	33	20	7	0	0	21	7
Green-winged Teal	8	5	**200**	67	25	8	4	2	35	12
Bufflehead	**860**	485	170	81	48	16	315	206	411	221
Red-breasted Merganser	274	109	66	37	48	18	101	73	149	67
RAPTORS										
Black Vulture	10	5	18	6	7	4	0	0	10.67	4.26
Turkey Vulture	103	79	85	58	103	70	68	64	97	67
Bald Eagle	18	13.25	12	10	14	9	12	9.5	15	10.12
Northern Harrier	32	29	25	22	34	27	17	17	37	31
Sharp-shinned Hawk	3	1.5	2	1	2	1.67	0	0	2.89	1.42
Cooper's Hawk	4	2.25	2	0.67	2	1	1	0.5	3	1.45
Northern Goshawk	0	0	0	0	0	0	0	0	0.11	0.02
Red-shouldered Hawk	1	0.5	2	1.33	0	0	1	0.5	1.11	0.44
Red-tailed Hawk	**48**	36	30	22	29	18	22	22	37	28
Rough-legged Hawk	1	0.75	4	1.67	5	4.33	3	2	6.78	3.84
Golden Eagle	1	0.5	0	0	1	0.67	0	0	1.44	0.55
Am. Kestrel	0	0	0	0	0	0	0	0	0.33	0.12
Merlin	1	0.25	0	0	1	0.67	1	0.5	1.11	0.36
Peregrine Falcon	6	2.75	4	2	3	1.67	2	1	4.56	2.66

All-time highest counts shown in **BOLD FACE**
N = number of surveys per field season

Table 5

Comparison of the Great Egg Harbor River and the Mullica River Winter Raptors and Waterfowl

	GREAT EGG HARBOR RIVER			MULLICA RIVER		
		10 Year Average			9 Year Average	
	Absolute PEAK	of Peak (N = 82)	of Avg.	Absolute PEAK	of Peak (N = 42)	of Avg.
WATERFOWL:						
Canada Goose	906	567	270	1293	757	427
Brant	5440	2605	1387	6500	1961	993
Am. Black Duck	1369	984	523	892	591	370
Mallard	683	264	103	772	497	343
Northern Pintail	1294	704	234	100	21	7
Green-winged Teal	2510	1259	385	200	35	12
Bufflehead	1670	903	378	860	411	221
Red-breasted Merganser	180	140	72	410	149	67
RAPTORS						
Black Vulture	16	11.2	4.76	25	10.7	4.26
Turkey Vulture	132	115	83	119	97	67
Bald Eagle	24	17.4	10.28	20	15	10.12
Northern Harrier	47	36	26	58	37	31
Sharp-shinned Hawk	17	5.1	1.65	5	2.89	1.42
Cooper's Hawk	5	3.3	1.58	4	3	1.45
Northern Goshawk	1	0.3	0.04	1	0.11	0.02
Red-shouldered Hawk	4	1.7	0.43	3	1.11	0.44
Red-tailed Hawk	71	53	37	48	37	28
Rough-legged Hawk	10	4.3	1.83	21	6.78	3.84
Golden Eagle	2	1.2	0.34	4	1.44	0.55
Am. Kestrel	4	1.4	0.21	2	0.33	0.12
Merlin	2	0.6	0.1	2	1.11	0.36
Peregrine Falcon	6	4.2	2.28	8	4.56	2.66

N = total number of surveys

COMPARISONS TO GREAT EGG HARBOR RIVER HISTORICAL DATA

While there is little published systematic or long-term historical data available for the Great Egg Harbor study area, it is none-the-less desirable to attempt to compare and contrast the results of the winter 2003-2013 studies to any available previously gathered data. By reviewing current findings in a historical perspective we can perhaps even better assess changing status and trends over time. One source of historical data is site-specific Christmas Bird Count (CBC) data for the region. The southwestern part of our Great Egg study area falls within the boundaries of the Marmora CBC, and as such was counted by Sutton and his CBC "party" from 1983 to 1992, a ten year period. This CBC coverage was a full day winter event, comparable in time and timing to the modern method. And while this territory of the Marmora CBC only covers a portion of the current study area, it is a key portion and highly central for the purpose of counting raptors -- highly mobile along the river and, when soaring, visible for several miles. Accordingly, the historical data set is far more valuable for assessing raptor numbers than it is for waterfowl or waterbird comparisons. (For example, Great Egg Harbor Bay and the Tuckahoe impoundments were not included in the Sutton CBC territory, therefore making most waterfowl comparisons impossible).

Table 6 shows historical winter raptor and waterbird records for the Great Egg Harbor River gathered by Sutton as part of the Marmora CBC from 1983 to 1992. Peaks for all species are shown in **Bold Face**, and the ten-year average is shown for relevant key species. The area covered (the Sutton CBC "territory") was Gibson Creek Road to Tuckahoe, and mostly east of Route 50 -- primarily the impoundments at Corbin City. While direct comparisons are not possible or highly valid, some very useful information is readily gleaned when comparing current results with the historical record. **Table 7** shows 2003-2013 results compared with that of 1983-1992. Canada Geese, as would be expected, are three times more common in the modern era than in the historical, although some of this could be due to the reduced geographical coverage in the 1983-1992 era. It also bears noting that the Am. Black Duck peak from this more limited geographical area is well higher than the overall average for the entire river in the modern era.

Among raptors, where the best comparisons are possible, Turkey Vultures have become over 10 times more common during current winters, a well-known (but little-documented) region-wide trend. Black Vultures, the "southern vulture" that has only recently expended its range into New Jersey, were yet completely unknown in winter in the 1980s, and are far more common in southern New Jersey today.

As predictable, due to region and nation-wide recovery, Bald Eagles have become far more common in the modern era. Only 1.1 was seen on average in the historical years where 10.28 were averaged in the period 2003-2013. For large birds like eagles and vultures, comparisons are quite valid even though the historical geographical coverage area was less. These birds are highly visible and range widely up and down the river and throughout the estuary, not to mention that because Bald Eagles were so rare (and desirable) back then, they were targeted and *intensely* searched for during the CBC!

Sharp-shinned Hawk was similarly common historically, but Cooper's are more than twice as common today, also showing an expected trend and change in status as birds have recovered from the DDT era. Red-shouldered Hawk numbers are quite the same but Red-tailed Hawks have become far more common today (for unknown reasons). On the other hand, Rough-legged Hawks were far more common historically. The decline of wintering Rough-legs (and Short-eared Owls) over time is a well-known regional phenomenon – not linked just to the Great Egg – and probably related to the rapid and pervasive loss of the Rough-legged Hawk's preferred high marsh (*Spartina patens*) habitat due to both sea level rise and mosquito control practices throughout the region. So too Golden Eagles seemed more numerous historically than currently, despite far less coverage (the CBC was one day each year). Peregrines, similar to Bald Eagles, have undergone a nation-wide recovery and are far more common today. A true victim is American Kestrel -- an average of 1.2 and a peak of 3 were seen historically (in less area) where no true wintering birds were seen at all in the 2003-2013 survey efforts. Ruffed Grouse (see Table 6) are well known to have declined drastically in the region, and the historical record clearly highlights this loss when compared to modern-day findings. Where 12 grouse were seen in ten surveys historically, they were completely absent on 82 survey routes run from 2003-2013).

It is important to remember that all historical samples were taken in late December. Historical averages shown are for that period only -- and do not span the season as do current survey averages. While not directly comparable, the historic information none-the-less offers considerable insight into region-wide changes and trends over time for many key species in the Great Egg drainage, and offers for some species a dramatic perspective on the findings of the 2003-2013 studies.

Table 6 – HISTORICAL (1983 to 1992)
Great Egg Harbor Winter Raptor and Waterbird Survey (Marmora CBC)

	12/31/83	12/16/84	12/29/85	12/21/86	12/27/87	12/19/88	12/30/89	12/16/90	12/31/91	12/31/92	Avg. / N = 10
Pied-billed Grebe					1						
American Bittern			1								
Great Blue Heron	4	2	10	11	**12**	6	5	6	8	7	
Great Egret								1			
Black-cr Nt-Heron			1	1							
Turkey Vulture	0	0	6	0	9	**23**	1	10	0	0	5
Canada Goose	**330**	102	10	171	101	0	124	43	31	45	96
Brant			50		1000					**2000**	
Mute Swan		8		7		**26**		7	9	16	
Tundra Swan	8	**54**	4	46	46	11			28	7	
Wood Duck		2		1	2						
Gadwall				2	2				**20**		
American Wigeon									**68**		
Am Black Duck	250	33	27	63	272	121	144	123	255	**713**	200
Mallard	2	4	4	7	**16**	11	10	4	12	14	
Northern Pintail		**27**		17	6	9	2	2		16	
Green-winged Teal				1	1			7	**31**	3	
Ring-necked Duck										1	
Common Goldeneye				4							
Hooded Merganser		2		18	8	1	2	5	**148**	41	
Common Merganser				3			**15**	2	13	12	
Red-br Merganser		1			1						
Bald Eagle	1i	0	0	0	1a	**3i**	0	2i	1a	**3a**	1.1
Northern Harrier	**35**	22	20	21	21	32	9	31	14	8	21
Sharp-shinned Hawk	1	1	0	**3**	2	1	**3**	**3**	1	1	1.6
Cooper's Hawk	0	0	0	1	**2**	0	1	0	**2**	0	0.6
Red-shouldered Hawk	1	**2**	0	1	**2**	**2**	1	0	0	0	0.9
Red-tailed Hawk	10	5	12	15	11	13	8	**21**	8	8	11
Rough-legged Hawk	**12**	2	8	8	5	4	4	3	2	1	4.9
Golden Eagle	1a	0	1sa	**2a**	1a	0	0	0	**2a - i**	1a	0.8
American Kestrel	1	0	2	1	**3**	1	1	1	1	1	1.2
Peregrine Falcon	0	0	2	0	0	0	0	0	0	0	0.2
Ring-nk Pheasant	1	1	**2**	1		1			1		
Ruffed Grouse		1	**6**	1	1		2			1	
Wild Turkey										**5**	
Northern Bobwhite		1	1				1				
Clapper Rail		**2**			1	1					
Virginia Rail		1				1					
Killdeer					2				4		
Greater Yellowlegs					**3**			1	**3**	2	
Lesser Yellowlegs					1						
Dunlin		**70**		15	61	10		21			
Wilson's Snipe		1	**2**	1	1	1		1			
American Woodcock		1	**3**	1	1			1			
Ring-billed Gull		9	2	22	20	4		47	30	35	
Herring Gull	35	35	50	269	60	70	32	26	50	12	
Gt Bl-backed Gull	1		2	6	1	1	1	6	1	2	
Barn Owl				1							
E. Screech-Owl		1	4	1	4		3	1	1		
Great Horned Owl	8	13	14	10	16	2	2	3	2	11	
Barred Owl			1	1	2					1	
Long-eared Owl				1							
Short-eared Owl	1	0	**7**	5	0	1	1	6	1	0	2.2
N. Saw-whet Owl					1						
Belted Kingfisher	1	3	4	3	3	3	3	4	**5**	2	

Table 7

Comparison of Winter Raptor Numbers
Historical Great Egg Harbor River Data
Compared to Present Day Great Egg Harbor River Survey

	1983 - 1992		2003 - 2013	
	Absolute PEAK	Average (of Average #s) (N = 10)	Absolute PEAK	Average (of Average #s) (N = 82)
Canada Goose	330	96	906	270
Am. Black Duck	713	200	1369	523
Black Vulture	0	0	16	4.76
Turkey Vulture	23	5	132	83
Bald Eagle	3	1.1	24	10.28
Northern Harrier	35	21	47	26
Sharp-shinned Hawk	3	1.6	17	1.65
Cooper's Hawk	2	0.6	5	1.58
Northern Goshawk	0	0	1	0.04
Red-shouldered Hawk	2	0.9	4	0.43
Red-tailed Hawk	21	11	71	37
Rough-legged Hawk	12	4.9	10	1.83
Golden Eagle	2	0.8	2	0.34
Am. Kestrel	3	1.2	4	0.21
Merlin	0	0	2	0.1
Peregrine Falcon	2	0.2	6	2.28
Short-eared Owl	7	2.2	10	3

N = Number of surveys

COMPARISONS TO MULLICA RIVER HISTORICAL DATA

When reviewing 2004-2013 Mullica River data and assessing its relevance to current Great Egg Harbor River studies, it is important to evaluate whether this nine-year data set is applicable and comparable, and if it reflects similar historic changes to that seen for the Great Egg Harbor River. While nine years of data can only hint of long-term trends, as with the historical data for the Great Egg we can augment the Mullica data (and its value) by reviewing it in light of known historical findings. Virtually all historic Mullica River ornithological information is of an anecdotal, non-standardized sort. While considerable reference to the Mullica can be found in the literature over many decades, little if any of it is systematic or standardized. That said, one old non-published data set stands out – Clay Sutton's own field notes relating to informal raptor studies conducted along the Mullica dating back to 1974.

Table 8 shows the results of raptor surveys along the Mullica River between 11 December 1974 and 9 December 1984. This data set summarizes 37 surveys conducted over eleven winter seasons on the Mullica. Peak counts are shown in **Bold Face**, and averages are given. While non-standardized as to route and methodology, these informal counts none-the-less covered almost the exactly the same geographical area as the current Mullica survey route – and were conducted by one of the current study's counters/authors, Clay Sutton. These historical field studies were very specifically raptor-oriented, and in a broad-brush approach, offer some valid comparisons over time – and insight into the temporal implications and relevance of today's counts. They offer too poignant evidence of the amazing changes in the abundance of some raptors over time.

Table 9 compares historical Mullica River winter raptor data to that gathered during this 2004-2013 winter survey. Peaks and averages are presented. Between 1974 and 1984, Mullica Bald Eagles peaked at a mere 6 and averaged only 1.8 birds per survey. When these meager numbers are compared to current numbers we can see stunning proof of the recovery of Bald Eagles in New Jersey and in the east. So too, Sharp-shinned Hawk and Cooper's Hawk numbers clearly reflect known recoveries of these species from both DDT and shooting. The Peregrine's dramatic recovery can be seen not only in the comparison but even in the clear trend visible in the 1974-1984 data alone.

Northern Harrier winter populations – a key feature of the Mullica – show a clear upward trend over time, with Harriers being twice as common today. Red-shouldered Hawk and Merlin, although found in only very small numbers, show marked upward trends when comparing the 1974-1984 period to today. Historical Rough-legged Hawk peaks (20 birds, achieved twice) and today's 21 are almost identical, although the historical average is notably higher, corroborating observed current trends. Golden Eagle status and trends over time are inconclusive; while the modern peak is higher, the historical average is much higher. The Red-tail Hawk trend is curious. Historical counts confirm that Red-tails were never numerous on the Mullica (at least when compared to the Great Egg Harbor River and also to the Maurice River), but also that they have clearly become much more numerous over time -- as attested to by historical peaks and averages when compared to the present. (Interestingly, in the 1970s and 1980s, Rough-legs were actually slightly more numerous than Red-tails on the Mullica in winter.) Red-tail is well-known to have experienced a long-term and on-going population increase throughout the northeast.

The most dramatic trends are seen in Turkey Vulture and Black Vulture. Turkey Vultures were almost non-existent in winter in the 1970s and 1980s and Black Vultures unheard of and completely absent. Reflecting a known region-wide trend, vulture populations have exploded in recent years, possibly in part due to climate change and warmer winters. In the 1970s and prior, Turkey Vultures were historically absent from the Mullica and Pinelands in winter, and the Delaware Bayshore and Cape May peninsula were generally regarded as the northern limit of the winter range of the species in the East. Today's dramatic increase and range expansion is clearly seen when comparing the two data sets, and are thought to be linked to not only the warmer temperatures (that allow for increased soaring opportunity and therefore greater foraging time), but also to the booming White-tailed Deer population that provides for greatly increased feeding opportunities for vultures (road-kills, hunter losses, and discarded carcasses).

Another observed trend is more sobering. American Kestrel averaged 2.24 per survey in historical surveys with a peak of 10 in 1976. In 2004-2013, only 0.12 were averaged per survey, with the peak a mere 2. These two, seen at the very end of the survey period in 2005, were both spring migrants - seen in flight high up and heading north. Only *one* Kestrel was actually known to have wintered along the vast Mullica in the entire nine years of study. In essence, wintering Merlin and Peregrine were both far more common than Kestrel on both the Mullica and the Great Egg in 2004-2013, stark evidence of the sad and drastic decline of the beleaguered and fast disappearing American Kestrel.

In addition to the above, historic Christmas Bird Counts (CBCs) can give us further perspective on the depth of the decline of the American Kestrel. The Oceanville CBC, which encompasses most of our Mullica River Study Area, recorded 24 kestrel in 1970 and 1974; 25 in 1976; and 34 in 1978. In nine years of our current Mullica study, in 42 days afield, a total of only 3 sightings were accrued. The Marmora CBC encompasses most of our current Great Egg Harbor River study area. This CBC recorded a peak of 28 American Kestrel in 1976. In the ten years of our Great Egg study, only 14 were seen in 82 days afield and even here, virtually all were judged to be early or late migrants – not true wintering birds.

Given that breeding data (there are far more Bald Eagle nests known in New Jersey today than American Kestrel nests) and migratory count data fully confirm and corroborate winter findings, American Kestrel (currently listed only as "threatened") is as severely endangered in New Jersey as any other avian species. This current research and many other data sets confirm the overdue and drastic need for endangered species status for the American Kestrel in New Jersey and beyond.

In summary, although it was non-standardized, available historical Mullica River data offers good perspective and insight on the modern 2004-2013 findings. Clear trends are discernable over time, and historical numbers confirm and corroborate current findings regarding many key raptor species. Not only important in its own right (as it highlights the Mullica River's stellar status over time as one of New Jersey's most important river systems), Mullica winter raptor data also serves to place current Great Egg Harbor River findings in a proper regional perspective.

Table 8

Historical Mullica River Winter Raptor Surveys
1974 to 1984
(37 surveys over 11 Winter Seasons)

Species	12/11 1974	1/5 1975	1/4 1976	1/23 1976	2/7 1976	2/16 1976	2/28 1976	12/5 1976	12/22 1976	12/27 1976	1/1 1977	1/19 1977	3/17 1977	12/26 1977	12/28 1977	1/2 1978	1/15 1978	1/28 1978	3/5 1978	12/17 1978
Turkey Vulture																				
Bald Eagle	3	1	3	1	1	2	1	1		1	1	1	1	2	1	2	1	1	2	3
Northern Harrier	35	6	**50**	15	25	20	4	12	12	15	20	8	12	10	6	10	12	25	10	4
Sharp-sh Hawk	1	1	2	1					1		2	1		3				3	1	
Cooper's Hawk					1			**2**												
Northern Goshawk																				**1**
Red-sh Hawk					1	**3**														
Red-tailed Hawk	8	12	5	8	5	**20**	10	3	6	2	4	2	15	8	2	3	2	10	6	2
Rough-legged Hawk	8		3	10	15	10	4	1	4	1	4	4	1	1	2	3	**20**	8	10	4
Golden Eagle	1		2	1	**3**	1		1	**3**	2	1	1	1	**3**	2	**3**	**3**	2		2
American Kestrel	8	1	3	4	3	**10**	6	1	2		2	2	2	6		2	2	2	2	1
Merlin	1		1						**1**											
Peregrine Falcon																1				2
unidentified eagle									2		2						1	1		2

Species	12/22 1978	12/27 1978	1/15 1979	1/27 1979	12/2 1979	2/2 1980	2/23 1980	3/1 1980	12/20 1980	12/21 1981	1/8 1982	2/21 1982	12/18 1982	1/1 1983	1/1 1984	1/22 1984	12/9 1984	Average (N = 37)
Turkey Vulture							**6**					4					1	0.3
Bald Eagle	1	2	2	3		**6**	2	1	1	1	4	2	4	1		2	5	1.8
Northern Harrier	6	10	10	12	25	8	2	2	12	15	18	3	20	10	20	8	30	14.11
Sharp-sh Hawk	1	1	1		**4**				1		1					1	2	0.76
Cooper's Hawk		1						1										0.14
Northern Goshawk			**1**															0.05
Red-sh. Hawk											1				1	1		0.19
Red-tailed Hawk	2	4	2	6	8	4	5	3	2	3	**8**	10	10	10	5	6	6	6.14
Rough-legged Hawk	2	6	4	**20**	4	5	2	6	4	5	12	3	**20**	10	6	2	6	6.22
Golden Eagle	1	2		2		1			1	2	1	2	2	1			2	1.32
American Kestrel	1	1	1	2	4	1	1		1	2	1	2		2	2	1	2	2.24
Merlin															**1**		**1**	0.14
Peregrine Falcon					**3**				2	1	2	2	2	1		2	2	0.54
unidentified eagle		2	1	2														0.35

Peak daily counts shown in **BOLD FACE**

Table 9

Comparison of Winter Raptor Numbers
Historical Mullica River Data
Compared to Present Day Mullica River Survey

	1974 - 1984		2004 - 2013	
	Absolute Peak	Average (N = 37)	Absolute Peak	Average (of Average #s) (N = 42)
Black Vulture	0	0	25	4.26
Turkey Vulture	6	0.3	119	67
Bald Eagle	6	1.8	20	10.12
Northern Harrier	50	14	58	31
Sharp-shinned Hawk	4	0.76	5	1.42
Cooper's Hawk	2	0.14	4	1.45
Northern Goshawk	1	0.05	1	0.02
Red-shouldered Hawk	3	0.19	3	0.44
Red-tailed Hawk	20	6.14	48	28
Rough-legged Hawk	20	6.22	21	3.84
Golden Eagle	3	1.32	4	0.55
American Kestrel	10	2.24	2	0.12
Merlin	1	0.14	2	0.36
Peregrine Falcon	3	0.54	8	2.66

N = number of surveys

SPRING AND FALL MIGRATION ON THE GREAT EGG HARBOR RIVER

Even as early as the inaugural season (the winter of 2003-2004), and particularly during the 2005-2006 season, core winter research efforts were supplemented and expanded to encompass the full seasonal cycle on the Great Egg Harbor River. Adjunct spring migration period counts were undertaken, beginning in April and running through May, and fall migration was monitored from July through November, when the core long-term winter sampling period began anew. While the frequency of sampling in these "shoulder seasons" was by no means as intense as in the winter, the protocols for migratory counts were largely the same as employed during core winter surveys.

The findings of the spring survey efforts for raptors and waterbirds are shown in **Table 10**. Full bird species lists and counts are shown for each of the 16 individual spring season sampling dates. The all-time high spring season count for each species is shown in **Bold Face**. The results of 20 individual fall season bird counts on the Great Egg Harbor River are shown in **Table 11**. Here too, all-time high fall season counts are shown in **Bold Face**. To date, in addition to the 82 days spent investigating core winter raptor and waterfowl use, 36 days of expanded studies have now been carried out in spring and fall.

There have been substantial discoveries made through the expansion to a full season, year-round effort. Migratory patterns and conditions during autumn are a key causal influence on wintering bird populations, but more importantly (for conservation reasons), migratory concentrations and the status and distribution of migrants are a major component of the significant wildlife values of the Great Egg Harbor River region. Because migration is a crucial component of a bird's life cycle, and because of the inestimable importance of stopover habitat to a bird's ultimate survival, spring and fall raptor and waterfowl use are as equally important as winter bird use of the Great Egg.

Findings from 2004 to the present were significant, both confirming and corroborating previous anecdotal and less-focused studies regarding migratory bird use of the Great Egg region. Spring efforts have shown that waterfowl use can remain quite high following the end of core winter surveys. Some spring Brant counts have exceeded the peak winter counts recorded in some years. Counts of Black Ducks, Pintails and many diving ducks remain high in early spring. Migrant Green-winged Teal (a late migrant) counts remain high well into the spring, and some spring high counts have exceeded those of some winters. The all-time peak of Blue-winged Teal has come in spring rather than the winter. In short, important waterfowl use of the Great Egg continues well into the spring and long after core winter counts have ended. Fall waterfowl numbers were unexpected and surprising. While fall numbers are generally not as high as those in spring – largely due to waterfowl hunting that disperses birds over a wide area, and particularly drives them out of popular duck hunting spots such as the WMA impoundments -- late fall numbers of Black Ducks, Mallards, Pintails and Green-winged Teal were often as high (and significant) as numbers found in winter.

One significant finding of the targeted late spring and "early fall" (summer….) studies

was the number of breeding raptors documented. Northern Harrier (Endangered) breeding was proven or suspected on the lower Great Egg in all years of study (although a recent decline is detected, and possibly related to sea level rise and the loss of high marsh habitat). The amazing come-back of the Osprey (Threatened) is clearly seen in Osprey counts garnered during late spring and early fall surveys. Mirroring core winter findings, the comeback of Bald Eagles, Cooper's Hawks, and Peregrine Falcons, as breeders and migrants, is easily seen in spring and fall data. The well-known and rapid northern range expansion of Mississippi Kite is represented on the Great Egg by the two Mississippi Kites seen together at Gibson Landing on 25 May 2010, potential breeders in highly potential breeding habitat.

While the above addresses breeding raptors, the fall survey dates have also hinted at the high numbers of migratory raptors transiting the Great Egg system, with many pausing to use quality stop-over habitat along the Great Egg. Daily counts of up to 11 Bald Eagles, 35 Northern Harriers, 140 Sharp-shinned Hawks, 35 Cooper's Hawks, and 25 American Kestrels have been tallied. These are all migrant raptors moving through – and using – the Great Egg Harbor area. The coastal migration of autumn raptors is one of the best known birding events of Southern New Jersey, and the Great Egg plays a large role in supporting this annual pageant.

Although monitored and documented by the DFGW's Nongame and Endangered Species Project, our expanded seasonal studies have confirmed and corroborated major colonial waterbird rookeries and beachnester colonies on the lower Great Egg Harbor Bay. Large heron, egret, and Glossy Ibis rookeries have been documented on dredge spoil islands behind Ocean City and Longport. While no absolute numbers of nests or fledged young were gathered, our standard protocol and route recorded very significant numbers (see Tables 10 and 11) of wading birds both in these rookeries and using nearby salt marshes for feeding, including numerous Black-crowned Night heron (Threatened) and Yellow-crowned Night-herons (Threatened).

We have also monitored the major beachnester colony that formed near Longport in or before 2008, and have recorded a huge colony of up to 2,800 Black Skimmers (Endangered), 196 Least Terns (Endangered), and up to 342 Common Terns nesting there. Piping Plover (Endangered) also nest there, as do American Oystercatchers. This is one of the northernmost colonies of Black Skimmers on the East Coast, and one of the largest and most successful tern colonies in the state. It is a key natural resource of the Great Egg Harbor. As these birds are the bailiwick of the ENSP, and as such carefully monitored, we will not discuss this spectacular colony in length here, only adding that these birds are a wonderful feature of the Great Egg and should receive the greatest protections possible.

A final discovery of our expanded spring and fall surveys is the high numbers of shorebirds using Great Egg Harbor mudflats and WMA impoundments during migration. Totals of up to 2,543 shorebirds were achieved during the fall (southbound) migration, and up to 4,430 shorebirds have been counted during the spring migration period. Thirty-one species of shorebirds have been found, and up to 412 Red Knots (Endangered) and 60 Whimbrel (a species of special concern) have been counted. Shorebirds are found primarily on the vast low tide mudflats of the lower estuary, but have also been found to be numerous at times in the impoundments of the Tuckahoe and Corbin City WMA mudflats. When water levels are drawn down during shorebird's spring and fall migration periods, the resultant muddy flats of these

impoundments are ideal feeding habitat for shorebirds, as well as a favored high tide roost area for shorebirds when tidal mudflats elsewhere are covered. Key finds at the WMAs have included such uncommon shorebirds as Baird's Sandpiper, Buff-breasted Sandpiper, and 3 American Avocets. We commend the DFGW for drawing down these impoundments when possible for shorebirds; such enlightened management techniques not only benefits many shorebirds, including uncommon ones, but also provides ecotourism opportunities as well.

While these numbers of shorebirds found during spring and fall surveys are substantial and significant, they still only hint at the shorebird use of the lower Great Egg -- due to the fact that the current methodology and point count locations are far from prime low tide mudflats and high tide roost sites. (Distance, especially during the heat waves and haze of summer, precludes accurate counting and identification of many or most shorebirds on far-away mudflats). In short, shorebirds are drastically undercounted using our regular methodology; access by boat would be required to fully assess shorebird numbers using the Great Egg Harbor estuary. Based on these preliminary findings, however, suffice it to say that migratory shorebird use of the Great Egg is significant and substantial, and another of the many keystone ornithological events occurring on the Great Egg.

Further analyses and understanding of spring and fall migration of waterfowl, raptors, and all waterbirds might be possible in the future, but for now, in summary, the extended seasons of our Great Egg Harbor River studies have been highly successful. The protracted study period yielded notable findings for spring, the summer breeding period (which for local breeders coincides with both spring *and* fall shorebird migration), and the all-important fall migration. Spring and fall data for the Great Egg supplements the substantial and significant existing winter bird-use data. Most importantly, these findings importantly append core winter studies in confirming that significant bird use of the Great Egg occurs throughout the seasons. This recent spring and fall data augments and reinforces our existing ten years of core winter data, and complements known wildlife values with important new information regarding status, seasonal distribution, and numbers of birds using the Great Egg Harbor River and Bay. Expanded and supplemental seasonal studies confirm and corroborate previous winter survey efforts, and show that for both bird-use and the enjoyment of birds by visitors, the Great Egg is a place for all birds, and at all seasons of the year.

Table 10

Great Egg Harbor River
Raptor and Watebird Survey
SPRING MIGRATION

SPRING	2004	2006				2007			2008			2009			2010	
FIELD SEASON	5/6	3/30	4/16	5/2	5/24	4/9	5/16	5/31	4/10	4/24	5/30	4/9	5/19	6/10	4/22	5/25
LOONS to CORMORANTS																
Red-throated Loon	**6**	1	6	2		6			2			4	1			
Common Loon	6	8	10	10		10		1	**46**	26		34	2		24	
Pied-billed Grebe		**2**														
Horned Grebe		5				**40**			12			22				
Northern Gannet	10		2									10	1		12	
Double-crested Cormorant	262	258	491	**1205**	79	539	54	49	247	341	4	130	74	22	571	95
HERONS to VULTURES																
Least Bittern					1									1		
Great Blue Heron	2	8	1	6		8	2	5	**17**	3	2	4	6	2	3	4
Great Egret	41	15	72	56	49	35	28	36	43	22	30	30	70	58	39	74
Snowy Egret	47	6	79	21	17	11	26	37	14	38	25	47	**137**	27	62	100
Little Blue Heron	**24**	1		1	2			1				3	3	2	1	3
Tricolored Heron	1		1	3		2		1		1		1	1	1	1	3
Cattle Egret																1
Green Heron	1															
Black-crowned Night-Heron	1			2			2	**21**		2			2	4	2	1
Yellow-crowned Night-Heron	1				1	1		1		4			1	**11**		7
heron/egret (sp.)																
Glossy Ibis	32	2	229	22	21		1	14		3	50	6	6	26	69	162
White-faced Ibis			1													
Black Vulture	7	4	6	5	2	**9**	2	1	6	1	2	1	9	1	4	5
Turkey Vulture	67	97	**127**	78	67	97	37	46	98	76	50	80	79	32	80	80
WATERFOWL																
Canada Goose	94	115	92	80	73	55	45	71	72	41	**200**	29	88	61	83	64
Brant	664	516	790	746	32	**1790**	150	3	712	1043		1256	422		1252	5
Mute Swan	46	109	105	70	89	68	31	45	38	49	**125**	55	45	40	35	38
Wood Duck														1		
Gadwall		24	**27**						8	2		18				

Peak Counts are **BOLD FACED**
N = number of surveys per field season

Table 10

Great Egg Harbor River
Raptor and Watebird Survey
SPRING MIGRATION

SPRING	2011		2012		2013	
FIELD SEASON	4/26	5/11	4/20	5/24	4/8	5/22
LOONS to CORMORANTS						
Red-throated Loon	1		2		4	
Common Loon	15	3	22		28	7
Pied-billed Grebe					2	
Horned Grebe	2		2		12	
Northern Gannet	3	5	2		**25**	
Double-crested Cormorant	288	125	427	57	464	166
HERONS to VULTURES						
Least Bittern		**5**				
Great Blue Heron	3	2	6	3	2	3
Great Egret	63	49	38	44	56	**168**
Snowy Egret	46	79	21	46	21	99
Little Blue Heron	1	2				4
Tricolored Heron		1		2		**4**
Cattle Egret						
Green Heron						
Black-crowned Night-Heron		1		2		2
Yellow-crowned Night-Heron		10	4	1	2	9
heron/egret (sp.)			100+	100+		
Glossy Ibis	2	**330**	9	37	2	25
White-faced Ibis						
Black Vulture	5	4	5		1	2
Turkey Vulture	77	102	65	45	102	52
WATERFOWL						
Canada Goose	77	58	66	53	78	44
Brant	1060	244	744	3	796	42
Mute Swan	101	87	24	36		
Wood Duck		**4**				
Gadwall	14		3		5	

Peak Counts are **BOLD FACED**
N = number of surveys per field season

Table 10

Great Egg Harbor River
Raptor and Watebird Survey
SPRING MIGRATION

SPRING	2004	2006				2007			2008			2009			2010	
FIELD SEASON	5/6	3/30	4/16	5/2	5/24	4/9	5/16	5/31	4/10	4/24	5/30	4/9	5/19	6/10	4/22	5/25
American Wigeon		**28**	8						3			5				
Am. Black Duck	7	233	122	157	13	**372**	14	14	117	41	8	205	19	14	11	11
Mallard	7	37	24	16	26	23	8	47	26	16	16	23	24	**64**	11	19
Blue-winged Teal	1	4	**12**			5			10	2		3				
Northern Shoveler		**12**	10						2							
Northern Pintail		65	8			11			**115**	4		16				
Green-winged Teal	6		575	308	10	539			**1376**	425		1223			126	
"Common Teal"																
Ring-necked Duck																
Greater Scaup						1										
Lesser Scaup			3			2										
Scaup (sp.)		20				**750**			190	3		451			12	
Common Eider															1	
Surf Scoter		**4**							2							
Black Scoter										3						
Long-tailed Duck		30				96			**560**			45			1	
Bufflehead	4	**623**	45			281			577	1		556			1	1
Com. Goldeneye		6														
Hooded Merganser		2				**20**						3				
Com. Merganser		3				2			**6**							
Red-breasted Merganser	3	74	117	9		66		1	**193**	3		146			16	
Ruddy Duck																
DIURNAL RAPTORS																
Osprey	38	52	73	53	31	38	28	35	42	27	14	61	66	56	46	**79**
Mississippi Kite																2
Bald Eagle	4	5	10	10	5	6	3	2	**22**	5	3	10	10	4	7	4
Northern Harrier	5	23	17	8	1	24	1		**35**	10	3	12	6	2	3	2
Sharp-shinned Hawk	**3**	1	1							1		1				
Cooper's Hawk	1	4	2	4	1	1	1		1	2	1	4	3	1	**5**	

Peak Counts are **BOLD FACED**
N = number of surveys per field season

Table 10

Great Egg Harbor River
Raptor and Watebird Survey
SPRING MIGRATION

SPRING	2011		2012		2013	
FIELD SEASON	4/26	5/11	4/20	5/24	4/8	5/22
American Wigeon					14	
Am. Black Duck	75	41	32	17	111	11
Mallard	50	29	15	23	33	24
Blue-winged Teal	8		8		8	
Northern Shoveler	2					
Northern Pintail	6				42	
Green-winged Teal	212		124		428	
"Common Teal"			1			
Ring-necked Duck					10	
Greater Scaup						
Lesser Scaup		1			**8**	
Scaup (sp.)		2				
Common Eider						
Surf Scoter						
Black Scoter						
Long-tailed Duck					18	
Bufflehead	21				136	
Com. Goldeneye						
Hooded Merganser						
Com. Merganser						
Red-breasted Merganser	36				106	3
Ruddy Duck			10			
DIURNAL RAPTORS						
Osprey	59	64	73	64	63	61
Mississippi Kite						
Bald Eagle	8	11	10	10	8	2
Northern Harrier	3	5	5		10	4
Sharp-shinned Hawk			1		1	
Cooper's Hawk		4	3	1	3	1

Peak Counts are **BOLD FACED**
N = number of surveys per field season

Table 10

Great Egg Harbor River
Raptor and Watebird Survey
SPRING MIGRATION

SPRING	2004	2006				2007			2008			2009			2010	
FIELD SEASON	5/6	3/30	4/16	5/2	5/24	4/9	5/16	5/31	4/10	4/24	5/30	4/9	5/19	6/10	4/22	5/25
Broad-winged Hawk			1	1									1	1		1
Red-tailed Hawk	33	40	**43**	40	33	37	9	10	25	11	4	30	28	10	26	30
American Kestrel			**2**			2				1		2				
Merlin	1		1							1		1			1	
Peregrine Falcon	1	1	2	1	1				2			**4**	1		3	1
GROUSE to SHOREBIRDS																
Ring-necked Pheasant		1												1		
Wild Turkey		1	1						**15**					3		
Clapper Rail	14	1	3	8	7		4	16	1	3	10		15	3	4	22
Black-bellied Plover	9		4	7	5		24	6			1		**196**		14	111
Semipalmated Plover				1	22		54	48			30		**194**			92
Piping Plover																
Killdeer		1	1	1		1			**3**	2	1		1	1		1
Am. Oystercatcher	7	10	26	14	20	17	4	11	13	2		14	36	12	**37**	30
Greater Yellowlegs	15	60	**195**	33	4	40	3	2	31	51	1	34	6		33	2
Lesser Yellowlegs		4	**42**			1		1	2		1	7				
Solitary Sandpiper							1									
Willet	79		17	76	40		51	57		34	18		81	32	56	**86**
Spotted Sandpiper	3				3		**6**				1					
Whimbrel	15			**60**			1			1			2		1	44
Ruddy Turnstone					2								**90**			85
Red Knot				10									**412**			356
Sanderling			7		210		80	52					**375**			185
Semipalmated Sandpiper					36		821	805			1320		848			1191
Western Sandpiper											1					
Least Sandpiper	73	1	10	1	88		**345**	22		2	10		239			48
White-rumped Sandpiper							1	**6**								
Purple Sandpiper																1
Dunlin	380	26	85		9	102	3		2	25		**1355**	1014		95	1075

Peak Counts are **BOLD FACED**
N = number of surveys per field season

Table 10

Great Egg Harbor River
Raptor and Watebird Survey
SPRING MIGRATION

SPRING	2011		2012		2013	
FIELD SEASON	4/26	5/11	4/20	5/24	4/8	5/22
Broad-winged Hawk	1	**2**	1			2
Red-tailed Hawk	29	32	29	12	28	5
American Kestrel	1				1	
Merlin						
Peregrine Falcon	1	2		2	2	1
GROUSE to SHOREBIRDS						
Ring-necked Pheasant						
Wild Turkey	6	2	1		1	4
Clapper Rail	21	20	20	13		**26**
Black-bellied Plover	9	4	1	10		114
Semipalmated Plover		55				113
Piping Plover		1		**2**		1
Killdeer	1	1	2		2	
Am. Oystercatcher	27	6	17	11	32	15
Greater Yellowlegs	61	18	61	2	65	4
Lesser Yellowlegs	8	1	15		2	2
Solitary Sandpiper						
Willet	79	57	46	39		69
Spotted Sandpiper				1		
Whimbrel	1	74				2
Ruddy Turnstone				6		35
Red Knot				2		49
Sanderling				130		248
Semipalmated Sandpiper		16		1030		**2621**
Western Sandpiper						
Least Sandpiper	25	247				5
White-rumped Sandpiper						1
Purple Sandpiper						
Dunlin	15	1	160		18	1087

Peak Counts are **BOLD FACED**
N = number of surveys per field season

Table 10

Great Egg Harbor River
Raptor and Watebird Survey
SPRING MIGRATION

SPRING	2004	2006				2007			2008			2009			2010	
FIELD SEASON	5/6	3/30	4/16	5/2	5/24	4/9	5/16	5/31	4/10	4/24	5/30	4/9	5/19	6/10	4/22	5/25
Short-billed Dowitcher	118			4	5		10	3			2		335			**647**
Wilson's Snipe			1			**2**			1							
unidentified shorebirds							225						540			
Total shorebirds	699	102	388	207	600	163	1629	1013	52	117	1411	1410	4369	45	263	3954
GULLS to ALCIDS																
Laughing Gull	√	22	√	√	√	50	√	√	**500**	√	√	330	√	√	√	√
Bonaparte's Gull						1	1			**7**						
Ring-billed Gull	√	√	√	√		√	√	1	√	√	√	√	√		√	√
Herring Gull	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Great Black-backed Gull	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Lesser Black-backed Gull		1				1										
Gull-billed Tern					1		1	1					3	2		**4**
Caspian Tern	1		**2**				1	1					1			2
Common Tern	75			2	40			4					46	50		95
Forster's Tern	**287**	2	270	215	207	5	183	99	42	163	√	36	184	62	178	147
Least Tern					8		2	10					34	8		25
Black Tern																
Black Skimmer					6								42	254		226
OWLS to KINGFISHERS																
Short-eared Owl									1							
Belted Kingfisher		1	2		1	1			2			**3**				

Peak Counts are **BOLD FACED**
N = number of surveys per field season

Table 10

Great Egg Harbor River
Raptor and Watebird Survey
SPRING MIGRATION

SPRING	2011		2012		2013	
FIELD SEASON	4/26	5/11	4/20	5/24	4/8	5/22
Short-billed Dowitcher	6	15		33		64
Wilson's Snipe						
unidentified shorebirds						
Total shorebirds	232	496	302	1266	119	**4430**
GULLS to ALCIDS						
Laughing Gull	√	√	√	√	√	√
Bonaparte's Gull						
Ring-billed Gull	√	√	√	√	√	√
Herring Gull	√	√	√	√	√	√
Great Black-backed Gull	√	√	√	√	√	√
Lesser Black-backed Gull						
Gull-billed Tern		1				1
Caspian Tern						
Common Tern	3	60	2	**140**		56
Forster's Tern	219	161	179	106	2	118
Least Tern		7		**54**		20
Black Tern				1		
Black Skimmer	4	10		**310**		249
OWLS to KINGFISHERS						
Short-eared Owl						
Belted Kingfisher					2	

Peak Counts are **BOLD FACED**
N = number of surveys per field season

Table 11

Great Egg Harbor River
Raptor and Watebird Survey
FALL MIGRATION

FALL	2005		2006		2008				2009				2010				2011	2012		2013
FIELD SEASON	10/15	11/17	10/21	11/21	9/2	9/24	10/10	11/22	8/7	8/27	9/18	11/17	6/23	7/16	8/26	9/13	11/11	8/17	11/25	7/24
LOONS to CORMORANTS																				
Red-throated Loon		2		**4**				1				4							1	
Common Loon		9		7				11				9					11		**13**	
Pied-billed Grebe		3		2		1				1		**5**							1	1
Horned Grebe								2												
Northern Gannet							2					**11**								
Brown Pelican							15			2	**26**				8	1				1
Am. White Pelican		1																		
Double-cr Cormorant	225	133	**350**	147	176	192	259	103	157	113	131	84	38	61	169	43	68	3	69	85
HERONS to VULTURES																				
Least Bittern														5						
Great Blue Heron	8	7	26	9	20	10	**29**	17	14	11	9	12	2	6	8		5	8	17	6
Great Egret	25	1	20		90	76	78	2	**143**	47	106	8	66	34	39	25		31	5	49
Snowy Egret	50		10		91	107	38		81	73	**209**		39	57	36	55		59		39
Little Blue Heron					**16**	5	3		7	1	3		2	3	3	2				5
Tricolored Heron					**2**	1	1		2	2	1		1	1						1
Green Heron					1					1					1					**4**
Black-cr Night-Heron					10	2	2		15				1	6				2		**17**
Yellow-cr Night-Heron					6				4	5	1		10	**15**	5					6
heron/egret (sp.)									100	50										**355**
Glossy Ibis									**121**	35	16		79	27				3		66
Black Vulture	1	9	3		2	8	7	9	1	3	**10**	9	2		6		4	4	7	3
Turkey Vulture	100	**106**	88	76	73	76	97	83	69	72	73	92	36	29	73	26	81	38	91	38
WATERFOWL																				
Snow Goose								**124**			9									
Cackling Goose																			2	
Canada Goose	4	6	15	100	19	90	93	**337**	113	16	130	5	57	54	71	1	56	36	210	122
Brant		630	40	1038			185	**1835**				1760					440		779	
Mute Swan		63		52	47	57	62	78	35	37	54	43	67	**86**	67	6	65	15	70	
Tundra Swan								**6**									6		1	

Peak Counts are **BOLD FACED**
N = number of surveys per field season

Table 11

Great Egg Harbor River
Raptor and Watebird Survey
FALL MIGRATION

FALL	2005		2006		2008				2009				2010				2011	2012		2013
FIELD SEASON	10/15	11/17	10/21	11/21	9/2	9/24	10/10	11/22	8/7	8/27	9/18	11/17	6/23	7/16	8/26	9/13	11/11	8/17	11/25	7/24
Wood Duck													1				**10**			
Gadwall						2									1	2	**4**		4	
American Wigeon												2					**6**			
Am. Black Duck	105	41	15	130	43	46	69	**554**	11	11	46	144	17	17	73	75	253	5	206	2
Mallard	3	3		2	66	23	26	82	69	96	17	18	54	75	117	90	13	1	**157**	8
Blue-winged Teal															**3**	2				
Northern Shoveler																			13	
Northern Pintail		6			14	32	18	19		1						2	**102**		17	
Green-winged Teal		40		5	240	42	**464**	141		26	7	1			30	100	37		49	
Ring-necked Duck				**3**															1	
Greater Scaup							3													
Lesser Scaup																			4	
Scaup (sp.)				**60**								3								
Common Eider												7								
Surf Scoter												**15**					2		6	
White-winged Scoter												1								
Black Scoter							1					**14**							4	
Long-tailed Duck		**10**		6				4											8	
Bufflehead		55		37				138				**139**					11		118	
Hooded Merganser				6				**34**				6							4	
Com. Merganser				1													3		**6**	
Red-breasted Merganser				2				**18**				5								
Ruddy Duck		**33**					3	1									1		3	
DIURNAL RAPTORS																				
Osprey	25	4	3	1	46	11	25	2	101	53	18		66	47	71	11	1	55		**103**
Bald Eagle	8	10	**11**	3	5	8	7	10	4	5	8	7	2	1	3	1	9		6	3
Northern Harrier	20	34	6	**35**	2	15	18	35		6	16	28	1	2	5	2	26		13	1
Sharp-shinned Hawk	**140**	10	29	4		28	2	1				5					4		1	
Cooper's Hawk	**35**	2	6	2	1	4	8	1			3	3		1			5	2	1	1
Northern Goshawk																				

Peak Counts are **BOLD FACED**
N = number of surveys per field season

Table 11

Great Egg Harbor River
Raptor and Watebird Survey
FALL MIGRATION

FALL	2005		2006		2008				2009				2010				2011	2012		2013
FIELD SEASON	10/15	11/17	10/21	11/21	9/2	9/24	10/10	11/22	8/7	8/27	9/18	11/17	6/23	7/16	8/26	9/13	11/11	8/17	11/25	7/24
Red-shouldered Hawk		**3**						1				1							1	
Broad-winged Hawk																		1		
Red-tailed Hawk	15	40	21	46	9	15	25	**62**	17	14	12	30	12	1	7		25	6	33	7
Rough-legged Hawk		1						1				1							1	
Golden Eagle																				
American Kestrel	**25**		7			6	1		1		1						2			
Merlin	3		2			**4**		1			2					1	1			
Peregrine Falcon	3	**4**	4	4		2	3	2	3	3	3	2					4	1	2	1
GROUSE to SHOREBIRDS																				
Ring-necked Pheasant							1	1				1							**3**	
Wild Turkey						2				**20**										
Clapper Rail					5		1		8	13	9	1	17	**29**	7	1		7		13
Black-bellied Plover		20			48	24	75	17	4	57	1	86	1		24	3	**92**	1	32	3
Semipalmated Plover					**158**	6			22	33	32			1	63	16		122		3
Killdeer							1	1	1	4	4			5			3		**25**	2
Am. Oystercatcher		92		26	24	38	101	10	4	52	101	**107**	14	5	41	69	105	76	69	12
American Avocet															3					
Greater Yellowlegs		3	2	2	**127**	27	53	9	48	12	8	20		10	38	15	70	29	7	20
Lesser Yellowlegs		20			**120**	1	4		11	1	3			14	37	2	9	27		34
Willet					4								**120**	13	2	7		1		1
Spotted Sandpiper					**3**		1		3	2								2		5
Ruddy Turnstone					8		5		3	22	12	**34**		1	15					
Red Knot						**10**		2	9			1	1							
Sanderling				12	620	65	120	60	920	**1200**	126	196			80	700	65	200	70	218
Semipalmated Sandpiper					**666**	1			469	83	37			208	660	280		180		71
Western Sandpiper					6						**15**					1		10		
Least Sandpiper		2			**484**				111	101	9			28	133	45	1	49		87
White-rumped Sandpiper															**11**	2	2	4		
Baird's Sandpiper																1				
Pectoral Sandpiper							1			1					3	4				

Peak Counts are **BOLD FACED**
N = number of surveys per field season

Table 11

Great Egg Harbor River
Raptor and Watebird Survey
FALL MIGRATION

FALL	2005		2006		2008				2009				2010				2011	2012		2013
FIELD SEASON	10/15	11/17	10/21	11/21	9/2	9/24	10/10	11/22	8/7	8/27	9/18	11/17	6/23	7/16	8/26	9/13	11/11	8/17	11/25	7/24
Purple Sandpiper																			2	
Dunlin		60	3	1			227	167				**1110**					803		586	
Stilt Sandpiper					1				3									**4**		
Buff-breasted Sandpiper																6				
Short-billed Dowitcher					**74**				23	4				43	17			14		32
Long-billed Dowitcher		1													1					
Wilson's Snipe				1						1		1			1					
Wilson's Phalarope															1					
unidentified shorebirds					200					200								300		
Total shorebirds		198	5	42	**2543**	172	588	249	1631	1774	348	1555	136	328	1129	1151	1150	1019	791	488
GULLS to ALCIDS																				
Laughing Gull	√	√	√	2	√	√	√		√	√	√		√	√	√	√	√	√		√
Ring-billed Gull	√	√	√	√	√	√	√	√		√		√		2	√	√	√	√	√	
Herring Gull	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Great Black-backed Gull	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Gull-billed Tern									3				3	4	5			**10**		3
Caspian Tern					6	**8**	4		3					2	2					
Royal Tern		2			15	**27**	6		1	6	1	2			5	2				
Common Tern					**342**	72			198	99	5		100	142	76	30		75		219
Forster's Tern	100		√		**187**	135	64	4	82	42	52		72	84	92	25	14	73	1	87
Least Tern					10				105	24			100	**196**	21					29
Black Tern						1														
Black Skimmer					940	981	700	45	1545	1252	750	5	800	1300	1003	**2800**		1000+		303
OWLS to KINGFISHERS																				
Belted Kingfisher	2	3	1	4	2	2	4	1		3	**5**	2			2	1	3		1	

Peak Counts are **BOLD FACED**
N = number of surveys per field season

CONCLUSIONS AND SUMMARY

Ten intensive seasons of winter study on the Great Egg Harbor River, and nine comparative years of study on the Mullica River – studies designed in-part to place the Great Egg findings in a regional perspective – have documented high concentrations of wintering raptors, wintering waterfowl, and other waterbirds. These populations are deemed significant and substantial for the Atlantic Coastal marshes in all of New Jersey, and in the Mid-Atlantic region. Few areas have reported numbers that rival the Great Egg Harbor River, and fewer still if any can claim the level of documentation that is now available for the Great Egg Harbor River (and to a lesser degree the Mullica River).

We submit that the goals and objectives of this project, as conceived in concert with the Great Egg Harbor Watershed Association in 2003, have been substantially met (see page 8). The goals of discovery, documentation, awareness, and protection remained unchanged over the past decade, and have led to findings that highlight the extraordinary avian resources of the Great Egg Harbor River and Bay. Through strong protocols, we have established an avian data base to determine status and trends in winter bird populations and bird use; through the establishment of nine specific point count sites on the river we have determined key use areas of winter raptors and waterbirds. Through the submission of rare, threatened, and endangered species use mapping to the Endangered and Nongame Species Program, the Great Egg Harbor Watershed Association has amply supplemented and assisted the important work of the Division of Fish, Game and Wildlife.

In addition to the core winter studies, expanded seasonal coverage has discovered significant fall migration through the Great Egg system, and late winter and spring surveys have found important spring migration and spring staging occurring as well. Although winter raptor and waterbird studies were the primary focus, we have found that important bird use of the region doesn't begin on December 1 and end on March 31, and that avian ecovalues occur in all seasons.

Finally, through the provision of this and all seasonal reports to concerned citizens, organizations, and agencies, we have met the key objective of discovering and providing avian resource data to be used in Great Egg Harbor River management and protection. Through the posting of these reports on-line, as well as through programs and presentations, the Great Egg Harbor Watershed Association has gained important publicity and brought overdue recognition to the extraordinary avian resources and resultant ecotourism opportunities of the Great Egg Harbor River and Bay. The Great Egg Harbor Watershed Association-sponsored studies outlined herein are one of very few true long-term avian status and distribution surveys that have been carried out anywhere in New Jersey or the region, and are particularly important as land-use changes continue and accelerate in the area. Energy choices, including but not limited to wind power projects, also call for current and in-depth knowledge of the status and trends of birds.

A major analysis was carried out at the five-year mark, and now with this report, at the ten-year milestone as well. At the conclusion of the tenth field season, this in-depth review and

analysis were performed on this entire body of work to establish the significance of observed status and trends of Great Egg Harbor River raptors and waterfowl populations. While this report looks primarily at status and general trends, many other possibilities remain in regards to data analysis. Trends have been discussed throughout, but we held off on creating trend lines because in part, ten years is not truly long enough a time span to determine long-term trends. Plus, and more to the immediate point, we could not help but feel that the extremely mild winters that characterized the second five-year segment of the study in fact masked many perceived and expected long-term trends. (For example, many ducks, and Bald Eagles simply stayed north during these warm winters, not allowing for a good comparison to the first five-year segment). None-the-less, relevant trend lines could yet be generated for key species, and statistical validation of discovered trends might also be carried out. It is possible that the Great Egg Harbor Watershed Association might find a partner to assist in creating the trend lines and statistical tests that might further confirm and corroborate the observed trends, taking the analyses and proof to a higher level than we have currently presented here.

Many other possibilities for data review remain and have been alluded to. We have frequently mentioned, both herein and in the individual season reports, the effects of warm versus cold winter seasons on both raptor and waterfowl populations, but it would be highly interesting to overlay the findings for individual years with prevailing weather conditions and overall average air and water temperatures (as well as snow and ice cover both on the immediate Great Egg and to our north). Over the ten years, each individual season has been analyzed in relation to prevailing weather and temperatures, but a long-term comparison of weather indices and on-the-ground Great Egg Harbor and Mullica River bird population findings would take speculation to a higher level of scientific understanding as to the causes and effects of weather on bird population variations, changes, and trends over the years.

Similarly, it would be germane to compare and overlay long-term flyway waterfowl production indices (from distant breeding areas or "sending districts") to the observed waterfowl numbers on the Great Egg Harbor River for each of the ten years of study. This could go a long way in answering the questions as to whether duck population changes/trends on the Great Egg are a response to local habitat changes or perhaps conditions and factors far away, such as, for example, drought in the Upper Mid-west Prairie Pothole region.. Finally, a comparison of winter raptor numbers to classic raptor migration indices (such as hawk count numbers at Cape May Point, NJ and Hawk Mountain, PA) might lend insight as to how and why local winter raptor populations might vary in regards to weather patterns, breeding productivity, and regional migration counts.

Finally, and strongly underscoring both the above and the crucial need for long-term and ongoing studies, as this project began its final season, Hurricane/Superstorm Sandy devastated the New Jersey Coast on 29 October 2012. Record tidal flooding, and unprecedented damage and destruction resulted here as in much of the Northeast. The impacts on fish and wildlife populations and habitats were severe, long-term, and far-reaching. The indirect but crucial impact to wintering raptors was the record tide levels and storm surge which drowned a very high percentage of tidal wetlands rodents – the prey base on which many raptors depend – principally meadow voles, mice, and rice rats. Natural Lands Trust land manager Brian Johnson reported finding hundreds of drowned rodents in a very small area near Dividing Creek (on the

Delaware Bayshore) in the immediate aftermath of Sandy. This no doubt occurred on the Great Egg as well.

In addition, Hurricane Sandy came on the heels of Hurricane Irene. Irene made landfall as a tropical storm near Little Egg Harbor on 28 August 2011, and was responsible for severe tidal flooding throughout Southern New Jersey. It was then theorized that Irene's impacts on prey were a factor in winter 2011-2012's very low raptor totals on both the Great Egg Harbor River and on the Delaware Bayshore's Maurice River. It is now easily postulated that Sandy lead to the unprecedented low raptor numbers observed in winter 2012-2013.

As attested to by Table 2, there is little doubt that the record low Great Egg Northern Harrier counts in winter 2012-2013 – both the peak count of only 22 and the average count of 14 are record lows by far – were a direct result of Sandy. (The previous Harrier lowest peak was 28 in 2010-2011, and the previous record low average was 20 – following Hurricane Irene). Similarly, the Great Egg Red-tailed Hawk peak count of 40 was the lowest ever (previous lowest was 42 in 2011-2012 following Irene), and the Red-tail average count was the second lowest (31 – the lowest average of 28 also followed Hurricane Irene – see below). In short, with little food available on the Great Egg Harbor River and Bay marshes, birds of prey such as Harriers and Red-tails that specialize on rodent were either forced to move on and hunt elsewhere, or, in some cases -- mostly with inexperienced young birds -- possibly starve.

The findings on the Mullica River mirror the findings on the Great Egg: the peak and average of only 17 Northern Harriers is by far the lowest in the nine years of comparative studies. (see Table 4). The meager peak of only 22 Red-tailed Hawks is easily the lowest ever, and the average is the second lowest in nine years -- second only to the average of 18 that followed Hurricane Irene in winter 2011-2012.

Long-term raptor studies carried out on Cumberland County's Maurice River for Citizens United to protect the Maurice River (see Literature Cited/For Further Reference) also strongly confirm and corroborate the findings on the Great Egg and Mullica. There is little doubt that the record low Maurice Red-tailed count and very low Harrier count in winter 2012-2013 were a direct result of Sandy. The Red-tailed Hawk peak of just 43 birds was the second lowest peak on record (a peak of 40 was counted in winter 1987-1988), and the seasonal average of just 31 was the lowest average ever (second only to the average of 33 in 1987-1988, 1988-1989, and again in 2011-2012 – following Hurricane Irene). The Northern Harrier peak of 22 birds tied the lowest peak ever (1989-1990), and the average of 17.63 was the fourth lowest Harrier average ever recorded on the Maurice River in 26 years of study.

It remains to be seen how long salt marsh rodent populations will take to recover from the combined effects of two major storm/flooding events back to back, and we eagerly anticipate the planned, upcoming 2013-2014 winter raptor surveys on Maurice River to provide further insight on this climate change/sea level rise related issue. Of interest, these counts such as we have on the Great Egg and the Mullica (and on the Maurice) are among very few studies that can provide definitive data of the cause and effect impacts of Hurricane/Superstorm Sandy on raptors. Ten years of data offers a good long-term perspective of the effects of Sandy on the birds of the Great Egg Harbor River.

Finally, damage from the storm surge from Sandy (and Irene) are suspected in low waterfowl totals as well – particularly for Brant – as shallow bays and mudflats were both scoured and received siltation from the flooding, potentially severely impacting submerged aquatic vegetation and other food resources. In addition, Sandy devastated key Great Egg Harbor River wildlife areas such as Corbin City WMA and Tuckahoe WMA, where flooding destroyed the dikes (berms), wildlife drive, and water control structures. Here as in many other places, both short-term and long-term impacts to wildlife are yet to be fully discovered and reported, and it remains to be seen what the lasting impacts of Sandy might be on coastal wildlife resources.

Against such a backdrop of frequent and severe storms, as well as widespread and frequent droughts, it is studies such as these on the Great Egg Harbor River that might provide small but important pieces of the entire puzzle of climate change and sea-level rise. Sea level rise on the Atlantic Coast has been proven as accelerating and among the most severe that has been documented. Record heat and average temperatures continue to be reported season after season. Droughts continue throughout much of the nation, impacting waterfowl productivity and raptor nesting and survival in a myriad of ways such as low rodent/prey availability (another possible suspect in the recent low 2011-2012 raptor numbers on the Great Egg). In short, climate change and sea level rise are presenting a matrix of possible scenarios and interactions of various factors. It is important to note that the availability of these long-term raptor and waterbird studies on the Great Egg Harbor River might offer a key piece of the insight and facts needed to help decipher this matrix of causes and effects, and that recent weather events only underscore the importance of carrying out such studies over time.

Ten years of ongoing and systematic long-term studies on the Great Egg Harbor River have discovered and documented regionally significant and extraordinary numbers and diversity of raptors and waterfowl. The length of this study period, combined with the historical data discussed within, have clearly demonstrated that these high avian ecovalues are not intermittent or fluctuating, but that they have existed substantially and over time. These documented natural resources are of great significance in the New Jersey coastal region and take on even greater consequence as land-use changes continue, and are predicted to accelerate, in the Great Egg Harbor River corridor and surrounding area. As the goals of this long-term project state, the key objective of these survey efforts was to discover and provide cornerstone avian resource data to be used in guiding river management, protection, and appreciation. With the publication of this ten year summary report, this goal has been substantially met, with studies yielding significant insight on avian status and trends. This long-term study can now become a strong part of the vast array of information provided by the Great Egg Harbor Watershed Association in their praiseworthy and far-reaching educational efforts on many levels, as well as a key part of the group's awareness activities and advocacy efforts.

While these ten years of winter raptor and waterfowl studies are perhaps not "rocket science" of the popular (and costly) twenty-first century remote-sensing and tracking genre (radio telemetry, satellite telemetry, and geolocator tracking), this systematic survey effort is one of the few long-term ornithological studies being carried out in the entire Southern New Jersey coastal region. It is one of the most accessible, available, and widely distributed studies, and has

proven to be a valuable tool in the determination of status and trends – and subsequent protection -- of the avian resources of the Great Egg Harbor River.

While some of the trends discussed herein, the increases and decreases of certain species, may be in part well-known, prior to this study much of our local information was, for many years, largely anecdotal. For the Great Egg, ten years of intensive study has now taken our perceptions of status and trends from "suspected" to the realm of documented and proven. An amazing 82 individual winter surveys, plus 36 additional expanded season surveys and 42 comparative Mullica River surveys (equating to 160 calendar days and 320 man days total), have given us a database of unprecedented and significant proportion, and a true baseline from which to draw our conclusions on the health of the Great Egg system and the species dependant upon it. And, importantly, we have a baseline to which we can compare the effects and impacts of future changes on the river, be they man-made or natural.

Very few areas on the Jersey Coast or elsewhere in the Mid-Atlantic can today offer such solid proof of its environmental quality as can the Great Egg Harbor River. The Great Egg Harbor Watershed Association, through their foresight and commitment to sound and long-term environmental studies, provide a solid foundation and underlying strength to their exemplary protection and advocacy efforts. Such strong baselines and up-to-date knowledge yield high confidence that perceived environmental trends are either positive or negative, and that actions can and will be based on hard facts and irrefutable evidence. Of all this, the Great Egg Harbor Watershed Association can be proud, and we as the "field team" and the authors of this report, are privileged and very proud to have been a part of this effort.

We note, with attachment and with wonder, that even though Great Egg Harbor River bird study has now been occurring for over two centuries, dating back to those heady, seminal adventures of Alexander Wilson and John James Audubon, that there are still exciting discoveries to be made on the Great Egg. We marvel that (as Robert Cantwell wrote) "the long-legged creatures" known to Wilson still pace endlessly along the shore, the "shovel-mouthed sea birds" (Black Skimmers) are yet scooping up their food over the waves, and that all continue to be nurtured by the slow-moving rivers that today still pour from deep-shaded cedar swamps, through large stands of dwarf pines and on to "the white sand and salt sea." The Great Egg remains a truly great place indeed.

ACKNOWLEDGMENTS

We thank all those friends of the Great Egg Harbor River for their encouragement and support during the course of this ten year project. We thank Pat Sutton and Gail Dwyer for their generous assistance with data charts and report writing, and we thank Doyle Dowdell, Michael O'Brien, Carole Brown, and Pat Sutton for assistance in the field on a number of surveys. We heartily thank Karen and Brian Johnson for sharing so many Great Egg sightings with us, and for showing such great interest in the study.

Capt. Jim Watson took a major interest in the project, and offered great logistical input and field assistance that dates all the way back to the "historical" studies. Ward Dasey, Jon Sutton, and Jack Miller have long shown an interest in the rivers, and have offered encouragement and appreciation over many years. Paul Kosten and Karen Williams-Kosten shared many interesting sightings and offered considerable insight and knowledge of both the Great Egg and Mullica Rivers' avian resources. A sincere thank you to all. Your appreciation and love of the rivers and their birds are infectious.

We sincerely thank *all* of the officers and members of the Great Egg Harbor Watershed Association for their interest, support, and great enthusiasm for this winter study. We particularly thank Lynn Maun and Fred and Julie Akers for their advocacy for the study, and for their knowledge and assistance in the planning and preparation for the field work. We had some fun in the field, too! Thanks, Fred, for nurturing a tiny idea into a landmark long-term study, and thanks for your always friendly encouragement and optimistic outlook. Keep up all your good work on the Great Egg. The river would not be the same without you.

We remember and salute the late Belinda Irizarry, the Education and Outreach Coordinator for the Great Egg Harbor Watershed Association during the first years of this study; Belinda's spirit, energy, and enthusiasm for the river were an inspiration to any and all who knew her.

We thank the U.S. Department of the Interior's National Park Service, Wild and Scenic Rivers Program for their long-time assistance to the Great Egg Harbor Watershed Association. The award of a Wild and Scenic River Partnership Grant enabled this survey to be conducted and the report compiled. Conectiv Energy, BL England Station, and RC Cape May Holdings also supported this project during several of the winter study seasons, and we graciously thank them for their interest and support. Thank you all for your visions of a wild and scenic Great Egg and Southern New Jersey.

We sincerely thank the late Lynn Ward, the daughter of Jean and James F. Akers, for her love of wild Southern New Jersey and specifically for funding comparative studies on the Mullica River. From her hospice bed, she indicated to her brother, Fred Akers, that she wished for her estate to support the protection of her beloved rivers. Also, we thank the estate of the late Jean Akers for supporting the final years of study and analyses, a tribute dedicated and facilitated by her son, Fred Akers, in memory of his parents.

It was a pleasure and privilege working with all of you, named and unnamed, on this important study aimed at keeping the Great Egg Harbor River healthy, protected, and available to the myriad of birds and other wildlife so dependent upon it. We look forward to seeing you in the field, on the banks of the timeless Great Egg.

We dedicate these studies, and this report,

to the memory, lives, and works, of

Lynn Ward

and

Jean and Jim Akers

-- Clay Sutton

July 2013

ABOUT THE AUTHORS

Bios of the Authors of this study:

CLAY SUTTON the project leader, is a life-long resident of Cape May County, where he has worked as an environmental planner, environmental program administrator, vice-president of an environmental consulting firm specializing in threatened and endangered species, and for the past fifteen years as a self-employed environmental consultant, naturalist, field biologist, and writer (Clay and Pat Sutton LLC). Clay was the senior author of *The Scientific Characterization of the Delaware Estuary* for the Delaware Estuary Program, USEPA (1996, 228 pages). Clay is a co-author, with Pete Dunne and David Sibley, of the classic *Hawks in Flight* (Houghton Mifflin, 1988; Second Edition, 2012), and Clay and his wife Pat co-authored the acclaimed *Birds and Birding at Cape May* (Stackpole Books, 2006, 568 pages), among many other titles and articles. Clay also authored *Birding Cumberland: A Complete Guide to Birds and Birding in Cumberland County, NJ,* for Citizens United to Protect the Maurice River. Even long before this Great Egg project came to fruition, Clay counted the Great Egg Harbor and Tuckahoe Rivers among his very favorite places.

JAMES DOWDELL lives in Cape May County, where he has worked as a naturalist, field biologist, and with wildlife consulting firms for over thirty years. He has served as the official counter for the Cape May Bird Observatory at the Cape May Point autumn hawk watch, and for many years he was a key part of the DFGW team that conducted Delaware Bay aerial shorebird censuses in spring. Jim is one of New Jersey's most highly respected birders and natural history authorities. His interests extend well beyond birding, into herpetology, lepidoptera, botany, and more. He has both worked and birded in most of the lower forty-eight states, bringing deep perspective and skill to the Great Egg Harbor River studies. Jim and his wife Deb for many years owned the popular natural history shop "For the Birds" in Cape May.

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All comparative Maurice River ornithological studies discussed and / or referenced in this Great Egg Harbor report and the previous 2003-2013 Great Egg reports have been directed and co-authored by Clay Sutton, either as an independent contractor or formerly as staff ornithologist, Southern Regional Manager and Vice President of Herpetological Associates, Inc., Plant and Wildlife Consultants. (Comparative Cohansey River studies are embedded within the Maurice River annual reports). Principal publications resulting (either wholly or in part) from these studies (and funded or co-funded by Citizens United to Project the Maurice River and its Tributaries, Inc.) are as follows:

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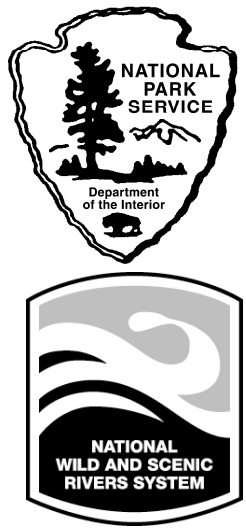

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