RAPTORS, WATERFOWL, SHOREBIRDS and WATERBIRDS

ON THE MAURICE RIVER

CUMBERLAND COUNTY, NJ

A TWENTY-FIVE YEAR SUMMARY OF OBSERVED STATUS AND TRENDS

1987-2012

Clay Sutton and James Dowdell

October 2012

Long-term studies sponsored by
Citizens United to Protect the Maurice River and its Tributaries, Inc.

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ABSTRACT: Under the auspices of Citizens United to Protect the Maurice River and its Tributaries, Inc., and with funding from the National Park Service, US Department of the Interior, and with goals of discovery, documentation, and conservation, raptors and waterfowl have been studied on Cumberland County, NJ's tidal Maurice River for 25 years. Over 476 days of field work have been carried out in this long term study. Initially implemented to document avian ecovalues in response to industrial barging and dredging proposals, core winter raptor and waterfowl point counts have been maintained every season since 1987-1988. Significant increases are shown for Bald Eagle, Peregrine Falcon, Cooper's Hawk, Black Vulture, Green-winged Teal and Canada Goose; substantial declines are seen for American Kestrel, Rough-legged Hawk, Am. Black Duck, Mallard, and Northern Pintail over the study period. Supplemental/adjunct fall raptor migration counts have been conducted at East Point, NJ to monitor the hawk migration moving west around Delaware Bay; in 60 days of observation in 1990 over 9,000 migrant raptors were counted (35% of the number recorded at Cape May). In 2003, studies were expanded into year-round census efforts for all water birds, including focused surveys of spring migratory shorebird use of the Maurice River; a daily high count of over 45,000 shorebirds using the lower Maurice was attained in 2009. Studies have yielded significant data on status and trends, spatial and temporal distribution, and habitat change (with implications regarding sea level rise and climate change). Findings have been used in the RTE listing process, oil spill protection, prioritization of conservation purchases, testimony in land use proceedings, in management decisions, as well as for educational and awareness projects. These long-term and continuing studies have substantiated the tidal Maurice River as an important bird use area for the Delaware Estuary, New Jersey, and the entire Mid-Atlantic region by any and all standards and at all seasons.

Submitted to:

Citizens United
to Protect the Maurice River and its Tributaries, Inc.

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On the cover: **Adult Bald Eagle in flight.** Bald Eagles are a flagship species of the Maurice River system at all seasons -- as breeders, migrants, and as wintering birds in large numbers.

– Photo by Clay Sutton, Autumn 2011

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EXECUTIVE SUMMARY

Initially in response to proposed land-use changes and potential threats to the Maurice River, and thereafter in an attempt to establish baseline data on raptor and waterfowl use, a systematic study was established during the winter of 1987-1988 and continued through 2011-2012 (and is ongoing to the present). For this twenty-five year period, data was gathered at nine established point count sites on the tidal lower Maurice River watershed. Raptors and waterfowl were counted for approximately forty-five minutes per site at a rate of every 10-14 days during the period from the first week of December through the last week of March in order to assess winter populations (as well as spring staging) and distribution of raptors (hawks, eagles and vultures) and waterfowl (ducks and geese).

With goals of discovery, documentation, conservation and protection, efforts were made to obtain information that over time could be used to determine status and trends in avian use and populations. Substantial avian ecovalues were discovered and extraordinary bird-use of the Maurice River was proven. Twenty-five years of systematic sampling of the Maurice River – in one of the very few true long-term studies being carried out in the Delaware Estuary on any group of animals -- has determined raptor use of the Maurice River to be substantial and highly significant for the Delaware Bayshore, in New Jersey, and in the entire Mid-Atlantic Region. Principal raptor species include Bald Eagle, Red-tailed Hawk, and Northern Harrier among up to fifteen species observed annually. Winter waterfowl numbers were equally substantial and significant for both the Delaware Estuary and for New Jersey. Populations of Snow Geese, Canada Geese, American Black Ducks, Mallards, Northern Pintail, and Green-winged Teal were found to be substantial and represent some of the highest concentrations reported for New Jersey. Numbers and a wide variety of diving ducks were recorded as well.

In twenty-five years of systematic studies, Maurice River winter raptor and waterfowl were documented in numbers judged to be regionally significant. Status and observed trends for key species of raptors and waterfowl are reported and discussed, and studies remain ongoing. Significant increases over the twenty-five year period are shown for Bald Eagle, Peregrine Falcon, Cooper's Hawk, Black Vulture, Green-winged Teal and Canada Goose; substantial declines are seen for American Kestrel, Rough-legged Hawk, American Black Duck, Mallard, and Northern Pintail over the study period.

Beginning in 2003, the core winter studies were expanded to monitor and document spring and fall migration of raptors, shorebirds, and all waterbirds. These additional

supplemental efforts are reported and discussed as well, although these studies have not been underway long enough to yet discern true status and trends.

Prior to the 2003 seasonal expansion, adjunct fall raptor migration counts had been conducted at East Point, NJ, at the mouth of the Maurice River, since 1987 (primarily from 1989 to 1991) to discover, document, and monitor the substantial hawk migration that moves west around Delaware Bay in autumn. These studies have been reported on previously (see Literature Cited/For Further Reference), but are briefly summarized here in relation to subsequent work and findings. Expanded studies have complemented core winter efforts in documenting the Maurice River as a place for all waterbirds and raptors and at all seasons.

Cumberland County, NJ

A TWENTY-FIVE YEAR SUMMARY of Observed Status and Trends 1987-2012

CORE WINTER STUDIES

BACKGROUND AND INTRODUCTION

"As you head into Maurice River Cove from Delaware Bay by boat, the great eagle's nest of Garron's Neck Swamp soon looms into view. It is a famous nest, and an ancient nest, for it has a place in the chart of every boat that sails up the river, and has had for I don't know how many years. Beyond the swamp and the nest stretched a vast wild marsh-land, where the reeds grew, and the tides came in, and the mud hens lived. And beyond that flowed the river, and beyond the river lay another marsh, and beyond the marsh another swamp. And over...this vast wild world towered the nest of the eagles, like some ancient castle . . . Over it all – swamp and marsh and river – ruled the eagles, as bold and free as the mighty barons of old."

Dallas Lore Sharp, *The Fall of the Year*, 1911

The Maurice River, including its important Menantico, Manumuskin, Muskee, and Buckshutem tributaries, is one of New Jersey's great river systems. The Maurice River joins the Mullica River / Wading River complex, the Tuckahoe and Great Egg Harbor Rivers, and the Cohansey River as one of the largest and most important river and estuary systems in southern New Jersey. The Maurice system is indeed the largest river flowing into Delaware Bay except for the Delaware River, with a watershed totaling 386 square miles. Despite a long and storied history of settlement in the areas surrounding the river, and despite recent and substantial regional growth and development, much of the Maurice River remains quite wild and highly scenic, and many areas would yet qualify as pristine under most standards of review. Indeed, many sections of the Maurice are recognized and included in the National Park Service's Wild and Scenic River Program. The Maurice River is certainly one of South Jersey's gems -- in pleasing vistas, rich natural resources, wildlife use, and recreation and ecotourism opportunities.

Despite its well-established reputation for substantial wildlife populations and avian resources, prior to 1987 surprisingly little systematic ornithological data had been gathered on the Maurice River. Most published avian use data was anecdotal at best -- chance sightings or non-systematic surveys. State and federal waterfowl counts documented substantial use, yet were conducted infrequently and with results generally unavailable to the public. In short, available records hinted at exceptional bird use of the Maurice River region, but unfortunately offered biologists or planners little definitive data or mapping for use in resource management, land use planning options, decision-making, and protection strategies.

Beginning in 1987, numerous studies have now been conducted by Citizens United on the birds of the Maurice River region. These research efforts have taken place throughout the seasons, and have investigated the breeding birds of the river and its tributaries (principally the Manumuskin River), winter bird populations, and the use of the area by migratory birds in spring and fall. Also, key parcels of land have been specifically surveyed for bird use, an important aspect of assessing the preservation potential and priority of undeveloped or threatened lands.

The principal on-going Citizens United project has been an investigation of the status and trends of wintering raptors and waterfowl on the Maurice River. This study is one of very few true long-term systematic biota monitoring studies conducted in the Delaware Estuary. The winter of 2011-2012 marked the twenty-fifth year of this study. The survey was initiated in 1987 to document avian resources and ecovalues in response to major industrial barging and dredging proposals. The early focus was to provide data and input for crucial land-use decisions at the local, state, and federal (coastal zone) levels. Yet when these barging proposals were defeated, Citizen's United looked well beyond the immediate sites, and well beyond the immediate time frame, to plan and maintain studies that would continue to monitor the health of the living resources of the river over time. Original studies were continued and expanded, based on a philosophy that conservation must to be grounded on in-depth study, sound data, and understanding. Underpinning all this was a belief that such goals were only possible over time and through long-term studies.

The methodology employed has been the same for all twenty-five years; nine sites (point counts) are surveyed on the 14.4 mile tidal section of the Maurice (the area stretching southward from the Union Lake Dam at Millville) for approximately 45 minutes per site on an average of every ten days throughout the winter. For this project, "Winter" is arbitrarily defined as the period between 1 December and 31 March. Raptors and waterfowl are counted concurrently. In the twenty-five years of study, 234 individual winter surveys have been carried out, creating a substantial and broad long-term database, and one equaled by few other avian studies in the Delaware Estuary or in New Jersey.

To date, raptors (hawks, eagles, and vultures) have now been monitored for twenty-five consecutive winter seasons. Raptor studies have yielded significant long-term data on the status and trends of birds of prey in the Maurice River region. Raptors are predators at the top of the food chain. Accordingly, raptor numbers are a good barometer of an area's environmental quality, and the Maurice River system supports one of the largest wintering hawk and eagle concentrations known in New Jersey or the Delaware Estuary region. Fourteen species of raptors are recorded most winter seasons.

Ducks and geese have also been counted (concurrently with raptors) along the tidal portions of the Maurice River for the past twenty-five winters. For waterfowl particularly, the March survey dates have allowed for a broad understanding of spring "staging" and spring migration through the area. Through this methodology, the status and trends of waterfowl on the Maurice River can be fully assessed. While a total of 36 species of waterfowl have now been recorded on the Maurice River between 1987 and 2012, key species are Snow Goose, Canada Goose, American Black Duck, Mallard, Northern Pintail, and Green-winged Teal.

GOALS AND OBJECTIVES

In the mid-Atlantic region, winter is an exceptional time for bird-use, particularly raptor and waterfowl use of regional river, estuary, and coastal wetland habitats. Vast river and bay systems attract and support both a wide variety and large numbers of winter birds -- birds which have migrated in autumn from regions farther north and west, including high Arctic regions, to feed in milder, snow and ice-free river and bay habitats. Winter is a crucial time in the life cycle and survival for all Mid-Atlantic region raptors and waterfowl, and this is particularly true during very cold winters that cause prolonged local freeze-ups.

Although significant avian use of the Maurice River occurs on a year-bound basis, the suspected importance of the river as a key wintering area called for systematic surveys to be conducted at a time when raptor and waterfowl numbers are at their seasonal highest in the region. The goals of the core Maurice River winter raptor and waterfowl survey, as determined in concert with Citizens United to Protect the Maurice River and its Tributaries, Inc., were as follows:

1. The establishment of an avian database 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 and as sea-level rise alters wetland habitats and wetland-upland ecotones.

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 wildlife management needs.

3. Submission of rare, threatened and endangered species records. By submission of copies of ongoing yearly reports to the Endangered and Nongame Species Program (ENSP) of the NJDEP Division of Fish and Wildlife (DFW), findings of these studies can supplement and aid ENSP's Landscape Project, Habitat Rules, Wildlife Incentive Programs, and other Department programs in protecting key Maurice River region habitats and avian-use areas.

4. Bring recognition and publicity to the considerable avian resources of the Maurice River watershed. While there was scattered anecdotal information on the area's bird life, no systematic raptor or waterbird studies had been carried out prior to 1987 on the Maurice River (excepting the DFW's twice-annual waterfowl counts). The lack of Maurice River data on winter raptors, a hallmark feature of South Jersey river systems, was noteworthy in its absence prior to 1987.

5. Discover and provide cornerstone avian resource data to be used in river management and protection. Baseline knowledge backed by strong systematic data can play a crucial role in decision making, land-use planning, and resource management on the Maurice River. Long-term monitoring, leading to an in-depth 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 wildlife resources of the Maurice River.

METHODS

For twenty-five full winter seasons, from the inaugural winter 1987-1988 study and continuing through the 2011-2012 season, raptor and waterfowl surveys on the Maurice River were conducted systematically between 1 December and 31 March. An average of 9.36 surveys was conducted each field season over the 25 years of study, at a rate of once every ten days to two weeks during this winter period. The definition of winter in the region was subjective, and if arbitrary, it does define the times of peak raptor and waterfowl use. It should be noted that early December sometime sees substantial late southbound "fall migration" into the South Jersey region (this has been particularly evident in recent warm seasons), and that March is a time of substantial spring migration build-up or "staging," particularly for waterfowl.

Two observers working in concert, Clay Sutton and James Dowdell, spent approximately 45 minutes apiece at each of nine sampling sites. All raptors and waterfowl 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 (1996). Raptors were identified, aged, and sexed in accordance with Dunne, Sibley, and Sutton (1988), Clark and Wheeler (1987), Wheeler and Clark (1995), and Ligouri (2005 and 2011). Waterfowl and other waterbirds were found and identified in accordance with Sibley (2000), Sutton, *et al.*, (2004), and, additionally, the two authors' many, many years of extensive field experience throughout Southern New Jersey and elsewhere.

While primarily a point count protocol, additional birds, most often raptors, observed *between* the nine official count sites were recorded if, *and only if*, the observers were confident that they had not previously been sighted and 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. Also, some raptors are most often seen perched. Over the course of the study, most winter Red-shouldered Hawks, for example, were found perched (they are a fairly sedentary perch hunter in winter, whereas Red-tailed Hawks are an active aerial hunter, most often seen on the wing). In the early years of the study, when American Kestrel were frequently observed, almost all were seen perched as we traveled between point count locations. For a study with conservation goals, it would be counterproductive not to include key finds made between the point counts. As another example, a pond we passed on each survey route frequently held a very large flock of Ring-necked Ducks. To not count this flock would not do justice to the conservation goal of fully documenting the scope of Maurice River avian resources.

Accordingly, the methodology should be defined as a point count and transect combination. For the transect segment, it should be noted that the route never varied, and the transect portions of the study therefore were identical and repeatable, decreasing any variability possibly associated with this combined technique. The transects and point counts are shown on the accompanying map; the transect that traversed the banks of the 14.4 mile tidal Maurice River is a 37.4 mile route that ran from East Point north along the east bank to Route 49 in Millville, and then south along the west bank to Bivalve.

While the nine sampling sites were generally far enough apart to preclude "double-counting," the observers used extreme care and caution to avoid recounting the same bird or birds. For example, eagles range widely up and down the river; a Bald Eagle perched or roosting at the Peek Preserve near Millville may subsequently range south to the Maurice River

Causeway or farther. A "new" eagle would only be counted when direction of flight, age, plumage, or circumstance (such as concurrent sightings) would allow the observers to confidently assess that it was highly unlikely that it could have been counted previously.

Waterfowl counts are thought to be largely conservative; unless flushed by hunters, boats, or eagles, many ducks consistently remained out of sight in coves, creek beds, or guts. Also many distant ducks were often largely unseen due to heat waves, haze, tidal stage, rough water (Maurice River Cove), or distance from the observers. Due to similar factors and constraints, counts of raptors, particularly vultures, are thought to be conservative as well. As discussed below, the Maurice River basin is a very large area, and fairly 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. For raptors, peak seasonal counts -- usually obtained when conditions were ideal and most raptors were soaring -- are probably fairly close to actual numbers present. Also note that this study counted the main stem river only, from the Peek Preserve near Millville south to East Point (the 14.4 mile tidal stretch), and did not census the major tributaries to the Maurice River, that of course on all days held many additional raptors and waterfowl.

Of some 475 days spent on the entire CU project to date, 234 days have been devoted to the core winter raptor and waterfowl surveys. Of note and interest, of these 234 days, Sutton was present for about 98% of the surveys, and Dowdell was present on over 95% of the days. (One of the two authors was present on 100% of the surveys). On the very rare days that both observers were unavailable due to scheduling conflicts or travel, one observer conducted the survey. We feel that on these rare single observer days, little effect occurred with key species, and that only counts of less common and secretive species may have been adversely impacted (for example: that low-flying Cooper's Hawk dashing across the road, visible for only a few seconds, is more likely to be seen by two observers than one). But with the same two individual observers conducting the count for twenty-five years, protocols have been both fine-tuned and little-changed. In short, because of the same two individual observers, findings for each and all of the entire twenty-five years are almost uniquely comparable. Few long-term studies can boast of the non-biased aspect of having the same investigator or investigators present on every single sampling date. Also, few studies can claim the optimal weather conditions for each survey that having two locally-based observers available allowed (field days were not locked in to the calendar, but instead chosen – often on short notice -- for days that the weather would allow for excellent counting conditions.

The nine count locations, the official Point Count methodology sampling sites, are shown on the map included here as **Figure 1**. Also shown is the 37.4 mile transect route that connected the points. Some sites did have supplemental count locations (labeled A, B, and C on our field maps, but not on Figure 1) to allow for all areas to be seen and thereby most birds counted. For example, the Heislerville Wildlife Management Area (WMA) site, Site 7, at Matt's Landing has three impoundment pools, and not all pools can be viewed or counted from the same immediate location. Therefore, the daily Site 7 count is a composite of tallies taken at three separate but nearby locations, but only one final tally was given for the site on the daily and summary data sheets. In this case, the approximately 45 minutes are expended at the three stops put together. A similar situation exists at the Bivalve site; perhaps raptors might be reasonably counted from a single location, but waterfowl, shorebirds and other waterbirds present can not all be seen from a single spot. Only by using such supplemental viewing locations could all waterbirds be

reasonably and reliably tallied to the greatest extent possible. One caveat regarding protocol is that when high numbers of birds of many species are present, it may take more than the prescribed 45 minutes to reliably count them. On short early winter days, this might mean that other sites populated by comparatively fewer birds might of necessity be counted for a period less than 45 minutes. From the conservation goals standpoint, it was important to conduct the survey in a manner that would most reliably count the most birds.

The nine Point Count sites chosen as part of a reasonable and "do-able" sampling route are as follows. They essentially monitor the 14.4-mile long tidal stretch of the river between the dam at Millville (Union Lake) and the Delaware Bay at East Point (Maurice River Township):

(1) **The Peek Preserve of The Natural Lands Trust, Inc.** This site, at the modest canoe landing by the office, allowed counting of the largely fresh water section adjacent to The Nature Conservancy's (TNC) Maurice River Bluffs Preserve.

(2) **Private dock at the Galetto Property** (private property used with permission). North of Laurel Lake, this site allowed for a key and expansive overview of a lengthy section of the brackish (tidal) portion of the Maurice River.

(3) **West bank of Maurice River, near Buckshutem Road.** Just south of Laurel Lake; a small bluff at a New Jersey Conservation Foundation property, at a section of the river known as "Sweet Meadows."

(4) **Foot of the Maurice River Bridge on the north side of the Maurice River Causeway.** West side of the river, on the berm of the bridge, looking north over the tidal river and wetlands.

(5) **Foot of the Maurice River Bridge on the south side of the Maurice River Causeway.** East side of the river, looking south over the tidal river and wetlands. (Note: although these two sites are immediately adjacent, the bridge and embankments do not allow a view in both directions at once; #4 faces to the north and #5 faces to the south).

(6) **East bank of the Maurice River adjacent to Maurice River Road**. Just south of Leesburg in Maurice River Township; a tidal river and wetlands overlook.

(7) **Heislerville Wildlife Management Area (WMA).** As stated above, this is actually three sites in one, to allow for the counting of waterfowl in each of the three tidal impoundments (no single spot allows an observer to see all three impoundments at once.) The three overlooks or "views" are counted as one site in all analyses; each site is located at the outfall of the three individual impoundments. Overall, this site allows for a view of the Basket Flats area mudflats (at low tide) and the shallow bay (at high tide).

(8) **East Point Lighthouse**. The seawall at the parking lot / boat ramp offers a view of all of Maurice River Cove -- a shallow, open-water area of Delaware Bay that is used by substantial numbers of diving ducks in winter (and shorebirds in

spring).

(9) **Bivalve, also known as the Commercial Township Estuary Enhancement Program (EEP) Site owned by Public Service Electric and Gas (PSE&G).** As with Heislerville WMA, no single point allows one to see all the tidal impoundments at once. Therefore #9 is also three sites in one: (1) the berm and boardwalk off CR 631 south of Port Norris; (2) the boardwalk and observation platform off Strawberry Avenue, south of Route 553, in Port Norris; and (3) the berm at the west end of the impoundments at Berrytown Road.

To the greatest extent practicable, all counts were conducted in good weather. The observers carefully selected sampling days that were sunny and breezy, conditions that allowed for the best raptor counts. (On cloudy, windless days raptors often spend much of their time perched, and therefore are often out of sight. Breezy days in turn readily facilitate raptor soaring, hunting and movement along the river). Weather conditions and tide level/direction were recorded at the outset and at the conclusion of each field day. In order to avoid time-of-day bias in the sampling technique, the route was reversed on each subsequent sampling date, run "up-river" one day and then "down-river" on the next sampling day.

In addition to the core winter studies outlined above, adjunct fall raptor migration counts have been conducted at East Point, NJ since 1987 (primarily and in-depth from 1989 to 1991) to monitor the hawk migration moving west around Delaware Bay. Because these studies have been reported on elsewhere, they will only be summarized briefly herein as they relate to ongoing studies and to the year-round aspects of raptor-use on the Maurice. Note however that these fall hawk migration counts were conducted primarily at Sites 7 and 8 as outlined above – at East Point and/or Heislerville WMA depending on wind direction, time of day, and resulting flight path of the migrant hawks.

In 2003 the core winter studies were expanded into year-round census efforts for all water birds, including focused surveys of spring and fall migratory shorebird use of the Maurice River. While some spring and fall surveys were carried out using the exact same methodology and full route as the winter studies, at peak shorebird season (primarily in April, May, July, August, and September) usually only the lower Maurice River was counted. These targeted shorebird counts were conducted at Sites 7, 8, and 9 – East Point, Heislerville WMA, and Bivalve -- in an attempt to maximize our efforts where (by-far) the most shorebirds were to be found. In reporting, we used the summer solstice, 21 June, as the dividing line between "Spring" (northbound) birds and "Fall" (southbound) birds. And while no "Summer" results are specifically included here, spring and early fall studies have also offered ample data on Maurice River breeding birds – raptors and waterbirds alike.

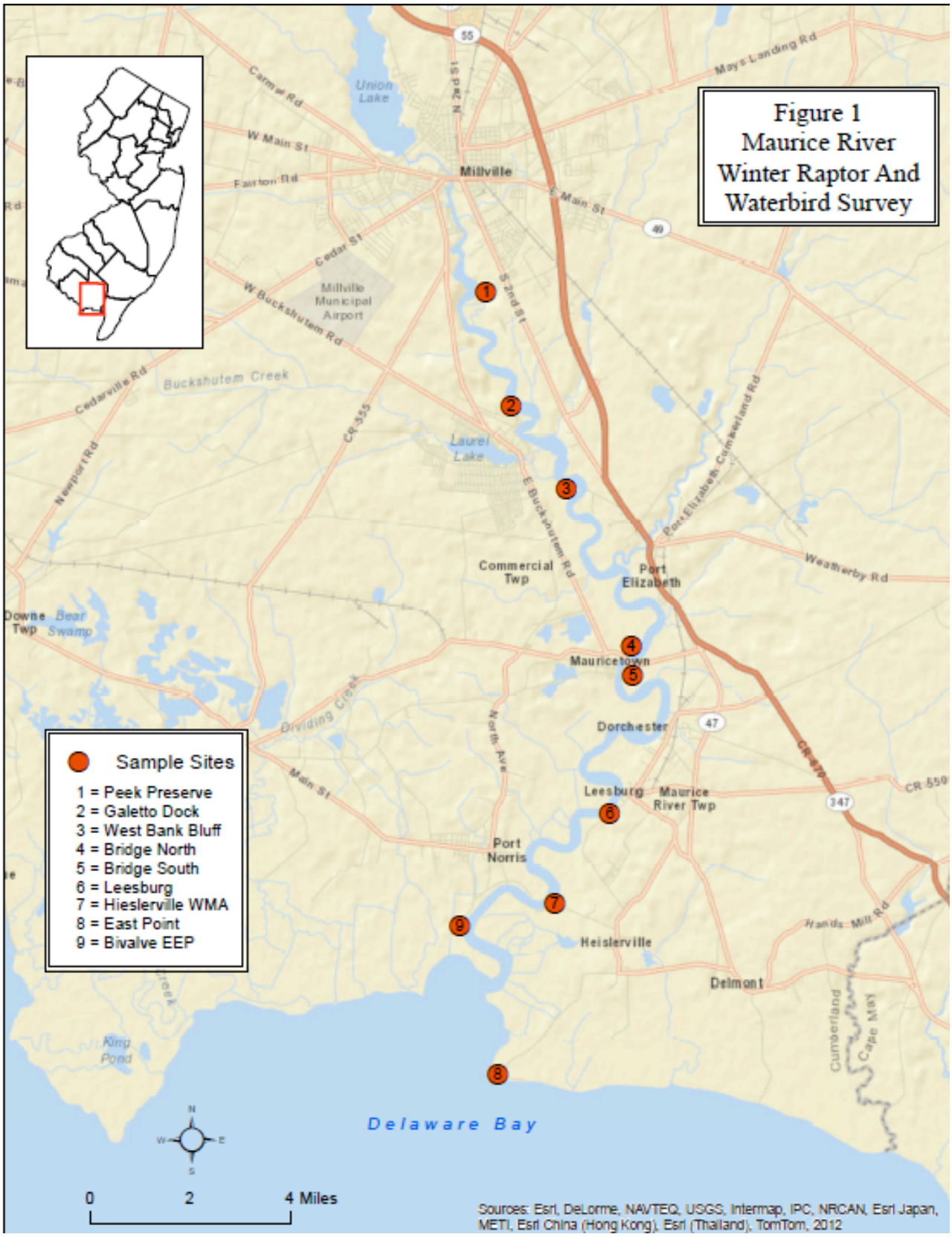


Figure 1
Maurice River
Winter Raptor And
Waterbird Survey
Sample Sites
1 = Peek Preserve
2 = Galetto Dock
3 = West Bank Bluff
4 = Bridge North
5 = Bridge South
6 = Leesburg
7 = Hieslerville WMA
8 = East Point
9 = Bivalve EEP
Millville
Commercial Twp
Port Elizabeth
Mauricetown
Dorchester
Leesburg
Maurice River Twp
Port Norris
Heislerville
Delmont
Downe Twp
Delaware Bay
Union Lake
Laurel Lake
Buckshutem Creek
Dividing Creek
King Pond
Bear Swamp
Millville Municipal Airport
0
2
4 Miles
Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, IPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

FINDINGS

Twenty-five seasons of winter raptor and waterfowl studies have now been conducted on the Maurice River under the auspices of Citizens United to Protect the Maurice River and its Tributaries. 234 individual surveys have been conducted over the 25 year period, for an average of 9.36 counts per winter. **Table 1** shows the results of twenty-five seasons of waterfowl counts on the Maurice River. Shown are high counts for each species for each winter season -- from the inaugural 1987-1988 study to the most recent 2011-2012 season. Note that for initial analyses, the twenty-five years of study are divided into five equal five-year segments. **All-time high daily counts for each species** are shown in **Bold Face.**

Table 2 shows yearly peak and average numbers of key species of wintering waterfowl on the Maurice River for the period from 1987-1988 to 2011-2012. The number of surveys for each season is shown and the data is again shown in five-year segments. **Table 3** shows the best (highest) count, the five-year average of peak counts, and the five-year average of average (mean) counts for key waterfowl species for each successive five-year segment of study. These three barometers are a succinct and easy way to view and ascertain changes and trends in waterfowl populations on the Maurice River over time.

While average counts are of value in comparing data from year to year, and in part reflect the amount of time over the winter season that birds spend on the river (as well as the inevitable impacts of both daily and prolonged weather conditions upon count results), the peak seasonal count for many species far better reflects the true numbers present. For example, the peak of 8,120 American Black Ducks recorded in 1987-1988 far better reflects the true number present in winter than the average seasonal count of 2,611. Weather, including snow, ice, cloud conditions, haze, and heat waves can greatly vary and alter the results of any given survey. Tide can be a key factor in waterfowl detection and observability, and we have repeatedly noted that early winter season waterfowl hunting pressure tends to greatly disperse ducks and geese – leading to counts lower than the true numbers present. This is why a minimum of 7-10 surveys per season were required to truly assess bird populations present in the system.

Among waterfowl, Snow Geese are a key species, and characteristically found in the salt marshes on the lower river. An average of 3,000 to 4,000 Snow Geese are found each winter. The peak daily high count of this Delaware Estuary hallmark species was 14,000 recorded in 1990. Canada Geese are widespread along the river, but are usually most numerous on the brackish upper river. American Black Ducks are found in large numbers along the length of the river, with average counts between 1,000 and 3,000 each winter. Peaks have been as high as over 8,000 birds for this species of special concern to the US Fish and Wildlife Service.

Mallard and Northern Pintail are found primarily on the wild rice fresh to brackish marshes of the upper river, with largest numbers usually recorded in late winter and early spring. Pintails, along with Green-winged Teal, are also numerous at the tidal impoundments of the Commercial Township Estuary Enhancement Program site at Bivalve. Early March is generally best -- the time of peak spring migration build-up or "staging" for these handsome ducks. Average numbers vary considerably due to the severity of the winter, but peaks of nearly 4,000 Mallards and 3,000 N. Pintails have been recorded. Also found along the river in significant numbers each winter are Bufflehead, Red-breasted Merganser, and many other diving duck species. During some winters, scaup, scoters, and Common Goldeneye are abundant in Maurice

River Cove.

Table 4 shows Maurice River winter raptor peaks and averages for each of the twenty-five seasons of study. Data is depicted for each five-year segment of the twenty-five years of survey efforts. **All-time high daily counts** for each species are shown in **Bold Face**. **Table 5** depicts Maurice River raptor findings in five-year segments, showing the best (highest) count, the five year average of peak counts, and the five year average of average (mean) counts for each of the five-year segments of the study. For rarer species, the total number of sightings is shown.

Fourteen species of raptors are recorded most winters. Turkey Vultures are the most numerous species found, and regional Turkey Vulture roosts support upwards of 250-300 birds each winter. Formerly, Turkey Vultures were once near the northern limit of their winter range in southern New Jersey, but mild winters continue to change winter vulture distribution in eastern North America, and increasing numbers are wintering farther and farther north.

Red-tailed Hawks are the second most numerous species on the winter river. Average daily counts of 40-50 birds are achieved along the 14.4 mile stretch of river surveyed. Northern Harrier, formerly and eponymously known as "Marsh Hawk," is another highly representative species of the vast tidal wetlands of the Maurice River. Peak counts of over 30 Northern Harriers per day are achieved most winters.

The Bald Eagle is a hallmark species on the Maurice River and its tributaries. The numbers found here each winter are regionally highly significant -- in many winters representing the highest concentrations reported in both New Jersey and in the entire Delaware Estuary region. Numbers have grown very significantly over the twenty-five years of study, and currently peak daily counts of over 25 Bald Eagles are achieved each winter.

Table 1
Peak Numbers of Wintering Waterfowl on the Maurice River

Twenty-five Year Summary: 1987 - 2012

	Segment I					Segment II				
Species	**1987-88**	**1988-89**	**1989-90**	**1990-91**	**1991-92**	**1992-93**	**1993-94**	**1994-95**	**1995-96**	**1996-97**
Gr. White-fronted Goose										
Snow Goose	5000	1550	**14000**	3500	3500	6500	9200	2355	13100	5150
Ross's Goose					1		1			
Brant			2	2	**25**				5	20
Canada Goose	899	110	450	37	1000	187	880	290	475	660
Tundra Swan	**19**	12	14		3	7			13	4
Mute Swan	8	9	21	25	21	25	19	40	14	17
Wood Duck	1	1	4	6	3	4	5	2	12	4
Gadwall	60	39	20	40	11	3	7	8	6	25
American Wigeon	38	32	8	30	10	6		7	1	4
Eurasian Wigeon										
American Black Duck	**8120**	4470	4867	5448	4290	4877	1488	1509	1149	1495
Mallard	3250	2660	2179	3758	2180	**3896**	547	671	356	1320
Blue-winged Teal	3	1		1		1	1		1	2
Northern Shoveler	6		2	1		1	3	4		3
Northern Pintail	3020	547	1227	1503	850	**3293**	347	680	240	1712
Green-winged Teal	1378	330	625	1045	562	765	355	544	229	1170
Common Teal										
Canvasback	5	**51**	6	9		23	32	9	50	32
Redhead							1			
Ring-necked Duck	7	3	79		4	1	1	31	60	1
Greater Scaup	18	12	226	**930**	40	83	67	4	10	19
Lesser Scaup	26	3		12	1	10	19	68	21	19
scaup species		690	20	400		50	40	1000	100	50
Common Eider										
Harlequin Duck										
Black Scoter	1	1		2				3	1	1
Surf Scoter				**2160**			1	6	2	
White-winged Scoter				**200**			1	2		1
scoter species					1000	5		15	15	8
Long-tailed Duck	1	3			4	1	2	5	1	1
Bufflehead	55	154	125	60	108	108	150	125	181	177
Common Goldeneye	20	24	36	48	305	55	**900**	22	65	51
Barrow's Goldeneye										
Hooded Merganser	3	3		12	3	20	19	8	20	10
Common Merganser	9	74	51	5	1	4	4	33	34	32
Red-breasted Merganser	25	20	150	28	62	32	85	82	144	47
Ruddy Duck		1				1	34	3	2	6
Unidentified diving ducks							4000			

All-time high daily counts shown in **Bold Face**

* Not seen on regular survey date and / or seen by other reliable observers

Table 1 (continued)
Peak Numbers of Wintering Waterfowl on the Maurice River
Twenty-five Year Summary: 1987 - 2012

	Segment III					Segment IV				
Species	**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**2006-07**
Gr. White-fronted Goose				1*						1*
Snow Goose	8500	4300	7910	4300	6107	3600	4000	5350	5251	7150
Ross's Goose							1			
Brant	9				13	4	11		19	
Canada Goose	709	650	775	1038	620	1081	1520	1111	423	415
Tundra Swan	10	1			2	5	4	3	15	7
Mute Swan	45	**76**	11	26	21	37	39	34	54	18
Wood Duck	1	13	4	2	5	4	**22**	8	2	11
Gadwall	132	400	**565**	270	130	65	50	23	30	65
American Wigeon	147	160	**260**	8	42	12	10	3	20	42
Eurasian Wigeon			1							
American Black Duck	2660	8060	3310	3027	2270	2578	1950	2432	2858	1046
Mallard	2868	3325	370	958	703	302	994	793	478	431
Blue-winged Teal	3		**12**	2	2				1	
Northern Shoveler	130	**154**	105	20	62	2			5	10
Northern Pintail	1012	569	300	810	1069	755	1495	796	1225	910
Green-winged Teal	1495	950	3914	4071	3521	1261	1793	1358	3779	2110
Common Teal			**2**				1			1
Canvasback	20	27	19	23	19	42	40	44	14	17
Redhead									1	1
Ring-necked Duck	10	22	3	1	430	314	680	375	13	311
Greater Scaup	140	50	126	160	500	30	850	110	15	30
Lesser Scaup	30	53	3	1	**140**	106	79	87	19	38
scaup species	61	**5100**	100	135	2500	400	250	187	200	50
Common Eider								2*		
Harlequin Duck								1*		
Black Scoter		6	5				**100**	2		
Surf Scoter	1	75	61		2	40	100	3	47	1
White-winged Scoter						1	3			
scoter species	3	**5008**	2		5		25	7	8	3
Long-tailed Duck	4	1		1		2	18	**28**	2	25
Bufflehead	110	259	180	**482**	210	410	326	320	323	188
Common Goldeneye	11	47	30	160	12	498	235	271	68	147
Barrow's Goldeneye				1						
Hooded Merganser	30	25	14	10	35	9	8	12	48	**81**
Common Merganser	4	9	51	47	1	62	52	96	13	24
Red-breasted Merganser	63	164	35	308	144	172	**331**	111	264	109
Ruddy Duck	53	4	52		74	6	6	**102**	16	22
Unidentified diving ducks										

All-time high daily counts shown in **Bold Face**

* Not seen on regular survey date and / or seen by other reliable observers

Table 1 (continued)
Peak Numbers of Wintering Waterfowl on the Maurice River
Twenty-five Year Summary: 1987 - 2012

Segment V

Species	2007-08	2008-09	2009-10	2010-11	2011-12
Gr. White-fronted Goose					
Snow Goose	5040	7120	12324	2439	6100
Ross's Goose				1	
Brant			2		
Canada Goose	987	692	489	**1538**	275
Tundra Swan				5	
Mute Swan	27	10	15	18	9
Wood Duck	9	3	8	2	
Gadwall	101	67	72	35	44
American Wigeon	28	19	28	12	16
Eurasian Wigeon					
American Black Duck	1274	776	1024	722	350
Mallard	649	445	408	406	408
Blue-winged Teal	4	1	2	1	2
Northern Shoveler	29	28	2	10	
Northern Pintail	928	753	330	581	550
Green-winged Teal	**5850**	3220	3727	1955	1597
Common Teal	1		**2**	1	1
Canvasback	31	6			
Redhead					
Ring-necked Duck	220	220	68	**703**	420
Greater Scaup	6	36	9	6	3
Lesser Scaup	22	42	28	70	52
scaup species	38	360	332	74	180
Common Eider			1*		
Harlequin Duck					
Black Scoter		2	2		10
Surf Scoter			1	1	3
White-winged Scoter					1
scoter species	20	8	4	4	10
Long-tailed Duck	5	1	2	1	11
Bufflehead	340	280	446	269	243
Common Goldeneye	70	239	223	6	83
Barrow's Goldeneye					
Hooded Merganser	53	20	24	10	43
Common Merganser	14	96	**102**	53	4
Red-breasted Merganser	110	129	207	130	90
Ruddy Duck	44	41	39	3	
Unidentified diving ducks					

All-time high daily counts shown in **Bold Face**

* Not seen on regular survey date and / or seen by other reliable observers

Table 2
Peak and Average Numbers of Key Species of Wintering Waterfowl on the Maurice River
Twenty-five Year Summary: 1987 - 2012

Segment I	1987-88	N = 13	1988-89	N = 8	1989-90	N = 11	1990-91	N = 7	1991-92	N = 7
	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg
Snow Goose	5000	1333	1550	299	14000	3898	3500	1352	3500	2356
Canada Goose	899	112	110	30	450	110	37	21	1000	249
Am. Black Duck	8120	2611	4470	2343	4867	2411	5448	3804	4290	1983
Mallard	3250	1247	2660	1010	2179	825	3758	2585	2180	846
Northern Pintail	3020	968	547	261	1227	348	1503	852	850	266
Green-winged Teal	1378	301	330	44	625	111	1045	360	562	161

Segment II	1992-93	N = 8	1993-94	N = 9	1994-95	N = 9	1995-96	N = 10	1996-97	N = 10
	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg
Snow Goose	6500	2724	9200	3796	2355	779	13100	3422	5150	1288
Canada Goose	187	96	880	144	290	96	475	134	660	193
Am. Black Duck	4877	2916	1488	953	1509	810	1149	595	1495	893
Mallard	3896	2048	547	318	671	375	356	185	1320	687
Northern Pintail	3293	1630	347	131	680	360	240	72	1712	532
Green-winged Teal	765	225	355	130	544	179	229	77	1170	374

Segment III	1997-98	N = 10	1998-99	N = 9	1999-00	N = 10	2000-01	N = 9	2001-02	N = 10
	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg
Snow Goose	8500	3212	4300	2121	7910	2432	4300	1743	6107	2461
Canada Goose	709	337	650	262	775	326	1038	436	620	245
Am. Black Duck	2660	1465	8060	2456	3310	1285	3027	1381	2270	1387
Mallard	2868	906	3325	1189	370	160	958	469	703	396
Northern Pintail	1012	410	569	369	300	122	810	327	1069	518
Green-winged Teal	1495	320	950	438	3914	1331	4071	758	3521	882

Segment IV	2002-03	N = 11	2003-04	N = 10	2004-05	N = 8	2005-06	N = 10	2006-07	N = 9
	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg
Snow Goose	3600	2129	4000	1342	5350	2261	5251	2135	7150	2091
Canada Goose	1081	440	1520	497	1111	523	423	287	415	311
Am. Black Duck	2578	1116	1950	1035	2432	1118	2858	1357	1046	768
Mallard	302	198	994	504	793	456	478	298	431	296
Northern Pintail	755	350	1495	528	796	364	1225	478	910	326
Green-winged Teal	1261	310	1793	501	1358	362	3779	1049	2110	565

N = number of surveys

Table 2 (continued)
Peak and Average Numbers of Key Species of Wintering Waterfowl on the Maurice River
Twenty-five Year Summary: 1987 - 2012

Segment V	2007-08	N = 9	2008-09	N = 8	2009-10	N = 8	2010-11	N = 8	2011-12	N = 9
	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg
Snow Goose	5040	2105	7120	2220	12324	3582	2439	1318	6100	2318
Canada Goose	987	329	692	254	489	249	1538	378	275	130
Am. Black Duck	1274	748	776	524	1024	458	722	476	350	231
Mallard	649	441	445	301	408	188	406	243	408	105
Northern Pintail	928	431	753	259	330	127	581	335	550	255
Green-winged Teal	5850	1525	3220	1196	3727	969	1955	664	1597	588

N = number of surveys

Table 3
Wintering Waterfowl on the Maurice River
Comparisons of Five Year Segments for Key Species
1987 - 2012

	1987-1992 Segment I			1992-1997 Segment II		
	Best	Avg. Peak Count	Avg of Average Counts	Best	Avg. Peak Count	Avg of Average Counts
Snow Goose	14,000	5,510	1,848	13,100	7,261	2,402
Canada Goose	1,000	499	104	880	498	133
Am. Black Duck	8,120	5,439	2,630	4,877	2,103	1,233
Mallard	3,758	2,805	1,303	3,896	1,358	723
Northern Pintail	3,020	1,429	539	3,293	1,254	545
Green-winged Teal	1,378	788	195	1,170	613	197

	1997-2002 Segment III			2002-2007 Segment IV		
	Best	Avg. Peak Count	Avg of Average Counts	Best	Avg. Peak Count	Avg of Average Counts
Snow Goose	7,910	6,223	2,394	7,150	5,070	1,992
Canada Goose	1,038	758	321	1,520	910	412
Am. Black Duck	8,060	3,865	1,595	2,858	2,173	1,079
Mallard	3,325	1,645	624	994	600	350
Northern Pintail	1,069	752	349	1,495	1,036	409
Green-winged Teal	4,071	2,790	746	3,779	2,060	557

	2007-2012 Segment V		
	Best	Avg. Peak Count	Avg of Average Counts
Snow Goose	12,324	6,605	2,309
Canada Goose	1538	796	268
Am. Black Duck	1,274	829	487
Mallard	649	463	256
Northern Pintail	928	628	281
Green-winged Teal	5,850	3,270	988

Table 4
Peak and Average Numbers of Wintering Raptors on the Maurice River
Twenty-five Year Summary: 1987 - 2012

Segment I

Species	1987-88	N = 14	1988-89	N = 7	1989-90	N = 10	1990-91	N = 7	1991-92	N = 7
	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg
Black Vulture	6	0.5	3	0.7	9	2.4	35	9	45	12
Turkey Vulture	82	44	209	116	123	58	105	61	160	79
Osprey *	10						1			
Bald Eagle	6	2.7	4	2.6	15	5.7	10	5.4	10	5.9
Northern Harrier	32	20.5	32	21	22	18	23	17	31	24
Sharp-shinned Hawk	12	3	8	2	5	2.3	5	2.7	13	3.7
Cooper's Hawk	3	1.1	2	0.7	5	1.3	3	1.4	3	1.1
Northern Goshawk			**1**		1					
Red-shouldered Hawk	1	0.21	1	0.14	2	0.4			1	0.13
Red-tailed Hawk	40	33	44	33	59	38	53	37	58	41
Rough-legged Hawk	3	1	2	0.88	**4**	2	4	2	3	1.4
Golden Eagle	1		1		**2**				1	
American Kestrel	6	2.5	4	2.9	8	2.3	4	2	5	2.6
Merlin					1					
Peregrine Falcon	1	0.14	1	0.14			1	0.14		0.13

Segment II

Species	1992-93	N = 8	1993-94	N = 9	1994-95	N = 9	1995-96	N = 10	1996-97	N = 10
	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg
Black Vulture	22	9	58	25	45	21	30	14	21	8
Turkey Vulture	77	59	**266**	107	99	59	120	84	93	55
Osprey *			10				10		15	
Bald Eagle	11	8.4	16	9.5	6	3.9	20	10.1	14	7
Northern Harrier	30	16	33	19	28	24	29	20	23	15
Sharp-shinned Hawk	11	2.5	8	2	6	2.8	16	3.5	5	1.6
Cooper's Hawk	5	1.5	4	1.7	3	1.4	4	1.5	7	2.2
Northern Goshawk	1						1			
Red-shouldered Hawk	3	0.38	1	0.22	2	0.22	2	0.5	2	0.2
Red-tailed Hawk	57	41	47	36	52	42	52	41	59	41
Rough-legged Hawk	1	0.25	1	0.22	1	0.44	3	1.3	1	0.3
Golden Eagle	1				1		1		1	
American Kestrel	4	1.9	5	1.7	3	1.1	3	1.5	3	0.7
Merlin	1		2				1		1	
Peregrine Falcon			1	0.11	1	0.33	1	0.4	2	0.4

N = number of surveys
* Osprey not a wintering species; table shows peak spring count attained during standard survey
All-time high daily counts shown in **Bold Face**

Table 4 (continued)
Peak and Average Numbers of Wintering Raptors on the Maurice River
Twenty-five Year Summary: 1987 - 2012

Segment III

	1997-98	N = 10	1998-99	N = 10	1999-00	N = 10	2000-01	N = 10	2001-02	N = 10
	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg
Black Vulture	**76**	17	37	10	18	9	31	13	51	20
Turkey Vulture	89	60	137	81	133	84	195	96	175	108
Osprey *			1		19		31		13	
Bald Eagle	11	6.6	12	7	17	9.3	20	10.4	15	8.5
Northern Harrier	25	22	34	23	33	23	38	23	30	24
Sharp-shinned Hawk	7	2.6	7	3.2	6	2.1	6	2.8	7	2.9
Cooper's Hawk	5	3	4	1.7	4	2.4	5	2.2	4	2.1
Northern Goshawk					1				1	
Red-shouldered Hawk	1	0.3	1	0.3	2	0.22	2	0.2	1	0.1
Red-tailed Hawk	56	42	57	45	49	37	52	42	53	42
Rough-legged Hawk					1	0.22	1	0.3	1	0.1
Golden Eagle	1		1		1		1			
American Kestrel	2	0.5	3	0.9	2	0.66	2	1.3	4	1.3
Merlin					1		1		1	
Peregrine Falcon	1	0.2	1	0.3	1	0.33	1	0.2	2	0.8

Segment IV

	2002-03	N = 11	2003-04	N = 10	2004-05	N = 8	2005-06	N = 10	2006-07	N = 9
	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg
Black Vulture	36	13	75	23	68	19	35	18	53	22
Turkey Vulture	117	89	142	95	154	95	129	95	155	96
Osprey *	14		34		18		41		18	
Bald Eagle	25	14.2	28	13.7	25	15.1	26	13	31	18.6
Northern Harrier	36	26	40	29	39	26	33	25	35	26
Sharp-shinned Hawk	11	4.2	5	2.3	8	2.9	6	2.3	5	1.4
Cooper's Hawk	3	2	5	2.4	5	2.8	7	2.4	5	2.8
Northern Goshawk	1									
Red-shouldered Hawk	2	0.36	8	1.5	3	0.63	3	0.8	1	0.45
Red-tailed Hawk	55	45	**87**	50	63	43	64	42	61	41
Rough-legged Hawk	1	0.09	1	0.3	2	0.38	1	0.1		
Golden Eagle	1		1		1		1		1	
American Kestrel	2	0.73	2	0.3	1	0.25	2	1	4	1.2
Merlin	1				1		**2**			
Peregrine Falcon	2	0.36	2	0.3	2	0.75	1	0.4	3	0.89

N = number of surveys
* Osprey not a wintering species; table shows peak spring count attained during standard survey
All-time high daily counts shown in **Bold Face**

Table 4 (continued)
Peak and Average Numbers of Wintering Raptors on the Maurice River
Twenty-five Year Summary: 1987 - 2012

Segment V

	2007-08	N = 9	2008-09	N = 8	2009-10	N = 8	2010-11	N = 8	2011-12	N = 9
	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg
Black Vulture	27	13	26	10	57	38	26	16	55	35
Turkey Vulture	133	90	153	86	120	107	162	109	147	103
Osprey *	50		72		44		28		6	
Bald Eagle	25	16.9	24	18.25	**48**	30.5	40	30.75	36	24.33
Northern Harrier	40	28	37	29	39	26	**43**	28	31	18
Sharp-shinned Hawk	5	3	15	4.63	5	2.25	4	2	**18**	3.33
Cooper's Hawk	6	2.9	**10**	3.75	5	3.5	7	3	6	2.89
Northern Goshawk	1				1					
Red-shouldered Hawk	4	1.1	3	0.88	4	0.88	5	1.88	**26**	3.3
Red-tailed Hawk	59	43	53	43	59	44	62	47	64	33
Rough-legged Hawk	1	0.11	1		1	0.13				
Golden Eagle	1						2		1	
American Kestrel	3	1.7	**10**	1.75			2	0.38		
Merlin	1		1				2		1	
Peregrine Falcon	2	0.67	2	1.38	2	1.13	**4**	1.25	2	0.44

N = number of surveys
* Osprey not a wintering species; table shows peak spring count attained during standard survey
All-time high daily counts shown in **Bold Face**

Table 5
Wintering Raptors on the Maurice River
Comparisons of Five Year Segments: 1987 - 2012

	1987-1992 Segment I			1992-1997 Segment II		
	Best	**Avg. Peak Count**	**Avg of Average Counts**	**Best**	**Avg. Peak Count**	**Avg of Average Counts**
Black Vulture	45	19.6	4.92	58	35.2	15.40
Turkey Vulture	209	135.8	71.60	**266**	131.0	72.80
Bald Eagle	15	9.0	4.46	20	13.4	7.78
Northern Harrier	32	28.0	20.10	33	28.6	18.80
Sharp-shinned Hawk	13	8.6	2.74	16	9.2	2.48
Cooper's Hawk	5	3.2	1.12	7	4.6	1.66
Northern Goshawk	1 (2 total)			1 (2 total)		
Red-shouldered Hawk	2 (9 total)	1.0	0.18	3 (14 total)	2.0	0.30
Red-tailed Hawk	59	50.8	36.40	59	53.4	40.20
Rough-legged Hawk	**4** (51 total)	3.2	1.45	3 (24 total)	1.4	0.50
Golden Eagle	**2** (10 total)			1 (5 total)		
American Kestrel	8	5.4	2.46	5	3.6	1.38
Merlin	1 (1 total)			**2** (8 total)		
Peregrine Falcon	1 (5 total)	0.8	0.11	2 (12 total)	1	0.25

	1997-2002 Segment III			2002-2007 Segment IV		
	Best	**Avg. Peak Count**	**Avg of Average Counts**	**Best**	**Avg. Peak Count**	**Avg of Average Counts**
Black Vulture	**76**	42.6	13.80	75	53.4	19.00
Turkey Vulture	195	145.8	85.80	155	139.4	94.00
Bald Eagle	20	15.0	8.36	31	27.0	14.92
Northern Harrier	38	32.0	23.00	40	36.6	26.40
Sharp-shinned Hawk	7	6.6	2.72	11	7.0	2.62
Cooper's Hawk	5	4.4	2.28	7	5.0	2.48
Northern Goshawk	1 (4 total)			1 (1 total)		
Red-shouldered Hawk	2 (11 total)	1.4	0.23	8 (36 total)	3.4	0.75
Red-tailed Hawk	57	53.4	41.60	**87**	66.0	44.20
Rough-legged Hawk	1 (6 total)	0.6	0.12	2 (8 total)	1.0	0.17
Golden Eagle	1 (5 total)			1 (7 total)		
American Kestrel	4	2.6	0.93	4	2.2	0.70
Merlin	1 (7 total)			**2** (10 total)		
Peregrine Falcon	2 (18 total)	1.2	0.37	3 (25 total)	2	0.54

All-time high daily counts shown in **Bold Face**

Table 5 (continued)
Wintering Raptors on the Maurice River
Comparisons of Five Year Segments: 1987 - 2012

	2007-2012 Segment V		
	Best	**Avg. Peak Count**	**Avg of Average Counts**
Black Vulture	57	38.2	22.4
Turkey Vulture	162	143	99
Bald Eagle	**48**	34.6	24.15
Northern Harrier	**43**	38	25.8
Sharp-shinned Hawk	**18**	9.4	3.04
Cooper's Hawk	**10**	6.8	3.21
Northern Goshawk	1 (3 total)		
Red-shouldered Hawk	**26** (69 total)	8.4	1.62
Red-tailed Hawk	64	59.4	42
Rough-legged Hawk	1 (3 total)	0.6	0.07
Golden Eagle	**2** (7 total)		
American Kestrel	**10**	3	0.77
Merlin	**2** (7 total)		
Peregrine Falcon	**4** (40 total)	2.4	0.98

All-time high daily counts shown in **Bold Face**

WATERFOWL – SPECIES ACCOUNTS AND TREND ANALYSES

Comparison of successive five-year segments allows for a good first cut analysis of trends in Maurice River waterfowl. Observed peak seasonal counts best illustrate the true Maurice River potential for each species, although averages help us understand the amount of time birds spend on the river in a given winter. The average of the peak counts and the average of the average (mean) counts for each five-year segment (shown for key waterfowl species in Table 3) clearly show changing numbers and trends over time, and to some degree mitigate the high or low results that may result for a particularly cold or very warm individual winter season.

While some obvious trends can be seen in the comparison of the five year segments, the availability of twenty-five years of data offer the unusual opportunity to present and compare twenty-five data points – for both annual peak counts and annual median counts – of all key species. Looking at all twenty-five years together, as opposed to five year segments, allows for a much better statistical determination of true trends than the somewhat limited review/analysis of just the five year segments. Also, median counts present the opportunity for a better statistical test than do more problematical and variable average (mean) counts. Therefore, all figures shown below present peak counts and median counts for all twenty-five years of study. Trend lines shown are computer-generated (in Microsoft Excel), but no statistical tests are carried out or discussed at this time (although it is anticipated that these additional statistical reviews and analyses may be completed and applied in the future – perhaps by CU in concert/partnership with other organizations or academic institutions).

None-the-less, for many species of waterfowl and raptors, Microsoft Excel trend lines present a very clear and graphic picture of the changing status of species over time. For the six signature species of Maurice River waterfowl, two show increasing trends, one is remarkably stable, and three show significant and alarming downward trends.

Diving Ducks

Diving ducks can be abundant on the lower river and in Maurice River Cove, yet varying numbers no doubt have more to do with food resources than seasonal temperatures or climate change. In some winter seasons, large numbers of scoter and scaup are present near the mouth of the river, attracted by exceptional "sets" of mollusks – small clams and oysters – that vary greatly from year to year in quantity and location. The 1998-1999 winter season was exceptional, when over 5,000 scaup and 5,000 scoter were present in Maurice River Cove. Common Goldeneye numbers vary greatly as well, but this seems more related to the amount of ice in the Delaware Bay; Goldeneye are known to be present in the bay in good numbers every year, but highest counts occur in colder winters when offshore ice in the Delaware Bay pushes them to water remaining open in Maurice River Cove. To a lesser degree, this is true of Red-breasted Merganser, a signature but variable species of the Maurice River Cove area. Common Merganser numbers are also highly variable, present on the upper tidal river in large numbers only in cold winters when ice pushes them south from lakes and rivers far to the north. Among diving ducks, Bufflehead seem to exhibit a clear increasing trend, as numbers have grown considerably over the five-year segments of this study (for unknown reasons). Bufflehead are found mainly at Heislerville WMA, on the lower river, and in Maurice River Cove. The substantial increase in Ring-necked Ducks is linked solely to the high numbers recently attracted each season to the large fresh water sand plant (quarry) lake found just off the river at

Mauricetown. No trend analyses are presented for diving ducks, but are shown below for all key species of Maurice River ducks and geese.

Canada Goose

Canada Geese show a clear increasing trend, with best counts, highest average peak count, and highest average of average (mean) counts coming in the 2002-2007 segment (Segment IV – see Table 3). The all-time best count comes from Segment V, although the very mild winters that characterized most winters in Segment V dropped the averages below those of Segment IV. More tellingly, **Figure 2** shows the trend in the Maurice River Canada Geese population over all twenty-five years of study. Peak counts and median counts are presented for each winter season. A moderate increasing trend is observed for Canada Geese.

Of interest, the increasing trend is not nearly as strong as we suspected it would be. To this we can only offer that true regional numbers of Canada Geese are not represented by our counts or count technique. We note anecdotally and almost daily that regional Canada Geese numbers have greatly increased; yet perhaps due to increasing recreational hunting pressure and expanded goose seasons, we suspect that many (or even most) Canada Geese only use the Maurice River at night -- spending their days in the complete safety of the expansive Bayside State Prison grounds near Leesburg, where many hundreds or even thousands can be seen daily in winter.

As many studies have shown, New Jersey is indeed troubled by many thousands of year-round resident, non-migratory, "golf course geese" that continually soil parks, ball fields and school grounds. On the Maurice River, non-migratory Canada Goose herbivory (occurring at night and/or outside of hunting seasons) on wild rice marshes has decimated the wetlands, and has adversely impacted many other species (see "Discussion" below). But it is important to remember that these "local" (non-migratory) Canada Geese are joined in winter by an influx of many migratory Canada Geese – wild birds that breed in Canada and the high arctic and migrate thousands of miles to find food in winter. That not all geese are local is proven by the fact that in most winters, New Jersey hosts numerous White-fronted Geese (from both northern Alaska and Greenland), Cackling Geese (Northern Canada and Aleutians), Ross's Geese (Nunavut), Barnacle Geese (Greenland), and in 2011, a Pink-footed Goose (Greenland and Iceland). The higher Canada Goose counts on the Maurice River over time have all coincided with migration events (and resting and feeding) of wild migratory "northern" geese.

Proposed controls on geese in winter in New Jersey might have impacts on far more than the local problem geese. Some populations of high arctic migratory geese have experienced major population declines, and as a result have seen targeted federal efforts and monies to aid their recovery. Even Snow Geese are not a black and white issue (pardon the pun); while Lesser Snow Goose (a race) populations have boomed, those of Greater Snow Geese apparently have not. Pending decisions on control of geese should be mindful that arctic and local geese cannot be separated in winter. Because both local and arctic Canada Geese are identical in plumage, and all species and races of geese join together in Delaware Estuary fields and marshes, we suggest that control should be limited to non-migratory flocks only.

Winter flocks of geese are iconic images of wild New Jersey, long chronicled in waterfowl literature, art, and decoys – a key part of the bayman tradition and heritage today immortalized in museums in New Jersey and all along the coast. Geese are featured on kiosks and signage, on

the New Jersey Coastal Heritage Trail, by the Delaware Estuary Program, and on birding and wildlife trail maps. Any benefits of requested goose control should be weighed against known ecotourism values, as hundreds of birders and naturalists, not to mention waterfowl hunters, visit the Delaware Bayshore region each winter to enjoy the spectacle of many thousands of geese.

Snow Goose

Snow Goose is a flagship or signature species of the Delaware Estuary. In any given season, Snow Goose numbers vary greatly from survey to survey as these somewhat nomadic geese range widely up and down the Delaware Bayshore. **Figure 3** shows the trend in Snow Geese on the Maurice River over twenty-five years. Trends in peak counts and median counts are presented. Numbers and use have remained remarkably steady on the Maurice River over time, an interesting finding in light of frequent references elsewhere to growing Snow Goose populations in the Delaware Estuary region. It does appear that peak counts have diminished somewhat in recent years, and this could be linked to increasing pressure and disturbance both from hunters and eagles in recent years. Human hunting pressure has in part increased due to the accessibility offered at the EEP sites, and avian hunting pressure has greatly increased due to the burgeoning Bald Eagle population on the Bayshore. Both factors may combine to keep Snow Geese moving around more, and flock size lower, than in previous years.

American Black Duck

American Black Duck, a species of special concern, are a true hallmark species of southern New Jersey salt marshes. On the Maurice River they are found in substantial and significant numbers along the length of the tidal portions of the river. **Figure 4** shows the trend in Maurice River Black Ducks for both peak counts and median counts over time. Black Ducks have shown a steady and strong decline on the Maurice River, as they have throughout much of their range. Numbers remain regionally high on the Maurice River, but declining peaks and averages give cause for concern. With their preferred salt marsh habitat intact, declines may be linked only to mild winters – with fewer pushed south in winter by freeze-ups and ice to the north of New Jersey. (See "Discussion" below). Also, in milder winters, less or no ice on the Maurice River itself means far less concentration of area waterfowl. During major freeze-ups in the region, the Maurice sometimes has the only open water, as strong tidal flow will usually keep numerous or at least some stretches of water free of ice. Waterfowl from a wide area then concentrate in these open "leads." None-the less, recent Black Duck peaks and averages are paltry compare to those seen in Segments I through III, and whether indicative of a true population decline or (more likely) a bellwether of the impacts of climate change, declining numbers of such a key species give pause, and are a major finding of this long-term study. When comparing Segment I to Segment V (as shown in Table 3), Black Duck peak counts show a sobering 85% decline over the course of the study, and average counts show an 81% decline.

Mallard

Mallards and Northern Pintails are highly representative species of the low salinity brackish tidal (wild rice) marshes of the Maurice River. Both have shown considerable declines. **Figure 5** shows the long-term trend in peak and median counts for Mallard on the Maurice River over twenty-five years. When comparing Segment I to Segment V (as seen in Table 3), Mallard peak counts have declined 83% over the course of the study. Average counts have declined by 80%.

Unlike Pintail (see below), Mallards have not just moved to the lower river impoundments – Mallards are simply gone. Numbers today are a shadow of those recorded in the early years of the study.

Northern Pintail

Figure 6 presents the trend in Northern Pintail peak and median numbers on the Maurice over time. For Pintails, an overall moderate yet steady decline is observed. More than any species, Pintails seem to have left the declining rice marshes of the upper river, but have instead gravitated down-river to the emergent EEP mudflats and shallow waters at Bivalve. (See discussion below). When comparing Segments I and V (Table 3), Pintails peak counts have declined by 56%, and average counts by 48%.

Green-winged Teal

Green-winged Teal peak and median counts have increased substantially over time as is readily seen in **Figure 7**. Green-winged Teal show a clear upward trend, particularly in peak counts. At one time widely and evenly distributed along the river (and usually numerous at Heislerville WMA), today very large numbers are consistently present at the Bivalve EEP site. The increasing numbers are perhaps primarily linked to the quality shallow water and emergent mudflat habitat now offered at Bivalve, although the trend toward milder winters no doubt plays a role in more teal remaining farther to the north (in New Jersey as opposed to farther to the south) in the winter.

When viewed overall, waterfowl populations have remained somewhat stable on the Maurice River over twenty-five years of study. Severe declines in some species have been offset by increases in others, with a noted increasing diversity made possible by waterfowl management techniques at Heislerville WMA and at the emergent high quality wetlands at Bivalve EEP. Ducks and geese remain key components of the Maurice River fauna as they have for centuries. Twenty-five years of study have shown that over the length of the river and over time, Maurice River waterfowl are present in substantial and significant numbers for both the Delaware Estuary and the entire Mid-Atlantic region. Despite observed significant declines for Black Duck, Mallard and Pintail, numbers and concentrations are yet exceptional for the Delaware Bayshore. And, few areas can boast the extensive long-term spatial and temporal documentation that Maurice River waterfowl now enjoy after twenty-five years of investigation.

Figure 2
CANADA GOOSE

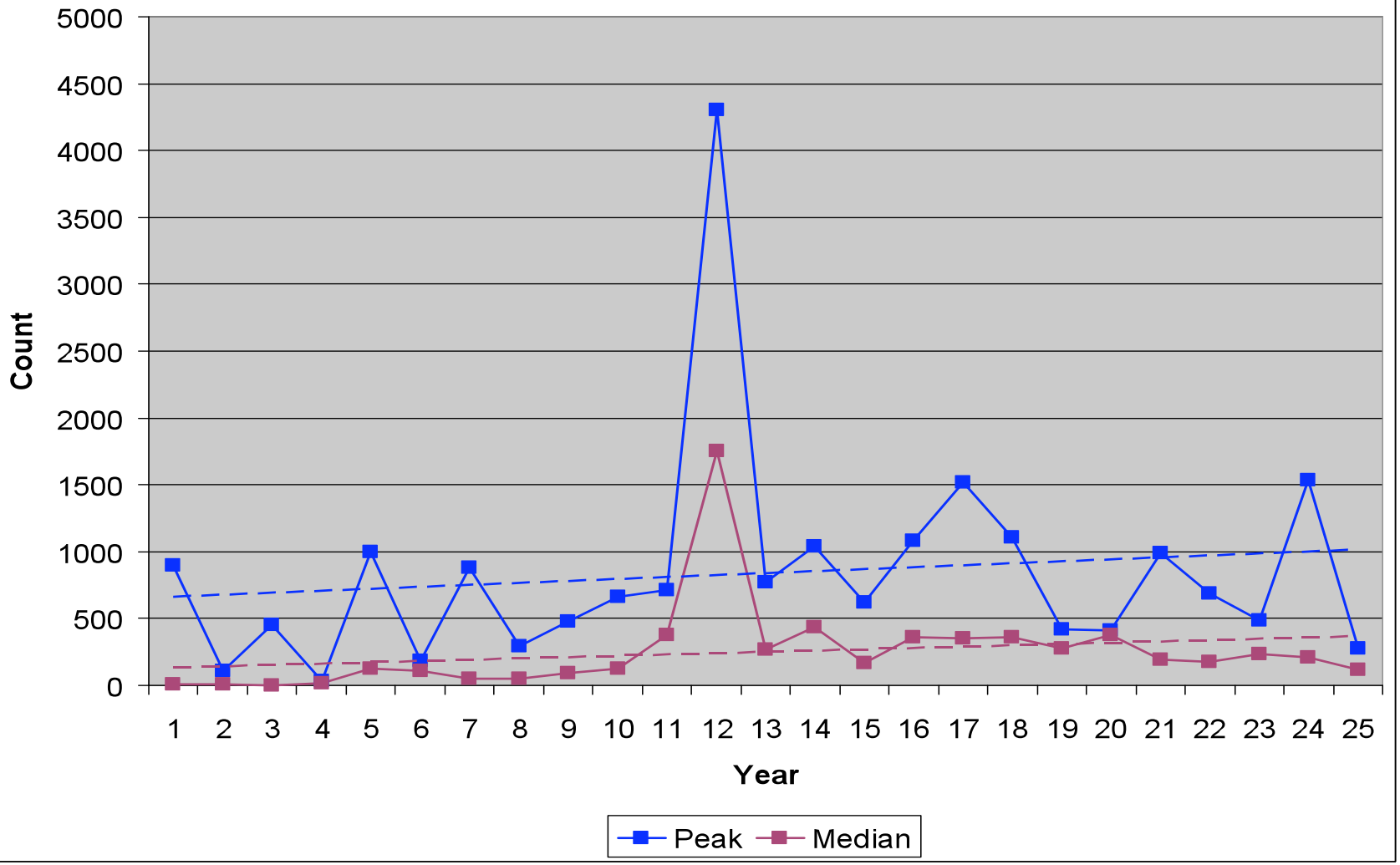


Figure 3
SNOW GOOSE

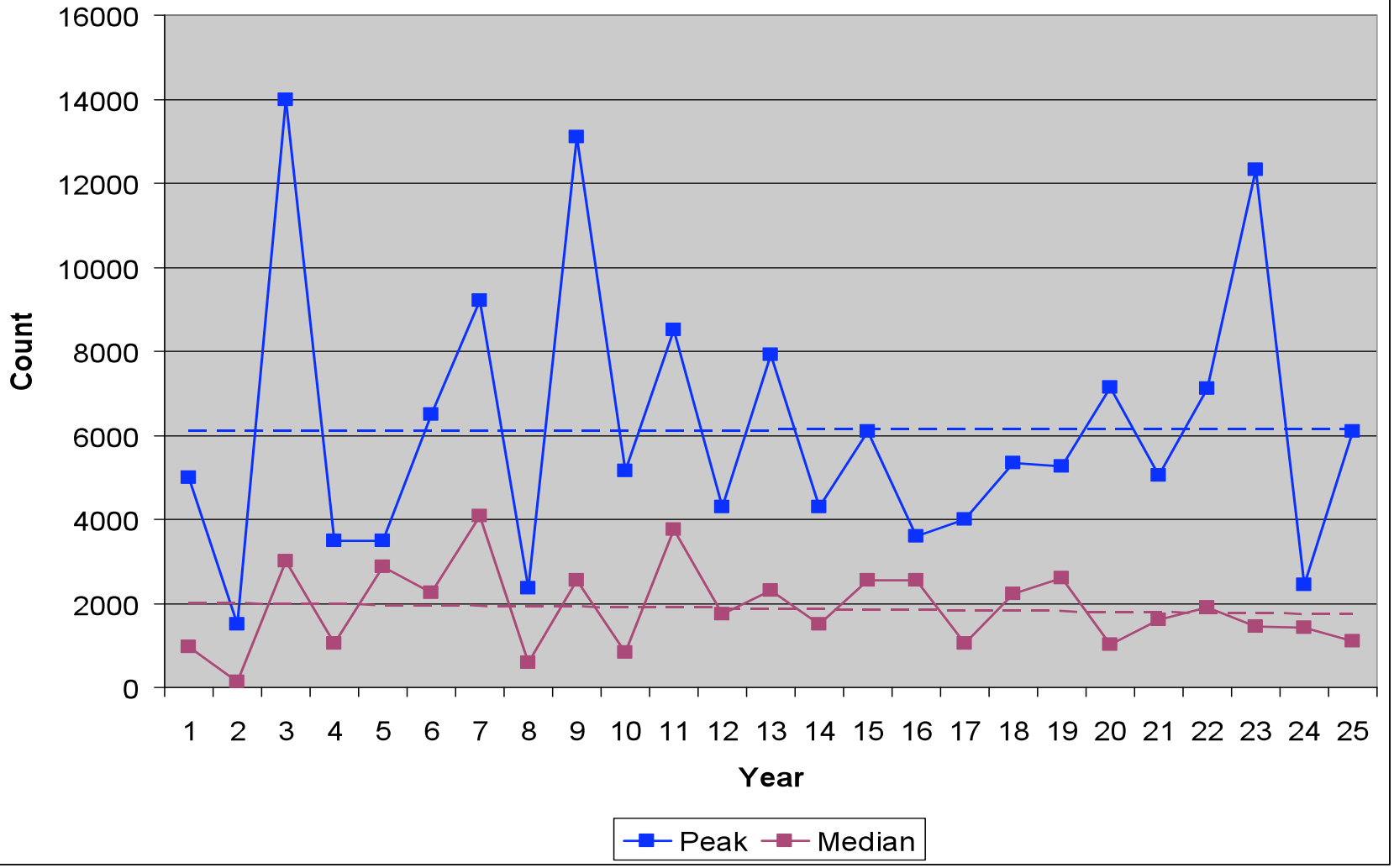


Figure 4
AMERICAN BLACK DUCK

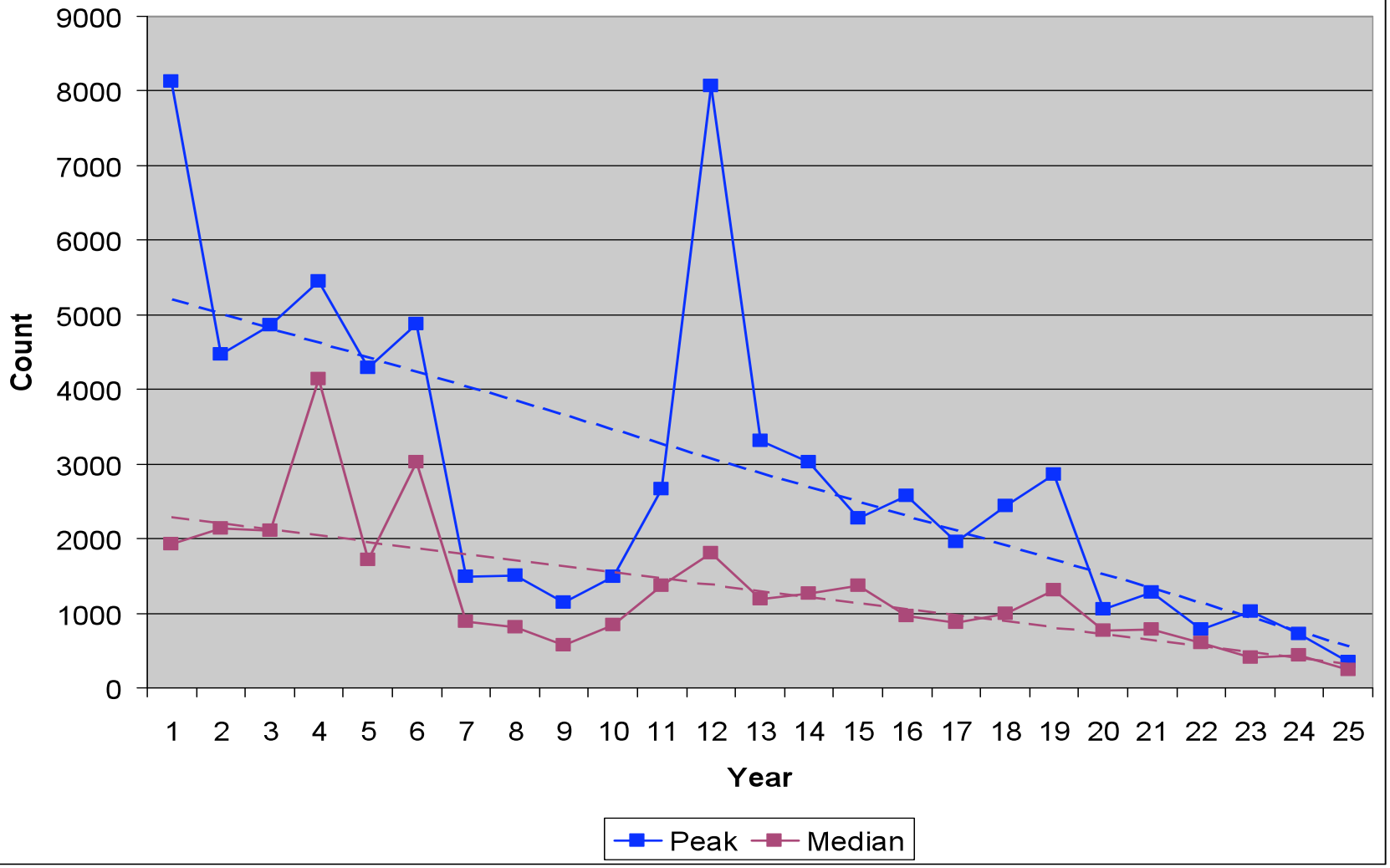


Figure 5
MALLARD

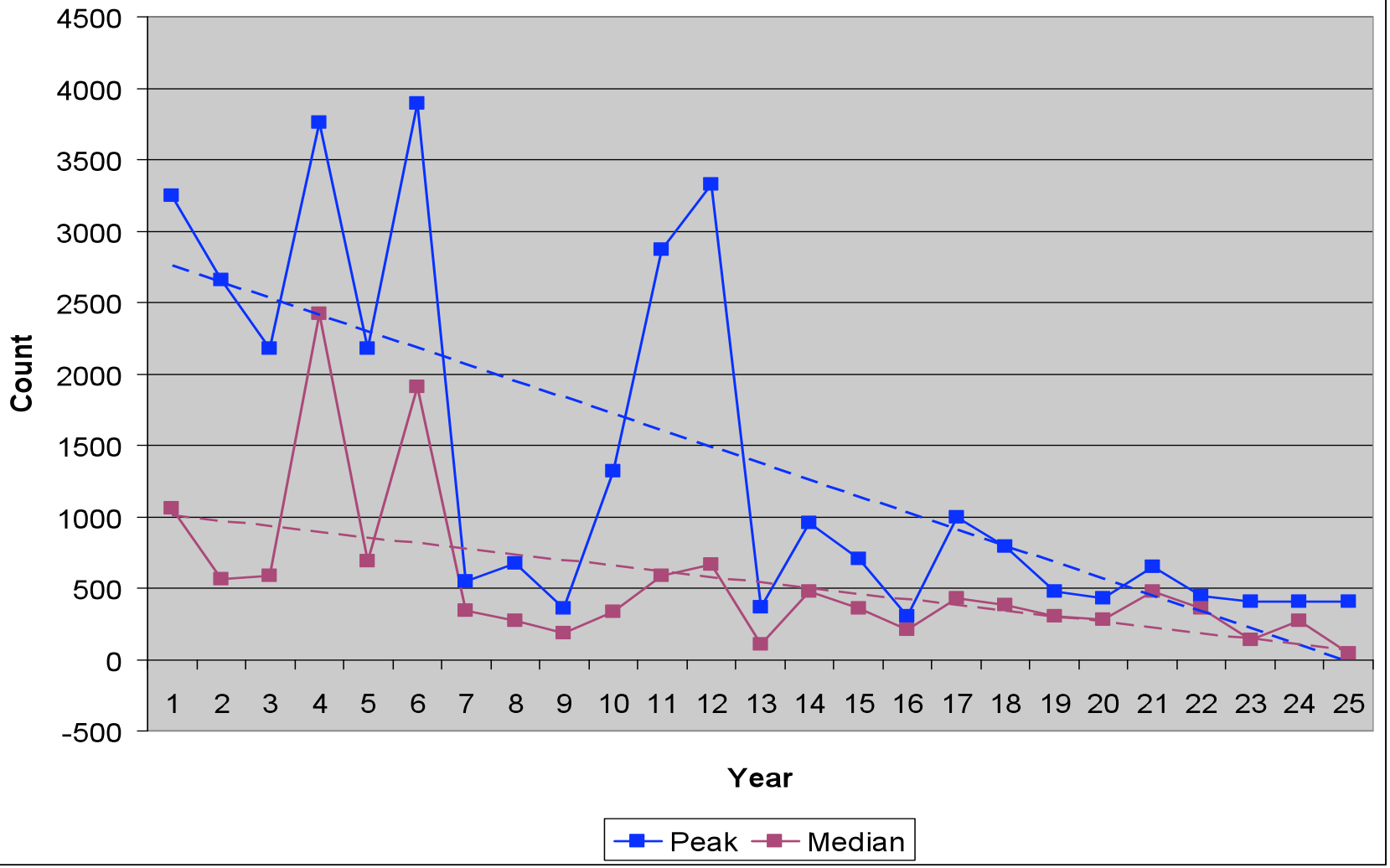


Figure 6
NORTHERN PINTAIL

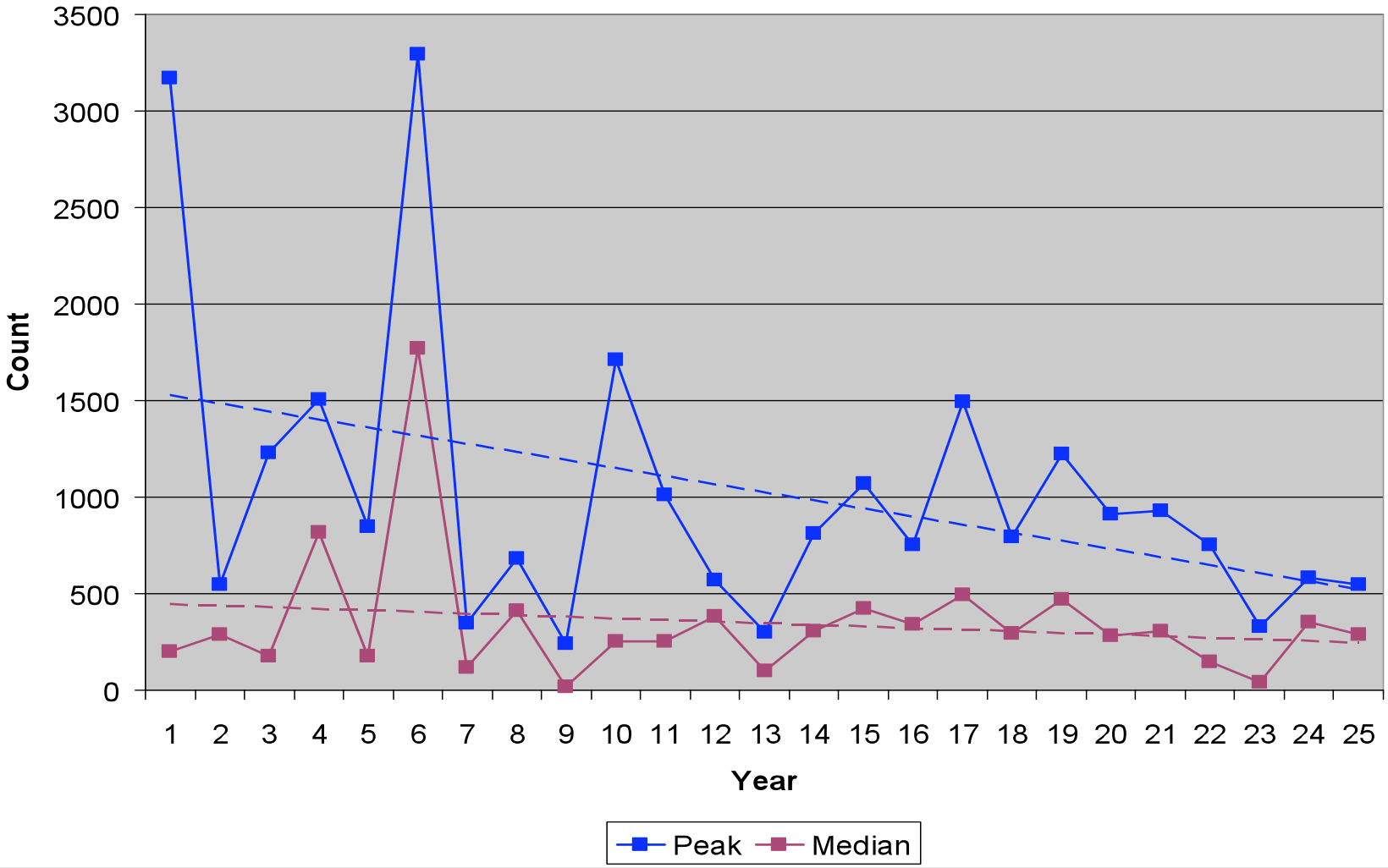
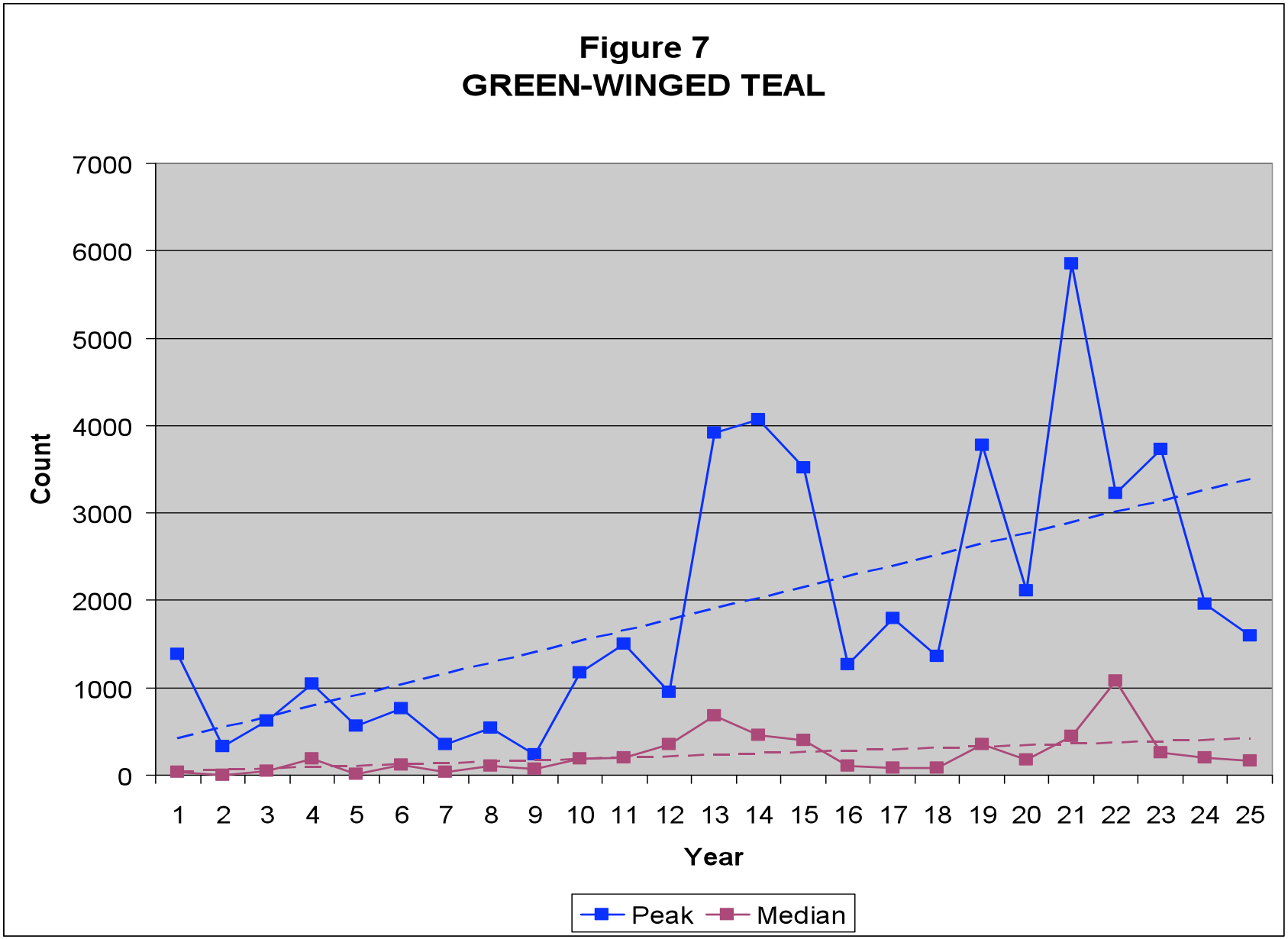


Figure 7
GREEN-WINGED TEAL



RAPTORS – SPECIES ACCOUNTS AND TREND ANALYSES

Fifteen species of raptors have been documented in winter on the Maurice River, with all but one (the Osprey) being true wintering species. At least thirteen, and sometimes fourteen, species are encountered every winter season. Four species show clear and strong increasing trends, four show moderate increasing trends, one shows a stable pattern of occurrence, and two species exhibit precipitous declines over the twenty-five year period. As with waterfowl, the figures below present all twenty-five years of data for both peak counts and median counts. Trend lines are created in Microsoft Excel. While no statistical tests are applied to the trends at this time, this may readily be carried out at a later date.

Black Vulture

Vulture populations are known to have increased substantially in both the Mid-Atlantic and the Northeast in recent decades, and the Maurice River shows no exception. It bears mentioning that it is long-term studies like these on the Maurice River that underpin our broader knowledge of increases or decreases in the status of birds. Black Vulture, formerly thought of as a "southern vulture," has rapidly increased its range in the northeastern states. Black Vulture populations have exploded, with theories ranging from climate change/global warming (increasing temperatures allowing for increased feeding success due to the increased thermal activity – and soaring -- that supports successful searching for food) to the burgeoning White-tailed Deer population that offers greatly increased feeding opportunities (through sport hunting -- lost animals and gut piles -- and road kills). **Figure 8** represents the observed trend for Black Vulture on the Maurice River over the full twenty-five years of winter studies; the trend lines show a strong and significant increase in both peak and median numbers. As Table 5 also amply shows, peaks and average counts have increased steadily over twenty years -- from an average 4.92 Black Vultures present in 1987-1992 (Segment I) to an average of 22.4 present in 2007-2012 (Segment V), an increase of 355%. Peak counts have shown an increase of 95%.

Turkey Vulture

Turkey Vultures are by far the most numerous raptor species present on the Maurice River in winter or at any season. Like Black Vultures, Turkey Vultures have increased as well, but more slowly – from an average 72 in 1987-1992 to 99 in 2007-2012. Of interest when comparing five year segments (Table 5), is that averages have slowly increased, yet best counts were achieved in the first two segments of study (and have declined since). Seemingly counterintuitive, this is actually explained by the increase in vultures. In early years, most or all Turkey Vultures were concentrated and centered in the well-known Laurel Lake roost, which on occasion was counted when the sample route and timing coincided with vultures either entering or leaving the roost. Today, anecdotally, there are many more roosts along the length of the river, but with no such single big concentration as we previously recorded at Laurel Lake. There are far more vultures today, but they are more spread out along the river and in the region. **Figure 9** shows the observed trends in peak and median counts for Turkey Vulture on the Maurice River over twenty-five years of study. Because median counts present the opportunity for a better statistical test than do more problematical and variable average (mean) counts, Figure 9 helps give a clearer picture in the steady increase of Turkey Vultures over time. While not a visibly steep trend line, it is important to note that Turkey Vulture median counts have doubled over this long-term study.

Bald Eagle

The most dramatic and remarkable increase among raptors has been shown by the Bald Eagle. Best counts, the average of peak counts, and the average of average (mean) counts have steadily and dramatically risen throughout all five segments of study (see Tables 4 and 5). When comparing Segment I to Segment V, Bald Eagle peak counts show a 284% increase, and average counts show a 441% increase. **Figure 10** presents trends in peak and median counts for Bald Eagle over all twenty-five years. Bald Eagles have clearly shown a very substantial and significant increase on the Maurice River in our twenty-five years of study – a welcome and glowing highlight of these long-term studies.

Anecdotally, they have, for us, gone from *zero* Bald Eagles on the very first survey ever done, in December 1987 (incidentally, one of only two times they have ever been completely missed in over 234 winter surveys!) to the remarkable peak of 48 recorded in the winter of 2009-2010. Today an average of over 25 Bald Eagles is seen on the river in winter. On the survey route, they are expected at virtually each and every stop, and today the numbers are conservative, simply because so many need to be dropped from the totals in order to avoid potential double-counting.

The recovery on the Maurice River mirrors and at the same time strongly represents the Bald Eagle's comeback in New Jersey and throughout North America, a comeback from the ravages of the DDT era (and before that persecution). The opportunity to witness and document the recovery of the Bald Eagle, from the dark days of the 1980s to the abundance of today, has been a glowing highlight of these long-term studies. The Bald Eagle is again today an iconic signature species of the Maurice River. The eagles once again "rule the swamp and marsh and river" as Dallas Lore Sharp wrote in 1911 (see page 8). Whether high overhead in the halcyon blue, at rest in a sentinel pine, or commanding a distant mudflat by its very presence, Bald Eagles are a fitting symbol of the wild and scenic Maurice River.

Northern Harrier

Northern Harrier is an icon of the Delaware Bayshore winter marshes. **Figure 11** shows the trends for Harrier peak and median numbers on the Maurice River over time. Harriers have shown a moderate increasing trend in these studies, a somewhat surprising find. That Harriers have remained steady, and have in fact increased over the twenty-five years of study, despite the many habitat changes observed in the Maurice River system during this time (see discussion below on waterfowl and habitat change) is welcome news. We speculate that the trend toward mild winters may be off-setting both sea level rise and the loss of high marsh habitat for Harriers by allowing for greater winter survivability (as Harriers are adversely impacted by heavy snow and freeze-ups during harsh winters). An additional factor might be possible increased detectibility/observability of Harriers resulting from the improved visibility afforded observers at Bivalve due to the elevated berms and observation tower now present at the point count sites (but unavailable in the earlier years of the study).

Sharp-shinned Hawk

Wintering Sharp-shinned Hawk numbers have remained quite steady over twenty-five years, and is easily discerned by trends (or the lack thereof) in peak and median counts shown in **Figure 12**.

A secretive, forest-dwelling hawk, this small accipiter is far more numerous than recorded daily counts indicate. Great fluctuations in peak counts are due only to those years when an early winter official count (early December) coincided with a late "fall migration" event, with numerous migrant Sharp-shins encountered along the lower river.

Cooper's Hawk

Figure 13 depicts the significant increasing trend for Cooper's Hawk on the Maurice River over twenty-five years. Cooper's Hawks have increased steadily and dramatically, today over twice as common on the Maurice River than at the outset of these studies. This reflects known region-wide trends as this bird completes a recovery from population declines linked to the DDT era and before that to the persecution of hawks in the 1930s-1950s. Like Sharp-shins, Cooper's Hawks are furtive and secretive in winter, and far less detectable than Red-tailed Hawks or Northern Harriers, for example. Numbers present are no doubt considerably higher than recorded averages would suggest.

Northern Goshawk

The largest accipiter, Northern Goshawk, is peripheral on the Maurice River, and sightings remain low but roughly equal throughout the five segments. In most winters, few if any goshawks (an accipiter of northern forests) winter as far south as the Maurice River region. Because of the paucity of sightings, no trend is calculated for Goshawk.

Red-shouldered Hawk

Shown in **Figure 14**, Red-shouldered hawk also continues to recover from declines linked to the DDT era. A very slight increasing trend in peak and median counts is noted. Red-shoulders are a low density wintering species on the Delaware Bayshore, yet numbers have been slowly increasing in the region and on the Maurice River in recent years. This may be more likely linked to the trend toward milder winters than to any real population increase/recovery. Not only do warm winters mean that more Red-shoulders both attempt to winter (and successfully winter) in the Bayshore region, warm falls have meant that Red-shouldered migration today seems to occur later in the season than it did in the early years of this study. Indeed the all-time best count occurred on 1 December 2011, when 26 migrant Red-shoulders were counted during the official winter season (albeit "day one" of the arbitrary winter count period). This is just one of many examples of the impacts of warmer falls and winters on trends in raptor use of the Maurice River region.

Red-tailed Hawk

Red-tailed Hawk, the most encountered and most conspicuous of all Maurice River winter raptors, has shown a slight increase over time as can be seen in **Figure 15**. The increase may well be linked to warmer fall and winter seasons, and resultant delayed late migration into the region. The exceptional all-time high daily winter count of 87 (in Segment IV) was due to the scheduled winter survey coinciding with a very late fall migration movement in early December 2003. All this said, the extremely warm fall of 2011 brought very few migrants, and resultant fewer wintering birds, leading to an all time low winter median count (as seen in Figure 15). Highest Red-tailed Hawk counts are usually in early December or in late March, when migrants

mix with conspicuous local resident Red-tails. Soaring high overhead or perched prominently on a dead snag on the forested edge of the salt marsh, the ubiquitous Red-tail, although common, is none-the-less a welcome and able ambassador of the wild Maurice River.

Rough-legged Hawk

Rough-legged Hawk, a migrant to our area from high Arctic breeding grounds, has shown a serious decline over twenty-five seasons of study. Twenty-five years ago it was an expected bird, albeit in small numbers/low density, but today it is a peripheral species – in fact not recorded during the final two winters of Segment V. When comparing Segment I to Segment V, Rough-leg peaks have seen an 81% decrease, and average numbers have decreased by 95%. **Figure 16** shows the long-term trends in peak and median numbers for Rough-leg. This steady decline is in-part linked to climate change and has been noted throughout the Mid-Atlantic region (as many birds remain north of us during mild winters). However the more localized Maurice River area decline is also in part due to the near complete loss of their preferred high marsh (*Spartina patens*) habitat at Thompson's Beach, East Point, Bivalve, Robbinstown, etc. The creation of the EEP impoundments – formerly high marsh -- has had significant adverse impacts on near-obligate (in our area) high marsh habitat hunters such as Rough-legged Hawk and Short-eared Owl (see discussion in waterbirds section).

Golden Eagle

Golden Eagle is far less common than the Bald Eagle in our region or anywhere in eastern North America. As a northern and western-nesting species, they are another somewhat peripheral Delaware Bayshore wintering species. Although no trend is calculated, Golden Eagle numbers have remained somewhat steady on the Maurice, with just one or two sightings recorded each season. Nonetheless, when present this charismatic eagle is always a highlight of any winter survey, and particularly memorable when a "Golden" is seen dramatically stooping (diving) from on high into a flock of Black Ducks or Snow Geese.

Merlin

Merlin has increased slightly, as it has throughout the long-term in the Mid-Atlantic in winter. Merlins are highly migratory, and most are well south of the Delaware Bayshore region in winter. In recent years, usually one or two of these dashing falcons have wintered in the Maurice River study area, but because of the low overall numbers, no trend is calculated for Merlin.

American Kestrel

American Kestrel, once a common daily bird (in numbers) on the Delaware Bayshore, has declined alarmingly over the twenty-five years of study. When comparing Segment I and Segment V of this study, the Kestrel peak counts have declined by 44%, and the average count per survey has declined 69%. Never an abundant species on the Maurice River due the lack of extensive grassland or pasture habitat, none-the-less an average of 2.46 were present per survey in Segment I, whereas only 0.7 were found per survey in Segment IV and 0.77 in Segment V. This severe downward trend in both peak and median numbers is shown in **Figure 17**. American Kestrel has declined precipitously as a breeding species and a wintering species in New Jersey and throughout the Northeast and Mid-Atlantic states. On the Maurice River (and the Delaware

Bayshore) its disappearance is probably linked to the loss of farmland, fallow fields and pastures, as well as the loss of high marsh salt hay (*Spartina patens*) habitats. The American Kestrel, a member of the imperiled "grassland guild" of birds, is in grave trouble as this and many other studies attest. The Cumberland County Christmas Bird Count (an important regional index) that once recorded as many as 71 American Kestrel (in 1976 and 1979), now records only about 10-12 kestrel a year, with an all-time low of 3 counted in 2009. The American Kestrel has recently been listed as threatened by the NJDEP, but sadly should more realistically be described (for all intents and purposes) as extirpated or nearly so as both a breeding and wintering bird in the Delaware Bayshore region.

Peregrine Falcon

While the picture for American Kestrel, our smallest falcon, appears quite dim, that of our largest, the Peregrine, is much brighter. Peregrines have increased dramatically as DDT has been slowly eliminated from the marshes and as the praiseworthy and yeoman ENSP reintroduction effort has come to fruition. **Figure 18** shows the welcome and steady upward trend for Peregrine Falcon on the Maurice River over time. When comparing Segment I with Segment V (in Table 5), Peregrines have shown a 200% increase in their peak numbers, and an amazing 791% increase in the average number per winter survey (although they are of course a low density species at the top of the food chain). Two pairs of Peregrines nest in the Maurice River region, and one or two other individuals usually winter in the area prior to returning to northern nesting territories. This comeback has meant that Peregrines are almost a daily sight on the Maurice (in winter and at all seasons), generally on the lower river where they are frequently seen hunting shorebirds or teal at Heislerville WMA or at Bivalve – an always spectacular sight.

Figure 8
BLACK VULTURE

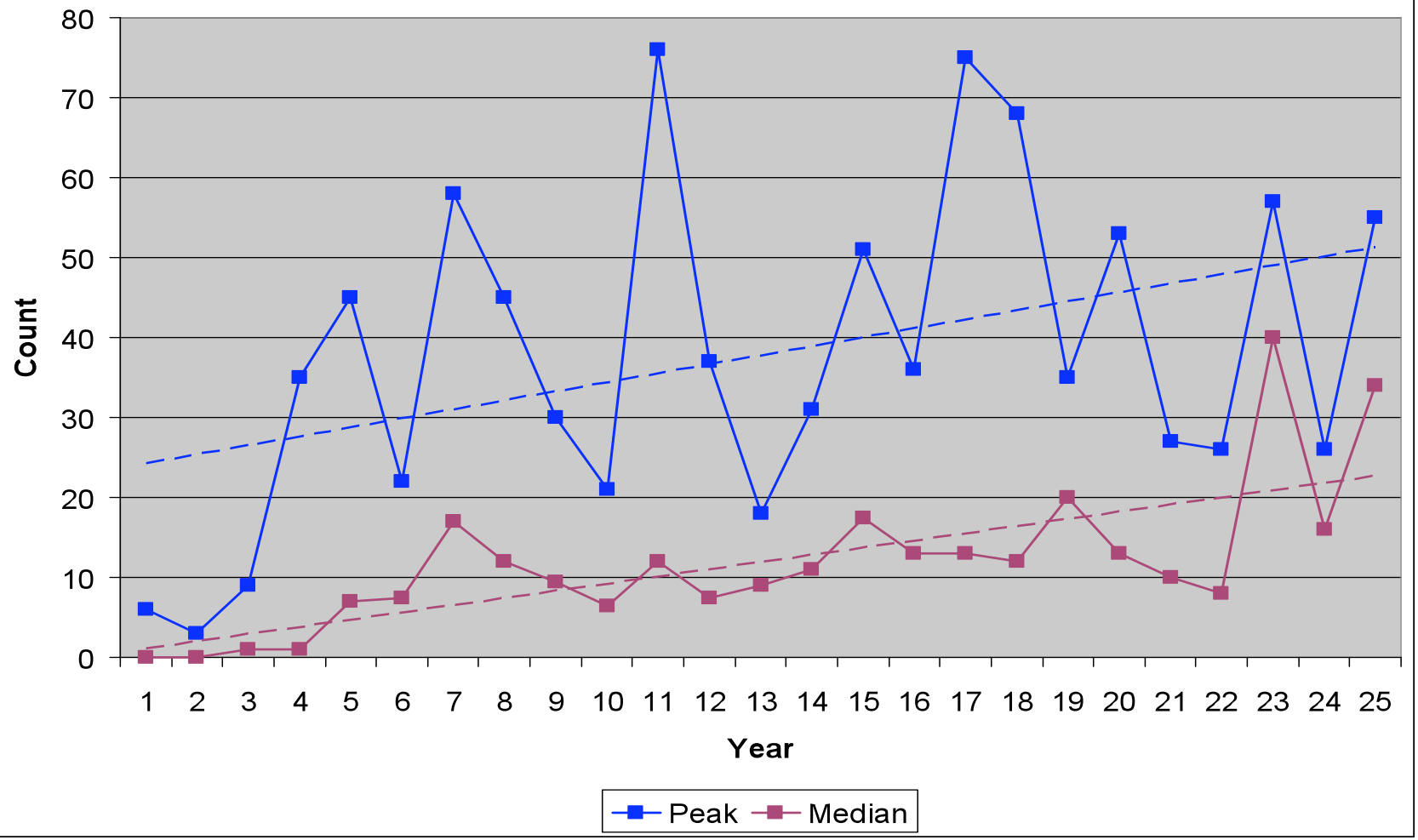


Figure 9
TURKEY VULTURE

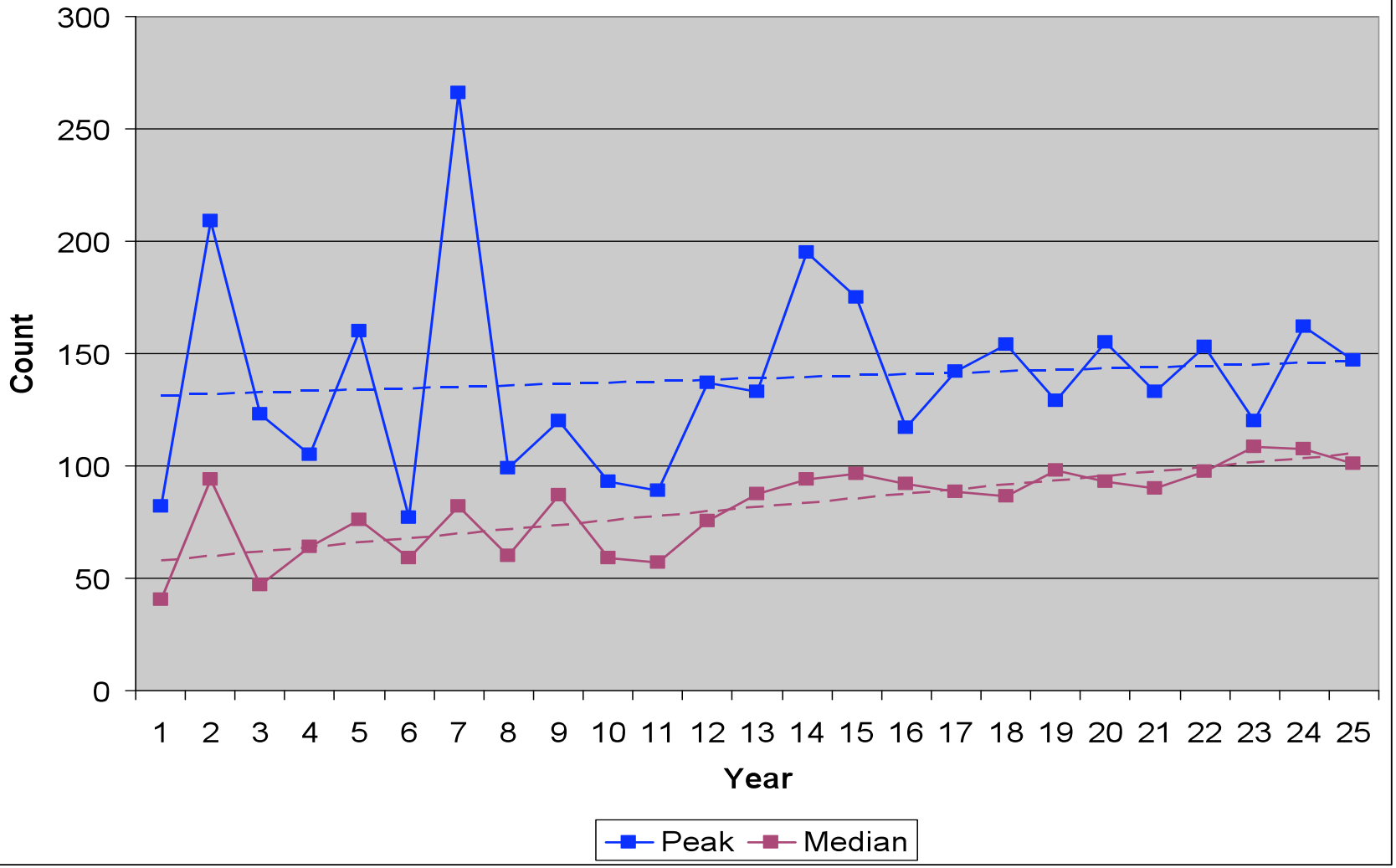


Figure 10
BALD EAGLE

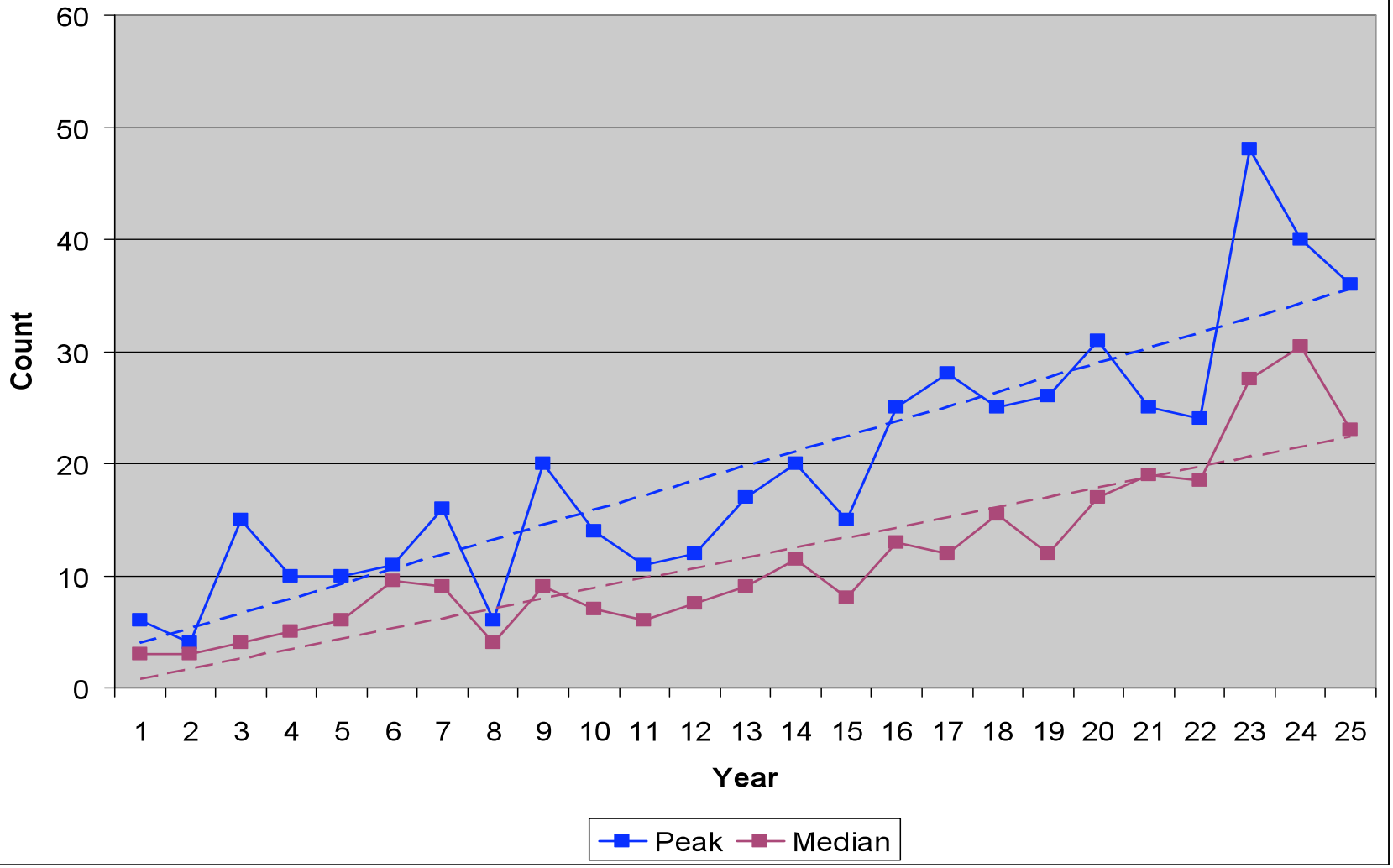


Figure 11
NORTHERN HARRIER

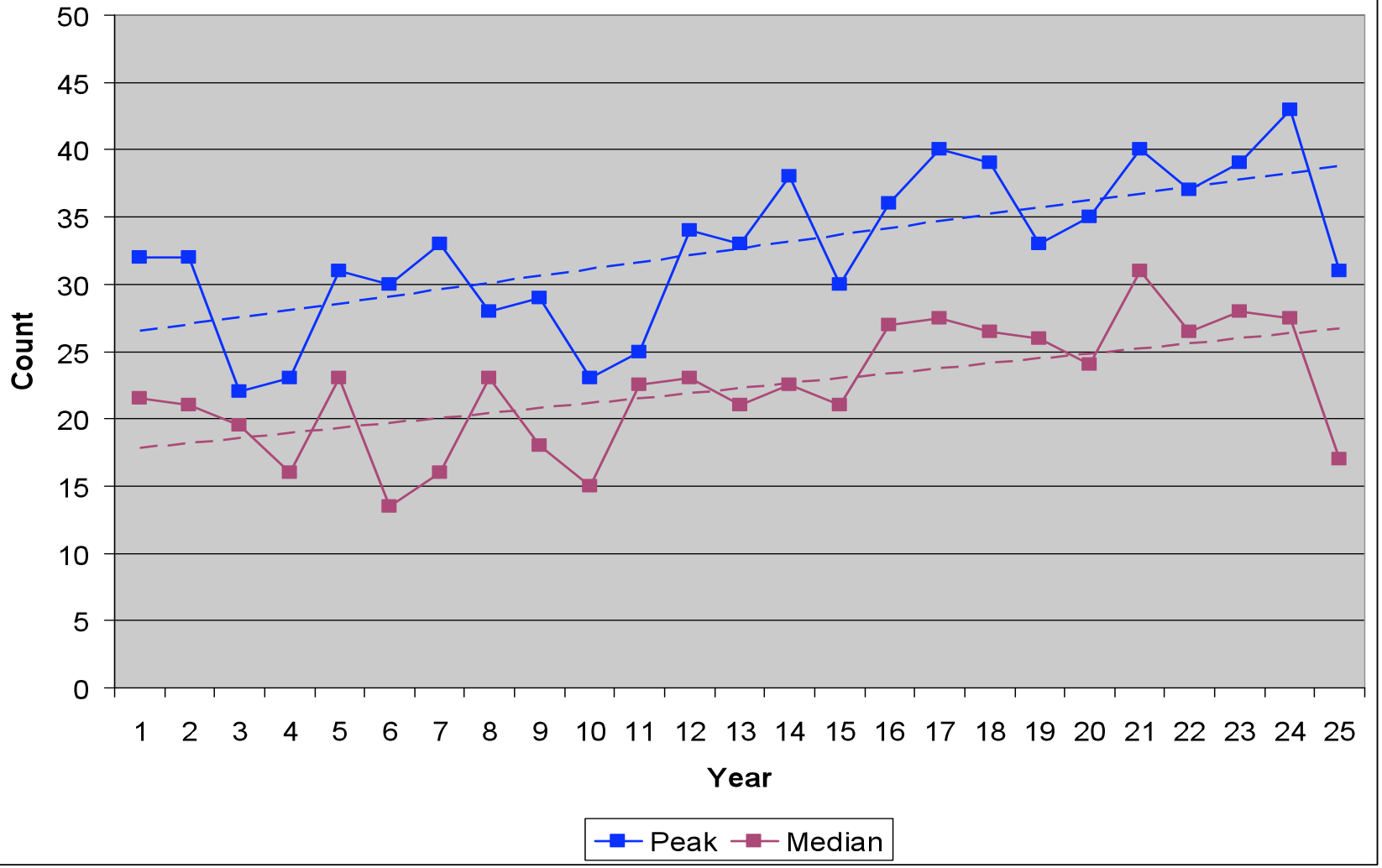


Figure 12
SHARP-SHINNED HAWK

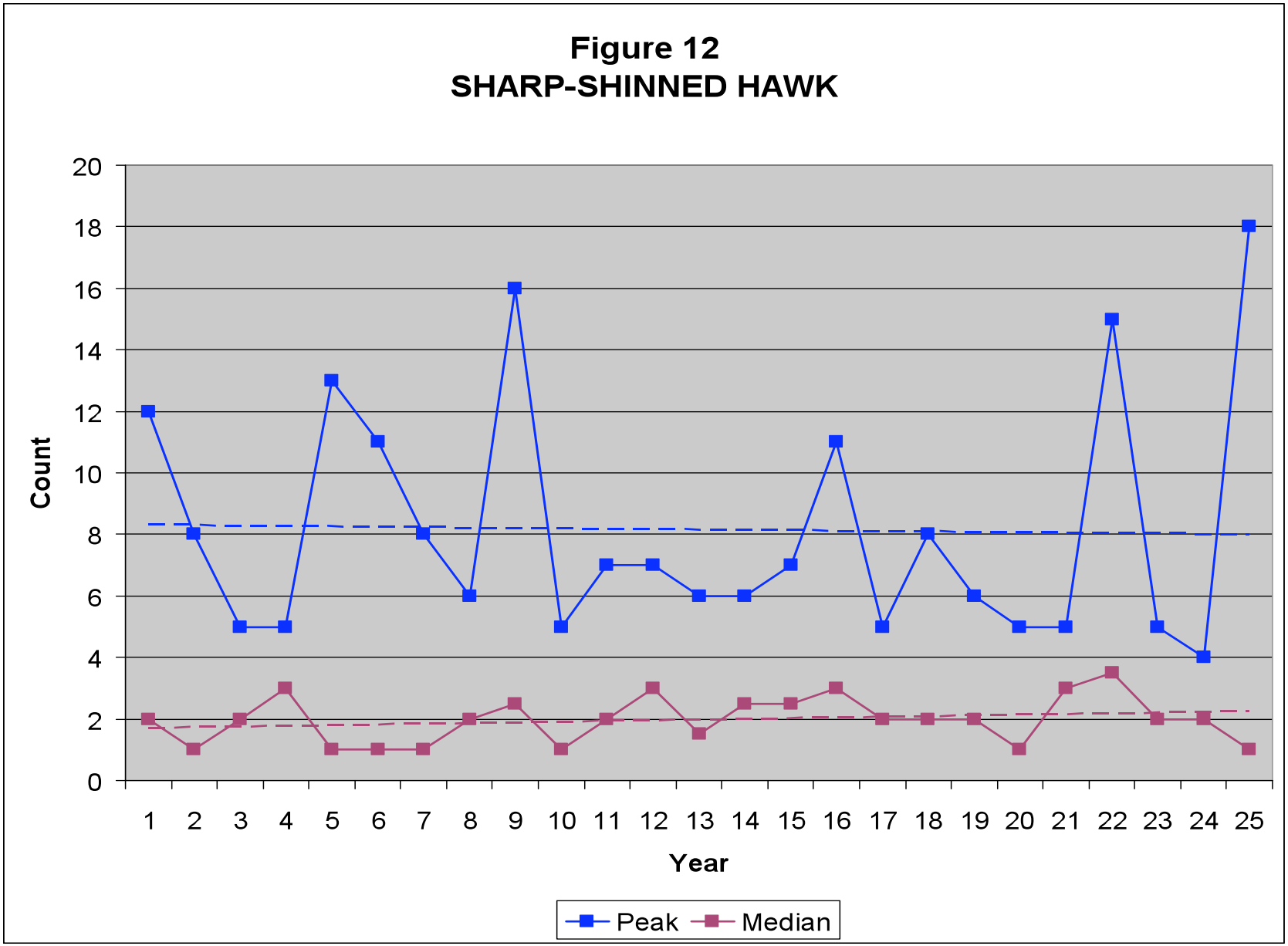


Figure 13
COOPER'S HAWK

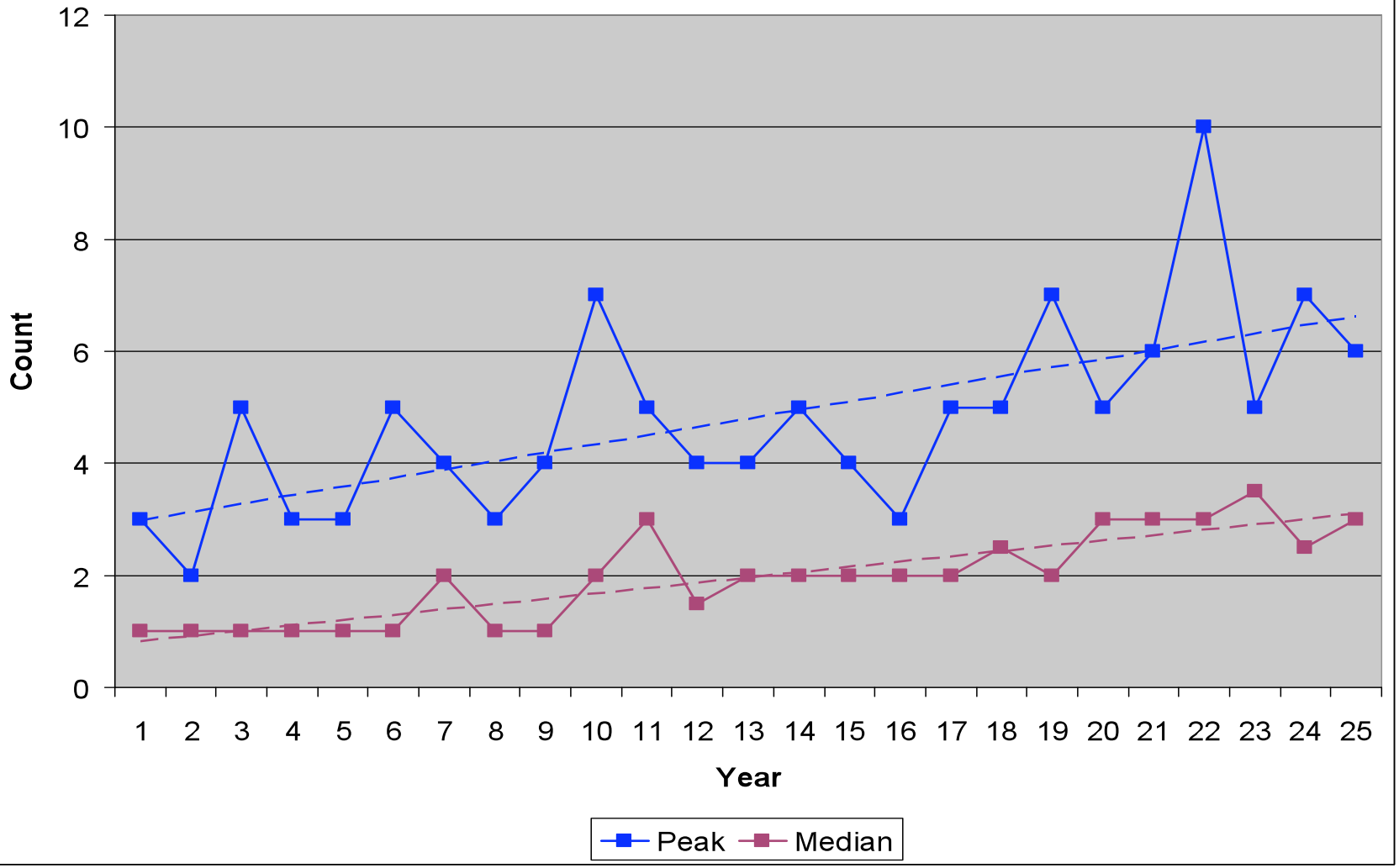


Figure 14
RED-SHOULDERED HAWK

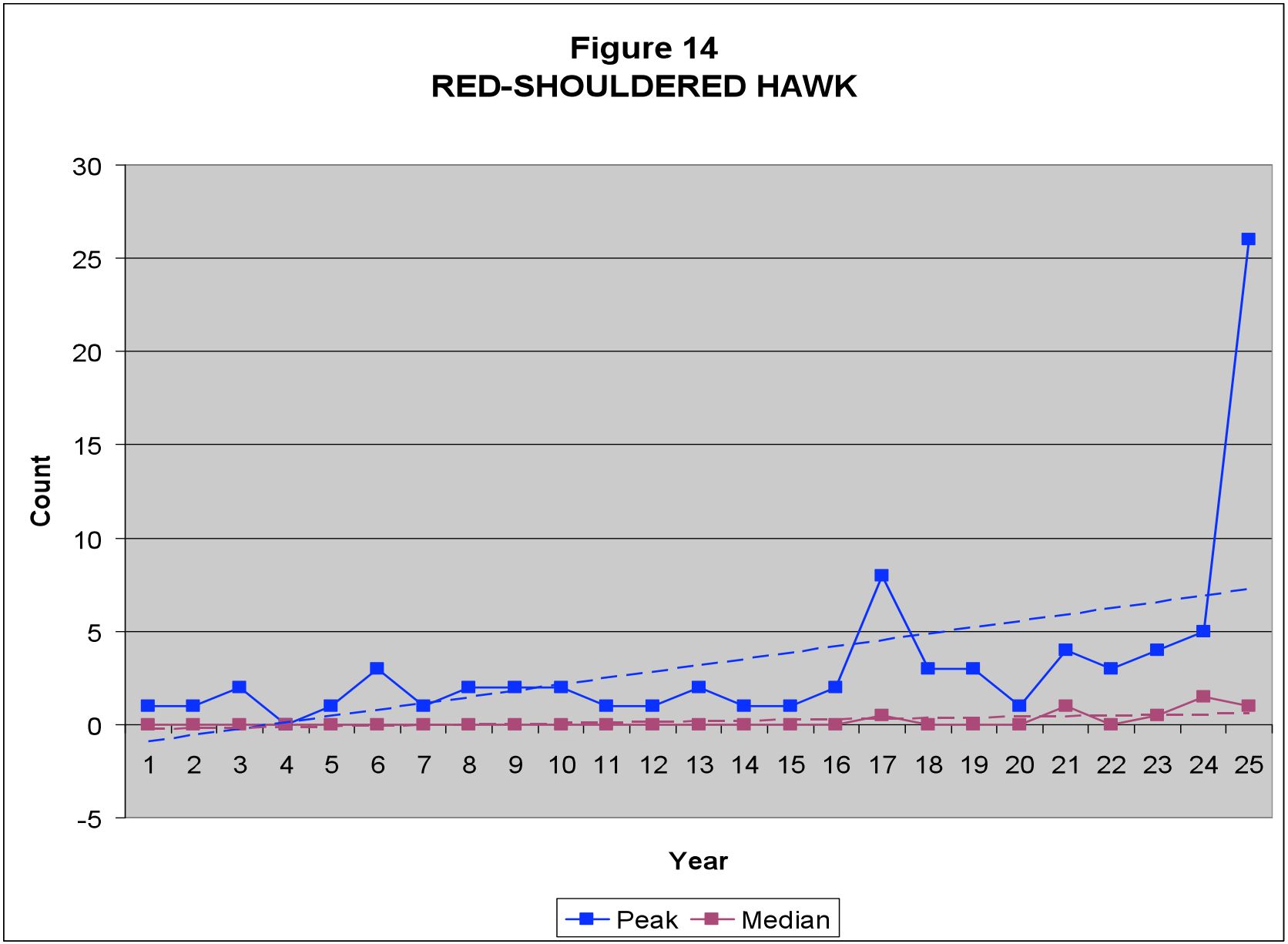


Figure 15
RED-TAILED HAWK

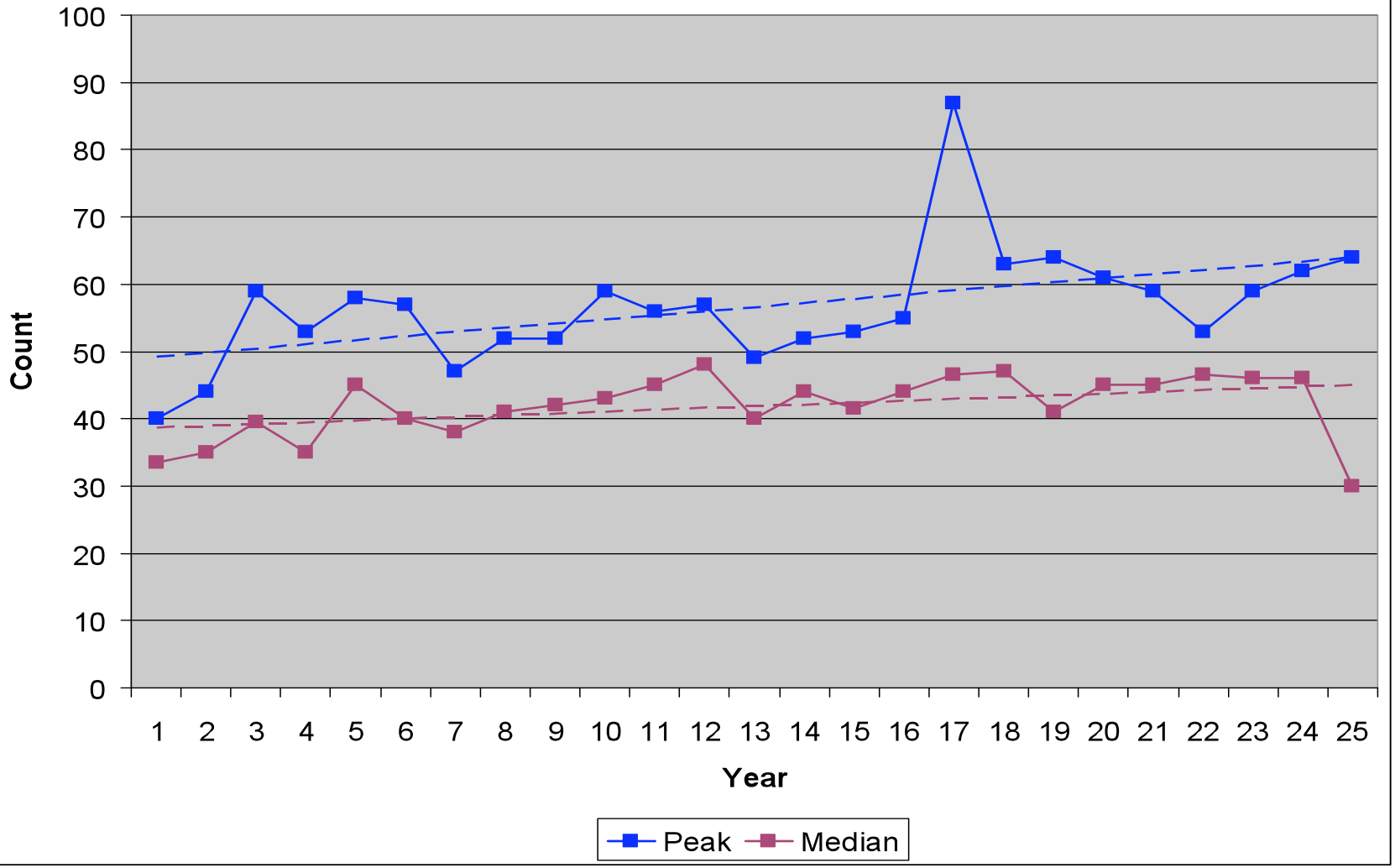


Figure 16
ROUGH-LEGGED HAWK

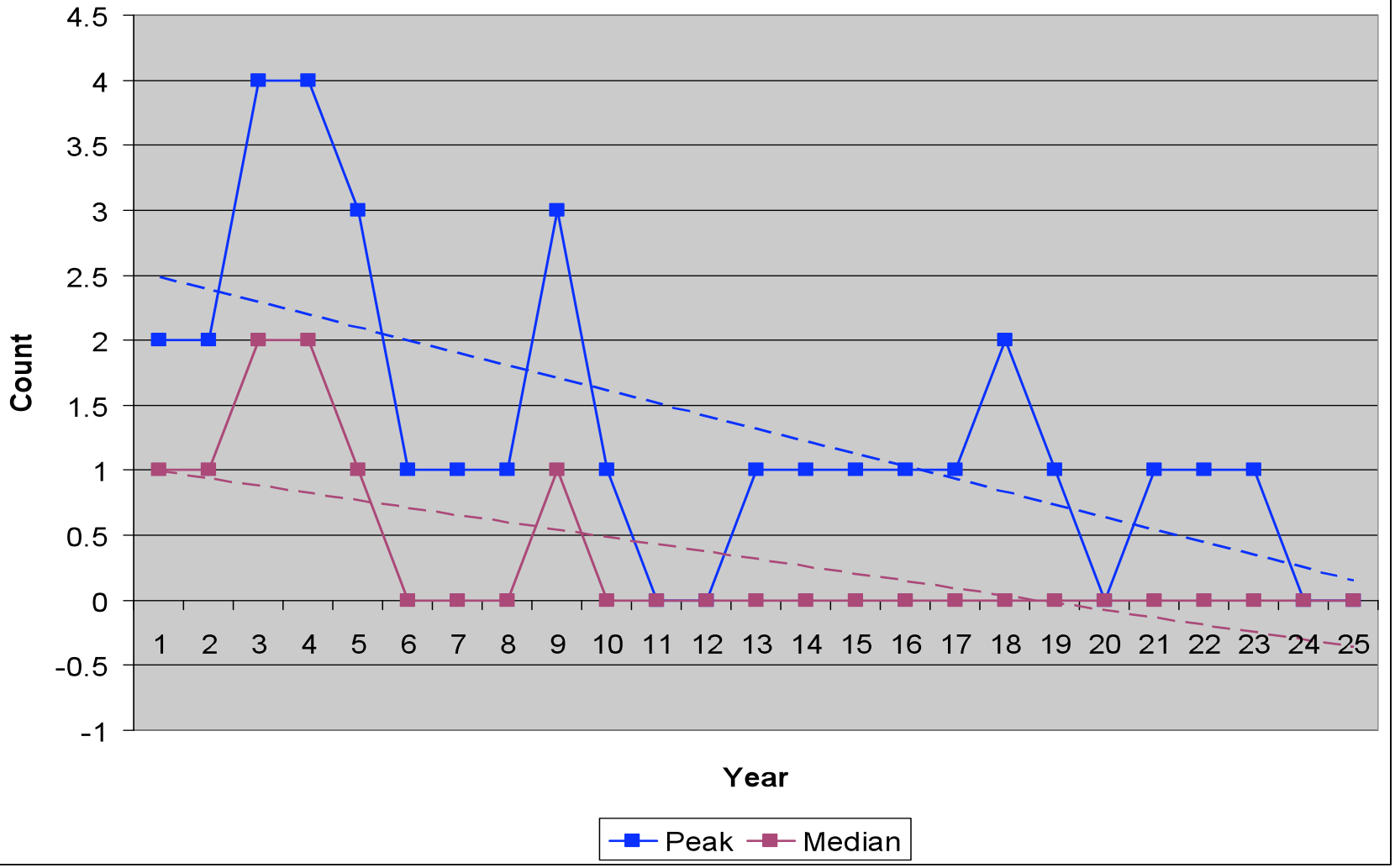


Figure 17
AMERICAN KESTREL

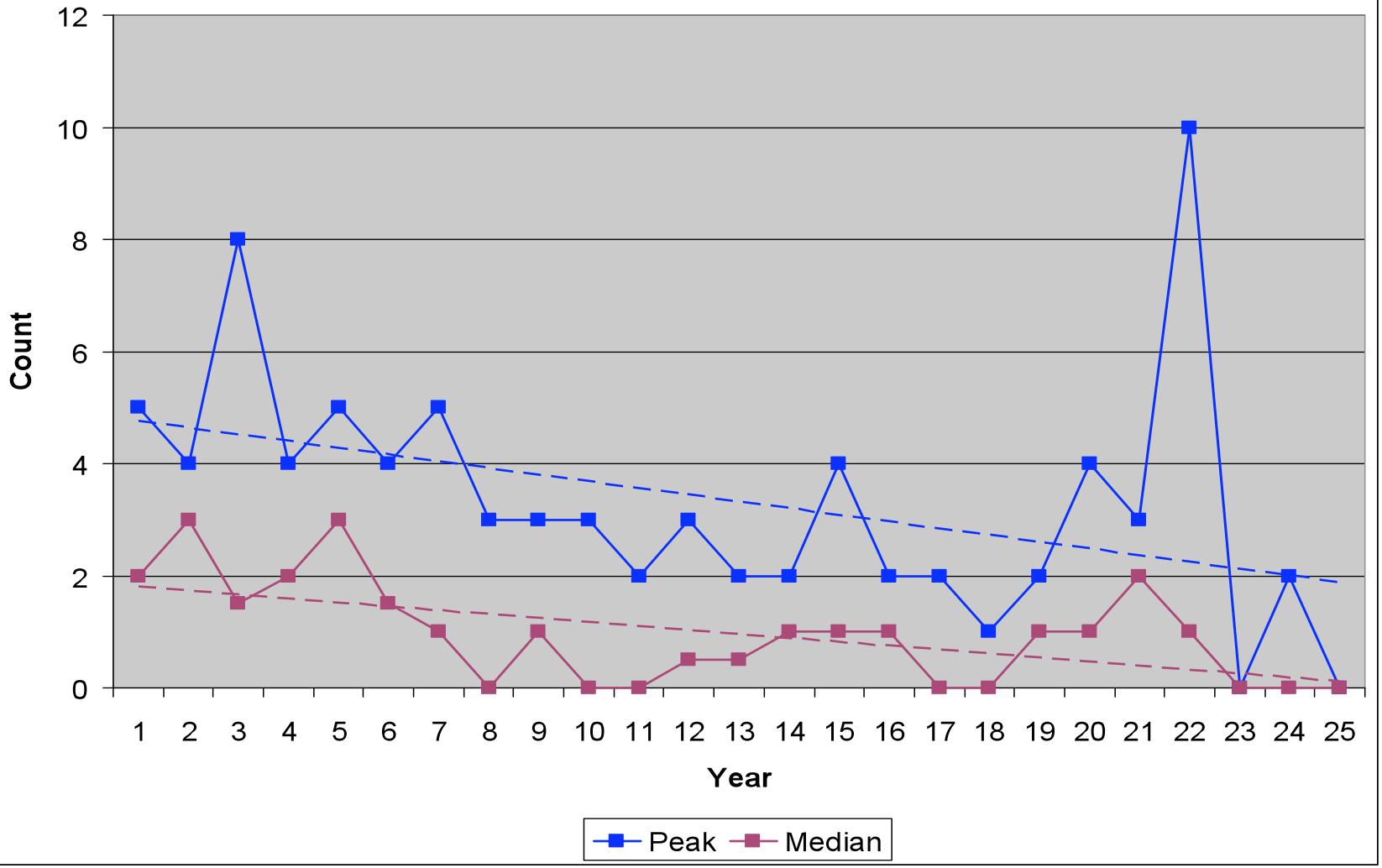
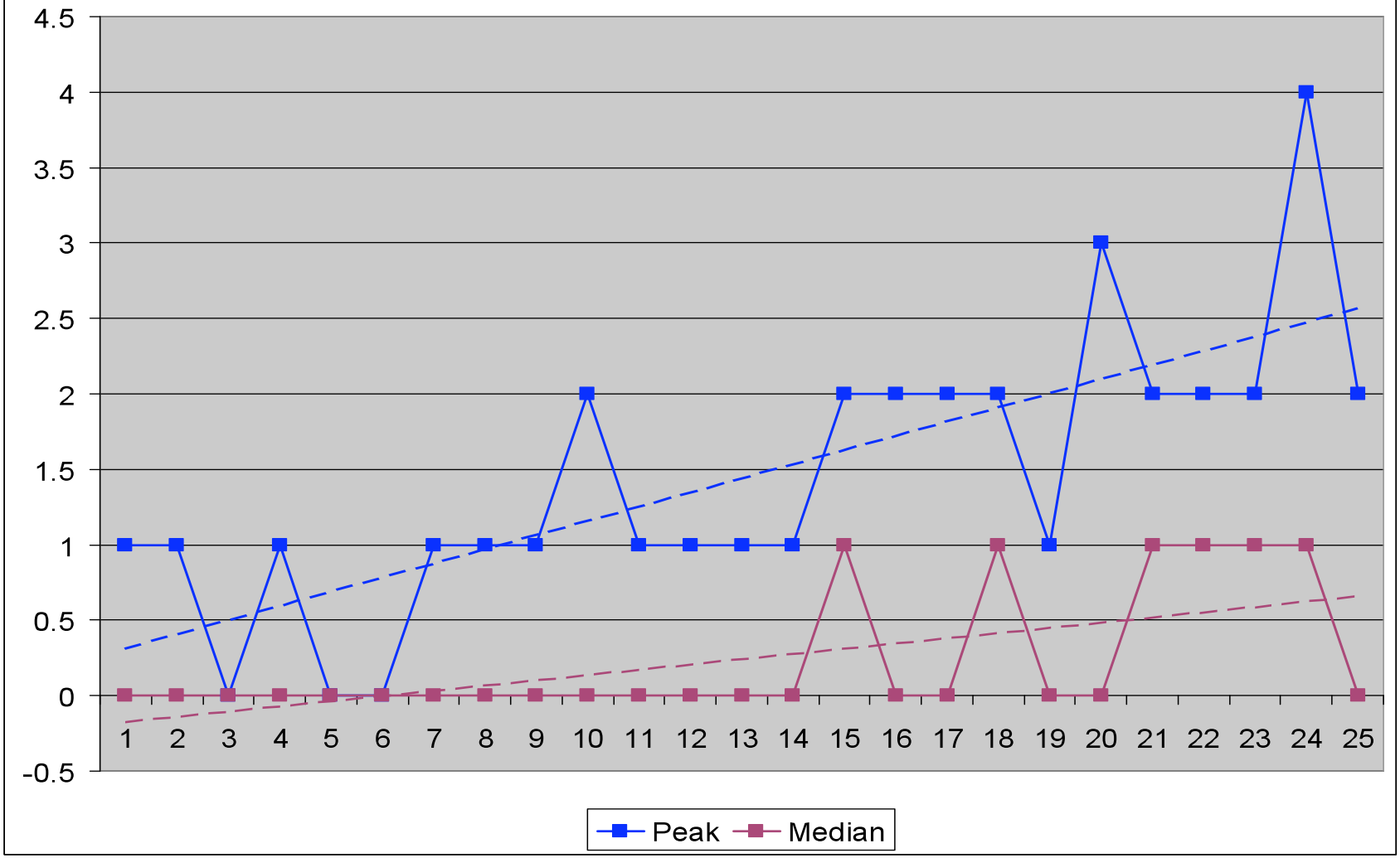


Figure 18
PEREGRINE FALCON



DISCUSSION: WINTER WATERFOWL OF THE MAURICE RIVER

The analysis of twenty-five years of systematic data allows for considerable insight into both status and trends as well as the distribution of waterfowl on the Maurice River. Spatial distribution of ducks and geese along the river is easily ascertained in the raw data from these twenty-five years of regular counts (data was kept separately for each of the nine point count sites), although this is not explored or analyzed in this report. Likewise, phenology (seasonal timing) of waterfowl (and raptor) populations and movements is easily discernable, and while also not explored in depth or analyzed here, it bears mentioning that there is an observed clear trend of waterfowl arriving later and departing sooner in recent mild winters than occurred in the harsher and generally colder early years of the study.

The well-known trend toward the milder falls and winters associated with accelerating climate change has generally meant that waterfowl numbers are lower today than historically. Twenty-five years of data shows that the largest numbers of ducks and geese occur during the colder winters when birds are pushed here by harsh conditions -- snow cover and freeze-ups to our north. On milder winters, many waterfowl simply remain north of the Delaware Bay region. In the later two segments of the study, most winters have seen above average temperatures, and some winters have been well above average, particularly the last season of study – winter 2011-2012 – one of the warmest over-all winter seasons ever recorded.

A second clear observable trend is the loss in numbers of upper tidal river waterfowl from the low salinity areas dominated by wild rice. This drop in waterfowl numbers is presumed to be due to both the adverse impacts of increasing salinity on wild rice and the effects of Canada Goose herbivory on wild rice stands. Canada Geese are well-known to feed heavily on the shoots (and seeds) of wild rice, and booming populations of "local" (non-migratory) Canada Geese have decimated many stands of rice on the upper tidal regions of the Maurice River. The increasing salinity – the "salt line" moving steadily north up the Maurice – is linked in part to increasing fresh water withdrawals upstream but more emphatically to sea level rise associated with climate change. Also, the increasingly more frequent drought conditions seen in the mid-Atlantic, including southern New Jersey (also linked to climate change), means far less fresh water moving down the river, another factor in the moving salt line and loss of wild rice. A final factor in the loss of wild rice may be the proliferation of an invasive *Bidens* that appears to be rapidly out-competing the native wild rice in some sections of the upper river.

This observed upriver loss of waterfowl however has been somewhat countered by a downriver gain in duck numbers resulting from the creation and management (and resultant recruitment of ducks) of the salt marsh restoration site at Bivalve by the PSE&G Estuary Enhancement Program (EEP). This project was begun in 1995; as the 4,171 acre project has come on line, and has continued to attract greater and greater numbers of ducks each season, the loss of upriver birds has been offset considerably. Interestingly, it is not known, nor can be, whether the EEP site is simply pulling in birds that would otherwise be upriver were the EEP not in place. This massive salt marsh restoration project may well be concentrating regional birds due to its high quality habitat. It is important to note however, that this situation appears to be in fact a temporary one, as *Spartina alterniflora* stands continue to replace and fill in quality mudflats highly favored by ducks (and shorebirds) during the lower stages of the tide. Fewer flats and pools will eventually mean fewer ducks.

Another associated and more recent factor involves the observability or detectability of waterfowl. As mudflats slowly but inexorably fill with *Spartina alternaflora*, ducks (and again shorebirds) are harder to see and count -- as many can remain hidden behind patches of salt marsh grass. The degree to which this impacts counts is unknown, but we sense that this is becoming more of an issue with each season of growth. The ice and snow of harsh winters knocks down and flattens the grass, allowing ducks to more easily be detected, but the trend towards milder and iceless winters tends to mean such flattening often doesn't occur.

A final intangible factor may be an issue in declining Maurice River waterfowl counts. As discussed herein, Bald Eagles have made a huge comeback everywhere, and numbers are booming on the Maurice River and throughout the Delaware Bayshore region. The constant presence of eagles may well be impacting waterfowl counts. The occasional predation by eagles on ducks or geese is not in any way harming these populations, but they indeed may be affecting our count totals. In our experience, as Bald Eagles have become far more numerous over the years, waterfowl have become far more tolerant of them, "more used to them." Because of hidden coves and guts on the river, the best waterfowl counts in the early years of the study were always obtained on days of high eagle activity, as eagles flushed ducks which would have otherwise gone uncounted by observers because they were out of sight. Sometimes, such "flushes" made the difference between merely a good count and a "great count." We have anecdotally but frequently observed that in recent years, ducks seem to have become far more acclimated to the constant presence of eagles. When Bald Eagles were "rare," with just two or three present, ducks panicked if they saw an incoming eagle. If ducks flushed today each and every time they saw an eagle -- with possibly 30 or 40 present and virtually *always* overhead and in view -- they would spend all day in the air, never being able to feed (resulting in an enormous energy drain). This habituation to eagles could be an unknown, and almost certainly unquantifiable, factor in lower averages of ducks in recent years, yet it is interesting food for thought. A determined hunting eagle still flushes ducks, but their more casual presence no longer creates the panic among waterfowl that it always seemed to in years past.

DISCUSSION: WINTER RAPTORS OF THE MAURICE RIVER

Twenty-five years of systematic winter counts of vultures, hawks, and eagles have greatly contributed to our understanding of these iconic symbols of the wintertime Maurice River marshes. Perhaps more so than with waterfowl, clear pictures of status and trends have emerged. Findings have documented the Maurice River to be exceptional and important raptor habitat by any criteria or measure. Of interest, the Maurice is not only important to birds of prey in winter, but at virtually all seasons as adjunct seasonal studies to be discussed below will attest. The Maurice River, and particularly the lower river near East Point and Heislerville, is important as stopover habitat for fall migrant raptors. Fall migration plays a big role in the establishment of wintering raptors, and the migratory route westward along Delaware Bay is a large causal factor in the now-proven regionally significant numbers of hawks and eagles that winter on the Maurice River. So too, many of the wintering hawks remain well into spring, with spring counts sometimes rivaling winter, and substantial numbers remain to breed -- Red-tailed Hawks, Cooper's Hawks, and Bald Eagles alike (not to mention the Maurice being the regional stronghold for breeding Osprey).

Among true wintering species, four species show strong increasing trends over time, four species show slight to moderate increases, one species shows a stable winter population, and two species show alarming declines over the past twenty-five years. Much like with waterfowl, it can be difficult to ascertain whether patterns and trends are linked to true changes in the overall population or to more localized changes and impacts that may be affecting distribution in the region and/or in the flyway. Sometimes the picture is clear: with Osprey, Bald Eagle and Peregrine Falcon, nationwide populations are booming as these poster species recover from the ravages of DDT. For other species the picture is less clear. Rough-legged Hawk, a far northern breeder, is thought to be remaining largely north of the Mid-Atlantic region in recent winters, as less snow cover means they simply don't need to go as far south to find hunting opportunities. That said, the preferred winter habitat for Rough-legs in the region – high marsh and meadow/pastureland -- is rapidly disappearing due to the loss of diked salt hay farms, open marsh water management (mosquito control), and to a far greater, more pervasive degree, sea level rise. The loss of Rough-legged Hawks in our region is easily seen in these twenty-five years of winter data, as well as in the fall migration findings presented below.

Likewise, the American Kestrel is well-known to be declining nation-wide, and particularly in the East, as habitat loss, perhaps combined with loss of its prey base (due to pesticides?) have combined in many regions to almost completely extirpate the Kestrel as a breeder. On the Delaware Bayshore, there remains a lot of open space, but precious little of it today is preferred Kestrel habitat. Mechanized agriculture, no-till practices, the loss of dairy farms and pastureland, the proliferation of nurseries, and of course suburbanization, combine to leave little if any classic Kestrel habitat in much of the region. And, as Rough-legged Hawks and Short-eared Owls once did, Kestrels also once used salt hay farms for hunting to a great degree in winter.

Sadly, the plight of the American Kestrel is even worse than the numbers and trends reported herein show. For example, in 2008-2009, a new winter record (Best Count) of 10 American Kestrels was recorded, but these were all early spring migrants counted on the very last day of the winter count period, 31 March. These were all northbound migrants as opposed to true wintering birds, and only one individual Kestrel actually wintered on the river that season.

The 10 migrants were dutifully averaged in, as protocol required, yet in reality skewed the winter average which would have been 0.5 rather than the 1.75 as reported if the 10 hadn't been averaged in. (Also see related discussion on Red-shouldered Hawk above). Today, on the Maurice and throughout the Bayshore, there are far fewer Kestrel than Bald Eagles at any season save the very peak of fall migration. The Kestrel is virtually extirpated on the Delaware Bayshore as a breeding bird and as a wintering bird. It is a great loss of a beautiful and beneficial hawk that once, and in the very near past, helped enliven and define the Bayshore countryside.

Fortunately, other raptor species are doing far better. Red-tailed Hawks and Northern Harriers, two other hawks that are so highly representative of the Maurice River, appear to be remarkably stable and even increasing over time. Turkey Vulture numbers are steadily increasing, and Black Vultures are in fact booming on the Bayshore. Cooper's Hawks are completing a comeback from near regional extirpation, and are a principal wintering raptor of the Maurice River once again.

Bald Eagle and Peregrine Falcon require little comment, but maybe some quiet reflection. Both have seen a comeback from the dark days of DDT that few wildlife managers or biologists expected. As this twenty-five year data set and many others amply illustrate, Bald Eagles and Peregrines again grace the Bayshore skies in large numbers. Maurice River studies show a remarkable upward trend for these raptors over time; in fact these studies chart the return of the Bald Eagle almost in its entirety, from the absolute lows of the mid 1980s to the actual "kettles" (soaring groups) sometimes seen today. The Bald Eagle is back, as a wintering bird, migrant, and breeding species. And while we don't know what impact the continuing trend toward milder winters may have on Bald Eagle long-term average numbers in the future (by far the most eagles are present during the coldest winters), for now, documenting the return of the Bald Eagle to Maurice River skies has been the most heartening and rewarding aspect of these long-term studies.

SUPPLEMENTAL AND EXPANDED STUDIES:

WATERBIRDS

The term waterbirds is a general term for wetland and open water species such as loons, cormorants, wading birds (herons, egrets, and ibis), rails, terns, and gulls. The definition usually includes waterfowl (ducks and geese) as well, and at times even shorebirds, but since waterfowl are focused on in the core studies, waterfowl will not be included in these adjunct waterbird findings and discussion presented below.

Prior to the 2000 – 2001 season, during the regular raptor and waterbird surveys only anecdotal records had been kept regarding Maurice River waterbird numbers, and these records were generally of rare or unusual bird sightings. But beginning in the summer and fall of 2001, information was gathered and recorded regularly and systematically on all waterbirds as a formal adjunct to the core winter raptor and waterfowl studies. Simply put, at that time we began to record *all* waterbirds while conducting regular scheduled raptor and waterfowl counts. Also at this time we began to take counts of raptors, waterfowl, and waterbirds throughout the seasons and throughout the year. Methodology of year-round efforts remained the same as in the core winter studies, yielding a full and systematic count for all waterbirds (including shorebirds – which will be discussed elsewhere herein).

Peak high counts for waterbirds on the Maurice River for each yearly cycle from 1987 to 2012 are shown in **Table 6**. **All-time peak high counts** are shown in **Bold Face.** Data for 1987 to 2000 represents non-systematic and anecdotal sightings; data shown for 2000 onward is for regular, systematic counts. Although of course not waterbirds, gallinaceous game bird and owl species are shown as well. And finally, Belted Kingfisher is included too – an "honorary waterbird" to say the least.

Waterbird use of the Maurice River is substantial and significant, yet varies considerably from season to season and from year to year. Loons and cormorants use the river fall through spring, and Double-crested Cormorants now nest at Heislerville WMA as well. Northern Gannet use Maurice River Cove in fall and spring. Gull numbers are large at all seasons, including a noteworthy annual late winter-early spring gathering of Bonaparte's Gulls at East Point and Heislerville WMA. The endangered Least Tern uses the area in small numbers in spring and summer, and a sizable flock of Black Skimmers (endangered) stages at Heislerville WMA each year in May before moving to Atlantic coastal barrier islands to breed.

Clapper Rail are abundant spring through fall (far more abundant than survey numbers show for this extremely secretive and species), and many remain in winter – particularly during milder winters. The Maurice River has long been well-known too for the large fall concentrations of Sora in the upriver wild rice marshes, but survey methods/protocol do not allow for counting this tiny and highly secretive "railbird." Heron and egret use is substantial throughout the seasons. Great Egrets, Snowy Egrets, and Black-crowned Night-Herons use the river early spring through late fall, and now nest in a large rookery at Heislerville WMA. Great Blue Herons are found at all seasons in numbers.

The adjunct and expanded waterbird counts were initiated in part to document and quantify the extremely high regional significance of the PSE&G Bivalve wetlands restoration

site for waterbirds – particularly herons and egrets. When this EEP site first went "on-line," wading bird use was intense for several seasons, probably due to the number of concentrated and trapped small fish. (For several years, wetlands managers frequently reworked channels to allow for proper tidal exchange. Trapped pockets of water were a part of this problem, and one which herons and egrets clearly exploited). Today these gatherings are much reduced, but for several years, wading bird numbers were unusually high, particularly in late summer when immigrant egrets from southern states (a well-known phenomenon for wading birds) joined dispersing local New Jersey breeders. The estimated 6,000 Snowy Egrets and 1,500 Great Egrets recorded on 24 August 2001 are apparently an all-time single-spot maxima for New Jersey. And while the numbers on that day were really just an estimate, due to many flocks constantly trading about, it was an amazing event, with egrets filling not only the wetlands but also the trees surrounding the EEP site in every direction – and a spectacle that Sutton had only before witnessed to such a degree in the Florida Everglades.

We offer no in-depth review and analysis of waterbird status and trends here. This will be deferred until several more years of data on waterbird use are gathered in order to properly put previous findings into perspective and context. However we will here note that Maurice River waterbird (and shorebird) use, particularly of the lower river – at the Bivalve EEP site and at the Heislerville WMA impoundments and mudflats -- are highly important and regionally of major significance. Waterbird counts have complemented core raptor and waterfowl studies in an emerging understanding of both the scope and depth of the Maurice River's avian resources.

In summary, Maurice River open waters, tidal impoundments, and intertidal zones are regionally highly significant, and provide and support major waterbird concentrations and migratory staging areas. Heislerville and Bivalve combined are arguably the best birding site on the New Jersey Delaware Bayshore, and one of the top sites in all of New Jersey. Joining raptors and waterfowl, the waterbirds of the Maurice River are a major draw for ecotourism, and another good barometer on water quality and the environmental health of this amazing "Down Jersey" region.

Table 6
Waterbirds on the Maurice River
Peak High Counts for Each Yearly Cycle
1987 – 2012

DATE	1987-1988	1990 EP	1998-1999 W	1999-2000 W	2000-2001	2001-2002	2002-2003 W	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
LOONS to CORMORANTS																
Red-throated Loon				3	2	8	1	**9**	5	1	1	2	3	4	4	8
Common Loon		4					1	1	1	**3**	1	1	2	1	1	1
Pied-billed Grebe			**4**	4		4	1	1	1	1	1	3	1	3	2	2
Horned Grebe									2		7	1		2	9	
Red-necked Grebe							**43**	1								
Wilson's St-Petrel											6					
Northern Gannet				1				16	**135**	3	6	5	12	14		52
Brown Pelican					**56**			3	7			17	1			
White Pelican					**2***			1*	1							
Double-cr Cormorant	100	200	2	6	**1000**	350	5	355	606	660	377	279	131	443	469	556
Great Cormorant	1	1				**3**	2	1	2				2		1	1
BITTERNS to VULTURES																
Wood Stork					**1**											
American Bittern			**1**									1				1
Least Bittern		1						**3**			2	1			1	1
Great Blue Heron	22	14	28	46	**50**	37	35	24	25	27	27	24	27	24	22	25
Great Egret	20	10	5		**1500**	1500	2	255	77	90	152	112	101	28	122	129
Snowy Egret	50	40			2500	**6000**		730	310	285	226	432	402	95	368	450
Little Blue Heron	1	3						1	**4**	2	1		1	1	2	3

W: Winter Season ONLY
EP: East Point Fall Hawk Watch

* seen by other observers
All-time high count shown in **Bold Face**

Table 6 (continued)
Waterbirds on the Maurice River
Peak High Counts for Each Yearly Cycle
1987 – 2012

DATE	1987-1988	1990 EP	1998-1999 W	1999-2000 W	2000-2001	2001-2002	2002-2003 W	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
Tricolored Heron							1			**4**	1		1		1	1
Cattle Egret		2						1		**3**	2		1		1	1
Green Heron		3				2		6	**12**	3	7	2	8	3	2	4
Black-cr Nt-Heron	12	2	62	21	50	11	11	10	18	19	41	21	53	62	152	**203**
Yellow-cr Nt-Heron					1			1				**3**			1	2
Glossy Ibis		1		16	326	250		540	**575**	154	185	170	100	114	152	106
White-faced Ibis								1*				1*		**1**		1
White Ibis								1*								
GROUSE to CRANES																
Ring-nk Pheasant	1	1					1	1	1	**12**	6	2	3	3	2	3
Ruffed Grouse	1	1														
Wild Turkey	2	2	7				11	36	85	45	41	37	51	42	74	**100**
Northern Bobwhite	**15**	1						1	2	1	1			8	2	
Black Rail		1														
Clapper Rail	2	3			#	#	27	26	37	22	24	18	60	45	64	**71**
King Rail												**1**		1	1	1
Virginia Rail	1	1					**2**								1	2
Sora	1	1												**3**		2
American Coot	1						1	2	8	**21**		1				
Sandhill Crane				1*								2*				**2**

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EP: East Point Fall Hawk Watch

* seen by other observers
All-time high count shown in **Bold Face**

Table 6 (continued)
Waterbirds on the Maurice River
Peak High Counts for Each Yearly Cycle
1987 – 2012

DATE	1987-1988	1990 EP	1998-1999 W	1999-2000 W	2000-2001	2001-2002	2002-2003 W	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
JAEGERS to ALCIDS																
Parasitic Jaeger											**1**					
Laughing Gull		400	#	#	3500	1000	#	**6000**	1000	#	#	#	#	#	#	2000
Com. Bl-headed Gull				1	1*					1			2		**3**	1
Bonaparte's Gull	6	8	29	17	125	252	1	71	**256**	9	75	132	180	60	80	38
Ring-billed Gull	**500**	500	#	#	237	200	293	350	214	375	106	108	400	312	300	500
Herring Gull	2180	750	#	#	500	**2500**	1995	1200	860	1375	#	#	#	#	#	1000
Iceland Gull											**1**					1
Lesser Bl-bkd Gull		1					**1**	1	1	1					1	1
Glaucous Gull			**1**											1		
Gt Bl-backed Gull	240	100	#	#	**500**	400	96	280	500	185	#	#	#	#	#	500
Gull-billed Tern					**8***			2	2	2		2			2	
Caspian Tern		1			3	**50**		3	2	4	7	7	15	7	8	4
Royal Tern		6			2	50		12	2	7	12	1	13	12		**110**
Roseate Tern											**2**					
Common Tern									**3**				1		1	2
Arctic Tern									**1***							

W: Winter Season ONLY
EP: East Point Fall Hawk Watch

* seen by other observers
All-time high count shown in **Bold Face**

Table 6 (continued)
Waterbirds on the Maurice River
Peak High Counts for Each Yearly Cycle
1987 – 2012

DATE	1987-1988	1990 EP	1998-1999 W	1999-2000 W	2000-2001	2001-2002	2002-2003 W	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
Forster's Tern	275	40			500	**1000**		375	322	337	340	228	388	202	525	200
Least Tern								12	**19**	2	7	8	18	8	6	18
Black Tern										**2**		1*				
Black Skimmer					139			47	96	239	62	285	281	54	**302**	170
PIGEONS to WOODPECKERS																
E. Screech-Owl								1	1			1	1		1	**2**
Great Horned Owl								1	2			2	3	**4**		1
Snowy Owl													**1**			
N. Saw-whet Owl												1				
Long-eared Owl				**1**												
Short-eared Owl			1	1				3*			1	1	1			
(A peak of 4 Short-eared Owls were seen in 89-90; 2 in 88-89 and 92-93; 1 in 90-91).																
Belted Kingfisher	**20**	7						14	12	10	7	6	11	10	6	10

W: Winter Season ONLY
EP: East Point Fall Hawk Watch

* seen by other observers
All-time high count shown in **Bold Face**

SUPPLEMENTAL AND EXPANDED STUDIES:

SPRING AND FALL MIGRATION PERIODS

In the 2003-2004 season, the seventeenth year of Maurice River long-term studies, research efforts were expanded to encompass the full seasonal cycle. Adjunct autumn migration period counts were undertaken, beginning in July and August and running through November, when the core winter sampling period began anew. Spring migration was monitored as well, from the beginning of April through early June. While the frequency of sampling is not as intense as in the core winter period, the Maurice River has been monitored at least once a month from fall 2003 up to the present time (and usually more often during peak migration periods such as May and October).

The findings of the fall survey efforts for waterfowl are shown in **Table 7**. The peak seasonal count for each year is shown, and the **all-time high fall season count** for each species is shown in **Bold Face**. The results of spring season waterfowl counts on the Maurice River are shown in **Table 8**. Here too, **all-time high spring season counts** are shown in **Bold Face**. Finally, **Table 9** shows spring migrant raptors recorded on the Maurice River in the period from early April through early June, and again **all-time spring season high counts** are shown in **Bold Face.** Note that these tables show only waterfowl and raptors; spring and fall waterbirds are wrapped into the full season findings shown in Table 6, and are not separated out as we have done for waterfowl and raptors. Also, both autumn raptor migration and spring and fall shorebirds will be treated separately below because they are such key phenomena on the Delaware Bayshore and the Maurice River.

To date, in addition to the 234 days spent investigating core winter raptor and waterfowl use, 187 days of expanded studies effort have now been carried out in fall (a total that includes 70 days of targeted hawk migration counts in 1989 and 1990 – see below) and 54 days of effort in spring. This is a total of 241 days of expanded seasonal investigations to date (and a grand total of 475 days of Maurice River avian studies over the past twenty-five years).

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 Maurice 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, fall raptor and waterfowl findings are of as great importance as winter bird use of the Maurice River.

Findings from 2003 to the present were significant, both confirming and corroborating previous anecdotal and less-focused studies regarding autumn bird use of the region and particularly the lower Maurice River area. Waterfowl numbers were unexpected and surprising. The post-breeding, pre-migration staging of American Black Ducks was highly significant; 915 American Black Ducks were counted at Bivalve on 15 August 2003, and both fall and spring counts of over 1,000 Black Ducks were attained on several occasions. In addition, late fall

numbers of Mallards, Pintails and Green-winged Teal were often as high (and significant) as numbers found in winter. Spring efforts have shown that waterfowl use can remain quite high following the end of core winter surveys. The 1,265 Black Ducks on 6 April 2004 amply proved continued spring use of Maurice River marshes, and migrant Green-winged Teal counts remain high well into the spring. In short, important waterfowl use of the Maurice continues long after classic winter counts have ended. Of note are two all time peak high counts for waterfowl species that come in the shoulder seasons -- the 44 Blue-winged Teal in spring and the 607 Brant recorded in fall. Also, near-record counts of Canada Goose (fall) and Northern Shoveler (spring) have been recorded during these expanded seasonal studies.

One significant finding of the targeted summer ("early fall") studies was the number of breeding raptors documented. Northern Harrier breeding was proven or suspected on the lower Maurice 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, and the success of the praiseworthy Citizens United Osprey project, are clearly seen in Osprey counts garnered during late spring and early fall surveys (and is well-documented in CU reports elsewhere). Mirroring core winter findings, the comeback of Bald Eagles, Cooper's Hawks, and Peregrine Falcons, both as breeders and migrants, is easily seen in spring and fall data. Not only was substantial early spring hawk migration noted, particularly for Red-tailed Hawks, but interesting numbers of Red-tails have been recorded mid-summer too, proof that not only do high numbers of birds use the river year round, but also that up to one-half of the "winter" Red-tails are possibly local resident birds that remain on and near the river at all seasons. Regionally significant and heavy raptor use of the Maurice River is now proven and documented to occur at all seasons

While the Purple Martin is of course neither a waterbird nor a raptor, it is important to reiterate here that the Purple Martin gathering and roost on the Maurice River in August is one of the great wildlife spectacles and events both in the state and the Mid-Atlantic region. Each year, over 100,000 Purple Martins roost in the wetlands north of the Maurice River causeway each night for nearly a month before departing for the south. While not monitored by the studies detailed here, it should be noted that this storied and unique-to-the-region roost is highly dependent on the same crucial Maurice River wetlands that support all the raptors and waterbirds discussed throughout this report.

Further analyses of spring and fall migration of waterfowl, raptors, and all waterbirds will be carried out as more seasons of data are gathered, but in summary, the extended seasons of Maurice 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 Maurice River study area 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 Maurice occurs at all seasons. This recent spring and fall data augments and reinforces our existing twenty-five years of winter data, and both supplements and complements known wildlife values with important new information regarding status, seasonal distribution, and numbers of birds using the Maurice River. Expanded seasonal studies confirm and corroborate previous winter survey efforts, and show that for both bird-use and the enjoyment of birds, the Maurice is a place for all seasons.

Table 7
Fall Waterfowl on the Maurice River
Peak High Counts for Each Year
1987 – 2011

DATE	FALL										
	1987	1990	2003	2004	2005	2006	2007	2008	2009	2010	2011
		*									
WATERFOWL											
Snow Goose	252	**8000**	3	1650		20	100	20			28
Canada Goose	200	**1500**	414	935	178	168	90	157	22	103	65
Brant		**607**			5						
Mute Swan	8	10	50	28	**109**	47	12	20	14	2	6
Tundra Swan		**14**			1						
Wood Duck	**115**	2			6		2			3	
Gadwall	10		**16**	11	5	6	1	6		6	5
Eurasian Wigeon											
American Wigeon	**6**	1								1	
Am. Black Duck	**1350**	1000	1181	626	720	409	582	473	89	109	34
Mallard	**600**	100	447	125	141	62	45	69	18	17	8
Blue-winged Teal	3		1	12	**33**	13		26	10	2	
Northern Shoveler				18	17	**40**	2			2	
Northern Pintail	161	85	1057	**1204**	953	546	22	138	60	225	31
Green-winged Teal	**1500**	400	292	482	861	1073	8	1341	442	423	121
Common Teal											
Canvasback				1							
Ring-necked Duck	2		1	**350**		4		14			
Greater Scaup		36	**50**		3		2		24		
Lesser Scaup				**19**	3		17				
scaup sp.					4	8	**38**		4		
Surf Scoter		**20**	15				4		1		
Wh-winged Scoter											
Black Scoter		**7**	7				1	2			
scoter (sp.)							**50**	3		30	
Long-tailed Duck	1						**3**				
Bufflehead	50	16	54	**168**	119	70	120	130	114	19	
Com. Goldeneye	**8**	2			1	1	2		2		
Hooded Merganser	5	4		**10**				8			
Com. Merganser								1			

Red-br Merganser			1	**20**				8		4	
Ruddy Duck	10		1	**45**	42	10	16	28	9	24	

All-time high seasonal count shown in **Bold Face** *Counts taken from East Point Hawkwatch

Table 8
Spring Waterfowl on the Maurice River
Peak High Counts for Each Year
1987 – 2012

	SPRING									
DATE	2000	2004	2005	2006	2007	2008	2009	2010	2011	2012
WATERFOWL										
Snow Goose			30	3	**75**		12			
Canada Goose	110	**335**	159	105	125	91	132	67	82	57
Brant									8	
Mute Swan	21	**74**	40	58	18	20	16	10	9	6
Tundra Swan										
Wood Duck						1		2	1	**5**
Gadwall	**285**	51	2	19	56	131	21		2	
Eurasian Wigeon	1									
American Wigeon	**75**	2	1	1	4	13				
Am. Black Duck	360	**1265**	568	271	831	592	221	154	178	136
Mallard	4	97	25	6	23	14	**28**	20	6	4
Blue-winged Teal	**44**	10	7	3	5	8	10	6	5	
Northern Shoveler	**150**		1	5	4	8	15		7	2
Northern Pintail	33	**225**	40	8	6	17	6		6	8
Green-winged Teal	2680	1376	1668	1114	2044	**2970**	2131	2168	1609	1202
Common Teal	1									
Canvasback										
Ring-necked Duck		7	1				**8**		4	
Greater Scaup		**10**				2			6	
Lesser Scaup		30		2	**25**	35	2		20	1
scaup sp.		**85**			5					
Surf Scoter				**28**					20	2
Wh-winged Scoter										2
Black Scoter				1	**20**					20
scoter (sp.)						1			**40**	
Long-tailed Duck		1								
Bufflehead	20	**181**	39	10	160	122	40		26	
Com. Goldeneye		**16**		1	1					
Hooded Merganser	3	2		**12**	4			8	6	
Com. Merganser			4				3			
Red-br Merganser	2	**101**	8	37	25	53	8		11	2
Ruddy Duck	4			3	**16**	15		1	7	

All-time high seasonal count shown in **Bold Face** **No Counts**: Spring 2001, 2002, 2003

Table 9
Spring Raptors on the Maurice River
Peak High Counts for Each Year
2000 – 2012

Year	2000	2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of Surveys	3	5	4	3	5	5	4	5	6	5
Black Vulture	7	**42**	10	3	9	21	19	14	19	11
Turkey Vulture	32	**142**	92	40	79	78	92	88	78	75
Swallow-tailed Kite							1*		1*	
Mississippi Kite							2	**4**	1	1
Osprey	10	76	76	68	74	82	87	**112**	48	75
Bald Eagle	5	18	14	10	12	10	**19**	18	15	12
Northern Harrier	9	**38**	12	12	18	13	24	5	17	12
Sharp-shinned Hawk	1	3	1			1	2			
Cooper's Hawk	2	6	1	1	1	3	**11**	4	2	3
Red-shouldered Hawk							1			
Broad-winged Hawk		1	1						1	
Red-tailed Hawk	9	**62**	33	13	39	19	48	31	16	20
Rough-legged Hawk		1								
Golden Eagle		1								
American Kestrel	5	3	1	2	**11**	2	8	2	8	
Merlin	2	**3**	1			1	1	1		
Peregrine Falcon	1	4	1	**5**	1	1	4	**5**	3	2

All-time seasonal high count shown in **Bold Face**

SUPPLEMENTAL AND EXPANDED STUDIES:

AUTUMN HAWK MIGRATION

One of the outstanding features of the Delaware Estuary, and a phenomenon that gives the region a national significance and notoriety, is the autumn hawk migration that first sweeps west along the shore of New Jersey's Delaware Bay and then south across the narrowing Bay and on through the Delmarva peninsula. A major concentration or bottleneck for this annual hawk flight occurs at and near East Point at the mouth of the Maurice River.

While raptors have long been characterized as reluctant to cross water barriers, some studies have shown that some hawks regularly make water crossings under the right conditions. The Delaware Bay crossing from Cape May Point to Cape Henlopen (about 10 miles) should be of little impediment to southbound autumn raptors, yet for as long as it has been known that major hawk concentrations occur at Cape May, it has also been well known that not all raptors recorded there cross the Delaware Bay. Many return north up the western side of the Cape May peninsula and west along the upland edge of the Delaware Bay – particularly during the strong northwest winds of autumn cold fronts. It is theorized that, rather than risk being blown to sea during a water crossing of Delaware Bay, many hawks instead return north up the peninsula, and finally turn west along the Delaware Bayshore in an attempt to find a shorter and safer crossing site – in effect flying around Delaware Bay.

In 1987 and 1988, Sutton noted considerable hawk migration occurring in fall along the lower Maurice River system during exploratory work for CU. It was found that the geography of the East Point area (East Point is actually a small south-facing peninsula) concentrated the westward raptor flight line to a great degree by creating a "dead-end" bottleneck as hawks avoided the open waters of Maurice River Cove. These findings and other anecdotal reports in turn led to the CU and Cape May Bird Observatory (CMBO) co-sponsored hawk migration studies at East Point carried out in 1989 and 1990. In 1990, the primary count season, a full time hawk watch was conducted; a total of 308.5 hours of observation (all by Sutton and Dowdell) occurred on 60 days spanning from 9 September to 7 December. The objectives of this study were to determine the numbers of hawks going around Delaware Bay by comparing East Point numbers with those counted during the same time period at the official CMBO Cape May Point Hawkwatch site. A comparative count would allow a determination of the migratory route, habitat use, and an estimation of the importance of the Bayshore marshes and upland edge habitat to migrating hawks. A major goal was to provide conservation agencies and groups with data relevant to the identification and protection of stop-over habitat – those areas critical for resting and feeding for migratory raptors.

The results of the East Point Hawkwatch effort have been reported on elsewhere (see References), and will not be reiterated here in-depth. In summary, 9,042 raptors of 17 species were recorded as migrants at East Point in 1990. This was an average of 150.7 hawks per day or 29.3 hawks per hour, compared to Cape May Point's 36.9 hawks per hour. The East Point total was 34.6% of the total hawks counted at Cape May during the same 60 day period. Except for Osprey, Merlin, and Peregrine Falcon – species known not to be averse to water – virtually all birds were moving west around Delaware Bay, giving us a remarkable picture of the importance

of Bayshore habitats to migratory raptors. The percentage of the East Point count compared to the Cape May Point count varied by species: Peregrine Falcon: 9%; Osprey: 12%; Broad-winged Hawk; 18%; Merlin: 21%; Northern Goshawk: 23%; American Kestrel: 26%; Sharp-shinned Hawk: 36%; Red-shouldered Hawk: 38%; Cooper's Hawk: 40%; Golden Eagle: 57%; Northern Harrier; 68%; Bald Eagle: 90%; Red-tailed Hawk: 91%; Turkey Vulture:107%; Black Vulture: 166%; Rough-legged Hawk: 900%.

Because of the high significance of autumn hawk migration in the Maurice River region, hawk counts have been continued on a smaller scale since 1990 to date, with expanded seasonal efforts allowing for limited yet targeted hawk counts each season. **Table 10** shows the results of all focused hawk count efforts from 1987 through 2011. Also shown are historical counts prior to 1987. Peak counts and total counts are presented for each fall season, and **all-time daily high counts** are highlighted in **Bold Face**. It is noteworthy that not all high counts came from the full time 1990 season; many records have been broken since – highlighting the recovery of many raptor species nationwide (Bald Eagle, Cooper's Hawk). The count history also shows the disappearance of two other hawks -- Rough-legged Hawk and American Kestrel. Table 10 continues the consecutive and chronological picture of the important hawk migration flowing west past East Point every autumn, and we continue to confirm and underpin the strong findings of the previous targeted hawk migration studies.

Because the 1988 through 1990 East Point hawk migration studies were so focused, and due to the fact that the dynamics of these flights have been analyzed and reported on in-depth, no further evaluation will be included here. Autumn hawk counts continue to be a key part of expanded Maurice River ornithological studies. Prior to the 1990 full season study, virtually all knowledge of this return flight up and around the Bayshore was speculative and anecdotal, but from that pivotal count and subsequent corroborating efforts, we now have a far clearer picture of the dynamics of coastal plain raptor migration through New Jersey and the Mid-Atlantic, and of the key role that quality Maurice River and Delaware Bay habitats play in this annual pageant.

Table 10
Fall Raptor Migration on the Maurice River
Twenty-five Year Summary: 1987 – 2012

Year	**1979**	**1981**	**1983**	**1987**		**1988**		**1989**		**1990**		**1991**	
Days	1	1	1	7		4		10		60		17	
Hours	6	5	5	35		16		43		309		54	
	14-Oct	25-Nov	11-Dec	PEAK	TOTAL	PEAK	TOTAL	PEAK	TOTAL	PEAK	TOTAL	PEAK	TOTAL
Black Vulture						1	1			6	15	5	14
Turkey Vulture	8			76	340	68	163	105	502	40	596	37	182
Osprey				3	7	7	15	4	11	23	**182**	9	40
Bald Eagle			6	5	14	4	10	9	33	9	46	6	18
Northern Harrier	5	30	40	30	171	22	65	38	262	27	**538**	31	116
Sharp-shinned Hawk	192	1		12	39	40	67	155	249	528	**4013**	176	486
Cooper's Hawk	1	1		7	23	6	10	21	69	63	**604**	21	85
Northern Goshawk		1	1	1	2			1	1	2	**7**	1	1
Red-shouldered Hawk			1	1	1	1	1	10	20	11	**68**	8	9
Broad-winged Hawk	4			1	1	**2000**	2000	1	2	73	183	1	3
Swainson's Hawk										1	1		
Red-tailed Hawk	2	6	4	42	203	34	83	**195**	546	84	**753**	58	141
Rough-legged Hawk		**15**	5	3	4	1	1	3	11	5	**27**	3	8
Golden Eagle			**3**	1	1			1	2	**3**	**12**	1	1
American Kestrel	419	3	1	9	29	16	25	42	62	**495**	**1663**	38	129
Merlin				1	3	5	6	14	15	**76**	**270**	5	12
Peregrine Falcon				1	2	2	4	2	4	**13**	**64**	2	4
peak flight						*2000+*				*1185*			
Total Raptors	632	57	61		840		2450		1788		**9042**		1249

All-time high daily and seasonal count shown in **Bold Face**
Historical Counts by Dave Ward in 1979 and by Clay Sutton in 1981 and 1983
No Counts: 1992, 1995, 1997, 1998, 2002

Table 10 (continued)
Fall Raptor Migration on the Maurice River
Twenty-five Year Summary: 1987 – 2012

Year	1993		1994		1996	1999		2000		2001	
Days	4		4		1	9		4		5	
Hours	7		9		7	33		16		20	
	PEAK	TOTAL	PEAK	TOTAL	12-Nov	PEAK	TOTAL	PEAK	TOTAL	PEAK	TOTAL
Black Vulture	1	1	2	5	7	23	71	8	17	1	1
Turkey Vulture	20	51	24	64	128	124	524	60	176	109	194
Osprey	6	6	2	3	1	5	13	8	10	12	15
Bald Eagle	4	5	2	4	5	4	16	5	8	4	8
Northern Harrier	11	24	13	36	30	22	99	20	32	12	28
Sharp-shinned Hawk	7	10	41	96	9	66	211	30	33	14	20
Cooper's Hawk	2	4	3	7	5	10	49	10	13	8	8
Northern Goshawk	3	3				3	6			1	1
Red-shouldered Hawk	1	1	2	2	3	7	26	3	4	2	2
Broad-winged Hawk			2	2		1	1				
Swainson's Hawk						1	1				
Red-tailed Hawk	15	34	73	85	82	154	393	12	27	35	45
Rough-legged Hawk						2	8				
Golden Eagle						2	5				
American Kestrel	1	1	101	136	2	5	10	1	1	8	12
Merlin	1	2	2	2		2	6	1	1		
Peregrine Falcon	1	1	1	2		2	3	1	2	4	4
peak flight											
Total Raptors		143		444	272		1445		324		339

All-time high daily and seasonal count shown in **Bold Face**
Historical Counts by Dave Ward in 1979 and by Clay Sutton in 1981 and 1983
No Counts: 1992, 1995, 1997, 1998, 2002

Table 10 (continued)
Fall Raptor Migration on the Maurice River
Twenty-five Year Summary: 1987 – 2012

Year	2003		2004		2005		2006		2007		2008	
Days	5		5		5		7		4		3	
Hours	20		25		30		23		13		17	
	PEAK	TOTAL	PEAK	TOTAL	PEAK	TOTAL	PEAK	TOTAL	PEAK	TOTAL	PEAK	TOTAL
Black Vulture	8	21	**47**	**114**	22	56	16	64	20	51	17	46
Turkey Vulture	126	310	168	478	172	484	165	**613**	113	311	119	318
Osprey	22	40	37	64	**73**	115	17	34	11	15	14	16
Bald Eagle	17	41	20	59	21	78	31	**82**	18	27	17	46
Northern Harrier	**51**	94	27	84	31	88	42	111	36	73	31	60
Sharp-shinned Hawk	248	260	50	87	**671**	814	270	596	31	46	51	81
Cooper's Hawk	61	64	15	40	**90**	115	62	128	13	16	11	22
Northern Goshawk	1	1							1	1	**4**	4
Red-shouldered Hawk	1	2	6	6	5	6	9	9			8	8
Broad-winged Hawk	1	2			2	2	1	2				
Swainson's Hawk												
Red-tailed Hawk	75	120	65	166	65	150	72	154	29	70	118	162
Rough-legged Hawk			1	1								
Golden Eagle			1	1	1	1	**3**	3				
American Kestrel	25	36	15	33	62	92	27	64	6	13	13	19
Merlin	5	6	4	7	25	33	13	25	2	4	4	8
Peregrine Falcon	1	3	6	9	3	5	2	2	2	4	4	7
peak flight					*1029*							
Total Raptors		1000		1149		2044		1887		632		797

All-time high daily and seasonal count shown in **Bold Face**
Historical Counts by Dave Ward in 1979 and by Clay Sutton in 1981 and 1983
No Counts: 1992, 1995, 1997, 1998, 2002

Table 10 (continued)
Fall Raptor Migration on the Maurice River
Twenty-five Year Summary: 1987 – 2012

Year	2009		2010		2011	
Days	3		3		2	
Hours	18		18		12	
	PEAK	TOTAL	PEAK	TOTAL	PEAK	TOTAL
Black Vulture	31	78	33	68	23	27
Turkey Vulture	103	279	138	295	**176**	251
Osprey	4	4	2	2	21	22
Bald Eagle	**36**	60	22	47	20	37
Northern Harrier	24	60	38	95	18	24
Sharp-shinned Hawk	10	22	66	146	77	97
Cooper's Hawk	4	10	14	30	8	18
Northern Goshawk						
Red-shouldered Hawk	2	2	**13**	13	2	2
Broad-winged Hawk					3	3
Swainson's Hawk						
Red-tailed Hawk	26	67	104	148	41	58
Rough-legged Hawk						
Golden Eagle	2	2	1	2		
American Kestrel	3	5	28	36	12	24
Merlin	4	4	8	16	2	2
Peregrine Falcon	10	12	2	6	1	1
peak flight						
Total Raptors		605		904		566

All-time high daily and seasonal count shown in **Bold Face**
Historical Counts by Dave Ward in 1979 and by Clay Sutton in 1981 and 1983
No Counts: 1992, 1995, 1997, 1998, 2002

ADJUNCT AND EXPANDED STUDIES:

MAURICE RIVER SHOREBIRDS

In recent years, core winter raptor and waterfowl studies have been expanded to include both the spring and fall migration seasons. Beginning in 2000, we began to focus specifically on migratory shorebird use of the Maurice River, and in fall 2003 and spring 2004, systematic counts were begun and continue to the current time. For a number of years, Citizens United has been a partner and stakeholder in both the New Jersey DFW ENSP and international efforts and programs to protect migratory shorebirds on Delaware Bay. Therefore, it was deemed appropriate and timely to focus CU inventory and monitoring resources on gaining valuable data on shorebird use of the Maurice River itself.

The Delaware Bay is well known as a migratory shorebird staging area of international significance, as shorebirds gather to feed on the eggs of Horseshoe Crabs. The Maurice River area has also long been known to support significant numbers of migratory shorebirds. Both anecdotal data from birders and NJ DFW ENSP aerial surveys have shown the Delaware Bay beaches of the lower Maurice River, at and near East Point, to support high numbers of shorebirds in spring. What was less-known and understood is the extent of shorebird use of *other* tidal portions of the Maurice River Basin – those areas away from the immediate Delaware Bay beaches.

Heislerville Wildlife Management Area (WMA) has long been known to attract numerous shorebirds in spring (and fall), primarily on the Basket Flats mudflats south of the wildlife drive at low tide. However, beginning in 2006, the DFW began drawing down one or more of the tidal impoundments each May. This enlightened management technique, which provides rich mudflats at all tide stages, quickly attracted highly significant numbers (and variety) of shorebirds, birds that both roost and feed at the site. In addition to East Point and Heislerville WMA, the 4,171 acre Commercial Township Wetlands Restoration Site at Bivalve attracts large numbers of shorebirds in spring and fall. Beginning in about 1995, when these tidal impoundments were first created by PSE&G as a mitigation project (the Estuary Enhancement Program – said to be the world's largest salt marsh restoration project), the vast mudflats at Bivalve began to attract many thousands of shorebirds annually.

It is against this backdrop, beginning in fall 2003, that Citizens United has supported systematic and targeted shorebird surveys in spring and fall on the lower Maurice River. This report summarizes twelve spring seasons and thirteen fall seasons of Maurice River shorebird surveys. Point counts methodology differed from the protocol used in winter surveys. For spring and fall shorebirds, counts were conducted at three primary locations on the lower Maurice River: East Point, Heislerville WMA, and Bivalve. (These sites correspond to Sites 7, 8, and 9 of the core winter studies, and were shown in Figure 1).

- At **East Point**, a composite count was done from three vantage points: the boat ramp at the end of Lighthouse Avenue by the East Point Lighthouse; the seawall at the end of East Point Road; and the road end at the eastern end of Bay Avenue

- At **Heislerville Wildlife Management Area (WMA)**, all three impoundments are counted, as well as the Basket Flats mudflats south of the wildlife drive dike (if exposed at lower tide levels).

- At **Bivalve**, counts are taken from the EEP Wetlands Restoration Site boardwalk/ observation platform accessible from Shell Road (adjacent to/across from the Bayshore Discovery Project office); the boardwalk/observation platform at the southern end of Strawberry Avenue in Port Norris; and the dike overlook at the southern end of Berrytown Road. On a few occasions in spring, usually at high tide or following rain, shorebirds have packed the freshly plowed farm fields at Robbinstown Road, and on these occasions these roosting and feeding birds are added to the Bivalve composite total.

In summary, there are three primary count locations, but three individual count stations are found at each location; therefore nine point counts are taken during each shorebird survey. Two observers, Sutton and Dowdell, count shorebirds as quickly and efficiently as possible. Counts are conducted both by binocular and spotting scope, depending on the distance of the flocks. Normally different species are tallied by each observer in order to get through the vast flocks before they flush or move around. Birds on the mudflats are tallied individually as far as is possible, although many large groups must be counted in blocks of ten or even higher. Flying flocks, if not previously counted on the ground, are estimated by each observer and if totals differ, they are averaged. (All waterbirds and raptors are tallied, but only shorebirds are reported on in this section – see above). Point counts are not timed; birds are counted until all present are tallied; observers then move quickly to the next point in order to hopefully get there before birds possibly move into or out of the area. The nine point counts at the three locations usually take about five to six hours to carry out. Counts were conducted only in good weather and good visibility; tidal stage and water levels are recorded. As far as is practicable, observers attempt to count Heislerville at high tide (when shorebirds have been pushed off most other feeding sites and are roosting or feeding in the drawn-down impoundments) and Bivalve at lower stages of the tide (since a high tide normally fills the impoundments at Bivalve, leaving no mudflats to attract shorebirds).

Twelve spring seasons of Maurice River shorebird counts, 2000-2012 (no counts were conducted in Spring 2003), are shown in **Table 11**. Shown are spring season high (peak) counts for each year for the spring (northbound) migration period. Thirteen fall (southbound) seasons of Maurice River shorebird counts, 2000-2011 are shown in **Table 12** (as well as older counts done in 1988 and 1990; no counts were conducted in 2002). High (peak) counts are shown for each fall migration period. In Tables 11 and 12, **all-time peak seasonal shorebird counts** for the lower Maurice River study area are shown in **Bold face**.

In the twelve years of focused study, 34 species of shorebirds have been recorded on the Maurice River, some in small numbers and some in very high numbers. One additional subspecies has been recorded, the "Western Willet." Recorded on several occasions, the Western Willet breeds on the Great Plains, and is reportedly a candidate for "splitting" – that is, to gain full species status. Because of the ephemeral nature of shorebird migration, we make no attempt here to compare data from year to year, or to compute average numbers. With conservation goals in mind, we made every effort to survey when peak numbers for key species occur during their sometimes short seasonal stay on the Maurice River, yet truly hitting that

absolute peak is a challenge met with unknown success.

Tables 11 and 12 on a few occasions show unusual shorebirds that were known present on count day, but that were recorded by other reliable observers. Heislerville WMA and the Bivalve EEP site are now heavily birded in spring, and inevitably other rarer species have been seen by the multiple observers present. (In short, it is hard to search for a Curlew Sandpiper hidden among 15,000 other shorebirds, especially when you are tasked with accurately counting the 15,000 others!) Unusual shorebirds seen by other observers (but not recorded by the official point counts) are noted with an asterisk in prior individual seasonal reports. Finally, at least one additional shorebird species not shown in the tables is known to have once occurred on the lower Maurice River; a Spotted Redshank (a Eurasian shorebird) was well seen and photographed at Heislerville WMA on 27 March 1977 by Clay Sutton and Alfred Nicholson, a fond memory from a long time ago.

Two shorebird species are greatly under-reported in Tables 11 and 12, and for this reason, **Table 13** shows shorebird species sighted over the years during regular core winter raptor and waterfowl survey efforts. Wilson's Snipe is a very early migrant through our region (late February and March) and numbers peak long before the normal "spring" survey period. As many as 107 Wilson's Snipe have been counted on the Maurice River during winter raptor and waterfowl surveys (seen on 28 March 2006, 107 Wilson's Snipe is the second highest maxima "one spot total" ever recorded in New Jersey). Also note 75 Wilson's Snipe on 14 March 2002, and 51 on 20 March 2007. Likewise, American Woodcock is a numerous migrant through the South Jersey region in spring and particularly in fall. Nocturnal and secretive, this "upland" shorebird is rarely detected by standard survey techniques. Nonetheless, up to 14 American Woodcock have been counted during a winter raptor and waterfowl survey (28 December 2000) and 10 were counted on 12 February 2010, all pushed to roadsides by heavy snow cover. It is important to remember that these two shorebirds are also a key part of the Maurice River shorebird group.

Spring Shorebirds on the Lower Maurice River
Peak High Counts for Each Year: 2000 – 2012

	SPRING											
Year	**2000**	**2001**	**2002**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Number of Surveys	1	2	2	5	3	3	5	5	4	5	6	5
Black-bellied Plover	50	300	215	**860**	580	243	525	495	784	570	314	164
Am. Golden Plover	1			1					1	1		
Semipalmated Plover		3		468	3494	630	**5075**	2155	1045	1410	790	2000
Piping Plover											1	
Killdeer	5	9	3	**20**	6	7	13	7	6	4	5	10
Am. Oystercatcher				2	1	**4**	2	2	3	2		2
Black-necked Stilt							2		1			**4**
American Avocet									1			
Greater Yellowlegs	25	**815**	155	269	335	246	106	260	625	252	172	312
Lesser Yellowlegs	250	125	15	427	194	40	150	**575**	411	213	367	143
Solitary Sandpiper				1				1		1		**3**
Willet	10	25	12	36	53	38	24	53	55	64	30	**100**
"Western" Willet				1		1			1			
Spotted Sandpiper				1	3		6	**7**	1	3	2	3
Upland Sandpiper												
Whimbrel				1	1	1						
Hudsonian Godwit												
Marbled Godwit												5
Ruddy Turnstone				35	59	35	50	123	**192**	138	322	172
Red Knot				260	**625**	152	25	55	108	18	580	150
Sanderling				**450**	125	30	320	16	200	20	8	100
Semipalm.Sandpiper		20		6900	17965	5960	7700	14950	16587	**28050**	19950	11100
Western Sandpiper												1
Least Sandpiper				**932**	795	188	20	404	95	168	80	200
Wh-rump.Sandpiper				4	7	9	3	4	13	8	**26**	5
Pectoral Sandpiper				2		5		2	1	**6**		
Dunlin	10000	6300	1520	7800	4053	5336	13300	**14000**	7390	9840	12575	4400
Curlew Sandpiper						2	1	**3**	2	1	2	1
Stilt Sandpiper	2				2		2					**5**
Ruff	1	1		1				1		1		
Sht-billed Dowitcher		1500		1525	1619	2600	8900	**12334**	6400	4556	2900	2500
Lng-billed Dowitcher		1			1		1	1			1	
Wilson's Snipe			9	**18**	1	3	1		1		13	5
Am. Woodcock							1					2
Wilson's Phalarope				1	1					1		1
Red-neck. Phalarope									1		1	
unid. Shorebird					775		20000	8000	7000	2000	6200	2600
TOTAL Shorebirds	10344	7557	1917	11894	24968	11490	40929	**45487**	25735	30947	36101	19283

All-time seasonal high count for key species shown in **Bold Face**
No Count: Spring 2003

Fall Shorebirds on the Lower Maurice River
Peak High Counts for Each Year: 2000 – 2011

	FALL												
Year	**1988**	**1990**	**2000**	**2001**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Number of Surveys	*	*	5	5	6	4	5	6	5	5	4	5	5
Black-bellied Plover	50	28	**500**	500	291	252	375	279	69	428	150	136	47
Am. Golden Plover		1											
Semipalmated Plover		1	250	300	750	510	340	**1145**	526	490	422	318	210
Piping Plover													
Killdeer		15	4	6	24	3	10	5	3	**36**	2	10	2
Am. Oystercatcher			0	4	1		4	4					
Black-necked Stilt													
American Avocet				**2**	1					1	1		
Greater Yellowlegs	**500**	55	400	300	86	64	105	150	110	127	60	171	43
Lesser Yellowlegs	50	13	**200**	200	71	72	38	101	42	75	48	177	43
Solitary Sandpiper	1		**2**				1						1
Willet			2	6	**14**	**14**	13	2	3	4	1		5
"Western" Willet		1						**3**			1		
Spotted Sandpiper	1			1	**4**	1	2	2	3	1	3	2	1
Upland Sandpiper		1	1										
Whimbrel													
Hudsonian Godwit				3			1			1		3	
Marbled Godwit				2			1			**5**		1	
Ruddy Turnstone			20	**35**		8	9	12	2		6		
Red Knot			**15**	1	8				1				
Sanderling					1	32	5	106	**326**	49	1	8	
Semipalm.Sandpiper		100	**10000**	8500	6245	4020	5462	4351	2520	1686	4940	3605	9054
Western Sandpiper	10	10	20	5	25	**59**	32	5	14	4	1	2	3
Least Sandpiper		100		50	**300**	87	87	205	74	49	39	54	40
Wh-rump.Sandpiper			4	2	**25**	1	1		6		4	4	
Pectoral Sandpiper		4		2		7		1	2	**8**		1	1
Dunlin	1000	200	**12000**	10000	1810	3420	846	295	1100	2181	4365	6532	852
Curlew Sandpiper													
Stilt Sandpiper		2			3	1		**7**				1	
Ruff													
Sht-billed Dowitcher		3	2000	**3000**	624	1401	1770	1355	925	1077	625	1016	707
Lng-billed Dowitcher		**11**	**3**		1	2	1			2	2		
Wilson's Snipe	**25**				2			1	2			**3**	
Am. Woodcock													
Wilson's Phalarope													
Red-neck. Phalarope													
unid. Shorebird						2000			900	600	250	2000	
TOTAL Shorebirds	1637	545	**12632**	11407	6912	6279	7643	6794	5040	3574	6552	6880	10087

All-time seasonal high count for key species shown in **Bold Face**
***East Point Fall Hawkwatch: 1988, 1990** **No Count**: Fall 2002

Winter Shorebirds on the Maurice River
2001 – 2012

YEAR	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
Black-bellied Plover	**205**	11	18	15	4	17	42	23	8	2	8
Semipalmated Plover	**17**	2									
Killdeer	56	8	23	**86**	14	23	20	21	23	8	16
Am. Oystercatcher				**3**		1		3		2	
American Avocet								1			
Greater Yellowlegs	123	77	47	37	173	43	**152**	72	35	89	57
Lesser Yellowlegs	72	25	79	8	77	92	33	21	41	**110**	65
"Western" Willet								1	1		
Red Knot				1							
Sanderling	30	40	6		12		21	**51**			
Western Sandpiper	1			**4**		1	2	1			
Least Sandpiper	**78**										6
Pectoral Sandpiper		**6**			1				1		
Dunlin	**4340**	4050	1700	870	1350	1058	1310	1155	363	4030	1079
Stilt Sandpiper										1	
Short-billed Dowitcher	1							1			
Long-billed Dowitcher						1					
Wilson's Snipe	75	22	7	14	**107**	51	11	16	3	13	3
Am. Woodcock	1	5		1		3	1	1	**8**	1	

All-time peak seasonal count shown in **Bold Face**

Since the late 1970s it has been well known that the Delaware Bayshore hosts globally significant numbers of shorebirds in spring. It is also known that the Delaware Bay beaches near East Point support large numbers of shorebirds at that time, principally Red Knot, Sanderling, Ruddy Turnstone, Dunlin, and Semipalmated Sandpiper. Now, twelve years of focused and targeted spring shorebird counts on key lower Maurice River areas have documented large numbers of shorebirds using Maurice River mudflats and impoundments as well. Large numbers of Black-bellied Plover, Semipalmated Plover, Greater Yellowlegs, Lesser Yellowlegs, Semipalmated Sandpiper, Dunlin, and Short-billed Dowitcher are found each spring on the Maurice River, mixed between Heislerville WMA and Bivalve depending on the tide stage and resultant water levels. In addition, some mudflat-specialist shorebirds such as Least Sandpipers are found along much of the length of the tidal Maurice during the lower stages of the tide.

Because conservation, greater awareness, and recognition of Maurice River shorebird resources were the principal goals of these shorebird studies, every effort was made to maximize the limited time (the number of survey dates available), as well as find the best route that would allow counters to "work the tide" to find the true number of birds present.

As shorebirds move around a great deal in relation to tide and water depth, there was some concern with the possibility of double-counting, and on a number of occasions the observers backtracked to recheck numbers. For example, on 17 May 2007 an amazing 40,929 shorebirds were carefully counted -- by far a new record at that time for "total shorebirds" on the Maurice River. On that day the Heislerville WMA impoundments held over 17,000 shorebirds. We immediately went to Bivalve, where the EEP held 22,000 additional shorebirds (due to distance, haze, and heat waves, 20,000 of these were recorded as "unidentified shorebirds"). For clarification, we then immediately went back to Heislerville where 17,000 shorebirds were still present – eliminating the issue of possible double-counting due to shorebird movements in relation to the stage of the tide. These astounding numbers occurred on a day that we were truly able to "hit the peak" of shorebird spring migration staging. (It is important to again note that the now annual spring drawdown of Heislerville WMA's impoundments is highly beneficial to shorebirds. The Division of Fish and Wildlife should be highly commended for this enlightened management strategy).

Also on several occasions our counts were corroborated by researchers from the New Jersey Audubon Society (NJAS) in the area to study Semipalmated Sandpipers. For example, on 19 May 2010 we counted 17,489 shorebirds using our standard protocol. On the same day NJAS researcher Vince Elia had established 15,000+ shorebirds to be present, a remarkably similar count when dealing with such large (and mobile) numbers. Likewise, in 2008, when we estimated 45,487 shorebirds to be present, our all-time peak "total shorebird" count, Vince Elia said he strongly believed "at least 40,000" shorebirds were present.

There have been other days when counts were more difficult and problematical. At high tide on some days, many shorebirds depart Bivalve to fly to the drawn-down impoundments at Heislerville WMA to roost and feed. Conversely at low tide, many depart Heislerville to feed on Basket Flats, the beaches, and at Bivalve. On the day discussed above, that did not happen, but on a number of surveys we first counted Bivalve, then watched many shorebirds leave for Heislerville as water levels rose. On these days few if any additional shorebirds were added to the count at Heislerville WMA. Despite repeatable methodology, on some days numbers were,

to some degree, the observers' best guess at true numbers present. Nonetheless, we make every attempt to err on the side of caution, and often numbers recorded are conservative.

An additional reason to believe that numbers are largely conservative is based on the very size of the Bivalve Wetlands Restoration Site. At 4,171 acres, much of it is inaccessible, and vast areas of distant mudflats remain unseen by counters at the three point count sites. Perhaps hunting Peregrines may flush distant, previously unseen flocks so they might be counted in flight (as happened on the day recounted above), but short of this scenario, many birds often remain unseen and uncounted. We believe that the shorebird numbers reported herein are a reliable, yet conservative estimate of the shorebird numbers on the lower Maurice River. Such numbers are significant for the Delaware Bayshore, New Jersey, and the entire flyway.

DISCUSSION: FALL SHOREBIRDS ON THE MAURICE RIVER

While we have long recognized the value of Delaware Bay to shorebirds in spring, far less information was available regarding potential shorebird use in fall. Except for Delaware's remarkable refuges (Bombay Hook NWR, Little Creek WMA, Ted Harvey Conservation Area, etc.), in the recent past few associated the Delaware Bay with shorebird migration in fall.

Delaware Bay beaches receive relatively little use by shorebirds during fall migration. However, the mudflats and impoundments at Heislerville WMA and Bivalve see heavy use by migrant shorebirds during fall migration. We use the term "fall migration" for southbound shorebirds, even though most of the northern and Arctic breeders that pass through our area do so in July, August, and early September. (And while we say "relatively little use," it is important to note that, on occasion, bay beaches can be extensively used by southbound migrant shorebirds. For example, on 3 August 2010, Sutton counted over 2,000 shorebirds, mostly Semipalmated Sandpipers and Sanderling, on the beach at Reed's Beach in Cape May County – all feeding on Horseshoe Crab eggs and larvae made available by crabs that had nested during July's moon tides. Southbound shorebirds eat Horseshoe Crab eggs too!)

While 2000 and 2001 studies discovered considerable use and the potential for targeted surveys, from 2003 through 2011 focused efforts documented substantial use of the lower Maurice River by southbound shorebirds. While total shorebird numbers are nowhere near what they are in spring (plus Heislerville WMA was usually not drawn down for shorebirds in fall), shorebird use in fall is still highly significant for the region. Up to 12,632 shorebirds have been recorded (10 August 2000) on the lower Maurice River, numbers undocumented elsewhere on New Jersey's Delaware Bayshore. In New Jersey, only Forsythe NWR regularly reports higher fall shorebird numbers than those we have now documented for the lower Maurice River.

In a careful review of Table 12, it appears that in recent years fall shorebird numbers have dropped substantially from those recorded in 2000 and 2001, possibly calling into question the numbers estimated in those years. It is true that 2000 and 2001 saw exploratory surveys and were prior to current strict protocol; numbers were largely estimated rather than systematically counted (2000 and 2001 shorebird counts were ancillary and taken during raptor and waterfowl survey efforts). Data from 2003 to the present has been much more systematically gathered, with careful counts rather than any estimates. Yet it needs to be remembered that the Bivalve

Wetlands Restoration Site is not what it was in 2000. The area is growing up ("growing in") with *Spartina alterniflora*, and each year available mudflat area is substantially less than the prior year. This is particularly true in fall – following the growing season that has produced lush growth; this impacts not only the acreage of mudflats available to shorebirds, but also their visibility to observers – their detectability. A major goal of PSE&G management and mitigation efforts is fish production – not the creation of shorebird habitat. The goal of the wetlands management is for the area to largely fill in with *Spartina*, and this effort seems to be working. A similar picture has emerged in the past and elsewhere. The Thompson's Beach PSE&G site (Maurice River Township) a decade ago was prime shorebird mudflats, yet today has substantially filled in with *Spartina* and provides far less shorebird habitat. In the 1970s, nearby Moore's Beach was a prime shorebird-use area (and a birder's mecca), yet today virtually no mudflat remains as *Spartina* has totally reclaimed once vast mudflats. The point is, despite different survey protocols between 2000-2001 and today, we really believe that shorebird habitat and shorebird numbers have declined at Bivalve, an alarming trend that should be a focus point for shorebird managers.

All that said, 2011 finally did see a good count of over 10,000 shorebirds in fall, reasonably close to the 12,000+ recorded in 2000, and a count that somewhat corroborates the early findings. Also of note, in recent years the DFW managers have begun to draw down the one (back) impoundment at Heislerville WMA in mid-to-late summer through early fall as a shorebird management technique – a commendable practice highly beneficial to shorebirds, shorebird counts, and shorebird watchers.

Through time, Maurice River fall shorebird surveys have shown that the lower river supports regionally significant numbers and variety of shorebirds during their southbound migration, numbers that should compel recognition, protection efforts, and management priorities.

In summary, Citizens United-sponsored shorebird surveys on the Maurice River have documented substantial and significant shorebird use in both spring and fall. Twelve years of point counts during both spring (northbound) and thirteen in fall (southbound) shorebird migration have shown the lower Maurice River – particularly the East Point, Heislerville WMA, and Bivalve Wetlands Restoration Site – to host large numbers and a wide variety of shorebirds. Importantly, studies have shown that Delaware Bay shorebirds use far more area and habitat than the beaches and flats at the edge of the bay. Large numbers occur on natural mudflats (Basket Flats), in tidal impoundments, and even on the intertidal banks and mudflats of the river itself.

These CU-sponsored ten years of shorebird counts augment DFW ENSP aerial censuses of the Delaware Bayshore and further substantiate the need to protect the resources of the lower Maurice River. The presence of such numbers of migratory shorebirds on the river's mudflats and tidal impoundments should call for management of resources and habitats that will promote the long-term protection and conservation of these long-distance migrants. Migratory shorebirds are one more among many documented and proven ornithological highlights of the Maurice River, and brightly colored, restless, feeding shorebirds by the thousands are yet one more reason that the Maurice River is a very special place indeed.

A final note is the large number of birders (ecotourists) who are coming to the Delaware Bayshore region, and particularly the lower Maurice River to view the migratory shorebirds

gathered there. Places such as East Point, Heislerville WMA, and Bivalve have become a definitive birding destination in spring, visited by dozens of birders daily and by hundreds on weekends at the peak of the shorebird season. Such coverage leads to many discoveries and many "good birds." It is simply fact (and not overstatement) to say that Heislerville WMA has become THE best and most reliable place to see Curlew Sandpiper (a Eurasian species that is very rare anywhere in the New World) in all of North America, with up to 3 individuals recorded each spring from 2006 through 2012. Indeed, birders have come from all over North America to enjoy the lower Maurice River and Delaware Bayshore at their finest – teeming with shorebirds on their way to or from the high Arctic breeding grounds. The Maurice River is an important way station on that journey.

SUPPLEMENTAL AND EXPANDED STUDIES

COMPARISONS TO OTHER RIVERS

During the fourth season of winter studies on the Maurice River (1990-1991), a similar, yet unrelated investigation was begun on another tidal Delaware Bayshore river, the Cohansey River, that flows west and south below Bridgeton, NJ. In that season, a winter raptor and waterfowl study was carried out by Sutton for the environmental group Citizens Allied for River Protection (CARP). Following this one season of funded studies, Sutton decided to keep this Cohansey project going as an adjunct to the on-going Maurice River long-term studies.

While not an original goal of the CARP project, the Cohansey River effort provided an excellent comparison for Maurice River data. To put the Maurice River findings and results into perspective, it was deemed important to have a comparison river – to be able to compare and contrast a somewhat similar Bayshore tidal river on both a yearly/seasonal basis, as well as over the long-term. Maurice River resources can best be evaluated and understood when reviewed in light of known values on other similar rivers. Having data on a "comparison river" gave Maurice River researchers a known set of findings by which to judge each season's results. While not a baseline *per se*, findings on the Cohansey can strongly assist in putting Maurice River results into a regional perspective. It can help to know if numbers attained, be they high or low, are unique to the Maurice, or whether they depict a region-wide phenomenon. As a theoretical example, in a given winter, are Black Duck numbers down throughout the region, or just on the Maurice River? And not to mention, are Maurice Black Duck numbers truly exceptional region-wide and in comparison to other tidal rivers on the Delaware Bayshore?

To this end, the Cohansey River has now been monitored as an adjunct to the Maurice River studies for 22 winter seasons, from 1990 to the present, for a total of 64 times, yielding an average of about three surveys per winter season. While this rate is far less than the average 9.4 surveys per winter on the Maurice, it does meet the goal of putting Maurice River findings into perspective, even if comparisons are imperfect due only to the lesser frequency of the Cohansey monitoring.

The Cohansey River protocol was carefully designed to allow comparisons, and is therefore remarkably similar to that employed on the Maurice: 9 point counts are conducted for approximately 45 minutes apiece on the 13.5 mile (Maurice = 14.4 mile) tidal portion of the Cohansey from Route 49 in Bridgeton south to Tindall's Island near Cohansey Point on the Delaware Bay. Over the 21 year period following the single season of CARP-funded study, all Cohansey counts have been conducted by Clay Sutton with Pat Sutton as the second observer. All counts have been carried out *pro bono* by the Suttons at no cost to Citizens United, and should be considered as CU volunteer hours.

The Cohansey River findings, while having been included in each Maurice River yearly report for comparison and contrast, will not be presented or analyzed here. They will be explored in-depth and in relation to the Maurice River findings over time at a later date and in a different venue. Likewise, recent comparative explorations on the Salem River, carried out by the Suttons on 18 sampling dates over the last eight winter seasons, will also be included in an eventual paper comparing and contrasting *all* South Jersey river systems for winter raptors and waterfowl (including the Atlantic-side Tuckahoe, Great Egg Harbor, and Mullica Rivers as well). Suffice it to say here only that Cohansey River raptor concentrations and densities are remarkably similar to those documented for the Maurice; that ducks are found in far fewer numbers; and geese are found in far greater numbers on the Cohansey (a river surrounded by far more agricultural land) than on the Maurice River.

The point is that we have made a substantial effort to not only study the Cohansey River in its own right, but to design an on-going and long-term study that will offer an informed regional comparison and perspective for the findings of the 25-year Maurice River studies. After 64 Cohansey surveys over a 22 year period, we can now put the exceptional Maurice River into perspective, and judge its avian resources not in a vacuum, but in relation to proven values for another remarkably similar and viable Delaware Bayshore river system.

Maurice River raptors and waterfowl have now been systematically studied and reported on for twenty-five years, from December 1987 through June 2012. Beginning in 2003 survey efforts were expanded into a year-round study of raptors and all waterbirds and shorebirds, yet core winter studies, including coverage and methodology, remain unchanged and are ongoing.

Major analyses have now been carried out at the 10-year mark, the 15-year mark, the 20-year mark, and now with this report, at the 25-year milestone as well. At the conclusion of the twenty-fifth season, major reviews and analyses were performed on this entire body of work to establish the significance of observed status and trends of Maurice River raptors and waterfowl populations. While this report looks primarily at status and trends, many other possibilities remain in regards to data analysis. Simple yet relevant trend lines have been generated for key species, but statistical validation of these trends remains to be carried out. It is hoped that CU might find a partner to create those statistical tests that will further confirm and corroborate the observed and presented trends, taking the analyses and proof to a higher level than we have currently presented.

Many other possibilities for data review remain and have been alluded to. We have frequently mentioned 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 temperatures (as well as snow and ice cover both on the immediate Maurice and to our north). Over the twenty-five 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 Maurice 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 Maurice River for each of the 25 years of study. This could go a long way in answering the questions as to whether duck population changes on the Maurice 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 report was in very the final stages of preparation, Hurricane/Superstorm Sandy devastated the Delaware Bayshore on 29 October 2012. Record tidal flooding, and unprecedented damage and destruction resulted here as in much of the Northeast. At this time, the impacts of Sandy on birds is unknown, yet The Natural Lands Trust's field biologist Brian Johnson reported finding hundreds of dead meadow voles and rice rats (drowned from the flooding) in wrack lines soon after the storm. It was suspected that low raptor numbers in winter 2011-2012 were due to a similar die-off of rodent prey following Hurricane Irene, and it is postulated that Sandy may lead to unprecedented low raptor numbers in winter 2012-2013. In addition, Sandy devastated key Maurice River wildlife areas such as East Point, Bivalve, and particularly Heislerville WMA, where flooding destroyed the dikes and wildlife drive. Here as

well, both short-term and long-term impacts to wildlife remain to be discovered. It remains to be seen what the lasting impacts of Sandy might be on Bayshore wildlife resources, but it is studies such as these that will provide insight.

Against such a backdrop of frequent and severe storms, as well as widespread and frequent drought, it is studies such as these on the Maurice 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. As this report is written, 2012 is expected to be the hottest on record ever in the Northeast. 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 suspect in the low 2011-2012 raptor numbers on the Maurice). In short, climate change and sea level rise are presenting a matrix of possible scenarios and interactions of various factors. It can not be gainsaid that the availability of these long-term raptor and waterbird studies on the Maurice River might be a key piece of this matrix of causes and effects, and recent weather events underscore the importance of maintaining such studies over time.

The potential statistical analyses mentioned above, as well as any future analytical needs that arise due to changing times, remain possibilities should partnerships and funding become available. Yet one major recommendation has already been realized: that these twenty-five years of studies are so unique in southern New Jersey and in the Delaware Estuary region that they cannot be allowed to end. A commitment has been made by Citizens United to stretch these twenty-five years of studies to twenty-six years and beyond.

Twenty-five years of ongoing and systematic long-term studies on the Maurice River have discovered and documented regionally significant and extraordinary numbers and diversity of raptors and waterfowl. The length of this study period has 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 Delaware Bayshore region and take on even greater consequence as land-use changes continue, and are predicted to accelerate, in the Maurice 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 twenty-five summary report, this goal has been substantially met. Not only have these studies yielded significant insight on status and trends, they have also been used by CU in numerous key awareness activities and advocacy efforts, including recommendations in the RTE listing process, oil spill protection, prioritization of conservation purchases, testimony in land use proceedings, and in wildlife management decision-making processes. Perhaps most importantly, these studies played an important role in the National Park Service Wild and Scenic River designation for the Maurice River. Finally, the results of these studies have been a constant part of the vast matrix of information provided by CU in their praiseworthy, extensive, and far-reaching educational efforts on many levels.

While these twenty-five 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 and satellite telemetry and geolocator tracking), this ongoing and systematic survey effort is one of the few long-term ornithological studies being carried out in the entire Delaware

Estuary. It is one of the most accessible, available, and widely distributed, and has proven to be a valuable tool in the determination of status and trends – and subsequent protection -- of the avian resources of the Maurice 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 Maurice River, twenty-five years of intensive study has now taken our perceptions of status and trends from "suspected" to the realm of documented and proven. An amazing 234 individual winter surveys (and 241 additional expanded season surveys) 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 Maurice River 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 Delaware Bayshore or elsewhere in New Jersey can today offer such solid proof of its environmental quality as can the Maurice River. Citizens United, 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, CU can be proud, and we as the "field team" and the authors of this report, continue to be privileged and very proud to be a part of this effort.

I will close with a personal reflection on these past twenty-five years, as well as with a thought on the immediate and sometimes stark present. At the beginning of the twenty-third season of this study, and as I was already beginning to prepare the summary charts for this twenty-five year report, *The New York Times* featured an editorial (on 31 March 2009) after Ken Salazar, the Secretary of the Interior, released a new nationwide survey assessing the state of bird populations in America. It is reproduced below:

> *Ken Salazar, the Secretary of the Interior, released a new, nationwide survey last month that assesses the state of bird populations in America. The news is grievous. Over all, a third of the bird species in this country are endangered, threatened, or in serious decline. There is special concern for grassland birds – whose habitat has been vanishing steadily for decades – for birds in Hawaii, where a variety of species face a variety of threats, and for coastal species. The good news is that wherever nature is allowed to recover, especially in the case of wetland birds, it shows its usual resilience.*
>
> *But there is no glossing over these staggering losses, and there is no dismissing what they*

mean. There is nothing accidental or inevitable about the vanishing of these birds. However unintentional, it is the direct result of human activity – of development, of global warming, of air and water pollution and of our failure to set aside the habitat these birds need to flourish. Every threatened species reveals some aspect of our lives that could be adjusted.

The survey also shows that where humans have made an effort – as with migratory waterfowl and with endangered species like the Peregrine Falcon – good things have happened, with some species recovering even as others declined. This in turn argues that the programs now in place to protect habitat should not only be spared the budgetary wrecking ball but also expanded – most conspicuously those managed by the Agriculture Department that seek to preserve wetlands and prairie grasslands as well as the Interior Department's Land and Water Conservation Fund.

The remarkable recovery of ducks and geese and other wetland species – thanks to strong conservation efforts – should remind us of what is possible. The only other outcome is too grim to consider – a landscape steadily emptying of birds.

The incomparable Maurice River, one of "Down Jersey's" finest jewels, embodies so much of what Ken Salazar spoke. Human activity has brought change – land use changes that have brought drastic changes to our bird life. We have seen loss, such as the grassland guild including Northern Bobwhite and American Kestrel, and declines of a number of duck species. But we have also seen dramatic recovery and gains – in Wild Turkey, Osprey, Peregrine Falcon, and Bald Eagle. The gains temper the losses perhaps; as the great Roger Tory Peterson once said, "It is as if we are balancing a ledger, with the losses of some species offset by the gains in others." But perhaps the greatest and best thing we see in and on the Maurice River is the evidence of what is possible in the protection of birds and so much more. And with that evidence, and example, comes hope.

The Maurice River may have been "recently" studied for over twenty-five years, but the interest of naturalists in its wonders goes much farther back, as evidenced by Dallas Lore Sharp's record of the Garron's Neck Bald Eagle nest that dates to 1911 (see page 8). Amazingly, the great eagle's nest still towers over the marsh at the edge of Garron's Neck Swamp, as it has for over one-hundred years. It may not be the exact same nest of which Dallas Lore Sharp wrote in 1911, but as near as we can tell, it is in virtually the same location.

Although this historical nest was not active at the time (with the sole surviving pair of Bald Eagles in New Jersey then found in Cumberland County's Bear Swamp), I well remember a remnant vacant eagle nest there (near where it stands today) from my first-ever visit to Garron's Neck with naturalist, friend, and mentor Al Nicholson some thirty-seven years ago. Vacant into the mid-1980s, it was first reclaimed by Osprey, and then usurped by Bald Eagles. The great nest was eventually too much for the long dead tree; during a violent storm and 60 knot winds the tree snapped off and the nest fell early in 2007. It seemed to be the end of a long era, yet unexpectedly (even with the strong Bald Eagle recovery and comeback) by 2010 another sentinel pine held yet another great eagle nest at Garron's Neck – one of many marvelous eagle nests today in the incomparable Maurice River system.

The Bald Eagles, a full century later, again rule Garron's Neck Swamp and the wondrous Maurice River. Legions of Osprey join them in another comeback that seems to be nothing short of a miracle, and another of many miracles in which Citizens United has played a very major and admirable role.

– Clay Sutton
October 2012

We thank all those friends of the Maurice River for their encouragement and support during this long-term project. We thank Pat Sutton for her long-time generous assistance with data charts and report writing, and we thank Lillian Armstrong of CU for her help with so many aspects of the project – in both the print and electronic forms. We thank Josh Nemeth and Dr. Dennis Allen for insight and assistance with the data review and trend analyses.

We thank Michael O'Brien, Carole Brown, Diane Jones, Pam Higginbotham, Deb Dowdell, Doyle Dowdell, and Pat Sutton for companionship and assistance in the field on a number of surveys. We heartily thank Karen and Brian Johnson for sharing so many Maurice River sightings with us, and for showing such great interest in the study. So too Janet Crawford, Dave Lord, Sandra Keller, Tony Klock, Jim Watson, Tom Reed, Vince Elia, Pete Dunne, Steve Eisenhauer, Steve Glynn, Bob Barber, Karen Williams, and Paul Kosten have shared so much support, interest, and so many Cumberland sightings over so many years. Thank you all; your enthusiasm and love of the river and its birds are infectious.

Leslie and Tony Ficcaglia have provided encouragement, logistical support, and have shared many interesting sightings and offered considerable insight on both Maurice River resources and conservation challenges. Our days on the water are favorite memories. Clay Sutton remembers and thanks too the late Al Nicholson, who first introduced him to the wonders of the Maurice way back in 1974. Al's mentoring -- on both birds and conservation advocacy -- is a large factor in this project coming about, not to mention his kindling of an excitement about the Maurice and the Bayshore that remain undiminished for Clay even after nearly 40 years afield in the region.

The first ten years of this twenty-five year study were conducted while Sutton and Dowdell worked for Herpetological Associates, Inc., Plant and Wildlife Consultants (HA), and the project was carried out as a Citizen's United contract with HA. We sincerely thank Bob Zappalorti, Founder and President of HA, for his gracious support of this project -- interest that often went far beyond budgetary constraints and contract requirements. New Jersey Audubon's Cape May Bird Observatory co-sponsored the East Point hawk migration study, and we thank then-Director Paul Kerlinger and Chris Schultz for their efforts, assistance, and support.

We sincerely thank *all* of the officers and members of Citizens United to Protect the Maurice River and its Tributaries for their interest, support, and great enthusiasm for these long-term studies. The conservation goals of the project would remain unmet were it not for all the yeoman efforts of so many CU people in so many ways. You have brought the study to fruition. We particularly thank Jane Galetto for her advocacy for the project, and for her knowledge and assistance in the planning and preparation for the field work. We had some fun in the field too! Thanks you, Jane, for nurturing a tiny idea into a landmark and ongoing long-term study, and thanks for your always friendly encouragement and optimistic outlook. Keep up all of your good work on the Maurice River.

Finally, we whole-heartedly thank the U.S. Department of the Interior National Park Service Wild and Scenic Rivers Program for their assistance to Citizens United. The award of ongoing Wild and Scenic River Partnership Grants has enabled these surveys to be conducted and reports compiled. A special thank you goes out to the NPS for your vision of a wild and scenic Maurice River and Delaware Bayshore.

It was a pleasure and privilege working with all of you -- those named above and those many individuals named (and unnamed!) in the acknowledgements found in previous seasonal reports -- on this important study aimed at keeping the Maurice River healthy, protected, and available to the myriad of birds and other wildlife so dependent upon it. We look forward to continuing studies with great anticipation, and we look forward to seeing you all in the field. Thank you.

– Clay Sutton and James Dowdell

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CLAY SUTTON 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 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 previously authored *Birding Cumberland: A Complete Guide to Birds and Birding in Cumberland County*, which was co-sponsored by CU Maurice River and Cumberland County.

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. For many years he was part of the DFGW team that conducted Delaware Bay aerial shorebird censuses in spring. He 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 fifty states, bringing deep perspective and skill to the Maurice River studies. Jim and his wife Deb formerly owned the popular natural history shop "For the Birds" in Cape May.

All comparative Maurice River ornithological studies discussed and / or referenced in this report have been directed and co-authored by Clay Sutton, either as an independent contractor or formerly (prior to 1996) 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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