Gray Ghosts: The Relative Occurrence of Adult Males Among Northern Harriers Wintering on Southern New Jersey Tidal Rivers

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Introduction

Northern Harrier (*Circus hudsonicus*) is a hallmark raptor of New Jersey's Delaware Bayshore marshes and nearby uplands. The male of the species, known as the "Gray Ghost" (the sobriquet often fondly used for the distinctive adult male), is one of the most anticipated and appreciated hawks at hawk migration sites or on winter outings in and around the Delaware Valley. Beyond its unique and dramatic plumage, a big part of its appeal is its mysterious relative scarcity in the overall harrier population. The perceived infrequency of adult males only adds to both its mystique and our delight whenever an iconic Gray Ghost graces a hawkwatch or a somber winter marsh.

But just how rare is the Gray Ghost in relation to the broader population? The paucity of adult males has often raised questions in my experiences as both a naturalist field trip leader and as a wildlife biologist. There is no simple answer, since the infrequent status of adult males likely has many causal factors. The most popular explanation is that there are fewer males in the population because the Northern Harrier is polygynous (like many harrier species worldwide), with a single male often not only mating with but also provisioning several females and broods (Watson 1977, Simmons 2000). But the idea that widespread polygyny results from a skewed sex ratio has largely been discounted, as female-biased sex ratios in eggs and fledglings are rarely seen and are therefore not the prime reason for polygyny (Simmons et al. 1986). The well-known polygyny may relate to another factor at work in the less frequent sightings of adult males: having more numerous mates, their home territories are frequently much larger than those of females, as the males hunt far more widely for food. Having far larger territories, and therefore distributed perhaps farther away from birders' favored observation points, may well translate to fewer sightings.

There are other factors at play, too. The perception of the infrequency of males is partly based on comparing how many adult males one sees relative to total harrier sightings. Most harriers seen are "brown birds," and few birders or field biologists attempt to separate young (brown) harriers from adult females (also brown). While a close or lengthy sighting may allow this, most field situations and distances do not lend themselves to this key differentiation (Dunne et al. 2012). The point is that there may in fact be as many or as few adult females encountered (but not recognized) on a given day as adult males. And regarding the sex ratio, remember that young males are "brown" harriers too, usually going unsexed and thereby adding to our perception that there are fewer males in the population.

Harriers are hawks of the marshes and grasslands (Hamerstrom 1986), and with many farms and grasslands vanishing regionally, today, most harriers seen in the Delaware Valley are recorded at coastal hawkwatches and on saltwater tidal wetlands in winter. As with many species of raptors, a large percentage of coastal migrant raptors are immatures. While there have been some attempts at some hawkwatch sites to differentiate and record harrier age and sex, this has been intermittent and largely unreported. But, anecdotally, most coastal migrants are young birds of the year, with adult females and adult males being a very small part of the totals. Autumn migration both routes and stages wintering populations of raptors particularly on New Jersey's Delaware Bayshore (Sutton and Kerlinger 1997), so it is no leap to assume that most coastal harriers found in winter are immatures as well.

The behavior of adult males during migration is an additional anecdotal factor affecting their perceived paucity. Young harriers, while indeed often migrating quite high, are probably more likely to fly low to allow for opportunistic hunting during their migratory

flight. Young raptors of all species are less successful hunters than experienced adults and therefore more likely to be in need of successful prey capture. I have particularly noted that adult males (with less need to hunt) seem to be more prone to high or very high migratory flight over Cape May Point, New Jersey. This may be true with adult females as well, but here again, they are mostly inseparable from brown immatures at high altitudes. The takeaway here is that some or many adult male migrant harriers may remain unseen to the casual observer due to the altitude they frequently select. Associated with this, at Cape May Point, many adult male harriers migrate very late in the fall (Amesbury 2022) near the end of the hawkwatch season or even beyond (Tom Reed 2022, pers. comm.) when few birders are there to see them — again adding to the perception of fewer males. In my experience, a late-season migrant harrier is much more likely to be an adult.

In my experience over many years, adult male harriers are much more secretive than immatures. Especially during nesting season, they remain inconspicuous and even reticent to fly when an observer is present (Dunne 1995, Pete Dunne 2012, pers. comm.). As a photographer, I can almost count on my fingers the number of times an adult male has come truly "close" for photography, compared to almost daily encounters with immatures. Not only do adult males keep their distance, but they are more accomplished hunters and therefore hunt less often, and both of these factors may add to the perception that there are fewer adult males and that they are less common.

While much of the above is speculation, a final and more tangible aspect of adult male scarcity is that male and female harriers classically partition their prey resources (MacWhirter and Bildstein 1996). Larger and stockier females mostly hunt small mammals. In the Delaware Valley, this includes mice, meadow voles, rice rats, shrews, and juvenile (smaller) muskrats. Being smaller, rangier, and apparently more agile, males are bird specialists far more than females, though they certainly do take small mammals. Therefore, they are more frequently seen in upland fields and weedy habitats that are inland and away from the salt marsh, since those areas hold more (and more easily accessible) small birds. Anecdotally, but based on many years afield, I find that inland and upland harriers are much more likely to be males than are those seen in New Jersey's Atlantic coastal and Delaware's bayshore marshes. So, birders seeing few adult male harriers in winter may also be because they are much more likely to be birding more productive coastal wetland habitats frequented by female harriers.

The "Gray Ghost," the iconic adult male Northern Harrier, is a welcome and memorable sighting on any field trip in the Delaware Valley. © 2015 Clay Sutton

Methods

Now, even though relevant issues are raised, the introductory speculation and informal discussion do not address the specific question of the true relative occurrence of adult males among Northern Harriers wintering in the Delaware Valley region. While I cannot address the entire region (including inland and upland areas), as an adjunct to larger studies of wintering raptor and waterfowl populations on southern New Jersey river systems, I kept track of adult male Northern Harrier sightings in relation to total harrier sightings beginning in December 1987 and continuing through March 2022.

A systematic study sponsored by Citizens United to Protect the Maurice River in response to proposed land-use changes and potential threats to the river was launched during the winter of 1987–1988 and con-

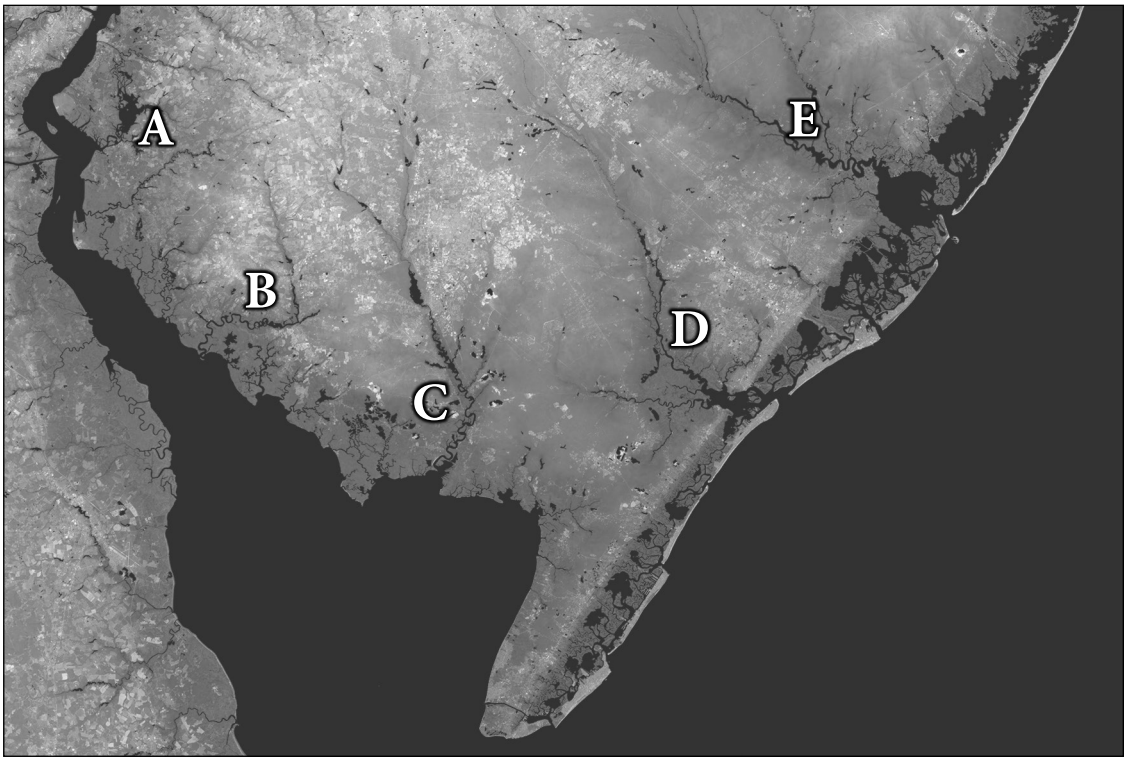

FIGURE 1. Five major tidal rivers in southern New Jersey were surveyed: Salem River (**A**), Cohansey River (**B**), Maurice River (**C**), Great Egg Harbor River (**D**), and Mullica River (**E**). Map data © 2024 OpenStreetMap and TessaDEM

tinued through 2021–2022 to establish baseline data on raptor and waterfowl presence. For this 35-year period (35 winter seasons), data were gathered at nine established point count sites in the tidal Maurice River watershed. Raptors and waterfowl were censused at a frequency of every 10 to 14 days from the first week of December through the last week of March in order to assess winter (and spring staging) populations, as well as distribution of all raptors and waterfowl. In order to address the goals of discovery, documentation, conservation, and protection, efforts were made to obtain information that (over time) could be used to determine the status and trends in avian populations and habitat use. In the winter of 1990–1991, a similar survey was begun on the Cohansey River not only to provide comparisons that would put Maurice River findings into a regional perspective but also to document the rich avian resources of a similar and similarly threatened river. The Cohansey River was studied over 30 years, from 1990 to 2022, and substantial yet differing avian populations were discovered.

Given the Maurice River findings and resultant fact-based conservation successes, a similar effort was initiated by the Great Egg Harbor Watershed Association to establish baseline data on winter raptor and waterfowl use of the lower Great Egg Harbor River. This systematic study began during the winter of 2003–2004 and continued for ten years through winter 2012–2013. The design, protocols, and methodology were identical to those used on the Maurice and Cohansey Rivers, and significant bird use of the Great Egg Harbor River system was found. As an adjunct to the Great Egg study, comparative studies were conducted on the Mullica River for nine winter seasons from 2004 through 2013. Initially designed to offer a regional perspective on the Great Egg findings, Mullica River methods were identical. Finally, in 2004 and continuing for nine seasons until 2013, similar survey efforts were begun on the Salem River in order to "complete the picture" in our understanding of all five of southern New Jersey's major tidal rivers (Fig. 1). Yet again, the design and protocols were exactly the same

as the other river studies, allowing the findings from all rivers to be confidently compared.

Although the length of the tidal portions of the rivers differed (as did width and acreage), the methodology was the same for all rivers. Nine point counts were established on each river to allow all sections and the complete length of the tidal rivers to be monitored. Two observers counted raptors and waterfowl concurrently for 45 minutes at each site. I was the principal observer on nearly 98% of all surveys; Jim Dowdell was the second observer on approximately 82%. Using the same observers on all five rivers in all years yielded exceptional consistency of technique and comparability of data.

While all raptors (and waterfowl) were counted, and many were aged and sexed in an effort to avoid any double counting, a focused effort was made to record all male harriers. While it is possible that a few adult males were missed due to distance and/or lighting, their distinctive white ventral and gray dorsal plumage allowed us to record them sometimes even at great distances. Early on, we also attempted to record adult females whenever possible but soon learned that real-world distance and lighting rarely allowed us to confidently ascertain the age of brown harriers with any frequency, and this effort was soon abandoned.

Findings

As an adjunct to wider studies, adult male Northern Harriers were recorded on the five major South Jersey tidal river wetlands for 35 winter seasons beginning in winter 1987–1988 and continuing through winter 2021–2022. The methodology was identical on all rivers and all surveys, but effort varied by river. Adult male Northern Harriers were tallied as a subset number of all harrier sightings on all rivers. The results of this effort are shown in Table 1. Five hundred sixty-eight surveys on all rivers yielded 11,786 Northern Harrier sightings, of which 593 (5.03% of all harriers) were adult males. The differing percentages for each river are also shown in Table 1.

The results of the wider studies on the status and trends of raptors and waterfowl on South Jersey Rivers have been reported elsewhere, but substantial avian eco-values were discovered and documented for all river systems (Sutton et al. 2015). The length of these long-term studies, particularly for the Maurice and Cohansey Delaware Bay tributaries, allowed for significant trends to be discovered and reported (Sutton and Dowdell 2012). Harrier numbers have declined significantly on the Maurice River showing a 26.43% decrease in the 35 years of study, particularly and precipitously in the eleven winter seasons following Hurricane Irene in August 2011 and Superstorm

Table 1. Percentage Occurrence of Adult Males Among Northern Harriers Wintering on Southern New Jersey Tidal Rivers

RIVER	LENGTH OF SURVEY ROUTE	YEARS	NUMBER OF WINTER SEASONS	NUMBER OF SURVEYS	HARRIER SIGHTINGS	ADULT MALE SIGHTINGS	% ADULT MALES
Maurice	14.4 miles	1987–2022	35	341	6474	292	4.51
Cohansey	13.5 miles	1990–2022	32	85	1479	108	7.30
Salem	11.4 miles	2004–2013	9	19	317	29	9.15
Great Egg Harbor	12.6 miles	2003–2013	10	81	2124	113	5.32
Mullica	15.6 miles	2004–2013	9	42	1392	51	3.66
All rivers/ All years				568	11786	593	5.03

Note: While the length of the survey routes varied, protocols were the same for all five river systems: nine point counts sampled for 45 minutes each.

Sandy in October 2012 (Sutton and Dowdell 2018). We hypothesize that this significant harrier decline is linked to the severe flooding from both these and continuing storms, frequent tidal flooding due to ongoing and accelerating sea-level rise, and the resultant substantial loss of marsh rodents as prey for harriers (through initial storm deaths by drowning, and subsequent population decline due to inability to recover). The loss of high marsh habitat and continuing widespread severe *Phragmites* encroachment are also thought to be factors affecting harriers. We have documented and continue to monitor this disturbing decline in harriers but due to the small sample size and confounding variables we have not yet examined whether this has affected the ratio of adult male harriers to total harriers.

Discussion

This study has investigated the number of Northern Harriers and the percentage of adult male harriers that winter on South Jersey tidal rivers. Proving the regional scarcity of adult males, 568 surveys on all rivers produced 593 adult male sightings for an average of only 1.04 per field day. This compares to 20.75 total harriers per field day for all South Jersey rivers combined. Overall, 5.03% of harriers on the five rivers in winter are adult males. This varies from a high of 9.15% adult males on the Salem River to a low of 3.66% adult males on the Mullica River, a difference possibly due to habitat preference.

There are substantial clues in the life history of the Northern Harrier that may in part explain why so few adult males are seen in the South Jersey tidal river wintering populations. Despite the well-known polygyny of the Northern Harrier and many harrier species worldwide, little difference is seen in the sex ratio of eggs and nestlings. Survival to adulthood could be a factor and it is possible that the males' selection of more upland and inland habitats could place them at greater risk due to urbanization, roads, and industrial farming with its associated habitat conversion, pesticides, and herbicides. Differential migration is also known, with adults more often taking inland routes and young birds taking coastal routes (Bildstein et al. 1984), but it is quite possible that adult males are also selecting different wintering areas.

Migratory ratios for South Jersey are partially known. Of 415 captures of fall migration Northern Harriers at the Cape May Point Raptor Banding Project from 1971 to 1980, 218 (53%) were juvenile males, 137 (33%) were juvenile females, 31 (7%) were adult males, and 29 (7%) were adult females (Bildstein et al. 1984). Such data partly confirm the coastal route proclivities of many young hawks but also point to the possibility that adult birds are usually better fed (less hungry), far more wary than juveniles, and therefore less likely to be trapped at a banding station. Notable was the nearly 50/50 ratio of adult males to adult females. Because males hunt birds to a far greater degree than females, banding technique may introduce bias here, since the banding stations use birds instead of mammals for lures. Therefore, females are less likely to be attracted to the offerings. Thus, it would be unwise to apply such known banding station ratios to wider migratory or wintering scenarios.

To some degree, previous studies and these discussions indicate a number of "missing" adult male harriers. But I believe that with the differing ratios found among and between the South Jersey river systems, therein lies a clue. The literature clearly suggests that male harriers, due to structure and size, more often select avian prey and, due to this preference, they are likely to select hunting habitats that differ from females'. The five South Jersey rivers studied are alike in some ways but differ in others. While a determination of actual habitat types and acreages was beyond the scope of this study, there are habitat differences that could explain the disparity in adult male percentages. All the rivers have extensive tidal salt marsh, but of the two rivers studied most extensively (the Maurice and the Cohansey), the Cohansey River study area also contains extensive agricultural acreage and the many upland fields of the expansive Dix Wildlife Management Area (WMA). The Maurice River has good wetlands and salt marsh habitat but comparatively little or no adjacent or nearby farmland or fields. The 7.30% of adult male harriers is a likely reflection of the upland field acreage of the Cohansey region, and the Maurice River's 4.51% may well reflect the substantially more wooded forest habitat along the banks of the wetlands.

Among the other rivers, the Salem River showed the highest percentage of adult male harriers, 9.15%,

and of all the rivers, the Salem River study area is by far the most rural and contains far greater acreage of upland agricultural habitats, including dairy farms and hay fields. On the Atlantic side of New Jersey, the Mullica River, with the lowest percentage of adult males at 3.66%, has the most salt marsh but clearly the least farmlands/agricultural acreage of any of the rivers. The Mullica River region, away from the riparian tidal wetlands, is largely Pine Barrens forest. Finally, the Great Egg Harbor, with 5.32% adult males, represents a somewhat middle ground, with considerable salt marsh but some remnant agricultural uplands and the Tuckahoe/Corbin City WMAs. Short of the effort and resources required to map the acreage of the various habitats of the five river systems, I believe a general overview of the differing land use explains the disparity in adult male presence and use. While it would be good to have similar comparative studies of other areas in the Delaware Valley and the Delmarva Peninsula to further expand our understanding of adult male Northern Harrier habitat selection and preferences, it can still be said with some confidence that where one looks is critical to how many Gray Ghosts may be seen.

These systematic studies are continuing (on a reduced schedule) on the Maurice and Cohansey Rivers, and it will be interesting to see, in time, if sea level rise continues not only to adversely impact harrier numbers but also impact age and sex ratios. Unfortunately, these habitats are not only changing due to sea level rise but also on all rivers due to the conversion of cropland, dairy farms, pastures, and hayfields to ubiquitous orchards and ornamental nurseries — habitats that are comparatively sterile and far less attractive to harriers. Such confounding variables limit our ability to determine the principal causes and effects of declining harrier numbers (Sutton and Kerlinger 2025, in preparation). Nevertheless, they lead us to think that we are seeing an array of issues that do not bode well for wintering Northern Harriers in the Delaware Bayshore and Atlantic Coast regions.

Acknowledgments

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