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## **Survival, Nest Success and Productivity of Female Common Eiders (*Somateria mollissima dresseri*) on Flag Island, Harspswell, Casco Bay, Maine**

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**Survival, nest success and productivity of female common eiders (*Somateria mollissima dresseri*) on Flag Island, Harspswell, Casco Bay, Maine.**



**Final Report 2003-2008**

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This final report was prepared by Brad Allen, Anthony Tur and D. McAuley. K. Sarah Fleming provided significant contributions to some sections.

### **Executive Summary**

In 2008, we concluded the 6<sup>th</sup> and final year of what was originally designed as a 5-year study to examine survival, recruitment and recovery rates of nesting common eiders (*Somateria mollissima dresseri*) on Flag Island, Harpswell, Maine. The total breeding population of common eiders on Flag Island was estimated to be about 500 nesting pairs in 2008, which is at the long term estimate of approximately 500-600 nesting pairs for this island. Both the 2007 and 2008 nesting estimates were, however, a marked improvement from the 2006 estimate when only 200 hens actually nested. This low point coincided with the beginning of significant non-nesting events by hen eiders in east Casco Bay at and leading up to two significant mortality events on the wintering grounds in Massachusetts. One cause contributing to these die-offs was determined to be by an RNA virus. Nest success over the duration of this study was high at 75% in 2005, 74% in 2006 to 89% in 2007. Although the percentage of nesting great black-backed gulls increased during this investigation, the overall size of the nesting gull population remained fairly constant.

During this investigation, we banded 608 hen eiders and 2 male eiders on Flag Island. One hundred and seventy-six (176) hens were recaptured during the 6 year banding effort as part of a mark-recapture study. We calculated a survival estimate for Flag Island females, which had a fairly stable nesting population (2006 was an exception) between 2003-2008 and a consistent banding effort each year. The estimate of survival for females banded on Flag Island was 0.86 (SE 0.046). To date, 23 band recoveries have been reported. Hunters reported shooting 17 Flag Island birds, 15 in Maine and 2 in Massachusetts. Most hunter recoveries were in Casco Bay. A total of 6 birds were reported as "Found Dead". Three of these recoveries were on Flag Island, 2 on other southern Maine coastal beaches and one in Massachusetts.

We also determined that Flag Island is not utilized as a brood-rearing area for eiders; crèches left the island for the mainland within hours after reaching the water. As expected, great black-backed gulls were the most significant predator of eider ducklings. However, duckling predation rates adjacent to Flag Island and on brood rearing habitats were not as high as those observed at other locations in previous studies along the Maine coast. Although 10% and 4.5% of the ducklings were depredated during their island exodus in 2006 and 2007, overall productivity, estimated at 0.354 ducklings per breeding female in 2006 and 0.278 ducklings/breeding female in 2007. We identified several important brood-rearing habitats along the mainland coast but their use by creches varied between years.

North Cape Oil Spill settlement dollars played a significant role by providing permanent protection to one of the most important seabird nesting islands in Casco Bay, Maine. During this investigation we documented annual changes in the common eider

nesting population, banded 610 eiders, determined average nest success, measured female survival rates and causes of mortality, assessed productivity and duckling survival, and identified several important mainland brood-rearing areas.

## **Background**

In 1996, the North Cape Oil Spill occurred along the Rhode Island coast, leading to the death of 2,294 birds, many of which were common eiders and common loons. To compensate for the loss of eiders, monies were made available from the responsible party to protect eider nesting site(s) in Maine. Funds from the North Cape Oil Spill, the Julie N Oil Spill in Portland, Maine, a National Coastal Wetlands Conservation grant, the Land for Maine's Future Program, and the Outdoor Heritage Fund were collectively used to purchase Flag Island from the Maine Coast Heritage Trust (MCHT). MCHT bought the island from the private landowner to protect the island's unique natural resources. Flag Island is now part of MDIFW's Coast of Maine Wildlife Management Area and is permanently protected from development while visitor day-use is managed with "no trespass dates" (April 15 to July 31) to protect nesting waterfowl and sea birds.

## **Study Site**

Flag Island is a 26-acre island located 2 miles southeast of Cundy's Harbor, Maine in the eastern portion of Casco Bay (Figure 1, 43°45'00" by 69°54'05"). Flag Island is a generally low-lying island that has an extensive rocky intertidal zone. There are some steep sided ledges on the east and west sides, however the north and south portions are more level and slope gently into the water. A band of scrub-shrub habitat, dominated by poison ivy (*Rhus toxicodendron*), extends from the upper intertidal zone for some distance inland. The interior of the island is dominated by red oak (*Quercus rubra*), red maple (*Acer rubrum*) and balsam fir (*Abies balsamea*) with a thick understory of poison ivy. The island is considered one of the most important nesting islands for eiders in Casco Bay; the island was reported to have over 600 nesting eiders as recently as 1999. In addition to the eiders, approximately 70 pairs of herring gulls (*Larus argentatus*), 40 pairs of great black-backed gulls (aka "black-backs", *Larus marinus*) and 5 pairs of ospreys (*Pandion haliaetus*) nest there. A pair of great horned owls (*Bubo virginianus*) nested on the island in 2004, as well as an unknown number of American crows (*Corvus brachyrhynchos*) (A.Tur, personal observation). The white-tailed deer (*Odocoileus virginianus*) is the only large land mammal known to use the island (A.Tur, personal observation).

## **Background information on Common Eiders in Maine**

The common eider (*Somateria mollissima dresseri*) is a member of a group of waterfowl known as sea ducks (Tribe Mergini). In North America there are five subspecies of the common eider (Palmer 1976, Mendall 1980). Eiders in Maine belong to the *dresseri* race and can be found breeding from central Labrador to Massachusetts. They winter from Newfoundland to Rhode Island. Compared to most waterfowl, sea ducks exhibit delayed sexual maturity, small clutch size and low annual recruitment rates. While some females may breed at 2 years of age, most do not breed until they are four or

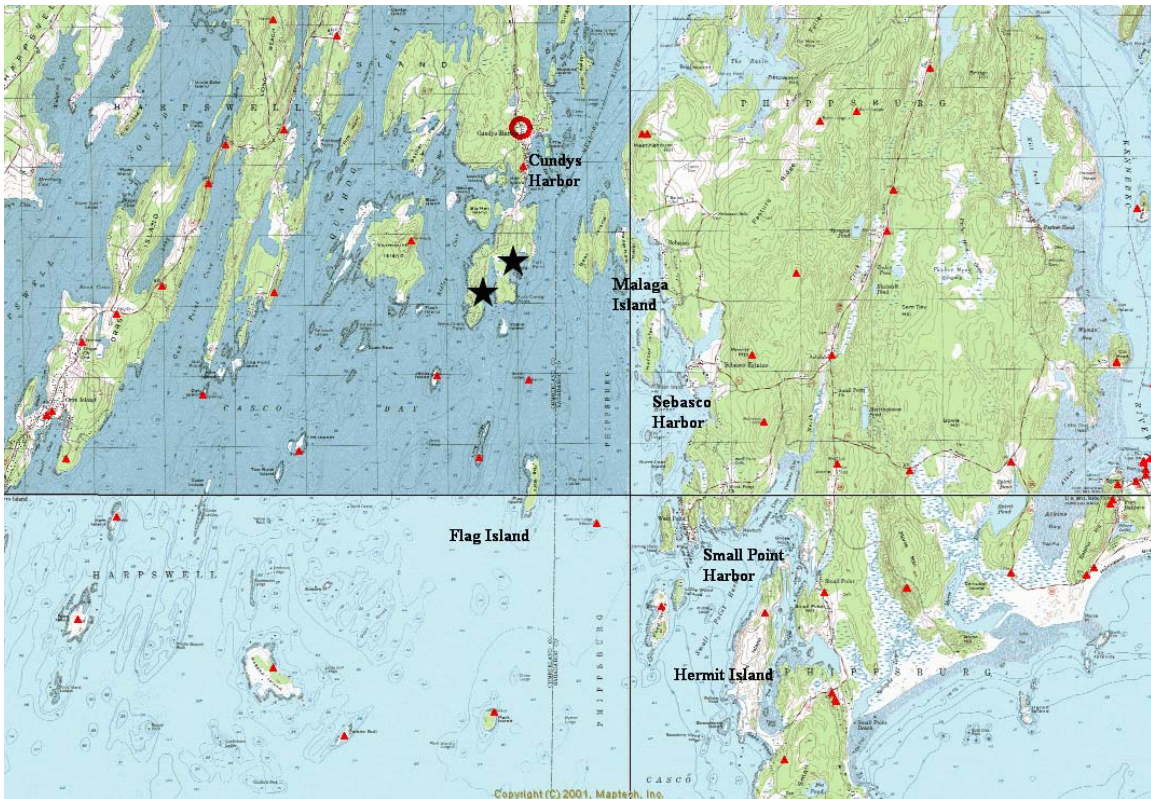


Figure 1. Map of east Casco Bay. Flag Island and several important brood-rearing habitats are identified in bold type. Other areas where broods were frequently observed for short periods of time are identified by stars.

more years old (Goudie *et al.* 1999). Males generally do not breed until they are at least three years of age (Goudie *et al.* 1999). Clutches average 3.4 to 5 eggs (Goudie *et al.* 1999). Mawhinney *et al.* 1999 reported the total number of fledged young ranged from 4 to 15% of the number of breeding females in their studies in the Gulf of Maine. The estimated mean life span of adult eiders is about 7.36 years (Krementz *et al.* 1996). In contrast, the life history of puddle ducks (Tribe Anatini) is quite different and is better suited to cope with reduced survivorship than are the sea ducks. Males and female mallards (*Anas platyrhynchos*), for example, are capable of breeding in their first year (Drilling *et al.* 2002) and mean clutch size ranged from 5.7 to 10.6 eggs across several North American studies (Drilling *et al.* 2002). Further, 15% of the hens produce flying young in a year, probably with many of these hens producing more than one offspring (Cowardin *et al.* 1985).

Eiders have experienced a tremendous population increase during the last 100 years. In the early 1900s, market hunting, egg collecting, and year-round shooting had suppressed numbers so that there were only a few nesting pairs in Maine in 1907 (Gross 1944, Goudie *et al.* 1999). Allen (2005a) reported a population high of approximately 29,000 nesting pairs on 341 islands, and speculated that the population peaked in late 1980s or early 1990s. Despite their historic comeback, eiders in Maine were believed to be in decline beginning in the 1990s (Krohn *et al.* 1992, B. Allen, personal observation). Because eiders experience low lifetime reproductive rates, population levels are sensitive

to factors that reduce adult survivorship. Therefore, recent natural mortality events (avian cholera in Quebec, die-offs due to virus and other causes in Massachusetts, and high rates of predation) and demand for sea duck hunting in the northeast has led to concerns about the sustainability of this increased harvest of eiders in New England, Quebec, and the Canadian Maritimes.

For eider eggs and ducklings, predation by herring gulls (on eggs) and great black-backed gulls (on eggs and ducklings) is the major cause of mortality (Mawhinney 1997). Along the northeastern coast of North America, gulls and eiders often share the same nesting island (Bolduc *et al.* 2005, Bourget 1973). Eider nest depredation is largely a result of avian predators (gulls and crows), because mammals infrequently visit islands with seabirds and common eiders (Laurila 1989). Egg depredation has been considered to be the main factor limiting nest success for some colonies in the early 1970s (Bourget 1973). Today, predation of hen eiders by a burgeoning bald eagle population, river otters (a relatively new predator to the offshore islands) and mink is cause for concern (B. Allen, personal observation).

The great black-backed gull is the largest and heaviest gull in North America, and its reputation as a predator of eider duckling is well documented. In a Bay of Fundy study, Mawhinney and Diamond (1999) reported that, “Young broods were most vulnerable and ducklings were depredated within the first 7 days following hatching. In most cases, if a brood was attacked by great black-backed gulls, the entire brood of ducklings was taken. Less than 25 ducklings fledged of the more than 2,000 hatched from the Wolves Archipelago between 1995 and 1997.” Similar reports are common among researchers (Gross 1945, M. Abbot Frazar 1887 in Gross 1945, C. Donehower, personal observation, Stratton Island, 2005). Beetz and Townsend (1916) considered the great black-backed as “The greatest destroyer of the eider.” Swennen (1989), however, suggested that “good” and “bad” years were related to the availability of eider food and that depredation by gulls may be compensatory to starvation. Clearly, black-backs are capable of virtually eliminating the reproductive output of some eider colonies during some years and managers are concerned that their present abundance may be unduly suppressing recruitment rates for eiders below desirable levels.

Like the eider, great black-backed gull numbers changed dramatically along the coast of Maine during the 20<sup>th</sup> Century. According to Gross (1945), great black-backed gulls probably nested in low numbers, if at all, along the coast of Maine during the early 1800s and apparently could not be found nesting anywhere along the coast of Maine during the later 1800s. This absence is believed to have resulted from the persecution of these birds for the millinery trade (Gross 1945, Good 1998). The next record of black-backs nesting along the New England coast was not until 1928 at the Isles of Shoals (Jackson and Allan 1932). Norton and Allen (1931) reported finding black-backs nesting at ten different islands along the coast of Maine during a coast-wide inventory. By 1945, a conservative estimate placed the great black-backed gull nesting population on the coast at 3,500 individuals. By 1965, 12,400 nested along the coast to Long Island (Nisbet 1978). Today, black-backs are ubiquitous along Maine’s coast. It is likely that great black-backed gull numbers today greatly exceed historic levels. The reasons for this are a lack of take (see Good 1998 for a discussion of evidence of use by archaic peoples), open dumps and landfills, abundance of fish processing waste, and subsidized feeding from commercial fishing vessels. Because of the elevated numbers of great black-backed

gulls, managers are concerned that further reductions in the naturally low recruitment rates for eiders will further decrease the ability of eiders to sustain current population levels.

### Methods

In 2003, we initiated what was initially proposed to be a five-year field investigation on Flag Island to determine eider survival, recruitment, and productivity. The Flag Island study site dovetailed into a common eider research project currently underway on other mid-coast and eastern Maine islands used by Allen and McAuley.

Each year, in mid-May, we documented eider nesting phenology. When the timing was right, we assembled a large banding crew for one pass through the nesting cover. During this effort, two to three biologists walked through the dense vegetation on the island. This disturbance caused hens to leave their nest, most often they walked through the vegetation until they got to the vegetation immediately above the intertidal zone. Here, biologists carrying long-handed nets attempted to capture them before they became airborne or reached the water (Figure 2).



Figure 2. Capture technique.

The hens were banded with a standard USGS band and released. The single pass through the island resulted in only one disturbance event to the colony during the nesting season and is believed to have no adverse affects to the birds. Survival and recovery of eiders were determined by using band recovery data (Brownie *et al.* 1985). Similarly, using recapture procedures designed by Jolly-Seber Models (Jolly 1965, Seber 1965) we recorded recaptures of nesting female eiders to generate a survival estimate.

Eider nest success (the percentage of nests were one or more of the eggs in the nest hatch), was monitored in 2005-07. Nests where marked to reduce double counting.

A nest was considered successful if a shell membrane was found in the nest, indicating a hatched egg (Girard 1939). If no membranes were observed or if only depredated eggs were observed, the nest was considered unsuccessful (Girard 1939). Figure 3 shows a typical eider nest with down and 6 eggs. The average eider nest contains 4 eggs.



Figure 3. A typical eider nest in the forest interior of the island

The use of conventional methods for assessing productivity was problematic for the study of Flag Island eiders. One reason is the presence of large amounts of poison ivy (*Toxicodendron radicans*) and brown tail moth (*Euproctis chrysorrhoea*) and associated dermatitis (severe skin rash), both are formidable environmental hazards to some researchers. Further, studies of recruitment of eider ducklings are highly susceptible to human disturbance. Given the nature of the island (poor sight distance due to terrain and vegetation) it was determined that the observers could have substantial negative effects on the results. Subsequently, a more disturbance-free methodology was employed to examine duckling survival. A boat and trained observers were used to record predation events, estimate duckling numbers and duckling size class, and estimate their survival to fledging, beginning in 2005. Subsequently, in 2006 and 2007, additional efforts were made to increase the boat surveys and observations of crèches to estimate duckling survival and productivity of female eiders from Flag Island.

## **Results and Discussion**

### Nesting Phenology

During this investigation, the nesting phenology of the Flag Island population of eiders was fairly predictable over time. By way of example, this progression of eider and gull nesting activities on Flag Island during the 2007 breeding season is depicted in Figure 1. We estimated nest initiation dates by back calculating the reported incubation period from the date of the first observed signs of hatching (pipped eggs or hatchlings).



Initiation of nesting activities on Flag Island by great black-backed gulls, herring gulls, and common eider was similar to 2006 and typical for most nesting seasons in other areas (Good 1998; Pierotti and Good 1998; Goudie *et al.* 1999).

The hatching of eider ducklings occurred throughout the study period in 2007 (Figure 4). Based upon the number of nests that were still being actively incubated (the presence of a complete clutch, dry down, or a hen) at the end of June, it is believed that the majority of Flag Island nesting had been completed.

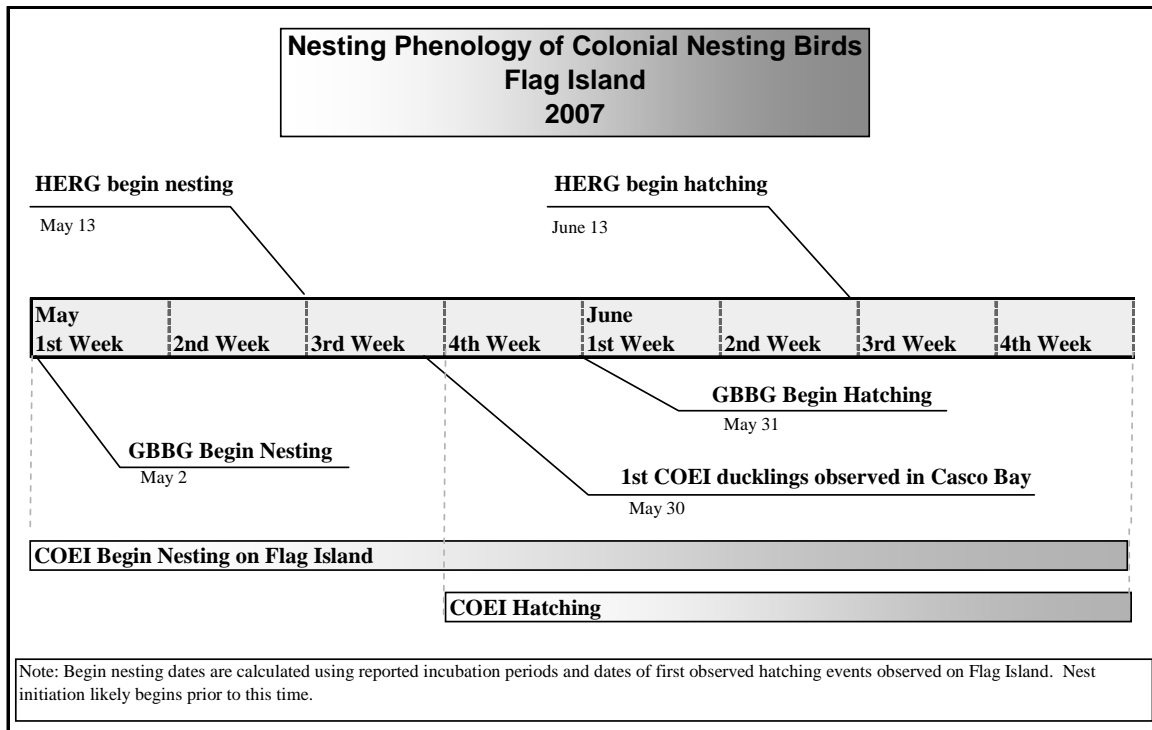


Figure 4. Progression of eider and gull nesting activities on Flag Island during the 2007 breeding season.

### Banding and Survival Estimates

During most years, the majority of eiders were banded in May. On occasion, a few other late-nesting hens were banded in June. In many parts of the coast a large percentage of the breeding-aged females did not nest at all in 2006. This was particularly true of east Casco Bay as we recorded a reduction in nest numbers of nearly 63% on several eider nesting islands in the vicinity of Flag Island (Houston, unpublished data, Appendix 1).

In total, we banded 608 hen eiders and 2 male eiders on Flag Island. One hundred and seventy-six (176) hens were recaptured during the 6 year banding effort as part of a mark-recapture study.

Since 2002, in the broader coast wide eider investigation, we have banded nearly 11,000 eiders. We have banded >6,500 females and >4,400 males. We have >1,100 recaptures of previously banded birds and >600 recoveries of dead birds. We used Program Mark to determine survival and recovery rates from band recovery data. Preliminary results indicated that 2 models were very close. Model 1 indicated survival was constant (0.862, SE 0.028) for both sexes over time while recovery rates varied by

sex and years. Yearly recovery rates for males ranged from 0.015, SE 0.003 (2003 + 2007) to 0.027, SE 0.003 (2006) and for females ranged from 0.006, SE 0.001 (2004) to 0.022, SE 0.003 (2005). Model 2 indicated survival rates were constant over years but varied by sex and recovery rates varied by sex and year. Using model 2, female survival was 0.886 SE 0.039, while male survival was 0.835 SE 0.041. Survival estimates using mark-recapture data from recaptures of live birds were calculated for all birds captured during the spring and summer banding period and then for nesting females only. Mark-recapture survival estimates for males was 0.874 (SE 0.106) and for females was 0.824 (SE 0.026). The estimate for females captured during nesting indicated survival of nesting females was constant (0.757, SE 0.026) while capture probabilities varied by year from 0.079. to 0.19. Because of weather and predation on some islands spring nesting effort by eiders differed over the years. We calculated a survival estimate for Flag Island, which had a fairly stable nesting population over the years and a consistent banding effort each year. The estimate of survival for females banded on Flag Island was 0.860 (SE 0.046) (McAuley et al. 2008).

To date, 23 band recoveries have been reported. Hunters reported shooting 17 Flag Island birds, 15 in Maine and 2 in Massachusetts. Most hunter recoveries were in Casco Bay. A total of 6 birds were reported as “Found Dead”. Three of these recoveries were on Flag Island, 2 on other southern Maine coastal beaches and one in Massachusetts.

### **Nest Success**

Common eider nest success, as reported in the literature, generally ranges from 15-79% and is affected by predation, adverse weather, island size, topography and cover. Human disturbance is also a factor that reduces nest success. On Flag Island, nest success was generally high. Nest success was 73.4% in 2006, compared to 74% in 2005 (Allen 2005b). There was no difference in nest success between the interior (77.3%) and exterior (68.6%) portions of the island. Similarly, the type of vegetation at the nest site was not correlated with nest fate ( $P > 0.05$ ), although most nests were located under low hanging evergreen boughs, under dead and down material or in areas of dense overhead (at ground level) cover.

Nest success was higher in the forested interior of the island than in the shrub area (84.5% vs. 60%). However, we found no effect of location (df 4, 74,  $F = 2.48$ ,  $P = 0.1193$ ), vegetation type (df 4, 74,  $F = 2.21$ ,  $P = 0.1196$ ), or in the interaction of vegetation within each location (df 4, 74;  $F = 0.75$ ;  $P = 0.3902$ ). Also, the distribution of successful and unsuccessful nests did not differ between the interior and exterior of the island ( $n = 79$ , chi-square = 0.7563).

We recorded three habitat variables at each nest. Forest type at the nest was recorded as coniferous, deciduous, or shrubs (any dense vegetation less than 15 ft. tall). Next, percent cover was determined by estimating the amount of vegetation that concealed the nest, which was evaluated by looking directly down on the nest from a standing position (Choate 1967). Finally, the location of the nest was recorded as interior (located in the central forested area) or exterior (located in the middle ring of shrubs and bushes). No eider nests were observed on the exterior rock ledges and this area was excluded from the nest survey.

In 2007, nest success reached an astounding 89.3 % and eclipsed that recorded in the two previous two years. During field efforts in 2008, 13 hen eiders were captured and sampled for Avian Influenza (Figure 5). No cases of H5N1 were found.



Figure 5. A hen eider ready for banding and AI sampling in 2008.

### **Gull nesting**

In 2006, we recorded 72 herring gull (mean number of eggs = 2.3) and 41 great black-backed gull nests (mean number of eggs = 2.4). Almost all gull nests were located on the southern end of the island (Figure 6). Six additional gull nests were found scattered in other locations around the island, all of these were in the upper intertidal zone.

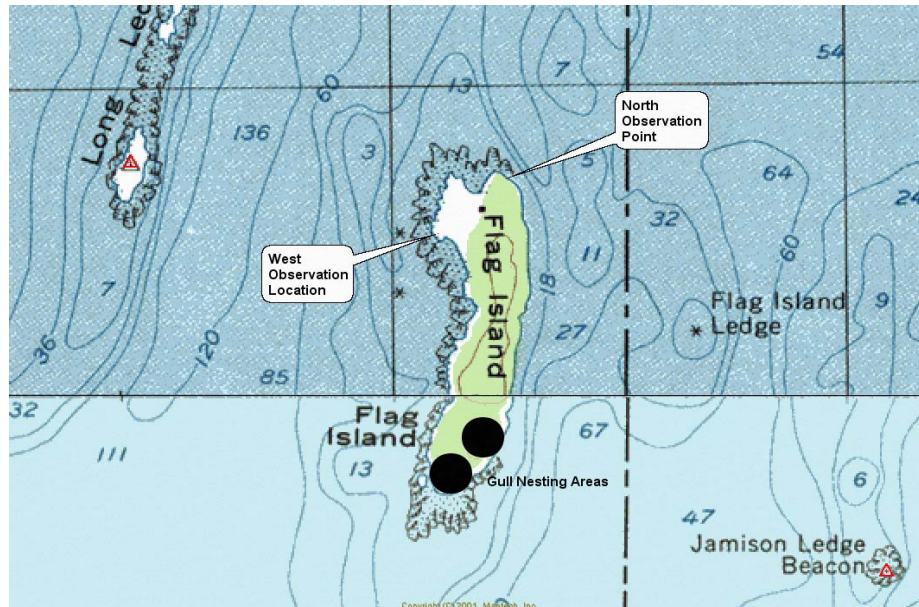


Figure 6. Topographic map of Flag Island depicting the observation locations and locations for most of the nesting gulls.

In 2007, we recorded 66 herring gull and 59 great black-backed gull nests. Twenty-one fresh nest bowls were also observed. Later visits to a few of these bowls confirmed that they were constructed by herring gulls. The number of nests counted indicate a 8.3% decrease in herring gulls and 30% increase in great black-backed gulls from 2006. Almost all gull nests were located on the southern end of the island. Within this area, the majority of great black-backed gulls tended to be concentrated along the south west side.

### **Productivity Investigations in 2006 and 2007**

We measured duckling survival and eider productivity during the 2006 and 2007 field investigations. In the final year of intensive survey efforts, we studied common eiders on or around Flag Island from 21 May to the 28 June, 2007. These dates corresponded to peak eider nesting season and early brood-rearing period. The island was visited 4-5 times per week (with the exception of days with adverse weather conditions that prevented safe access to the island). Observation protocols were modified from 2006 in an attempt to minimize observer-induced mortality of ducklings by gulls. Observations began by circling the island in the boat at a distance that avoided disturbing the birds. In 2006, we found that disturbance to the crèche usually resulted in separation of ducklings from the crèche, thereby facilitating predation by great black-backed gulls. Response to disturbance by researchers was most severe if hens were flushed away from the crèche while traversing the rocky intertidal zone. All crèches observed were mapped, the numbers of attendant hens and ducklings recorded, ducklings were assigned to an age class (Gallop and Marshall 1954) and predation events were noted. Following the initial circling of the island, an observer either went ashore or remained offshore in the survey boat, attempting to minimize disturbance. Boat based observations allowed for data collection at the southern end of the island without the observer influenced mortality associated with the onshore methods used in the 2006 study. This adjustment may have

resulted in reduced predation during the island exodus. Observations were typically conducted for several hours each day while using a spotting scope and binoculars to document the above-described parameters of crèches, as well as the length of time the crèche stayed in the vicinity of Flag Island. We also documented the heading and general mainland destination of departing crèches. The departure point for each crèche was assigned to one of six locations around the island.

On May 25, 2007, an aerial survey was conducted to estimate the number of male eiders adjacent to Flag Island. A properly timed male count provides an estimate to the number of nesting females on the island (Lock 1986, B. Allen, personal observation). Additionally, a nest census was conducted at the beginning of the study to aid in estimating the breeding population. Searches were conducted on the island and nests were counted. Any nest that had one or more eggs or contained fresh down (representing a started nest) was recorded. On June 6<sup>th</sup>, 2007 a census of the nesting gull colony was conducted. Herring and great black-backed gulls nest on the south end of Flag Island along the rock ledges and into the exterior shrubs. Nests were counted by searching all areas that appeared to have suitable conditions (upper intertidal zone, areas of low lying vegetation or areas proximal to these open areas) for gull nesting. Total number of eggs was recorded and the species determined by measuring the egg size (Bent 1921).

In an attempt to determine recruitment rates, we performed weekly surveys to census ducklings and determine the distribution of crèches within east Casco Bay. From this we determined the number of ducklings that could be attributed to Flag Island by calculating the product of the count and the percentage of nesting hens from Flag Island. Several assumptions would have to be made including the assumption that all islands within Casco Bay share similar rates of nest success and duckling survival.

### **Crèche Behavior: Exodus from Flag Island**

Previous work on Flag Island indicated that ducklings were generally absent around Flag Island shortly after the peak of the hatch, indicating that hens were either moving their broods to a brood-rearing area or duckling mortality (usually a result of predation by gulls) was very high (Allen 2005b, Allen 2006). This was reaffirmed in field investigations during 2006 and 2007 as ducklings hatched at the island leave soon after entering the water (within 6 hours). This could be attributed to a lack of brood-rearing habitat at the island or the presence of a large population of predatory gulls, or both.

We observed 52 crèches around (within 20 to 30m) Flag Island during the field studies. We believe all crèches observed were comprised of ducklings hatched on Flag Island. All ducklings were observed as Class Ia, (1 to 7 days of age). Crèches were comprised of a mean number of 8.9 ducklings (range=2 to 27) with 1.57 attendant hens (range=1 to 18). Broods typically departed the island soon after reaching the water. No crèches stayed in the vicinity of the island for more than six hours. Most broods leaving the island headed east and northeast, toward Sebasco Harbor and Carrying Place Cove (n=29) (Figure 7). Five crèches departed north toward Cundy's Harbor and Bear Island. Six headed west toward the Long Ledges. Thus, while Flag Island is an important nesting island for eiders in east Casco Bay, the island appears to provide little to no value as brood-rearing habitat.

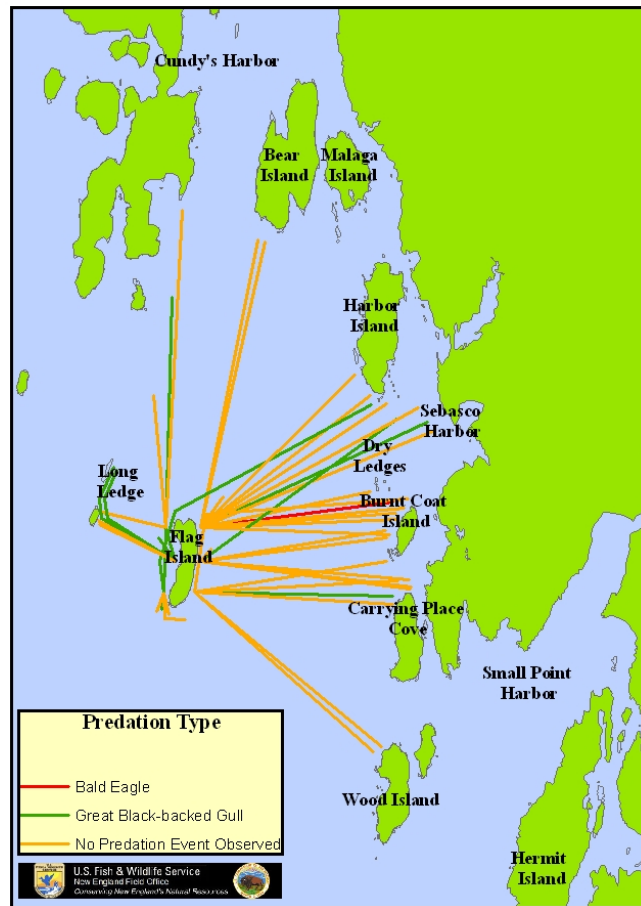


Figure 7. General locations of crèche exodus starting locations and routes. Predation classifications is classified by line color.

### Important Brood-rearing Habitats in east Casco Bay

Boat surveys were conducted throughout east Casco Bay during the study beginning in 2004, was expanded in 2005 (see Tupper report in Appendix) and was further refined in 2006 and 2007. Several areas were important for brood-rearing of eider ducklings in east Casco Bay because crèches frequented several locations (Figures 8 and 9). A majority of the Flag Island crèches left the island on a path toward Sebasco Harbor, Phippsburg. Cundy's Harbor was also an important area. A crèche composed of 2 Ia ducklings and two hens was first observed there on 24 May. This group stayed in Cundy's Harbor throughout the study period and were at least 37 days old when the study ended. At this stage they were Class IIc ducklings, being almost completely feathered and nearly equal in size to the hens. Ducklings of this size are considered safe from



Figure 8. Eiders and ducklings along the mainland shore.

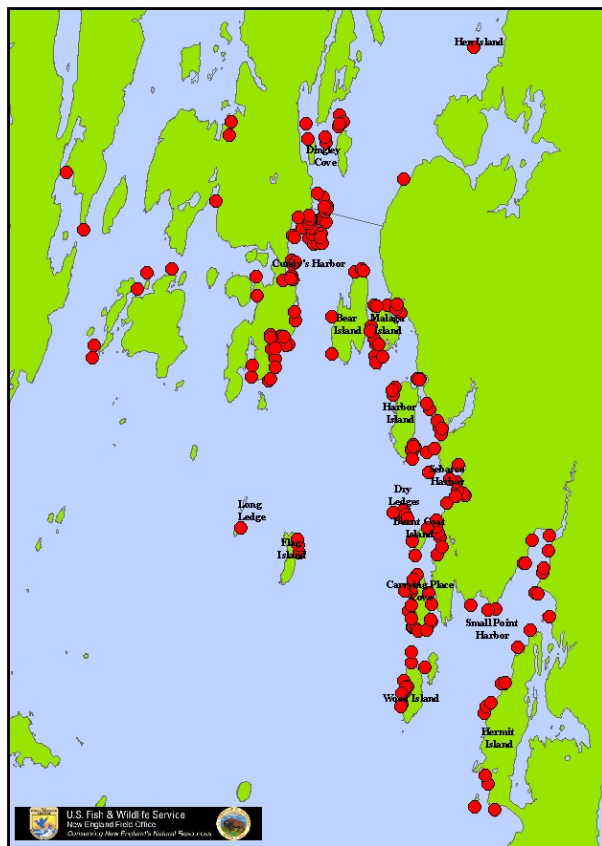


Figure 9. Map showing the locations of crèches observed during boat surveys of East Casco Bay.

predation by black-backs. Based upon the distribution of sightings of banded eider hens, we believe that crèches of Flag Island origin utilize many of the brood rearing sites to the east and directly north of Flag Island and depicted in Figure 10.

Crèches were not randomly distributed across all other seemingly suitable habitats in east Casco Bay. For example, we observed few crèches in Quahog Bay or further up the New Meadows River than Dingley Cove. The single crèche observed at Hen Island is believed to have originated from Hen Island since nests were observed in association with the active tern colony found there. During the last boat census of east Casco Bay ducklings, 471 ducklings were counted. Ducklings ranged in age from class Ia to IIc (37 to 42 days of age).

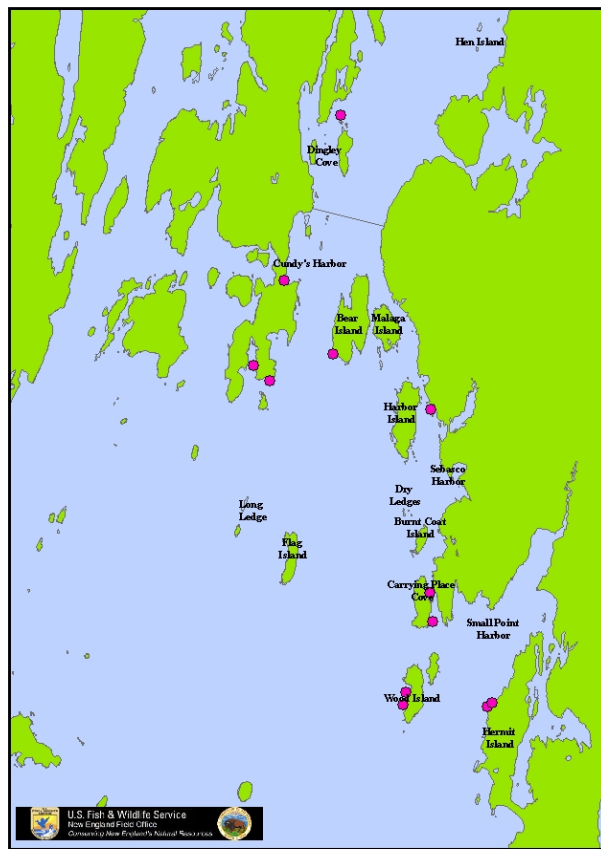


Figure 10. Map showing observation locations for banded hen eiders in East Casco Bay. All banded hens are considered Flag Island birds.

### **Duckling Survival and Productivity Estimates**

The dispersal of ducklings from Flag Island makes estimating recruitment difficult. As hens move their ducklings off Flag Island it was observed that they generally move east towards the mainland. It is likely that other crèches from other



islands make a similar journey and, therefore, the crèches observed in various locations may be a mix from several islands. Cooch (1965) reported that some preflight young may travel more than 80 km from where they hatch. It should be noted however that Flag Island has the largest nesting eider population in east Casco Bay. A conventional approach to determining recruitment for Flag Island would require marking a large number of hens from the island. An effort of this magnitude would be highly invasive to the birds and would likely result in a large negative effect to nesting success. Further, marking hens so that they could be identified as Flag Island birds would jeopardize an on-going study to determine hen survival rates as marked hens are more vulnerable to hunters than unmarked hens.

In an attempt to estimate recruitment at Flag Island, we surveyed ducklings within all known brood-rearing areas in east Casco Bay. From this we could estimate the number of ducklings that could be attributed to Flag Island by comparing simple proportions of nesting hens from Flag Island to the number of hens from nearby islands. For this estimate to be valid we assumed that all islands within east Casco Bay share similar rates of nest success and duckling survival and that there is no immigration or emigration from east Casco Bay

In 2006, great black-backed gulls ate 24 ducklings (10% of the ducklings) in the vicinity of Flag Island. We classified 13 duckling predations as “observer influenced” because we thought our presence caused a sufficient amount of disturbance to the crèche to have facilitated the predation. Typically, the disturbance resulted in separation of at least some ducklings from the hens as the group crossed the exposed intertidal zone. These occurred throughout the observation period. Unlike the previous observations, the 11 unfacilitated predation events occurred during the last week of the study. Although black-backs demonstrated interest in depredate vulnerable ducklings at other times, they were particularly bold during this time. These predation events took place on the water and not on land in the intertidal zone.

More predations were observed on brood-rearing areas throughout the study period. On 21 June, we observed an immature bald eagle (*Haliaeetus leucocephalus*) unsuccessfully attempting to depredate a crèche composed of 10 female eiders and 23 Class Ib ducklings (Age 8 to 13 days). On 27 June, a crèche of three hens with 3 Ia ducklings was observed in Cundy’s Harbor. Two of these ducklings seemed too weak to keep up with the attendant hens as they foraged, undisturbed, in the harbor. These two ducklings were depredated by black-backs within an hour of first observation.

In 2007, we observed the predation of 20 ducklings (4.5% of the ducklings) within 10 crèches (19% of crèches) in the vicinity of Flag Island. Great black-backed gulls ate 17 and 3 were taken by a pair of subadult bald eagles as the crèche approached the Dry Ledges at the entrance to Sebasco Harbor after departure from Flag Island.

### **Productivity Calculations**

In 2006, we assumed that Flag Island contained 30% of the nesting hen eiders found in East Casco Bay. From this estimate we concluded that productivity Flag Island in 2006 was 0.354 ducklings per breeding hen.

Estimated number hen eiders in East Casco Bay, 2006	655
Estimated number hen eiders on Flag Island, 2006	200
Proportion of hen eiders from Flag Island in East Casco Bay	30%
Number of ducklings counted in East Casco Bay, 2006	232
Number of ducklings estimated to be from Flag Island	70 (.30* 232)
Productivity estimate for 2006	0.354 young/hen

Regardless, if the assumptions are somewhat based in fact, we estimated that if 655 nesting hen eiders in east Casco Bay, with 200 nesting pairs of eiders from Flag Island, or 30 %, then 30% of 232 ducklings observed at the end of the field season results in 71 ducklings from Flag Island, for a gross recruitment rate of 0.354 ducklings per breeding hen.

Similarly, in 2007 productivity was calculated as follows:

Estimated number hen eiders on Flag Island, 2007	450
Proportion of hen eiders from Flag Island in East Casco Bay (used 2006 estimate of percentage)	30%
Number of ducklings counted in East Casco Bay, 2007	417
Number of Flag Island ducklings	125 (.30* 417)
Gross Productivity estimate for 2007	0.278 young/ hen

Alternatively, there is some evidence to suggest that the ducklings counted in our east Casco Bay survey are comprised almost entirely of Flag Island origin birds. Pond Island and Ragged Island are two other sizeable eider nesting islands located in East Casco Bay. Opportunistic observations in the area surrounding Bailey Island, which defines the western edge of East Casco Bay, revealed that eiders make use of the brood rearing habitats available in that area. Based upon the proximity of Bailey Island to Pond and Ragged Islands, we speculate that eiders in the Bailey Island area originate from these two large colonies. Also, direct observations of Flag Island eiders suggest that they are unlikely to be found in the Bailey Island area. Therefore, it may be reasonable to assume that all the ducklings counted in our efforts can be attributed to Flag Island.

Gross Productivity estimate for 2007	417/450 yields	0.93 young/hen
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Other productivity estimates for eiders are generally lacking. Swennen (1991 in Goudie *et al.* 1999) estimated that eiders in his Netherlands study area produced 0.34 young per female with a standard deviation of 0.46. In reality, the productivity of Flag Island is somewhere between our two estimates. We suggest caution in interpreting our results since eiders are known to experience high losses of young in most years, near disaster in others, and occasional years of high survival (Goudie *et al.* 1999).

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## **Appendix 1.**

### **Annual Highlights**

#### **2003**

- Acquired 16' Lund with outboard
- Initiated field work
- Banded: 107 Recaptured: 0

#### **2004**

- Nesting phenology 2-3 weeks later than previous year
- Environmental conditions require a change in research strategy to minimize the number of trips to the island.
- Recorded one Great Horned Owl nest.
- Modification in the duckling survival portion of this investigation required frequent trips to brood rearing areas to record the total number of hens and ducklings seen and record duckling size class.
- Initiated boat surveys by Bob Houston (USFWS) and Helen Tupper. Recorded ducklings in important off island brood rearing areas along the mainland.
- Banded: 122 Recaptured:

#### **2005**

- Helen Tupper hired to conduct 3 surveys per week for 6 weeks for duckling surveys by boat (see report in Appendix ). Identified important inshore brood rearing areas
- Significant non nesting on some coastal survey islands but Flag Island was an exception and status quo for nesting was recorded.
- Nest Success was determined to be 75%.
- Determined that hen eiders leave Flag Island as soon as possible after they hatch their eggs and head approximately one mile in shore to brood rearing habitat; areas with many intertidal ledges and boulders.
- Banded: 130 Recaptured:

#### **2006**

- Breeding population reduced to an estimated 200 pairs due to significant non-nesting by breeding aged females.
- Boat surveys and an aerial survey conducted in early May estimated the total population to be about 500 pairs, which is comparable to previous years. However, although present around the island in May, many females did not nest in 2006. We speculate that winter conditions may have compromised female fitness, leading to non-nesting in 2006.
- Recorded significant drop in total eider nesting effort on several East Casco Bay Islands (Appendix Table).
- Recorded 72 Herring Gull nests, 41 GBBG nests, all located on the southern end of the island, and 5 pairs of ospreys.

- Banded: 45; Recaptured: 23.
- Nest success was 73.4 % in 2006. Depredation by crows was believed to be the cause of many nest failures. There was no difference in nest success between the interior and exterior portions of the island.
- Ten percent of the ducklings from 44 broods were lost during island exodus.
- Productivity measured at 0.354 ducklings per breeding female. Some brood rearing areas used in 2005 did not receive significant use in 2006.

## **2007**

- Nesting phenology was earlier than 2006.
- Estimated breeding population of 400 pairs.
- Adult male count on 5-25-07 was 320
- Nest success was estimated at 89% (n=63).
- Proposed an adjustment in our schedule to increase our level of effort to further evaluate productivity.
- Banded: 72; Recaptures: 49
- 4.5% of the ducklings depredated during island exodus (down from 10%).
- Productivity estimated at 0.278 ducklings per breeding aged female.
- HERG = 66; GBBG = 59.

## **2008**

- 2008 estimated nesting populaion of 500
- Banded 134
- Total recaptures to date: 176



## Appendix 2

**Common Eider nest surveys in east Casco Bay, 2006. Data source: R. Houston, USFWS.**

<u>Island Name</u>	<u>Eiders-1999</u>	<u>Eiders-2006</u>	<u>Eiders -2007</u>	<u>% Change (2006)</u>
Cedar Ledge	22	11		-50%
Duck Rock	15	2		-87%
Elm Island (E)	88	48		-45%
Elm Island (W)	64	33		-48%
<b>Flag Island</b>	<b>626</b>	<b>150*</b>	<b>450</b>	<b>-76%</b>
Jenny Island	7	6		-14%
Long Ledge	3	0		-100%
Long Ledge (S)	34	10		-71%
Pond Island	300	107		-64%
Ragged Island	450	225		-50%
Rogue Island	10	0		-100%
Two Bush Island	14	1		-93%
White Bull	20	13		-35%
Total:	1,653	606		-63%

\* 150 nests during the survey window, and an additional 50 nests late in the season

### Appendix 3

#### 2005 BOAT SURVEY OF EIDER DUCKLINGS ASSOCIATED WITH FLAG ISLAND AND VICINITY EASTERN CASCO BAY, MAINE by Helen C. Tupper 8/5/05

Fifteen boat surveys were conducted between May 19 and June 26, 2005, in order to locate and assess crèches of eider ducklings. The purpose of these surveys was to gather data relevant to the study, “Survival of Common Eider (*Somateria mollissima*) Ducklings Associated with Flag Island and vicinity, Casco, Bay, Maine.” This work was conducted by Helen Tupper, a contractor of MDIFW. The surveys were conducted by following the shoreline at idle speed in a shallow draft outboard boat, and, when a crèche was located, noting the number of individual ducklings, the size class of the ducklings, and the number and gender of adult ducks in attendance. Any evidence of predation was also noted. In order to minimize disturbance, care was taken to make observations at the maximum distance that would allow the use of binoculars to count individuals. On rough days, this led to an occasional approximation of crèches composed of Class I, or downy, ducklings. These are expressed as a low and high count; for example, eight to ten individuals are tallied as (n= 8 –10). When observations revealed the movement of crèches to inshore brood rearing areas in the New Meadows River and Ridley Cove, an inshore survey route was established, and subsequent surveys alternated between “inland” and “offshore” routes. Data were tabulated in both a map and a spreadsheet format. This report is a brief overview and commentary by the boat surveyor.

#### Ducklings Associated with Flag Island

Of the fifteen islands investigated, Flag Island produced the highest frequency of Ia duckling sightings (n=102 -112.) Adults were observed to move crèches of Ia ducklings over open water. Peak hatch, using the presence of Ia ducklings as an indicator, occurred between mid May and mid June, with no discernable spike; surveys on 5/21, 5/23, 5/27, 6/1 and 6/9 each showed between 10 and 24 Ia ducklings.

The greatest number of ducklings associated with Flag Island occurred on May 29<sup>th</sup>. This day, 56 – 67 Ib ducklings, and no Ia ducklings, were observed in 4 creches. These birds were not seen two days later, but were replaced by 22 Ia ducklings. Ib ducklings were observed only one other time, when five Ib were seen on June 13. No older ducklings were observed at Flag Island and no ducklings at all were observed at Flag Island from June 13 to the end of the survey period on June 26.

#### Ducklings Associated with Nearby Islands in Eastern Casco Bay

The Elm Island/Two Bush Island archipelago, hereafter named the “Elm Islands,” produced the second highest number of Ia duckling sightings (n= 47- 49). Ram Island (n=30,) Jenny Island (n=24,) Ragged Island (n= 12 –15,) and Pond Island (n=12) also produced ducklings. Both Jenny Island (n= 62) and the Elm Islands (n=32-34) hosted a large number of Ib ducklings on May 29, the same day that Flag had its record 56 - 67 Ib ducklings. Mark Island, surveyed less often due to its far offshore location, also had a total of 18-20 Ib ducklings, on May 29. As at Flag Island, these large Ib aggregations

disappeared by the next survey on June 1, replaced by small groups of Ia ducklings. The Elm Islands (n=17) and Jenny Island (n= 62) had accumulated large aggregations of Ib ducklings again by June 13; and as with Flag Island, no eider ducklings were seen near the offshore islands for the remainder of the survey. One exception to this trend was Jenny Island, a common and roseate tern colony and island owned by MDIFW and managed by National Audubon Society. Here a small numbers of ducklings survived for several weeks. A crèche of seven Ib ducklings was seen on 6/24, the only class II ducklings seen offshore. The same observer, working as a tern restoration volunteer on Jenny Island from July 1 – 10, noted that seven ducklings remained near the island during that time.

The Cedar Ledges and the Duck Rocks, neither of which offer significant nesting habitat, occasionally hosted eider crèches. 20-25 Ia were seen at the Cedar Ledges on 5/27; and the Duck Rocks hosted 18 Ib on 6/1.

### **Predation**

Great Black Back Gulls were seen attacking eider crèches on five occasions: three attempts occurred within a few minutes of each other at the Elm Islands, which host a large gull colony. At Ram Island, also a gull nesting island, a group of 7 hens guarding 3 ducklings fended off a GBBG. The group composition strongly suggests that attrition had previously occurred in the crèche. Approximately ½ mile north of Flag Island, two GBBG's threatened a group of 18 Ia ducklings, attended by 4 drakes and 7 hens, that were traveling from Flag Island to Rogue Island; the adults and the chance passing of a boat discouraged the gulls. At the Cedar Ledges and Duck Rocks, eiders were observed occasionally being harassed by GBBG attracted to the byproducts of seal pupping, which was ongoing in those locations.

On one other occasion, a single Herring Gull descended on a crèche of 14 Ib ducklings attended by 7 hens. No ducklings were lost. This event occurred in the New Meadows River, three miles upstream from the open ocean.

### **Movement of Creches**

On 5/21, a crèche of 6 Ia ducklings, accompanied by 1 hen and 1 drake, was seen swimming away from Jenny Island, in the direction of Long Ledge and Flag Island. The same day, 18 Ia's were followed by the surveyor as they moved from Flag Island at a speed of about 1 ½ MPH, toward the north, arriving at the southern tip of Rogue Island, close by the southern end East Cundy's Point on the mainland and less than 1 mile from Flag Island. This observation, taken with many word of mouth accounts by Cundy's Harbor lobstermen who were reporting large crèches of eiders in Cundy's Harbor, another mile to the north, suggested that inshore migration could account for much of the disappearance of ducklings from the islands. An examination of the East Cundy's Point shore found USGS banded eider hens resting near Cundy's Harbor. This further promoted the likelihood that Flag Island Eiders were making the New Meadows River an inshore brood-rearing area; and extensive searches of the New Meadows River (east of Cundy's Point,) Ridley Cove (west of Cundy's Point,) and Yarmouth Island (west of

Ridley Cove and the nearest land north of Jenny and the Elm Islands) were begun, alternating with the offshore surveys.

### **Inshore Brood-rearing Areas**

The New Meadows River, especially Cundy's Harbor and the Bear / Malaga Island area, proved to be well populated with eider crèches, including several that attained IIB status. While scattered crèches were found more than 2 miles upstream, the bulk of the activity was focused within a mile of the open ocean.

Cundy's Harbor, on the west bank of the New Meadows, hosted large concentrations of eider ducklings, especially within the Cedar and Green Ledges, an area of dry ledges and shallow, rocky ground forming the north east corner of the harbor. On June 10, a crèche of 43 Ic was observed, along a crèche of 23 Ib, another of 22 II a, and various smaller groups, totaling 94 ducklings. A similarly large aggregation was found here five days later on June 15. Forty-five ducklings were present June 21; and on June 26, the last day of the survey, 25 were still present. Of these, 15 were in the size II category. Just north of Cundy's Harbor, the waters surrounding the south end of Dingley Island, including Hopkins Island, Sheep Island, and the Sheep Island Ledges, also supported abundant ducklings; on June 10, a total of 59 were present; these numbers held on June 15; and on June 26 there were still 12 IIa.

Bear and Malaga Islands (and adjacent Phippsburg shore across the New Meadows from Cundy's Harbor) supported duckling numbers similar to the Dingley Island area. The Bear/Malaga area was furthermore notable for the number of large ducklings to be found in late June. On June 21, there were 41 Class IIa and IIb in the area; and the same total were present on June 26.

Cundy's Point, which includes Rogue Island, seemed to serve as an important waypoint for crèches as they migrated inshore. On four occasions, four crèches were located within the small area. Some of these were quite large. May 27 saw a group of 25 – 30 Ia, while on June 3, there were 34 Ib. Smaller groupings were seen in the interim; and on June 26, there were two class II ducklings still present.

To the west of Cundy's Point, Yarmouth Island and Ridley Cove supported crèches of eider ducklings. The narrows between Big and Little Yarmouth Island, especially, hosted significant numbers; 31 Ib were present on June 13. Five ducklings at the IIb size class were present on June 26.

### **General Comments**

The overall impression is that the hen eiders leave Flag Island as soon as possible after they hatch their eggs and head approximately one mile inshore to brood-rearing habitat; areas with many intertidal ledges and boulders. Hens and ducklings appear indifferent to docks and lobster boat traffic in Cundy's Harbor and Phippsburg. The New Meadows River area contained many crèches; Ridley Cove, to the west, contained fewer. Even

further west, Quahog Bay, which is identical habitat to much of the New Meadows River, had virtually no eiders and ducklings. This leads to a preliminary conclusion that the eastern Casco Bay islands, especially Flag Island, produced more ducklings than the western islands, such as Pond and Ram. While the incidence of small crèches guarded by more than one adult per duckling wasn't unique to Pond and Ram Island, this combined with harassment by gulls and the presence of widespread gull colonies on both islands, suggests that gull predation may have affected productivity at these locations.

Flag Island produced the largest numbers of ducklings in the New Meadows River area. Since females have been banded on Flag Island in 2003, 2004 and 2005, the presence of banded females on the New Meadows River indicates that they brought at least some broods to that area. Although Flag Island is also a gull colony (and some gull predation adjacent to Flag Island was observed) the relative proportion of eiders to gulls nesting on Flag appears to provide conditions whereby at least some females to make it to the mainland and raise ducklings to the size II class.

Jenny Island, managed by National Audubon for common and roseate terns, may also factor into the East Casco Bay's relative duckling success. Gulls are discouraged from nesting on the island, both by Audubon personnel and the terns themselves. The fact that a crèche remained at the island and grew to size IIb may be the result of the gull suppression activity. The overall boat survey method used in 2005 appeared effective. Three trips per week were almost always possible, and changes in crèche location and duckling age were both successfully monitored. A flexible survey route was beneficial, allowing for varying wind and visibility conditions as well as the option to observe crèche migrations. Although crèches were found as far as three miles upstream in the New Meadows, the greatest concentrations were within 1 ½ mile of the open ocean.

## Appendix 4.

### Summary of Expenditures

#### 5/01/03 through 6/30/07

Contractual/Other Services	\$18,315
Supplies and Equipment	9,416
State Admin Cost	<u>174</u>
Total	\$27,905

#### 07/01/07 through 7/31/2008

Prof Services Not By State of Maine	\$6,422
Utilities	600
Rent (Field Station HQ and Vehicle)	5,353
Repairs to Equipment	387
Misc Foods	343
Safety Clothing	138
Other Supplies	<u>783</u>
	\$14,026
Indirect Costs	982
State Cap	<u>293</u>
Total	\$ 15,301

**Grand Total (5/1 through 7/31/2008) \$43, 206**