# Field Ecology: Quantifying Variables at Braddock Bay Raptor Research Center

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## Abstract

New York State's Braddock Bay Park and Wildlife Management Area (WMA) is an important bird conservation area, particularly for young, migrating, and nesting birds of prey, known also as raptors. The following ecological plot survey and species field census was performed for the purposes of systematically evaluating phenotypic and behavioral variables of a metapopulation of two organisms in a specific designated area. By delineating a fixed plot at the Braddock Bay Raptor Research Center Hawk Watch platform within the greater Braddock Bay Park and WMA, subsequent organismal census data was obtained, including a reliable sample metapopulation estimate of 16 bald eagles (*Haliaeetus leucocephalus*) and 13 northern harriers (*Circus cyaneus hudsonius*), two raptor species that utilize the area for food, shelter, migration flyway, and nesting purposes. As ornithological censusing can pose significant challenges due to a multitude of different factors, two ecological methods were incorporated to ensure accuracy, elimination of bias, and a continuous state of observation: a point count via binoculars and a double-observer approach. Additionally, variables were used to visually categorize both species. Finally, and in addition to the technical reporting of this field project, some information is presented graphically, along with several photographs which were taken to document the process.

## Introduction

Concerning *in situ* conservation and wildlife management strategies designed to protect various bird of prey species, one key element required is an accurate, reliable estimate of their population in a given area (Brouwer & Trolliet, 2003; Taylor, 2008). Likewise, researchers must be able to obtain organism variables (e.g. coloration, feather patterns, height, etc.) to determine morphological, genetic, phenotypic, and behavioral variation.

In order to learn more about a metapopulation of two species of raptors, the bald eagle (*Haliaeetus leucocephalus*) and the northern harrier (*Circus cyaneus hudsonius*), the Braddock Bay Park and Wildlife Management Area (WMA) was selected as an ecosystem site where a reliable sample metapopulation estimate could take place and quantifiable variables could be obtained. Moreover, a plot was delineated within the site to accurately obtain and quantify phenotypic and behavioral variables of the sample population.

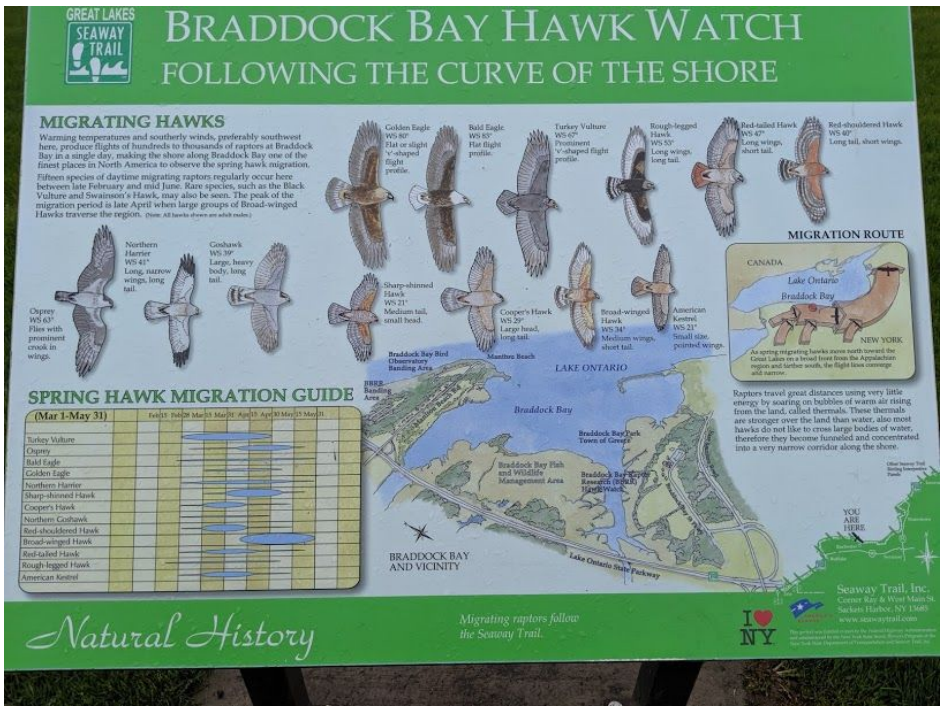
Bald eagles and northern harriers are two bird of prey species, both of which are known to frequent the Braddock Bay Park and WMA in the Town of Greece, New York. While the International Union for Conservation of Nature and Natural Resources (IUCN) lists both species as being of least concern, it is key to note that both bald eagles and northern harriers experienced significant population reductions during the mid-20th century, due in large part to the use of

dichlorodiphenyltrichloroethane (DDT), a pesticide which led to egg shell thinning (Birdlife International, 2016; Brown, 1976). Both species, however, have seen a recovery and rebound in overall population numbers.

Bald eagles underwent a rebound after DDT was banned and other government regulatory provisions were put into place. In particular, Eakle et al. (2015) found that the species experienced a 3.9% increase in the northeastern United States between 1986 and 2010. Likewise, northern harriers experienced a population increase, in part due to the ban on DDT, and also due to additional federal protections and the concomitant conservation of wetlands (Slater & Rock, 2005).

*H. leucocephalus* and *C. cyaneus hudsonius* are very common in forest-wetland ecosystems that dominate the wet temperate zone of the northeast United States (Smith & Smith, 2015). As diurnal predatory birds, each species relies on their acute sight, sharp talons, and flight speed to bring down vertebrate prey species, including animals that can be proportionally larger and heavier (McDonald, Olson & Cockburn, 2004).

Concerning location, the Braddock Bay Park and WMA area was chosen as it is well known for sustaining a large number of different bird of prey species, many of which prefer an admixture of forests, marshes, swamps, river courses, and bay areas where they can hunt for fish, their primary source of food (New York State Department of Environmental Conservation, n.d.). Both bald eagles and northern harriers are also known to utilize the area for breeding, nesting, and migratory purposes (Cornell Lab of Ornithology, n.d.; Eakle et al., 2015).




**(Left) A sign showcasing raptor species seen near the Braddock Bay Hawk Watch platform.**

## Site description

The Braddock Bay Park and WMA, located in the Town of Greece, New York, is a designated wildlife conservation site managed by the New York State Department of

Environmental Conservation (NYSDEC). A "2,125 acre parcel," this expansive tapestry of deciduous forest, wet grasslands, marshland, and open water, located on the southern shore of Lake Ontario just west of the city of Rochester, serves as a critical stopover on the Atlantic Flyway for waterfowl, songbirds, and many species of migrating raptors (New York State Department of Environmental Conservation, n.d.) such as bald eagles (*H. leucocephalus*), northern harriers (*C. cyaneus hudsonius*), red-tailed hawks (*Buteo jamaicensis*), and goshawks (*Accipiter gentilis*).

According to the NYSDEC, the unique, "geography here funnels thousands of birds to food, shelter, and nesting sites among the wetlands, scrub, and woods." As such, the Braddock Bay Park and WMA is a designated Bird Conservation Area (New York State Department of Environmental Conservation, n.d.). It is in this humid, midlatitude northeastern site that abiotic factors such as the moist climate, and the littoral, limnetic, profundal, and benthic zones associated with Lake Ontario and concomitant inlets produces a bordering forest ecosystem dominated by broadleaf deciduous trees such as beech-maple and northern hardwood (Kalff, 2002; Smith & Smith, 2015; Hayford et al., 2015).

On a general note, this freshwater forest-wetland ecosystem site is rich in species biodiversity, with a biotic mix of woody and herbaceous plant species (Bertaba, 2011) and a number of animal species. More specifically, the area surrounding the marsh site consists of the following: aspen (*Populus*), shagbark hickory (*Carya ovata*), white ash (*Fraxinus americana)*, white oak (*Quercus alba*), Eastern hop hornbeam (*Ostrya virginiana*), Eastern cottonwood (*Populus deltoides*) American beech (*Fagus grandifolia*), red oak (*Quercus*), chokeberries (*Aronia*), and red pine (*Pinus resinosa*). The marsh itself, meanwhile, is dominated by cattails (*Typha*) where, aside from a varied number of raptor species, red-winged blackbird (*Agelaius phoeniceus*), tree swallow ( *Tachycineta bicolor*), yellow warbler (*Setophaga petechia*), American goldfinch (*Spinus tristis*), and Canada goose (*Branta canadensis*) species are in abundance. There are also regular sightings of white-tailed deer (*Odocoileus virginianus*).

**Michael Schwartz at the Braddock Bay Park and WMA site.**

While the bay and lake serve as natural boundaries on the north and northeastern side of Braddock Bay Park and WMA, the southern area of the site is heavily fragmented by human development, though it is noteworthy to add that the stewardship of the NYSDEC has ensured that no additional development be permitted.

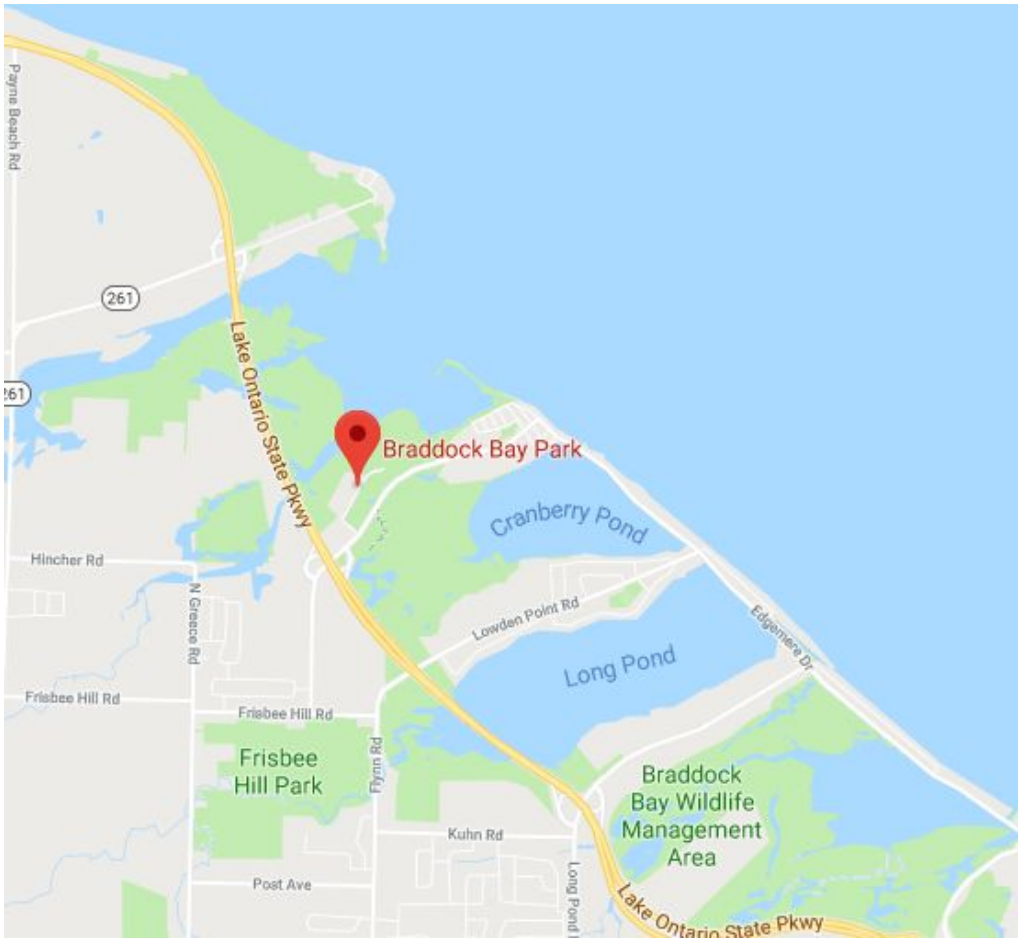
In particular, the Braddock Bay Park is bounded by Lake Ontario on the northern side. The marsh area of the ecosystem is naturally bisected by Braddock Bay itself, which runs northeast toward the lake. This natural ecosystem boundary also provides a slight transition zone

between two different habitats - the significantly more marshy northern side, and the marsh-deciduous mozaic on the southern end near Cranberry Pond, the Braddock Bay Hawk Watch station (plot), Long Pond, and the WMA.

Also dividing a smaller portion of Braddock Bay Park and WMA - located on the western side - from the larger section of the park and WMA in the east is the Lake Ontario State Parkway. While areas north and northeast of the parkway consist of the aforementioned deciduous-marsh complex that comprises the park and WMA, the transition to the south and southeast of the parkway leads to a decreasing spatial environmental gradient of biotic and abiotic factors, including less marsh area overall, a loss of water area and volume, a significant reduction in herbaceous and woody plant life, and a drop in the number of bird species both seen and heard. This is primarily due to significant anthropogenically created boundaries (Banks-Leite & Ewers, 2009), primarily in the form of development south and southeast of the Ontario State Parkway. These areas mostly consist of increasing amounts of roads, residential neighborhoods, and commerce zones.

Lastly, it should be noted that aside from the naturally occurring ecosystem boundaries of Cranberry and Long ponds, there exists a small residential area between both bodies of water, coupled with a stretch of road running parallel with Lake Ontario with marginal human development.

**A screenshot of the Braddock Bay Park and WMA site. Screenshot courtesy of Google Maps.**



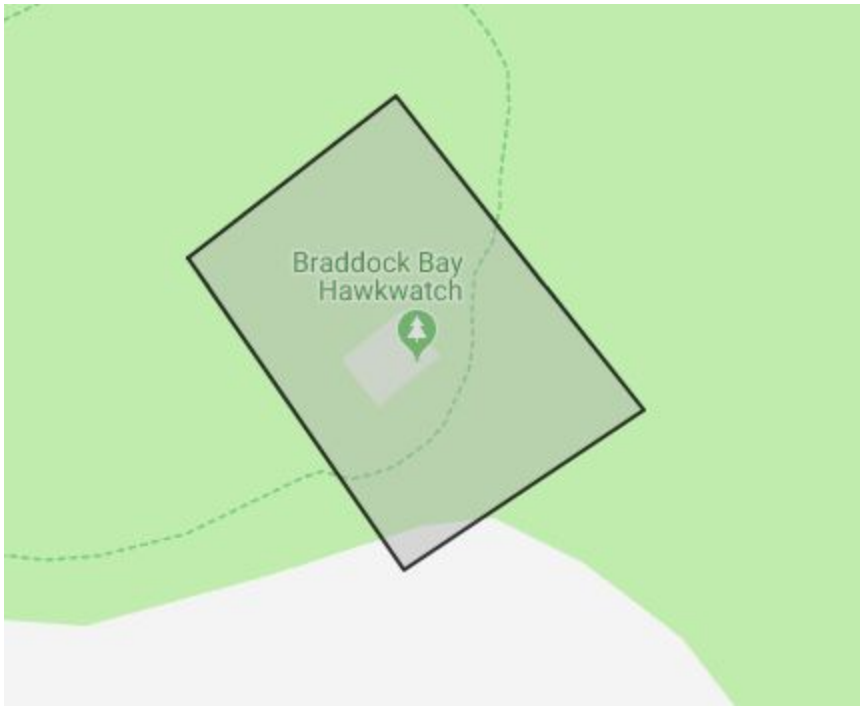
## Plot description

The selected plot included a portion of land stretching beyond the Braddock Bay Raptor Research Center Hawk Watch platform within the greater Braddock Bay Park and WMA. The plot itself consisted of a mix of wetland, grassland, and woody vegetation.

**Michael Schwartz measuring the plot boundary at Braddock Bay Park and WMA.**

Plot delineation consisted of measuring 3716.1216 meters squared around the hawk watch platform. From the hawk watch station, a 100 foot (30.48 meter) tape measure was used to measure away from each edge of the hawk watch platform. That created a 200x200 foot (60.96 x 60.96 meter) square around the hawk watch, giving a total area of 40,000 square feet (3716.1216 square meters).

**The following image is roughly the plot measured. Screenshot courtesy of Google Maps.**




**The Braddock Bay Hawk Watch Platform.**

## Organisms

**Northern Harrier. Wikimedia Commons.**

As previously written, the two organisms censused and variably quantified within the plot were the bald eagle (*H. leucocephalus*) and northern harrier (*C. cyaneus hudsonius*).

As phenotypic variation is often dependent on a combination of genetic (random) and environmental (nonrandom) factors, one can then infer that the survival of a species largely depends on the genotypic and phenotypic variations themselves (Nevo, 2001). As such, the following coloration features were used to visually categorize and age each organism:

**Bald Eagle Immature Coloration** - brown head/brown and white underbelly

**Bald Eagle Adult Coloration** - white head/brown body

**Northern Harrier Juvenile Coloration** - pale orange breast/brown head

**Northern Harrier Adult Coloration** - pale gray/black wingtips/white

**Bald Eagle. Wikimedia Commons.**

It should be noted that concerning phenotypic variation and age association, the designated hawk watcher from the Braddock Bay Raptor Research Center provided accurate descriptions in order to identify each individual and age them accordingly based on coloration. It should also be briefly mentioned that *C. cyaneus hudsonius* is a sexually dimorphic species upon adulthood. Since *H. leucocephalus* is not sexually dimorphic, and because a number of immature bald eagles and juvenile northern harriers were spotted, the quantifiable variables measured were based on varying behaviors.

Lastly, the designated hawk watcher explained that prior to adulthood (but after the first year), bald eagles are referred to as immature. As for northern harriers, their young fully mature after one year, meaning no defined “immature” stage of development. As such, they are considered juveniles.

## Organism Variables

The organism variables include coloration, aging based on coloration, adult versus juvenile based on coloration, and quantifiable behavior. Concerning behavior, it was determined that this was the most quantifiable variable to measure between the two species, though there is a short section in the discussion that touches on the importance of this type of phenotypic variation and species survival.

In particular, three different behaviors were observed; they are categorized by flying, hunting, and perching.

## Methods

The methodology consisted of an introductory field visit. This was done for the purposes of performing an initial walk-through to gain a visual assessment of the site, to select the plot within the site, and to better analyze and understand the ecosystem and organism (vegetation, animal species, etc.).

Following the initial site visit, a follow-up field visit was arranged with a professional bird of prey watcher, who performs annual bird of prey census collections on behalf of the Braddock Bay Raptor Research Center. Based on the measurement and plot delineation, bird of prey censusing was done via a point count with the aid of binoculars, and a double-observer approach, whereby the designated hawk watcher validated the count of the researcher. Birds of prey that were either perched, flew within, or were observed hunting inside the delineated plot were identified, cencused, aged, and characterized by color and behaviorally. Both the point count and double-observer method were utilized over a course of three hours, beginning at 8:00AM Eastern Standard Time, and finishing at 10:00AM Eastern Standard Time during the second field visit. The hawk watcher was also on hand to ensure that the same individual was not counted twice. Birds of prey seen perched in trees within the plot were described well enough to identify them as individuals.

Ages and life stages were estimated based on coloration and plumage, which were described by the hawk watcher whenever an individual was spotted.

## Results

**Table 1 Bald Eagle (*Haliaeetus leucocephalus*)**

| Species # | Immature/Adult | Estimated Age | Age Associated Phenotype | Behavior |
|---|---|---|---|---|
| 1 | Immature | 2 | brown head/brown and white underbelly | flying |
| 2 | Immature | 2-4 | brown head/brown and white underbelly | flying |
| 3 | Immature | 2-4 | brown head/brown | flying |

| | | | | |
|---|---|---|---|---|
| | | | **and white underbelly** | |
| **4** | **Immature** | **2-4** | **brown head/brown and white underbelly** | **flying** |
| **5** | **Immature** | **2-4** | **brown head/brown and white underbelly** | **flying** |
| **6** | **Immature** | **2-4** | **brown head/brown and white underbelly** | **hunting** |
| **7** | **Adult** | **5+** | **white head/brown body** | **flying** |
| **8** | **Immature** | **2-4** | **brown head/brown and white underbelly** | **perched** |
| **9** | **Adult** | **5+** | **white head/brown body** | **perched** |
| **10** | **Adult** | **5+** | **white head/brown body** | **perched** |
| **11** | **Immature** | **2-4** | **brown head/brown and white underbelly** | **flying** |
| **12** | **Immature** | **2-4** | **brown head/brown and white underbelly** | **flying** |
| **13** | **Adult** | **5+** | **white** | **flying** |

| | | | | |
|---|---|---|---|---|
| | | | **head/brown body** | |
| **14** | **Immature** | **2-4** | **brown head/brown and white underbelly** | **flying** |
| **15** | **Immature** | **2-4** | **brown head/brown and white underbelly** | **flying** |
| **16** | **Immature** | **2-4** | **brown head/brown and white underbelly** | **hunting** |

**Table 2 Northern Harrier (*Circus cyaneus hudsonius*)**

| Species # | Juvenile/Adult | Estimated Age | Age Associated Phenotype | Behavior |
|---|---|---|---|---|
| **1** | **Adult** | **2+** | **pale gray/black wingtips/white underbelly** | **flying** |
| **2** | **Adult** | **2+** | **pale gray/black wingtips/white underbelly** | **flying** |
| **3** | **Juvenile** | **1** | **pale orange breast/brown head** | **flying** |
| **4** | **Juvenile** | **1** | **pale orange breast/brown head** | **flying** |
| **5** | **Juvenile** | **1** | **pale orange breast/brown head** | **flying** |
| **6** | **Juvenile** | **1** | **pale orange breast/brown** | **flying** |

| | | | | |
|---|---|---|---|---|
| | | | **head** | |
| **7** | **Adult** | **2+** | **pale gray/black wingtips/white underbelly** | **hunting** |
| **8** | **Adult** | **2+** | **pale gray/black wingtips/white underbelly** | **flying** |
| **9** | **Adult** | **2+** | **pale gray/black wingtips/white underbelly** | **flying** |
| **10** | **Juvenile** | **1** | **pale orange breast/brown head** | **hunting** |
| **11** | **Juvenile** | **1** | **pale orange breast/brown head** | **flying** |
| **12** | **Juvenile** | **1** | **pale orange breast/brown head** | **flying** |
| **13** | **Juvenile** | **1** | **pale orange breast/brown head** | **flying** |

**Table 3 Quantifiable Behavior Variables**

| | Bald Eagle Immature | Bald Eagle Adult | Northern Harrier Juvenile | Northern Harrier Adult |
|---|---|---|---|---|
| Flying | 9 | 2 | 7 | 4 |
| Perched | 1 | 2 | 0 | 0 |
| Hunting | 2 | 0 | 1 | 1 |

**Table 4 Behavior Variable Comparison**

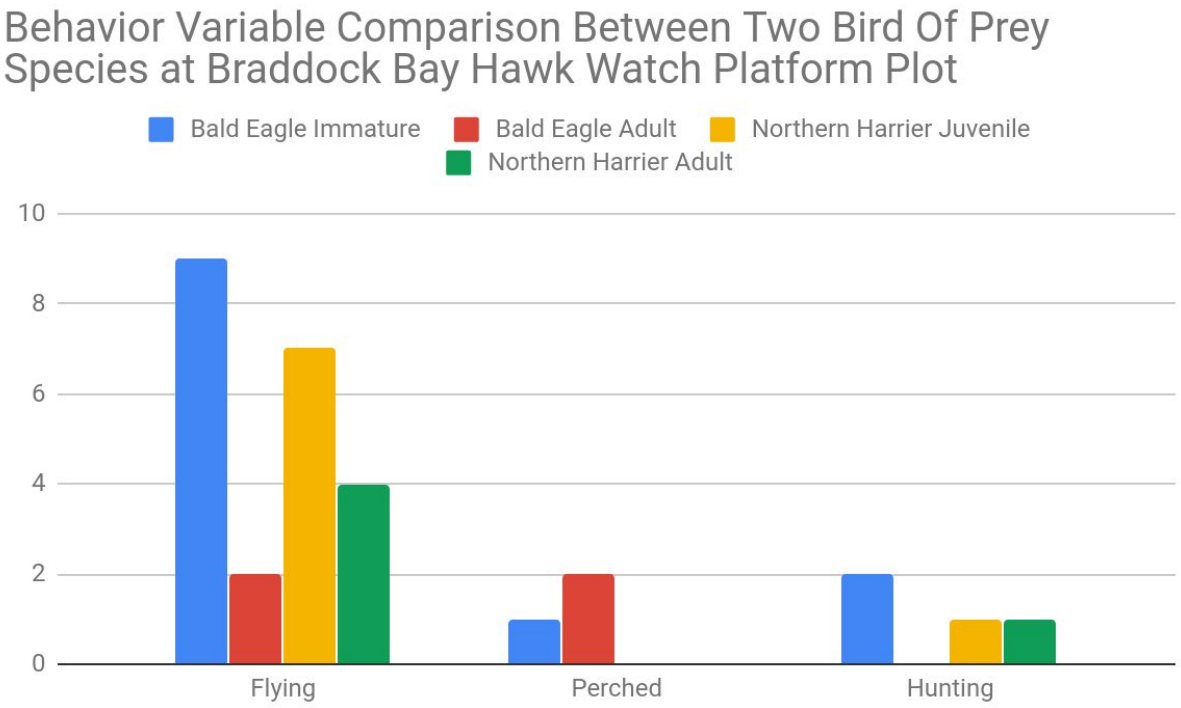
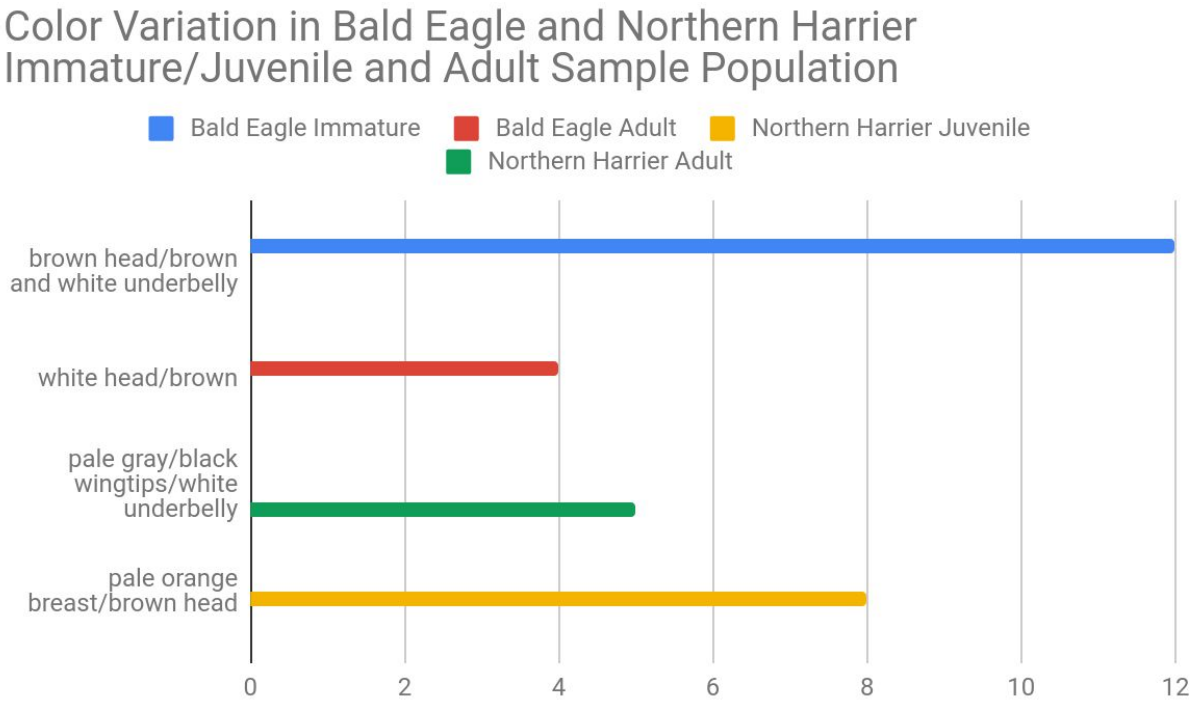



**Table 5 Coloration Variables**

| | Bald Eagle Immature | Bald Eagle Adult | Northern Harrier Juvenile | Northern Harrier Adult |
|---|---|---|---|---|
| brown head/brown and white underbelly | 12 | 0 | 0 | 0 |
| white head/brown | 0 | 4 | 0 | 0 |
| pale gray/black wingtips/white underbelly | 0 | 0 | 0 | 5 |
| pale orange breast/brown head | 0 | 0 | 8 | 0 |

**Table 6 Coloration Variable Comparison**




**Discussion**

Based on the above data, it can be inferred that immature bald eagles and juvenile northern harriers spend a substantially large amount time flying. It might even be argued that younger birds of prey spend more time flying than their adult counterparts. This could potentially happen for three reasons.

First, while a disproportionately larger number of immature and juvenile individuals were counted than adults, one could hypothesize that younger bird of prey species spend more time airborne in order to improve newly acquired skills that would lead to better hunting and thus more successful kills. This, of course, will need further testing with a more reliable sample population in order to validate.

Second, it is possible that as a bird of prey ages, the skills gained as an adult apex predator might

incur an ecological cost of physical impairments that come with aging and associated temporal energy use costs. Thus, an adult bald eagle or adult northern harrier might spend more time perched to conserve energy than an immature eagle or juvenile northern harrier. Again, this will require the testing of a larger sample population with a more equal distribution between immature/juvenile and adult individuals of both populations.

Thirdly, adults often have young to feed, meaning that they will likely have to spend a great deal more time conserving energy to hunt. Young birds of prey, meanwhile, engage in post natal dispersal in lieu of nesting.

Lastly, and in furtherance of bird of prey conservation strategies, the phenotypic findings - though not quantifiable in this particular study - conclude that species diversity is not only vital for the survival of the species itself, but also to ensure the stability of the ecosystem that a population inhabits.

Consider as an example the mesopredator release hypothesis and its impact on trophic levels. In short, mesopredator release is an ecological hypothesis whereby the reduction or extinction of an apex predator population like the bald eagle within an ecosystem could give rise to uncontrolled numbers of mesopredators (Terraube & Bretagnolle, 2018), such as the Eastern racoon (*Procyon lotor lotor*), the striped skunk (*Mephitis mephitis*), or even aquatic mesopredators like the largemouth bass (*Micropterus salmoides*). Consequently, such an alteration of predator assemblages in the food web (Terraube & Bretagnolle, 2018) not only reduces competition, but can likewise lead to unchecked populations feeding on a finite supply of resources.

Moreover, bald eagles and northern harriers are as much opportunistic feeders as they are formidable predators, meaning they will also consume carrion. From an ecological view, this behavior by predators and true scavenger species greatly assists in breaking down organic matter and recycling it back into an ecosystem as nutrients (National Geographic Society, 2012).

To reiterate, an ecosystem cannot function at normal capacity without the stable population of apex predator species. However, a predator species cannot survive unless there is variation, which biotic and abiotic factors depend on as well. It is therefore advisable that an additional study that quantifies coloration pattern variation in sample populations be performed to better assess phenotypic variation and what that implies for individual and population fitness.

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