Mute Swans: an ecological overview with an emphasis on the lower Detroit River

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Cover photo: Darrin O'Brien. Mute Swans and other waterfowl in the Detroit River, south of Mud Island, Ecorse.

EXECUTIVE SUMMARY

Mute Swans (*Cygnus olor*) are native to Eurasia. Introduction into North America occurred prior to 1900, and Mute Swans are now established in North America, Australia, New Zealand, South Africa, and Japan. Michigan has one of the highest populations of Mute Swans in North America, with the first pair having been introduced in Charlevoix Co. in 1919. The first published record for southeast Michigan was from Lake Erie in Monroe Co. in April 1945. Mute Swans have been nesting on or near the Detroit River since at least 1985.

Mute Swans generally occupy and defend a single territory year round, with mated pairs usually only moving from their breeding territories due to ice cover or food shortages. Mute Swans prefer shallow shorelines of slow moving rivers, lakes, or ponds with ample amounts of emergent and submerged vegetation. This species is nearly entirely herbivorous, feeding almost exclusively on submerged aquatic vegetation (SAV) throughout the year. Mute Swans forage in water that is shallow enough to allow them to access SAV, up to 3.5 feet deep, although they often favor depths of less than 30 inches. Adults swans may consume up to 8 pounds of plant material each day, with additional SAV uprooted but not eaten. The most common species of submerged aquatic vegetation consumed by adult Mute Swans in lower Great Lakes coastal marshes are *Potamogeton* spp. (pondweed), *Ceratophyllum demersum* (coontail), *Elodea canadensis* (waterweed), *Najas flexilis* (slender naiad), *Zizania palustris* (wild rice), and *Chara vulgaris* (stonewort).

Mute Swans are very territorial. Aggressive defense of territory is most pronounced during the nesting season, and generally directed toward other Mute Swans. However, they have been known to be aggressive toward other wetland bird species, through threat displays, charging intruders, and sometimes physical contact, but the level of aggression varies widely among individual swans. Canada Geese (*Branta canadensis*) are the most common target of Mute Swan aggression. Many reports of direct conflict with other bird species are anecdotal. Quantifiable studies would be useful in determining the actual frequency and severity of these conflicts.

There is potential for dietary competition between Mute Swans and other waterfowl. As Mute Swans occupy habitats year round, they have the potential to deplete SAV by continuously feeding on plant reproductive parts. Most research regarding the impacts of grazing by Mute Swans has been done in the brackish or saline systems of the Atlantic seaboard; less information is available for freshwater ecosystems. The magnitude of competition between Mute Swans and

migrant and wintering waterfowl on the Detroit River depends on regionally-specific diets, how much SAV resident Mute Swans eat and deplete prior to the fall arrival of Tundra Swans and diving ducks, and the current distribution and abundance of SAV in the lower Detroit River. Studies in other regions have indicated that there are some mechanisms in place that help prevent total loss of SAV from grazing pressure by waterfowl, including botanical adaptations to heavy grazing, and the discontinuation of foraging by waterfowl when SAV (typically tubers) falls below a certain threshold.

Potentially complicating interpretation of SAV depletion in the lower Great Lakes is the effect, if any, of increasing numbers of Tundra Swans wintering in the region. Increases in the Tundra Swan population have coincided (in time and rate of increase) with the increase in Mute Swans, with Tundra Swans being the more abundant of the two species.

There has been concern that Mute Swans could act as reservoirs of avian influenza ("bird flu"). This is unlikely to be an issue in the lower Great Lakes. Mute Swans are generally not migratory or among the bird species most likely to make contact with Asian birds that might be infected by the highly pathogenic avian influenza of the subtype H5N1 that causes illness in humans.

Nuisance impacts such as aggression towards humans and pollution problems due to fecal contamination are likely to be of most concern in urban areas where swans and humans are in close contact.

All of these potential impacts will continue to be of concern as Mute Swan populations grow. In the Atlantic Flyway, the Mid-Summer Mute Swan Survey indicated a population growth rate of 5.8% per year between 1986 through 2002, although the pace has since slowed. The Ontario Mid-summer Mute Swan Survey showed an annual rate of increase since 1986 of roughly 6%. A more thorough analysis of regional Mute Swan numbers in Ontario has indicated growth rates of 10 to 18% per year for the 20 or 30 years prior to 2000.

Breeding Bird Atlas data from southeast Michigan and southwest Ontario show that the distribution of breeding Mute Swans has increased over the last 20 years. Analyses of two Christmas Bird Counts (CBCs) that cover the Detroit River show that the numbers of Mute Swans have increased roughly 15% annually since the mid-1970s. Land-based surveys along the lower Detroit River (nine counts between 5 December 2009 and 13 February 2010) counted an average of 1,053 swans (range 258 to 1,953) wintering between Ecorse and the mouth of the

river.

Mute Swans are long-lived, very adaptable to urban sites, and have few natural enemies. Thus, it is likely that populations of this species will continue to increase in the lower Great Lakes. Further, there is no reason to suppose, given their longevity and resource requirements, that increased numbers of Mute Swans will not have some environmental impact.

Other states and entities have found that reducing reproductive success as a means of population control (e.g., egg addling) for Mute Swans has had limited success. Both real-world experience as well as statistical models have indicated that the best method for reducing numbers of a long-lived species such as the Mute Swan is to reduce adult survival. Further, focusing population control on adults has been found to be more economical, requires far less labor, and resulted in fewer total swans being killed in the long run than trying to reduce reproductive success.

Mute Swans are not a protected by the Migratory Bird Treaty Act in the United States, and management is up to individual states. Michigan's policy is provided as an appendix to this paper, as are examples of recent lawsuits by animal rights activists arguing for legal protection for Mute Swans.

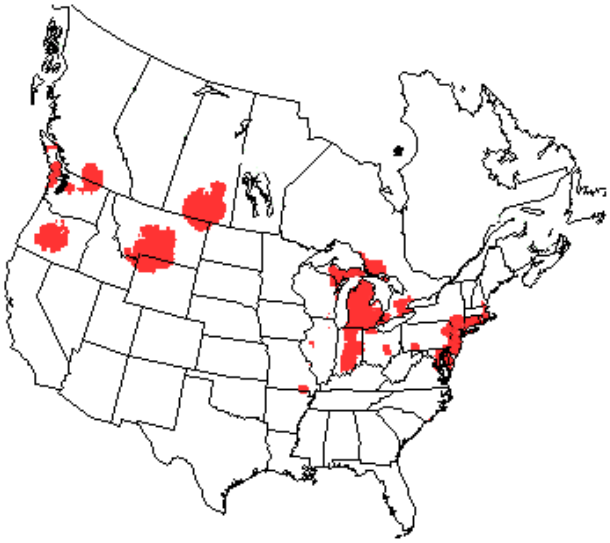
INTRODUCTION

Mute Swans (*Cygnus olor*) are native to Eurasia. They have been kept in captivity, semi-domesticated, or introduced in many localities for hundreds of years, with records of introduced populations dating back to the sixteenth and seventeenth centuries in Europe (Long 1981, Ciaranca et al. 1997). Mute Swans are now established in North America (Figure 1), Australia, New Zealand, South Africa, and Japan.

History in North America

According to Long (1981), the precise date Mute Swans were first brought to North America is not known, but apparently occurred prior to 1900. Mute Swans were imported multiple times and to multiple locations for private collections, zoos, and parks, and all the now-naturalized populations of this species on this continent originated from the escape or release of swans from these and subsequent introductions (Ciaranca et al. 1997). Populations are now established along the Atlantic seaboard from New Hampshire to Virginia, in all of the Great Lakes states, and in coastal British Columbia (Ciaranca et al. 1997).

Figure 1. Winter distribution of Mute Swans in North America based on Christmas Bird Count data. Map from USGS (Gough et al. 1998).



Recently, Mute Swan advocates have been circulating information contending that there is evidence that Mute Swans are actually native to North America. Publication of these claims in a non-peer-reviewed newsletter (Alison and Burton 2008) resulted in rebuttals in the form of an outline of the factual errors in the piece (Warnock 2009), and thorough and detailed debunking of its claims by the USFWS in the Federal Register (Anon. 2005) and by ornithologists (Askins 2009, Elphick 2009, Seymour and Peck 2009). During a series of lawsuits by animal rights activists against the U.S. Fish and Wildlife Service (USFWS), the pro-swan plaintiffs actually conceded that the Mute Swan was not native to North America (Fund for Animals v. Norton, 374 F.Supp.2d 91 (D.D.C.2005)). Nonetheless, swan advocacy groups continue to present this discredited material. It is provided, along with counter-arguments, in Appendix A.

History in Michigan

A single pair of Mute Swans was introduced to Michigan in Charlevoix Co. in 1919. They were originally imported from England in 1918 for the Iowa estate of a wealthy businessman. The male swan proved to be a menace to the owner's children, so the pair of swans was moved to the Chicago Club resort on Round Lake in Charlevoix (Gelston and Wood 1982). The location is often reported as East Jordan (Van Deusen 1991, Granlund 1994), apparently because the swans (which were pinioned and could not fly) would swim from Round Lake to Lake Charlevoix and down to East Jordan, where they would have to be retrieved by the resort caretaker and transported back to Round Lake (Gelston and Wood 1982).

The swans were allowed to reproduce and the young to fly free, and the flock established itself largely around the East Jordan area, often wintering in Traverse City and Traverse Bay. Humans cared for the swans by building nest platforms and controlling predators (Gelston and Wood 1982). Primarily, though, the Michigan Mute Swan population was kept alive and growing by supplemental feeding. Gelston and Wood (1982) noted that food was provided annually from November until April with daily provisions of several hundred pounds of corn, a hundred loaves of bread or baked goods, and seven or eight bushels of lettuce or produce. Twenty tons of corn was fed to the swans in 1971 alone (Root 1988).

Eventually, feeding was curtailed, resulting in some birds moving south in the state on their own (Prince et al. 1992), or being translocated to southern Michigan locations; these populations were augmented by additional releases and introductions (Gelston and Wood 1982, Granlund 1994).

Southeast Michigan

The first published record for southeast Michigan was from Lake Erie in Monroe Co. in April 1945 (Wallace 1945, Kelley 1978), and the first published record for the Detroit River was a single bird in January 1969 (Kelley 1969). By 1973, Mute Swans were nesting in Oakland Co. (Kelley 1973), with the first published Wayne Co. nesting report occurring in 1980, although a specific location was not given (Belyea 1980). Certainly Mute Swans nested on or near the Detroit River no later than 1985, when summer records for Grosse Ile probably indicate breeding birds (E. Carhart, unpub.data).

Other regional history

Ontario

The first feral Mute Swan in Ontario was reported in 1934 at Long Point (Petrie 2004), and the

first published report of nesting swans came from the greater Toronto area in 1958 (James 1991, Petrie 2004).

Ohio

The first published report for Ohio was a single bird at a Cleveland park in January 1936 (Skaggs 1936, Peterjohn and Rice 1991). Closer to Michigan, the first report from Sandusky Bay was in 1948 and they became regular in the state in the 1960s (Peterjohn 2001). The first nesting record did not occur until 1987, and was recorded in the final year of the first Breeding Bird Atlas project for Ohio (Peterjohn and Rice 1991) at Cedar Point National Wildlife Refuge in Lucas Co.

GENERAL ECOLOGY

Habitat

Mute Swans generally occupy and defend a single territory year round (but see "Movements," below). Territory size can range from less than 0.5 ac (0.2 ha) in high-quality habitat up to 15 ac (6 ha) in open-water situations; the average is 4.5 ac (1.8 ha) (Ciaranca et al. 1997, Petrie and Francis 2003). Preliminary results from a study in central Illinois found an average territory size of 10.4 ac (4.2 ha) (Eichholz et al. 2009). Observations of northern Michigan Mute Swans indicated average territory was 6.4 ac (2.6 ha) with nests of adjacent pairs typically 0.12 to 0.25 mi (200 to 400 m) apart, although in dense populations or well-vegetated areas nest spacing could be as close as about 30 ft (10 m) (Koechlein 1971, Wood and Gelston 1972).

Mute Swans prefer shallow shorelines of slow moving rivers, lakes, or ponds with ample amounts of emergent and submerged vegetation (Ciaranca et al. 1997). Preferred nest sites require easy access to water and nesting material, which may include emergent vegetation such as reeds, rushes, and cattails, as well as some woody vegetation (Ciaranca et al. 1997). In Michigan, marshy edges of lakes and ponds have been found to be favored nesting habitat, especially cattail and bulrush communities, with abandoned muskrat houses often used as nest sites (Wood and Gelston 1972, Van Deusen 1991).

Reproduction

Mute Swans generally begin breeding by their third spring and will breed throughout their lives. Although they may live 25 years in the wild, seven years is a more typical life span (AFC 2003). Peak egg laying in this area occurs in early to mid-April (Van Deusen 1991). If a previous nest site is available, it will often be refurbished and reused in successive seasons (Reese 1975). The

average clutch size is four to six eggs (Ciaranca et al. 1997). Based on nests from Macomb and St. Clair counties in the early 1980s, clutch size ranged from five to eight with an average of six, and eggs hatching typically occurred by the end of May (unpub. data). Cygnets fledge in 120 to 150 days (Ciaranca et al. 1997). Mute Swans raise only one brood per year.

Causes of mortality

See "Limiting factors," below.

Movements

Mute Swans are largely sedentary, with mated pairs usually only moving from their breeding territories due to ice cover or food shortages. Mute Swans molt after breeding. Females molt before males, less than two months after eggs hatch, while males commence about one month after their mates (Ciaranca et al. 1997, Czapulak 2002). This extends the overall flightless molt period to six to eight weeks, when the birds may gather in groups in open, shallow wetlands (Ciaranca et al. 1997, AFC 2003, RIDEM 2007). In this region, the molt period occurs in late summer.

If fall movement occurs, it commences from September to mid-December, depending on location and conditions, prior to birds settling into a place for the winter. Non- or unsuccessful breeders and some family groups may make short seasonal movements to wintering areas with open water and abundant food. Actual movements of individuals may be masked by the presence of resident birds (Ciaranca et al. 1997).

At a site in England, most pairs spent at least half the winter on their breeding territories, with the fewest pairs on territory in January and February when temperatures were lowest. Territories in which birds stayed all winter were higher quality (greater net weight of aquatic vegetation) than vacated territories. Birds that left their territories moved less than 2 mi (3 km) (Scott 1984). Fifteen pairs of Mute Swans studied on freshwater ponds in Connecticut occupied their breeding territories all year except when the ponds froze (Conover and Kania 1994).

Studies of marked individuals have indicated fidelity to natal, breeding, and wintering sites. In England, Coleman et al. (2001) found that females showed more fidelity to natal sites than males, with half establishing territories less than 3 mi (5 km) from where they were born; 33% of males showed the same pattern. Thirty-four percent of males and 21% of females dispersed > 9 mi (15 km). The same study noted that approximately 40% of Mute Swans kept the same territory and

mate throughout their lives. Another study in England noted that 71% of surviving young swans ended up in their local flock (Watola et al. 2003).

In Massachusetts, up to 95% of Mute Swans were faithful to wintering areas (Ciaranca et al. 1997). Marked individuals in the vicinity of Chesapeake Bay were noted up to 45 mi (72 km) from the point at which they were banded, but no average distances or seasonal information was provided (Reese 1975).

In this region, pairs move back to breeding territories as soon as the sites become ice-free, typically by March, and begin nesting activities and incubation by mid-April (Granlund 1994, Badzinski 2007). Gelston and Wood (1982) stated that movements from wintering sites to nesting areas could be up to 90 mi (145 km), but the population studied was in northern Michigan and maintained overwinter by supplemental food placed in several pre-determined areas. Distances might be shorter for a southern Michigan population not provided with artificial sustenance. Lacking a marked population (neck bands, radio telemetry), it is probably not possible to determine the dispersal and movements of the local swan population.

Diet

Mute Swans are nearly entirely herbivorous, and feed almost exclusively on submerged aquatic vegetation (SAV) throughout the year, although they will switch to diets higher in animal matter if SAV is not available (Ciaranca et al. 1997, Sousa et al. 2008). All portions of SAV may be consumed, although leaves and stems may be most common, with roots, stolons, rhizomes, and seeds eaten less frequently (Bailey et al. 2008). Small amounts of terrestrial vegetation and animal matter may also be eaten, especially during molting periods (Gelston and Wood 1982, Ciaranca et al. 1997).

Mute Swans forage in water that is shallow enough to allow them to access SAV, up to 3.5 ft (107 cm) deep, although they often favor depths of less than 30 in (0.75 m) (Owen and Cadbury 1975, Ciaranca et al. 1997, Allin and Husband 2003, Tatu 2006). One study indicated that the highest herbivory was found in years where average water depth was 24 in (62 cm) and that very soft substrate in shallow water could prevent feeding if it was difficult for the swans to walk on (Allin and Husband 2003).

Mute Swans also take vegetation from, at, or just below the surface of the water. In shallow water, swans expose roots and rhizomes of plants by raking with their feet. Uprooted SAV is torn

apart and eaten at the water's surface (Ciaranca et al. 1997). Adults swans may consume up to 8 lbs (3.7 kg) of plant material each day, with additional SAV uprooted but not eaten (Owen and Cadbury 1975, Ciaranca et al. 1997).

Types of SAV consumed in North America – marine and brackish water

On Chesapeake Bay, main foods eaten are *Ruppia maritima* (widgeon grass), *Potamogeton pectinatus* (sago pondweed), *P. perfoliatus* (claspingleaf pondweed), *Zannichellia palustris* (horned pondweed), *Zostera marina* (eelgrass), and *Myriophyllum spicatum* (Eurasian watermilfoil); *Ruppia maritima* is frequently preferred (Ciaranca et al. 1997, Perry et al. 2004, Tatu et al. 2007). In Maryland, Mute Swans feed almost exclusively on *Ruppia maritima* and *Zostera marina* (Hindman and Harvey 2004). *Ruppia maritima* and *Zannichellia palustris* were preferred by Mute Swans in a brackish coastal marsh in Rhode Island (Allin and Husband 2003).

Types of SAV consumed in North America – fresh water

In Connecticut, the three most common food plants in freshwater ponds occupied by Mute Swans were *Potamogeton* spp., *Nymphaea odorata* (American white waterlily), and *Elodea canadensis* (American waterweed) (Conover and Kania 1994).

Gelston and Wood (1982) provided no detail on the diets of Mute Swans in Michigan.

Bailey et al. (2008) examined diets of 132 Mute Swan specimens taken from the coastal marshes of the lower Great Lakes, including the Canadian side of the Detroit River. Specimens were taken in all seasons of the year and intake of top food items did not vary by season. Swans ate primarily leaves and stems, with seeds, roots, and tubers taken less frequently. Invertebrates also occurred in 14% of female and 32% of male samples. Table 1 lists the most common plant species found in the diets of adult Mute Swans.

Table 1. The most common species of submerged aquatic vegetation consumed by adult Mute Swans in lower Great Lakes coastal marshes, based on percent occurrence of identifiable food items. Data from Bailey et al. (2008).

SAV species	*Rank in diet*	
	Female	*Male*
Potamogeton spp. (pondweed)	1	1
Ceratophyllum demersum (coontail)	2	2
Elodea canadensis (waterweed)	3	1
Najas flexilis (slender naiad)	4	2
Zizania palustris (wild rice)	5	4
Chara vulgaris (stonewort)	6	3

POTENTIAL IMPACTS OF MUTE SWANS

Direct conflict with other birds

Mute Swans are the largest waterfowl in Michigan, with the exception of Trumpeter Swans (*Cygnus buccinator*), which occur locally in small numbers as the result of state restoration efforts. Mute Swans aggressively defend their territories during the nesting season through threat displays, charging intruders, and sometimes physical contact. This aggression may potentially displace native waterfowl and other wetland bird species from breeding and staging areas (Ciaranca et al. 1997). In regions where wetland loss has reduced the amount of habitat available to waterfowl, there is concern that established populations of Mute Swans could compete for space and resources and reduce the carrying capacity of habitats (Petrie and Francis 2003).

Mute Swan aggression is most pronounced during the nesting season, and generally directed toward other Mute Swans (Ciaranca et al. 1997). Mute Swans have been known to be aggressive toward other wetland bird species, mostly Canada Geese (*Branta canadensis*), but the level of aggression varies widely among individual swans (Ciaranca et al. 1997, Therres and Brinker 2004). An overview of these interactions was made by Therres and Brinker (2004). They noted several unpublished accounts of Mute Swans killing Mallard ducklings and Canada Goose goslings provided by the public to the Maryland Department of Natural Resources. They also cited one published account of a fatal attack of a Mute Swan on another species, a Blue-winged

Teal *(Anas discors*), documented in Allin et al. (1987).

Stone and Marsters (1970) documented a number of fatal attacks by Mute Swans on other waterfowl species, but these occurred among captive birds on a 1.2 ac (0.5 ha) zoo pond occupied by 110 ducks and 20 geese. This may suggest that the most serious aggression by Mute Swans could take place in small ponds or marshes in overcrowded conditions, although how frequently these circumstances might occur in natural settings, especially during the breeding season, requires more study.

A study in central Illinois (Eichholz et al. 2009) is examining interactions between Mute Swans and other waterbirds. Preliminary results have indicated:

- Mute Swans (mostly males) were most aggressive during territory formation in early March. Aggressive behavior declined throughout the nesting season to very low levels during brood rearing.
- Most aggression was directed toward other swans, with another large proportion toward Canada Geese. The remaining 7% of aggressive encounters were spread out among 12 other waterbird species.
- Canada Geese, Mallards, Blue-winged Teal, Northern Shoveler (*Anas clypeata*), and American Coots (*Fulica americana*) were all found significantly closer to Mute Swans than randomly-placed control stakes at the study sites. Only Gadwall (*Anas strepera*) were found closer to control points than to swans. This may suggest that the benefits of sharing habitat with Mute Swans outweighs the costs of limited aggressive encounters for most species, but the reasons for these distribution results are provisional and have not been fully tested (M. Eichholz, pers. comm.).

Allin and Husband (2003) noted that a brackish coastal pond in Rhode Island had nesting American Black Ducks, Blue-winged Teal, and Mallards in the 1950s, but more recently Mute Swans were the predominant summering species, with only very limited numbers of nesting Canada Geese and Mallards.

Over seven years of observation of breeding Mute Swans in Chesapeake Bay, Reese (1975) did not observe any serious attacks on other waterfowl, and stated that several other authors believed that attacks were rare.

Conover and Kania (1994) studied 15 pairs of Mute Swans on freshwater ponds in Connecticut and found that about a third of aggressive interactions were directed against other bird species, primarily Mallards *(Anas platyrhynchos*), American Black Ducks *(A. rupripes*), and Canada Geese (*Branta canadensis*). Most waterfowl simply moved away; they were bitten by swans in fewer than 20% of the attacks. The authors did not observe any instances of the swans foiling breeding attempts by other species, which did nest along with swans at most of the sites.

Kania and Smith (1986) documented a pair of swans in Connecticut nesting on top of two sequential active Mallard nests. Therres and Brinker (2004) gave a report from Maryland Department of Natural Resources biologists of a Mallard nest within 16 ft (5 m) of a Mute Swan nest.

In the early 1990s in Maryland, a large (>600 birds) flock of Mute Swans caused Black Skimmers (*Rynchops niger*) and Least Terns (*Sterna antillarum*), both state-threatened species, to abandon two nesting colonies. During their flightless molting period, the swans used sites occupied by the nesting terns and skimmers as loafing sites, and apparently trampled on nests, eggs, and young (Hindman and Harvey 2004, Therres and Brinker 2004).

Winter aggression is more limited (Ciaranca et al 1997). Reese (1975) reported that Canada Geese and Tundra Swans (*Cygnus columbianus*) were seldom tolerated in Mute Swan territories on a few properties in Chespeake Bay, but the data was anecdotal. Hindman and Harvey (2004) stated that Mute Swans drove Tundra Swans from winter foraging and protective sites, but gave no further details.

During approximately 20 hours of winter swan counts along the lower Detroit River (see "Population Trend" section, below), I observed no aggressive encounters between Mute Swans and other waterfowl species, although systematic observations were not conducted.

Competition for food

Food availability in the Detroit River

Several surveys of aquatic vegetation have been published for the Detroit River. Hunt (1963) sampled the lower Detroit River in 1950-1954, and also listed some species found in earlier surveys (Campbell 1886, Farwell 1901, and an uncited 1935 survey). Schloesser and Manny (1982) provided a list of 13 taxa from the Detroit River from sampling done in fall 1978. In 1984-1985, Schloesser and Manny (1990) sampled sediments for winter buds *of Vallisneria*

americana in the lower Detroit River and found several other species. Appendix B lists all the species reported from those surveys.

Overall, the most common SAV species that have been found in the Detroit River include (in approximate rank order):

- *Vallisneria americana*
- *Heteranthera dubia* (grassleaf mudplantain)
- *Myriophyllum spicatum*
- *Potamogeton* spp. (especially *P. crispus,* curly pondweed, and *P. richardsonii,* Richardson's pondweed)
- *Chara* spp.
- *Elodea canadensis*

Myriophyllum spicatum and *Potamogeton crispus* are introduced species. *M. spicatum* is considered an invasive species across its range in North American, including Michigan (MISIN 2009, NISIC 2009). *Potamogeton crispus* is considered invasive in some states (USDA 2010).

Vallisneria americana is often considered to be one of the most important species of SAV because of its value to waterfowl, especially Canvasbacks (*Aythya valisineria*) (Hunt 1963, Lovvorn 1989, Schloesser and Manny 1990, 2007). The abundance of *Vallisneria* in the Detroit River declined between the 1950s and the mid-1980s (Schloesser and Manny 1990), but increased 251% between the mid-1980s and the late 1990s (Schloesser and Manny 2007). This recovery was attributed to pollution abatement and increased light penetration due to the filtering of suspended sediments by introduced dreissenid mussels. Similarly, changes in the comparison of SAV in Long Point Bay, Lake Erie, Ontario between 1976 and the early 1990s indicated that *Vallisneria* and *Najas flexilis/guadalupensis* have expanded their ranges, also probably due to increased light penetration associated with dreissenid mussels (Knapton and Petrie 1999). Bailey et al. (2008) found *Vallisneria* ranked 7th in diets of female Mute Swans and 6th in diets of males in coastal Great Lakes marshes.

Species of waterfowl using the Detroit River

Based on the last 20 years of Christmas Bird Counts (CBCs, more detail in "Population Trend" section, below) that cover the Detroit River (NAS 2002, Craves and Fowler 2003, Craves 2006), the most frequent and abundant species of waterfowl, other than Mute Swan, wintering on the Detroit River (in taxonomic order) are:

- Canada Goose
- Mallard (*Anas platyrhynchos*)
- Canvasback
- Common Goldeneye (*Bucephala clangula*)
- Common Merganser (*Mergus merganser*)

Other common waterfowl species on both counts include Redhead (*Aythya americana*), Bufflehead (*Bucephala albeola*), and Greater Scaup (*Aythya marila*), while Tundra Swan (*Cygnus columbianus*) and Gadwall are abundant mostly on the Rockwood CBC, and American Black Duck (*Anas rubripes*) on the Detroit River CBC. These species also represent many of the common and abundant migrant waterfowl staging in the Detroit River during migratory periods.

Diets of other waterfowl

Knapton and Petrie (1999) found that *Vallisneria americana* was the most common SAV present in the diets of waterfowl in Long Point Bay, Lake Erie, Ontario, with other commonly-occurring species being *Chara vulgaris*, *Potamogeton* spp., *Polygonum* spp. (knotweeds), and *Najas flexilis/quadalupensis*.

A few other studies have examined various aspects of the diets of some species of waterfowl in the region, while other studies provided less regionally-specific information about waterfowl eating habits. Table 2 summarizes the main diets of nine species of waterfowl which commonly winter on the Detroit River taken from sources in the literature, focusing on food items consumed during winter or in the Great Lakes area when available. Based on these data, which may not be inclusive or strictly indicative of local diets, the greatest likelihood of dietary overlap with Mute Swans in the Detroit River occurs with Tundra Swan and Redhead, and possibly Canvasback.

In many studies, Tundra Swans favor tubers over above-ground vegetation, with a strong preference for *Potamogeton pectinatus* where it occurs (Limpert and Earnst 1994, Earnst 1994, Jonzen et al. 2002, Badzinski et al. 2006, Klaassen et al. 2006). The current diversity, distribution, and relative abundance of *Potamogeton* spp. in the Detroit River is apparently not known. While other authors have mentioned dietary overlap between these two swan species, they have also noted that Tundra Swans feed far more often in agricultural fields, which is also frequently observed in southern Wayne and Monroe counties (P. Cypher, pers. comm.; pers. obs.). In Chesapeake Bay, Tundra Swans eat mostly clams (Perry et al. 2004).

Redheads prefer to forage in water 5 to 12 in (12 to 30 cm) deep (Woodin and Michot 2002), within the foraging range of Mute Swans. The studies cited above indicate that *Potamogeton* spp. and *Elodea canadensis* are preferred foods of both Redheads and Mute Swans, while *Chara vulgaris* is favored by Redheads more than it is by swans.

In the 1950s, *Vallisneria americana* was found growing in the Detroit River at depths of 12 and 132 in (30 and 335 cm) and most densely at 56 to 128 in (142 to 325 cm), with more tubers per square yard in deeper water (Hunt 1963). Mute Swans are generally limited to a foraging depth of 42 in (107 cm), while Canvasbacks sometimes dive in water as deep as 36 ft (11 m), although 20 to 80 in (50 to 200 cm) is more typical (Mowbray 2002, Robison and Kafcas 2007).

Determining current distribution (including depth) and abundance of *Vallisneria* in the lower Detroit River would provide insight on potential competition between Mute Swans, Canvasbacks, and other waterfowl.

Table 2. Primary diets of important species of waterfowl which occur on the Detroit River, with an emphasis on regional or non-breeding diets.

Species	**Notes on diet**
Tundra Swan	• Mostly vegetation, often tubers and rhizomes. Tubers of *Potamogeton pectinatus* and *Sagitaria latifolia* (broadleaf arrowhead) important, but increasing dependence on corn and other agricultural waste.[1] • *Potamogeton pectinatus* tubers strongly preferred, especially during fall migration.[2,3] • *P. pectinatus*, *Sagitaria* spp., and *Vallisneria* in the upper Mississippi River in winter or migration.[4] • Soft-shelled clams primary item in Chesapeake Bay.[5]
Gadwall	• In fall and winter, *Myriophyllum spicatum*, algae, *Eleocharis parvula*, *Ruppia maritima*, seeds of *Cyperus* spp., and seed and rhizomes of *Lachnanthese caroliniana* (redroot), some invertebrates.[6] • At Long Point, Ontario, *Myriophyllum spicatum* and seeds of *Scirpus* spp. occurred most frequently.[7]
American Black Duck	• In fall and winter, roots and tubers of *Scirpus* spp. (bulrush), *Sagitaria* spp., and *Eleocharis* (spikerush), and seeds of many plant species, including *Potamogeton* spp., *Carex* (sedges), and *Zizania aquatica*.[8] • *Elodea canadensis* eaten in small quantities in Long Point Bay, Lake Erie, Ontario.[9]
Canvasback	• Food selection varies seasonally, geographically, and by availability in habitat, being positively correlated with occurrence. Tubers of *Vallisneria americana* and *Sagittaria rigida* (stiff arrowhead) during migration on upper Mississippi River.[10] • *Vallisneria americana* tubers primary item in western end of Lake Erie.[11] • *Vallisneria americana* primary item, seeds of *Sparganium eurycarpum* (giant bur-reed) and *Scirpus acutus* (hardstem bulrush) major items in Long Point Bay, Lake Erie, Ontario.[9] • Baltic clams *(Macoma balthica)* primary item in Chesapeake Bay, with *Ruppia maritima* and *Potamogeton perfoliatus* main plant items; *Vallisneria americana* only a minor item.[12]
Redhead	• Winter diet on large inland lakes mostly SAV (*Potamogeton* spp. and *Elodea*) and seeds.[11] • Zebra mussels (*Dreissena polymorpha*) a primary item in western end of Lake Erie, but thought to have been ingested because mussels were attached to *Potamogeton* leaves.[11] • *Chara vulgaris* primary item, *Vallisneria americana* major item in Long Point Bay, Lake Erie, Ontario.[9] • In fall along upper Mississippi River *Vallisneria americana* tubers; at Long Point, Ontario *Chara* spp., *Potamogeton friesii* (Fries' pondweed), *Vallisneria americana*, *Najas* spp., and agricultural grains.[13]

Table continued on next page.

Table 2, continued.

Greater Scaup	• Primarily animal matter, including crustaceans and small bivalves, especially zebra mussels in the Great Lakes.[14] • Seeds of *Scirpus acutus* and *Nuphar variegata* (bullhead waterlily) primary plant items in Long Point Bay, Lake Erie, Ontario.[9] • Prior to zebra mussel establishment, winter diet in Detroit River about 70% plants, with 30% being *Vallisneria americana*. Most common animal matter snails and aquatic worms.[15]
Bufflehead	• Primarily aquatic invertebrates, mostly insects in freshwater, and some seeds. In winter snails and clams important, as are seeds of *Potamogeton* and *Najas* spp. and *Scirpus* spp.[16] • Amphipods (*Hyalella/Gammarus* spp.) and zebra mussels main items in western end of Lake Erie.[11] • *Chara vulgaris* primary plant item in Long Point Bay, Lake Erie, Ontario.[9]
Common Goldeneye	• Primarily animal matter, including some fish, and small amount of plants. Animal matter mostly crustaceans and insects, plants mostly seeds of *Potamogeton* spp., *Najas* spp., *Scirpus* spp., and *Nymphaea* spp.[17] • Zebra mussels primary item in western end of Lake Erie.[11] • Seeds of *Sparganium eurycarpum* primary plant item in Long Point Bay, Lake Erie, Ontario.[9] • Plant items in Detroit River included *Vallisneria americana*, *Potamogeton* spp., and *Scirpus* spp. Major animal items included aquatic worms, water mites, and midge larvae.[15]
Common Merganser	• Primarily small fish, but also aquatic invertebrates, a few small amphibians or terrestrial vertebrates. Traces of plant material thought to be incidental to consumption of other foods.[18]

[1]Limpert and Earnst 1994, [2]Earnst 1994, [3]Badzinski et al. 2006, [4]AHEPTSC 2007, [5]Perry et al. 2004, [6]Leschack et al. 1997, [7]Petrie 1998, [8]Longcore et al. 2000, [9]Knapton and Petrie 1999, [10]Mowbray 2002, [11]Custer and Custer 1996, [12]Perry and Uhler 1988, [13]Woodin and Michot 2002, [14]Kessel et al. 2002, [15]Jones and Drobney 1986, [16]Gauthier 1993, [17]Eadie et al. 1995, [18]Mallory and Metz 1999.

The magnitude of competition between Mute Swans and migrant and wintering waterfowl on the Detroit River also depends on how much SAV resident Mute Swans eat and deplete prior to the fall arrival of Tundra Swans, Canvasbacks, and other diving ducks (Naylor 2004). As suggested by Bailey et al. (2008), there is great potential for dietary competition between Mute Swans and other waterfowl in the region. Certainly more study is warranted.

Potential impact on SAV

Native species of SAV have evolved with native waterfowl, with coordinated timing of SAV reproduction and waterfowl consumption (Naylor 2004). Non-native, largely sedentary Mute Swans may represent a deviation from this pattern.

As previously noted, adult Mute Swans eat between four to eight pounds of SAV per day and dislodge additional SAV with their feet or bills. As Mute Swans occupy habitats year round, they have the potential to deplete SAV by continuously feeding on plant reproductive parts, especially those species that rely on nutrient reserves in their tubers for the following year's growth, such as *Vallisneria americana* and *Scirpus americanus* (Petrie 2002). In England, Mute Swan grazing disproportionately on leaves and perhaps flowering parts of an aquatic plant (*Ranunculus penicillatus*) reduced the plants' ability to support new growth and possibly set seed (O'Hare et al. 2007).

Other studies have indicated that non-breeding Mute Swans, feeding in concentrated flocks, may be more detrimental to SAV than breeding pairs which exclude other swans from a territory (Sousa et al. 2008).

Most of the research done on the impact of Mute Swans on SAV has focused on the Chesapeake Bay ecosystem. High- and moderate-salinity areas of the Bay are dominated by *Ruppia maritima*, *Zostera marina*, and *Zannichellia palustris*; while *Myriophyllum spicatum*, *Hydrilla verticillata* (water thyme), and *Vallisneria americana* are the most abundant species in low-salinity and freshwater portions of the Bay (Moore et al. 1998).

SAV in Chesapeake Bay began declining in the late 1960s due to increased sedimentation and pollutants (primarily nutrients via fertilizer runoffs) (Lovvorn 1989, Hindman and Harvey 2004). Overgrazing by Mute Swans added to the stressors of SAV in the Bay as the population of birds exploded in the 1980s (Hindman and Harvey 2004). Mute Swans had the most impact on reduction in cover, shoot density, and canopy height of SAV (*Ruppia maritima* and *Zannichellia*

palustris) in shallow water less than 40 in (1 m) deep in Chesapeake Bay (Tatu et al. 2007). In summarizing the food habits of Mute Swans in Chesapeake Bay, Perry et al. (2004) stated that more information is needed to understand the cumulative effects of year-round foraging by Mute Swans on beds of SAV in the Bay.

Less research has been published on the impacts of grazing by Mute Swans in freshwater systems. On 15 freshwater ponds in Connecticut occupied by Mute Swans, Conover and Kania (1994) found no significant differences in above-ground biomass of SAV (predominantly *Potamogeton* spp., *Nymphaea odorata*, and *Elodea canadensis*) between grazed and exclosed sites.

Preliminary results of a study underway in central Illinois indicates that grazing by Mute Swans is having an impact on below-ground biomass of SAV (Eichholz et al. 2009). There is also concern that Mute Swan grazing of native vegetation may be facilitating the invasion of non-native *Myriophyllum spicatum*, thwarting wetland restoration (M. Eichholz, pers. comm.).

At least some species of SAV are able to adapt to heavy grazing. Studies have shown that increased predation pressure on *Potamogeton pectinatus* in Europe by Bewick's Swans (*Cygnus columbianus bewickii*, a subspecies of Tundra Swan,) resulted in deeper burial of tubers, an adaptive response that occurred over approximately 20 years (Santamaria and Rodriguez-Girones 2002, Hidding et al. 2009).

A population model, also examining Bewick's Swans and *Potamogeton pectinatus*, indicated that while fall tuber depletion decreased the density of sprouting colonies in spring, the density of tubers produced the following fall increased – the swans removed tubers before overcrowding occurred, stabilizing the SAV population, albeit sometimes at lower densities (Jonzen et al. 2002).

SAV populations at a large freshwater lake in North Carolina, dominated by *Vallisneria americana,* have been well-studied. Despite historically heavy use by winter waterfowl, primarily Canvasback and Tundra Swans, *Vallisneria* was able to persist in dense stands and recover from salinity-induced declines (Froelich and Lodge 2000). Sponberg and Lodge (2005) found no carryover effects on aboveground vegetation of *Vallisneria* despite significant winter reduction of tubers by waterfowl.

In the Great Lakes, Badzinski et al. (2006) looked at grazing pressure by Canada Geese and Tundra Swans on SAV in Lake Erie at Long Point, Ontario, because populations of Tundra Swans have been increasing in North America since the early 1980s. That study found no evidence that Tundra Swans or Canada Geese had any more impact on *Chara* spp., *Vallisneria americana,* or *Potamogeton pectinatus* than other abundant waterfowl species staging in the area in the fall.

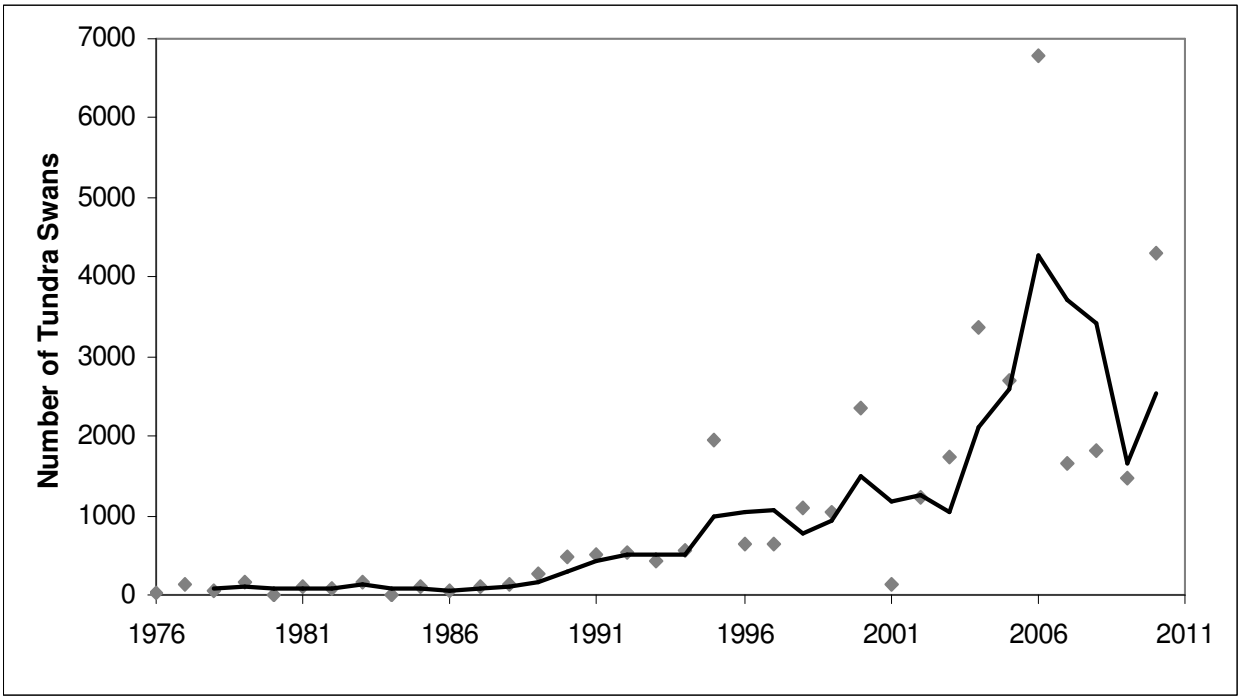
A number of studies have indicated that diving ducks and swans are bioenergetically unable to totally eliminate SAV because they discontinue foraging when SAV (typically tubers) falls below a certain threshold, sometimes called the "giving-up density" (Lovvorn 1994, Lovvorn and Gillingham 1996, Nolet et al. 2001, Sponberg and Lodge 2005). This threshold varies with season, water depth, and the proportion of overall profitable foraging habitat, but was found to be in the range of 200 to 278 *Vallisneria* tubers/m^2 (Lovvorn 1994, Sponberg and Lodge 2005). It appears there are some mechanisms in place that help prevent total loss of SAV from grazing pressure by waterfowl, at least in some systems.

Potentially complicating interpretation of SAV depletion in the lower Great Lakes is the effect, if any, of increasing numbers of Tundra Swans. The eastern population breeds in the northern prairies and winters primarily along the Atlantic coast, but also locally in the eastern Great Lakes, particularly the southern shore of Lake Erie (Limpert and Earnst 1994). The total continental population of Tundra Swans in 1952-1956 averaged 85,700, with eastern birds making up about 60% of the total (Stewart and Manning 1958). Between 1955 and 2000, the eastern population more than doubled, but has decreased an average of 2% per year since then. It currently exceeds 100,000 birds (Serie et al. 2002, USFWS 2009).

On the Rockwood Christmas Bird Count (see "Population Trend" section, below, for more details and caveats), Tundra Swans have increased at approximately 13% annually between 1976-2010, based on an exponential growth model (Figure 2). The average number of Tundra Swans recorded on this count between 1976-1997 was 326; this number has risen to 2,286 for the years 1998-2010.

More diving ducks, in particular Canvasbacks, have also been wintering on the lower Great Lakes, including the lower Detroit River, during mild-weather years (Robison and Kafcas 2007). In late winter 2007-2008, hundreds of Canvasbacks and Redheads, as well as Mute Swans, died of malnutrition in the St. Clair River and Lake St. Clair, which state officials attributed to the

Figure 2. Raw numbers of Tundra Swans on the Rockwood Christmas Bird Count, 1976-2010, not adjusted for effort. Trendline represents a three-year moving average.



larger-than-usual number of waterfowl wintering on the Lake, which remained open well into January (MDNR 2008).

As resources become depleted by high numbers of waterfowl, they may not have the energy reserves to move out of the region when lakes and rivers finally freeze. Annual maximum ice cover on Lake Erie during 1998-2001 represented the lowest four-winter average on record (Assel et al. 2003). For the Great Lakes region, the trend has been for freeze-up to occur later in the fall. Models under various climate change scenarios predict that declines in ice cover on the Great Lakes and inland waters will continue, with up to 61% of winters being ice-free on Lake Erie by 2030, versus 2% currently (Kling et al. 2003). In the future, less ice and more waterfowl may lead to additional die-offs such as were seen in winter 2007-2008.

Finally, although not currently an issue, Trumpeter Swan numbers in the state are on the rise. Reintroduction efforts began in the 1980s, and the Michigan population grew 20% annually between 1996 and 2005, when it reached over 700 birds, and there are now over 7,000 in the Midwest (Johnson 2009, Trumpeter Swan Society 2009). Two Trumpeter Swans were observed by the author off Grosse Ile on 23 January 2010. Because of the difficulty in distinguishing

Trumpeter and Tundra Swans, especially at a distance, they may be under-reported. Trumpeter Swans have similar dietary habits as other swans. Preferred foods in a western population were *Potamogeton* (especially *P. pectinatus*) tubers, *Chara* spp., and *Elodea* spp. (Squire and Anderson 1995). Unlike most wild populations in the west, the reintroduced Trumpeter Swans in this region generally do not migrate (Eichholz and Verner 2005, Lumsen 2005, Gillette 2009). How Trumpeter Swans might impact local resources or interact with other swan species is unclear at this time.

Other potential impacts

Mute Swans as reservoirs of avian influenza ("bird flu")

Low pathogenic avian influenza (LPAI) viruses, which generally present no clinical signs in birds and are not harmful to humans, are common in wild birds. LPAI viruses have been found in over two dozen families of birds, with wetland species being major reservoirs since the viruses are easily spread in water (Olsen et al. 2006). Among tens of thousands of waterbirds of 36 species sampled worldwide, LPAI viruses were most prevalent in American Black Duck, Blue-winged Teal, and Northern Pintail *(A. acuta*). Prevalence was less common in swans, with 76% of 17 waterfowl species (including Tundra Swans) having higher rates of positive test results than Mute Swans (Olsen et al. 2006).

In Michigan, LPAI of the subtype H5N1 has been detected in the American Black Duck in St. Clair Co. in 2007, Mallards in in St. Clair Co in 2006, and in two Mute Swans from Pointe Mouille State Game Area in Monroe Co. in 2006 (USDA 2006a, 2008).

Highly pathogenic avian influenza (HPAI) of the subtype H5N1, which does cause illness and mortality in birds, humans, and some other animals, emerged in Hong Kong in 1996. HPAI H5N1 spread throughout Asia through poultry, and into Europe via migratory birds (Kilpatrick et al. 2006). In Europe, the last report of HPAI H5N1 was in a duck shot in January 2009 as part of a surveillance program; this was the first report in a wild bird since the virus was found in a Canada Goose in Great Britain in February 2008 (Marshall 2009). HPAI H5N1 has not been detected in North America. Very few bird species migrate between areas in the Old World were HPAI H5N1 is endemic and North America, so wild birds are not considered to be the primary potential pathway for the spread of the virus into the Americas (Kilpatrick et al. 2006). Mute Swans are generally not migratory or among the bird species most likely to make contact with Asian birds that might be infected by HPAI H5N1, and they are not included as priority species in the North American HPAI H5N1 surveillance strategy (USDA 2006b).

Nuisance impacts
Mute Swans have been known to attack people that venture near their nests and young, although often the information is anecdotal (AFC 2003, RIDEM 2007). This problem might be of most concern in urban areas where swans and humans are in close contact.

Pollution problems due to fecal contamination by Mute Swans has not been well researched (AFC 2003, RIDEM 2007). It is most likely to have potential impact in areas where swans are fed by humans and thus congregate, or small bodies of water such as retention ponds.

POPULATION TRENDS OF MUTE SWANS

Like many other introduced species, Mute Swan populations tend to show lag times between initial colonization in an area and the period of rapid growth and spread. Lag times may be due to any number of factors, including the expected lag phase in an exponential growth curve, dependence on a particular density, or time needed for evolutionary adaptation to new habitats (Sakai et al. 2001).

Mute Swans have been present for so long in Europe, with coordinated counts not being organized until the mid-1960s (Fouque et al. 2007), that examples of this type of trend from there are limited. However, this pattern played out in Finland, France, and northern Italy for more recently introduced populations (Nummi and Saari 2003, Fouque et al. 2007, Ventolini et al. 2008). In modern times, most European breeding populations underwent modest increases between 1970-1990, but overall underwent a large increase during 1990-2000 (Burfield and von Bommel 2004). Reasons for these recent increases are discussed in "Factors in success," below.

North America: Atlantic Flyway
In North America, waterfowl are managed by the USFWS and Canadian Wildlife Service in four administrative flyways. Ontario is considered part of the Atlantic Flyway, while Michigan is in the Mississippi Flyway. However, as a non-native, non-migratory species, Mute Swan has not been traditionally monitored or regularly included in some annual status reports (e.g., Waterfowl Population Status reports).

In response to growing numbers of Mute Swans in the Atlantic Flyway, a mid-summer Mute Swan count was initiated, and has been conducted approximately every three years since 1986. The Mid-Summer Mute Swan Survey from 1986 through 2002 indicated a population growth

rate of 5.8% per year (AFC 2003, RIDEM 2007). However, numbers have decreased in the subsequent two surveys, with an increase only 3% from the long-term average (AFC 2009).

Lower Great Lakes

The 2005 Ontario Mid-summer Mute Swan Survey tallied the lower Great Lakes population at 2,737 birds, nearly double the 2002 figure (Badzinski 2007). This number declined to 2,357 in 2008 (AFC 2009). The overall average annual rate of increase since 1986 has been roughly 6%.

Petrie and Francis (2003) did a more thorough analysis of regional Mute Swan numbers. They utilized aerial migration period surveys from Long Point, Ontario (1971-2000), ground-based midwinter Lake Ontario waterfowl inventories (1980-2000), and Christmas Bird Count data (1980-2000, from over 50 count circles including many in southeast Michigan) to examine population trends of Mute Swans in the lower Great Lakes. The calculated estimated average population growth rates ranged from 10 to 18% per year for the periods indicated. The authors noted that at the lower threshold rate of 10% per annum, swan populations would double every seven to eight years.

Michigan/local populations

Michigan Spring Waterfowl Survey

The Michigan Department of Natural Resources and Environment (MDNRE) has conducted an aerial spring waterfowl inventory annually in April or May since 1991 to examine distribution and abundance of waterfowl at a statewide scale (Souilliere and Chadwick 2003). However, due to data limitations, MDNRE does not think that this data can be used "to make inferences about distribution, abundance, or changes in abundance for mute swans at the scale of the lower Detroit River" (D. Luukkonen, MDNRE, pers. comm.).

Breeding Bird Atlas data

A breeding bird atlas (BBA) project seeks to map the distribution of each bird species that nests in a region. The primary data collected is the highest level of breeding evidence for each species in each atlas unit, or "block." As such, it provides information on presence/absence, not abundance. Both Michigan and Ontario have each completed two breeding bird atlases.

The field work for the first Michigan BBA took place in 1983-1988, the second took place in 2002-2008. Michigan designated a quarter-township as an atlas block. The first Michigan BBA detected no evidence of Mute Swans breeding along the Detroit River in Wayne Co. (but

confirmed nesting in two inland blocks). Mute Swans were confirmed in two blocks and possibly nesting in one block in Monroe Co., all in coastal areas (Van Duesen 1991). Provisional data from the second BBA found Mute Swans confirmed nesting in 19 blocks (six along the Detroit River), probable in four blocks (three along the river), and possible in two blocks in Wayne Co. (RRBO 2008). Data for Monroe Co. are not yet available.

Ontario's first BBA was in 1981-1985, the second was 2001-2005. Ontario used 10-km squares as their atlas sampling unit. The first Ontario BBA found possible breeding evidence of Mute Swans in one block along the Detroit River, while the second BBA found swans confirmed in 3 blocks along the Detroit River (Badzinski 2007).

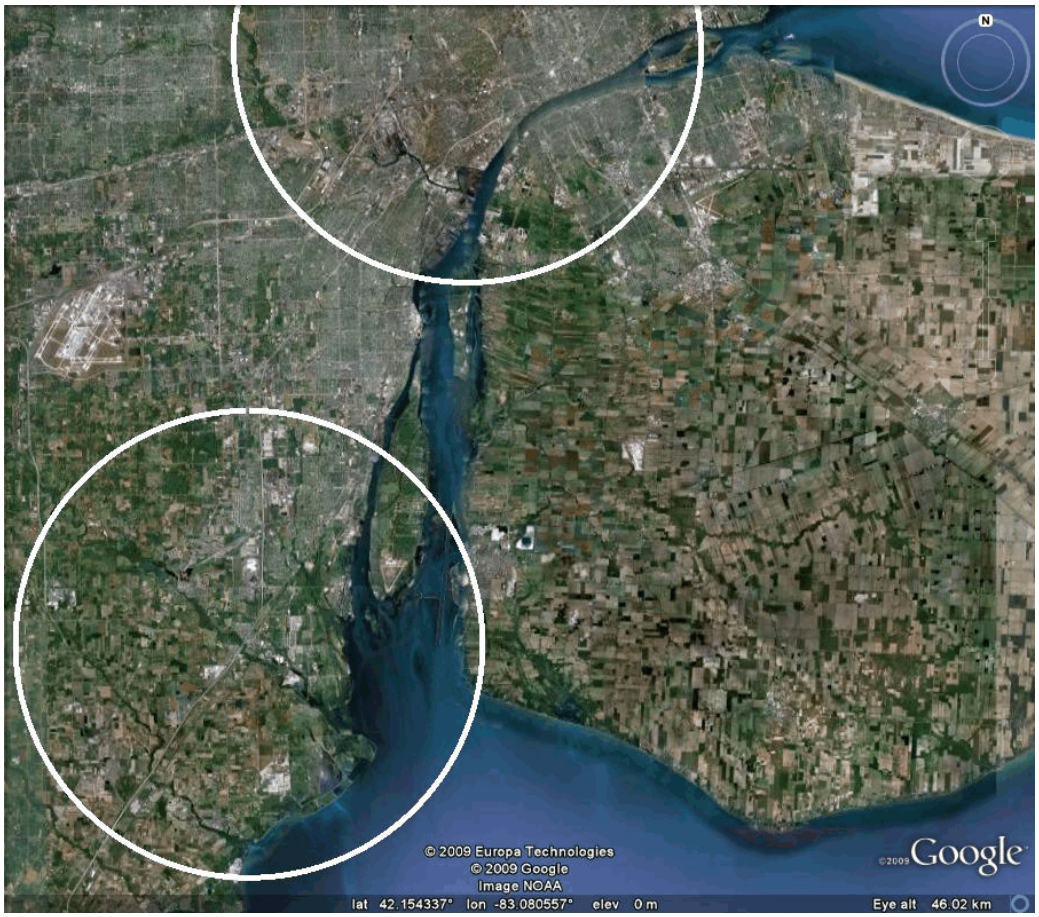
Christmas Bird Counts

Christmas Bird Counts (CBCs) tally all birds located within a 15 mi- (24.1 km) diameter circle on a single day in early winter around Christmas, and are held across the Western Hemisphere. CBCs are sponsored by the National Audubon Society (NAS), which acts as a central repository for results (NAS 2002).

Two CBCs with long-term data sets cover the Detroit River. The Detroit River MI-ON count is centered at 42.3448, -83.1135, and includes the Detroit River from Belle Isle to the northern part of Fighting Island. The Rockwood MI count is centered at 42.0685, -83.250 and includes the Detroit River from mid-Grosse Ile, past the mouth of the River, and the Lake Erie shoreline to the Enrico Fermi Nuclear Power Plant in Estral Beach, Monroe County. Boundaries of the two count circles are shown in Figure 3. In both counts, birds are also tallied on the Canadian side of the River.

CBC circles are not randomly placed, and therefore are not necessarily representative of habitat that occurs in a region. Counting within each circle is not distributed randomly, or homogenously, and is usually not standardized. Effort varies each year, and depends on the number of people in the field, their skill, the time spent counting, and weather. Waterfowl counting is also complicated by the response of the birds to weather and ice conditions, which varies from year to year, day to day, and even within the same day (Butcher et al. 1990, Sauer and Link 2002, Petrie and Francis 2003). For all these reasons, making conclusions regarding populations of waterfowl based on CBCs must be viewed with caution.

Figure 3. Boundaries of the two long-running Christmas Bird Count (CBC) circles that cover the Detroit River. Detroit River CBC on top, Rockwood CBC below.



Figures 4 and 5 show the number of Mute Swans counted on the Detroit River and Rockwood CBCs. The Rockwood count has typically been held on the weekend closest to Christmas, while the Detroit River count has always taken place on New Year's Day. Therefore, these two counts are not independent and should not be considered in combination, since in any given year some of the same swans, due to their movements, may have been counted on both CBCs.

Numbers of Mute Swans on the Detroit River CBC have increased approximately 15% annually since 1978 based on an exponential growth model. Growth appears to have slowed in the last dozen years, but the wide fluctuation in the numbers during this period make trend estimation unreliable.

Of the approximately 2,000 counts held in the United States, the Rockwood CBC has had the highest number of Mute Swans in four of the last five years (Ortego 2005, 2007, 2008, 2009).

Numbers of Mute Swans on the Rockwood CBC have also increased approximately 15% annually since 1976 based on an exponential growth model. Since 1998, the average annual rate of increase has been over 20% per year.

Michigan Mid-winter Waterfowl Inventory

Since the mid-1950s, biologists for the U.S. Fish and Wildlife Service and state agencies have conducted a mid-winter waterfowl count designed to determine distribution and numbers of waterfowl on their wintering grounds (Eggeman and Johnson 1989). Survey design and procedures are determined by each state, but the surveys are generally done in early January by fixed-wing aircraft (USFWS 2006). In Michigan, the survey is conducted by the MDNRE, and one of the waterfowl concentration areas surveyed includes the Detroit River and the Michigan portion of Lake Erie (Miller 1952).

MDNRE only provided me with Mute Swan data from 2005 to 2010. For Wayne County, numbers for this one-day January count ranged from 52 to 1,031. The mean was 318. For Monroe County, numbers ranged from 75 to 3,851. The mean was 1,103. The mean for the two counties combined was 1,422. The very high annual variability is thought to be due to weather and ice conditions (J. Robison, MDNRE, pers. comm.). These data did not furnish any discernible or significant trends.

Figure 4. Raw numbers of Mute Swans counted on the Detroit River Christmas Bird count, 1978-2010, not adjusted for effort. Trendline represents a three-year moving average.

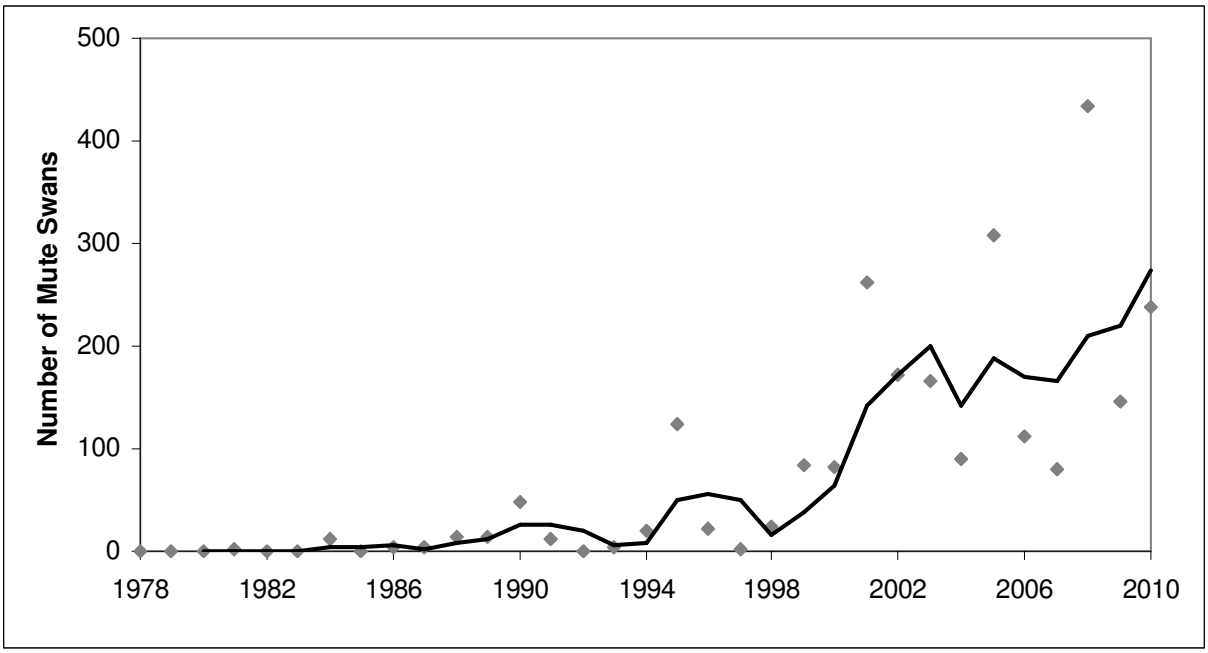
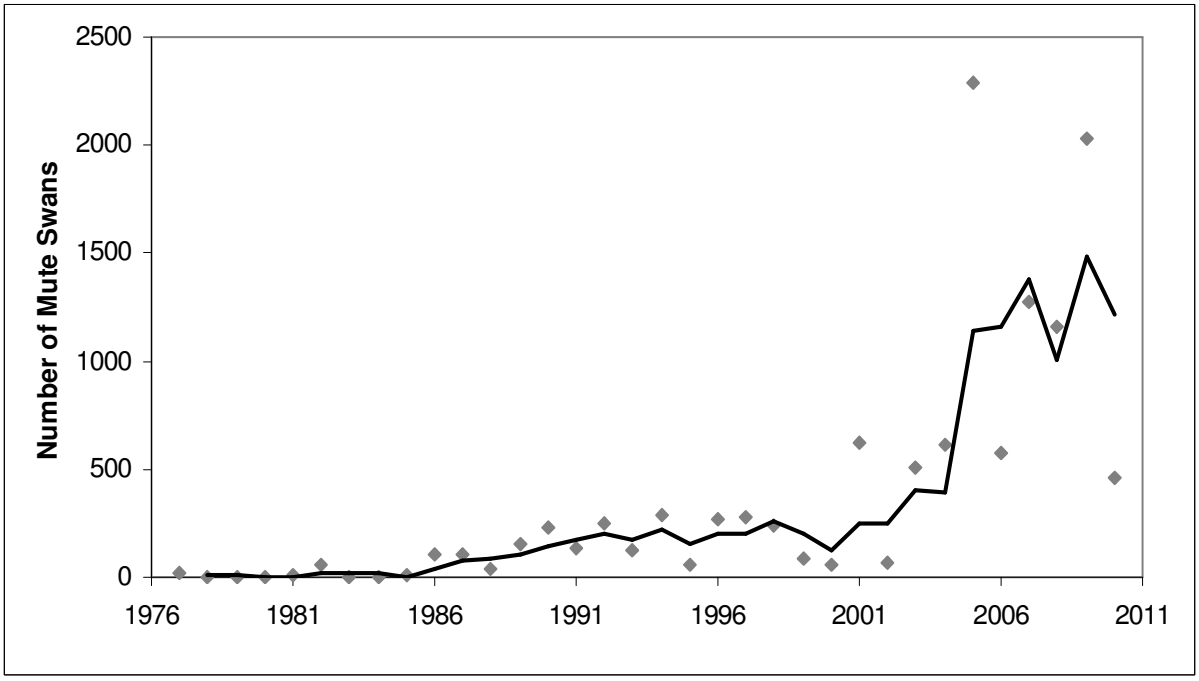


Figure 5. Raw numbers of Mute Swans on the Rockwood Christmas Bird Count, 1976-2010, not adjusted for effort. Trendline represents a three-year moving average.

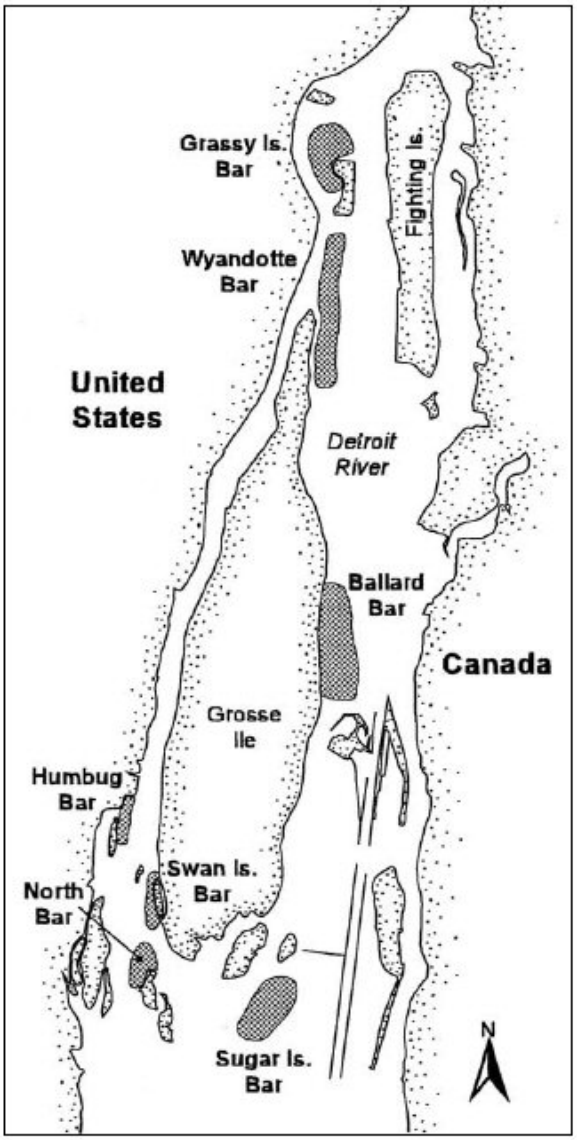


2009-2010 Lower Detroit River count

Winter waterfowl counts are sometimes considered of limited value for population monitoring because they are influenced to such a great extent by weather conditions, both prior to and during the counts (Swift 2007). However, between 5 December 2009 and 13 February 2010, I conducted nine counts of Mute Swans on the Detroit River, along with a partner.

Swan counts were based on land along the U.S. side of the river. Land-based counts of Mute Swans were found to correlate closely with aerial surveys (Pehlak et al. 2006). Count locations roughly coincided with named beds of submerged vegetation (primarily *Vallisneria* beds) identified during sampling in 1996-1997 (Schloesser and Manny 2007; Figure 6), and past winter concentrations of Mute Swans based on the author's previous experience. Other studies have suggested that the density of Mute Swans utilizing a particular area can give some indication of the status of the area's SAV (Day 2004).

Figure 6. Location of SAV (dark hashing) in the lower Detroit River. From Schloesser and Manny 2007.



These count locations were:

- Mud/Grassy Island: Dingell Park and Ecorse Rowing Club on Jefferson Avenue south of Southfield Road, Ecorse.
- Wyandotte: Bishop Park, near Superior Boulevard and Van Alstyne Street, Wyandotte.
- Ballard Bar: Grosse Ile, along East River Drive at Church and Macomb Streets.
- Stony Island: Sugar Island Bar is not readily visible from any publicly-accessible place. However, large numbers of swans are typically seen west and south of Stony Island. Swans were counted from along East River

Drive between Grosse Ile Parkway and Bellevue Road on Grosse Ile.

- Detroit River International Wildlife Refuge, Humbug Marsh Unit, Trenton.
- Swan Island Bar and North Bar. Viewed from Lowell Street between Coral and Davis, Humbug Marina, Gibraltar, and/or West River Road on Grosse Ile.

Swans were also counted south of the mouth of the River, at Lake Erie Metropark, from the Cove Point and/or boat launch areas.

All swans visible from the counting points with the aid of a 20 to 60 power spotting scope were recorded, including those not actually over the areas of the vegetation beds. Additionally, the river was scanned at all times traveling between each count location (usually the entire perimeter of Grosse Ile was surveyed) and these swans were also noted. Counts were conducted once every week to ten days, and each count took approximately three to four hours.

Swans were rarely seen flying between locations, except on a few occasions when they were flushed by boats, so double-counting of individuals on any given day was probably minimal. Count days were chosen for good visibility, so a large proportion of swans that were on the Detroit River on those days were likely counted. Swans obscured by land, such as islands, would not be counted, but the same bias would occur each count day. Therefore, these numbers represent a snapshot of swans present on any given day. Due to the strong response of waterfowl to changing weather, wind, and ice conditions, they may not reflect an accurate index of the true population. However, since the counts took place periodically over the season, they may be more robust than single-day counts.

Table 3 shows the numbers of Mute Swans on each date at each location, as well as summary information by date and location. The fewest number of Mute Swans, 258, were counted during the first survey on 5 December 2009. The highest number occurred on 9 January 2010, when 1,953 were counted. The average for the nine survey days was 1,053 (1,152 if the first survey is excluded).

These counts give some indication of the typical places where swans occur. Mute Swans appeared to favor two locations: between Mud Island and Grassy Island, roughly corresponding to the Grassy Island Bar; and along the west side and off the south end of Stony Island. This site does not correspond to one of the named beds of submerged vegetation.

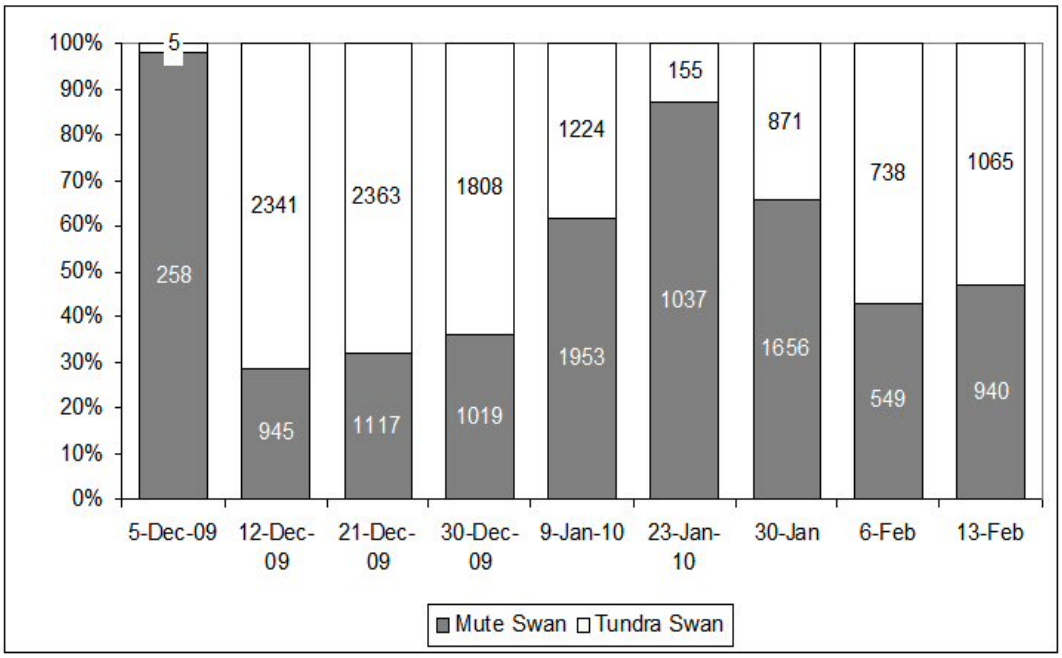
The Humbug Bar location typically had few swans. Numbers of Mute Swans there usually only exceeded 15 individuals if much of the river had ice cover. Swan numbers at the Wyandotte, Ballard, and North/Swan Islands bars were generally low. The highest concentrations of Mute Swans away from the standard count locations were in Gibraltar Bay early in the season, and north of the Grosse Ile toll bridge later in the season if near-shore areas were not iced over. However, pairs or small groups of Mute Swans could usually be found in scattered locations close to shore, especially around the perimeter of Grosse Ile and then often on the west side of the island.

During most of the count season, Tundra Swans were found in the same locations as Mute Swans, although the two species tended to segregate themselves. Tundra Swans arrive in the lower Detroit River region in late November (MDNR 2010). Figure 7 shows the ratio of Mute Swans to Tundra Swans during each date of the counts. They peaked on these counts in mid-December, with a maximum of 2.5 Tundra Swans to each Mute Swan on 12 December; the season average was 1.2 Tundra Swans to each Mute Swan. The number of Tundra Swans decreased as the season progressed. Spring migration of Tundra Swans through the area begins in March.

Table 3. Mute Swans counted on the lower Detroit River, winter 2009-2010.

Location	**Count Date**									**Total for location**	**Average for location**
	5 Dec	*12 Dec*	*21 Dec*	*30 Dec*	*9 Jan*	*23 Jan*	*30 Jan*	*6 Feb*	*13 Feb*		
Grassy/Mud Island	52	307	842	400	465	233	473	5	68	2845	316
Wyandotte	13	88	150	6	4	111	0	20	79	471	52
Ballard	29	102	29	4	94	162	148	30	15	613	68
Stony Island	160	317	36	37	43	9	69	11	147	829	92
Humbug	0	12	11	4	347	4	235	151	208	972	108
North/Swan Island	2	26	19	45	217	21	121	72	97	620	69
Detroit River mouth	2	52	13	2	18	0	12	11	66	176	20
Misc.	0	41	17	521	765	497	598	249	260	2948	328
Total for date	258	945	1117	1019	1953	1037	1656	549	940	9474	

Figure 7. Ratio Tundra Swans to Mute Swans on the lower Detroit River, winter 2009-2010.



Factors in success

Mute Swans are long-lived, very adaptable to urban sites, and have few natural enemies (Fouque et al. 2007). In addition, the success and increase of Mute Swans over the last several decades in both Europe and North America has been attributed to limited hunting pressure, lowered exposure to lead poisoning as lead shot and lead fishing tackle have been banned, and mild winters (Hindman and Harvey 2004, Petrie 2004, Fouque et al. 2007, Ward et al. 2007).

In Europe, Mute Swans are known to use *Phragmites* for nesting (Ventolini et al. 2008) and there are indications that they favor it in North America as well (Ciaranca et al. 1997). There are both native and non-native genotypes of *Phragmites australis* present in North America (Saltonstall 2002). It is believed the non-native genotypes are particularly aggressive, are displacing native genotypes, and becoming invasive in many wetlands, including those in the Great Lakes. Dramatic increases in wetland acreage taken over by *Phragmites* have been documented at Long Point, Lake Erie, Ontario and Erie Marsh Preserve, Monroe County, Michigan (Wilcox et al. 2003, Pearsall and Muller 2007). Recent declines in Great Lakes water levels and increased air temperatures are thought to have facilitated these invasions. This spread of *Phragmites* could also be facilitating the success of Mute Swans in the region.

Causes of mortality and limiting factors

Natural and indirect human-related causes

Typical causes of mortality of Mute Swans during the breeding season have been mostly attributed to wave action or flooding destroying nests or chilling eggs; exposure of young cygnets to cold or storms; and predation of cygnets by snapping or marine turtles, fox, raccoons, and other animals (Reese 1980, Gelston and Wood 1982). In a population studied over two years in Italy, 80% of cygnets were preyed upon by Yellow-legged Gulls (*Larus michahellis*) (Ventolini et al. 2008). For post-fledging cygnets and adults in Michigan, starvation and disease have been cited as the primary causes of mortality in Michigan (Gelston and Wood 1982, Ciaranca et al. 1997).

Severe winters contribute to starvation if feeding is restricted by ice, and may also impact reproductive output in subsequent nesting seasons (Ciaranca et al. 1997, Petrie and Francis 2003; *contra* Nummi and Saari 2003). Inadequate food and exposure during extreme or extended cold periods may increase susceptibility of swans to disease or predation (Ciaranca et al. 1997).

In a large reservoir in Essex, England, peak numbers of Mute Swans during late fall declined over 90% in a single year following a cool and very wet summer that resulted in high water levels and a corresponding shortage of accessible forage; increased parasitic disease also contributed to the decline (Jennings et al. 1961).

Disease mortality is commonly from *Sphaeridiotrema globulus*, a parasitic intestinal fluke which causes ulcerative hemorrhagic enteritis, but aspergillosis fungus (often caused by moldy food, including bread and grains) and botulism types C and E have also been cited as fairly common in Mute Swans, especially in Michigan (Gelston and Wood 1982, Ciaranca et al. 1997).

Both here in North America and abroad, human-related causes of mortality include collisions with power lines and other structures, and lead poisoning from ingestion of lead shot and lead fishing sinkers (Ciaranca et al. 1997). The latter has declined in recent years due to the banning of lead shot for waterfowl hunting in the U.S. in 1991 and in Canada in 1999, and declining use of lead fishing weights (Petrie and Francis 2003, Bowen and Petrie 2007).

Density effects which limit populations have been reported. A Finnish population declined over 22 years, primarily due to the best habitats being occupied in the early years of population build-up, with established pairs excluding new swans from vigorously defended territories (Nummi and

Saari 2003).

Direct control measures

Currently, there is no hunting season for Mute Swans in North America (AFC 2003).

As a species that is not protected by the federal Migratory Bird Treaty Act (see Appendix C for recent legislation clarifying this), it is up to individual states to manage their Mute Swan populations. Michigan's policy is provided in Appendix D.

In Canada, Mute Swans are covered under the Migratory Birds Convention Act (see http://laws.justice.gc.ca/en/M-7.01/); possession of Mute Swans is controlled, release is prohibited, and wild Mute Swans may not be taken except under permit from the Canadian Wildlife Service.

Because of the longevity of Mute Swans, reducing reproductive success as a means of population control has had limited success. In 1979, Rhode Island initiated an egg-addling control project. This method involves locating nests and shaking the eggs, which ruptures the yolk, preventing further development. Over 22 years, Rhode Island destroyed 9,474 eggs from 1,636 nests, at an annual cost of approximately $8,000 (Allin and Husband 2004). Although this was estimated to be eggs from 79% of nests in the state, Rhode Island's Mute Swan population continued to grow at 5.6% annually (Petrie 2004), and grew so large that continued egg-addling control is limited by staffing constraints (Allin and Husband 2004).

A model used by the state of Maryland indicated reduction of hatching success (via egg addling or nest destruction) would have to be at least 80% to stabilize that state's population (Harvey 2000 in RIDEM 2007).

Models constructed using data from long-term studies of marked Mute Swans in the UK found that clutch reduction (by removal or oiling of most of the eggs) had limited effect on local populations when immigration was occurring, and noted populations continued to increase at another site even when most clutches were reduced to two eggs and many of the adults were also culled (Watola et al. 2003).

Generally, the best method for reducing numbers of a long-lived species is to reduce adult survival (Petrie and Francis 2003, Ellis and Elphick 2007, RIDEM 2007). This may involve

removing adults and placing them in captivity, or lethal control. The former has not met with success where it has been attempted (e.g., Rhode Island) because there is not enough capacity for the number of swans that need to be removed to stabilize or lower populations (Ellis and Elphick 2007, RIDEM 2007). Further, it is labor intensive and costly to capture and transport the swans.

In their estimates of lower Great Lakes Mute Swan populations, Petrie and Francis (2003) noted a decline in numbers in the mid-1990s due to decreased winter temperatures and an "unsanctioned localized human control effort." The rapid rebound of the population led the authors to conclude that control measures must be sustained to be effective, and that 20-30% of population would need to be removed annually to achieve a decline of 10% a year.

The model mentioned above (Harvey 2000) projected that it would require an 80% reduction in hatching success to maintain stable numbers, but only a 20% annual reduction in adults to lower the population over time. Similarly, a model examining alternative strategies for controlling Mute Swans found that reproductive success would need to be reduced at least 72% to be nearly certain of achieving a decline, but that the same goal could be attained by reducing adult survival by about 17%, and was more economical, requiring far less labor (Ellis and Elphick 2007). A final finding of this study was that for a given population goal, implementing lethal control killed fewer total swans if the time frame was short, rather than spreading culling out over a longer time period: 80% more swans would be killed in a 20-year management plan than a 5-year plan in their simulation.

Various models agree that reduction in adult survival is more effective than reducing reproductive output. Population-specific parameters (population size, growth rate, immigration rates, etc.) need to be incorporated into any model developed to guide regional management.

Lethal control measures targeted at adult Mute Swans may be confounded by the presence of other protected swan species. In Michigan, Tundra Swans are present most of the year except during the summer months, and there is no hunting season for Tundra Swans in the state. Due to introduction efforts, Trumpeter Swans are present year-round in Michigan; as a state-threatened species they are also protected by law. The similarity between Trumpeter and Tundra Swans, and the specter of accidental illegal "takes" of protected species complicates the process of using hunts to reduce numbers of adult Mute Swans.

Carrying capacity of local area

At 15 ac (6 ha) per territory (based on a large territory estimate for open water or low-quality habitats), Petrie and Francis (2003) estimated that the 116,140 ac (47,000 ha) of Canadian coastal wetlands along Lakes Erie and Ontario could support 8,000 pairs of Mute Swans, or up to 30,000 individuals including non-breeders. More could be supported if territories were smaller.

Prince et al. (1992) gave the total area of wetlands along the Detroit River, including the Canard River marshes, as 3,410 ac (1380 ha), and an area of 14,554 ac (5,890 ha) of wetlands from the mouth of the Detroit River to Sandusky Bay, although not all coastal wetlands may be appropriate for the swans. Based on the Petrie and Francis (2003) calculations, the Detroit River could potentially support 230 pairs, or around 850 individual swans, and the entire Detroit River-western Lake Erie wetlands could hold about 1,200 pairs or up to 4,500 individuals, based on large territory estimates. There are already more than 850 Mute Swans wintering on the Detroit River, but these include swans that have vacated their year-round territories due to inland freeze-up. Mute Swans are using inland wetlands for breeding. For instance, Mute Swans were recorded nesting in 13 inland quarter-townships in Wayne County during the recent Breeding Bird Atlas period, 2003-2007 (RRBO 2008).

ADDITIONAL NEEDS

Predicted mild winters and the lack of significant limiting factors to Mute Swan numbers make it likely that populations of this species will continue to increase in the lower Great Lakes. While specific studies have not quantified some of the ecological impacts Mute Swans may have in the lower Detroit River, there is no reason to suppose, given their longevity and resource requirements, that increased numbers of Mute Swans will not have an impact.

Wetland loss has already resulted in concentrating more birds into less habitat. Habitat degradation due to invasive plant species such as *Phragmites* is an on-going problem. Recent warming trends have influenced habitat and resource availability for waterfowl, especially in winter. Adding increased numbers of Mute Swans, a non-native species, only adds stress to this system.

Further studies focused on the lower Detroit River and adjacent areas would improve our understanding of Mute Swan impacts and the dynamics of these ecosystems as a whole. Particularly useful topics include:

- Targeted Mute Swan population monitoring (including both breeding and winter distribution and abundance), as state wildlife agencies may not have surveys that sufficiently track Mute Swan numbers at small geographic scales.
- Quantified studies of Mute Swan interactions with other water birds.
- Mute Swan diet, including seasonal changes; winter diet of Tundra Swans.
- Data on Mute Swan dispersal and movements.
- Mapping and evaluation of the distribution and abundance of SAV in the Detroit River.
- Identification of main Mute Swan molting sites.

Clarification of these issues would help guide Mute Swan management goals and practices.

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APPENDIX A

Claims that Mute Swans are native to North America, and counter-arguments.

The following were printed in *Picoides*, the Bulletin of the Society of Canadian Ornithologists. It is not peer-reviewed. They are printed in their entirety in their original form, but without unnecessary graphics.

The articles, in the order they appear here are in the Literature Cited as:

Alison, R., and K. S. Burton. 2008. New evidence of early presence of Cygnus olor. *Piciodes* 21(3):36-45.

Warnock, R. 2009. Corrections to the Mute Swan paper by Alison and Burton. *Piciodes* 22(1):15.

Askins, R. 2009. Historical information on bird distributions indicates that Mute Swans were introduced to North America. *Picoides* 22(1):16-19.

Elphick, C. S. 2009. Evidence that Mute Swans are native to North America is lacking. *Piciodes* 22(1):20-23.

Seymour, K. L., and M. K. Peck. 2009. Re-identification of the Fort Albany Mute Swan bone. *Picoides* 22(3):16-20.

New Evidence of Early Presence of *Cygnus olor*

Robert Alison, PhD, Victoria, BC and Kathryn Stillwell Burton, Old Lyme, CT

Abstract: For many years, despite solid evidence to the contrary, the Mute swan (*Cygnus olor*) has been called a non-native bird, imported from Europe. It is, in fact, an ancient circumboreal bird, with a history across Europe and Asia and into the Russian Maritimes and Kamchatka, (Dement'ev 1967, Weiloch 1992) a major staging area for millions of birds on migration across the American continent, a short distance away. It has been recorded in Alaska (Sladen and King 1976, Heilprin 2006), Saskatchewan (Greenwood, 2000) and found in 17th century, precolonized James Bay area at Ft. Albany (Baldwin and Churcher 1967). Douglas Sadler and Howard G. Savage (2003) notes several digs in the James Bay area, confirming a very early presence of Mute Swans in Canada. Federal agency testimony in Federal Court, District of Columbia, USA, states that Mute Swans migrate from the Hudson Bay into the United States (Cirianca 2003). This is an ancient route, in which prevailing winds and open waters, but not "the hand of man" assists migration

Introduction

A criteria used in the US Federal Register, 01/2005, relating to the "nativeness" of the Mute Swan asks: "Why, if it has been here since before colonization, John White did not paint a Mute swan, while he DID paint the Trumpeter Swan in 1585 Roanoke?" That was a trick question. In fact, the Mute Swan (left) is from the British Museum's John White Collection. This watercolour, done during the 1585 scientific exploration to America for Sir Walter Raleigh, is on watermarked paper, (1580s) revealing much earlier occurrence of *Cygnus olor* (Mute Swan) on the Atlantic coast, than previously thought. It was mislabelled in the 1960s as a "Trumpeter Swan", at the University of North Carolina, but of course, it is not. Among northern hemisphere swans, only the Mute Swan has a knob, on a black bill in this painting, because the leaded paint used, four hundred years ago, degraded with time, according to Kim Sloan, (2007) curator of the John White collection, at the British Museum. In her book, *A New World*, the process is described in depth. The knob, s-curved neck, lifted rear feathers, in fact the entire countenance defines the Mute Swan in the field. There are several swans clearly identifiable as Mute swans in the De Bry engravings in Thomas Harriot's journal, kept during the exploration in 1585 Virginia.

Historian and scholar, David Beers Quinn (1964) and Paul Hulton (1964) former Director of the British Museum, compiled the artworks and records of the Roanoke Voyages and produced "The Complete Drawings of John White" in two volumes. Hulton wrote " It is clear that White's main aim was to impart information and that his drawings can be considered purely as historical and scientific documents of remarkable validity." Quinn wrote that "there would be nothing in the paintings that the artist did not see, these men were scientists" (pers. comm.).

Clearly, White felt it his mission to show what he saw, and over the period in which he was in Virginia, he saw Mute Swans. If he had seen and drawn Trumpeter swans, that would have been of more interest to the people back in England, but obviously, he did not. The mislabelling of the drawing, at University of North Carolina, is very curious, and deserves additional research.

Robert Bateman, the internationally known wildlife artist, agrees that the White painting is of a Mute Swan and Roland Clement, also a noted artist in the field, who was head biologist for National Audubon for many years, agrees. David Beers Quinn, said "Nothing would be in the paintings unless it was seen by the artist, these were noted scientists of the day. Do not rely on the De Bry engravings alone, look at the swan painting and that will solve your Mute Swan problems" (hand written letter, 2005, sent from Ireland, just prior to his death).

Audubon on Swans

Among the other early major artists, swans did not appear until Audubon's work, although many early journals of people like Wood (1634), Henlopen (1683) and the Jesuit Marquette (1673) mention many swans in seasons in which the Trumpeters and Tundras would be in the far north.

In Audubon's Birds of America, 1840-1844, he stated, "The history of the American swans has been but very slightly traced. Few records of the habits of these majestic, elegant and useful birds exist, upon which reliance can be placed; their geographical range still remains an unsolved problem; one species has been mistaken for another, and this by ornithologists who are said to be of the first order. It is possible we have more than two species of swan within the limits of North America but I am at present acquainted with only that which forms the subject of this article (the Trumpeter) and the *Cygnus Americanus* of Sharpless."

This insight was shared by Karl W. Kenyon (1986) on finding Whooper Swans in the Aleutians: "Since the Whooper Swan was not expected, even trained ornithologists may have assumed that swans reported by natives or seen at a distance were Whistling Swans. They still do, as "probably Tundra swans, etc." is seen again and again in serious ornithological publications.

Archaeological Finds

In 1961-5, excavations at the Fort Albany Post site on James Bay, Canada (Kenyon 1986) yielded Mute Swan material in several sites, including a Mute swan sternum, the defining element, according to Storrs L. Olson, Curator of Birds, AMNH, Smithsonian Institution (pers. comm.). The area of interest was first occupied from 1674 to about 1690, pre European colonization. The sternum was identified at the site, not only by Walter Kenyon, archaeologist-in-charge of the excavation, but by Howard G. Savage, MD PhD, zoologist/ornithologist, for whom the faunal lab at University of Toronto was named. Rufus Churcher, professor of ornithology and archaeology at University of Toronto and ornithologist Donald Baldwin, who later published an account of the finding, (Baldwin and Churcher 1967) all naming it a Mute Swan sternum. The sternum was carefully examined before its conclusive identification, according to Dr. Churcher (now Department of Zoology Professor Emeritus Paleontology, University of Toronto), who was present at the site at the time the sternum was found and examined.

It should be noted that Kortright, nor Bellrose, nor Jarnsgard would have known of these specimens,

only recently announced, in *Birds from the Ground* (Sadler and Savage 2003)

The sternum was eventually housed in the collection at the Howard Savage Faunal Laboratory, University of Toronto. It was noted in a subsequent book on Ontario archaeology, *Birds from the Ground* (Sadler and Savage 2003), and according to Doug Sadler, who co-wrote the text, Dr. Savage personally confirmed the identity of the bone before including it in the book's contents.

It is very doubtful that the Hudson's Bay Company (HBC) employees would have brought a Mute Swan to North America from England, due to the easy availability of swans and other bird species in much of Canada. It is well documented that HBC company policy, from the beginning was to have North American posts rely on local provisions as far as possible (Lindsay 2003).

Since the killing of Mute Swans was illegal under English law and that law extended to Canada, according to Dr. Churcher, (2008 pers. comm.), it would be reasonable to understand why these takings would not be immortalized in writing, much as the species' "removal" was handled, traditionally, by agency people in the United States, prior to the 2001 re-inclusion of the Mute Swan under the Migratory Bird Treaty Act (MBTA), by Federal US law.

Wild Mute Swans currently occur in the area of Fort Albany in habitats similar to those that were present there in the 17th Century. On July 16, 2004, a Mute Swan was seen on mudflats only a few miles from the site where the swan sternum was found by the Kenyon group (op. cit). This was amplified by a paper by Abraham and Ross (2005) in which movement of Mute Swans into that very area was noted, suggesting an historic migration route.

D.M. Dawson, Canadian Geological Survey, March 7, 1890 stated, 954,000 square miles of the Dominion, Is for all practical purposes entirely unknown."

<u>The Fossil Record</u>

We have assembled historic and scientific documents and specimens that create a time line ranging from Miocene to present, showing a Mute Swan (*Cygnus olor*) homotaxic presence in at least four States on the North American continent: Oregon, Idaho, California and Arizona.

In current theory, all swans are thought to have originated in the southern hemisphere, several species moving, through the ages, northward, through the Americas. Dr. K.H. Voous, (2000) a proponent of that theory, noted the Mute Swan, *Cygnus olor* as a possible relation of *Cygnus paloregonus*. Hildegarde Howard (1946, 1956) went further, in her studies of the Fossil Lake Oregon anatidae, she used the name *Cygnus olor* in comparative studies and "probably Mute Swan," in the description of a fossil found in Arizona. Fossils, at sites in the United States, represent *Sthenelides paloregonu*s, a Mute Swan genotype (ancestor) found at Fossil Lake, in large numbers. Wetmore (1968) singled this species out, saying " At Fossil Lake, Oregon, the most interesting species is a swan, *Cygnus paloregonus*, as large in bulk as the great trumpeter swan, but with shorter legs and longer toes." *Cygnus olor* also has these identifying features.

The fossils were studied by Cope (1878), Schufeldt (1892, 1913) and Howard (1946), as well as others

working on the Fossil Lake, Oregon, Froman's Ferry, Idaho, and Arizona material. Arizona fossils described: "specimens are thought to represent mute type of swan." (Howard 1964). Howard compared *Sthenelides paloregonus* to *Sthenelides olor* in many areas. Prior to the 1930s, *Sthenelides olor* was the correct name for the Mute Swan (Scott 1972).

These fossil swans were "very similar to, but somehow distinct" from *Cygnus olor*, the Mute Swan (Cope 1878, Coues 1887). The distinction was primarily size. Work hypothesized by Bergmann (1847) and proven in Baird's extensive collection at the Smithsonian, provides a reason for the size difference within a living species and their fossils, dependent on a number of things, but primarily on altitude, latitude, temperature, inland and coastal humidity (Lindsay, 1993) and, of course, food availability and climate extremes. Storer (1959) studied Western Grebes that had been frozen in Lake Newell, Alberta, against those housed in museums in California and at the American Museum. He concluded that significant skeletal differences between the two groups could be attributed to geographic variations, post mortem wear, or preparation techniques, and not to genetic variations.

This would account for a size difference in the same species of bird from modern United States and the Russia/Siberia coast, in avian fossils. The Caspian Sea has the largest Mute Swans in the World, for example, and they migrate from that area to far eastern Russia/Kamchatka and the Maritimes (Dement'ev 1989). These are the birds we believe came across, just as the other three swan species in that area do and stayed in the huge, undeveloped areas, of this continent, at some point in history. The data suggests an ancestral proto-Mute Swan or swans, whose structure and measurements are the same species found in the Caspian Sea area, in Russia and Siberia, as far east as the Russian Maritimes (Dement'ev 1989) generated lineages over an extensive period of time, evolving perhaps simultaneously in North America and Eurasia, shaped divergently by different local environmental pressures but nonetheless homotaxic. Ancestral Mute Swan type fossils have been found in four states (Anza Borego Desert in California; Fossil Lake, Oregon; Froman's Ferry, Idaho and Arizona.) as well as Europe and Asia. They circle the globe in northern latitudes and have no subspecies. While American imports of Mute Swans have been documented, and expected, the probability of a "natural migration" at some historic date becomes obvious, as all three species of swan with which the Mute Swan flies in parts of Europe and Asia have also been known to arrive here "without the hand of man." Many early colonists noted a great number of "swannes," in America, making their use as an imported food unnecessary, and as noted, the Hudson Bay Company lived off the land.

Documents produced in Hill v Norton, 2001 for the federal government's argument, admit the movement of Mute Swans from Canada into the United States, through the Great Lakes (Cirianca 2001). Is this not a migration "without the hand of man?"

"The question is not, would Mute Swans have come onto this continent? but rather, why would they not?" (Paul S. Martin, University of Arizona, 2001)

<u>Results of Mislabelling</u>

This species, *Cygnus olor* is put at a disadvantage in protection and evaluation of environmental impact, by being labelled "non-native." While many agency people admit studies do not show extensive negative effects to habitat or surroundings, caused by them, the unproven " non-native" status is

presented as representing “potential” problems, such as “eating food that belongs to other birds”….” Normal bird behaviour is seen as extreme, and given as a reason for “removal” of the species. The extensive Berglund studies (1963), compiled over a six-year period in Sweden, where fishermen complained about Mute Swan activities among the waterfowl and some loss of eelgrass, showed no cause for removal. Winston E. Banko, who wrote The Trumpeter Swan (1960), reviewed the Berglund study for The Auk, Vol.82, and agreed with that conclusion.

Similar results have been found in Maryland’s Chesapeake Bay, according to government agency “experts”. In fact, the Mute Swan is rarely mentioned in studies of the very polluted and degraded state of the Bay. Instead the damage is blamed on hog and chicken farms, dredging and trawlers, hurricanes and tornadoes, increased development and massive growth among high speed boats. However, the public is deluged by stories anti-Mute Swan and flagrant lies, to justify the killings. The “potential,” presented by the Mute Swan, may never occur, has been used to justify killings.

It has been promoted in parts of Canada, by agencies and NGOs there, that are rewarded by grants from the USF&WS. “ This agency action is based on no science,” according to a Federal District Court in Washington, D.C. yet, it continues, as the Ornithological Newsletter suggests.

Historic Status as a Circumboreal Species

In northern latitudes all of the four swan species fly together on migration throughout Europe and Asia (Weiloch 1989) to the Russian Maritimes (Dement’ev 1967). Bewick’s, Whooper and Whistling (now Tundra) swans have long been known to come into Alaska, with fatal results on US federal properties, according to Trumpeter Swan Society reports (Sladen 1978, King 1978). It is not unlikely Mute Swans continued the same ancient route, joining them in migration from Russia.

Today the Mute Swan is circumboreal across much of Europe and Asia. The proximity of Alaska to Kamchatka Peninsula, the site of Mute Swan population even today, suggests such relocation is feasible. An Icelandic population, once established by pioneering Mute Swans, has since disappeared (Sutton 1961), and that stock doubtless originated in Europe as they are also known in the Scandinavian countries of Sweden and Finland, in northern Scotland and in the Isle of Man, UK vagrant occurrences of Mutes in Iceland persist (op. cit.).

The North American genotype possibly never went extinct, but became exceedingly rare and may have persisted in small pockets of unexplored parts of the continent of America” (E.C. Pielou 2001 pers. comm.) This pattern also describes the history of another swan in America, a swan that was found with Mute swans in Fossil Lake, Oregon, the Trumpeter.

Annual Reports from The Trumpeter Swan Society include mentions of Eurasian Mute, Bewick’s, and Whooper Swans coming into Alaska, all without the hand of man” (Sladen 1978, King 1978). The Whooper Swans also are known to arrive in the Aleutians (Kenyon 1963, Eichholz and James 1997), Yosemite National Park, Massachusetts, and Iceland, another area in which the Mute Swans have a history (Sutton 1962).

Both Whooper Swans and Mute Swans were known in Yosemite early on, as were Trumpeters and

Tundras, before their near extinction due to over hunting. It is very difficult for hunters to identify swan species, "in the midst," as shown in data collected on Trumpeter losses during Tundra Swan hunting season in the Pacific Flyway. A Mute Swan removal program on all US federal lands was initiated by the Trumpeter Swan Society and the US federal government and an "open season on swans" was proposed by the agencies and endorsed by Harvey Nelson, then president of the Trumpeter Swan Society, an ex-agency man.

Recently, the Trumpeter Swan was removed from Endangered Species Act protection. It's future, after 75 years of a restoration program, is very much at risk.

MBC, MBTA, MBTRA History re: *Cygnus olor*

The Migratory Birds Convention (MBC) (1916) is the primary authority for US and Canadian federal protection of migratory birds—the Migratory Bird Treaty Act (MBTA) is its enabling legislation. It specifically names families rather than species in many cases, but the Anatidae family, of which the Mute Swan is a member, is listed as a protected group of waterfowl. In fact, swans and eiders are listed as exempt from hunting and research "takings. Mute Swans were present and well known in North America when the MBTA and MBC were fashioned, and had they not been intended for protection, the MBC would doubtless have so indicated.

Nonetheless, virtually ever since, federal authorities have operated as if swans are unprotected by the MBTA and state as much in federal court cases. But, in 2001, a DC Federal Circuit Court of Appeals ruled (Hill v Norton) all swans are protected by the MBTA, including the Mute Swan. This prompted the US federal agencies to regroup and promote legislative steps to remove US federal Mute Swan protection. This was lobbied and formalized, as the Migratory Bird Treaty Reform Act of 2005, based on the contention that the bird is not native to North America. While more than 100 other species of birds were put on the unprotected list, the Federal Register entry made by their attorney, Helen Paul, made it clear that the Mute Swan was the target of interest, but the reasoning is flawed and evidence goes against it.

Since ancestral Mute Swans were prehistoric inhabitants of North America, were here during early colonization in Canada as well as the United States (S.D. Ripley 1965) and information from the Trumpeter Swan Society papers indicates a movement of Eurasian Mute swans into Alaska (King 1968). Federal agency testimony in Federal Court, DC Circuit admits movement of Mute Swans from the Hudson Bay area into the United States (Cirianca in Hill v Norton 2001) this should constitute a homecoming into a former niche, through surviving kin of a once-present genotype that became extinct or rare. This is rather like the restoration of Trumpeter Swans by federal and state agencies, from stock bought from Dr. Blauuw, in Holland, (Derscheid 1939), which the agencies view as "a homecoming" in the US Federal Register.

The Maryland Removal Programs-No Science Used

The Chesapeake Bay and its tributaries cover 41,000,000 acres. It is nearly 200 miles long and 35 miles wide at its widest point and has a shoreline approximately 11,700 miles long. The Bay has never met the basic standards of the Clean Water Act and is becoming the responsibility of the NOAA agency in a restoration effort, similar to the clean up of several Canadian bodies of water.

Of the more than 1,500,000 waterfowl that overwinter or pass through the Chesapeake Bay annually, no more than 3800 mute swans have ever been counted there, according to Maryland Department of Natural Resources (DNR) 2004 estimates. Many of these are birds from inland states that move to open water from areas where lakes freeze in winters. In 2006-2007 the Maryland DNR killed 2,700 Mute Swans with no scientific backup. Most of these swans came from other states, to overwinter. While US federal agency people readily admit that although they cannot say the Mute Swan is a major problem in the Bay, they continue that appraisal with "there is a potential that it could be."

North American Mute Swan Records Timeline

Timeline, difficult because of the long held mistaken opinion of the status of this bird:

1585 - John White drawing in Virginia

1600s - Many mentions of "swans such as we have at home," in early journals (1600/1700) during seasons in which the other swan species would be nesting in the north. Mute Swans were recorded at Lake Erie (Hennepin, 1698), Upper Mississippi (Jacques Marquette, 1673) and Cabot Strait, St. Lawrence (Father Joseph Jouvency 1610) (Bellrose 1976, Thwaites 1959).

1650-70s - specimen from James Bay, found in the 1960s (no publicity)

1700s - Gmelin lists *Cygnus olor* in Kamchatka, see also Pennant, Arctic Zoology,

John Latham, "General Synopsis of Birds,1781-1801."

1785-1851s - J.J. Audubon (Birds of North America, 1820s) states "It is possible we may have more than two species of swan within the limits of North America" This quote from section on Trumpeters and Tundras.

1804 - Lewis and Clark saw "many young swans in a lake" in Atchison, Kansas area July 4-7, captured them but did not mention species. They do, however, excitedly note first sightings of Trumpeters and Whistling swans at the base of the Columbia River, in March, 1806, on the trip homeward.

1872 - Courier & Ives show "Mute and Tundra Swans, Carroll Island, Maryland. "caption from photo showing Haunts of the Wild Swans" print in the book (USF&W book, The Atlantic Flyway, by R. Elman, 1977)

1880s - Fossil Lake gives up numerous Trumpeter and *Sthenelides Paloregonus* specimens. (Cope, 1878) "Sthenelides" the old fashioned name for Mute Swan," (Scott1972)

1946 - Hildegarde Howard releases studies on Fossil Lake fossil anseriformes, including *Cygnus paloregonus*, with comparisons to *Sthenelides olor* (short tarsi and long toes) in several instances

stating "similar to *Cygnus olor*", and "thought to represent the Mute-type swan." (see Wetmore 1957 p.268)

- 1967- Royal Ontario Museum, Archaeology Newsletter, item: THE FORT ALBANY BIRD BONES pg.3. "the breast bone of a mute swan, (ca.1650-1700)." This area was not colonized at that period. The species identification was done additionally by Rufus Churcher, Howard Savage, and Walter Kenyon, ROM. It is published in *Birds from the Ground*, by Dr. Savage and Douglas C.Sadler and published as Occasional Papers in Archaeology No.15, 2003.
- 1967 - In Birds of the Soviet Union, Dement'ev (1967) states: 4. Hissing Swan (Mute Swan) pg.302,

under Distribution: Range: extensive area, ending with, "and further east near Sidemi in Maritime Territory."

- 1970s - There are also many notes in Trumpeter Swan Society papers, showing presence of
- Mute Swans, and three colours of bands to accommodate the three species being studied, Trumpeter, Tundra and Mute Swans.

Fossil swans have been found and named *Cygnus paloregonus*, in at least four states. However, most studies have been on behaviour, in the recent past rather than history.

Discussion and conclusions:

Convincing paleontological evidence confirms Miocene, Pliocene and Pleistocene presence in North America of now-extinct swans homotaxic with the Mute Swan. The fossil Mute Swans are probably a lineage of an ancestral proto-Mute Swan, conceivably arisen in the New World and subsequently pioneered across the Northern Hemisphere, eventually branching into Eurasian and North American genotypes that diverged over time. Mute Swans did not spring up spontaneously in pre-European colonization in Canada.

It is indisputable that Mute Swans were present in the early 20th Century in North America, when the MBC and MBTA were being drafted and ratified. It would be extremely unlikely that the formulators of those documents were unaware that Mute Swans were present in North America at that time. Failure of the MBC to specifically exclude Mute Swans from its protective provisions suggests the authors did not intend for them to be excluded, because they were here. In fact, in the MBTA, swans and eiders were separated out and taking them through hunting or for medical research was deemed illegal.

Although, in the United States, the de-listing of Mute Swans has resulted in the destruction of birds, as state-initiated programs, the Canadian Wildlife Service considers the birds to be fully protected in Canada. Only in British Columbia has a local removal been conducted, and that was in conjunction with a Trumpeter Swan introduction project.

The Ornithological Newsletter recently stated: Most federal agencies have little or no scientific expertise. Therefore the “NLAA”decision would be devoid of science. We believe the activities created by the agencies to make the Mute Swan extinct on this continent are also devoid of science.

Acknowledgements:

Howard Savage (now deceased) was a former staff paleontologist at the University of Toronto, Department of Ornithology, and his many comments of swan bones are appreciated. The Howard Savage Faunal Laboratory is named in his honour. Roland Clement was head biologist for National Audubon for many years, working as liaison with the Federal and state agencies and wrote extensively for them. CS (Rufus) Churcher is Professor Emeritus (Paleontology), Department of Zoology, University of Toronto (retired), who has been extremely helpful in some of the paleontological aspects of this investigation. Ken Ross is a senior biologist with the Canadian Wildlife Service, Ontario Region. Dr. Peter Storck, Curator. Emeritus, Department of Anthropology, ROM was very helpful and informative and patient. George Jefferson, of Berkeley, NMLA and a State of California paleontologist in residence, was helpful and gets the last word: “Good morning Kathryn, I have no problem providing you with a

statement or professional opinion concerning the paleontological evidence, or the lack there of, for *Cygnus olor* and its possible fossil ancestors. This is simply an issue of evidence, which, as you have pointed out, is largely ignored by some. Communications from this office are considered a matter of public record. The relationships of North American Plio-Pleistocene fossil species of the genus *Cygnus* (in part assigned to *Sthenelides* or *Olor* by previous workers), including *C. hibbardi* and *C. paloregonus* to the modern species *C. olor* have not been well studied. Although it has not been shown through any rigorous anatomical research that these taxa form a clade, there are no compelling reasons to reject such a hypothesis. It has been recognized that *C. paloregonus* is a likely candidate ancestor for *C. olor* but this remains to be fully demonstrated. Until then, *C. olor* must be considered a taxon with potential North American ancestry. Best, George"

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Corrections to Mute Swan paper by Alison and Burton

I have since come to learn that the Mute Swan paper by Alison and Burton contained factual errors. There is now a SCO committee to assist the editor with fact checking of submissions. I have addressed Picoides' status as non-peer-review publication elsewhere in this issue. I apologize to members of Society of Canadian Ornithologists and especially the Ornithological Council and its staff for publishing these errors that harmed their public credibility. Specifically, I want to correct the following:

1. The Ornithological Council's Executive Director is named Ellen Paul, not Helen Paul. She did not represent herself to be the attorney for the Ornithological Council in the comments submitted to the U.S. Fish and Wildlife Service. At no time has Ellen Paul represented herself as an attorney in this or other matters involving the Ornithological Council; she has not practiced law since 1991, before she became a staff member for the Ornithological Council.

2. The Ornithological Council was not involved in lobbying for the *Migratory Bird Treaty Reform Act*.

3. Subsequent to the enactment of this statute by the U.S. Congress, the U.S. Fish and Wildlife Service, acting as directed by the U.S. Congress, published a notice in the Federal Register comprising a "*Draft List of Bird Species to Which the Migratory Bird Treaty Act Does Not Apply*." The Alison/Burton piece implies that the Ornithological Council was somehow involved in the development of this Federal Register notice, but that in fact, the Federal Register is a publication of the United States government and the Ornithological Council played no role in the publication of the notice.

4. The Ornithological Council submitted comments addressing various aspects of the criteria for exclusion of a species, but did not address any particular species on the list. Mute Swans were mentioned only once, and then only to point out that "*The Migratory Bird Treaty Act* is silent about whether a country can protect taxa that are not included in one or more of the treaties. In practice, each country has some latitude about how to interpret the treaty. Indeed, Canada is electing to protect Mute Swans, or at least giving its provinces the option to do so, and yet apparently accedes to the U.S. decision not to protect Mute Swans." Therefore, the statements by Alison and Burton that the "reasoning is flawed and evidence goes against it" were erroneous.

5. Alison and Burton took out of context a statement made by the Ornithological Council, in comments made jointly with the Society for Conservation Biology and the Wildlife Society, in November 2009, pertaining to a change proposed by the U.S. Department of the Interior about the manner in which the Endangered Species Act is implemented. That statement, regarding the extent to which federal agencies in the United States employ staff with scientific expertise was incorrect. In fact, the comments argued that the U.S. Fish and Wildlife Service has the requisite biological expertise to make determinations about the impact of agency actions on endangered species, whereas other agencies - to whom this new policy would delegate this determination - do not. The Burton/Alison piece implies that this statement pertains to the U.S. Fish and Wildlife Service, and to the determination made by that agency with regard to the Mute Swan. The letter does not address the Mute Swan or the Migratory Bird Treaty Act at all, and asserts that te U.S. Fish and Wildlife Service does have the biological expertise to make this kind of decision.

6. The Ornithological Council did not address a scientific issue in a manner that involved flawed reasoning or that contradicted the available evidence, as the one comment about Mute Swans did not involve a scientific issue; that in fact, the letter did not address the extensive discussion in the notice published by the USFWS about the scientific merits pertaining to the status of the Mute Swan.

Rob Warnock, Editor of Picoides

Historical Information on Bird Distributions Indicates that Mute Swans Were Introduced to North America

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In a recent issue of Picoides, Alison and Burton (2008) challenged the long-accepted view that the Mute Swans (*Cygnus olor*) in North America are derived from captive birds imported from Europe. Using information from historical accounts; paleontological and archaeological records; and descriptions of current swan distributions, they argue that the Mute Swan was already present when Europeans settled North America, and therefore is a native (not an introduced) species. Unfortunately their paper was not peer-reviewed, so it is particularly important to assess their sources of information and their methods before accepting their conclusions. I will focus on the historical records from early European explorers and settlers that they cited. I will also address the scientific information on swan distributions from the past 300 years that they chose not to consider in their analysis. Others are responding to their paleontological, archaeological and distributional evidence.

The most concrete historical evidence presented by Alison and Burton for the occurrence of Mute Swans in North America at the time of European settlement is the painting of a swan by John White. The painting was completed in the 1500s in Virginia. Alison and Burton argue that this is clearly a Mute Swan because of the curved neck, raised wings and knob on the bill. The shape of the neck is often used as a general field mark for distinguishing both Tundra Swans (*C. columbianus*) and Trumpeter Swans (*C. buccinator*) from Mute Swans, and standard field guide illustrations show the first two species with straight, vertical necks and Mute Swans with sinuously curved necks. This difference in posture is not dependable, however, because Tundra and Trumpeter swans often have curved necks when they are in relaxed positions (Figures 1, 2 [removed]), while alert Mute Swans may have straight necks. A comparison of photographs in the Birds of North America accounts for Tundra and Mute Swans demonstrate that either species can show a straight-necked or curve-necked profile (Limpert and Earnst 1994; Ciaranca et al. 1997). The knob on the bill in the painting would be diagnostic for Mute Swan, but it is smaller than in either a typical male or female Mute Swan. The Swans have longer, more pointed tails (Ciaranca et al. 1997). The long, thick bill shown in the painting is most similar to that of a

Figure 1. Tundra Swans at Ridgefield National Wildlife Refuge, Washington. Note the curved necks of many of these swans. Photograph by Gerrit. Vvn.

Trumpeter Swan, a species that originally occurred on the eastern coast of North America (Mitchell

1994). Mute Swans and Tundra Swans have thinner, shorter bills with a sloping, concave upper surface, and this is probably why this painting is sometimes labelled as a Trumpeter Swan. (Some of John White's other paintings show birds with inaccurate proportions, however. For example, see his painting

Figure 2. Trumpeter Swans (with one Mute Swan on the far right) at LaSalle Park Marina, Burlington, Ontario. Note the curved necks of many of the Trumpeter Swans. Photograph by Ken Abraham.

of the Brown Noddy (Anous stolidus) at the British Museum website (http://www.bnimages.com/resultsframe.asp?W+4&F=0001&Step=37); both the bill and tail are disproportionately long for a Brown Noddy.) The other reliable characteristic for distinguishing Mute Swan is the orange bill color. The painting shows a black bill like that of a Tundra Swan or Trumpeter

Swan, but this is apparently inconclusive if the authors are correct about the paint becoming darker over time. If the painting originally showed the orange bill with a black base that characterizes the Mute Swan, however, then one might expect to see two dark tones (the original black and the darkened orange). The entire bill appears to be uniformly dark black. Overall, the swan depicted in the painting appears to mix characteristics of different species of swans, so it cannot be conclusively identified as a particular species.

This detailed comparison of the White painting with swan photographs is probably not very relevant, however. I suspect that the iconic image of a curved necked swan with raised wings would be so strongly engrained in the mind of any 16th century Englishman that he would draw swans with these characteristics after seeing them from a distance. Because the swan was a symbol of royalty and aristocracy in England and was a common element in heraldry in both England and continental Europe, swan iconography was highly standardized, and the curved neck, raised wings and knobbed bill were part of this image.

The earliest European visitors and settlers perceived their surrounding through a European lens. For example, my efforts to deduce the types of birds that were common in New England at the time of English settlement from early accounts such as "New Englands Prospect" by William Wood (1634) ended when I found only vague descriptions of "linnets" and "partridges" (European birds that are not found in North America) or general descriptions of "swans" and "eagles" with no indication of the particular species. Only the most distinctive birds, such as hummingbirds and turkeys, can be precisely identified in these accounts. John White is well known for his painting exceptionally accurate illustrations of indigenous people (Hulton and Quin 1964), but even he would have been influenced by European expectations and assumptions.

The other historical information presented by Alison and Burton consists of vague travelers' accounts of unidentified species of swans. Nothing in these accounts suggests that Mute Swans were involved. The more parsimonious explanation is that Tundra or Trumpeter Swans were observed. These species were known to occur in North America, and their historical distribution has been carefully documented with museum specimens as well as from archaeological sites (Lumsden 1984). Their distribution and seasonal occurrence differed from current distributions before the extensive destruction of wetlands in central North America and the near extinction from which the Trumpeter Swan is now recovering, so differences from current distributional or migration patterns in historical records do not constitute a strong case that these observations represented a third species of swan.

While emphasizing inconclusive observations of unidentified swans, Alison and Burton ignore the large amount of precise evidence about bird distributions in the 18th and 19th centuries. Why weren't Mute Swans collected or painted by experienced and widely traveled early naturalists such as Mark Catesby, Alexander Wilson and John James Audubon? Specimens, not notes based on visual observations, were the only accepted source of information on bird distributions until the 1940s, when field guides and better optics made visual identification reliable. In the 1800s dozens of naturalists and professional collectors traveled to every region of North America collecting both common and rare birds. Common birds were collected from each region to determine whether there were regionally distinctive populations (subspecies). By the 19th century, the professionals were joined by hundreds of amateur ornithologists, virtually all of whom used shotguns to collect specimens. The hundreds of thousands of study skins prepared by professional and amateur ornithologists were preserved in natural history museums. North American museums have preserved four to five million bird specimens (Peterson et al. 2005), a large proportion of which were collected in North America. Every state and province has at least one such collection, and until recently the distributions of bird species were mapped primarily by using information from these collections. For example, the detailed descriptions of distribution of waterfowl in Bent (1923 - 1925) are based primarily on museum specimens. Even small and elusive songbirds that live deep within swamps, such as Bachman's Warbler (*Vermivora bachmanii*) and Swainson's Warbler (*Limnothlypis swainsonii*), are represented in museum collections. It is difficult to conceive of how a large, conspicuous species such as the Mute Swan would not end up in some of these collections if there had been a North American population. If they had been rare, they would have been more highly sought after. (There are dozens of Ivorybilled Woodpecker specimens in collections, for example.) If there were one or two specimens in collections, this might indicate that Mute Swans were occasional winter vagrants from Eurasia, like Eurasian Wigeons (*Anas penelope*) or Tufted Ducks (*Aythya fuligula*), but as far as I know there is not even a single specimen from before the period of known introductions of Mute Swans in the 1800s. A breeding population of Mute Swans certainly would have yielded numerous specimens in a number of museums. Why did Mute Swans disappear from the record for 200 to 300 years? Were they extirpated in the 1600s only to be reintroduced in the early 1900s? Why would they go extinct in North America at a time when only a narrow coastal band of eastern North America was settled by Europeans?

Alison and Burton also ignore the carefully documented evidence for the first records and subsequent spread of Mute Swans in the late 1800s and early 1900s. The references to the historical spread of Mute Swans are summarized in Appendix 1 of Ciaranca et al. (1997). Feral birds were first recorded close to known captive populations of Mute Swans, and they slowly spread out from several regions where they originally escaped from captivity. The historical evidence indicates that they spread from places like the Boston Public Garden and large private estates in Long Island, not from some hidden refuge in the wilderness where a native population had remained undetected for more than 200 years.

In the process of gathering vague accounts of swans in North America and ignoring the precise and easily verified record of bird distributions based on museum collections, Alison and Burton provide a misleading description of the available historical information. Other than a painting of a swan that has a mix of characteristics of different swan species and may have been heavily influenced by the standard European iconography of swans, they provide no new information about the historical record of Mute

Swans in North America. They certainly do not demonstrate conclusively that Mute Swans were found in North America at the time Europeans first settled the region.

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Evidence that Mute Swans are Native to North America is Lacking

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Mute Swans (*Cygnus olor*) have long been considered a non-native species to North America by the vast majority of professional ornithologists (e.g., American Ornithologists' Union 1998). Introductions during the 1800s have been well documented (Ciaranca et al. 1997), and the subsequent population increase and range expansion follows that expected of an introduced species (e.g., Ellis and Elphick 2007: Fig. 2 therein). In the November 2008 issue of Picoides, however, Alison and Burton (2008) assert that this view is mistaken and claim that they have found evidence suggesting that the species is native to the Americas. Given that their article was not subjected to peer-review, I offer some counterpoints that call into question Alison and Burton's interpretation of the evidence.

My focus is on the documented fossil evidence from the American West and on known movement patterns in modern swans. Others will provide detailed responses to the other points raised by Alison and Burton (2008). In my view, however, none of the evidence purportedly showing that Mute Swans are native to the Americas meets modern scientific standards. For instance, if one were to take the statement attributed to David Beers Quinn that "there would be nothing in the paintings that the artist [John White] did not see, these men were scientists" to be literally and absolutely true, as Alison and Burton apparently do, then one has to wonder why he painted a swan with a pale iris. In addition, the bill shape and the dark colour around the eye and gape of the swan that White painted in 16th century Virginia are not accurate for any modern species of swan. Either John White sometimes painted things that he did not see, or he painted a bird that was neither a Mute Swan nor a Trumpeter Swan (C. buccinator).

The centerpiece of Alison and Burton's fossil evidence is the studies of Hildegarde Howard, who thoroughly reviewed and reanalysed the Pleistocene avifauna from Fossil Lake, Oregon (Howard 1946). In addition to considering new material from the site, Howard's paper makes reference to previous studies conducted by two earlier paleontologists (Cope and Shufeldt) and reassesses some of their work. The paper is long and in places quite technical, with detailed discussions of certain bones. The paper deals with all birds found at the site, although the majority of the fossils come from species of waterfowl.

The discussion of swan bones is seven pages long (pp. 159-165). Prior to Howard's work, four species of swans had been identified from the site: Trumpeter Swan, Tundra ("Whistling") Swan (*C. columbianus*), and two extinct species (C*. paloregonus* and *C. matthewi*). In her reassessment, Howard determined that in fact there was sufficient evidence to recognize only two species, Trumpeter Swan and *C. paloregonus*.

Nowhere in the document does Howard suggest that fossils of Mute Swans have been found at the site, nor that anyone has ever suggested that they have. The paper does, however, make numerous comparisons between modern Mute Swan bones and swan fossils found at Fossil Lake, which is perhaps the source of the confusion. Howard considered the extinct species *C. paloregonus* to be more closely related to the Mute Swan than to either of the extant North American species. At the time this paper was written, the modern *Cygnus* swans were split into two genera, with Mute Swan placed in the genus Sthenelides. Howard considered the extinct species *paloregonus* to belong in the genus *Sthenelides,* rather than Cygnus, and many aspects of the description of its bones refer to similarities to those of Mute Swan to support this classification.

For example, in her summary passage, Howard states that Shufeldt's identification of certain bones as

belonging to a species of goose ("*Anser condoni*") were in error because he did not have any Mute Swan specimens for comparison. A careful reading of the detailed fossil descriptions that follows demonstrates that Howard believed that Shufeldt made his misidentification because he thought that all swans have a furcula similar to that of Trumpeter and Tundra Swans. Had he had a specimen of a Mute Swan (or another of the "*Sthenelides*" swans), Howard argues, he would have known that some swans have a furcula that resembles that of a goose. This knowledge would have allowed him to recognize that the bones he assigned to *Anser condoni* actually belonged to a swan and would have led him to the conclusion that Howard draws, which is that these bones belonged to *paloregonus*. It is clear from several passages in the paper that Howard did not think that the fossils she assigns to *Sthenelides (Cygnus) paloregonus* (including the bones Shufeldt identified as *Anser condoni*) belonged to Mute Swans. Several quotes from the paper demonstrate that she considered *paloregonus* and Mute Swan to be distinct (though related) species. As Alison and Burton note, most of these statements refer to the larger size of *paloregonus*. For example:

"In length of the skeletal elements, paloregonus exceeds S. olor throughout …" (p. 160);

"The blunt contour of the tip of the blade, with slight dorsal excrescence, has an almost exact counterpart in a furcula of *S. olor* now available (L. A. Co. Mus. no. Bi69), and in the symphyseal area closely resembles another specimen of the same species (L. A. Co. Mus. no. Bi1096). Both modern furculae, however, are smaller than the fossil." (p. 162); and

"The humeri now assigned to *S. paloregonus* are large, exceeding *S. olor* and *C. columbianus* in size …" (p. 163).

Importantly, however, other comments go beyond the size differences between the two species, and refer to shape differences:

"Fossil similar to S. olor, though depression more proximal in extent than in living form and pisiform process itself broader and less pointed; … " (p. 164); and

"Distance from pisiform process to tip of internal edge of trochlea relatively less than in Cygnus or S. olor, and similar to S. melancoriphus." (p. 164).

Probably the best demonstration that Howard did not consider Mute Swan to have occurred at Fossil Lake is the species list that she gives on p. 190, which does not include Mute Swan either in the "List according to Shufeldt (1913)" or in Howard's "List as now amended".

In short, there is no evidence that Howard considered Sthenelides paloregonus to be a "Mute Swan genotype (ancestor)" as described by Alison and Burton (2008: 38). What Howard does suggest is that paloregonus was more closely related to Mute Swan and Black-necked Swan (C*. melancoryphus*) than to the other North America swans. Based on her analysis, it is equally plausible that the closest modern relative of paloregonus is the Black-necked Swan of South America.

In their letter, Alison and Burton also imply that there is a history of natural movements from the current native range of Mute Swans to North America, and that such movements are to be expected. Evaluating many aspects of these arguments is complicated by the fact that Alison and Burton do not follow widely accepted citation norms for scientific documents. Many of their claims lack reference to the source material; for example, the claim that "Mute Swans were known in Yosemite early on". Other items appear to be attributed, but the references are then found to be missing from the citation list. For example, the Abstract refers to sightings in Alaska that are attributed to "Sladen and King 1976, Heilprin 2006", and in Saskatchewan that are attributed to "Greenwood 2000". None of these three references appears in their citation list, so it is impossible to verify what the source documents actually say, or

determine whether these hypothetical sightings have been subjected to any form of review. It seems possible, for example, that the Saskatchewan reports involved the breeding attempts in the 1960s that have been ascribed to introduced birds (Lever 2005).

Even those claims that are referenced do not seem to have withstood scrutiny. For instance, various references are made to Mute Swan records from Alaska, yet the species does not appear on the most recent edition of the "Checklist of Alaska Birds" (Gibson et al. 2009: http://www.uaf.edu/museum/bird/products/checklist.pdf), and no reports have ever been submitted to the Alaska Checklist Committee for review (D. D. Gibson, in litt.).

Mute Swan introductions have been described in various places across the continent, including British Columbia, Montana, Saskatchewan, Minnesota, Wisconsin, and Ontario, as well as along the Atlantic seaboard, where the main North American population lies (American Ornithologists' Union 1998). In addition there are "numerous reports elsewhere in North America [that] pertain to local escapes from captivity" (American Ornithologists' Union 1998), some of which result in limited breeding (e.g., in Nevada; Floyd et al. 2007). Thus, careful elimination of such origins for any reported birds would be essential before any modern report could be accepted by the scientific community.

In discussing whether it is plausible for Mute Swans to have reached North America, Alison and Burton pose a question that they attribute to Paul S. Martin: "The question is not, would Mute Swans have come onto this continent? but [sic] rather, why would they not?" Leaving aside the obvious point that the mere ability for something to have happened does not mean that it actually has happened, there is considerable evidence that Mute Swans are unlikely to make long-distance over water movements on a regular basis. Moreover, this evidence demonstrates that the movement behaviour of Mute Swans differs from that of Arctic-nesting swans.

Mute swans are certainly capable of overland movements of hundreds of miles, but such movements over water appear to be exceedingly rare. For instance, out of 82,000 Mute Swans banded in Britain, and >19,700 subsequent reports of those birds, there are only 45 records of birds moving the short over-water distance to continental Europe, with the farthest going little further than Denmark (Wernham et al. 2002). In contrast, in both Bewick's (*C. columbianus bewickii*) and Whooper Swans (*C. cygnus*) there have been more long-distance recoveries from many fewer banded birds, suggesting that the low number of Mute Swan movements cannot be explained by a lack of observers available to record movements. In addition to their much reduced propensity towards long-distance migrations, Mute Swans also have a more southern range than do Bewick's and Whooper Swans, so the overwater distance to North America is much greater for Mute Swans than for the other two species.

For all of these reasons, Mute Swans are far less likely to occur as natural vagrants in North America, than are either Bewick's or Whooper Swans. For such vagrancy to occur, Mute Swans would have to make much longer over water flights than the other two species, or one would have to invoke a northward movement prior to their over water flight. Given the rarity of vagrancy in Bewick's and Whooper Swans, the chance of a natural Mute Swan vagrant to North America must be exceedingly low. Even if such vagrancy did occur, it would not provide evidence for a natural breeding population; many other bird species occur as very rare vagrants in North America without ever establishing populations.

In conclusion, given the absence of evidence that meets the rigours of both peer-review and formal acceptance by the appropriate committees of leading professional organizations (e.g., the American Ornithologists' Union's Check-List Committee), there appears to be no reason to overturn the prevailing view that Mute Swans have only ever established sustainable populations in the Americas as a result of human introductions.

Acknowledgements:

I thank J. Nocera for asking me to write this response; K. Burton for discussing her ideas about swans with me; and R. Askins, D. Gibson, and S. Olsen for providing helpful answers to my recent questions about swans and for commenting on an earlier draft.

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Re-identification of the Fort Albany Mute Swan bone

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The incredible claims of Alison and Burton (2008) have largely been corrected by subsequent authors here in *Picoides*. The focus in particular was on their factual errors (Warnock, 2009), their misinterpretation of the swan fossil record (Elphick, 2009), the notorious unreliability of many early illustrations (Askins, 2009), the well-documented evidence for the first records and subsequent spread of Mute Swan *Cygnus olor* in the late 1800's and early 1900's (Askins, 2009) and the lack of records for any naturally vagrant Mute Swans (Elphick, 2009). One substantive claim is still outstanding; the accurate identification of an archaeological Mute Swan bone from Fort Albany, Ontario. In this note, we will establish that this bone was misidentified and subsequently, misrepresented. The bone in question is actually from a Canada Goose, thereby removing Mute Swan from the archaeological record of Ontario.

The site

The Fort Albany archaeological site is an early historic site, occupied by English and French traders from approximately 1679 to 1721 AD, and frequented year round by native peoples with firearms. Mammal and bird remains collected from this midden have been studied (Churcher 1965, Baldwin 1967). Overall, thirty-one species of birds were identified, including Snow Goose *Chen caerulescens*, Ross's Goose *Chen rossii,* two races of Canada Geese *Branta canadensis*, Mute Swan, Tundra Swan *Cygnus columbianus* and at least 10 species of ducks (Sadler and Savage 2003).

In 1775 John Foster described five bird species new to science: Eskimo Curlew *Numenius borealis*, Great Gray Owl *Strix nebulosa*, Boreal Chickadee *Poecile hudsonicus*, Blackpoll Warbler *Dendroica striata* and White-crowned Sparrow *Zonotrichia leucophrys*. All five had been collected in northern Ontario by Andrew Graham. The Eskimo Curlew is said to have been collected in the Fort Albany area (Baldwin, 1967). The Fort Albany site was therefore well-known to European ornithologists at the time.

There certainly were European influences evident in the archaeological material at Fort Albany because rat, dog, pig, cow and sheep bones were identified amongst the mammal material (Churcher, 1965) and Domestic Chicken (*Gallus gallus*) amongst the avian material. Shot holes are not uncommon in these archaeological specimens (Sadler and Savage, 2003), therefore these remains, in most cases, represent bones left after the birds were shot and consumed.

It would not have been impossible that a Mute Swan could have been brought from Europe to live at this site. Nor would it have been impossible that swan meat may have been salted and sent over as additional meat resources. Nevertheless, contrary to Burton's claims (Burton, 2009) this site is not "dated to a period in which there was no European colonization of the area". And, as we will show, there are no Mute Swan bones from this site anyway.

To provide a clear understanding of the process that Baldwin went through to identify the bone it is best to track the material from the Fort Albany site. Photos and description of the archaeological excavation can be found in Kenyon (1986). During excavation of the stockade in 1963 numerous bird bones were found amongst the litter and garbage of the compound floor (Baldwin 1967). The bones were not numbered nor catalogued as to location specificity during the excavation. All avian skeletal material was collected at the site and brought in five bushel baskets to the Royal Ontario Museum (ROM).

Upon arrival of the material at the ROM, Don Baldwin, a technician in the Ornithology Department was asked to identify the skeletal material (Fig. 1, next page). Baldwin was considered a natural choice for the job because for the previous three years he had been given the responsibility of expanding the museum's bird skeleton collection which, at the time, was still in its infancy. Today the number of skeletons in the Ornithology collection is just over 45,000. The number of skeleton

Figure 1. Don Baldwin in the earlystages of processing and identifying the Fort Albanyarchaeological bird remains.

specimens dated earlier than 1964 is 2,776, of which only two are Mute Swan and seventeen are Canada Goose. The Fort Albany bones are presently housed in two locations. The non-accessioned skeletal material remains in New World Archaeology. The artifacts have been placed in large cardboard boxes and wrapped in plastic. The material has been roughly separated by species, presumably by Baldwin, but it has not been uniquely identified or accessioned into any collection. Most of this skeletal material has been identified as Canada Goose, Blue Goose *Chen caerulescens*, grouse or shorebird. The Canada Goose box is the largest and contains numerous sterna amongst many other elements. There is little doubt that this material was identified and kept for comparative purposes but we did not find any evidence to suggest the possibility of a mix up occurring during processing and identification.

Fully accessioned, representative materials from 29 of the 31 species presented in the Baldwin (1967) paper are housed in the Ornithology skeleton collection. These bones were selected by Baldwin for inclusion into the collection however; they represent only a small fraction of the 2,357 bones collected at the site. Prior to deposition into the collection the bones were cleaned, uniquely numbered and protected with a lacquer-like substance (polyvinyl acetate, or gelva). The representative bones for each species have been grouped together and placed in individual species boxes with the associated data placed on labels glued to the top of the box. All boxes from the Fort Albany site were pulled from the collection drawers during this investigation and checked to ensure accurate deposition. The only bone in the box originally labeled as *Cygnus olor* ROM 159698 is the bone in question: a partial sternum matching the description provided by Baldwin (1967). None of the other bones in the accessioned material matches the Baldwin description. This is contrary to the contention of Burton (2009), that “Mute Swan remains” were found, implying more than one specimen.

The bone

ROM 159698 is a partial sternum and keel (Figs. 2 and 3, next page). It is the anterior part of the keel with several mm of the sternum on each side. The width of the bone at its widest point is 29 mm. The length of the broken keel is 117 mm and the depth of the keel at its highest point is 33.7 mm.

To identify the bone to species we used 3 characters; overall size of keel, slope of keel and the dorsal median ridge running the length of the sternum. The slope of the keel was calculated for several specimens of Mute Swan and Canada Goose *interior* contained in the Ornithology collections and compared with the Fort Albany sternum (Fig. 4, next page). The dorsal median ridge on swans was found to protrude dorsally, while on Canada Goose the ridge is impressed ventrally. The bone was compared with several waterfowl species including; Trumpeter Swan, Tundra Swan, Mute Swan, Snow Goose *Chen caerulescens*, Canada Goose *B. c. interior*, Greater White-fronted Goose *Anser albifrons* and Brant *Branta bernicla*. The larger keel size excluded White-fronted Goose, Brant and Snow Goose while the gentler slope of the keel (Fig. 2) and the morphology of the dorsal median ridge (Fig. 3) excluded the three swan species. All three of the qualitative characters are congruent with Canada Goose.

Figure 2. Ventral view of sterna (from left to right) of Mute Swan *Cygnus olor*, Fort Albanysternum and Canada Goose *Branta canadensisr.* Photo byBrian Boyle, ROM.

Figure 3. Dorsal view of sterna showing the median ridge (from left to right) of Mute Swan *Cygnus olor*, Fort Albanysternum and Canada Goose *Branta canadensis.* Photo byBrian Boyle, ROM.

Since there is no doubt as to the identification of this bone fragment as that of a Canada Goose, one question remains: how could so many experts misidentify this bone fragment? After careful review of the history, it is clear they all did not. The original identification was made by Baldwin in 1967, at a time when

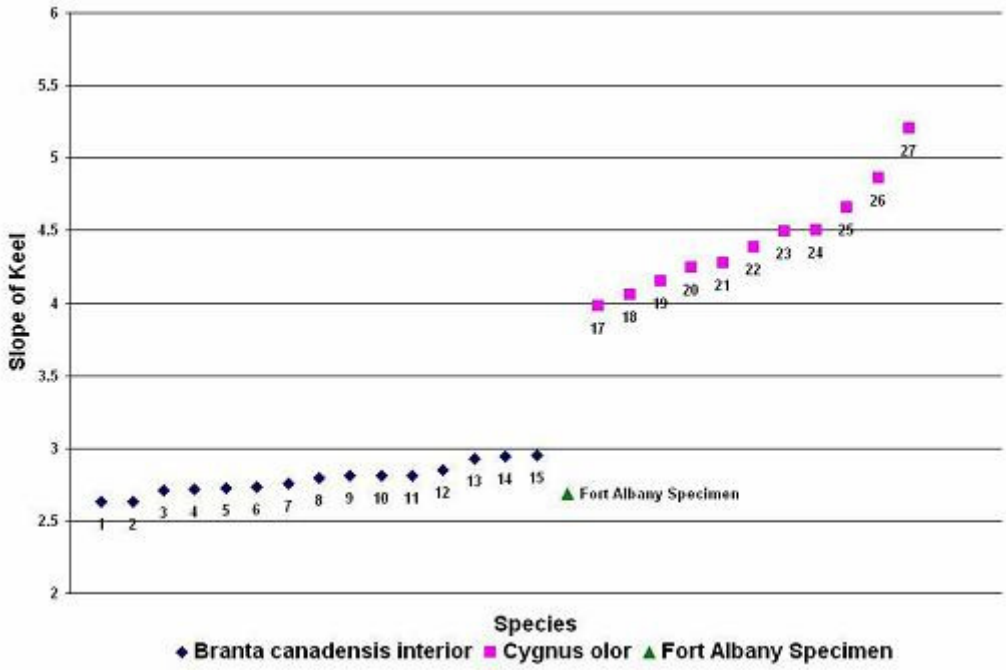

Figure 4. Slope of keel calculated for Mute Swan *Cygnus olor*, Fort Albanyspecimen and Canada Goose *Branta canadensis interior.* Measurements taken from specimens contained in ROM,Ornithology

the ROM did not have a significant bird bone collection. Baldwin decided to travel to the American Museum of Natural History in New York and U.S. National Museum (Smithsonian) in Washington DC.

(Baldwin, 1967) in order to complete the identification of these bones, and hence neither Savage nor Churcher could have had a hand in its identification at that time. Churcher's name appears in Sadler and Savage (2003) associated with this site because he was paleontologist in charge of the project, and he studied the mammal remains found therein, published in 1965. It is important to note that Churcher is not "an ornithologist and archaeologist" as Alison and Burton (2008) claim but a mammalogist and paleontologist. We regard him highly for his wide-ranging abilities, including having supervised the PhD thesis of one of the authors (KLS). However, we also have his verbal assurances that he did not have a hand in the bone's identification.

Howard Savage (who was not a "staff paleontologist at the University of Toronto, Department of Ornithology" as Alison and Burton (2008) claim but a professor of faunal-zooarchaeology in the Department of Anthropology, University of Toronto) had a rigorous bone-identification ethic and we are confident that he could not have made such a flagrant identification error. Sadler and Savage (2003) was published some years after Savage's death in 1996, and given this book is a compilation of ALL archaeological bird bones found in Ontario (tens of thousand of specimens are represented), we are confident that Savage could not have personally checked the identification of every bone listed in this volume. As Sadler himself mentioned in the acknowledgements to the work (Sadler and Savage, 2003:331) they had to rely on the publications and reports of many individuals before them, such as Don Baldwin. Unfortunately, errors in identification do happen which may have been amplified in Baldwin's case, as he was a neophyte student and this was the first bone identification project that he had tackled (Baldwin, 1967). Therefore, we contend that the bone identification error was Baldwin's and Baldwin's alone.

Alison and Burton did not cite Lumsden (1984) or Abraham and Ross (2005) in their original discussion. Lumsden's (1984) work is relevant, as it discusses the pre-settlement breeding distribution of Trumpeter and Tundra Swans in Eastern Canada, and the archaeological and fur trader records of Trumpeter Swan. The problematic identity of the swans in early archaeological reports is specifically discussed, and Mute Swan is not mentioned. Abraham and Ross (2005) note the first 4 records of feral Mute Swan in Hudson Bay Lowlands of Northern Ontario and Manitoba (from 1996, 1997, 2001 and 2004). They documented no other records prior to these dates, which further demonstrate the lack of early evidence for Mute Swans in Eastern Canada.

In addition, we informed Burton in writing about the re-identification of the sternum ROM 159698 during August 2005. It was on her urging that we sent the bone to Dr. Richard Harington, retired Pleistocene paleontologist from the Canadian Museum of Nature, in Ottawa, Ontario. He also agreed with our re-identification of this bone as Canada Goose in January 2006, and this was communicated to Burton. However, Burton ignored this new information and instead re-published the former misidentification of the bone and in our view misrepresented the truth.

Discussion

From what we are able to ascertain Baldwin had a "few bones which defied identification" including the sternum in question. He eventually identified three bones as belonging to the "Common Domestic Chicken" *Gallus gallus* while the other "puzzler" was identified as the "breast bone of a Mute Swan" after additional comparisons with other "European avifauna".

From all accounts Don Baldwin was a careful observer and researcher. During his research Baldwin realized that the ROM's skeleton collection was not sufficient and so he traveled to the American Museum and the Smithsonian Museum to assist with his identifications. The box containing the sternum also contains a small label with "yellowlegs?" handwritten on one side and "Cygnus olor" on the other side. It also contains a small rectangular piece of paper with the words "O.K. New York., O.K. Wash". suggesting that he had confirmed his identification in all three museums. Shortly after the identification of the Fort Albany material Baldwin left the ROM to teach at Upper Canada College. Don Baldwin passed away in 2007 and we were unable to contact him prior to his death. As a result, it remains unclear why Baldwin considered the bone to be problematic or how he concluded the bone belonged to a Mute Swan.

The list of species Baldwin identified is of further interest in two ways. The first is the number of unusual species present on the list. There are several species of waterfowl, grouse, owls and shorebirds as expected, but more notably, the list contains several unusual species: Ross's Goose (uncommon in east), Whooping Crane (endangered), Willet (extralimital), Eskimo Curlew (endangered/extinct), Common Murre (extralimital) and Passenger Pigeon (extinct). We consider all of these species unusual for the area by today's standards. The second point of interest is the species missing from the list. A few species of shorebirds, such as Marbled Godwit, and Lesser Yellowlegs are common in the area today but are not represented within this archeological material. Were they not there? Were they not hunted? Are there additional mistakes in identification? The resultant reanalysis of additional accessioned material is currently under review.

Summary

We have reexamined (ROM 159698) found at the historic Fort Albany archaeological site This alleged Mute Swan sternum does not represent a swan at all, but represents a Canada Goose. It falls within the range of keel size, keel slope and ridge position.for Canada Goose. Therefore, there is no archaeological record of Mute Swan in Ontario to date.

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APPENDIX B

Aquatic vegetation species reported from the lower Detroit River.

Species (alphabetical order)	Source
Ceratophyllum demersum – coontail	Hunt 1963, Schloesser and Manny 1982
Chara sp. – muskgrass	Hunt 1963, Schloesser and Manny 1982
Elodea canadensis – American waterweed	Hunt 1963, Schloesser and Manny 1982, Schloesser and Manny 1990
Heteranthera dubia – grassleaf mudplantain	Hunt 1963, Schloesser and Manny 1982, Schloesser and Manny 1990
Myriophyllum sp. – watermilfoil	Hunt 1963
Myriophyllum spicatum – Eurasian watermilfoil	Schloesser and Manny 1982
Najas flexilis – slender naiad	Hunt 1963, Schloesser and Manny 1982
Nymphaea sp. – water lily	Schloesser and Manny 1982
Potamogeton spp.	Schloesser and Manny 1982, Schloesser and Manny 1990
Potamogeton crispus – curly pondweed	Hunt 1963, Schloesser and Manny 1990
P. gramineus – variableleaf pondweed	Schloesser and Manny 1982
P. illinoensis (formerly *lucens*) – Illinois pondweed	Hunt 1963, Schloesser and Manny 1982
P. natans – floating pondweed	Hunt 1963
P. nodosus (formerly *lochites*) – longstemmed pondweed	Hunt 1963, Schloesser and Manny 1982
P. pectinatus – sago pondweed	Hunt 1963
P. perfoliatus – claspingleaf pondweed	Hunt 1963
P. pusillus (includes *berchtoldi*)– small pondweed	Hunt 1963
P. richardsonii – Richardson's pondweed	Hunt 1963, Schloesser and Manny 1982, Schloesser and Manny 1990
P. zosteriformis (formerly *compressus*) – flatstemmed pondweed	Hunt 1963

Sagittaria sp. – arrowhead	Hunt 1963
Tolypella sp. – tasselwort	Hunt 1963
Utricularia macrorhiza (formerly vulgaris) – common bladderwort	Hunt 1963
Vallisneria americana – wild celery	Hunt 1963, Schloesser and Manny 1982, Schloesser and Manny 1990
Zannichellia palustris – horned pondweed	Hunt 1963

APPENDIX C

Recent lawsuits by animal rights activists arguing for legal protection for Mute Swans: outcomes and resultant legislation.

Background

In 1999, the state of Maryland appointed a task force to make recommendations regarding the burgeoning population of Mute Swans in Chesapeake Bay. The primary concern with these birds was the potential impact on submerged aquatic vegetation (SAV) in the Bay. Management options recommended by the task force included egg removal and addling, as well as lethal control. The Maryland Department of Natural Resources (DNR) had the authority to reduce wildlife populations on state property as long as supporting documentation is provided. No public notification was required by law, as non-native species Mute Swans were not (and are not, due to the amendment we will be discussing) offered federal protection by the Migratory Bird Treaty Act (MBTA).

The Migratory Bird Treaty Act (MBTA)

The MBTA (U.S. Code [USC] 703-712, Ch. 128; July 13, 1918; 40 stat. 755), enacted by Congress in 1918, authorizes the U.S. Department of Interior, represented by the U.S. Fish & Wildlife Service (USFWS), to regulate the take of migratory game birds that appear in the List of Migratory Birds. The list was not included in the original text of the Act, but beginning in the 1970s, the USFWS periodically published a list of protected species, based on four bird treaties between the U.S. and Mexico, Great Britain (for Canada), Japan, and the USSR. The Act did not or does not offer strict protection of listed birds, but establishes a framework of procedures for obtaining permits for actions that constitute "take" of these birds.

Hill v. Norton

In an effort to block lethal control measures of Mute Swans proposed in Maryland, a complaint was filed in July 1999 with the U.S. District Court in the District of Columbia by Joyce Hill, a Maryland resident. Hill was used as a plaintiff in the suit because she had Mute Swans on her property, a reduction in their numbers would reduce the aesthetic enjoyment of her property, and thus she had standing, which the District Court confirmed.

The complaint claimed that Secretary of the Department of the Interior's (at the time, Gale Norton) failure to include the Mute Swan on the List of Migratory Birds protected under the MBTA was arbitrary and capricious under the Administrative Procedure Act (USC Title 5, Part 1. Ch. 5, Subchapter 2). On these merits, the Court granted summary judgement in favor of the defendants, due to the ambiguity of the treaties and conventions underlying the MBTA.

The suit also claimed that the government was required to provide an Environmental Impact Statement (EIS), as noted under the National Environmental Policy Act (NEPA). The Court ruled against her on this claim, as she introduced nothing to support her contention that there were any "major Federal actions" that would require the preparation of an EIS.

Appeal

Hill appealed to the U.S. Court of Appeals for the District of Columbia Circuit (275 F.3d 98), wanting to directly address the language of the underlying conventions of the MBTA, based on four different treaties. In its decision in December 2001, the Court found nothing specific in the treaties or statutes to justify excluding the Mute Swan from the list of protected species. There was nothing in the statute regarding relevancy of whether a species is native or non-native. The Court ruled that since at least two of the underlying treaties reference "swans" and the family Anatidae, and Mute Swans are plainly swans and members of Anatidae, that Mute Swans must be protected under the MBTA.

This ruling did not mean Mute Swans could never be controlled by lethal means, only that Maryland (or other states) would have to obtain depredation permits issued by the USFWS.

Lethal control following the appeal ruling

In 2003, a number of state agencies applied to the USFWS for depredation permits to allow lethal control of Mute Swans.

As issuing the permits could be considered a "major federal action" under the National Environmental Policy Act (NEPA), a review needed to be conducted. If an action might result in *significant environmental impact*, an Environmental Impact Statement (EIS) has to be prepared. If the action is *not likely to cause significant impact*, a shorter document, called an Environmental Assessment (EA) can be prepared; the EA can be used to determine whether or not a full EIS is necessary. If a finding of no significant impact (FONSI) is the result of a review of an EA, no EIS need be prepared, and NEPA analysis ends.

NEPA only requires that prospective impacts of actions be understood and disclosed in advance. That is the function of an EIS or EA. They are not binding documents, and NEPA does not prohibit the actions from harming the environment.

An EA was prepared concerning the issuance of depredation permits for the removal of no more than 3,100 Mute Swans in the Atlantic Flyway in response to a challenge by the Fund for Animals, an animal rights organization, to an earlier permit issuance. The Fund dropped its challenge when Maryland agreed to surrender the permit and prepare an EA. The result of the EA was a FONSI issued by USFWS in August 2003.

This FONSI was completely logical, as the only significant impact would occur if the swans were **not** controlled and left to exert their influence on the environment. Later that month, depredation permits were issued.

Fund for Animals v. Norton (281 F.Supp.2d 209, 216 [D.D.C. 2003])

Within days, the Fund for Animals and two citizen plaintiffs filed suit challenging the FONSI, requesting a preliminary injunction to halt the issuance of the permits. The irreparable harm cited by the plaintiffs included decreased opportunities to view swans if some or all were killed. The Court ruled for the plaintiffs, relying on case law that found irreparable harm "even though plaintiffs did not establish that the exact animals they regularly observed would be directly affected by the proposed action" and that even “aesthetic injury based on the mere contemplation of a particular treatment of the animals in

question” could be considered irreparable harm. Unfortunately, the defense did not adequately address what harm would be incurred if the injunction was imposed (e.g., if the control measures were delayed). This also contributed to the finding in favor of the plaintiffs.

The USFWS opted to withdraw their EA, the FONSI, and the depredation permits. Therefore, the Fund dismissed the case.

MBTA amendment (Migratory Bird Treaty Reform Act of 2004)

Meanwhile, it was evident that the MBTA (originally passed in 1918 and last amended in 1976) was in need of clarification to clearly define which birds were protected under the Act and which were not. In December 2003, a Congressional subcommittee began hearing testimony regarding the MBTA and non-native species, legislation was introduced in April 2004, and it was signed into law later that year.

The MBTA now “applies only to migratory bird species that are native to the United States or its territories” and the term is further defined to mean “occurring in the United States or its territories as the result of natural biological or ecological processes.” It further specifies that “a migratory bird species that occurs in the United States or its territories solely as a result of intentional or unintentional human-assisted introduction shall not be considered native to the United States or its territories." The USFWS published a final list of bird species to which the MBTA does not apply in March 2005.

Fund for Animals v. Norton II (374 F.Supp.2d 91 [D.D.C.2005)]

In April 2005, the Fund filed suit again, seeking an injunction against the lethal control of swans. The plaintiffs contended that the control was in violation of the MBTA because of ambiguities in the Reform Act of 2004.

The Court denied the injunction. It ruled that"nothing in the Reform Act itself appears ambiguous," and the Reform Act's terms showed "that Congress intended to modify the [Migratory Bird Treaty Act] to exclude nonnative species." The Court added, "Congress clearly has the power to abrogate or modify a treaty or earlier legislation, and when it does so, that is the final word."

Fund for Animals v. Kempthorne [Secretary of the Interior replacing Norton] (2006 WL 3687107 ([D.C. Cir. 2006])

In August 2006, the Fund appealed the above ruling. The Court ruled in December 2006 that the MTBA Reform Act of 2004 modified the act to allow killing of non-native birds, and therefore did not protect Mute Swans.

APPENDIX D

Michigan Mute Swan policy

2006 DNR Mute Swan Management and Control Program Procedures

The feral, free flying, mute swan (*Cygnus olor*) population is large and expanding in the lower peninsula of Michigan. The 2005 spring statewide population was estimated to be 7,100 versus the estimated 5,400 in 2000. As the population has grown, so has the level of conflict with humans. Reported attacks on humans in boats and on shore have become frequent. Implementation of management efforts will help to ensure success of the native trumpeter swan reintroduction program, efforts to protect the endangered loon, and other native waterfowl, as well as reduce the number of potentially dangerous conflicts with humans.

Goal: The short-term (2005-2010) goal of management efforts is to reduce the mute swan spring population by 50% (3,500) of the 2005 spring population (7,100). The longterm goal (2030) is to maintain a spring population less than 2,000 mute swans.

Achievement of the short-term and long-term goals will require reduction of the number of mute swans on lands managed by the Wildlife Division, including state game and wildlife areas and wildlife floodings on state forest lands. Management of mute swan populations on private lands and other public waters will also be covered by these procedures. Movement toward the goal can be adequately assessed by the Winter Waterfowl Survey, the Statewide Spring Breeding Waterfowl Survey, and trumpeter swan population estimates. The Statewide Mute Swan Management Program and progress toward stabilization of the mute swan population will be reassessed in 2010. However, the management program will be revised and updated as needed.

I. Authority

Federal Authority

On December 28, 2001 the United States Court of Appeals for the D.C. Circuit ruled that mute swans are migratory birds, which afforded them protection under the Migratory Bird Treaty Act (MBTA). Previously, mute swans (*Cygnus olor)* were not protected under federal law, and their regulation was under the exclusive jurisdiction of the states. Protection of the mute swan was removed when the US Congress passed the "Migratory Bird Treaty Reform Act" in 2004. The act amends the original MBTA to state that it applies only to migratory bird species that are native to the United States or its territories. The "Final List of Bird Species to Which the Migratory Bird Treaty Act Does Not Apply" was published in the Federal Register March 15, 2005. The mute swan is on this list of species excluded from MBTA protection. Therefore, the regulation of mute swans is the exclusive jurisdiction of the state.

State Authority

The Department, under Public Act 451 of 1994, is empowered to "protect and conserve the natural resources of this state" [MCL 324.503 (1)]. In addition, MCL 324.40105 states, "All animals found in this state, whether resident or migratory and whether native or introduced, are the property of the people of the state, and the taking of all animals shall be regulated by the Department, as provided by law." Further, the Department has authority to issue orders determining the kinds of animals that may be taken

and determining the animals or kinds of animals that are protected [MCL 324.40107 (1)].

These regulations are incorporated under the Wildlife Conservation Order, as amended

by the Natural Resources Commission and the Director of the Department. Section 9.3 (2) (Protected Animal; Unlawful Acts) lists mute swans as a protected species that can be taken only by means identified in Section 9.1 (Permitted Acts, Certain Species).

9.1 Permitted acts; certain species.

Sec. 9.1. (2) Mute swans and their eggs and nests may be taken by department personnel, and persons authorized in writing by the department to control mute swans under one or more of the following situations:

(a) To stabilize or reduce mute swan population levels or to prevent new populations of feral mute swans

from being established in this state.

(b) To prevent mute swans interference with the establishment, reestablishment, or reproductive success

of native wildlife and with the establishment or reestablishment of native vegetation.

(c) To prevent mute swans interference with the establishment, reestablishment, or reproductive success

of endangered or threatened species.

(d) To protect public health, safety, or welfare.

(3) Mute swans taken as provided in this section shall not be released back into the wild in this state. Mute swans rendered and certified incapable of flight by a licensed veterinarian and prevented from reproducing at the permittee's expense may be possessed with written authorization. For the life of the swan, this authorization will be contingent upon the ability of the permittee to render any resulting eggs incapable of hatching. The permit may be revoked by the department upon evidence that the mute swan has successfully reproduced.

Under Section 5.51 (Damage and nuisance animal control permit, issuance) permits may be issued to prevent or control the depredations of animals. Permits will be issued for mute swan control as outlined in the following policy and as outlined in Section E of this document.

II. Procedure

A. <u>Public Health, Safety, or Welfare</u>

Mute swans and their eggs and nests may be taken on public or private property by DNR

personnel, local and state police agencies, and under a Department permit by local units of government, private citizens or a contracted nuisance animal control firm at any time if they are endangering or about to endanger public health, safety, or welfare.

B. Native and Endangered/Threatened Species Concerns - Public or Private Lands

Mute swans and their eggs and nests may be taken on public or private property by DNR personnel, local and state police agencies, and under a Department permit by local units of government, private citizens or a contracted nuisance animal control firm if conflicts on public or private lands involving native species occur, especially endangered or threatened species. The quantity of swans removed and the manner of take shall be determined by the Management Unit Supervisor or the District Law Enforcement Supervisor. If actions are to be taken on private properties, the landowners involved shall be consulted and engaged in the determination of management actions. Benefit of doubt in the decision process shall favor native species, especially threatened and endangered species such as common loons, trumpeter swans, and wild rice.

C. Stabilization of Population Levels/Prevention of New Populations on Public Land

1. Remove all mute swans from all Wildlife Division administered properties and prevent their establishment by direct removal, nest destruction, and egg destruction/removal. State parks, recreation areas, and forest lands may remove mute swans by direct removal, nest destruction and egg destruction/removal to meet population goals or to prevent their establishment. These activities shall be accomplished by DNR personnel or by a permitted nuisance animal control firm or individual. Mute swans and their eggs will be removed using capture and/or euthanasia procedures which are consistent with Section G and Section H of this document.

2. County, township and city ownerships, or national parks, wildlife refuges, and forests may request in writing that a permit be issued for swan removal to meet their area wildlife objectives. The request must be made by the land manager. Permits will be issued by the Wildlife Management Unit Supervisor and will be valid for five years. The issued permit may cover direct removal (as outlined in Section G), nest destruction, or egg destruction/removal (as outlined in Section H).

D. Stabilization of Population Levels/Prevention of New Populations on Private Lands

To stabilize population levels, to prevent new populations, and to prevent mute swan establishment and interference with the establishment, reestablishment or reproductive success of native wildlife and the establishment or reestablishment of native vegetation on private lands, mute swans may be removed (as outlined in Section G), nests destroyed, and eggs destroyed/removed (as outlined in Section H) under the following conditions:

1. Residential and Commercial Properties

A private landowner, land manager, or their designee may remove mute swans or their eggs and nests from their property with a written permit issued by the Wildlife Management Unit Supervisor or the District Law Enforcement Supervisor. The land encompassing the nest must be entirely owned by the requesting landowner; otherwise removal of the eggs shall fall under Section D2 for multiple lakeshore landowners. The water utilized by the mute swans to be destroyed must also be entirely owned by the requesting landowner; otherwise removal of swans shall fall under Section D2 for multiple lakeshore landowners. This section shall also include an institution, corporation, or other entity which owns or controls all lands surrounding or containing the subject lake or water body site. This may include apartments, golf courses, parks, recreational areas, business sites, and industrial sites.

2. Multiple Lakeshore Landowners and Lake Associations

a. Petition

i. The lakeshore landowners, or lake association representing lakeshore landowners, must document the extent of the problem and must concur through a petition offered to the Management Unit Supervisor that population control is desirable.

ii. This petition must be approved by 70 percent of the lakeshore landowners.

iii. It shall be the responsibility of the lake association, or other petition circulators, to certify that the list of names on the petition has been verified by the township or other local unit of government, and that the governmental unit has a list of all eligible property owners.

iv. It shall be the responsibility of the lake association, or other petition circulators, to certify that they made a reasonable attempt to contact all lakeshore landowners, and must indicate when/where the petition is available for public review.

v. The petition document(s) presented to the lakeshore landowners for signature, and available for public review, must specifically state that birds removed will be euthanized for population control.

b. When a mute swan nest occurs solely within the property boundaries of a single lakeshore landowner the property owner or their designee, with a permit, may destroy the nest or shake the eggs as per section D1 and consistent with local ordinances.

3. A written report of the number of mute swans removed, the nest locations, the number of eggs destroyed or removed, and the total hatch for the year shall be submitted to the issuing office of the Department within 15 days of management activities by the person(s) to whom the permit was issued.

E. Issuance of Permits

Permits to control mute swans may be issued as authorized by the Wildlife Conservation Order Section 5.51. Permits may be issued by either the Wildlife Management Unit Supervisor or the District Law Enforcement Supervisor. Permits shall be valid for one year, shall be issued to landowners, lessees, or land managers and shall contain the following:

1. Name of landowner, land manager, or lessee,

2. Name of designated agent or licensed nuisance animal control firm (when required) to conduct the control of the mute swans.

3. Authorized swan capture and/or euthanasia methods. Methods of capture and/or euthanasia must be as outlined in Section G of this document unless otherwise authorized by the veterinarian-in-charge at the State Diagnostic Lab,

4. Authorized carcass disposal methods as outlined in Section I of this document,

5. Authorized methods of nest and egg destruction or removal as outlined in Section H of this document.

A written report of the number of mute swans removed, the nest locations, the number of eggs destroyed or removed, and the total hatch for the year shall be submitted to the Department office who issued the permit within 15 days of management activities by the person(s) to whom the permit was issued. The information will then be forwarded to the Waterfowl and Wetland Specialist by December 1.

F. Nuisance Animal Control Firms

Nuisance animal control firms conducting mute swan removal must be licensed by the Wildlife Division. Equipment used to capture and euthanize mute swans must be consistent with Section G of this document.

G. Swan Capture and/or Euthanasia

Under no condition will captured mute swans be released back into the wild in Michigan. With the exception of an individual that is in imminent danger or being attacked by a mute swan, only DNR personnel, local, state, and federal law enforcement, permitted nuisance animal control firms or permitted landowners (or their designee) may destroy mute swans. The method of euthanasia will be indicated in the permit issued to the landowner.

1. Swans will be euthanized by one of the following methods approved by the American

Veterinary Medical Association,

a. Live capture and euthanized by a veterinarian at the State Diagnostic Lab,

b. Live capture and inhalation of carbon dioxide,

c. Live capture and injection of approved euthanasia drugs,

d. Live capture and cervical dislocation,

e. Capture with Alpha Chloralose: Alpha Chloralose may be used only by USDA/Wildlife Services personnel to capture mute swans. Pursuant to FDA restrictions, waterfowl captured with Alpha Chloralose for subsequent euthanasia must be killed and buried or incinerated.

f. Single shot to the head with approved firearm as indicated in the permit.

2. Euthanasia allowances of free swimming mute swans shall be listed on the permit and follow all safety protocols. Where feasible firearms should be restricted to those lawful during the regular waterfowl season and shot should be restricted to non toxic varieties.

3. Department personnel do not require a permit to euthanize mute swans. Department personnel and local and state police agencies may use firearms and ammunition consistent with those used in their day

to day operations or those deemed appropriate by the Management Unit Supervisor or the District Law Enforcement Supervisor.

H. Egg and Nest Destruction

Mute swan eggs and nests may be destroyed only in the following manner:

1. Eggs may be sprayed with 100% food grade corn oil,

2. Eggs may be shaken,

3. Eggs may be chilled,

4. Eggs may be removed and disposed of according to local ordinances and applicable state laws,

5. Nest material may be physically removed or altered to deter nesting and/or re-nesting.

I. Carcass Disposal

Mute swans euthanized by approved methods must be incinerated, buried, or placed in landfill according to federal, state, and local regulations.

J. Captive Mute Swans

Approximately 284 mute swans are currently held in Michigan by persons with a Permit to Hold Wildlife in Captivity. Some birds (including progeny produced) escape from persons with permits and contribute to the feral population problem.

1. Pinioning and Banding Requirements

To prevent and control escape of mute swans to the wild from captive facilities, all progeny produced in captivity must be pinioned and banded with numbered bands provided by the Management Unit Supervisor within five days after hatch.

2. Importation

The importation of mute swans or the eggs of mute swans is prohibited. *[Note exception for commercial re-importation across state lines by a licensed facility in the next section].*

3. Commercial Use of Mute Swans

a. Some banded adult mute swans are shipped out-of-state each spring by Michigan licensed breeders to supply show ponds in neighboring states. These birds are then imported back into

Michigan for the winter period. The importation back into Michigan of banded Michigan birds is lawful, provided interstate shipping regulations of the Michigan Department of Agriculture

are complied with and the facility engaging in the activity has a Permit to Hold Wildlife in Captivity. This importation is permitted under provisions of the interstate commerce clause.

Birds not originating in Michigan may not be imported.

b. Some captive mute swans are moved within the state from one location to another. This is lawful provided the locations are licensed under the Permit to Hold Wildlife in Captivity, and the

birds are transported and held in accordance with all permit requirements. Licensed premises shall include man-made or natural barriers to keep mute swans from escaping.

c. Captive mute swans may be exported to other states only with written permission from the State agency responsible for wildlife management in the receiving state.

K. Record of Public Contacts

All mute swan contacts from the public shall be systematically recorded at all Department field stations on the Public Contact Record - Mute Swan form (Attachment 1). It does not appear that there has been a systematic attempt in all Management Units (in the past) to quantify contacts from the public or the type of contacts. Therefore, it has been difficult to categorize and fully quantify problems which have been encountered and solutions utilized. An annual summary by the Management Unit shall be forwarded to the Waterfowl and Wetland Specialist by December 1 each year.

L. Record of Management Activity

A report of the number of mute swans removed, the nest locations, the number of eggs destroyed or removed, and the total hatch for the year on state managed properties shall be submitted to the Waterfowl Specialist by December 1 of each year. Data shall be recorded into the Mute Swan Management Datasheet (Attachment 2).

M. Population Surveys

1. A survey of mute swans will be made in all Management Units of the state during the first week of January as part of the Winter Waterfowl Survey, as outlined in annual accomplishment directives issued by the Wildlife Management Section Supervisor. The count data will be used to track the status and distribution of the winter mute swan population in Michigan.

2. Mute swans will be counted statewide in conjunction with the spring waterfowl survey, as outlined in annual accomplishment directives issued by the Wildlife Management Section Supervisor. The count data will be used to track the status and distribution of the resident mute swan population in Michigan.