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**Preliminary Biodiversity and Fish Assessment of Tillson Lake,
Town of Gardiner, Ulster County, New York**

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Introduction

Hudsonia was asked by the Friends of Tillson Lake to conduct a preliminary biodiversity and fish assessment of Tillson Lake in the Town of Gardiner, Ulster County, New York. The aim of this assessment was to examine the habitats in and adjoining the lake, discern the lake's importance to biological resources including species of conservation concern, and identify potential effects of the proposed dam removal and wetland restoration on those resources. Our study was limited in scope and did not include water quality analyses, conservation of the Palmaghatt Kill below and above the lake, the place of the lake in the regional panoply of lakes and dams, or the recreational use of the lake. Hudsonia does not normally take advocacy positions regarding land use projects; rather, we make observations and collect data, consult available scientific information from other sources, and comment on potential or likely outcomes of actions in land use or environmental management.

There is a movement to demolish old dams on Hudson River tributaries for the purposes of facilitating American eel passage upstream, improving connectivity for other fully aquatic animals, and restoring stream-type habitat. Currently it is proposed to remove the extant dam impounding Tillson Lake. Each impoundment is different ecologically and provides a different spectrum of ecosystem services. Therefore, our report specifically addresses aspects of the biology of Tillson Lake and the potential effects of dam removal.

The Lake

Tillson Lake, at elevation 113 meters, has an area of 7.8 hectares, and a shoreline length of 1.61 kilometers (Swart and Bloomfield 1985). The Palisades Interstate Park Commission (PIPC) owns the entire shore of Tillson Lake. PIPC proposes to remove the dam and restore wetland and stream habitat within the extant lake basin (Tesik 2017). The lake is surrounded by forest except for the mowed grassy area on the dam. Tillson Lake is a recreational lake with an unimproved boat landing that supports angling. The dam was built in 1929. In 1983 the lake was drained by a previous landowner and it was reflooded in 1995; it has remained so since then (Monica Manalo, (personal communication).

Methods

We surveyed the lake on 13 July 2018, paddling slowly around the shoreline clockwise starting at and returning to the dam ca 1045-1545 hours EDT with a lengthy pause at the inlet (delta of Palmaghatt Kill) at the west end of the lake to explore the delta and associated beaver ponds. The weather was sunny, warm, near-calm or with a light breeze.

We also reviewed satellite imagery (Google Earth), agency data on water quality, fish, and aquatic plants, a bird list, and photographs of various organisms found in the lake, and we conducted a Web search for information about the lake. We looked for New York animal Species of Greatest Conservation Need (SGCN) and plants that are either ranked rare statewide (New York Natural Heritage Program S1, S2, S3) or are regionally-rare in the Hudson Valley according to Hudsonia observations.

Habitats

The western half of the lake is shallow and the eastern half is deeper. Beaver ponds and other wetland habitats border the open water areas of the western end of the lake. Forest surrounds the lake except for the earthen dam at the east end, which is covered by mowed grass, and a small area of disturbed vegetation at the boat landing on the south side. The delta of the Palmaghatt Kill in the western end of the lake has a complex stream channel, beaver ponds, and a gravelly deltaic deposit.

Schneller-McDonald (2018) concluded that the western half of the lake with adjacent habitats meets criteria for federal and state-regulated wetland. We did not check this determination, instead focusing on the biota of the lake.

Plants and Algae

We found several species of submergent vascular plants in the lake, including coontail (*Ceratophyllum demersum*), pondweeds (*Potamogeton* spp.), watermilfoil (*Myriophyllum*), and waterweed (*Elodea canadensis*). Specimens are awaiting identification to species. Growth (biomass) of these species in the shallows was moderately sparse. In at least portions of the shallows (e.g., much of the southern edge of the lake) there was a dense short growth of charophytes (often called stoneworts, these are highly organized algae that resemble vascular plants).

Robust emergent plants such as cattail and bur-reed were very localized. Common reed (*Phragmites australis*) occurred in a very small area of the southwestern corner. Purple loosestrife (*Lythrum salicaria*) was very sparsely distributed along the shorelines and plants were not robust.

In the disturbed sandy area of the boat landing we found swamp agrimony (*Agrimonia parviflora*). This is listed as S3 in New York (on a scale of S5 most frequent to S1 least frequent statewide; S1, S2, S3 species are of conservation concern); it is uncommon in Ulster County. On the gravelly delta of the Palmaghatt Kill, where plant diversity is high, we found many-leaved bulrush (*Scirpus polyphyllus*), a plant we consider regionally-rare in the Hudson Valley. The occurrence of these two species indicates that rarer plants are likely present. The human-disturbed sandy soil of the boat landing, and the stream-disturbed gravelly soil of the delta, are likely to support organisms associated with disturbed, coarse-textured soils, and those could include a number of rare species.

Winged monkeyflower (*Mimulus alatus*, S3), threadfoot (*Podostemum ceratophyllum*; S2S3) and wingstem (*Verbesina alternifolia*; formerly considered a rare native species in New York and now considered nonnative), which occurred along the Shawangunk Kill (Kiviat 1991) may well be found along the Palmaghatt Kill and at Tillson Lake. Threadfoot in particular could be sensitive to changes in flow or siltation. Winged monkeyflower also occurred along the Mara Kill, a tributary that joins the Shawangunk Kill downstream of the Palmaghatt Kill (Nyman 1987). Green dragon (*Arisaema dracontium*), a regionally-rare plant, was found on both the Mara Kill and the Shawangunk Kill.

Unpublished data from the New York State Office of Parks, Recreation and Historic Preservation report a variety of submergent plant species including several pondweeds (*Potamogeton* spp.), both Eurasian watermilfoil (*Myriophyllum spicatum*) and the native northern watermilfoil (*Myriophyllum sibiricum*). These data also report both the nonnative purple loosestrife and an unidentified native loosestrife (*Lythrum* sp.). We are inquiring about documentation for these reports, inasmuch as the unidentified loosestrife and the northern watermilfoil, if confirmed, would be interesting finds. Schneller-McDonald (2018) also identified multiple *Potamogeton* species in the lake.

Invertebrates

We have seen no data on invertebrates of the lake. We observed several species of dragonflies and damselflies as we paddled around the lake. Although we can't make a rigorous comparison with other lakes, there seemed to be good diversity of this group of insects.

Rare mollusks are known from the Shawangunk Kill, including at least one rare freshwater mussel (the brook floater, *Anodonta varicosa*) and one rare fingernail clam (*Sphaerium fabale*) (Schmidt and Kiviat 1989, Kiviat 1991). Tillson Lake and the Palmaghatt Kill below the lake should be surveyed for aquatic mollusks.

We observed the bryozoan *Pectinatella magnifica* (sometimes called the “magnificent bryozoan”) in the lake on 13 July 2018. Subsequently Annie O’Neill photographed this organism in the lake. The magnificent bryozoan constitutes a colony of many small individuals embedded in a large (e.g., 30 cm long) mass of somewhat firm jelly-like material that is often pointed at both ends and attached to a twig under water. This is a native, uncommon, animal, and in our region is typically associated with hardwater lakes and ponds.

Fish

One of our tasks was to compile a list of fishes that inhabit Tillson Lake. We did this by our own visual observations and with a fishing rod. We spoke with local residents and a gentleman fishing on the lake. Finally, there are several videos on the internet that document anglers catching fishes on Tillson Lake.

It is worth mentioning that, of the fishes documented in the lake, only three species are native: American eel, brown bullhead, and pumpkinseed. The rest were stocked at one time or another, a typical situation for lakes in the Hudson Valley. The presence of American eel in the lake is noteworthy, but needs confirmation. Eels could only get into Tillson Lake from the Hudson River, a long and daunting but not impossible journey. It may well be worth sampling the outlet stream to determine if there are more eels in the vicinity. American eels in upland streams and lakes are valuable contributors to the North American spawning population. A brief summary about eels in the Wallkill watershed is in Appendix 2.

Table 1. List of Fishes in Tillson Lake. (A summary of earlier fish survey results is in Appendix 1.)

American eel (<i>Anguilla rostrata</i>)- interview
Black crappie (<i>Pomoxis nigromaculatus</i>)- interviews and video
Bluegill (<i>Lepomis macrochirus</i>)- personal observation and video
Brown bullhead (<i>Ameiurus nebulosus</i>)- interviews and video
Brown trout (<i>Salmo trutta</i>)- interviews
Largemouth bass (<i>Micropterus salmoides</i>)- personal observation, interviews, videos
Pumpkinseed (<i>Lepomis gibbosus</i>)- personal observation

It is well known that American eel inhabit large lakes. The commercial harvest of American eel from Lake Ontario historically was between 70-80 metric tons per year (but has recently fallen drastically- Mathers and Stewart 2009). Several studies have been done on the Lake Champlain population of American eel and a commercial fishery was attempted in 1982, which proved economically unfeasible (Verdon et al. 2003). The latter authors stated that all American eel sampled from Lake Champlain were females. This is a significant statement because production of females determines the magnitude of the next generation. Very small impoundments are not inhabited by large American eel (Anderson and Schmidt 2006) but little is known about larger impoundments as American eel habitat. Schmidt and Brase (2016) provided observations from the Hudson Valley that support the concept that larger impoundments are important habitat for large female eels. This could be the case for Tillson Lake.

We walked up the inlet stream to the first beaver dam, less than 200 feet from the lake. We dipnetted young of year blacknose dace (*Rhinichthys atratulus*) and white sucker (*Catostomus commersonii*). These two species are common upland stream inhabitants. The presence of the young white sucker may indicate that this species is in the lake but the young could also have drifted downstream.

While on the lake (13 July 2018), we captured six largemouth bass. These fish were measured (total length, cm) and weighed (grams, triple beam balance) and scales were collected. Scales were used to determine age of each fish and length and weight were compared to average sizes of largemouth bass in the Northeast.

Table 2. Length, Weight, and Age of Six Tillson Lake Largemouth Bass. Note that the State minimum size of largemouth bass for possession is 12 inches.

TL (inches)	Weight (lbs)	Age (yrs)	Average Weight ¹	Average Size at Age ²
3.9	0.16	2	0.04	7.5
4.2	0.16	2	0.05	7.5
8.6	0.26	4	0.40	14-15
11.6	0.68	5	0.98	16-17
11.7	0.75	5	1.00	16-17
11.8	0.66	5	1.03	16-17

¹Taken from: <https://www.fishingnortheast.net/largemouth-and-smallmouth-bass-length-to-weight-conversion-chart/>

²Taken from: <http://bassboatchatter.com/largemouth/how-old-is-that-largemouth-bass.html>

The largemouth bass in Tillson Lake are growing slowly and are significantly underweight for a given length except for the very smallest individuals. These observations are typical for over-exploited bass populations. We saw a moderate number of small sunfishes (*Lepomis*) in the lake shallows and they would certainly serve as a food resource for the bass, however we did not observe any minnows. It is not unusual to stock minnows, like golden shiners (*Notemigonus crysoleucas*), in lakes to support a largemouth bass population. Our observations on the bass population were quite limited and a lakewide assessment using a boat shocker would give a better picture of the current status of the population.

Water quality data collected by the New York State Office of Parks, Recreation and Historic Preservation include several instances of very low or zero dissolved oxygen (e.g., July 2008 and September 2015). This is concerning because fishes will not tolerate these low oxygen concentrations. We did see two dead bluegill on the lake, but we don't know the cause of death and it certainly could be something other than poor oxygen availability. Aquatic plants use oxygen from the water at night. It could be that the dense aquatic plant beds in the shallow end of the lake are using enough oxygen to cause very low levels in the early mornings.

Herpetofauna

Annie O'Neill provided photographs of painted turtles, and we also observed this species on 13 July 2018. The gravelly soil of the higher portions of the Palmaghatt Kill delta had abundant evidence of turtle nesting, during the late spring – early summer nesting season, in the form of eggshells from depredated

nests observed on 13 July. We expect these turtles to be mostly or all painted turtles and snapping turtles. The lake has the potential to support three species of conservation concern: musk turtle, spotted turtle, and wood turtle, all NYS SGCN. (Although the wood turtle is commonly considered a stream and riparian species, it also uses springfed ponds and lakes in the Hudson Valley [Kiviat and Stevens 2001; Kiviat, personal observations].)

The Palmaghatt Kill above and below Tillson Lake is potential habitat for the northern red salamander (NYS SGCN). This species is known from, for example, Mohonk Preserve. We found the remains of American toad egg strings in the lake; this is a common species.

Birds

We reviewed a bird list compiled for the lake (Crepet and Vecchione 2018) and made observations ourselves on 13 July. The following bird SGCN occur at the lake: common loon, ruddy duck, bald eagle, red-shouldered hawk, brown thrasher, and scarlet tanager.

The lake is not open to hunting and boat motors are not permitted, thus it may be a refuge for ruddy duck and other duck species during fall migration. Bald eagles evidently forage at the lake. Forests surrounding Tillson Lake are sufficiently extensive to support breeding red-shouldered hawks which may forage around the edges of the lake. On 13 July we heard red-shouldered hawks at multiple times and locations. We saw a brown thrasher dust-bathing in the disturbed sandy soil at the boat landing. Shrubby areas there likely support breeding by this species. We also found singing yellow-throated vireo, an uncommon species.

Mammals

On 13 July we observed lots of beaver sign around the lake shorelines, and muskrat sign was also in evidence.

Overall Condition of the Lake

Based on our limited reconnaissance of the lake, the diversity of aquatic plants and dragonflies, and other aspects of the lake, we conclude tentatively that the lake is somewhat eutrophic (nutrient rich) but generally in good condition. Certain plants (e.g., blue vervain, swamp agrimony, soft-stemmed bulrush) indicate a circumneutral pH. We did see and photograph small slicks of an odd-looking, floating, non-filamentous alga superficially resembling a patch of bluish-green paint. This organism should be identified in case it's an indicator of potential change in the lake.

Potential Benefits of Dam Removal

Dam removal would allow eels, some other fishes, and possibly freshwater mussels to move upstream more readily (however, eel passage could be developed at the existing dam). If wetland restoration were successful it might provide a small amount of habitat for marsh birds such as Virginia rail that probably do not use the lake at present.

Potential Detriments of Dam Removal

The Palisades Interstate Park Commission has proposed to remove the Tillson Lake dam and create a small pond and stream in the lake basin. This would result in the loss of most of the recreational values of the lake; a smaller pond would not support the large trout now occurring in the lake and would offer

reduced fishing opportunities. The potential value of the lake to the growth of large female eels would be lost. The apparently unusual gravelly stream delta habitat would likely erode and disappear eventually, and with it potentially the rare plants and concentrated turtle nesting. The lake bed would likely proliferate invasive plants, such as purple loosestrife and common reed, and would almost certainly require perpetual management. Nutrients could become concentrated in the pond, in part due to decomposition of organic matter in the extant lake sediments, and harmful algal blooms could occur. Some of the sediment now trapped in the lake, perhaps a large amount, would erode into the Palmaghatt Kill and be transported down to the Shawangunk Kill where it would probably cause damage to a high quality river that currently supports rare animals and plants. The brook floater and threadfoot may be most at risk.

The Restoration Concept

PIPC is proposing (Tesik 2017) to breach the dam and draw down the lake in stages, then seed and plant the lake bottom and maintain a small pond and a stream channel across the former lake bottom. The proposal is brief and vague. Given the unpredictability, vagaries, and frequent failures of wetland restoration projects (there is a large scientific literature on this subject), and the lack of detail in the PIPC proposal, we are skeptical about the potential of this restoration to provide a reasonable tradeoff of ecosystem services.

We opine that it would be better for the American eel to maintain the dam and lake in their current form, and install an eel ladder to facilitate eel passage over the dam. There are eel ladder designs that are relatively simple and inexpensive. The existing lake may be beneficial to eels that are able to make their way that far upstream.

Riparian buffer zones of seminatural soils and vegetation are critical to maintaining water quality in streams. Portions of the Palmaghatt Kill between Tillson Lake and the Shawangunk Kill are insufficiently buffered from the influences of intensive land uses (Karen Schneller-McDonald, personal communication). The concern about conditions in the Palmaghatt Kill and the Shawangunk Kill should be considered on a scale larger than a single dam.

Recommended Further Studies

We recommend additional biological surveys of the lake and its environs to inform planning. These include eel surveys above and below the lake; a survey for freshwater mussels above and below; a thorough survey of the plants of the Palmaghatt Kill delta and the boat landing, as well as the rest of the lake and its shoreline; and a dedicated survey of the herpetofauna in the lake and the Palmaghatt Kill. The algae of the lake should be examined for species that could be harmful under existing or changed conditions.

Conclusions

Tillson Lake as it now exists has an apparently unusual habitat (the gravelly stream delta), supports birds of conservation concern and rare plants, and has potential habitat value for the growth of large female American eels. The small pond intended to remain after dam removal, and the suggested restoration of wetland in the lake bed, would likely have poor water quality and be colonized by nonnative weeds requiring long-term maintenance. We believe the habitat functions and other ecosystem services of the existing lake are greater than would exist following the proposed dam removal. The barrier to upstream migrating eels represented by the existing dam could be offset by installing an eel ladder.

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Appendix 1. Summary of Fish Studies by the New York State Department of Environmental Conservation in the Vicinity of Tillson Lake

1983- The lake was drained and the subsequent fish kill was documented. Fishes noted were White sucker, Bluegill, Pumpkinseed, Largemouth bass, Golden shiner, Brown trout (very large).

1991- Fishes were collected 1.3 miles upstream of the lake. Stream minnows (Blacknose dace, Creek chub) and Brown trout were reported. Note that the last time the stream was stocked was 1953.

2013- Lake was sampled with an overnight fyke set, bag seine, and night electroshocking.

2014- Lake was sampled with gill nets.

Fish observed: Black crappie, Bluegill, Brown bullhead, **Golden shiner** (1 only), Largemouth bass, Pumpkinseed, **Rock bass**, White sucker, **Yellow bullhead**. [species in bold are ones we did not list for the lake]

2014- Four stream sites were sampled with a backpack shocker (Doug Carlson), two sites upstream of the lake and two downstream.

Upstream fishes: Brown trout, Blacknose dace, Creek chub, Bluegill, Pumpkinseed

Downstream fishes: Redbreast sunfish, Bluegill, Pumpkinseed, Golden shiner, Spotfin shiner, Fallfish, Fathead minnow, Sand shiner, Common shiner, White sucker, Tessellated darter.

There is a notable lack of American eel in any of the above sampling. Some of the methods were not appropriate to catch eels, but the stream electroshocking and the night boat shocking of the lake should have caught some eels if they were abundant. Anytime you sample for rare organisms, you run the risk of failing to find them, no matter how good your sampling methods. These data and the record of two eels caught on rod and reel last year, suggest that eels are very uncommon in Tillson Lake. The stream sampling stations were widely spaced, and there could be an eel or two in the stream below the dam.

The observations on brown trout do indicate that individuals in the lake had moved downstream from spawning populations in the stream.

Appendix 2. Summary: Wallkill River watershed eels.

1. NYS Fish Atlas has eels in the Wallkill near the NJ border from records after 1970. They list eels in the Shawungunk Kill only prior to 1970 (Carlson et al. 2016).
2. We did not find eels in our 1989 Shawungunk survey, but we did not use a shocker at all sampling stations (Schmidt and Kiviat 1989).
3. We did not list eels in our 1994 Wallkill survey either, but we only used a small seine in this study (Kiviat et al. 1994).
4. I believe I shocked some eels from the mouth of the Shawungunk Kill when looking for (and finding) Oriental weatherfish there in 2009 (Schmidt and Schmidt 2014).
5. The quote below is from, Snell (1881). He is referring to the “Drowned Lands”, the area of the Wallkill in vicinity of the New Jersey border. (The Drowned Lands included the Black Dirt peatlands and probably surrounding wetlands as well.)

“About the only result of the work was the starting of eels down the stream in unusual quantities. The fall of 1817 was remarkable for the numbers of eels that came down the ditches. Eel-weirs were plenty, but there was hardly a night that season in which every one was not filled to overflowing with eels, some of which weighed eight pounds apiece. One weir in Hampton milldam captured over two thousand in one night. George Phillips salted down twenty barrels. He bought the first four-wheeled wagon ever seen in this region for the express purpose of peddling eels in the surrounding country. The wagon was the wonder of western Orange County, and made a sale for thousands of eels. The Wallkill yielded abundantly of eels until 1826, when a law prohibited the placing of weirs in the stream.

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