Limnological investigations of Larchwood Lake, Otsego County, NY

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INTRODUCTION

Larchwood Lake (N42°33.100, W75°10.300) is an impoundment in the headwaters of Wharton Creek (tributary to Otego Creek) in the Town of Laurens, Otsego County NY (Figure 1). It is fairly shallow, having a maximum depth of 4.3 meters (14 ft.) near the dam. The lake's surface area is 22.2 ha (55 ac) and its watershed is 134 ha (331 ac).

At the request of a member of the Larchwood Lake Association, a team from the Biological Field Station (BFS) visited the lake on 25 July 01 to collect baseline data on its chemistry and biology to characterize the waterbody as related to management concerns. The following were done on-site:

1) Temperature, dissolved oxygen, pH, conductivity, total phosphorus, nitrate nitrogen, alkalinity and calcium were profiled at the deepest point of the lake.
2) Zooplankton samples were collected for the evaluation of that community, including checks for exotic introduced species (such as zebra mussel larva).
3) An exploratory evaluation of the near-shore macro-benthic (large bottom associated animals) and meiofauna (microscopic benthic animals) communities was conducted.
4) Qualitative observations of the rooted plant communities were made, noting the presence and dominance by non-native species.

METHODS

Larchwood Lake was visited on 25 July 01. Transparency was measured with a standard Secchi disk. At the deepest site encountered (4.3 m), temperature, dissolved oxygen, pH, alkalinity and conductivity were measured at 1 m intervals using a Hydrolab Scout 2® multiprobe digital microprocessor which had been calibrated according to manufacturer's instruction (Hydrolab Corp., 1994) immediately prior to use. Water samples were retrieved from the surface, 2 and 4 m for the analyses of total phosphorus, nitrate nitrogen, chlorides, alkalinity and calcium. A summary of methodologies for chemical analyses employed is given in Table 1.

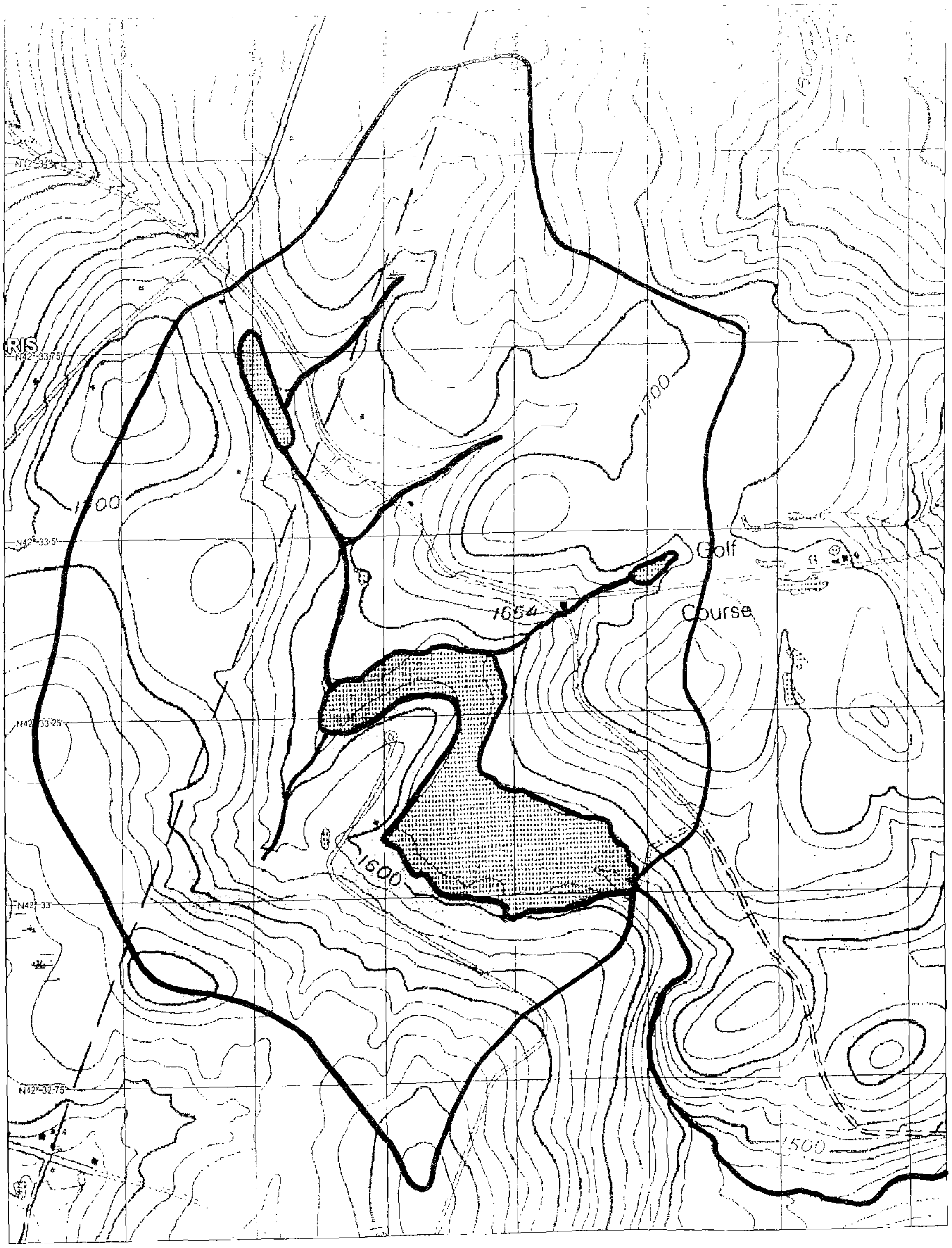

Figure 1. The watershed of Larchwood Lake, Otsego County, NY.

Parameter	Sample volume	Preservation	Method	Reference
Total Phosphorus-P	40 ml	H_2SO_4 to pH<2	Persulfate digestion followed by single reagent ascorbic acid	EPA, 1983
Nitrite+Nitrate-N	25 ml	Filter and cool to <4° C	Cadmium reduction	APHA, 1989
Calcium	50 ml	None	EDTA titrimetric	EPA, 1983
Chloride	100 ml	None	Mercuric nitrate titration	APHA, 1989
Alkalinity	100 ml	Cool to <4°C, measure ASAP	Titration to pH=4.6	APHA, 1989

Table 1. Summary of laboratory methodologies employed.

Qualitative zooplankton samples were collected with a .25 m diameter 63 *u*m mesh plankton net. Both horizontal and vertical (bottom to surface) tows were taken. Samples were preserved with 1% Lugol's iodine and were surveyed under a dissecting microscope.

The benthic macoinvertebrate and meiofaunal communities were evaluated by collecting substrate samples with a 15x15 cm (225 cm^2) Eckman dredge using an extension handle. Substrate was transferred to 2 l plastic jars and preserved with 70% ethanol. Organisms were separated from the material and identified using procedures outlined in Thorp and Covich (2001).

While on the lake, qualitative notes were made on the presence of rooted aquatic plants. Voucher specimens were collected and pressed.

RESULTS

The deepest spot encountered, at 4.3 meters (14 feet) was about 10 m from, and adjacent to, the spillway. The water was moderately well mixed to about 3 m, with deeper unmixed waters being distinct in nature. Surface waters were 28.38°C (83.1°F); bottom temperatures were 13.84° C (56.9°F). Oxygen was near saturation levels through the top 3 m (~8.5 mg/l); below that depth the water was anoxic (devoid of oxygen). Specific conductance (an indirect measure of ions in solution) was quite low in the upper layer (~40 mmho/cm), but increased sharply toward the bottom (~120 mmho/cm). This is likely related to the anoxic conditions. In the absence of oxygen, many compounds become reduced and are converted from an insoluble form to a soluble one. The water's pH was fairly high throughout, ranging from 8.99 at 1m to 7.59 near the bottom. However, the lake has a limited ability to buffer against pH swings and we expect pH to be somewhat variable temporally. This measurement, termed alkalinity, ranged from 10.7 mg/l (calcium carbonate equivalent) at 1 m to 12.9 mg/l near the bottom. This correlated well with calcium, which ranged from 5.6 mg/l at the surface and at 2 m to 6.4 mg/l near the bottom. Those parameters are mainly dictated by local geology, with high values associated with limestones and low values usually with acid shales (locally, at least).

One potential problem that may arise in lakes having low alkalinities relates to acid rain. Due to the inability to absorb acids, those lakes may experience sharp pH drops if acid precipitation is excessive. However, little evidence of this problem exists locally, as even regional lakes on acid shales (as is Larchwood) have substantially higher alkalinity values than do many Adirondack lakes, where values often approach 1.0 mg/l. A benefit of having low calcium levels is that the lower tolerance limit for the exotic zebra mussel is approximately 40 mg/l (D'Itri, 1998). Larchwood Lake is well below that and will not be threatened by that pest.

Phosphorus levels throughout the water column, at 28, 36 and 51 *u*g/l at the surface, 2 and 4 m respectively, are adequate to support high algal production. Nitrite+nitrate concentrations, at 0.07 mg/l throughout the column, suggest possible nitrogen limitation. This is in contrast to phosphorus limiting algal growth as is more typical of eastern temperate lakes. Nitrogen limitation tends to lead to dominance by nitrogen fixing bacteria (blue-green algae), which is consistent with what was encountered (see below).

The lake's algae community was dominated by the bluegreen *Anabaena* sp. This is probably what imparts the tea color to the water. These algae (actually, photosynthetic bacteria) are quite ubiquitous in nutrient rich, eutrophic waterbodies. It is not a particularly good food source for zooplankton (the microscopic animals that are fed upon by smaller fish, and so are indirectly important to the gamefish). This is consistent with our sampling of the zooplankton. Small-bodied rotifers dominated the community, particularly *Asplanchna* sp., which, itself, feeds upon other zooplankton. Various crustacean plankton were present, including calanoid, cyclopoid and harpacticoid copepods and *Bosmina* sp. (a cladoceran). Large-bodied crustaceans are generally considered beneficial, as they are effective algae grazers and are a good food source for fish. We did not encounter these. The fish in your lake are probably dependent upon insects as a food source.

The benthic invertebrate community of Larchwood Lake is extremely diverse, which is indicative of a healthy benthic community. The dominant animals collected included non-parasitic nematodes (round worms), chironomid larvae (non-biting midges), and harpacticoid copepods (benthic microcrustaceans). Nematodes are the most numerous animal in the benthos of most lakes. Not much can be interpreted from their presence since they are found in both healthy and heavily-impacted lakes, depending on the species. On the other hand, the presence of harpacticoids indicates a healthy system. Harpacticoids are quite sensitive to pollution, and the fact that we collected them in high numbers is a good sign. Other benthic invertebrates collected, in order of their relative abundance from high to low, include mayfly larvae of the family Caenidae (square-wing seeums), caddisflies of the family Hydroptilidae (purse-case caddis), oligochaete worms, and a single Bryozoan. Again, this is a very diverse community, and a benthic community where only a few taxa are present (e.g., just oligochaetes and chironomids) indicates a problem, but that is not the case for Larchwood Lake. Particularly nice to see was the presence of Bryozoans, albeit in low numbers. They, similar to harpacticoids, are very sensitive to pollution, and their presence indicates a clean lake. Many of the benthic animals collected help breakdown the dead plant material that collects on the lake's bottom, and in turn, many of these animals serve as food for both bait-type fish (i.e., minnows) and young game fish. They form a vital part of the lake's food web, and maintain a healthy ecosystem.

A cursory look at the rooted plant community did not reveal great diversity, though only native species were encountered. The submersed plants included *Najas* sp. (bushy pondweed) and *Potamogeton pusillus* (smaller pondweed). *Eriocaulon* sp. (pipewort), an emergent, dominated much of the immediate shoreline. We doubt that these plants will require any sort of management in the near future.

Larchwood Lake is certainly a eutrophic waterbody. This is the latter stage of succession, compared to a young oligotrophic lake, which would be deep, clear, well oxygenated, have low concentrations of nutrients and little organic production. Larchwood's eutrophic nature is reflective of its shallowness, low transparency, near-bottom oxygen depletion and high phosphorus levels. However, it seems naturally eutrophic, rather than being the result of cultural pollution as are many other regional lakes. That does not mean that human derived nutrients are having no impact at all. Nutrients (phosphorus and nitrogen) are undoubtedly being augmented by certain agricultural practices in the watershed or potentially by septic systems near the lake's shore. That accelerates the rate at which lakes evolve into wetlands.

Limiting phosphorous inputs during the summer would help maintain water quality during that time. Anthropogenic inputs include those derived from agricultural practices throughout the watershed as well as from near-shore development. The latter includes the creation of impervious surfaces, shoreline destabilization, and, possibly the most important, septic system leachate. Management activities to consider include the creation and management of vegetated buffer strips around the lake, maintaining aquatic vegetation in shallow areas and limiting activities that agitate shallow water and the substrate beneath it. Current technologies exist that can intercept phosphorous derived from septic systems (see Baker et al., 1998).

While on site, we noted the condition of the spillway. Regular maintenance should include clearing debris from the overflow and, given its age, routine inspections of its integrity.

In short, Larchwood Lake seems to be near pristine (i.e., its character seems to be little affected by human disturbances). Some very general suggestions related to keeping it in this state include the avoidance of nutrient additions (from the above mentioned sources as well as from excessive development near the lake) and preventing the addition of exotic species. While zebra mussels would not find your lake hospitable, there are many non-native plants, plankton, fish, etc. that could disrupt the ecological balance of the lake as well as causing significant aesthetic and recreational problems. Educating residents in your area about the importance of these issues is of the utmost importance. Boats should be sterilized, by steam cleaning or a prolonged drying period, before being launched on the lake. Baitfish, a common source of non-native introductions, should not be used unless derived from Larchwood Lake itself.

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