# Continued monitoring of fish community dynamics and abiotic factors influencing Moe Pond, summer 2006

Erika Reinicke[1]
Georgette M. Walters[1]

## INTRODUCTION

Moe Pond (Figure 1) is a eutrophic water body located on the Upper Site of the Biological Field Station in Otsego Country, New York. Moe Pond is the headwater to Willow Brook, a tributary to Otsego Lake (Albright 2005). It is a 38.5 acre (15.6 ha) impoundment with an average depth of 1.8 m and is 3.8 m at the deepest point (Sohacki 1972), though in 2006 the maximum depth encountered was 2.3 m. Historically, Moe Pond had a fish community consisting of golden shiners (*Notemigonus crysoleucas)* and brown bullhead (*Ictalurus nebulosus*). Golden shiners, being efficient planktivores, suppressed the abundance of zooplankton. Low algal grazing caused lower transparencies in Moe Pond due to algal blooms. During this time, rooted plants were absent (McCoy et al. 2000). In 1999, the unauthorized stocking of largemouth bass (*Micropterous salmoides)* and smallmouth bass (*M. dolomieu*i) caused trophic changes in Moe Pond (Lopata 2004). Following the bass introduction, high piscivory on shiners caused a change in top down predation (Tibbits 2000). As large bodied zooplankton rebounded, algal grazing increased and the pond became more transparent. Clearer waters allowed for the establishment of rooted plants, namely *Elodea canadensis,* beginning in 2002. It practically covered the pond's surface in 2002. As the bass' forage was depleted, they turned to other food sources, including crustacean zooplankton, apparently functionally replaced the shiners as planktivores. The zooplankton population was reduced, causing an increase in phytoplankton and reduced rooted macrophyte communities (Dresser 2005).

Annual surveys of Moe pond were started in 1999 after the discovery of bass by Wilson et al. (2000). The surveys assessed the fish (including relative abundances, diet and age structure), macrophyte and zooplankton communities. Physical and chemical water quality parameters were also assessed on a weekly basis.

The purpose of this study is to continue the monitoring of tropic changes in Moe Pond. Continuing limnological and ecological surveys of Moe Pond will lend to better management of water quality and fish communities of small eutrophic ponds.

[1] Robert C. MacWaters Internship in the Aquatic Sciences, summer 2006. Present affiliation: Department of Fisheries and Wildlife Technology, SUNY Agriculture and Technical College.

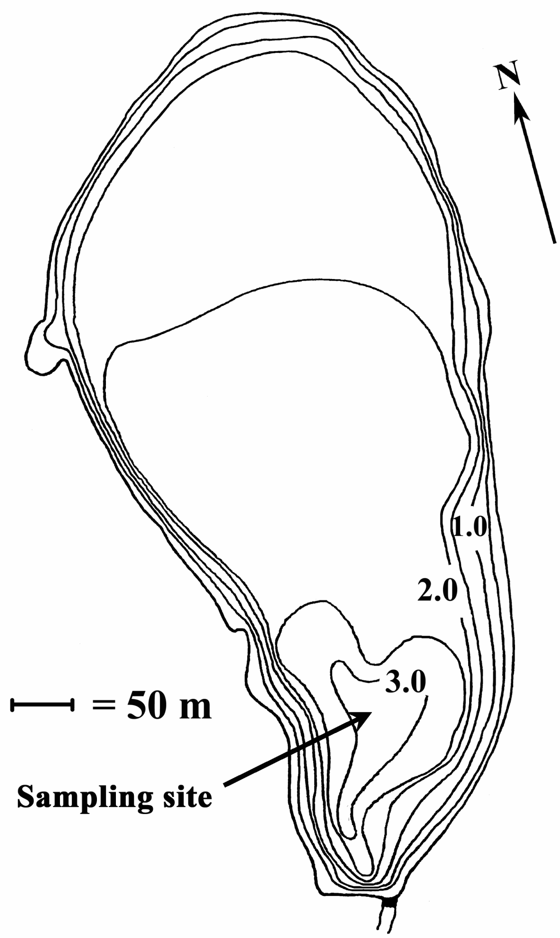


Figure 1. Bathymetry of Moe Pond, Otsego County, NY showing the sampling location. Contours in meters (modified from Sohacki 1972).

# METHODS

## Water Quality

Moe pond was monitored weekly from 5 May to 1August 2006. Data were taken at the deepest point of the pond at 2.3m marked with a buoy (N 42 50.153', W 075 40.112'). Physical data were collected using a Hydrolab Scout or a Eureka Manta. Calibration was done according to manufacturer's specifications prior to use. (Eureka 2005, Hydrolab 1995). At one meter intervals from the surface to the bottom, temperature (degrees C), dissolved oxygen (mg/l), conductivity(*u*s/cm) and pH were taken. A standard Secchi disk was used to measure transparency.

Surface water samples were collected each week and were analyzed for total phosphorous (ascorbic acid method following persulfate digestion; Liao and Marten 2001), total nitrogen (cadmium reduction method; Pritzlaff 2003) following peroxodisulfate digestion (Ebina et al. 1983), ammonia (phenolate method; Liao 2001), and nitrate+nitrate-nitrogen (cadmium reduction method; Pritzlaff 2003). All of these parameters were analyzed using a Lachat QuickChem FIA+ Water Analyzer®.

Chlorophyll *a* was also measured each week. The samples were collected in a plastic Nalgene bottle and returned to the lab. Under subdued light, samples were processed in duplicate and run through a Whatman GF/C filter, each filter having 100ml passed through. Then the filters were cut and placed in buffered acetone. The filters were ground with an electric drill to extract the chlorophyll. The amount of chlorophyll *a* was determined by a Turner flourometric reader (Welschmeyer 1994).

**Fish/Zooplankton Community**

Zooplankton samples were collected using a Van Dorn bottle. Five liters of water was filtered trough a 63um mesh screen, concentrated, and preserved in 70% ethanol in the lab**.** Volume was recorded to back calculate the number of zooplankton per liter. Three 1 ml samples were viewed in a sedgewich-rafter cell using a compound microscope. Each zooplankton found was measured, identified and recorded.

The fish community of Moe Pond was sampled on 30 May, 5, 14 June, and 11 July, 2006. A 200 ft haul seine was used to capture and collect fish. Similar methods were used in 2000 and 2001 were seining was used to collect fish by Tibbits (2001) and Wojnar (2001). In 2003 and 2004 Hamway (2004, 2005) used an electrofishing boat to collect samples due to an inability to seine because of the large standing crop of rooted macrophytes.

Each seine was conducted on the south shore off the west side corner. Seines were set using a john boat. On 14 June and 11 July seines were also run on the south shore along the east side, directly above the outlet. Captured fish were measured (mm) and a scale sample was taken from fish over 150mm. Scales were taken from above the lateral line, directly behind the operculum. Scales were aged using a microprojector to determine the number of annuli. Pulsed gastric lavage, as described by Foster (1977), was used to extract stomach contents from live fish over 150mm. Stomach contents were then identified in the lab using Pecharsky (1990).

Largemouth bass population size was estimated through the area extrapolation method. The area seined was estimated to be $300m^2$. The number of bass caught per seine was divided by the area seined. The number of fish per $m^2$ was then multiplied by $155{,}800m^2$, the area of Moe Pond. Though this method is not considered to accurately estimate population size, it can be considered a proxy of abundance (Lopata 2004), thereby allowing for relative year to year abundance estimates.

**Invertebrate Community Survey**

The invertebrate community at Moe Pond was surveyed on 13 July 2006. The samples were taken using a semi-quantitative method at the south end and the northwest end of the Pond. The sites were chosen due to their similarity in macrophyte cover and benthic composition. Triangle nets were used to collect invertebrates. Nets were swept along the shore for 3 minutes in a 7m section. All rock and plant material was carefully scoured. Materials and organisms collected were stored in glass collection jars and preserved in 70% ethanol. Invertebrate organisms were then identified according to Pecharsky (1990).

### Macrophyte Community

No formal marcophyte survey was conducted on Moe pond during 2006. However, widespread growth of *Elodea canadensis* was evident. In addition, filamentous algal growing on the *Elodea* became prolific, starting in July.

## RESULLTS AND DISCUSSION

### Limnology

Moe Pond limnological data from 1972 to 2006 is presented in Table 1. After bass were introduced in 1999, Moe Pond water quality seemed to improve in that total phosphorus and cholorphyll *a* decreased and transparency increased (Lopata 2004). However, in 2004 and 2005 conditions seemed to revert to what they had been prior to the bass introduction. In 2006, improved water quality parameters again prevailed.

| | **1972** | **1994** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** |
|---|---|---|---|---|---|---|---|---|---|
| **Secchi Depth (m)** | NA | 0.85 (0.1) | 1.2 (0.2) | 1.1 (0.1) | >2.2 | >2.33 | 1.26 (0.13) | 1.26 (0.13) | 2.20 (0.15) |
| **Total phosphorus (ug/l)** | 40-70 | 36.7 (3.7) | NA | NA | 26.4 (2.6) | 29.05 (2.12) | 42.29 (2.04) | 56.64 (7.44) | 26.91 (5.49) |
| **Nitrite+nitrate (mg/l)** | NA | <0.05 | NA | NA | 0.14 (0.02) | 0.11 (0.02) | 0.10 (0.01) | 0.01 (.006) | 0.31 (0.04) |
| **Chlorophyll a** | NA | 37.1 (2.2) | 25.6 (0.20) | 20.4 (8.1) | 12.0 (2.4) | 9.76 (2.49) | 22.94 (4.4) | 17.03 (2.41) | 20.53 (19.4) |
| **Alkalinity** | 26-37 | 18.0 (0.4) | | 17.0 (0.2) | 16.0 (0.5) | NA | NA | NA | 2.1 (0.1) |
| **pH** | 6.8-10.2 | 7.93 (0.37) | 8.63 (0.35) | 8.66 (0.32) | 9.08 (0.18) | 6.84 (0.44) | 7.3 (0.07) | 7.66 (0.62) | 7.30 |

Table 1. Summer mean values (+/- standard error) of Secchi transparency, total phosphorus, nitrite+nitrate , chlorophyll a, alkalinity and pH for Moe Pond, 1972, 1994 and 2001-2006. In 2002 and 2003, Secchi transparency often exceeded water depth.

### Fish Community

Golden shiners were not collected over the study, and have not been collected since 2003 (Hamway 2004). Given that, it is likely that they have been extripated from Moe Pond. In addition, there were no smallmouth bass found in 2006. This is the first year smallmouth bass have not been found in Moe Pond since they first appeared in 1999 (Wilson 2000).

Table 2 provides a summary of population estimates (+/- standard error) since monitoring began in 1994, though in 2002 and 2003 luxuriant *Elodea* growth prevented seining (Hamway 2004). In those years, data represent catch per hour during electrofishing surveys

| Year | Golden Shiner | Largemouth Bass | Smallmouth Bass |
|---|---|---|---|
| 1994 (McCoy et al. 2000) | 7,154:+12,701;-6,356 | 0 | 0 |
| 1999 (Wilson et al., 2000) | 3,210+/- 1,760 | 1,588+/- 650 | 958+/- 454 |
| 2000 (Tibbits, 2001) | 381+/- 296 | 2,536+/- 1,177 | 945+/- 296 |
| 2001 (Wojnar, 2002) | 1,708+/- 1,693 | 3,724+/-3,447 | 504+/- 473 |
| 2002 (Hamway, 2003)[1] | 3 | 206 | 20 |
| 2003 (Hamway, 2004)[1] | 2 | 318 | 1 |
| 2004 (Lopata, 2005) | 0 | 6,924+/- 2,912 | 0 |
| 2005 (Dresser, 2005) | 0 | 12,019+/- 3,577 | 223+/- 257 |
| 2006 (Current ) | 0 | 11,555.17+/- | 0 |

Table 2. Golden shiner, largemouth bass and smallmouth bass abundances (+/- standard error), 1994, 1999-2001 and 2004-2006.

[1] Indicates years during which *Elodea* growth prohibited seining. Data reported as fish collected per hour of electrofishing.

A summary of length vs. age is given in Figure 2. Age was estimated by viewing scales. The seined largemouth bass in summer 2006 were all under 380mm and 7 years of age. The figure shows there are three dominant size distributions at young of the year, one year old and three year old fish.

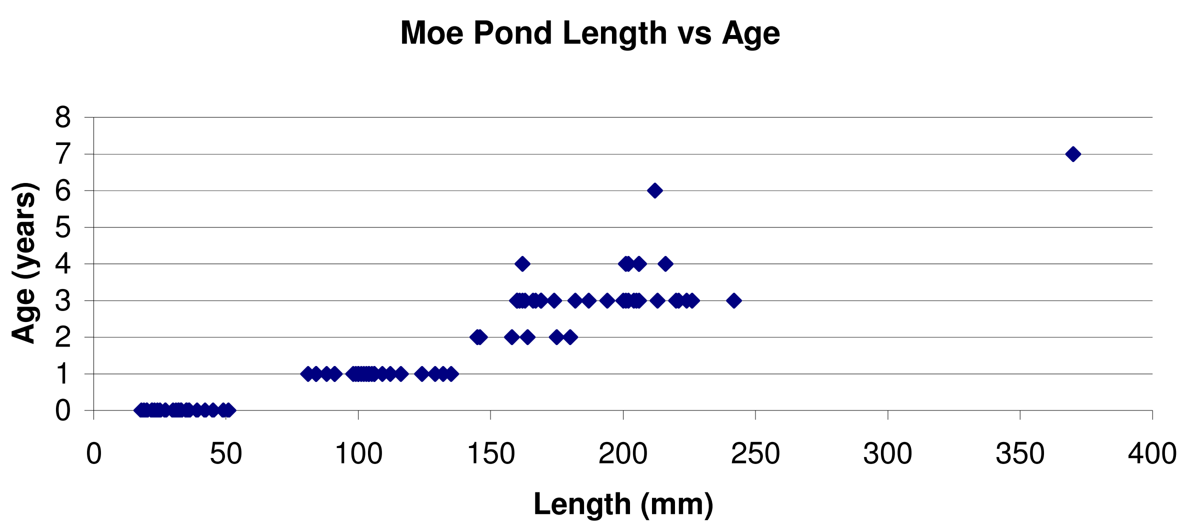


Figure 2. Largemouth bass length vs. age for Moe Pond, summer 2006.

Figure 3 summarizes the diet analysis of largemouth bass over 2006, providing the mean number of each food item per stomach and the percent frequency of occurance (the percentage of bass having one or more of each food item in their stomachs). Consistent with most recent years, dipterans were the most common taxon consumed. However, the second most prevalent taxon found was amphipoda, whereas odonatates has been predominant in previous year (Lopata 2004). Daphnia numbers per stomach, while common, have continued to decrease, as they have since 2004.

| Taxa | Mean per stomach | % Occurrence Largemouth Bass |
|---|---|---|
| **Acariformes** | 0.01 | 7.14 |
| **Copepod** | 0.09 | 7.014 |
| **Amphipoda** | 3.44 | 42.86 |
| **Ephemeroptera** | 0.07 | 8.57 |
| **Odanata** | 1.43 | 32.86 |
| **Hemipetra** | 0.07 | 7.14 |
| **Coleoptera** | 1.77 | 25.71 |
| **Daphnia** | 10.81 | 25.71 |
| **Diptera** | 5.8 | 68.57 |
| **Decapoda** | 0.07 | 7.14 |
| **Arachnid** | 0.1 | 8.57 |
| **Ostracod** | 0.23 | 4.29 |
| **Mollusca** | 0.07 | 5.71 |
| ***Ictaluria nebulosus*** | 2.86 | 8.57 |

Table 3. Stomach contents, including mean number of items per stomach and percent occurrence of each, of largemouth bass collected in Moe Pond, summer 2006.

**Invertebrate Community**

Invertebrates collected and documented in 2006 (Table 4) were found to be significantly less then in previous years (Lopata 2004).

| **South End** | |
|---|---|
| **Taxa** | **# Collected** |
| Hirudinea | 2 |
| Planorbidae (Rams Horn Snails) | 0 |
| Valvatidae (Valve Snails) | 7 |
| Sphaeriidae (Finger Nail Clams) | 0 |
| Amphipoda (Scuds) | 6 |
| Acariformes (Water Mites) | 2 |
| Ephemeroptera (Mayflies) | 1 |
| Trichoptera (Cadisflies) | 4 |
| Hemiptera | 7 |
| Anisoptera (Dragonflies) | 1 |
| Zygoptera (Damsleflies) | 0 |
| Coleoptera (Beetles) | 13 |
| Diptera (True Flies) | 0 |
| **TOTAL** | **43** |

| **North End** | |
|---|---|
| **Taxa** | **# Collected** |
| Hirudinea | 12 |
| Planorbidae (Rams Horn Snails) | 1 |
| Valvatidae (Valve Snails) | 20 |
| Sphaeriidae (Finger Nail Clams) | 1 |
| Amphipoda (Scuds) | 36 |
| Acariformes (Water Mites) | 2 |
| Ephemeroptera (Mayflies) | 8 |
| Trichoptera (Cadisflies) | 12 |
| Hemiptera | 4 |
| Anisoptera (Dragonflies) | 2 |
| Zygoptera (Damsleflies) | 4 |
| Coleoptera (Beetles) | 9 |
| Diptera (True Flies) | 0 |
| **TOTAL** | **111** |

Table 4. Invertebrate collected at Moe Pond, summer 2006.

The lack of invertebrates could be attributed to the large bass population present in Moe Pond. The rocky shore where the inverts were collected may have actually hindered collection as there may be more invertebrates using plants as cover (Dresser 2005, Lopata 2004). Consistent with 2005 results, there were more species collected at the northern end of the pond. Also, similar to 2004 and 2005, the most abundant organisms found were amphipods and snails (Lopata 2004, Dresser 2005).

**Zooplankton Community**

The mean abundance of zooplankton and their mean lengths, by taxa, for the summers of 2005 and 2006, are provided in Table 5. Mean abundances and lengths for each sampling period id given in Table 6. Densities were found to be significantly lower in 2006 then in recent years. It seems as though as the bass ate other available forage, they turned to alternative food sources, including large bodied zooplankton. The high chlorophyll *a* concentrations also indicate suppressed filtering rates.

| **Summer 2005** | | |
|---|---|---|
| **Species** | #/liter | mean length (µm) |
| **Cladoceran** | | |
| *Bosmina longirostris* | 32 | 304 |
| *Daphnia pulex* | 15 | 801 |
| **Copepods** | | |
| *Cylopoid* sp. | 43 | 541 |
| *Calanoid* sp. | 8 | 466 |
| Nauplius sp. | 26 | 218 |
| **Rotifers** | | |
| *Kellicotia longispina* | 10 | 185 |
| *Keratella cochlearis* | 321 | 103 |
| Ostracoda | 8 | 577 |
| Unknown Rotifers | 17 | 139 |
| **Mean Total /L:** | **480** | |

| **Summer 2006** | | |
|---|---|---|
| **Species** | #/liter | mean length (µm) |
| **Cladoceran** | | |
| *Bosmina longirostris* | 3 | 360 |
| *Daphnia pulex* | 2 | 204 |
| **Copepods** | | |
| *Calanoid* | 1 | 497 |
| *Cylopoid* sp. | 13 | 446 |
| Nauplius sp. | 37 | 171 |
| **Rotifers** | | |
| *Asplanchna priodontus* | 7 | 353 |
| *Kellicotia longispina* | 7 | 134 |
| *Keratella cochlearis* | 22 | 109 |
| *Polyartha vulgaris* | 0 | 234 |
| **Mean Total/L:** | **92** | |

Table 5. Zooplankton abundances and mean length in Moe Pond, summer and 2005 2006.

| **Moe Pond 5/25/2006** | | |
|---|---|---|
| **Species** | #/liter | mean length (µm) |
| **Cladoceran** | | |
| *Bosmina longirostris* | 0 | |
| *Daphnia pulex* | 0 | |
| **Copepods** | 0 | |
| Calanoid | 0 | |
| *Cylopoid* sp. | 0 | |
| Nauplius sp. | 40 | 154 |
| **Rotifers** | | |
| *Asplanchna priodontus* | 23 | 116 |
| *Kellicotia longispina* | 17 | 124 |
| *Keratella cochlearis* | 13 | 111 |
| *Polyartha vulgaris* | 0 | |
| **Mean Total/L:** | | |

| **Moe Pond 6/1/2006** | | |
|---|---|---|
| **Species** | #/liter | mean length (µm) |
| **Cladoceran** | | |
| *Bosmina longirostris* | 10 | 182 |
| *Daphnia pulex* | 0 | |
| **Copepods** | | |
| Calanoid | 0 | |
| *Cylopoid* sp. | 16 | 614 |
| Nauplius sp. | 27 | 178 |
| **Rotifers** | | |
| *Asplanchna priodontus* | 7 | 391 |
| *Kellicotia longispina* | 30 | 139 |
| *Keratella cochlearis* | 33 | 101 |
| *Polyartha vulgaris* | 0 | |
| **Mean Total/L:** | | |

| **Moe Pond 6/7/2006** | | |
|---|---|---|
| **Species** | #/liter | mean length (µm) |
| **Cladoceran** | | |
| *Bosmina longirostris* | 0 | |
| *Daphnia pulex* | 0 | |
| **Copepods** | | |
| Calanoid | 0 | |
| *Cylopoid* sp. | 17 | 515 |
| Nauplius sp. | 10 | 122 |
| **Rotifers** | | |
| *Asplanchna priodontus* | 3 | 712 |
| *Kellicotia longispina* | 3 | 118 |
| *Keratella cochlearis* | 13 | 90 |
| *Polyartha vulgaris* | 3 | 234 |
| **Mean Total/L:** | 49 | |

| **Moe Pond 6/14/2006** | | |
|---|---|---|
| **Species** | #/liter | mean length (µm) |
| **Cladoceran** | | |
| *Bosmina longirostris* | 3 | 79 |
| *Daphnia pulex* | 0 | |
| **Copepods** | | |
| Calanoid | 0 | |
| *Cylopoid* sp. | 0 | |
| Nauplius sp. | 0 | |
| **Rotifers** | | |
| *Asplanchna priodontus* | | |
| *Kellicotia longispina* | 17 | 156 |
| *Keratella cochlearis* | 30 | 82 |
| *Polyartha vulgaris* | 0 | |
| **Mean Total/L:** | 50 | |

Table 6. Zooplankton abundance and mean length by week, summer 2006.

| **Moe Pond 6/27/2006** | | |
|---|---|---|
| **Species** | #/liter | mean length (µm) |
| **Cladoceran** | | |
| *Bosmina longirostris* | 7 | 157 |
| *Daphnia pulex* | 0 | |
| **Copepods** | | |
| Calanoid | 0 | |
| *Cylopoid* sp. | 7 | 539 |
| Nauplius sp. | 93 | 148 |
| **Rotifers** | | |
| *Asplanchna priodontus* | 0 | |
| *Kellicotia longispina* | 0 | |
| *Keratella cochlearis* | 30 | 89 |
| *Polyartha vulgaris* | 0 | |
| **Mean Total/L:** | 137 | |

| **Moe Pond 7/5/2006** | | |
|---|---|---|
| **Species** | #/liter | mean length (µm) |
| **Cladoceran** | | |
| *Bosmina longirostris* | 0 | |
| *Daphnia pulex* | 0 | |
| **Copepods** | | |
| Calanoid | 7 | 497 |
| *Cylopoid* sp. | 40 | 257 |
| Nauplius sp. | 7 | 248 |
| **Rotifers** | | |
| *Asplanchna priodontus* | 20 | 242 |
| *Kellicotia longispina* | 0 | |
| *Keratella cochlearis* | 47 | 181 |
| *Polyartha vulgaris* | 0 | |
| **Mean Total/L:** | 121 | |

| **Moe Pond 7/11/2006** | | |
|---|---|---|
| **Species** | #/liter | mean length (µm) |
| **Cladoceran** | | |
| *Bosmina longirostris* | 0 | |
| *Daphnia pulex* | 0 | |
| **Copepods** | | |
| Calanoid | 0 | |
| *Cylopoid* sp. | 30 | 420 |
| Nauplius sp. | 43 | 174 |
| **Rotifers** | | |
| *Asplanchna priodontus* | 0 | |
| *Kellicotia longispina* | 0 | |
| *Keratella cochlearis* | 20 | 147 |
| *Polyartha vulgaris* | 0 | |
| **Mean Total/L:** | 93 | |

| **Moe Pond 7/18/2006** | | |
|---|---|---|
| **Species** | #/liter | mean length (µm) |
| **Cladoceran** | | |
| *Bosmina longirostris* | 0 | |
| *Daphnia pulex* | 3 | 204 |
| **Copepods** | | |
| Calanoid | 0 | |
| *Cylopoid* sp. | 20 | 339 |
| Nauplius sp. | 47 | 190 |
| **Rotifers** | | |
| *Asplanchna priodontus* | 7 | 198 |
| *Kellicotia longispina* | 0 | |
| *Keratella cochlearis* | 17 | 91 |
| *Polyartha vulgaris* | 0 | |
| **Mean Total/L:** | 94 | |

Table 6 (cont.). Zooplankton abundance and mean length by week, summer 2006.

| **Moe Pond 7/24/2006** | | |
|---|---|---|
| **Species** | #/liter | mean length (µm) |
| **Cladoceran** | | |
| *Bosmina longirostris* | 0 | |
| *Daphnia pulex* | 10 | 320 |
| **Copepods** | | |
| Calanoid | 0 | |
| *Cylopoid sp.* | 0 | |
| *Nauplius sp.* | 73 | 174 |
| **Rotifers** | | |
| *Asplanchna priodontus* | 3 | 459 |
| *Kellicotia longispina* | 0 | |
| *Keratella cochlearis* | 20 | 92 |
| *Polyartha vulgaris* | 0 | |
| **Mean Total/L:** | 106 | |

| **Moe Pond 8/1/2006** | | |
|---|---|---|
| **Species** | #/liter | mean length (µm) |
| **Cladoceran** | | |
| *Bosmina longirostris* | 7 | 1020 |
| *Daphnia pulex* | 3 | 87 |
| **Copepods** | | |
| Calanoid | 0 | |
| *Cylopoid sp.* | 3 | 438 |
| *Nauplius sp.* | 30 | 148 |
| **Rotifers** | | |
| *Asplanchna priodontus* | 0 | |
| *Kellicotia longispina* | 0 | |
| *Keratella cochlearis* | 0 | |
| *Polyartha vulgaris* | 0 | |
| **Mean Total/L:** | 43 | |

Table 6 (cont.). Zooplankton abundance and mean length by week, summer 2006.

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