Endemic annelids in two Oregon lakes
Steve Fend, Jim Carter
stevenfeld@gmail.com

Annelids are typically a significant component of lake benthos.

So, why do we (humans) care?

Role of worms in the lake environment: some examples from recent USGS studies of eutrophic Upper Klamath Lake.

**Upper Klamath Lake:**
- Historically eutrophic; now considered hyper-eutrophic, with summer blooms of cyanobacteria.
- Basin probably formed in late Miocene, several lakes may have formed a large piedmont lake during the Pleistocene.
- Prior river connections (late Tertiary through Pleistocene) have been proposed on the basis of fish and mollusk faunas, but the upper basin has a distinctive fauna.

**Upper Klamath Lake may be a special case:**
- Nominally dominant oligochaetes in the tributaries and wetlands could generally be attributed to freshwater, wide-ranging species.
- Contrast: worms in the lake were a mix of wide-ranging species and unusual morphotypes (possibly new species).

Abundance: Nominally, annelids were 62%–79% of the macroinvertebrates. (500 – 8,000 ind/m²; 1985, Souther-Quinn et al. 1985).

Phyllodocidae (commonly known as leaf miners) was not numerically dominant, but it was dominant in terms of biomass at many shallow lakes in the region. In this type of ecosystem, it is a keystone species.

**Rhabdocoela:**
- Amphineura: a diverse group within this clade, species diversity is currently under investigation.

**Fish food?**
- Soft bodied invertebrates are rarely consumed in fish guts.

- A qualitative assessment of juvenile Lost River Delticole (Delticole sp.) and Shortnose Sculpin (Cottus cognatus) gut contents has found oligochaetes remains in about half of the individuals examined, yet quantitative data suggest that organisms are a minor dietary component (Carter & Fend unpublished).

**Nutrient recycling: excess phosphorus released m-1 day-1 by some nemertean and freshwater oligochaetes, based on lab experiments. Magnitude is comparable to the mean values of PP released in bentic flux studies by freshwater andmarine, oligochaete elasmodrilus, 150 mg P m-2 day-1. Similar published results for Giant clams (Gupta, et al. 1986) and other regions.

Annelids are rarely identified to species in North American lake studies.

A few western North American lakes with worm data:

- Lakes are variable!
- Some are quite recent.
- Many have been affected by climate change, agriculture, and agricultural withdrawals or overuse.
- Other lakes may have been studied; they could be interested in reports from other lakes.

**Annelids reported from some western lakes:**

Shading indicates unusual morphotypes that may represent endemic species.

<table>
<thead>
<tr>
<th>Upper Klamath Lake (OR)</th>
<th>Lower Klamath Lake (CA)</th>
<th>Lake Tahoe (NV)</th>
<th>Clear Lake (CA)</th>
<th>Clear Lake (CA)</th>
<th>Clear Lake (CA)</th>
<th>Clear Lake (CA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Water Temperature (°C)</td>
<td>Mean Water Temperature (°C)</td>
<td>Mean Water Temperature (°C)</td>
<td>Mean Water Temperature (°C)</td>
<td>Mean Water Temperature (°C)</td>
<td>Mean Water Temperature (°C)</td>
<td>Mean Water Temperature (°C)</td>
</tr>
<tr>
<td>Mean Temperature (°C)</td>
<td>Mean Temperature (°C)</td>
<td>Mean Temperature (°C)</td>
<td>Mean Temperature (°C)</td>
<td>Mean Temperature (°C)</td>
<td>Mean Temperature (°C)</td>
<td>Mean Temperature (°C)</td>
</tr>
<tr>
<td>Mean pH</td>
<td>Mean pH</td>
<td>Mean pH</td>
<td>Mean pH</td>
<td>Mean pH</td>
<td>Mean pH</td>
<td>Mean pH</td>
</tr>
<tr>
<td>Mean Conductivity (µS/cm)</td>
<td>Mean Conductivity (µS/cm)</td>
<td>Mean Conductivity (µS/cm)</td>
<td>Mean Conductivity (µS/cm)</td>
<td>Mean Conductivity (µS/cm)</td>
<td>Mean Conductivity (µS/cm)</td>
<td>Mean Conductivity (µS/cm)</td>
</tr>
<tr>
<td>Mean Chlorophyll-a (µg/L)</td>
<td>Mean Chlorophyll-a (µg/L)</td>
<td>Mean Chlorophyll-a (µg/L)</td>
<td>Mean Chlorophyll-a (µg/L)</td>
<td>Mean Chlorophyll-a (µg/L)</td>
<td>Mean Chlorophyll-a (µg/L)</td>
<td>Mean Chlorophyll-a (µg/L)</td>
</tr>
<tr>
<td>Mean Dissolved Oxygen (µg/L)</td>
<td>Mean Dissolved Oxygen (µg/L)</td>
<td>Mean Dissolved Oxygen (µg/L)</td>
<td>Mean Dissolved Oxygen (µg/L)</td>
<td>Mean Dissolved Oxygen (µg/L)</td>
<td>Mean Dissolved Oxygen (µg/L)</td>
<td>Mean Dissolved Oxygen (µg/L)</td>
</tr>
<tr>
<td>Mean Water Temperature (°C)</td>
<td>Mean Water Temperature (°C)</td>
<td>Mean Water Temperature (°C)</td>
<td>Mean Water Temperature (°C)</td>
<td>Mean Water Temperature (°C)</td>
<td>Mean Water Temperature (°C)</td>
<td>Mean Water Temperature (°C)</td>
</tr>
<tr>
<td>Mean Temperature (°C)</td>
<td>Mean Temperature (°C)</td>
<td>Mean Temperature (°C)</td>
<td>Mean Temperature (°C)</td>
<td>Mean Temperature (°C)</td>
<td>Mean Temperature (°C)</td>
<td>Mean Temperature (°C)</td>
</tr>
<tr>
<td>Mean pH</td>
<td>Mean pH</td>
<td>Mean pH</td>
<td>Mean pH</td>
<td>Mean pH</td>
<td>Mean pH</td>
<td>Mean pH</td>
</tr>
<tr>
<td>Mean Conductivity (µS/cm)</td>
<td>Mean Conductivity (µS/cm)</td>
<td>Mean Conductivity (µS/cm)</td>
<td>Mean Conductivity (µS/cm)</td>
<td>Mean Conductivity (µS/cm)</td>
<td>Mean Conductivity (µS/cm)</td>
<td>Mean Conductivity (µS/cm)</td>
</tr>
<tr>
<td>Mean Chlorophyll-a (µg/L)</td>
<td>Mean Chlorophyll-a (µg/L)</td>
<td>Mean Chlorophyll-a (µg/L)</td>
<td>Mean Chlorophyll-a (µg/L)</td>
<td>Mean Chlorophyll-a (µg/L)</td>
<td>Mean Chlorophyll-a (µg/L)</td>
<td>Mean Chlorophyll-a (µg/L)</td>
</tr>
<tr>
<td>Mean Dissolved Oxygen (µg/L)</td>
<td>Mean Dissolved Oxygen (µg/L)</td>
<td>Mean Dissolved Oxygen (µg/L)</td>
<td>Mean Dissolved Oxygen (µg/L)</td>
<td>Mean Dissolved Oxygen (µg/L)</td>
<td>Mean Dissolved Oxygen (µg/L)</td>
<td>Mean Dissolved Oxygen (µg/L)</td>
</tr>
</tbody>
</table>

**Several glossiphoenid leeches are common in UCL (Bill Moser, US National Museum):**

The recently described, possibly endemic Meisneriella baumanni.

The widespread P. elegans (metabasal) is common in the UCL delta and upper watershed.

Another scutellum-bearing species, probably not described.

This morphotype resembles Melobesia robusta.

**Lake Abert: a single salinity-tolerant annelid:**

An endemic species probably attributable to the marine/estuarine genus Monophasyalus has been collected from 3 lakes with high salinity (also in Volkner Lake and Big Soda Lake, Nevada).

- This undescribed species differs markedly from known Pacific coastal Monophasyalus species (or related genera).
- Fresh water is needed for DNA.
- It has not been collected in Lake Abert in recent years, perhaps due to a recent period of increased salinity.

**Finding a single endemically-adapted species (living near a lake)?**

- A single annelid species is rare.

**Endemic(?) annelids in Upper Klamath vs. well-studied (but very different) ancient lakes:**

<table>
<thead>
<tr>
<th>Approx. Age</th>
<th>Oligochaetes</th>
<th>Leeches</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 25 Ma</td>
<td>&gt; 25 Ma</td>
<td>&gt; 25 Ma</td>
</tr>
<tr>
<td>3 Ma</td>
<td>3 Ma</td>
<td>3 Ma</td>
</tr>
</tbody>
</table>

**Discussion:**

- These differences suggest that the Upper Klamath may have a more ancient history than the other lakes, which may explain the presence of more endemic species.

**First sketch of diagnostic reproductive organs (description in progress):**

- Small annelid endogonan; note the distinctive cilia/bristles in [segment] K1.