Manual of Fisheries Survey Methods II: with periodic updates

Chapter 18: Sampling Zooplankton in Lakes

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Chapter 18: Sampling Zooplankton in Lakes

Merle G. Galbraith, Jr. and James C. Schneider

This chapter describes methods for sampling zooplankton in lakes, laboratory procedures for determining the number of large (≥1.4 mm) zooplankters, and applications of results.

18.1 Equipment

- A portable fathometer for locating the sampling sites.
- Equipment for determining dissolved oxygen.
- A Wisconsin-style plankton net with straining bucket. Net 30-inches long with mesh size of 153- or 160-µm nytex netting and mouth opening of 4.5-5 inches. May use larger mouth diameters if numbers caught are adjusted to an area of 16 square inches.
- Three 125-ml plastic wash bottles with fine-tipped spouts.
- Widemouth bottles, 3- or 4-ounce, to preserve samples.
- Formalin.
- A homemade filter funnel of No. 30 mesh/inch brass screening (0.02-inch openings), made with a pouring spout.
- A pipet for removing subsamples.
- A petri dish (grid counting) or other type of counting chamber.
- Binocular microscope, at least 20× magnification, with an ocular micrometer which covers as a wide field as possible.

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Suggested sources of equipment:

Wildco Instruments, 301 Cass Street, Saginaw, MI 48602 (catalog no. 40-A65)
Phoenix Wire Works, Inc., 585 Stephenson Hwy, Troy, MI 48084

18.2 Sample sites

Most lakes have one large basin with a zone of deoxygenated water in summer. This lake type should be sampled as follows. Determine the depth at which dissolved oxygen is *less* than 0.5 ppm. This depth will hereafter be referred to as the "critical depth" because zooplankton will not occur below it. Retrieval of the plankton net should begin at that depth. To locate sampling stations, divide the lake into four quadrants centered over the deepest basin (Figure 18.1). One axis of the quadrants should be in line with the direction of the wind. Choose a site on each axis as far out from the center as possible and near where critical depth intersects the lake bottom. Allow enough room below the critical depth so that the plankton net will not stir up bottom sediments.

Some lakes, with greater depth or lower productivity (oligotrophic), retain some dissolved oxygen in bottom waters during summer. The oxygen may be confined to a very small basin and, if one uses the critical depth previously defined, the sampling stations will be too close together. Therefore, the critical depth is redefined as the lower limit of zooplankton. To find that critical depth, take water samples with a Kemmerer bottle (or similar device) from the deepest part of the lake at 2-foot intervals, progressing upward from the bottom. Draw at least three-fourths of the water from the

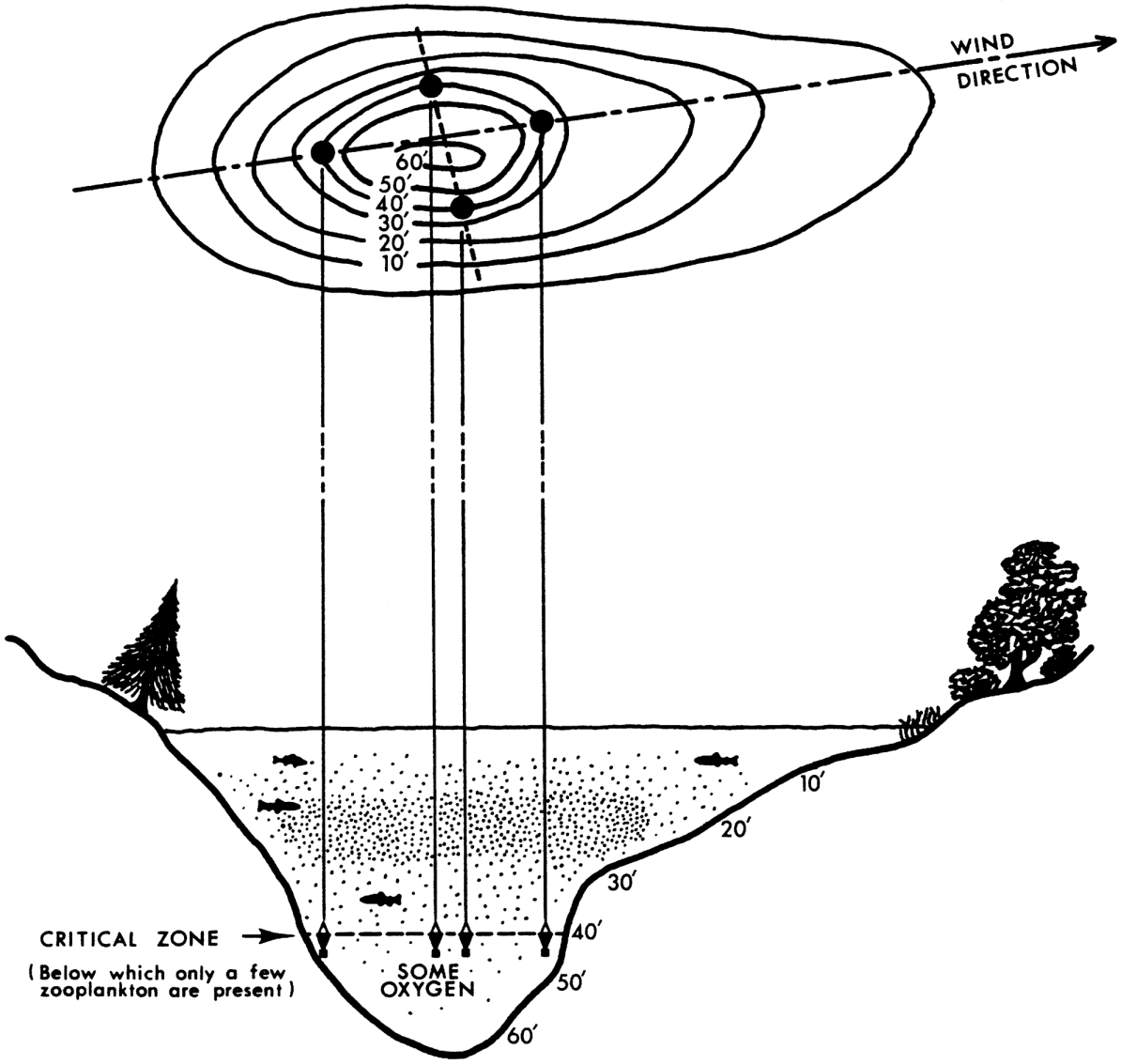

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Fig 18.1–Location of stations for sampling zooplankton in a deep lake with little or no oxygen depletion.

sampler into a standard 250-ml water bottle, stopper it, and examine the contents for zooplankton. Holding the bottle toward a light background will aid visual inspection. If several zooplankters are observed, take another sample 1 foot deeper. The critical depth will either be at that depth or deeper.

Other lakes are so shallow that dissolved oxygen occurs throughout the water column and there is no critical depth. Instead, select station locations, with equal depth, that are approximately equidistant from the center of the lake and the shoreline. This lake type also should be divided into quadrants, as described above.

If a lake has more than one basin, one or both criteria for determining critical depths may have to be used to locate sampling sites. In some of these lakes, the zone of deoxygenated water may be similar in every basin, so there is no need to intensively sample each one. However, if the oxygen profiles of the basins differ, then each should be sampled separately. At least two stations should be sampled in each "different" basin at locations 180° from each other, and all counts from the lake should be averaged for computing average plankton density.

Note that one sample collected from each lake quadrant is barely adequate for estimating plankton populations. An additional sample from the center of the quadrants, and the same critical depth, will probably improve the estimate. If even more samples are deemed necessary, select station locations in pairs 180° apart. Be cognizant of wind direction (both current and preceding) because strong continuous winds tend to "pile up" zooplankton on the lee side of a lake.

18.3 Taking samples

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As a precaution, tie net, bucket, and brass stopper together with a safety string to prevent loss of parts. To minimize agitation of the bottom, always lower the net very slowly and carefully for the last 3 feet. Upon reaching the proper depth, pause for at least 30 seconds, then raise the net at a rate of approximately 4 feet per second. A hand reel with revolving handles on both sides will greatly facilitate smooth, uninterrupted retrieval. Raise the net out of the water in one motion until the plankton bucket is just above the surface. While hanging on to the net with one hand, splash lake water on the *outside* of the net to dislodge plankton that may still adhere to the inside of the net. After washing all plankton into the bucket, detach the bucket and wash down its sides with a 125-ml wash bottle. Remove stopper, and allow sample to drain into a preservation bottle while washing the inside of the bucket with a squeeze bottle. Add enough formalin to make approximately a 5% solution.

18.4 Lab procedures

If interested only in the larger zooplankton (≥1.4 mm), pour the contents of a sample through a 30-mesh screen to get rid of the smaller organisms. Thoroughly wash the contents through the screen using either a wash bottle, or a 5-mm (inside diameter) tap hose to which a small tapered eyedropper is attached. When using the hose, be sure to regulate water pressure carefully beforehand so that organisms are not accidentally splattered off the screen or forced through it. Pour screen contents into a counting dish containing 70% alcohol.

Examine the washed sample under magnification and count zooplankters ≥1.4 mm. An ocular micrometer should be installed in the microscope eyepiece to make measurements. Measure daphnids from the crest of the head to the base of the spine and copepods from the head to the last segment on the tail which bear the long hairs. After measuring organisms in a few samples it will become easy to judge size of most zooplankters.

If there are too many zooplankters in a sample to easily count (i.e., over 200 individuals of each of several species), then a sample may be properly diluted to a known volume and subsampled. The proper dilution is when at least 30 organisms of each of the common species, or of a particular species, will be in a l-ml aliquot subsample. To remove an aliquot from a sample, use a Wildco-Hensen-Stemple pipet, with plunger spring, designed for this purpose. Alternatively, use an automatic pipet with a tip constructed from a burette tip (2-3 inches long, inside diameter ≥5 mm).

While removing each aliquot, gently agitate the sample so that plankton is uniformly dispersed. Take five l-ml aliquots subsamples, make counts of organisms in each, and average them. The total count for a sample is calculated by multiplying this average by the original total volume of liquid in the sample. After counting organisms in an aliquot, they must all be returned to the sample before removing the next aliquot.

As a final step, volume and relative size of large zooplankton (mostly daphnids) may be determined. First, pour the sample containing large zooplankton into a centrifuge tube and spin it until the zooplankton stops settling. Next, read their volume (in cc) from the graduated marks on the tube. Finally, compute "volumetric index" (another measure of zooplankter size) by dividing volume by number of large daphnids per sample, then multiplying by 1000.

18.5 Computations and applications

The density of each important species in a lake may be calculated from average counts per sample, per quadrant, and per lake. Ultimately, density can be expressed either in number of organisms per net haul, per lake surface area, or per volume of water strained through the plankton net. The later two require that area of the mouth of the plankton net be known; the volume calculation additionally requires that distance (depth) the net was raised be factored in. A complication with this seemingly simple calculation is that volume of water actually strained will be less than so computed because water "piles up" in front of the net's mouth, especially if the net is pulled too fast. (Volume of water actually strained is most accurately measured by a flow meter mounted on the net.) That is why it is important to maintain the recommended pulling speed (see above), so that a consistent estimate of *relative* density will be obtained across samples.

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Large *Daphnia* (≥ 1.4 mm) are useful indicators of habitat and food conditions for both bluegill and rainbow trout. Lakes with larger *Daphnia* tend to have faster growing bluegills (Theiling 1990) and, therefore, are more likely to have larger bluegills (Schneider 1981 and 1990). Galbraith (1975) related zooplankton to rainbow trout stocking success (i.e., growth and survival). He found that poor trout lakes had less than 100 large daphnids per net haul (and the volumetric index was <0.65) and good trout lakes had more than 150 large daphnids per net haul (and the volumetric index was > 0.80). Galbraith's guidelines should be applied to the management of small trout lakes.

Zooplankter mean length is also an indicator of overall fishing quality (Mills et al. 1987). In the State of New York, zooplankton sampling during spring and midsummer is a standard element of routine lake surveys. The information is used to evaluate relative year class strength of young fish, relative abundance of older planktivors, and predator-prey ratios.

18.6 References

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