MN SEA GRANT EXTENSION

LACUSTRINE LESSONS

University of Minnesota

Aquatic Topics for Grades K-12

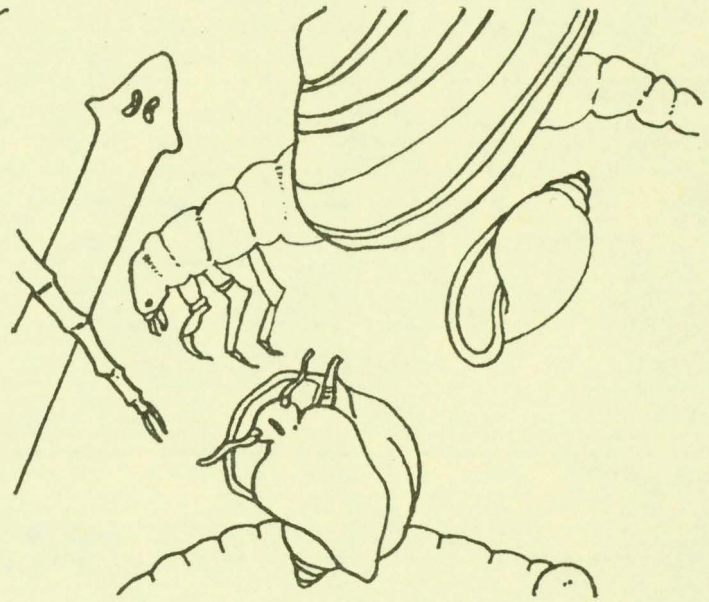
MAY/JUNE 1985

Minnesota Natural History Survey of Aquatic Invertebrates

The Science Museum of Minnesota is currently developing a new collection and research resource center for aquatic invertebrates from Minnesota and the upper Midwest. Up until this development Minnesota has not had a reference center with a complete collection of the state's aquatic invertebrates nor a research facility specifically equipped for studies of this important group of animals.

The animals which make up the group called aquatic invertebrates include thousands of animal species - all of which spend at least a portion of their life in water and all of which lack the backbone and bony internal skeleton found in most higher forms of animals. Some notable examples of aquatic invertebrates are:

sponges
leeches
snails
clams
copepods
larvae of some insects
cladocerans (water fleas)
(dragonflies, mayflies, mosquitoes, etc.)
some adult insects (water scorpions, diving beetles, etc.)



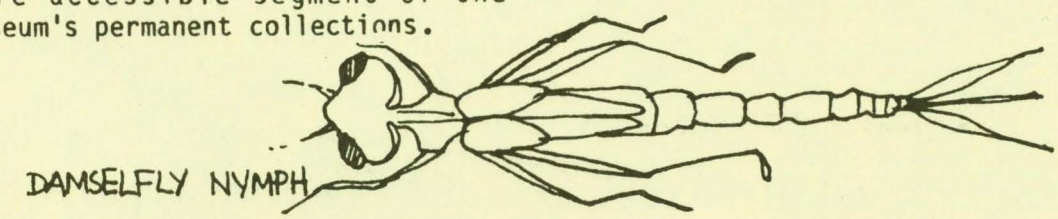
Aquatic invertebrates constitute a very important group of animals for two major reasons: 1.) they comprise the basis for the biological food chain in the aquatic environment; and 2.) many species serve as important indicators of water quality. Academic institutions, governmental agencies, and private consultants are continually engaged in research on the aquatic environment but often find it difficult to retain the complete collections necessary for research.

The Natural History Survey of Aquatic Invertebrates will include three collections.

1. **Research Collection** - A permanent catalogued collection of documented specimens accompanied by field and research data when available. It will be used to provide distribution records, as a resource in planning and would be expected to attract taxonomic specialists and other biologists for research.
2. **Reference Collection** - A special part of the research collection selected for regional taxonomic completeness, including adults of both sexes and juveniles. It also may include non-local species that demonstrate key characteristics that are absent in our local fauna. It will be used by professional biologists who need to be able to identify local aquatic invertebrates: biologists working for consulting firms, state and federal agencies, ecological researchers, and graduate students. This collection is similar to catalogued components of other museum exhibits in that they are a more accessible segment of the museum's permanent collections.
3. **Teaching Collection** - An uncatalogued collection designated for occasional intensive use by adult classes and considered to be somewhat expendable. Most specimens will be undocumented and excess to the research collection. This collection should have many specimens (20 each) of common local invertebrates prepared in such a way that they demonstrate features of the taxonomic groups.

Schools, groups and individuals interested in the aquatic environment are invited to contribute information and specimens to the survey. For additional information contact:

Natural History Survey of Aquatic Invertebrates
Science Museum of Minnesota
30 East 10th Street
St. Paul, MN 55101
(612) 221-4707



NOTEWORTHY COLLECTIONS

"Specimens without complete accompanying data are worthless." (Freshwater Invertebrates, Pennak)

Collecting notes need to be recorded for any aquatic invertebrate collection. All collecting notes must include:

1.) name of the collector
2.) date of collection (use abbreviation for month rather than a number)
3.) precise location and habitat

Additional information which can be useful include the time of collection and method of collecting. Notes on associated organisms, weather, and water conditions should be as detailed as possible. School groups frequently focus on identification of organisms, but identification may have to be left for a laboratory exercise. Invertebrate specimens which are in good condition, but can't be identified may still be important in constructing a reference collection for a particular area.

The following collecting form is an example of forms used by Dr. Ann Heuschele of the Aquatic Invertebrates Natural History Survey. It may be more complete than you need, but can be used to help you design your own collecting forms.

COLLECTING NOTES No. _____

Locality _____ Coords. _____
District _____ Sub. _____ Country _____
Date _____ Time _____ Elevation _____
Collected by _____ Method _____

SITE

TERRESTRIAL _____

Weather _____
Temperature _____ deg. F. _____ Humidity _____ rel.%
Barometric pressure _____ rise _____ fall _____
Clouds _____ Wind _____ force _____ direction _____
Terrain _____ slope _____ direction _____

AQUATIC _____

Size _____ Flow _____
Salinity _____ Other solutes _____
Temperature _____ deg. F. _____ Color _____ Surface _____
Bottom _____ Shade _____
Vegetation _____

ANIMAL HOST _____
Species _____ det. _____
Age _____ Size _____ Sex _____
Situs _____ Preserved: yes _____ no _____
Museum _____ no. _____

OTHER _____

GENERAL

COLLECTIONS

No.	Identification	Remarks

Aquatic Invertebrate Collections

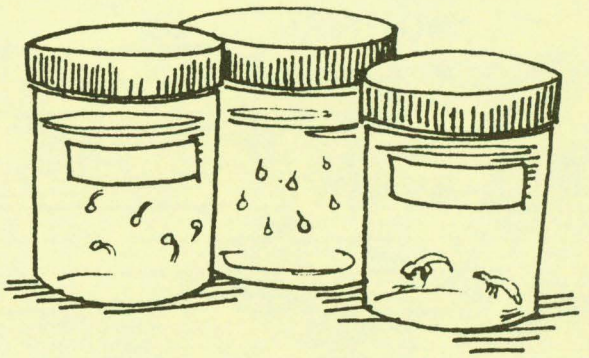
Past issues of Lacustrine Lessons (LL) have referred to collecting apparatus which can be homemade from inexpensive material (see LL issues: May/June 1981, - plankton net, observation chambers, bottom scraper; Sept./Oct. 1984 - leech traps). LL hasn't previously addressed the techniques required for developing freshwater invertebrate collections. Specimen collections can be an important educational tool as well as of potential value to researchers. However, we'd like to caution potential collectors to be sensitive to the habitat you're collecting from and please be sensitive to the relative abundance of the animals you're collecting. Don't destroy populations or habitats.

Collecting Containers

Virtually any kind of container can be used to bring specimens back to the laboratory for further study. Living specimens need to be brought back in water from which they were collected. If the specimens are being carried long distances the lid of the container needs to be removed periodically and/or more water needs to be added to renew the oxygen supply.

If specimens are to be killed in the field, denatured 95% ethyl alcohol generally works best. After the animals are dead transfer them to a container of 70% alcohol (more concentrated alcohol makes some specimens brittle).

Remember that regardless of whether specimens are being transported living or dead, the container should be filled close to the top with water or preserving fluid. Air bubbles have a tendency to damage fragile specimens.

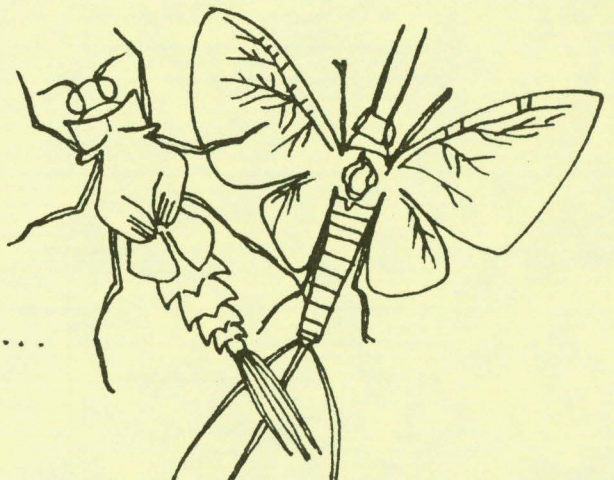


Field Methods for Preserving Freshwater Invertebrates

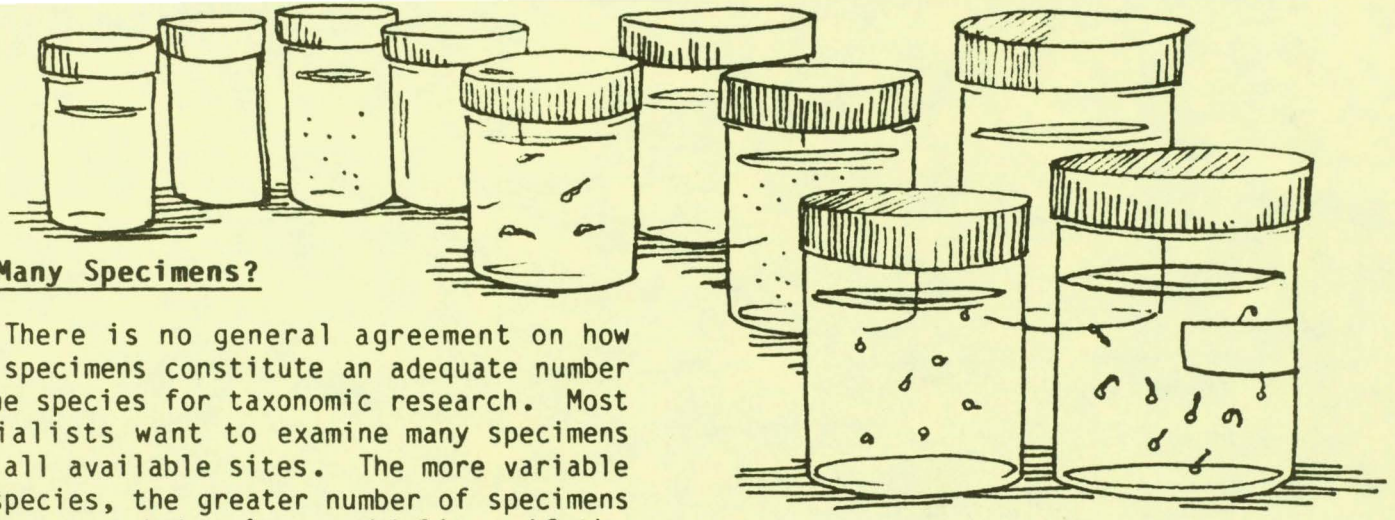
Dr. Heuschele has offered suggestions for taxon specific methods for examining, killing, fixing and preserving freshwater invertebrates (see the field methods chart). Additional details can be found in the texts listed in the resource section.

Sorting

Collections should be sorted free of sticks and other debris. A given vial from one site should contain only one kind of animal. It is not a problem if you can distinguish with certainty only one kind (of mayfly for instance), but what if your collection contains three kinds of mayflies? Simply group them in one vial and identify them as "Mayflies or Ephemeroptera, several species???"



MAYFLY LARVA AND ADULT...



How Many Specimens?

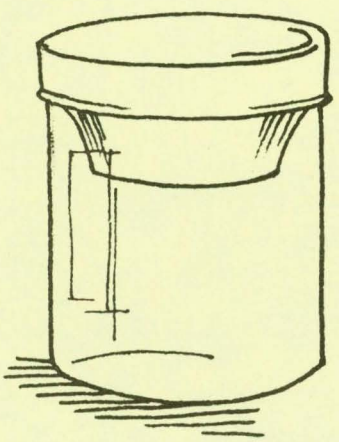
There is no general agreement on how many specimens constitute an adequate number of one species for taxonomic research. Most specialists want to examine many specimens from all available sites. The more variable the species, the greater number of specimens that are needed. As a guideline, if the organism is abundant and the collecting is easy, collect as many as will fit in the vial you are using; 200 or 300 may not be too many. However, if you are working with science classes and the students collect from the same site each year, over a period of time you may collect more duplicates than can be used by the Natural History Survey.

Which Individuals Make Good Specimens

Collections should contain representatives of each sex and all size classes present at the time the collection is made.

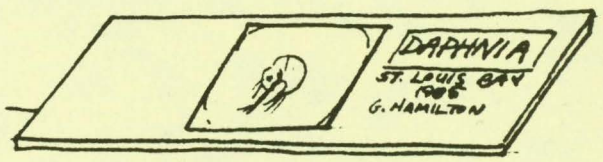
Vials

Many aquatic invertebrates can be stored in a preservative solution in glass specimen jars or vials. It's very important that the vials and jars have tight fitting caps. The caps with inverted plastic sealers are amongst the best. Cork caps are not recommended because they allow too much of the preservative to evaporate. Rubber stoppers are also a poor choice because the color of the stoppers sometimes leaks into the preservative.



Labels

Labels should be placed inside the jars or vials. Labels should be printed in lead pencil or india ink on 100% cotton fiber paper. If a permanent black ink is used be sure to dry the labels overnight before putting them in the preserving fluid. The labels have to include the name of the collector, date and location for collection and identification of the animal if possible.



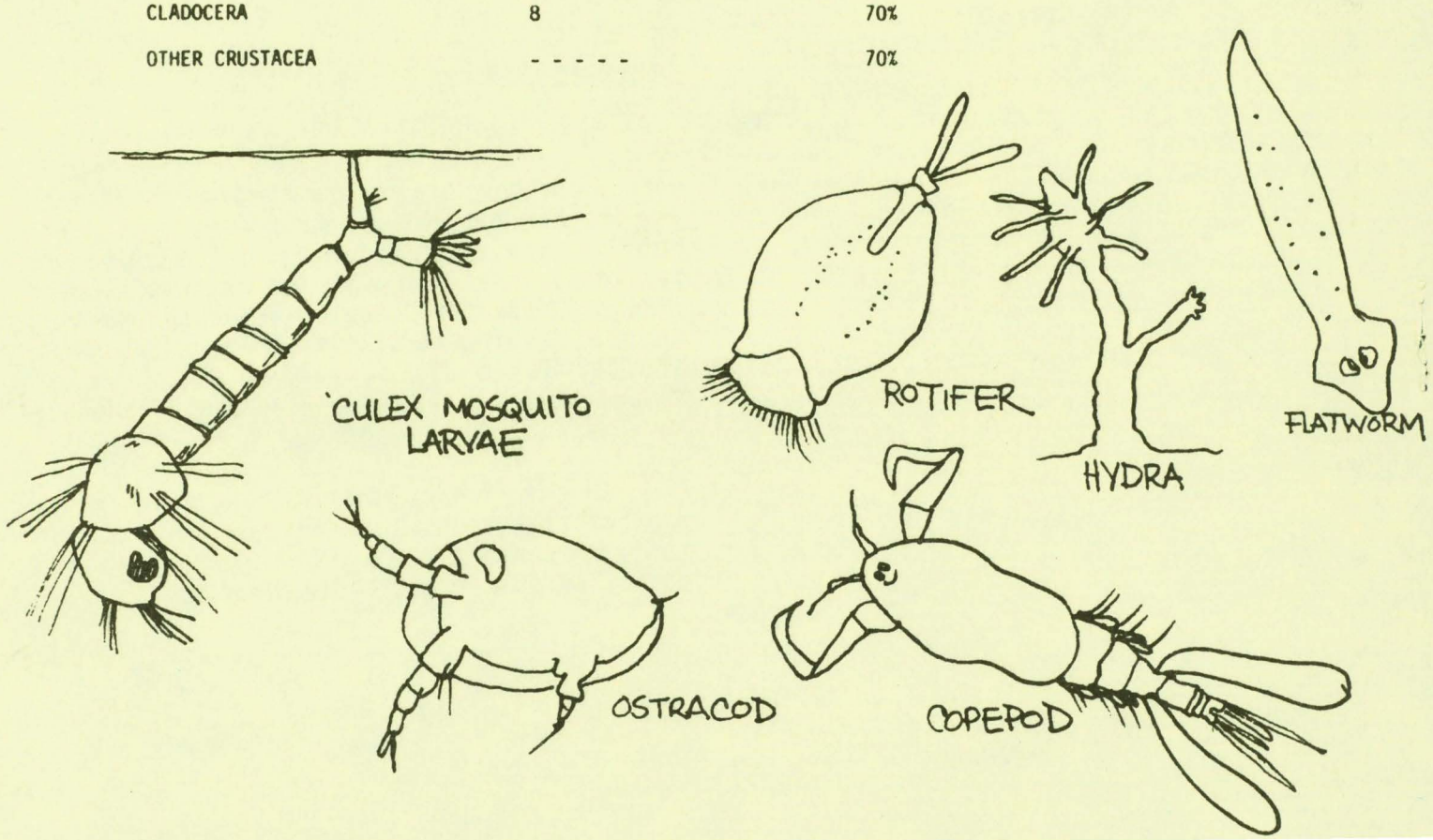
Fluid Levels in Vials

When everything is ready; specimens, vials, caps, labels, and preserving fluid; make sure the vials are completely filled and no air bubbles are trapped inside. Air bubbles can be removed from a stoppered bottle by inserting a piece of monofilament line or dissecting needle inside the opening before closing it with a stopper. When the stopper is in place, remove the line or filament; this should allow the air bubble to escape.

Check your specimen collection periodically and top up any vials which have lost preserving fluid. Even the best vials may allow some fluid to evaporate.

FIELD METHODS FOR PRESERVING FRESHWATER INVERTEBRATES *

ANIMAL	EXAMINE LIVE	NARCOTIZE/ ANESTHETISE	PRESERVATION		OTHER
			ALCOHOL[11] (ETHYL)	FORMALIN[9]	
SPONGES		- - - - -	70%		OR ALLOW TO AIR DRY
HYDRA	X	1, 2	70%		LIVING SPECIMENS IMPORTANT FOR IDENTIFICATION
FLATWORMS	X	1, 3	70%		HOT MERCURIC CHLORIDE TO KILL AND FIX FOR HISTOLOGICAL PREPARATION
GASTROTRICHS		3	70%	10%	
ROTIFERS WITH LORICA		- - - - -	70%	10%	
ROTIFERS WITHOUT LORICA	X	4	70%	10%	
NEMATODES		2, 5	85%	5%	
BRYOZOA	X	3, 6	70%	5%	
OLIGOCHAETES	X	5	70%		ENCHYTRAEIDAE SHOULD BE EXAMINED LIVE
LEECHES		2, 5, 7	80%	5%	
EUBRANCHIOPODA		- - - - -	70%	5%	
OSTRACODS		-X- - - -	70%	NO	
CRAYFISH		- - - - -	80%	5%	
CLADOCERA		8	70%		
OTHER CRUSTACEA		- - - - -	70%		



ANIMAL	EXAMINE LIVE	NARCOTIZE/ ANESTHETISE	PRESERVATION		OTHER
			ALCOHOL (ETHYL)	FORMALIN	
INSECTS		- - - - -	70%	NO	KILL AND FIX IN FIELD WITH KAA (19)
MOLLUSCA		2, 3	75-95%	NO	KEEP PAIRED CLAM SHELL VALVES TOGETHER

NARCOTICS/ANESTHETICS

1. Ethanol, 10%. Make up from absolute alcohol, if possible, not from low-grade alcohols with denaturating agents. Add the 10% alcohol a little at a time till the excitation ceases.

2. Magnesium sulfate(Epson salts). Add saturated solution drop by drop.

3. Menthol crystals. Place a few crystals on surface of water containing specimens. Apply cover to conserve fumes.

4. Neo-synephrine hydrochloride (Winthrop Laboratories). Obtainable in 1% solution at drugstores(nose drops), is best used as 0.1% to 0.5%. Many rotifers can be extended. It seems to work best in acid waters and rather poorly in alkaline waters.

5. Chloroform. Add small quantities to the surface of the water in the form of a spray and cover container. Saturated aqueous solution equals about 1%.

6. Acetone. Add pure acetone dropwise to small volume of water containing organisms.

7. Nicotine/Tobacco decoction. Leeches are very sensitive to nicotine. Drop few shreds of tobacco into the water with them, just enough to give water faint tint. Narcosis in 30-60 minutes. If decoction too strong, they die quickly and contracted.

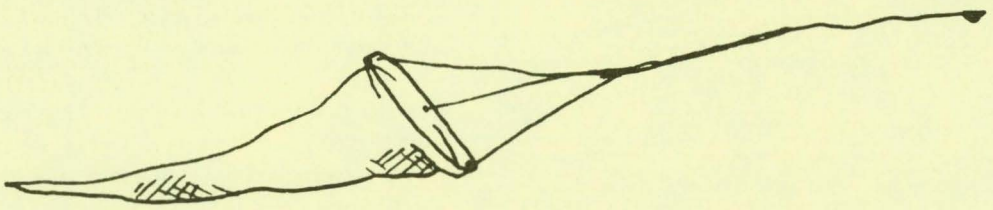
8. Hydrogen peroxide (3%). Add to habitat water.

PRESERVATIVES, FIXATIVES AND KILLING AGENTS

9. Formalin. Often used as a field preservative because of its low cost and because the concentrated form is easy to carry, formalin makes mollusc and ostracod shells brittle and will form a specimen-damaging precipitate under certain conditions (such as freezing).

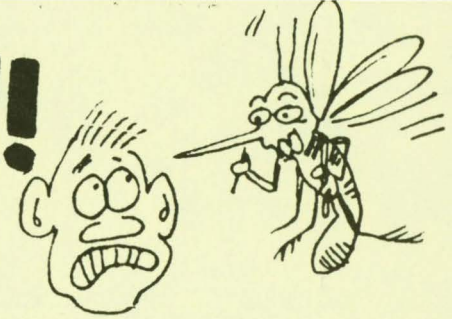
10. KAA (1 kerosene:2 acetic acid:10 ethyl alcohol). Aquatic insect field fixative which causes the sclerites to separate slightly, facilitating identification. Specimens should be transfered to 70% ethyl alcohol when returned to the laboratory.

11. Ethyl alcohol. Seventy percent ethyl alcohol is preferred for preservation of most invertebrate groups. Stronger solutions (85%) tend to render many forms brittle. For permanent storage, glycerol-alcohol (19 parts 70% ethyl alcohol to one part glycerine) prevents destruction of specimens should the fluid level in the vial become too low. If ethyl alcohol is not available, isopropyl alcohol may be used.



* Adapted from Delly, Johy Gustav. 1985 . Narcosis and preservation of freshwater animals. American Laboratory, April 1985. pages 31-40

mmmmmmmmm mosquito!!



by Dave Pederson

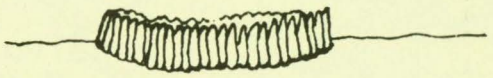
Jokingly the mosquito is called the Minnesota State Bird. It is both abundant and annoying. While out capturing aquatic invertebrates you will undoubtfully come across this pesty "bird" not only in the air but also in the water. Three of the mosquito's four life-stages are in the water: egg, larval and pupal stages. Only the adult lives out of water.

Eggs

There are about 50 species (from nine genera) of mosquitoes in Minnesota; the Aedes variety being the most common. All mosquitoes need water to begin their life cycles. They can be separated into two major groups depending on whether they lay dormant or non-dormant eggs. Aedes and Psorophoro mosquitoes are dormant egg layers. These females will generally lay their eggs in temporary and semi-permanent bodies of water. The eggs will go through a certain amount of development in the water and then can be dried and dormant for up to a year or more. When the conditions are right, like after a heavy thunderstorm, they will hatch.

Non-dormant egg laying mosquitoes (Anopheles, Culex, Culiseta, Mansonia, Uranotaenia and Wyeomyia) must lay their eggs on or in permanent and semi-permanent bodies of water. Some species of mosquitoes lay eggs which form a raft-like structure on the surface of the water. The shape of the egg rafts is usually species specific. Most of the non-dormant egg layers, however, either deposit their eggs singly or lay them in clusters attached to aquatic plants. All non-dormant eggs have a low tolerance for dryness and must be kept wet. Both dormant and non-dormant eggs can hibernate through the winter.

Mosquito eggs may be found while collecting aquatic invertebrates. Egg rafts are easier to find than single eggs and can be collected by pressing your hand down on aquatic plants in likely breeding places. The egg rafts will float up to the surface where they can be collected.

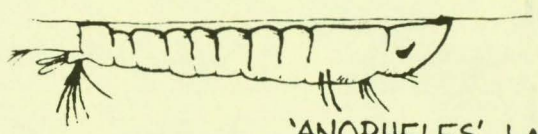


Breeding Places

Contrary to popular belief lakes are not major sources of mosquitoes. Marshes, swamps, and other depressions where water collects are major sources. The largest populations coming from water depths of only about six inches. A few species breed in specific places. For example, the Wyeomyia smithii breeds nowhere but inside the pitcher plant, and the california encephalitis carrier, Aedes triseriatus, prefers the water found in tree holes and stumps, old tires and other small containers of waters.

Mosquito Larvae

Although some eggs are laid in moist breeding places, and are resistant to drying, all mosquito larvae (also called "wrigglers") must live in water to develop. There are keys (e.g. Mosquitoes of Minnesota by A. Ralph Barr) to identify the different genera and species of mosquitoes in their larval stage. The keys use differences in respiratory tubes antennae, a mouth brushes, and body segments for identification. For example, most mosquito larvae have a long breathing siphon at the end of their tail to pentrate the surface of the water, allowing the larvae to dangle below the surface and feed on the algae, protozans and debris that float by. The Anopheles larvae, on the contrary, have no breathing siphon and must feed while laying horizontally at the surface. It takes the mosquito a week after hatching to complete larval development, though some species hibernate through the winter as larvae.



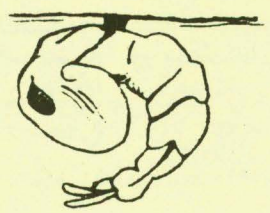
'ANOPHELES' LARVAE

Collecting larvae may be difficult - they will wriggle rapidly towards the bottom at the slightest change in light intensity. If there are no further disturbances the larvae then soon return to the surface. When collecting larvae be sure to remove any predators from the water sample.

Mosquito Pupae

Mosquito pupation for most species last for about two days. The pupa (also called a "tumbler") floats just under the water's surface with its breathing trumpets making contact with the air. The pupa does not eat. Its purpose is to transform the aquatic larva to a flying insect. Pupae are also sensitive to changes in light intensity. When disturbed the pupa dives to the bottom and sits there for up to two minutes, then quickly floats back up to the surface. Male pupae are generally smaller than their female counterparts and the differences between their reproductive organs make it possible to separate the sexes. But a mixture of species in the pupal stage are difficult, if not impossible, to identify.

MOSQUITO PUPAE



Adult Mosquito

Although the main emphasis of this issue of L.L. is on aquatic invertebrates it is difficult to discuss the mosquito without mentioning the adult stage. The first adult mosquitoes to appear in early spring are those which have hibernated through the winter as adults or larvae.

> Wyeomyia smithii and Mansonia perturbans may hibernate as larvae, and Anopheles, Culex, Culiseta, and Uranotaenia may hibernate as adults.

Those that had overwinter as eggs begin to hatch in the snowmelt; these then come out as adults in early May. By June all species should be out and biting. Several generations can develop during the summer since most species can fully develop in a matter of weeks and live from 4 weeks up to 5 months longer. The mosquito population usually peaks in June and decline by September.

Feeding

Both male and female mosquitoes use the nectar from various plants as their main food. Female mosquitoes are known as the ones that bite since most, but not all, female mosquitoes require a blood meal to produce eggs. The blood can usually be taken from any available vertebrate, but some species appear to prefer certain hosts. The Western Equine Encephalitis carrier, Culex tarsalis, for example, will feed on man but it prefers birds.

Disease carriers

In Minnesota there are three major diseases carried by mosquitoes. The Western Equine Encephalitis (sleeping sickness) that breaks out from time to time in northwestern Minnesota and eastern North Dakoata is carried by Culex tarsalis. It mainly affects horses but man can get it if bitten by a mosquito carrying the disease. In the woods of southeastern Minnesota and in the Twin Cities the treehole breeding Aedes triseriatus carries California encephalitis which affects people, especially children. The canine heartworm is a serious problem in dogs in Minnesota. Twelve species of mosquitoes pass this parasite from dog to dog, but it does not affect man.

Mosquito Control

The Twin Cities has developed a mosquito control program that uses a non-toxic mosquito hormone to stunt larval development. The hormone does not kill the mosquito larvae, it only keeps them from developing into adults. They are left to become food for other aquatic creatures.

We can help control mosquitoes in our own areas by eliminating breeding places. According to the Metropolitan Mosquito Control District the number of mosquitoes that carry California encephalitis. 1. Filling tree stumps and holes with gypsum wool rock, sand or cement. 2. Removing cans, bottles, tires and other items that hold water from outdoor sites where there are potential breeding places. Extensive spraying is not recommended for it is expensive, can be detrimental to the environment, and it is only effective for short periods of time. For more information about mosquitoes and their control contact: Metropolitan Mosquito Control District, 2380 Wycliff Street, St. Paul, MN 55114.

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Aquatic Invertebrates

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Lacustrine Lessons is published five times during the school year as an educational service of the Minnesota Sea Grant Extension Program. University of Minnesota Duluth Sea Grant is a state and federal program concerned with the understanding and wise use of our freshwater and saltwater seas.

"Lacustrine Lessons" is sent free of charge to anyone requesting this service. It is published with funds provided by the Office of Sea Grant National Oceanic and Atmospheric Administration, U.S. Dept. of Commerce and the University of Minnesota through the Agricultural Extension Service.

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"lacustrine/lə-'kəs-trən/adj.(prob. from French or Italian lacustre,' from Latin 'lacus' lake): of, relating to, or growing in lakes." *Webster's New Collegiate Dictionary*

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