

# Benthic Invertebrates

A Low-Impact, cost-effective way to determine ecosystem health.

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Environmental Services Group

# Overview

- Workshop Format
- What are Benthic Invertebrates
- Why study Benthic Invertebrates
- How do we study Benthic Invertebrates

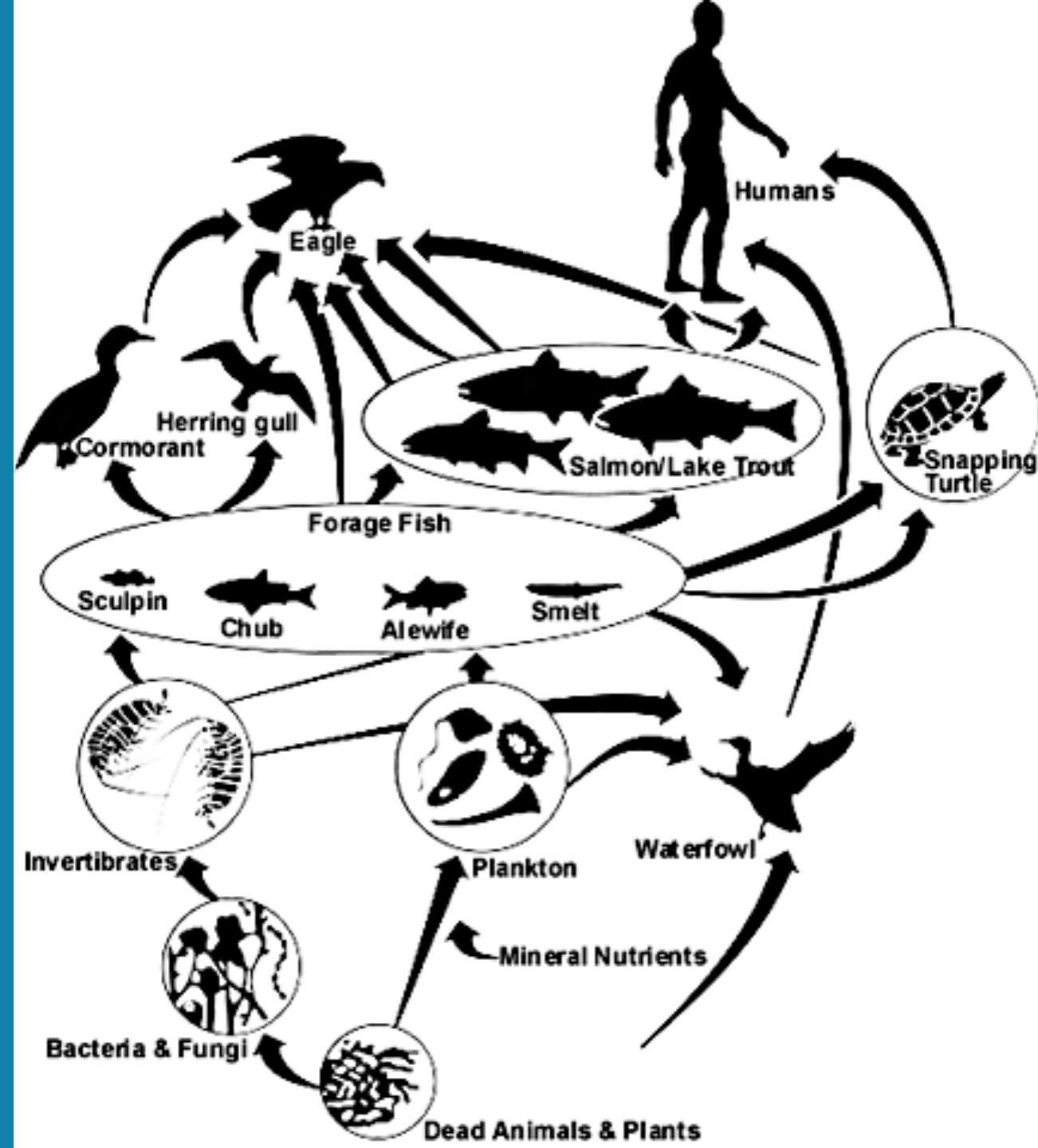


# Why study Benthic Invertebrates

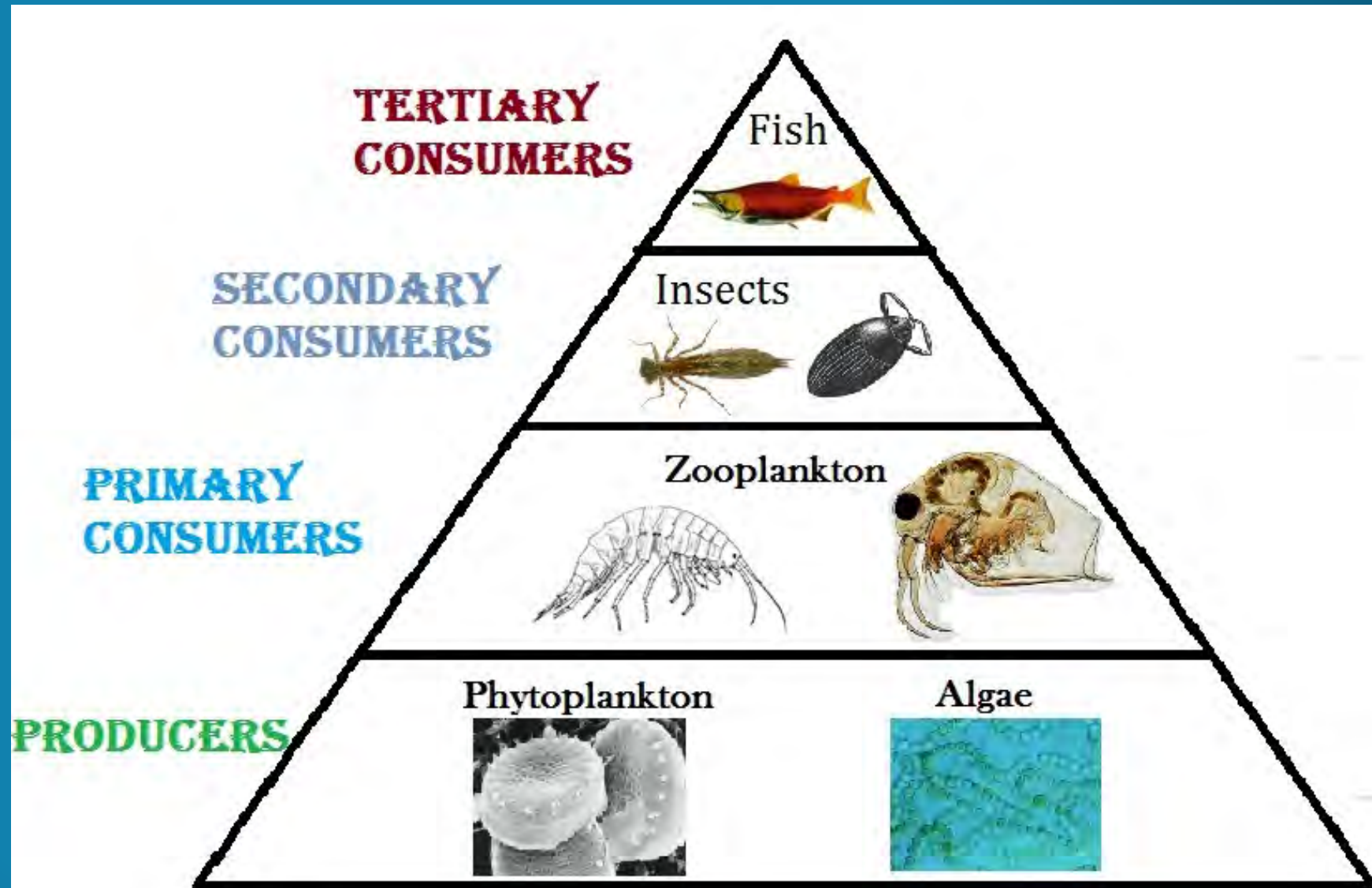
- Accurately reflects acute and chronic effects
- Cost effective
- Can act as Indicator Species
- Bottom of the food chain (Impacts go up!)

# Simple Food Web

Interruptions of food on lower Levels of the web will affect all higher levels.



# Simple Energy Pyramid



Sensitive species:  
 Mayflies (*Ephemeroptera*)  
 Stoneflies (*Plecoptera*)  
 Caddisflies (*Trichoptera*)

Tolerant species  
 Worms  
 Leeches  
 Nematodes

# Benthic Macroinvertebrates of Northern Ontario



**Sensitive**

**Plecoptera | Stonefly**

**Trichoptera | Caddisfly**

**Ephemeroptera | Mayfly**

**Odonata | Dragonfly**

**Coleoptera | Beetle**

**Megaloptera | Fish/Alderfly**      **Tubellaria | Flatworm**

**Lepidoptera | Moth**   **Hemiptera | True bug**   **Coelenterata | Hydra**   **Amphipoda**   **Scud**

**Decapoda | Crayfish**   **Hydrachnida | Mite**

**Diptera | True Flies**

**Odonata | Damselfly**   **Gastropoda | Snail**

**Isopoda | Sow bug**   **Bivalvia | Clam**

**Oligochaeta | Worm**   **Hirudinea | Leech**   **Nematoda | Roundworm**

**Tolerant**

Prepared by Chantal Tremblay-Delay (chantal.delay@laurentian.ca); photos by Lennie Witte except worms taken by Kim Fram, Cooperative Freshwater Ecology Unit, Laurentian University. Family names listed below photos followed by field number (col = collector; librec = lib; p = producer; scf = scraper; str = shredder; par = parasite) and tolerance levels (sensitive S0 to tolerant S10) based on Hilsenhoff's Modified Family Biotic Index. Images not to scale.



**Benthic Data Analysis**

School:	
Teacher:	
Stream:	
Monitoring Date:	

Taxon	Common Name	Tolerance Value	Count (#)
Amphipoda	Scud	6	
Anisoptera	Dragonfly	5	
Ceratopogonidae	No-see-ums	NA	
Chironomidae	Midge	7	
Coelenterata	Hydra	8	
Coleoptera	Beetle	4	
Cuclidae	Mosquito	5	
Decapoda	Crayfish	5	
Diptera, Misc.	Misc. True Flies	NA	
Ephemeroptera	Mayfly	5	
Gastropoda	Snail	8	
Hemiptera	True Bug	5	
Hirudinea	Leech	8	
Isopoda	Aquatic Sowbug	8	
Lepidoptera	Aquatic Moth	NA	
Megaloptera	Helgrammite, Fishfly, Alderfly	4	
Nematoda	Roundworm	8	
Oligochaeta	Aquatic Worm	8	
Pelecypoda	Clam, Mussel	6	
Plecoptera	Stonefly	1	
Simuliidae	Blackfly	6	
Tabanidae	Horsefly, Deerfly	5	
Tipulidae	Crane-fly	3	
Trichoptera	Caddisfly	4	
Trombidiformes-Hydracarina	Water Mite	6	
Turbellaria	Flatworm	8	
Zygoptera	Damselfly	7	
Unknown	Unknown	NA	
<b>Number (All Groups except Unknown)</b>			0
<b>Number (Diptera)</b>			0
<b>Number (Insects)</b>			0
<b>Number (Most Abundant Group)</b>			0

Index	Value	Result
1 % Worm (Oligochaeta, Nematoda and Tubellaria)	#DIV/0!	#DIV/0!
2 % Midge (Chironomidae)	#DIV/0!	#DIV/0!
3 % Aquatic Sowbug (Isopoda)	#DIV/0!	#DIV/0!
4 % Snails (Gastropoda)	#DIV/0!	#DIV/0!
5 <b>Number of Taxonomic Groups</b>	0	Impaired
6 % Dominant Taxon	#DIV/0!	#DIV/0!
7 % EPT (Ephemeroptera, Plecoptera, Trichoptera)	#DIV/0!	#DIV/0!
8 % Diptera (Diptera, Chironomidae, Culicidae, Simuliidae, Tabanidae, Tipulidae)	#DIV/0!	#DIV/0!
9 % Insects (All Diptera, Anisoptera, Coleoptera, Ephemeroptera, Hemiptera, Megaloptera, Plecoptera, Trichoptera, Zygoptera)	#DIV/0!	#DIV/0!
10 <b>Hilsenhoff Biotic Index (HBI)</b>	#DIV/0!	#DIV/0!

Criteria		
Impaired	Possibly Impaired	Unimpaired
> 30%	10% to 30%	< 10%
> 40%	10% to 40%	< 10%
> 5%	1% to 5%	< 1%
----	< 1% or > 10%	1% to 10%
≤ 11	-----	> 11
> 45%	40% to 45%	< 40
< 5%	5% to 10%	> 10%
< 15% or > 50%	15% to 20%, or 45% to	20% to 45%
< 40% or > 90%	40% to 50%, or 80% to	50% to 80%
> 7	6 to 7	< 6

<b>Overall Result</b>	
# Not Classified as "Unimpaired"	10
<b>Result</b>	<b>Potentially Impaired</b>



# How do we study Benthic Invertebrates

- Methods of collection
  - OBBN / CaBIN
- Live count or preservation
- Proportional sampling



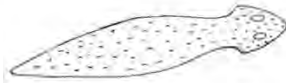
### Coelenterata

- Tube with tentacles
- Asexual reproduction by budding
- Inconspicuous, 2-25 mm long
- Variable colouration: often clear to whitish
- Sessile



### Turbellaria (Flatworms)

- Very flat 'worms', heads with eyespots
- Ventral mouth; may have pharynx
- 5-20 mm long, usually dark in colour: mottled grayish-brown to black dorsally
- Non-swimmers; creep slowly on bottom of sorting tray



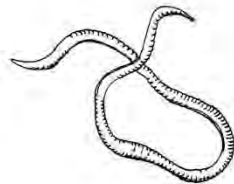
### Nematoda (Roundworms)

- Unsegmented, frequently clear
- Head usually tapered, tail pointed
- Often <1 cm long
- Rapid, whip-like movements



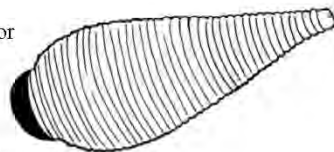
### Oligochaeta (Aquatic Earthworms)

- Bundles of hairs on each segment behind the first
- Segmented bodies are round, soft, muscular and elongate Look 1 to 30 mm long, often pinkish
- Look like like earthworms
- May crawl along bottom of tray but often coiled up
- No suckers or eyes



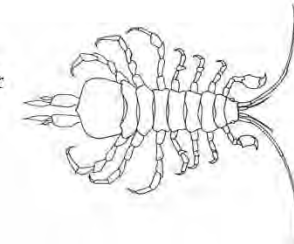
### Hirudinea (Leeches)

- Suckers at both ends, move by inching along or swimming
- 34 annulated segments, no chaetae
- ~5mm-30 cm long
- Head often with several pairs of eyes
- Colour varies, brown, olive and black common; typically patterned dorsally



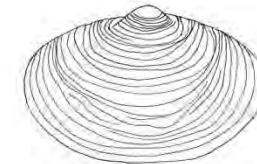
### Isopoda (Sow Bugs)

- 5-20 mm long; mini armadillos
- Dorso-ventrally compressed; 7 pairs of legs, adapted for crawling (first pair sub-chelate, others with simple claws)
- 1st antennae longer than 2nd
- Usually gray in colour
- Often associated with organic matter
- Uropods bifid



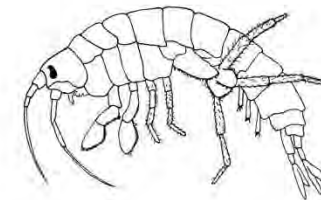
### Bivalvia (Clams and Mussels)

- Hard oval shell hinged in two halves
- 2 - 250 mm; colour variable
- Found in bottom of tray in sand or gravel
- Watch for (and don't count) empty shells



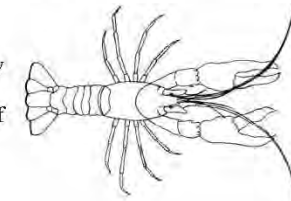
### Amphipoda (Scuds)

- Laterally compressed
- 2 Long antennae of approx. equal length
- 7 pairs of walking legs
- 6-segmented abdomen
- 5-20 mm long, colour variable
- Usually a translucent grey or light brown
- Catch with small piece of screen



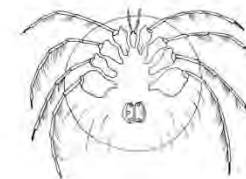
### Decapoda (Crayfish)

- Look like small lobsters; front half of body cylindrical, rear half dorso-ventrally flattened
- 5 pairs of walking legs: first 3 pairs chelate (claws of forelegs enlarged)
- Hard-shelled, eyes on stalks
- Broad telson used in backward-swimming escape
- 1 to 15 cm long, often green, brown, blue



### Hydrachnida (Mites)

- Adults with 4 pairs of segmented legs (larvae with 3)
- Body a sphere without visible segments
- Anterior finger-like pedipalps; simple eyespots; no antennae
- Often brightly coloured (red, green, blue, brown)



- Look like small (1-7 mm) spiders
- Uncoordinated, scrambling swimming motion

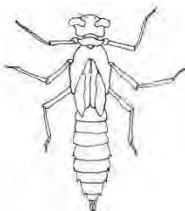
#### Ephemeroptera (Mayflies)

- Usually 3-tailed (sometimes 2-tailed)
- Single tarsal claw
- Gills held dorso-laterally on abdomen
- 3-28 mm long (not including tails)
- Swim using dorso-ventral undulations



#### Anisoptera (Dragonflies)

- Modified labium for catching prey
- Larger and heavier-bodied than mayflies; No visible external gills;
- Big head and eyes
- 15-45 mm; drab colours, often green to greenish brown
- Often flattened; Jet propulsion



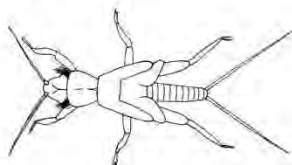
#### Zygoptera (Damselflies)

- Bodies more tubular, thinner than dragonflies
- 3 gills at terminus of abdomen
- Same modified raptorial labium as dragonflies
- Ten to 22 mm long, drab cryptic colours



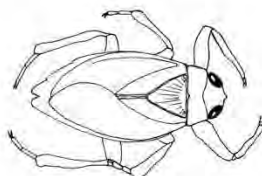
#### Plecoptera (Stoneflies)

- 2 tails
- Gills may be abdominal, thoracic, and on the ventral head or neck region (gills never insert dorso-laterally on abdomen)
- Tarsi with 2 claws
- 6-50 mm, yellowish, brown or blackish



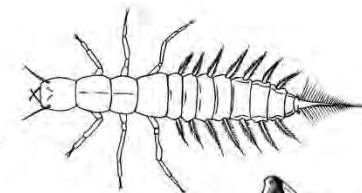
#### Hemiptera (True Bugs)

- 15-40 mm
- Sucking mouth parts (beak)
- No gills
- 2 claws on at least some legs
- Base of forewings leathery, otherwise membranous wings
- Often two pair of membranous wings
- Often with well developed breathing appendages



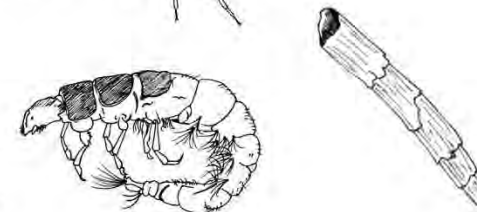
#### Megaloptera (Fishflies, Alderflies)

- Large: 25-90 mm long
- Lateral abdominal gill filaments
- Well developed mandibles
- Either with anal prolegs or a long terminal filament



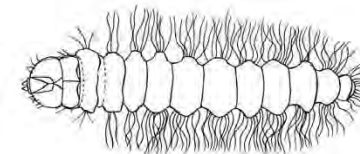
#### Trichoptera (Caddisflies)

- Anal prolegs with hooks
- Often with portable case or fixed- retreat
- Dorsal thoracic plates variously sclerotized
- 2-50 mm long, head and thorax compressed into anterior portion of body



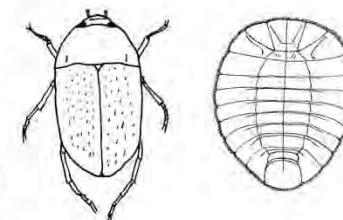
#### Lepidoptera (Aquatic Moths)

- Head with ring of ocelli
- 3 pairs of short, segmented, thoracic legs
- Ventral, abdominal prolegs
- 10 - 25 mm, crawl like a caterpillar



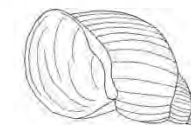
#### Coleoptera (Beetles)

- 2 - 20 mm
- 3 pairs of thoracic legs
- Adults: Fore-wing modified as elytra, and extends posteriorly to cover all or most of the body
- Antennae with 11 or fewer segments
- Larvae: Sclerotized head with mandibles, maxillae, labium and 2- or 3-segmented antennae; May have unsegmented terminal abdominal appendages



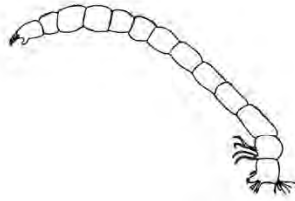
#### Gastropoda (Snails and Limpets)

- 2 - 70 mm
- hard spiral or cap-shaped shell
- Bodies with prominent head and tentacles
- May have operculum



### Chironomidae (Midges)

- 2 - 30 mm long, red, white, olive or yellowish
- Well developed, sclerotized head with eyes
- Anterior and posterior parapods with hooks
- Characteristic shape like letter “J”
- May be in a tube made of fine dirt particles
- Often caught in surface film



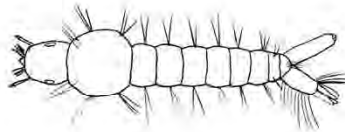
### Tabanidae (Horse Flies, Deer Flies)

- 3 or 4 pairs of creeping welts with hooks on each of the first 7 abdominal segments
- Pointed at both ends, leathery texture
- Head retracted into thorax
- 15 - 40 mm



### Culicidae (Mosquitoes)

- 3-15 mm
- Fused thoracic segments are wider than abdomen
- Brushes of hairs at front of head and sides of mouth
- Posterior respiratory siphon



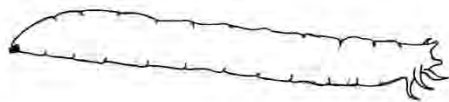
### Ceratopogonidae (No-see-ums, Biting Midges)

- very slender, pointed at both ends, segmented; small pointed sclerotized head
- No abdominal appendages but may be a tuft of terminal abdominal hairs
- 3-13mm, skin smooth shiny and creamy white
- remain stiff when picked up with forceps
- move by “whipping”



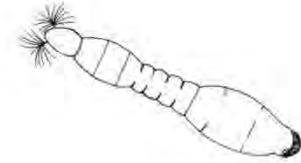
### Tipulidae (Crane Flies)

- 10-50 mm, white, yellowish or brown
- Reduced head is retracted into thorax
- Membranous body; may have creeping welts
- Posterior respiratory disc with lobes



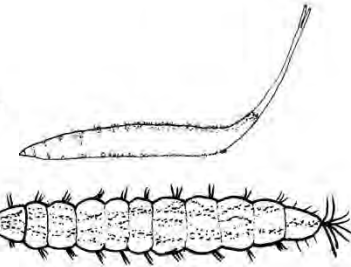
### Simuliidae (Black Flies)

- Often with labral fans
- like flattened maggot with one end 1/3 fatter
- Sessile with posterior attachment organ
- move with looping (inch-worm) movements
- 3 - 15 mm, brown or greyish clour



### Diptera, Miscellaneous (Other True Flies)

- Adults with single pair of wings
- May have parapods, pseudopodia, creeping welts or other appendages, but no jointed thoracic legs
- Often maggot-like; head may be retracted into thorax





Practical Exercise:

Field equipment techniques

Sampling methods

Invertebrate Identification



Thank you