

Aquatic Macroinvertebrates

A Presentation Created by Creek Connections





Aquatic Macroinvertebrates

 7% of the 91,000+ insects in North America are aquatic or semi-aquatic
 They are found in every type of waterway





Aquatic Macroinvertebrates What is a macroinvertebrate?

> Lack internal skeletons Visible by unaided eye

Includes: Arthropods -Insects in all life cycles -Crustaceans -Arachnids Mollusks Worms







http://www.thomasames.com/in sects/other/



Benthic Macroinvertebrates

What is Benthic?



Mayfly nymph Alderfly larv.

Bottom-dwelling





Substrate



Aquatic Insects Life Cycles Many insects start their lives in water

Juvenile

Adult







Metamorphosis



Aquatic Insects Complete Metamorphosis -Egg -Larva -Pupa -Adult



http://www.kidfish.bc.ca/caddisfly.htm



Aquatic Insects

Incomplete Metamorphosis

-Eggs -Nymph -Adult



http://www.naturenorth.com/dragonfly/DOM/Page02_Life_Cycle.html

Explore More:

-http://www.kidfish.bc.ca/insects.htm -Do the "Aquatic Insect Life Cycle" Activity from module





Creek

http://www.dnr.state.md.us/education/envirothon/aquatic_insect_ecology.html

Head



Generalized head of an orthopteroid insect showing major sulci or "sutures"

http://www.life.umd.edu/entm/shultzlab/snodgrass/Lecture1/indexq.htm



Thorax



http://ntugre.blogspot.com/2010_07_01_archive.html



Abdomen



http://www.sccs.swarthmore.edu/users/03/cweiss/bugs/glossary.html

Explore more:

-http://www.dddi.org/enttutorial/insect_anatomy/insectanatomy.html
 -Do the "Aquatic Insect Parts and Pieces" Activity from module.



Aeropneustic- "Air breathing" -Snorkel Approach



Pupa

Mosquito Pupa http://entnemdept.ufl.edu/fasulo/vector/chapter_03.htm



Water Scorpion

Aquatic Insect Breathing

Aeropneustic- "air breathing"

- -Scuba Approach
- -Able to survive in low dissolved oxygen settings -Low oxygen can be a sign of pollution



http://www.microcosmos.nl/bugs2/lbbouwabd.htm



Aquatic Insect Breathing

Hydroneustic-"Water Breathing" -Breathing through Gills





http://whatcom.wsu.edu/4-h/nrs/waterbugs/ex.html

http://www.cals.ncsu.edu/course/ent425/tutorial/aquatic.html

-Need sufficient DO levels to survive



FACTORS to consider:
 Necessary habitat
 Food availability
 Appropriate water conditions
 Size of the waterway



http://www.waterlandlife.org/enewsletters/may_12/french_creek.html



http://www.epa.gov/greatlakes/aoc/kalamazoo.ht

Habitat

-Place where organism lives that fulfills its need for food, water, shelter, temperature, reproduction, and space

Microhabitat

Explore More: -Review "Microhabitat" activities from module



Illustration Source: Aquatic Entomology by W. Patrick McCafferty, 1998

Microhabitat- Riffle





http://www.learnnc.org/lp/editions/mudcreek/6395

Illustration Source: <u>Aquatic Entomology</u> by W. Patrick McCafferty, 1998

Explore More: Review the "Aquatic Macro Sampling" Activity from module



Microhabitat- Pool



http://tahoetowhitney.com/Sonora%20Pass%20to%20Tuolu mne/kennedy-canyon-to-dorothy-lake-pass.html

TROUTHUT.COM



Illustration Source: Aquatic Entomology by W. Patrick McCafferty, 1998



Midge larva

http://www.troutnut.com/specimen/455

Where Aquatic Insects Live Microhabitat- Leaf Packs



Illustration Source: Aquatic Entomology by W. Patrick McCafferty, 1998



Microhabitat-Plants





Viacrophytes Algae



Illustration Source: <u>Aquatic Entomology</u> by W. Patrick McCafferty, 1998

creek

Where Aquatic Insects Live Micro habitat - On the surface



http://www.biosurvey.ou.edu/o kwild/misc/waterstrider.html http://faunanet.gov.au/wos/fac tfile.cfm?Fact_ID=161



Explore more:

• Do the "Life at the Surface" Activity from module.



Detritus

Shredders

Decomposers



Coarse Particulate Organic Matter (CPOM)



Cranefly Larva

http://fenwick.pvt.k12.il.us/Creek/webpage/ experimt/inverts/bugnumbr.html



Illustration Source: Stream Ecology: Structure and Function of Running Waters by J. David Allan, 1995

Fine Particulate Organic Matter (FPOM)

Collectors

Filtering Collectors



Blackfly Larva



Illustrations Source (both): Aquatic Entomology by W. Patrick McCafferty, 1998

Gathering Collectors



Brushlegged Mayfly Nymph



Grazers or Scrapers

Periphyton - algae on rocks



Illustration Source: <u>Stream Ecology: Structure and Function of Running</u> <u>Waters</u> by J. David Allan, 1995.





Water Penny

http://www.vvm.com/~je vans/sfaquaticinvertebra tes/folderaquaticinsects/ wpenn.html

Case-building Caddisfly Larva

www.rollanet.org/~str eams/ macroinv/caddiscase.j pq



Predators



Dragonfly Larva



Illustrations Source (two above): Aquatic Entomology by W. Patrick McCafferty, 1998

Ser -

Giant Water Bug

http://bruinbooks.com/giantwaterbug.htm

Giant Water Bug



Aquatic Food Web

All Feeding Groups





Clingers

Cling to rocks



Fishfly Larva http://www.pbase.com/tmurray74/im



Mayfly nymph http://www.wwf.org.nz/earthsaver/es_18.c



http://www.fishing-inwales.com/wildlife/insects/stonefly/



Water Penny

http://www.vvm.com/~jevans/sfaquati nvertebrates/folderaquaticinsects/wp n.html



age/59792311

Stonefly Nymph

Burrowers



Burrow in soft, sandy, silty bottoms found in pools or under rocks.

Burrowing Mayfly Nymphs



http://aquat1.ifas.ufl.edu/gallery4.html http://sherpaguides.com/georgia/flint_river/wi



Sprawlers

Move around on top of, below, or between rocks.





Dragonfly Larva and Case-Building Caddisfly

http://www.thomasames.com/insects/other/ www.rollanet.org/~streams/ macroinv/caddiscase.jpg



Illustration Source: <u>Aquatic Entomology</u> by W. Patrick McCafferty, 1998



Climbers





Dragonfly Larva

http://www.ento.csiro.au/Ecowatch/Primary/in sects/pages/dragonfly_nymph.htm

Climb on vegetation macrophytes & algal mats.

Damselfly Larva http://www.kendall-bioresearch.co.uk/odonata.htm





Swimmers

Swim through the water - from bottom to top.



Water boatman

C,

Diving Beetle

Creek

Illustrations Source: Aquatic Entomology by W. Patrick McCafferty, 1998

Floaters





Mosquito larva http://www.backyardnature.net/yucatan/wi ggtail.htm



Water scorpion http://www.szgdocent.org/ff/f-wtrbg2.htm



Skaters

Skate on the water surface.



Water Strider



Whirligig Beetle http://www.szgdocent.org/ff/f-wtrbg3.htm



All types of insects

Drift

- Escape pollution
- Escape lowering of water
- Find better food resources
- Escape predators
- Avoid overcrowding
- Find a better spot



Explore more:

• Do the "Create an Aquatic Macroinvertebrate" Activity from module.

Describes and compares the gradual changes in a stream system from headwaters (start) to mid-order creek to mouth.

Shows how the insect feeding habits and movement differ as you go downstream from small stream to big creek or river.



Headwaters

River Continuum Concept



http://www.epa.state.oh.us/dsw/wg

River Continuum Concept Headwaters



River Continuum Concept Mid-order



by J. David Allan, 1995.

Photos source: Creek Connections



Illustration Source: Stream Ecology: Structure and Function of Running Waters by J. David Allan, 1995.











Mouth



Confluence of Kiski and Allegheny River



http://www.panoramio.com/photo/28680516







Water Strider





Focuses on:

Food Conditions Habitat Conditions

Explore More:

<u>http://www.cotf.edu/ete/modules/waterq/</u> wqcontinuum.html



Woodcock Creek



Indian Run



http://www.stroudcenter.org/research/projects/Stream watch/sites/east_branch/site18.shtm



Insects Reveal Stream Health Chemical Testing vs. Biological Testing





Aquatic Insects are Indicator Organisms They will show if there have been negative changes in water quality or habitat conditions.



Pollution-Sensitive



Water Penny Beetle Larva



Dobsonfly Larva (Hellgrammite)



Riffle Beetle Adult



Gilled Snail (has a thin, horny plate to seal shell opening)



Group | Organisms

Mayfly Nymph



Stonefly Nymph



Non-Net-Spinning Caddisfly Larva

Illustrations sources: Monitor's Guide to Aquatic Macroinvertebrates, Save Our Streams – Izaak Walton League of America, 1994 and <u>Aquatic Entomology</u> by W. Patrick McCafferty, 1998



Facultative

Group II Organisms



Damselfly Nymph



Scud



Fishfly Larva



Clams

Alderfly Larva



Crayfish



Aquatic Sowbug





Net-Spinning Caddisfly Larva

Beetle Larv

Illustrations sources: Monitor's Guide to Aquatic Macroinvertebrates, Save Our Streams - Izaak Walton League of America, 1994 and Aquatic Entomology by W. Patrick McCafferty, 1998

Insects Reveal Stream Health Pollution Tolerant



Illustrations sources: Monitor's Guide to Aquatic Macroinvertebrates, Save Our Streams – Izaak Walton League of America, 1994 and <u>Aquatic Entomology</u> by W. Patrick McCafferty, 1998

Insects Reveal Stream Health Biodiversity= lots of different types of life



http://expertprojectaces.wikispaces.com/Macroinvertebrate+Introduction



http://www.fly-fishing-discounters.com/brook-trout.html



Biodiversity= Healthy Stream



Biodiversity= Healthy Stream









Biodiversity= Healthy Stream







2

10

5

Is the diversity of this stream good or poor?

Dobsonfly Larva (Hellgrammite)



This is still **Poor** biodiversity.

Biogurvey: Data Sheets

Macroinvertebrate Survey

Sample Drian//	School_School_1
Observations: "Creek Appendance (velocity, onles, fraces, etc.)	
"Weather in past 24 hrs (rain, mow, cate & dogs, etc.)	
*Relative Depth (higher/lower data normal, erc.)	

Macroinvertebrate Count

Identify the macroinvertebrates (to order) in your sample using the identification card. We are only concerned with organisms that appear on the identification card. Record the number of organisms below and then assign them letter codes based on their abundance:

R (rare) = 1-9 organisms; C (common) = 10-99 organisms; or D (dominant) = 100 plus organisms, example: <u>20</u> (<u>C</u>) Water penny larvae

Group I - Sensitive			
() Water	penny larvae		Riffle beetle adults
() Religra	immites	()	Stonefly nymphs
() Mayfly	nymphs	()	Non net-spinning caddisfly
() Gilled	smails		larvac
Group II - Somewhat Sens	átive		
() Beetle	larvae	()	Seuds
() Clams	_		Sowbugs
() Cranefi	ly larvac		Fishfly hirvae.
() Crayfis	h	()	Alderfly larvae
() Dansel	fly nymphs		Net-spinning caddisfly larvao
Group III - Tolerant			
() Aquatic	worms		Midge larvae
() Blackfly	y larvae	()	Snails
() Leeches	s		
	125	Chirk	Constitute, Alleghees Colores Meaderine, Ph.

Pollution Tolerance Indexes

A way to calculate stream health based on the aquatic macroinvertebrates that are caught.



Biosurvey: Data Sheets

Water Quality Rating

To calculate the index value, add the number of letters found in the three groups above and multiply by the indicated weighing factor.

Group I - Sensitive	
(# of R's) x 5.0 =	<i>—</i> stream to categorize its health
(# of C's) x 5.6 =	
(# of D's) x 5.3 =	
Sum of the Index Value for Group 1 =	
Group II - Somewhat Semilive	
(# of R's) x 3.2	
(# of C's) x 3.4 =	
(# of D's) x 3.0 =	
Sum of the Index Value for Group II =	
Group III - Tolerant	
(# of R*s) x 1.2 =	
(# of C's) x 1.1 =	
(# of D's) x 1.0 =	and the second se
Sum of the Index Value for Group III =	Explore more:
The extendence the sector of all the second for the second office	• Do the "Pollution Tolerance Index – Bag of Bugs" activ
idd together the index values for each group. The sum of these	• Do the "A quotie Magroinvortebrate Sampling" estivity
alues equals the water quality score.	• Do the Aquatic Macromvertebrate sampling activity
Water Quality Score #	
	Water Quality Score =
Grand and D Fair 2	
LI VILLE PILL A	
Note: The tolerance groupings (Group 1, II, II Compare this score to the	following number ranges to determine the quality of your stream site
leveloped for streams in the Mid-Atlantic sta	□ Fair 20-40 □ Poor <20
Conference a labor Constanting at 12	

Will provide a score for your egorize its health.

Pollution Tolerance Indexes



- erance Index Bag of Bugs" activity.
- oinvertebrate Sampling" activity

ater Quality Score =



Collecting Aquatic Insects

Qualitative Sampling



Explore more:

- EPA: Match the Hatch slide show movie http://www.epa.gov/OWOW/NPS/kids/MOVIE.HTM

- http://www.kidfish.bc.ca/insects.htm
- Do the "Aquatic Insect Life Cycle" Activity from module.

Quantitative Sampling





Photos source: Creek Connections

Collecting Aquatic Insects Qualitative Sampling

- Less scientific approach.
- Less strict methods.
- More concerned with observations
 of all aquatic organisms.
- What kinds of life is there instead of how much is there.
- Provide overall, general data.



Photo source: Creek Connections



Collecting Aquatic Insects



Photo source: Creek Connections

Quantitative Sampling

- Measure data, not just observe.
- Record the amount and type of aquatic life present.
- Specific and repeatable scientific methods.
- Better for comparing data and repeating research in the future or at a different site.



Collecting Aquatic Insects



Illustrations Source (all): <u>Aquatic Entomology</u> by W. Patrick McCafferty, 1998

Collecting Aquatic Insects Equipment / Method



Used to conduct quantitative studies and for filling out pollution tolerance inde

Identifying Aquatic Insects





Key to Aquatic Macroinvertebrates Groups



http://www.people.virginia.edu/~sos-iwla/Stream-Study/Key/MacroKeyIntro.HTML



Dichotomous key

Source of key: Save our Streams Program of Izaak Walton League of America <u>http://www.iwla.org/sos/</u>

Photos source: Creek Connections

Illustrations Source (above): <u>Aquatic Entomology</u> by Patrick McCafferty, 1998



Enjoying Aquatic Insects



Photos source: Creek Connections





http://www.cerc.usgs.gov/Branc hes.aspx?BranchId=41



Explore more:

- http://www.nysfola.org/alinks/#Insect%20Links
- •.http://zebu.uoregon.edu/%7Edmason/rivsci/aqua