Facilitators Notes

Concept

Biotic (living) and abiotic (non-living) factors independently and collectively influence which species live in a particular stream or river.

Glossary

Abiotic Factors – non-living characteristics (e.g. weather and climate)
Biotic Factors – living characteristics (e.g. presence or absence of invasive invertebrates)
Biological Diversity – number of different species or taxonomic groups (e.g. 16 species of diptera or 12 morphologically different types of invertebrates)

Examples of Abiotic Factors that Influence Biological Diversity in Streams and Rivers:

- Climate
- Weather
- Water Temperature
- Gases
  - Nitrogen
  - Oxygen
  - Carbon Dioxide
- Organic compounds (carbon-based)
  - Coarse Particulate Organic Material
  - Fine Particulate Organic Material
  - Dissolved Organic Material
- Inorganic compounds
  - Aluminum
  - Iron
  - Silica
  - Calcium
  - Potassium
  - Magnesium
  - Sodium
  - Nitrate
  - Phosphorus
- Trace Metals
- Substrate
- Light
- Current Velocity
Examples of Biotic Factors that Influence Biological Diversity in Streams and Rivers:

- Feeding relationships (e.g. food chains or food webs)
- Predation
- Competition
- Parasitism
- Invasive organisms
- Productivity
- Microbes

Thought Questions

1) List examples of biotic factors that are influenced by abiotic factors.

2) List examples of abiotic factors that are influenced by biotic factors.

3) How do biotic and abiotic factors influence biological diversity independently?

4) How do biotic and abiotic factors act in concert to influence biological diversity?

Sample Answers

1) Growth and development of most aquatic insects are influenced by water temperature.

2) Current velocity may be induced by the presence of submersed aquatic macrophytes (plants).

3) See figure 1C. For example, a relatively high current velocity would usually affect biological diversity by favoring species that had the ability to hide and or attach and would not favor organisms that were very active. Predators in a fast – moving stream would likely be more sit and wait or ambush type predators.

4) See Figure 1 C. For example, a relatively high current velocity could influence the substrate by reducing sedimentation and this might favor species that were able to filter particles from the water and not favor species that fed on food associated with sediments or particles that had settled to the bottom of the stream.
Figure 1b. How do abiotic and biotic factors interact to influence biological diversity in streams & rivers?
References for additional background


Facilitator’s Notes:

Concept

Spatial and temporal scales are important factors to consider when planning monitoring, sampling, and data interpretation.

Glossary

Spatial Scale – space defined at different units of measurement usually described from smaller to larger.
Temporal Scale – time defined at different intervals usually described from shorter to longer.
Organism – living and may be single-celled (protozoa) or multi-celled (insect).
Microhabitat – an area within an area that may be defined, described, and sampled (e.g. an individual rock within a rocky area of a stream).
Pool-Riffle Sequence – an upstream – downstream area of a stream that includes slower moving, deeper water and faster moving, shallow water.
Reach – an upstream – downstream area of a stream that includes several pool-riffle sequences measured over kilometers.
Watershed – the land surface that drains into a particular body of water and may include other streams and / or lakes.
Population – individuals of the same species (sometimes a taxonomic group) in a specified area (e.g. number of dragonfly larvae / square meter).
Community – groups of populations in an area that interact with each other.
Ecosystem – a spatially explicit unit that includes all of the organisms in that area and the associated abiotic or environmental factors.
Biome – an area that may include several ecosystems and that is defined by the primary vegetation (e.g. boreal forest, tundra).

Thought Question

What spatial and temporal scale would you choose to sample to determine changes in populations (number of individuals of the same species in a given area)?

Sample Answers

1) Microhabitats would be an appropriate spatial scale and a temporal scale of at least month would be required for measurement of births, deaths, immigration.
2) Changes in populations could be studied at all scales at or above microhabitats as long as the study focused on a specific population.

References


Facilitator’s Notes:

Concept

The diversity or number of species (biological diversity) measured in a particular area (microhabitat – biome) is influenced by the total number of individuals in that area.

Glossary

Biological Diversity – number of different species or taxonomic groups (e.g. 16 species of diptera or 12 morphologically different types of invertebrates)
Microhabitat – an area within an area that may be defined, described, and sampled (e.g. an individual rock within a rocky area of a stream)
Pool-Riffle Sequence – an upstream – downstream area of a stream that includes slower moving, deeper water and faster moving, shallow water
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Thought Questions

1) What ecological factors might explain the relationship that biological diversity increases as the number of individuals in a sample increases?

2) Under what conditions might you expect to see this relationship reversed?

Sample Answers

1) The greater the number of individuals that you found in a sample, like a stone, then you have a higher probability of having more species.

2) If the microhabitats in an area were very similar then you might have a scenario where the types of potential food sources were limited and only a small number of species could use the available food.

References

Facilitator’s Notes:
Concept

Characteristics of the watershed in which a stream is located influences the biological diversity in a stream. The size of the watershed is related to the number of species found in the watershed.

Glossary

Biological Diversity – number of different species or taxonomic groups (e.g. 16 species of diptera or 12 morphologically different types of invertebrates)
Watershed – the land surface that drains into a particular body of water and may include other streams and / or lakes

Thought Questions

1) Explain why watershed area or size is related to the biological diversity found within a stream in a watershed.

2) Under what conditions would you expect that biological diversity might be negatively related to watershed area or size?

Sample Answers

1) Larger watersheds could have more diverse resources of food or habitats than smaller watersheds.

2) If a larger watershed had more nutrient runoff compared to a smaller watershed, then the larger watershed might actually have less biological diversity than a smaller watershed with less nutrient run-off

References

Facilitator’s Notes

Concept

Measurement or estimates of biological diversity in streams are influenced by sampling effort.

Glossary

Biological Diversity – number of different species or taxonomic groups (e.g. 16 species of diptera or 12 morphologically different types of invertebrates)

Sampling Effort – number of samples and or the amount of time devoted to sampling

Thought Questions

1) If changes in sampling effort are related to changes in estimates of biological diversity, how would plan your sampling as part of your monitoring to ensure that your resulting estimates of biological diversity are comparable.

References

Facilitator’s Notes

Concept

The River Continuum Concept (RCC) is an illustration that helps to describe the structure and function of a stream system from headwaters to mouth.

Glossary

Stream Order – a classification system using a sequence of numbers to help characterize permanently flowing streams. For example, a first order stream has no other tributaries and is usually spring-fed, while a second order stream is formed from 2 first order streams.

Organic Energy Sources – food sources that are carbon-based.

Coarse Particulate Organic Matter (CPOM) – organic material often composed of leaves, twigs, and stems. This is typically suspended or associated with sediments.

Fine Particulate Organic Matter – organic material that often results from the mechanical breakdown of CPOM and may include feces from other animals. This is typically suspended or associated with sediments.

Dissolved Organic Matter (DOM) – organic material that is in solution.

Periphyton – algae that are attached to surfaces.

Phytoplankton – algae that are suspended or that float.

Zooplankton – small (mm sized) crustaceans such as daphnia or copepods that are typically found in the water column and that swim.

Shredder – animals that chew and tear organic material

Grazers – animals that scrape the surface of things such as leaves or stones to remove attached algae or fungi

Collectors – animals that filter organic materials that are suspended in the water and that have settled on the substrate.

Predators – animals that consume other animals

Microbes – single-celled bacteria and protozoans

Ecological Community – groups of populations in an area that interact with each other

Channel Width – the width of a stream measured from bank-bank

Thought Questions

1) How would water temperature change as you move from streams of a lower order to streams of a higher order in a stream system?

2) How would you expect the types of predators (e.g. species or groups) to change as you move from lower order streams to higher order streams in a stream system?

3) Think about a stream that you’re familiar with its watershed. Determine the stream order. Based on the stream order and using the river continuum concept, determine and describe how the physical and biological characteristics of the stream match what the river continuum concept would predict.
Sample Answers

1) As the width of the channel increases with increasing stream order, you would expect water temperatures to also rise.

2) You would expect to find more mobile predators in higher order streams because current velocity would also decrease in higher order streams compared to lower order streams.

References


Figure 6c. Stream Order Determination

Use what you’ve learned about how to classify streams by stream order and for each of the streams on the hypothetical stream network determine stream order.
Concept

Organic food in streams can come from two different pathways. Allochthonous inputs come from sources outside of the stream (e.g. leaves and twigs from stream banks) and autochthonous inputs come sources in the stream. These are typically autotrophs or producers that photosynthesize (e.g. periphyton). Allochthonous and autochthonous inputs may be used by different consumers or heterotrophs as part of a stream food web.

Glossary

Allochthonous – a source outside of the stream
Autochthonous – produced from sources in the stream
Autotroph – uses energy from light to convert carbon dioxide to carbohydrates
Heterotroph – uses or consumes organic compounds from other sources for energy
Organic Energy Sources – food sources that are carbon-based.
Coarse Particulate Organic Matter (CPOM) – organic material often composed of leaves, twigs, and stems. This is typically suspended or associated with sediments
Fine Particulate Organic Matter – organic material that often results from the mechanical breakdown of CPOM and may include feces from other animals. This is typically suspended or associated with sediments.
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Collectors – animals that filter organic materials that are suspended in the water
Predators – animals that consume other animals
Microbes – single – celled bacteria and protozoans
Ecological Community – groups of populations in an area that interact with each other

Thought Questions

1) How might seasonal changes influence the relative importance of autochthonous production and allochthonous production in a first order stream?

2) Explain how fine particulate organic matter may enter a stream food web from both autochthonous and allochthonous sources?
Sample Answers

1) In a first order stream, autochthonous sources of organic food may be more important in spring before the stream is shaded by trees. As the stream becomes more shaded and light levels are decreased, then photosynthetic or autotrophic production may decrease. Allochthonous sources of organic food may be more important later in the fall after leaves are colonized by fungi and bacteria.

2) Fine particulate organic matter may originate from autochthonous production from Periphyton like diatoms and also from the mechanical breakdown of coarse organic material such as leaves, stems, and twigs.

References


Concept

Energy is transferred from organism to organism within a stream. Some of this originates outside of the stream and is terrestrial in origin and some of the energy is produced within the stream.

Glossary

Vertebrate predators – typically fish, but may also include birds, mammals, reptiles, and amphibians
Invertebrate predators – typically insects, but may include other groups such as leeches, spiders, mites
Vertebrate Herbivores – some fish species, this may also include omnivorous species
Invertebrate Herbivores – typically insects, but may include other groups such as planaria, roundworms, earthworms, crayfish, sow bugs, scuds, snails, mussels, clams, and springtails. Many of these are also omnivores and include microbes and non-living organic material.
Omnivore – feeds on a variety of animal and plant life and non-living organic material.
Microbes – may include bacteria, protozoans, and microscopic fungi

Thought Questions

1) How might abiotic factors influence food web dynamics?

2) How might the presence of an invasive organism, such as an introduced crayfish species influence food web dynamics?

Sample Answers

1) Light could influence photosynthesis of algae and plants in the stream. For example, if a stream is surrounded by trees, then earlier in the spring before the trees have leaves, then photosynthesis rates might be high because of the high light levels compared to later in the summer when the stream might be more shaded and photosynthesis rates decrease. We might then expect that insect herbivores might shift from food produced in the stream earlier in the spring to food entering the stream from outside sources during the summer.

2) Many invasive organisms are able to outcompete native species for food resources. Invasive organisms also typically have higher population growth rates compared to native species. This is because invasive species often have higher reproductive rates and they also typically have higher survival rates because they have a wider range of tolerance to adverse conditions than do native species.
Figure 8. Basic Food Web Illustration.
References


