Food Web Ecology

Studying lotic energy flow can be a complicated, but by breaking apart the components of energy sources for a stream can simplify the process. On the most basic level energy sources can be categorized as allochthonous and autochthonous. In this study experiments will be conducted to determine the importance of each of these energy sources. These sources of energy directly influence the macroinvertebrate composition of the stream. Several experiments will be conducted to determine the specific macroinvertebrate assemblage of this stream and how energy flows to and from the macroinvertebrate community. The fish community will be studied in a similar fashion to determine its assemblage and role in the food web.

The first step in understanding energy flow for a stream is gathering background information from previous research. Past research will be used to become familiar with the stream and possible energy sources. This will provide information on riparian vegetation, aquatic invertebrates, and fish inhabiting the system. Additional research on each individual species can identify food preferences. From this information a basic connectance food web will be constructed for the stream. This is a preliminary web and must be verified in the field in order to determine precise connections and energy flow.

Using a bottom up approach qualitative and quantitative data will be collected on allochthonous nutrient and energy sources. Water samples will be collected to determine background water chemistry data. Nitrogen and phosphorous levels will be examined exclusively to determine if the stream is subject to organic pollution. Examining land use adjacent to the stream will also be used to determine if outside nutrient sources are a factor. GIS analysis will be implemented in identifying agricultural, forested, and urban areas in the watershed.

Small streams often rely heavily on allochthonous sources for dissolved and particulate organic matter. These inputs drive the energy flow through the aquatic community. Litter fall provides nutrients and habitat for microbial colonization. This is important because algae and microbes are the primary carbon sources for aquatic macroinvertebrates. Comparing a control section to a section of stream where litter fall has been excluded may indicate the significance of allochthonous material. Exclusion will occur through an overhead canopy and streamside fencing. Additional instream barriers will be constructed to prevent litter from being transported into the study area. Over a five year period comparisons in biomass, abundance, and production will be made between the experimental and control reaches. In another section of the stream leaf bundles will be placed in the stream to examine microbial colonization. The bundles will be collected multiple times over the course of the year to analyze the extent of microbial growth.

In small forested streams microbes are often the principal energy source for macroinvertebrates, because primary production is frequently limited by the inability of light to penetrate overhead canopy. Lack of light penetration inhibits algal growth and availability as a food source for invertebrates. To examine net primary production light/dark bottle reactions will be conducted at multiple sites throughout the study area. In addition to the light/dark bottle experiment clean rocks will be placed in the stream to study algal growth. The rocks will be removed periodically throughout the course of the year and algal colonization will be noted. Rocks scrapings will be used to identify algal species present.

Working up the food web energy flow encompassing macroinvertebrates will be investigated. Macroinvertebrate samples will be gathered from multiple sites on the stream. Kick nets will be used to gather samples to establish a macroinvertebrate assemblage of the stream. Multiple Surber samples will be collected to estimate macroinvertebrate density for each specie collected. Once a comprable number of samples are collected they will be preserved and identified to the species level. Individuals from each species will undergo stable isotope analysis to determine their primary energy sources. This analysis will link allochthonous inputs, algae, bacteria, and macroinvertebrates.

Continuing to the next trophic level the fish community of the stream will be studied. A community assemblage of species will be developed by sampling multiple reaches in the stream. Sampling will be conducted using backpack electroshockers. The fish will be identified on site. Fish species and number of each specie will be recorded. Species densities will be calculated from this data. Length and weight measurements will also be taken. Larger individuals classified as gamefish will have their gut contents purged and saved for further analysis. These fish will be immediately released. More prevalent species such as minnows, chubs and sculpins will be preserved for gut content analysis. Different size individuals will be collected for each of these species. The preserved specimens will be dissected and the gut contents will be analyzed. Invertebrates and fish collected from dissection will be identified to the lowest possible level. Dry mass of the gut contents for each specie of fish dissected will be measured and used to identify any feeding preferences. According to feeding preferences fish will be categorized as piscivores, insectivores, detritivores, or generalists. Tissue samples will also be analyzed using stable isotopes to determine transfer of energy to fish body mass.

From the information gathered the streams food web will be constructed and compared to the preliminary web. Stable isotope analysis conducted on the macroinvertebrates will identify the primary sources of energy for the base of the food web. Examining net primary production and allochthonous inputs will aid in identifying the significance of litter fall and algae as energy sources. Stable isotope and gut content analysis of tissue samples from fish specimens may indicate importance of specific food sources for each species. Species density for the macroinvertebrates and fish may also give clues to which species are dominant food sources. Combined these studies may give a more detailed description of energy flow through the food web in this stream.

After the food web has been finalized it will be compared to food webs developed for similar streams in southeastern Michigan. This can provide evidence to the health of the aquatic community in this stream and others. Although not to be conducted in this study it would be interesting to see the role of amphibians, reptiles, birds and terrestrial mammals in the food web for this stream.