PHYSICAL HABITAT: Narrative for detailed conceptual diagram

Alterations of physical habitat, defined here as changes in the structural geomorphic or vegetative features of stream channels, can adversely affect aquatic organisms, potentially changing community structure and ecosystem function. This conceptual diagram illustrates linkages between physical habitat-related stressors (middle of diagram), the human activities and sources that can increase those stressors (top of diagram), and the biological responses that can result (bottom of diagram). In some cases, additional steps leading from sources to stressors, modes of action leading from stressors to responses, and other modifying factors also are shown.

This narrative generally follows the diagram top to bottom, left to right. For more information on interpreting CADDIS conceptual diagrams, see the Conceptual Model page in the Causal Database section of CADDIS.

Linking Sources to Stressors

Many human activities and land uses can lead to changes in in-stream physical habitat. Activities that decrease riparian, bank, or watershed vegetation (e.g., mining, agriculture, forestry, urbanization) and the specific sources associated with those activities (e.g., mines, cropfields, pastures, impervious surfaces) can affect physical habitat by increasing bank, channel, and watershed erosion; reducing cover, bank habitat, and large woody debris; and increasing stormwater runoff. Bank and channel erosion also may occur when livestock have access to riparian areas and streams and trample banks. Erosion can result in increased bedload and deposited sediment in streams (see the Sediment module for more information on sediment-related stressors), though this relationship often depends upon the geology and the gradient of the system.

Direct alteration of streams channels also influences physical habitat. Instream sand and gravel mines can alter sediment particle size distributions within streams. Impoundments, detention basins, levees, road crossings, and channelization, armoring, burial, piping, or dredging of streams can adversely affect in-stream habitat by changing discharge patterns, changing hydraulic conditions (water velocities and depths), creating barriers to movement and reducing immigration, increasing bank and channel erosion, and decreasing riparian connectivity and habitat. Stormwater runoff, point effluent discharges (e.g., from wastewater treatment plants or industrial facilities), and drainage infrastructure (e.g., tile drains) also can alter discharge patterns (see the Flow module for further information on stressors associated with discharge patterns or changes in water velocity or depth). All of these sources associated with channel alteration can alter the structure of stream geomorphological units (e.g., by increasing the prevalence of run habitats, decreasing riffle habitats, and increasing or decreasing pool habitats). In addition, these sources may increase channel incision, decrease channel sinuosity, and alter channel width-to-depth ratios.

Linking Stressors to Biological Responses

The activities and sources discussed above can result in decreased physical habitat availability (e.g., decreased snag habitat, decreased riffle habitat) or decreased physical habitat quality (e.g., increased

fine sediment cover). Decreases in habitat availability or habitat quality may contribute to decreased condition, altered behavior, increased mortality, or decreased reproductive success of aquatic organisms. Ultimately, these effects may result in changes in population and community structure and ecosystem function. Changes in population and community structure that may be associated with changes in physical habitat include: decreases in riparian- and floodplain-dependent taxa; decreases in top carnivores, piscivores, darters, salmonids, and young-of-year fish; decreases in clinging macroinvertebrates, decreases in taxa richness or diversity, and changes in functional feeding groups. Ecosystem function also can be affected directly (e.g., decreases in large woody debris can lead to reduced organic matter retention).