**Effects of Wildfire on Stream Ecosystems and Fish Exercise**

**Materials**

1. Stream simulation diorama
2. Watering can
3. Five or so small model fish (Optional)
4. Paint tray with vegetated sod
5. Paint tray with burned or hydrophobic soil
6. Green tree branches (riparian and conifer)
7. Burned tree branches
8. Rubbermaid wash tub to catch runoff from diorama (if indoors)
9. Bucket with macroinvertebrates on algae covered rocks (Optional)

**Exercise**

1. Discuss Unburned Stream
   1. Place green trees in holes on diorama and 3 pseudo fish in stream channel (current carrying capacity).
   2. Pour water over paint tray with vegetated sod into diorama stream.
   3. Explain how vegetation prevents erosion, promotes streambank stability, influences infiltration, and provides stream shading.
2. Discuss Immediate Effects of Wildfire on Stream Ecosystems
   1. Replace green trees with burned trees.
   2. Stream heating from the fire itself.
   3. Altered water chemistry from smoke and ash leaching (phosphorous, ammonium, nitrogen).
   4. Fish population declines and even complete fish kills are possible. Remove all fish from stream channel to simulate a fish kill.
3. Short Term Effects of Wildfire on Stream Ecosystems
   1. Decreased stream shading-increased solar radiation-increased stream temperature. Point out burned trees and open canopy.
   2. Increased nutrient inputs from burned trees.
   3. Increased productivity-algae, macroinvertebrates, fish condition and population size (if connectivity permits recolonization from complete fish kill). Put all five fish in stream channel to show increased production.
   4. Pour water over paint tray with hydrophobic soil.
   5. Discuss altered hydrology and sediment delivery effects: increased surface runoff, increased peak flow, increased erosion, increased sediment delivery (fines and gravel-debris flows cobble?)-may cause habitat and fish population instability-explain why fine sediment is bad for fish (take three fish out to show population instability). Contrast this with the unburned demonstration.
4. Discuss Long Term Effects of Wildfire on Stream Ecosystems
   1. Simulate a wind/blow down event. Place streamside burned trees in stream channel and discuss benefits of increased LWD recruitment-cover, pool formation, gravel deposition etc.
   2. Discuss how spring high water events eventually remove fine sediment exposing gravel recruited from the fire/debris flows. Explain or ask why gravel is important to trout.
   3. Increased size and abundance of fish (4-5 fish in stream channel for the long-term as opposed to the three fish we started out with in the unburned scenario-increased carrying capacity).
   4. Habitat and population stability.

Alternatively discuss macroinvertebrate population response and shifts in macroinvertebrate functional feeding groups following a wildfire (immediate, short term, and long term) in relation to habitat change and recovery (increased fine sediment and increased algae production). Show live macroinvertebrates.

**References (Gresswell 1999 is the best summary)**

Albin, D. P. 1979. Fire and stream ecology in some Yellowstone tributaries. California

Fish and Game 65:216-238.

Amaranthus, M., H., Jubas, and D. Arthur. 1989. Stream shading, summer streamflow,

and maximum water temperature following intense wildfire in headwater streams. U.S. Forest Service General Technical Report PSW-109:75-78.

Beschta, R. L., R. E. Bilby, G. W. Brown, L. B Holtby, and T. D. Hofstra. 1987. Stream

temperature and aquatic habitat. Pages 191-232 *in* E. O. Salo and T. W. Cundy,

editors. Streamside management: forestry and fishery interactions. University of

Washington, Institute of Forest Resources.

Beschta, R. L. 1990. Effects of fire on water quantity and quality. Pages 219-232 *in* J.

D. Walstad, S. R. Radosevich, and D. V. Sandberg, editors. Natural and prescribed fire in Pacific Northwest forests. Oregon State University Press, Corvallis, Oregon.

Gresswell, R. W. 1999. Fire and aquatic ecosystems in forested biomes of North

America. Transactions of the American Fisheries Society 128:193-221.

Hauer, F. R., and C. N. Spencer. 1998. Phosphorus and nitrogen dynamics in streams

associated with wildfire: a study of immediate and long-term effects. International Journal of Wildland Fire 8:183-198.

Helvey, J. D. 1972. First-year effects of wildfire on water yield and stream temperature

in North Centeral Washington. Pages 308-312 *in* S. C. Callanyl, T. G. McLaughlin, and W. D. Striffler, editors. Watersheds in transition. American Water Resource Association, Proceedings Series 14, Urbana, Illinois.

McMahon, T. E., and D. S. DeCalesta. 1990. Effects of fire on fish and wildlife. Pages

233-250 *in* J. D. Walstad, S. R. Radosevich, and D. V. Sandberg, editors. Natural and prescribed fire in Pacific Northwest forests. Oregon State University Press, Corvallis.

Minshall, G. W., and J. T. Brock. 1991. Observed and anticipated effects of forest fire

on Yellowstone stream ecosystems. Pages 123-135 *in* R. B. Keiter and M. S.

Boyce, editors. The Greater Yellowstone Ecosystem: redefining America's

wilderness heritage. Yale University Press, New Haven, Connecticut.

Minshall, G. W., and C. T. Robinson. 1995. Response of stream ecosystems to wildfire:

Yellowstone National Park 1988-1993. Final report to U.S. National Park’s Service. Yellowstone National Park.

Minshall, G. W., C. T. Robinson, and D. E. Lawrence. 1997. Postfire responses of lotic

ecosystems in Yellowstone National Park, U.S.A. Canadian Journal of Fisheries and Aquatic Sciences 54:2509-2525.

Rieman, B. E., D. Lee, G. Chandler, and D. Myers. 1997. Does wildfire threaten

extinction for salmonids: responses of redband trout and bull trout following recent large fires on the Boise National Forest. Pages 47-57 *in* J. M.Greenlee, editor. Proceedings of the symposium on fire effects on threatened and endangered species and habitats. International Association of Wildland Fire, Fairfield, Washington.

Rinne, J.N. 1996. Short-term effects of wildfire on fishes and aquatic macroinvertebrates

in the southwestern United States. North American Journal of Fisheries Management 16:653-658.

Spencer, C. N., and F. R. Hauer. 1991. Phosphorus and nitrogen dynamics in streams

during a wildfire. Journal of the North American Benthological Society 10:24-30.

Young, M. K., and M. A. Bozek. 1996. Post-fire effects on coarse woody

debris and adult trout in northwestern Wyoming streams. Pages 137-143 *in* J. M. Greenlee, editor. Ecological Implications of Fire in Greater Yellowstone. International Association of Wildland Fire, Fairfield, Washington.