

**Riparian-Littoral Zone Habitat Workshop Proceedings**  
**Trout Lake Station**  
**September 23-25, 2003**

**Participants:**

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**Michael Bozek** – Wisconsin Cooperative Fishery Research Unit/ College of Natural Resources, University of Wisconsin-Stevens Point  
**Bill Cole** – Ontario Ministry of Natural Resources  
**Mara Finkelstein** – Department of Botany/Center for Limnology, University of Wisconsin-Madison  
**Tessa Francis** – University of Washington  
**Steve Gilbert** – Wisconsin Department of Natural Resources  
**Matthew Helmus** – Department of Zoology/Center for Limnology, University of Wisconsin-Madison  
**Martin Jennings** – Wisconsin Department of Natural Resources  
**Motomi Genkai Kato** – Center for Limnology, University of Wisconsin-Madison  
**Susan Knight** – Trout Lake Station, Wisconsin Department of Natural Resources  
**Tim Kratz** – Trout Lake Station  
**Elaine Mallory** – Ontario Ministry of Natural Resources  
**Ken Mills** – Department of Fisheries and Oceans – Winnipeg, Manitoba, Canada (ELA)  
**Tom Pratt** – Department of Fisheries and Oceans – Sault Ste. Marie, Ontario, Canada  
**Jeff Reed** – Minnesota Department of Natural Resources  
**Brian Roth** – Center for Limnology, University of Wisconsin-Madison  
**Jim Rusak** – Trout Lake Station  
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**Anna Sugden-Newberry** – Department of Zoology/Center for Limnology, University of Wisconsin-Madison  
**Scott Van Egeren** – Trout Lake Station  
**Michele Woodford** – Trout Lake Station

**Presenters:**

**1. Anna Sugden-Newberry**

CWH tagging 1996 and 2003

- found many old logs, different proportions per lake, patterns stable over time, little movement over time, many new logs, movement is species specific

- Natural range of wood variability? Add houses? Riparian to littoral relationship?

- examine over gradient of lakes (low development, low conductivity to high development, high conductivity)
- Low development lakes: high overall variability, high individual lake variability, amount to CWH is function of stand structure and lake characteristics (Negative, average size of trees; Positive, shape)
- All lakes: (Positive, riparian CWH; Negative, average size; Positive, shape)
- Riparian tree density: trees larger with more houses, no relationship between number of trees and development
- Discussion: Beavers?, Logging history?, Dendrochronology of CWH?

## **2. Bill Cole**

- Many more lakes in Ontario, deal extensively with more logging; how much riparian zone is needed?
- Federal gov't, no net loss of fish productivity by management activities
- Hypothesis; destruction of CWH, decrease fish production, enhance CWH, increase fish production
- Questions: Does habitat complexity correlate with diversity or density of fish?; What is the connection between fish and fish habitat?; How do we quantify productive capacity of habitat?
- Five research areas: 1) CWH ecology; 2) CWH removal, series of lakes; 3) Habitat restoration, add habitat to pits and quarries; 4) Fish habitat preferences; 5) Riparian tree mortality
- Key variables that need to be measured for habitat assessment
- White pine move a lot, buoyant for centuries (found parallel to shore)
- Perpendicular logs likely fell there
- Zone of accumulation (macrophytes and plants grow where sediment is stabilized from logs)
- Prevailing wind is key to accumulation of CWH
- Wood is around for very long periods of time, humans remove it very quickly; 930 AD white pine (in water for 700 years), 850 AD red pine (in water for 800 years)
- Huge CWH input from logging, legacy
- Discussion: Forest-lake ecotone dynamics?, Tree mortality and input?, What do fish care about?, Riparian management practices?

## **3. Tessa Francis**

- Salmonids to Riparian to Littoral to Lake
- Urbanization of lakeshores in Pacific Northwest
- Wood retains organic sediment
- Relation between people and wood; effects on littoral zone
- Negative decaying relationship between 1) riparian trees, 2) CWH, 3) organic sediment, and development
- Leaf litter? Retention? Interaction?
- Greater organic sediment with more CWH

#### **4. Matt Helmus**

- Benthic invertebrates in Little Rock Lake
- Prior to wood removal, insect density on CWH about 3x greater than on benthos
- No difference between basins prior to manipulation
- Similar diversity and evenness between habitats
- Five developed, five undeveloped lakes with unwooded and wooded sites with similar lake morphometry
- Preliminary results: CWH has higher familial richness; Benthic invertebrate abundance is  $BTH < CBTH < CWH$

#### **5. Brian Roth**

- Model linking riparian forest and aquatic food webs through CWH
- Forest has early and late successional species that become CWH through direct fall into the lake or through snags
- CWH abundance in lakes determines hiding, vulnerability, and benthic invertebrate resources to the fish food web
- Riparian forest and CWH subjected to human development (CWH loss) and blowdown (CWH addition) scenarios
- Aquatic food web subjected to piscivore harvest
- Without fishing, development results in crash of benthivore population
- With fishing, development results in dominance of benthivore population
- Blowdown does little to change food web dynamics; suggests threshold behavior that above certain levels of CWH, little change occurs in the food web

#### **6. Greg Sass**

- Fish community responses to a whole-lake removal of littoral zone CWH
- Little Rock Lake separated into two basins by curtain to allow for reference and treatment basin
- 75% reduction of CWH on treatment basin (475 logs/km shoreline to 128 logs/km)
- Bass diets reflect increased reliance on terrestrial sources of food following manipulation; suggests decrease in growth rates due to lack of high energy density prey items (supported by decrease in condition factor of treatment basin bass)
- Four lines of evidence to suggest that yellow perch population in process of collapsing with decreased probability of recovery in the treatment basin: 1) disappearance of perch in bass diets; 2) decrease in numbers seen during snorkeling surveys and estimated by mark-recapture studies; 3) very low CPUE for perch in minnow traps on treatment basin; and 4) little change in reference basin perch population
- Tethering experiments reveal strong reliance of predator and prey on edge habitat (abundant CWH and macrophytes); suggest that littoral habitat may be essential for the persistence of predator and prey populations, i.e. species diversity
- Abundant CWH allows more bass nests to be made per transect of shoreline; may increase the probability of consistent year classes of bass

## **7. Tom Pratt**

- 50% reduction of CWH in whole-lake
- Turkey lakes watershed – acid rain experimental area, Ontario
- Fish species; brook trout, finescale dace, golden shiner, burbot, white sucker, various other minnow species
- Variables measured; water chemistry, chlorophyll a, zooplankton, fish CPUE, abundance, biomass, production
- Multiple BACI design (Keough and Quinn 2000)
- Results: chl a (no change); zooplankton (no change); Fish CPUE (no change); Fish size (slight, but not significant, increase of big fish after manipulation); lost emerald and spottail shiner and replaced by fathead and log perch; Biomass (no change); Low power to detect effect
- Fish observation of habitat use; typical preference is Beaver > Wood > Vegetation > Open > Rock
- High number of cyprinids in new CWH, relation ship decreases with increasing decay

## **8. Ken Mills**

- Experimental Lakes Area (Ontario), Lake 191 macrophyte removal
- Changes in pike productivity and quantity changes in other fish species
- Removed 50% of macrophytes for 3 years
- System dominated by northern pike with few yellow perch and pumpkinseed
- Increased growth of northern pike, big fish growth rate increased, cannibalism
- Abundance of pike decreased, abundance of perch and pumpkinseed increased, cladoceran size decreased
- 25% reduction of macrophytes next

## **9. Martin Jennings**

- 1) Lakes classification, 2) Riparian development, land use, 3) Fish assemblages, 4) Macrophytes
- Similar lakes can be managed similarly (instead of experiment or time series), use snapshot looks along gradient of lakes
- Habitat variables in lakes affected by development (16 lakes, high landscape position with and without development)
- > CWH on undeveloped lakes, > CWH with lower density of cabins, > MWH on undeveloped lakes
- More fine sediment near cabins
- < less emergent macrophytes at sites with houses, < floating leaf macrophytes on developed lakes
- Proportion of intolerant fish species decreases with increasing eutrophication
- All plant species richness decreases with increasing development (Floristic Quality Index)

## 10. Jeff Reed

- Western Minnesota; no CWH, macrophyte dominated systems, high development
- Nest site selection for largemouth bass and black crappie, effects of development on bluegill growth
- BC, LMB choose undeveloped areas for spawning whether undeveloped, moderately developed, or highly developed
- Black crappie prefer canopy, understory, and emergent macrophytes; largemouth bass stay away from development
- Bluegill growth; no relationship between development and growth for 60mm, 100mm, and 140 mm bluegill; growth increased with productivity and decreased with more forest

## 11. Michael Bozek

- Functional responses influencing what is happening with: 1) macrophytes; 2) relationship between fish and habitat (micro-scale); and 3) wood in lakes
- Are similar fish species found in lakes with similar macrophytes (18 lakes)? Patterns are not generalizable among lakes, but interesting findings within individual lakes
- Weevil introductions to control milfoil, large positive changes in the plots
- Smallmouth bass nest site selection and success – does habitat effect numbers off nest?, SMB need gravel and sand, but no relationship survival and substrate, suggests other variables important
- Similar models of riparian forest to CWH to fish, but look at fish abundance and richness, branching complexity of CWH is most important

## Brainstorm Session of Key Issues

1. Forestry for CWH
  - dating in U.S.
  - what is natural state? Pulse due to logging?
  - Bozek – Katherine Lake - Now
  - composition of riparian spp.
  - modeling and lag of forest stand
  - magnitude of stochastic events
2. Beavers – as disturbance and input regulators – like deciduous forests which are here now
  - how vary with development?
3. Large gradient on undeveloped systems in CWH amount.
4. Complexity and CWH?, <60, >60
5. why/how is CWH important to fish?
  - predation, refuge, food, shade etc.
  - structure, substrate, scale?
6. Stand dynamics in Riparian zones
  - succession, periodicity, spp of wood “a tree is not a tree...”

7. thresholds and management implications in CWH amounts
  - risk and uncertainty
8. fishing pressure CWH, oral history, traditional knowledge?
  - where to fish, beaver lodges, cribs or coffins
9. human survey of CWH/fish where they fish
  - quantifying angling pressure
10. Time scales of different variables/systems
  - use of models conceptual
11. whole system metabolism
  - if organic sediment is not trapped at warm littoral zone, it moves to profundul then how effects whole lake metabolism?
12. macrophytes and CWH and organic sediment
  - distribution of macrophytes and CWH
  - Look at LR and distribution of Macrophytes
  - Anna Mara looking at Macros and CWH
  - human effects on both, do humans push both macro and CWH systems to similar states
  - removal of CWH may influence further from shore than macrophyte removal which may only affect close to shore
13. using fish as indicators
  - spp composition
  - effects
  - “Critic for Ecology” – Peters
  - compare each study and time scale of each try to maintain for an ecologically important period of time- problem with funding – needs to be a bold statement in review paper
  - human development is a chronic disturbance
14. Sylvania tract forest finding areas that have not been logged?
  - Is logging a loss or addition term?
  - Lucy Terrel CWH in old growth forests worked with Don Waller
  - Margaret Davis – disturbance rates at lake scale?
15. variables that need to be measured for the CWH for importance to food web structure in these lakes –1’, 2’, 3’ levels
16. Meta-analysis for the future? Data has not been published yet?
17. way to measure three D habitat of these CWH
  - Habitat Classification approach? Like in forestry yet attempt to standardize for all organisms. A complexity classification integrating boulders logs macros... in three D
  - Species areas relationships
  - Pixel size and fractal dimensions – Mark Bane (Cornell) Characterize dimension capacities of habitats
  - DNR looking at sensitive estimates of habitats they get macro, fish, etc. people with different eyes on same system in order to put it into a data base ‘polygons’ to look at biological integrity of Lake.
18. Lake classification of Martin public perception and cumulative effects of whole lake not just singling out little pieces – necessary but not sufficient

- Cumulative effects – judges are accepting it now and it is becomes part of case law
  - Measuring in finite time is difficult
  - Water shed boundaries and modeling – at what scale and needs to be empirical
19. Stream/River Ecology and Riparian zone Naiman and DeCamps review paper
- what is riparian area?
  - Lyons et. al. CFAS paper just came out – reach vs. watershed effects as whole system became more effected, reach effects did not make a big difference
  - Purdue prof core terrestrial habitat that includes water quality and ecological ranges for spp adjacent to lake shore - Jeff used this for last assessment
20. Use of metadata bases?
- who is doing what
  - time scales
  - communities
  - variables measured and precision
  - link to websites with extended abstracts on it
  - Greg’s proceedings handouts
21. paper on 10 rules of thumb for management
- lake classification system by counties for allowing amount of development around lakes
  - Brian Pierce (Villas county extension) headed a summary statement for zoning ordinances ad hoc doc
  - Oneida County these ordinances are being pushed, what about rest of counties?
  - Like consensus paper on climate change in Science – asking questions by scaling by certainty
  - Move up to the next hierarchy level

### **Identified Key Questions for Review Paper**

1. What is the role of the riparian forest in lakes?
2. What is the role of woody habitat in lakes?
3. What is the role of macrophytes in lakes?
4. How do humans influence the land-water interface?

### **Groups and Assignments**

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Coordinator for Question 1 – Bill Cole

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**Deadlines for Completion:**

**October 5, 2003** – Outline of manuscript to coordinators

**December 1, 2003** – Return of completed sections to manuscript coordinator

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**Potential Journals:**

Limnology and Oceanography

Lake and Reservoir Management

Ecosystems

Ecological Applications

Annual Reviews of Ecology and Systematics