Assigning Fish to Guilds for Flow-Ecology Analysis

Ecological Flows Science Advisory Board
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Review

- RTI and TNC are investigating flow-ecology relationships by comparing flow metrics to fish abundance
  - RTI
    - Compare different locations, times
    - Statewide
  - TNC
    - Compare same location over time
    - Four basins (LTN, CFR, TAR, RKE)
Fish Dataset

- NCDWQ – wadeable streams; not trout
Why Use Guilds?

- Most species can be grouped by the habitats they use based on life history requirements and physiology.
- “Smoothes out” data compared to species data.
- Allows comparison among streams, basins, provinces.
- Used in habitat-based models (e.g., PHabSim).
### Guild Frameworks

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>shallow fast higher velocity</td>
<td>Shallow Fast Coarse</td>
<td>Fast Riffle</td>
<td>Riffle</td>
<td>Riffle</td>
</tr>
<tr>
<td>shallow fast moderate velocity</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>shallow fast lower velocity</td>
<td>Shallow Fast</td>
<td>Slow Riffle</td>
<td>Riffle Run</td>
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<tr>
<td>deep fast, fine substrate</td>
<td>Deep Fast</td>
<td>Raceway</td>
<td>Fast Generalist</td>
<td>Fast Generalist</td>
</tr>
<tr>
<td>deep fast, gravel/cobble substrate</td>
<td>Deep Fast Cover</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>deep fast, coarse substrate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>shallow slow, coarse substrate</td>
<td>Shallow Slow</td>
<td></td>
<td>Shallow Rheophilic</td>
<td></td>
</tr>
<tr>
<td>shallow slow, young of year</td>
<td>Shallow Slow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>shallow slow, aquatic vegetation cover</td>
<td>Shallow Slow Cover</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>shallow slow, woody debris cover</td>
<td>Shallow Slow Cover</td>
<td>Shallow Slow Cover</td>
<td></td>
<td></td>
</tr>
<tr>
<td>shallow slow, fine substrate, no cover</td>
<td>Shallow Slow Fine</td>
<td>Medium Pool</td>
<td>Pool Run</td>
<td>Pool Run</td>
</tr>
<tr>
<td>deep slow, no cover</td>
<td>Deep Slow</td>
<td>Open Pool</td>
<td></td>
<td></td>
</tr>
<tr>
<td>deep slow, cover</td>
<td>Deep Slow Cover</td>
<td>Deep Pool</td>
<td>Pool Cover</td>
<td>Pool Cover</td>
</tr>
<tr>
<td>deep slow, cover (version 2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Guild Frameworks

Vadas

**Guild Structure**

- Previously established Guilds

```
Depth (cm)
```

Vadas and Orth (2000) Guild Structure

Persinger

```
Depth (m)
```

Pool-Cover
Pool-Run
Fast Generalist
Riffle/Run
Fast Riffle

Vadas and Orth (2000) Guild Structure
Guild Frameworks

- Decided to use simple framework
  - Reduce problems of assigning to similar adjacent types
  - Easier for public to understand
  - Restrict guilds to habitats indicative of flow (i.e., ignore substrate/cover parameters, which we can't manage)
  - All the DWR PHabSim guilds (14) can be grouped within the flow-based guilds, except for backwater
## Proposed NC Guild Structure

<table>
<thead>
<tr>
<th>Persinger</th>
<th>NC Study</th>
<th>Comment</th>
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<tbody>
<tr>
<td>Riffle</td>
<td>Riffle</td>
<td></td>
</tr>
<tr>
<td>Fast-generalist</td>
<td>Riffle-run</td>
<td>Name change only</td>
</tr>
<tr>
<td>Pool-run</td>
<td>Pool-run</td>
<td></td>
</tr>
<tr>
<td>Pool-cover</td>
<td>Pool</td>
<td>Name change; with or without cover</td>
</tr>
<tr>
<td>Margin</td>
<td>Added; shallow-slow habitats</td>
<td></td>
</tr>
<tr>
<td>Backwater</td>
<td>Added; mostly coastal</td>
<td></td>
</tr>
</tbody>
</table>
Proposed NC Guild Structure
Assigning Fish to Guilds

- Used “Fishes of” books
  - Freshwater Fishes of Virginia (Jenkins and Burkhead 1994)
  - The Fishes of Tennessee (Etnier and Starnes 1993)
  - Freshwater Fishes of South Carolina (Rohde et al. 2009)
  - Inland Fishes of Mississippi (Ross 2001)
  - Fishes of Alabama (Boschung and Mayden 2004)

- These books describe habitat use based on direct observation and summarizing information from other sources
- Typically habitat was described for both spawning and adult/ juvenile lifestages
Assigning Fish to Guilds

- Goudreau made initial review of books and assigned guilds to spreadsheet of fish
- Rohde and Tracy reviewed/edited the spreadsheet and added assignments to those species not described in the books
- Some species use multiple habitat types
- Made notes on species that are exotic, introduced to particular basins, or estuarine
## Results

<table>
<thead>
<tr>
<th></th>
<th>Adult/Juvenile</th>
<th>Spawning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riffle</td>
<td>15</td>
<td>21</td>
</tr>
<tr>
<td>Riffle-run</td>
<td>25</td>
<td>47</td>
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<tr>
<td>Pool-run</td>
<td>49</td>
<td>41</td>
</tr>
<tr>
<td>Pool</td>
<td>60</td>
<td>33</td>
</tr>
<tr>
<td>Margin</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Backwater</td>
<td>16</td>
<td>22</td>
</tr>
</tbody>
</table>

Note: Species using multiple guilds were assigned to predominant guild
Use of Guild Data – RTI

- Focus on Riffle-Run guild
  - Flow sensitive
  - High number of species
  - Use if either lifestage (adult or spawning) is in guild, but must only use Riffle-Run

- Select five Riffle-Run species
  - High count (>100 records)
  - Wide geographic distribution (multiple basins)
  - Creek Chub, Fantail Darter, Rosyside Dace, Central Stoneroller, Blacknose Dace
Use of Guild Data – TNC

- Focus on all Guilds, example application:
  - What is the percent occupancy by guild type at each survey site and each survey date?
  - Is guild composition and percent distribution at a site consistent over time? If not, how is it changing, and why?
    - Select sites with multiple surveys over time
    - Measure changes in guild occupancy over time at a specific locations
  - Possible controls on variation: Flow alteration, combined flow and habitat changes, seasonality and lifestage characteristics...