

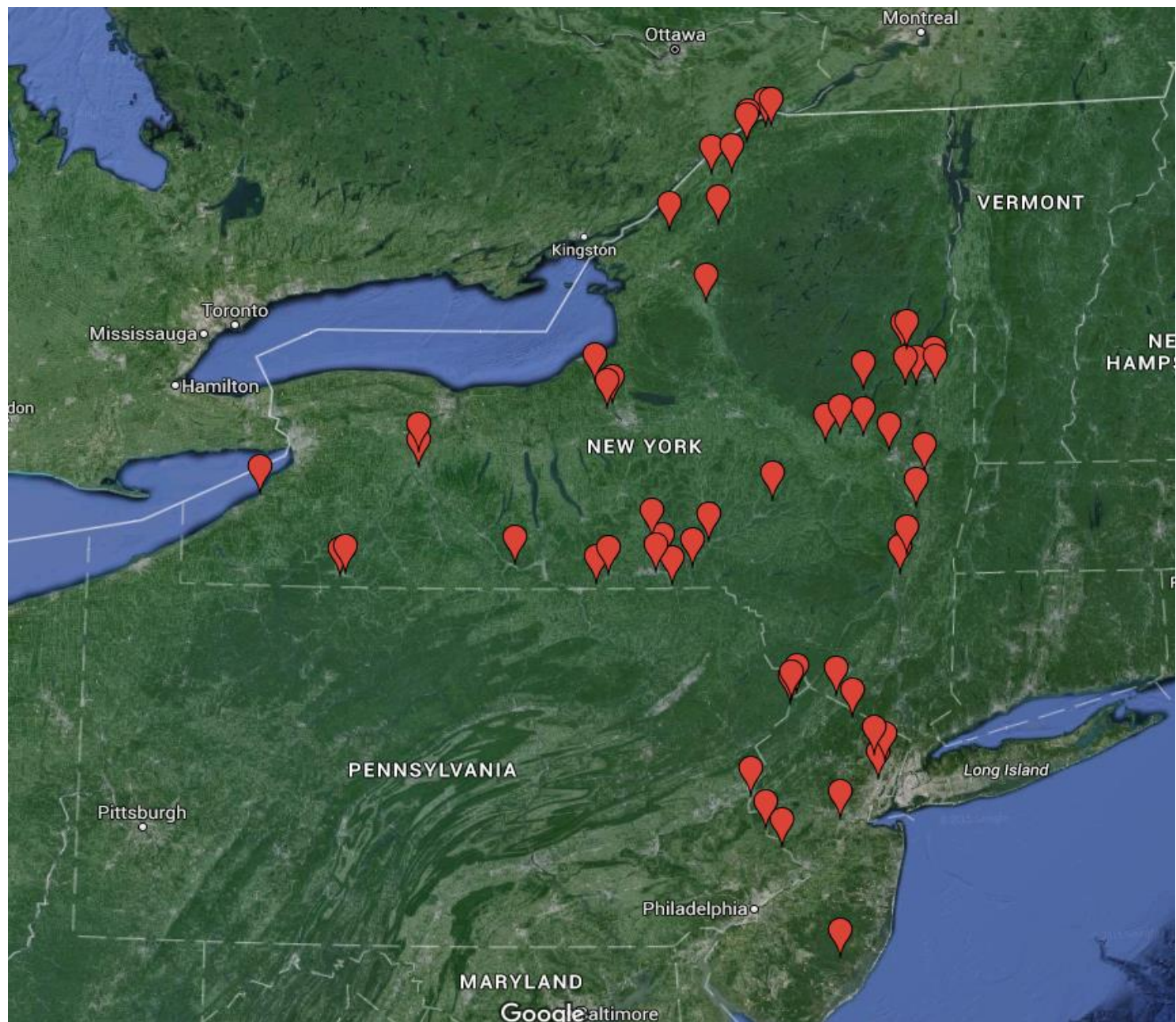
# Examination of Ecological Attributes for Large River Fish Communities in NJ and NY: Implications for Index of Biological Integrity Development



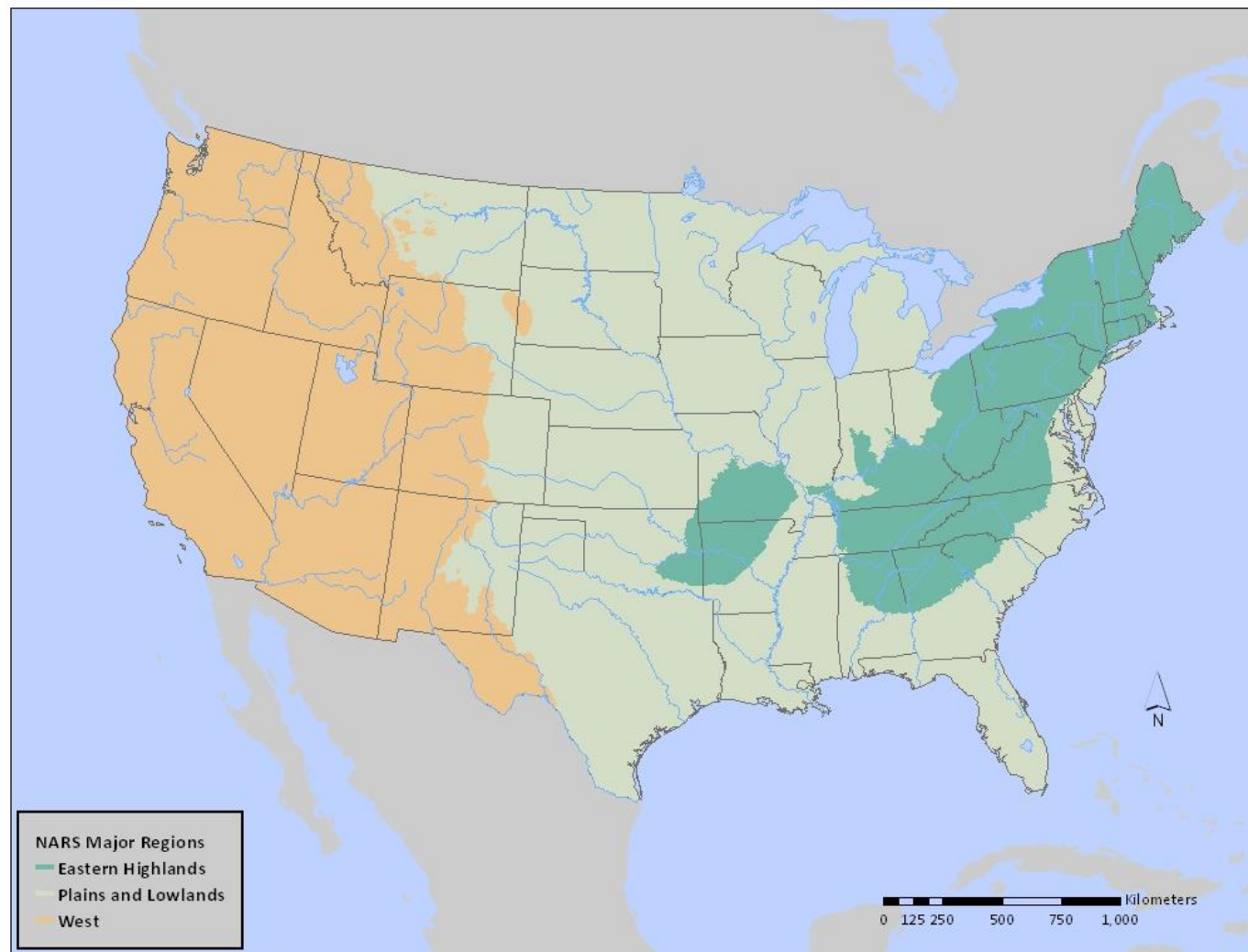
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# Objectives

- To examine various ecological attributes of large river fish communities in NJ and NY across major drainages, tidal freshwater vs non-tidal, and large river vs wadeable
- Address the importance of these factors in the development of large river fish indicators
- Use this information to guide discussions and planning for future development of large river fish biological indices





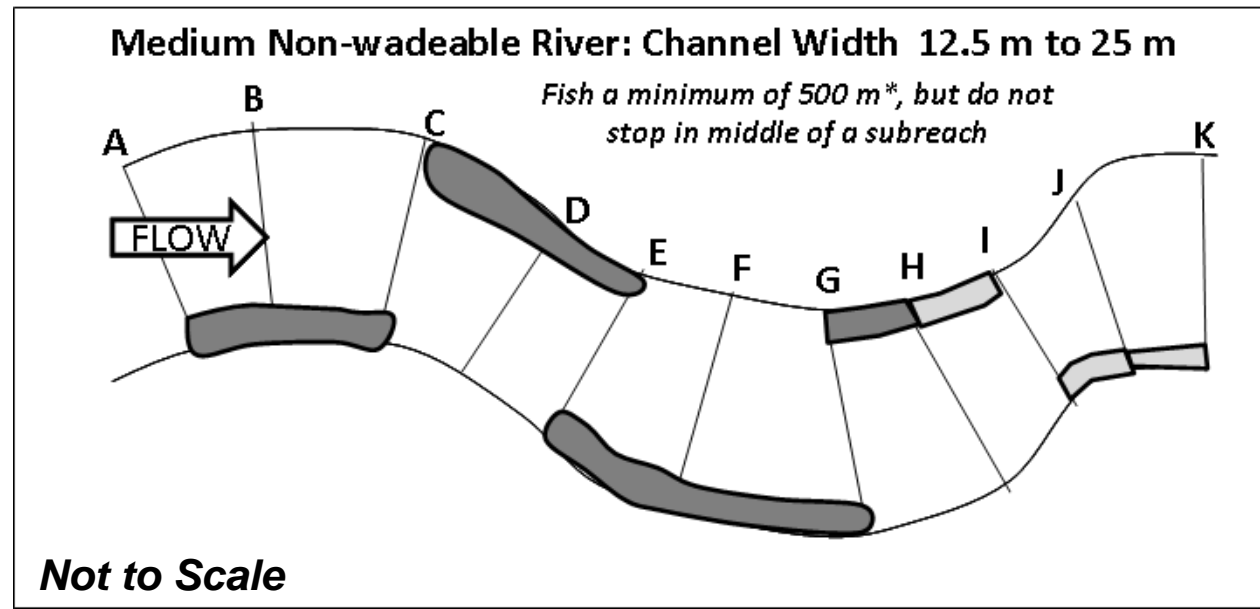


# USEPA National Rivers and Streams Assessment: Boatable Fish Method

- Electrofishing non-wadeable streams and rivers
- Sampling reach = 40 x mean wetted width for medium non-wadeable and 20 x mean wetted width for large non-wadeable
- Minimum fish collected is 500 unless all 10 subreaches are sampled
- Typical settings are: 500-1000VDC; 8-20A; and 120Hz
- Sampling all habitats at the banks corresponding to the transect sampling stations
- Fish captured by one netter using a dip net with ¼" mesh size
- Fish > 25 mm total length identified, examined for external anomalies and recorded on field forms

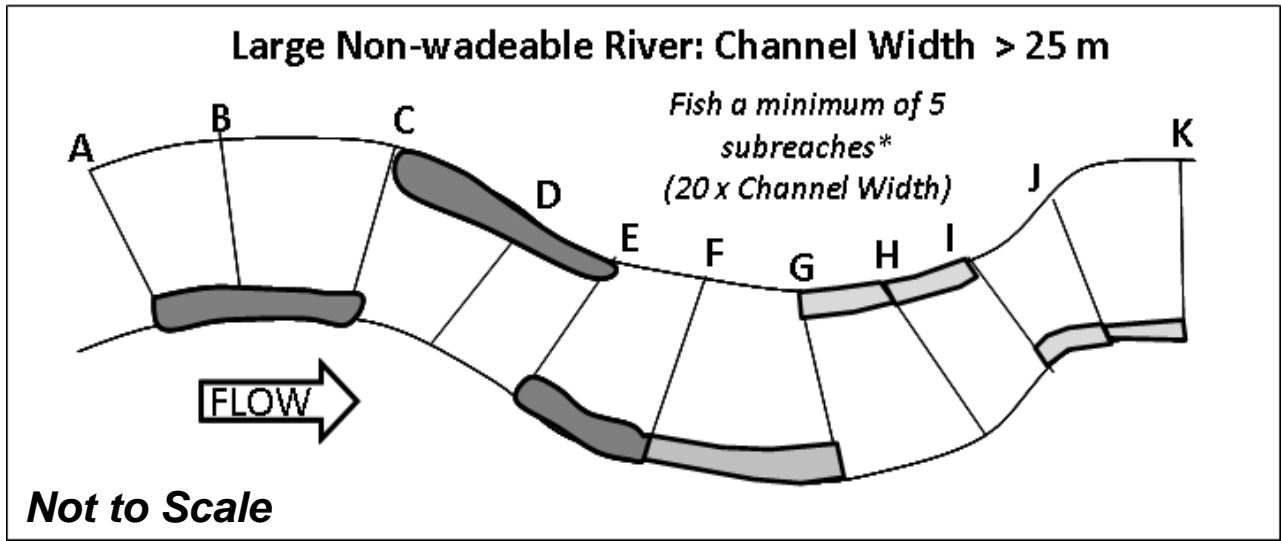
# Medium Non-Wadeable (12.5 – 25 m)

- Sampling reach will be between 500 and 1000 meters
- Subreaches will be between 50 and 100 meters each
- Minimum fishing length = 500 meters which will be between 5 and 10 subreaches. *If needed, extend fishing length to end at a transect*
  - Fish each subreach along bank in pairs of subreaches starting at a random bank at Transect A
  - Button time is roughly 700 seconds per subreach
  - Minimum fish number is 500 unless all 10 subreaches have been fished.



# Large Non-Wadeable ( $\geq 25$ m)

- Sampling reach will be between 1000 and 4000 meters
- Subreaches will be between 100 and 400 meters each
- Minimum fishing length = 5 subreaches (which will equal between 500 and 2000 meters)
  - Fish each subreach along bank in pairs of subreaches starting at chosen PHab bank at Transect A
  - Button time is roughly 700 seconds per subreach
- Minimum fish number is 500 unless all 10 subreaches have been fished.



# Ecological Attributes (Metric Classes) of Fish Communities in Rivers

1. Native/Non-native
2. Taxonomic richness and composition
3. Habitat guild (waterbody type, temperature regime, substrate preference, geomorphic preference)
4. Life history (migratory vs non-migratory)
5. Reproductive guild (migratory, broadcaster, simple nester, etc.)
6. Pollution tolerance
7. Trophic guild (carnivores, herbivores, insectivores, planktivores, etc.)





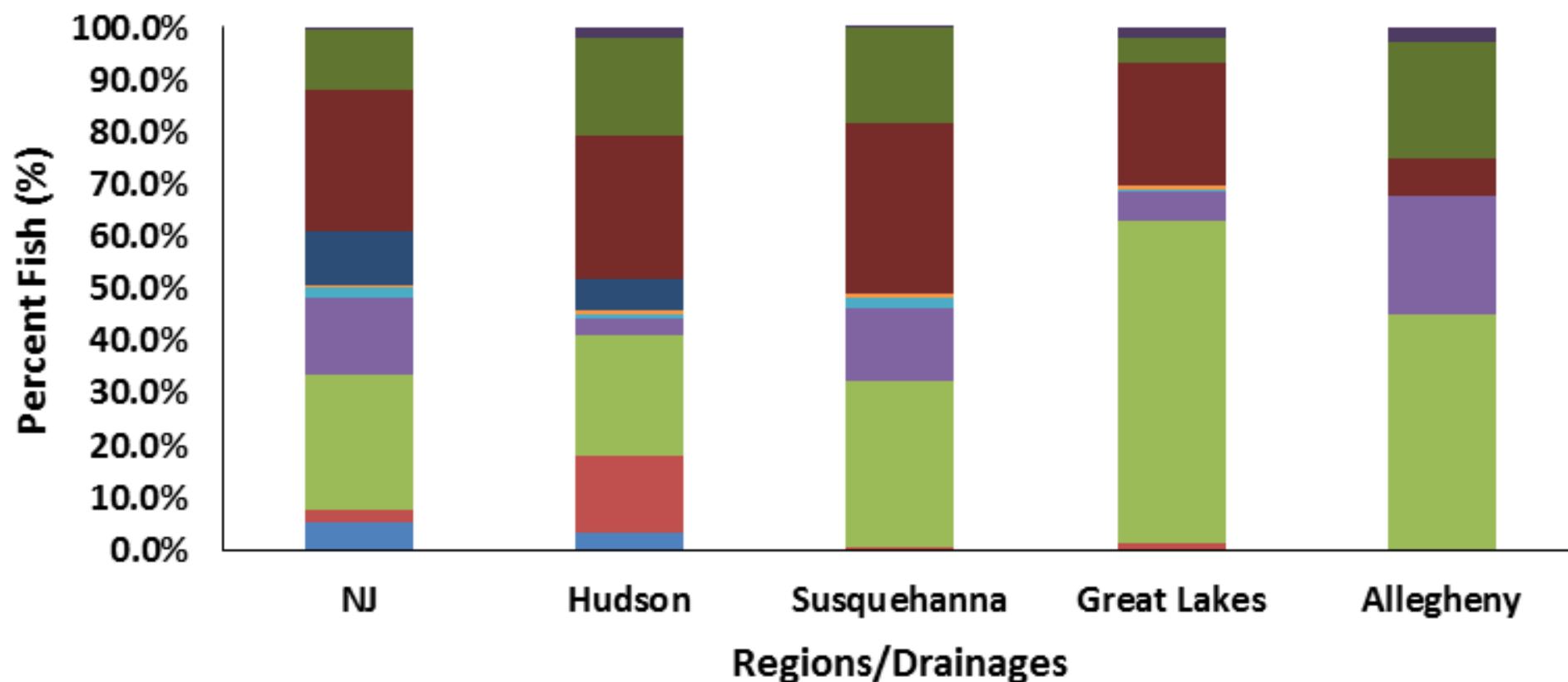
# Data Method: Examine Taxonomic Composition, Trophic Class\*, Migratory Strategy, and Habitat Guild\*

- Across major drainages and regions
- Freshwater tidal vs non-tidal river reaches
- Non-wadeable vs wadeable rivers



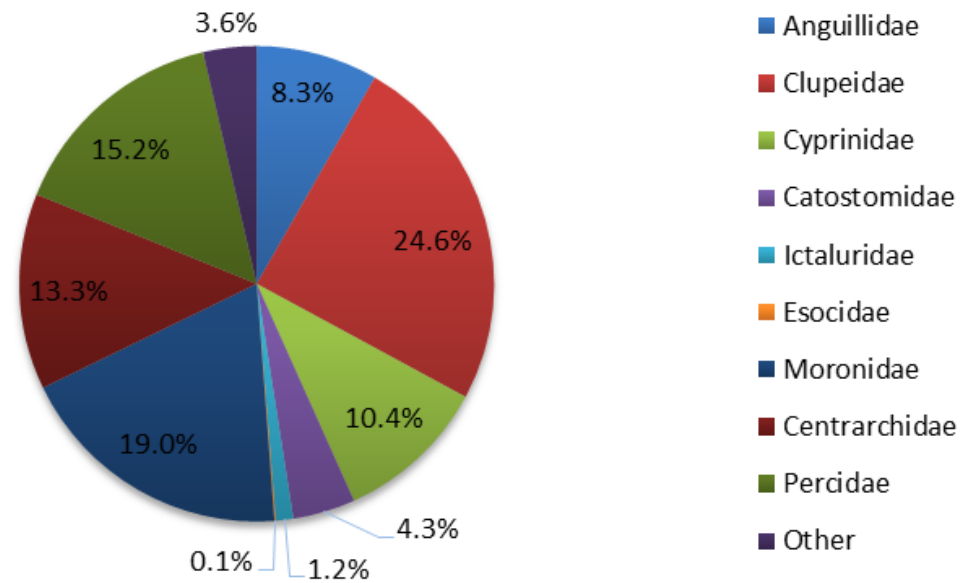
\* Halliwell et al. (1999) Classification of freshwater fishes of the northeastern United States for use in the development of indices of biological integrity, with regional applications.

## Taxonomic Composition

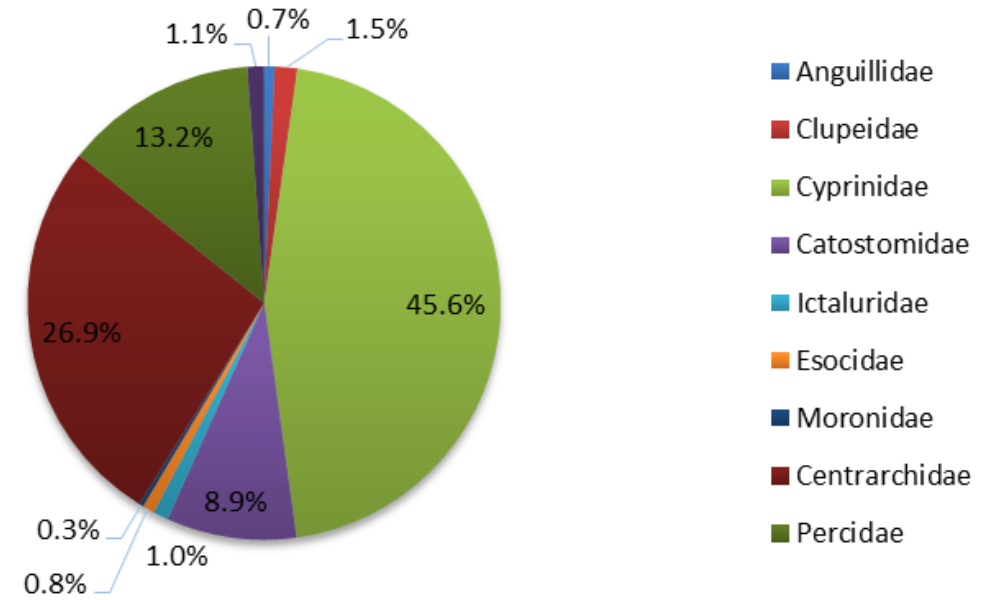


Anguillidae   Clupeidae   Cyprinidae   Catostomidae   Ictaluridae  
Esocidae   Moronidae   Centrarchidae   Percidae   Other

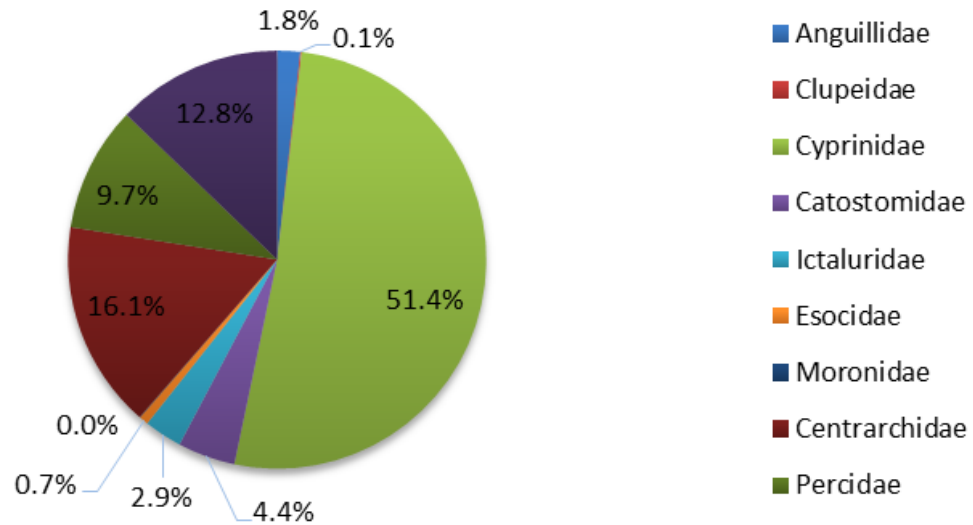
### Tidal Rivers Taxonomic Composition



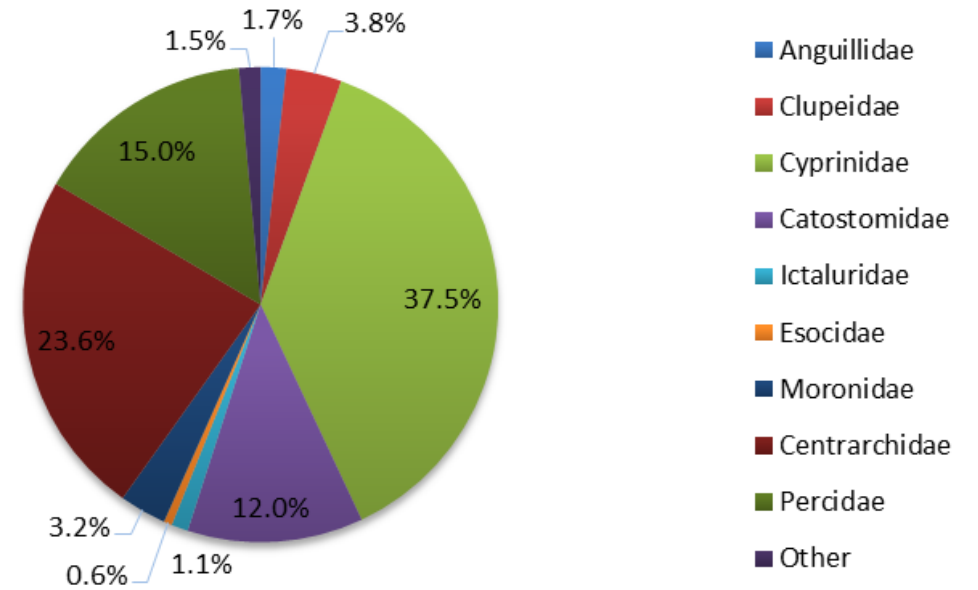
### Non-Tidal Rivers Taxonomic Composition



### Wadeable Streams Taxonomic Composition



### Large River Taxonomic Composition

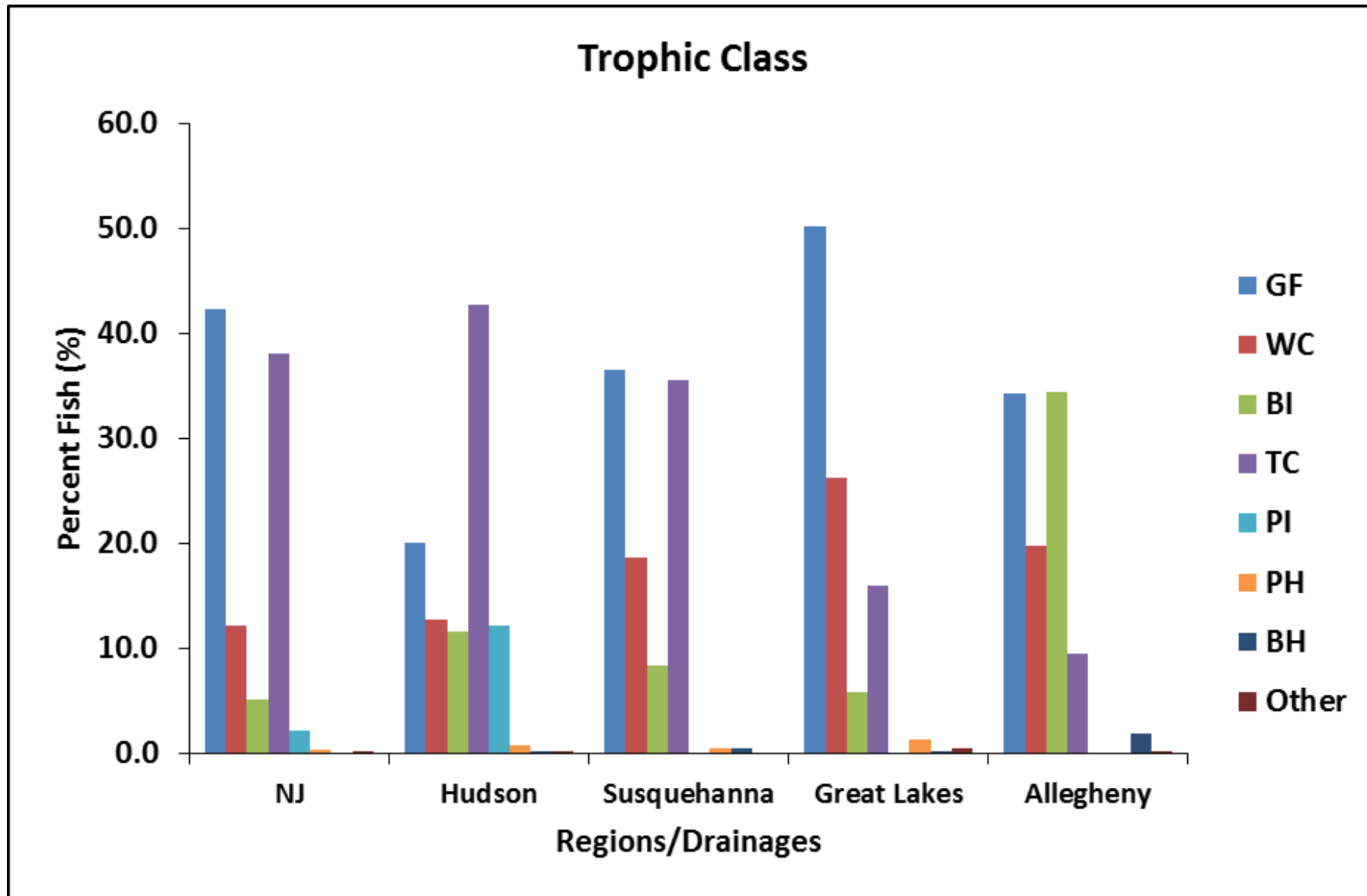


# Taxonomic Composition – Key Findings

- Together Anguillidae and Clupeidae are only significantly present in NJ and Hudson drainages.
- Cyprinidae is present in the greatest amounts in the Great Lakes and Allegheny drainages compared to the other drainages. It is significantly present in all the drainages.
- Catostomidae is present in the greatest amount in the Allegheny drainage compared to the other drainages. It is significantly present in all the drainages.
- Ictaluridae and Escocidae are not prominent in any of the drainages and are completely absent in the Allegheny drainage.
- Moronidae is only significantly present in the NJ and Hudson drainages.
- Centrarchidae is least present in the Allegheny drainage, but significantly present in all drainages.
- Percidae is significantly present in all the drainages, but least present in the Great Lakes drainage.
- Greater abundance of Anguillidae, Clupeidae, Moronidae making up 51.9% of the family composition in tidal rivers vs greater abundance of Cyprinidae and Centrarchidae making up 72.5% of family composition in non-tidal rivers.
- Clupeidae are absent in wadeable streams. Cyprinidae and other families are less abundant in large rivers, Catostomidae and Centrarchidae more abundant in large rivers.

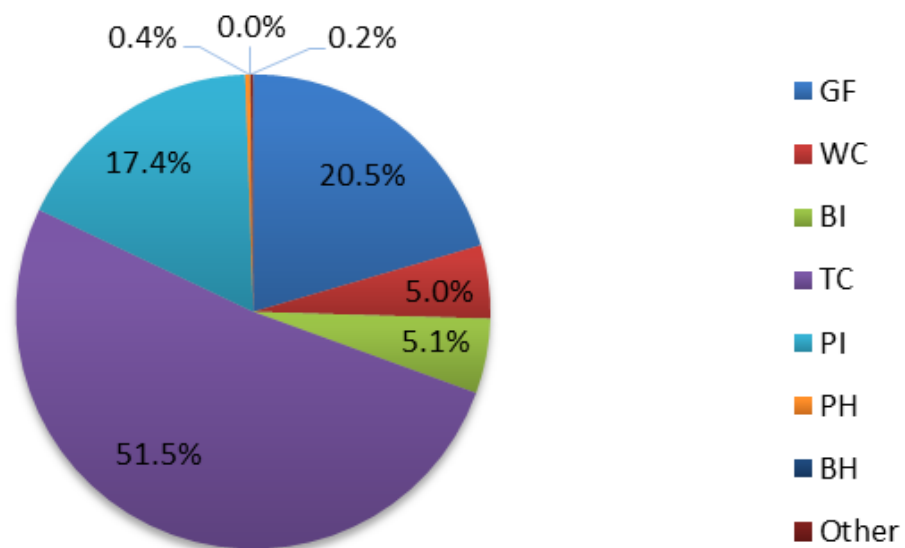




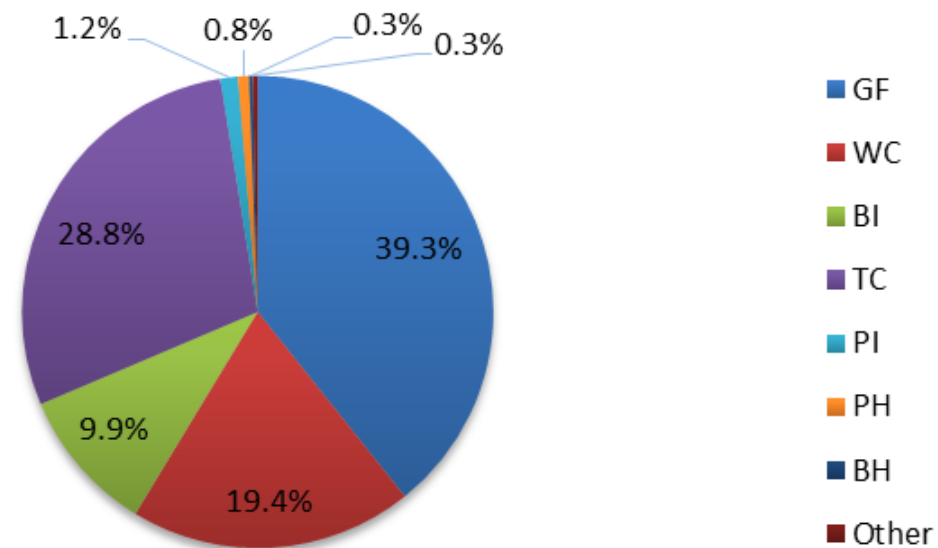


GF=Generalist Feeder; WC=Water Column Insectivore; BI=Benthic Insectivore; TC=Top Carnivore; PI=Planktivorous Insectivore; PH=Planktivorous Herbivore; BH=Benthic Herbivore

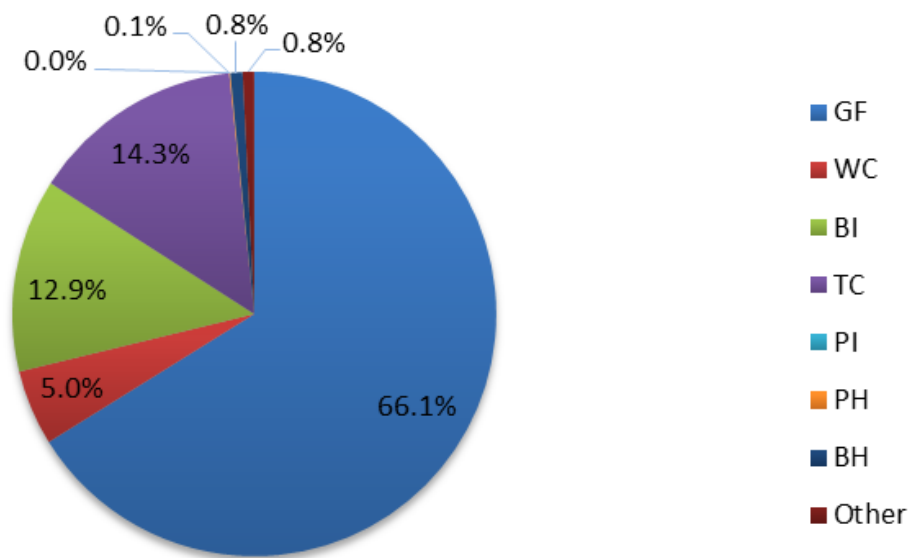
### Tidal Rivers Feeding Groups



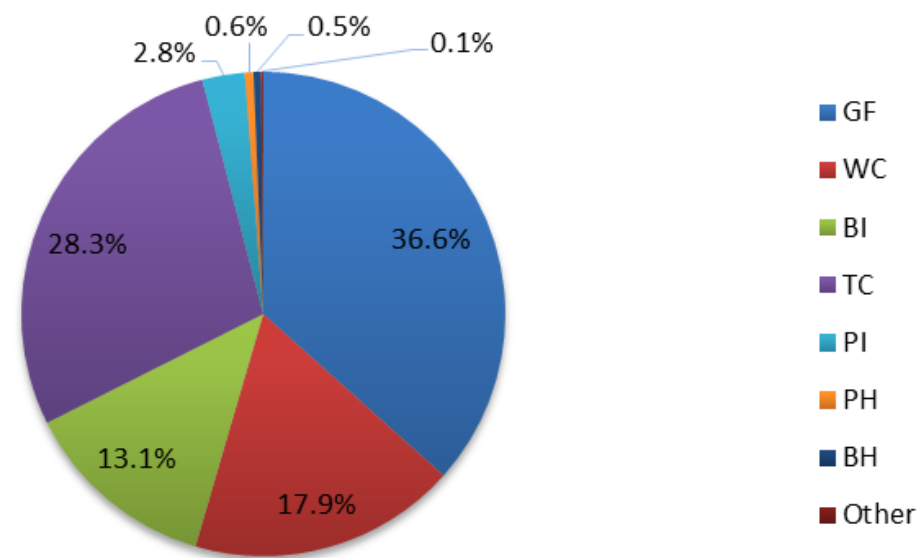
### Non-Tidal Rivers Feeding Groups



### Wadeable Streams Fish Feeding Groups



### Large Rivers Fish Feeding Groups

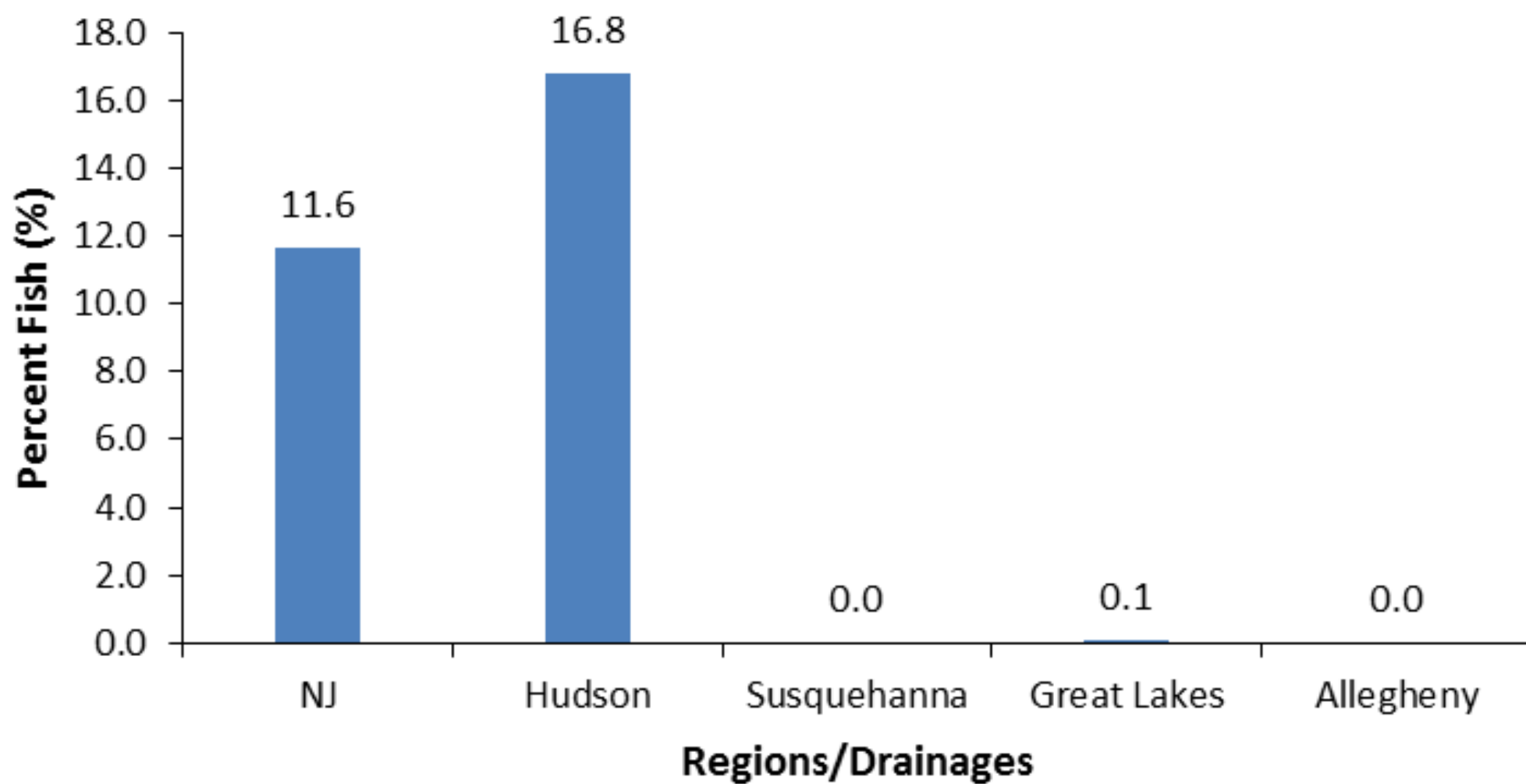


# Trophic Class – Key Findings

- Benthic insectivores highly more abundant in the Allegheny drainage; top carnivores generally half the abundance in the Great Lakes and Allegheny drainages; planktivorous insectivores absent in the Susquehanna, Great Lakes, and Allegheny drainages
- Tidal rivers have a higher abundance of PI and TC (68.9%) feeding groups, while non-tidal have a greater abundance of GF, WC and BI feeding groups making up 68.6% of the trophic composition
- Wadeable streams had a disproportionate abundance of the GF trophic class, while large rivers had a greater abundance of WC and TC feeding groups, with more trophic evenness

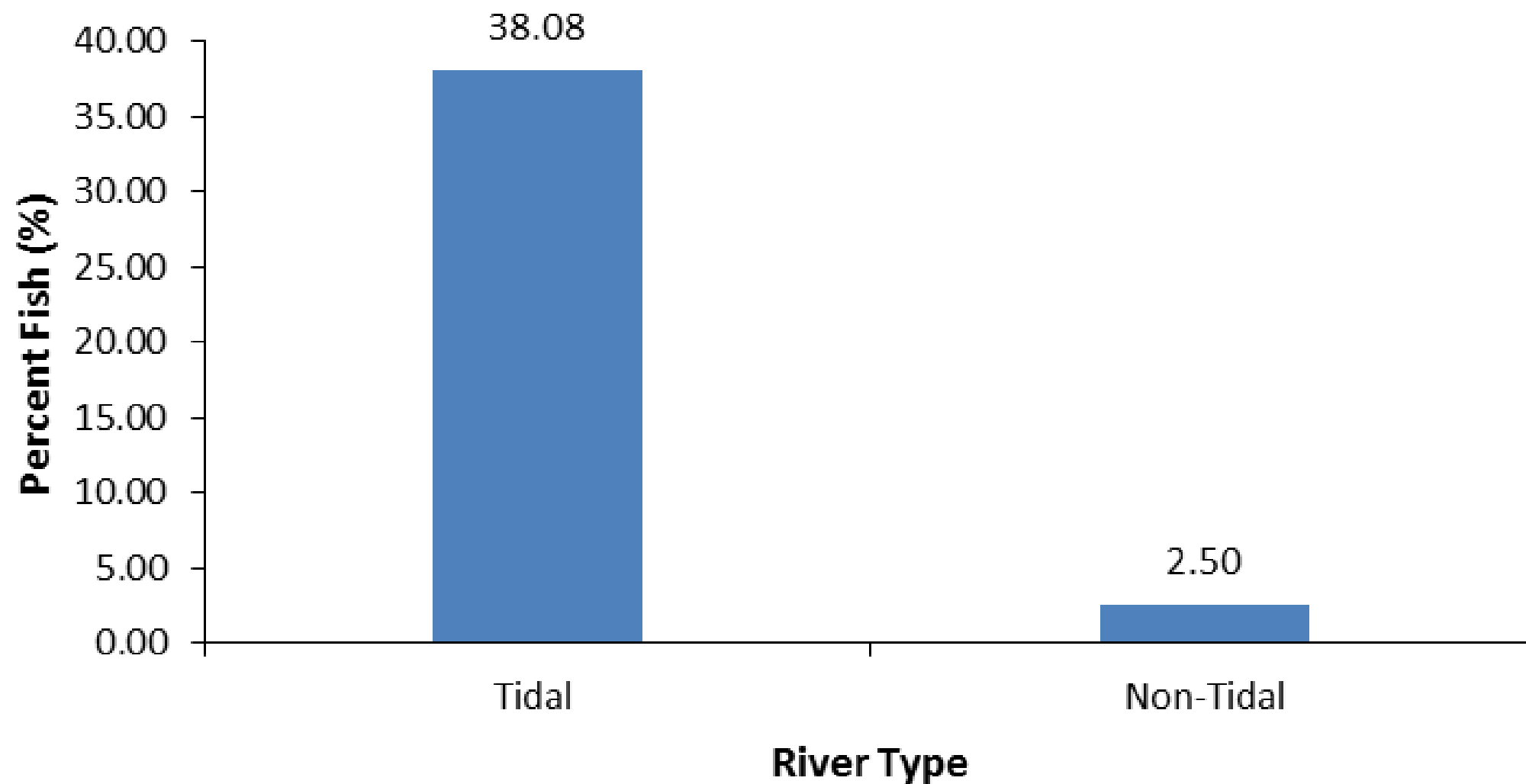


## Migratory Fish

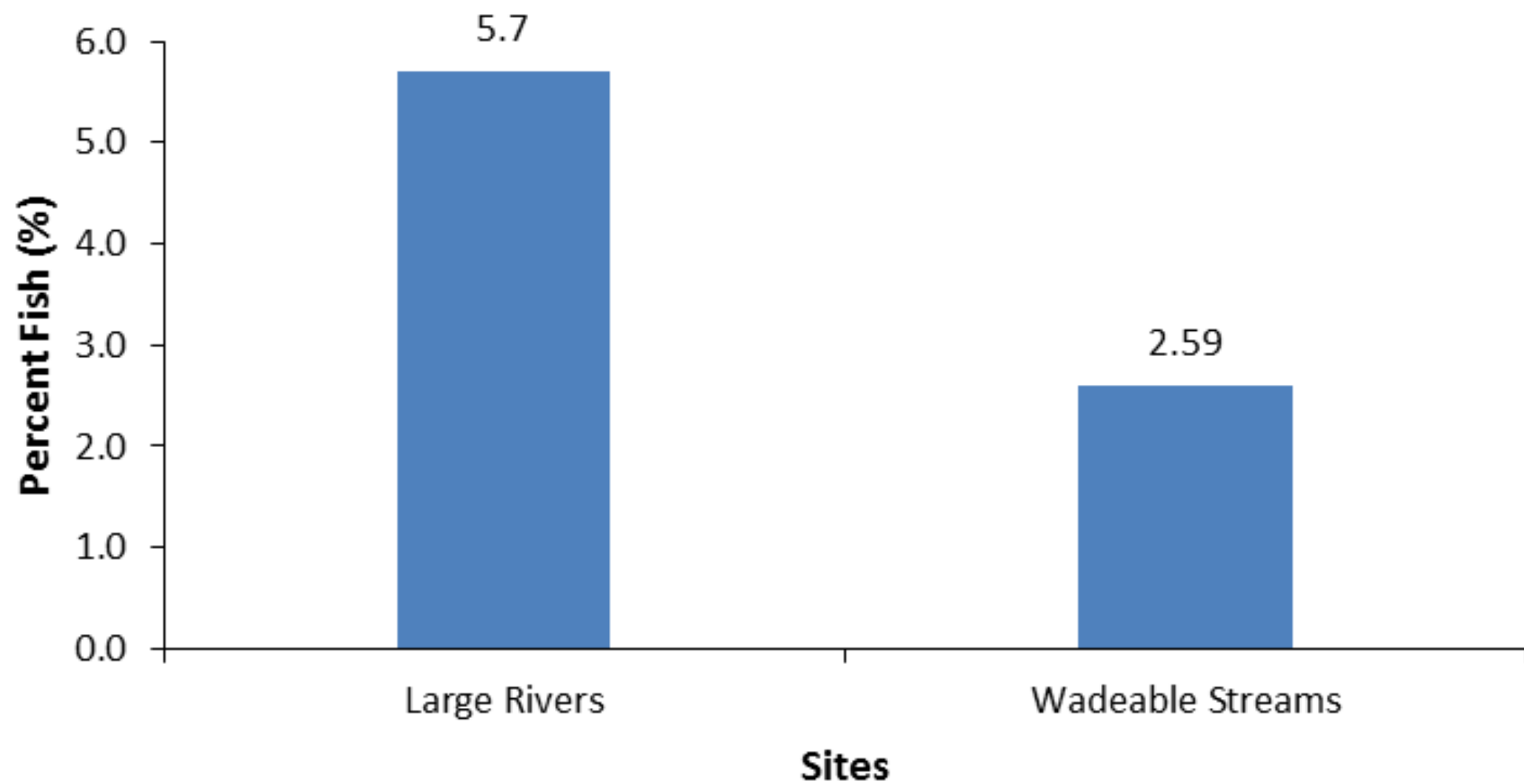




## Migratory Fish

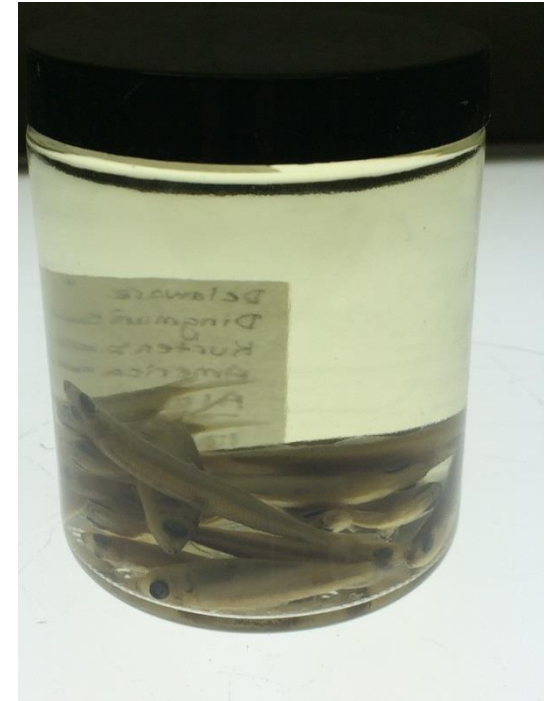


## Migratory Fish

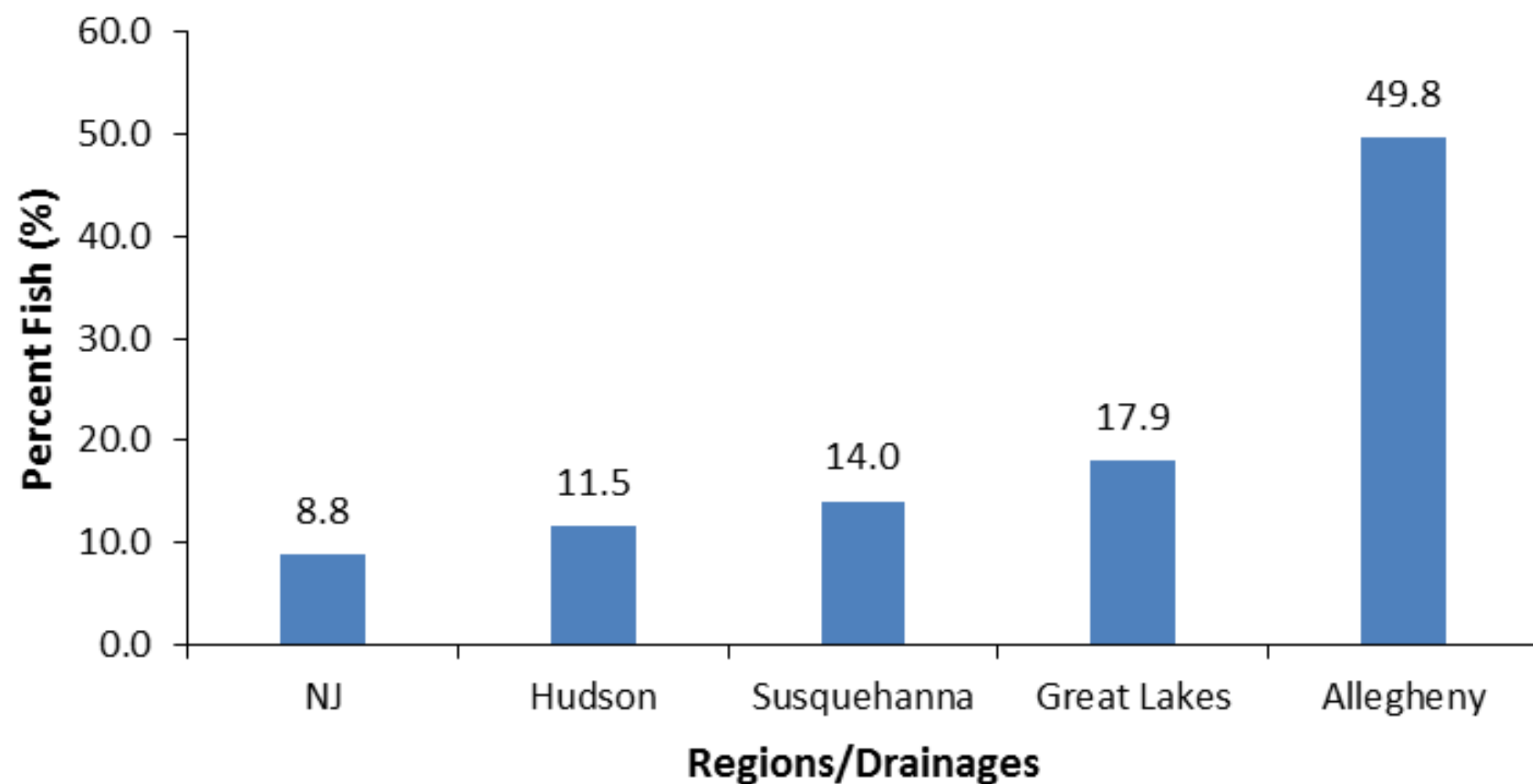


# Migratory Strategy – Key Findings

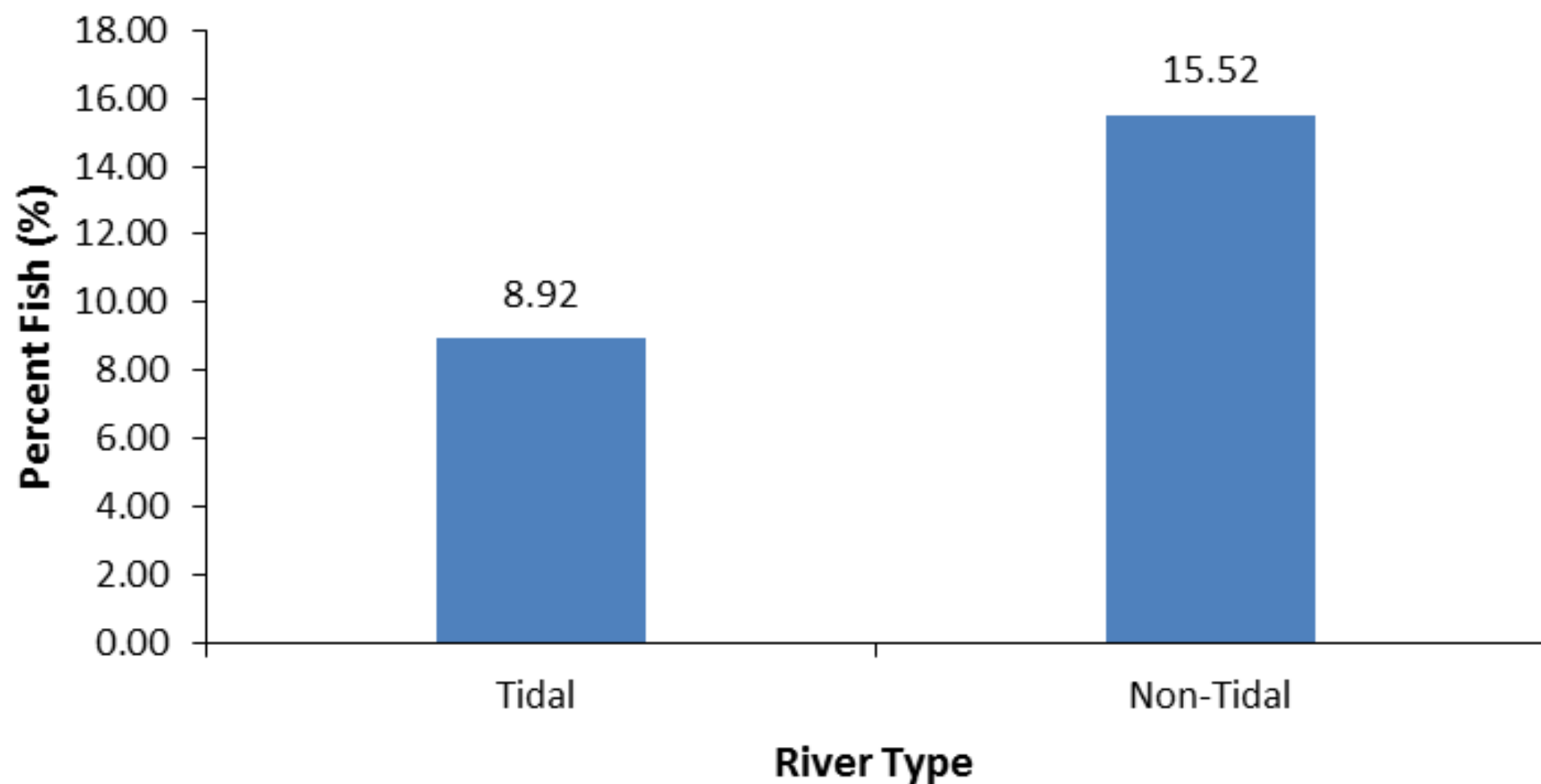
- Migratory fish only collected in NJ and Hudson river drainages
- Migratory fish abundance in tidal rivers is almost 20 times that of non-tidal abundance
- Percentage of migratory fish in large rivers is approximately 2 times that of wadeable streams



## Riverine Fish

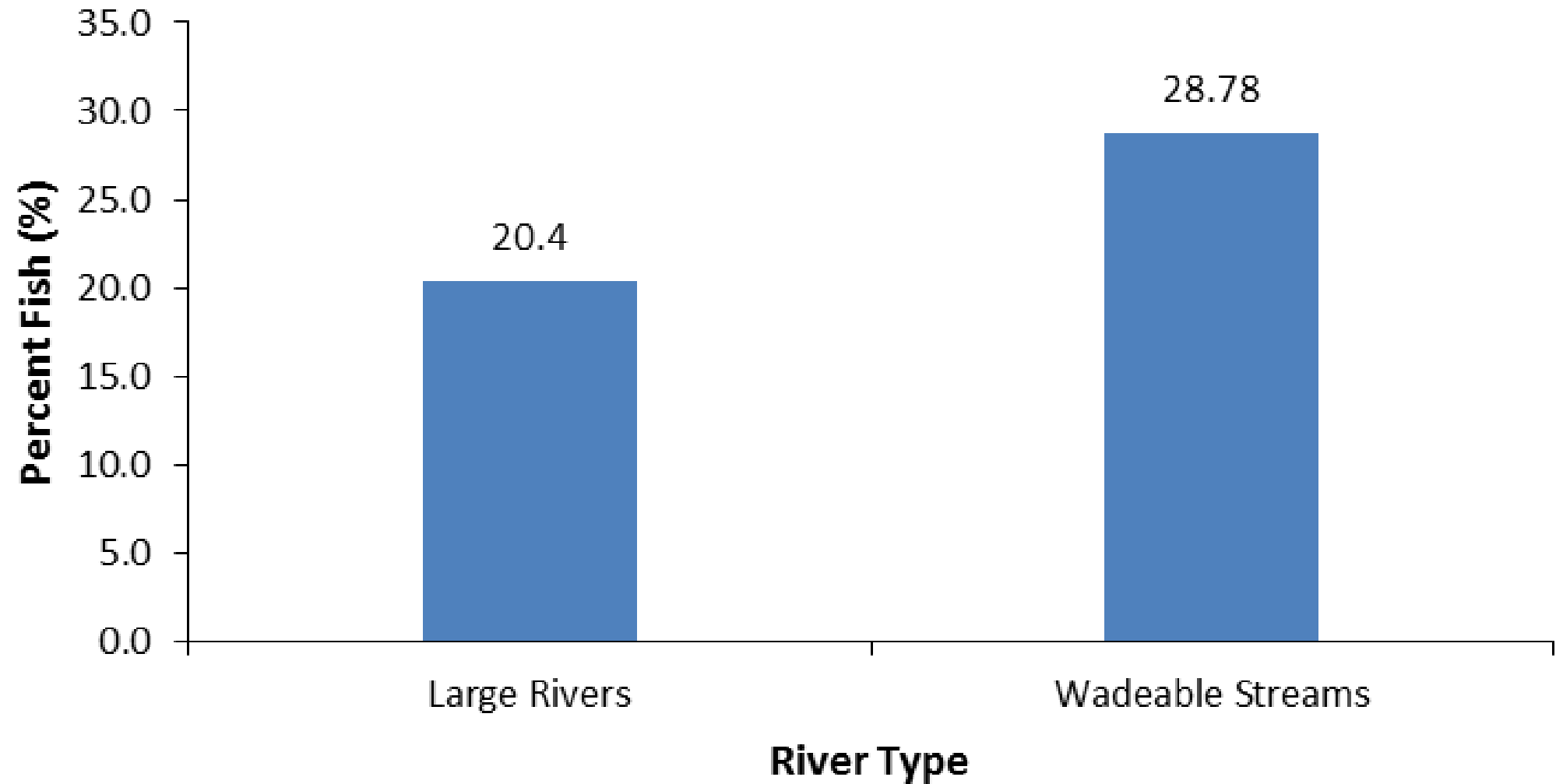


## Riverine Fish





## Riverine Fish



# Habitat Guild – Key Findings

- Riverine fish abundance 3-5 times greater in the Allegheny versus other drainages
- Riverine fish abundance almost double in non-tidal versus tidal rivers
- No major differences in abundance of riverine fish between large rivers and wadeable streams



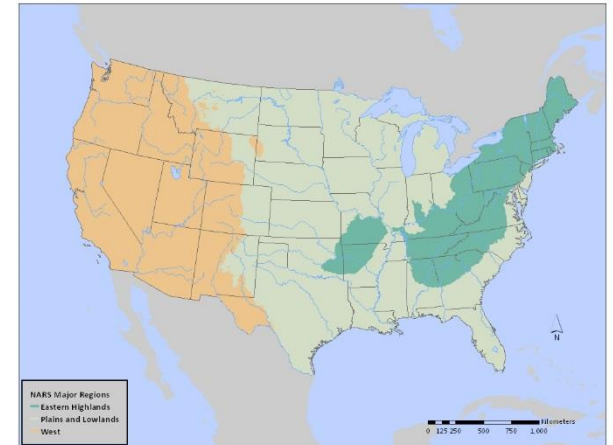
# Development of a Fish Multimetric Index (FMMI) – Peck et al. 2015

- Random Forest Model – for candidate metrics apply set of predictor variables to set of reference sites
- RFM provided expected metric values
- Approach used to remove effects of natural gradients on metric response
- RFM then applied to the entire set of sites
- Then evaluate metrics for their response to disturbance
- Metrics then selected to represent different classes of assemblage structure or function

# IBI Implications: Using the NRSA Eastern Highlands Climatic Region Fish Multimetric Index (FMMI)

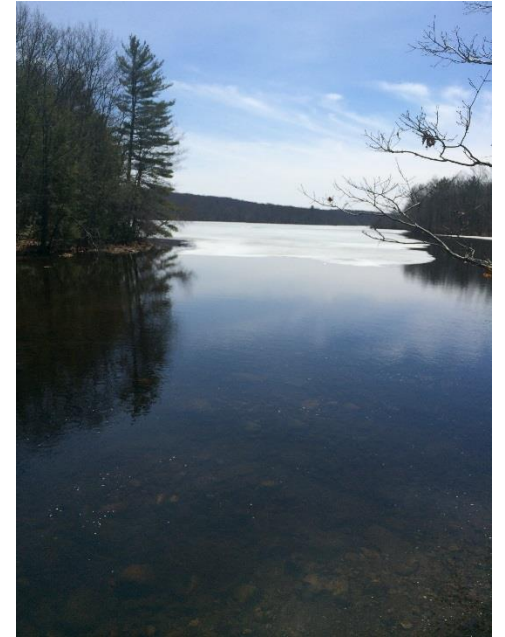
## Example

1. Nonnative - % individuals that are native
2. **Taxonomic composition** – No. of native Centrarchid taxa
3. **Habitat guild** - % taxa that are native, intolerant rheophils
4. **Migratory strategy** - % individuals that are native and migratory
5. Reproductive guild - % individuals that are lithophilic spawners
6. Richness - % taxa that are not tolerant
7. Tolerance - % taxa that are tolerant
8. **Trophic guild** - % taxa that are native invertivores



# Eastern Highlands Climatic Region FMMI – Key Findings

- **No. of native centrarchid taxa** – centrarchids 3-4 times less abundant in the Allegheny vs other drainages; 2 X the centrarchid abundance in non-tidal vs tidal rivers; centrarchids more abundant in large rivers than wadeable streams
- **% taxa that are native, intolerant rheophils** – riverine fish abundance 2-3 X greater in the Allegheny drainage vs other drainages; no major differences in abundance of riverine fish between tidal vs non-tidal and large rivers vs wadeable streams
- **% individuals that are native and migratory** – migratory fish only collected in NJ river drainages and Hudson drainage; migratory fish abundance in tidal rivers is almost 20 times that of non-tidal abundance; percentage of migratory fish in large rivers is approximately 2 X that of wadeable streams
- **% taxa that are native invertivores** – WC insectivores generally the same abundance across drainages, but BI are highly more abundant in the Allegheny drainage and PI are only present in NJ and Hudson drainages; PI more abundant in tidal rivers, but WC and BI more abundant in non-tidal rivers; large rivers have 2 X the insectivorous (PI, WC, BI) abundance vs wadeable streams and significantly greater taxa richness





# Conclusions

- Drainage, tidal influence, and river size does matter in the development of biological indices for large rivers
- Drainage, tidal influence, and river size has the potential to affect 5 of the 8 metrics that comprise the FMII
- Fish assemblage taxa richness, composition and autecological traits vary across large rivers in the Eastern Highlands

# Acknowledgements

- USEPA Corvallis, OR (Dave Peck, Karen Blocksom)
- Oregon State University (Alan Herlihy)
- NJDEP (John Vile and Brian Henning)
- Great Lakes Environmental Center, Traverse City, MI
- Tetra Tech, Inc. Owings Mills, MD
- Midwest Biodiversity Institute, Columbus, OH