Prediction of Fundamental Assemblages of Mid-Atlantic Highland Stream Fishes

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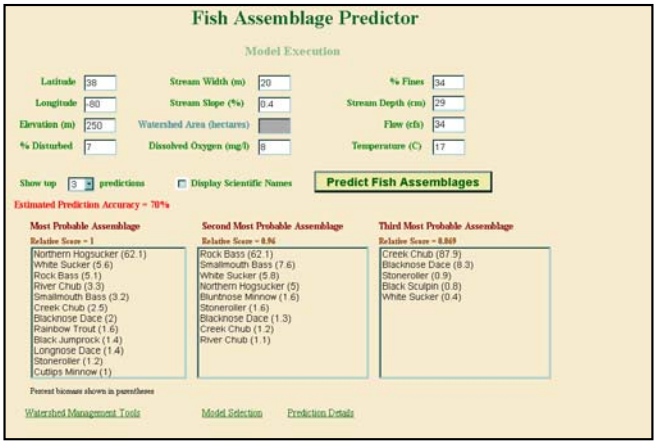
A software tool, the *Stream Fish Assemblage Predictor* (SFAP), developed using the USEPA's EMAP stream sampling data in the mid-Atlantic Highlands, can predict stream fish communities using stream and watershed characteristics. Step one in the tool development was a cluster analysis that formed groups (clusters) of streams with similar fish species. Each cluster has a multidimensional mean, or centroid, defined by the biomass of each species in the group. Using an iterative process, streams were added, one by one, to the cluster with the nearest centroid. I specified that each cluster had to have a membership of at least 1% of the total sample size of 665. Smaller clusters were deleted at the end of each iteration step. In addition, observations could not join a cluster if they were more than a specified Euclidean distance from the cluster centroid. This methodology produced 21 total clusters (see table at top right).

Step two was a discriminant analysis, which produced a system of equations to predict a stream's cluster based on characteristics of that stream and its watershed (e.g., stream depth, width, and flow; percent forested area in the watershed; amount of in-stream fine sediments).

Using the EMAP dataset, I tested the predictive accuracy of the discriminant equations. Streams were correctly classified approximately 42% of the time (i.e., the actual cluster was the most likely cluster). The actual cluster was one of the *three* most likely clusters approximately 70% of the time. Randomly, given three choices, one would only have a 3 in 21 chance of picking the correct assemblage (14%).

I envision use of this software by a wide diversity of stakeholders, from private landowners and public interest groups to municipal planners and developers to environmental management professionals. One goal would be to predict fish communities in streams for which basic watershed and stream characteristics are known, when actual sampling of the stream is cost prohibitive. Users could also investigate potential impacts of environmental restoration/degradation by altering stream and watershed characteristics, then noting subsequent changes in the predicted fish community. For researchers, this tool's basic fish community information can be passed to more complex, mechanistic fish community models that examine the effects of stressors on stream fish communities.

This tool can be accessed from the Canaan Valley Institute's website at www.canaanvi.org. A desktop version of the software is also being developed at ERD Athens. When completed, it will be distributed from EPA's Center for Exposure Assessment Modeling (CEAM) website: www.epa.gov/ceampubl/



IDENTIFIED FISH ASSEMBLAGES

Clusters are ordered by their number of member sites, from most members to least.

These numbers represent the average percentage of this cluster's total fish biomass attributable to this particular fish species.

Cluster 6	87
White Sucker	35.3
Blacknose Dace	11.3
Longnose Dace	7.3
Creek Chub	7.1
Rock Bass	5.9
Fallfish	5.0
Northern Hog Sucker	4.7
Cutlips Minnow	2.9
Sum	79.4

Cluster 10	58
White Sucker	71.5
Creek Chub	4.6
Blacknose Dace	4.5
Rock Bass	1.9
Northern Hog Sucker	1.5
Slimy Sculpin	1.4
Brown Trout	1.3
Brook Trout	1.2
Sum	87.9

Cluster 3	55
Northern Hog Sucker	26.6
Rock Bass	16.2
White Sucker	6.2
Smallmouth Bass	5.1
Stoneroller	5.0
Creek Chub	4.1
Bluntnose Minnow	3.7
Longnose Dace	2.9
Sum	69.8

Cluster 7	46
Rock Bass	62.1
Smallmouth Bass	7.6
White Sucker	5.8
Northern Hog Sucker	5.0
Bluntnose Minnow	1.6
Stoneroller	1.6
Blacknose Dace	1.3
Creek Chub	1.2
Sum	86.2

Cluster 9	40
Creek Chub	51.6
Blacknose Dace	23.9
White Sucker	3.9
Stoneroller	3.1
Bluehead Chub	2.4
Northern Hog Sucker	1.8
Longnose Dace	1.4
Black Sculpin	1.2
Sum	89.4

Cluster 2	31
Creek Chub	87.9
Blacknose Dace	8.3
Stoneroller	0.9
Black Sculpin	0.8
White Sucker	0.4
Pumpkinseed	0.2
Silvergaw Minnow	0.1
Bluntnose Minnow	0.1
Sum	98.6

Cluster 5	31
Blacknose Dace	93.9
Creek Chub	1.2
Fantail Darter	1.0
Smallmouth Bass	0.7
Bluehead Chub	0.6
Brook Trout	0.4
Black Sculpin	0.4
Stoneroller	0.4
Sum	98.5

Cluster 11	30
Smallmouth Bass	34.9
Rock Bass	12.9
White Sucker	5.6
Northern Hog Sucker	5.6
Stoneroller	3.6
Walleye	2.6
Largemouth Bass	2.5
Redbreast Sunfish	2.1
Sum	69.9

Cluster 20	28
Creek Chub	35.3
White Sucker	32.9
Blacknose Dace	12.5
Longnose Dace	1.8
Pumpkinseed	1.6
Mountain Redbelly Dace	1.3
Fallfish	1.2
Rock Bass	1.0
Sum	87.7

Cluster 13	26
Bluehead Chub	44.8
Creek Chub	10.2
Northern Hog Sucker	6.5
Blacknose Dace	3.4
Mountain Redbelly Dace	3.0
Green Sunfish	3.0
White Sucker	2.9
Creek Chubsucker	2.9
Sum	76.9

Cluster 16	26
Blacknose Dace	53.8
Creek Chub	16.4
White Sucker	6.7
Black Sculpin	2.4
Bluehead Chub	2.1
Stoneroller	1.9
Mountain Redbelly Dace	1.6
Fantail Darter	1.6
Sum	86.5

Cluster 12	22
Northern Hog Sucker	62.1
White Sucker	5.6
Rock Bass	5.1
River Chub	3.3
Smallmouth Bass	3.2
Creek Chub	2.5
Blacknose Dace	2.0
Rainbow Trout	1.6
Sum	85.4

Cluster 14	21
Torrent Sucker	60.0
Blacknose Dace	9.2
Bluehead Chub	6.0
Fallfish	4.9
Brook Trout	2.3
White Sucker	2.2
Stoneroller	1.3
Yellow Bullhead	1.0
Sum	86.8

Cluster 19	20
Blacknose Dace	34.1
Longnose Dace	21.8
Brook Trout	15.4
Black Sculpin	5.8
Slimy Sculpin	5.5
White Sucker	2.5
Stoneroller	2.2
Bluntnose Minnow	1.4
Sum	88.6

Cluster 4	16
Gizzard Shad	22.3
Longnose Gar	15.2
Flathead Catfish	12.3
Largemouth Bass	6.1
Silver Redhorse	4.6
Channel Catfish	4.4
Bluegill	4.0
Smallmouth Bass	2.8
Sum	71.6

Cluster 18	16
Creek Chubsucker	29.3
Chain Pickerel	18.1
Fallfish	11.7
White Sucker	7.4
Pumpkinseed	6.2
Largemouth Bass	2.9
Stoneroller	2.5
Torrent Sucker	1.9
Sum	80.0

Cluster 8	15
Brook Trout	87.3
Blacknose Dace	5.1
Black Sculpin	3.7
Mottled Sculpin	1.7
Longnose Dace	1.3
Slimy Sculpin	0.5
Fantail Darter	0.3
Sum	100.0

Cluster 21	15
Northern Hog Sucker	40.9
Smallmouth Bass	28.5
River Chub	6.4
Rock Bass	6.1
White Sucker	1.8
Muskellunge	1.5
Bluntnose Minnow	1.3
Creek Chub	1.3
Sum	87.8

Cluster 1	13
Creek Chubsucker	69.9
Bluehead Chub	7.0
White Sucker	3.3
Blacknose Dace	2.3
Largemouth Bass	2.2
Bluegill	1.7
Pumpkinseed	1.7
Green Sunfish	1.5
Sum	89.5

Cluster 15	9
Bluehead Chub	28.6
Roanoke Hogsucker	27.9
White Sucker	16.4
Black Jumprock	5.7
Torrent Sucker	5.5
Mountain Redbelly Dace	3.0
Stoneroller	1.7
Creek Chub	1.6
Sum	90.5

Cluster 17	9
Golden Redhorse	34.9
Smallmouth Bass	10.9
Northern Hog Sucker	6.5
Silver Redhorse	4.8
Torrent Sucker	3.4
Rock Bass	3.0
Redbreast Sunfish	3.0
Shorthead Redhorse	2.4
Sum	68.8

A sum of 100% and a low number of species means this cluster is well-defined, but it only has 15 member sites. Homogeneity in a larger cluster is more notable (e.g., Clusters 2 and 5).

A low sum indicates that this cluster is very heterogeneous. It takes 33 species to increase the summed cluster biomass to > 95%. Beyond saying that the presence of Golden Redhorse is likely, it is difficult to predict with accuracy what a fish community in streams of this cluster will look like.

SPATIAL DISTRIBUTIONS OF IDENTIFIED ASSEMBLAGES