U.S. Department of the Interior
U.S. Geological Survey

FISH-COMMUNITY COMPOSITION IN OTSELIC RIVER, IN THE VICINITY OF WHITNEY POINT LAKE, BROOME AND CORTLAND COUNTIES, NEW YORK, 2000

Open-File Report 01-78

Prepared in cooperation with the

U.S. ARMY CORPS OF ENGINEERS, BALTIMORE DISTRICT

U.S. Department of the Interior
U.S. Geological Survey

FISH-COMMUNITY COMPOSITION IN OTSELIC RIVER, IN THE VICINITY OF WHITNEY POINT LAKE, BROOME AND CORTLAND COUNTIES, NEW YORK, 2000

by Robin A. Brightbill and Michael D. Bilger

Open-File Report 01-78

Prepared in cooperation with the

U.S. ARMY CORPS OF ENGINEERS, BALTIMORE DISTRICT

New Cumberland, Pennsylvania
2001

U.S. DEPARTMENT OF THE INTERIOR

GALE A. NORTON, Secretary

U.S. GEOLOGICAL SURVEY

Charles G. Groat, Director

For additional information
write to:

District Chief
U.S. Geological Survey
215 Limekiln Road
New Cumberland, Pennsylvania 17070-2424

Copies of this report may be
purchased from:

U.S. Geological Survey
Branch of Information Services
Box 25286
Denver, Colorado 80225-0286

CONTENTS

ILLUSTRATION

TABLES

CONVERSION FACTORS AND ABBREVIATIONS

Multiply	By	To obtain
	Length	
millimeter (mm)	0.03937	inch
meter (m)	3.281	foot
kilometer (km)	0.6214	mile
	Area	
square meter (m^2)	10.76	square foot
square kilometer (km^2)	0.3861	square mile
	Mass	
gram (g)	0.03527	ounce, avoirdupois
	Temperature	
degree Fahrenheit (F)	°F = 1.8°C + 32	degree Celsius

Abbreviated water-quality units used in report:
µS/cm, microsiemens per centimeter at 25 degrees Celsius

FISH-COMMUNITY COMPOSITION IN OTSELIC RIVER, IN THE VICINITY OF WHITNEY POINT LAKE, BROOME AND CORTLAND COUNTIES, NEW YORK, 2000

by Robin A. Brightbill and Michael D. Bilger

ABSTRACT

The U.S. Army Corps of Engineers, Baltimore District, has been conducting biological surveys of the inflow and outflow streams of Whitney Point Lake since the early 1980's. These surveys are made to identify possible detrimental effects as well as benefits of the reservoir and to better understand the aquatic communities in the vicinity of the lake at the present and over time. The U.S. Army Corps of Engineers and the U.S. Geological Survey jointly conducted a survey of the fish communities upstream and downstream of the reservoir in Otselic River in September 2000. The fish communities upstream and downstream were compared and any differences or similarities seen in the communities were noted.

This study found the fish communities upstream and downstream of Whitney Point Lake to be in good condition, with Index of Biotic Integrity (IBI) scores 4.3 upstream and 4.5 downstream. The habitat conditions of both reaches were of suboptimal quality, with a score of 15 for both reaches as determined by use of the U.S. Environmental Protection Agency's Rapid Bioassessment Protocols, yet are capable of supporting fish communities. The Shannon Index was 3.83 upstream and 3.16 downstream of the lake, indicating that both reaches are slightly impacted by species richness and lack of individual evenness among the species. The communities also were different from each other. Only 11 of the 21 species upstream were also captured downstream. The Jaccards Coefficient and the Index of Similarity reflect this community difference with scores of 0.39 and 0.56, respectively.

INTRODUCTION

Biological surveys of streams in the vicinity of selected lakes were initiated in 1982 by the Baltimore District, U.S. Army Corps of Engineers (COE). The principal objective of the surveys is to identify possible detrimental effects as well as benefits of the lakes, add to a database that was developed for monitoring the composition, abundance, diversity, and distribution of fishes over time, and provide a better understanding of the aquatic resources in the vicinity of the lakes. The fish communities at the inflow and outflow of the Whitney Point Lake were surveyed on September 12 and 28, 2000.

The study was a joint effort between the COE and the U.S. Geological Survey (USGS). An assessment of the habitat suitability for sustaining fish communities also was included in the study. Fish communities were sampled to determine their structure and health and any differences that may exist upstream and downstream of the lake.

DESCRIPTION OF THE DAM AND STREAM STUDY REACHES

The Whitney Point Dam was completed in 1953 for the purpose of flood control in the Otselic River (U.S. Army Corps of Engineers, 2000). The dam is operated by use of a gated outlet bottom release system. Otselic River is a tributary to the Tioughnioga River, which flows into the Chenango River, then into the Susquehanna River near Binghamton, N.Y.

Stream reaches were selected to correspond with existing COE macroinvertebrate reaches and previously sampled fish-community reaches. Each reach was a minimum of 100 m (330 ft) long and included a proportional representation of the available geomorphologic units for the stream—riffle, run, or pool.

Two reaches, one upstream and one downstream of Whitney Point Lake, were chosen for the fish-community study (fig. 1). The upstream reach is Otselic River upstream of Whitney Point Lake at Landers Corner Fishing Access, N.Y. (latitude / longitude = 42°25′22″ / 75°56′59″). The downstream reach is Otselic River downstream of Whitney Point Dam, N.Y. (latitude / longitude = 42°20′02″ / 75°58′05″).

Otselic River upstream of Whitney Point Lake at Landers Corner Fishing Access begins approximately 5 stream km (3 mi) upstream from where the river flows into the reservoir and extends upstream 147 m (482 ft). The drainage area is 559 km^2 (216 mi^2). The approximate area sampled was 5,439 m^2 (58,523 ft^2). The geomorphic channel units were riffle and pool, and bottom material was cobble and boulder. Both banks of the lower half of the reach were capped by roads. A bridge crossed over the reach, and above this reach on the left bank the riparian zone was estimated at greater than 100 m (330 ft) in width. At the top of the reach along the left bank was a pool of backwater and the bottom was silt, cobble, and boulder. There was a pool along the right side of the stream in the vicinity of the bridge that had a cobble, boulder bottom. Water quality parameters for the reach were a pH of 7.79, a water temperature of 19.0°C (66.2°F), and specific conductance of 146 µS / cm.

Otselic River downstream of Whitney Point Lake begins approximately 400 m (1,300 ft) downstream of the dam and extends upstream 185 m (607 ft). The drainage area is 666 km^2 (257 mi^2). The approximate area sampled was 6,845 m^2 (73,652 ft^2). The geomorphic channel units were riffle and pool, and the bottom material was cobble and sand. The riparian zone on the left bank was between 6 and 12 m (20 and 39 ft) in width and on the right bank it was less than 6 m (20 ft) in width. Along the left edge of water was a channel running the length of the pool that was too deep to electrofish. On the right edge of water was a back water channel with a silty bottom that was incorporated into the reach. Water quality parameters for the reach were a pH of 7.82, a water temperature of 20.5°C (68.9°F), and specific conductance of 156 µS / cm.

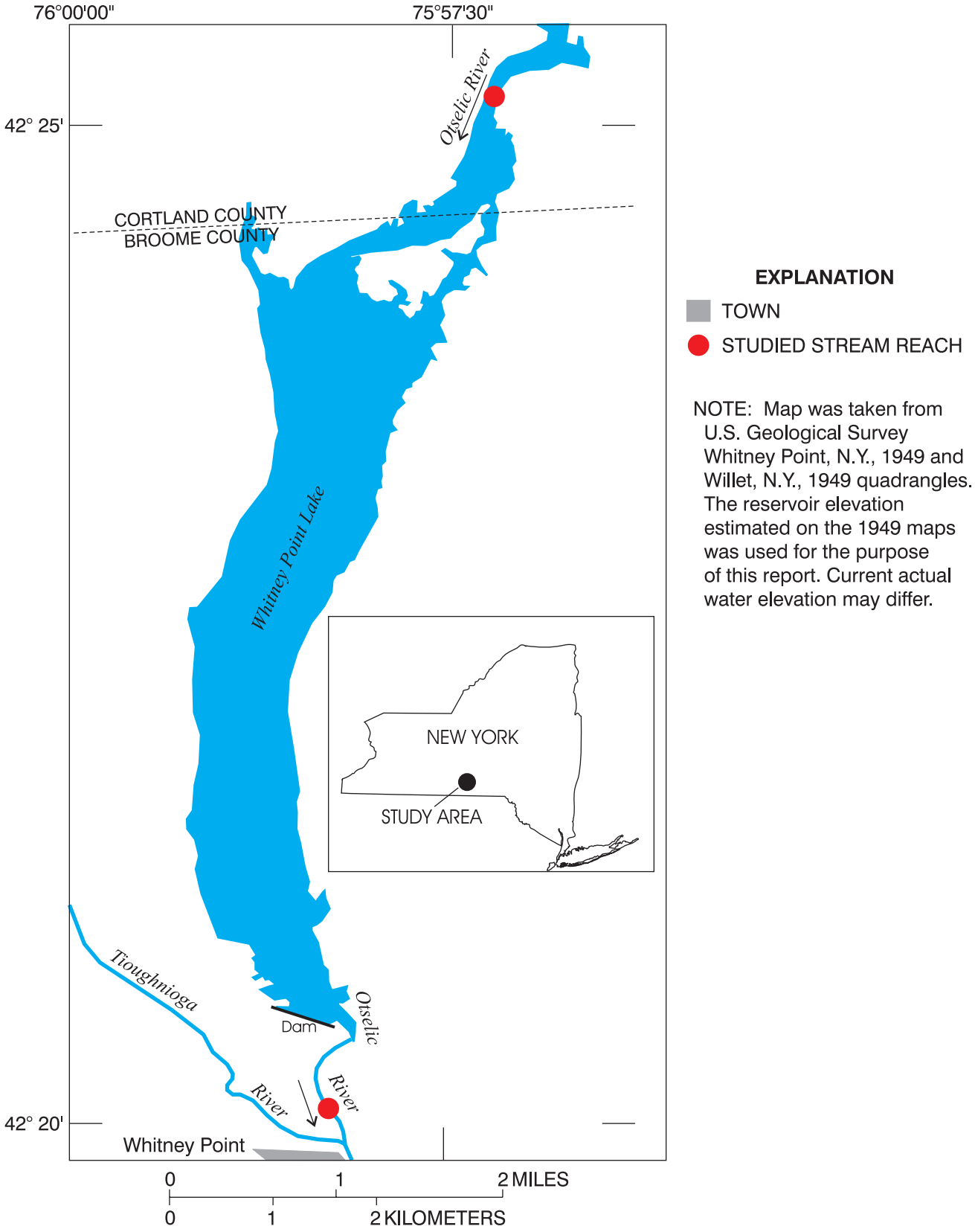

Figure 1. Location of reaches sampled for fish communities upstream and downstream of Whitney Point Lake, N.Y., 2000.

STUDY METHODS

The fish communities upstream and downstream of Whitney Point Lake were surveyed on September 12 and 28, 2000. These communities were characterized by total number of species collected and relative abundance of each species. Habitat was assessed and related to the fish communities present in each stream reach.

Fish Sampling

Both reaches were wadable. A Smith-Root Model 12-B backpack electroshocker incorporating pulsed DC was used at each sampling reach. Both reaches were covered with a double pass in an upstream direction. Crew size consisted of six individuals downstream (shock time of 5,109 seconds) and five individuals upstream (shock time of 6,676 seconds). The backpack electroshocker, an electrode, and a net were carried by one person. The other individuals on the crew netted the fish and put them in buckets.

After each pass, the captured fish were placed into rubber tubs with aerators, sorted, and identified to species using regional texts to confirm identifications (Jenkins and Burkhead, 1994; Page and Burr, 1991; Smith, 1985). A maximum of 30 individuals per species were weighed (grams), measured for total and standard lengths (millimeters), and examined for external anomalies (Meador and others, 1993). After 30 individuals of a species were weighed and measured, the remaining fish were counted and mass weighed to the nearest gram. A summary of the fish data can be found in the appendix. A few specimens were put into 10 percent buffered formaldehyde for a voucher collection and verification in the USGS laboratory in Lemoyne, Pa. Fish from the first pass were placed in a live cage away from the reach being shocked to prevent further trauma. After both passes were completed, the fish were released back into the stream.

Habitat Quantification

Habitat assessment was conducted according to the Rapid Bioassessment Protocols (RBP) (Barbour and others, 1999). The riffle and run prevalence data form was used. Ten criteria were used to assess the quality of the fish habitat. Each criterion is rated on a score of 1 to 20. These scores were summed for a total habitat score. An average was then calculated and assessment was made on this averaged score. A score of 0-5 is poor, 6-10 is marginal, 11-15 is suboptimal, and 16-20 is optimal (Barbour and others, 1999; Klemm and Lazorchak, 1995). A reach with a higher habitat score should, theoretically, support a healthier fish community than a reach with a lower habitat score.

Data Analysis

The numbers of fish and their weights were totalled by species. The catch-per-unit-effort (CPUE) was calculated by dividing the number of fish collected by the total electroshocking time (Nielsen and Johnson, 1983). CPUE was used to compare the number of fish collected at each reach for the amount of time used for the effort. A higher CPUE would show more fish in an area than a lower CPUE. The reach with the lower CPUE is typically considered to be more impaired than a reach with a higher CPUE (Nielsen and Johnson, 1983).

Four indices were generated to further assess the health of the fish communities found in these reaches. The Shannon Index (H') is a value that combines species richness and evenness where >3.99 can be considered non-impacted; 3.00-3.99, slightly impacted; 2.00-2.99, moderately impacted; and <2.00, severely impacted (Bode and others, 1993). This calculation gives one estimate of the health of the entire fish community in each reach. A Jaccard Coefficient of Similarity and an Index of Similarity (Klemm and others, 1990) measure community similarity using the species present in both reaches and those found only in one reach or the other. These index scores can range between 0.0 and 1.0, with values increasing as the similarities between reaches increase (Plafkin and others, 1989). The fourth index is an Index of Biotic Integrity (IBI). The Maryland IBI for non-coastal streams (Roth and others, 1997) was used because no IBI's have been developed for Pennsylvania and New York streams. The IBI score is used to measure the health of a fish community taking into consideration the number of native species, feeding habits of the species present, and their tolerance or intolerance to water pollution and sediment. The first two metrics for the

IBI, number of native species and number of benthic species, are adjusted for watershed areas using the formula in Roth and others (1997). A numeric scale where 1.0-1.9 is very poor, 2.0-2.9 is poor, 3.0-3.9 is fair, and 4.0-5.0 is good (Roth and others, 1997) is used to show the health of the community. These indices in combination with the CPUE are used to show any differences between the fish communities in the reaches surveyed, to determine if the fish communities show any impairment, and to aid in assessing if differences seen in the communities are because of the dam.

The state of New York is in the process of developing IBI's for each drainage basin in the state (K.R. Murray, U.S. Geological Survey, oral commun., 2000). However, the IBI will not be complete before the end of this project. Because of this fact, the well-researched and highly tested model developed by the Maryland Biological Stream Survey (MBSS) was selected. The use of regional IBI's has been endorsed by Miller and others (1988) and use of regional reference sites by Hughes and others (1986). These studies indicate that when geographically specific IBI's or reference conditions are not available, reasonably comparative conditions from ecologically similar areas may be used.

Although somewhat geographically distant, the fish faunal assemblages of Maryland were thought to better represent the Susquehanna River Basin drainage than the species depauperate northeastern region or the Ohio region where species are dissimilar to those found in the Susquehanna River drainage. Many metrics included in all multi-metric scoring systems seem to have 4-5 core metrics that explain most of the classification efficiency of the index. The remaining metrics add redundancy to ensure that a strong mathematical signal is developed. For example, 4 of the 12 metrics in the original IBI (Karr, 1981) are influenced by sediment.

The Maryland area where the IBI was developed may not be locally specific, but it does include a portion of the lower Susquehanna River drainage. The IBI also includes many sites, covers many species collected in the study area, and, very importantly, is adjusted for basin size. It is the logical alternative to use under these conditions.

FISH-COMMUNITY COMPOSITION

In the Whitney Point Lake river system, the number of fish species identified at the upstream site was 21, with central stoneroller followed by fallfish as the dominant species. The number of fish species at the downstream site was 18, with banded darter followed by rock bass as the dominant species (table 1).

Table 1. *Taxa list, native or exotic, trophic status, tolerance value, number of individuals, total weight by species and for all species, total number of individuals, total number of species, catch-per-unit effort, Shannon Index, Jaccard Coefficient, and Index of Similarity for fish communities upstream and downstream of Whitney Point Lake, N.Y., 2000*

[N, native; E, exotic; G, generalist; H, herbivore; S, insectivore; P, piscivore; I, intolerant; M, intermediate; T, tolerant; —, not collected in this sample]

Taxa	Native or exotic[1]	Trophic status[2]	Tolerance value[2]	Otselic River upstream		Otselic River downstream	
				Number of individuals	Species total weight in grams	Number of individuals	Species total weight in grams
Central stoneroller, *Campostoma anomalum*	N	H	T	122	342	—	—
Spotfin shiner, *Cyprinella spiloptera*	N	S	T	—	—	22	44
Cutlips minnow, *Exoglossum maxillingua*	N	S	I	43	273	—	—
Common shiner, *Luxilus cornutus*	N	S	M	—	—	1	4
River chub, *Nocomis micropogon*	N	G	M	2	44	—	—
Spottail shiner, *Notropis hudsonius*	N	S	M	22	38	—	—
Rosyface shiner, *Notropis rubellus*	N	S	I	42	44	—	—
Bluntnose minnow, *Pimephales notatus*	N	G	T	15	33	24	103
Blacknose dace, *Rhinichthys atratulus*	N	G	T	16	23	—	—
Longnose dace, *Rhinichthys cataractae*	N	S	M	13	26	—	—
Fallfish, *Semotilus corporalis*	N	G	M	107	290	7	12
White sucker, *Catostomus commersoni*	N	G	T	18	586	2	236
Northern hog sucker, *Hypentelium nigricans*	N	G	M	53	1,152	1	88
Yellow bullhead, *Ameiurus natalis*	N	G	T	—	—	2	133
Margined madtom, *Noturus insignis*	N	S	M	48	332	—	—
Brown trout, *Salmo trutta*	E	P	I	1	107	—	—
Sculpin, *Cottus spp.*	N	S	M	85	284	—	—
Rock bass, *Ambloplites rupestris*	N	P	M	30	605	74	2,543
Green sunfish, *Lepomis cyanellus*	N	G	T	—	—	2	15
Pumpkinseed, *Lepomis gibbosus*	N	G	M	8	55	1	18
Bluegill, *Lepomis macrochirus*	N	G	T	51	118	17	519

Table 1. *Taxa list, native or exotic, trophic status, tolerance value, number of individuals, total weight by species and for all species, total number of individuals, total number of species, catch-per-unit effort, Shannon Index, Jaccard Coefficient, and Index of Similarity for fish communities upstream and downstream of Whitney Point Lake, N.Y., 2000—Continued*

[N, native; E, exotic; G, generalist; H, herbivore; S, insectivore; P, piscivore; I, intolerant; M, intermediate; T, tolerant; —, not collected in this sample]

Taxa	Native or exotic[1]	Trophic status[2]	Tolerance value[2]	Otselic River upstream		Otselic River downstream	
				Number of individuals	Species total weight in grams	Number of individuals	Species total weight in grams
Smallmouth bass, *Micropterus dolomieu*	N	P	M	63	908	65	602
Largemouth bass, *Micropterus salmoides*	N	P	M	1	83	7	29
Tessellated darter, *Etheostoma olmstedi*	N	S	M	34	55	39	81
Banded darter, *Etheostoma zonale*	N	S	I	—	—	84	172
Yellow perch, *Perca flavescens*	N	P	M	—	—	7	88
Shield darter, *Percina peltata*	N	S	M	10	22	17	78
Walleye, *Stizostedion vitreum*	N	P	M	—	—	1	86
Totals				784	5,420	373	4,851
Total number of species				21		18	
CPUE (number of individuals per shocking time in minutes)				7.1		4.4	
H' (Shannon Index)				3.83		3.16	
Jaccard Coefficient				.39			
Index of Similarity				.56			

[1] Halliwell and others, 1999.
[2] Barbour and others, 1999.

The Jaccard Coefficient and the Index of Similarity were 0.39 and 0.56, respectively (table 1). The CPUE score was 7.1 upstream and 4.4 downstream. The IBI scores of the two reaches were 4.3 upstream and 4.5 downstream (table 2). Average habitat scores were both 15, indicating the habitat was on the line between suboptimal and optimal. The differences seen were in individual parameters of epifaunal substrate / available cover and the frequency of riffles (table 3).

Table 2. *Index of Biotic Integrity (IBI) metrics and scores for fish communities upstream and downstream of Whitney Point Lake, N.Y., 2000*

[Scores: 4.0-5.0, good; 3.0-3.9, fair; 2.0-2.9, poor; 1.0-1.9, very poor]

IBI metric [1]	Otselic River upstream	Otselic River downstream
Number of native species (adjusted value)	5	5
Number of benthic species (adjusted value)	5	5
Percentage tolerant individuals	5	5
Percentage abundance of dominant species	5	5
Percentage generalists, omnivores, and invertivores	5	5
Percentage insectivores	3	5
Number of individuals per square meter	1	1
Percentage lithophilic spawners	5	5
Average IBI score	4.3	4.5

[1] Roth and others, 1997.

Table 3. *Habitat parameters and assessment upstream and downstream of Whitney Point Lake, N.Y., 2000*

[Scores: 0-5, poor; 6-10, marginal; 11-15, suboptimal; 16-20, optimal]

Habitat parameter[1]	Otselic River upstream	Otselic River downstream
Epifaunal substrate / available cover	18	10
Embeddedness	15	19
Velocity / depth regime	20	20
Sediment deposition	16	19
Channel flow status	19	17
Channel alteration	15	18
Frequency of riffles (or bends)	12	5
Bank stability	17	18
Vegetative protection	18	14
Riparian vegetative zone width	2	6
Total score	152	146
Average score	15	15

[1] Barbour and others, 1999.

The IBI scores for both reaches indicate that the communities in each reach are in good condition. The condition of the upstream community appears to be a little less than what would be expected for a stream reach its size. However, the Shannon Index indicates that both reaches are slightly impacted as far as species richness and evenness is concerned and that upstream was a little better than downstream as seen by the values of 3.83 and 3.16, respectively. The IBI score takes into account the types of species found and their functions in the community; the Shannon Index takes into account the number of species and the number of individuals. Both scores indicate that the communities are not pristine but they are in good condition and the stream is able to support a variety of aquatic life.

The Jaccard Coefficient (0.39) and the Index of Similarity (0.56) indicate that the communities, even though close in number of species, are different. These differences could be caused by the habitat of the reaches. The epifaunal substrate and available cover for fish upstream was more diverse and provided more places for the fish to live. The downstream reach had less cover for fish to live around, the frequency of riffles was less, and fewer cyprinid species were caught, possibly a result of a pooled area in the upper portion of the downstream reach that was inaccessible. The water in the pool was too deep to wade. If electrofishing could have been possible in this pool, one or a few more taxa may have been added to the list and the numbers of fish caught may have increased.

The community differences seen in Otselic River between the upstream and downstream reaches is not in the number of species captured but rather in the community composition. Upstream 21 and downstream 18 species were captured; however, only 11 species were captured in both reaches. The three dominant species upstream were central stoneroller, fallfish, and sculpin; downstream, they were banded darter, rock bass, and smallmouth bass (table 1).

The dominant species upstream that were not captured downstream were central stoneroller and sculpin. Only 7 fallfish were captured in the downstream reach compared to 107 upstream (table 1). All three species are typically found in streams with rubble, gravel, or rock bottoms and clear, cool waters with moderate currents (Jenkins and Burkhead, 1994; Page and Burr, 1991; Rohde and others, 1994; Smith, 1985). The sculpin and the central stoneroller are algal feeders (Jenkins and Burkhead, 1994); the fallfish are more general (Barbour and others, 1999) in their feeding habits and can survive in a greater variety of habitats than the other two mentioned.

The dominant species in the downstream reach were the banded darter, rock bass, and the smallmouth bass (table 1). Of the three, the banded darter was the only species captured exclusively in the downstream reach. About twice the number of rock bass were captured in the downstream reach and about the same number of smallmouth bass were captured in both reaches. Banded darter requirements are similar to those of the sculpin and central stonerollers (Page and Burr, 1991; Rohde and others, 1994) with the main difference being they are insectivores (Barbour and others, 1999) and do not depend on algae for their food supply. Rock bass habitat requirements are similar to those of the other species in needing a rock, gravel bottom, but they are found in deeper and slower moving waters around boulders and snags (Jenkins and Burkhead, 1994; Page and Burr, 1991; Rohde and others, 1994). These species differences also reflect the habitat differences noted in table 3.

The fish communities appear to be in good condition, according to the IBI score. External anomalies included blackspot and leeches at both sites. Some parasites were noted on the margined madtoms, and many of the centrarchids were missing eyes at the upstream reach (see Appendix). The missing eyes are thought to be caused by the presence of cutlips minnows, which in confined spaces will attack other fish, knock their eye(s) out, and then eat the eye(s) (Jenkins and Burkhead, 1994; Smith, 1985). This behavior is thought to be a territorial response to overcrowding (Jenkins and Burkhead, 1994). Several species in the downstream reach showed signs of fin erosion that was not noted upstream. With the exception of blackspot, less than 50 percent of the fish captured showed signs of anomalies (see Appendix). Parasitic anomalies show an inconsistent relation with water quality and are therefore recorded but not used in assessments of water quality but can be used to show fish health (Sanders and others, 1999). Fin erosion seems to correlate nicely with point-source discharges of factories and wastewater treatment facilities where chlorine products are used (Sanders and others, 1999) or can be a clinical sign for possible bacterial infections (Nielson and Johnson, 1983). The anomalies do not indicate that there are any serious water-quality problems.

The Whitney Point Lake may or may not have caused the differences seen at the downstream reach. Both communities appear to be in good health as indicated by the IBI scores (table 2) yet are different in community structure. Specific conductance, temperature, and pH of the two reaches were similar and water quality does not appear to be the reason for the differences. The difference seems to be attributable to habitat. Whether or not these two reaches were similar in habitat before the dam was built is not known. The reach downstream of the dam is also only about 2 km (1 mi) from the mouth where the Otselic River flows into the Tioughnioga River. Without historical data, no cause for the habitat and community

differences can be directly linked to the installation of the dam nor can it be linked to the influence of the Tioughnioga River. Present data shows the communities within the surveyed reaches are in good condition but their species compositions are different.

SUMMARY

Otselic River upstream and downstream of the Whitney Point Lake was studied to evaluate the current status of fish communities in the vicinity of the lake. The intent was to determine if the communities above and below the lake are similar or different and to comment on the health of the communities present in each reach.

On the basis of calculated Index of Biotic Integrity (IBI) scores, both fish communities are in good condition. The habitats in both reaches were suboptimal and different, which was reflected in the fish-community composition. The Jaccards Coefficient of 0.39 and an Index of Similarity of 0.56 statistically show the difference. Only 11 of the 21 species captured upstream were the same species captured downstream. The Shannon Index indicates that both communities are slightly impacted with downstream being more impacted than upstream.

Whether the dam is the cause for the differences seen in these habitat and community structures can not be determined from this point-in-time study. The downstream reach is only a short distance from the mouth of Otselic River where it flows into the Tioughnioga River. The differences seen may be natural, could have been accentuated by the barrier of the dam, or maybe some habitat alteration was caused by the dam. Only pre-dam historical data compared to present data would give an indication whether or not the dam has influenced the downstream reach causing the differences noted in this study.

REFERENCES CITED

Barbour, M.T., Gerritsen, J., Snyder, B.D., and Stribling, J.B., 1999, Rapid bioassessment protocols for use in streams and wadable rivers—Periphyton, benthic macroinvertebrates and fish, (2d ed.): Washington, D.C., U.S. Environmental Protection Agency, EPA 841-B-99-002, 202 p. + 4 appendices.

Bode, R.W., Novak, M.A., and Abele, L.E., 1993, 20 year trends in water quality of rivers and streams in New York State based on macroinvertebrate data, 1972-1992: Albany, N.Y., New York State Department of Environmental Conservation, 217 p.

Halliwell, D.B., Langdon, R.W., Daniels, R.A., Kurtenbach, J.P., and Jacobson, R.A., 1999, Classification of freshwater fish species of the northeastern United States for use in the development of indices of biological integrity, with regional applications *in* Simon, T.P., ed., Assessing the sustainability and biological integrity of water resources using fish communities: Boca Raton, Fla., CRC Press, p. 301-338.

Hughes, R.M., Larsen, D.P., and Omernik, J.M., 1986, Regional reference sites—A method for assessing stream pollution: Environmental Management, v. 10, 7 p.

Jenkins, R.E., and Burkhead, N.M., 1994, Freshwater fishes of Virginia: Bethesda, Md., American Fisheries Society, 1,079 p.

Karr, J.R., 1981, Assessment of biotic integrity using fish communities: Fisheries, v. 6(6), 7 p.

Klemm, D.J., and Lazorchak, J.M., 1995, Environmental monitoring and assessment program, surface waters—Field operations and methods for measuring the ecological condition of wadable streams: Cincinnati, Ohio, U.S. Environmental Protection Agency, EPA/620/12094/004, 130 p. + 9 appendices.

Klemm, D.J., Lewis, P.A., Fulk, F., and Lazorchak, J.M., 1990, Macroinvertebrate field and laboratory methods for evaluating the biological integrity of surface waters: Cincinnati, Ohio, U.S. Environmental Protection Agency, EPA/600/4-90/030, 256 p.

REFERENCES CITED—CONTINUED

Meador, M.R., Cuffney, T.F., and Gurtz, M.E., 1993, Methods for sampling fish communities as part of the National Water-Quality Assessment Program: U.S. Geological Survey Open-File Report 93-104, 38 p.

Miller, D.L., Leonard, P.M., Hughes, R.M., Karr, J.R., Moyle, P.B., Schrader, L.H., Thompson, B.A., Daniel, R.A., Fausch, K.D., Fitzhugh, G.A., Gammon, J.R., Halliwell, D.B., Angermeier, P.L., and Orth, D.J., 1988, Regional applications of an index of biotic integrity for use in water resource management: Fisheries, v. 13(5), 9 p.

Nielsen, L.A., and Johnson, D.L., eds., 1983, Fisheries techniques: Bethesda, Md., American Fisheries Society, 468 p.

Page, L.M., and Burr, B.M., 1991, Peterson field guide to freshwater fishes: New York, Houghton Mifflin Company, 432 p.

Plafkin, J.L., Barbour, M.T., Porter, K.D., Gross, S.K., and Hughes, R.M., 1989, Rapid bioassessment protocols for use in streams and rivers—Benthic macroinvertebrates and fish: Washington, D.C., U.S. Environmental Protection Agency, EPA/440/4-89/001, 128 p. + 4 appendices.

Rohde, F.C., Arndt, R.G., Lindquist, D.G., and Parnell, J.F., 1994, Freshwater fishes of the Carolinas, Virginia, Maryland, and Delaware: Chapel Hill, N.C., The University of North Carolina Press, 222 p.

Roth, N.E., Southerland, M.T., Chaillou, J.C., Vølstad, J.H., Weisberg, S.B., Wilson, H.T., Heimbuch, D.G., and Seibel, J.C., 1997, Maryland biological stream survey—Ecological status of non-tidal streams in six basins sampled in 1995: Linthicum, Md., Versar, Inc., Columbia, Md. and Coastal Environmental Services, Chesapeake Bay and Watershed Programs Monitoring and Non-tidal Assessment, CBWP-MANTA-EA-97-2. 151 p. + 6 appendices.

Sanders, R.E., Miltner, R.J., Yoder, C.O., and Rankin, E.T., 1999, The use of external deformities, erosion, lesions, and tumors (DELT anomalies) in fish assemblages for characterizing aquatic resources—A case study of seven Ohio streams *in* Simon, T.P., ed., Assessing the sustainability and biological integrity of water resources using fish communities: Boca Raton, Fla., CRC Press, p. 225-248.

Smith, C.L., 1985, The inland fishes of New York State: Albany, N.Y., New York State Department of Environmental Conservation, 522 p.

U.S. Army Corps of Engineers, 2000, Civil Works Project Information: accessed November 13, 2000, at URL <http://crunch.tec.army.mil/dpn/webpages/DPNSearch.html#General>

APPENDIX

Study Unit: COE
Station Name: Otselic River upstream of Whitney Point Lake at Landers Corner Fishing Access, N.Y.
Sampling Gear Code: backpack electroshocker

Date of Collection: 9/28/00
Number of Species at Site: 21
Time (min)/Pass: 51/pass1; 60/pass2

Species name	Total number of fish per species	Percentage of total number of fish	Total weight per species (grams)	Percentage total weight	Average weight (grams)	Range of weights (grams)	Average total length (millimeters)	Range of total lengths (millimeters)	Average standard length (millimeters)	Range of standard lengths (millimeters)
Central stoneroller, *Campostoma anomalum*	122	17	342	6	3	1-35	63	44-146	50	34-120
Cutlips minnow, *Exoglossum maxillingua*	43	6	273	5	6	1-22	74	35-123	60	28-101
River chub, *Nocomis micropogon*	2	<1	44	1	22	1-43	102	47-157	84	37-130
Spottail shiner, *Notropis hudsonius*	22	3	38	1	2	1-7	48	29-92	38	23-75
Rosyface shiner, *Notropis rubellus*	42	6	44	1	1	1-3	49	38-80	40	29-65
Bluntnose minnow, *Pimephales notatus*	15	2	33	1	2	1-5	57	25-83	47	20-70
Blacknose dace, *Rhinichthys atratulus*	16	2	23	<1	1	1-3	45	30-60	36	25-50
Longnose dace, *Rhinichthys cataractae*	13	2	26	<1	2	11-8	57	45-95	46	35-78
Fallfish, *Semotilus corporalis*	107	15	290	5	3	1-33	65	47-155	51	36-125
White sucker, *Catostomus commersoni*	18	3	586	11	33	5-193	111	67-251	89	51-210
Northern hog sucker, *Hypentelium nigricans*	53	8	1,152	21	22	2-303	94	49-291	76	37-240
Margined madtom, *Noturus insignis*	48	7	332	6	7	1-16	81	32-120	53	26-105
Brown trout, *Salmo trutta*	1	<1	107	2	107	107	227	227	182	182
Sculpin, *Cottus spp.*	85	12	284	5	3	1-9	61	29-85	50	31-69
Rock bass, *Ambloplites rupestris*	30	4	605	11	20	1-201	74	7-206	62	21-180
Pumpkinseed, *Lepomis gibbosus*	8	1	55	1	7	5-8	65	56-73	52	45-57
Bluegill, *Lepomis macrochirus*	51	7	118	2	2	1-31	44	35-115	33	25-90
Smallmouth bass, *Micropterus dolomieu*	63	9	908	17	14	2-51	86	47-160	69	39-130
Largemouth bass, *Micropterus salmoides*	1	<1	83	2	83	83	190	190	155	155
Tessellated darter, *Etheostoma olmstedi*	34	5	55	1	2	1-4	49	36-71	39	29-58
Shield darter, *Percina peltata*	10	1	22	<1	2	1-5	59	45-80	48	35-68
Totals for site:	784		5,420							

Reported anomalies: Cutlips minnow—10 percent with blackspot; River chub—100 percent with blackspot; Blacknose dace—19 percent with blackspot; Fallfish—36 percent with blackspot; Margined madtom—13 percent with parasites; Rock bass—10 percent missing an eye; Pumpkinseed—38 percent with leeches, 12 percent missing an eye; Bluegill—3 percent with leeches, 6 percent missing an eye; Smallmouth bass—20 percent missing an eye, 2 percent with lesions; Largemouth bass—100 percent with blackspot, 100 percent missing an eye

Study Unit: COE
Station Name: Otselic River downstream of Whitney Point Lake, N.Y.
Sampling Gear: backpack electroshocker

Date of Collection: 9/12/00
Number of Species at Site: 18
Time (min)/Pass: 43/pass1; 42/pass2

Species name	Total number of fish per species	Percentage of total number of fish	Total weight per species (grams)	Percentage total weight	Average weight (grams)	Range of weights (grams)	Average total length (millimeters)	Range of total lengths (millimeters)	Average standard length (millimeters)	Range of standard lengths (millimeters)
Spotfin shiner, *Cyprinella spiloptera*	22	6	44	1	2	1-4	59	49-75	46	39-60
Common shiner, *Luxilus cornutus*	1	<1	4	<1	4	4	69	69	55	55
Bluntnose minnow, *Pimephales notatus*	24	6	103	2	4	1-6	71	51-82	57	42-68
Fallfish, *Semotilus corporalis*	7	2	12	<1	2	1-10	69	50-96	55	40-75
White sucker, *Catostomus commersoni*	2	<1	236	5	118	32-204	200	144-256	160	117-203
Northern hog sucker, *Hypentelium nigricans*	1	<1	88	2	88	88	195	195	160	160
Yellow bullhead, *Ameiurus natalis*	2	<1	133	3	66	66-67	164	160-1,617	136	132-140
Rock bass, *Ambloplites rupestris*	74	20	2,543	52	34	2-266	102	41-215	82	30-180
Green sunfish, *Lepomis cyanellus*	2	<1	15	<1	8	5-10	86	75-96	68	60-75
Pumpkinseed, *Lepomis gibbosus*	1	<1	18	<1	18	18	95	95	71	71
Bluegill, *Lepomis macrochirus*	17	5	519	11	31	1-63	100	20-138	79	15-110
Smallmouth bass, *Micropterus dolomieu*	65	17	602	12	9	3-127	77	55-205	62	45-165
Largemouth bass, *Micropterus salmoides*	7	2	29	<1	4	2-6	62	51-71	50	42-46
Tessellated darter, *Etheostoma olmstedi*	39	10	81	2	2	1-6	53	38-83	42	29-69
Banded darter, *Etheostoma zonale*	84	23	172	4	2	1-4	53	44-61	43	34-51
Yellow perch, *Perca flavescens*	7	2	88	2	13	3-27	93	62-133	76	50-110
Shield darter, *Percina peltata*	17	5	78	2	5	2-7	72	52-82	60	41-69
Walleye, *Stizostedion vitreum*	1	<1	86	2	86	86	227	227	183	183
Totals for site:	373		4,851							

Reported anomalies: Bluntnose minnow—4 percent with blackspot; Rock bass—2 percent with blackspot, 18 percent with leeches; Bluegill—6 percent with fin erosion, 6 percent with leeches; Smallmouth bass—6 percent with fin erosion, 2 percent with leeches; Tessellated darter—9 percent with fin erosion; Banded darter—7 percent with fin erosion; Yellow perch—14 percent with fin erosion; Shield darter—24 percent with fin erosion