Freshwater Mussel Translocation at Highland Park Dam

Swan Creek - Toledo - Ohio

Final Report to Partners for Clean Streams

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18 Oct 2008

Introduction

Swan Creek is a small tributary of the lower Maumee River, draining 204 mi^2 at the mouth in downtown Toledo, OH. The creek rises in the rural landscape of Fulton County and meanders southeast through Oak Openings Metropark before turning northeast towards the City of Toledo.

In the first half of the 20th century, unionid collections were made on Swan Creek by Calvin Goodrich and Clarence Clark. Records at the University of Michigan Museum of Zoology (UMMZ) indicate that a total of 13 species were recovered by these two malacologists. Museum records at the Ohio State Museum of Biological Diversity document the presence of just 6 species. More recently, studies by Grabarkiewicz (2007; 2008) reported 24 species, with 17 species found live. These surveys also documented new and viable populations of the Ohio state endangered and federal candidate rayed bean (*Villosa fabalis*).

Dams have long been implicated in the decline of freshwater mussels throughout the United States (Ellis 1942; Bates 1962; Coon et al. 1977; USFWS 1985; Bogan 1993; Neves et al. 1993; Yeager 1993; Neves et al. 1997; Hughes and Parmalee 1999). In fact, of the habitat alterations initiated by humans, the systematic impoundment of large rivers has likely contributed more to the decline of freshwater mussels than any other perturbation (USFWS 1985; USFWS 2004). Impoundment not only reworks the depth and hydraulics of a river reach, but also prevents the migration of host fishes and may severely alter downstream water quality (e.g. hypolimnetic releases altering stream temperature and oxygen) (Watters 1996; Vaughn and Taylor 1999; Watters 2000). As a result, mussel species adapted to shallow, flowing rivers are now some of the most imperiled animals in the United States. The destruction of the *Epioblasma* (riffleshells), for example, has been attributed largely to the impoundment of small and large rivers (USFWS 1983; USFWS 1985; USFWS 2004).

In the short-term, dam removal or modification may have deleterious consequences for resident freshwater mussel communities (Doyle et al. 2004; Sethi et al. 2004). Localized changes in bed stability, water levels, channel morphology, and sediment transport may initially displace, smother, or create habitat conditions unsuitable for unionids. For this reason, mussels are typically relocated (termed "translocation") when channel disturbance or dam work is planned. This report details the translocation of the freshwater mussel community found below Highland Park dam in Swan Creek, Toledo, OH (Photo 1).

Methodology

A full coverage, qualitative survey (see Strayer and Smith 2003) was performed across the area of impact, downstream of the area of impact (to just before the park footbridge), as well as upstream of the dam. In total, qualitative sampling was conducted in a cell that extended 129 m downstream (dam to footbridge) and 52 m upstream of the dam (Figure 1). One pass was made by Phil Mathias and two passes were made by Jeff Grabarkiewicz starting near the footbridge working upstream. Underwater viewers were used to assist in the visual detection of freshwater mussels (Photo 2).

In addition to qualitative searches, quantitative samples were taken every meter along two transects laid parallel to flow (Figure 2). A total of 20 quadrats (0.25 m^2) were excavated with a small steel scoop. Sediments were deposited and sieved with a mesh (mesh = 2.5 mm) bag. All quadrat samples were excavated within the heaviest populated area in an effort to detect burrowing unionids, small individuals, and overlooked mussels (Photo 3).

Live mussels were identified, measured, and tagged with a unique tracking number (Table 1; Table 2). Shellfish tags were adhered to both valves using instant KRAZY glue gel (Photos 4-6). After allowing a short time for the glue to dry, tagged unionids were deposited in mesh bags and placed in Swan Creek until translocation. When survey and tagging activities were complete, all mussels were transported via an aerated cooler to the Anderson Property.

Unionids were hand placed at the Anderson Property using a view-bucket and wetsuit (Photo 7). Photos were taken to document the exact area of translocation and a reference measurement from the dam was recorded (Photo 8).

Survey Results

A total of 69 live unionids were collected during qualitative sampling, with six species found live and an additional six species represented by shell only (12 total species). The unionid species found live included fatmucket (*Lampsilis siliquoidea*), white heelsplitter (*Lasmigona complanata complanata*), fragile papershell (*Leptodea fragilis*), pink heelsplitter (*Potamilus alatus*), giant floater (*Pyganodon grandis*), and creeper (*Strophitus undulatus*) The species represented by shell only included spike (*Elliptio dilatata*), Wabash pigtoe (*Fusconaia flava*), plain pocketbook (*Lampsilis cardium*), creek heelsplitter (*Lasmigona compressa*), rayed bean (*Villosa fabalis*), and rainbow (*Villosa iris*). No live state or federally listed mussels were found. Evidence of recent reproductive success was found for fatmucket (*L. siliquoidea*) [(2) < 46 mm], white heelsplitter (*L. c. complanata*) [(3) < 51 mm], and fragile papershell (*L. fragilis*) [(1) 48 mm). Quantitative sampling yielded a total of just two live mussels, both *L. c. complanata*.

All sampled unionids were translocated to the Anderson Property, which is approximately 7.3 river miles upstream of Highland Park (Figure 3). The majority of the mussels found on the Anderson Property occur in a pool just below the Anderson Dam (41.60286, -83.67748).   All tagged unionids were hand placed in this pool near the left downstream bank

Remarks and Conclusions

The species found during survey and translocation activities typically do not burrow deeply into substrates and are often associated with lentic habitats. Most of the collected species also tolerate fine substrates. A single subfossil rayed bean (*V. fabalis*) valve was recovered from the study area. In my opinion, live *V. fabalis* does not occur at the Highland Park site.

While dam turbulence does likely increase D.O. levels downstream, the excavated substrates exhibited signs of hypoxia/anoxia (gray material, sulfide/methane odor, etc.). For this reason, I believe that unionid species often found burrowed in the substrate (e.g. *F. flava*, *E. dilatata*, *V. fabalis*, etc.) have likely been extirpated from the area. In fact, our surveys over 2006 - 2008 show that these species occur chiefly in stream reaches where substrates are comprised of stable, clean sand and gravel (Grabarkiewicz 2007; 2008).

One unusual result of this project was the translocation of mussels to a point 7.3 river miles upstream of the project site. Typically, translocated mussels are placed just a short distance (usually 100 m to 500 m) upstream of a proposed disturbance if suitable habitat exists. This was ultimately due to the lack of a nearby (and known) unionid bed. To the best of my knowledge, the Anderson Property was the closest protected location with a unionid community in lower Swan Creek (see Grabarkiewicz 2008). In addition, the resident mussel community and habitat features of the Anderson Property closely matched the Highland Park site (see Grabarkiewicz 2008). For these reasons, it seemed appropriate to move the tagged unionids to this location.

Future Monitoring

The mussels translocated to the Anderson Property from Highland Park will require monitoring to evaluate survivorship and health. Generally, an exhaustive sampling effort is performed to locate translocated mussels. All recovered individuals are measured with a metric caliper to the nearest tenth of a millimeter. Recovery rates are then calculated and an analysis of overall health is assessed by comparing shell lengths at the time of translocation and the time of sampling. Positive growth is generally used as an indicator of health. It is recommend that monitoring take place two years after translocation.

Table 1. Summary table of unionids surveyed during Highland Park qualitative and quantitative sampling activities.

COMMON NAME	SCIENTIFIC NAME	NOTATION	TOTAL	MIN LENGTH	MAX LENGTH	OH LIST
fatmucket	*Lampsilis siliquoidea*	LASI	4	45.6	70.3	-
white heelsplitter	*Lasmigona c. complanata*	LACL	46	38.9	105.3	-
fragile papershell	*Leptodea fragilis*	LEFR	2	47.7	78.3	-
pink heelsplitter	*Potamilus alatus*	POAL	12	81.0	122.9	-
giant floater	*Pyganodon grandis*	PYGR	2	68.6	69.4	-
creeper	*Strophitus undulatus*	STUN	3	53.6	61.9	-
spike	*Elliptio dilatata*	ELDI	S	-	-	-
Wabash pigtoe	*Fusconaia flava*	FUFL	S	-	-	-
plain pocketbook	*Lampsilis cardium*	LACA	S	-	-	-
creek heelpslitter	*Lasmigona compressa*	LACR	S	-	-	-
rayed bean	*Villosa fabalis*	VIFA	S	-	-	-
rainbow	*Villosa iris*	VIIR	S	-	-	-

Table 2. Raw survey data with unique tracking numbers for each individual.

DATE	SITE	SPECIES	LENGTH (mm)	TRACK1	TRACK2
8/10/2008	HIGH	LEFR	47.7	2500	2501
8/10/2008	HIGH	LACL	83.9	502	503
8/10/2008	HIGH	LACL	97.1	504	505
8/10/2008	HIGH	LACL	105.3	506	507
8/10/2008	HIGH	LACL	103.1	508	509
8/10/2008	HIGH	LACL	64.6	510	511
8/10/2008	HIGH	LACL	94.2	512	513
8/10/2008	HIGH	POAL	122.9	514	515
8/10/2008	HIGH	LACL	87.0	516	517
8/10/2008	HIGH	LACL	74.8	518	519
8/10/2008	HIGH	POAL	118.9	520	521
8/10/2008	HIGH	LACL	85.7	522	523
8/10/2008	HIGH	POAL	106.5	524	525
8/10/2008	HIGH	POAL	107.7	526	527
8/10/2008	HIGH	POAL	110.5	528	529
8/10/2008	HIGH	LACL	103.9	535	534
8/10/2008	HIGH	LACL	74.2	531	530
8/10/2008	HIGH	POAL	90.9	532	533
8/10/2008	HIGH	POAL	111.9	537	536
8/10/2008	HIGH	POAL	91.5	543	542
8/10/2008	HIGH	LACL	73.9	540	541
8/10/2008	HIGH	LACL	98.1	538	539
8/10/2008	HIGH	POAL	108.7	545	544
8/10/2008	HIGH	PYGR	68.6	546	547
8/10/2008	HIGH	LACL	70.1	548	549
8/10/2008	HIGH	LACL	79.7	552	553
8/10/2008	HIGH	LACL	84.5	550	551

8/10/2008	HIGH	LACL	71.1	556	557
8/10/2008	HIGH	LACL	63.0	558	559
8/10/2008	HIGH	LASI	52.6	563	562
8/10/2008	HIGH	LASI	45.6	560	561
8/10/2008	HIGH	LACL	77.0	555	554
8/10/2008	HIGH	LACL	73.4	568	569
8/10/2008	HIGH	LACL	53.9	566	567
8/10/2008	HIGH	PYGR	69.4	564	565
8/10/2008	HIGH	LACL	70.5	570	571
8/10/2008	HIGH	LACL	74.7	572	573
8/10/2008	HIGH	LACL	82.1	574	575
8/10/2008	HIGH	LACL	66.8	576	577
8/10/2008	HIGH	POAL	109.5	578	579
8/10/2008	HIGH	LACL	60.6	580	581
8/10/2008	HIGH	LACL	50.9	582	583
8/10/2008	HIGH	POAL	92.6	584	585
8/10/2008	HIGH	LACL	89.5	599	598
8/10/2008	HIGH	LACL	86.1	592	593
8/10/2008	HIGH	LACL	90.8	596	597
8/10/2008	HIGH	LACL	103.8	594	595
8/10/2008	HIGH	LACL	92.7	588	589
8/10/2008	HIGH	LACL	85.5	590	591
8/10/2008	HIGH	LACL	101.5	586	587
8/10/2008	HIGH	LACL	85.7	600	601
8/10/2008	HIGH	LACL	99.2	602	603
8/10/2008	HIGH	LACL	79.5	604	605
8/10/2008	HIGH	LACL	75.8	608	609
8/10/2008	HIGH	LACL	77.8	606	607
8/10/2008	HIGH	LASI	70.3	610	611
8/10/2008	HIGH	LACL	105.6	612	613
8/10/2008	HIGH	LACL	105.6	612	613
8/10/2008	HIGH	LACL	66.4	616	617
8/10/2008	HIGH	LACL	83.2	614	615
8/10/2008	HIGH	STUN	61.9	618	619
8/10/2008	HIGH	STUN	53.6	620	621
8/10/2008	HIGH	LACL	38.9	626	627
8/10/2008	HIGH	STUN	61.1	628	629
8/10/2008	HIGH	LEFR	78.3	622	623
8/10/2008	HIGH	POAL	81.0	630	631
8/10/2008	HIGH	LACL	79.8	632	633
8/10/2008	HIGH	LACL	75.1	634	635
8/10/2008	HIGH	LACL	80.9	636	637
8/10/2008	HIGH	LASI	46.0	638	639

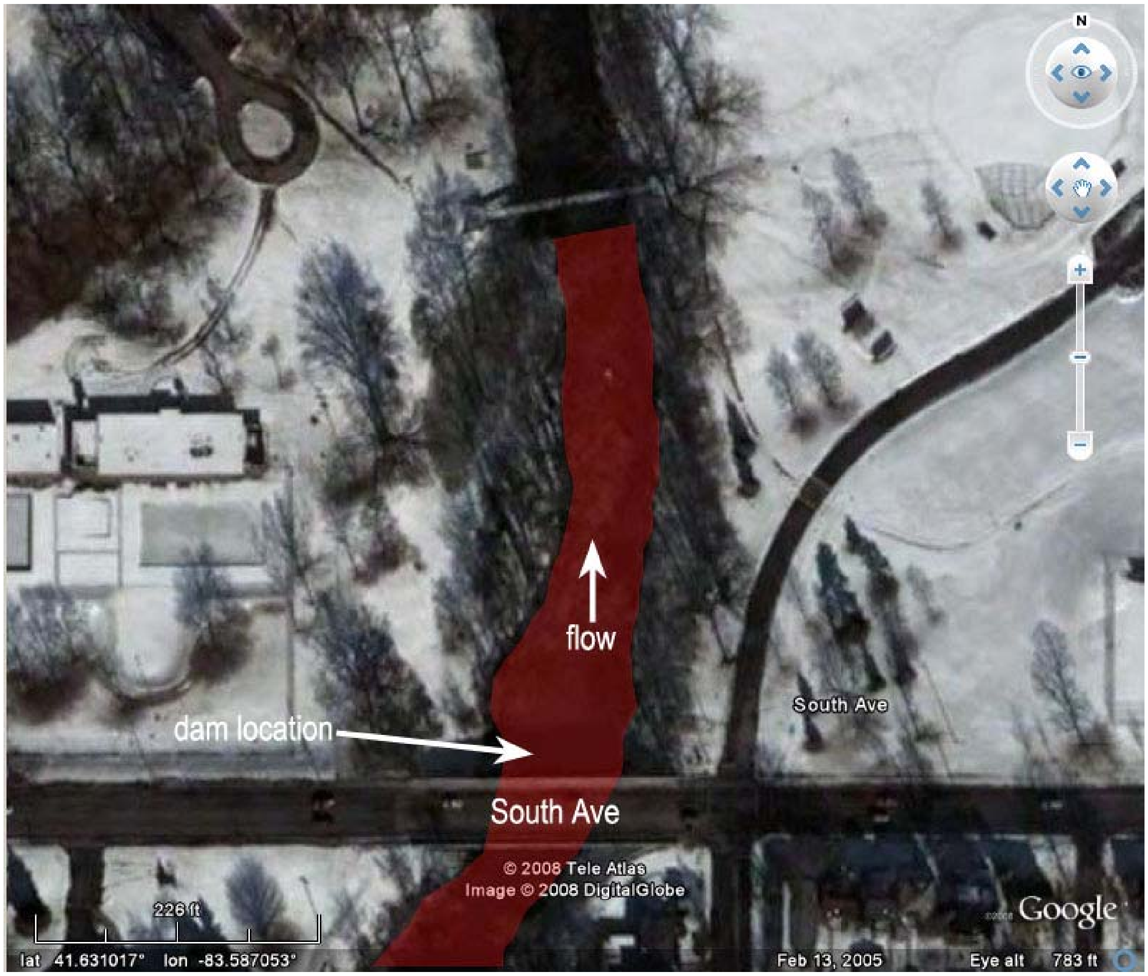

Figure 1. Plan view of Highland Park. Shaded in dark red is the extent of the qualitative sampling area.

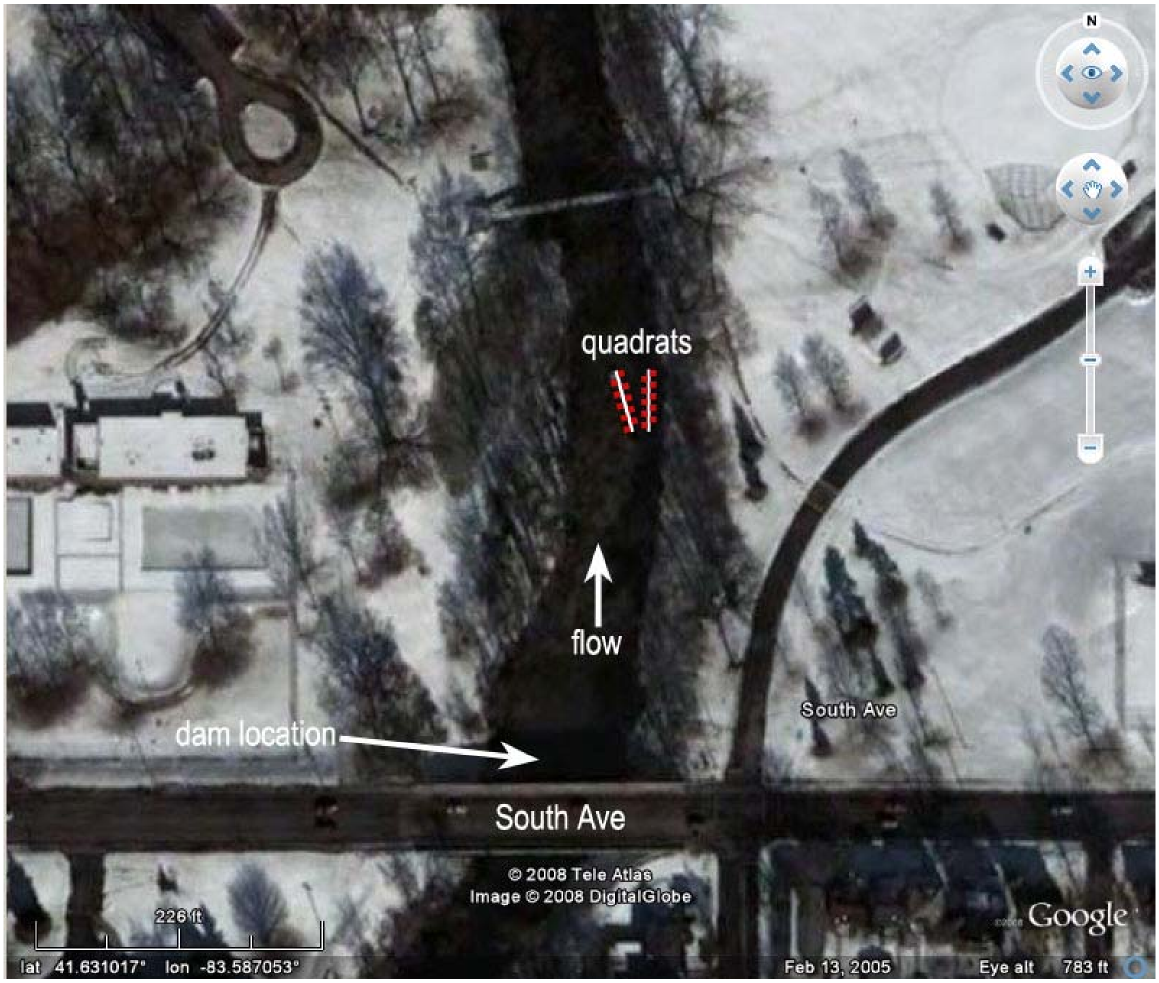

Figure 2. Plan view of Highland Park. The two transects laid parallel to flow are in white, with individual 0.25 m^2 quadrats in red. Note: the quadrats and transects are not to scale.

Figure 3. Location of the dam site and upstream translocation site.

Photo 1: Highland Park dam and South Ave. bridge.

Photo 2: Jeff Grabarkiewicz (left) and Phil Mathias (right) surveying for mussels using view-buckets.

Photo 3: Jeff placing a quadrat along a marked transect.

Photo 4: Matt Horvat applying super glue to a white heelsplitter.

Photo 5: Matt adhering a unique tag to a white heelsplitter.

Photo 6: Mussels with drying tags on the workbench.

Photo 7: Jeff searching for spots to hand place unionids at the Anderson Property.

Photo 8: Jeff (right) standing near the point of translocation. Matt (far left) holding tape to measure the distance from the dam to the translocation point.

References

Bates, J.M. 1962. The impact of impoundment on the mussel fauna of Kentucky Reservoir, Tennessee River. American Midland Naturalist 68:232-236.

Bogan, A.E. 1993. Freshwater bivalve extinctions (Mollusca: Unionoida): a search for causes. American Zoologist 33:599-609.

Coon, T.G., Eckblad, J.W., and P.W. Trygstad. 1977. Relative abundance and growth of mussels (Mollusca: Eulamellibranchia) in pools 8, 9, and 10 of the Mississippi River. Freshwater Biology 7:279-85.

Doyle, M.W., Stanley, E.H., Orr, C.H., Selle, A.R., Sethi, S.A., and J.M. Harbor. 2004. Stream ecosystem response to small dam removal: Lessons from the Heartland. Geomorphology 71: 227-244.

Ellis, M.M. 1942. Fresh-water impoundments. Transactions of the American Fisheries Society, 71st Annual Meeting, 80-93. Evermann, B.W., and H.W. Clark. 1918. The Unionidae of Lake Maxinkukee. Proceedings of the Indiana Academy of Science 1917:251-285.

Grabarkiewicz, J.D. 2007. Investigations into Swan Creek for the rayed bean mussel (*Villosa fabalis*). Final Report to the Ohio Biological Survey Individual Grant Program 2006. 16 pp. + appendices.

Grabarkiewicz, J.D. 2008. A Unionid Survey of Swan Creek. Final Report to the ODNR State Wildlife Grant Program, Toledo Naturalists' Association, and Metroparks of the Toledo Area.

Hughes, M.H., and P.W. Parmalee. 1999. Prehistoric and modern freshwater mussel (mollusca: bivalvia) faunas of the Tennessee River: Alabama, Kentucky, and Tennessee. Regulated Rivers: Research and Management 15:24-42.

Neves, R.J. 1993. A state-of-the-unionids address. Pp. 1-10 In: S. K. Cummings, A.C. Buchanan, and L.M. Koch, editors. Conservation and management of freshwater mussels.

Neves, R. J., A. E. Bogan, J. D. Williams, S. A. Ahlstedt, and P. W. Hartfield. 1997. Status of aquatic mollusks in the southeastern United States: a downward spiral of diversity. Pp. 43-85 in: G. W. Benz and D. E. Collins, eds. Aquatic fauna in peril: the southeastern perspective. Special Publication 1, Southern Aquatic Research Institute, Chattanooga, Tennessee.

Sethi, S.A., Selle, A.R., Doyle, M.W., Stanley, E.H., and H.E. Kitchel. 2004. Response of unionid mussels to dam removal in Koshkonong Creek, Wisconsin (USA). Hydrobiologia 525:157-165.

Strayer, D.L., and D.R. Smith. 2003. A guide to sampling freshwater mussel populations. American Fisheries Society Monograph 8:1-103.

U.S. Fish and Wildlife Service. 1983. Green Blossom Pearly Mussel Recovery Plan. U.S. Fish and Wildlife Service. Atlanta, Georgia. 50 pp.

U.S. Fish and Wildlife Service. 1985. Recovery Plan for the Tubercled-Blossom Pearly Mussel, Turgid Blossom Pearly Mussel, and Yellow Blossom Pearly Mussel. Atlanta, Georgia. 42 pp.

U.S. Fish and Wildlife Service. 2004. Recovery Plan for Cumberland Elktoe, Oyster Mussel, Cumberlandian Combshell, Purple Bean, and Rough Rabbitsfoot. Atlanta, Georgia. 168 pp.

Vaughn, C.C. and C.M. Taylor. 1999. Impoundments and the decline of freshwater mussels: a case study of an extinction gradient. Conservation Biology 13(4):912-920.

Watters, G.T. 1996. Small dams as barriers to freshwater mussels (bivalvia: unionoida) and their hosts. Biological Conservation 75(1):79-85.

Watters, G.T. 2000. Freshwater mussels and water quality: a review of the effects of hydrologic and instream habitat alterations. Proceedings of the Conservation, Captive Care, and Propagation of Freshwater Mussels Symposium, 1999. pp. 1-14.

Yeager, B.L. 1993. Dams. Pp. 57-113 in: C. F. Bryan and D. A. Rutherford, eds. Impacts on warmwater streams: guidelines for evaluation. Warmwater Stream Committee, Southern Division, American Fisheries Society, Little Rock, Arkansas.