Water: Bioassessment

Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish - Second Edition

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Rapid Bioassessment Protocols
For Use in Streams and Wadeable Rivers:
Periphyton, Benthic Macroinvertebrates, and Fish
Second Edition

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FOREWORD

In December 1986, U.S. EPA's Assistant Administrator for Water initiated a major study of the Agency's surface water monitoring activities. The resulting report, entitled "Surface Water Monitoring: A Framework for Change" (U.S. EPA 1987), emphasizes the restructuring of existing monitoring programs to better address the Agency's current priorities, e.g., toxics, nonpoint source impacts, and documentation of "environmental results." The study also provides specific recommendations on effecting the necessary changes. Principal among these are:

1. To issue guidance on cost-effective approaches to problem identification and trend assessment.
2. To accelerate the development and application of promising biological monitoring techniques.

In response to these recommendations, the Assessment and Watershed Protection Division developed the rapid bioassessment protocols (RBPs) designed to provide basic aquatic life data for water quality management purposes such as problem screening, site ranking, and trend monitoring, and produced a document in 1989 (Plafkin et al. 1989).

Although none of the protocols were meant to provide the rigor of fully comprehensive studies, each was designed to supply pertinent, cost-effective information when applied in the appropriate context.

As the technical guidance for biocriteria has been developed by EPA, states have found these protocols useful as a framework for their monitoring programs. This document was meant to have a self-corrective process as the science advances; the implementation by state water resource agencies has contributed to refinement of the original RBPs for regional specificity. This revision reflects the advancement in bioassessment methods since 1989 and provides an updated compilation of the most cost-effective and scientifically valid approaches.

DEDICATION

All of us who have dealt with the evaluation and diagnosis of perturbation to our aquatic resources owe an immeasurable debt of gratitude to *Dr. James L. Plafkin*. In addition to developing the precursor to this document in 1989, Jim was a driving force within EPA to increase the use of biology in the water pollution control program until his untimely death on February 6, 1990. Throughout his decade-long career with EPA, his expertise in ecological assessment, his dedication, and his vision were instrumental in changing commonly held views of what constitutes pollution and the basis for pollution control programs. Jim will be remembered for his love of life, his enthusiasm, and his wit. As a small token of our esteem, we dedicate this revised edition of the RBPs to his memory.

ACKNOWLEDGMENTS

Dr. James L. Plafkin of the Assessment and Watershed Protection Division (AWPD) in USEPA's Office of Water, served as principal editor and coauthor of the original Rapid Bioassessment Protocols document in 1989. Other coauthors of the original RBPs were consultants to the AWPD, Michael T. Barbour, Kimberly D. Porter, Sharon Gross, and Robert M. Hughes. Principal authors of this revision are Michael T. Barbour, James (Sam) Stribling, Jeroen Gerritsen, and Blaine D. Snyder. Many others also contributed to the development of the original RBP document. Special thanks goes to the original Rapid Bioassessment Workgroup. The Workgroup, composed of both State and USEPA Regional biologists (listed in Chapter 1), was instrumental in providing a framework for the basic approach and served as primary reviewers of various drafts. Dr. Kenneth Cummins and Dr. William Hilsenhoff provided invaluable advice on formulating certain assessment metrics in the original RBP approach. Dr. Vincent Resh also provided a critical review that helped strengthen the RBP approach. While not directly involved with the development of the RBPs, Dr. James Karr provided the framework (Index of Biotic Integrity) and theoretical underpinnings for "re-inventing" bioassessment for water resource investigations. Since 1989, extensive use and application of the IBI and RBP concept has helped to refine specific elements and strengthen the overall approach. The insights and consultation provided by these numerous biologists have provided the basis for the improvements presented in this current document.

This revision of the RBPs could not have been accomplished without the support and oversight of Chris Faulkner of the USEPA Office of Water. Special thanks go to Ellen McCarron and Russell Frydenborg of Florida DEP, Kurt King of Wyoming DEQ, John Maxted of Delaware DNREC, Dr. Robert Haynes of Massachusetts DEP, and Elaine Major of University of Alaska, who provided the opportunity to test and evaluate various technical issues and regional specificity of the protocols in unique stream systems throughout the United States. Editorial and production support, report design, and HTML formatting were provided by a team of Tetra Tech staff -- Brenda Fowler, Michael Bowman, Erik W. Leppo, James Kwon, Amanda Richardson, Christiana Daley, and Abby Markowitz. Technical assistance and critical review was provided by Dr. Jerry Diamond of Tetra Tech.

A Technical Experts Panel was convened by the USEPA to provide an in-depth review and recommendations for revisions to this document. This group of esteemed scientists provided not only useful comments, but assisted in revising sections of the document. In particular, Drs. Jan Stevenson and Loren Bahls revised the periphyton chapter; and Dr. Phil Kaufmann provided assistance on the habitat chapter. The Technical Experts Panel included:

Dr. Reese Voshell, Virginia Tech University (Chair)

Dr. Loren Bahls, University of Montana

Dr. David Halliwell, Aquatic Resources Conservation Systems

Dr. James Karr, University of Washington

Dr. Phil Kaufmann, Oregon State University

Dr. Billie Kerans, Montana State University

Dr. Jan Stevenson, University of Louisville

Dr. Charles Hawkins (Utah State University) and Dr. Vincent Resh (University of California, Berkeley) served as outside readers.

Much appreciation is due to the biologists in the field (well over a hundred) who contributed their valuable time to review both the original and current documents and provide constructive input. Their help in this endeavor is sincerely appreciated.

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LIST OF ACRONYMS

Acronym	Full Name (acronym stands for)
AFDM	Ash Free Dry Mass
ANOVA	Analysis of Variance
APHA	American Public Health Association
ASTM	American Society of Testing and Materials
AUSRIVAS	Australian River Assessment System
AWPD	Assessment and Watershed Protection Division
BEAST	Benthic Assessment of Sediment
BMP	Best Management Practices
CBWD	Chesapeake Bay and Watershed Programs
CWA	Clean Water Act
DEC	Department of Environmental Conservation
DEM	Department of Environmental Management
DEM	Division of Environmental Management
DEP	Department of Environmental Protection

DEQ	Department of Environmental Quality
DHEC	Department of Health and Environmental Control
DNR	Department of Natural Resources
DNREC	Department of Natural Resources and Environmental Control
DQO	Data Quality Objectives
EDAS	Ecological Data Application System
EMAP	Environmental Monitoring and Assessment Program
EPA	Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, Trichoptera
GIS	Geographic Information System
GPS	Global Positioning System
HBI	Hilsenhoff Biotic Index
IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
ITFM	Intergovernmental Task Force on Monitoring
ITIS	Integrated Taxonomic Information Service
IWB	Index of Well Being
MACS	Mid-Atlantic Coastal Systems
MBSS	Maryland Biological Stream Survey
MIWB	Modified Index of Well Being
NAWQA	National Water Quality Assessment Program
NPDES	National Pollutant Discharge Elimination System
NPS	nonpoint source pollution
PASS	Preliminary Assessment Scoresheet
PCE	Power Cost Efficiency
POTWS	Publicly Owned Treatment Works
PTI	Pollution Tolerance Index
QA	Quality Assurance
QC	Quality Control
QHEI	Qualitative Habitat Evaluation Index
RBP	Rapid Bioassessment Protocols
RDMS	Relational Database Management System
RM	River Mile
RPS	Rapid Periphyton Survey
SAB	Science Advisory Board
SCI	Stream Quality Index
SOP	Standard Operating Procedures
STORET	Data Storage and Retrieval System
SWCB	State Water Control Board
TCR	Taxonomic Certainty Rating
TMDL	Total Maximum Daily Load
TSN	Taxonomic Serial Number
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WPA	Watershed Protection Approach
WQD	Water Quality Division

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Appendix C: (Part I)

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TOLERANCE AND TROPHIC GUILDS OF SELECTED FISH SPECIES

Appendix C has been split into 3 parts (I-III) due to its size.

- Download full PDF version of Appendix C (PDF, 6 KB)

Continue to Appendix C (Part II).

Appendix C

Appendix C is a list of selected fishes of the United States in phylogenetic order. Included are the Taxonomic Serial Number (TSN) and the Parent Taxonomic Serial Number for each of the species listed according to the Integrated Taxonomic Information System (ITIS). The ITIS generates a national taxonomic list that is constantly updated and currently posted on the World Wide Web at <www.itis.usda.gov> [BROKEN] EXIT Disclaimer . If you are viewing this document electronically, this page is linked to the ITIS web site.

Additionally, this Appendix details trophic and tolerance designations for selected fishes of the United States. To generate this list, we compiled a consensus rating for each taxon from the literature sources listed below. Exceptions are listed for each source that does not agree with the consensus of other cited literature. Exceptions are noted by first listing the designation then the literature source code in parentheses. The following is a list of the designations and literature sources used in this Appendix.

TROPHIC DESIGNATIONS

P=Piscivore
H=Herbivore
O=Omnivore
I=Insectivore (including specialized insectivores)
F=Filter feeder
G=Generalist feeder
V=Invertivore

Notes on Trophic Designations

Piscivore--although some investigators separate certain species into subcategories such as parasitic (e.g., sea lamprey) or top carnivore (e.g., walleye), we have grouped these together as piscivores for this list.

TOLERANCE DESIGNATIONS (relevant to non-specific stressors)

I = Intolerant
M = Intermediate
T = Tolerant

Notes on Tolerance Designations

Intolerant--although some investigators separate certain species into subcategories such as rare intolerant, special intolerant or common intolerant, we have grouped these together as intolerant for this list.

Literature Sources For Trophic/Tolerance Designations

(A) = Midwestern United States (Karr et al. 1986)

(B) = Ohio (Ohio EPA 1987)

(C) = Midwestern United States (Plafkin et al. 1989)

(D) = Central Corn Belt Plain (Simon 1991)

(E) = Wisconsin Warmwater (Lyons 1992)

(F) = Maryland Coastal Plain (Hall et al. 1996)

(G) = Northeastern United States (Halliwell et al. 1999)

Continue to Appendix C (Part II).

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Appendix C: (Part II)

TOLERANCE AND TROPHIC GUILDS OFSELECTED FISH SPECIES

Appendix C has been split into 3 parts (I-III) due to its size.

Return to Appendix C (Part I). Continue to Appendix C (Part III).

Parent TSN	TSN	Common Name	*Scientific Name*	Trophic	Trophic Exception	Tolerance	Tolerance Exception
159696	**159697**	**Lampreys**	***Petromyzontidae***				
159723	159724	Ohio lamprey	*Ichthyomyzon bdellium*	P		I	M(G)
159723	159725	Chestnut lamprey	*Ichthyomyzon castaneus*	P		M	
159723	159726	Northern brook lamprey	*Ichthyomyzon fossor*	F		I	
159723	159727	Southern brook lamprey	*Ichthyomyzon gagei*			I	
159723	159728	Mountain brook lamprey	*Ichthyomyzon greeleyi*	F		I	
159723	159730	Silver lamprey	*Ichthyomyzon unicuspis*	P		M	
159700	159705	Least brook lamprey	*Lampetra aepyptera*	F		M	I(D, G)
159700	159708	American brook lamprey	*Lampetra appendix*	F		I	
159700	159704	River lamprey	*Lampetra ayresi*				
159700	159709	Kern brook lamprey	*Lampetra hubbsi*				
159700	159701	Arctic lamprey	*Lampetra japonica*				
159700	159710	Pit-Klamath brook lamprey	*Lampetra lethophaga*				
159700	201891	Vancouver lamprey	*Lampetra macrostoma*				
159700	159711	Miller Lake lamprey	*Lampetra minima*				
159700	159707	Western brook lamprey	*Lampetra richardsoni*				
159700	201892	Klamath lamprey	*Lampetra similis*				
159700	159713	Pacific lamprey	*Lampetra tridentata*				
159721	159722	Sea lamprey	*Petromyzon marinus*	P		M	
161063	**161064**	**Sturgeons**	***Acipenseridae***				
161065	161069	Shortnose sturgeon	*Acipenser brevirostrum*	V		I	
161065	161071	Lake sturgeon	*Acipenser fulvescens*	V	I(E)	M	I(G)
161065	161067	Green sturgeon	*Acipenser medirostris*				
161065	161070	Atlantic sturgeon	*Acipenser oxyrhynchus*	V		I	
161065	161068	White sturgeon	*Acipenser transmontanus*				
161080	161081	Pallid sturgeon	*Scaphirhynchus albus*				
161080	161082	Shovelnose sturgeon	*Scaphirhynchus platorynchus*	I		M	
161063	**161085**	**Paddlefishes**	***Polyodontidae***				
161087	161088	Paddlefish	*Polyodon spathula*	F		I	
161091	**161092**	**Gars**	***Lepisosteidae***				
161093	161095	Spotted gar	*Lepisosteus oculatus*	P		M	
161093	161094	Longnose gar	*Lepisosteus osseus*	P		M	
161093	161096	Shortnose gar	*Lepisosteus platostomus*	P		M	
161093	161098	Florida gar	*Lepisosteus platyrhincus*				
.	161097	Alligator gar	*Lepisosteus spatula*	P		M	
161101	**161102**	**Bowfins**	***Amiidae***				
161103	161104	Bowfin	*Amia calva*	P		M	T(G)
161902	**161903**	**Mooneyes**	***Hiodontidae***				
161904	161905	Goldeye	*Hiodon alosoides*	I		I	
161904	161906	Mooneye	*Hiodon tergisus*	I		I	
161124	**161125**	**Freshwater eels**	***Anguillidae***				
161126	161127	American eel	*Anguilla rostrata*	P	G(F)	M	T(F,G)
161699	**161700**	**Herrings**	***Clupeidae***				
161701	161703	Blueback herring	*Alosa aestivalis*	F		M	
161701	161705	Alabama shad	*Alosa alabamae*			M	
161701	161707	Skipjack herring	*Alosa chrysochloris*	P		M	
161701	161704	Hickory shad	*Alosa mediocris*				
161701	161706	Alewife	*Alosa pseudoharengus*	F	V(C)	M	
161701	161702	American shad	*Alosa sapidissima*	V	F(G)	M	
161731	161733	Finescale menhaden	*Brevoortia gunteri*				
161731	161734	Gulf menhaden	*Brevoortia patronus*				
161731	161735	Yellowfin menhaden	*Brevoortia smithi*				
161731	161732	Atlantic menhaden	*Brevoortia tyrannus*				
161721	161722	Atlantic herring	*Clupea harengus*				

161721	551209	Pacific herring	*Clupea pallasi*				
161736	161737	Gizzard shad	*Dorosoma cepedianum*	O	F(E), H(G)	M	T(G)
161736	161738	Threadfin shad	*Dorosoma petenense*	O		M	
161742	161743	Round herring	*Etrumeus teres*				
161752	161753	False pilchard	*Harengula clupeola*				
161752	161754	Redear sardine	*Harengula humeralis*				
161752	161755	Scaled sardine	*Harengula jaguana*				
161752	161757	Flatiron herring	*Harengula thrissina*				
161758	161759	Dwarf herring	*Jenkinsia lamprotaenia*				
161758	161760	Little-eye herring	*Jenkinsia majua*				
161758	161761	Shortband herring	*Jenkinsia stolifera*				
161747	161750	Deepbody thread herring	*Opisthonema libertate*				
161747	161751	Middling thread herring	*Opisthonema medirastre*				
161747	161748	Atlantic thread herring	*Opisthonema oglinum*				
161762	161763	Spanish sardine	*Sardinella aurita*				
161762	161764	Orangespot sardine	*Sardinella brasiliensis*				
161728	161729	Pacific sardine	*Sardinops sagax*				
161699	**161826**	**Anchovies**	***Engraulidae***				
161837	161846	Key anchovy	*Anchoa cayorum*				
161837	161847	Deepbody anchovy	*Anchoa compressa*				
161837	161840	Cuban anchovy	*Anchoa cubana*				
161837	161848	Slough anchovy	*Anchoa delicatissima*				
161837	161838	Striped anchovy	*Anchoa hepsetus*				
161837	161841	Bigeye anchovy	*Anchoa lamprotaenia*				
161837	161842	Dusky anchovy	*Anchoa lyolepis*				
161837	161839	Bay anchovy	*Anchoa mitchilli*				
.	161843	Longnose anchovy	*Anchoa nasuta*				
161853	161857	Flat anchovy	*Anchoviella perfasciata*				
161860	161862	Anchoveta	*Cetengraulis mysticetus*				
161827	161830	Silver anchovy	*Engraulis eurystole*				
161827	161828	Northern anchovy	*Engraulis mordax*				
163341	**163342**	**Carps and Minnows**	***Cyprinidae***				
163530	163531	Chiselmouth	*Acrocheilus alutaceus*	H		M	
163532	163533	Longfin dace	*Agosia chrysogaster*				
163507	163508	Central stoneroller	*Campostoma anomalum*	H		M	T(G)
163507	163509	Largescale stoneroller	*Campostoma oligolepis*	H		M	
163507	163510	Mexican stoneroller	*Campostoma ornatum*				
163507	163511	Bluefin stoneroller	*Campostoma pauciradii*				
163349	163350	Goldfish	*Carassius auratus*	O	G(G)	T	
163370	163373	Redside dace	*Clinostomus elongatus*	I		I	
163370	163371	Rosyside dace	*Clinostomus funduloides*	I		I	
163534	163535	Lake chub	*Couesius plumbeus*	I	G(G)	M	
163536	163537	Grass carp	*Ctenopharyngodon idella*	H	O(D)	M	T(D)
163765	163766	Satinfin shiner	*Cyprinella analostana*	I		I	T(G)
163765	163768	Blue shiner	*Cyprinella caerulea*				
163765	163770	Ocmulgee shiner	*Cyprinella callisema*				
163765	163772	Alabama shiner	*Cyprinella callistia*				
163765	163774	Bluestripe shiner	*Cyprinella callitaenia*				
163765	163776	Bluntface shiner	*Cyprinella camura*				
163765	163778	Greenfin shiner	*Cyprinella chloristia*				
163765	163780	Beautiful shiner	*Cyprinella formosa*				
163765	163782	Whitetail shiner	*Cyprinella galactura*				
163765	163784	Tallapoosa shiner	*Cyprinella gibbsi*				
163765	163786	Thicklip chub	*Cyprinella labrosa*				
163765	163788	Bannerfin shiner	*Cyprinella leedsi*				
163765	163790	Plateau shiner	*Cyprinella lepida*				
163765	163792	Red shiner	*Cyprinella lutrensis*	O	I(B,C,D)	T	M(C)
163765	163795	Spotfin chub	*Cyprinella monacha*	I		T	
163765	163797	Whitefin shiner	*Cyprinella nivea*				
163765	163799	Proserpine shiner	*Cyprinella proserpina*				
163765	163801	Fieryblack shiner	*Cyprinella pyrrhomelas*				
163765	163803	Spotfin shiner	*Cyprinella spiloptera*	I		M	T(G)
163765	163806	Tricolor shiner	*Cyprinella trichroistia*				
163765	163809	Blacktail shiner	*Cyprinella venusta*				
163765	163811	Steelcolor shiner	*Cyprinella whipplei*	I		M	I(A)
163765	163814	Altamaha shiner	*Cyprinella xaenura*				
163765	163817	Santee chub	*Cyprinella zanema*				
163343	163344	Common carp	*Cyprinus carpio*	O	G(G)	T	
163512	163514	Devils River minnow	*Dionda diaboli*				
163512	163513	Roundnose minnow	*Dionda episcopa*				
163539	163540	Desert dace	*Eremichthys acros*				
163819	163820	Slender chub	*Erimystax cahni*				
163819	163821	Streamline chub	*Erimystax dissimilis*	I		I	
163819	163822	Ozark chub	*Erimystax harryi*				
163819	163823	Blotched chub	*Erimystax insignis*				
163819	163824	Gravel chub	*Erimystax x-punctatus*	I		M	I(E,G)

163355	163357	Tonguetied minnow	*Exoglossum laurae*	I		I	M(G)
163355	163356	Cutlips minnow	*Exoglossum maxillingua*	I		I	
163541	163542	Alvord chub	*Gila alvordensis*				
163541	163543	Utah chub	*Gila atraria*				
163541	163544	Tui chub	*Gila bicolor*				
163541	163547	Borax Lake chub	*Gila boraxobius*				
163541	163548	Blue chub	*Gila coerulea*				
.	163549	Leatherside chub	*Gila copei*				
163541	163350	Thicktail chub	*Gila crassicauda*				
163541	163551	Humpback chub	*Gila cypha*				
163541	163552	Sonora chub	*Gila ditaenia*				
163541	163553	Bonytail	*Gila elegans*				
163541	163560	Gila chub	*Gila intermedia*				
163541	163554	Chihuahua chub	*Gila nigrescens*				
163541	163555	Arroyo chub	*Gila orcutti*				
163541	163556	Rio Grande chub	*Gila pandora*				
163541	163557	Yaqui chub	*Gila purpurea*				
163541	163558	Roundtail chub	*Gila robusta*				
163562	163563	Flame chub	*Hemitremia flammea*				
163564	163565	California roach	*Hesperoleucus symmetricus*				
163358	163365	Rio Grande silvery minnow	*Hybognathus amarus*				
163358	163362	Western silvery minnow	*Hybognathus argyritis*				
163358	163363	Brassy minnow	*Hybognathus hankinsoni*	O	H(E,G)	M	
163358	163364	Cypress minnow	*Hybognathus hayi*	O		M	
163358	163360	Mississippi silvery minnow	*Hybognathus nuchalis*	H	O(D)	M	I(A,E)
163358	163361	Plains minnow	*Hybognathus placitus*				
163358	163359	Eastern silvery minnow	*Hybognathus regius*	H	O(D)	M	I(G)
163690	163691	Silver carp	*Hypophthalmichthys molitrix*	O		T	
163690	163692	Bighead carp	*Hypophthalmichthys nobilis*				
163566	163567	Least chub	*Iotichthys phlegethontis*				
163568	163569	Hitch	*Lavinia exilicauda*				
163570	163571	White River spinedace	*Lepidomeda albivallis*				
163570	163572	Pahranagat spinedace	*Lepidomeda altivelis*				
163570	163573	Virgin spinedace	*Lepidomeda mollispinis*				
163570	163574	Little Colorado spinedace	*Lepidomeda vittata*				
163575	163576	Ide	*Leuciscus idus*				
163825	163826	White shiner	*Luxilus albeolus*				
163825	163828	Cardinal shiner	*Luxilus cardinalis*				
163825	163830	Crescent shiner	*Luxilus cerasinus*				
163825	163832	Striped shiner	*Luxilus chrysocephalus*	I		M	T(G)
163825	163834	Warpaint shiner	*Luxilus coccogenis*				
163825	163836	Common shiner	*Luxilus cornutus*	I	G(G)	M	
163825	163838	Duskystripe shiner	*Luxilus pilsbryi*				
163825	163840	Bleeding shiner	*Luxilus zonatus*				
163825	163843	Bandfin shiner	*Luxilus zonistius*				
163846	163847	Rosefin shiner	*Lythrurus ardens*	I		M	
163846	163849	Blacktip shiner	*Lythrurus atrapiculus*				
163846	163851	Pretty shiner	*Lythrurus bellus*				
163846	163853	Ribbon shiner	*Lythrurus fumeus*	I		M	
163846	163855	Mountain shiner	*Lythrurus lirus*				
163846	163857	Cherryfin shiner	*Lythrurus roseipinnis*				
163846	163859	Ouachita shiner	*Lythrurus snelsoni*				
163846	163861	Redfin shiner	*Lythrurus umbratilis*	I		M	T(G)
163863	163864	Speckled chub	*Macrhybopsis aestivalis*	I		I	
163863	163866	Sturgeon chub	*Macrhybopsis gelida*				
163863	163868	Sicklefin chub	*Macrhybopsis meeki*				
163863	163870	Silver chub	*Macrhybopsis storeriana*	I		M	I(G)
163872	163873	Pearl dace	*Margariscus margarita*	I	G(G)	M	
163582	163583	Spikedace	*Meda fulgida*				
163584	163585	Moapa dace	*Moapa coriacea*				
163520	163521	Peamouth	*Mylocheilus caurinus*	I		M	
163586	163587	Hardhead	*Mylopharodon conocephalus*				
163391	163394	Redspot chub	*Nocomis asper*				
163391	163395	Hornyhead chub	*Nocomis biguttatus*	I	G(G)	I	M(G)
163391	163396	Redtail chub	*Nocomis effusus*				
163391	163393	Bluehead chub	*Nocomis leptocephalus*				
163391	163392	River chub	*Nocomis micropogon*	I	G(G)	I	M(F,G)
163391	163397	Bigmouth chub	*Nocomis platyrhynchus*				
163391	163398	Bull chub	*Nocomis raneyi*				
163367	163368	Golden shiner	*Notemigonus crysoleucas*	O	I(B,D),G(F,G)	T	
163399	163422	Whitemouth shiner	*Notropis alborus*				
163399	163423	Highfin shiner	*Notropis altipinnis*				
163399	163410	Texas shiner	*Notropis amabilis*				
163399	163475	Bigeye chub	*Notropis amblops*	I		I	M(G)
163399	163477	Orangefin shiner	*Notropis ammophilus*				
.	163411	Pallid shiner	*Notropis amnis*	I		I	

163399	163401	Comely shiner	*Notropis amoenus*	I		T	
163399	163424	Pugnose shiner	*Notropis anogenus*	I	H(E)	I	
163399	163425	Popeye shiner	*Notropis ariommus*	I		I	
163399	163426	Burrhead shiner	*Notropis asperifrons*				
163399	163412	Emerald shiner	*Notropis atherinoides*	I		M	
163399	163413	Blackspot shiner	*Notropis atrocaudalis*				
163399	163427	Rough shiner	*Notropis baileyi*				
163399	163428	Red River shiner	*Notropis bairdi*				
163399	163402	Bridle shiner	*Notropis bifrenatus*	I		I	
163399	163429	River shiner	*Notropis blennius*	I		M	
163399	163430	Bigeye shiner	*Notropis boops*	I		I	
163399	163431	Tamaulipas shiner	*Notropis braytoni*				
163399	163478	Silverjaw minnow	*Notropis buccatus*	I		M	T(G)
163399	163432	Smalleye shiner	*Notropis buccula*				
163399	163414	Ghost shiner	*Notropis buchanani*	I		M	I(E)
163399	163480	Cahaba shiner	*Notropis cahabae*				
163399	163433	Silverside shiner	*Notropis candidus*				
163399	163403	Ironcolor shiner	*Notropis chalybaeus*	I		I	M(G)
163399	163434	Chihuahua shiner	*Notropis chihuahua*				
163399	163435	Redlip shiner	*Notropis chiliticus*				
163399	163436	Greenhead shiner	*Notropis chlorocephalus*				
163399	163437	Rainbow shiner	*Notropis chrosomus*				
163399	163438	Dusky shiner	*Notropis cummingsae*				
163399	163439	Bigmouth shiner	*Notropis dorsalis*	I		M	
163399	163440	Fluvial shiner	*Notropis edwardraneyi*				
.	163441	Broadstripe shiner	*Notropis euryzonus*				
163399	163442	Arkansas River shiner	*Notropis girardi*				
163399	163443	Wedgespot shiner	*Notropis greenei*				
163399	163444	Redeye chub	*Notropis harperi*				
163399	163445	Blackchin shiner	*Notropis heterodon*	I		I	
163399	163446	Blacknose shiner	*Notropis heterolepis*	I		I	
163399	163447	Bluehead shiner	*Notropis hubbsi*				
163399	163404	Spottail shiner	*Notropis hudsonius*	I	G(F)	M	I(A,E,F)
.	163448	Sailfin shiner	*Notropis hypselopterus*				
163399	163449	Highscale shiner	*Notropis hypsilepis*				
163399	163481	Highback chub	*Notropis hypsinotus*				
163399	163450	Rio Grande shiner	*Notropis jemezanus*				
163399	163451	Tennessee shiner	*Notropis leuciodus*				
163399	163483	Lined chub	*Notropis lineapunctatus*				
163399	163452	Longnose shiner	*Notropis longirostris*				
163399	163453	Yellowfin shiner	*Notropis lutipinnis*				
163399	163454	Taillight shiner	*Notropis maculatus*				
163399	163455	Cape Fear shiner	*Notropis mekistocholas*				
163399	163485	Blackmouth shiner	*Notropis melanostomus*				
163399	163456	Ozark minnow	*Notropis nubilus*	H		I	
163399	163486	Phantom shiner	*Notropis orca*				
163399	163457	Kiamichi shiner	*Notropis ortenburgeri*				
163399	163415	Sharpnose shiner	*Notropis oxyrhynchus*				
163399	163458	Ozark shiner	*Notropis ozarcanus*				
163399	163459	Peppered shiner	*Notropis perpallidus*				
163399	163460	Coastal shiner	*Notropis petersoni*				
163399	163461	Silver shiner	*Notropis photogenis*	I		I	T(G)
163399	163416	Chub shiner	*Notropis potteri*				
163399	163407	Swallowtail shiner	*Notropis procne*	I		I	M(G)
163399	163409	Rosyface shiner	*Notropis rubellus*	I		I	
163399	163487	Rosyface chub	*Notropis rubescens*	I		I	
163399	163462	Saffron shiner	*Notropis rubricroceus*				
163399	163490	Bedrock shiner	*Notropis rupestris*				
163399	163463	Sabine shiner	*Notropis sabinae*				
163399	163464	New River shiner	*Notropis scabriceps*				
163399	163465	Sandbar shiner	*Notropis scepticus*				
163399	163466	Roughhead shiner	*Notropis semperasper*				
163399	163417	Silverband shiner	*Notropis shumardi*				
.	163467	Flagfin shiner	*Notropis signipinnis*				
163399	163418	Bluntnose shiner	*Notropis simus*				
163399	163468	Mirror shiner	*Notropis spectrunculus*				
163399	163469	Silverstripe shiner	*Notropis stilbius*				
163399	163419	Sand shiner	*Notropis stramineus*	I	G(G)	M	
163399	163470	Telescope shiner	*Notropis telescopus*				
163399	163420	Weed shiner	*Notropis texanus*	I	H(E)	I	
163399	163471	Topeka shiner	*Notropis topeka*				
163399	163472	Skygazer shiner	*Notropis uranoscopus*				
163399	163421	Mimic shiner	*Notropis volucellus*	I	G(G)	I	M(G)
.	163473	Bluenose shiner	*Notropis welaka*				
163399	163491	Channel shiner	*Notropis wickliffi*	I		M	
163399	163493	Clear chub	*Notropis winchelli*				

163399	163474	Coosa shiner	*Notropis xaenocephalus*				
163875	163876	Pugnose minnow	*Opsopoeodus emiliae*	I		I	
163878	163879	Oregon chub	*Oregonichthys crameri*				
163588	163589	Sacramento blackfish	*Orthodon microlepidotus*				
163501	163503	Riffle minnow	*Phenacobius catostomus*				
163501	163504	Fatlips minnow	*Phenacobius crassilabrum*				
163501	163502	Suckermouth minnow	*Phenacobius mirabilis*	I		M	
163501	163505	Kanawha minnow	*Phenacobius teretulus*				
163501	163506	Stargazing minnow	*Phenacobius uranops*				
163590	163591	Blackside dace	*Phoxinus cumberlandensis*				
163590	163592	Northern redbelly dace	*Phoxinus eos*	H	G(G)	M	
163590	163593	Southern redbelly dace	*Phoxinus erythrogaster*	H		M	I(A)
163590	163594	Finescale dace	*Phoxinus neogaeus*	I	G(G)	M	
163590	163595	Mountain redbelly dace	*Phoxinus oreas*				
163590	163598	Tennessee dace	*Phoxinus tennesseensis*				
163515	163516	Bluntnose minnow	*Pimephales notatus*	O	G(G)	T	
163515	163517	Fathead minnow	*Pimephales promelas*	O	G(F,G)	T	
163515	163519	Slim minnow	*Pimephales tenellus*				
163515	163518	Bullhead minnow	*Pimephales vigilax*	O		M	
163599	163600	Woundfin	*Plagopterus argentissimus*				
163881	163882	Flathead chub	*Platygobio gracilis*				
163601	163602	Clear Lake splittail	*Pogonichthys ciscoides*				
163601	163603	Splittail	*Pogonichthys macrolepidotus*				
163522	163524	Sacramento squawfish	*Ptychocheilus grandis*				
163522	163525	Colorado squawfish	*Ptychocheilus lucius*				
163522	163523	Northern squawfish	*Ptychocheilus oregonensis*	P		T	
163522	163526	Umpqua squawfish	*Ptychocheilus umpquae*				
163604	163605	Relict dace	*Relictus solitarius*				
163381	163382	Blacknose dace	*Rhinichthys atratulus*	G	I(A)	T	
163381	163384	Longnose dace	*Rhinichthys cataractae*	I		I	M(G)
163381	163388	Loach minnow	*Rhinichthys cobitis*				
163381	163390	Las Vegas dace	*Rhinichthys deaconi*				
163381	163385	Umpqua dace	*Rhinichthys evermanni*				
163381	163386	Leopard dace	*Rhinichthys falcatus*	I		M	
163381	163387	Speckled dace	*Rhinichthys osculus*	I		M	
163606	163607	Bitterling	*Rhodeus sericeus*				
163527	163528	Redside shiner	*Richardsonius balteatus*				
163527	163529	Lahontan redside	*Richardsonius egregius*				
163612	163613	Rudd	*Scardinius erythrophthalmus*	O	I(G)	T	
163374	163376	Creek chub	*Semotilus atromaculatus*	G	I(A)	T	
163374	163375	Fallfish	*Semotilus corporalis*	G		M	
163374	163377	Sandhills chub	*Semotilus lumbee*				
163374	163379	Dixie chub	*Semotilus thoreauianus*				
163347	163348	Tench	*Tinca tinca*				
163341	**163892**	**Suckers**	***Catostomidae***				
163916	163919	River carpsucker	*Carpiodes carpio*	O		M	
163916	163917	Quillback	*Carpiodes cyprinus*	O	G(G)	M	T(G)
163916	163920	Highfin carpsucker	*Carpiodes velifer*	O		I	M(C)
163893	163899	Utah sucker	*Catostomus ardens*				
163893	163900	Yaqui sucker	*Catostomus bernardini*				
163893	163894	Longnose sucker	*Catostomus catostomus*	I		M	I(G)
163893	163901	Desert sucker	*Catostomus clarki*				
163893	163897	Bridgelip sucker	*Catostomus columbianus*				
163893	163895	White sucker	*Catostomus commersoni*	O	I(A)G(F,G)	T	
163893	163902	Bluehead sucker	*Catostomus discobolus*				
163893	163904	Owens sucker	*Catostomus fumeiventris*				
163893	163905	Sonora sucker	*Catostomus insignis*				
163893	163906	Flannelmouth sucker	*Catostomus latipinnis*				
163893	163896	Largescale sucker	*Catostomus macrocheilus*	O		T	
163893	163907	Modoc sucker	*Catostomus microps*				
163893	163908	Sacramento sucker	*Catostomus occidentalis*				
163893	163909	Mountain sucker	*Catostomus platyrhynchus*	H		M	
163893	163910	Rio Grande sucker	*Catostomus plebeius*				
163893	163911	Klamath smallscale sucker	*Catostomus rimiculus*				
163893	163912	Santa Ana sucker	*Catostomus santaanae*				
163893	163913	Klamath largescale sucker	*Catostomus snyderi*				
163893	163914	Tahoe sucker	*Catostomus tahoensis*				
163893	163915	Warner sucker	*Catostomus warnerensis*				
163960	163961	Shortnose sucker	*Chasmistes brevirostris*				
163960	163962	Cui-ui	*Chasmistes cujus*				
163960	163963	June sucker	*Chasmistes liorus*				
163960	163964	Snake River sucker	*Chasmistes muriei*				
163952	163953	Blue sucker	*Cycleptus elongatus*	I	O(A)	I	
163969	163970	Lost River sucker	*Deltistes luxatus*				
163921	163924	Creek chubsucker	*Erimyzon oblongus*	I	O(F),G(G)	M	T(F),I(G)
163921	163922	Lake chubsucker	*Erimyzon sucetta*	I		M	

163921	163926	Sharpfin chubsucker	*Erimyzon tenuis*				
163948	163950	Alabama hog sucker	*Hypentelium etowanum*				
163948	163949	Northern hog sucker	*Hypentelium nigricans*	I	G(G)	I	M(B,D,G)
163948	163951	Roanoke hog sucker	*Hypentelium roanokense*				
163954	163955	Smallmouth buffalo	*Ictiobus bubalus*	I		M	I(E)
163954	163956	Bigmouth buffalo	*Ictiobus cyprinellus*	I	P(A)	M	
163954	163957	Black buffalo	*Ictiobus niger*	I		M	I(E)
163965	163966	Harelip sucker	*Lagochila lacera*	I		I	
163958	163959	Spotted sucker	*Minytrema melanops*	I		M	I(A,E)
163927	163933	Silver redhorse	*Moxostoma anisurum*	I		M	
.	163934	Bigeye jumprock	*Moxostoma ariommum*				
.	163935	Blackfin sucker	*Moxostoma atripinne*				
163927	163936	River redhorse	*Moxostoma carinatum*	I		I	
163927	163937	Black jumprock	*Moxostoma cervinum*				
.	163931	Gray redhorse	*Moxostoma congestum*				
163927	163938	Black redhorse	*Moxostoma duquesnei*	I	G(G)	I	
163927	163939	Golden redhorse	*Moxostoma erythrurum*	I		M	I(G)
.	163940	Rustyside sucker	*Moxostoma hamiltoni*				
163927	163941	Copper redhorse	*Moxostoma hubbsi*				
.	163942	Greater jumprock	*Moxostoma lachneri*	I		I	
163927	163928	Shorthead redhorse	*Moxostoma macrolepidotum*	I		M	
163927	163943	V-lip redhorse	*Moxostoma pappillosum*				
163927	163932	Blacktail redhorse	*Moxostoma poecilurum*				
.	163944	Torrent sucker	*Moxostoma rhothoecum*				
163927	163945	Smallfin redhorse	*Moxostoma robustum*				
.	163946	Striped jumprock	*Moxostoma rupiscartes*				
163927	163947	Greater redhorse	*Moxostoma valenciennesi*	I		I	
163967	163968	Razorback sucker	*Xyrauchen texanus*				
163992	**163995**	**Bullhead catfishes**	***Ictaluridae***				
164034	164035	Snail bullhead	*Ameiurus brunneus*				
164034	164037	White catfish	*Ameiurus catus*	I	P(G)	M	
164034	164039	Black bullhead	*Ameiurus melas*	I		M	T(D)
164034	164041	Yellow bullhead	*Ameiurus natalis*	I	O(F),G(G)	T	M(D)
164034	164043	Brown bullhead	*Ameiurus nebulosus*	I	G(F,G)	T	M(D)
164034	164045	Flat bullhead	*Ameiurus platycephalus*				
164034	164047	Spotted bullhead	*Ameiurus serracanthus*				
163996	163997	Blue catfish	*Ictalurus furcatus*	P	I(A)	M	
163996	164001	Headwater catfish	*Ictalurus lupus*				
163996	164000	Yaqui catfish	*Ictalurus pricei*				
163996	163998	Channel catfish	*Ictalurus punctatus*	P	I(A),G(C)	M	
164002	164006	Ozark madtom	*Noturus albater*				
164002	164007	Smoky madtom	*Noturus baileyi*				
164002	164008	Elegant madtom	*Noturus elegans*				
164002	164009	Mountain madtom	*Noturus eleutherus*	I		I	
164002	164010	Slender madtom	*Noturus exilis*	I		I	
164002	164011	Checkered madtom	*Noturus flavater*				
164002	164012	Yellowfin madtom	*Noturus flavipinnis*				
164002	164013	Stonecat	*Noturus flavus*	I		I	M(G)
164002	164014	Black madtom	*Noturus funebris*				
164002	164015	Carolina madtom	*Noturus furiosus*				
164002	164016	Orangefin madtom	*Noturus gilberti*				
164002	164003	Tadpole madtom	*Noturus gyrinus*	I		M	I(A)
164002	164017	Least madtom	*Noturus hildebrandi*				
164002	164004	Margined madtom	*Noturus insignis*	I		M	
164002	164018	Ouachita madtom	*Noturus lachneri*				
164002	164019	Speckled madtom	*Noturus leptacanthus*				
164002	164020	Brindled madtom	*Noturus miurus*	I		I	M(G)
164002	164021	Frecklebelly madtom	*Noturus munitus*				
164002	164005	Freckled madtom	*Noturus nocturnus*	I		M	I(D)
164002	164022	Brown madtom	*Noturus phaeus*				
164002	164023	Neosho madtom	*Noturus placidus*				
164002	164024	Pygmy madtom	*Noturus stanauli*				
164002	164025	Northern madtom	*Noturus stigmosus*	I		I	
164002	164026	Caddo madtom	*Noturus taylori*				
164002	164027	Scioto madtom	*Noturus trautmani*	I		I	
164028	164029	Flathead catfish	*Pylodictis olivaris*	P		M	
164030	164031	Widemouth blindcat	*Satan eurystomus*				
164032	164033	Toothless blindcat	*Trogloglanis pattersoni*				

A Checklist of Index of Biotic Integrity Designations for Fishes of the United States

(Nomenclature follows Robins et al. 1991)

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