



## **Classification of Texas Freshwater Fishes Into Trophic and Tolerance Groups**

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**River Studies Report No. 14**

**Resource Protection Division  
Texas Parks and Wildlife Department  
Austin, Texas**

**June 1998**





# Classification of Texas Freshwater Fishes into Trophic and Tolerance Groups

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The Index of Biotic Integrity (IBI) as proposed by Karr (1981) and modified by others (Miller *et al.* 1988) provides a means of assessing the health of a stream through attributes of its fish community. IBI is an EPA approved technique for conducting biological monitoring (Plafkin *et al.* 1989). It is comprised of biological metrics, which fall into three broad categories: species composition, trophic composition, and fish abundance and condition. Data are obtained for each of these metrics at a given site and evaluated in light of what might be expected at an unimpacted site located in a similar geographical region and on a stream of comparable size. Designation of fish into feeding guilds is an essential part of IBI. Trophic composition metrics offer a means of evaluating the shift toward more generalized foraging that typically occurs with increased degradation of the physical and chemical habitat. Identification of the most tolerant and intolerant fish species is also a vital part of IBI. Intolerant species are typically the first species to disappear following a disturbance and therefore provide a means for distinguishing high and moderate quality sites. Tolerant species typically show increased distribution or abundance despite the historical degradation of surface water and shift from incidental to dominant in disturbed sites. This metric therefore helps distinguish low from moderate quality waters. The absence of comprehensive lists for Texas species prompted this endeavor.

## Methods

Individuals with an expertise in Texas freshwater fishes were sent a survey requesting that a feeding guild (herbivore, invertivore, piscivore, or omnivore) be assigned to adult members of each fish species for which they had knowledge. The list of fishes included on the survey was modified from Hubbs (1982). The final species list included in this manuscript relies upon Hubbs *et al.* (1991). Scientific and common names follow Robins *et al.* (1991). Feeding guilds for the study were defined as:

herbivore (H) - diet of adult consists entirely of plant material;

invertivore (IF) - diet of adult consists primarily of insects, but may also occasionally include small crustacea and fish (or eggs and larvae);

piscivore (P) - diet of adult is predominantly fish, but may also include frogs, crustacea, and insects (Karr *et al.* 1986);

omnivore (O) - diet of adult consists of significant quantities of both plant and animal materials (at least 25% plant and 25% animal)(Schlosser 1982).

In addition, survey participants were requested to designate the species which are especially tolerant or intolerant of organic enrichment and low dissolved oxygen concentrations. Literature was also reviewed to supplement the returned surveys.

## Results and Discussion

Texas' freshwater fishes (Hubbs *et al.* 1991) were classified into trophic and tolerance groups (Table 1) using returned surveys from fishery professionals familiar with Texas fishes, and with information gathered from a comprehensive literature review. Survey responders are listed in Appendix A and literature relied upon for trophic and tolerance information is provided in Appendix B.

When conflicting responses occurred in trophic classifications that trophic group receiving the most positive responses was selected. In the event of ties, survey responses were given more weight than the literature since the literature represented information from a large geographical area.

Since the tolerance classification was to determine the most tolerant and intolerant species, conflicting responses were treated differently than those for trophic classification. Those few species with conflicting classifications were therefore not classified but were left within the intermediate range, except for gizzard shad (*Dorosoma cepedianum*) which was classified as tolerant due to the overwhelming number of tolerant responses and only one intolerant response.

Of the 235 fish species listed 2% were designated as herbivores, 21% as omnivores, 57% as

Table 1. Trophic and tolerance classification of Texas freshwater fish species. Trophic group designations are as follows: IF - invertivore; P - piscivore; O - omnivore; and H - herbivore. Tolerance designations are: T - tolerant; I - intolerant. Those species without a tolerance designation are considered intermediate.

<u>Scientific name</u>	<u>Common name</u>	<u>Trophic Group</u>	<u>Tolerance</u>
<i>Ichthyomyzon castaneus</i>	Chesnut lamprey	P	I
<i>Ichthyomyzon gagei</i>	Southern brook lamprey	NONE	I
<i>Carcharhinus isodon</i>	Fine tooth shark	P	
<i>Carcharhinus leucas</i>	Bull shark	P	
<i>Pristis pectinata</i>	Smalltooth sawfish	P	
<i>Dasyatis sabina</i>	Atlantic stingray	IF	
<i>Scaphirynchus platyrhynchus</i>	Shovelnose sturgeon	IF	
<i>Polyodon spathula</i>	Paddlefish	O	I
<i>Lepisosteus oculatus</i>	Spotted gar	P	T
<i>Lepisosteus osseus</i>	Longnose gar	P	T
<i>Lepisosteus platostomus</i>	Shortnose gar	P	T
<i>Lepisosteus spatula</i>	Alligator gar	P	T
<i>Amia calva</i>	Bowfin	P	T
<i>Hiodon alosoides</i>	Goldeye	IF	
<i>Elops saurus</i>	Ladyfish	P	
<i>Megalops atlanticus</i>	Tarpon	P	T
<i>Anguilla rostrata</i>	American eel	P	
<i>Myrophis punctatus</i>	Speckled worm eel	P	
<i>Alosa chrysochloris</i>	Skipjack herring	P	
<i>Brevoortia gunteri</i>	Finescale menhaden	O	
<i>Dorosoma cepedianum</i>	Gizzard shad	O	T
<i>Dorosoma petenense</i>	Threadfin shad	O	
<i>Harengula jaguana</i>	Scaled sardine	IF	
<i>Anchoa hepsetus</i>	Striped anchovy	IF	
<i>Anchoa mitchilli</i>	Bay anchovy	IF	
<i>Campostoma anomalum</i>	Central stoneroller	H	
<i>Campostoma ornatum</i>	Mexican stoneroller	H	
<i>Carassius auratus</i>	Goldfish	O	T
<i>Ctenopharyngodon idella</i>	Grass carp	H	T
<i>Cyprinella lutrensis</i>	Red shiner	IF	T
<i>Cyprinella proserpina</i>	Proserpine shiner	IF	
<i>Cyprinella venusta</i>	Blacktail shiner	IF	
<i>Cyprinus carpio</i>	Common carp	O	T
<i>Dionda diaboli</i>	Devils River minnow	IF	I
<i>Dionda episcopa</i>	Roundnose minnow	O	I
<i>Gila pandora</i>	Rio Grande chub	IF	I
<i>Hybognathus hayi</i>	Cypress minnow	O	
<i>Hybognathus nuchalis</i>	Mississippi silvery minnow	O	T
<i>Hybognathus placitus</i>	Plains minnow	O	T
<i>Luxilus chrysocephalus</i>	Striped shiner	IF	
<i>Lythrurus fumeus</i>	Ribbon shiner	IF	
<i>Lythrurus umbratilis</i>	Redfin shiner	IF	
<i>Macrhybopsis aestivalis</i>	Speckled chub	IF	
<i>Macrhybopsis storeriana</i>	Silver chub	IF	
<i>Notemigonus crysoleucas</i>	Golden shiner	IF	T

Table 1. continued.

<u>Scientific name</u>	<u>Common name</u>	<u>Trophic Group</u>	<u>Tolerance</u>
<i>Notropis amabilis</i>	Texas shiner	IF	
<i>Notropis amnis</i>	Pallid shiner	IF	
<i>Notropis atherinoides</i>	Emerald shiner	IF	
<i>Notropis atrocaudalis</i>	Blackspot shiner	IF	
<i>Notropis bairdi</i>	Red River shiner	IF	
<i>Notropis blennioides</i>	River shiner	IF	
<i>Notropis braytoni</i>	Tamaulipas shiner	IF	
<i>Notropis buccula</i>	Smalleye shiner	IF	
<i>Notropis buchanani</i>	Ghost shiner	IF	
<i>Notropis chalybaeus</i>	Ironcolor shiner	IF	I
<i>Notropis chihuahua</i>	Chihuahua shiner	IF	
<i>Notropis girardi</i>	Arkansas River shiner	IF	
<i>Notropis hubbsi</i>	Bluehead shiner	IF	
<i>Notropis jemezianus</i>	Rio Grande shiner	IF	
<i>Notropis maculatus</i>	Taillight shiner	IF	
<i>Notropis oxyrhynchus</i>	Sharpnose shiner	IF	
<i>Notropis potteri</i>	Chub shiner	IF	
<i>Notropis sabiniae</i>	Sabine shiner	IF	
<i>Notropis shumardi</i>	Silverband shiner	IF	
<i>Notropis stramineus</i>	Sand shiner	IF	
<i>Notropis texanus</i>	Weed shiner	IF	
<i>Notropis volucellus</i>	Mimic shiner	IF	I
<i>Opsopoeodus emiliae</i>	Pugnose minnow	IF	
<i>Phenacobius mirabilis</i>	Suckermouth minnow	IF	
<i>Pimephales promelas</i>	Fathead minnow	O	T
<i>Pimephales vigilax</i>	Bullhead minnow	IF	
<i>Platygobio gracilis</i>	Flathead chub	IF	
<i>Rhinichthys cataractae</i>	Longnose dace	IF	
<i>Scardinius erythrophthalmus</i>	Rudd	O	T
<i>Semotilus atromaculatus</i>	Creek chub	P	
<i>Carpionoxenus carpio</i>	River carpsucker	O	T
<i>Cycleptus elongatus</i>	Blue sucker	IF	I
<i>Erimyzon oblongus</i>	Creek chub sucker	O	
<i>Erimyzon sucetta</i>	Lake chubsucker	O	
<i>Ictiobus bubalus</i>	Smallmouth buffalo	O	
<i>Ictiobus cyprinellus</i>	Bigmouth buffalo	IF	T
<i>Ictiobus niger</i>	Black buffalo	O	
<i>Minytrema melanops</i>	Spotted sucker	IF	
<i>Moxostoma austrinum</i>	West Mexican redhorse	IF	
<i>Moxostoma congestum</i>	Gray redhorse	IF	
<i>Moxostoma erythrum</i>	Golden redhorse	IF	
<i>Moxostoma poecilurum</i>	Blacktail redhorse	IF	
<i>Astyanax mexicanus</i>	Mexican tetra	IF	
<i>Ameiurus melas</i>	Black bullhead	O	T
<i>Ameiurus natalis</i>	Yellow bullhead	O	
<i>Ictalurus furcatus</i>	Blue catfish	P	
<i>Ictalurus lupus</i>	Headwater catfish	O	
<i>Ictalurus punctatus</i>	Channel catfish	O	T
<i>Noturus gyrinus</i>	Tadpole madtom	IF	I

Table 1. continued.

<u>Scientific name</u>	<u>Common name</u>	<u>Trophic Group</u>	<u>Tolerance</u>
<i>Noturus nocturnus</i>	Freckled madtom	IF	I
<i>Pylodictis olivaris</i>	Flathead catfish	P	
<i>Satan eurystomus</i>	Widemouth blindcat	IF	
<i>Trogloglanis pattersoni</i>	Toothless blindcat	O	
<i>Arius felis</i>	Hardhead catfish	IF	T
<i>Bagre marinus</i>	Gafftopsail catfish	P	T
<i>Hypostomus plecostomus</i>	Suckermouth catfish	H	
<i>Esox americanus vermiculatus</i>	Grass pickerel	P	
<i>Esox lucius</i>	Northern pike	P	I
<i>Esox niger</i>	Chain pickerel	P	
<i>Oncorhynchus mykiss</i>	Rainbow trout	IF - LOTIC P - LENTIC	I I
<i>Aphredoderus sayanus</i>	Pirate perch	IF	
<i>Strongylura marina</i>	Atlantic needlefish	P	
<i>Adinia xenica</i>	Diamond killifish	O	T
<i>Cyprinodon bovinus</i>	Leon Springs pupfish	O	
<i>Cyprinodon elegans</i>	Comanche Springs pupfish	O	
<i>Cyprinodon eximius</i>	Conchos pupfish	O	
<i>Cyprinodon pecosensis</i>	Pecos River pupfish	O	T
<i>Cyprinodon rubrofluvialilis</i>	Red River pupfish	O	T
<i>Cyprinodon variegatus</i>	Sheepshead minnow	O	T
<i>Fundulus chrysotus</i>	Golden topminnow	IF	
<i>Fundulus dispar</i>	Starhead topminnow	IF	
<i>Fundulus grandis</i>	Gulf killifish	O	
<i>Fundulus jenkinsi</i>	Saltmarsh topminnow	IF	
<i>Fundulus notatus</i>	Blackstripe topminnow	IF	
<i>Fundulus olivaceus</i>	Blackspotted topminnow	IF	I
<i>Fundulus pulvereus</i>	Bayou killifish	IF	
<i>Fundulus similis</i>	Longnose killifish	O	I
<i>Fundulus zebrinus</i>	Plains killifish	IF	T
<i>Lucania parva</i>	Rainwater killifish	IF	
<i>Gambusia affinis</i>	Western mosquitofish	IF	T
<i>Gambusia gaigei</i>	Big Bend gambusia	IF	
<i>Gambusia geiseri</i>	Largespring gambusia	IF	
<i>Gambusia heterochir</i>	Clear Creek gambusia	IF	
<i>Gambusia nobilis</i>	Pecos gambusia	IF	
<i>Heterandria formosa</i>	Least killifish	IF	
<i>Poecilia formosa</i>	Amazon molly	O	
<i>Poecilia latipinna</i>	Sailfin molly	O	T
<i>Poecilia reticulata</i>	Guppy	IF	T
<i>Labidesthes sicculus</i>	Brook silverside	IF	I
<i>Membras martinica</i>	Rough silverside	IF	
<i>Menidia beryllina</i>	Inland silverside	IF	
<i>Menidia clarkhubbsi</i>	Texas silverside	IF	
<i>Menidia peninsulæ</i>	Tidewater silverside	IF	
<i>Microphis brachyurus</i>	Opposum pipefish	IF	
<i>Syngnathus louisianae</i>	Chain pipefish	IF	
<i>Syngnathus scovelli</i>	Gulf pipefish	IF	
<i>Centropomus parallelus</i>	Fat snook	P	

Table 1. continued.

<u>Scientific name</u>	<u>Common name</u>	<u>Trophic Group</u>	<u>Tolerance</u>
<i>Centropomus undecimalis</i>	Common snook	P	I
<i>Morone chrysops</i>	White bass	P	
<i>Morone mississippiensis</i>	Yellow bass	P	
<i>Morone saxatilis</i>	Striped bass	P	
<i>Ambloplites rupestris</i>	Rock bass	P	I
<i>Centrarchus macropterus</i>	Flier	IF	
<i>Elassoma zonatum</i>	Banded pygmy sunfish	IF	
<i>Lepomis auritus</i>	Redbreast sunfish	IF	
<i>Lepomis cyanellus</i>	Green sunfish	P	T
<i>Lepomis gulosus</i>	Warmouth	P	T
<i>Lepomis humilus</i>	Orangespotted sunfish	IF	
<i>Lepomis macrochirus</i>	Bluegill	IF	T
<i>Lepomis marginatus</i>	Dollar sunfish	IF	
<i>Lepomis megalotis</i>	Longear sunfish	IF	
<i>Lepomis microlophus</i>	Redear sunfish	IF	
<i>Lepomis punctatus</i>	Spotted sunfish	IF	
<i>Lepomis symmetricus</i>	Bantam sunfish	IF	
<i>Micropterus dolomieu</i>	Smallmouth bass	P	I
<i>Micropterus punctulatus</i>	Spotted bass	P	
<i>Micropterus salmoides</i>	Largemouth bass	P	
<i>Micropterus treculi</i>	Guadalupe bass	P	I
<i>Pomoxis annularis</i>	White crappie	P	
<i>Pomoxis nigromaculatus</i>	Black crappie	P	
<i>Ammocrypta clara</i>	Western sand darter	IF	
<i>Ammocrypta vivax</i>	Scaly sand darter	IF	
<i>Etheostoma asprigene</i>	Mud darter	IF	
<i>Etheostoma chlorosomum</i>	Bluntnose darter	IF	
<i>Etheostoma fonticola</i>	Fountain darter	IF	I
<i>Etheostoma fusiforme</i>	Swamp darter	IF	
<i>Etheostoma gracile</i>	Slough darter	IF	
<i>Etheostoma grahmi</i>	Rio Grande darter	IF	
<i>Etheostoma histrio</i>	Harlequin darter	IF	
<i>Etheostoma lepidum</i>	Greenthroat darter	IF	I
<i>Etheostoma parvipinne</i>	Goldstripe darter	IF	I
<i>Etheostoma proeliare</i>	Cypress darter	IF	I
<i>Etheostoma radiosum</i>	Orangebelly darter	IF	I
<i>Etheostoma spectabile</i>	Orangethroat darter	IF	I
<i>Etheostoma whipplei</i>	Redfin darter	IF	I
<i>Perca flavescens</i>	Yellow perch	P	
<i>Percina caprodes</i>	Logperch	IF	I
<i>Percina carbonaria</i>	Texas logperch	IF	I
<i>Percina macrolepada</i>	Bigscale logperch	IF	I
<i>Percina maculata</i>	Blackside darter	IF	I
<i>Percina sciera</i>	Dusky darter	IF	I
<i>Percina shumardi</i>	River darter	IF	I
<i>Stizostedion canadense</i>	Sauger	P	I
<i>Stizostedion vitreum</i>	Walleye	P	
<i>Caranx hippos</i>	Crevalle jack	P	I
<i>Diapterus auratus</i>	Irish pompano	IF	

Table 1. continued.

<u>Scientific name</u>	<u>Common name</u>	<u>Trophic Group</u>	<u>Tolerance</u>
<i>Eucinostomus argenteus</i>	Spotfin mojarra	IF	
<i>Eucinostomus melanopterus</i>	Flagfin mojarra	IF	
<i>Conodon nobilis</i>	Barred grunt	IF	
<i>Pomadasys crocro</i>	Burro grunt	IF	
<i>Archosargus probatocephalus</i>	Sheepshead	O	
<i>Lagodon rhomboides</i>	Pinfish	O	
<i>Aplodinotus grunniens</i>	Freshwater drum	IF	T
<i>Bairdiella chrysoura</i>	Silver perch	IF	
<i>Cynoscion arenarius</i>	Sand seatrout	P	I
<i>Cynoscion nebulosus</i>	Spotted seatrout	P	I
<i>Leiostomus xanthurus</i>	Spot	O	
<i>Micropogonias undulatus</i>	Atlantic croaker	IF	I
<i>Pogonias cromis</i>	Black drum	IF	
<i>Sciaenops ocellatus</i>	Red drum	P	
<i>Cichlasoma cyanoguttatum</i>	Rio Grande cichlid	IF	
<i>Tilapia aurea</i>	Blue tilapia	O	T
<i>Tilapia mossambica</i>	Mozambique tilapia	O	
<i>Tilapia zilli</i>	Redbelly tilapia	O	
<i>Agonostomus monticola</i>	Mountain mullet	O	
<i>Mugil cephalus</i>	Striped mullet	O	
<i>Mugil curema</i>	White mullet	O	
<i>Polydactylus octonemus</i>	Atlantic threadfin	IF	
<i>Dormitator maculatus</i>	Fat sleeper	O	
<i>Eleotris pisonis</i>	Spinycheek sleeper	O	
<i>Eretelis smaragdus</i>	Emerald sleeper	IF	
<i>Gobiomorus dormitor</i>	Bigmouth sleeper	IF	
<i>Awaous tajasica</i>	River goby	O	
<i>Bathygobius soporator</i>	Frillfin goby	IF	T
<i>Evorthodus lyricus</i>	Lyre goby	H	
<i>Gobioides broussonneti</i>	Violet goby	O	
<i>Gobionellus atripinnis</i>	Blackfin goby	O	
<i>Gobionellus boleosoma</i>	Darter goby	O	
<i>Gobionellus oceanicus</i>	Highfin goby	O	
<i>Gobionellus shufeldti</i>	Freshwater goby	IF	
<i>Gobionellus stigmaticus</i>	Marked goby	O	
<i>Gobiosoma bosc</i>	Naked goby	IF	T
<i>Gobiosoma robustum</i>	Code goby	IF	
<i>Microgobius gulosus</i>	Clown goby	IF	
<i>Citharichthys spilopterus</i>	Bay whiff	IF	
<i>Etropus crossotus</i>	Fringed flounder	IF	
<i>Paralichthys lethostigma</i>	Southern flounder	P	
<i>Achirus lineatus</i>	Lined sole	IF	
<i>Trinectes maculatus</i>	Hogchoker	IF	
<i>Sphoeroides parvus</i>	Least puffer	IF	

invertivores, and 19% as piscivores. Rainbow trout (*Oncorhynchus mykiss*) were split into two trophic groups (one for lotic and one for lentic), while brook lamprey (*Ichthyomyzon gagei*) were not given a designation since they do not feed as adults. Trophic classifications recommended in this paper do not differ substantially from those published by USEPA (1983) and Plafkin et al. (1989); however, many of the species found in Texas were not on these lists and USEPA (1983) did not identify invertebrate feeding species, but only listed top carnivores and omnivores. While classification differences do exist between our list and each of the other two lists, only one species common to all three lists was classified differently in this paper than in the other two lists. Golden shiner (*Notemigonus crysoleucas*) was classified as an omnivore by USEPA (1983) and Plafkin (1989) whereas it was identified as an invertivore in this report.

In regards to tolerance classification, 15% of the fish species were identified as especially intolerant to low dissolved oxygen concentrations; whereas, 16% rated as especially tolerant. USEPA (1983) provides a list of intolerant species (but not tolerant species) which designates a number of species as intolerant that our list classifies as intermediate. These discrepancies are attributed to the USEPA (1983) list covering a very broad geographical area (the list is considered a national list) and lumping all darters as intolerant. Differences also exist between our list and that of Plafkin et al. (1989); however, of the species present on all three lists, only one was classified differently in this paper than in the other two lists. Western sand darter (*Ammocrypta clara*) was classified as intermediate in our paper, but was designated as intolerant by USEPA (1983) and Plafkin (1989).

#### Acknowledgements

Appreciation is extended to those individuals who shared their years of experience and knowledge of fishery science through their completed surveys. We also thank D. Sager, K. Mayes, R. Moss, G. Garrett, and M. Luedke (Texas Parks and Wildlife Department) and D. Moiser (Texas Natural Resource Conservation Commission) for their comments and suggestions. M. Randle and the staff of the Learning Resources Center (Southwest Texas State University) helped us track down many of the publications referenced in this report.

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**APPENDIX A**  
**Survey Responders**

Appendix A. Responders to trophic and tolerance classification survey.

Cross, F.B. Museum of Natural History, University of Kansas, Lawrence, Kansas.

Echelle, A.A. Department of Zoology, Oklahoma State University, Stillwater, Oklahoma.

Hubbs, C. Department of Zoology, University of Texas, Austin, Texas.

Janssen, H.J. Cheniere Caminada Marine Life Education, Grand Isle, Louisiana.

Schramm, H.L., Jr. Mississippi Cooperative Fish and Wildlife Research Unit, Mississippi State, Mississippi.

Whiteside, B.G. Department of Biology, Southwest Texas State University, San Marcos, Texas.

APPENDIX B  
Referenced Literature

Appendix B. Sources referenced for designating trophic and tolerance classification.

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