Food Habits of Largemouth Bass in Two Heated East Texas Reservoirs

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Abstract: Food habits of largemouth bass, (*Micropterus salmoides*), from 2 heated East Texas reservoirs having different prey communities were studied. In Lake Monticello, shad, primarily threadfin shad (*Dorosoma petenense*), were the dominant prey most of the year. Sunfishes were the major food item in winter months. Shad were especially important in the diets of largemouth bass 153 - 306 mm in total length. Utilization of sunfishes increased with size of largemouth bass. Sunfishes and shad were equally abundant in the diets of largemouth bass ≥306 mm TL. Largemouth bass population structure and condition were good based on monthly proportional stock density and relative weight indices. In Lake Welsh, sunfishes were the dominant food of all sizes of largemouth bass, particularly during winter and spring. Many largemouth bass consumed insects during the summer, suggesting low forage fish populations. Based on monthly population and condition indices, largemouth bass population structure and condition were poor. Sunfishes alone may not provide adequate prey to support largemouth bass populations in heated reservoirs. Introduction of a clupeid such as threadfin shad, in heated reservoirs with low prey diversity, may benefit structure and condition of largemouth bass populations.

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The number of power plant cooling reservoirs in Texas has increased since the early 1970s. Management strategies for these impoundments have sometimes included introduction of exotic fishes, primarily Florida largemouth bass (*M. salmoides floridanus*). Lake Monticello and Lake Welsh are 2 heated reservoirs in Texas where Florida largemouth bass were successfully introduced. Although trophy largemouth bass fisheries have developed in both reservoirs, previous sampling indicated differences between the size structure and condition of the 2 populations (Forshage 1980, Ryan 1980). These differences were thought to be prey related, and possibly correlated to the availability of preferred sizes of clupeids, specifically threadfin shad. This species is present in Lake Monticello, but absent from Lake Welsh.

The dynamics of prey utilization by piscivores was studied by Ivlev (1961). He found that prey availability and distribution affected feeding intensities of predators.

He observed prey selectivity by predators was influenced by abundance, accessibility, and size of prey. The degree of satiation and intrinsic food preferences of individual predator species were cited as additional factors influencing selectivity.

Optimal forage concepts have been studied by many authors. Lewis et al. (1961) investigated the influence of availability and vulnerability of prey on food selection by largemouth bass. Under experimental conditions, they found that largemouth bass selected certain food items over others when availability of 2 food organisms was the same. Snow (1971) found changes in availability and accessibility of prey were important factors in prey selection by largemouth bass in Murphy Flowage, Wisconsin. The apparent decline in crayfish and reduction of aquatic vegetation during drawdown resulted in increased utilization of bluegills (*Lepomis macrochirus*). In observations by Lawrence (1958) regarding prey size preference of largemouth bass, he found that prey fishes with a maximum body depth equal to or slightly greater than mouth width of largemouth bass were utilized. However, largemouth bass appeared to prefer smaller sizes of prey fishes when given a choice. Timmons and Pawaputanon (1980) found that largemouth bass in West Point Reservoir, Alabama-Georgia, could utilize bluegills at 0.4 times their body weight and shad at 0.5 times.

Food habits of largemouth bass are well documented, however, the majority of these investigations were conducted in non-heated environments. Goodson (1965), Applegate et al. (1966), Aggus (1972), Pasch (1974), and Timmons et al. (1981) observed seasonal changes in food habits. Pasch (1974), Mitchell (1981), and Timmons et al. (1981) identified changes in food habits according to size of largemouth bass. In Lake Bastrop, Texas, a power plant cooling reservoir, Day (1981) found that prey utilization varied with season and size of largemouth bass.

This study was designed to compare food habits of 2 populations of largemouth bass having different prey bases to identify trends in prey utilization by season and size class. Concern regarding the developing trophy largemouth bass fisheries in both reservoirs and recruitment problems cited at Lake Welsh necessitated this investigation. By comparing the results, better understanding of prey dynamics would enhance identification of management needs.

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Methods

Lake Monticello is located on Blundell and Smith creeks, tributaries of the Big Cypress River, approximately 16 km southwest of Mount Pleasant, Texas. Constructed in August 1972 by Texas Utilities Generating Company (TUGCO), it covers 810 ha, has a maximum depth of 14 m and a mean depth of 6.6 m. The

watershed is 93.2 km^2, the shoreline length is 26 km, and the shoreline development ratio (S.D.) is 2.55.

During summer months, surface temperatures have been recorded as high as 45° C near the mouth of the discharge canal. The average annual water intake temperature was 26° C and ranged from 15.5° to 37.2° C (J. Abbott, pers. comm.). Threadfin shad, bluegill, and redear sunfish (*Lepomis microlophus*) comprise the dominant prey fishes (Table 1) (Ryan 1980). Gizzard shad (*Dorosoma cepedianum*) are present, but few shorter than 203 mm TL were collected.

Lake Welsh is located on Swauano Creek, a tributary of the Big Cypress River, approximately 16 km southeast of Mount Pleasant, Texas. It was constructed in 1975 by Southwestern Electric Power Company (SWEPCO) as a cooling reservoir for coal-fired steam electric power generation. The reservoir impounds 553 ha, the maximum depth is 12.2 m and mean depth is 5.2 m. The shoreline length is 43 km, the S.D. is 5.21, and the watershed covers 54.9 km^2. During summer months, surface water temperatures have been measured in excess of 40° C at the mouth of the discharge canal. The average annual water intake temperature was 23.4° C and ranged from 10 to 35.6° C (J. A. Pruett, pers. comm.).

Table 1. Biomass estimates, by species, from cove rotenone surveys in lakes Monticello and Welsh, Texas, 1979. Values are minimum estimates, not corrected for recovery rate.

Species	Lake Monticello		Lake Welsh	
	N/ha	kg/ha	*N*/ha	kg/ha
Bowfin (*Amia calva*)			0.4	1.8
Gizzard shad (*Dorosoma cepedianum*)	28.9	41.3	75.3	72.0
Threadfin shad (*Dorosoma petenense*)	2510.0	24.5		
Grass pickerel (*Esox americanus vermiculatus*)			3.3	1.1
Goldfish (*Carassius auratus*)	0.1	0.1		
Lake chubsucker (*Erimyzon sucetta*)	0.1	0.1	6.6	4.1
Spotted sucker (*Minytrema melanops*)			0.2	0.9
Black bullhead (*Ictalurus melas*)	0.5	<0.1	0.2	0.1
Yellow bullhead (*Ictalurus natalis*)	11.2	0.4	1.1	0.3
Channel catfish (*Ictalurus punctatus*)	3.4	7.3	1.2	11.1
Flathead catfish (*Pylodictis olivaris*)	0.4	2.7		
Flier (*Centrarchus macropterus*)			0.2	0.1
Warmouth (*Chaenabryttus gulosus*)	1.4	0.8	201.6	3.8
Green sunfish (*Lepomis cyanellus*)	1.4	0.8	11.5	0.7
Bluegill (*Lepomis macrochirus*)	329.8	10.4	484.2	17.4
Longear sunfish (*Lepomis megalotis*)	8.7	0.3	16.5	0.3
Redear sunfish (*Lepomis microlophus*)	597.6	40.0	1242.9	36.5
Spotted sunfish (*Lepomis punctatus*)			214.5	3.1
Spotted bass (*Micropterus punctulatus*)	0.4	0.7		
Largemouth bass (*Micropterus salmoides*)[1]	189.6	133.8	135.3	70.2
White crappie (*Pomoxis annularis*)			0.2	0.3
Black crappie (*Pomoxis nigromaculatus*)	1.4	0.6	2.1	2.6
Logperch (*Percina caprodes*)	2.1	<0.1		
TOTAL[2]	3688	264	2400	226

[1]Northern largemouth bass, Florida largemouth bass and their hybrids are included.
[2]Total includes madtom and minnow species.

Management survey data indicated low prey biomass in Lake Welsh. The biomass of bluegill decreased by 68% from 1977 to 1979. Forshage (1980) attributed this reduction to excessive predation. Threadfin shad were not present in the reservoir. Gizzard shad were found in early management surveys, however, individuals <203 mm TL were rare, and consequently, this species was not considered a major food item for largemouth bass.

Largemouth bass were collected with electrofishing gear from February 1980 to January 1981 on both reservoirs. Monthly collections were scheduled. However, elevated water temperatures reduced the effectiveness of sampling equipment and no samples were collected in August (Lake Monticello) and August through October (Lake Welsh). District management responsibilities in November and December conflicted with scheduled sampling on Lake Welsh and no collections were made during these months.

A 110 volt, 3,000 watt AC generator was used to sample littoral areas in both reservoirs. Specimens were immediately placed on ice and taken to the laboratory for processing. A sample size of 30 specimens from each lake per month was proposed. However, sample quotas were not met during certain months at both reservoirs.

Largemouth bass were weighed to the nearest gram and total length measured to the nearest millimeter. Stomachs were dissected, and individual food items were separated and counted. Food items were grouped into the following major categories: shad, sunfish, insects, crayfish, largemouth bass, minnows, detritus, unidentified fish remains (UFR), and miscellaneous. Volume of food items was estimated by water displacement. Prey utilization was summarized by season of the year and size of largemouth bass. Seasons were: spring (February-April), summer (May-July), autumn (August-October), and winter (November-January). Largemouth bass were separated into 2 size ranges for analysis; 153-306 mm (size class I) and longer than 306 mm (size class II).

Proportional stock density (PSD) as described by Anderson (1978) and relative weight (W_r) (Wege and Anderson 1978) were calculated from monthly samples to evaluate population structure and condition of largemouth bass.

Results and Discussion

A total of 339 largemouth bass were collected from Lake Monticello. Food habits differed among seasons and sizes of largemouth bass (Table 2). Shad were the major food item during most of the year (Fig. 1). Sunfish occurrence in stomach samples increased in autumn and became the dominant food item in winter months. Seasonal changes in food habits in Lake Monticello are similar to those found by Day (1981) in Lake Bastrop, Texas (a heated reservoir). He found largemouth bass fed primarily on shad during March-September, while centrarchids were the dominant food from November through January.

Largemouth bass (153 to 306 mm TL) in Lake Monticello utilized shad as a

Table 2. Number and percent number of food items by size and season from largemouth bass in lakes Monticello and Welsh, Texas, from February 1980 through January 1981.

Reservoir	Size (TL)/ Season	Total[a]	Empty		UFR		Shad		Sunfish		Insects		Minnows		LM bass		Crayfish		Detritus		Misc.	
		N	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Monticello	153–305 mm	201	62	30.8	44	30.4	68	46.9	10	6.9	9	6.2	7	4.8	1	0.7			3	2.1	3	2.1
	>306 mm	136	46	33.8	37	39.0	23	24.2	14	16.9	3	3.2	3	3.2	1	1.1			2	2.1	10	10.5
Welsh	153–306 mm	169	42	24.8	35	22.3	3	1.9	35	22.3	53	33.8	2	1.3	4	2.6	3	1.9	11	7.0	7	4.5
	>306 mm	17	7	41.2	4	33.3			3	25.0	2	16.7	1	8.3	2	16.7						
Monticello	Spring	109	48	44.0	14	21.9	26	40.6	3	4.7	8	12.5	5	7.8	1	1.6			1	1.6	6	9.4
	Summer	91	20	22.0	28	38.4	39	53.4	2	2.7			3	4.1	1	1.4						
	Autumn	64	16	25.0	19	37.2	24	47.1	6	11.8									1	2.0	1	2.0
	Winter[a]	75	25	33.3	21	40.0	2	3.8	15	28.3	4	7.5	2	3.8					3	5.7	6	11.3
Welsh	Spring[a]	118	21	17.8	25	19.8	2	1.6	24	19.1	43	34.1	3	2.4	6	4.7	3	2.4	9	7.1	11	8.7
	Summer	40	18	45.0	8	33.3			3	12.5	8	33.3							3	12.5		
	Autumn																					
	Winter[a]	31	10	32.3	4	18.2	1	4.6	11	50.0	5	22.7							1	4.6		

[a]Two (Monticello) or 3 (Welsh) largemouth bass <153mm (TL) were included in seasonal totals.

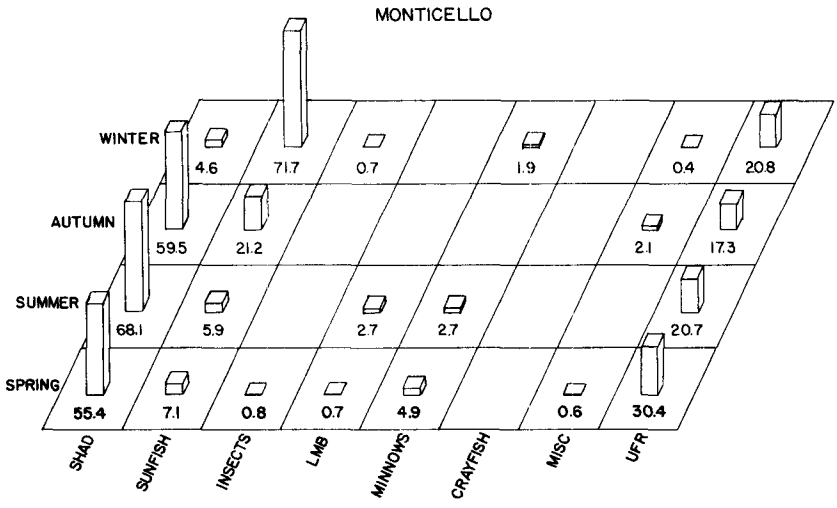

Figure 1. Percent volume of food items of largemouth bass from Lake Monticello, Texas, February 1980 through January 1981. Seasons are defined as Spring (Feb, Mar, Apr), Summer (May, Jun, Jul), Autumn (Aug, Sep, Oct), and Winter (Nov, Dec, Jan).

primary food item, but consumption of sunfishes increased as bass grew (Fig. 2). Shad and sunfishes were consumed in similar amounts (volume) by individuals >306 mm TL, suggesting changes in forage preference. Day (1981) found shad were important in the diet of small/intermediate size bass. He observed that utilization of sunfish as food items increased with the growth of largemouth bass. Pasch (1974) found similar changes in food habits by size of largemouth bass in Lake Blackshear, Georgia.

Monthly PSD values of largemouth bass in Lake Monticello ranged from 27% to 71% (Table 3). The annual mean PSD was 49%, indicating satisfactory population structure (Reynolds and Babb 1978). Mean monthly W_r values ranged from 98 to 122 and averaged 108 over the study period. Relative weight values near 100 are considered desirable according to Wege and Anderson (1978).

A total of 189 largemouth bass were collected from Lake Welsh. Sunfishes, UFR, and insects were the most utilized food items. By volume, sunfishes were the dominant food item observed in spring and winter (Fig 3). Numerically, insects appeared to be utilized more during spring and summer; however, 90% of the largemouth bass in these samples were between 153 and 306 mm long. Insects were also an important food item of largemouth bass in Lake Bastrop, Texas, during February-April (Day 1981). Mitchell (1981) found consumption of insects by largemouth bass <300 mm TL was higher from March-August in Canyon Reservoir, Texas.

Sunfishes were the major food item, by volume, of both size groups of largemouth bass (Fig. 4). Miscellaneous food items such as arachnids, copepods, mol-

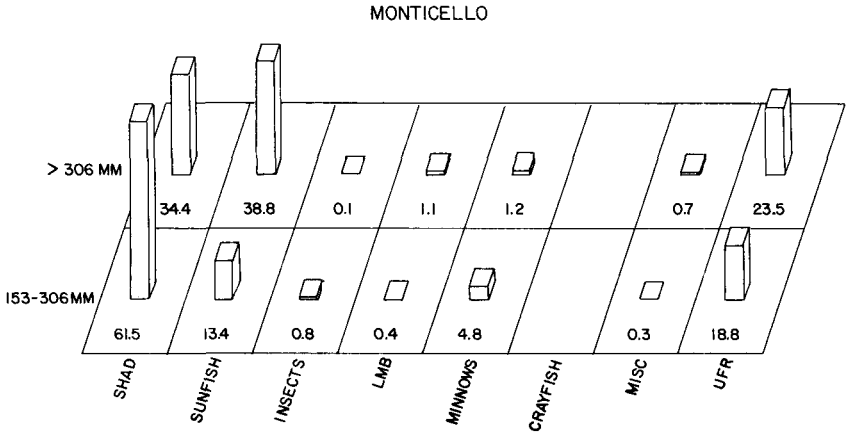

Figure 2. Percent volume of food items by size (total length) of largemouth bass from Lake Monticello, Texas, February 1980 through January 1981. Size Class I (153 to 306 mm), and Size Class II (>306 mm).

Table 3. Monthly proportional stock densities (PSD) and relative weights (W_r) of largemouth from lakes Monticello and Welsh, Texas 1980–81.

	PSD%		W_r	
Month	Monticello	Welsh	Monticello	Welsh
Feb (1980)	42	24	104	96
Mar	52	19	98	92
Apr	45	12	122	85
May	53	0	113	85
Jun	27	8	112	81
Jul	32	9	109	91
Sep	52		110	
Oct	58		105	
Nov	71		106	
Dec	45		104	
Jan (1981)	67	4	104	86
Yearly Average	49	11	108	88

lusks, decopods, minnows, and detritus comprised 15% (by volume) of the diet of individuals from 153 to 306 mm. None of these items were represented in sufficient numbers or volume to be considered important dietary components. However, the wide variety of miscellaneous food items in the stomachs of smaller bass may have been related to limited availability or accessibility of preferred sizes of sunfishes during certain seasons in Lake Welsh.

The monthly PSD values of largemouth bass from Lake Welsh ranged from 0% to 24%. The mean PSD was 11% indicating low numbers of quality size individuals (>305 mm) and poor population structure. Mean W_r for the study period was 88

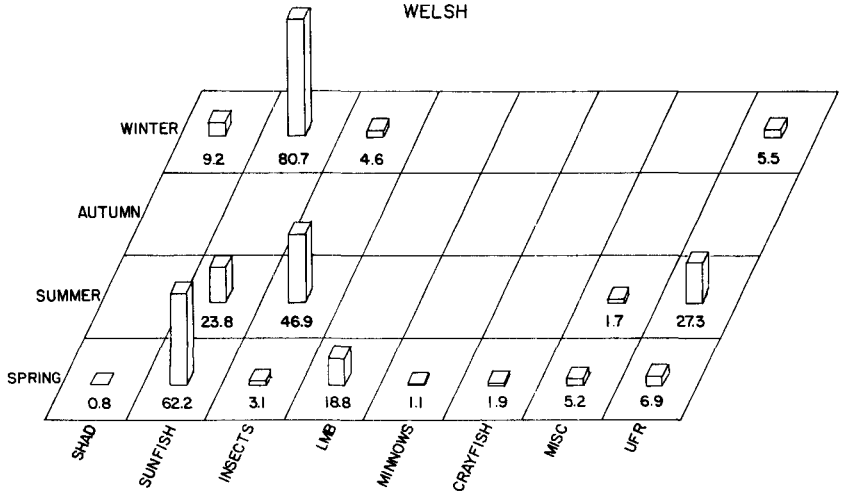

Figure 3. Percent volume of food items of largemouth bass from Lake Welsh, Texas, February 1980 through January 1981. Seasons are defined as Spring (Feb, Mar, Apr), Summer (May, Jun, Jul), Autumn (Aug, Sep, Oct), and Winter (Nov, Dec, Jan).

Figure 4. Percent volume of food items by size (total length) of largemouth bass from Lake Welsh, Texas, February 1980 through January 1981. Size Class I (153 to 306 mm), and Size Class II (>306 mm).

and ranged from 81 to 96. These population indices reflect poor recruitment and condition. Low PSD in a largemouth bass population may also indicate overharvest according to Anderson (1978). However, overharvest was not identified as a management problem based on creel survey data (Forshage 1980).

Unfortunately, data was insufficient to monitor food habits of bass during autumn months at Lake Welsh. Sunfish comprised a relatively small portion of food items utilized by bass during summer. This may reflect changes in availability or accessibility of preferred sizes of sunfishes. Since sunfish (primarily bluegill) are the only major food fish for bass in Lake Welsh, critical shortages of prey may occur during certain seasons. Based on largemouth bass population indices, it appears prey shortages may be particularly acute for <305-mm bass.

Management Implications

Sunfish, especially bluegill, are important prey for largemouth bass in these reservoirs. However, sunfish alone may not adequately meet prey demands of largemouth bass. In Lake Monticello, shad comprised a major food item in the diet of 153- to 306-mm bass. Although there may be interspecific resource competition between clupeids and sunfishes, availability of preferred sizes of clupeids may enhance production and condition of largemouth bass in heated impoundments. Elevated metabolism of fish in heated reservoirs and extended growing seasons increase demands on prey and predator populations. The introduction of a clupeid, such as threadfin shad, in heated reservoirs having low prey diversities may help to buffer food chains when availability or accessibility of a major food item is reduced.

Literature Cited

Aggus, L. R. 1972. Food of angler harvested largemouth, spotted and smallmouth bass in Bull Shoals Reservoir. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 26:519–529.

Anderson, R. O. 1978. New approaches in recreational fishery management. Pages 73–79 *in* G. D. Novinger and J. G. Dillard, eds. New approaches to the management of small impoundments. Spec. Publ. 5, North Central Div. Am. Fish. Soc.

Applegate, R. L., J. W. Mullan, and D. I. Morais. 1966. Food and growth of six centrarchids from shoreline areas of Bull Shoals Reservoir. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 20:469–482.

Day, H. P. 1981. Food habit study of the largemouth bass, Guadalupe bass and white bass x striped bass hybrid in a central Texas reservoir receiving heated effluent. M.S. Thesis, Southwest Texas State Univ., San Marcos. 103pp.

Forshage, A. A. 1980. Existing reservoir and stream management recommendations, Lake Welsh. Performance Rep., Proj. F-30-R-5, Job A. Texas Parks and Wildl. Dep., Austin. 14pp.

Goodson, L. F. 1965. Diets of four warmwater game fishes in a fluctuating, steep-sided California reservoir. Calif. Fish and Game. 51:259–269.

Ivlev, V. S. 1961. Experimental ecology of the feeding of fishes. Translated from Russian by D. Scott. Yale Univ. Press, New Haven. 302pp.

Lawrence, J. M. 1958. Estimated sizes of various forage fishes largemouth bass can swallow. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 12:220–225.

Lewis, W. M., G. E. Gunning, E. Lyles, and W. L. Gridges. 1961. Food choice of largemouth bass as a function of availability and vulnerability of food items. Trans. Am. Fish. Soc. 90:277–280.

Mitchell, D. C. 1981. A comparison of the tropic relationships of largemouth bass between the riverine and dam areas of Canyon Reservoir, Texas. M.S. Thesis, Southwest Texas State Univ., San Marcos. 46pp.

Pasch, R. W. 1974. Some relationships between food habits and growth of largemouth bass in Lake Blackshear, Georgia. Proc. Annu. Conf. Southeast. Game and Fish Comm. 28:307–321.

Reynolds, J. B. and L. R. Babb. 1978. Structure and dynamics of largemouth bass populations. Pages 50–61 *in* G. D. Novinger and J. G. Dillard, eds. New approaches to the management of small impoundments. Spec. Publ. 5. North Central Div. Am. Fish Soc.

Ryan, M. J. 1980. Existing reservoir and stream management recommendations. Lake Monticello. Performance Rep., Proj. F-30-R-5, Job A. Texas Parks and Wildl. Dep., Austin. 13pp.

Snow, H. E. 1971. Harvest and feeding habits of largemouth bass in Murphy Flowage, Wisconsin. Tech. Bul. 50, Wisc. Dep. Nat. Resour. 25pp.

Timmons, T. J. and O. Pawaputanon. 1980. Relative size relationship in prey selection by largemouth bass in West Point Lake, Alabama-Georgia. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 34:248–252.

———, W. L. Shelton, and W. D. Davies. 1981. Food of largemouth bass before and during the first three years after impoundment of West Point Reservoir, Alabama and Georgia. J. Tenn. Acad. Sci. 56:23–27.

Wege, G. J. and R. O. Anderson. 1978. Relative Weight (W_r): A new index of condition for largemouth bass. Pages 79–91 *in* G. D. Novinger and J. G. Dillard, eds. New approaches to the management of small impoundments. Spec. Publ. 5. North Central Div. Am. Fish. Soc.