INTERRELATIONSHIP OF VEGETATIVE COVER AND SUNFISH POPULATION DENSITY IN SUPPRESSING SPAWNING IN LARGEMOUTH BASS[a]

STEPHEN LEE SMITH, Florida Game and Fresh Water Fish Comm., P. O. Box 1903, Eustis, FL 32726
JOSEPH E. CRUMPTON, Florida Game and Fresh Water Fish Comm., P. O. Box 1903, Eustis, FL 32726

Abstract: Largemouth bass (*Micropterus salmoides*) fail to spawn in association with dense populations of sunfish (*Lepomis* sp.). Previous studies have demonstrated that suppression is behavioral in nature and linked to interspecific competition for space within spawning areas. In 1976 a series of ponds were stocked with 3 pairs of bass and densities of sunfish from 0-458 kg/ha to determine the density necessary to effect suppression. Results were inconclusive with spawning occurring in all ponds but only late in the season in ponds stocked at 250 kg/ha or above. It was not clear whether the growth of aquatic vegetation or cropping of the sunfish population resulted in spawning in these ponds. In 1977 a second series of paired ponds (1 with vegetation, 1 without) were stocked with 3 pairs of bass and sunfish at densities of 0-448 kg/ha. In ponds without vegetative cover bass spawning was completely suppressed at 336 kg sunfish/ha but spawning occurred in all ponds with vegetative cover (maximum of 448 kg sunfish/ha).

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The failure of largemouth bass to spawn successfully in the presence of large numbers of sunfish was documented more than 30 years ago with the postulation that sunfish predation on the eggs was responsible (Swingle and Smith 1943). Later, it was suggested that a chemical factor excreted into the water by the sunfishes might be involved (Swingle 1956 and Chew 1974). It was recently established that a chemical factor was not responsible (Barwick and Holcomb 1976) and that the suppression is behavioral in nature and is related to interspecific population densities in the spawning areas (Smith 1976).

The occurrence of this phenomenon in large eutrophic Florida lakes was first documented by Horel (1964) and later by Chew (1972). Smith (1976) suggested that the decrease in aquatic vegetation which occurs with advancing urban eutrophication was in part responsible for the decline in bass populations in these lakes, since interspecific population densities in spawning areas increase as vegetative cover decreases.

The study reported here was an attempt to determine the population density of sunfish necessary to effect suppression of bass spawning and to determine the role of vegetative cover in this suppression.

METHODS

Nine 0.04 ha hatchery ponds at the Richloam Fish Hatchery of the Florida Game and Fresh Water Fish Commission were utilized for the study. The study was conducted during February through May of 1976 and 1977. In the 1976 portion of the study the ponds were stocked with 3 pairs of bass and varying densities of juvenile sunfishes ($>$ 100 mm total length) at a rate of 0 to 458 kg/ha (Table 1). One pond was stocked with bass and adult golden shiners (*Notemigonus chrysoleucas*).

During 1977 the ponds were paired, one containing extensive vegetative cover and the other void of cover. The coverless ponds were denuded of cover prior to the study utilizing the grass carp (*Ctenopharyngodon idella*) and maintained during the study by 3 separate applications of Diquat herbicide. Stocking consisted of 3 pairs of bass per pond and varying densities of a mixture of adult and juvenile sunfish from 0 to 448 kg/ha (Table 2). The sunfishes were predominantly bluegill (*Lepomis macrochirus*) and readear sunfish (*Lepomis microlophus*). Two ponds were stocked with Florida gar (*Lepisosteus platyrhincus*) instead of sunfish.

Bass, adult sunfish and gar were collected from local lakes utilizing electrofishing gear. The juvenile sunfish were supplied by the hatchery. During both years ponds were maintained until the cessation of bass spawning in the adjacent hatchery brood ponds. These were then drained and the weight and numbers of recovered bass, bass fry and sunfish recorded.

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Table 1. Stocking rates for 1976 bass spawning suppression study.

Pond	*ha*	*Pairs of Bass*	*kg*	*Sunfish kg/ha*
1[a]	0.045	3	22.7	508.9
2	0.032	3	0	0
3	0.045	3	0.91	20.2
4	0.049	3	1.82	37.0
5	0.045	3	3.63	81.8
6	0.049	3	7.26	149.1
7	0.041	3	11.35	280.3
8	0.049	3	15.89	327.3
9	0.045	3	20.43	458.5

[a]150 mm (total length) golden shiners.

Table 2. Stocking rates for 1977 bass spawning suppression study.

Pond	*ha*	*Pairs of Bass*	*kg*	Sunfish *kg*	*Cover*
1	0.045	3	0	0	None
2A	0.032	3	7.3	224	None
2B	0.045	3	10.0	224	*Cover*
3A	0.049	3	16.3	336	None
3B	0.049	3	16.3	336	Cover
4A	0.045	3	20.0	448	None
4B	0.041	3	18.2	448	Cover
5A[a]	0.045	3	14.0	311[a]	None
5B[a]	0.049	3	12.5	256[a]	Cover

[a]Gar

RESULTS

In the spring of 1976 bass spawning occurred in all 9 study ponds (Table 3). In 5 ponds (2-6) stocked with sunfish at 0 to 149 kg/ha bass spawning occurred within 30 days coinciding with spawning in adjacent hatchery brood ponds. Spawning also occurred

Table 3. Results of 1976 bass spawning suppression study.

Pond	*Sunfish* Stocked (kg/ha)	*Sunfish* Recovered (kg/ha)	*Bass fingerlings recaptured*
1[a]	508.9	50.9	yes
2	0	0	yes
3	20.2	174.9	yes
4	37.0	62.8	yes
5	81.8	56.1	yes
6	149.1	109.9	yes
7	280.3	142.4	yes
8	327.3	51.6	only 3
9	458.5	202.9	fry observed

[a]150 mm (total length) golden shiners.

during this period in pond 1 stocked with 508.9 kg/ha adult golden shiners. However spawning in the remaining ponds (7-9) occurred much later with spawning in the pond stocked at 458 kg/ha of sunfish (9) occurring just prior to study termination in late May, coinciding with heavy growth of aquatic vegetation.

Draining of the ponds revealed that significant cropping of the sunfish population had occurred ranging up to 35 percent in pond 9. Cropping was actually more severe than the data in Table 3 indicate since the remaining sunfish had grown considerably and in ponds 2-6 the weight of recovered bass fingerlings is included in the recovery figures.

The data indicated that the critical population level necessary to suppress bass spawning in a coverless habitat lies between 149 and 250 kg/ha since spawning was delayed in ponds 7-9. It was unclear however, whether the growth of aquatic vegetation or the cropping of sunfish populations was responsible for the later spawning in these ponds. To eliminate the problem of sunfish cropping, a mixture of adult and juvenile sunfish was stocked in 1977. It was reasoned that sunfish spawning would compensate for cropping losses and this was indeed the result (Table 4).

Table 4. Results of 1977 bass spawning suppression study.

Pond	*Sunfish stocked (kg/ha)*	*Sunfish + YOY Bass recovered (kg/ha)*	*Cover*	*Bass spawning*
1	0	0	None	yes
2A	224	271	None	yes
2B	224	208	Cover	yes
3A	336	354	None	no
3B	336	289	Cover	yes
4A	448	360	Cover	yes
4B	448	454	Cover	yes
	Gar			
5A	311	310	None	yes
5B	256	256	Cover	yes

The 1977 data (Table 4) from the coverless ponds (1, 2A, 3A) paralleled the 1976 results with complete spawning suppression occurring at 336 kg sunfish/ha. Vegetated ponds (2B, 3B, 4A, 4B) yielded markedly different results with spawning occurring in all ponds including those stocked at 448 kg/ha. (Pond 4A had been designed as a non-cover pond but could not be maintained as such). In the ponds stocked with Florida gar spawning occurred regardless of the presence or absence of cover.

Data indicate that an inverse relationship between bass spawning suppression and vegetative cover exists. The population density of sunfish necessary to suppress bass spawning is determined in part by the amount of cover available. Since the mechanism of suppression is behavioral in nature and linked to aggressive interaction with other species (Smith 1976) the explanation for this relationship follows: cover reduces the number of individual contacts bteween bass and sunfish thus lowering the effective density in the spawning area.

DISCUSSION

For many years the decline of the sport fishery, especially for largemouth bass in many Florida lakes undergoing rapid urban eutrophication, had been evident and well documented (Ware et al. 1972). The initial effect of urban eutrophication is the reduction of aquatic plant communities. Holcomb (1976) documented the decline of spatterdock in Lake Griffin from 1846.4 ha in 1947 to 26.8 ha in 1976. In each documented case the effect on the sport fishery is first evidenced by a decline in the largemouth bass population. This can now be linked directly to the reduction in vegetative cover.

In Florida lakes aquatic plant growth is stimulated by lake level fluctuations occurring naturally by drought and flood or artificially through lake drawdown. Holcomb and Wegener (1971) were able to demonstrate a 16 percent increase in the area of littoral vegetation in Lake Tohopekaliga as a result of an artificial drawdown. This resulted in an increase in aquatic macroinvertebrate population levels (Wegener et al. 1974) and ultimately in increased standing crops of sport and forage fish (Wegener and Williams 1974). The numbers of harvestable bass in the littoral areas increased from a low of 43/ha prior to the drawdown to 102/ha 1 year following reflooding. This was linked indirectly through the food chain to the increased primary production. It was noted, however, that the spring following reflooding produced substantial increases in bass reproduction yielding the highest bass standing crop during the study. It can now be postulated that this response was in part due to the diminishing effect on bass spawning suppression afforded by the increase in available vegetative cover.

This role of vegetative cover in suppressing bass spawning establishes even more firmly the importance of aquatic vegetation to the maintenance of desirable fish population structure and levels in Florida lakes. It also has implications in many other areas of water management such as aquatic weed control and points out the need for long range integrated resource planning.

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