

A Literature Review on Blue Tilapia with an Emphasis on Feeding Habits

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The management of aquatic macrophytes is of significant concern considering that nearly all of the earth's lakes contain aquatic vegetation. State and local agencies, as well as private businesses, expend a large amount of time and money for the control of aquatic vegetation. For example, in the 1991-1992 fiscal year, the state of Florida spent 6.2 million dollars on the control of aquatic plants on public lakes and rivers (Schardt 1991).

The control of aquatic vegetation is often maintained by mechanical harvesting or herbicide treatment (Stickney 1979; Haller et al. 1980). Biological control, through the use of plant-eating fish is also a viable alternative (Avault, 1965; Butler et al., 1968). Grass carp *Ctenopharyngodon idella*, blue tilapia *Oreochromis aureus* (Steindachner), common carp *Cyprinus carpio*, and redbelly tilapia *Tilapia zilli* are some species that have been investigated (Cailteux 1988, Gu 1997, Noble 1989, Spataru and Zorn 1978) for the control of aquatic macrophytes.

This paper is a literature review on some of the history, biology, and feeding habits of the blue tilapia.

History

Blue tilapia have supported a large commercial fishery and have been used as an aquaculture species in Africa and the Middle East for many years (Spatara and Zorn 1978). This species is an exotic fish that was introduced into the United States in 1957 by

researchers at Auburn University from Israel, to investigate its use as a potential food source and sport fish (Swingle 1960). The native range of the fish is regions of West Africa and Palestine (Trewavas 1965).

Blue tilapia were brought to Florida in 1961 by the Florida Game and Freshwater Fish Commission to investigate their potential use as a biological weed control (Courtenay and Robins 1973) and sportfish (Crittenden 1962). Both ideas proved unfavorable and the population was thought to be eradicated, but by that time tilapia had been moved by fishermen to other water bodies (Buntz and Manooch 1968). Since then, the blue tilapia has spread throughout Florida, north to North Carolina (Noble 1989) and west to Texas (Courtenay et al. 1991). Shafland (1979), Zale (1984), and Radonski et al. (1984) reported that it is the most widely distributed exotic species in Florida due to its ability to tolerate colder temperatures than most other non-indigenous cichlids.

Biology

Blue tilapia are mouth brooders (Buntz and Manooch 1968). Males build the nest, as deep as 60 cm, and defend this area by ritualized displays and mouth fighting (Buntz and Manooch 1968). After the eggs have been fertilized the female will pick them up with her mouth and carry them to deeper water (McBay 1961). Blue tilapia can be fast growers and have been reported by Winfree and Stickney (1981) to reach total lengths of 350 mm in their first year. Females become mature at around 100 mm (Chervinski 1983) or at few weeks of age (Noble 1989).

Blue tilapia are most commonly found in freshwater, but can also inhabit brackish and saline waters (Shafland and Pestrak 1982, Trewavas 1983). It has been reported that

blue tilapia have been found in the marine waters of Tampa Bay, Florida (Courtenay et al. 1984).

Feeding Habits

The feeding habits of blue tilapia cover a wide range of aquatic organisms. Discussion of their primary diet has been contradictory in much of the literature. Noble (1989) reported that blue tilapia are obligate herbivores and are anatomically equipped for feeding on attached or matted algae, which they can graze, and on free floating algae. Noble (1989) also reported that they have minimal ability to consume submergent macrophytes because grazing is limited to very soft material. Blue tilapia were found to be mainly zooplanktivorous in Lake Kinneret, Israel, taking plant matter and algae as secondary food sources (Sparatu and Zorn 1978). Cailteux (1988) described blue tilapia as herbivores and/or detritivores. Other studies designate that this species feeds on phytoplankton and zooplankton (Zohary et al. 1994), a conjugation of plankton, benthos and detritus (Sparatu 1976), and also growing on synthetic feed for aquaculture (Schroeder 1983). Mallin (1985) described that over 99 percent of the stomach contents in sixty blue tilapia (42-286 mm) were comprised of organic and inorganic detritus. Mallin (1985) also reported that as this species becomes larger, they begin to consume a significantly larger amount of zooplankton and phytoplankton.

Due to the wide range of findings, Mallin (1985) probably described blue tilapia most accurately in his study on Lake Julian when he stated that they were found to be opportunistic omnivores. Blue tilapia can modify their feeding habits from pelagic filter feeding to bottom grazing when plankton densities are low in the water column (Mallin 1985). A study by Gu et al. (1997) on carbon and nitrogen isotopes agrees with Mallin

(1985), in that blue tilapia consume a wide array of potential food sources due to the broad ranges of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ that were found in gut contents. The diet of blue tilapia may also be dependent on the abundance and composition of foods available in different aquatic environments (Gu et al. 1997).

Findings by Mallin (1985) in Lake Julian suggest that larger tilapia, less apt to predation by large mouth bass *Micropterus salmoides*, may have a broader feeding range, utilizing both sediments and the water column. Largemouth bass may restrict smaller blue tilapia to shoreline and benthic feeding (Mallin 1985).

The control of aquatic vegetation by blue tilapia has had varying results. Whetstone (2002) reported that blue tilapia, stocked at 400 fish/acre and 200 fish/acre in experimental ponds, controlled filamentous algae in one-two months and three months, respectively. Blue tilapia also controlled watermeal *Wolffia spp.* after three months, but did not effectively control duckweed *Lemna valdiviana* (Whetstone 2002). Blue tilapia stocked at 500 adults/hectare and 2,500 adults/hectare, plus their offspring, controlled small ponds dominated by *Najas* and *Chara* within 120 and 90 d, respectively (Schwartz et al. 1986). Schwartz et al. (1986) related this success to the lack of predation and the high survival of stocked adults plus high reproductive success. Pierce and Yawn (1965) and Childers and Bennet (1967) reported that the vegetative control of Mozambique tilapia *Tilapia mossambica* decreased substantially in the presence of largemouth bass. Schwartz et al. (1986) reported that the control of aquatic vegetation by blue tilapia appeared to result from reduced light penetration from turbidity and from uprooting and defoliation of the macrophytes. Mallin (1985) reported that when blooms of filamentous

algae did appear in Lake Julian, their rapid disappearance may have been due to the tilapia.

Some secondary effects from the habits of blue tilapia are increased turbidity and decreased light penetration from uprooting of plants and nest building (Lasher 1967; Noble et al. 1976), increased temperature and dissolved oxygen levels, and lower stratification (Schwartz et al. 1986) in some water bodies.

The ecological role of blue tilapia is ever increasing as it expands its' range. The results discussed are findings based on specific studies and may not hold true in all systems. Further investigation should be implemented into the habits of blue tilapia. Ultimately, the expansion of tilapia will depend, in part, on temperature tolerances and food availability within a system.

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