

Preliminary Examination of Cultured Fish Consumption by the Diamondback Water Snake *Nerodia rhombifer*

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Abstract

The black hole so called for the lack of accounting, in aquaculture may account for unexplained losses of 20% or more per year in cultured organisms. Among potential causes are poor water quality and disease episodes, predation by birds, mammals, and reptiles/amphibians, and theft. At the Aquaculture Research Station of the University of Arkansas at Pine Bluff the diamondback water snake was commonly encountered. These live-bearing snakes of up to 2 m in length were observed consuming cultured channel catfish and baitfish, including goldfish. To begin to assess their capacity for damage, we held 3, 0.6-0.9 m adult snakes in large tanks. Each tank was supplied with a small water source for the goldfish, golden shiners and catfish fingerlings added, ad libitum. The consumption was monitored for three weeks. Consumption was no fish, 5 fish, and 1 fish; for an average of 0.7 fish/individual/week. Based on daytime observations of 5-10 snakes per 0.1 ha pond (likely an underestimate due to nocturnal activity in warm weather and under harassment) at the station and these results, an estimated loss of 5-10% per year may be expected.

Keywords: Black hole; Diamondback water snake; Channel catfish/golden shiners/goldfish.

Introduction

The genus *Nerodia* of water snakes are found from Canada to Mexico in North America. Major items in their diet are fish and amphibians (Plummer and Goy 1984). With the capacity for live birth of dozens of young, the potential for large population growth in habitats of abundant food exist. Aquaculture, and especially hatchery, facilities are one such environment. Published work on negative impacts in aquaculture farms cover the Northern water snake, *N. s. sipedonin* [1]. From examination of specimens at a private fish hatchery in Missouri, they assumed these snakes consumed fish every other week at 30% of the snake body weight. We estimated that number to be up to 10% of the cultured fishes, primarily goldfish. No studies have been conducted on the impact of *N. rhombifer*, the diamondback water snake [1].

This preliminary study sought to determine how often the diamondback water snake consumed cultured fish. The diamondback water snake is the predominant water snake at the Aquaculture Research Station of the University of Arkansas at Pine Bluff and was known to consume large quantities of cultured fish in the station's 0.45-0.1 ha ponds.

Methods and Materials

The study was conducted at the Aquaculture Research Station of the University of Arkansas at Pine Bluff. Three large tanks were partially filled with water and tilted to allow dry area for snakes to use. In each tank an adult diamondback water snake was placed. The snakes were captured on the station and were between 0.6 and 0.9 m. In each tank numbers of live golden shiners, goldfish, and juvenile channel catfish were placed. Consumption was recorded weekly by counting the surviving fishes. At the end of the three-week period, the snakes were released [2].

Results and Discussion

Consumption by week was: no fish during the three weeks by snake 1, 4 fish week 1, 1 fish week 2, and no fish week 3 by snake 2; no fish week 1, 1 fish week 2, no fish week 3 by snake 3. The highest consumption of 4 fish in the first week by snake 2 followed shedding, uring shedding, snakes do not feed and compensate after shedding.

The average consumption was 0.7 fish per week per snake. The high variability was not unexpected as the studies of the authors [1,2] found empty stomachs in 51% and 65%, respectively of snakes of this genus.

The consumption of 0.7 fish per week per snake could account for the some of the unexplained losses noted by fish farmers in the area, and termed the "black hole." With an estimated 5-10 snakes per 0.1 ha pond based on daytime counts (undoubtedly low as these snakes are largely nocturnal in warm weather and under harassment), the yearly losses could account for 5-10% of the total cultured fishes. As the observed losses to the "black hole" may be 20% and more, other likely contributors are predation from diving ducks such as mergansers, and water birds such as white pelicans, double-crested cormorants, egrets, and herons. Other predators might be mink, otters, and theft. Losses also are likely from poor water quality and disease, with the dead fish sinking or being removed by animals. However, the finding that fish-feeding Northern and diamondback water snakes could account for up to 50% of the "black hole" losses indicates they are significant predators on fish farms where large density of smaller fishes (i.e., hatcheries, bait fish, and goldfish farms) are found. Even with control measures, the live-bearing ability at one year of age by Northern water snakes has led to constant numbers harvested, albeit at a smaller size, at a Missouri goldfish hatchery (Bauman and Mettes 1976). Other areas of the world may experience similar issues depending on the species of water snake found and culture system. It should also be noted that many water snakes consume large numbers of amphibians, including large frogs that prey on small cultured fishes.

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Received October 30, 2017; **Accepted** November 27, 2017; **Published** December 05, 2017

Citation: Perschbacher P, Davis M (2017) Preliminary Examination of Cultured Fish Consumption by the Diamondback Water Snake *Nerodia rhombifer*. J Fisheries Livest Prod 5: 258. doi: [10.4172/2332-2608.1000258](https://doi.org/10.4172/2332-2608.1000258)

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