Control of the Invasive Exotic Island Apple Snail (*Pomacea insularum*) in Southwest Alabama

2009 After Action Report

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Ongoing

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(*Pomacea insularum*) in Southwest Alabama

2009 After Action Report:

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Executive Summary

The island apple snail is native to South America where it lives in a variety of aquatic habitats. It has been introduced around the world, where it often causes severe damage to native habitats and agricultural crops. Since its invasion into Florida in the 1970's, it has spread rapidly along the Gulf Coast and East Coast from Texas to South Carolina.

The Alabama Department of Conservation and Natural Resources (ADCNR) Wildlife and Freshwater Fisheries Division (AWFF), in cooperation with the U.S. Fish and Wildlife Service (USFWS) Alabama Ecological Services Field Office and several other partners (including many volunteers from the public), began efforts in Fall 2009 to control the population of exotic island apple snails that have become established in the lakes at Langan Municipal Park (LMP) and Threemile Creek (TMC) in Mobile, AL.

The island apple snail was anecdotally reported in the Threemile Creek watershed in 2004, but was not confirmed until 2008. It wasn't until 2008 that the densities noticeably escalated. It is likely that the population of apple snails at these locations originated from aquarium pet releases. An initial copper sulfate treatment to eradicate adult and juvenile snails was conducted on the LMP lakes October 6, 2009, and on TMC on October 7 and 9, 2009; a second application was made within the LMP lakes on October 15 and 16, 2009. Control measures also included trapping apple snails and the manual removal and destruction of apple snail eggs from these locations. An effort to remove eggs and adult snails was initiated October 3, 2009, at Langan Park involving 40-50 volunteers. Another volunteer effort on October 10, 2009, involved 30-40 volunteers. A trapping effort to monitor the apple snail population post-chemical treatment began October 20, 2009, with the deployment of 20 traps within the lakes at LMP, and has continued to present.

A long-term monitoring and control program will be needed to keep this species from expanding its range in Alabama and threatening other aquatic habitats. The primary goal of this plan is to greatly diminish the population of apple snails in the TMC drainage and restrict further expansion of their range in Alabama.

Background

Island apple snails (*Pomacea insularum*) have been observed in the 32- and 13-acre lakes located at Langan Municipal Park (LMP) and within a stretch of Threemile Creek (TMC) 8 miles downstream of LMP (Figure 1, 2, and 3). The lower most extent of apple snails within TMC currently ends within 1.5 miles of the confluence with the Mobile River. Approximately 370 acres of water are known to be infested by this snail.

The introduction of apple snails in TMC is of concern, as TMC drains directly into the Mobile River Ship Channel and the Port of Mobile. Salinity at the mouth of TMC, Mobile River, and Mobile Bay could be enough to limit apple snail movement, as apple snail upper salinity tolerance is around 6.8 parts per thousand (ppt) (Ramakrishnan 2007). However, water around the mouth of TMC and in the Mobile River can be quite fresh at certain times, depending on rainfall levels. Also, tides and currents could move newly hatched snails, potentially allowing apple snails to invade more than 20,000 acres of the Upper and Lower Mobile-Tensaw Delta (MTD). If apple snails become established in the MTD, there could be detrimental effects to natural resources through habitat degradation and direct competition with native species. Furthermore, once apple snails reach the mouth of TMC, they could attach and lay eggs on ships and barges. If this were to occur, the Port of Mobile could become a source of apple snails to the Tombigbee River, Alabama River, and ports outside Alabama. Therefore, we believe it is imperative to limit the snail to the TMC drainage, and eliminate them within the drainage if possible.

Biology and Life History

The island apple snail is native to South America, occurring in Argentina, Brazil, Bolivia, Uruguay, and Paraguay (Rawlings et al. 2007). This species has become an invasive pest in Southeast Asia, Sri Lanka, Guam, Hawaii, Papua New Guinea, Dominican Republic, Australia, and the southern United States (Rawlings *et* al. 2007). Currently island apple snails are found in Florida, Texas, Georgia, Mississippi, Louisiana, South Carolina, and Alabama (Rawlings *et* al. 2007, Ramakrishnan 2007).

Non-native apple snails (in the genus Pomacea) have been introduced in the continental United States since the 1960's (e.g., *Pomacea bridgesii* in 1966), with the first report of the island apple snail occurring in Palm Beach County, Florida, in 1978 (Rawlings *et* al. 2007). The Florida apple snail (*Pomacea paludosa*), is the only native apple snail to the United States; it occurs in the Choctawhatchee, Ecofina, St. Marks, and Suwanee River systems in Florida, in the Apalachicola system in Georgia, and in the Conecuh River system in Alabama (Burch 1989, Rawlings *et* al. 2007).

The island apple snail and the channeled apple snail (*Pomacea canaliculata*) are two of the more problematic species of non-native apple snails in the southern U.S., especially in rice growing regions (e.g., Texas) where these species have been recognized as devastating agricultural pests (Rawlings *et* al. 2007). They also represent a major risk to native wetland ecosystems through consumption of aquatic plants and direct competition with native species. Aquatic plants are essential to the health of wetland communities, as primary producers; they also create diverse/complex habitats, offer refugia and resources to macroinvertebrates and fish, and play a key role in nutrient cycling (Burlakova *et* al. 2008).

Research has documented the ability for the island apple snail to consume substantial amounts of important wetland aquatic macrophytes (plants). Apple snail consumption rates have been documented at between 55% to 96% on four of these native aquatic plant species (i.e., spider lilies, widgeon grass, arrowhead, and coontail) (Burlakova *et* al. 2008). Apple snails also will forage heavily on exotic macrophytes such as wild taro, alligator weed, and water hyacinth, though the impacts on native species would seem to outweigh any benefit of control of exotic plants (Burlakova *et al.* 2008).

Apple snails can also serve as disease vectors as they can harbor potentially harmful nematodes and trematodes that have potential to pose human health risks. The primary health risks are *Angiostongylus cantonensis* (rat ringworm), *Echinostoma ilocanum* (intestinal fluke) (Ramakrishnan 2007), and *Eosinophilic meningoencephalitis*, which is caused by a human endoparasite the rat lungworm (Joshi 2005).

The island apple snail is native to tropical and sub-tropical freshwater habitats. The thermal tolerance limits for island apple snail has been shown to exist between 15°C and 36.2°C (59-97°F) (Ramakrishnan 2007). However, they have been observed to be active at cooler temperatures (Personal Observation, Authors, 2009). Island apple snails have become established in many southern United States locations, where winter water temperatures are warm enough to support them. The apple snail's thermal tolerances could allow it to become established throughout southern Alabama, unless otherwise controlled.

When introduced into suitable habitats, apple snails have quickly established themselves due to fast maturation and high rates of fecundity. Island apple snails can lay more than 2,000 eggs per egg mass (though hatching rates are generally low), and can lay a new clutch of eggs nearly every two weeks (Ramakrishnan 2007). After emerging from the eggs (a 7-14 day incubation period), juveniles can attain sexual maturity within 60-80 days (Ramakrishnan 2007).

Females usually lay their eggs at night, as a mechanism to lower the risk of predation and desiccation. Egg masses are laid on hard vertical surfaces above the water surface (Ramakrishnan 2007). Eggs are laid in this manner because if eggs are covered by water the eggs will suffocate. After hatch, the young snails fall into the water, where they live a predominantly aquatic existence.

Once introduced to a new area, exotic apple snails generally spread by natural migration (downstream as well as upstream) and stream flow, which can be exacerbated by high flow events, such as those resulting from tropical systems and flash floods. Some species of apple snails can use their air-filled mantle cavity lung to regulate buoyancy, allowing them to float at the water surface (Ramakrishnan 2007). Snails have also been observed attached to drifting aquatic vegetation (A. Ford, pers. Obs.), allowing them to drift downstream into new unoccupied areas.

Methods and Results

There are several methods that have been used for apple snail control. These methods include biological, mechanical, and chemical control. In agricultural areas of Hawaii and the South Pacific islands, ducks have been a biological control of apple snails (Ako and Tamaru 2007; Levin and Hui Kalo 2006). Manual removal of snails and egg masses have also been used to control introduced apple snails, but this method is very labor intensive. Many states, including Florida, South Carolina, Alabama, and Georgia, have used copper sulfate in wetlands to chemically eliminate apple snails. Chemical treatments have been done with varying success, primarily due to lack of funding for follow-up treatments and improper application. To successfully control introduced apple snails, a combination of two or more of these methods may be required. Repeat application of these methods will be necessary.

2009 Activities

1. Manual removal of individual snails and egg masses.
2. Chemical treatment with copper sulfate.
3. Monitoring

1. <u>Manual removal of individual snails and egg masses</u>

Eggs and any visible adult snails were removed by hand and destroyed. Egg masses were removed by scraping egg masses off permanent structures or by clipping off vegetation with eggs attached. The eggs were destroyed by either knocking the egg masses into the water (suffocation), or by freezing, by placing them into a dry ice slurry (on site) or into a freezer (off site). Eggs masses that were knocked into the water were usually smashed or broken apart with a gloved hand or by slapping the mass with an object (usually a paddle) to assure that the mass would break apart and all the eggs would sink. If egg masses were knocked into the water without breaking the mass apart, they were usually semi-buoyant, depending on the stage of development, and could possibly result in only a partial kill. Adult snails were also destroyed by freezing.

Eleven egg scraping days occurred October 3 though 20, 2009. On October 3 and 10, 2009, volunteer efforts were publicized and organized by staff of Mobile Bay Keeper, in order to utilize volunteers from the public to assist in the egg scraping efforts. In total, 74 volunteers donated 290 hours of their time. The volunteer effort of October 3, 2009, focused efforts on the ponds at LMP, and the October 10 effort focused efforts at LMP and TMC. Volunteers not only contributed critical manual labor but also personal equipment, most importantly boats, canoes, and kayaks. Without this volunteer assistance, the egg scraping would not have been nearly as effective. Egg scrapings were conducted both before and after the copper sulfate treatments.

2. Chemical treatment with copper sulfate

On October 6 – 9, 2009 an application of copper sulfate was applied to the entire affected area at LMP and TMC to depress the population of island apple snails. A second treatment at LMP was also conducted on October 14 and 15, 2009. Ionic copper was measurable in the surface water, approximately 2 to 4 hours following treatment; however; copper concentrations declined successively and were non-detectable 24 hours after treatment. A total of 801 acre-feet of water was treated with copper.

The copper sulfate application was applied following the labeled instructions by a boat-mounted blower and hand application, where boat access was not possible. The copper sulfate was manufactured by Chem One Ltd., and was applied as a medium granule. Elemental copper comprised approximately 25 percent of the chemical mixture. The boat mounted blower, manufactured by Vortex Granular Systems, LLC, was designed with a large hopper (250 lb capacity) and was equipped with a vibration attachment for continuous flow of product, it was also designed to spread granular chemicals in an aquatic environment.

3. Monitoring

As a monitor of treatment success, eight minnow traps each with four sentinel snails were placed into each of the LMP lakes before treatment and monitored post-treatment as a measure of the effectiveness of the chemical treatment. The traps containing the snails were checked a full week after the chemical application. After a week, 5 out of 8 snails were dead, indicating mortality of 63%, though this measurement is more qualitative due to the low sample size. In the future, a larger sample size of sentinel snails will be utilized to help development a more quantitative measure with higher statistical confidence.

Snail traps were deployed before and after the copper treatment at LMP to evaluate changes in abundance of apple snails. Twenty traps were set in the lower lake and 5 traps in the upper lake on September 9, 2009. The traps were pulled 3 days later on October 2, 2009. No snails were collected in the upper lake, even though a few egg masses were previously seen, indicating a relatively low abundance. However, 222 snails were collected in 3 days, a rate of 3.7snails/trap/day, in the lower lake. The traps were set again in the lower lake on October 20, 2009, and are currently being checked and rebaited weekly. An 18-fold decrease in catch rate was observed after treatments were observed, with catch rates of 74 snails/day pretreatment and 4.6 snails/day post treatment (Figure 3). After the initial post-treatment drop, catch rates have maintained a relatively constant level.

We eventually expect to see a drop in numbers before warmer spring water temperatures, due to cold-related mortality or aestivation where snails burrow into the bottom sediments during cold periods (Ramakrishnan 2007). Trapping will continue until snail activity ceases due to temperature/seasonal variables but will begin again at or prior to the new seasonal snail activity.

Field Observations

Immediately following the copper sulfate treatment, many apple snails appeared to display certain response behaviors. Many individuals appeared to crawl toward the shoreline and/or up emergent vegetation or structures, though none were seen leaving the water. Some even crawled up timber pilings treated with chromium copper acetate. These treated pilings were some of the only structures in the lake not previously utilized as egg laying substrate (possibly due to the copper in the wood preservative). Some individuals could also be seen floating on the water surface. Apple snails, when taken from the treatment waters, appeared lethargic, producing excessive mucus, and appeared slow to close, or failing to close, the shell's operculum.

Dead or dying apple snails were observed floating at the water surface approximately 4 days following the initial treatment. Of these snails that were still alive, some were lethargic and slow to respond while other individuals seemed to appear normal, showing no continuing signs of copper toxicity.

Snail mortality is difficult to assess, though based upon trapping and mortality of sentinel snails, it is safe to estimate mortality from the treatment in the lake at 50% to 75%. Treatment within the creek is much more difficult to assess given the dynamic nature of a flowing system and the heterogeneous array of habitats, though mortality may be less than that in the lake based upon the difficulty of maintaining prolonged copper concentrations in a flowing system.

Proposed Activities for 2010

The following are apple snail control measures planned for 2010. These actions are dependent on funding and available manpower. Without assistance and cooperation from all stakeholder groups, the efficiency of this effort may diminish.

1. <u>Emergent Vegetation Management</u>

Managing the emergent vegetation, primarily cut grass, will be extremely important with any future snail control effort. With cooperation from the City of Mobile and ADCNR, it may be possible to spray herbicides and/or mow emergent plants in certain areas. By achieving this goal, the egg laying substrate can be limited and egg scrapings can be done more effectively and efficiently.

Emergent plant management should be done a month before egg scraping events and should be conducted at least twice a year. This action does not have to be conducted everywhere; however; there are several high priority areas where control of emergent vegetation is essential. These areas include the shoreline along the lakes at LMP and TMC from approximately McNair Park, downstream to the bridge crossing at Martin Luther King Boulevard.

2. Egg Scraping

Egg scraping will be conducted following the same methods used in 2009. Snail eggs will be scraped immediately before and/or after a copper sulfate application and other times when it may be required. Volunteer assistance will be paramount to achieve this effort. The most time and labor efficient way to scrape eggs would be to scrape the egg mass into a gloved (e.g., disposable nitrile or latex glove) hand and smash the egg mass under water. As with the 2009 effort, in 2010 we will plan to organize volunteer days to utilize a volunteer work force in egg scraping efforts. Staff with Mobile Bay Keeper will again serve as point of contact and play an integral part in organizing volunteer efforts. We anticipate a minimum of 12 completed scrapings of the affected area.

3. Control of Adult Snails

Similar to 2009, copper sulfate treatments will be used to control adult populations of island apple snails. In 2010, a minimum of 6 tandem applications of copper sulfate will be conducted in spring, early summer, and late summer. If more funding is available for additional chemical applications, they will be utilized at a time when they are thought to be most effective.

Ideally, one treatment a month during the summer would make great strides in limiting the apple snail populations. Concentrations of copper sulfate will range from 2.5 to 4 ppm depending on the priority of an area. Priority will be assigned according to risk of snail expansion. Areas where snails can more easily spread may be treated at a higher rate to increase apple snail mortality in the higher priority areas. These areas are likely the lakes at LMP and TMC from McNair Park to the bridge crossing at Martin Luther King Blvd.

4. Monitoring

As a method to monitor population trends and efficacy of treatments, baited snail traps will be used to monitor catch rates at set locations within LMP Lake and TMC. Snails will be collected from the traps weekly and the traps rebaited. The traps are baited with formulary bait manufactured by Snail Busters for use on apple snails. Length measures of snails as well as environmental variables (such as temperature) will be recorded and analyzed for population trends (e.g., snail going dormant in response to cool water temperatures). This effort will be coordinated through ADCNR, USFWS, and the University of South Alabama.

Cages will also be set within the LMP lake and TMC during chemical treatments to hold individual snails as sentinels. These individuals should give a monitor of the successfulness of the chemical treatment as measured by the mortality of the caged individuals. Morphometric measures of the individuals will also be taken to determine any trends that may occur related to the sizes of the individuals.

Budget for 2010

Below are the items needed to achieve our apple snail goals in 2010. Equipment and manpower will be provided by many agencies but are not included because their assistance has already been promised or costs are indirect. These costs are estimates and are subject to change.

Items	Amount	Cost
Habitat Management		
Glyphosate	25 gal @ $40/gal	1000
Surfactant (DyneAmic)	17.5 gal at $200/2.5gal	1400
Egg Scrapping		
3 in putty knife	50	50
Firm Grip 110 Pack Disposable Nitrile Gloves	5	75
Other Supplies Buckets, Bags etc…		500
Kayack/Canoe	2	1700
Paddles	3	120
Control of Adult Snails		
Copper Sulfate (top of the rate 4ppm)	6321 pounds at $1.59/pound	10050
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	TOTAL	$125,445

2009 and 2010 Partners

Alabama Division of Wildlife and Freshwater Fisheries

United States Fish and Wildlife Service

Alabama Department of Environmental Management

Mobile Baykeeper

City of Mobile

Snail Busters

Alabama Coastal Land Trust

Dauphin Island Sea Laboratory

University of South Alabama

Alabama Department of Public Health

Alabama Division of Marine Resources

Mobile Bay National Estuary Program

Possible Funding Sources

- Alabama Division of Wildlife and Freshwater Fisheries
- Alabama Coastal Foundation
- Alabama State Docks
- City of Mobile
- Mississippi-Alabama Sea Grant Consortium
- Mobile Bay National Estuarine Program
- National Aquatic Nuisance Species Task Force
- National Fish and Wildlife Foundation
- Southeastern Wildlife Conservation Group
- United States Department of Agriculture
- United States Fish and Wildlife Service
- Alabama Coastal Land Trust

Figures

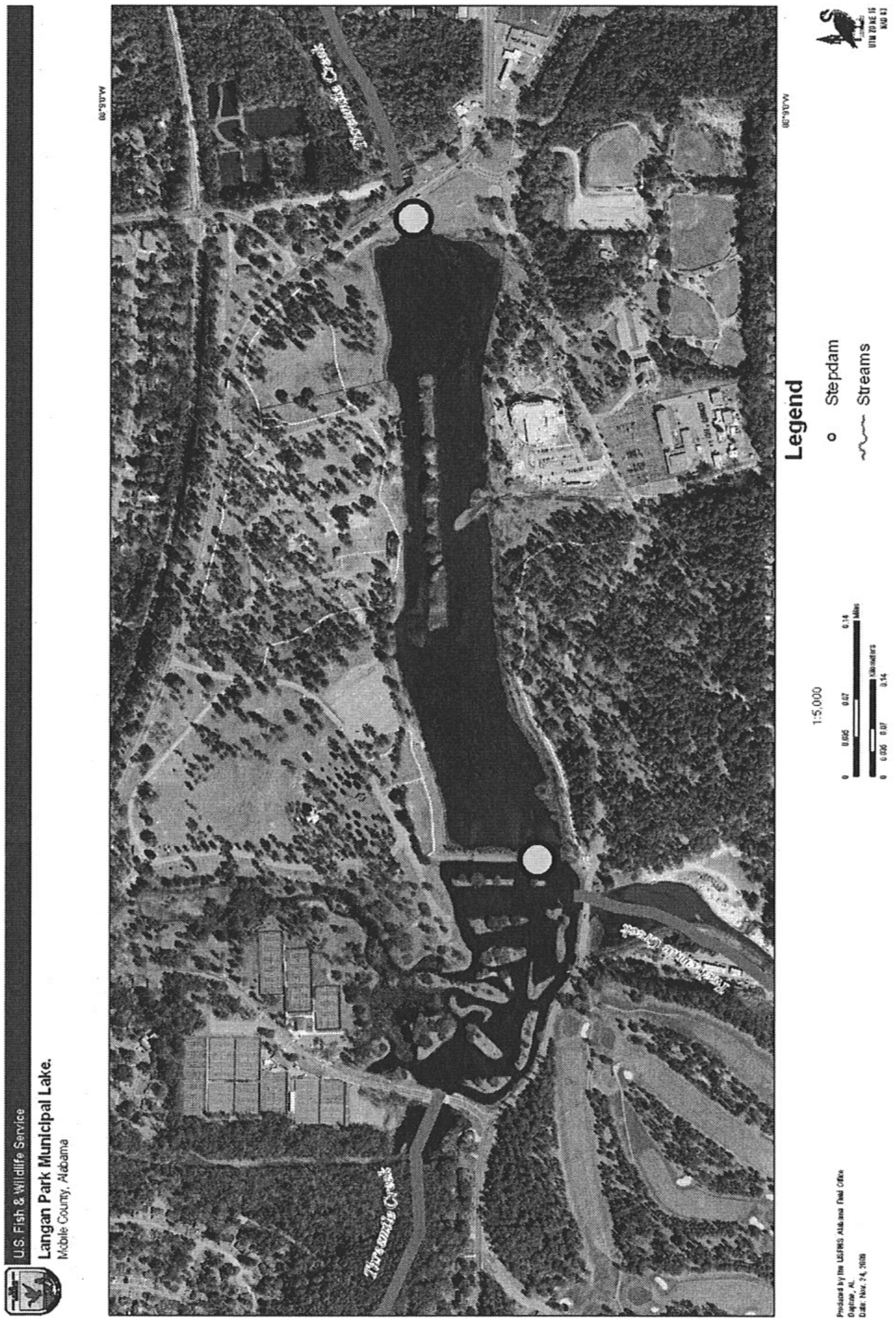

Figure 1: Map of Langan Park Lakes

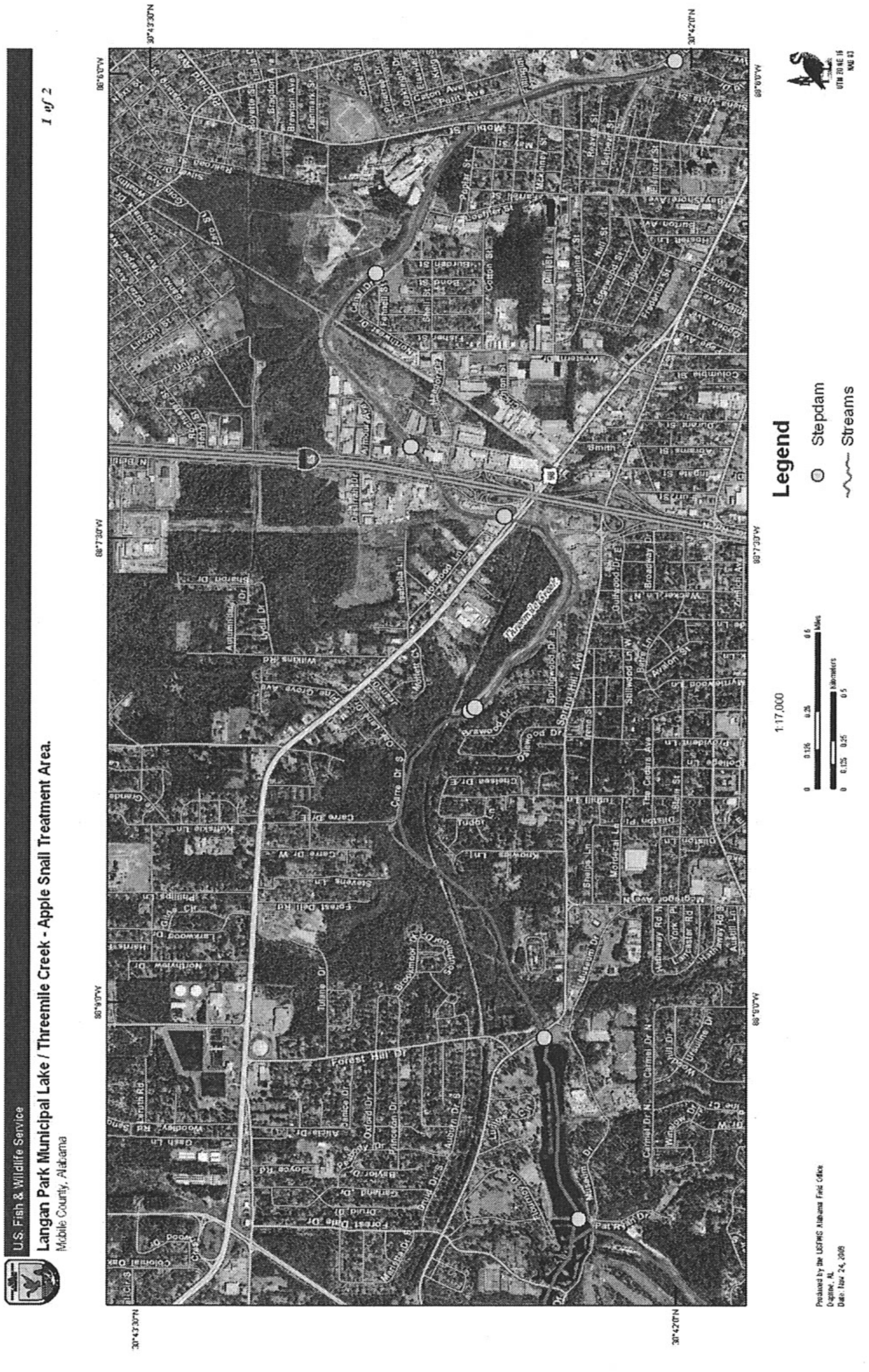

Figure 2. Map of Upper Reach of Threemile Creek

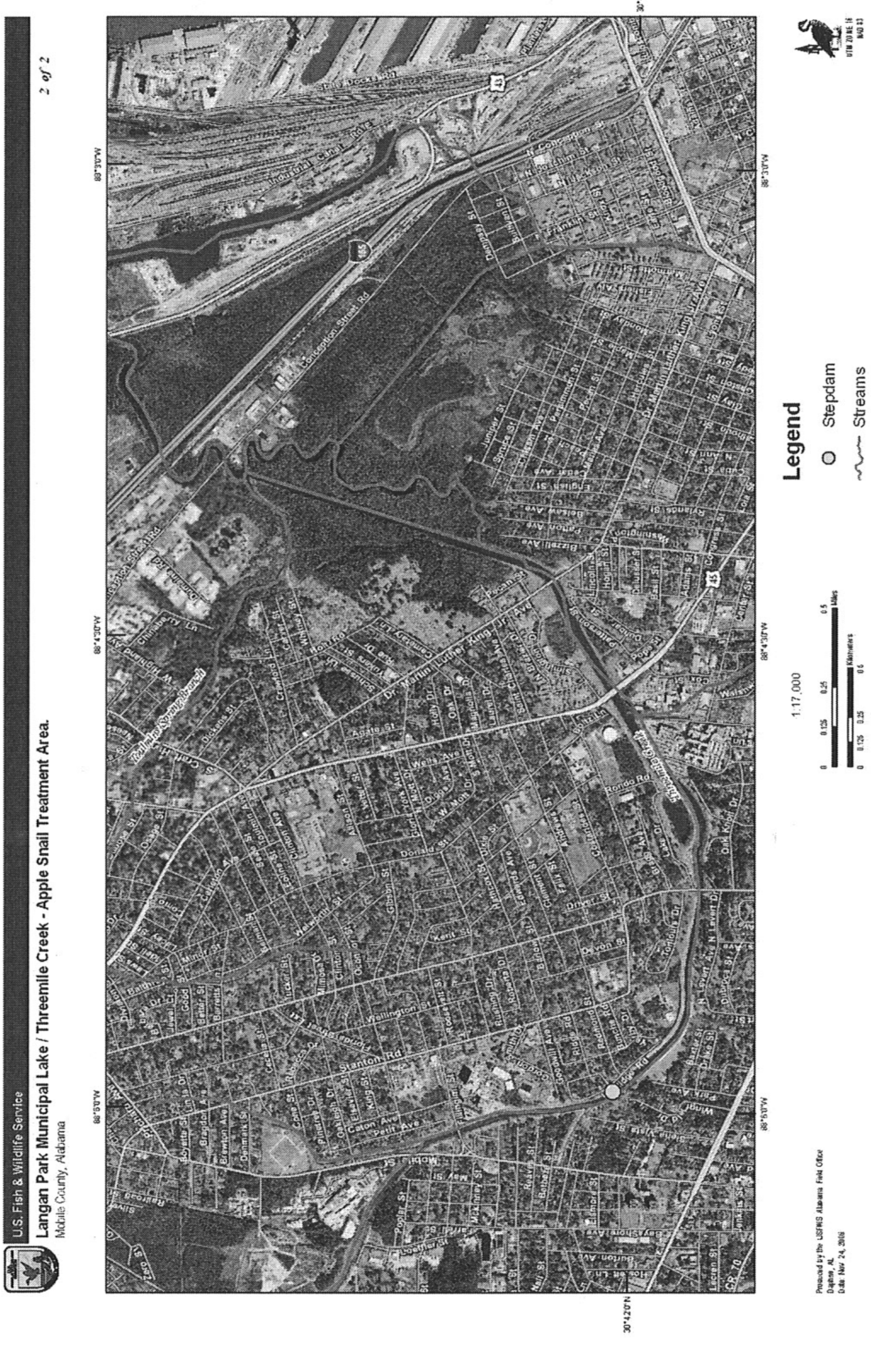

Figure 3. Map of Lower Reach of Threemile Creek

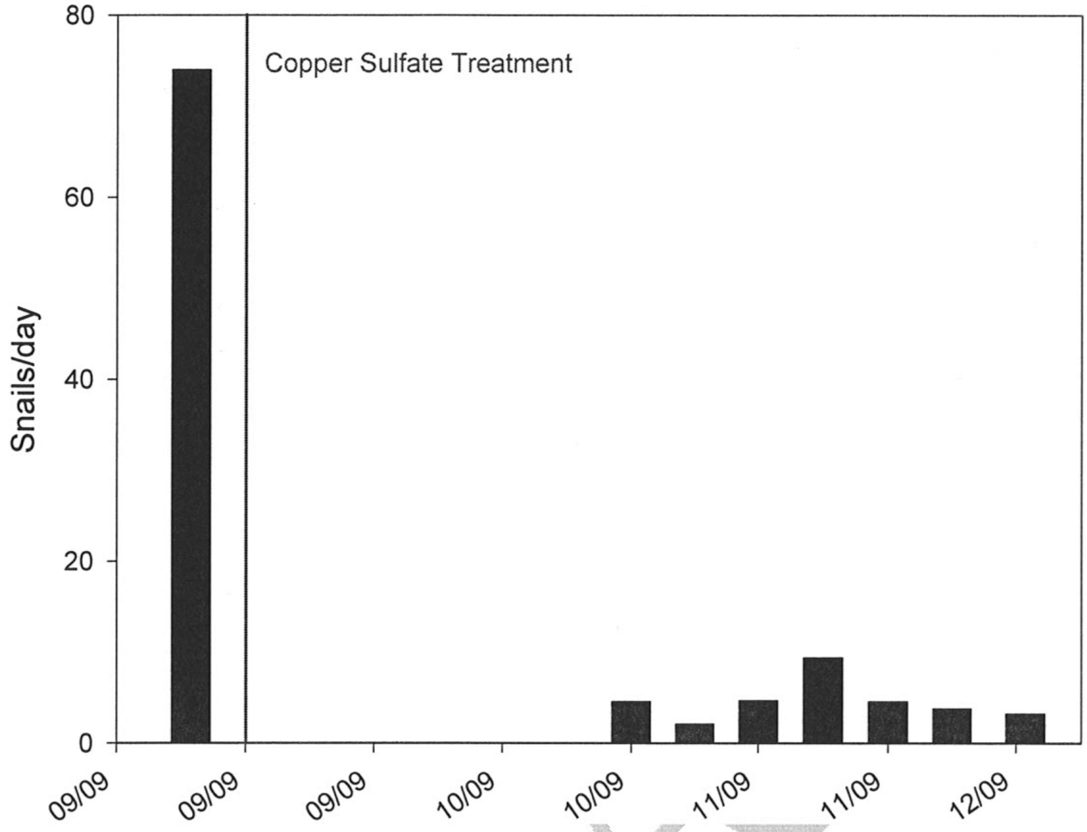

Figure 4. Daily Snail Catch from September 2009 to December 2009.

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