Local Area AIS Control Plan: Swamp eel (Synbranchidae: *Monopterus*)

http://news.ifas.ufl.edu/2006/04/uf-study-asian-swamp-eel-little-threat-to-states-60-million-aquaculture-industry/

http://www.livingreefs.com/help-identify-eel-t33391.html

Presented to GSARP
April 9-11, 2013

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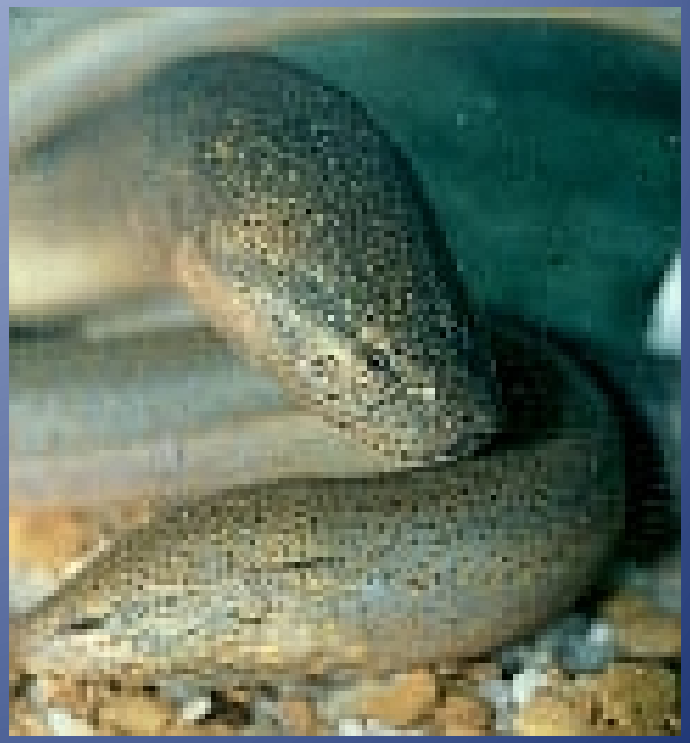
OBJECTIVES

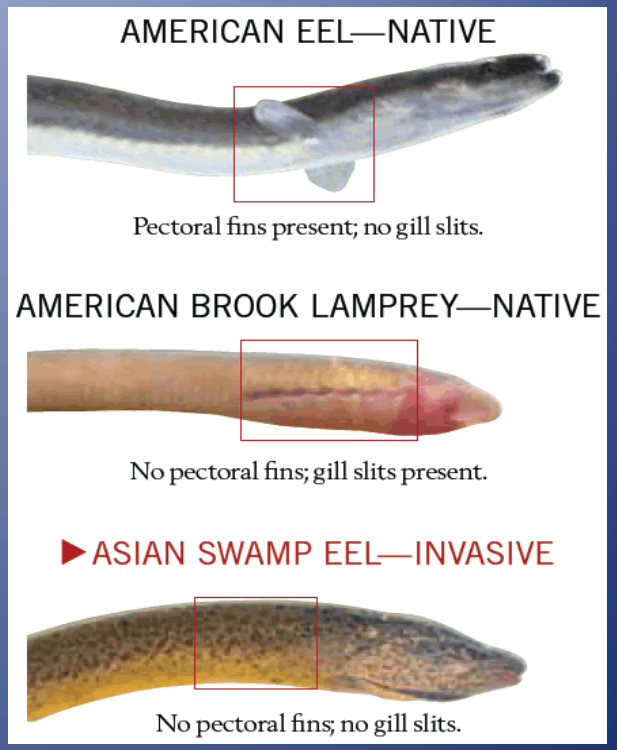
- Species Description
- Non-native range
- Local Population
  - History
  - Future



http://fl.biology.usgs.gov/Nonindigenous_Species/nonindigenous_species.html

Species Description

- *Monopterus albus*
- Asian swamp eels are morphologically similar to two North American native fishes: American eel (*Anguilla rostrata*) and lampreys
- Swamp eels are also morphologically similar to two native salamanders (*Siren* and *Amphiuma* spp.), but can be distinguished by the presence/absence of legs/limbs (front and hind legs present in *Amphiuma*, front legs only in *Siren*, no legs/limbs in *Monopterus*).
- The taxonomy of the genus *Monopterus* is in need of systematic review (Collins et al. 2002).
- **Size:** 100 cm (39 inches)
- Swamp eels are generally found in slow moving freshwater regions. They are noctural, and will often burrow into soft sediments or occupy crevices and small spaces (Shafland et al. 2010).

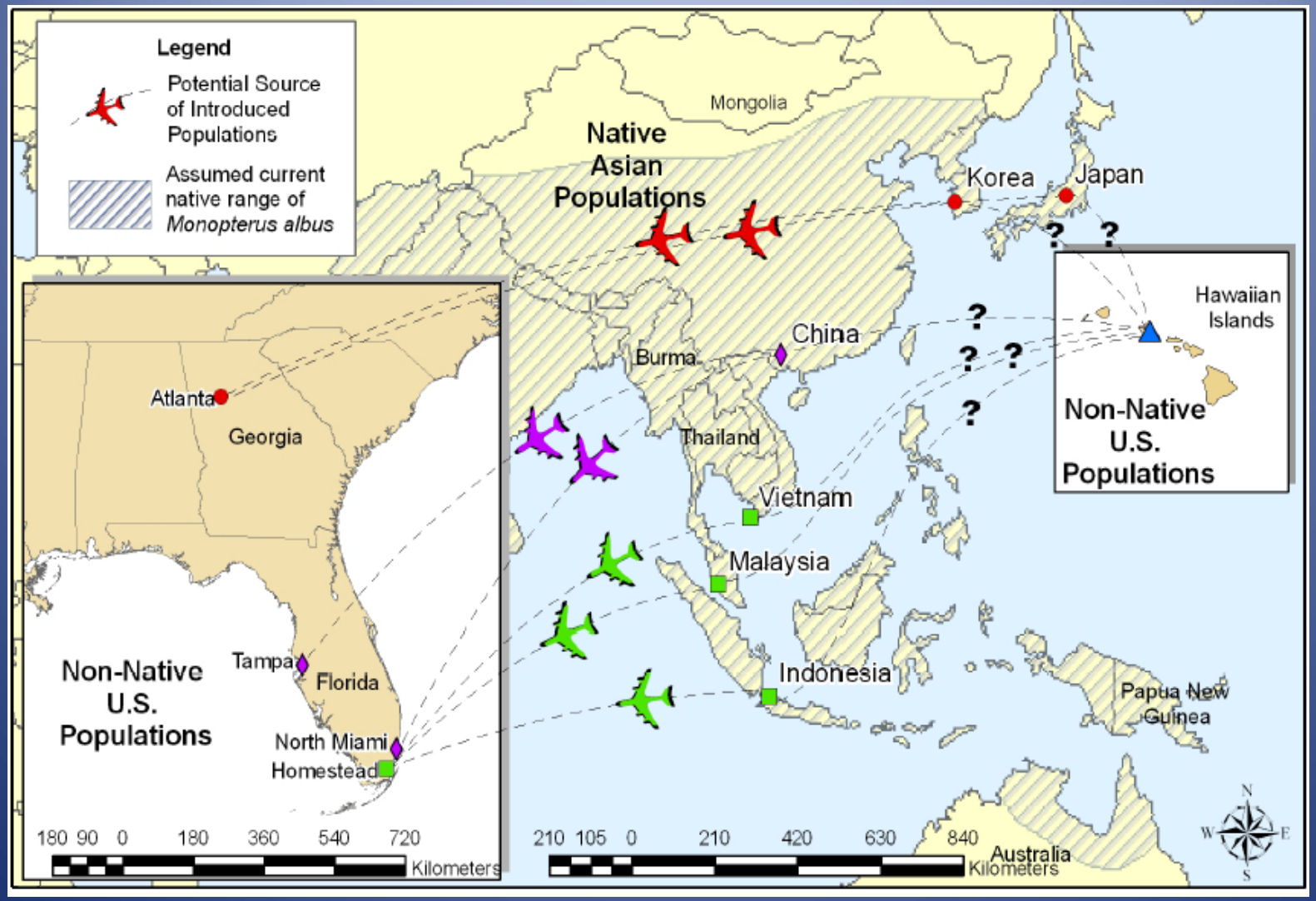


http://www.nj.gov/dep/fgw/aquatic_invasives.htm

Native Distribution

- They are native to tropical and temperate parts of Central and South America, Africa, Australia, and from India to eastern Asia (including much of China). In Asia, swamp eels are widespread and commonly sold live in markets as food for human consumption.

Possible Sources of Introduced Populations



Map from Freeman et al. 2005. Data derived from Collins, T., Trexler, J., Nico, L., and Rawlings, T. 2002. Genetic diversity in a morphologically conservative invasive taxon: multiple introductions of swamp eels to the southeastern United States. Conservation Biology 16: 1024-1035.

Feeding

- Sakaris et al. (2012) confirmed that Asian swamp eels from a population in South Florida were opportunistic predators, consuming a wide range of prey including aquatic invertebrates (e.g., insect larvae, snails, shrimp, etc.), various fish species, frogs and frog eggs, and tadpoles.
- Amphipods and dipterans were most often observed in the stomachs of small and medium sized Asian swamp eels, with these prey items becoming much less prevalent in the stomachs of larger eels. In the stomachs of larger eels, fish, dragonfly nymphs, and true bugs were more commonly identified. Asian swamp eels became increasingly piscivorous with size.

Other findings (Diet)

- Hill and Watson's (2007) investigation into the diet of an introduced population near Tampa, Florida, revealed prey items such as amphipods, crayfish, fish, fish eggs, insects, oligochaetes, orgainic material, plant material and a tadpole.

- Shafland et al. (2010) found primarily fish (in 56% of stomachs), crustaceans (32%) (mostly crayfish), and insects (27%). Fish species included swamp darter (*Etheostoma fusiforme*), bluefin killifish (*Lucania goodei*), eastern mosquitofish (*Gambusia holbrooki*), other swamp eels, fat sleeper (*Dormitator maculatus*), largemouth bass (*Micropterus salmoides*), Mayan cichlid (*Cichlasoma urophthalmus*), tadpole madtom (*Noturus gyrinus*), bluegill (*Lepomis macrochirus*), jaguar guapote (*Cichlasoma managuense*), jewelfish (*Hemichromis bimaculatus*), black acara (*Cichasoma bimaculatum*), and spotted sunfish (*Lepomis punctatus*).

Reproduction

- Spawns in summer; some reports indicate it is a bubble nest builder species, others say uses burrows for egg incubation; ripe female typically contains about 440 ready to spawn eggs; hermaphroditic-- all mature as females, and some of these females later become males; most populations have highly skewed sex ratio dominated by females
- Source: http://myfwc.com/wildlifehabitats/profiles/fish/freshwater/nonnatives/swamp-eel/

Native Habitat

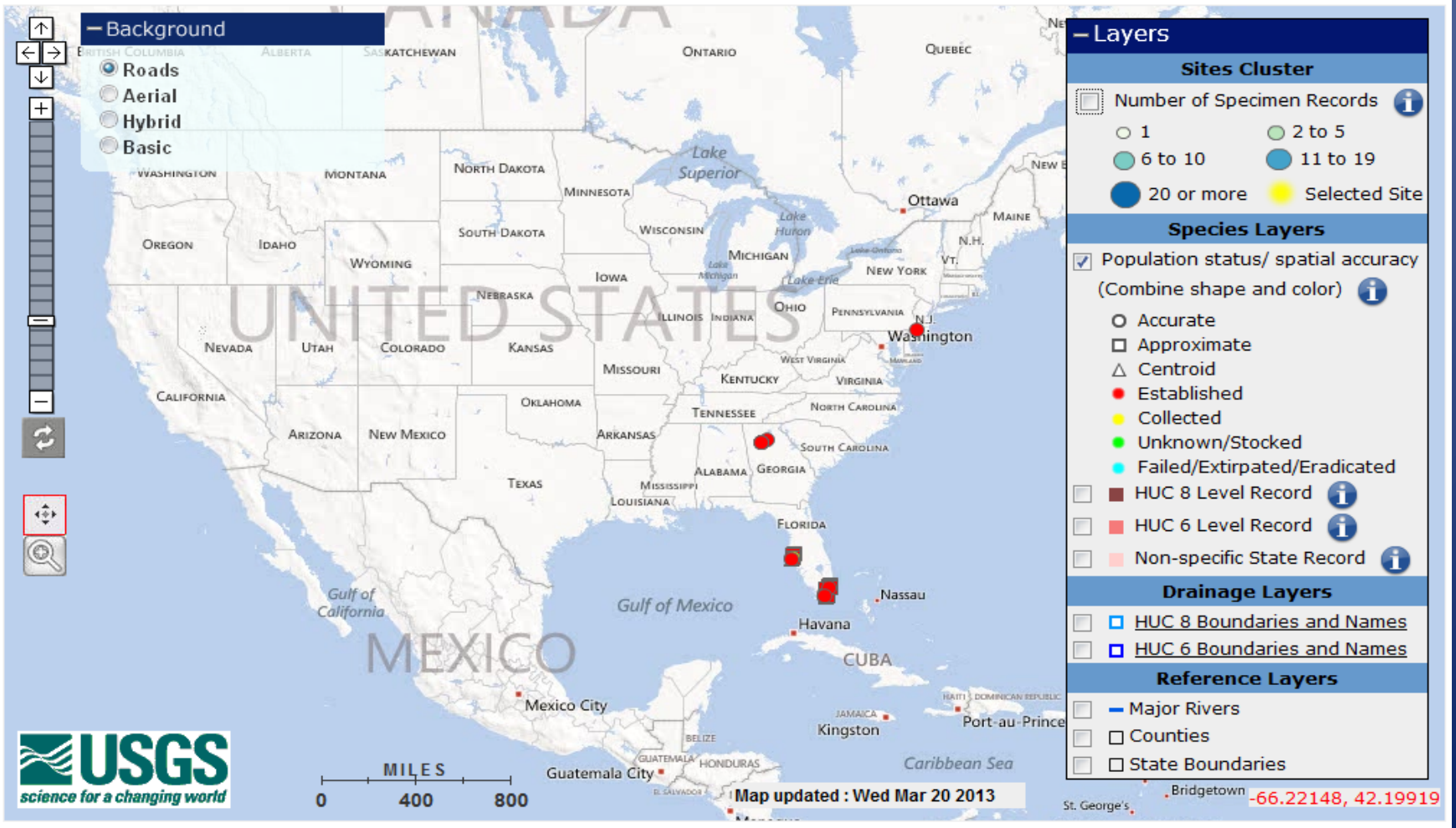
- The ideal habitat for Asian swamp eels is tropical and temperate freshwater systems. However, the swamp eel has a relatively high tolerance for temperature change, and thus has the potential to spread across a large portion of the Southern United States (Hamilton 2006). Agricultural areas, wetlands, muddy ponds, canals, swamps, and rice fields all provide suitable habitats. By burrowing in moist ground, the swamp eel can survive for long periods without water (ISSG 2005; Bricking 2002). They are found typically from 34 ºN to 6 ºS (FishBase 2006).
- Source: http://massbay.mit.edu/seafood/asianswampeel.pdf

Non-native range

Monopterus albus
(Asian swamp eel)
Fishes
Exotic to United States

Collection Info
HUC Maps
Fact Sheet

Disclaimer: Number of records does not imply species abundance



Threats Posed by Swamp eels

- Vectors of non-native parasites "...Some are harmful to humans and other vertebrates. For example, live swamp eels sold in markets in Southeast Asia are commonly infected with nematodes of the genus *Gnathostoma*,…" source: http://www.aquaticinvasions.net/2011/AI_2011_6_1_Nico_etal.pdf
- General Predator (Swamp eel feeding on LMB)

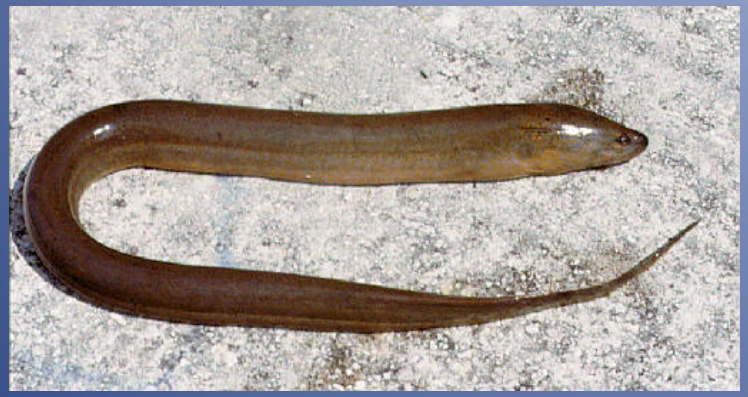
http://gallery.usgs.gov/videos/101

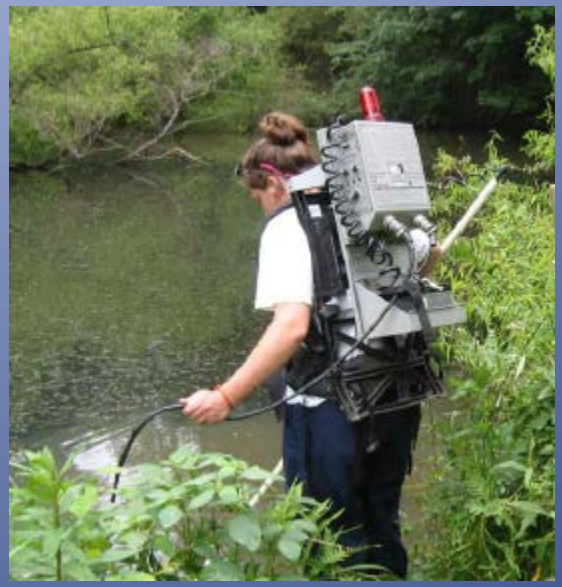
Vectors and Pathways

http://en.wikipedia.org/wiki/Clay_pot_cooking

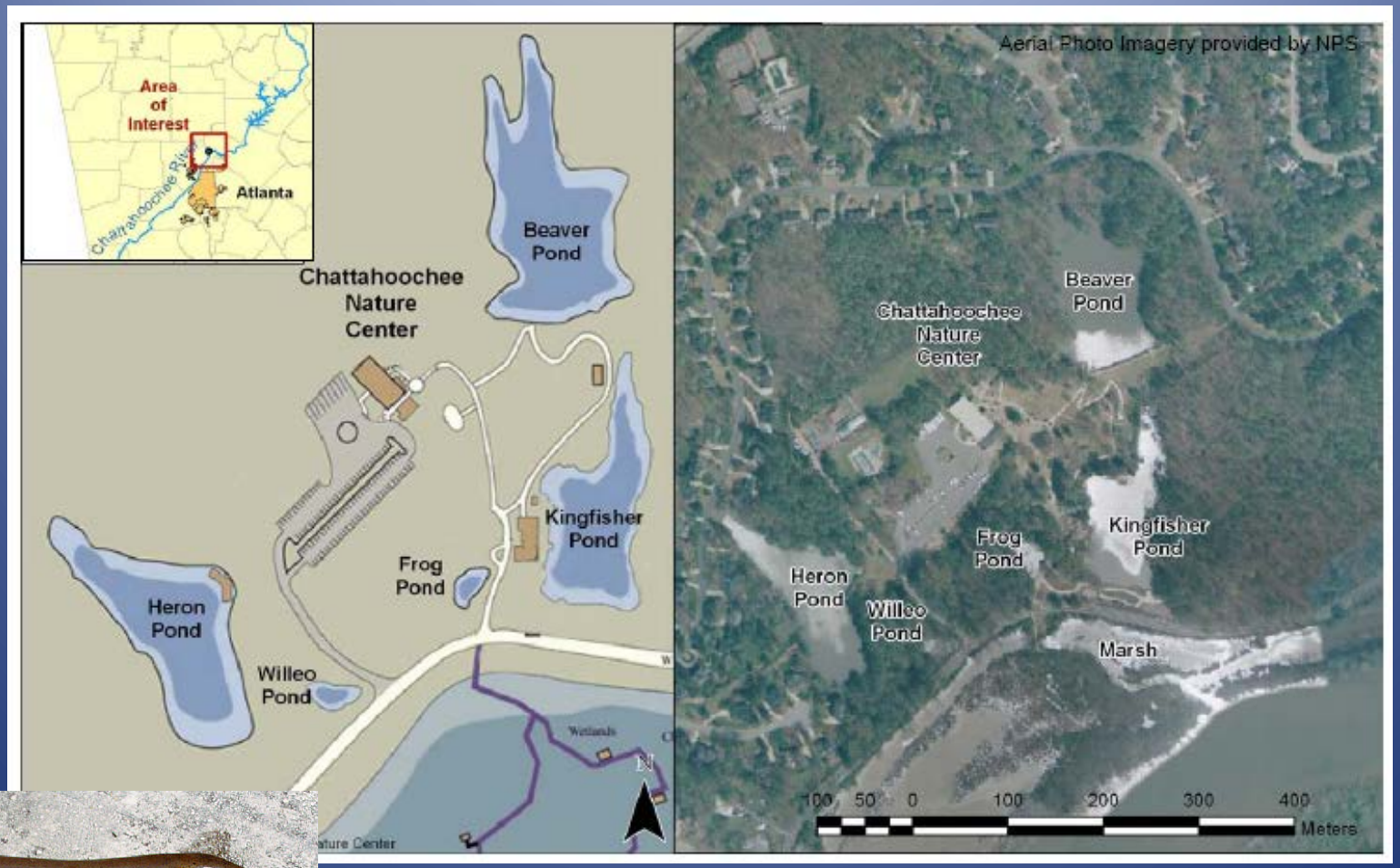
http://www.monsterfishkeepers.com/forums/showthread.php?391576-Would-anyone-buy-this-eel

Local Population: History and Future





The Chattahoochee Infestation

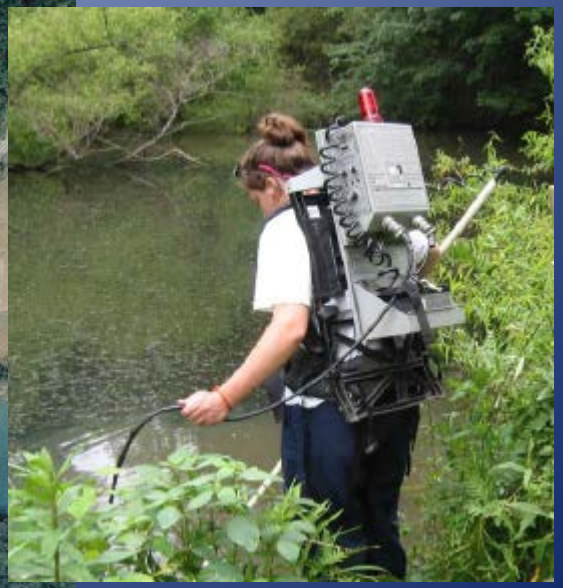


From Freeman et al. 2005

Starnes et al. (1998)

1994: Discovered Monopterus by dipnetting in one CNC pond.

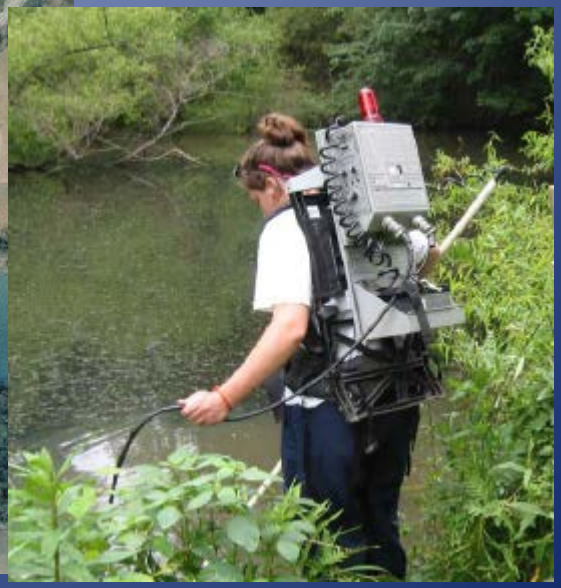
1996: Found in two other ponds by electrofishing But not detected elsewhere.



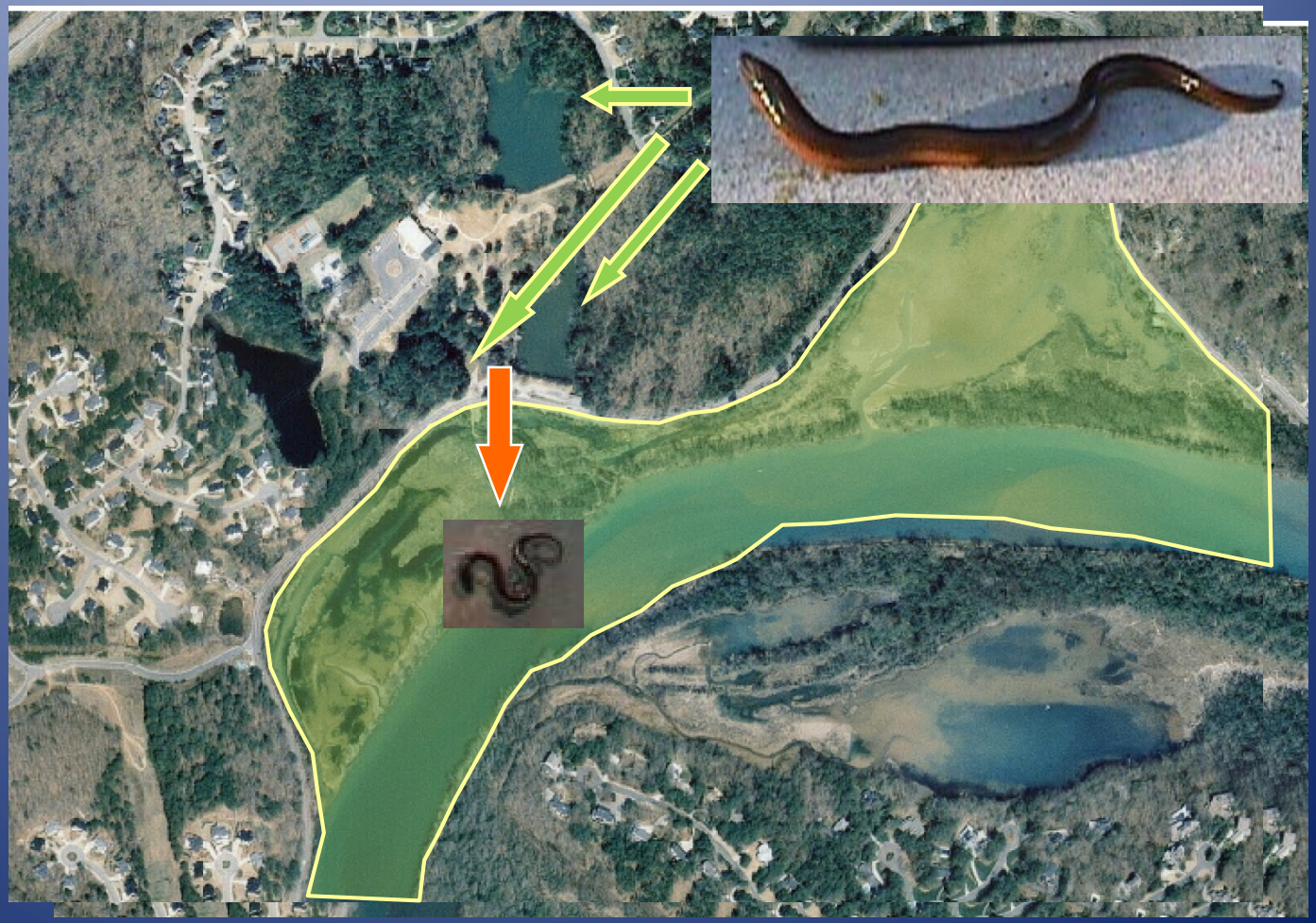
Freeman & Burgess (2000)

2000: Verified persistence in three ponds

Observed one specimen outside of ponds



Monopterus dispersal from CNC ponds to Chattahoochee River National Recreation Area

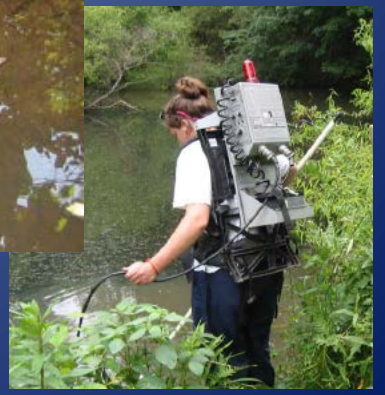


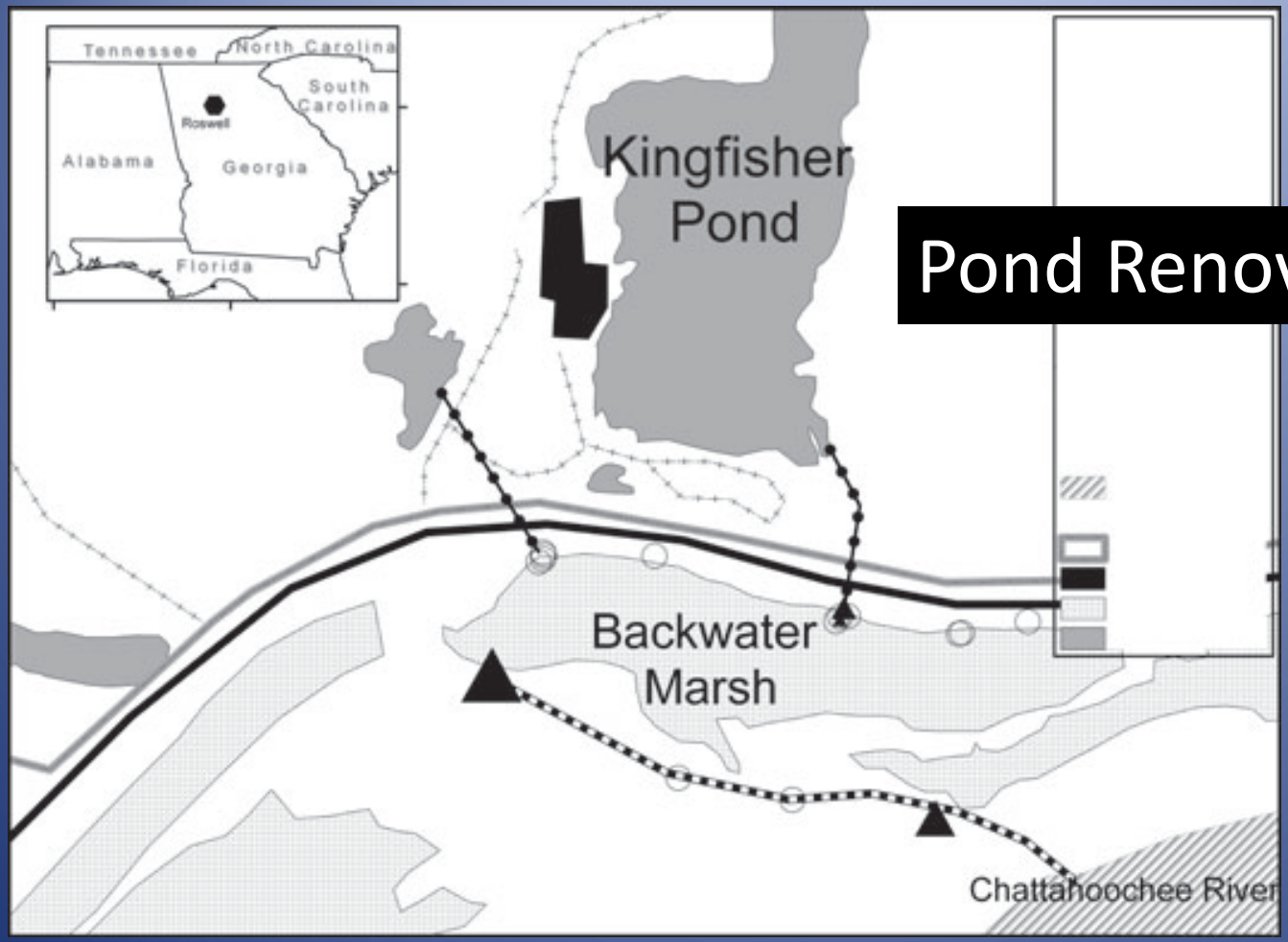
Freeman et al. (2005)

Verified persistence in three ponds and Chattahoochee River marsh area.

Tried new sampling methods

Found juveniles consistently with leaf litter traps





Pond Renovation (2007)

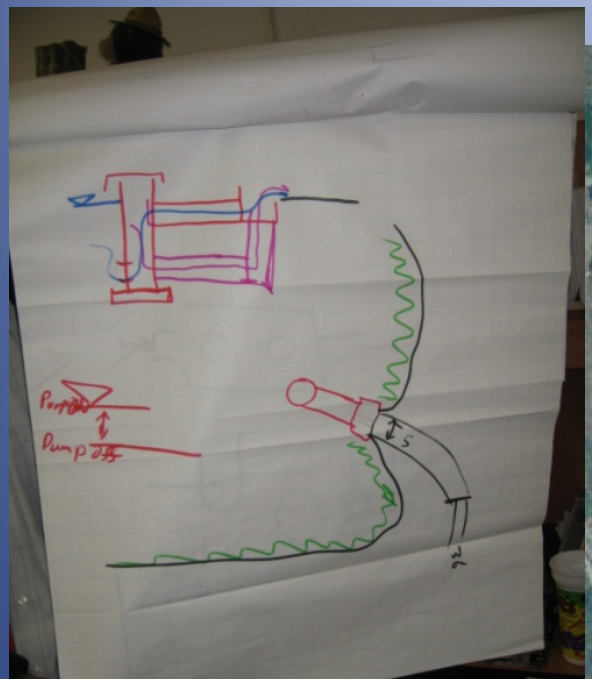
Map of Chattahoochee River near Chattahoochee Nature Center, Roswell, Georgia, USA, where exotic Asian swamp eels exist in ponds and a backwater marsh of the Chattahoochee River.

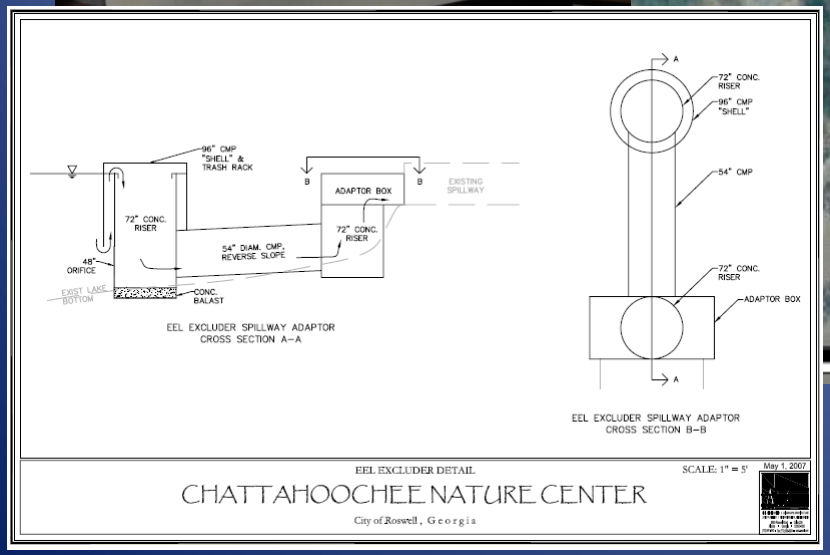
From Long & LaFleur 2010

Outflow Alteration

Frog Pond – shallow area leading to outflow system.

Outflow Alteration





Was Outflow Modification Effective for Frog Pond?

No formal follow-u BAD ing to ascertain.

Should we try the same for Kingfisher Pond?

Not sure of effectiveness

AND

Eels are already in marsh area.

Long & LaFleur (2011)

2008: Collected specimens from mid July to late August in the Chattahoochee River marsh area.

Estimated daily age (between 21-51 days old) and hatching timing (early June to early August 2008) of eels collected using otolith examination.

Local Population: Future

- Reinvigorated interest by NPS and USFWS in 2012.
- Determine current distribution in Chattahoochee River and tributaries
- Understand population demographics for a control project
- Gather a panel of experts to inform the plan
- Develop a suite of population control measures
- Develop an exploit model
- Monitor population demographics for response

Questions