

Asian Swamp Eel Control Project on the C-111 & C-113 Canals

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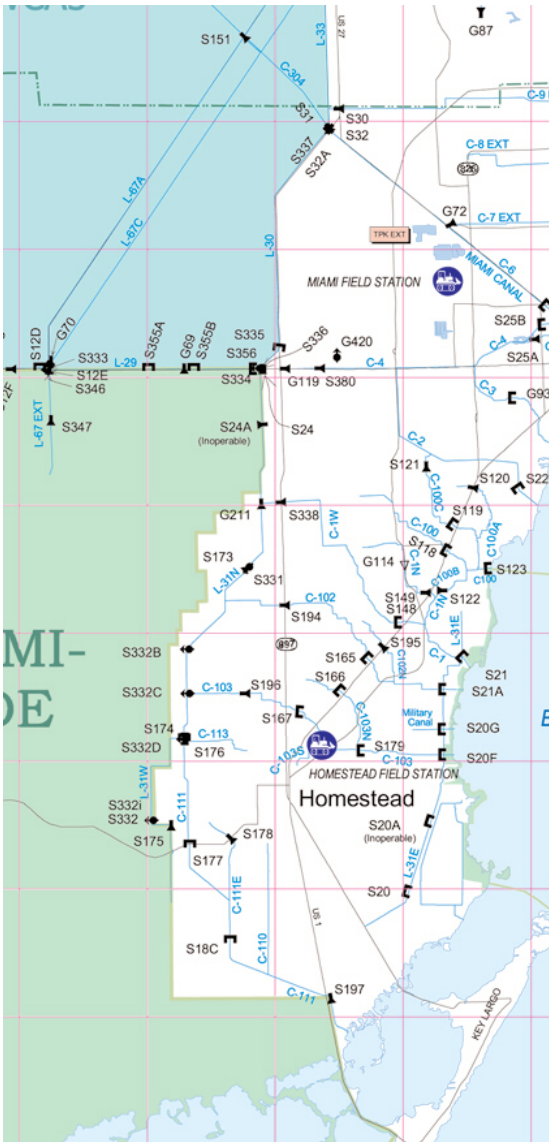
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Comprehensive Everglades Restoration Plan (CERP)

Restore Everglades ecosystem by removing Impediments to flow (e.g. Canals)

Purpose to improve:

- Quality
- Quantity
- Timing
- Distribution

Water that is wasted into the ocean will be re-directed back to the historical flow (ENP)

Canals provide refugia to invasive species.

Plan to back-fill canals could allow invasive species to move into the natural areas.

Injurious Wildlife Provisions of the Lacey Act: Fish Species Under Evaluation

- Black carp - Listed!
- Swamp eel family (17 species)
- Bighead carp - by petition
- Silver carp - by petition

Background

- Four populations of the Asian swamp eel (*Monopterus* sp.) in the southeastern United States: Atlanta (early 1990's), north Miami and Tampa (1997), and Homestead (December 1999)
- Unknown source of the introductions – probably aquarium trade or release of eels imported for food.
- In 2001, the Asian Swamp Eel Management Review Team (USFWS, USGS-FCSC, NPS, SFWMD and FWC) determined that electrofishing appeared to be the best tool to reduce the numbers and slow the spread into the Everglades.
- First evaluation conducted between June and December of 2001. A total of 1,425 swamp eels were removed from the C-111 and C-113 canals near Homestead.

Biology

Asian Swamp Eel (*Monopterus albus*) vs American Eel (*Anguilla rostrata*)

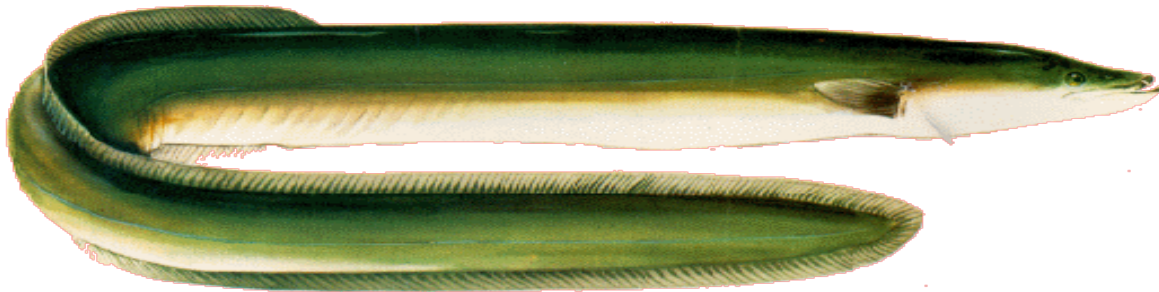
- Synbranchidae
 - Demersal; potamodromous; freshwater; brackish;
 - Depth range 3 – ? m
 - Climate: tropical; 25 – 28°C
 - Min population doubling time 1.4 - 4.4 years (Fec = 1,000)
 - Max Size: 100 cm (M); protandrous hermaphrodite
 - Nocturnal - prey on fishes, worms, crustaceans, and other small aquatic animals
 - Distribution: India to China, Japan, Malaysia and Indonesia.
 - Food fish, aquaculture, aquarium trade
 - Injurious Wildlife Consideration
- Anguillidae:
 - Demersal; catadromous; freshwater; brackish; marine;
 - Depth range 0 – 464 m
 - Climate: subtropical; 4 – 25°C;
 - Min population doubling time 1.4 - 4.4 years (tm=3-6; Fec=5 Million)
 - Max Size: 152 cm (M); 120 cm (F);
 - Nocturnal - prey on larvae of insects, gastropods, worms, small aquatic animals, and fish, including eels.
 - Distribution: Greenland to S. America
 - Food fish, aquaculture, aquarium trade (elvers and glass eels)
 - Petitioned for listing under ESA
 - USFWS - Director's Priority Species



Asian Swamp Eel (*Monopterus albus*)



Peacock Eel (*Macrogynatus siamensis*)



**American Eel
(*Anguilla rostrata*)**

Habitats for Eels

Asian Swamp Eels



Peacock Eels



Reduction in the Numbers of Asian Swamp Eel and Peacock Eel in South Florida using Electrofishing Gear

Goal: Control of Asian swamp eels and peacock eels in the C-111 and C-113 canals using boat electrofishing

- **Modified procedure as the one used by USGS - FCSC in 2001. We believe changes helped to improve eel collection.**
- **Funded by USFWS – Aquatic Nuisance Species Coordinator**



Asian Swamp Eel
Monopterus albus



Peacock Eel
Macrognathus siamensis

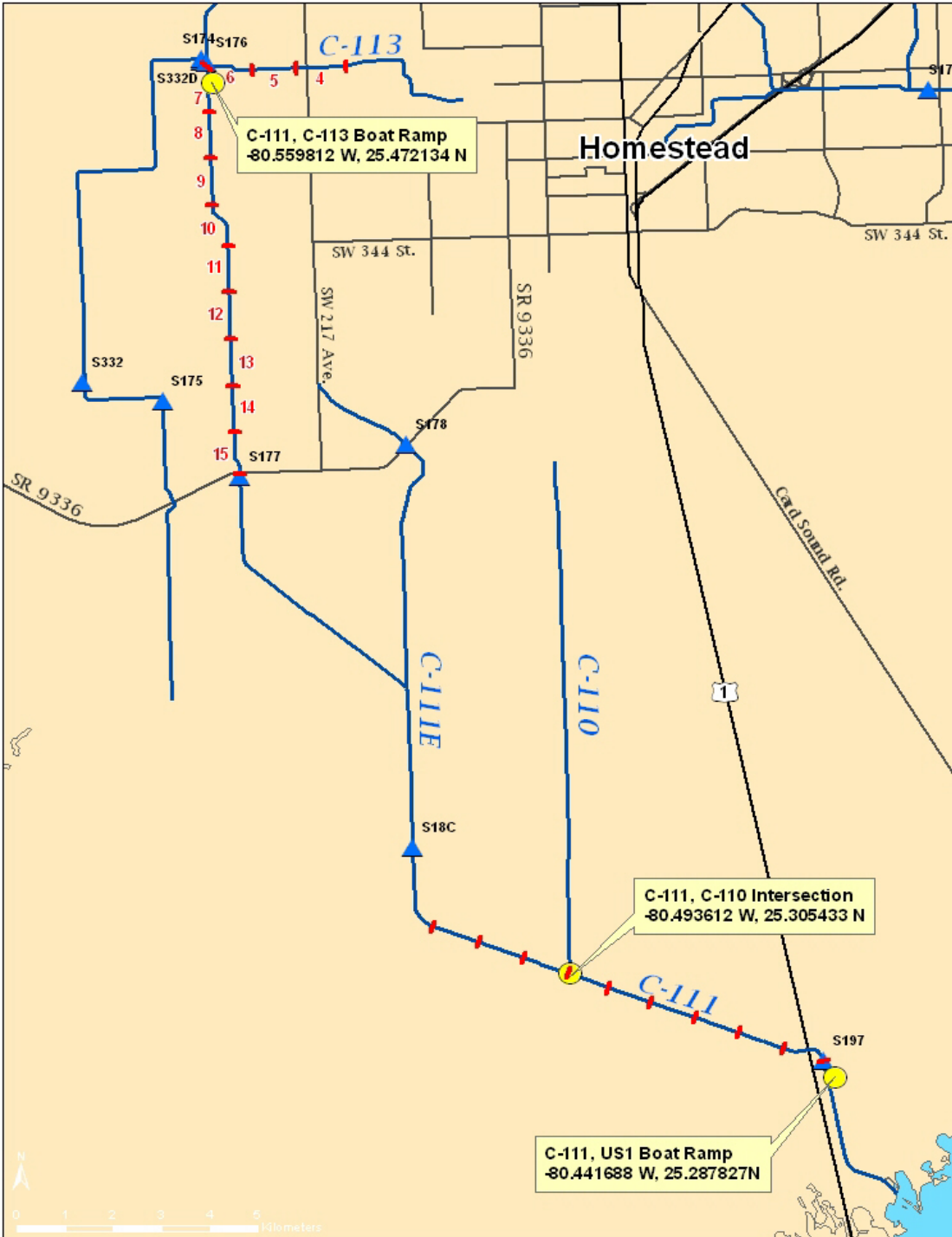
Methods

- Eels collected along canal banks using a 20-ft electrofishing boat
- Electrofisher average settings: 8.0 Amp, 30 volts DC, and operated until a 1-km transect was covered (15 km total).
- Eels removed using a dip net and euthanize in an ice-filled container.
- Non captured eels were counted and included as observations.
- Measurements: Total Length (mm) and Weight (g). Preserved in formalin.



Sampling Locations

- C-113 canal from the water control structure S-176 to the SW 217th Ave. bridge
- C-111 from the water control structure S-176 downstream to water control structure S-177
- C-111 from the boat ramp located at S-197 to water control structure S-18C



RESULTS

Total Number of Eels (ASE = Asian Swamp Eel; PEE = Peacock Eel; AEL = American eel)
Captured and Observed on the C-111 canal between July – December 2006

Canal	Date	ASE			PEE			AEL		
		Capt.	Observ	Total	Capt.	Observ	Total	Capt.	Observ	Total
C-111	July	86	43	129	0	0	0	0	0	0
	Aug	184	151	335	1	2	3	0	0	0
	Sep	155	154	309	13	6	19	1	0	1
	Oct	167	117	284	49	48	97	0	0	0
	Nov	---	---	---	---	---	---	---	---	---
	Dec	169	150	319	19	15	34	0	16	16
TOTAL		761	615	1376	82	71	153	1	16	17

Total Number of Eels (ASE = Asian Swamp Eel; PEE = Peacock Eel; AEL = American eel) Captured and Observed on the C-113 canal between July – December 2006

Canal	Date	ASE			PEE			AEL		
		Capt.	Observ	Total	Capt.	Observ	Total	Capt.	Observ	Total
C-113	July	11	21	32	0	0	0	1	0	1
	Aug	73	53	126	0	0	0	4	1	5
	Sep	28	24	52	0	0	0	0	0	0
	Oct	32	25	57	0	0	0	0	0	0
	Nov	---	---	---	---	---	---	---	---	---
	Dec	0	0	0	0	0	0	0	0	0
Total		144	123	267	0	0	0	5	1	6

Total Length (mm)

ASE C-111 2006

Parameter	July	Aug	Sept	Oct	Nov	Dec
N	86	184	155	167	---	169
Mean	437.3	387.7	367.6	333.2	---	341.4
Standard Error	18.1	10.8	8.9	8.8	---	9.6
Minimum	114	147	137	119	---	111
Maximum	800	765	708	675	---	735

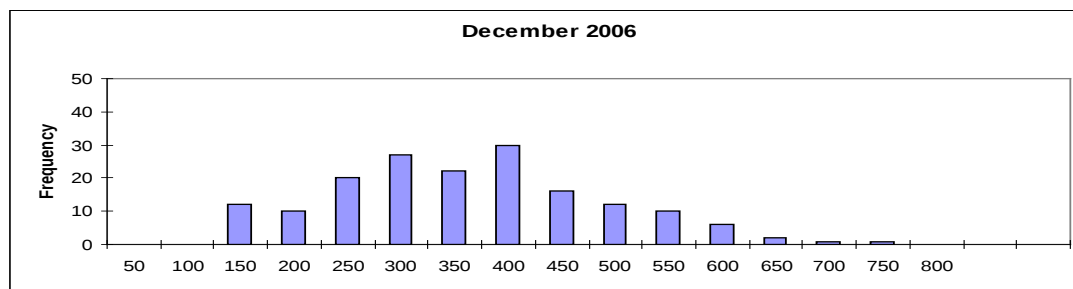
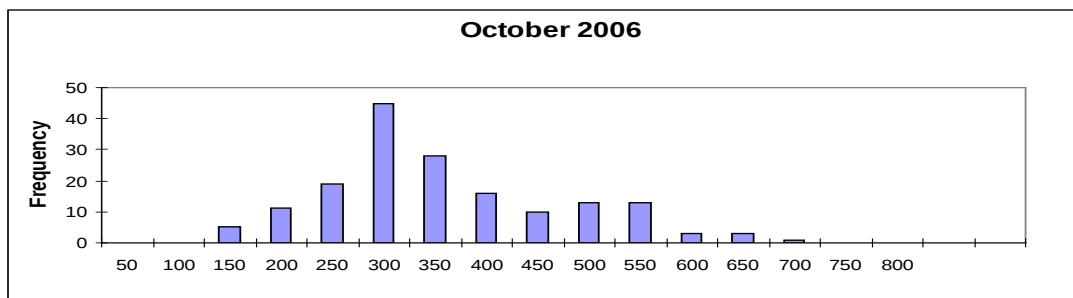
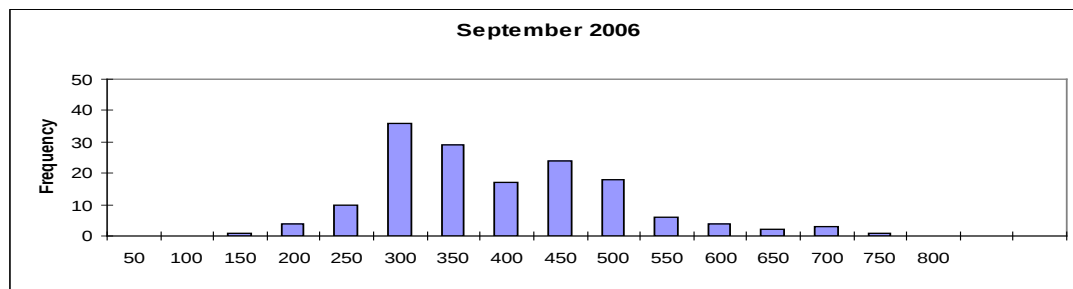
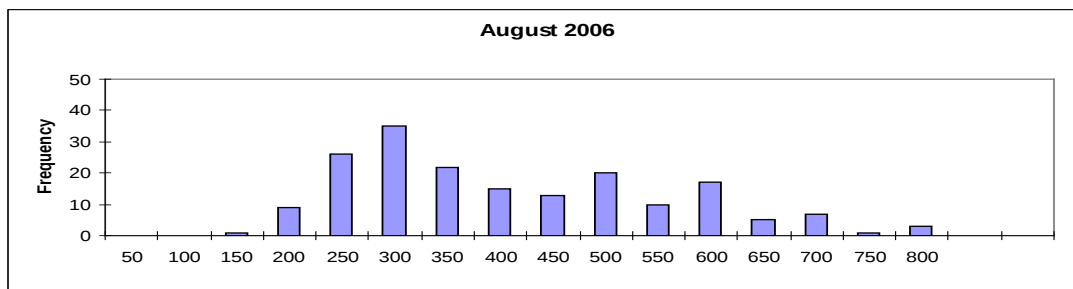
ASE C-113 2006

N	12	73	28	32	---	0
Mean	369.6	356.0	350.8	295.7	---	0
Standard Error	28.8	16.3	25.7	18.2	---	0
Minimum	247	89	113	134	---	0
Maximum	624	760	684	535	---	0

PEE C-111 2006

N	---	3	11	49	---	19
Mean	---	242.7	196.5	198.1	---	175.9
Standard Error	---	66.7	10.1	2.8	---	7.9
Minimum	---	162	175	162	---	117
Maximum	---	375	294	251	---	234

Asian Swamp Eel Total Length Histogram C-111 Canal (Aug – Dec 2006)



SUMMARY

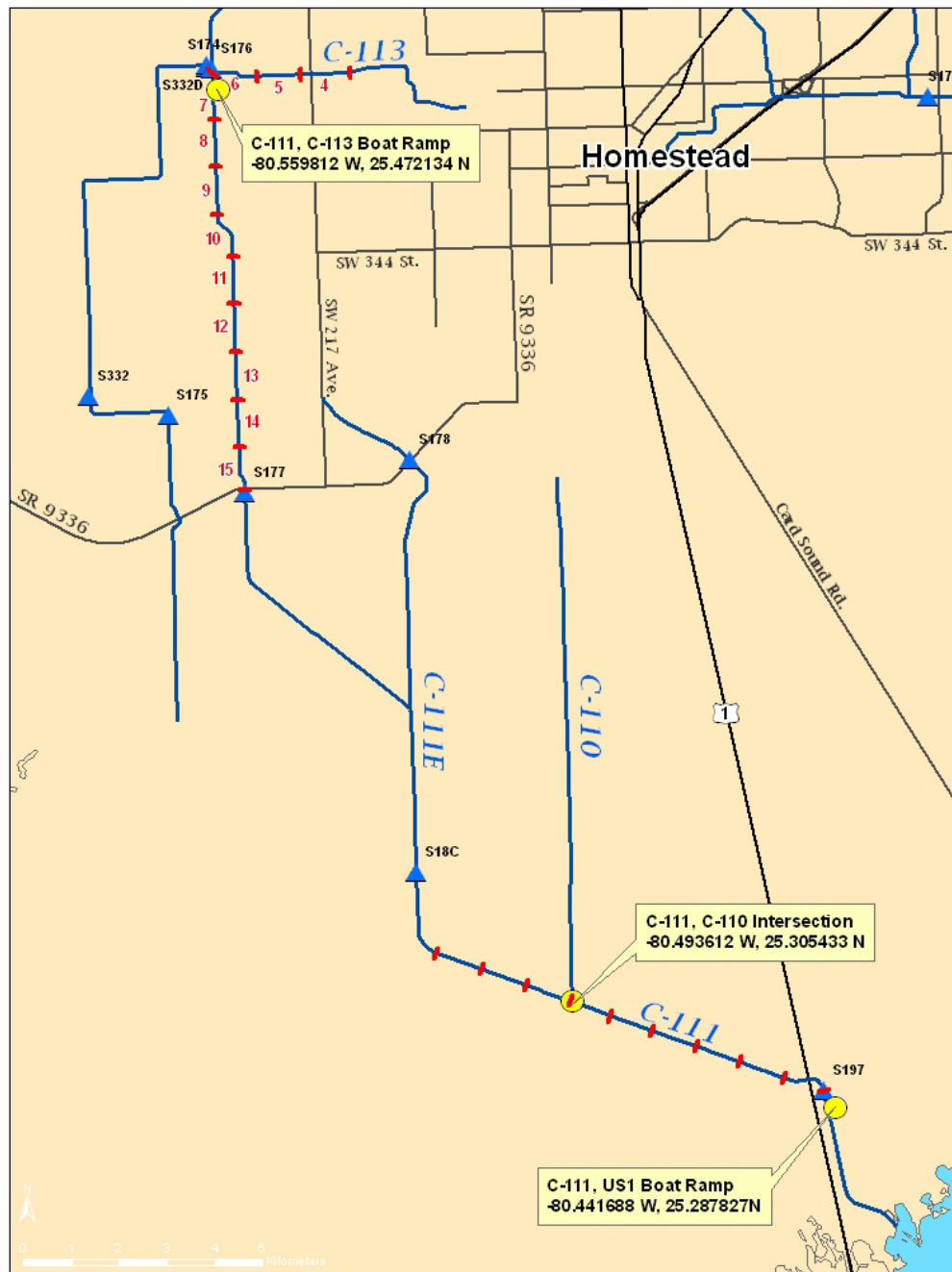
- 905 Asian swamp eels and 82 peacock eels were removed from the C-111 & C-113 canals between July – December 2006.
- 738 Asian swamp eel and 82 peacock eel were observed but not captured. The average capture efficiency was 54%.
- 23 American eels were counted (6 captured). This number is less than 1.3% of all swamp, peacock and American eels counted (captured + observed). American eels are considered a priority species by USFWS.
- Historically, American eels have not being found in large numbers in the area. Over 10 years of electrofishing data have shown that American eels made up < 1% of the numerical standing crop (Paul Shafland, Florida FWC, Pers. Comm, October 2007). Swamp eels may not been competing with American eels, though a stomach analysis study is being planned to determine prey species being targeted by eels.
- Additional areas are being sampled to determine if swamp eels are spreading beyond the C-111 canal.

2007 Sampling Season



Thanks to the assistance from SFWMD a boat ramp is now allowing access to the C-111 between S-177 and S-18C water control structures.





2007 Sampling

C-111 from S-176 to S-177

C-111 from S-177 to S-18C

C-111 E

C-111 from S-18C to S-197

C-113

North of S-176 on the L-31N-

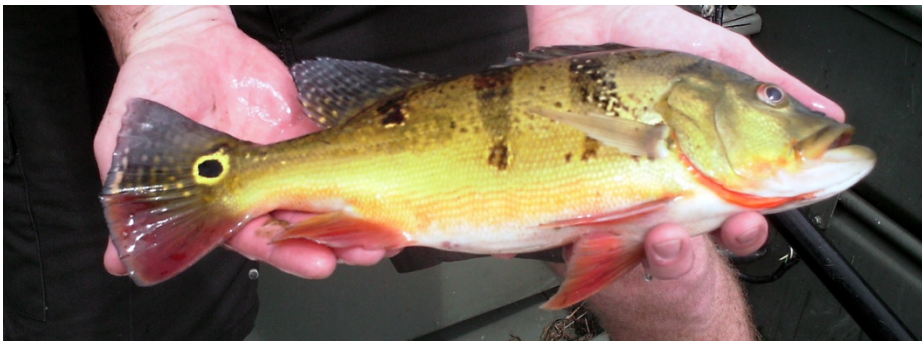
Other Non-native Species



Jaguar Guapote



Asian Swamp Eel Parasite



Peacock Bass



Questions?

