Freshwater Aquarium Hobbyists and Invasive Species in the Houston-Galveston Region

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HARC

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Pilot project funding by GSARP

Long term goal: Develop an Invasive Potential Scorecard integrating ecological and human dimensions

- **Current project:**
  1. Availability potential – Identify social and market networks through which aquarium species are exchanged
  2. Release potential – Identify factors driving release of NNIS by pet owners
  3. Survival /reproduction potential – Develop methodology to determine potential of invasion for a species released into the environment
  4. Participatory Research – Identify and evaluate potential strategies to discourage release

- **Future steps to reach long term goal:**
  1. Use results from current project to create Invasive Potential Scorecard
  2. Identify and evaluate candidate management strategies using the Invasive Potential Scorecard

Availability Potential

Species Attributes (maintenance, breeding, color, size, finnage)

Local Fish stores

Informal Web Sales

Local Breeders

Club Auctions

Large Pet stores

Big Box Stores

Imports

Release Potential

Species Attributes (personality, size)

Aquarium Owners' Attributes (aquarist identity, personal circumstances, where buy fish, where get information, how they frame release)

Survival and Reproduction Potential

Species Attributes

Ecosystem Attributes

Ability to survive in released environment

Reproduction Capability

Availability Potential

- Methodology
  - Surveys of sources for live aquarium fish
    - Local breeders
    - Local fish stores (Independent 4)
    - Local fish stores (Chain 9)
    - Internet sales by individuals
    - Discount stores (9)
    - Aquarium society auctions
    - International import data:

    (Dallas, Houston, Del Rio, El Paso, Laredo)

Availability Potential

- Imports – Houston

Name as Shipped	Common Name	Number of Shipments	Total
Tropical Fish	Tropical Fish	1,112	189,371
Non-cites fish	Non-cites Fish	328	130,122
Polypterus sp.	Bichir	298	9,944
Synodontis sp.	Catfish (squeaker)	289	32,906
Pseudotropheus sp.	Mbuna cichlid	160	29,342
Cichlasoma sp.	Cichlid (new world)	158	24,206
Pelvicachromis sp.	Cichlid (old world)	143	17,435
Aulonocara sp.	Peacock cichlid	121	8,716
Haplochromis sp.	Cichlid (old world)	103	6,458
Corydoras sp.	Cory cat	93	14,704

Availability Potential

- Auction Sales (2011)

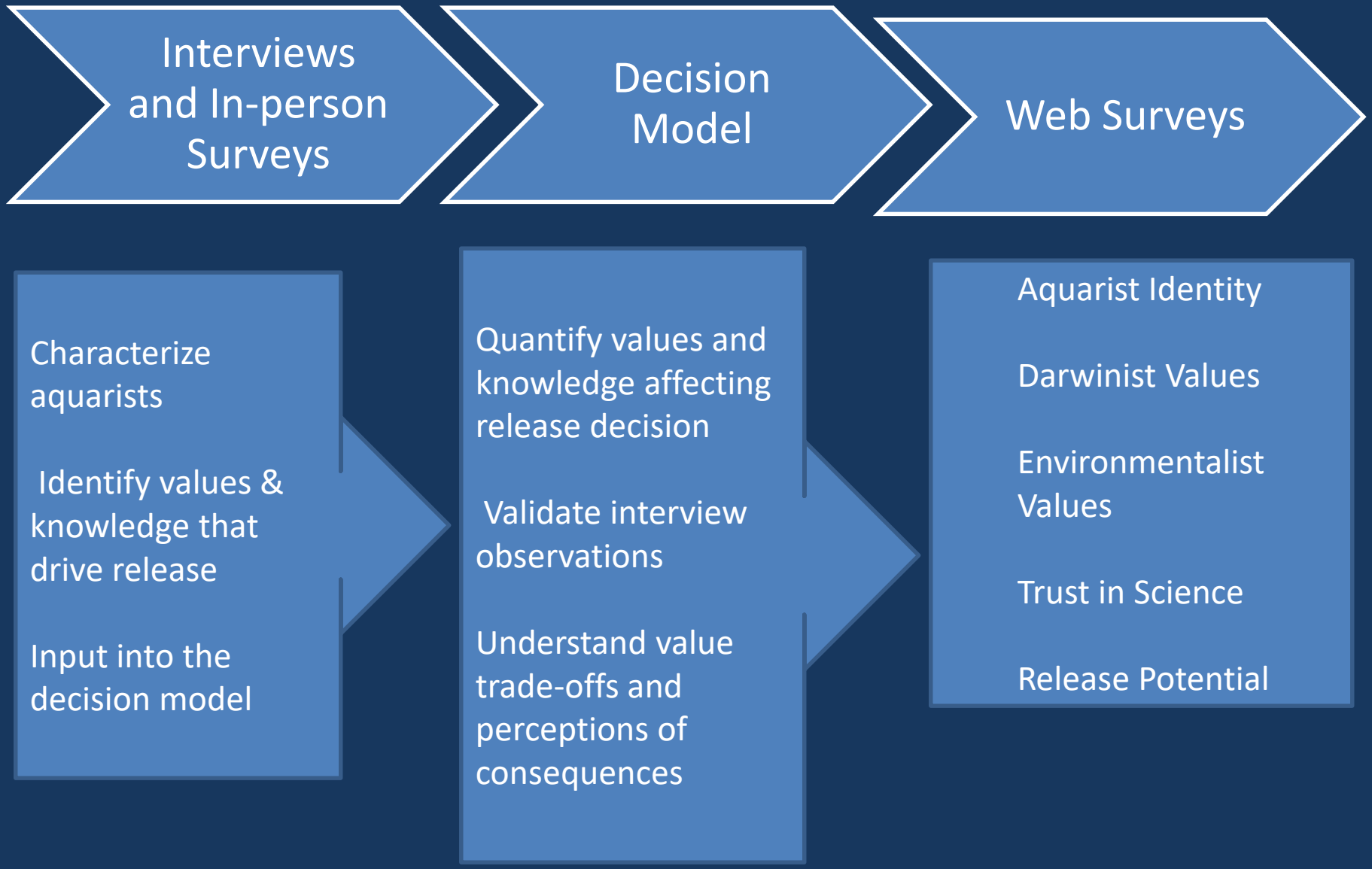
Common Name	Scientific Name	Family	Times Offered
Ancistrus (albino)	*Ancistrus sp.*	Loricariidae	10
Guppy	*Poecilia reticulata*	Poecilidae	8
Aeneus cory	*Corydoras aeneus*	Callichthyidae	4
Julidochromis marlieri	*Julidochromis marlieri*	Cichlidae	4
Gold severum	*Heros severus*	Cichlidae	3
Green severum	*Heros appendiculatus*	Cichlidae	2
Marbled angelfish	*Pterophyllum sp.*	Cichlidae	2
Melanochromis johanni	*Melanochromis johanni*	Cichlidae	1
Parachromis	*Parachromis sp.*	Cichlidae	1
Demasoni	*Pseudotrophis demasoni*	Cichlidae	1

Availability Potential

- Species ranked by number of sources.

Common Name	Scientific Name	Family	Number of Sources
Betta	*Betta splendens*	Osphronemidae	6
Yellow Labidochromis	*Labidochromis caeruleus*	Cichlidae	6
Guppy	*Poecilia reticulata*	Poeciliidae	6
African Peacock	*Aulonocara sp.*	Cichlidae	5
Discus	*Symphysodon sp.*	Cichlidae	5
Platty	*Xiphophorus sp.*	Poeciliidae	5
Oscar	*Astronotus ocellatus*	Cichlidae	4
Assorted Mbuna	*Pseudotropheus sp.*	Cichlidae	4
Jack Dempsey	*Rociooctofasciata*	Cichlidae	4
Tropheus	*Tropheus sp.*	Cichlidae	4

Release Potential



Methodology

- Multi-stage cluster approach to identify aquarists
- Created general population list totaling 201 of people who have aquariums or is thinking of getting one…drawn from 62 zip codes in the Houston region
- Using **stratified** random sampling based on **venues**, picked the research sample for the second round….sample consisted of 30 persons
  - …allows the research sample and findings to better represent the various subgroups of neophytes and hobbyists
- Survey/interview questionnaire: 31questions…..18 on release – lasted 1-2 hours; conducted two rounds with each interviewee

In-Person Survey Summary Findings

- Trade/selling is preferred option but release is a close second
- Release means giving a fish a fighting chance - If the fish dies, it is because of survival of the fittest
- Release benefits nature because it adds to diversity; nature is always changing; helps prevent extinction
- People will drive long distances to release a fish in an appropriate body of water
- Virtually no one was worried about legal consequences of release because they knew they would not get caught

Release Decision Model

Assessing Value trade-offs

- Convenience
- Fish well-being
- Environmental impact
- Legal consequences

Value Clusters

Balanced

- Fish well-being was most important value
- Balanced with moderate weight on environmental impact and convenience
- Majority were identified at the Houston Aquarium Society auction

Expedient

- Nearly as concerned about convenience as fish well-being
- Little value placed on environmental impact
- Identified at Walmart or Petco
- Lowest perceived likelihood of n0 environmental impact of release to waterway
- Highest perceived likelihood of bad fish well-being if released

Value Clusters

- Fish companion
  - Well-being of the fish is by far the most important value
  - Moderate weight placed on environmental impact and legal consequences
  - No substantive consideration of convenience
  - Identified at local fish stores or Petco
- Environmental
  - Fish well-being was most important
  - Nearly equal weight on environmental impact
  - Convenience and legal consequences are given low weight
  - Identified at the Houston Aquarium Society auction or local fish stores

Value Clusters

Model Summary Findings

- Well-being of fish is the primary value considered in making a relinquishment decision
- Environmental impact of release is a significant – but secondary – value
- Stressing legal consequences of release is not likely to effect release decision
- Less likely to release if…
  - Perceive that fish will not thrive
  - Perceive more likely to have negative environmental impact
  - Increased connections to aquarium community

Web-based Survey

- Survey was designed to capture a few dimensions of 5 primary constructs and determine what relationship these had to each other.
  - Aquarist Identity
  - Darwinist/Survivalist Values
  - Environmentalist Values
  - Trust in Science
  - Release Potential

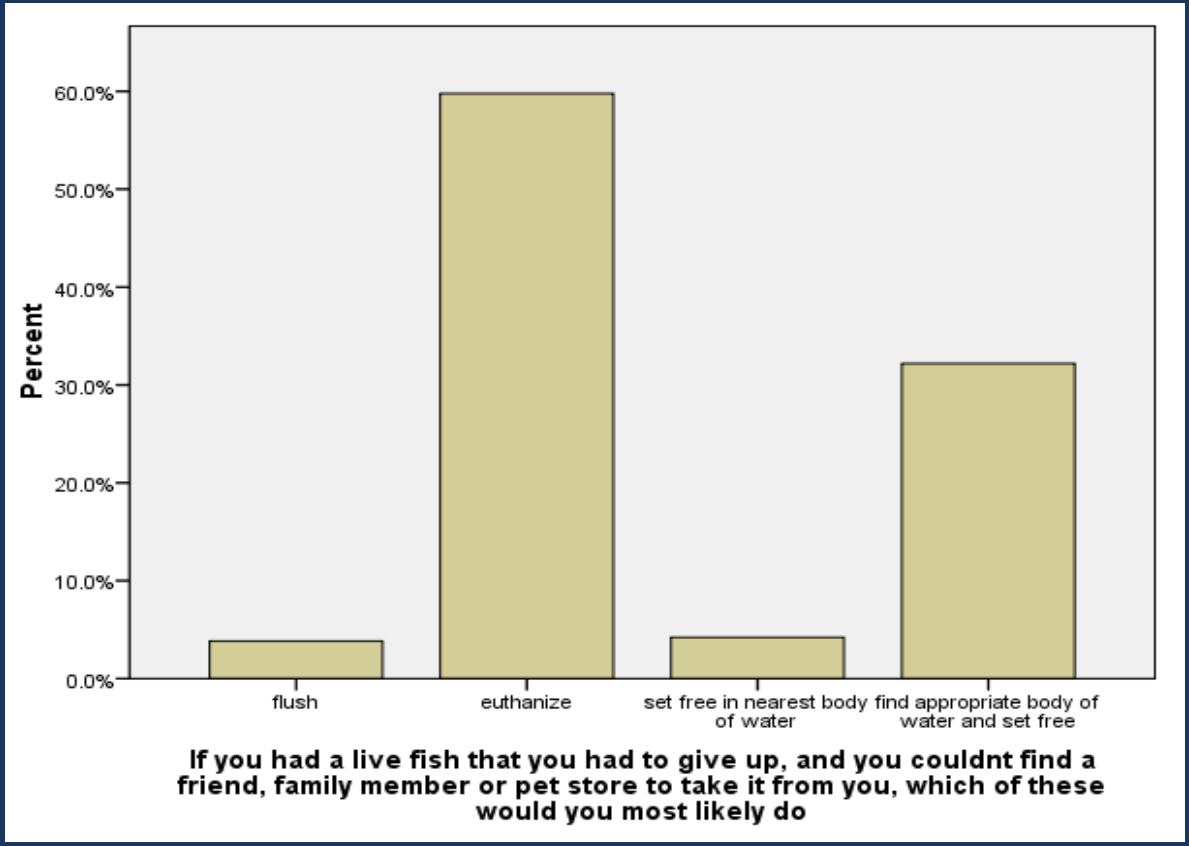
The Sample

- N = 261
  - US respondents: N = 211 (80%)
  - Texas respondents: N = 103 (40%)
  - Sex: men = 60% women = 40%
  - Age: mean = 32 median = 29
    - US*: mean = 36.6 median = 35.9
    - Range: 98 minimum = 12 maximum = 110
  - Aquarium Owners: 94%

*Source: http://www.census.gov/population/estimates/nation/intfile2-1.txt

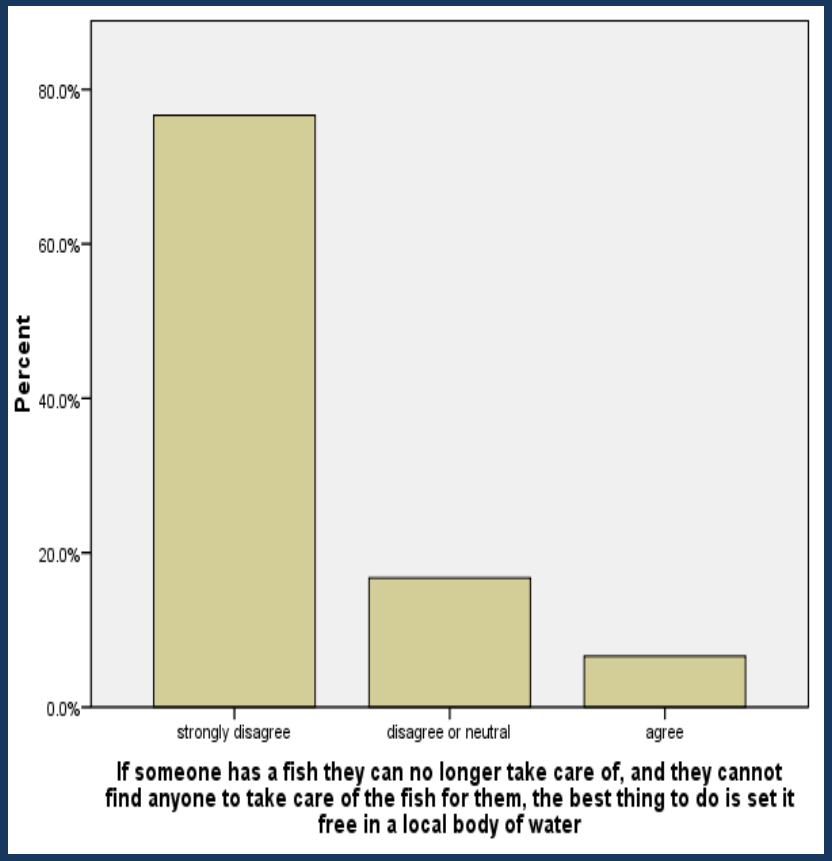
Release Patterns

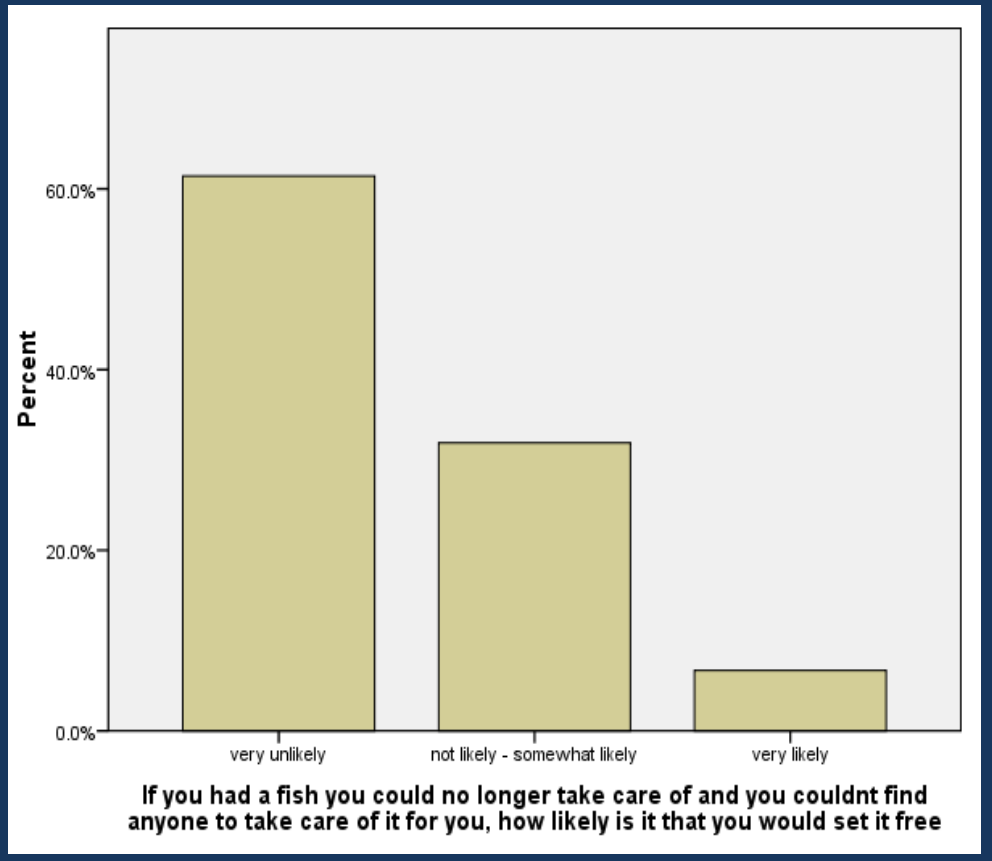
Nearly 35% of respondents admitted they would release if they couldn't find someone to take a fish from them. 30% would go so far as to seek out a body of water that seemed appropriate for the fish.



Release Patterns

Interestingly, although respondents were overwhelming opposed to release (80%), only 60% said they were very unlikely to release.





Factors that Raised a Person's Release Potential

- Darwinist/survivalist values
  - Strong species have a right to survive
- Emotional attachment to fish
- Purchase fish from big box stores
- Get information from big box stores
- Not connected into aquarium community

Factors that Lowered a Person's Release Potential

- Valuing stability of the ecosystem
- Viewing the environment as a public resource
- Being a serious aquarist
- Using local fish stores and web for information

Survival and Reproduction Potential –

A Methodology for Determining Survival Potential of Aquarium Fish Released in Houston's Bayous

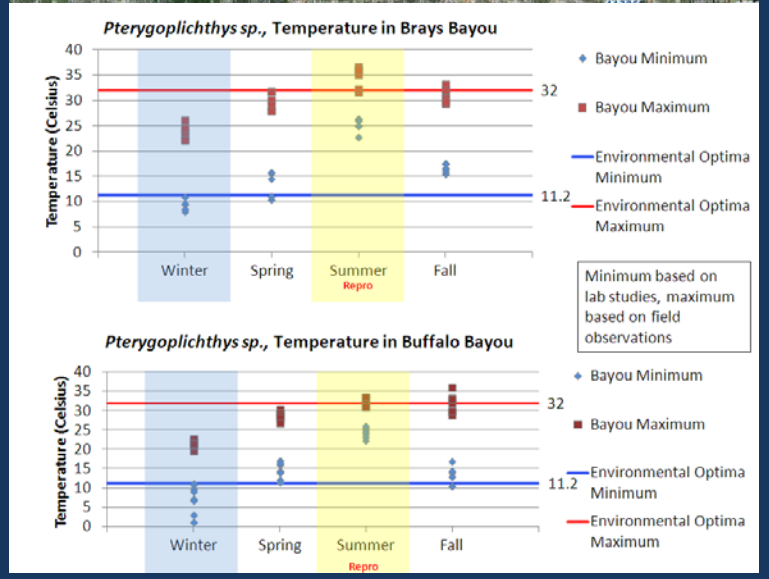
- Determine species' ability to become established in Texas waterways
- Develop a Survival Potential methodology
  - Combine with the Availability Potential and Release Potential aspects of the project
  - Use as an assessment tool for multiple species and areas
  - Inform education and outreach efforts
  - Support prevention strategies

Methodology

- 7 species chosen
  - Based on invasion status
  - Species attributes collected through lit review and compiled into species attribute charts
- Local habitat characterized
  - Stream water quality data collection and analysis
- Environmental optima charts developed
  - Compare species attributes to local habitat characterization (e.g. minimum winter water temperature compared species requirements)
- Species survival and reproduction potential combined with availability and release potential

Scientific name	Common name	Invasive/Native
Hypostomus plecostomus / Pterygoplichthys sp.	Common pleco / armored suckermouth catfish	Invasive reported in Houston-Galveston Region
Piaractus brachypomus	Red-bellied pacu	Exotic reported in Houston-Galveston Region
Poecilia reticulata	Guppy	Exotic reported elsewhere in Texas

		LIFE STAGE			
	CHARACTERISTIC	Egg	Larvae	Fry	Adult
Morphology	General description	Orange (*Pterygoplichthys* species)/yellow (*Ancistrus* species in aquaria) sticky egg mass [7, 10, 11]	Yolk sac with tail [11, 12]	Miniature adults	Ventral (stomach side) sucker mouth [13, 14] Specialized teeth scrap or rasp substrates [14] Dorsal (back side) eyes Compressed body [14] Bony plates [13, 14] Horizontal pectoral fins Dorsal fin rays (*Hypostomus* species have 7-8 rays, *Pterygoplichthys* species have 9-14 rays)[3, 6, 15-17] Cylindrical tail, not flattened [13] Brown coloration with spotted or vermiculated



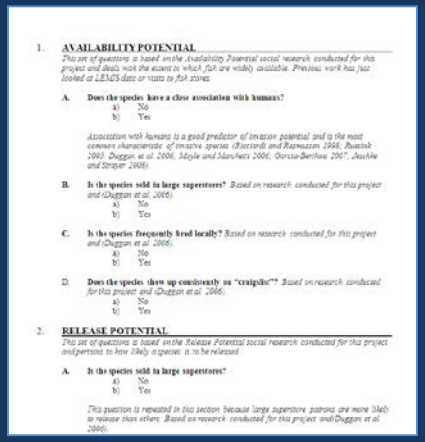
Survival and Reproduction Potential Conclusions

- Methodology shows promise
  - Using this methodology, one can relate species optima to environmental conditions
- Species and habitats are dynamic
  - Conditions for some parameters (pH or salinity) considered inhospitable for a species but still produce invasive results (i.e., *Piaractus*)
- Will be challenging to quantify
  - Should not unequivocally state whether species can/will invade but rather predict likeliest species to invade and likeliest habitat to be invaded

Future Goal – Invasive Potential Scorecard

- Differs from risk assessment…
  - Not seeking to assess quantitative or qualitative risk related to a threat
  - Not assessing impacts to ecological, social, or economic systems
  - Pathway specific – aquarium fishes only

- Instead, potential of invasion based on…
  - Availability potential
  - Release potential
  - Survival /reproduction potential



1. **AVAILABILITY POTENTIAL**

This set of questions is based on the Availability Potential social research conducted for this project and deals with the extent to which fish are widely available. Previous work has just looked at LEARS data or visits to fish stores.

A. Does the species have a close association with humans?
a) No
b) Yes

Association with humans is a good predictor of invasion potential and is the most common characteristic of invasive species (Ricciardi and Rasmussen 1998; Ruesink 2005; Duggan et al. 2006; Idoyle and Sanchez 2006; Garcia-Berthou 2007; Jeschke and Strayer 2008).

B. Is the species sold in large superstores? *Based on research conducted for this project and (Duggan et al. 2006).*
a) No
b) Yes

C. Is the species frequently bred locally? *Based on research conducted for this project and (Duggan et al. 2006).*
a) No
b) Yes

D. Does the species show up consistently on "croipsis"? *Based on research conducted for this project and (Duggan et al. 2006).*
a) No
b) Yes

2. **RELEASE POTENTIAL**

This set of questions is based on the Release Potential social research conducted for this project and pertains to how likely a species is to be released.

A. Is the species sold in large superstores?
a) No
b) Yes

This question is repeated in this section because large superstore patrons are more likely to release than others. Based on research conducted for this project and (Duggan et al. 2006).

Participatory Research

- Exploratory stakeholder workshop in August 2007
- Conducted workshop in April 2011
  - Aquarists
  - Public educators
  - Resource managers
  - Aquarium industry
- Reviewed project methodology
- Construct framework for ongoing collaboration
- Identified and evaluated potential strategies to discourage release

Outreach Oriented Management Strategies

- Long term
  - Work with big box stores on species lists (perhaps through a large NGO with a track record of working with large corporations)
  - Large ad campaign on the order of Don't Mess With Texas
- Short term
  - Ad campaigns and materials that target the knowledge and values of releasers

Responsible Aquarists Don't Release.

PROTECT TEXAS WATERS

Good Reasons Why We Shouldn't Release Our Aquarium Fish Into Texas Waterways

- Release of a single fish can turn into hundreds
- Non-native fish:
  - compete with native fish for food and habitat
  - can transmit diseases or parasites
  - prey on native fish
  - can alter natural habitat and make it unsuitable for native fish
- Some fish can't survive in the areas where they are released and suffer due to starvation or exposure

Plecos (*Hypostomus sp., Pterygoplichthys sp.)* compete with native fish for food resources and degrade habitats by burrowing into stream banks and compromising their stability.

Local aquarium society fish auctions and internet auctions provide alternatives to release.

What Are the Alternatives to Release?

- Sell or give away on Craig's list
- Sell or give away at local aquarium society fish auctions or on internet auction sites
- Sell, give or trade on aquarist web forums
- **If you don't know it, don't own it**
  - Is the fish aggressive?
  - Is it a "tankbuster"?
  - Does it have special tank requirements?
  - What are its breeding characteristics?

Although lionfish (*Pterois volitans)* make beautiful pets, these fish are not native to Texas and pose a threat to reef communities because they prey on native reef fish. Lionfish can also be a nuisance to divers and fishermen because of their venomous spines.

Photo Credits: Fish Auction (Dave Morton), *Hypostomus sp.* (Texas Rapid Assessment Team), *Pterois volitans* (USGS NAS Database)

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