Pretty Fish in Strange Places

The Ornamental Fish Trade Pathway

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GSARP Workshop
New Orleans, LA
10 October 2012

Historical Perspective

- 1848 First U.S. pet store
- 1910 Importers/growers
- 1980s Marine hobby
- Currently
  - 800+ varieties farmed in Florida
  - 2000+ species in trade (freshwater/marine)
- 12.8 million U.S. households with fish
- 159 million pet fish
  - APPMA 2012

Ornamental Trade

Internet

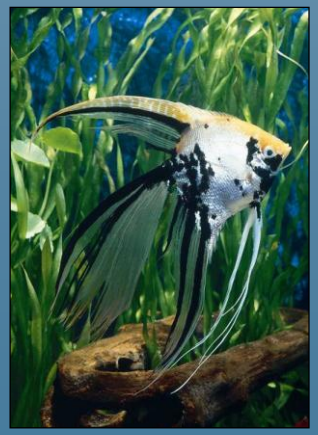
Import / Export

Farm/Breeder

Wholesale

Retail outlets

Hobby Shows
Flea Markets



Public

Ports of Entry

- Los Angeles
- Miami
- Tampa
- New York
- Chicago
- Atlanta
- San Francisco

US Ornamental Aquaculture

- Centered in Florida
- 800+ varieties
- US$32 M in 2007 (farm-gate, tropical fish only)
- 48% of Florida aquaculture value
- 130-150 producers
- Economic multipliers

Top 25 Freshwater Varieties

- Neon Tetra *Paracheirodon innesi*
- Zebra Danio *Danio rerio*
- Plecostomus *Pterygoplichthys* spp.
- Feeder Guppy *Poecilia reticulata*
- Male Betta *Betta splendens*
- Comet Goldfish *Carassius auratus*
- Ghost Shrimp *Nantia* sp.
- Painted Glassfish *Chanda ranga*
- Red Wag Platy *Xiphophorus maculatus*
- Black Molly *Poecilia latipinna*
- Tiger Barb *Puntius tetrazona*
- Mixed Fantail Goldfish *Carassius auratus*
- Velvet Swordtail *Xiphophorus hellerii*
- Black Neon Tetra *Hyphessobrycon herbertaxelrodi*
- Fancy Guppy Pair *Poecilia reticulata*
- Algae Eater *Gyrinocheilus aymonieri*
- Cherry Barb *Puntius titteya*
- Black Skirt Tetra *Gymnocorymbus ternetzi*
- Bala Shark *Balantiocheilus melantopterus*
- Serpae Tetra *Hyphessobrycon callistus callistus*
- Velvet Wag Swordtail *Xiphophorus hellerii*
- Otocinclus *Otocinclus affinis*
- Albino Aeneus Cory *Corydoras aeneus "albino"*
- Bloodfin Tetra *Aphyocharax anisitsi*


Jack's AQUARIUM and PETS


A-1 Aquarium


ANDYS
PET SHOP


WAL★MART
HOME OFFICE


PETCO
Supplies & Fish

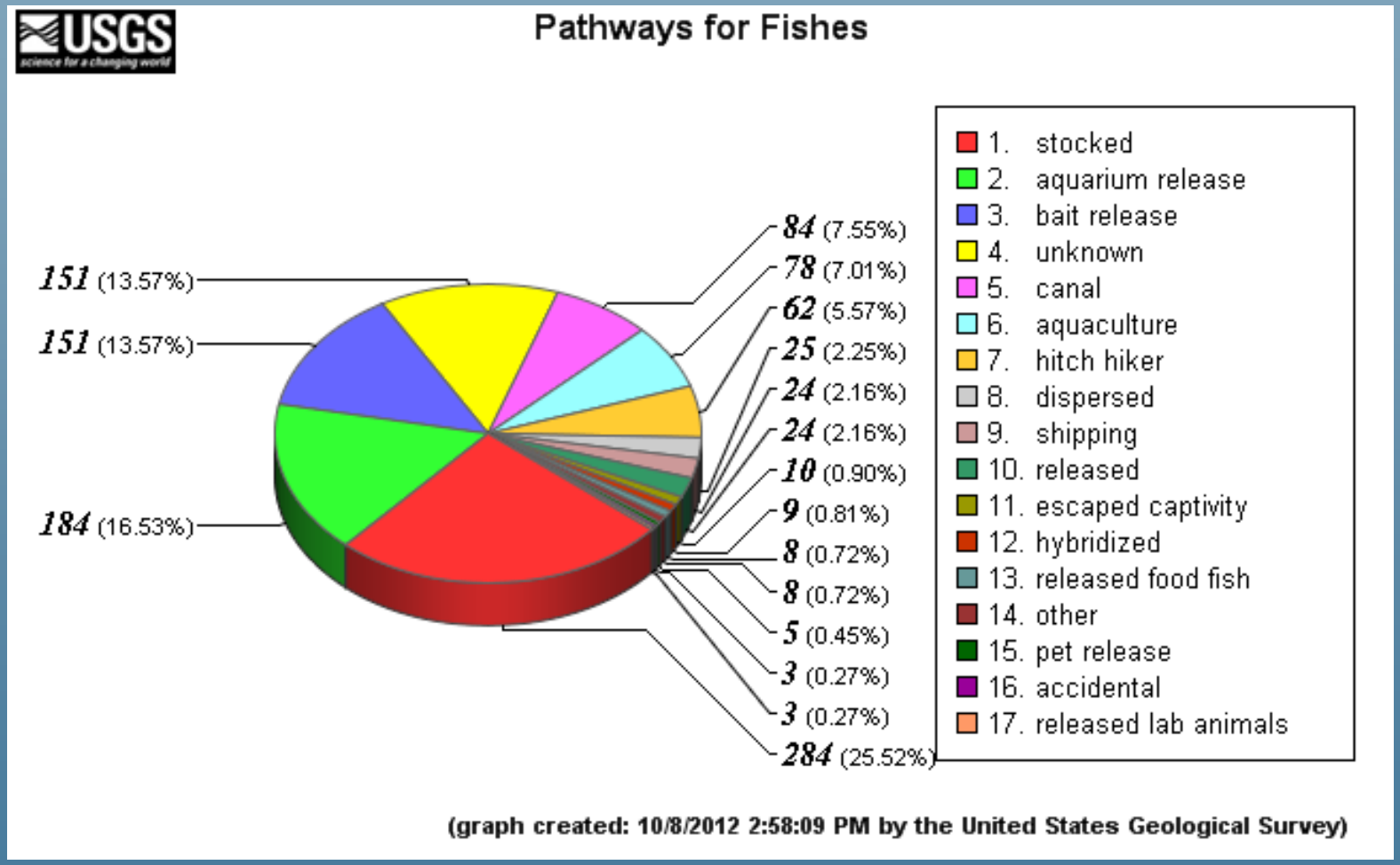

PETSMART


C & C tropical paradise
PET SHOP
Exotic Fish & Birds

Ornamental Fish Introductions

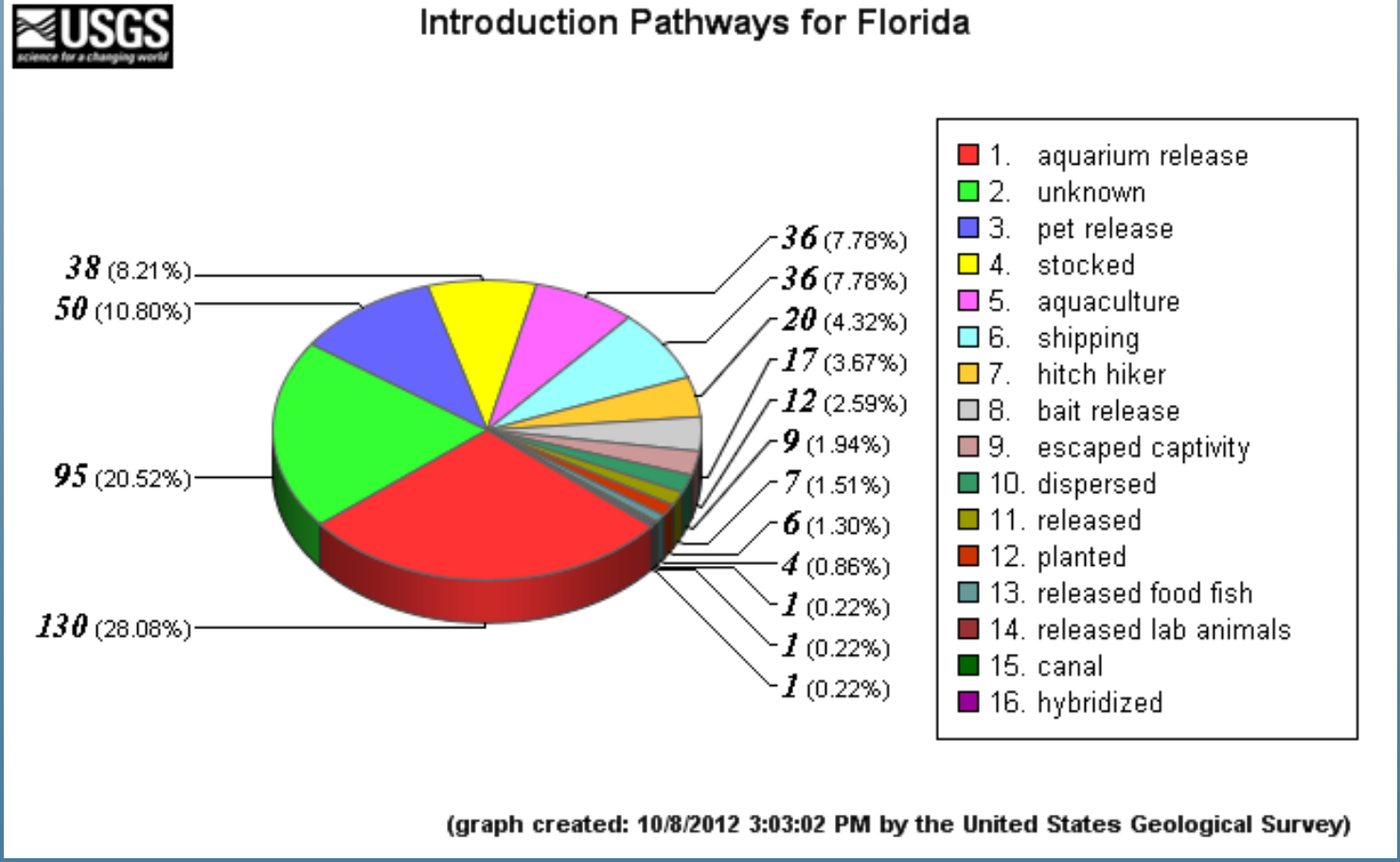
- Aquarium release
- Ornamental aquaculture escape
- Escape during transport
- Intentional release from farms
- Release or movement of source populations
- Water gardens
- Others – bait, live food fish, ceremonial release, other aquaculture escape
- Relatively little hitchhiking (SRAC Pub 3902)

US Pathways -- USGS



http://nas.er.usgs.gov/graphs/Group.aspx 8 Oct 2012

Florida Pathways



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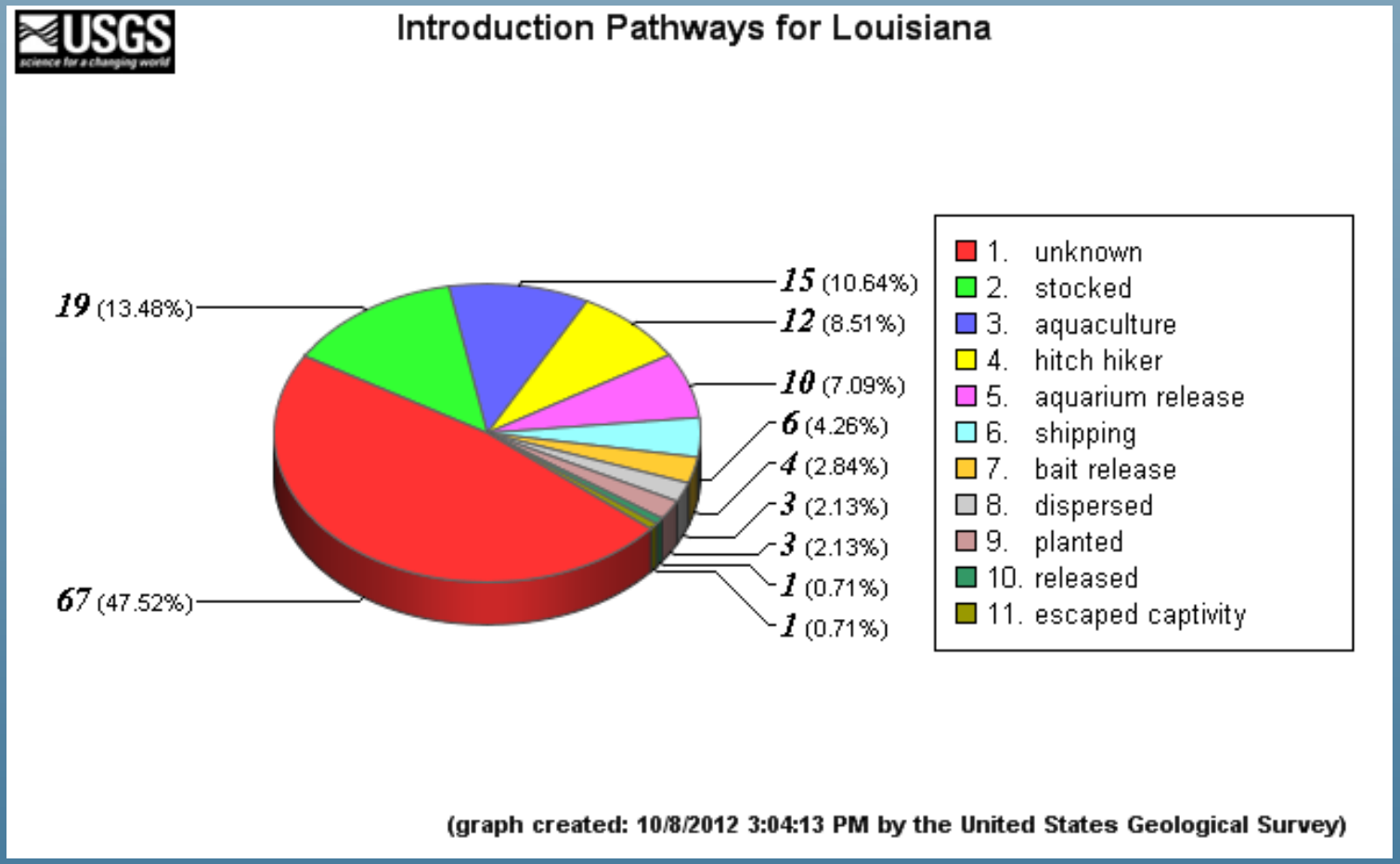
Louisiana Pathways



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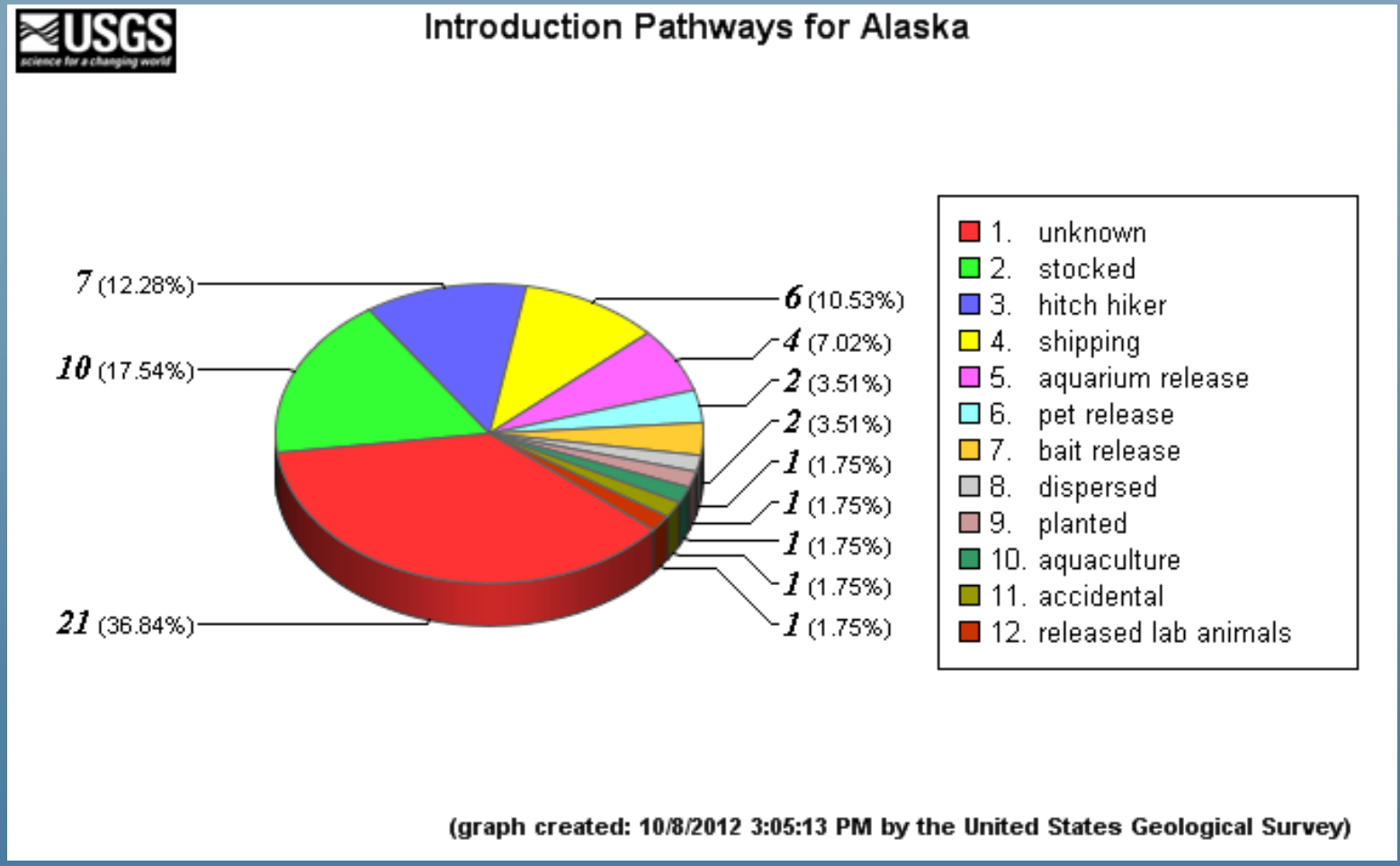
Alaska Pathways



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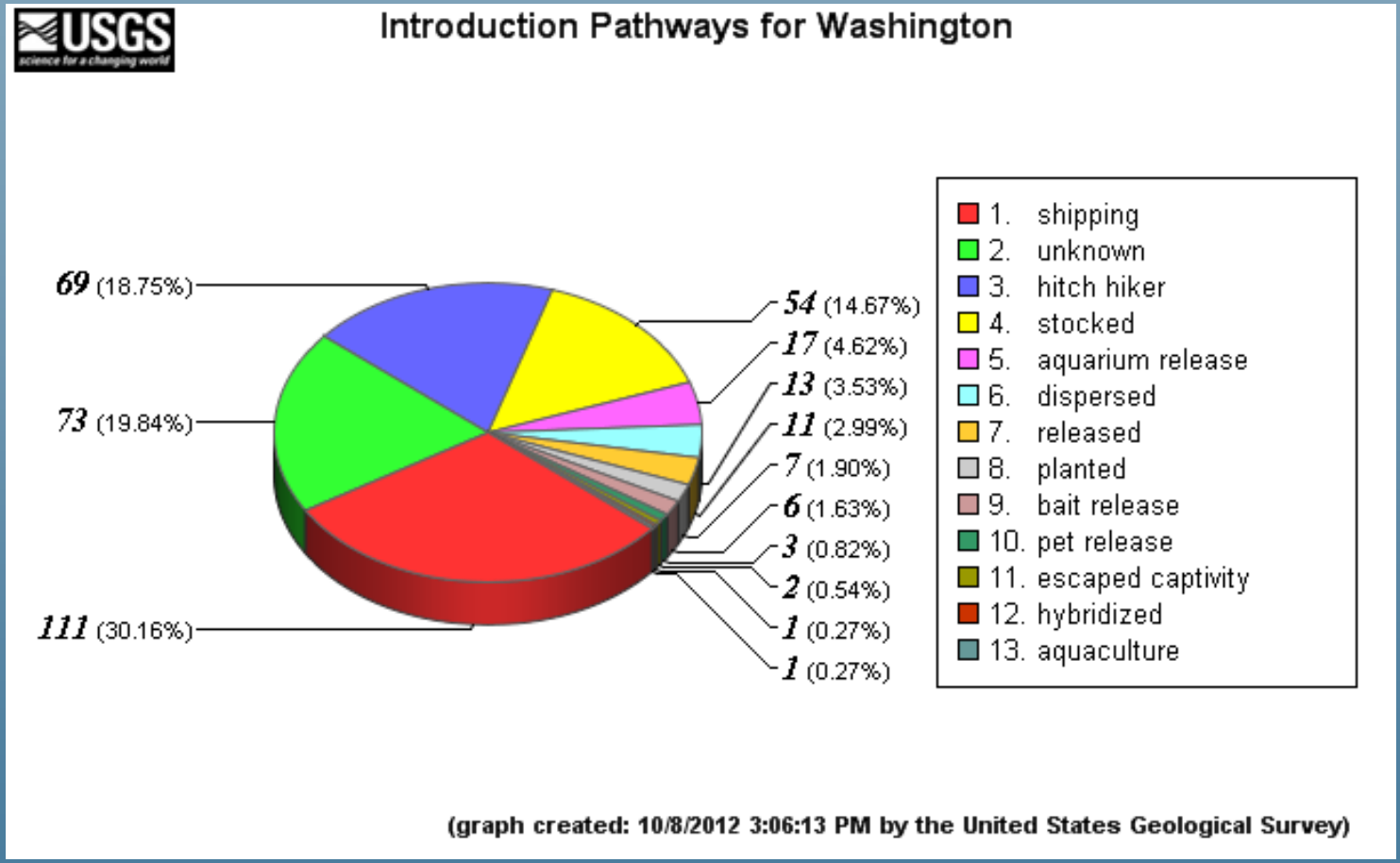
Washington State Pathways



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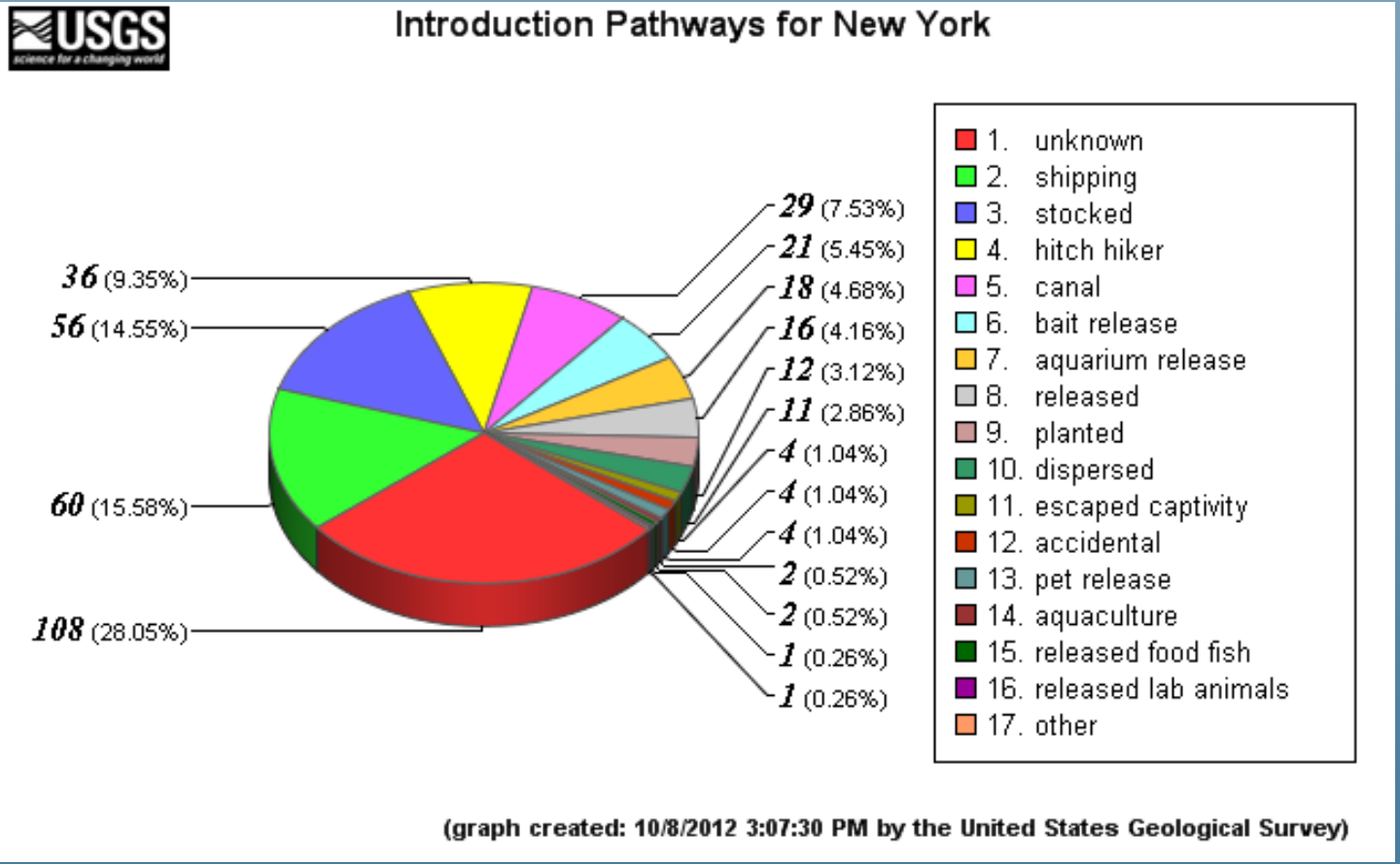
New York Pathways



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Species Numbers -- USGS

- Freshwater Fishes
- Aquarium releases – 178
- Pet escape – 5
- Aquaculture releases – 61 that could be ornamental
- Much overlap in lists
- Search conducted at http://nas.er.usgs.gov/ on 8 Oct 2012

Which Pathways???

- Many species show up in more than one pathway
- Sometimes, this is real
- Sometimes, no one knows
- Difficult to distinguish between farm escape and aquarium release in FL
- Do we really know the history???

Trends?

- Early trend in Florida (1950s-1970s) – ornamental aquaculture escape
- Recent trend in Florida (1980s on) – shift more towards aquarium release and other pathways; farms still may be sources
- National trends – increase in both
  - Aquarium release important
  - A number of recent releases from farms in other states (e.g., LA)
  - Also water gardens (esp with temperate fishes)

Freshwater Ornamental Fish in Florida: Case Study

- 152 freshwater fish introduced into Florida
- 97 ornamental species (64%)
- 29 of 34 reproducing species (85%)
- 5 species no longer ornamental
  - Tilapias
  - Walking catfish

Shared Characteristics

- Phylogeny
  - Cichlids (20 sp)
  - Catfishes (6 sp)
- Body size
  - > 6 inches
- Physiological tolerances
- Parental care

Limits on Success

- **Cold winter temperatures**
  - **Most in south Florida**

- **Biotic resistance**
  - **Predators**
  - **Competitors?**
- **Chance?**

Why Not the Rest of USA?

- Nearly all ornamental species are tropical
- Require strong and reliable thermal refuge
  - Hot springs
  - Power plants
- Winter kills in Florida
- Some other states (e.g., HI, CA, TX)
- There are a few temperate species

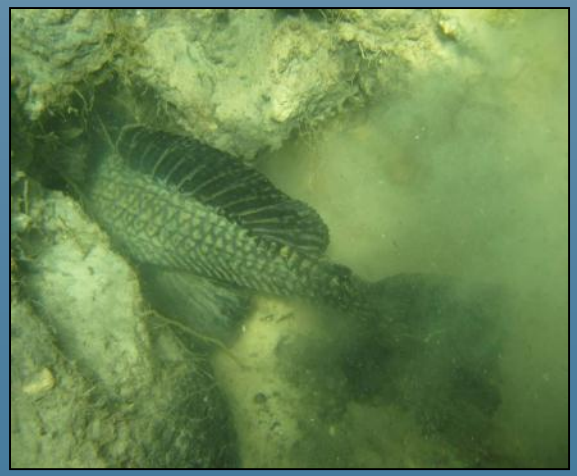
Impacts of Reproducing Ornamentals in Florida

	Types of Impacts				
	Predation	Competition	Genetic	Habitat Alteration	Disease
Documented	3	0	0	2	0
Anecdotal	9	14	0	0	1
Unknown	17	15	29	27	28

Hill and Fuller, unpublished data

Impacts

- Few documented impacts (17% of sp)
- Localized impacts
- Predation – localized
- Habitat alteration – highly localized
- Competition, Genetics, and Disease – little support



Types of Species in Trade

- Most species are:
  - small and brightly colored
  - tropical
- But, some are:
  - Large-bodied
  - temperate
- Risk?

www.glofish.com

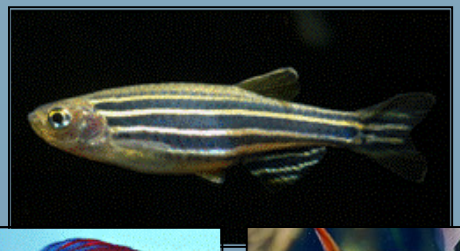
www.anglingthailand.com

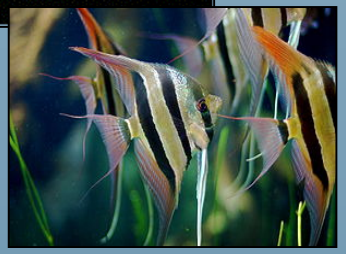
Risks of Ornamental Fishes

- Few established outside of warmest regions
  - FL, HI, LA, CA, Puerto Rico, etc.
- Few impacts overall
- Risk varies
  - Body size, physiological tolerances
  - invasion history(?), other (?)
- Risk screening
  - Fish Invasiveness Scoring Kit (FISK)
  - USFWS Ecological Risk Screening

FISK

- Adapted from Australian Weed Risk Assessment (WRA)- Pheloung *et al*. (1999) by Copp *et al*. (2005)
- Semi-quantitative
  - 49 questions
  - Scores -11 to 57: Low risk < 1, High risk >19
  - Adapted to multiple environments and taxa
- Biogeography, introduction/invasion history (including impacts), and biology/ecology

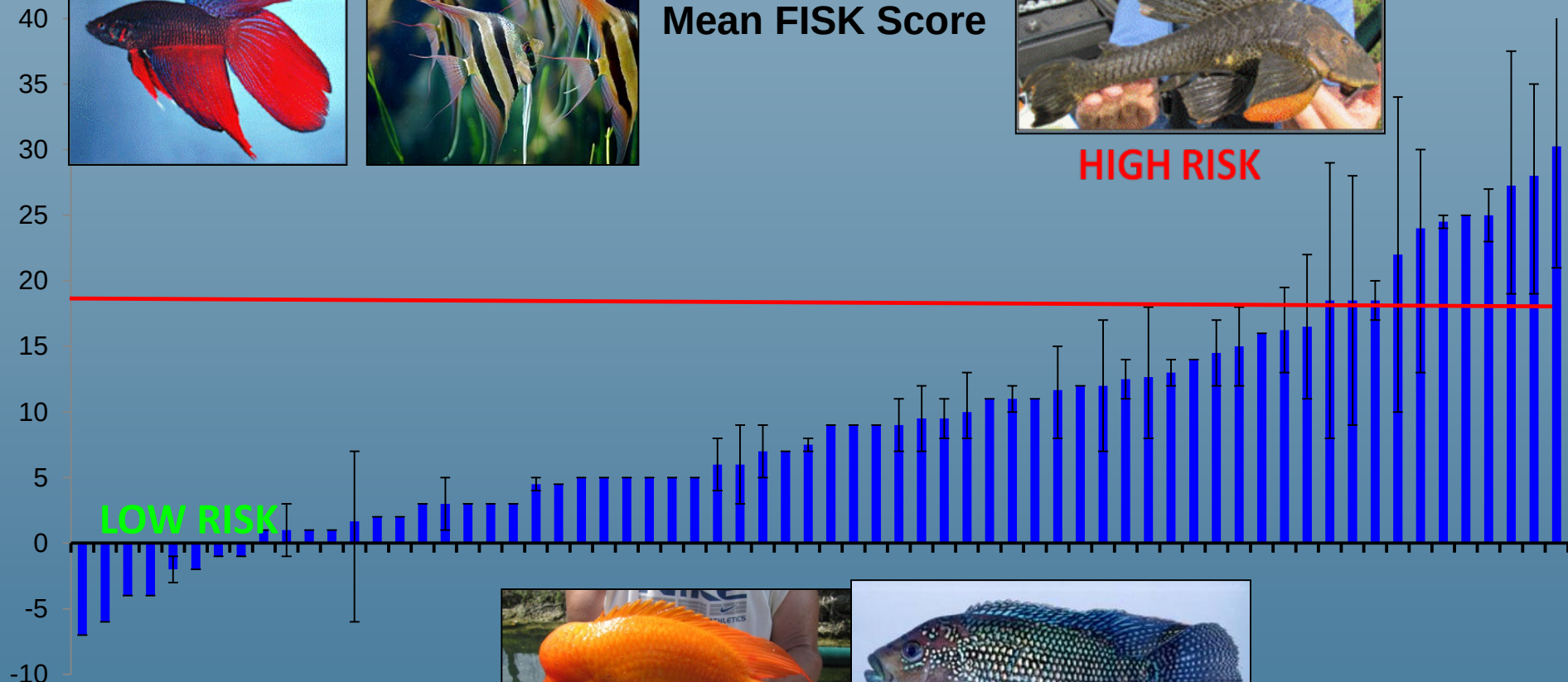




Mean FISK Score

HIGH RISK

LOW RISK



Lawson et al. unpublished data

Ecological Risk Screening

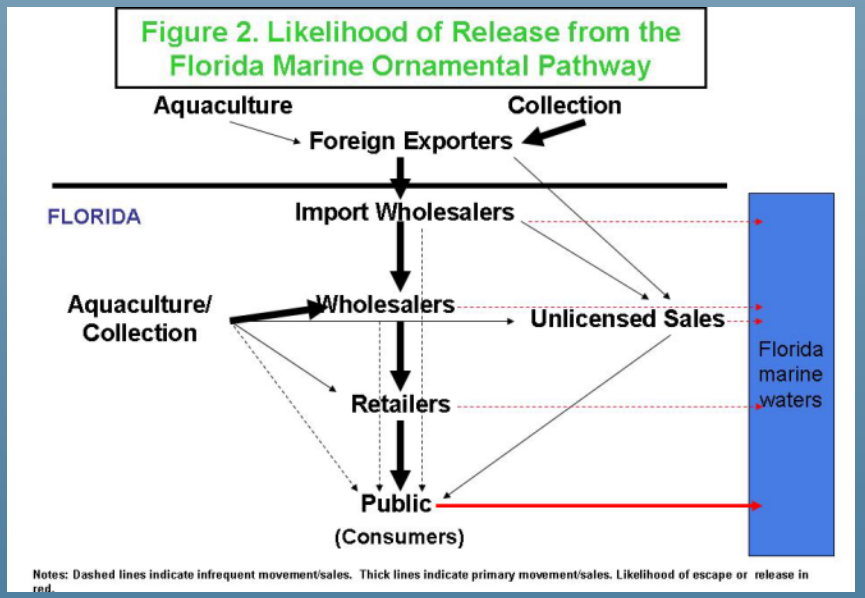
- USFWS
- Climate match and invasion history
- Few ornamental species assessed
  - Low – Betta and coolie loach
  - Medium – Brown hoplo

Marine Ornamental Production

- Indoor (building or greenhouse), tank-based facilities
- Limited to ~2 dozen species of fish
- Numerous invertebrates
- Wild-caught product dominates

Risks of the Marine Ornamental Pathway

- Zajicek et al. 2009
- Low risk of establishment
- Low risk of economic and environmental impacts
- High risk of social impacts



Lionfish

Pterois volitans and *P. miles*

Summary

- Ornamental aquaculture and aquarium hobby are complex pathways of entry
- The importance of these pathways varies geographically
- Most species are tropical and not a major concern for most regions
- Some species with greater risk than others

Acknowledgments

- James Ballard (GSMFC)
- GSARP, MRBP
- Funding sources:
  - Florida Fish and Wildlife Conservation Commission
  - US Department of Agriculture
  - Florida Department of Agriculture and Consumer Services
- Marshall Myers (PIJAC)
- Pam Fuller (US Geological Survey)
- Larry Lawson (UF-TAL)
- UF-TAL, Craig Watson, Director
- Florida Tropical Fish Farms Association
- Courtenay and Meffe 1989