Controlling an Invasive Species through Consumption: The Case of Lionfish as an Impure Public Good

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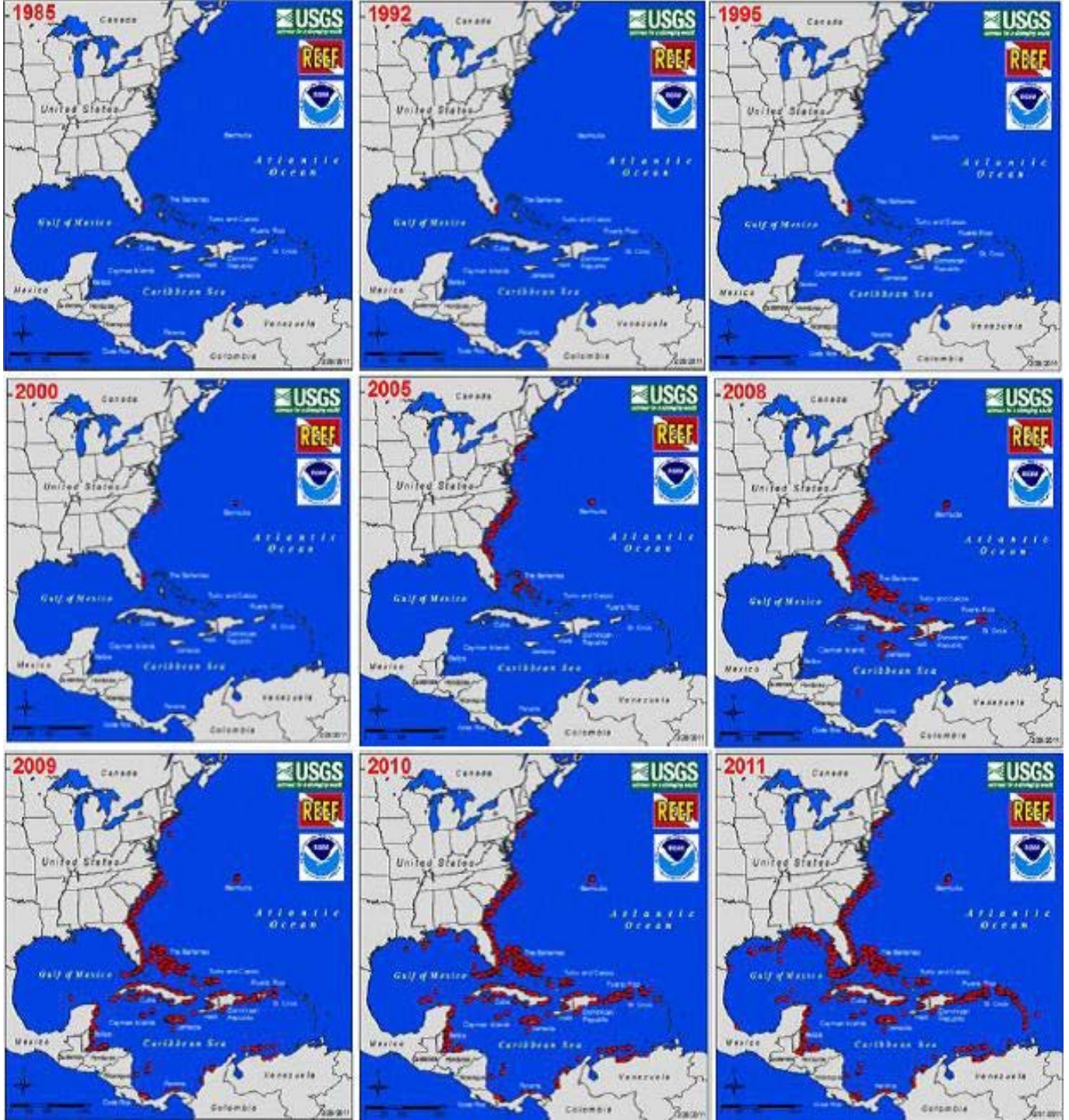
1985
Canada
United States
Bermuda
Atlantic Ocean
The Bahamas
Gulf of Mexico
Turks and Caicos
Puerto Rico
Cuba
St. Croix
Dominican Republic
Haiti
Cayman Islands
Jamaica
Belize
Mexico
Caribbean Sea
Guatemala
Honduras
Nicaragua
Panama
Venezuela
Costa Rica
Colombia
0 250 500 1,000
2/28/2011


1985
1992
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USGS
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United States
Canada
Atlantic Ocean
Gulf of Mexico
Caribbean Sea
Mexico
Venezuela
Colombia

Lionfish - The “Perfect Super-Invader”

- Invasive - native to the Indo-Pacific region
- A female lionfish can release between 10,000 and 30,000 unfertilized eggs every 4 days year around, approximately 2 MILLION eggs per year.
- No known predators - 18 venomous spines

Lionfish - The “Perfect Super-Invader”

- Voracious appetite - known to eat just about every marine creature in its range - 70 different fish, invertebrates and mollusks
- A single small lionfish may reduce the number of juvenile native fish on any given reef by approximately 79% in just 5 weeks.
- Decimating populations of commercially important fish (snapper, grouper, flounder, etc.)
- https://www.youtube.com/watch?v=1Ld8ta8rKgs&feature=youtu.be

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NOAA: More Fishing, Higher Consumption Might Help Reverse Lionfish Invasion

Massive fishing effort also involves chefs to introduce “delicious” fish to consumers

August 6, 2010

Lionfish.

High resolution (Credit: NOAA)

A new study looking at how to curb the rapid growth of lionfish, an invasive species not native to the Atlantic Ocean, suggests that approximately 27 percent of mature lionfish will have to be removed monthly for one year to reduce its population growth rate to zero.

But the good news is that the invasive fish happens to be delicious—and NOAA is encouraging chefs to find new ways to introduce it to U.S. consumers.

Lionfish are native to the western and central Pacific Ocean, but have established themselves from North Carolina to South America. They are a popular aquarium fish that were likely first released in Florida waters in the mid-1980s. Since then, the species has spread rapidly. Scientists and public officials are seriously concerned at the effect lionfish are having on reef ecosystems, since this predator is capable of rapid population growth and outcompeting native fish for food and territory.

“This study offers us the first target for fishing and other local control efforts such as lionfish derbies,” says Lad Akins, director of operations for the Reef Environmental and Education Foundation, an organization of divers and marine enthusiasts who are working to combat the lionfish problem.

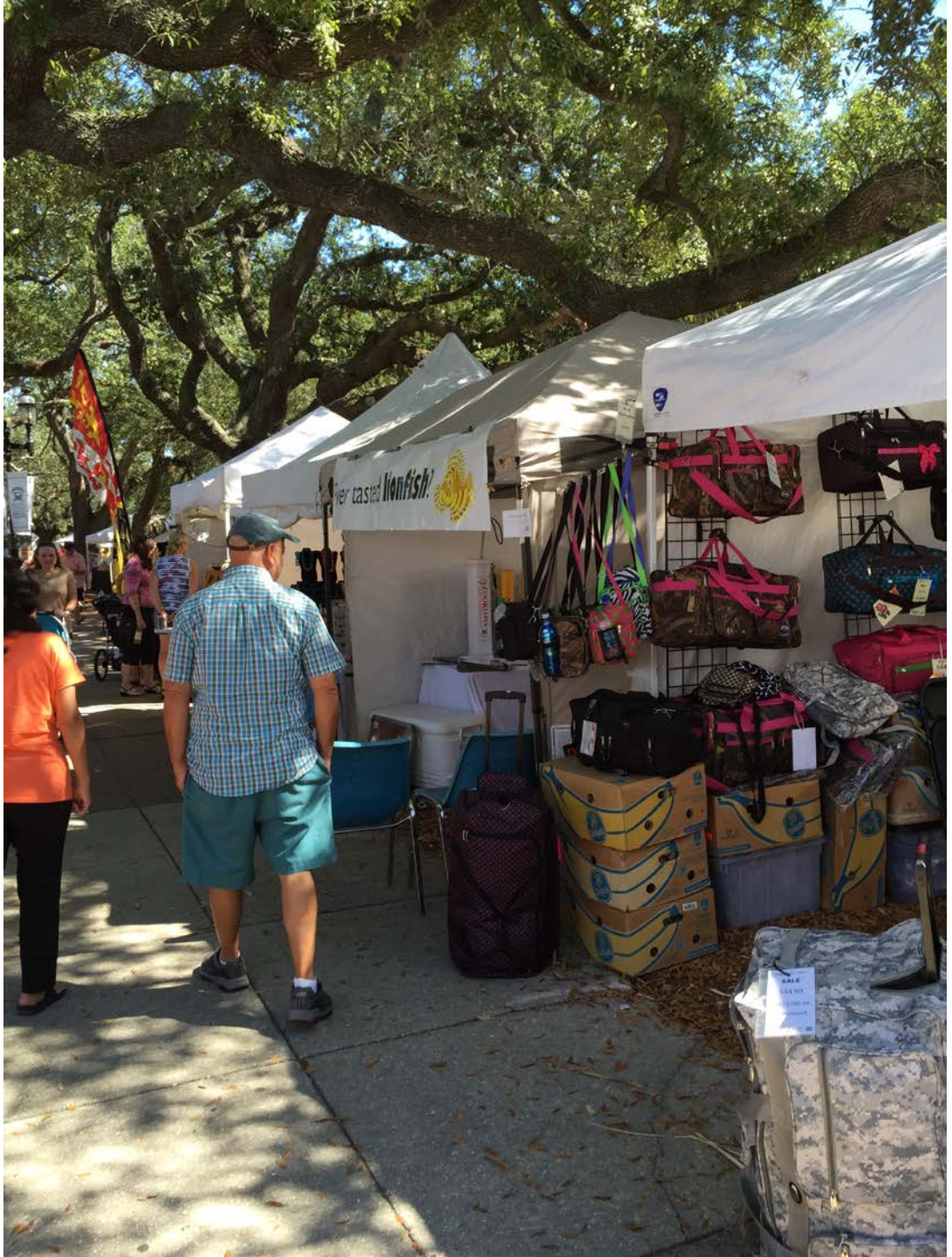
The effort to fish down the species has already begun. Caribbean nations such as the Turks and Caicos

Lionfish

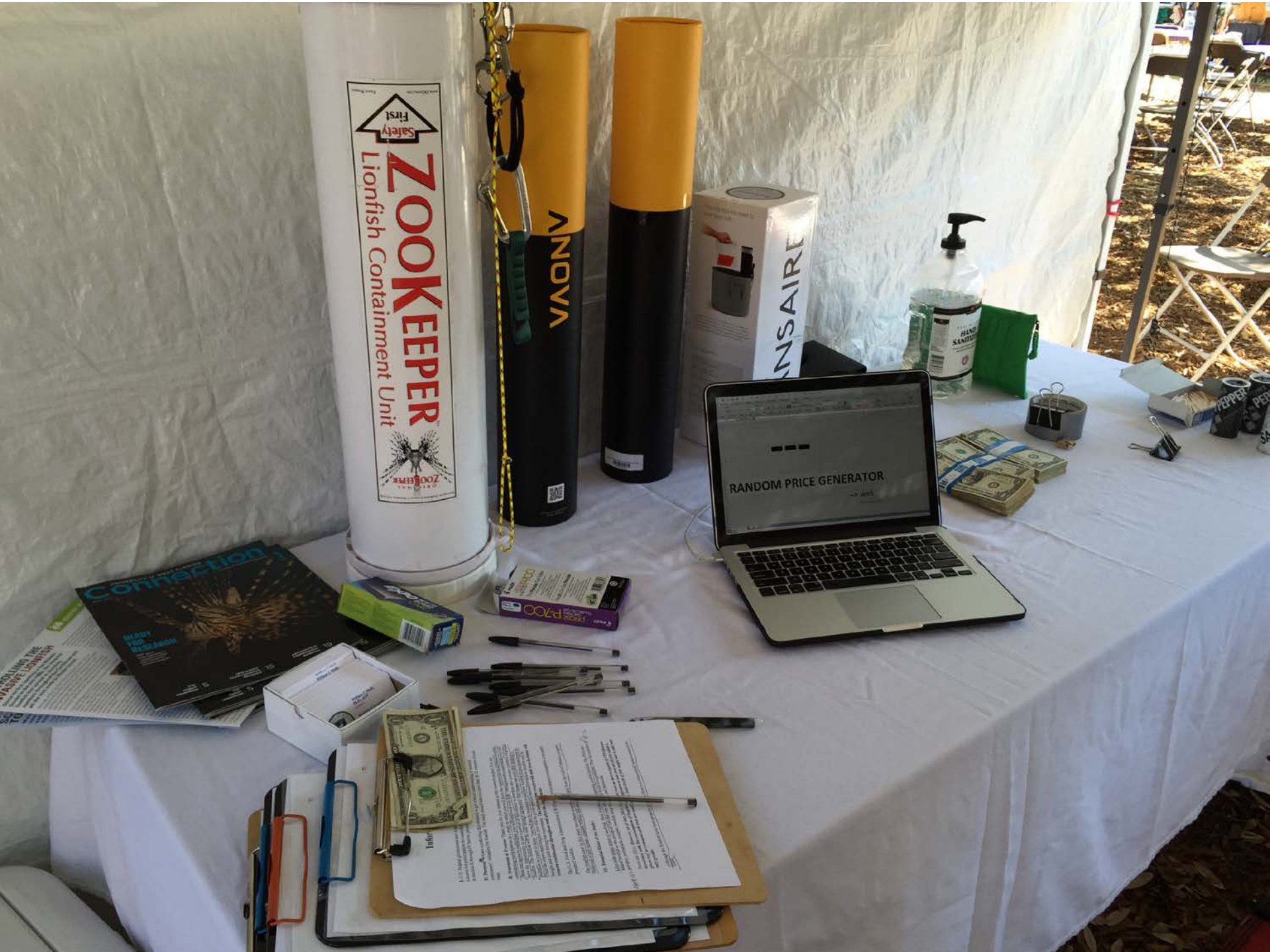
- Established market for lionfish does not currently exist.
- What are consumers willing to pay for lionfish?
- Examine premium when informed that consuming lionfish provides a public benefit
- Severity of threat effects

WTP for Lionfish

- Framed field experiment of seafood consumers
- Pensacola Annual Seafood Festival
- 2 days in September, 2015
- Participants bid on cooked lionfish fillets


ver tasted lionfish!


Ever tasted lionfish?


Safety First
ZOOKEEPER
Lionfish Containment Unit
ANOVA
RANDOM PRICE GENERATOR
Connection

Experimental Protocol

- Potential subjects were approached, briefly informed that the research team was conducting research on lionfish and asked if they would like to participate.
- Informed consent
- Verbal consent

Experimental Protocol

- Subjects handed $10
- Can use all or a portion of the money to try and purchase a three-ounce fillet of lionfish through an auction.
- Instructions

WTP for Lionfish

- 3 treatments:
- All treatments
  - participants were provided with some basic information about lionfish, such as how its taste is similar to other white fish, such as snapper or grouper

1) **Baseline** – No information

WTP for Lionfish

2) Management Treatment - provided information regarding the invasive nature of lionfish and consuming lionfish as a potential management strategy.

- Non-native
- Threatens local ecosystem
- Few known predators
- "Eat lionfish" campaign
  - *Consumption of lionfish indirectly helps manage invasive lionfish populations*

WTP for Lionfish

3) Management-Severe Treatment – As above plus increased real threat of localized extinction of highly valuable commercial species

"If we don't significantly reduce the population of lionfish in the Gulf, their presence could result in localized extinction of species like snapper and grouper."

- PMT

Experimental Protocol

- Becker-Degroot-Marschak (BDM) method
- Bid sheet
- Subjects bid on 3-ounce portion of cooked lionfish (sous vide)
  - cooked to a uniform 135 degrees Fahrenheit (57C) for 30 minutes
- Random price generator
  - $0.10 to $10 in $0.10 increments

Experimental Protocol

- If bid > price
  - purchased the fillet at the drawn price and received any change.
- If bid ≤ price
  - No lionfish, keep $10
- Before bidding, each participant received one of the three potential treatments

Table 1: Average bids by treatment and characteristics of the subject pool

	Baseline	*Management*	*Management-severe*	*Pooled*
Average Bid	6.28 (1.86)	6.99 (2.33)	7.94 (2.00)	7.12 (2.19)
Gender	Male = 56.2% Female = 43.8%	Male = 43.5% Female = 56.5%	Male = 52.3% Female = 47.7%	Male = 50.2% Female = 49.8%
Age	18 – 34 = 37% 35 – 49 = 23.3% 50 – 79 = 39.7% 80 or more = 0	18 – 34 = 17.4% 35 – 49 = 22.8% 50 – 79 = 47.8% 80 or more =1.1%	18 – 34 = 27.3% 35 – 49 = 22.7% 50 – 79 = 50% 80 or more = 0	18 – 34 = 30.4% 35 – 49 = 22.9% 50 – 79 = 46.2% 80 or more = 0.4%
Income	$0 - 50k = 35.6% $51 – 100k = 41.1% $101 – 150k = 12.3% > $150k = 11% Refused = 0	$0 - 50k = 37% $51 – 100k = 27.2% $101 – 150k = 14.1% > $150k = 16.3% Refused = 5.4%	$0 - 50k = 25% $51 – 100k = 43.2% $101 – 150k = 21.6% > $150k = 8% Refused = 2.3%	$0 - 50k = 32.4% $51 – 100k = 36.8% $101 – 150k = 16.2% > $150k = 11.9% Refused = 2.8%
Tasted before?	11.0%	9.8%	10.2%	10.3%
Hunger level (1="full"; 2 = "very hungry")	5.78 (2.15)	5.43 (2.28)	5.60 (2.09)	5.52 (2.16)
n	73	92	88	253

Results

- Average bids per 3oz portion
- **Baseline** = $6.28 for 3oz portion
  - Publix = $5.62 for 3oz portion
- **Management Treatment**
  - premium = $0.71 ($p$ = 0.035)
- **Management-Severe Treatment**
  - Premium over baseline = $1.66 ($p$ = 0.000)
  - Premium over mgt. treatment = $0.94 ($p$ = 0.000)

Table 2: Linear regression results

	Y = Bid
Constant	4.827***
	(0.488)
Management	0.654**
	(0.327)
Management-severe	1.570***
	(0.309)
Male	-0.107
	(0.265)
Age	0.143
	(0.112)
Income	0.188**
	(0.075)
Tasted before?	-0.643*
	(0.350)
Hunger level	0.091
	(0.061)
n	253
r-squared	0.148
F	8.28***

Notes: robust standard errors are in parentheses and *,**,*** indicate significance at the 10%, 5% and 1% levels respectively.

Conditional Results

- Consumers will pay premium for public good attributes of otherwise private good
- Significant premium exists for an *indirect* management strategy of population control through consumption
- Increasing the threat severity further raises premium
- Naïve consumers are willing to pay about $0.64 more to try lionfish compared to experienced consumers

Policy

- “Eat Lionfish” campaign is one management method that has the potential to mitigate lionfish population growth
- Cost per 3 oz fillet = $6.50
- WTP = $6.28 - $7.94
- Potential for viable commercial lionfish fishery?

The Next Step?

- Demand-side effort
- Measuring WTP across states
  - Food truck
  - Restaurants
- Supply-side effort
  - More cost-effective methods of harvesting?
  - Lobster traps (Key West)