Invasive Lionfish

Alex K. Bogdanoff

Marine Ecologist, NOAA National Ocean Service Affiliate

Ph.D. student, North Carolina State University

Photo by Rich Carey

Feeding Ecology

Feeding Ecology

<u>Regional Characteristics</u>

1) General opportunistic carnivores the consume at least 167 species across multiple trophic guilds

2) Dominated by carnivorous fish and shrimp that are not managed, at risk of extinction, or threatened fishery species

3) Size significantly influences diet composition

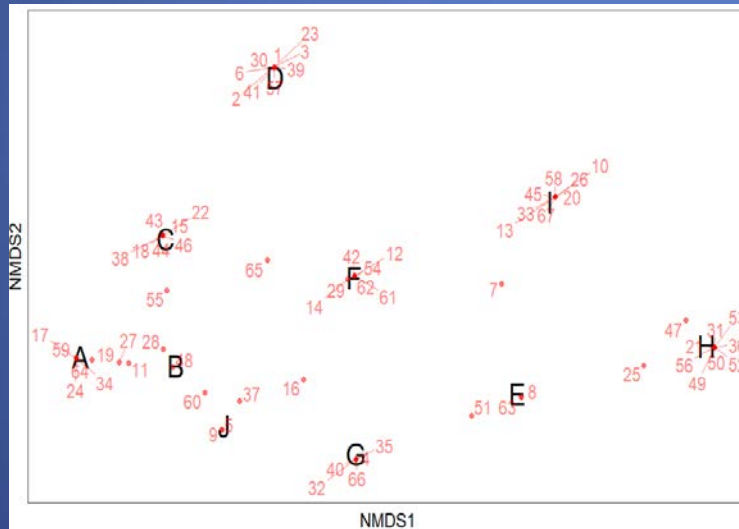4) Provide a model for prey biomass consumption from length-frequency data
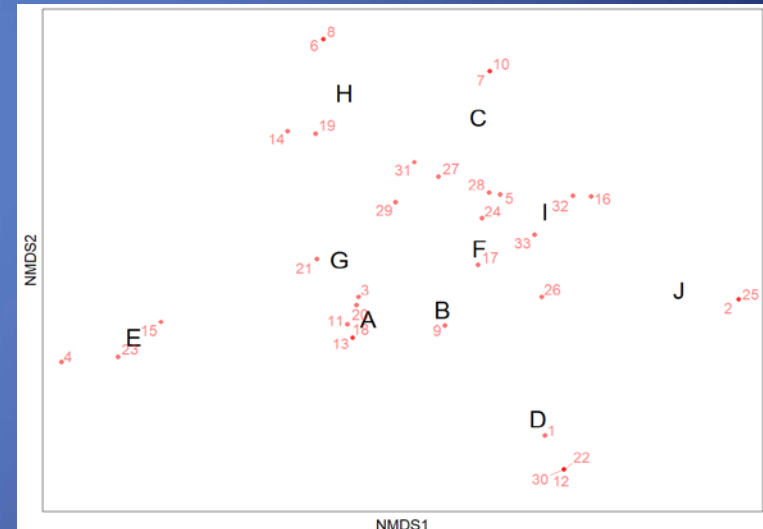

$y = 0.0002x^{1.6391}$
$R^2 = 0.9485$
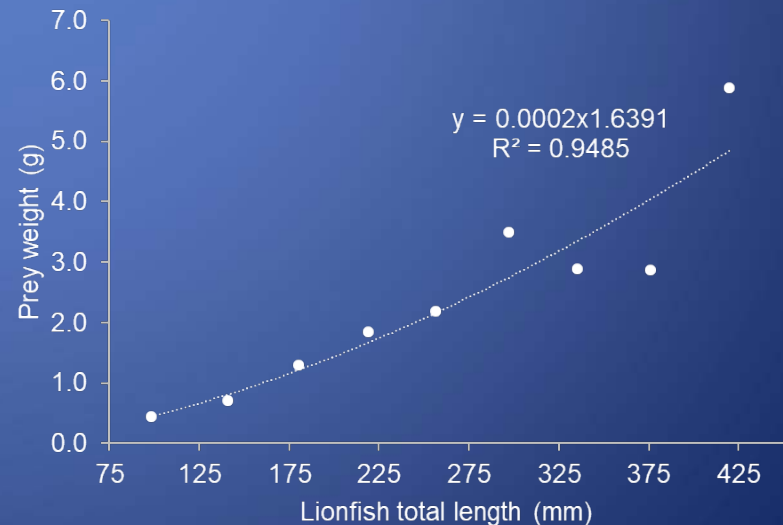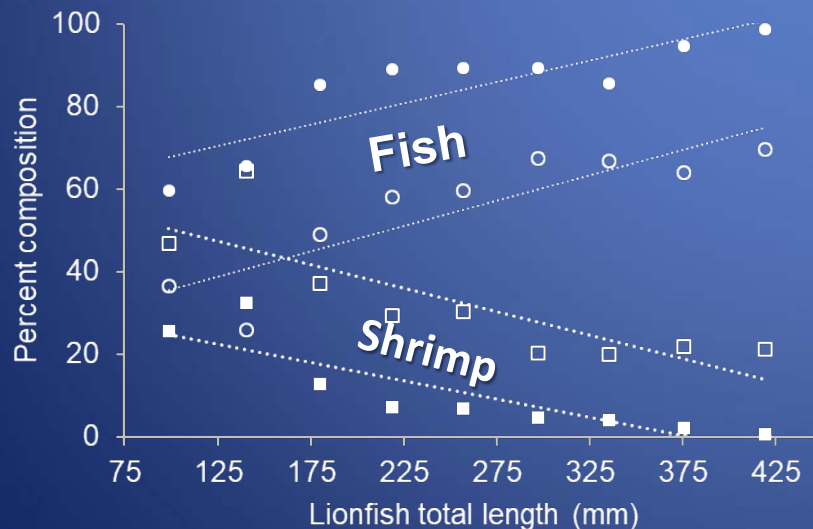
Feeding Ecology

Locational Comparisons

1) Diet varies significantly among locations

A) Bahamas
B) Belize
C) Bermuda
D) Costa Rica
E) Florida
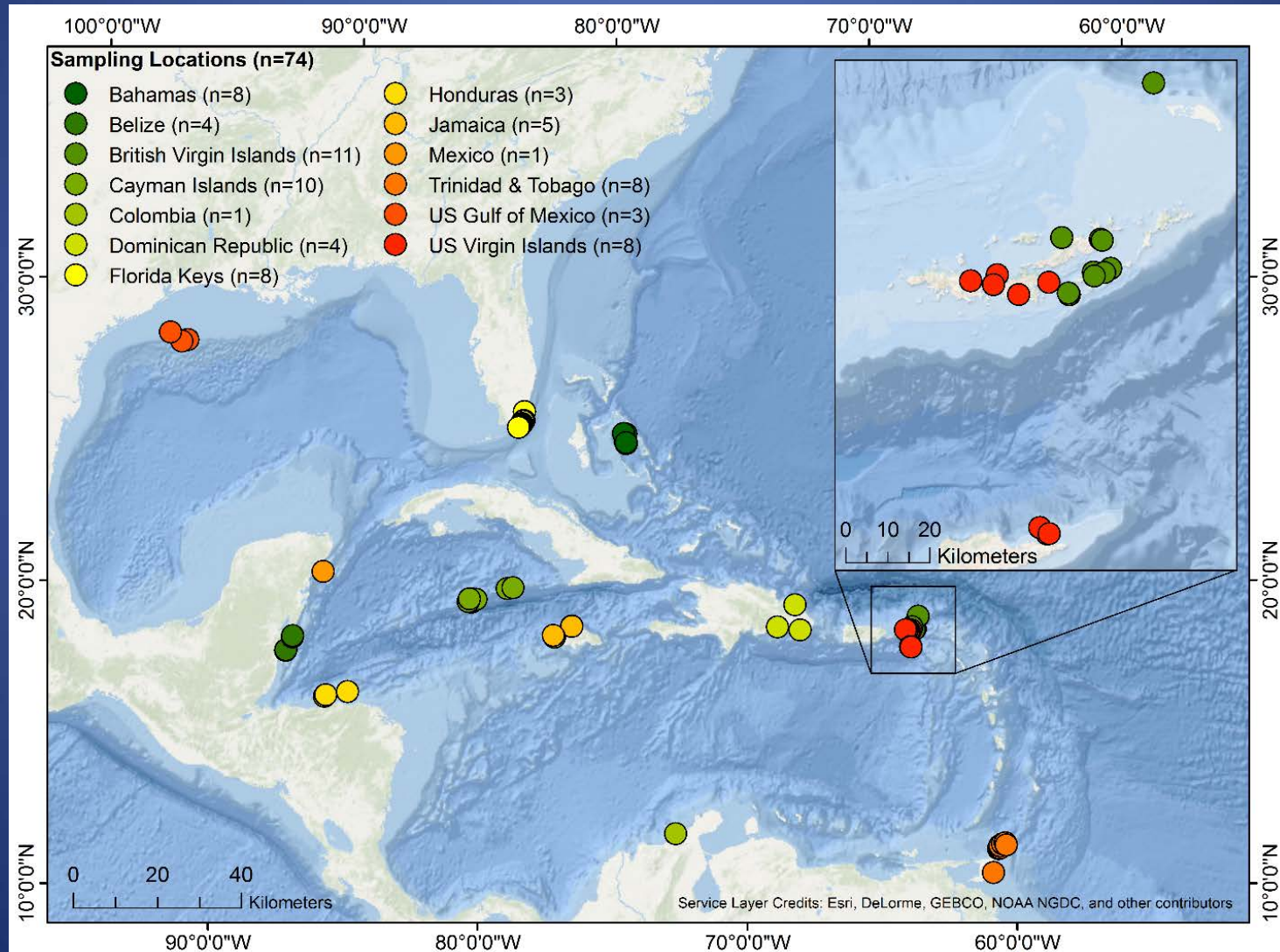F) nwGoM
G) Mexico
H) N. Carolina
I) neGoM
J) USVI

Species

Family

Ciguatera

Ciguatera

Location	Analyzed	RBA$_F$	CBA-N2a	LC-MS/MS
Bahamas	15	0	0	0
Belize	15	3	0	0
British Virgin Islands	15	9	8	6
Cayman Islands	15	0	0	0
Colombia	15	0	0	0
Dominican Republic	15	2	0	0
Florida Keys	20	5	1	1
Gulf of Mexico	33	0	0	0
Honduras	15	1	0	0
Jamaica	29	1	0	0
Mexico	15	1	0	0
Trinidad and Tobago	76	6	0	0
US Virgin Islands	15	2	0	0
Total survey	293	30	9	7 (2)

1) RBA$_f$ valuable rapid screening tool

2) Risk appears low, but is location dependent

3) Risk compared to other species also appears relatively low

Aggregation Structures

North Carolina
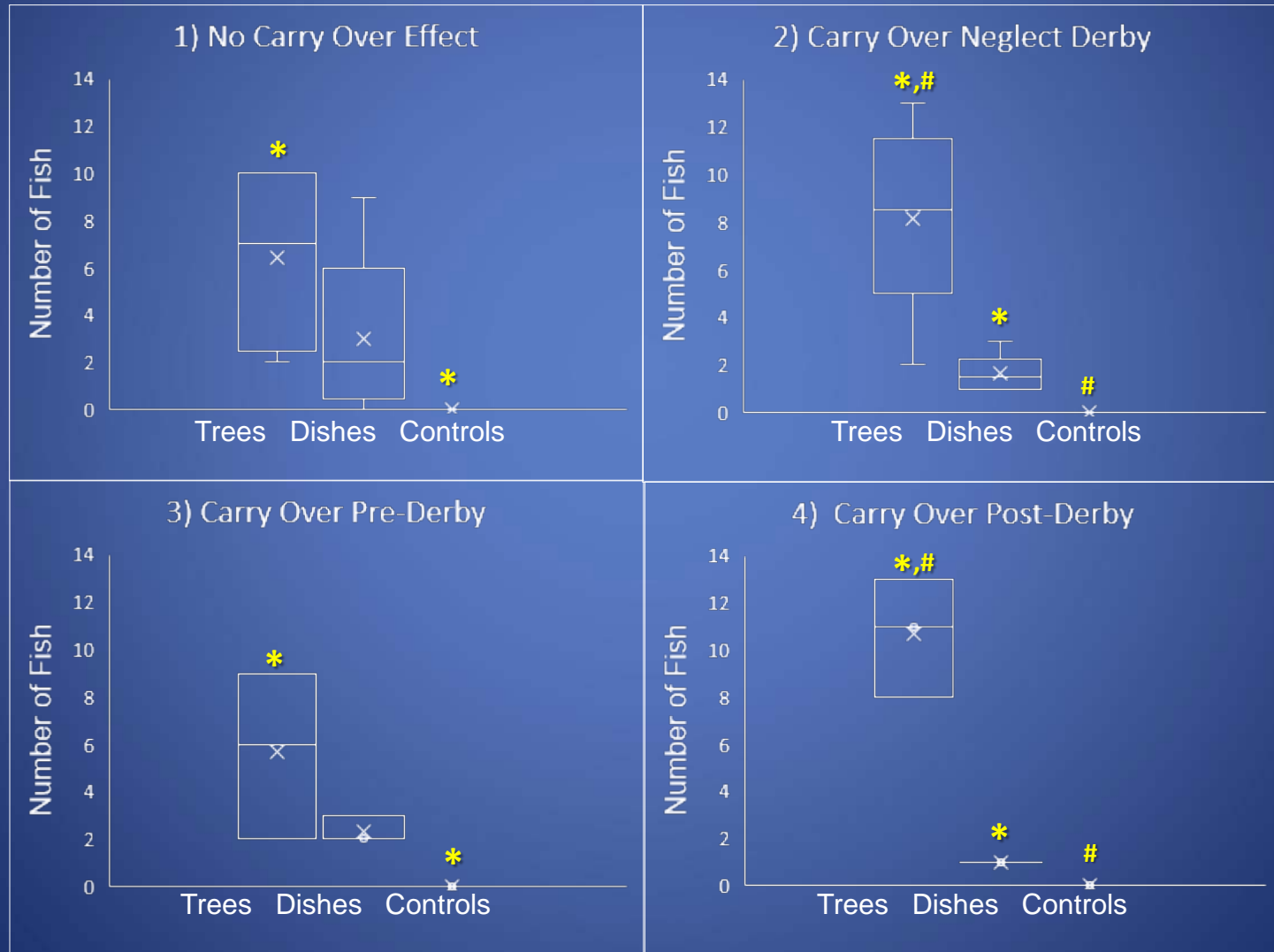- Deep temperate hard-bottom reef
- 7 replicates + 3 controls
- 5 months
- Monthly removals from devices
- Summary measures with ANOVA

The Bahamas
- Shallow tropical artificial reef
- 16 replicates + 5 controls
- 6 months
- Lionfish derby half way through
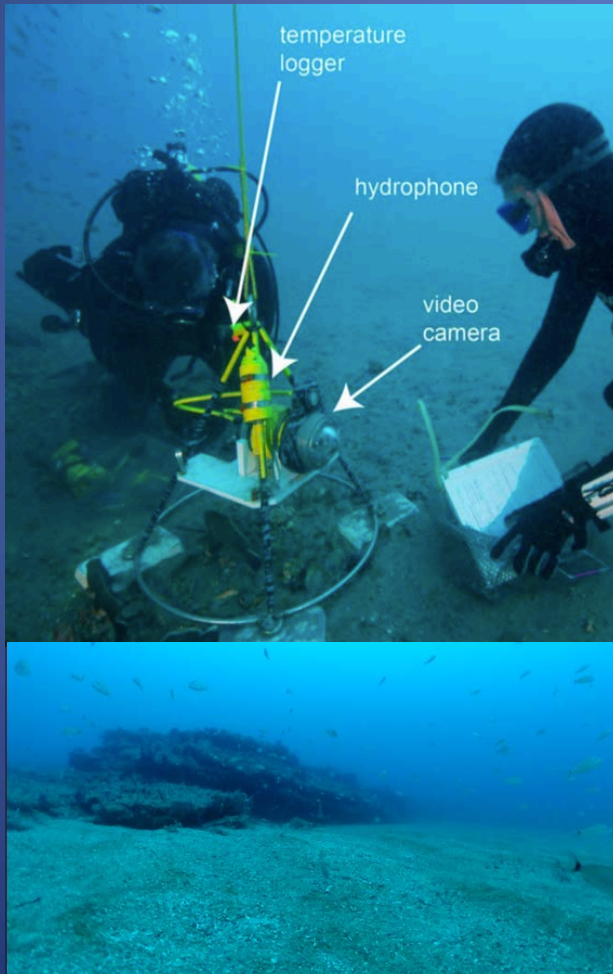- Summary measures with ANOVA

Aggregation Structures
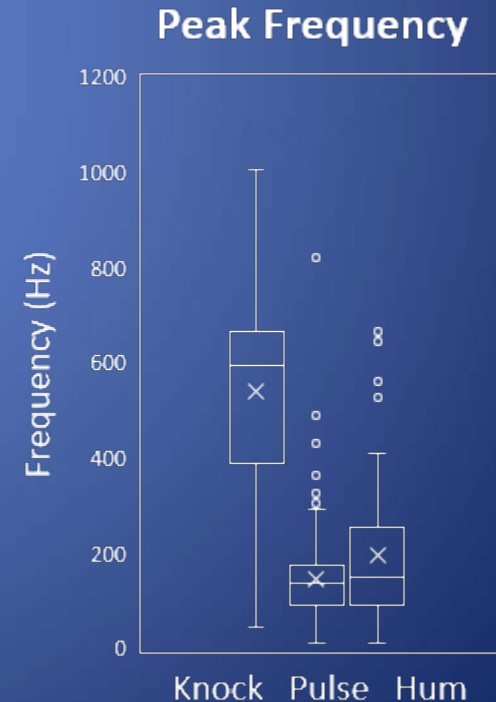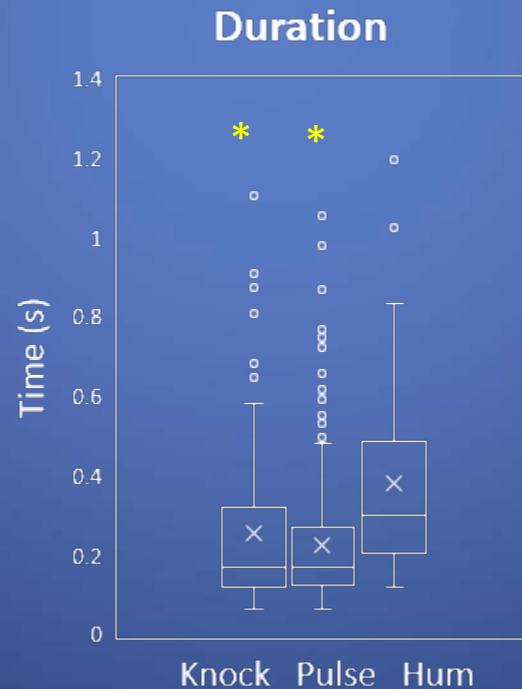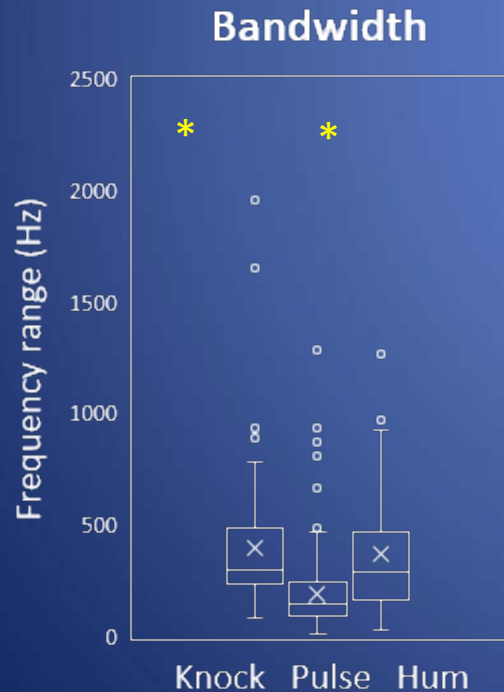
Sounds & Passive Acoustics

In Situ Descriptions

Tank Descriptions

Sounds & Passive Acoustics

In Situ Descriptions

1) In situ vocalizations can be identified, isolated, and processed

2) In situ vocalization rate = 15 calls per minute

3) Three distinct call types identified/confirmed

Sounds & Passive Acoustics

Tank Descriptions

1) Describe general call characteristics & diel patterns

2) Provide a model for estimating abundance from sounds
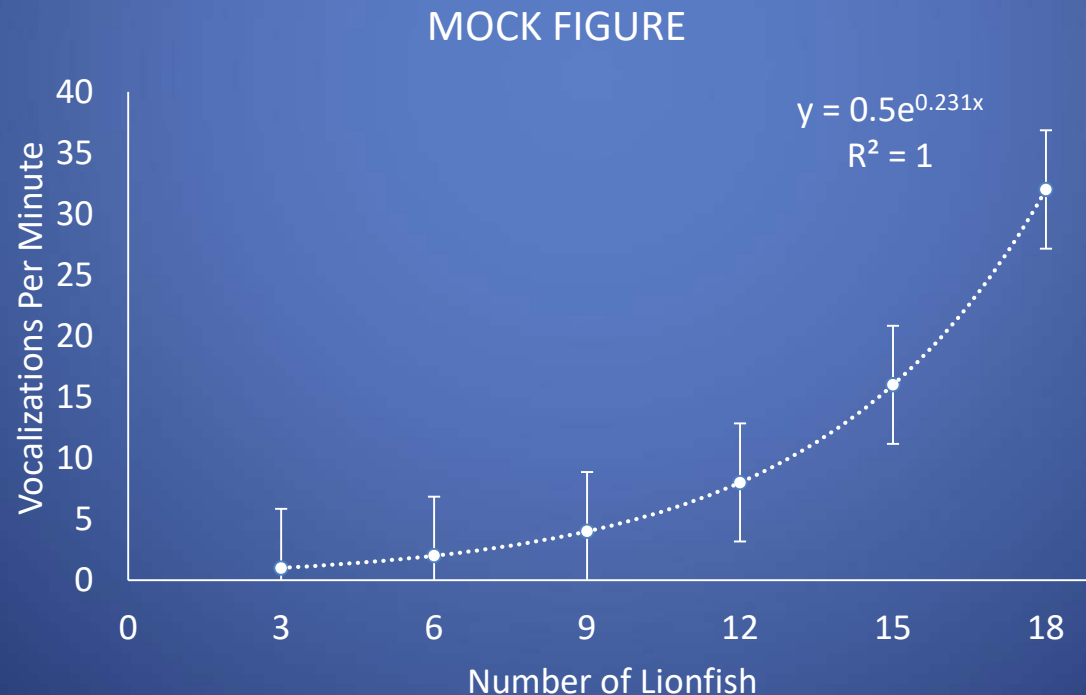
MOCK FIGURE

$y = 0.5e^{0.231x}$

$R^2 = 1$

Y-axis: Vocalizations Per Minute

X-axis: Number of Lionfish

Population Modeling

Belize National Lionfish Management Strategy

Population Modeling

Belize National Lionfish Management Strategy

Population Modeling

A generalized population model for management

```
60
61 -  #################################################################################
62
63    #Choose Growth Characteristics
64    Area="Bel"  #Options have been given so a wider range of scenarios can be modeled. The lo
65    if (Area == "Bel")
66 - {
67      Linf=441.5  #Asymptotic length from North Carolina length-at-age data
68      K=0.45       #Growth coefficient from North Carolina length-at-age data
69      a0=-0.31      #Theoretical age at size 0 from North Carolina length-at-age data
70      a=0.000007   #Length-weight coefficient estimated for lionfish in Belize in this study
71      b=3.11       #Length-weight exponent estimated for lionfish in Belize in this study
72    } else if (Area == "NC")
73 - {
74      Linf=441.5  #Asymptotic length in mm
75      K=0.45       #Growth coefficient
76      a0=-0.31     #Theoretical age at size 0
77      a=7.97e-6    #Length-weight coefficient
78      b=3.12       #Length-weight exponent
79    } else if (Area == "CI")
80 - {
81      Linf=349.0  #Asymptotic length in mm
82      K=0.42  #Growth coefficient
83      a0=-1.01  #Theoretical age at size 0
84      a=0.000003  #Length-weight coefficient
85      b=3.24  #Length-weight exponent
86    } else if (Area == "Mex")
87 - {
88      Linf=420.0  #Asymptotic length in mm
89      K=0.88  #Growth coefficient
90      a0=-0.107 #Theoretical age at size 0
91      a=0.000005  #Length-weight coefficient
92      b=3.33  #Length-weight exponent
93    } else
94 - {
95      print ("Error: Area not specified correctly.")
96    }
97
```
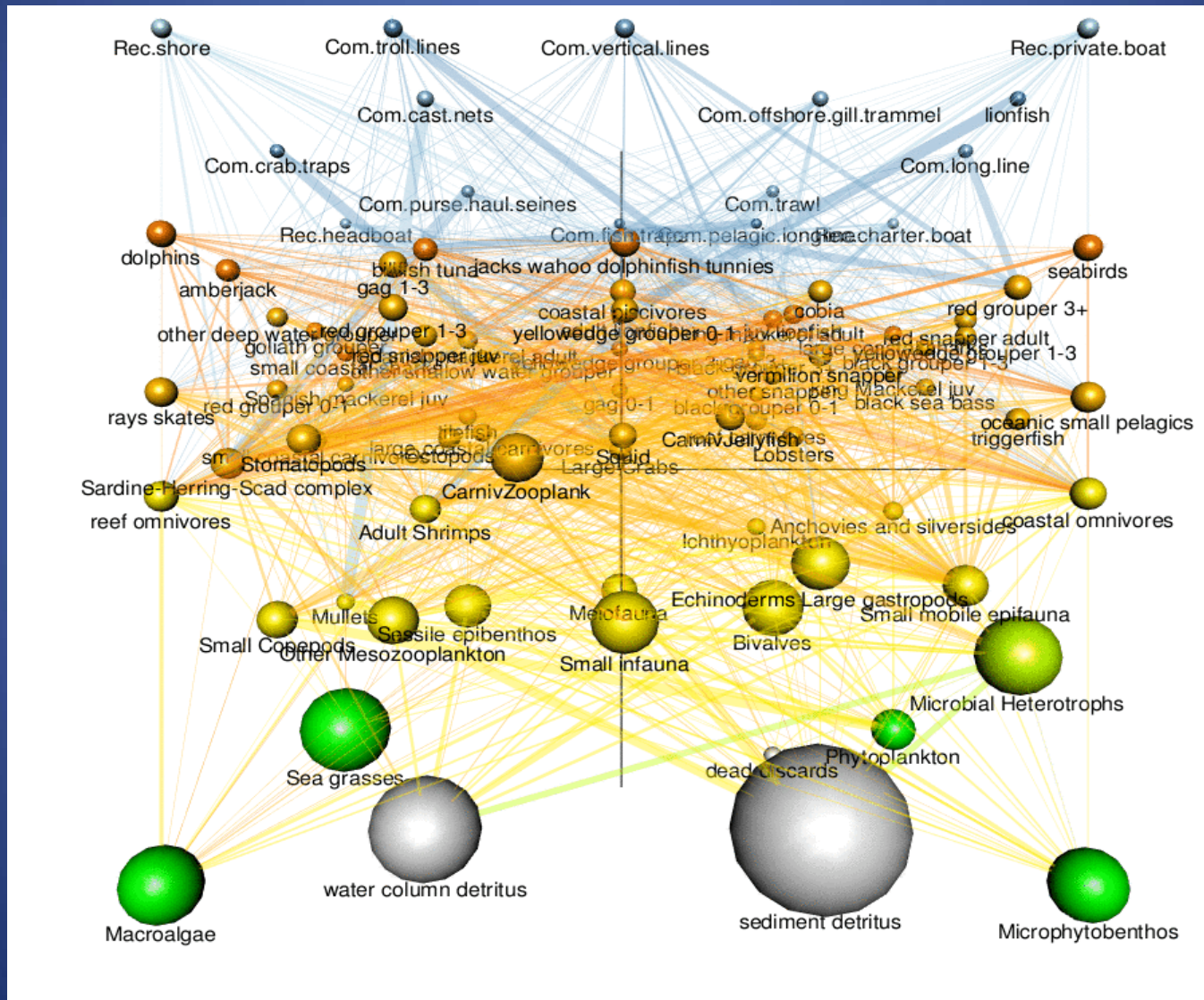
Provide options/ranges for
- Age-structure
- Sex structure
- Growth
- Mortality
- Initial abundance
- Length-weight relationship
- Selectivity

Ecosystem-Based Modeling

Ecosystem-Based Modeling

Model Projections

1) Strong positive and negative effects through trophic cascades, competitive release, and predation release

2) Small increases in lionfish harvest can translate to large reductions in biomass

3) Reducing reef fish harvest may help reduce lionfish biomass (opposite true)

Questions?
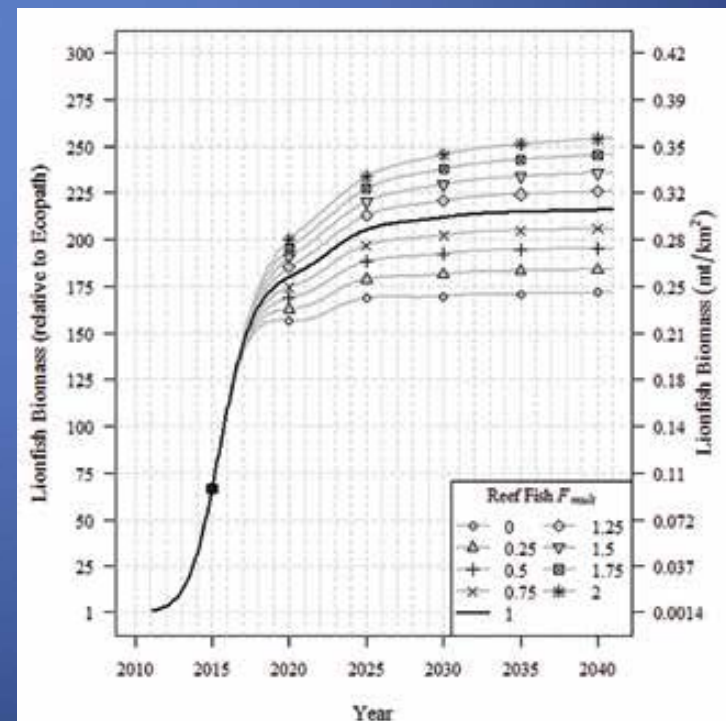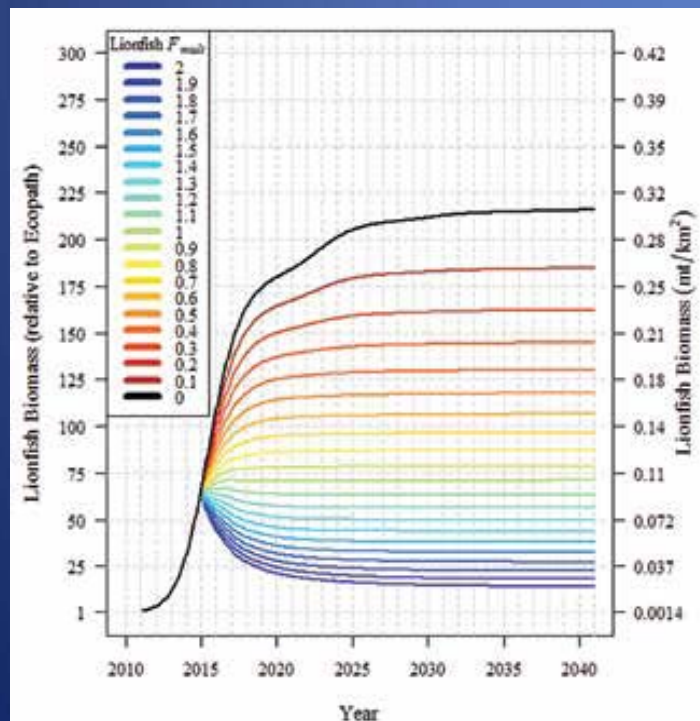
The Invasive Lionfish Web Portal at lionfish.gcfi.org