MANAGEMENT OF THE INVASIVE INDO-PACIFIC LIONFISH IN BISCAYNE NATIONAL PARK

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The Ultimate Invader

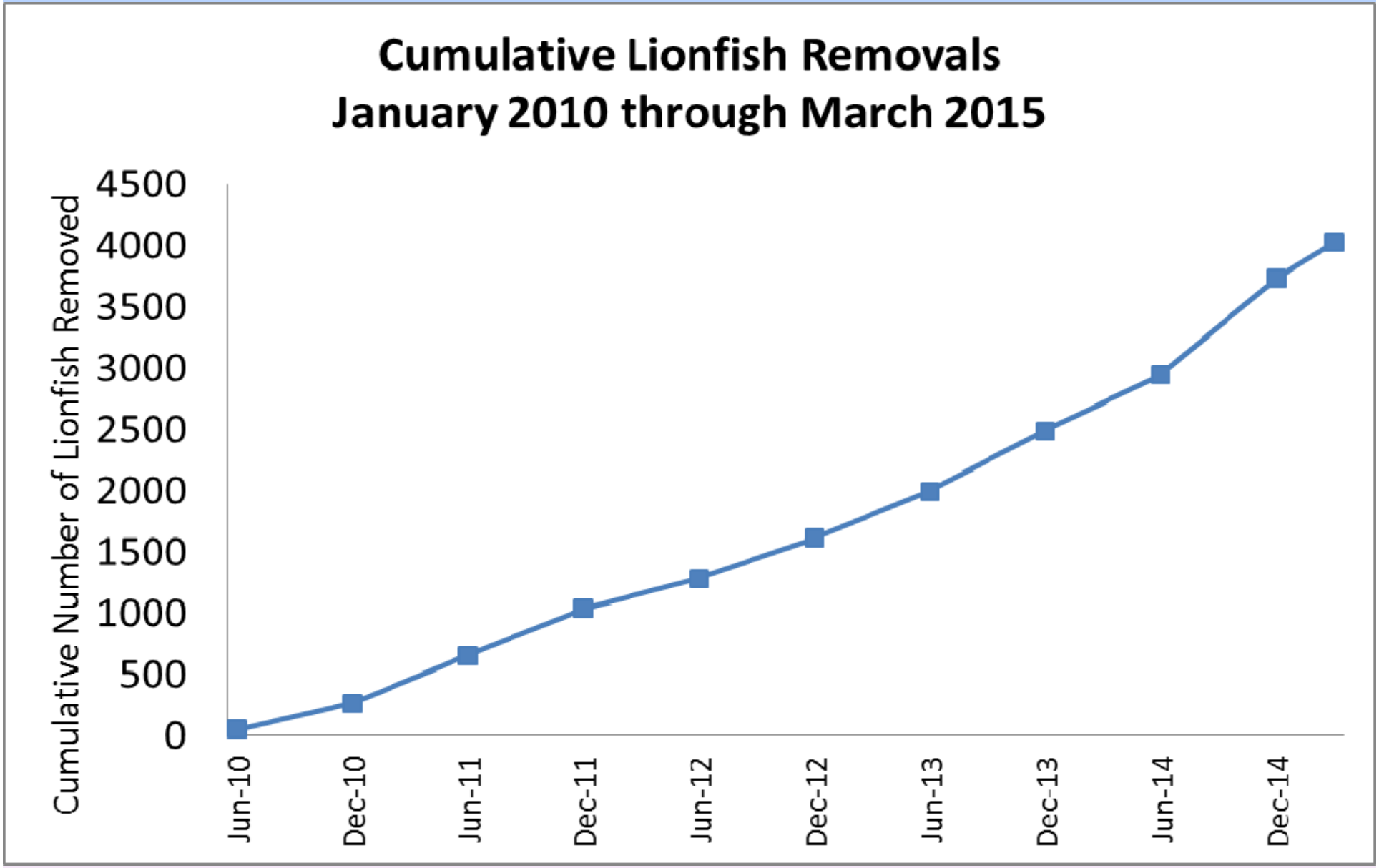
Popular in the aquarium trade

What it eats: Anything and everything
What eats it: Very few large fish (groupers, sharks)

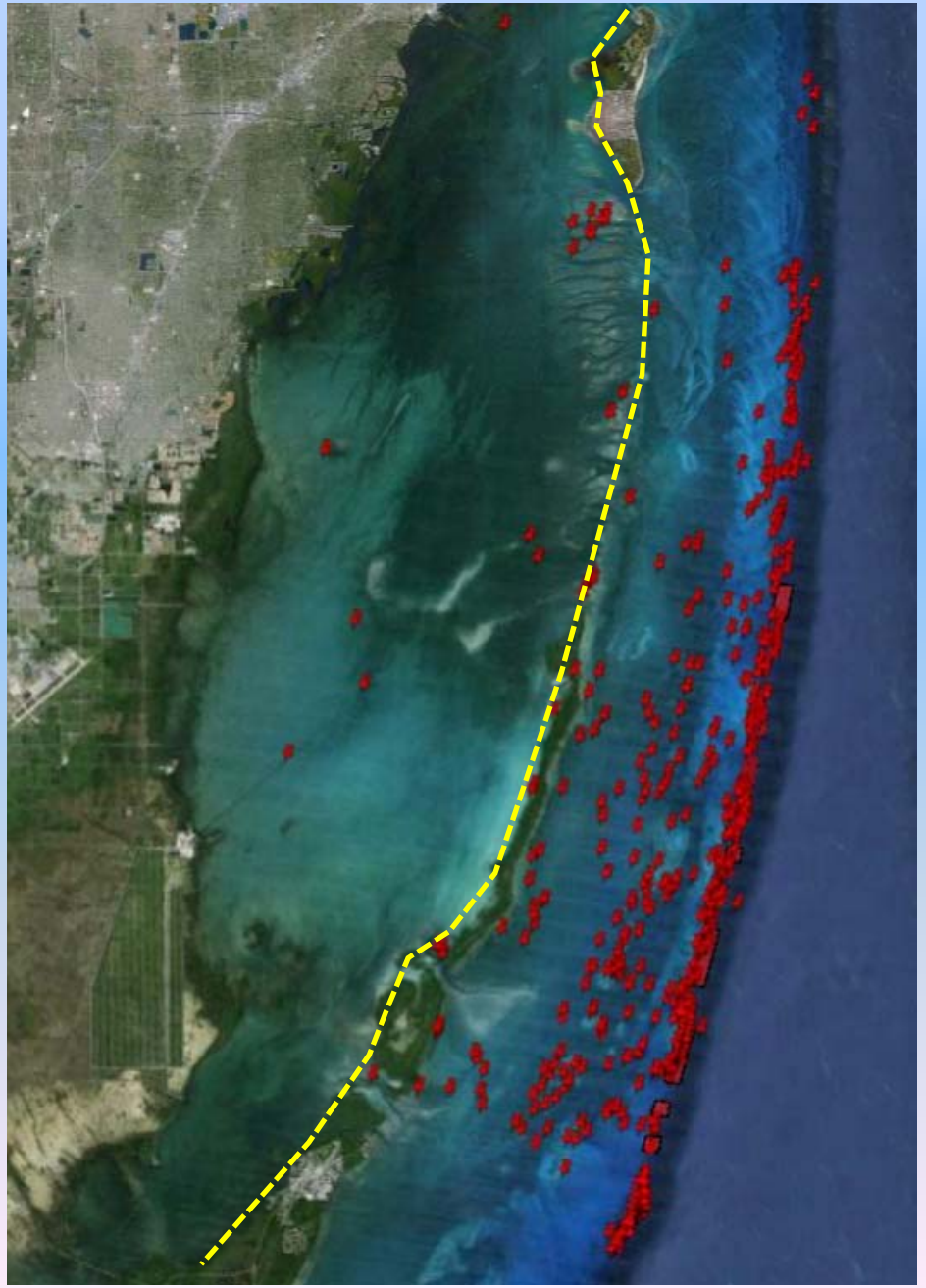
Self-defense: Armed with venomous spines in dorsal, pelvic and anal fins
Reproduction: Can spawn as frequently as every 4 days starting at ~ 1 year old

65 fish,
1 shrimp

Tracking the Invasion in Biscayne National Park



Lionfish are less common in the Bay



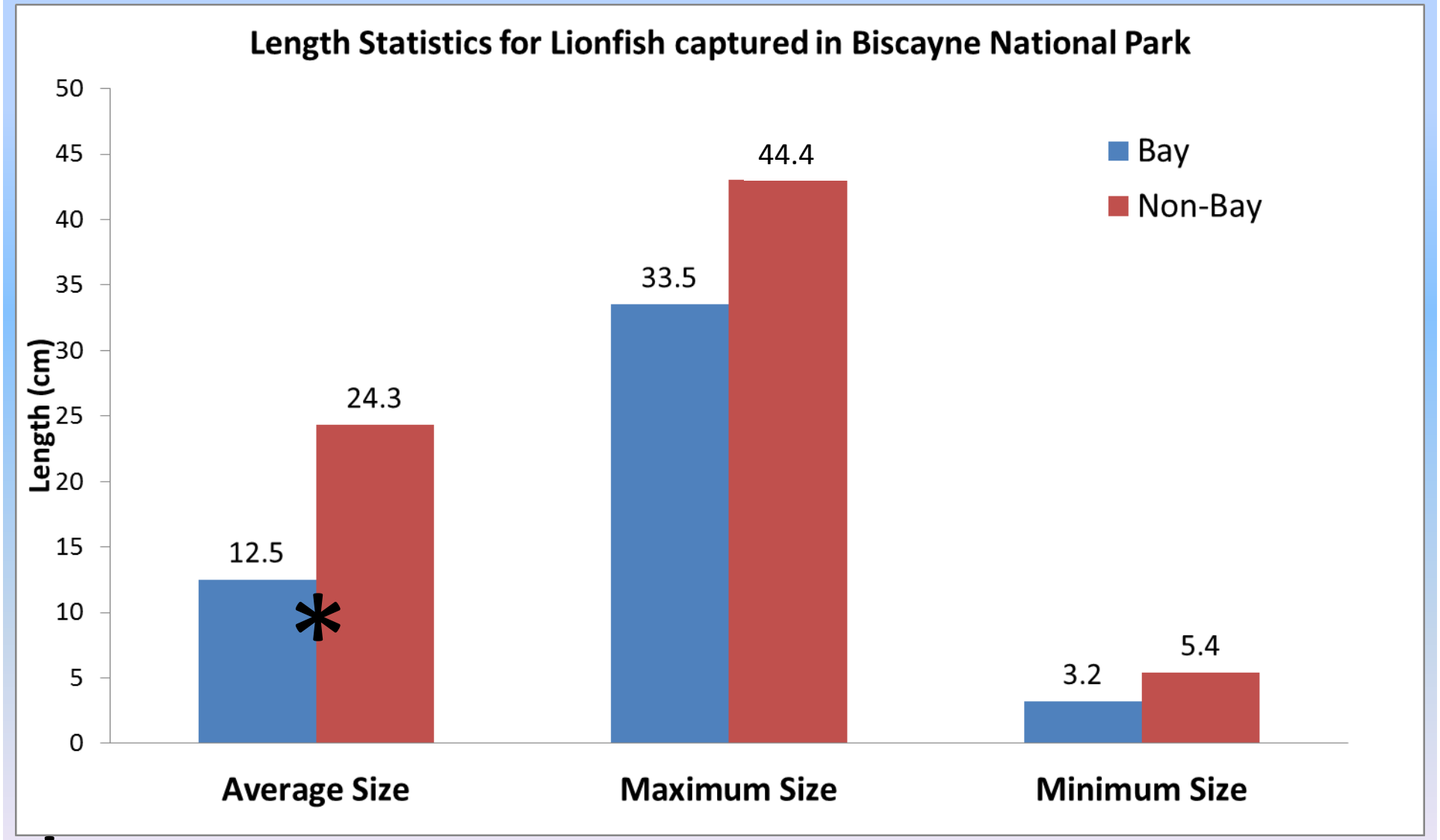
Lionfish captured in the bay

N = 680

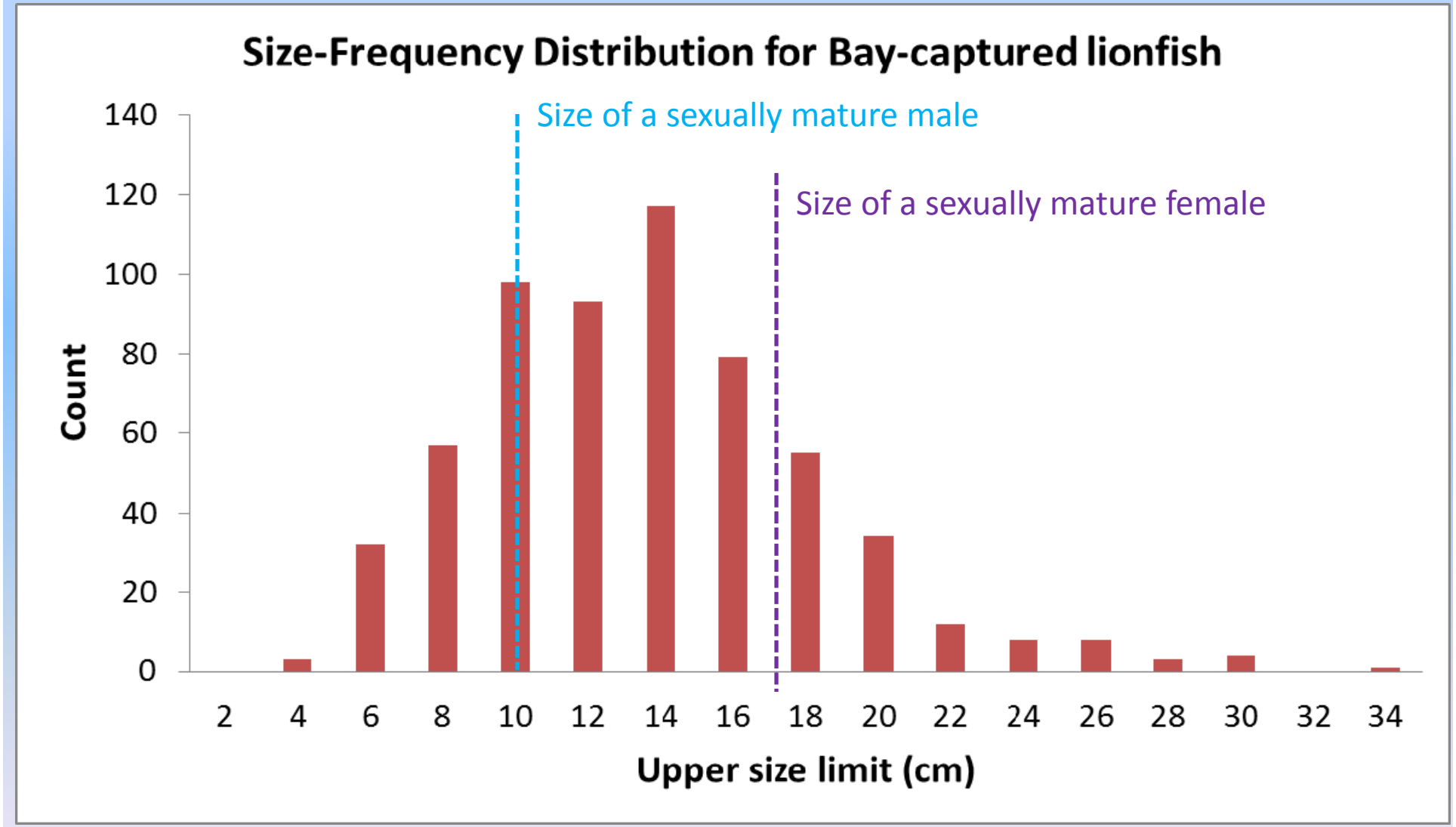
Lionfish captured beyond the bay

N = 3393

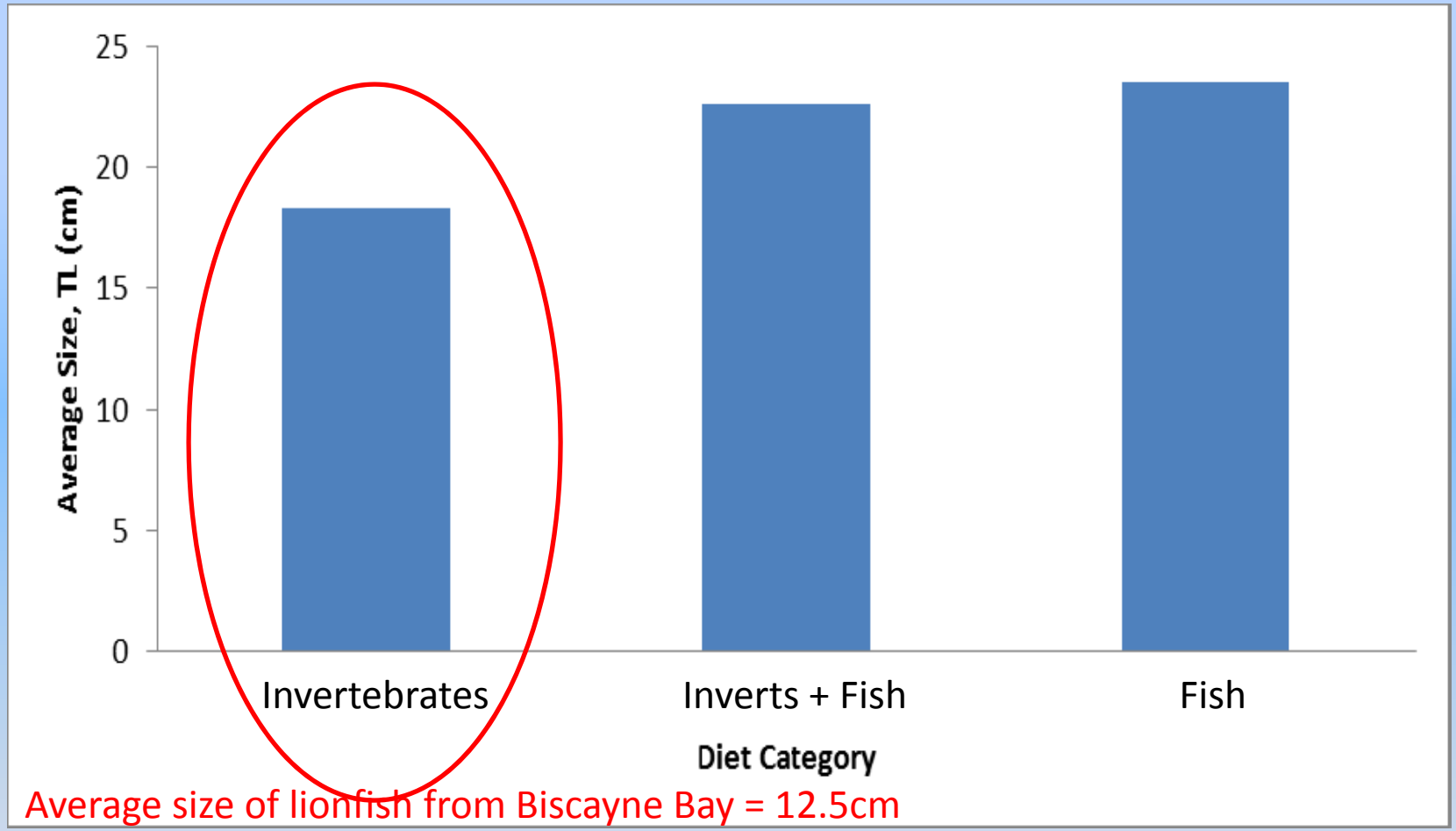
Size Differences by Habitat: Bay vs. non-Bay



* Lionfish from the bay are significantly ($p < 0.001$) smaller than lionfish from outside the bay


Size-Frequency Distribution for Bay-captured lionfish
Size of a sexually mature male
Size of a sexually mature female
Count
140
120
100
80
60
40
20
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
Upper size limit (cm)

Dietary Patterns



Average size of lionfish from Biscayne Bay = 12.5cm

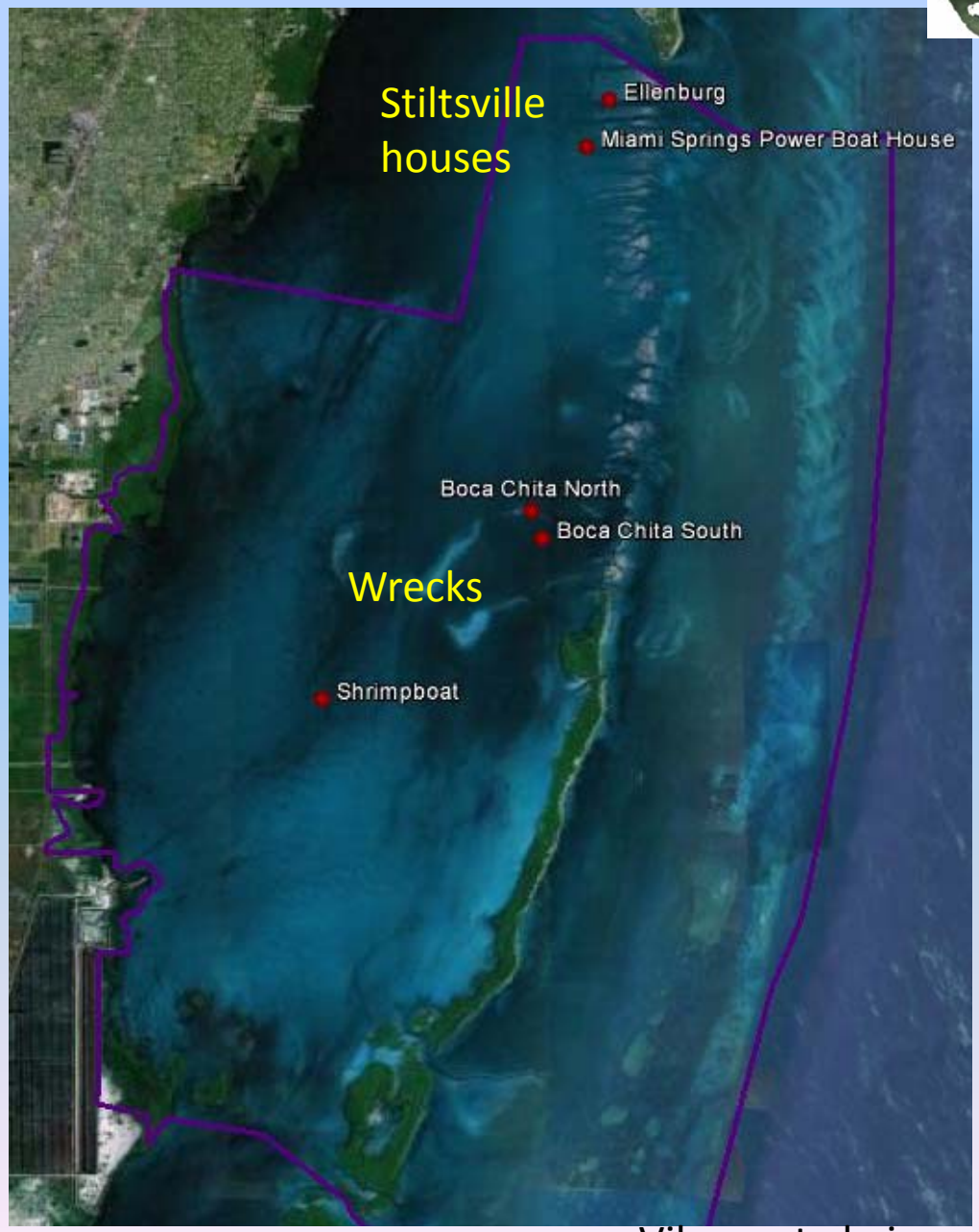
Kruskal-Wallis test:
Test statistic H= 95.284
$p < 0.001$ df = 2

Dwass-Steel-Chritchlow-Fligner Test for All Pairwise Comparisons:
all pairs are significantly different

Lionfish Recolonization Study

Research Questions:

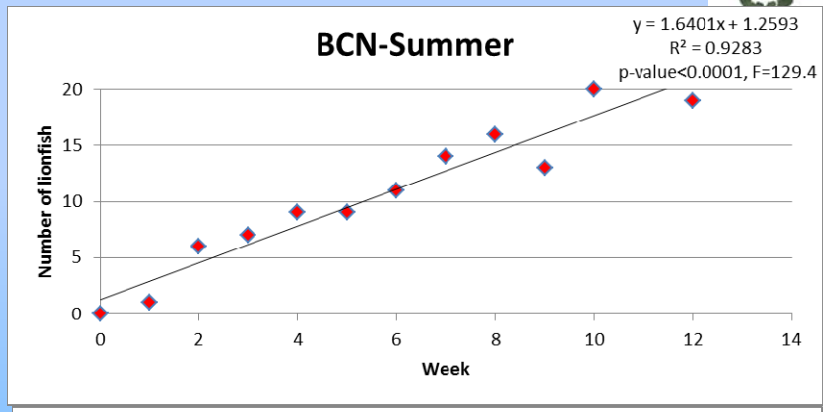
- How quickly do lionfish recolonize after removal?
- Does recolonization rate vary based on location of site and/or season?
- **Management Application**:
  How often is removal needed to keep a site free of lionfish?

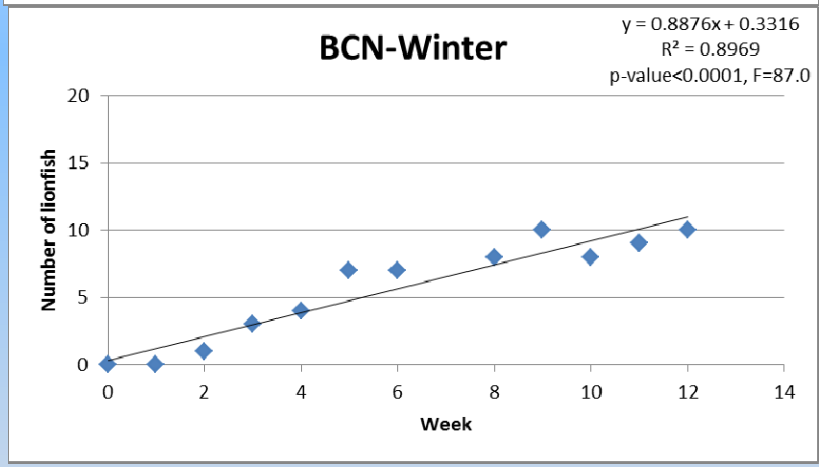


Vilmar et al., in prep

Recolonization Results

SITE	Summer recolonization rate (# LF per week)	Winter recolonization rate (#LF per week)
Shrimpboat (wreck)	0.38	0.04
Boca Chita South (wreck)	0.55	0.64
Boca Chita North (wreck)	1.64	0.89
Miami Springs Power Boat House (stilted house)	0.13	0.05
Ellenburg House (stilted house)	0.37	0.20





Among Sites

Summer: BCN significantly greater than all other sites

Winter: BCN & BCS > SB & Stiltsville sites

Between Seasons

Summer > Winter only at Shrimpboat

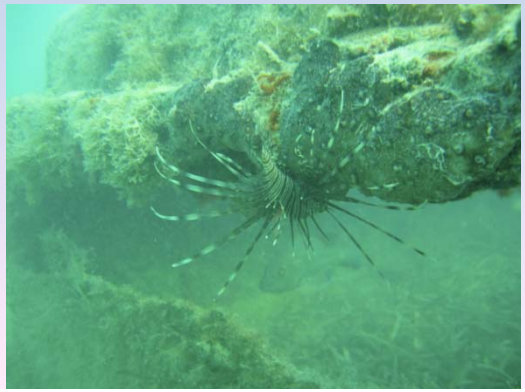
- Recruitment higher in spring-summer (D'Alessandro et al. 2007; Robertson 1990)
- But lionfish spawn year-round (Morris et al. 2011)

Management Applications

- Determine what is the minimal number of lionfish at a site to make a removal visit to that site worthwhile (we chose 3)
- Use regression equations to compute the visitation rate needed based on that determination
  - Can compute return frequency (# weeks) for each site/season individually

SITE	Summer	Winter
Shrimpboat (wreck)	8	>12
Boca Chita South (wreck)	7	8
Boca Chita North (wreck)	3	5
Miami Springs Power Boat House (stilted house)	>12	>12
Ellenburg House (stilted house)	6	>12
Stiltsville (as one site)	10	10

  - Quick and dirty average across all sites and seasons:
    - every 6 weeks (about 2 days of effort) to maintain minimal lionfish presence



Conclusions

- The Bay serves as habitat for smaller, younger lionfish
- Most lionfish captured in Biscayne Bay are associated with some sort of artificial or rocky structure
- Lionfish in the bay are primarily feeding upon invertebrates
- Lionfish “hotspots” in the Bay should be visited every 6 weeks for routine lionfish removals

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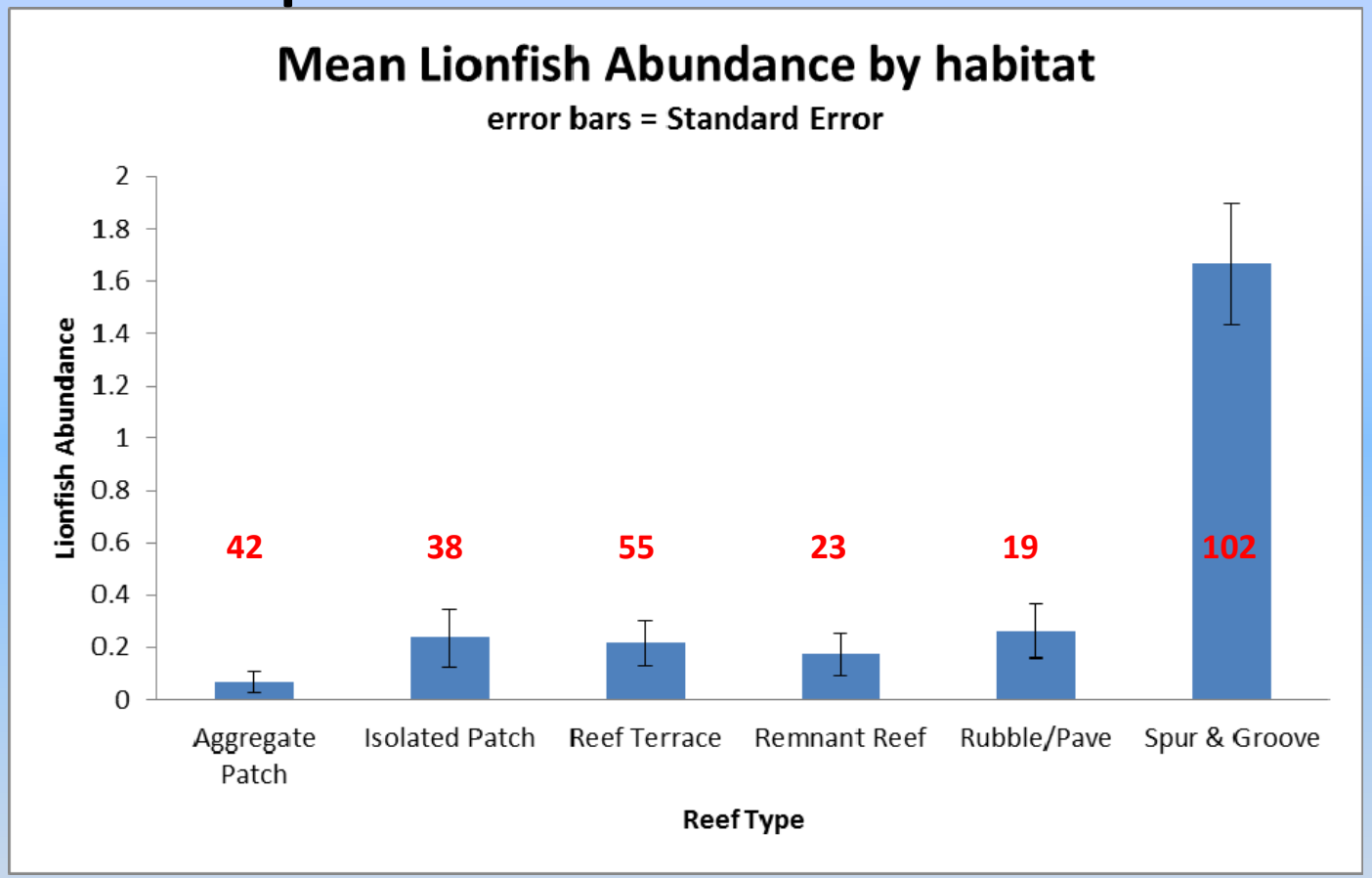
Can Lionfish distributions or sizes be explained by habitat characteristics?

- Used ArcGIS to select 300 random coral habitat points
- Each point was categorized into a rough coral habitat classification (e.g. spur and groove, or reef terrace)
- Data collected at each site:
  - rugosity
  - temperature
  - max depth
  - lionfish abundance
  - Lionfish size and mass (for those that were removed)

Reef-specific Habitat Associations



Kruskal Wallis test:
Test statistic H= 160.635 $p < 0.001$ df = 5

Dwass-Steel-Chritchlow-Fligner Test for All Pairwise Comparisons
All pairs significantly different *except*:
1) Aggregate Patch & Isolated Patch 2) Remnant Reef & Rubble/Pave

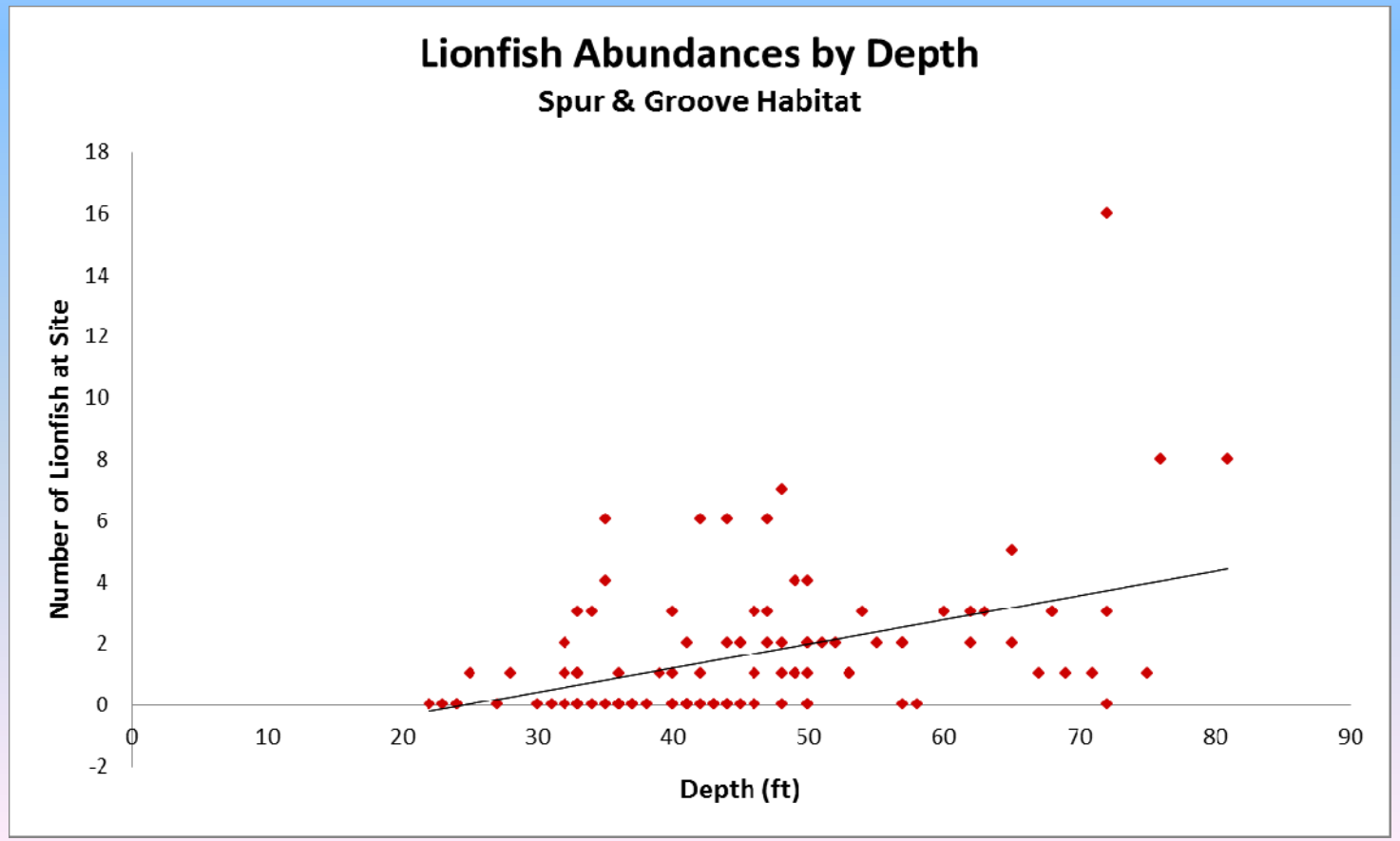
Do specific habitat features influence lionfish abundance?

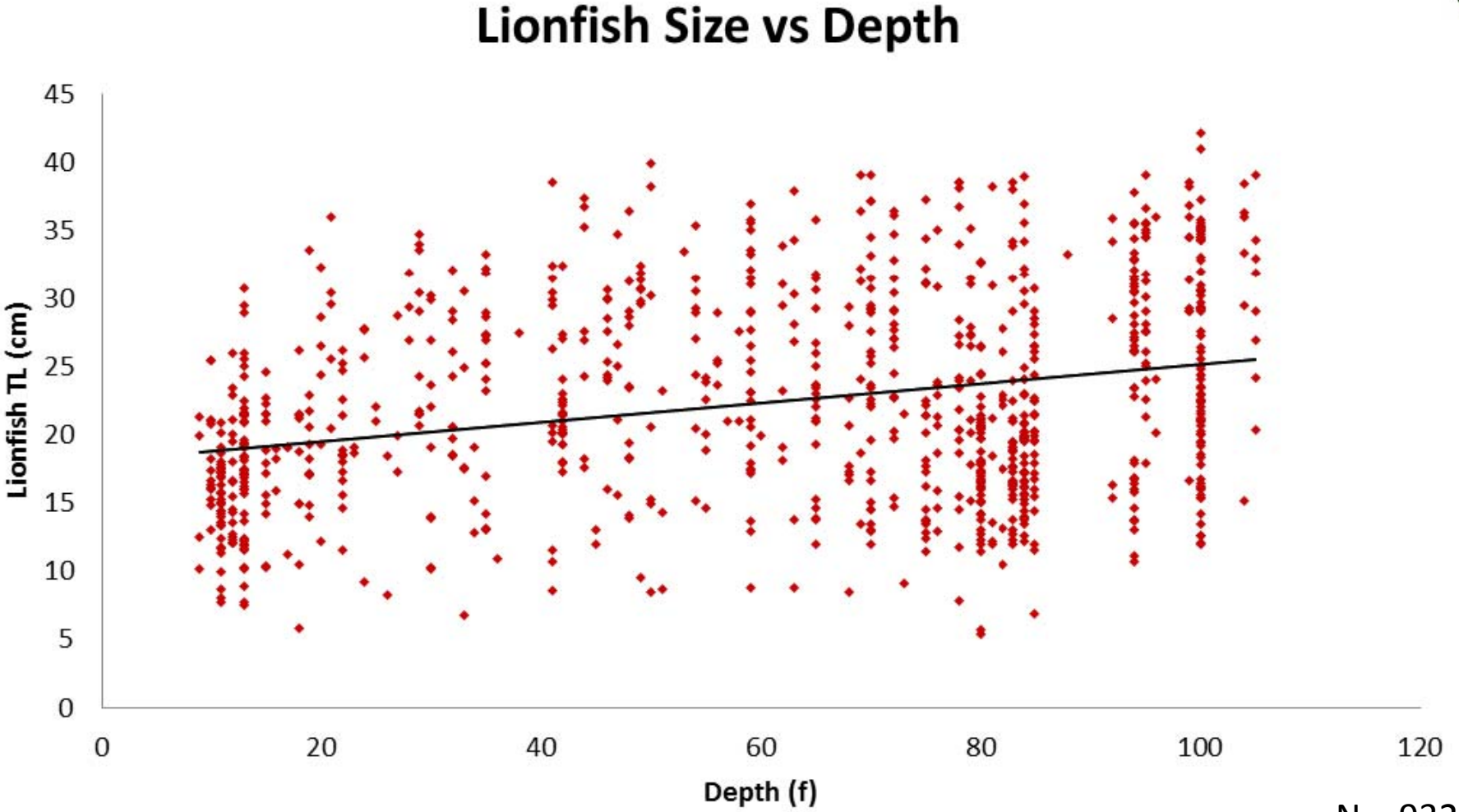
Examined the influences of depth, rugosity, temperature & year on lionfish abundances at each site, **using only spur-and-groove sites.**

Stepwise Backward regression performed on log-transformed lionfish abundances. Only depth was determined to be significant.

ANOVA : N = 102 df = 1 F = 8.014 p = 0.006

R^2 = 0.074 (Compare to initial value of 0.104 with all 4 variables included in model)





Regression:

ANOVA : N = 932 df = 1 F = 75.64 $p < 0.0001$

$R^2 = 0.0752$