



**Resistance is Futile!**



**Resistance is Futile!**  
Or is it?

# Lionfish 101

*Pterois volitans/miles*

Scorpaenidae (scorpionfish)

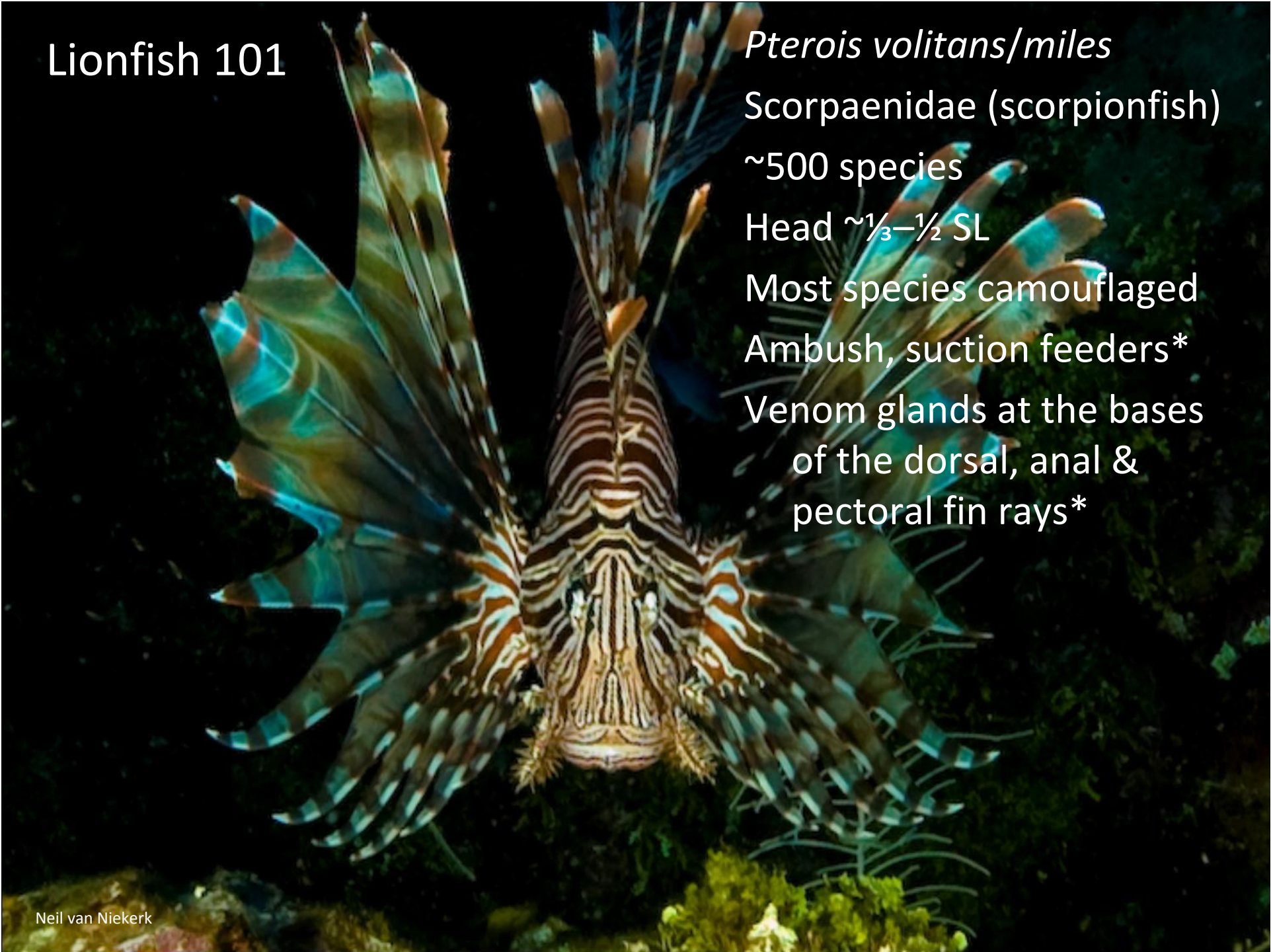
~500 species

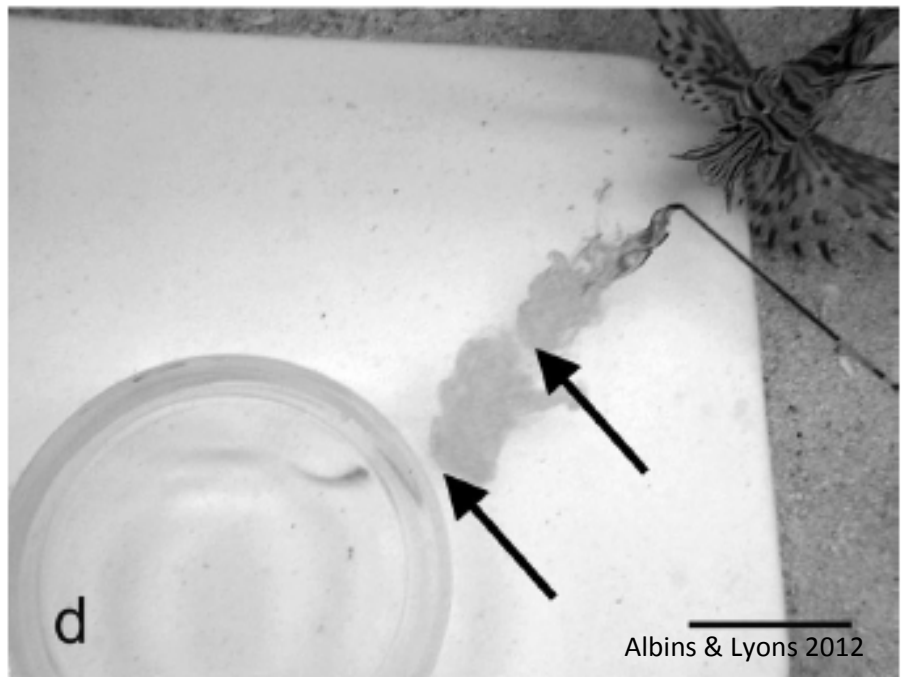
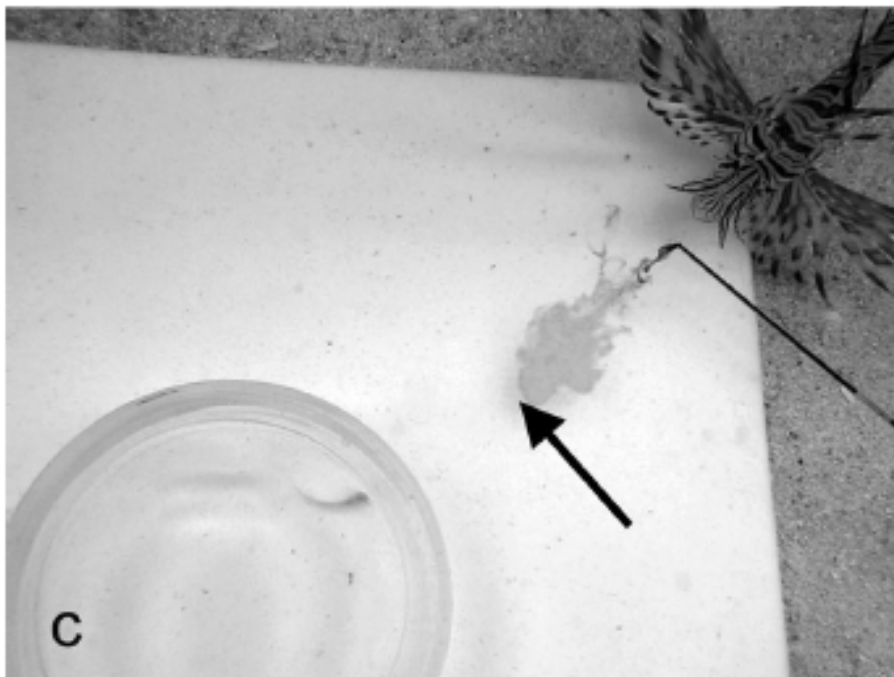
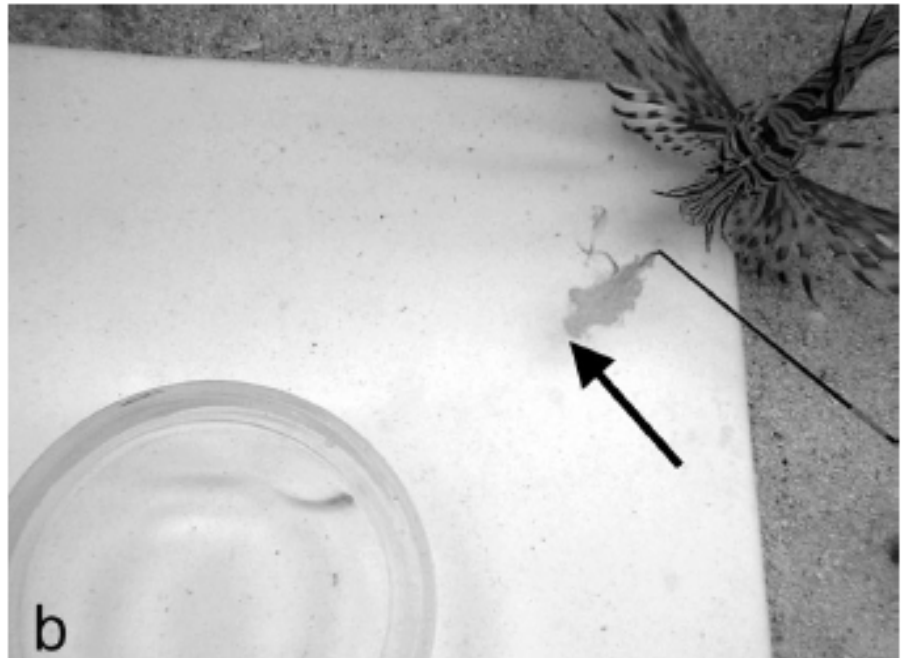
Head  $\sim\frac{1}{3}$ – $\frac{1}{2}$  SL

Most species camouflaged

Ambush, suction feeders\*

Venom glands at the bases  
of the dorsal, anal &  
pectoral fin rays\*





Skin forced down  $\Rightarrow$  compresses gland  $\Rightarrow$   
venom up grooves in spine

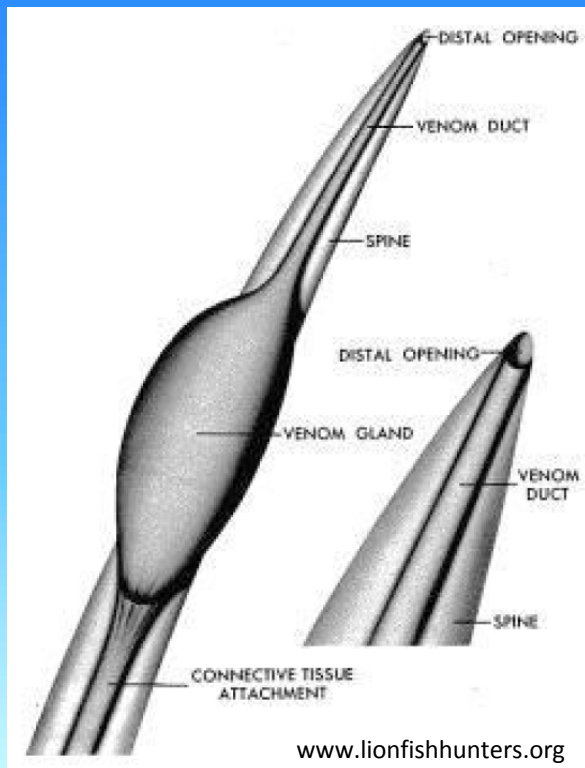
4 toxins

heat labile protein  $\Rightarrow$  allergic reaction (1° toxin)

acetylcholine (neurotransmitter)

neuromuscular toxin

low molecular weight ichthyotoxin



Sting painful but seldom fatal

Allergic reaction possible

Paralysis possible

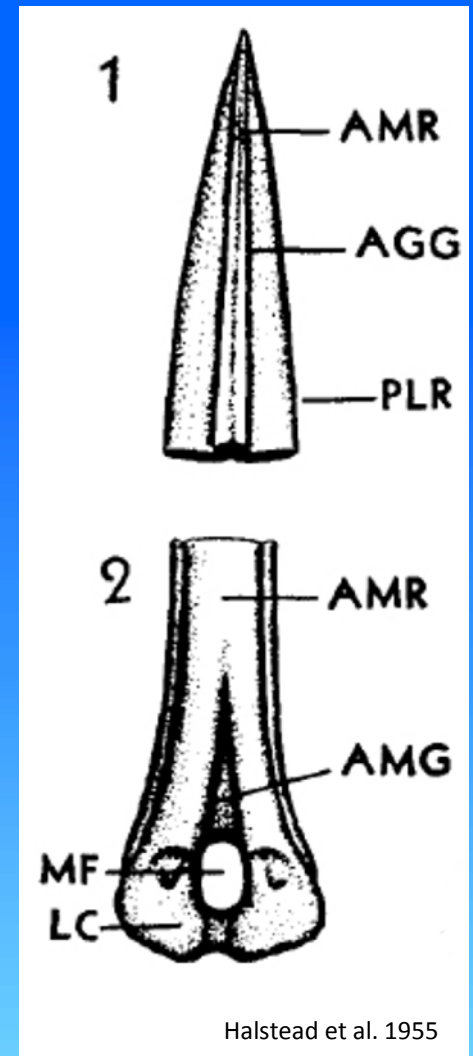
Treatment

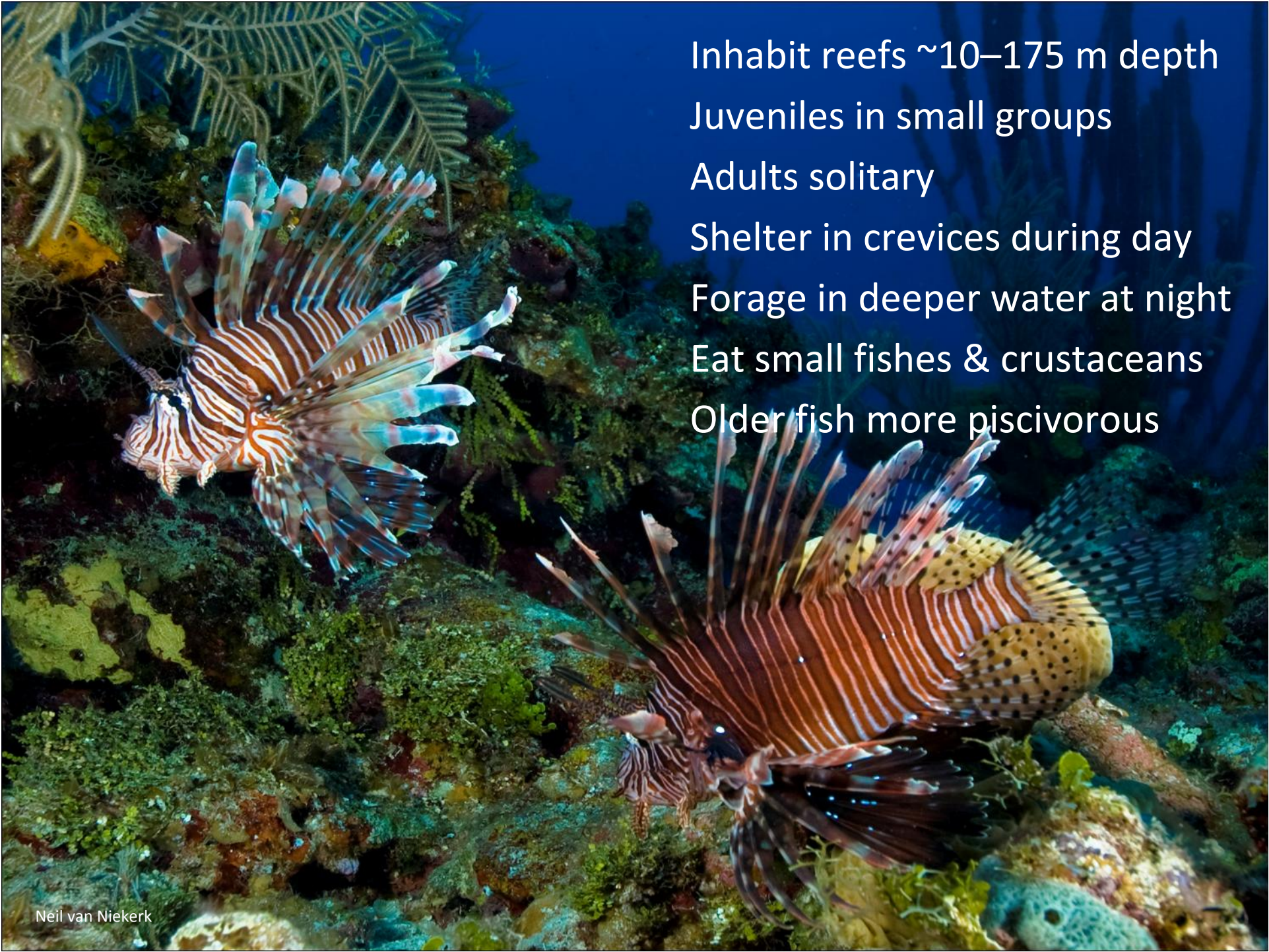
soak in hot water

painkillers

antibiotics

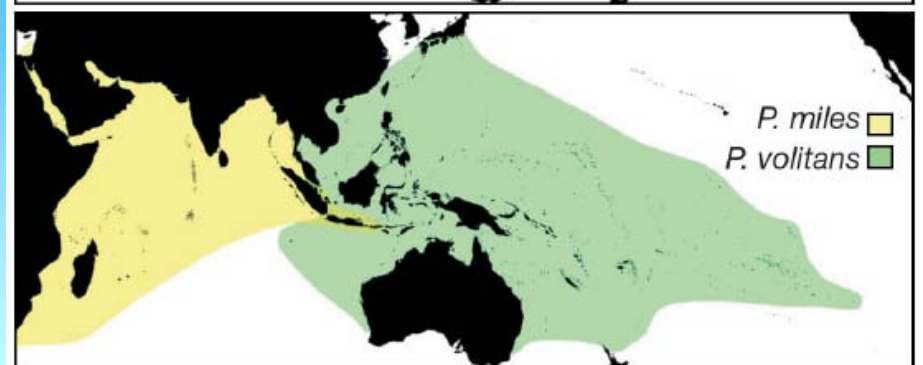
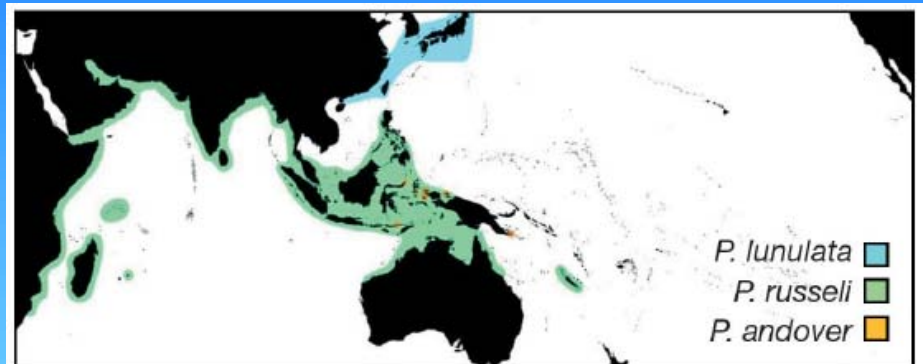
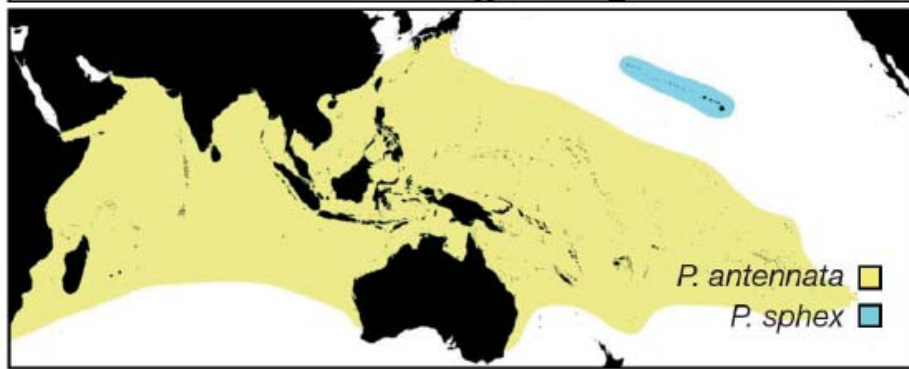
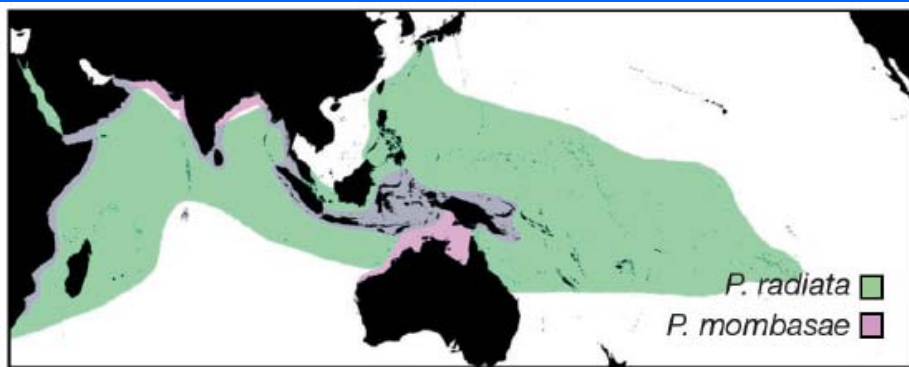
tetanus shot



A photograph of two lionfishes on a coral reef. The fish in the foreground is larger and has a yellowish-brown body with dark brown stripes and spots. The fish in the background is smaller and has a reddish-brown body with white stripes. Both fish have long, thin, translucent spines with blue and pink tips. They are swimming over a diverse coral reef with various species of coral and sponges.

Inhabit reefs ~10–175 m depth  
Juveniles in small groups  
Adults solitary  
Shelter in crevices during day  
Forage in deeper water at night  
Eat small fishes & crustaceans  
Older fish more piscivorous

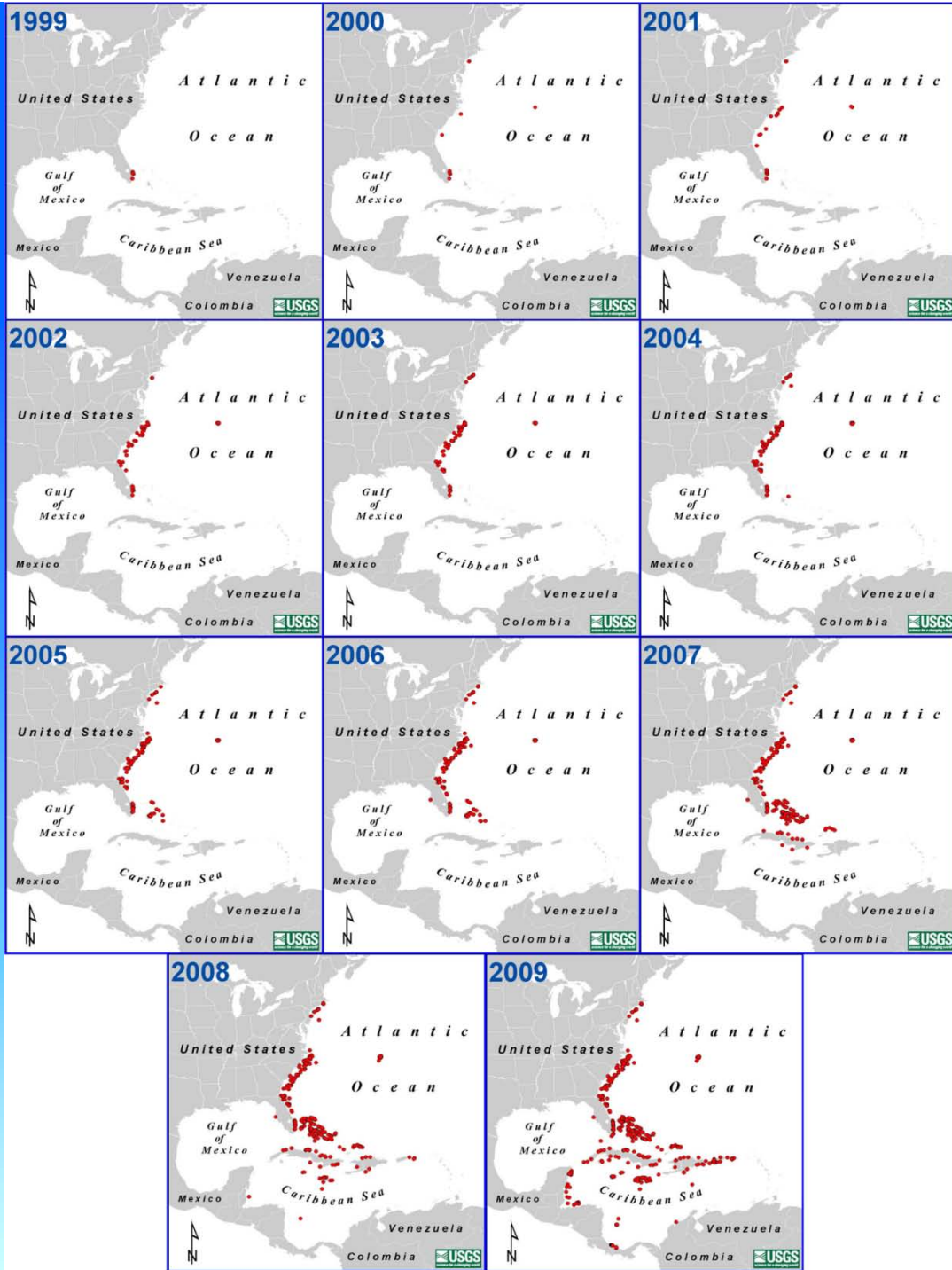


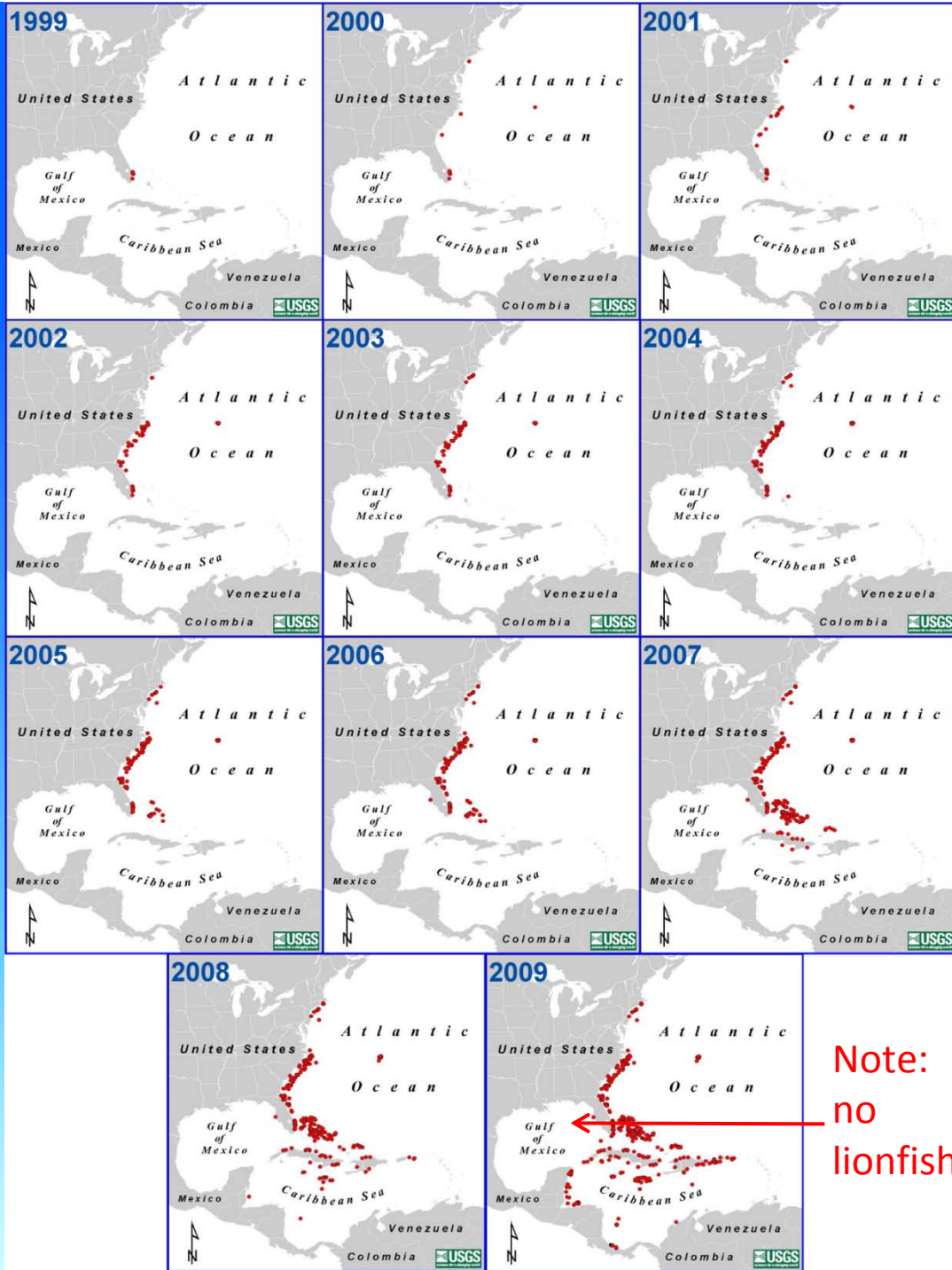




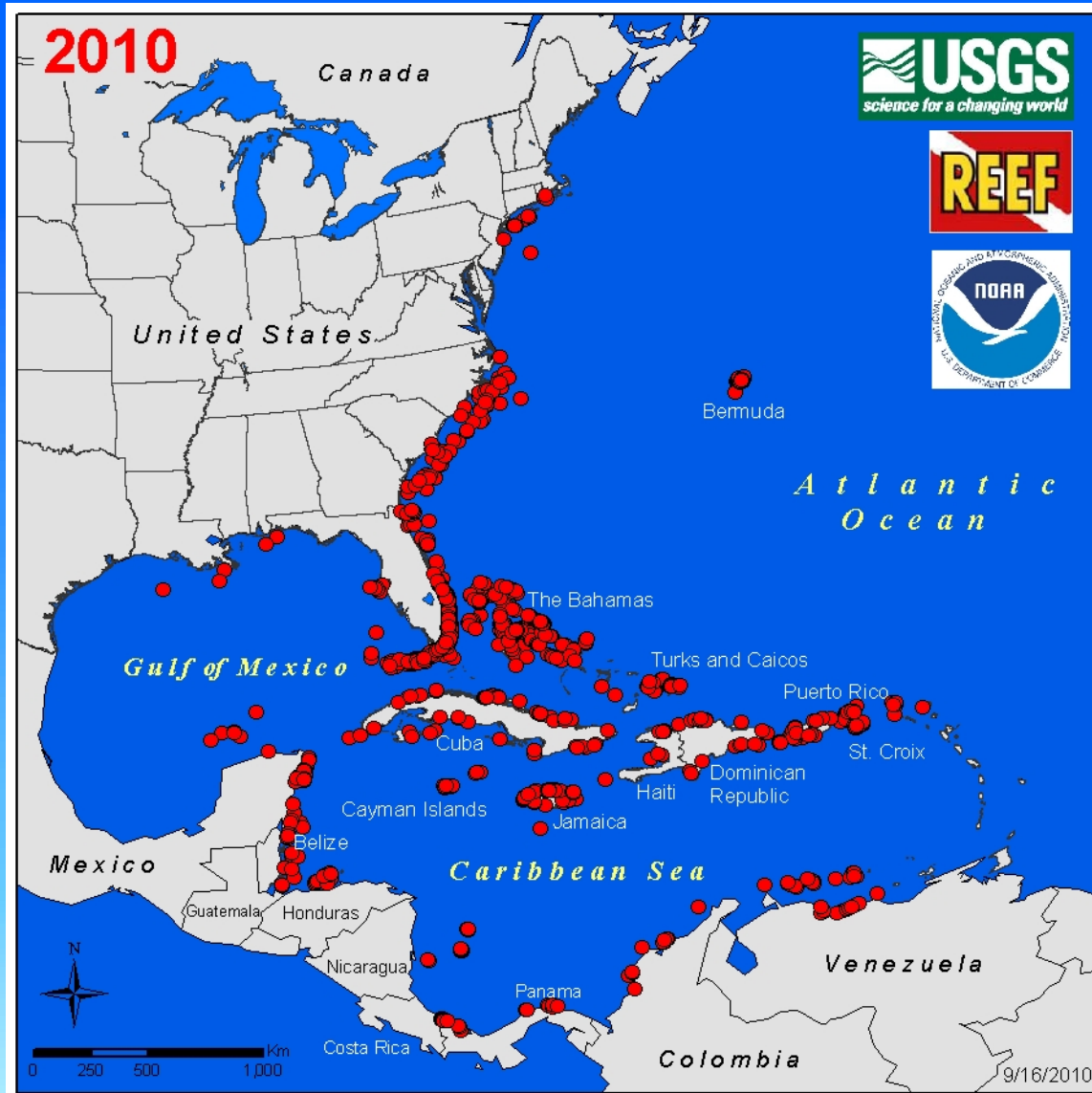
So, what's the hassle?

Like most invasives  
spread, abundance & impacts

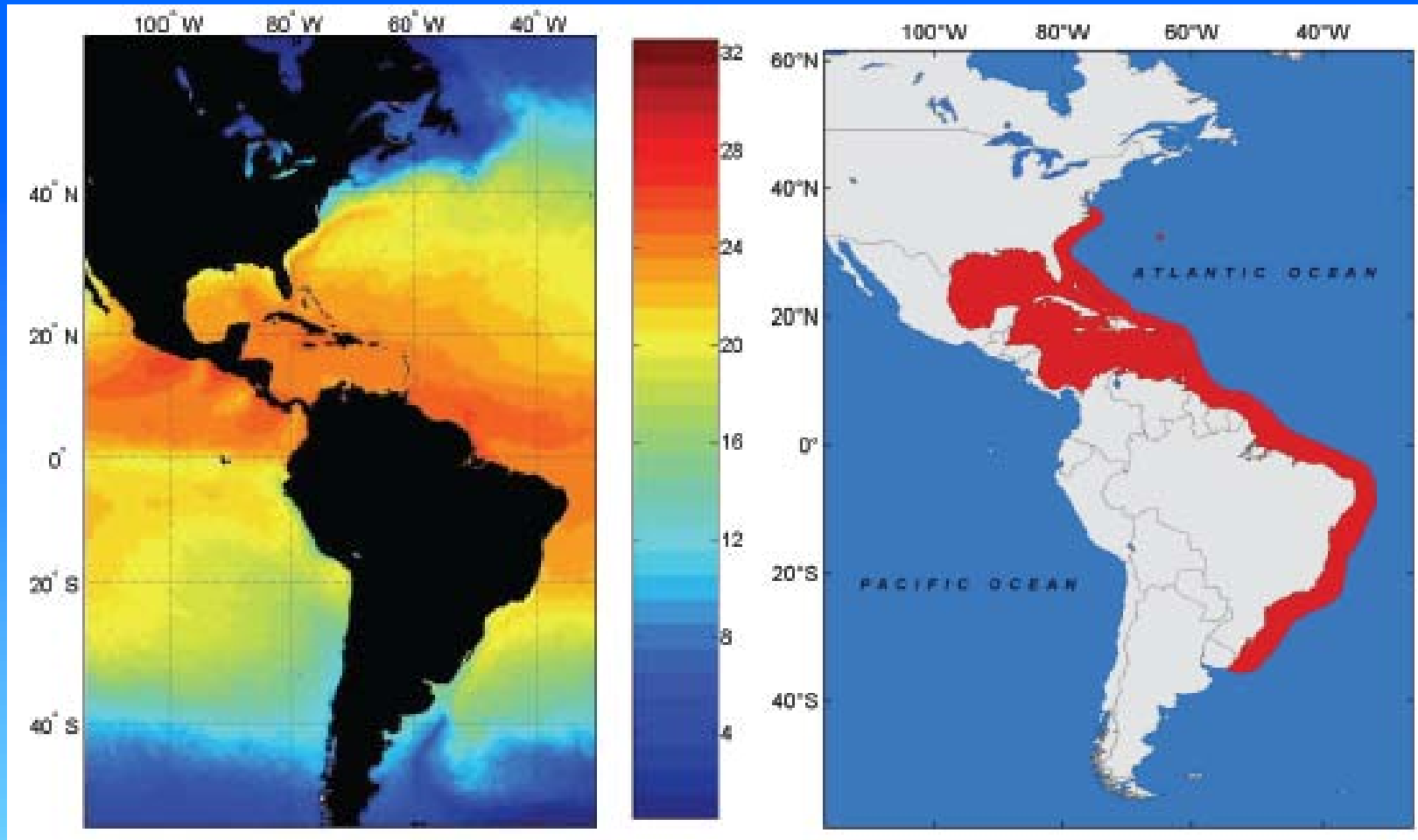




Note:  
no  
lionfish

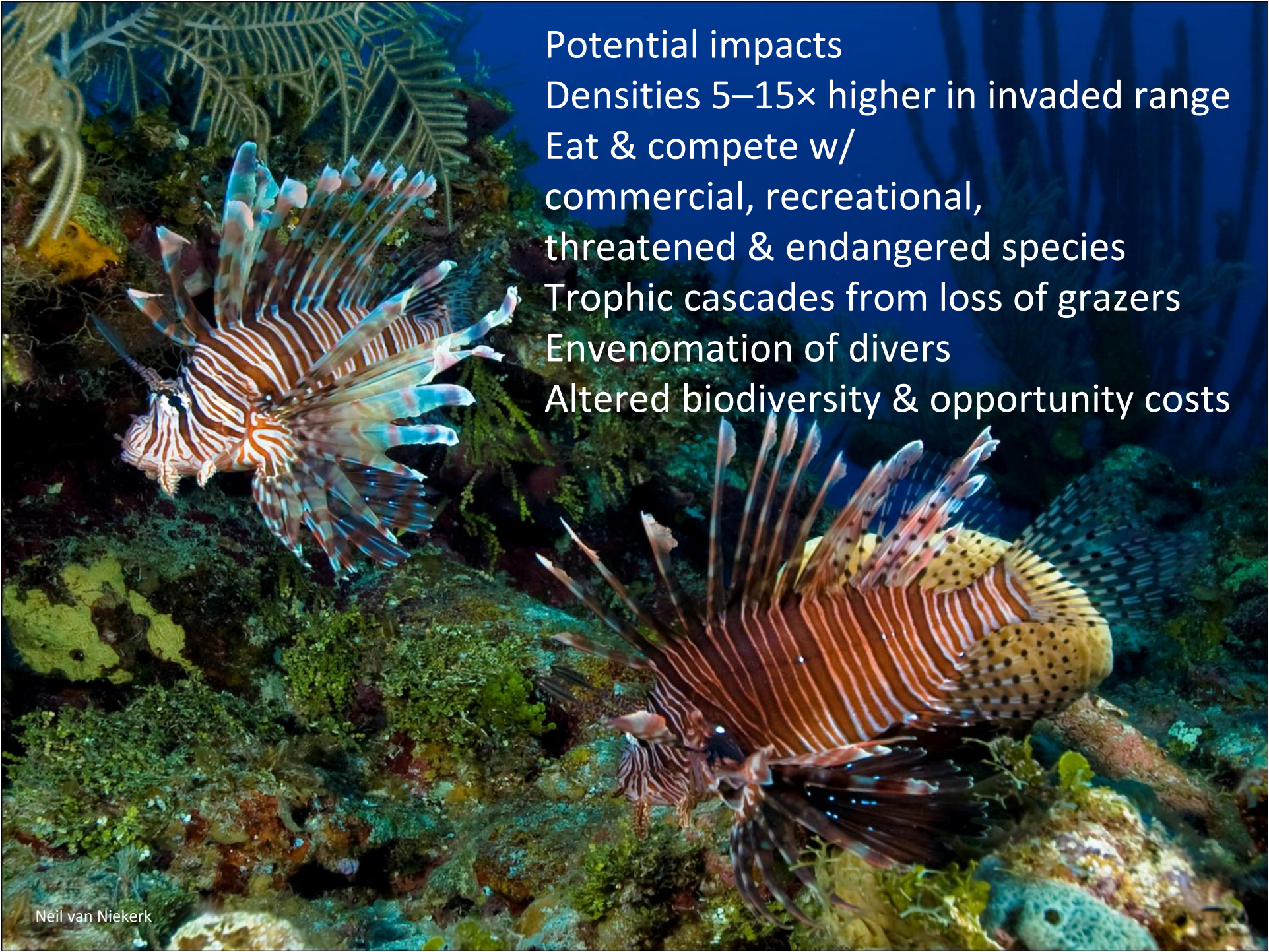






Average annual sea surface temperatures

Potential range based on  
lethal thermal minimum  
of 10°C

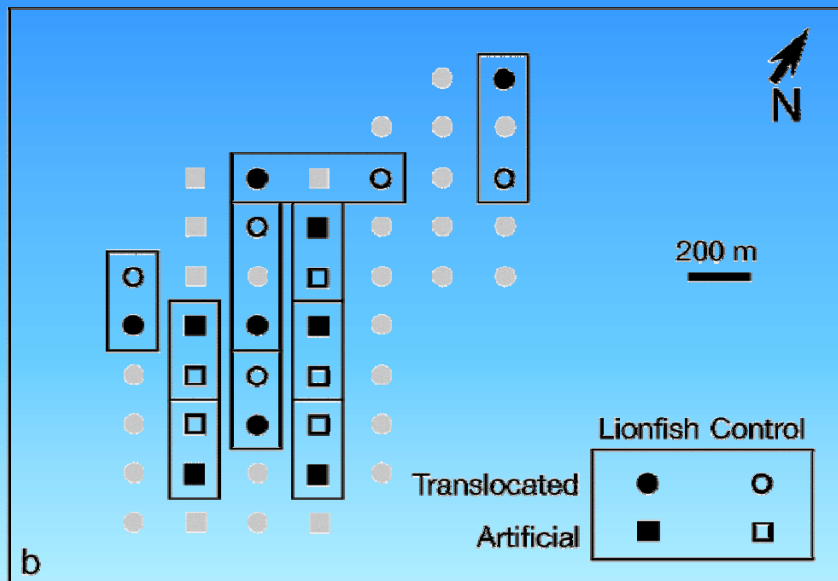
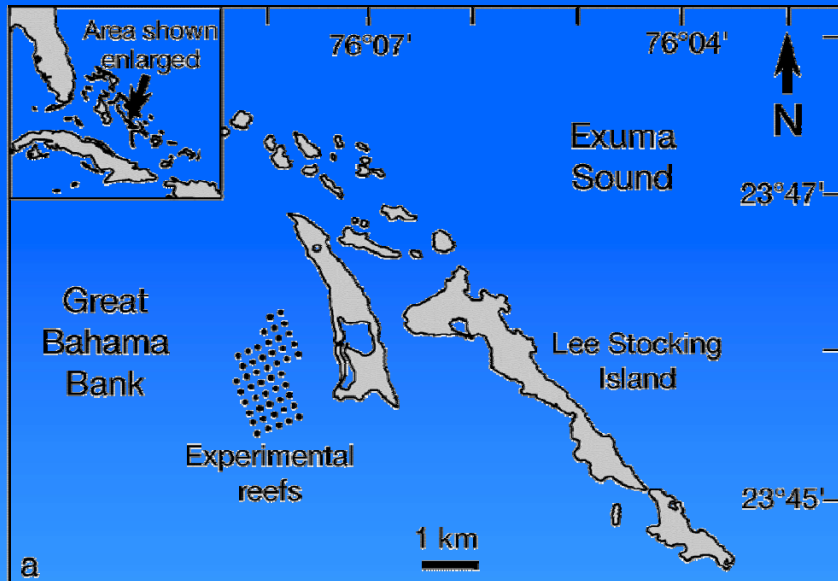
A photograph of two lionfishes on a coral reef. The lionfishes have distinctive brown and white vertical stripes and long, venomous spines. They are positioned on a reef covered in green algae and other marine life. The background is a deep blue ocean.

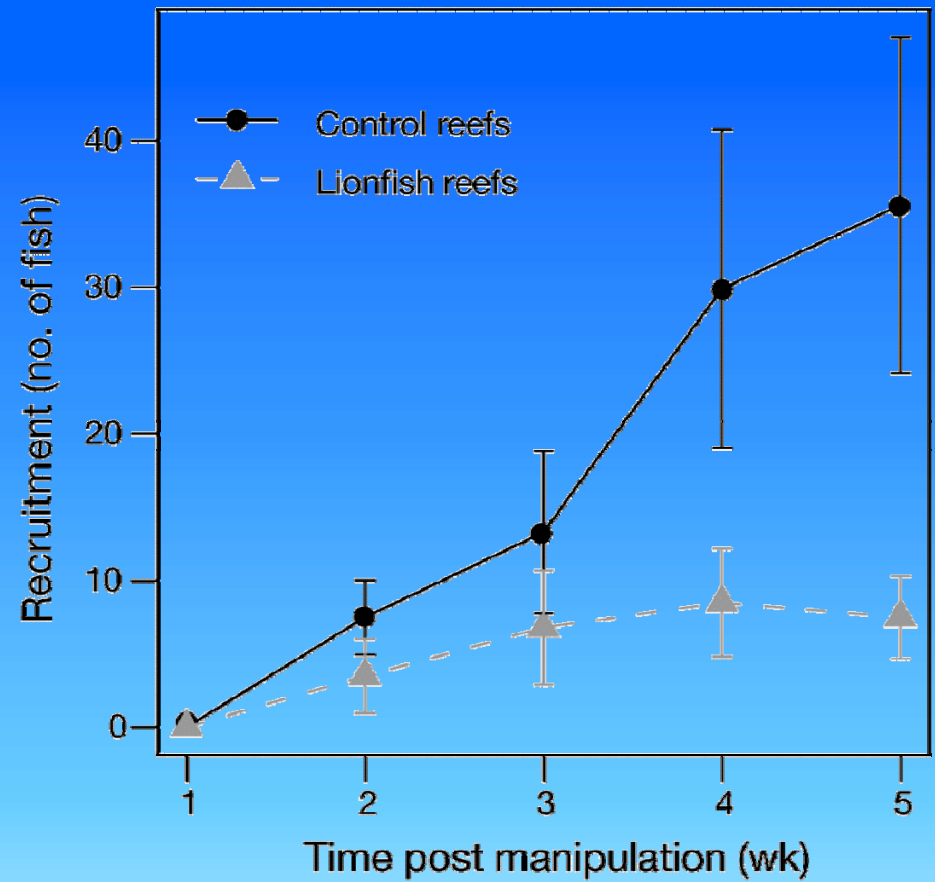
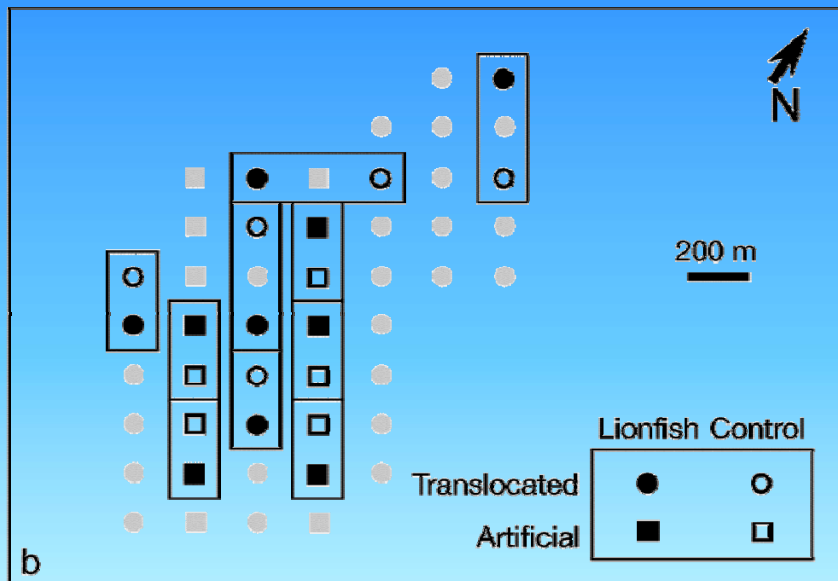
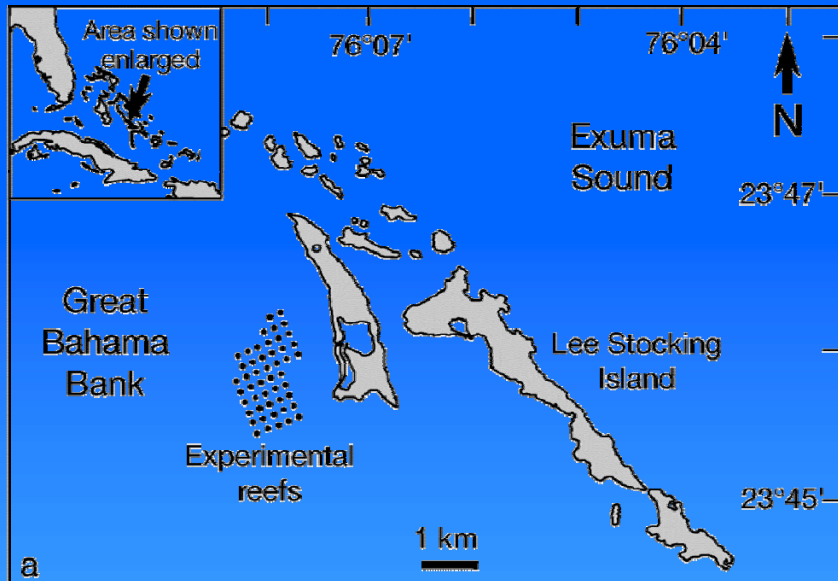
Potential impacts  
Densities 5–15× higher in invaded range  
Eat & compete w/  
commercial, recreational,  
threatened & endangered species  
Trophic cascades from loss of grazers  
Envenomation of divers  
Altered biodiversity & opportunity costs

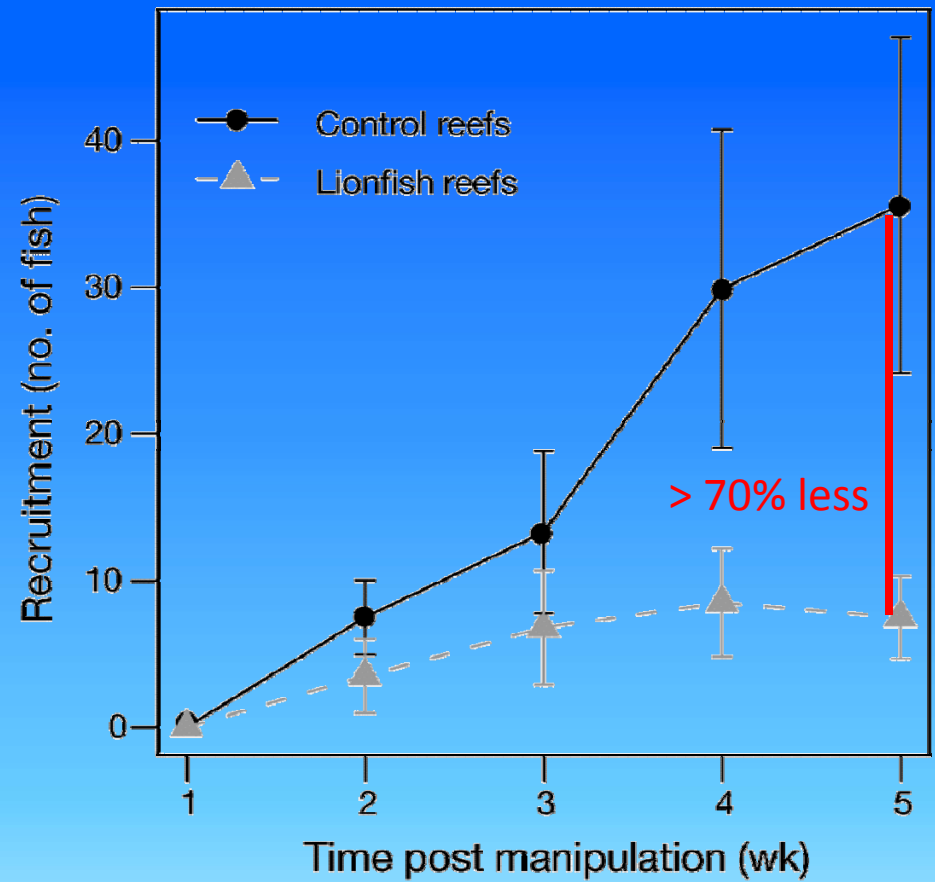
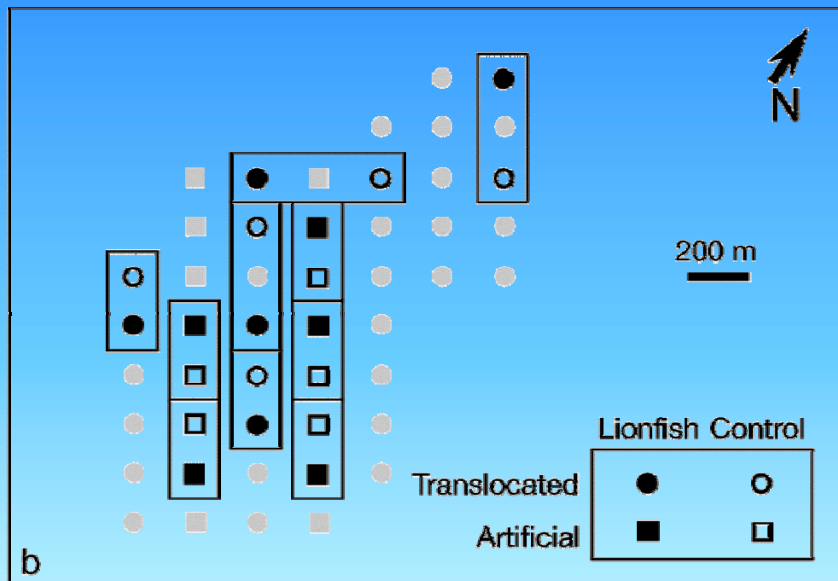
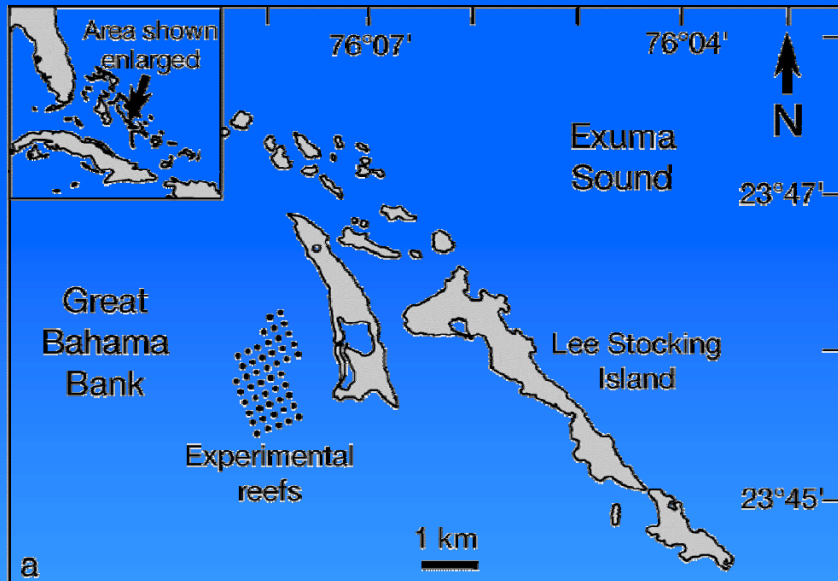
Any evidence of ecological impacts?

We're getting there









So, what do we do?!



# EAT LIONFISH

In the U.S. and the Caribbean, lionfish are an invasive species — a top predator with the potential to create massive and irreversible harm to our reef ecosystems. Fortunately for our reefs, the flashy lionfish has caught the attention of the hungriest predators of all: People! The “Eat Lionfish” campaign is a way to make the public aware of this growing threat and invite them to be part of the strategy to combat it and enjoy a tasty fish at the same time.

## THE FACTS

- We can't possibly eat too many of them.
- Eating lionfish can help reef recovery.
- Lionfish are an invasive species threatening the delicate balance of our US and Caribbean coral reefs, which support our fisheries.
- In the near future, struggling fishing communities may benefit from the income they can realize by harvesting lionfish.
- It would be a great success to eat them out of existence in these areas.
- The sooner we act the better.
- Lionfish threaten the recovery of overfished native stocks, like snapper and grouper, because they compete for the same food. Scientists fear that lionfish will also kill off helpful species such as algae-eating parrotfish, which would allow algae to overtake our reefs.
- Between 2004 and 2008, local densities of lionfish off of North Carolina increased approximately 700% in some locations. We expect lionfish densities to continue to increase in the Atlantic for the foreseeable future. We have some opportunity to limit the damage if we move quickly.

## THE BOTTOM LINE

Diners who choose lionfish are not only getting a delicious fish; they are making a direct contribution to preserving our coral reefs and our communities.

Eat sustainable, eat lionfish!



Dominican Republic  
Don Behringer



sea to table



### PARTNERS

**NOAA** is on the forefront of lionfish research, which is centered at its laboratory in Beaufort, NC. NOAA recommends eating lionfish as a way to help reduce the impact of this invader on US and Caribbean reefs.

**Barton Seaver** is a Nationally recognized chef and fellow with both the Blue Ocean Institute and National Geographic.

**Sean Dimin** is the proprietor of Sea to Table, a company that seeks out sustainably managed fisheries needing better access to markets, connecting fishermen with top chefs.

**REEF** (The Reef Environmental Education Foundation), a prominent grassroots organization of ecologically minded divers, fishermen, and others who work on research efforts to track lionfish.



2011 FLORIDA KEYS  
LIONFISH DERBY  
SERIES

# WANTED LIONFISH HUNTERS



## ★ 2011 FLORIDA KEYS LIONFISH DERBY SERIES

Saturday, May 14th - Middle Keys at Fiesta Key Resort - Long Key

Saturday, August 20th - Upper Keys at Coconuts - Key Largo

Saturday, November 5th - Lower Keys at Hurricane Hole - Key West



JOIN US: SATURDAY, OCT. 29, 2011  
 BISCAYNE BAY  
**LIONFISH SMASH**

PRESENTED BY:



TO BENEFIT:

**AWARDS & RAFFLE**  
 LARGEST: MOST/SMALLEST:  
**\$500+ PRIZES**



ROSENSTIEL  
 SCHOOL of MARINE &  
 ATMOSPHERIC SCIENCE  
 UNIVERSITY OF MIAMI

JOIN US IN THE FIGHT AGAINST LIONFISH - SIGN UP NOW:  
[SOUTHFLORIDAFREEDIVERS.COM](http://SOUTHFLORIDAFREEDIVERS.COM)

**LOCATION: RICKENBACKER MARINA**  
 3301 RICKENBACKER CAUSEWAY, KEY BISCAYNE, FL



RapidSignsMiami.com



Any Questions - Email:  
[FishHaveFeelings@Hotmail.com](mailto:FishHaveFeelings@Hotmail.com)

WA  
 LION

20  
 LION

Saturday, May 14  
 Saturday, Aug  
 Saturday, Novem

REEF WEEKLY

**WAL**  
**LION**

**20**  
**LION**

Saturday, May 14  
Saturday, Aug  
Saturday, Novem

**REEF WEEKLY**

**JOIN US IN BISCAYNE**  
**LION**

**AWARDS & PRIZES**  
LARGEST: **\$500+PRIZES**

JOIN US IN THE F  
SOUTHFLOR

**LOCATION:**  
3301 RICKENBA

**Ron Natasaalem**  
RUM

**f SOUTH FLORIDA FREEDIVERS**



**1st**  
**Lionfish**  
**hunting**  
**safari!**

**OCTOBER 19 - 23, 2011**

**15** **DANIVERSARIO**  
**PARQUE NACIONAL**  
ARRECIFES DE COZUMEL  
**INVITES YOU**

**BECOME AN OFFICIAL LIONFISH HUNTER AND SUPPORT COZUMEL'S REEF**

**Cozumel** **SAN PEDRO DOLLAR SPORTS** **SALUD** **ANOMAT** **MEDIO AMBIENTE Y ECOLOGIA** **CORAL**

**TURISMO** **PARQUE NACIONAL** **CONANP** **SECRETARIA DE ECONOMIA** **SECRETARIA DE COMERCIO Y TRANSPORTES** **SECRETARIA DE SALUD** **SECRETARIA DE TURISMO** **CANIRAC** **ISLA Cozumel**



Is there a dark cloud around  
that silver lining?

Perhaps

If lionfish have been found from depths of one foot to several feet deep to > 1000 feet, in various habitats and temperatures-- I think it is safe to assume they are here to stay. No amount of monitoring, spearfishing tournaments or seafood recipes will even begin to put a dent in their population. It might make folks feel good--that they are doing something, but that is about all it will do.

If lionfish have been found from depths of one foot to several feet deep to > 1000 feet, in various habitats and temperatures--I think it is safe to assume they are here to stay. No amount of monitoring, spearfishing tournaments or seafood recipes will even begin to put a dent in their population. It might make folks feel good--that they are doing something, but that is about all it will do.

In addition, even though we may never eliminate the lionfish at great depths, I am relatively confident we can maintain them under control in certain areas.

If lionfish have been found from depths of one foot to several feet deep to > 1000 feet, in various habitats and temperatures--I think it is safe to assume they are here to stay. No amount of monitoring, spearfishing tournaments or seafood recipes will even begin to put a dent in their population. It might make folks feel good--that they are doing something, but that is about all it will do.

In addition, even though we may never eliminate the lionfish at great depths, I am relatively confident we can maintain them under control in certain areas.

# Data?

Not really, but we have ...

# Models!

Stage-based, matrix population model  
mortality & survival for  
larvae, juveniles & adults

Model effects of removals

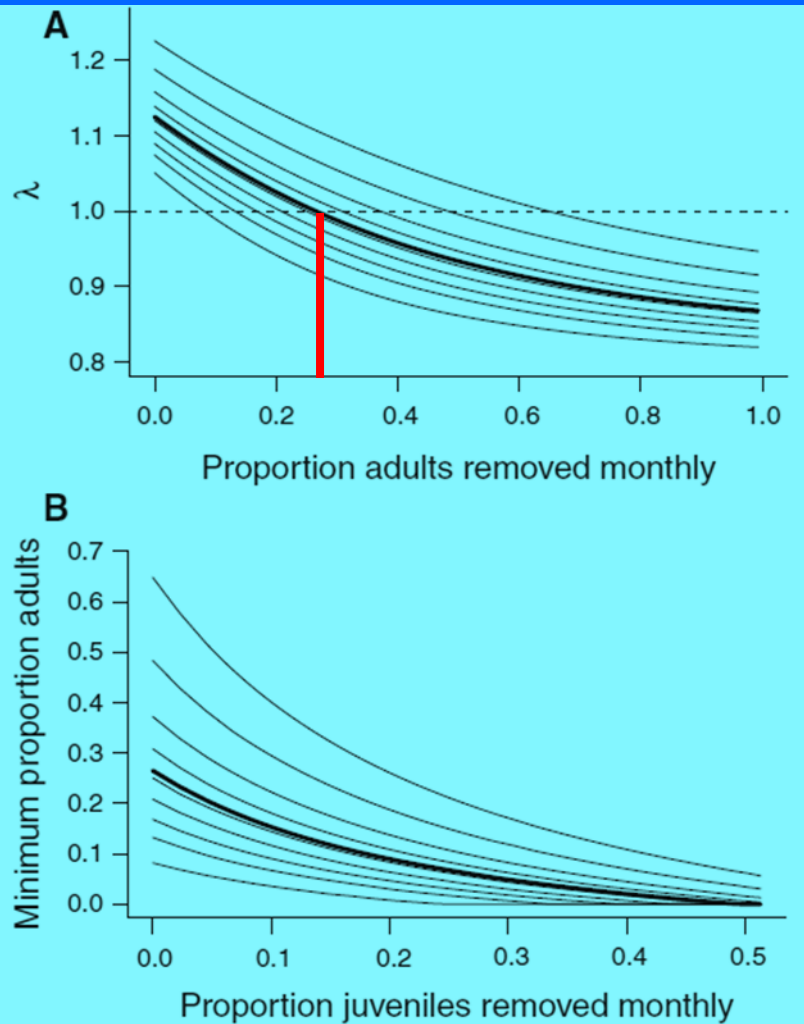
thick line = baseline

thin lines = percentiles in steps of 10  
from random runs (uncertainty)

Proportion of adults removed  $\Rightarrow$

– population growth ( $\lambda < 1$ ) = 27% month<sup>-1</sup>

Adding removal of juveniles reduces this value



# Age-structured population model

Length w/ 50% capture vulnerability

Natural mortality

Goodyear compensation ratio (> juvenile survival @ low densities)

Annual exploitation ratio (weighted spawning potential ratio < 0.35) ⇒

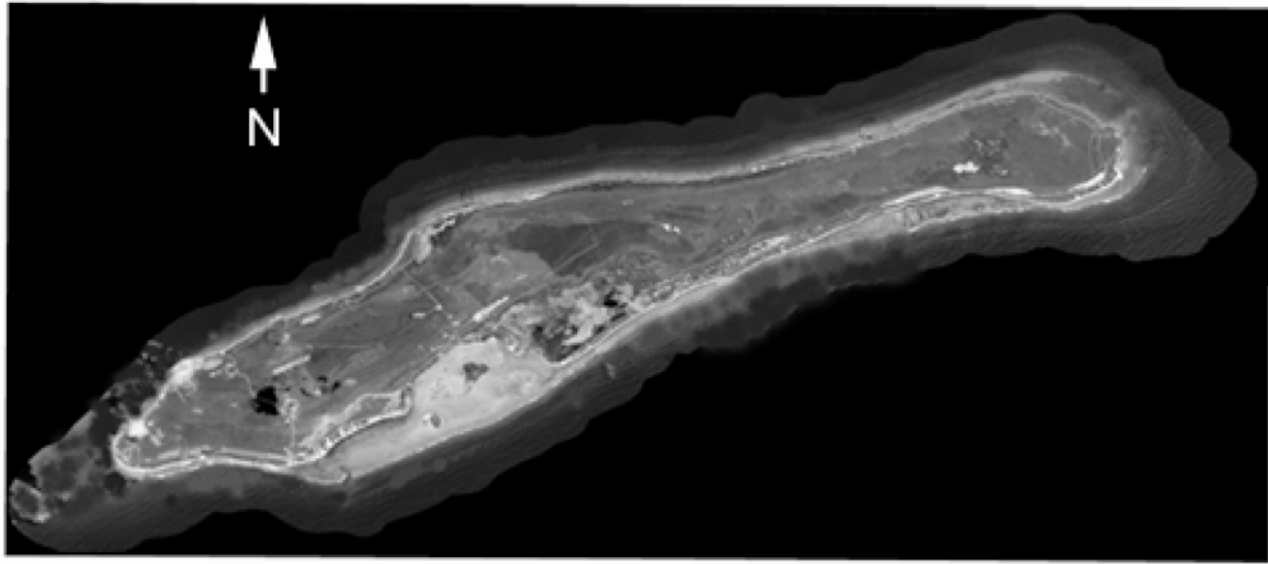
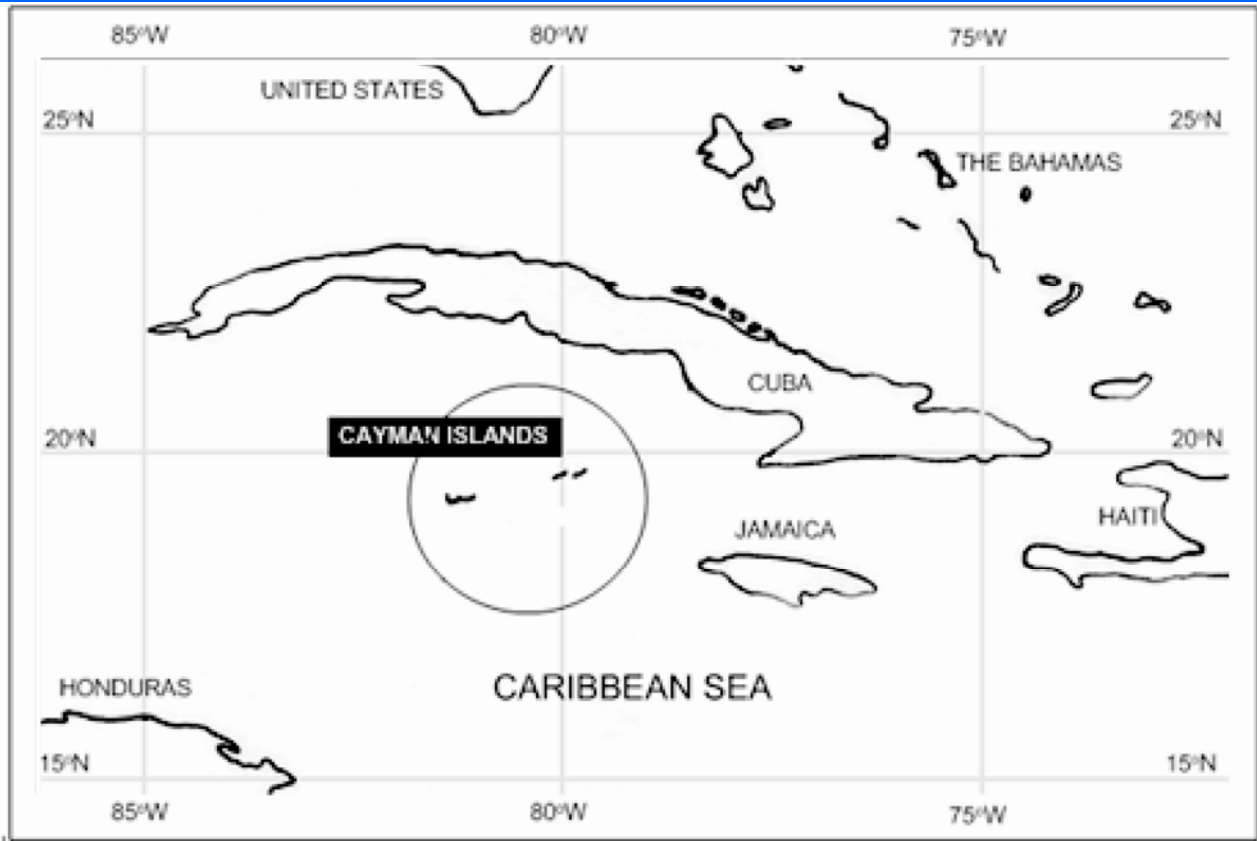
Years to recovery

$L_{vul}$ (mm)	M	CR	$U_{SPR < 0.35}$	Recovery (yrs) after $U_{SPR}$ Fishing
159	0.5	15	0.35	6
159	0.5	5	0.3	10
159	0.2	15	0.20	12
159	0.2	5	0.15	16
259	0.5	15	0.65	6
259	0.5	5	0.50	9
259	0.2	15	0.25	11
259	0.2	5	0.2	16

Barbour et al. 2011

Discouraging,  
but based on numerous  
assumptions – explicit & implicit

Let's go to Lil' Cayman &  
sort some things out





Volunteers  $\Rightarrow$  culls

Moorings  $\Rightarrow$  sites

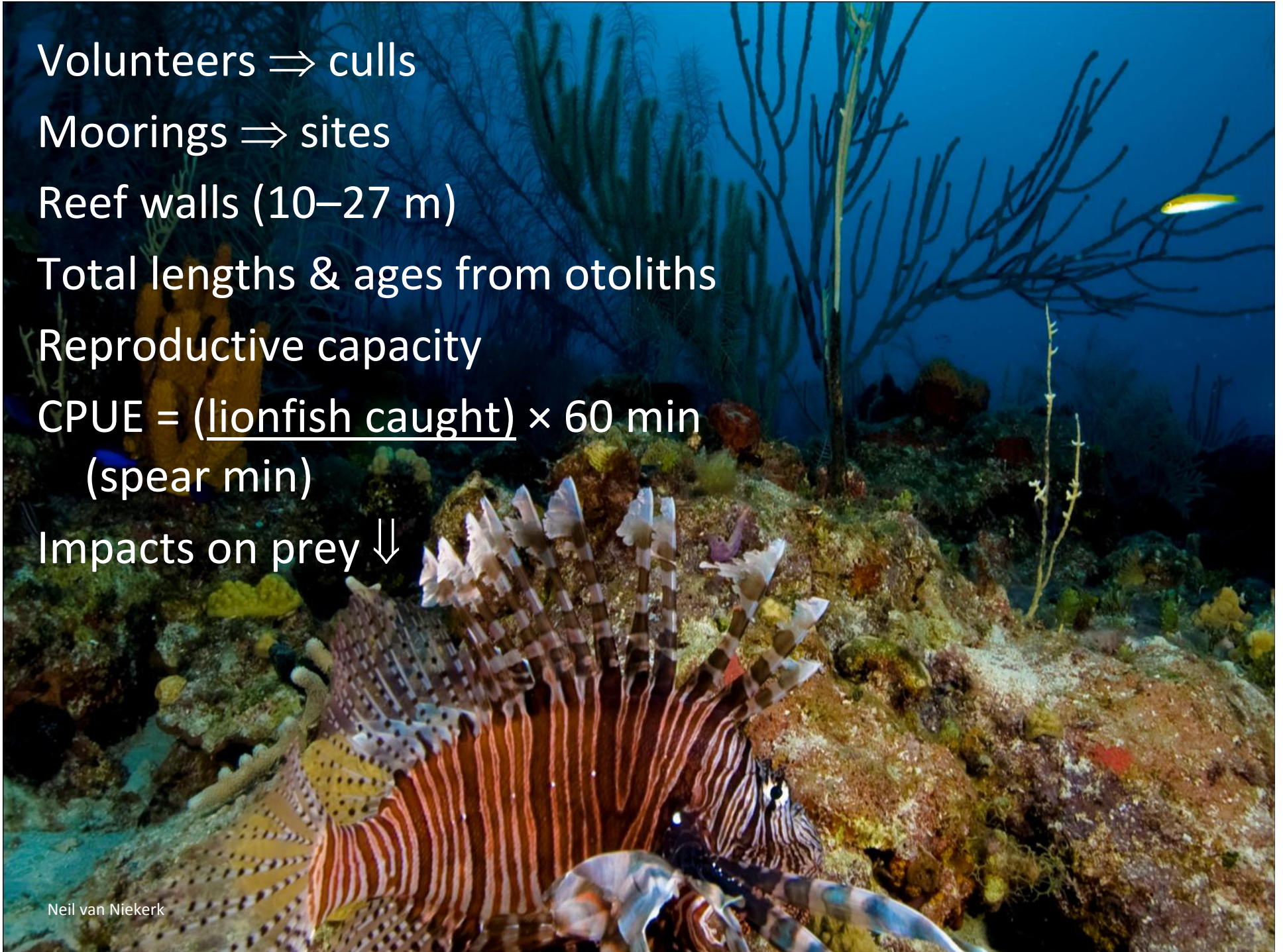
Reef walls (10–27 m)

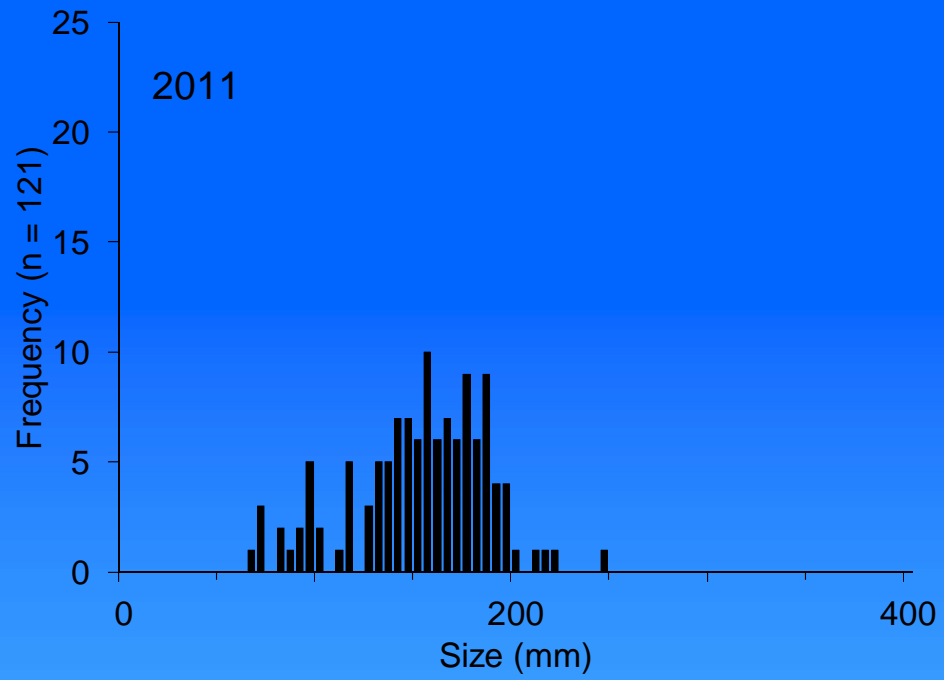
Total lengths & ages from otoliths

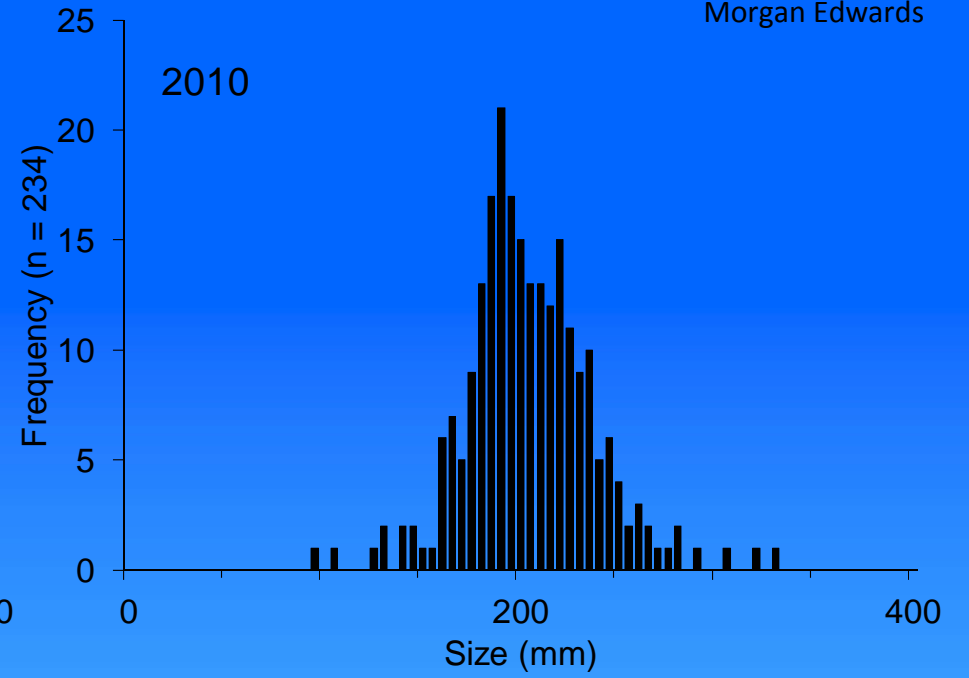
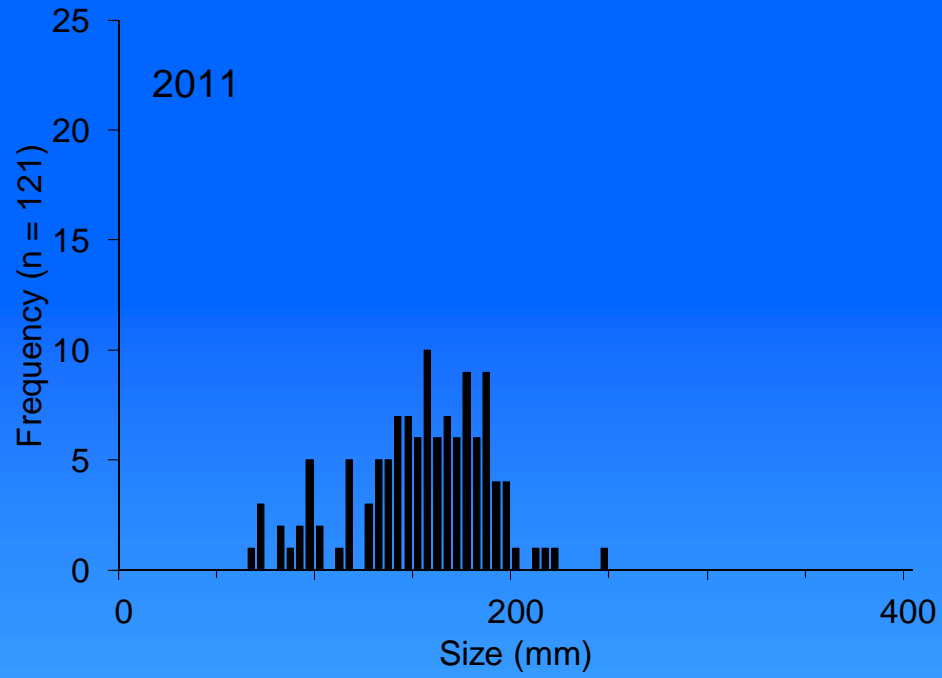
Reproductive capacity

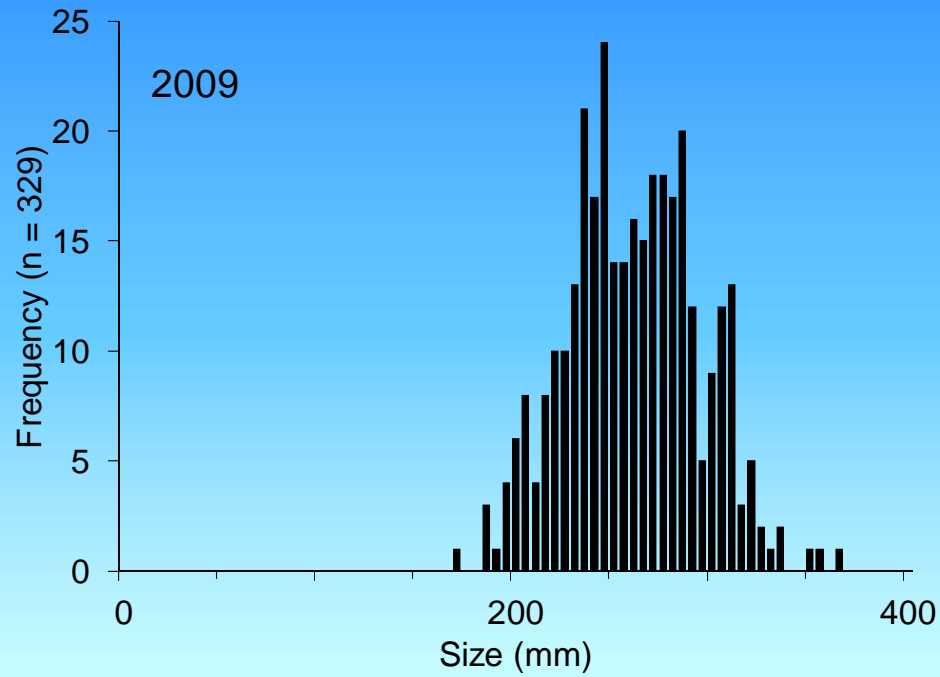
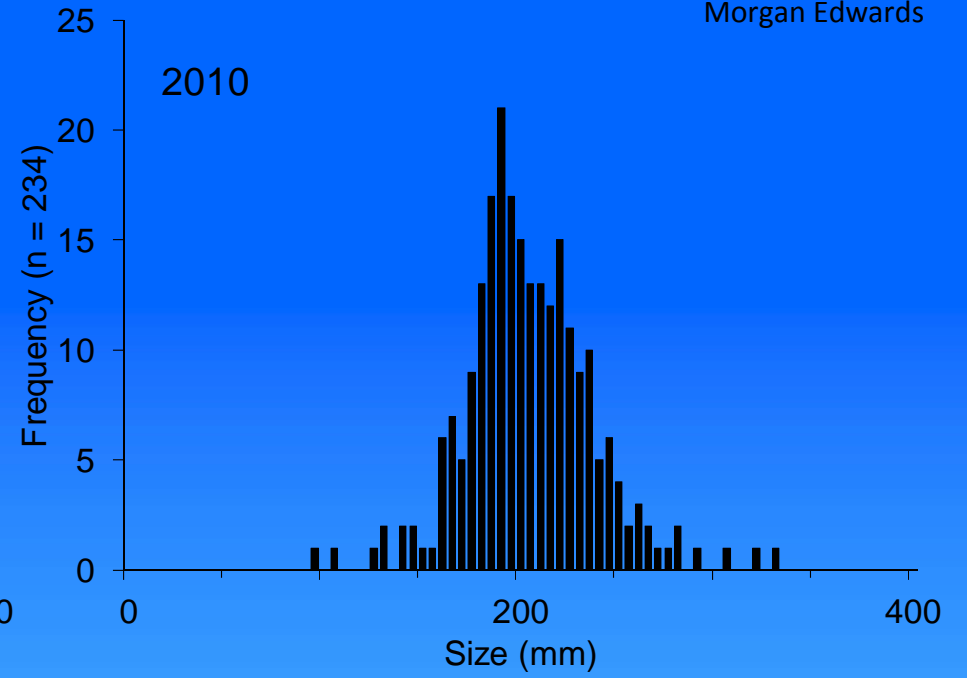
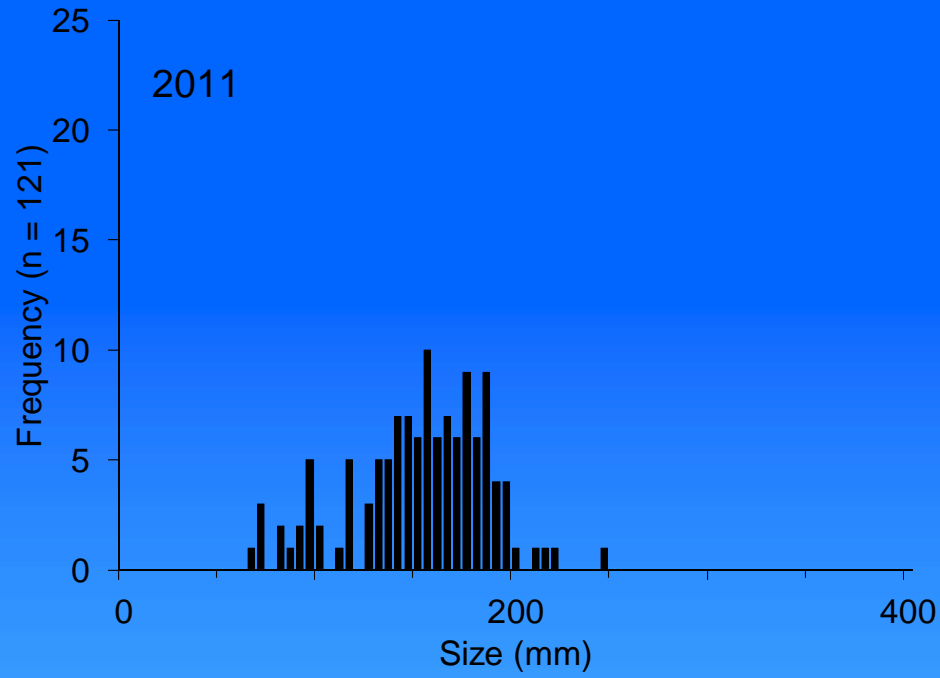
CPUE =  $\frac{\text{lionfish caught}}{\text{spear min}} \times 60 \text{ min}$

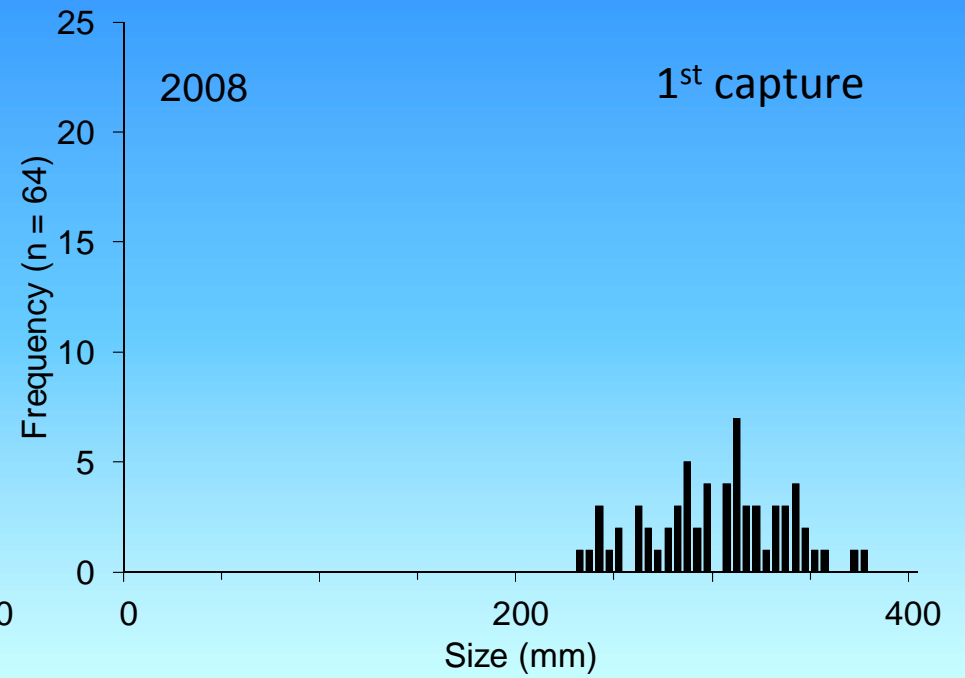
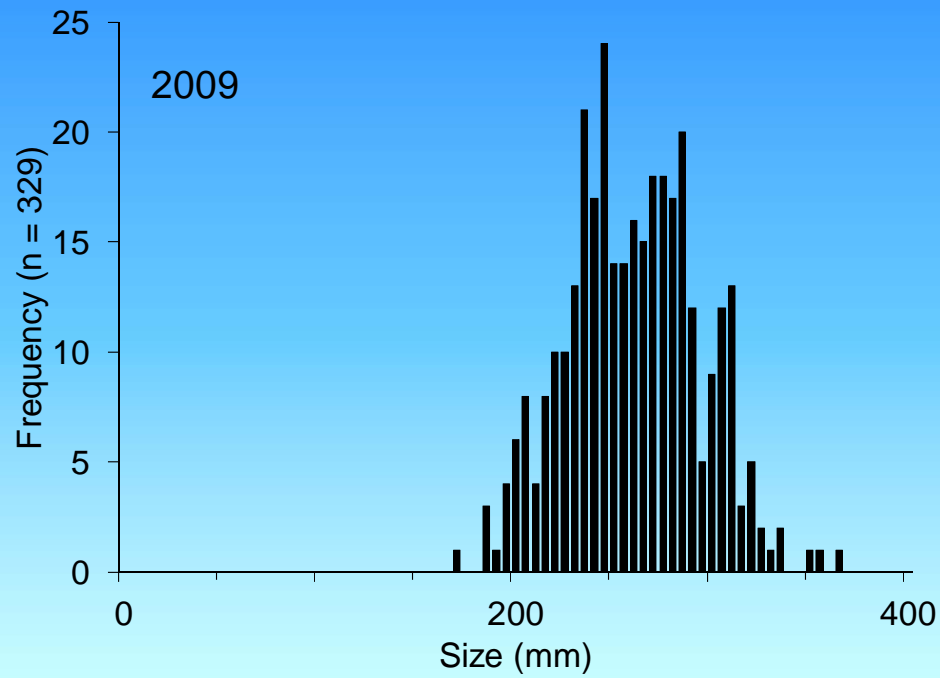
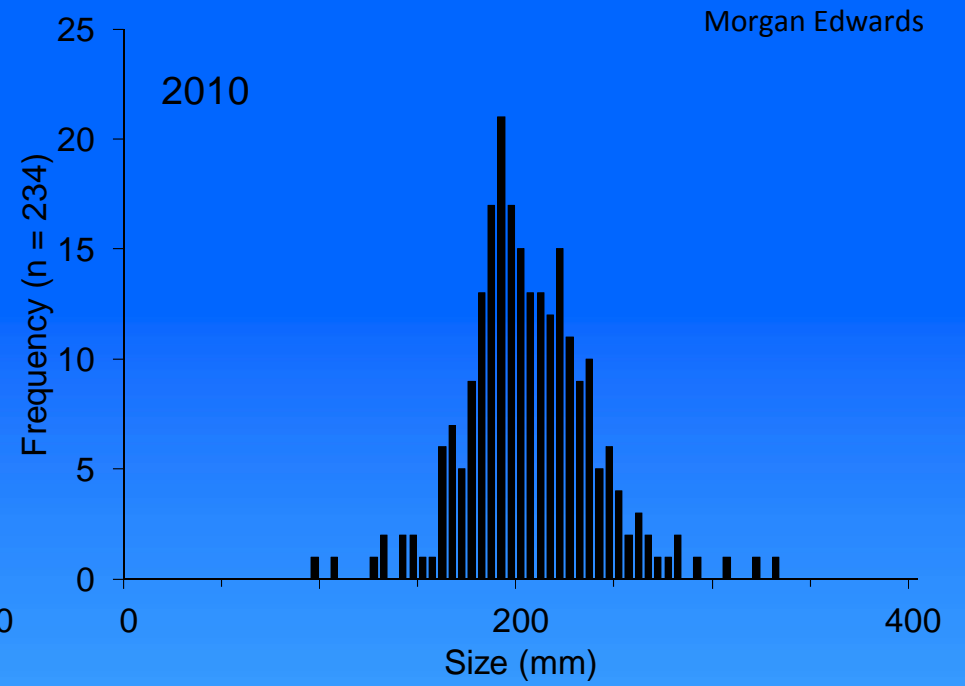
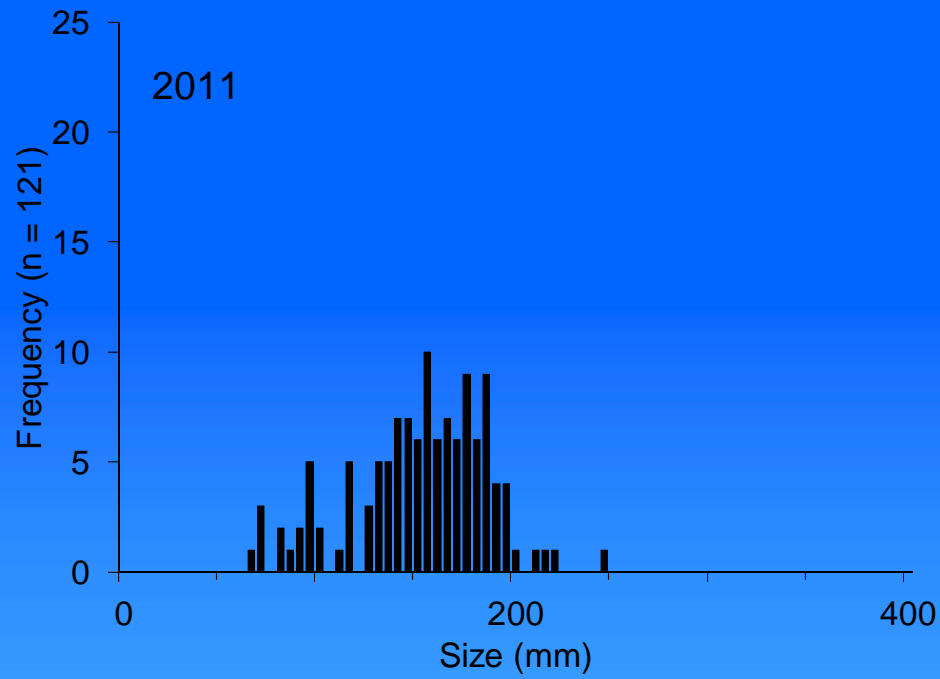
Impacts on prey  $\Downarrow$

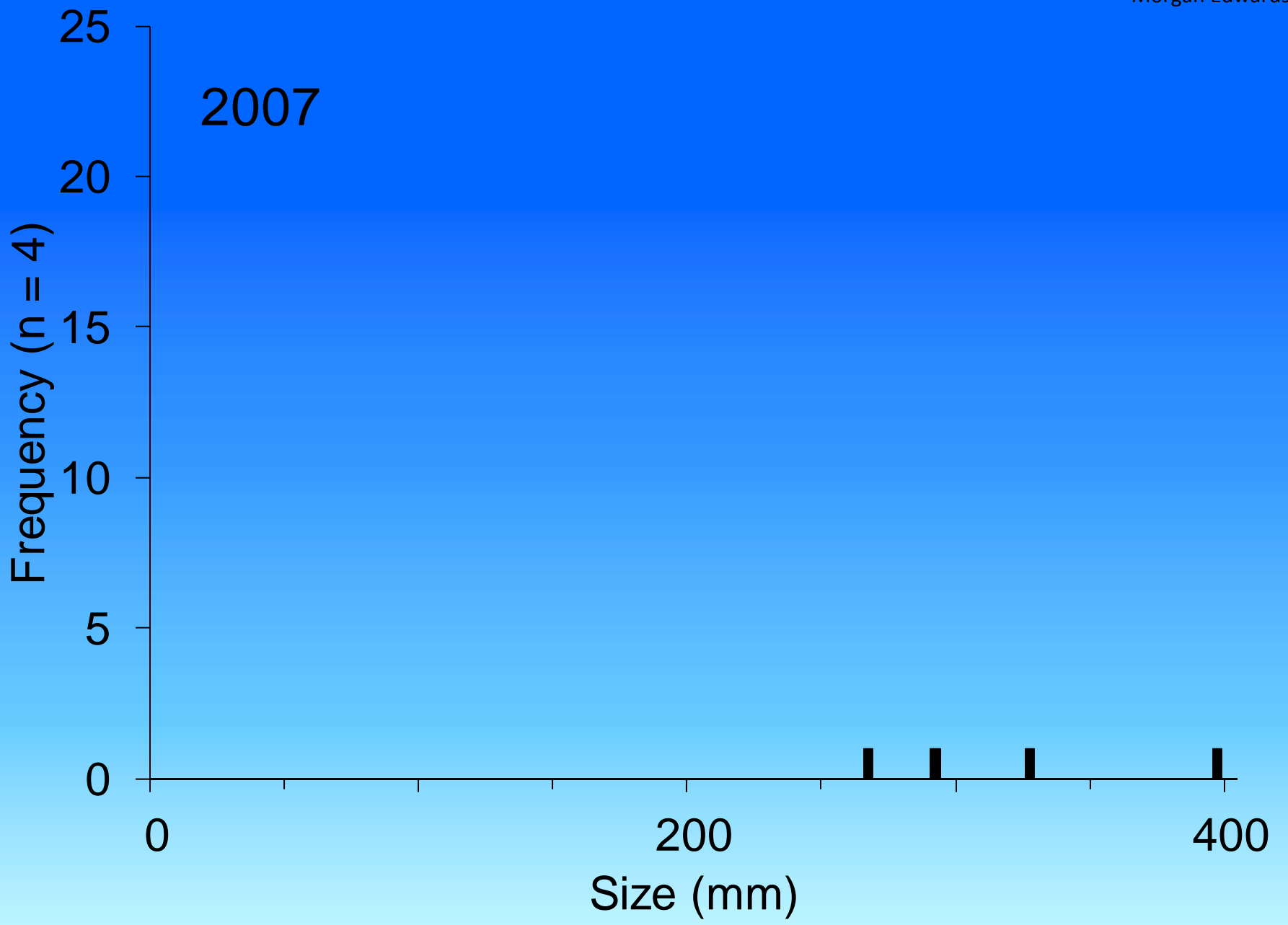


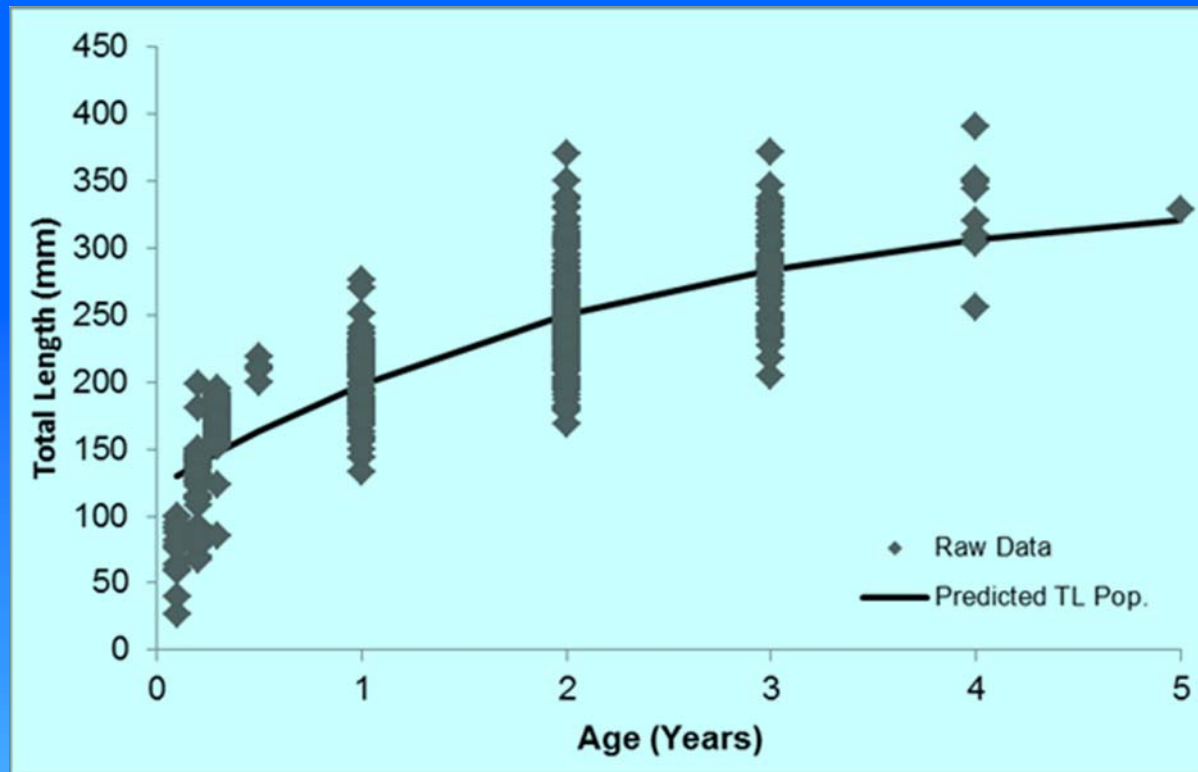












von Bertalanffy growth curve  $\Rightarrow$

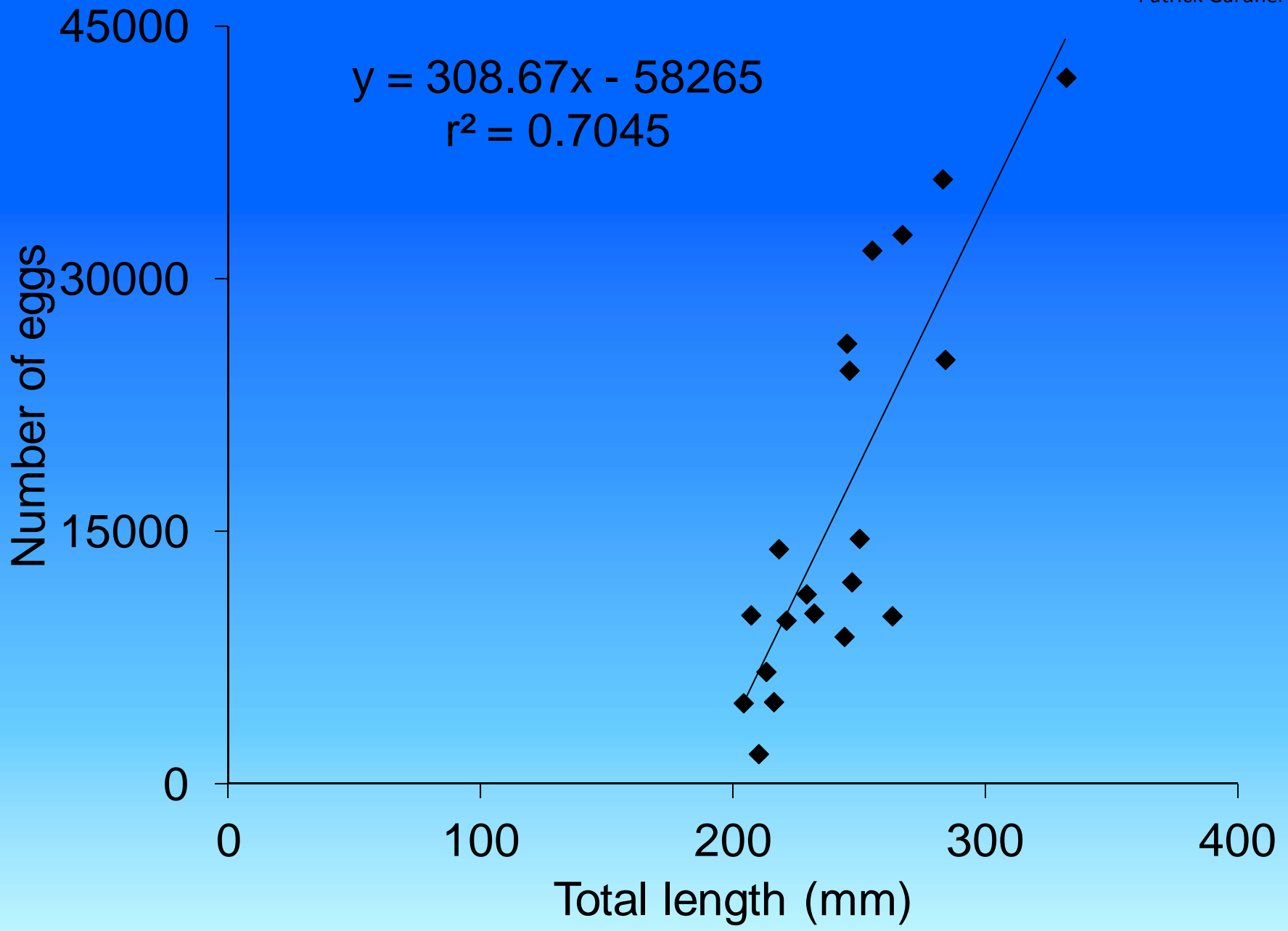
$L_{\infty} = 349$  mm

$K = 0.42$

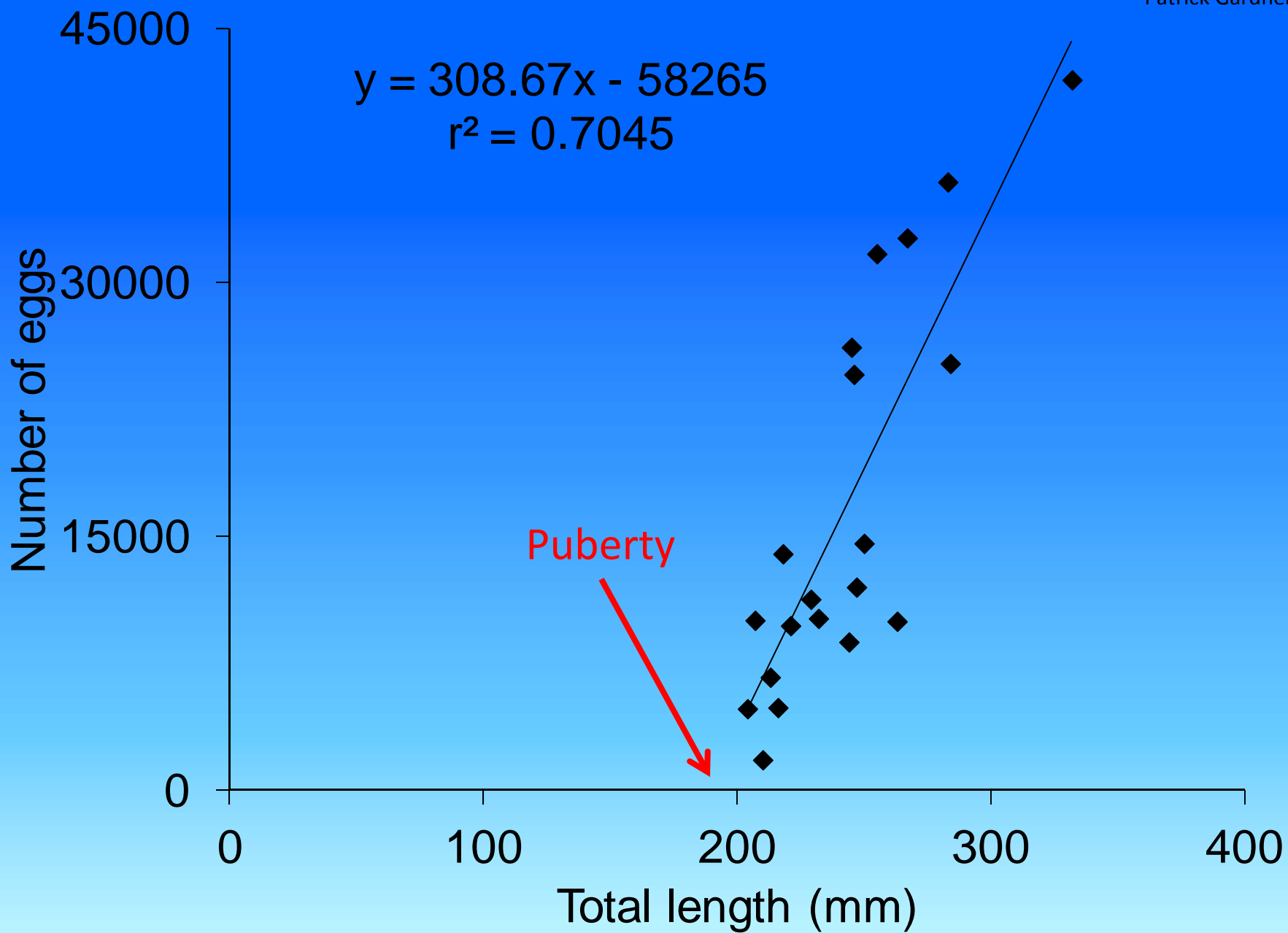
$K$  is high  $\Rightarrow$  hard to 'fish' down

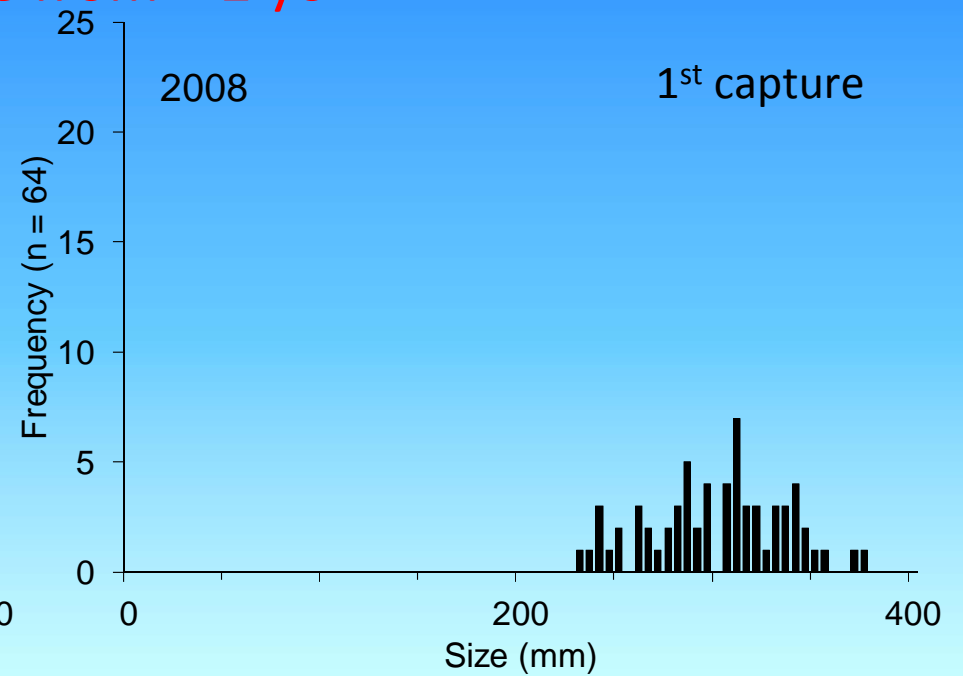
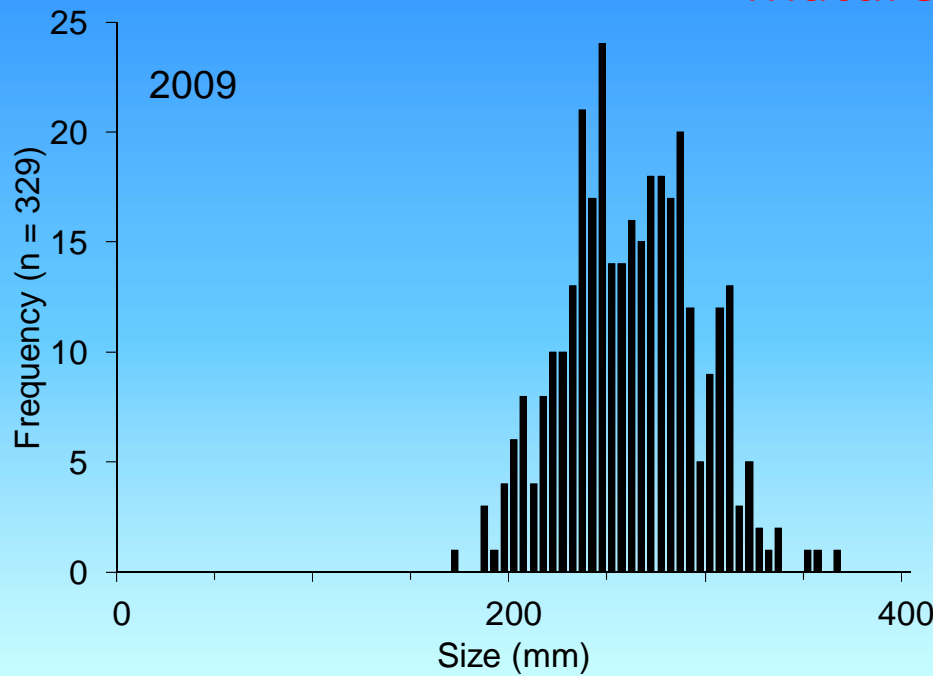
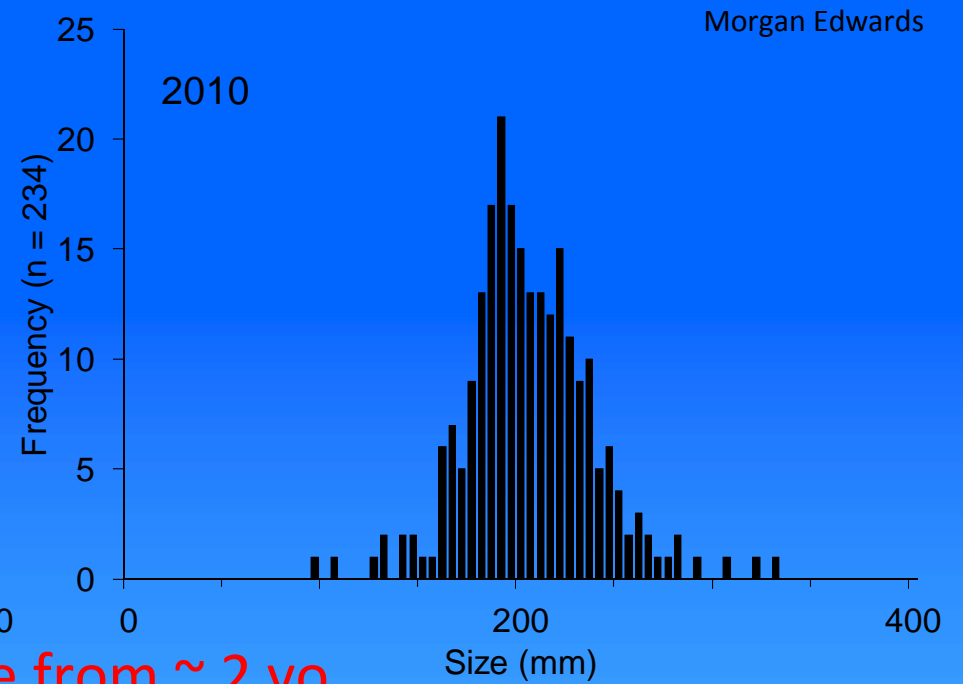
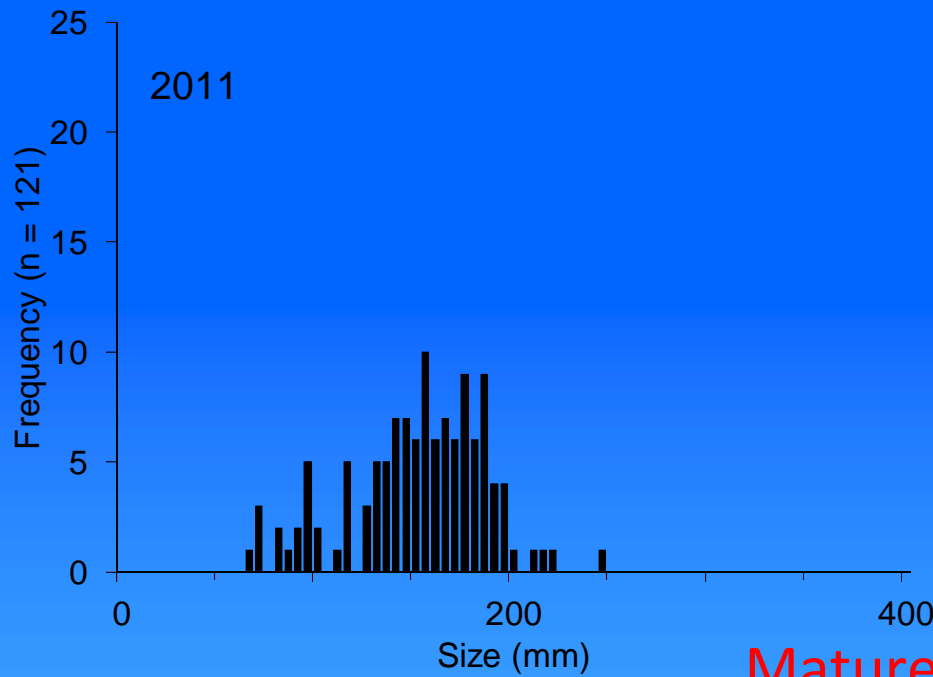
NB ♀♀ reach a smaller  $L_{\infty}$  faster than ♂♂

Grow & repro?

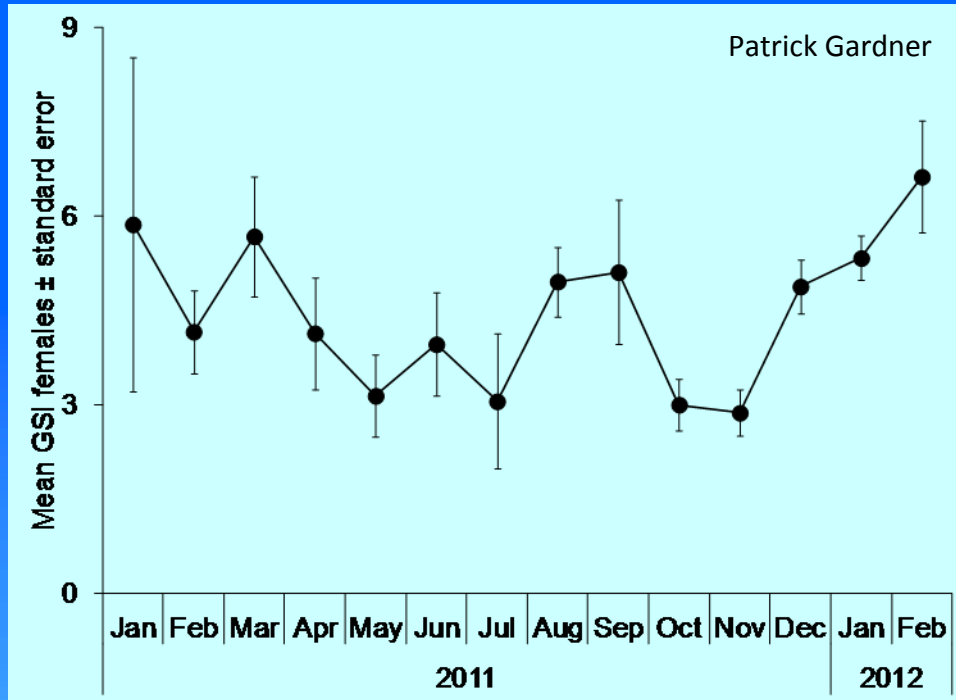








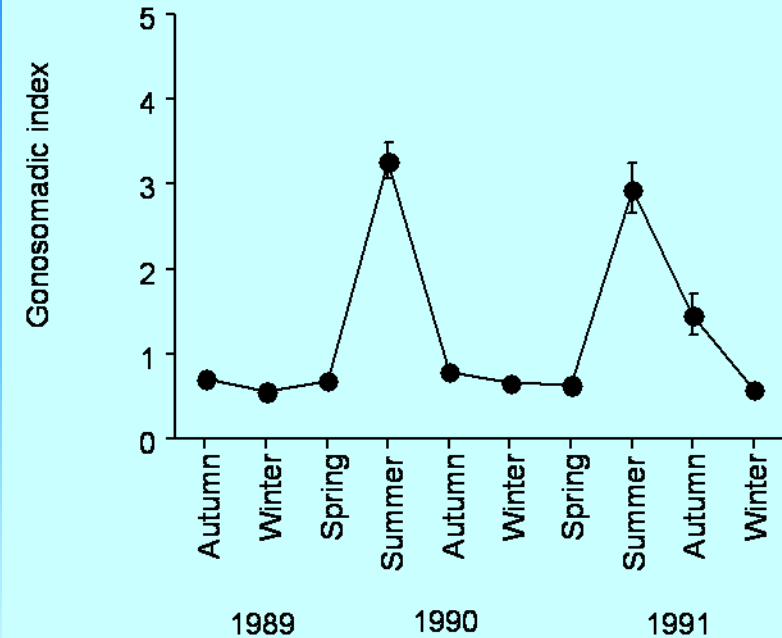
Mature from ~ 2 yo



Gonadosomatic index = GSI =  $\frac{\text{Gonad weight} \times 100}{\text{Body weight}}$

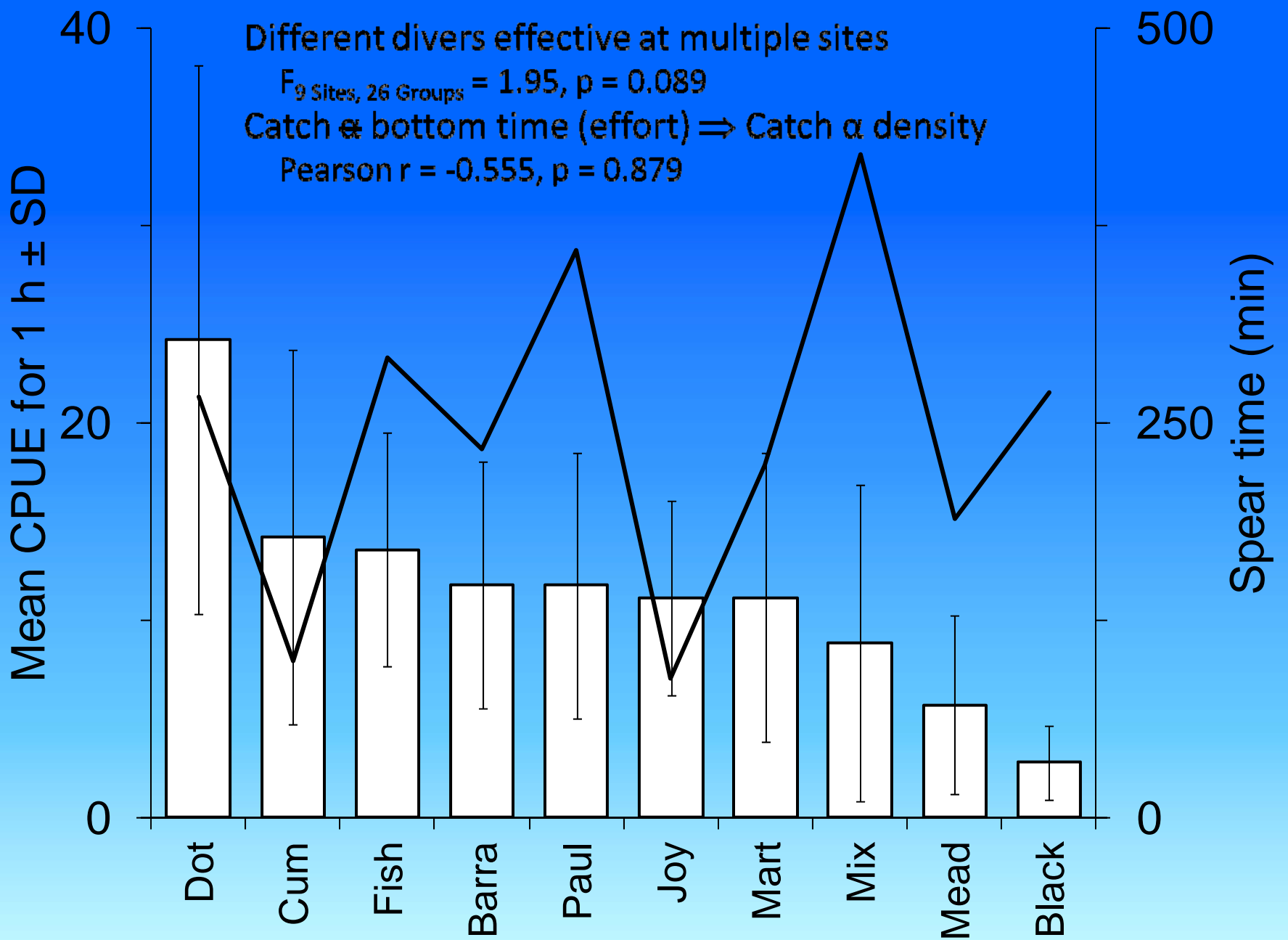
Lionfish reproduction not seasonal  
 May reproduce ea. 3–5 d  
 Confirms Morris' results  
 Lots of larval lionfish

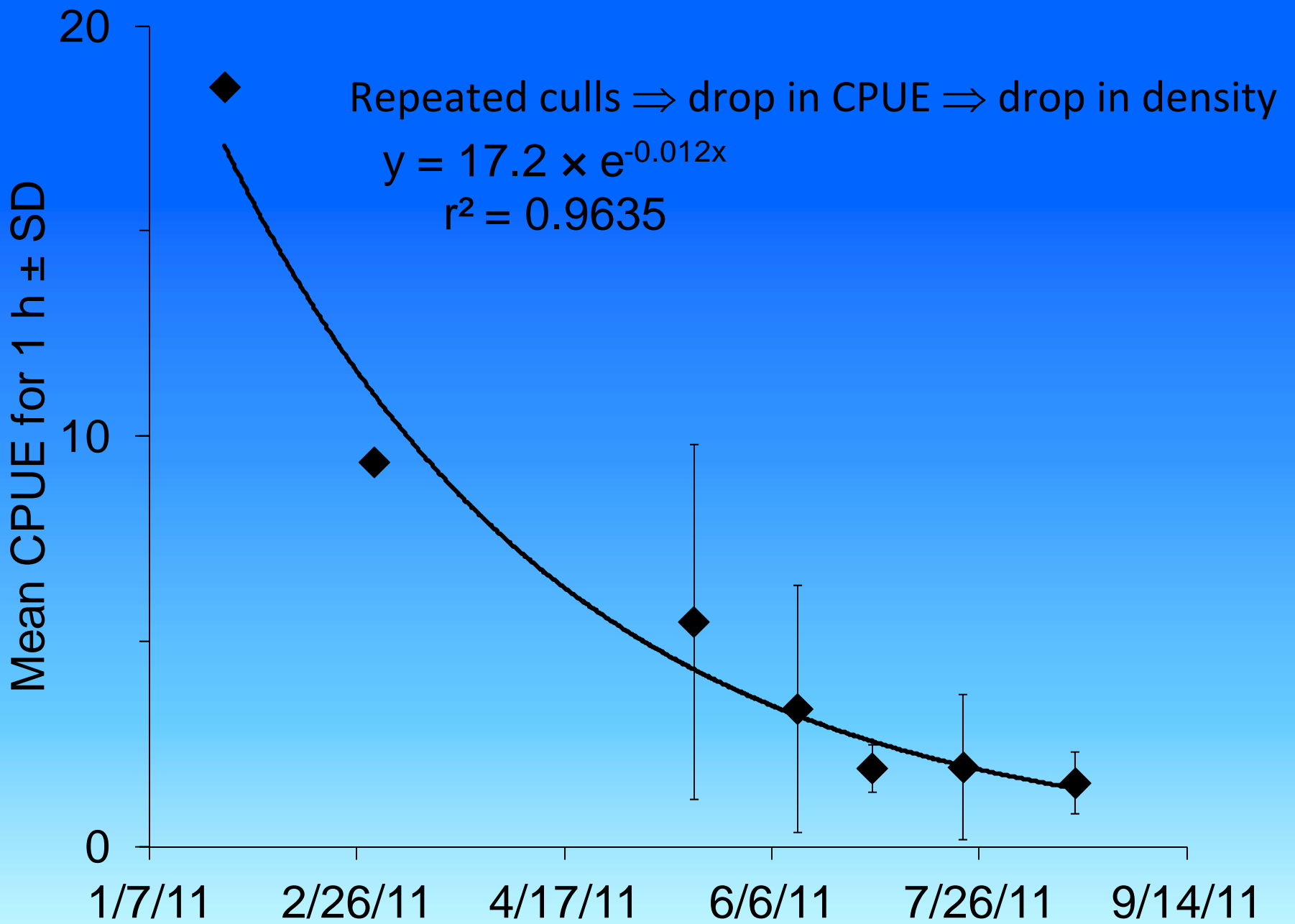
(a) Female sand whiting > 200 mm STL

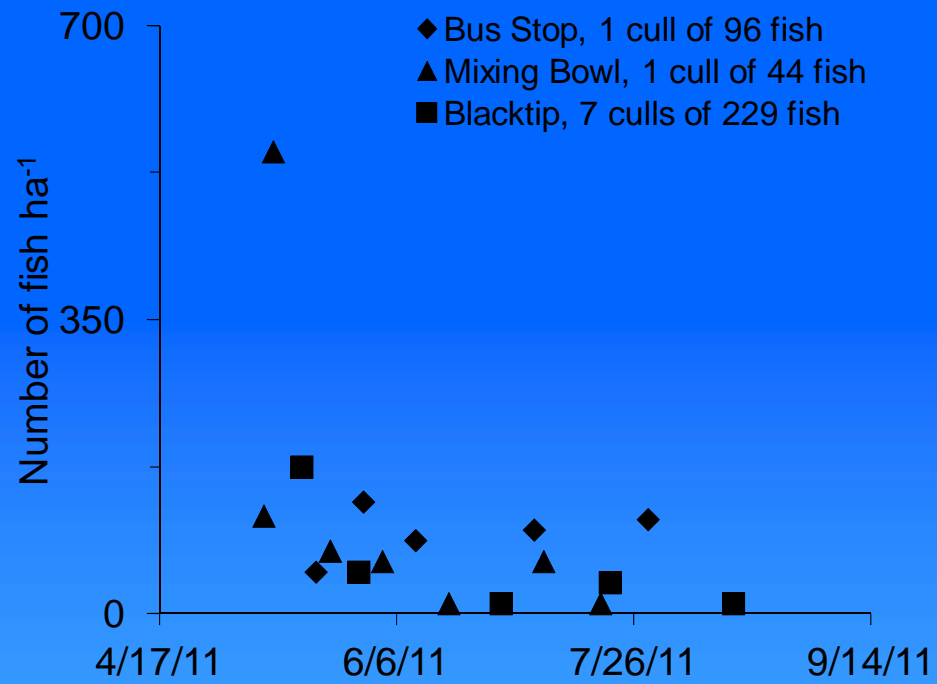


OK, will whacking help?

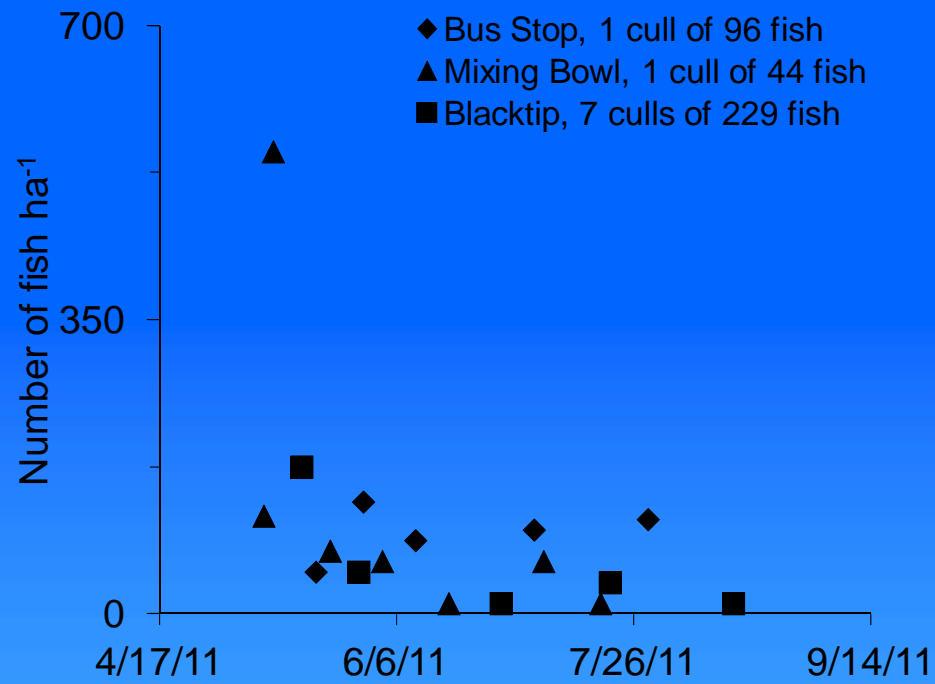
Potentially, yes





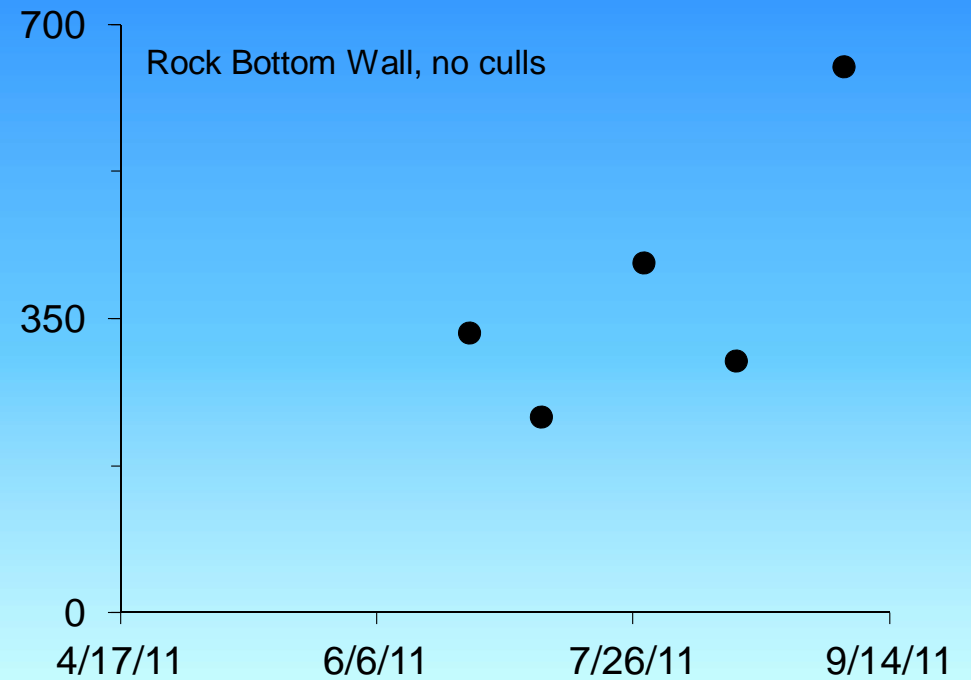


Surveys ⇒  
lionfish densities down  
where culled

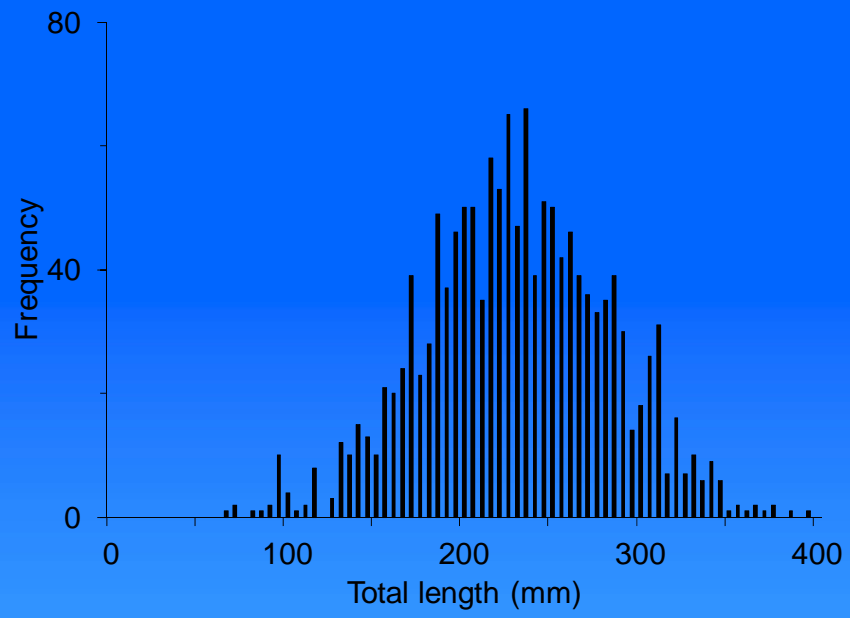


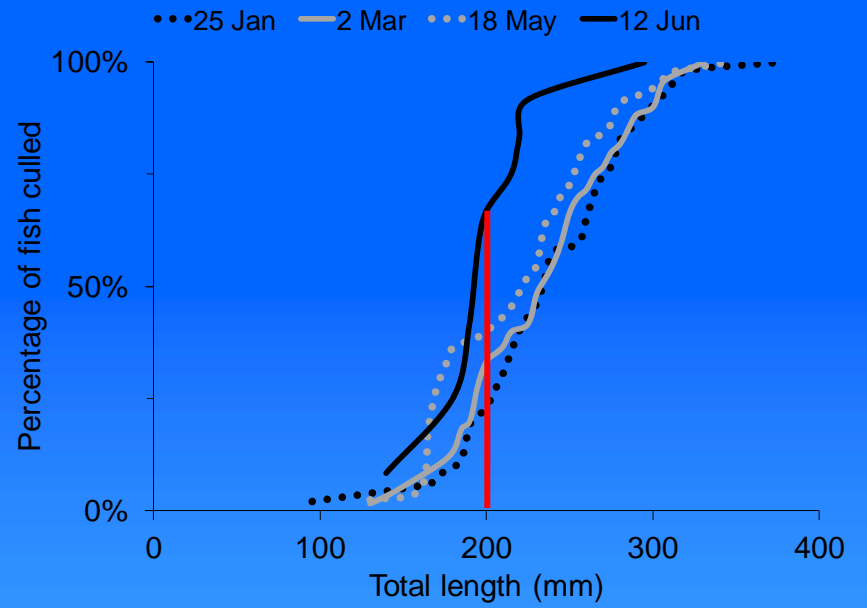
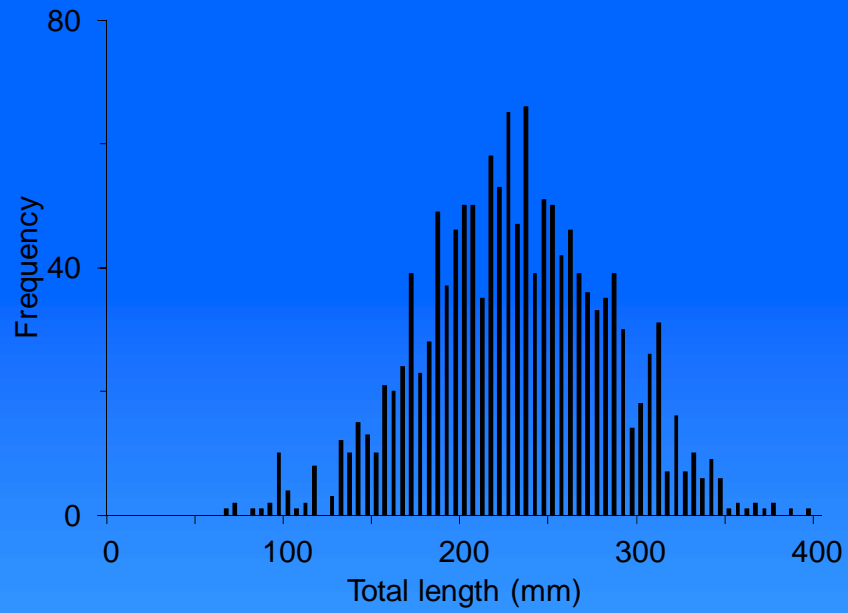
Surveys ⇒  
 lionfish densities down  
 where culled

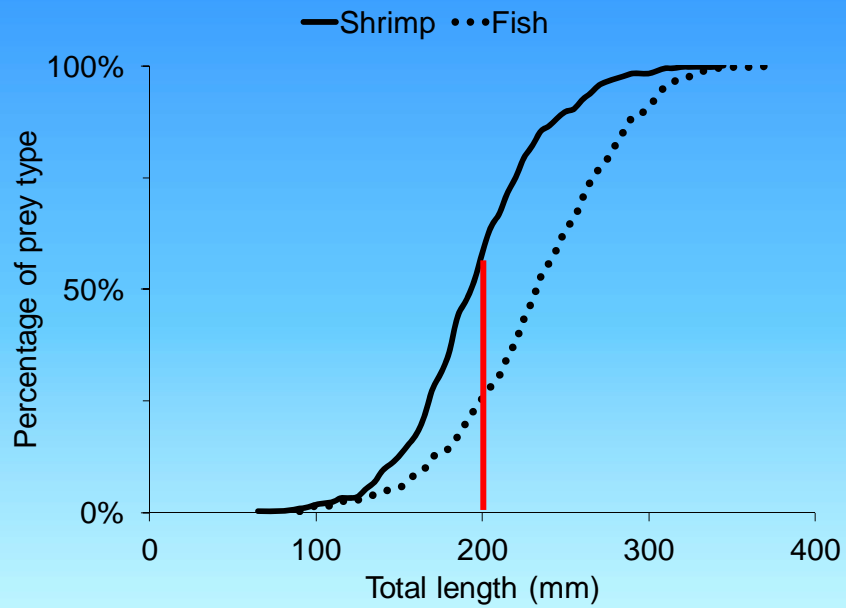
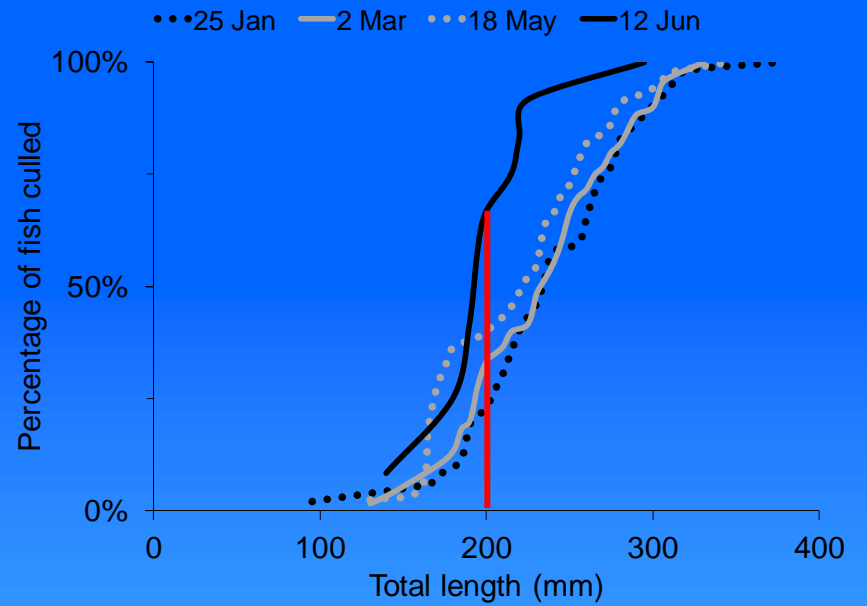
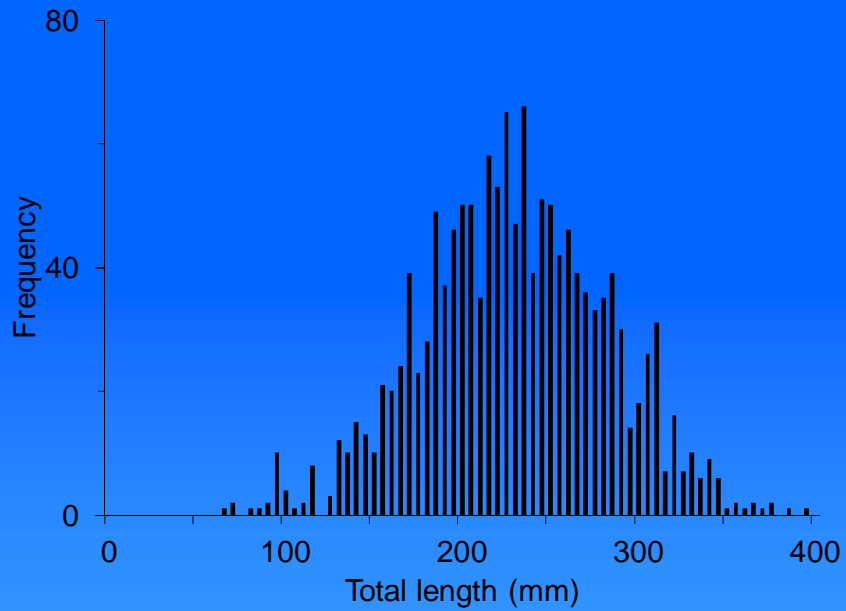
Surveys ⇒  
 lionfish densities stable  
 where not culled  
 Culling not crash





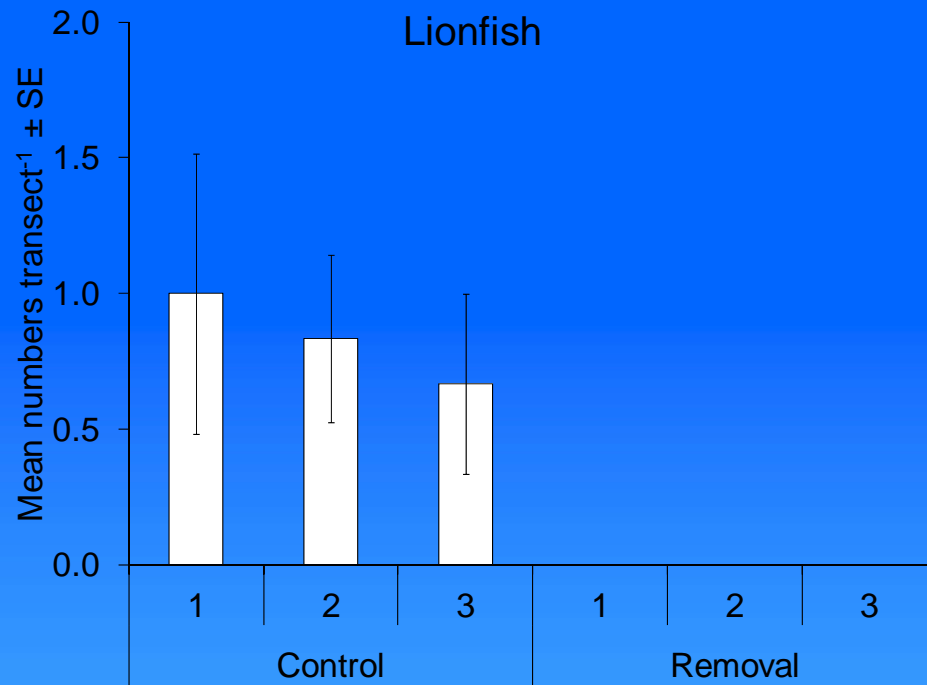




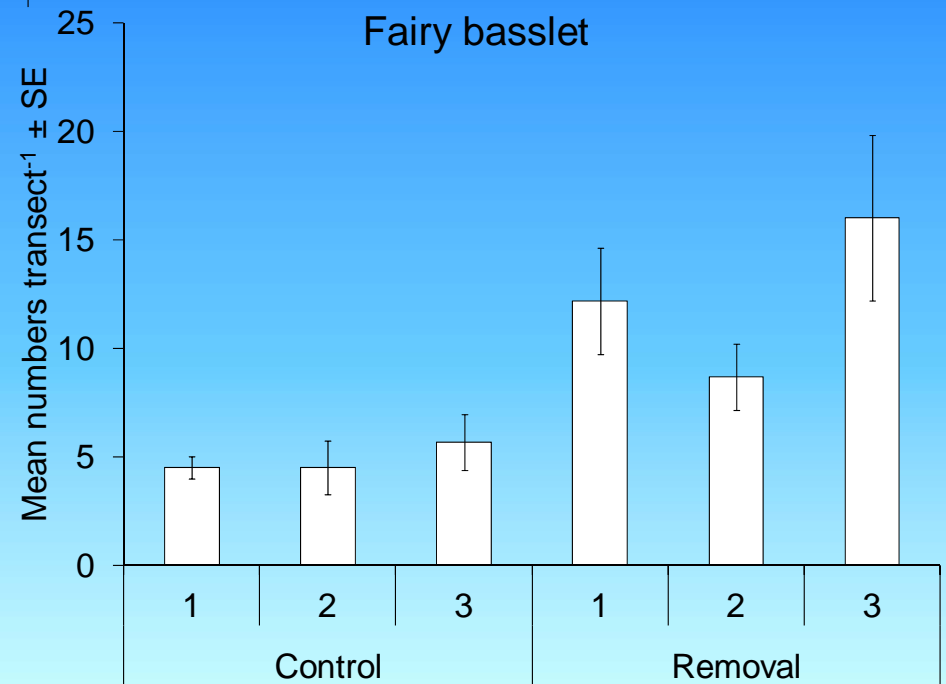


Any help to prey?

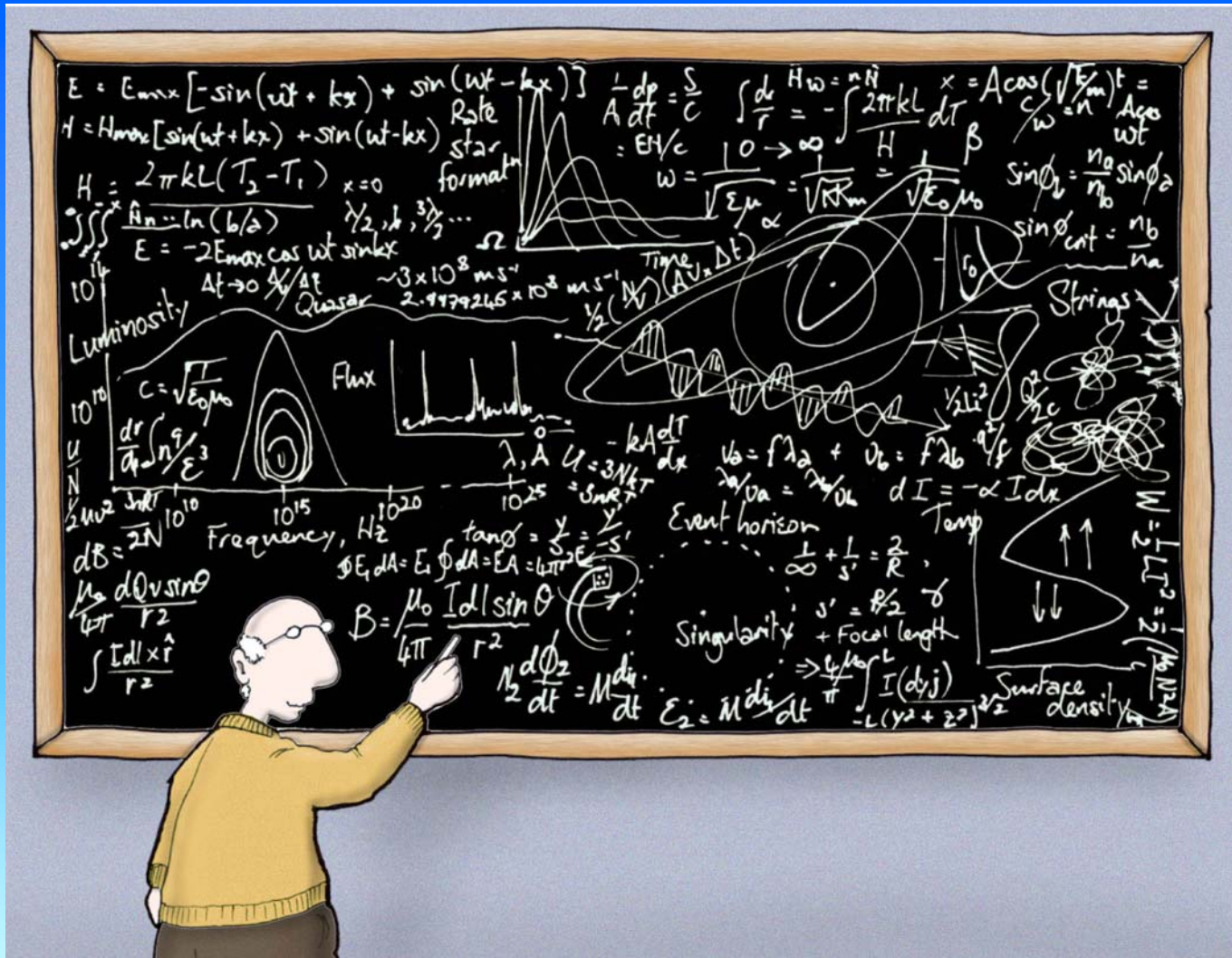
Potentially, yes

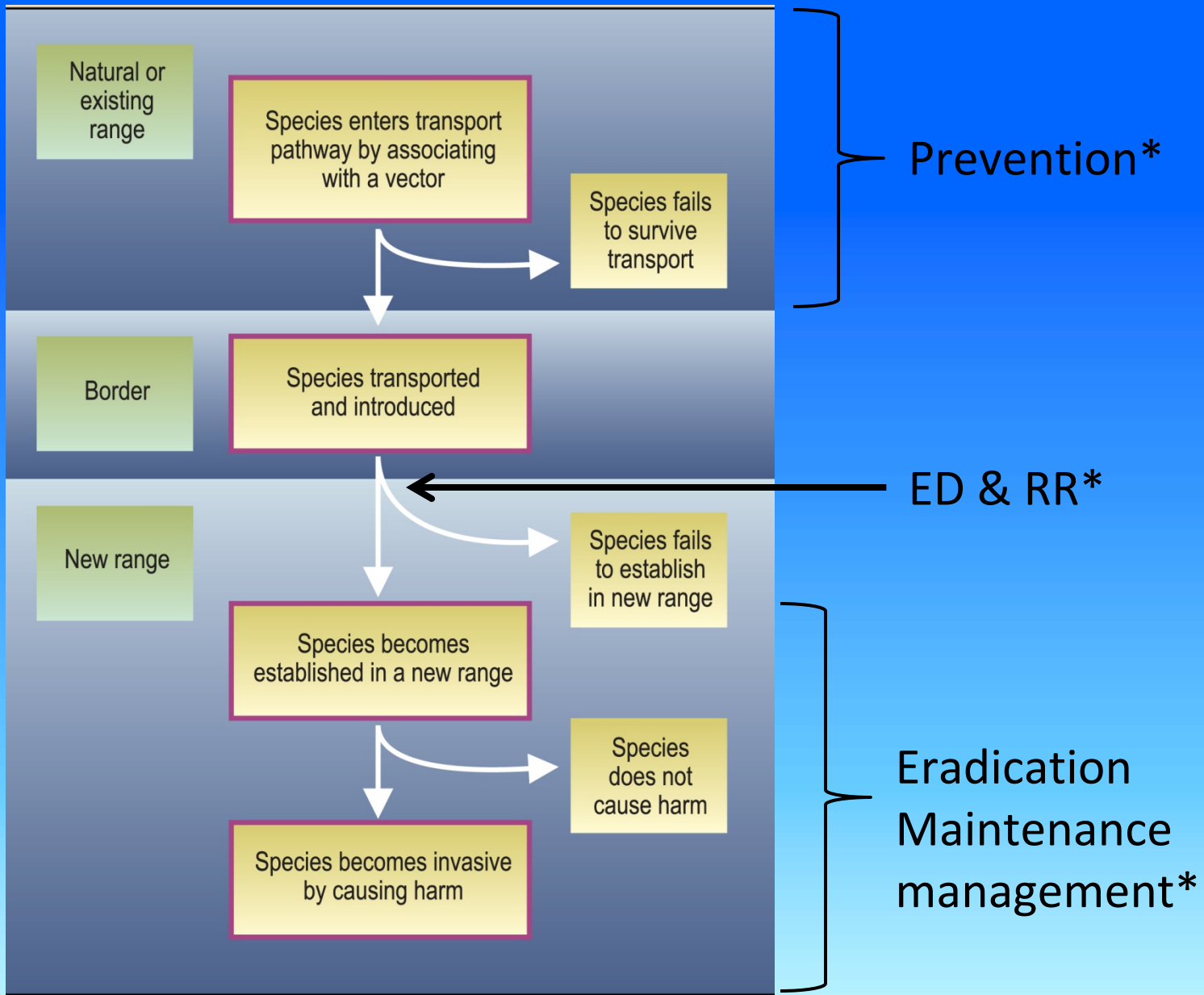


Early days, but things going in the right direction



That's all fine in practice,  
but will it work in theory?

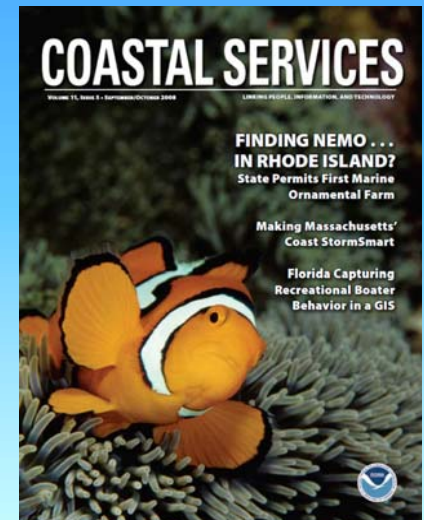




- Prevention = best solution but not easy
  - owners attitudes & behavior
    - one can't matter
    - right to live
    - select 'right spot' for release
    - buy a fish, & when it grows too large, have a family 'release' event before buying another, ...



- Prevention = best solution but not easy
  - owners attitudes & behavior
  - industry attitudes – parse problem
    - Bad Pet Owners
      - “It started out as a high-priority concern,” Watson says, “but it’s been almost taken off the list because it was determined the issue was with the hobbyist, not with the industry. Unless we’re ready to outlaw aquarium keeping, we need to look at educating the pet owner.”
    - sustainable attribution of benefits & costs
      - short-term benefits to relatively few
      - long-term opportunity costs to many



- Prevention = best solution but not easy
- ED & RR requires preparation
  - surveillance
  - plan
  - practice
  - outreach – before & after
    - what you may do
    - what you are doing
    - what you did
  - resources (< maintenance management)

- Prevention = best solution but not easy
- ED & RR requires preparation
  - surveillance
  - plan
  - practice
  - outreach
  - resources
- Maintenance management
  - establishment  $\Rightarrow$  eradication unlikely
  - collect data  $\Rightarrow$  better maintenance management

# Thanks to

- Morgan Edwards
- Savanna Barry
- Patrick Gardner
- Tom Frazer
- Neil van Niekerk
- All the volunteers
- Carrie Manfrino



Questions?