

# West Hawai'i Aquarium Project



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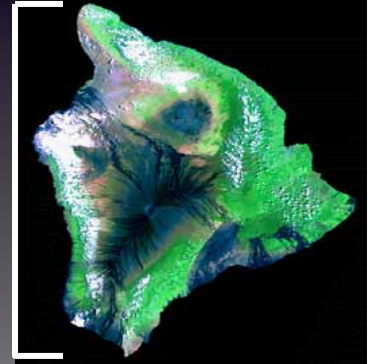
**Dave Pence** University of Hawai'i Mānoa



COASTAL  
OCEAN  
PROGRAM

## Act 306 (1998)

### *West Hawai'i Regional Fisheries Management Area*



Designate  $\geq 30\%$  of coastal waters as  
Fish Replenishment Areas (FRAs)  
where aquarium fish collecting is prohibited

Ensure substantial involvement of the  
Community in resource management decisions

Evaluate effectiveness after 5 years  
in cooperation with the University of Hawai'i

# WHAP

*Evaluate the effectiveness of a marine reserve network in Hawai'i*



*Evaluate impact of reserve network on aquarium fishery*

# WHAP Study Sites

- Open Sites
- MPA Sites
- FRA Sites
- 100 Fathom Contour
- Fish Replenishment Areas

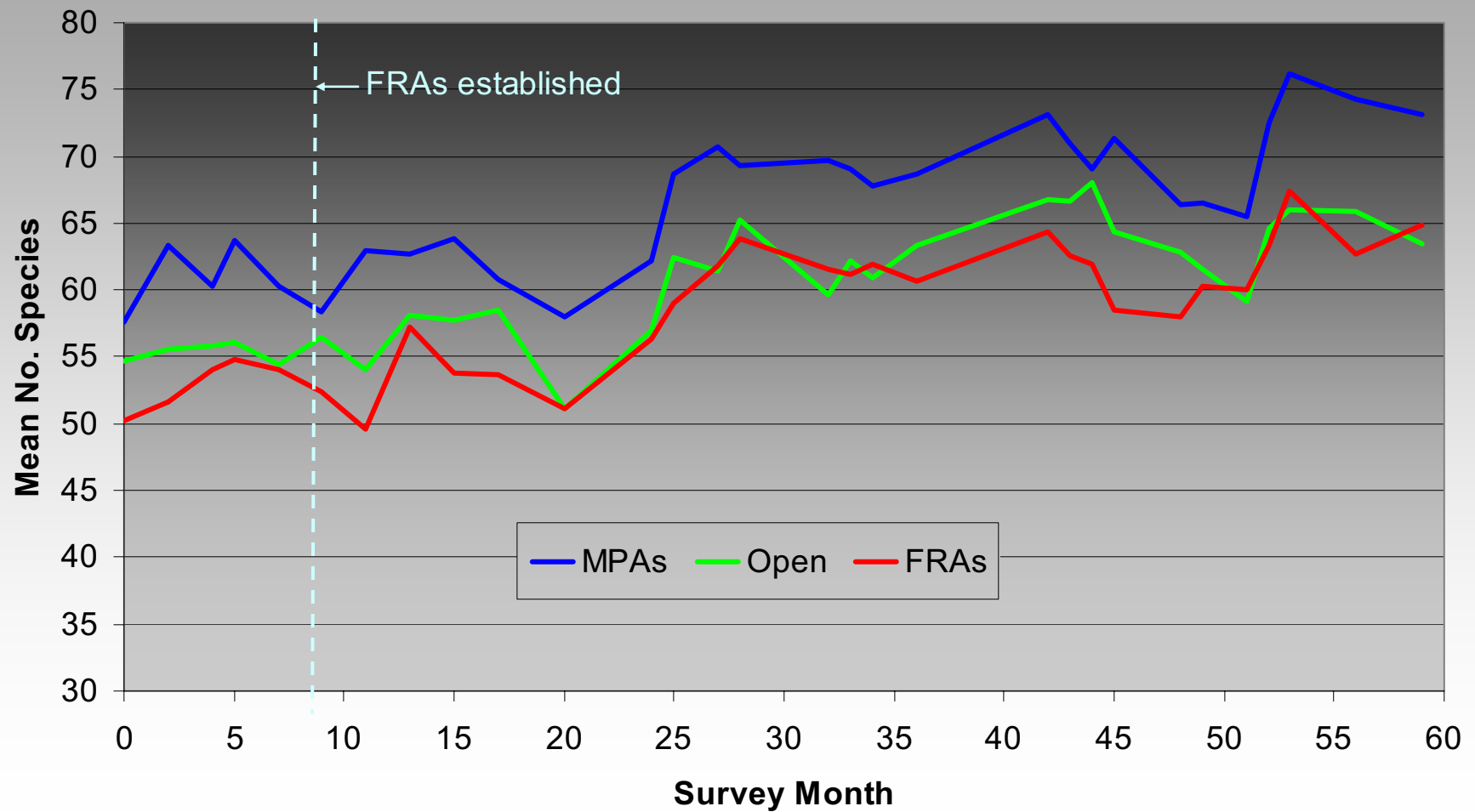


Map Projection: UTM Zone 4 1:600,000  
Data Provided by: State of Hawaii  
Map Created by: Lisa Wedding 6/27/02



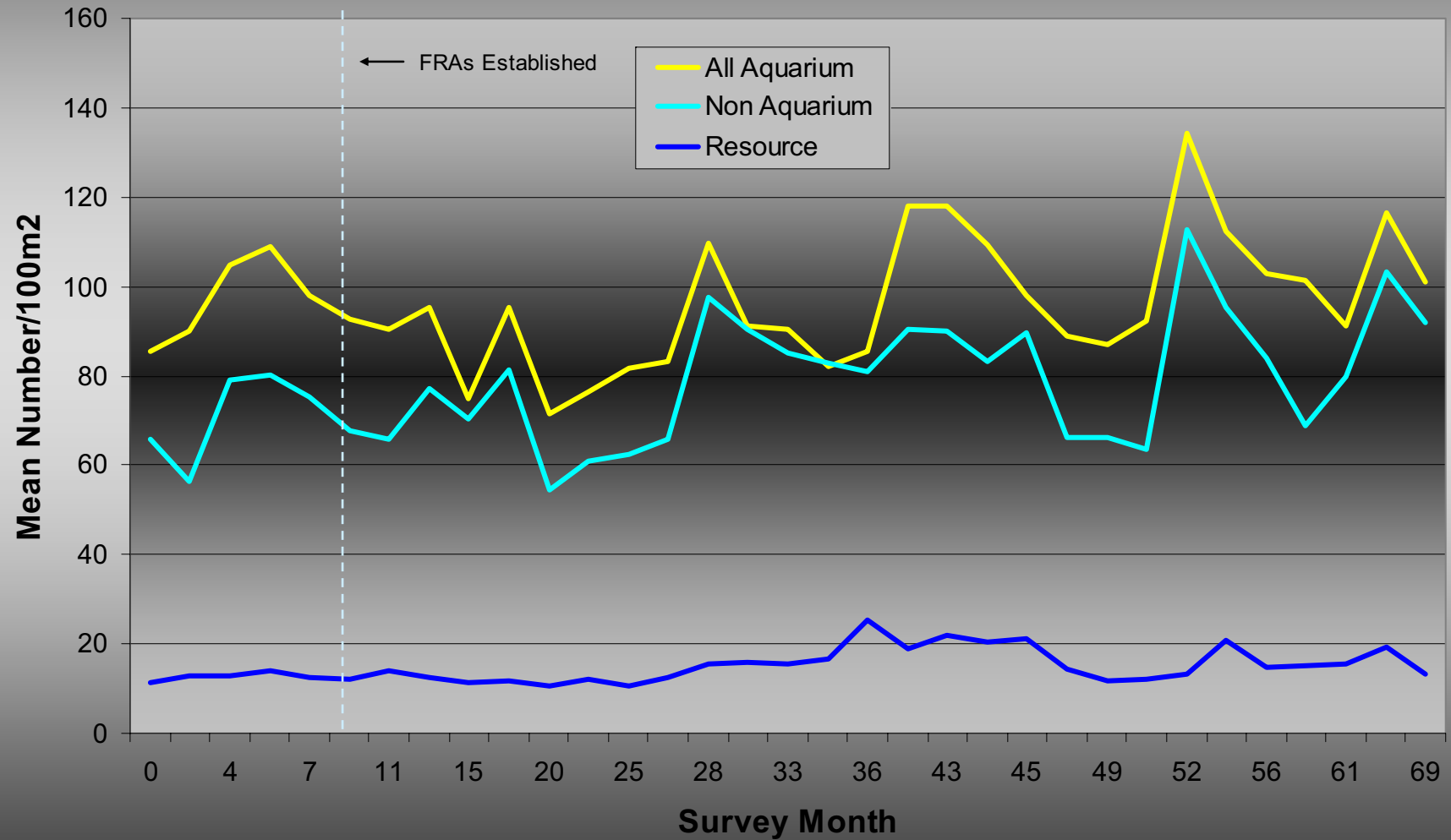
8 0 8 16 Miles

## Species Abundance at Study Sites

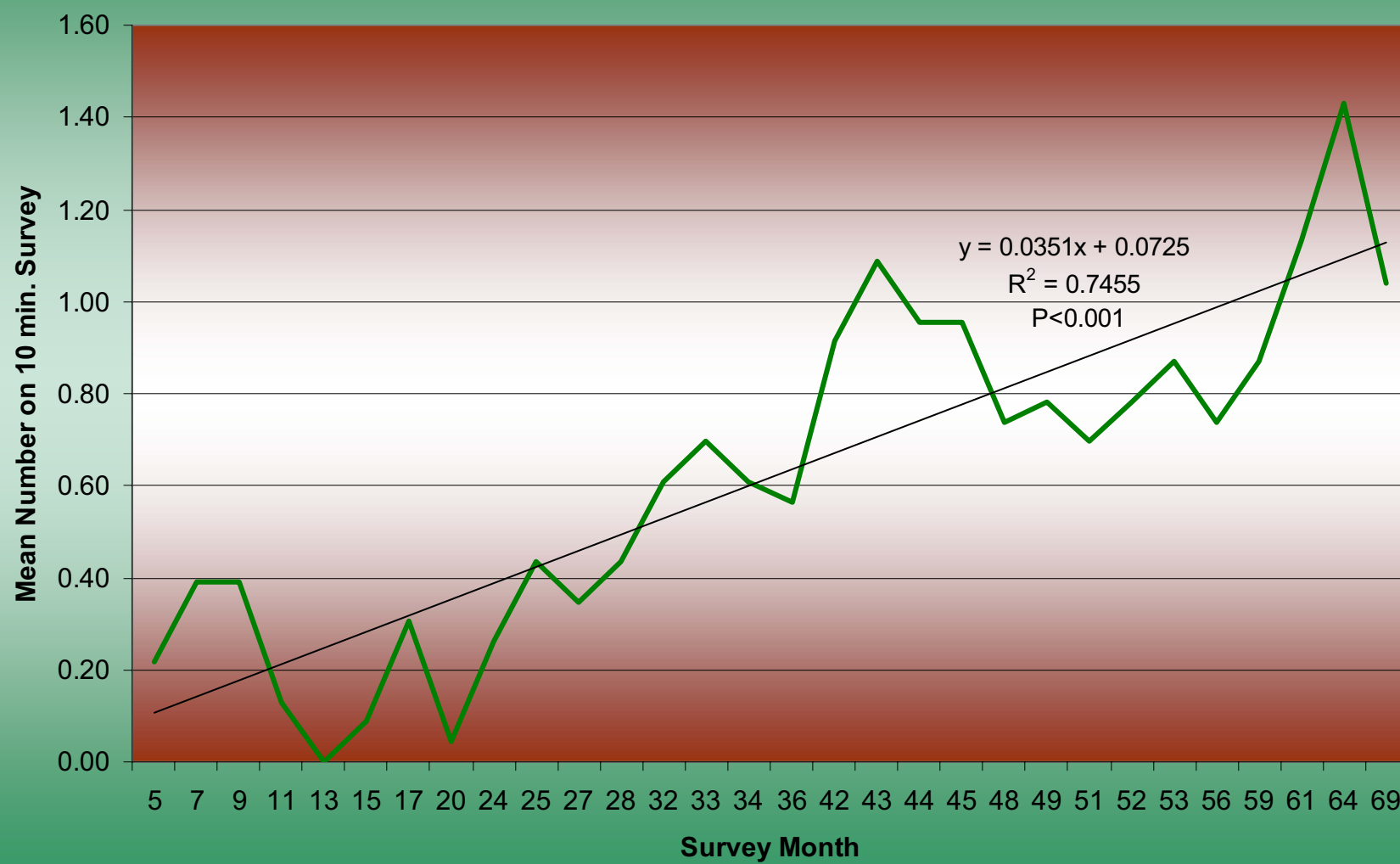




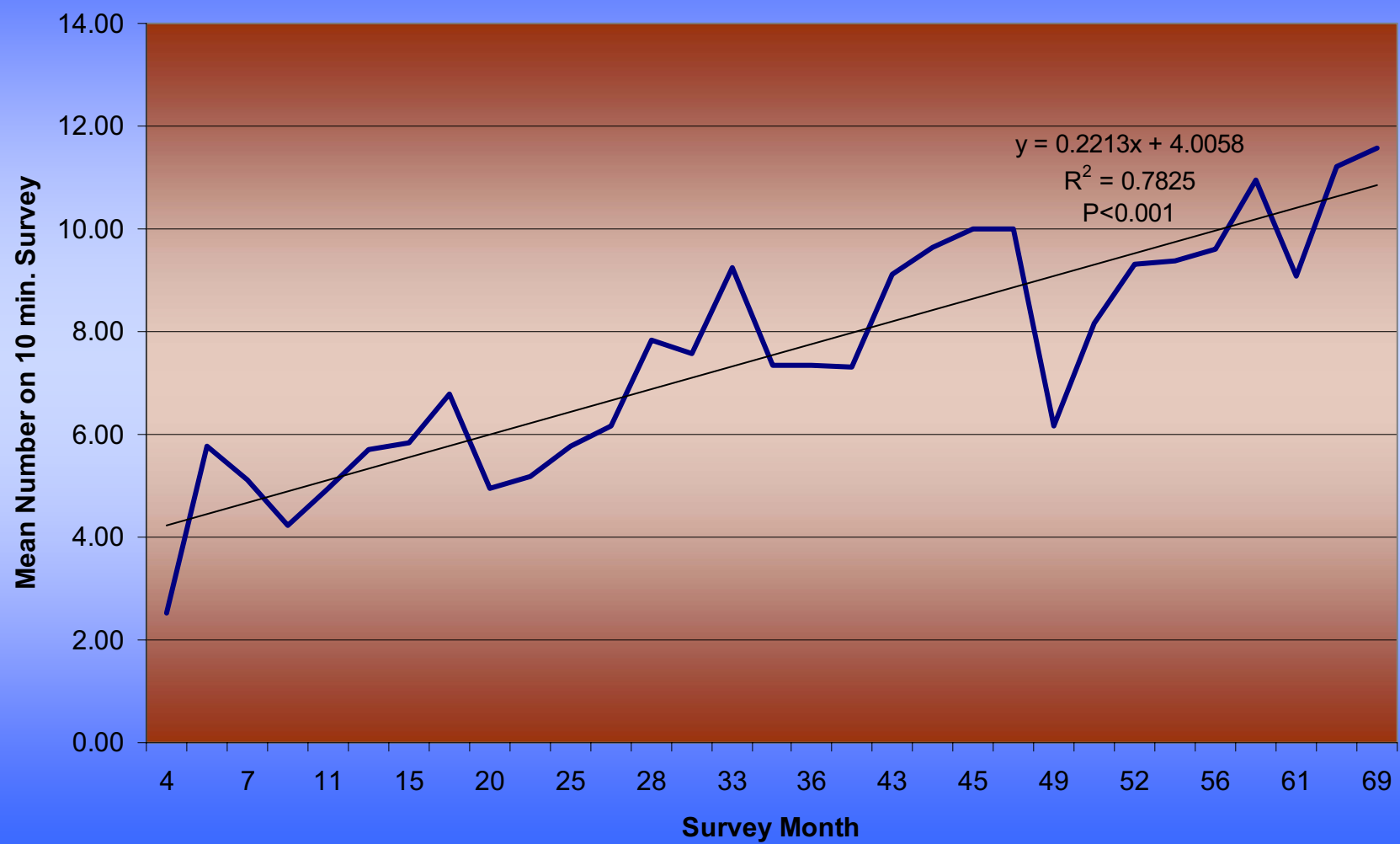
## Fish Density at Study Sites



## *Acanthaster* Abundance at Study Sites (n=23)

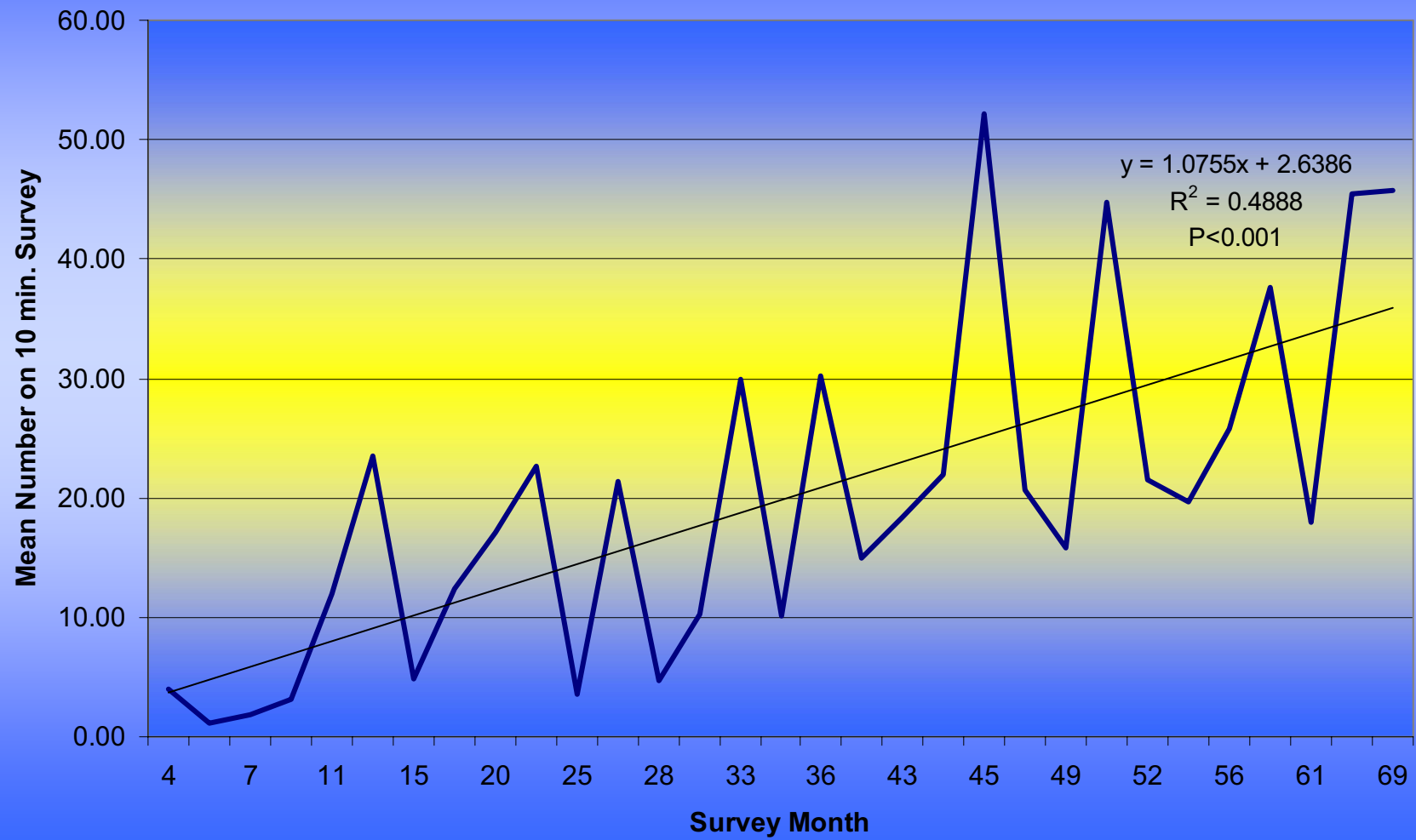


## ***Cephalopolis argus* Abundance at Study Sites (n=23)**





### *Lutjanus kasmira* Abundance at Study Sites (n=23)



## Overall FRA Effectiveness for fishes

Group	Overall % Change in Density	R	P
All aquarium fishes	+6%	+7%	0.28
Top 10 aquarium species	+16%	+8%	0.51
Resource fishes	+55%	+20%	0.79
<b>Non-aquarium fishes</b>	+8%	<b>-81%</b>	<b>0.01*</b>

\* P < 0.10

### Before-After Control-Impact (BACI)

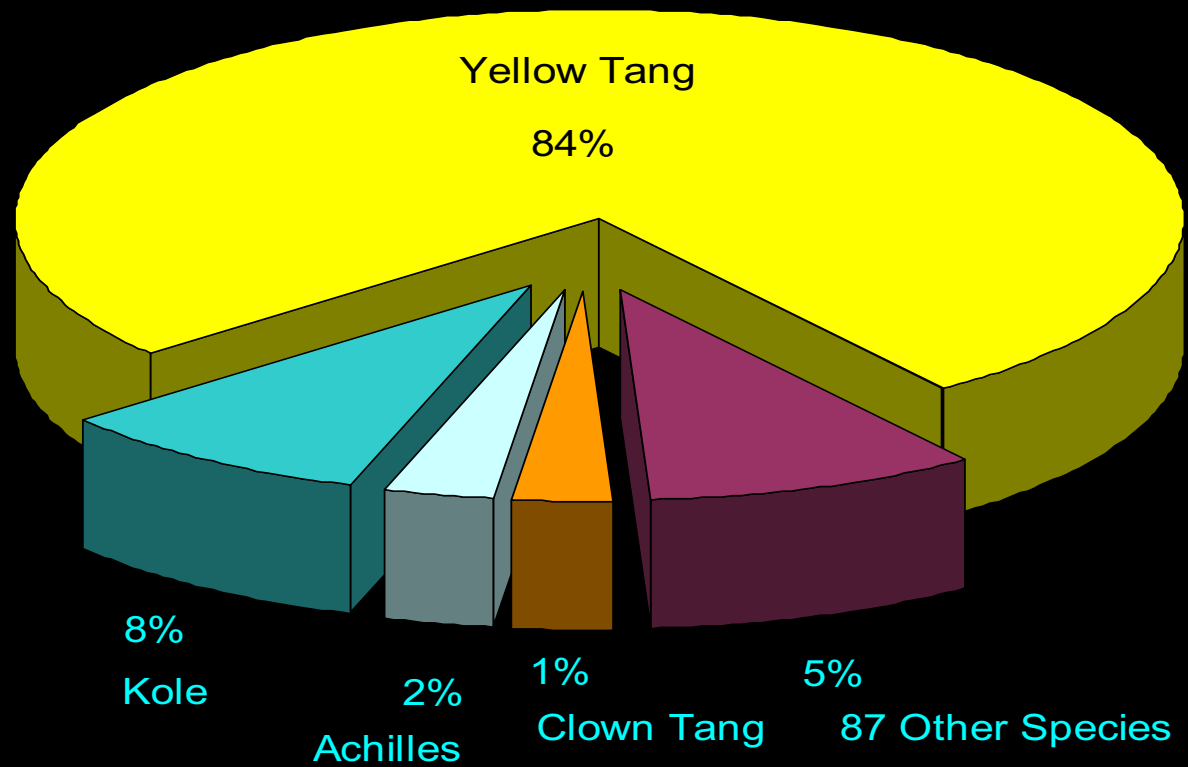
$$R = \left[ \frac{\sum_{i=1}^{t_{after}} \bar{X}_{control} - \bar{X}_{FRA}}{t_{after}} \right] - \left[ \frac{\sum_{i=1}^{t_{before}} \bar{X}_{control} - \bar{X}_{FRA}}{t_{before}} \right] \times 100$$

## Overall FRA Effectiveness for the top ten aquarium collected fishes

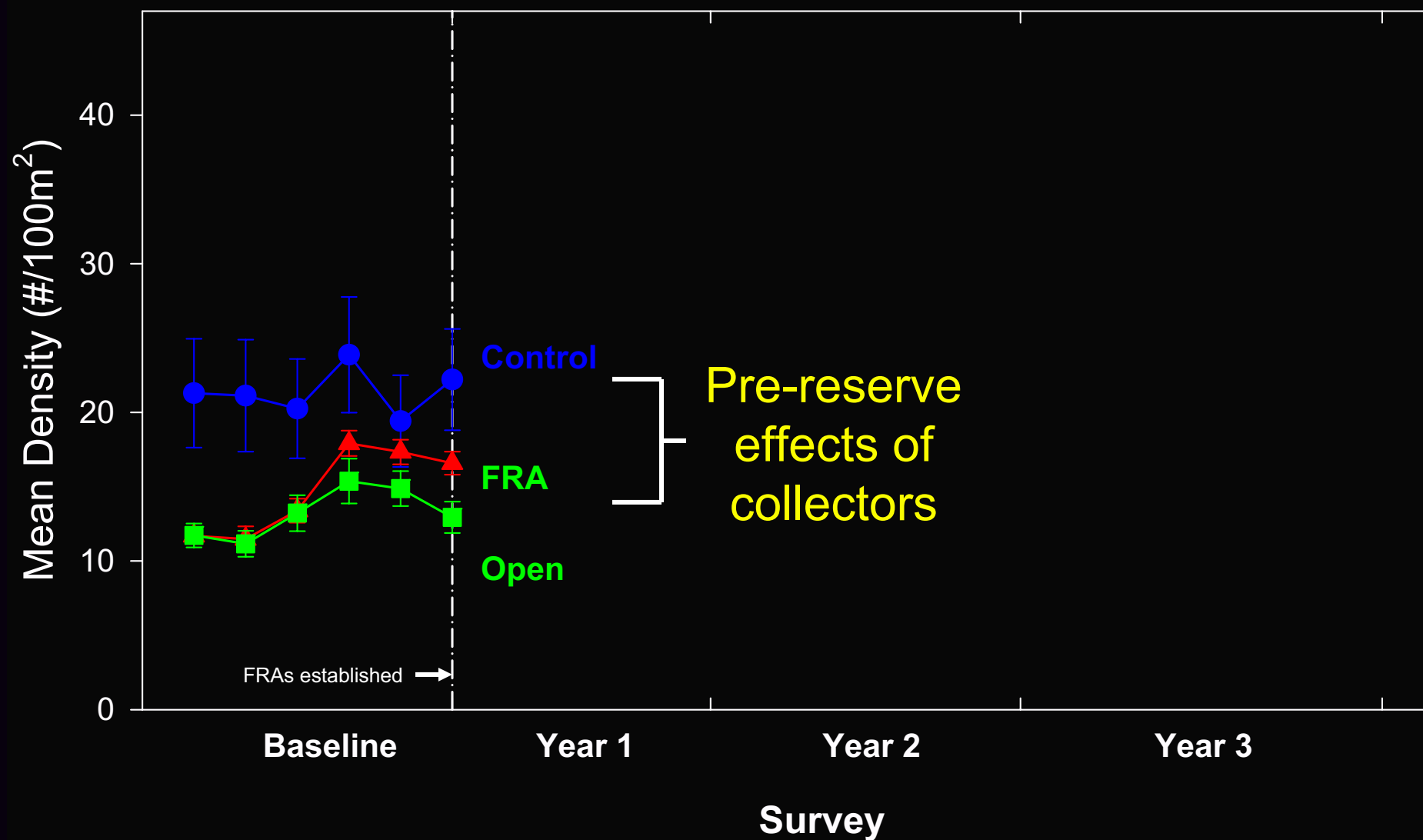
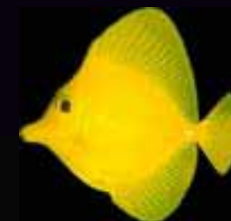
Common name	Scientific name	Mean density (No/100m <sup>2</sup> )		Overall % change in density	R
		Before	After		
<b>Yellow Tang</b>	<i>Zebrasoma flavescens</i>	14.7	21.8	+48%	<b>+49%*</b>
Kole	<i>Ctenochaetus strigosus</i>	31.0	33.3	+07%	-3.8%
Achilles Tang	<i>Acanthurus achilles</i>	0.24	0.30	+26%	-46%
Clown Tang	<i>Naso lituratus</i>	0.75	0.84	+11%	-41%
<b>Chevron Tang</b>	<i>Ctenochaetus hawaiiensis</i>	0.22	0.23	+02%	<b>+141%*</b>
Longnose and Forcepsfish	<i>Forcipiger spp.</i>	0.73	0.77	+06%	+65%
Fourspot Butterflyfish	<i>Chaetodon quadrimaculatus</i>	0.03	0.06	+100%	+116%
Ornate Butterflyfish	<i>Chaetodon ornatissimus</i>	0.87	0.75	-14%	+27%
Multiband Butterflyfish	<i>Chaetodon multicinctus</i>	5.71	5.02	-12%	-15%
Hawaiian Cleaner Wrasse	<i>Labroides phthiophagus</i>	0.88	0.73	-18%	+30%

\* P < 0.10

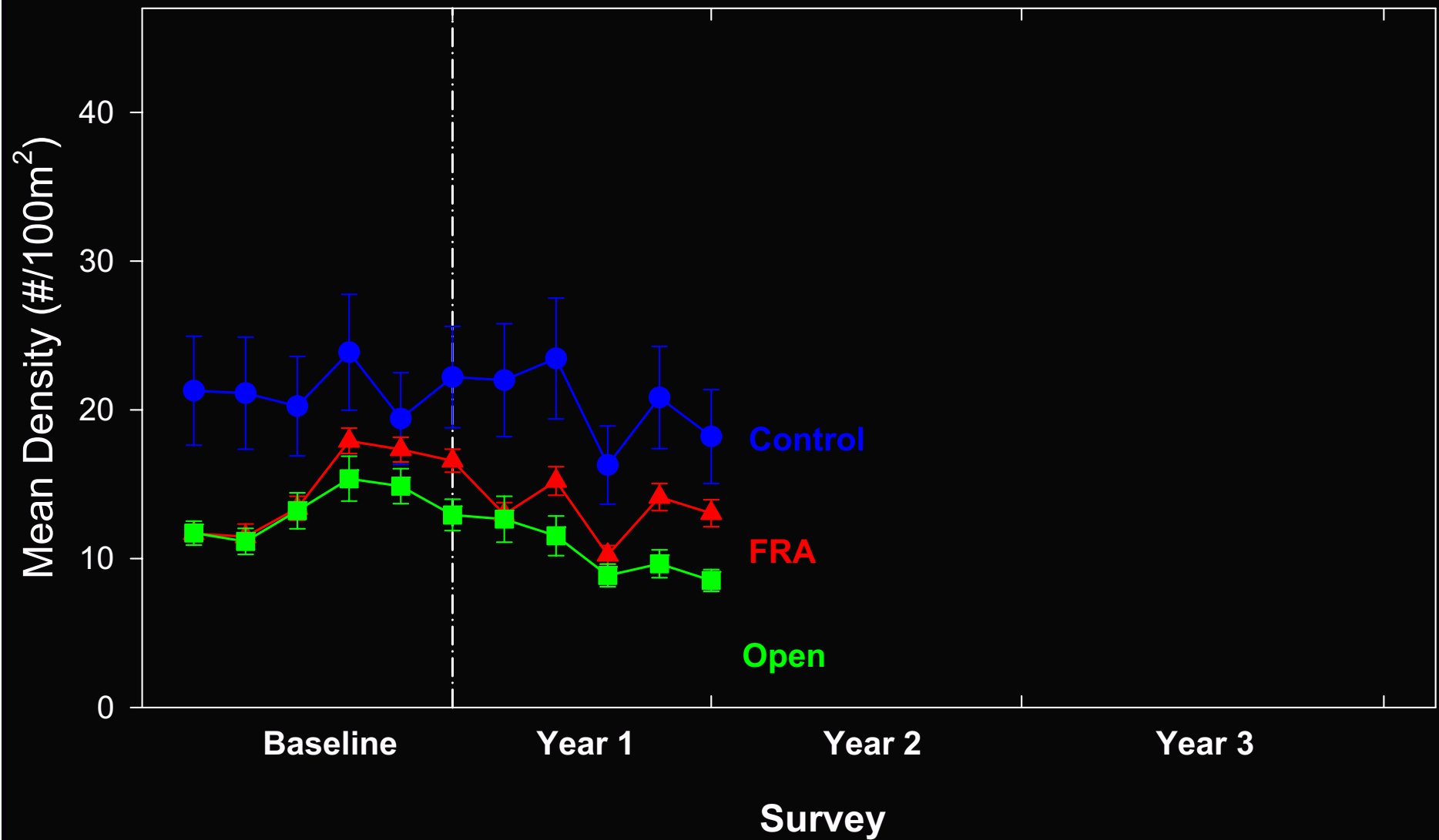
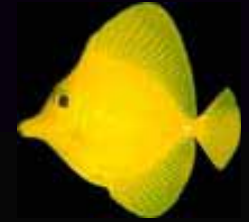
## Big Island Aquarium Catch Fiscal Year 2004



# *Zebrasoma flavescens*

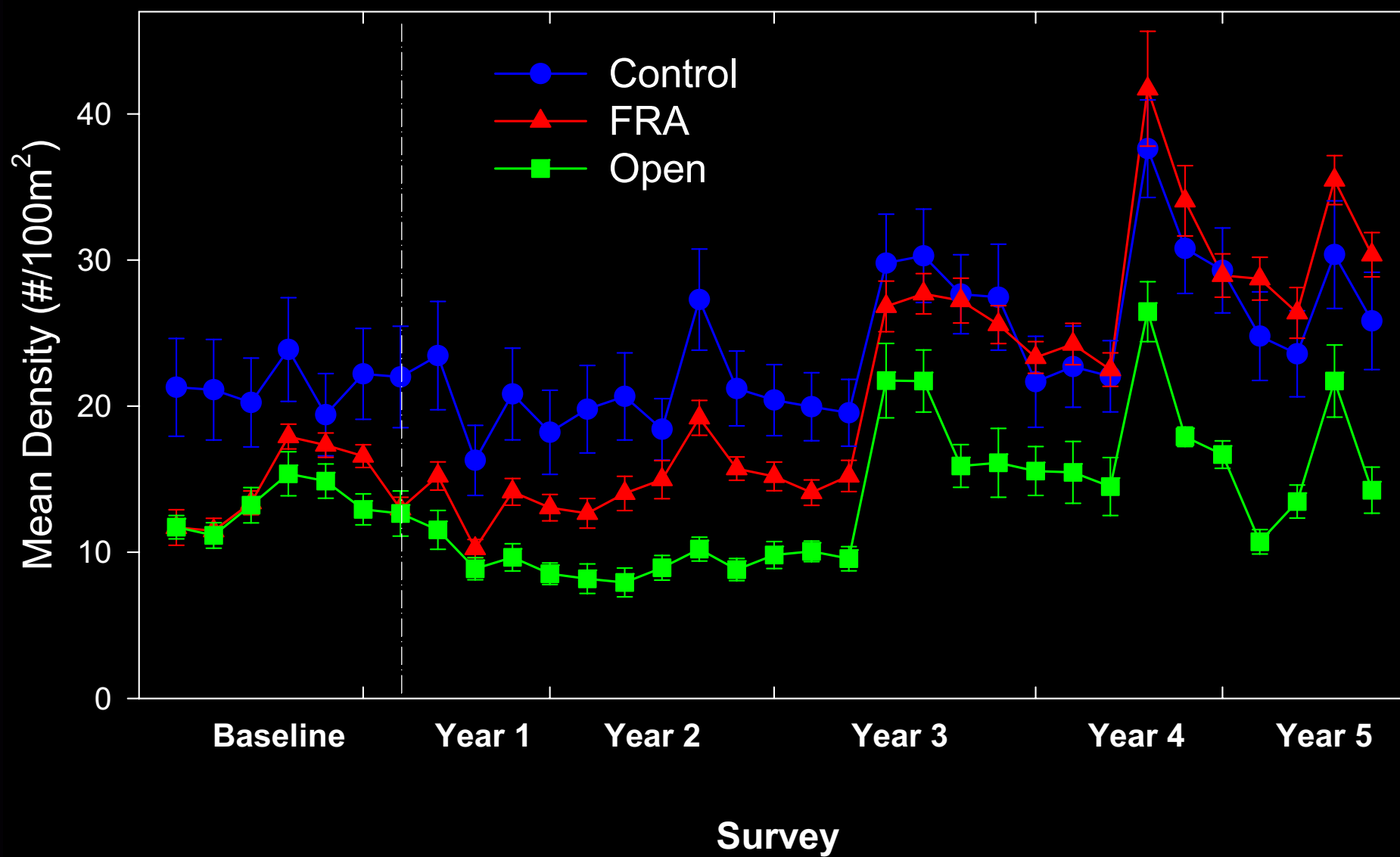


# *Zebrasoma flavescens*





## *Zebrasoma flavescens*

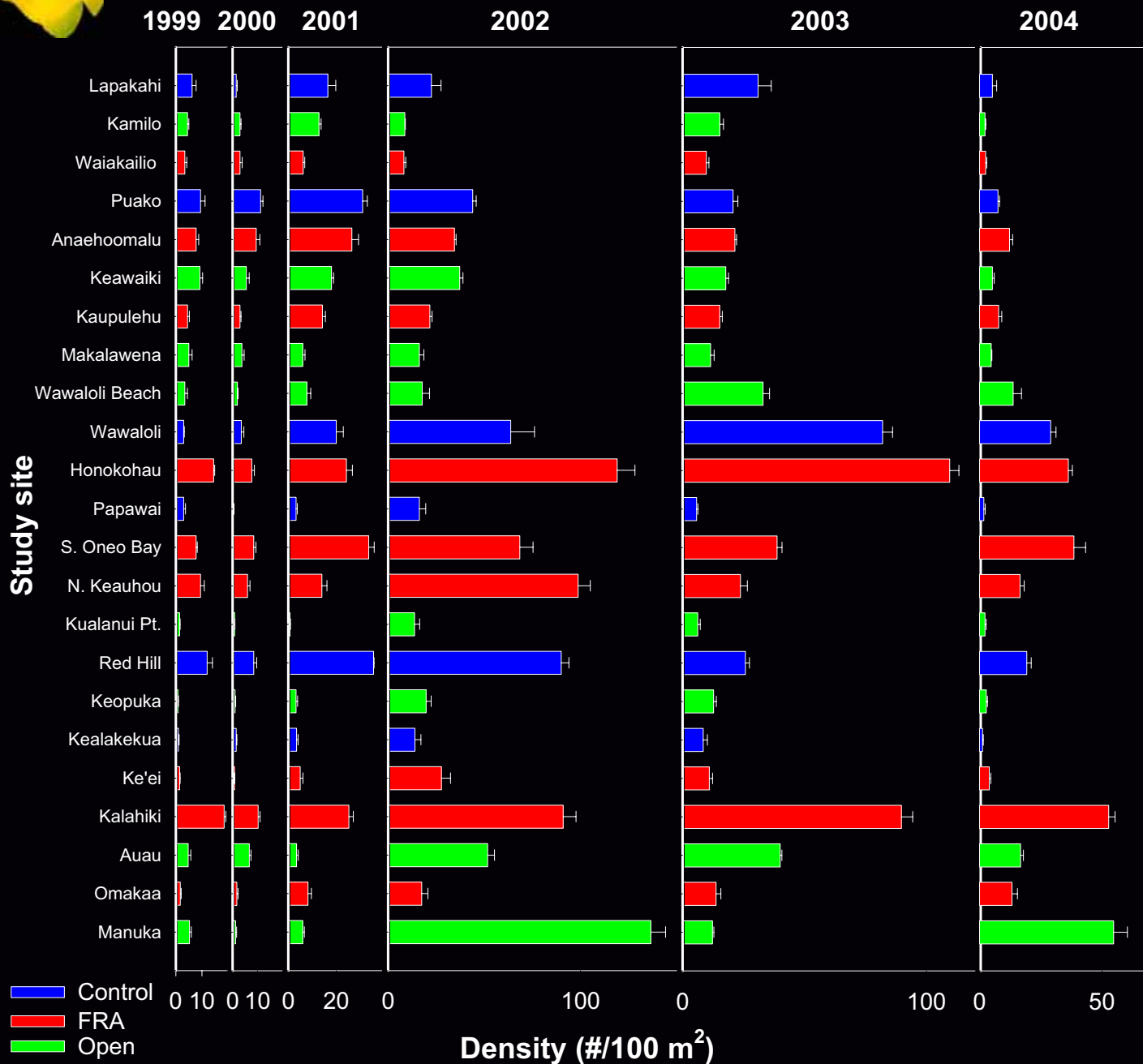






# *Zebrasoma flavescens* YOY

$r = .63^*$

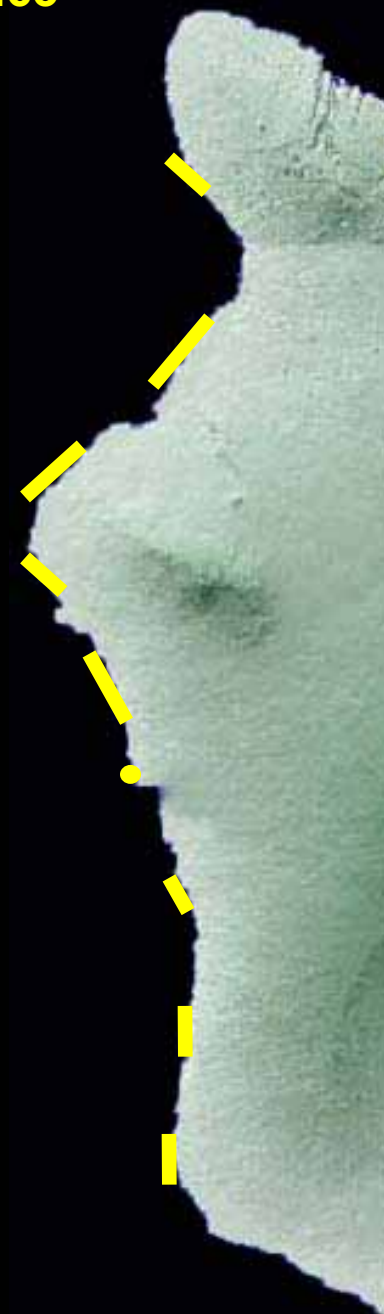
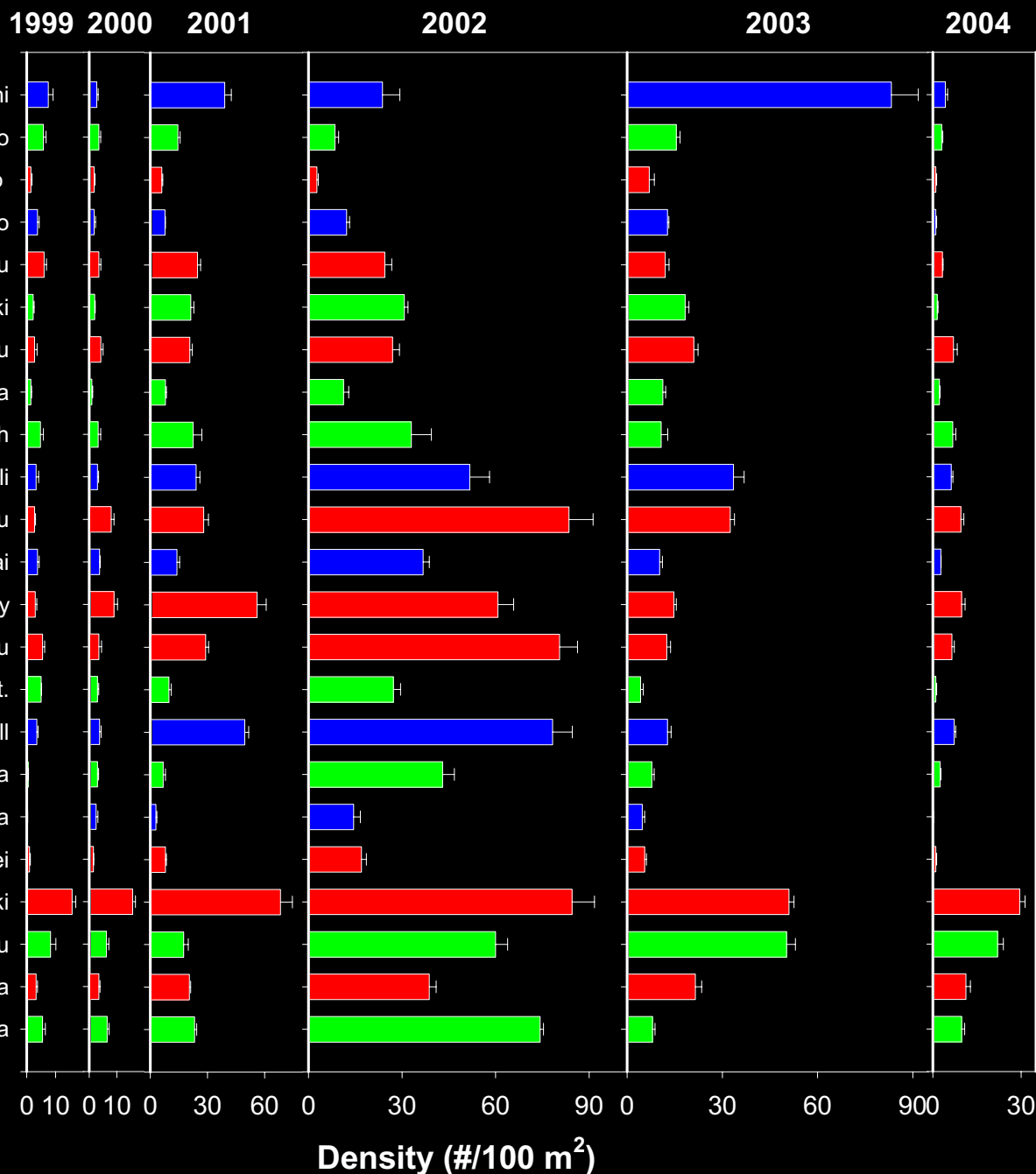


# *Ctenochaetus strigosus* YOY

$r = .63^*$



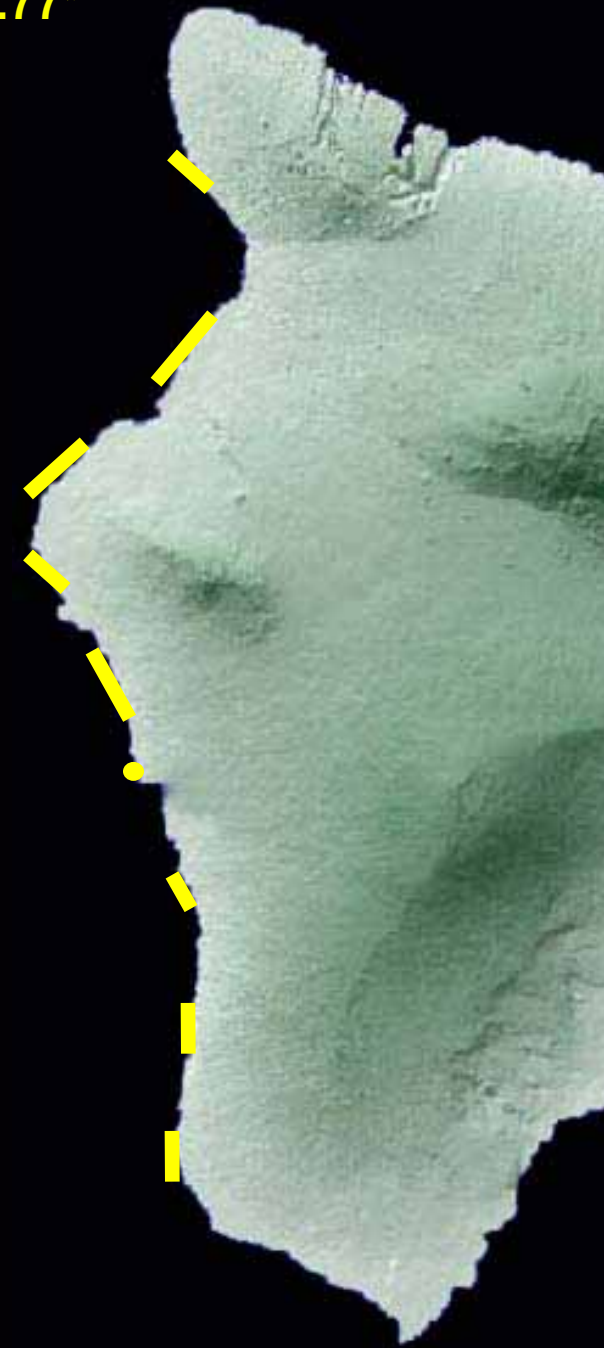
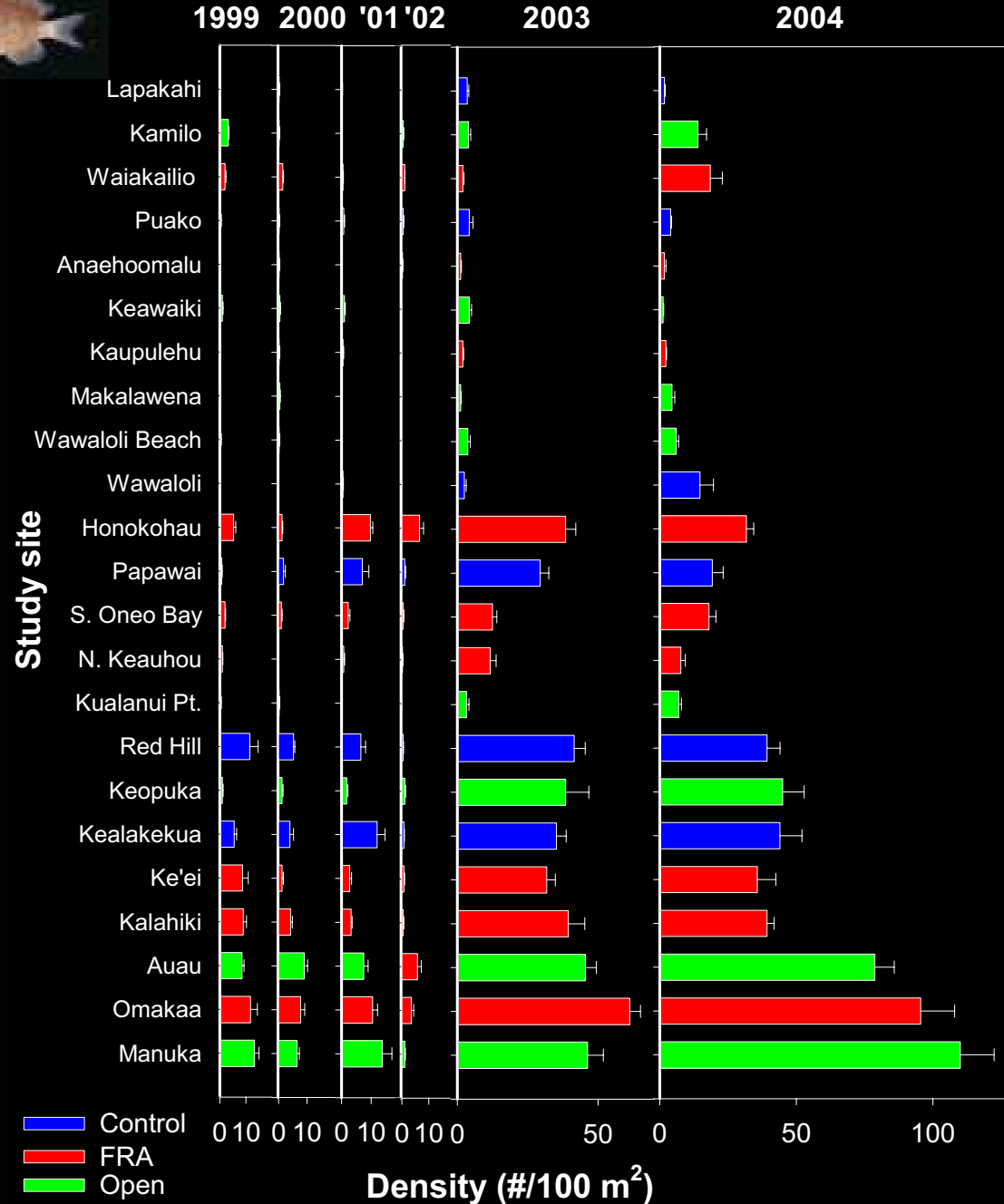
Study site



# *Chromis agilis* YOY



$r = .77^*$



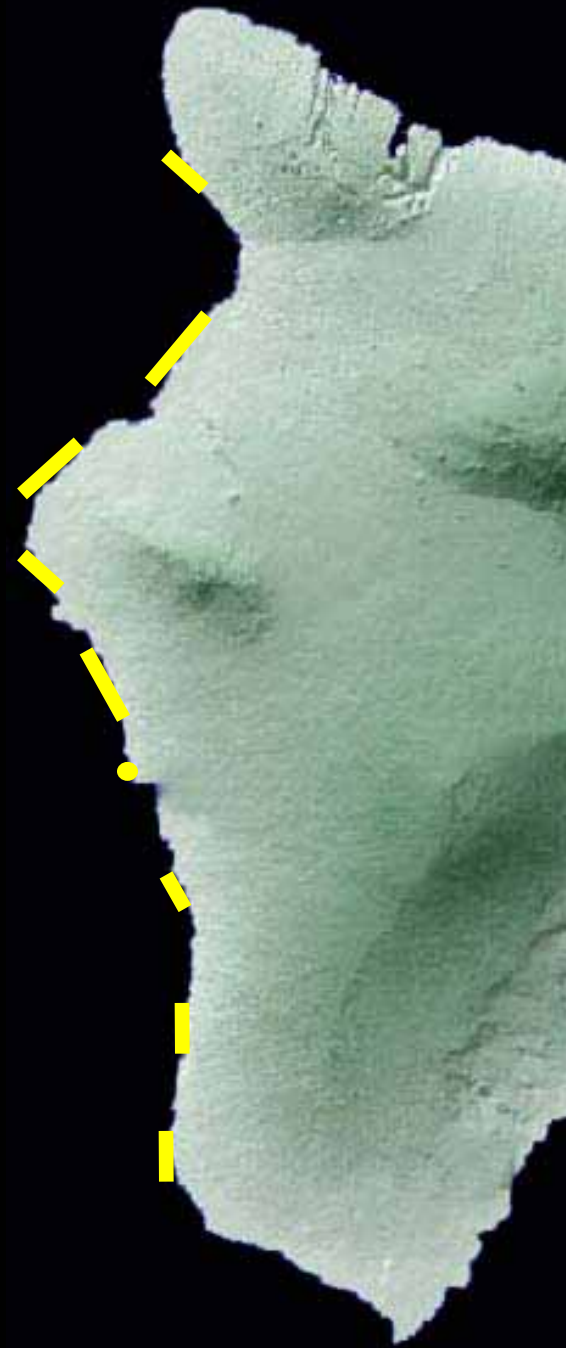
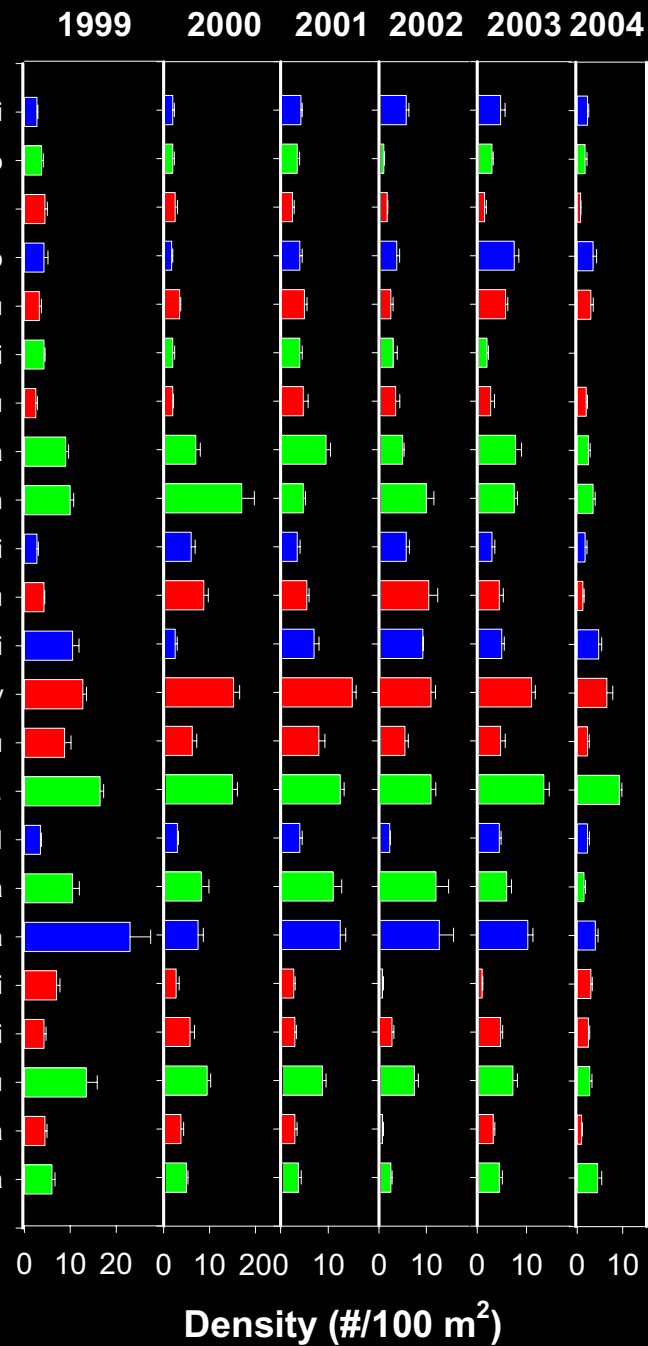
# *Thalassoma duperrey* YOY



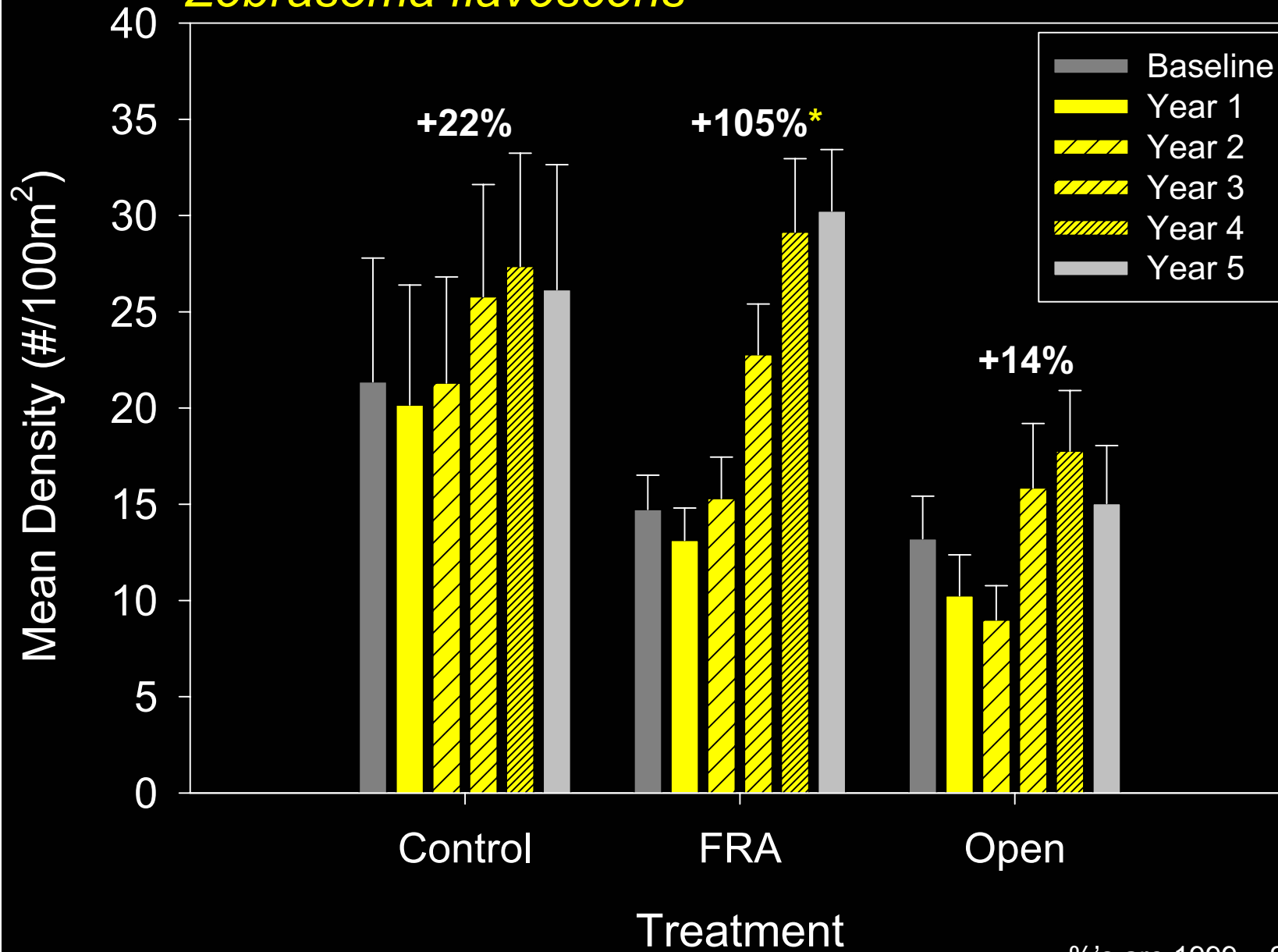
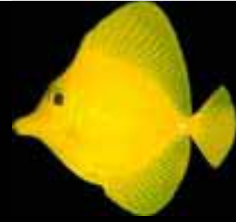
$r = .71^*$

Study site

Control  
FRA  
Open



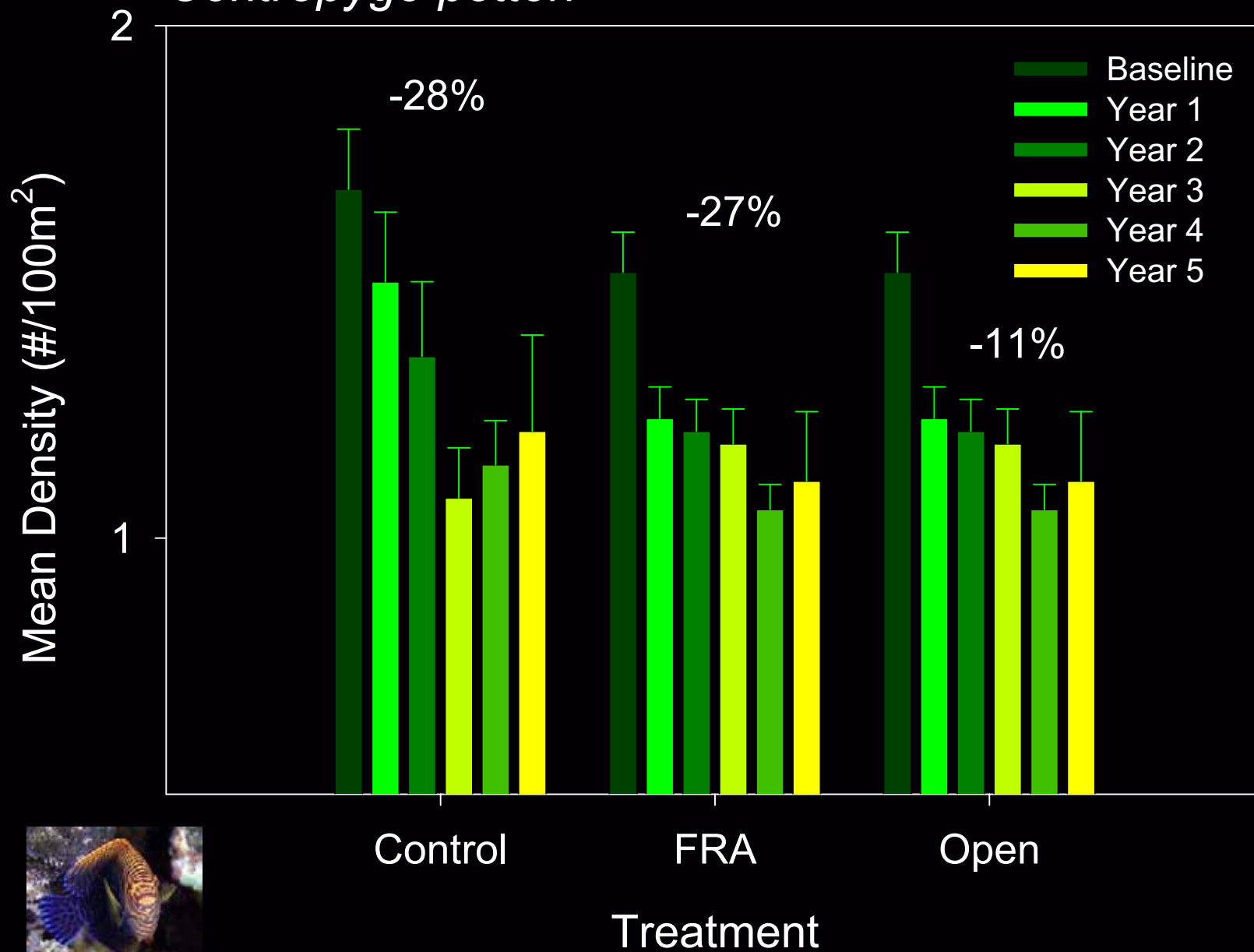
## *Zebrasoma flavescens*



%'s are 1999 – 2004 differences

\* P<0.01

# *Centropyge potteri*



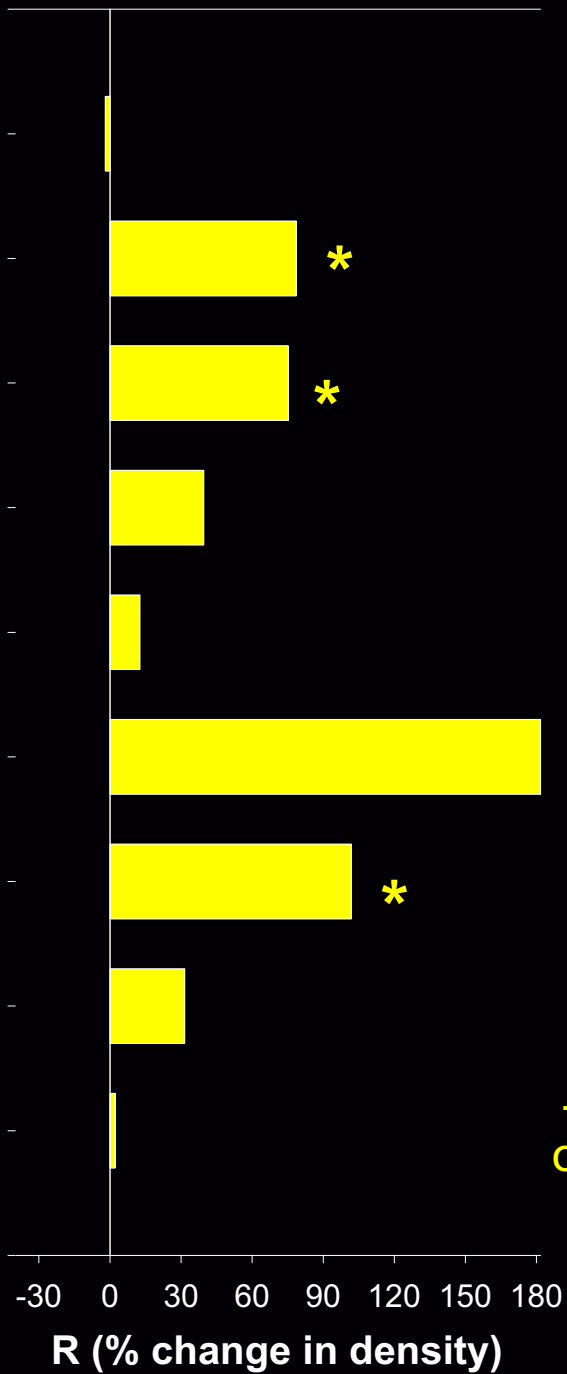
%'s are 1999-2004 differences



## *Zebrasoma flavescens*

FRA

Waiakailio -  
Anaehoomalu -  
Kaupulehu -  
Honokohau -  
S. Oneo Bay -  
N. Keauhou -  
Ke`ei -  
Hookena -  
Milioli -



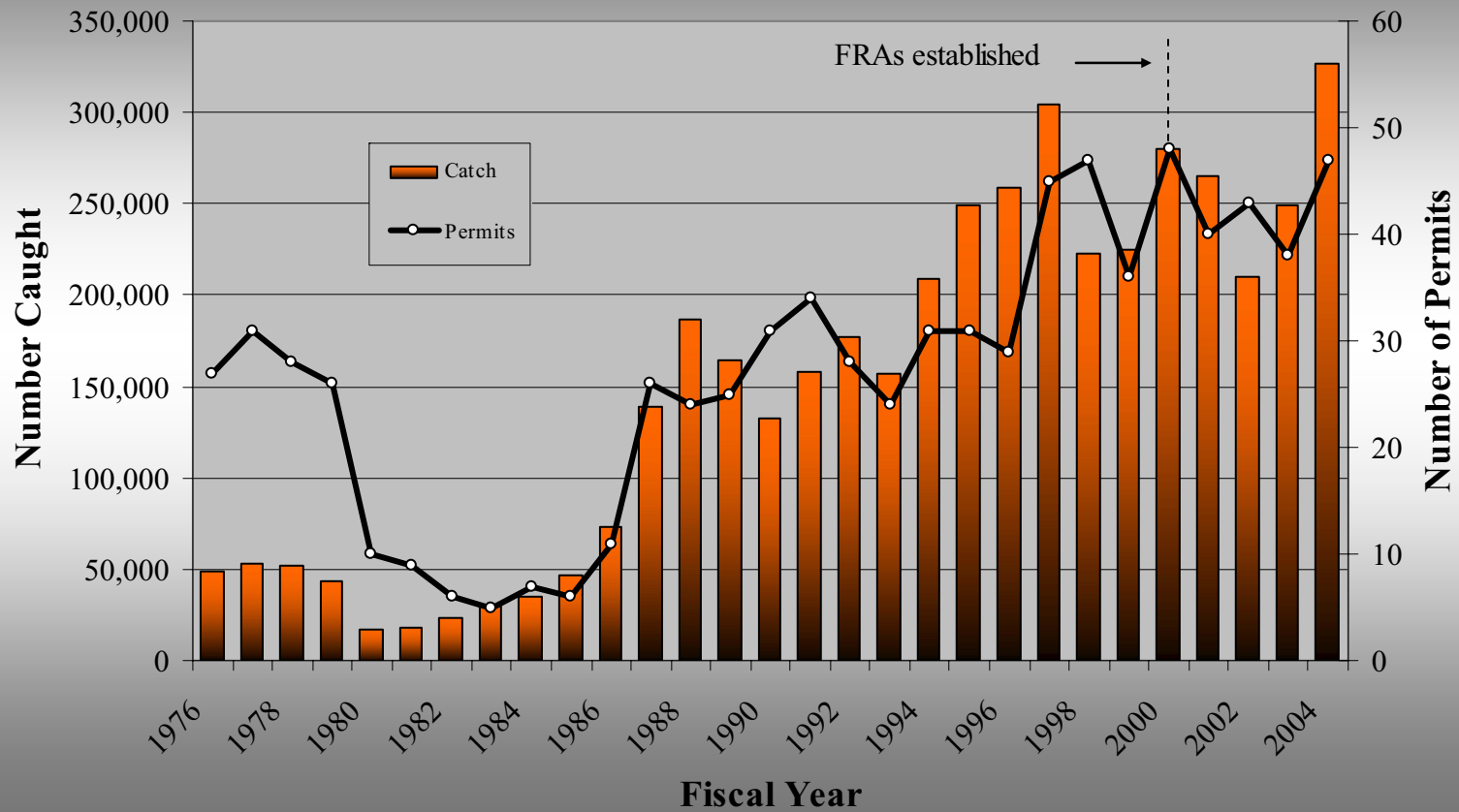
+49%  
overall

\* -  $P < 0.10$

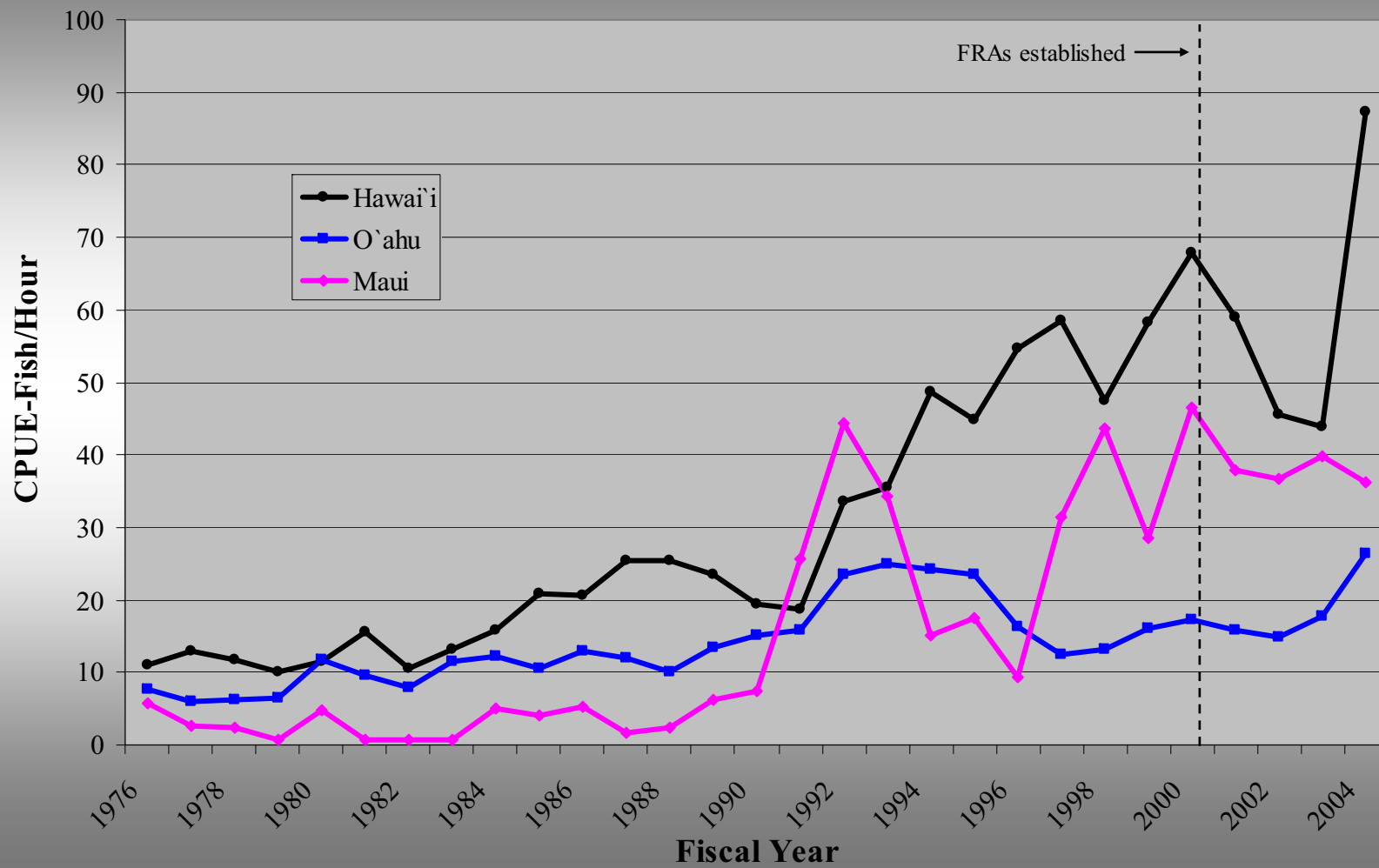




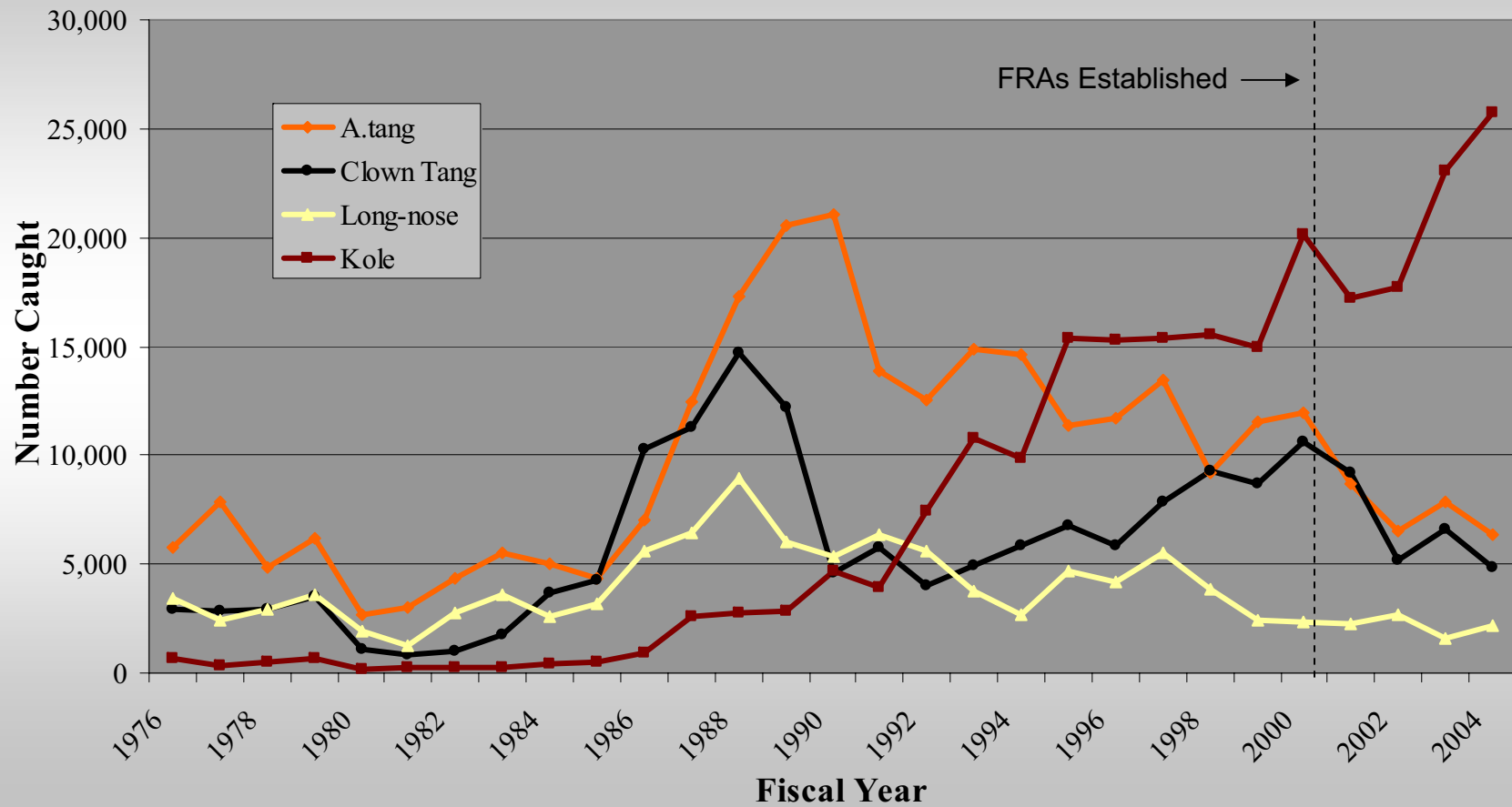
## Number of Aquarium Permits and Collected in West Hawai'i



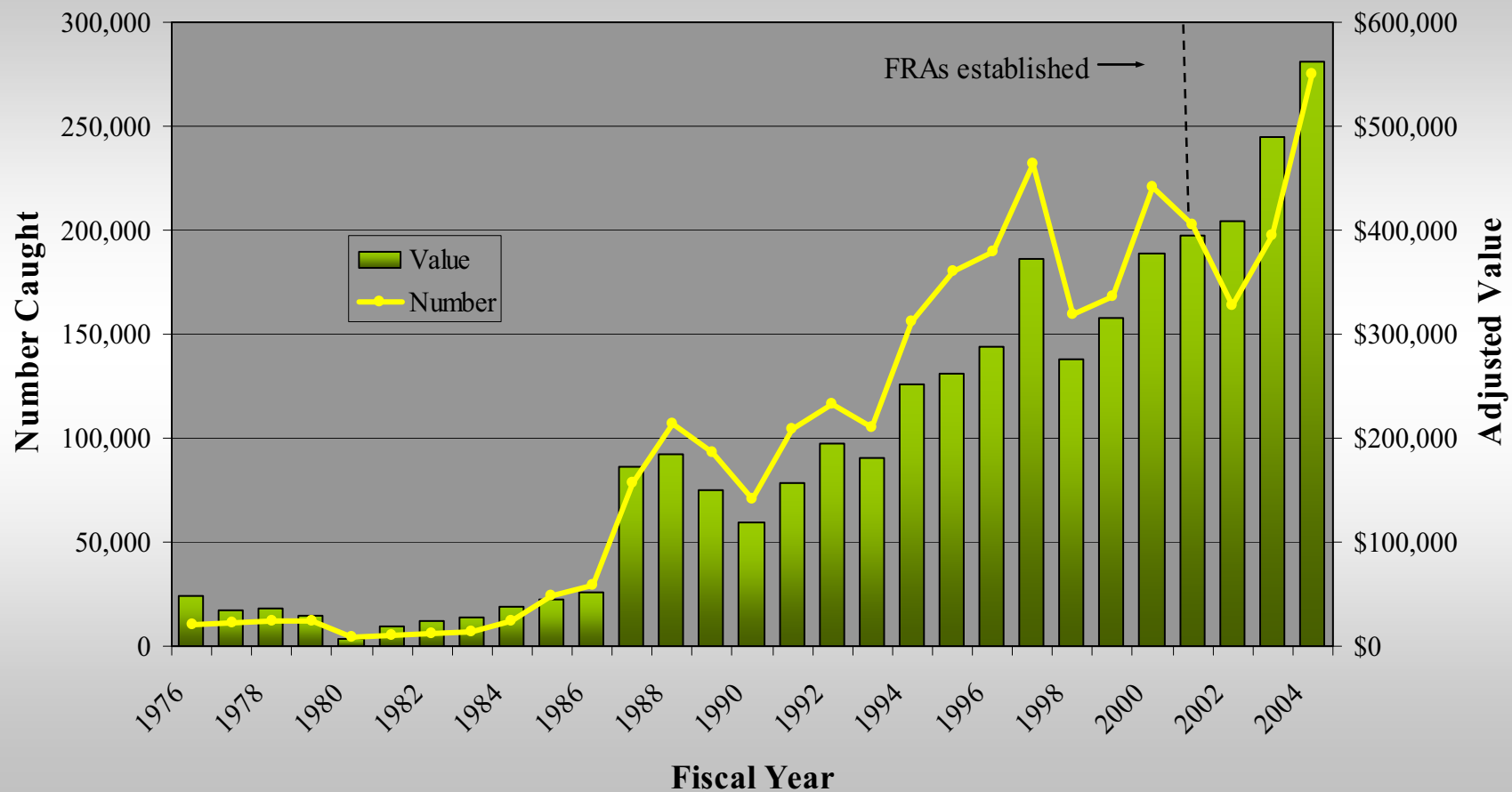
## Hawai'i Aquarium Fish Catch Rates



## Number of 2nd-5th Top Species Caught in West Hawai'i



## Number and Value of Yellow Tangs Caught in West Hawai'i



Special Thanks to:

WHAP Divers

Brent Carman DAR

Steve Cotton DAR

Mike Hamnett HCRI-RP

Christine Davidson HCRI-RP

Risa Minato HCRI-RP

