

# Queen Snapper

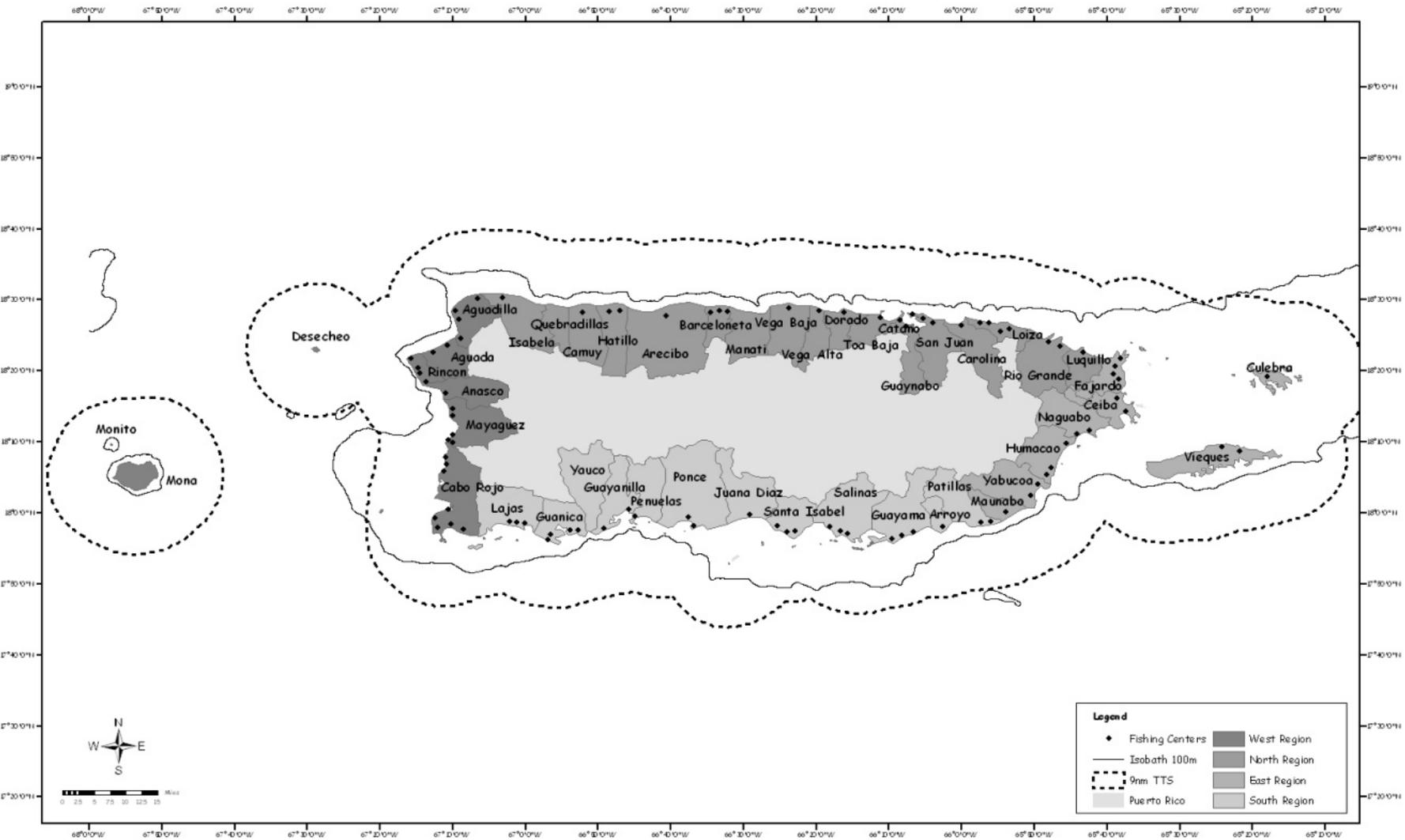


Photo of *Etelis oculatus*, queen snapper. Photo credit J.G. Romine (2004).

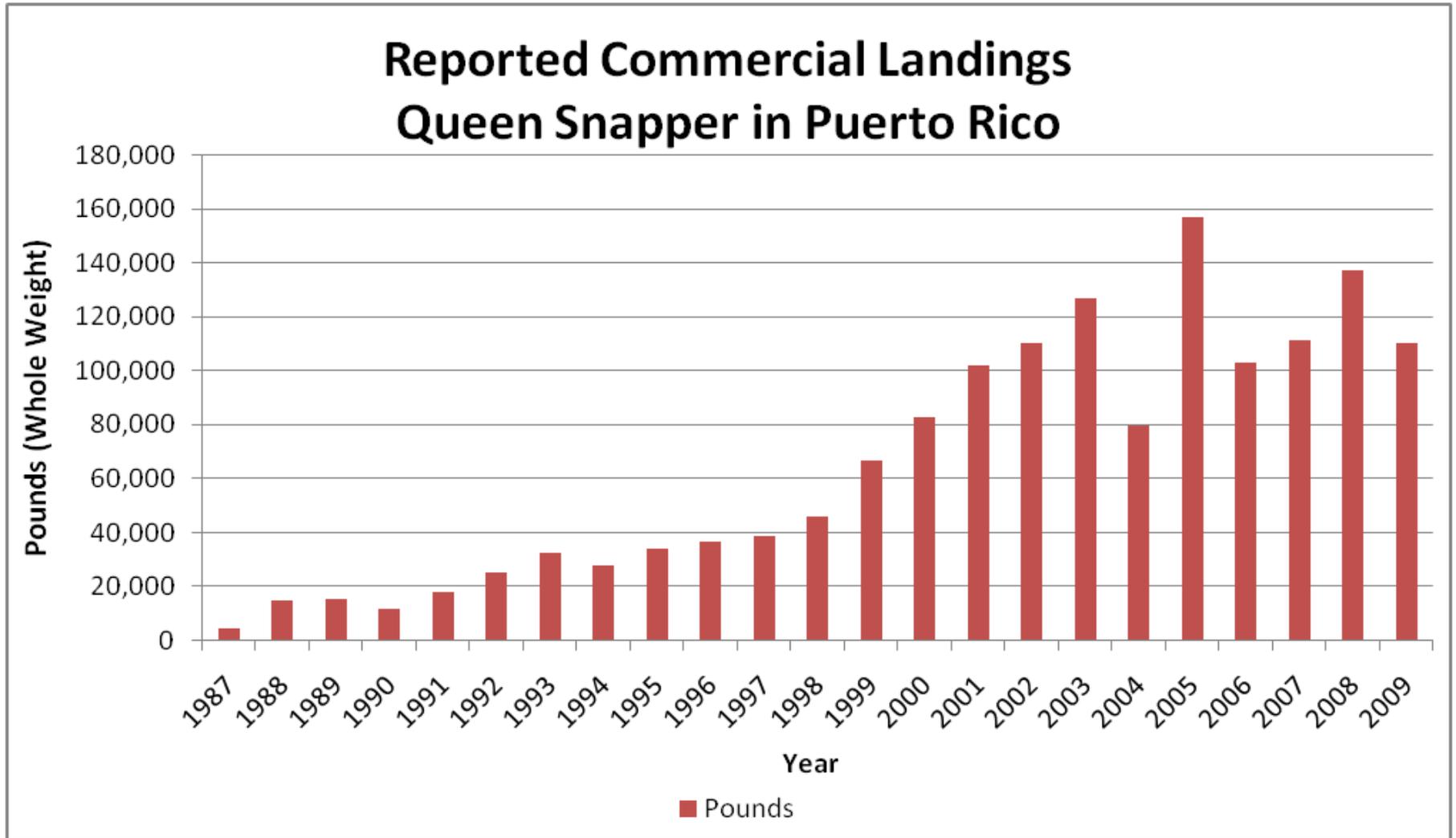
**NOAA  
FISHERIES  
SERVICE**

Todd Gedamke, Nancie Cummings,  
Meaghan Bryan and Kevin  
McCarthy (SEFSC)

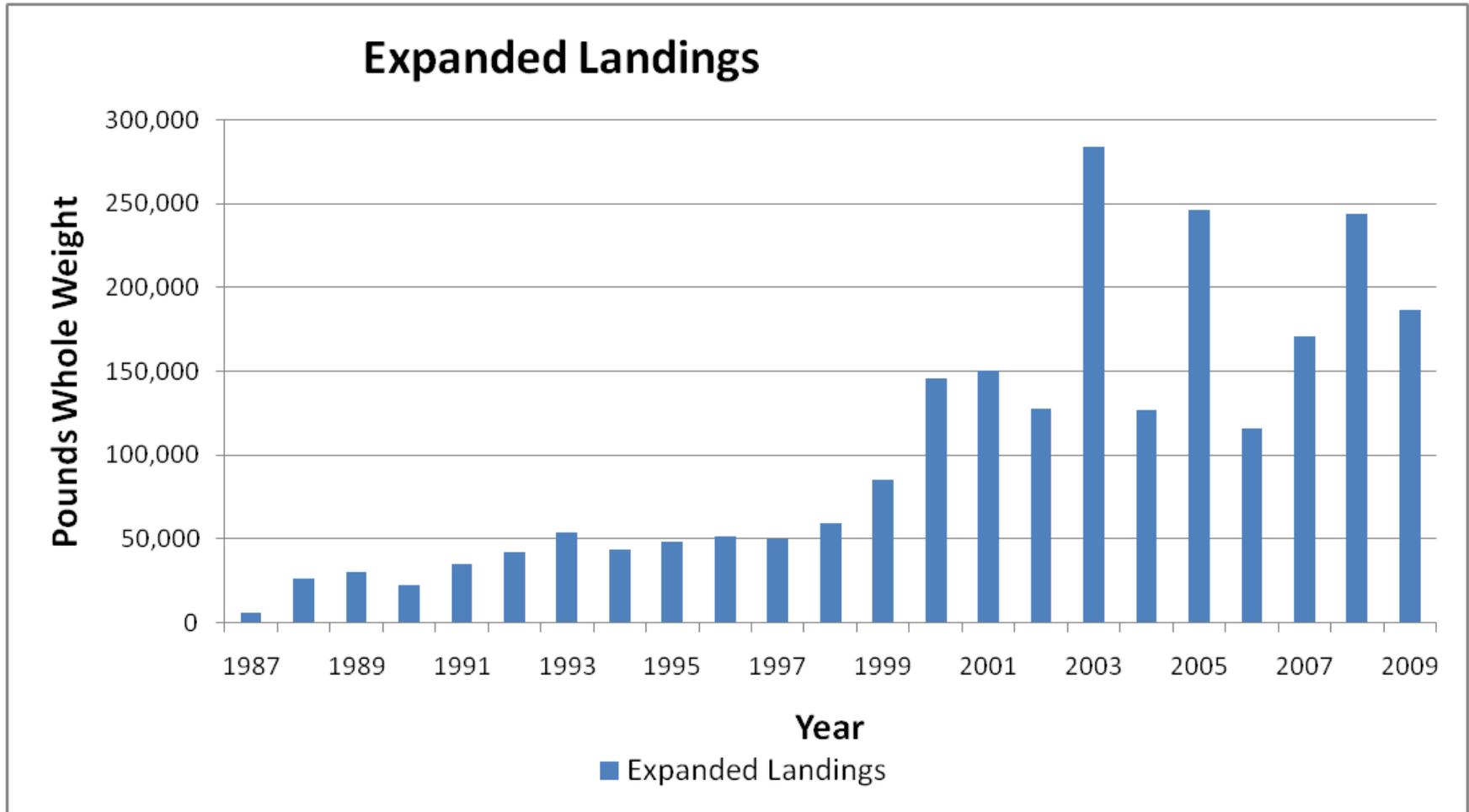
# Puerto Rico Commercial Fisheries Statistics Reporting Zones



# Puerto Rico Queen Snapper Reported Commercial Landings



# Puerto Rico Queen Snapper Expanded Landings



# Index Development Considerations

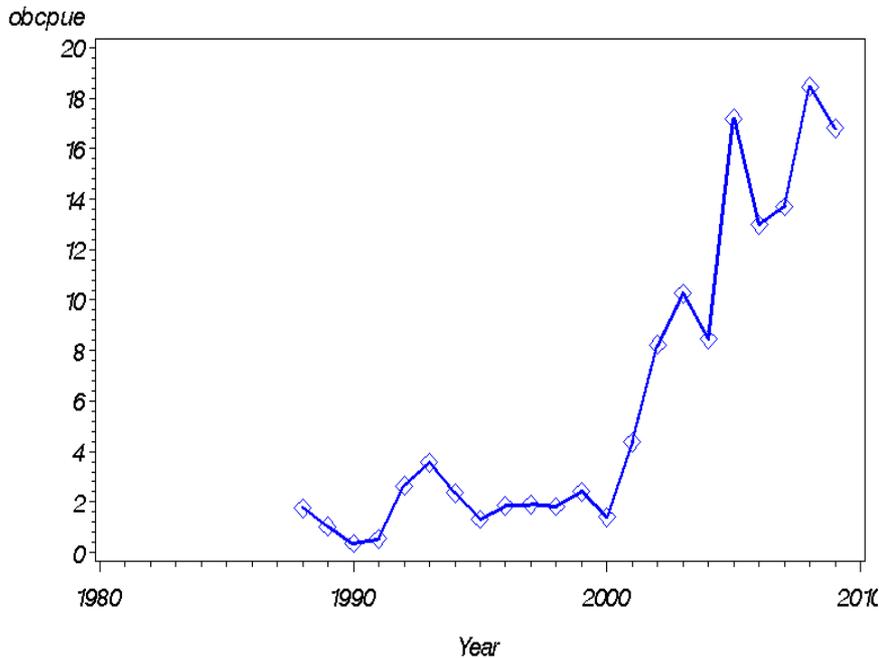
Species	Gear				
	Handline	Fishpots	Gillnet	Trammel Net	Dive
<b>Silk Snapper</b> <b>(with vermilion snapper,</b> <b>blackfin snapper, and</b> <b>black snapper)</b>	Start Year = 1983+	Start Year = 1983+			
	Gear = 104 + 112 + 113 + 105  Fishing Centers = 01 + 02 + 03 + 05 + 06 + 12 + 13 + 15 + 16 + 18 + 20 + 21 + 22 + 25 + 28 + 29 + 32 + 33 + 35 + 36 + 37 + 38 + 39 + 40 + 41 + 42	Gear = 101  Fishing Centers = 01 + 05 + 06 + 08 + 09 + 10 + 12 + 13 + 14 + 15 + 16 + 18 + 20 + 22 + 23 + 25 + 28 + 32 + 36 + 37 + 38 + 39 + 40 + 41 + 42			
<b>Queen Snapper</b> <b>(with cardinal snapper)</b>	Start Year = 1987+				
	Gear = 104 + 105  Fishing Centers = 01 + 05 + 06 + 12 + 13 + 15 + 16 + 28 + 32 + 35 + 36 + 37 + 38 + 39 + 40 + 41 + 42				
<b>Parrotfish</b>		Start Year = 1983+	Start Year = 1988+	Start Year = 1988+	Start Year = 1997+
		Gear = 101  Fishing Centers = 18 + 19 + 20 + 21 + 22 + 23 + 24 + 25 + 27 + 28 + 29 + 31 + 36 + 37	Gear = 103  Fishing Centers = 23 + 27 + 35 + 36 + 37	Gear = 118  Fishing Centers = 23 + 27 + 35 + 36 + 37	Gear = 110 + 114 + 115 + 116 + 119  Fishing Centers = 14 + 18 + 19 + 20 + 21 + 24 + 25 + 27 + 33 + 34 + 35 + 36 + 37 + 38 + 40

# Index Considerations

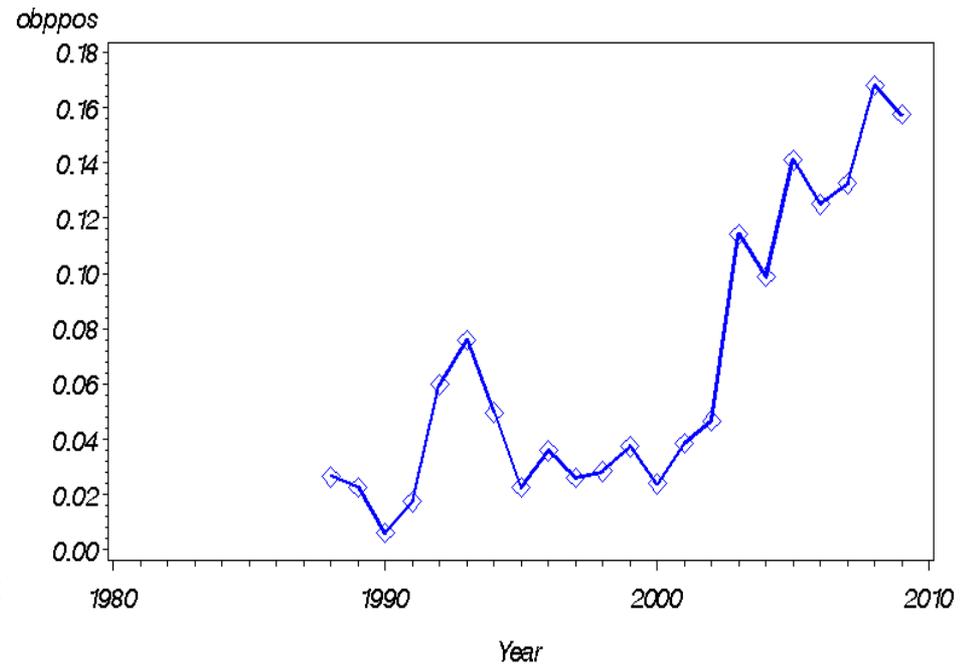
- Puerto Rico fishery platform group reviewed DW-03 (synopsis of fishery)
- A single gear dominated the queen snapper landings (bottom lines)
- CPUE abundance set construction restricted to bottom lines
- Delta lognormal fits made to each independent data series as well as lognormal fits to each of 2 alternative sets (10% and 50% queen trip weight cutoff percentage)

# Queen Snapper Delta Lognormal Abundance Indices

*Puerto Rico Queen Snapper Bottom Line Fishery 1987–2009 Full  
Nominal CPUE by year*



*Puerto Rico Queen Snapper Bottom Line Fishery 1987–2009 Full  
Observed proportion pos/total by year*

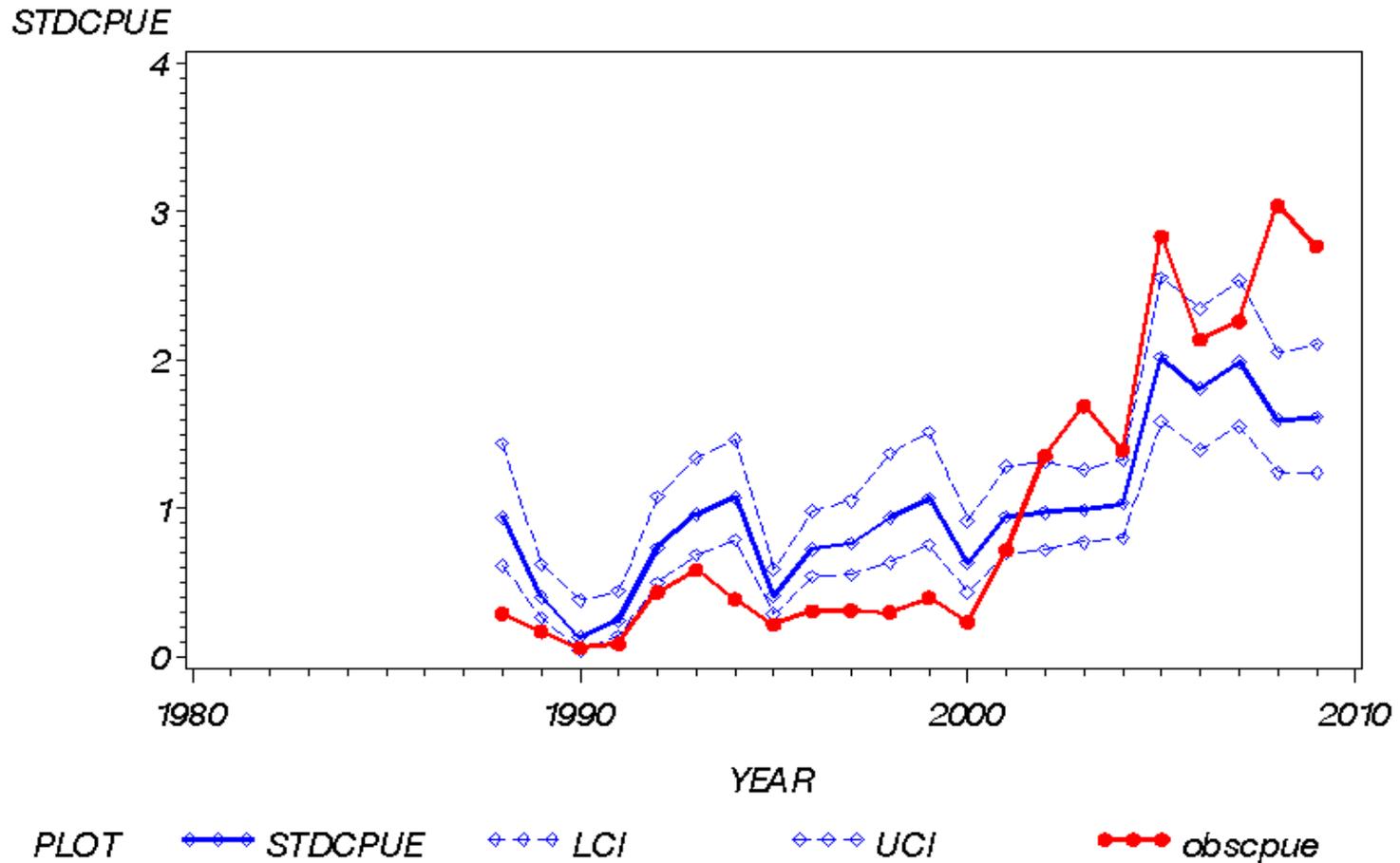


*If prop pos = [1 or 0] Binomial model no estimate for that year!*

# Delta Lognormal CPUE

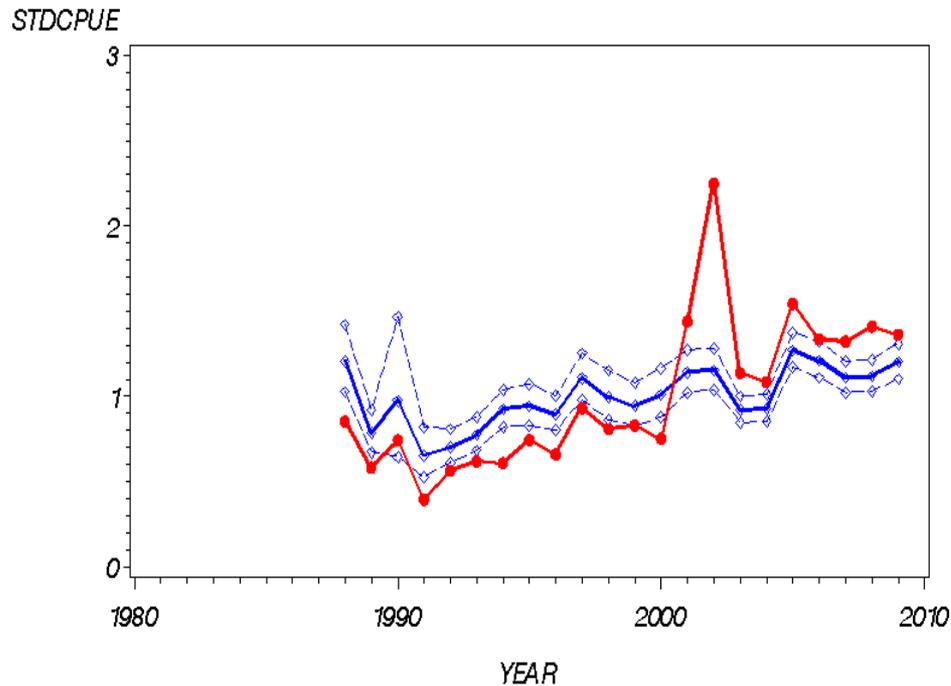
## Queen Snapper

*Puerto Rico Queen Snapper Bottom Line Fishery 1987–2009 Full  
Observed and Standardized CPUE (95% C)*



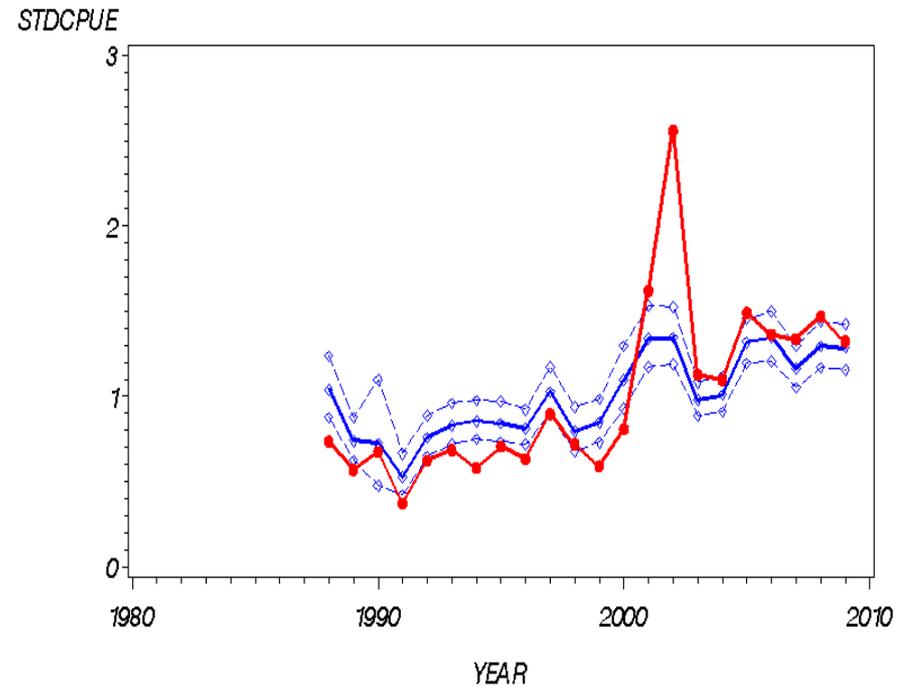
# Standardized Queen Snapper Alternative CPUE Models

Puerto Rico Queen Snapper Bottom Line Fishery 1987–2009 10% Trip Weight Cutoff  
Observed and Standardized CPUE (95% C)



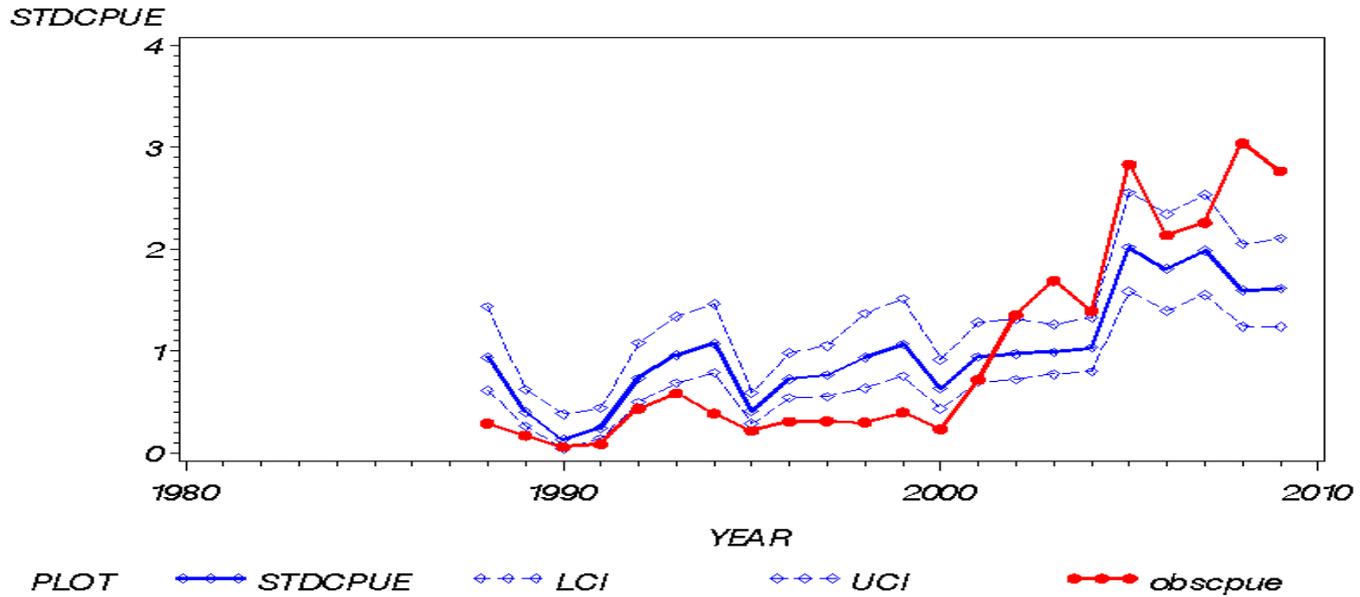
PLOT STDCPUE LCI UCI obscpue

Puerto Rico Queen Snapper Bottom Line Fishery 1987–2009 50% Trip Weight Cutoff  
Observed and Standardized CPUE (95% C)

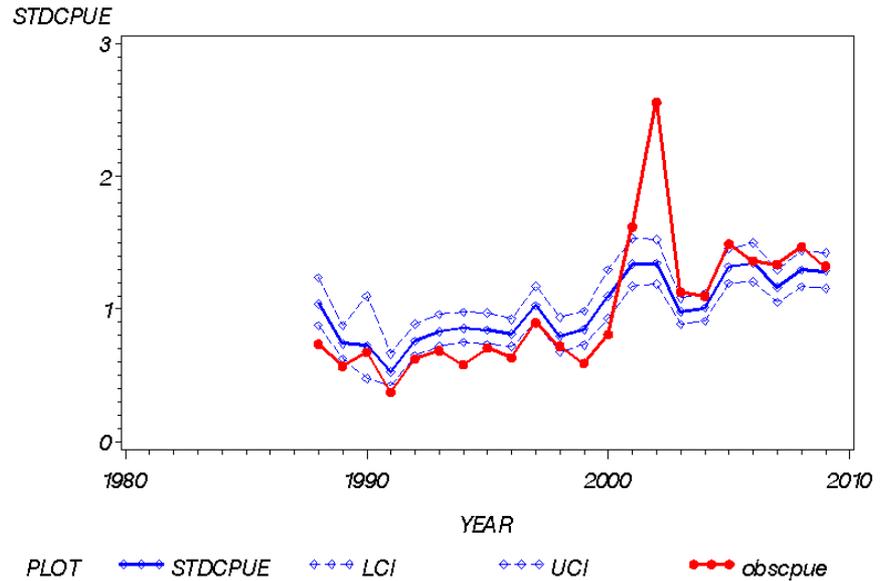


PLOT STDCPUE LCI UCI obscpue

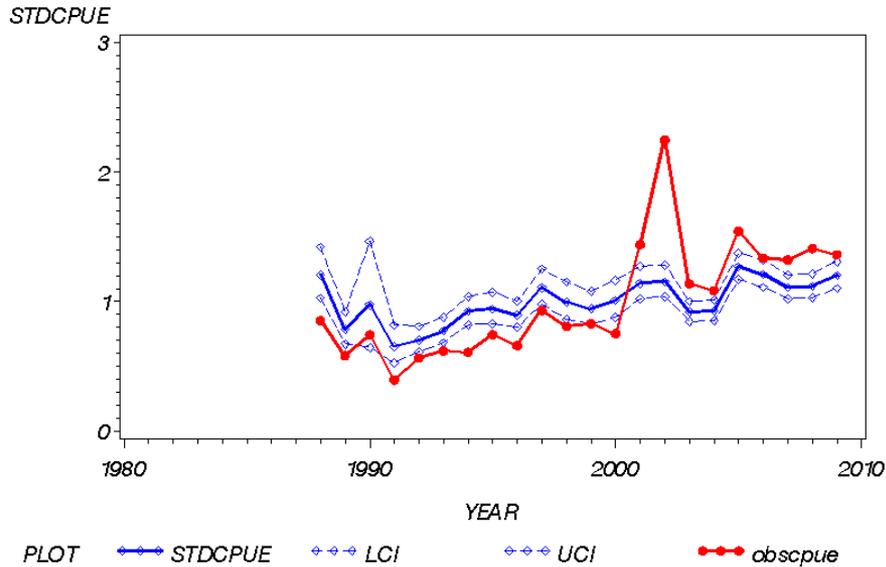
Puerto Rico Queen Snapper Bottom Line Fishery 1987–2009 Full  
Observed and Standardized CPUE (95% C)



Puerto Rico Queen Snapper Bottom Line Fishery 1987–2009 50% Trip Weight Cutoff  
Observed and Standardized CPUE (95% C)



Puerto Rico Queen Snapper Bottom Line Fishery 1987–2009 10% Trip Weight Cutoff  
Observed and Standardized CPUE (95% C)

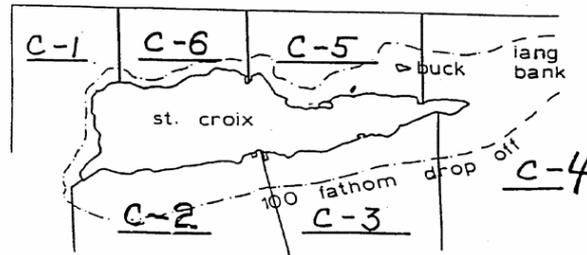
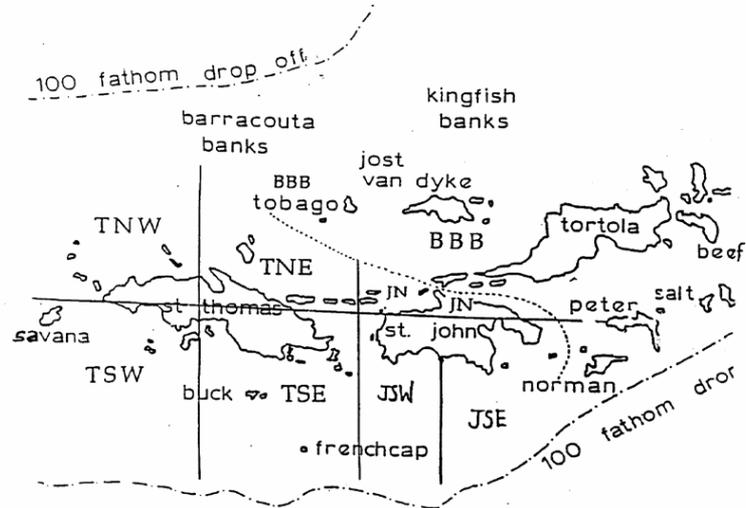


# Effort Trends Puerto Rico

- Reporting voluntary until 2006 in Puerto Rico
- Fishery reporting rates have high spatial and temporal variability.
- Expansion factors average  $\sim 60\%$  over the entire time series
- Trip Tickets represent multiple years in many cases prior to 2006

# US Virgin Islands Fishery Reporting Zones

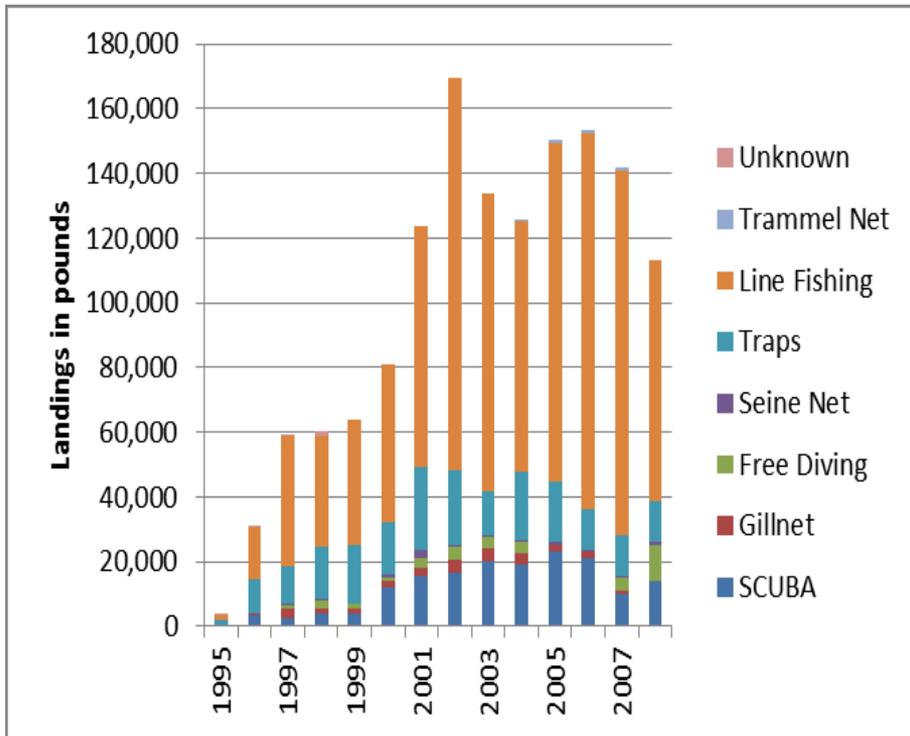
**Catch Report Forms, revised**  
 for Commercial Fisheries of the U.S. Virgin Islands  
 July 1999 - June 2000



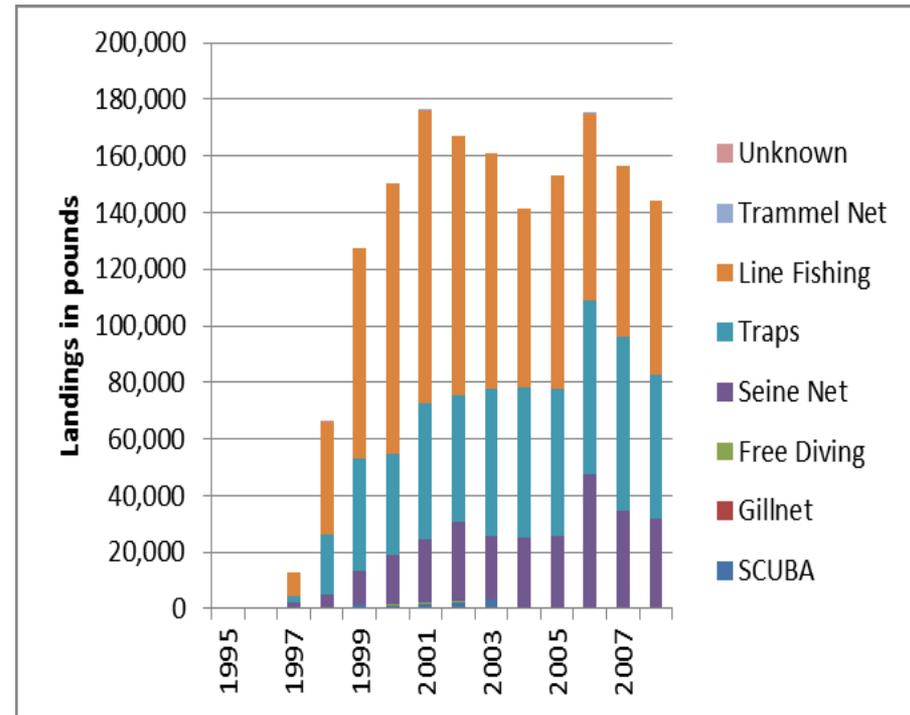
# US Virgin Islands Landings and Abundance Trends for Queen Snapper

- Queen snapper landings trends could not be quantified for the US Virgin Islands commercial fisheries as species level data are not available.
- Queen snapper abundance trends could not be developed as species specific landings data do not exist for US VI snapper category landings

# US VI Reported Snapper Category Landings St. Croix, St. Thomas-St. John



St Croix

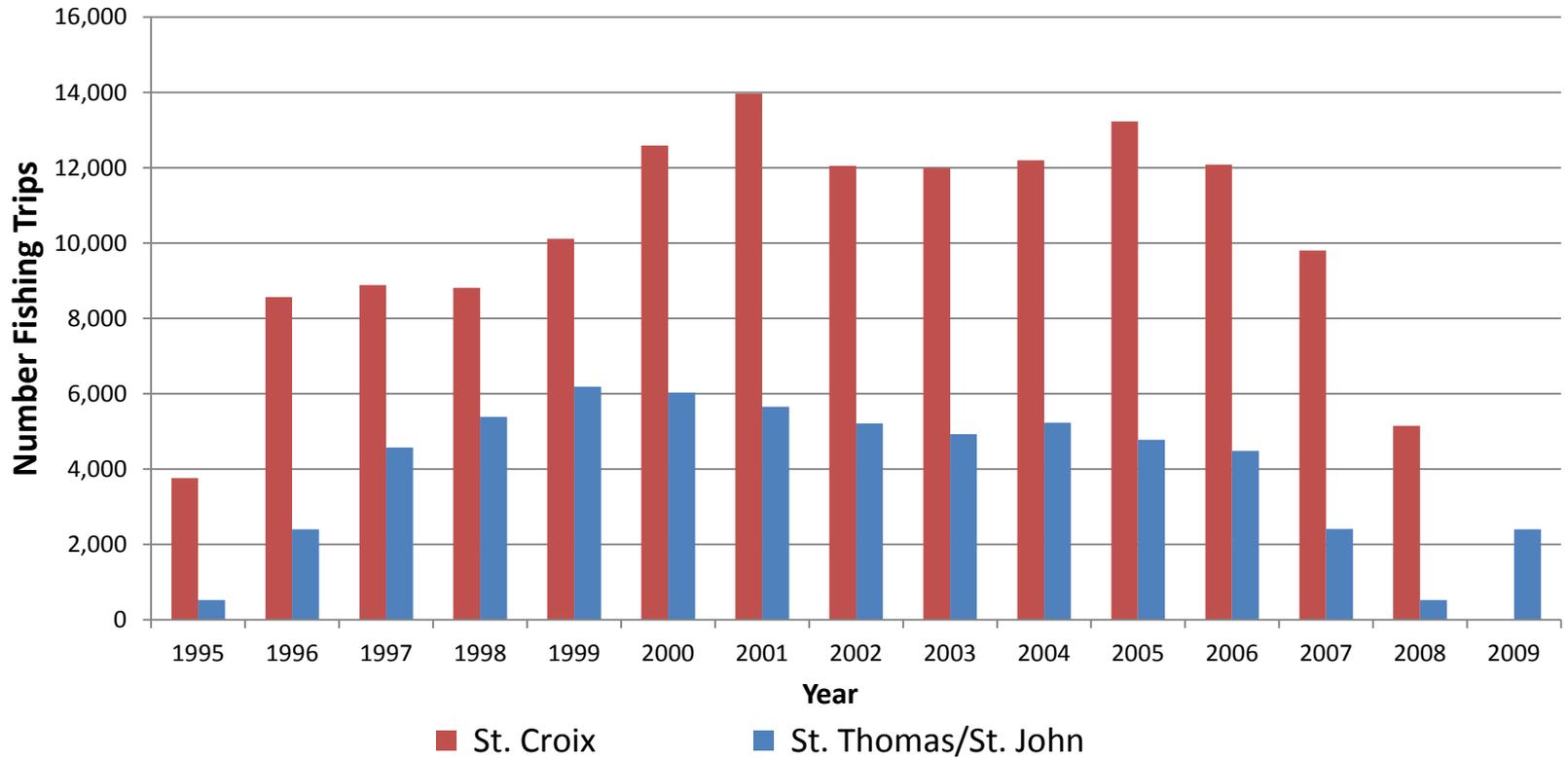


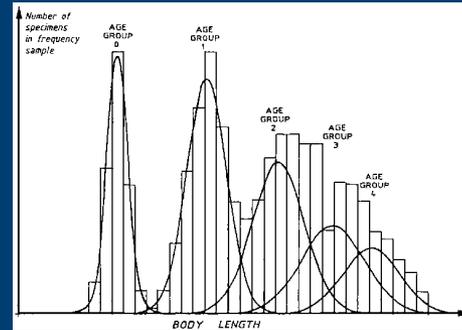
St. Thomas-St. John

# Effort Trends

## US Virgin Islands

**Reported Number Commercial Fishing Trips**  
**US Virgin islands**





# Queen Snapper - Analysis of size-frequency

NOAA



**NOAA  
FISHERIES  
SERVICE**

**Todd Gedamke (SEFSC)**

# **Mean Length Mortality Estimation**

## **Methodology**

(separate presentation)

# Queen snapper- Life history

Location	Reference	n	Sex	Age-length relationship						Length-weight relationship			Maturity	
				t <sub>0</sub>	L <sub>inf</sub>	K	M	L <sub>max</sub>	t <sub>max</sub>	a	b	W <sub>inf</sub>	L <sub>mat</sub>	t <sub>mat</sub>
St Lucia	Murray & Moore (1992a) * ζ	-	U	<b>-0.41</b>	1020	0.29	0.33	930	<b>10</b>	-	-	23300	<b>531</b>	<b>2</b>
St Lucia	Murray et al. (1992)* ζ	-	U	<b>-0.189</b>	1030	0.61	<b>0.76</b>	<b>1002</b>	<b>5</b>	-	-	23900	<b>536</b>	<b>1</b>
St. Lucia	Murray & Moore (1992b)	62	-	-	-	-	-	-	-	0.0632	2.771	-	-	-
South Atlantic	SAFE Report (2005)	-	U	-	-	-	-	1000	-	-	-	-	536	1
St Thomas	Bohnsack & Harper (1988) ζ	21	U	-	-	-	-	-	-	0.0233	2.55 <sup>‡</sup>	-	-	-
St. Croix	Bohnsack & Harper (1988) ζ	48	U	-	-	-	-	-	-	0.0173	2.578	-	-	-
Brazil	Frota et al. (2004)	27	U	-	-	-	-	-	-	0.0128	2.908	-	-	-
PR	Rosario et al. (2006)	187	M	-	-	-	-	-	-	-	-	-	233 <sup>‡</sup>	-
PR	Rosario et al. (2006)	187	F	-	-	-	-	-	-	-	-	-	310 <sup>‡</sup>	1
PR	Rosario et al. (2006)	419	M&F	-	-	-	-	715 <sup>‡</sup>	-	0.012	2.84 <sup>‡</sup>	-	-	-

# Model Inputs: Sensitivity range

queen snapper, Puerto Rico, Hook and line

Parameter	Lower Bound	Base Case	Upper Bound
$L_c^*$	366mm	486mm	546mm
K	0.25	0.45	0.65
$L_\infty$	846mm	888mm	906mm

\*  $L_c$  values misreported in assessment report, Table 4, section 2.2.4

# Model Inputs: Sensitivity range

queen snapper, St. Croix, Hook and line

Parameter	Lower Bound	Base Case	Upper Bound
$L_c$	335mm	365mm	465mm
K	0.18	0.45	0.68
$L_\infty$	799mm	888mm	899mm

**Silk and Queen Snapper**

Snapper species total observations by island for the years 1983-2011.

	<b>All</b>	<b>Puerto Rico</b>	<b>St Croix</b>	<b>St. Thomas / St John</b>
<b>SILK SNAPPER</b>	25980 (74%)	22052 (82%)	3216 (44%)	674 (78%)
<b>QUEEN SNAPPER</b>	9115 (26%)	4776 (18%)	4146 (56%)	193 (22%)

\* percent of column total shown in parentheses

# QUEEN SNAPPER

Number of observations of queen snapper by general gear type and island for the years 1983-2011.

<b>Queen Snapper</b>		
<b>PUERTO RICO</b>	<b>HAND LINE</b>	4456
<b>PUERTO RICO</b>	<b>LONG LINES</b>	164
<b>PUERTO RICO</b>	<b>GILL NETS</b>	61
<b>PUERTO RICO</b>	<b>POTS AND TRAP</b>	49
<b>PUERTO RICO</b>	<b>HOOK AND LINE</b>	40
<b>PUERTO RICO</b>	<b>NOT CODED</b>	6
<b>ST CROIX</b>	<b>HAND LINE</b>	1876
<b>ST CROIX</b>	<b>LONG LINES</b>	1153
<b>ST CROIX</b>	<b>HOOK AND LINE</b>	1082
<b>ST CROIX</b>	<b>POTS AND TRAP</b>	32
<b>ST CROIX</b>	<b>GILL NETS</b>	2
<b>ST CROIX</b>	<b>FIXED NETS</b>	1
<b>ST THOMAS/ST JOHN</b>	<b>LONG LINES</b>	130
<b>ST THOMAS/ST JOHN</b>	<b>HOOK AND LINE</b>	34
<b>ST THOMAS/ST JOHN</b>	<b>SPEARS AND GI</b>	16
<b>ST THOMAS/ST JOHN</b>	<b>DIP NETS AND</b>	7
<b>ST THOMAS/ST JOHN</b>	<b>POTS AND TRAP</b>	6

# Resulting sample sizes for island and gear combinations following DW guidance to combine specific gear categories.

The analysis type is also indicated (TS indicates a length-based time-series analysis was done and ID indicates insufficient data for analysis). Note: Sample sizes are reduced from previous slide due to QA/QC and removal of outliers and samples from multi-gear trips.

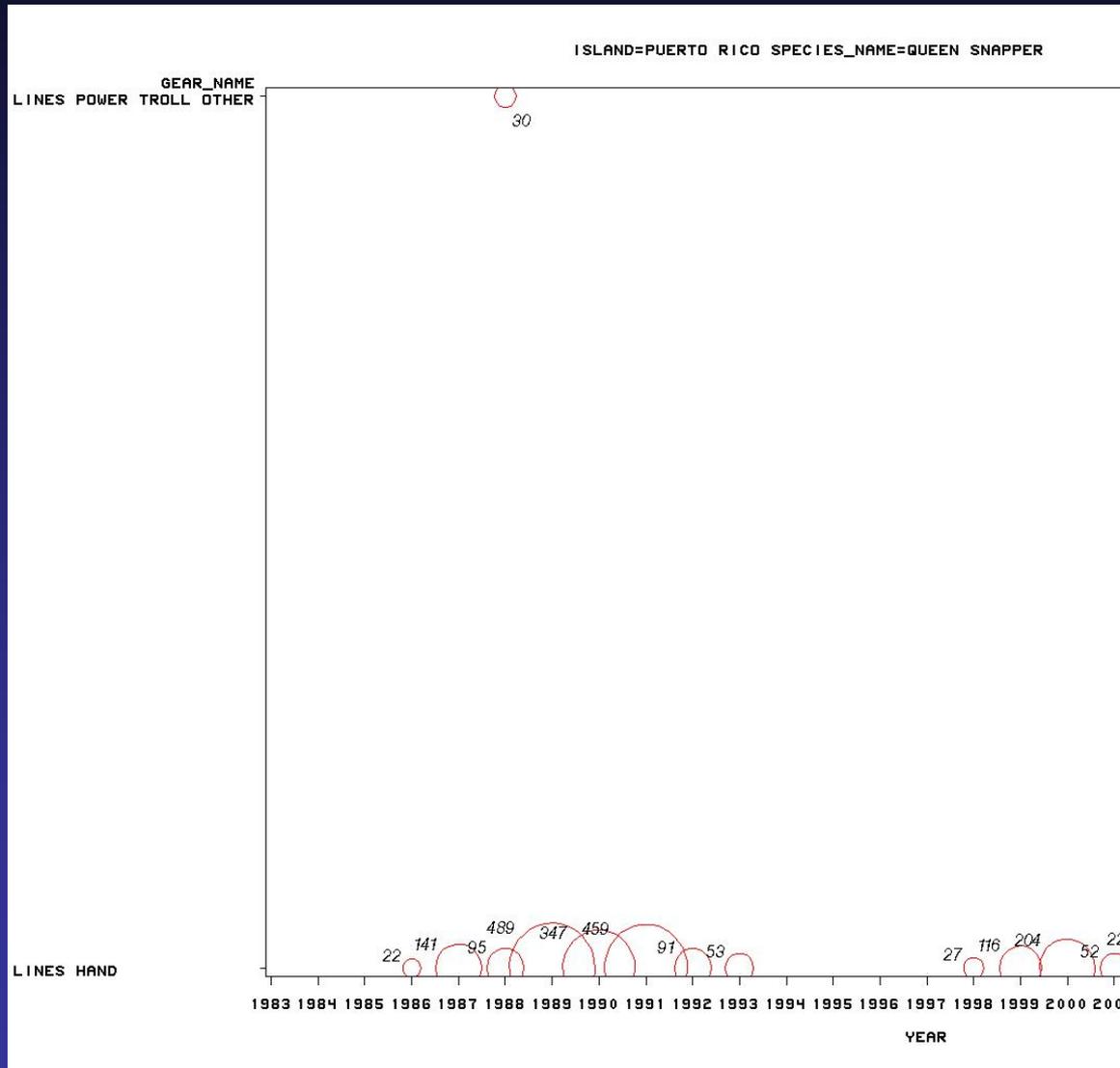
SPECIES NAME	ISLAND	GEAR NAME	SAMPLES	ANALYSIS
QUEEN SNAPPER	PUERTO RICO	HOOK AND LINE	3901	TS
QUEEN SNAPPER	PUERTO RICO	NETS	61	ID
QUEEN SNAPPER	PUERTO RICO	POTS AND TRAPS	9	ID
QUEEN SNAPPER	ST CROIX	HOOK AND LINE	4089	TS
QUEEN SNAPPER	ST CROIX	NETS	3	ID
QUEEN SNAPPER	ST CROIX	POTS AND TRAPS	24	ID
QUEEN SNAPPER	ST THOMAS	DIVERS	17	ID
QUEEN SNAPPER	ST THOMAS	HOOK AND LINE	176	ID
QUEEN SNAPPER	ST THOMAS	NETS	8	ID

# **Puerto Rico**

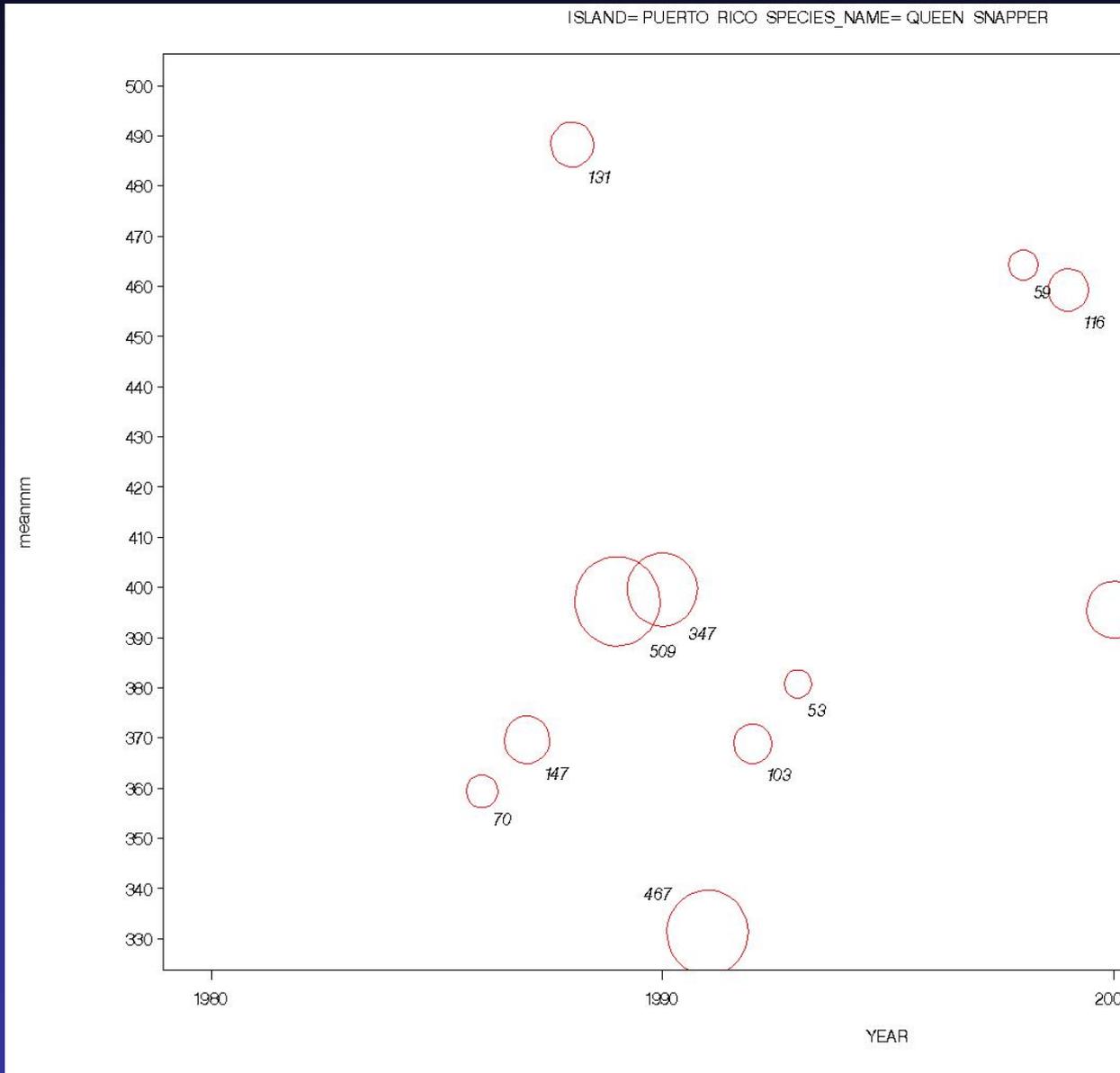
**Hook and Line Only**

## Puerto Rico–Queen Snapper

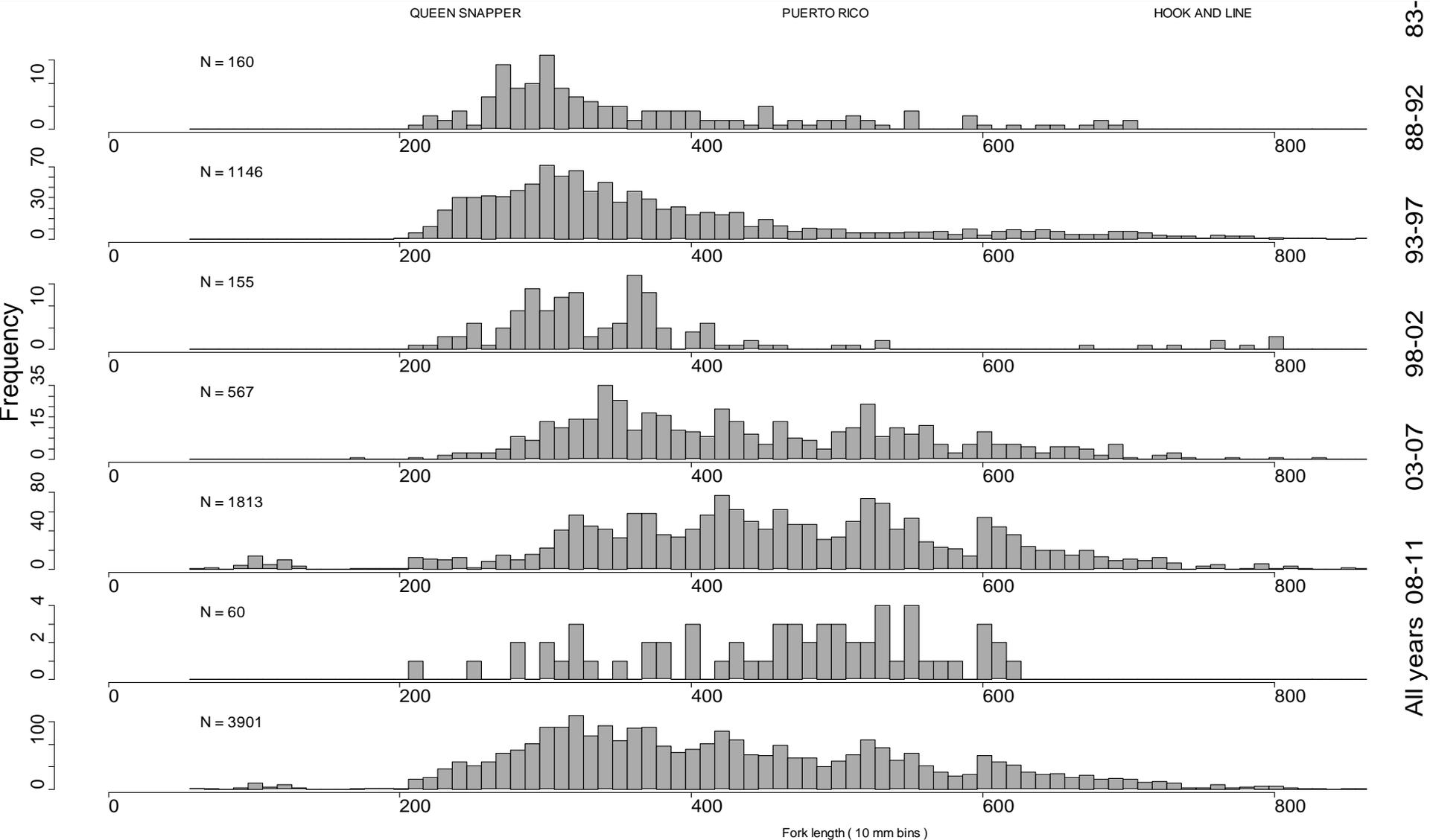
Queen snapper number of sampled fish by specific gear type - Puerto Rico, 1983-2011.



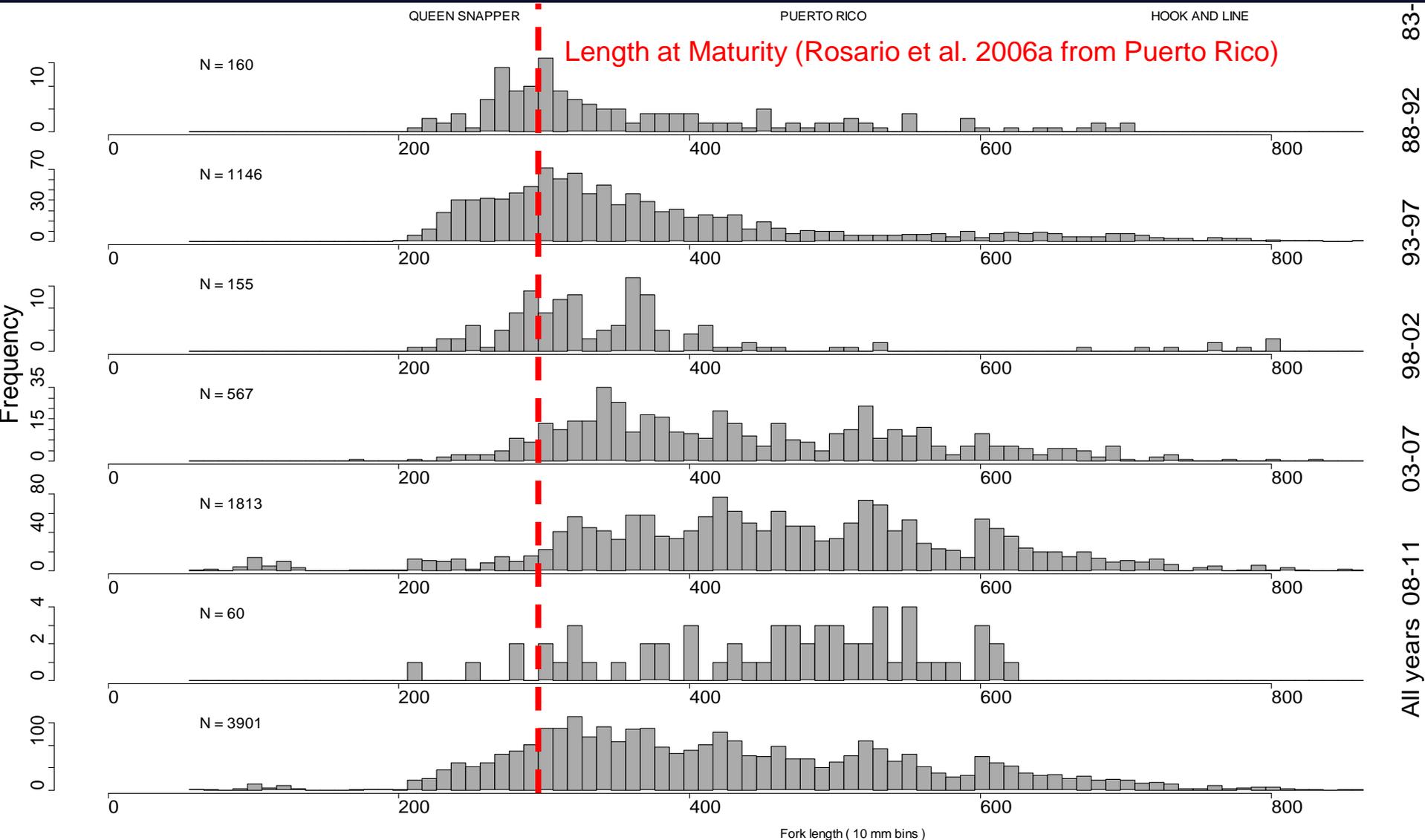
# Queen snapper mean lengths and sample sizes from Puerto Rico, 1983-2011.



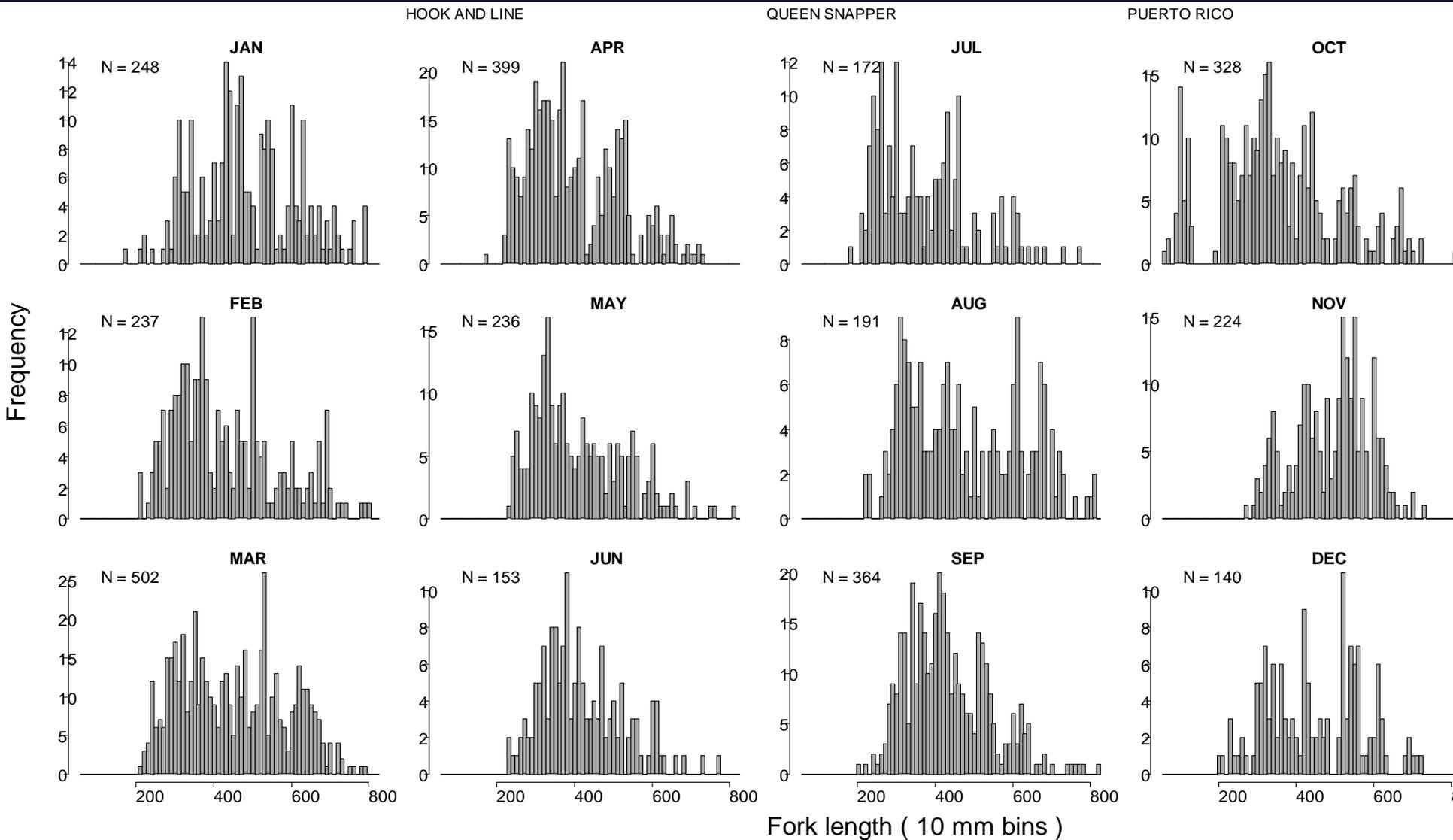
**Length-frequency histograms for Queen snapper caught by hook and line in Puerto Rico. Each panel includes data from a five-year time period, which is indicated at the right side of each panel. The bottom panel includes data from all years. Sample numbers (N) are indicated in each panel.**



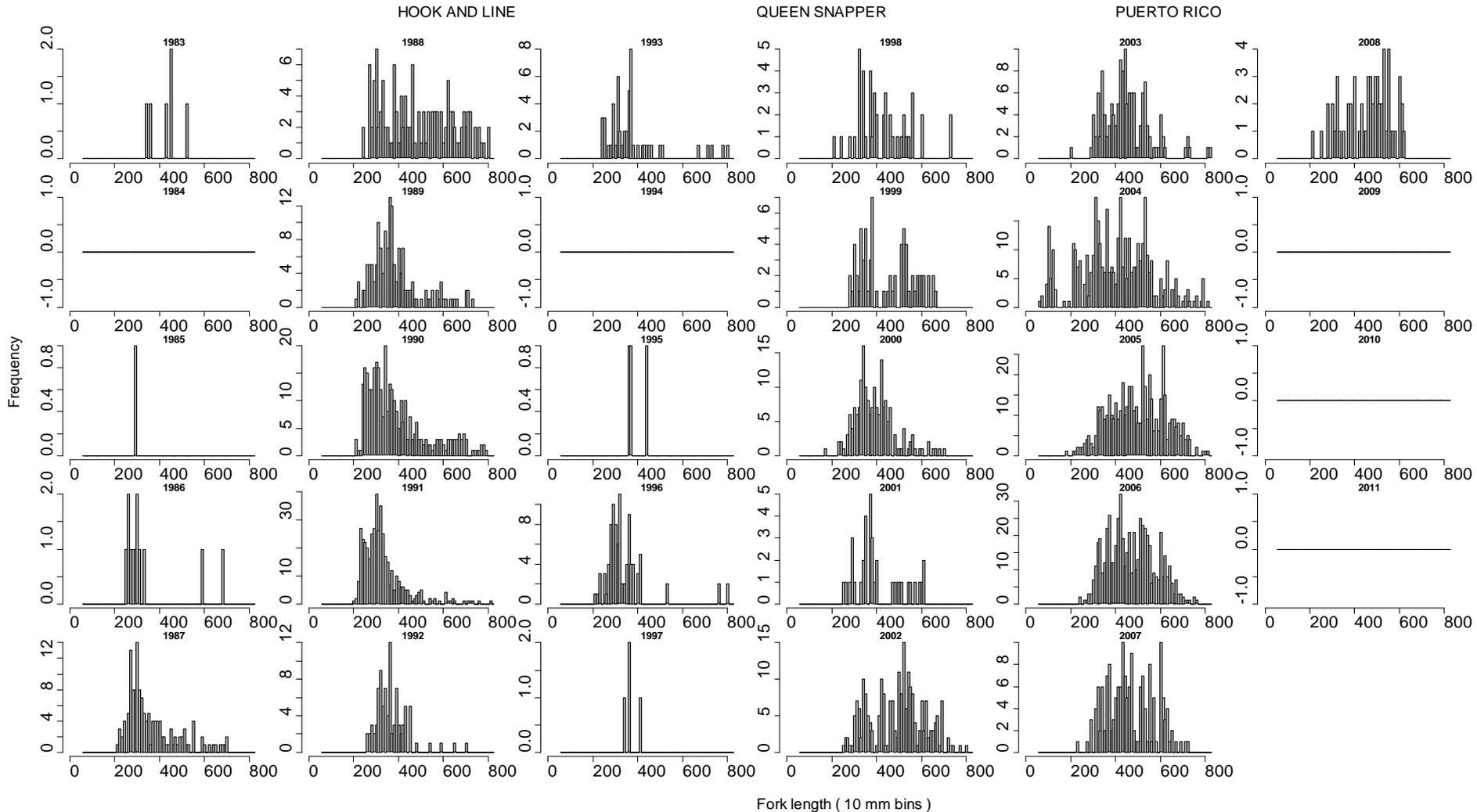
**Length-frequency histograms for Queen snapper caught by hook and line in Puerto Rico. Each panel includes data from a five-year time period, which is indicated at the right side of each panel. The bottom panel includes data from all years. Sample numbers (N) are indicated in each panel.**



**Monthly length-frequency histograms, where the length data was aggregated over years, for queen snapper caught by hook and line in Puerto Rico. N represents the sample size.**



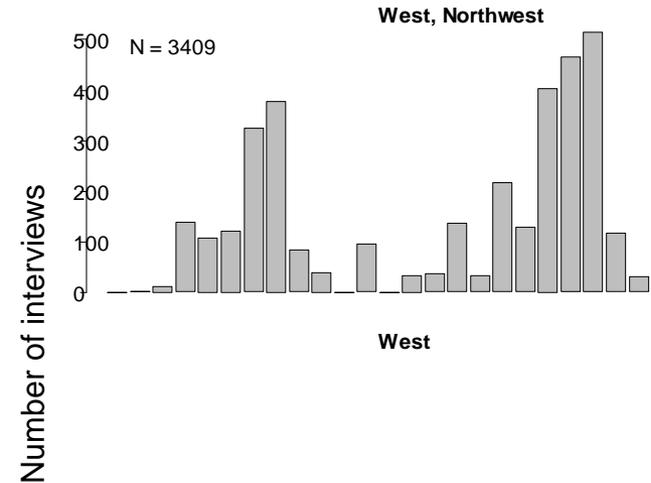
**Annual length-frequency histograms for queen snapper caught by hook and line in Puerto Rico. Flat lines at zero indicate length-data was not collected in those years. Please note that the y-axis differs for each panel.**



# Spatial Evaluation

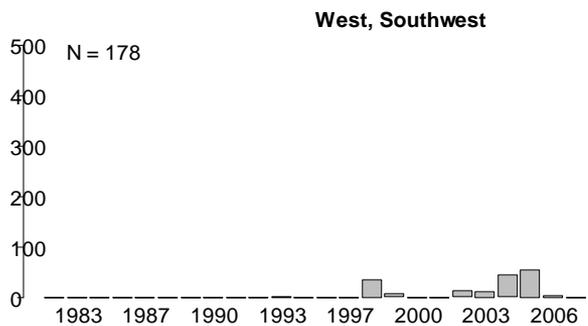
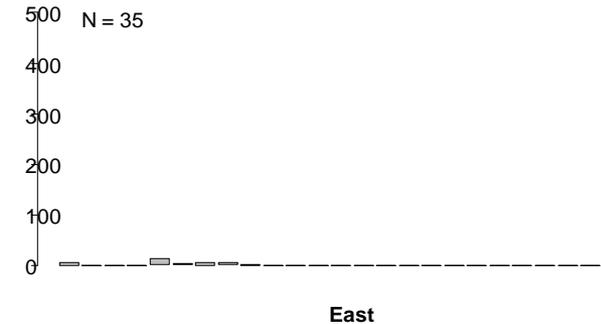
Number of interviews indicating fishing in a particular region around Puerto Rico where queen snapper was caught by hook and line. N is the total number of interviews indicating fishing within a given region.

QUEEN SNAPPER PUERTO RICO HOOK AND LINE



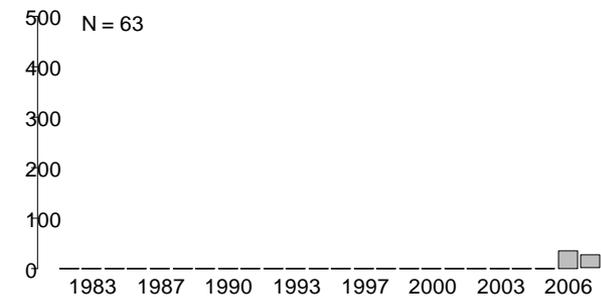
**North**

**Northeast**



**South**

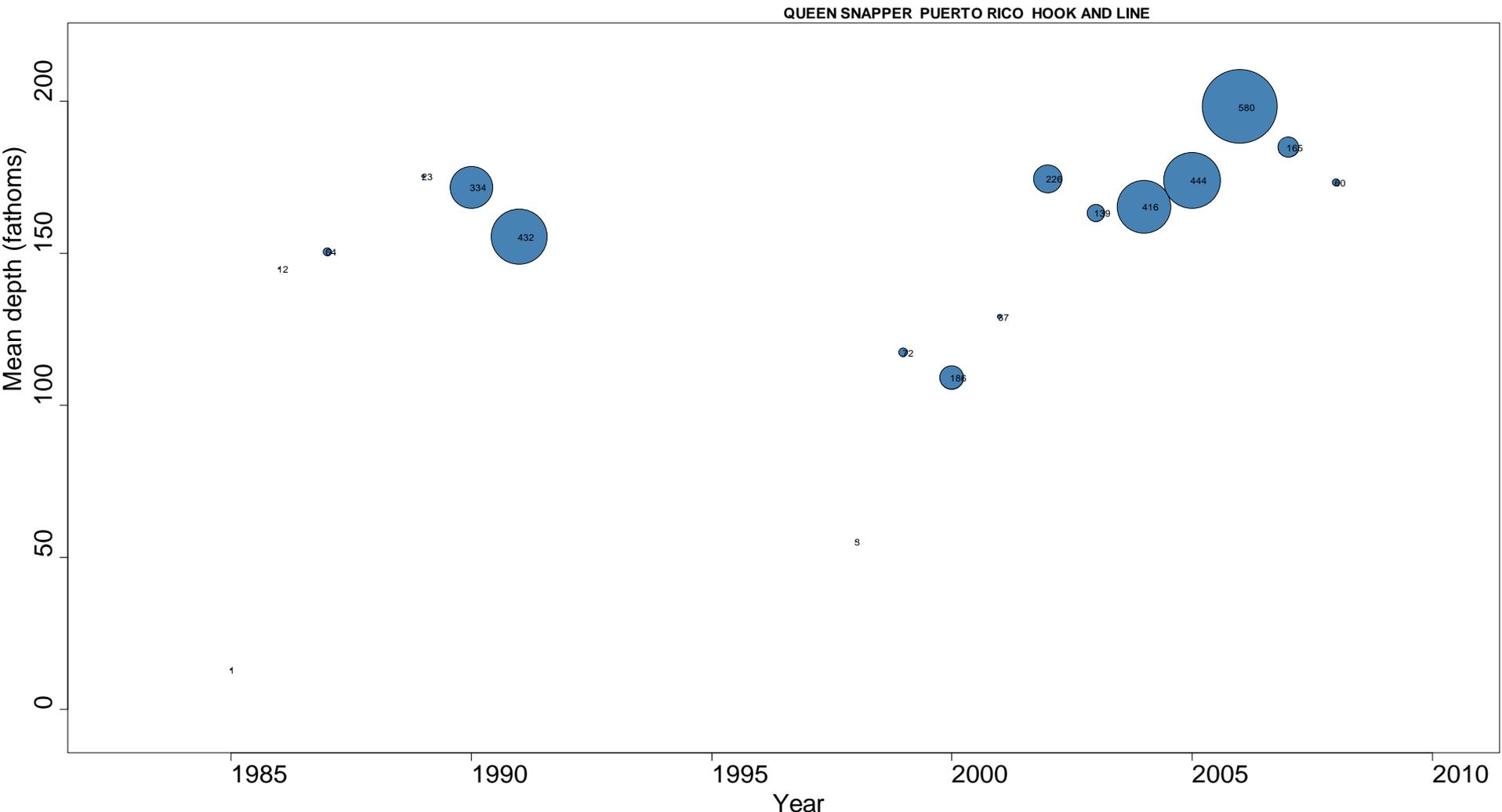
**Southeast**



Year

# Depth Evaluation

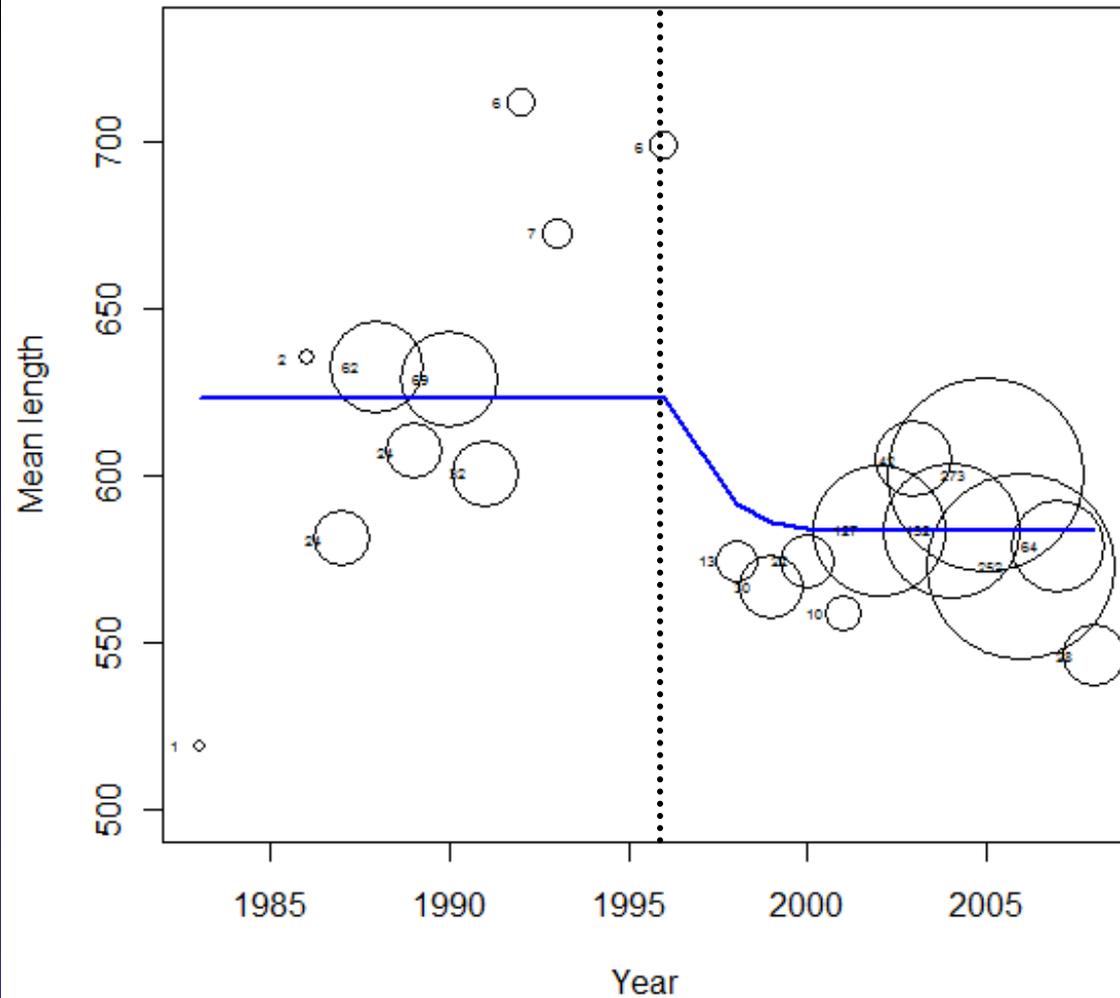
Mean depth (measured in fathoms) of fishing and capture of queen snapper using hook and line in Puerto Rico. Bubble size indicates the number of interviews from the TIP database for a given year that were used to calculate the mean and is scaled with respect to other years. The numbers plotted within the figure represent the number of interviews per bubble.



# Mean Length Analysis

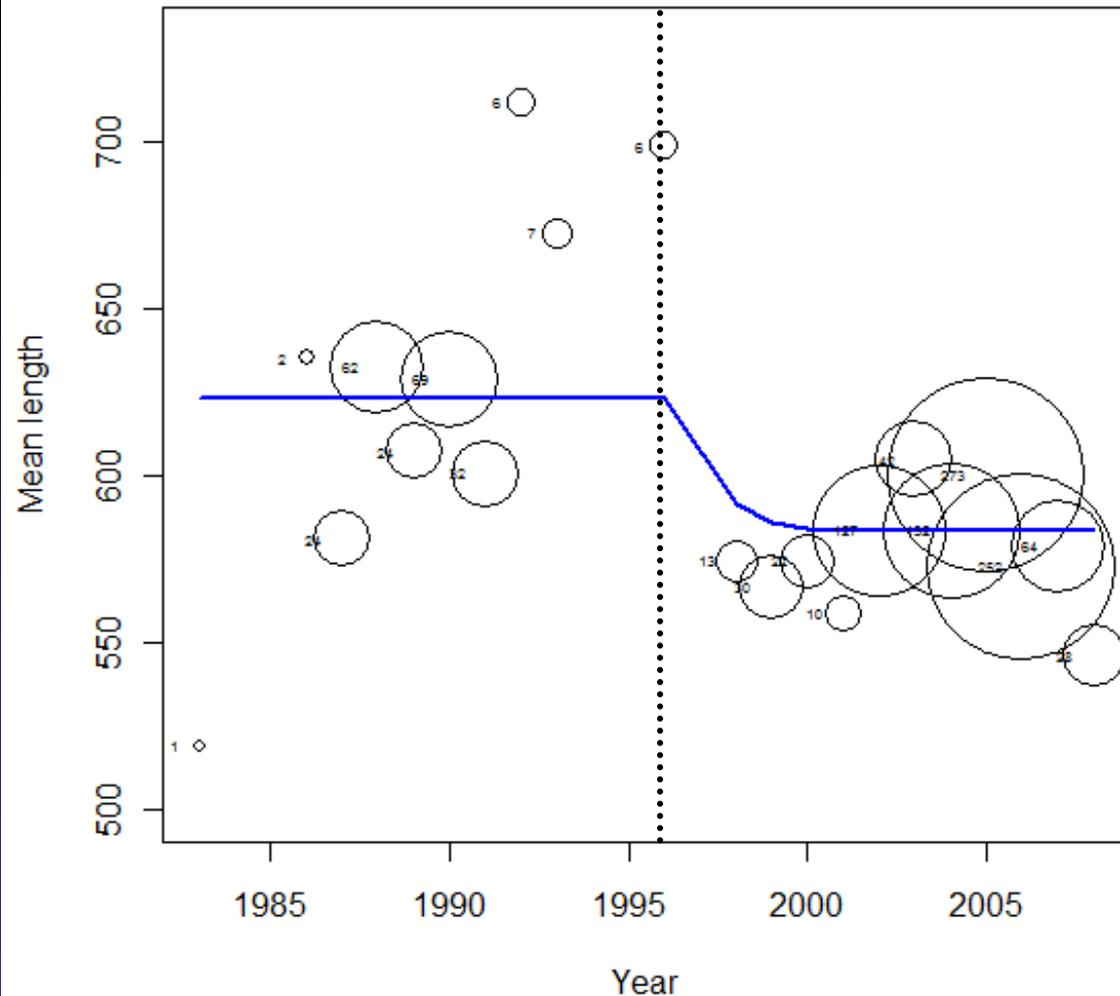
## Results

Puerto Rico – Hook and Line



## Base Case Queen snapper caught by hook and line in Puerto Rico.

<u>Parameter</u>	<u>Base</u>
$L_c$	365mm
VBK	0.45
$L_\infty$	888mm



**Base Case**  
**Queen snapper  
 caught by hook  
 and line in  
 Puerto Rico.**

<u>Parameter</u>	<u>Base</u>
$L_c$	365mm
VBK	0.45
$L_\infty$	888mm

Npar	AIC	LLIKE	Lc	VBK	L_Inf	Z	Z1	$\Delta$ Year1	Z2	$\Delta$ Year2	Z3	$\Delta$ Year3	Z4
2	213.81	104.57	486	0.45	888	1.26755	-	-	-	-	-	-	-
4	207.40	98.45	486	0.45	888	-	0.870	1996	1.404	-	-	-	-
6	210.02	96.01	486	0.45	888	-	0.873	1996	1.294	2005	1.887	-	-
8	214.88	93.44	486	0.45	888	-	0.912	1991	0.001	1994	1.287	2005	1.893

# Sensitivity Analysis

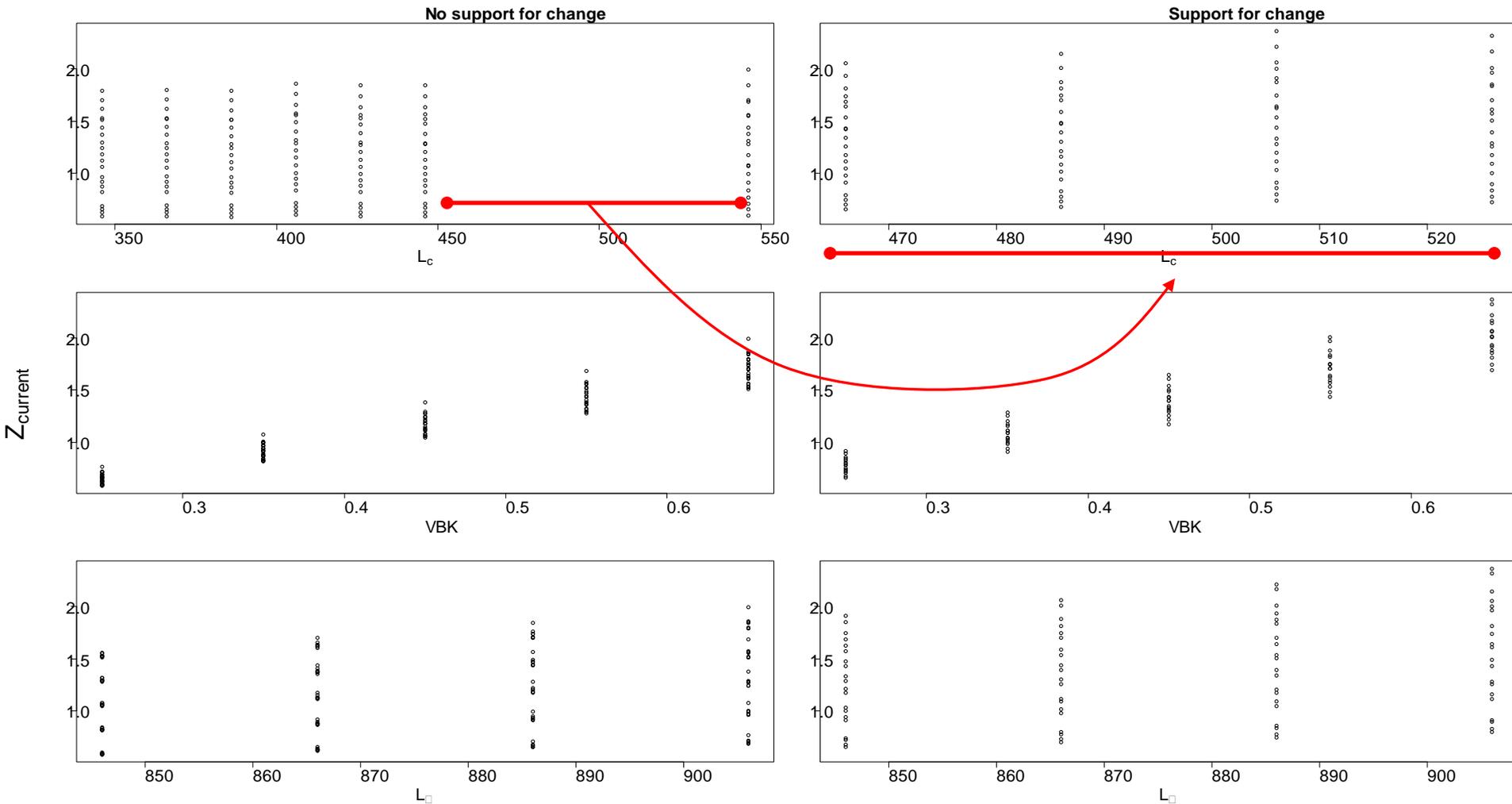
## Puerto Rico – Hook and Line

<u>Parameter</u>	<u>Lower bound</u>	<u>Base</u>	<u>Upper bound</u>
$L_c$	335mm	365mm	465mm
VBK	0.25	0.45	0.65
$L_\infty$	846mm	888mm	906mm

# Sensitivity Analysis

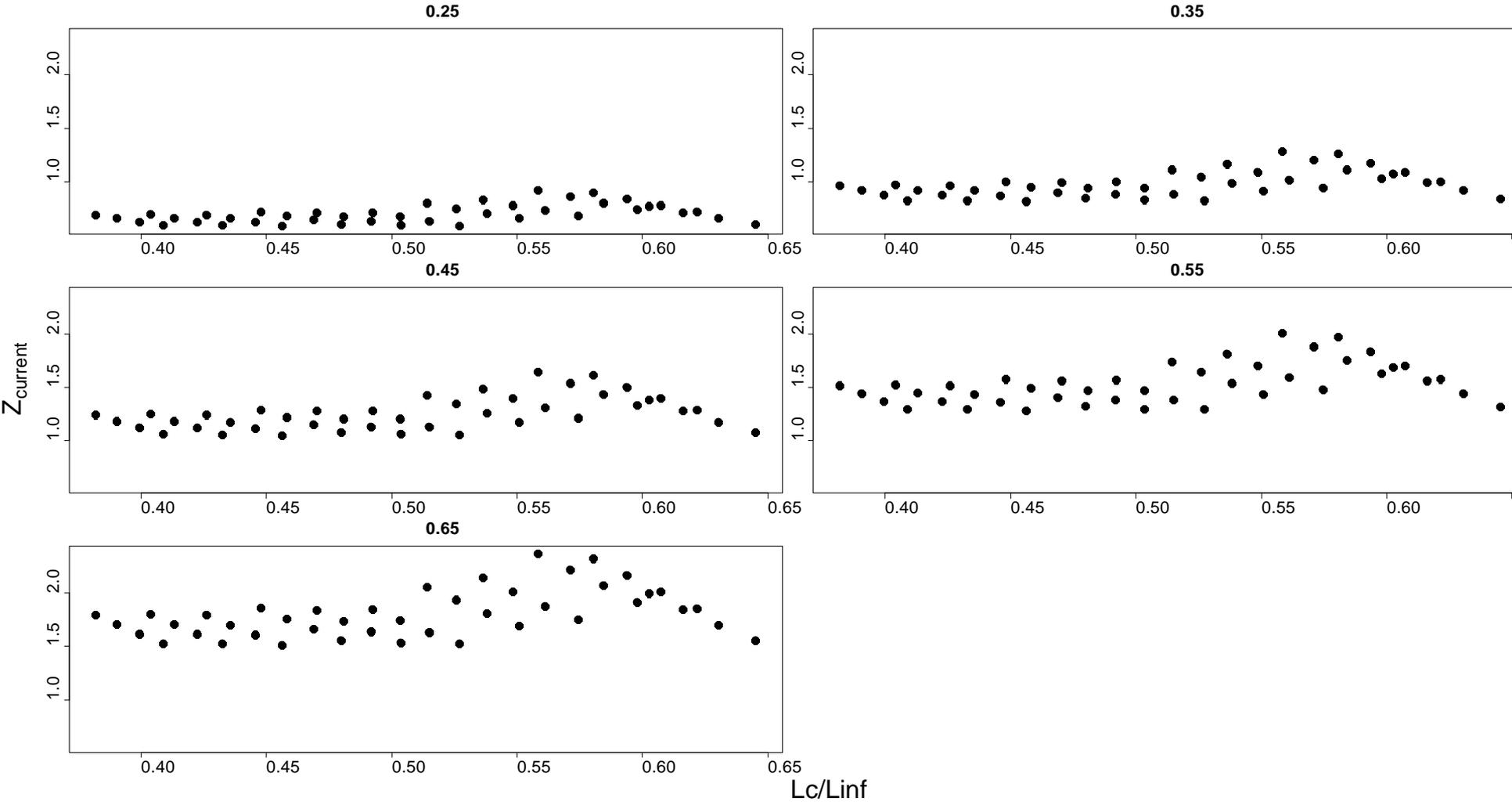
## Puerto Rico – Hook and Line

QUEEN SNAPPER.HOOK AND LINE.PUERTO RICO final\_summary.txt



Estimates of current total mortality ( $Z_{current}$ ) as a function of the von Bertalanffy growth parameter and the ratio between length at full vulnerability ( $L_c$ ) and the asymptotic length ( $L_\infty$ ) for Queen snapper caught by hook and line in Puerto Rico. Each panel represents a unique value of the von Bertalanffy growth parameter. Low values of the length ratio indicates either a small value of  $L_c$  or a large value of  $L_\infty$  and high values of the ratio indicate a high value of  $L_c$  and a small value of  $L_\infty$ . Strong support  $\Delta AIC > 5$ .

QUEEN SNAPPER.HOOK AND LINE.PUERTO RICO final\_summary.txt



# Using Proportional Change in Mortality

$$\text{Proportional Change in } Z = \frac{Z_2 - Z_1}{Z_1}$$

$$Z_1 = \frac{K(L_\infty - \bar{L}_1)}{\bar{L}_1 - L_c}$$

$$Z_2 = \frac{K(L_\infty - \bar{L}_2)}{\bar{L}_2 - L_c}$$

$$Z_{\text{prop. change}} = \frac{\frac{K(L_\infty - \bar{L}_2)}{\bar{L}_2 - L_c} - \frac{K(L_\infty - \bar{L}_1)}{\bar{L}_1 - L_c}}{\frac{K(L_\infty - \bar{L}_1)}{\bar{L}_1 - L_c}}$$

# Using Proportional Change in Mortality

$$Z_{\text{prop. change}} = \frac{\frac{\cancel{K}(L_{\infty} - \bar{L}_2)}{\bar{L}_2 - L_c} - \frac{\cancel{K}(L_{\infty} - \bar{L}_1)}{\bar{L}_1 - L_c}}{\frac{\cancel{K}(L_{\infty} - \bar{L}_1)}{\bar{L}_1 - L_c}}$$

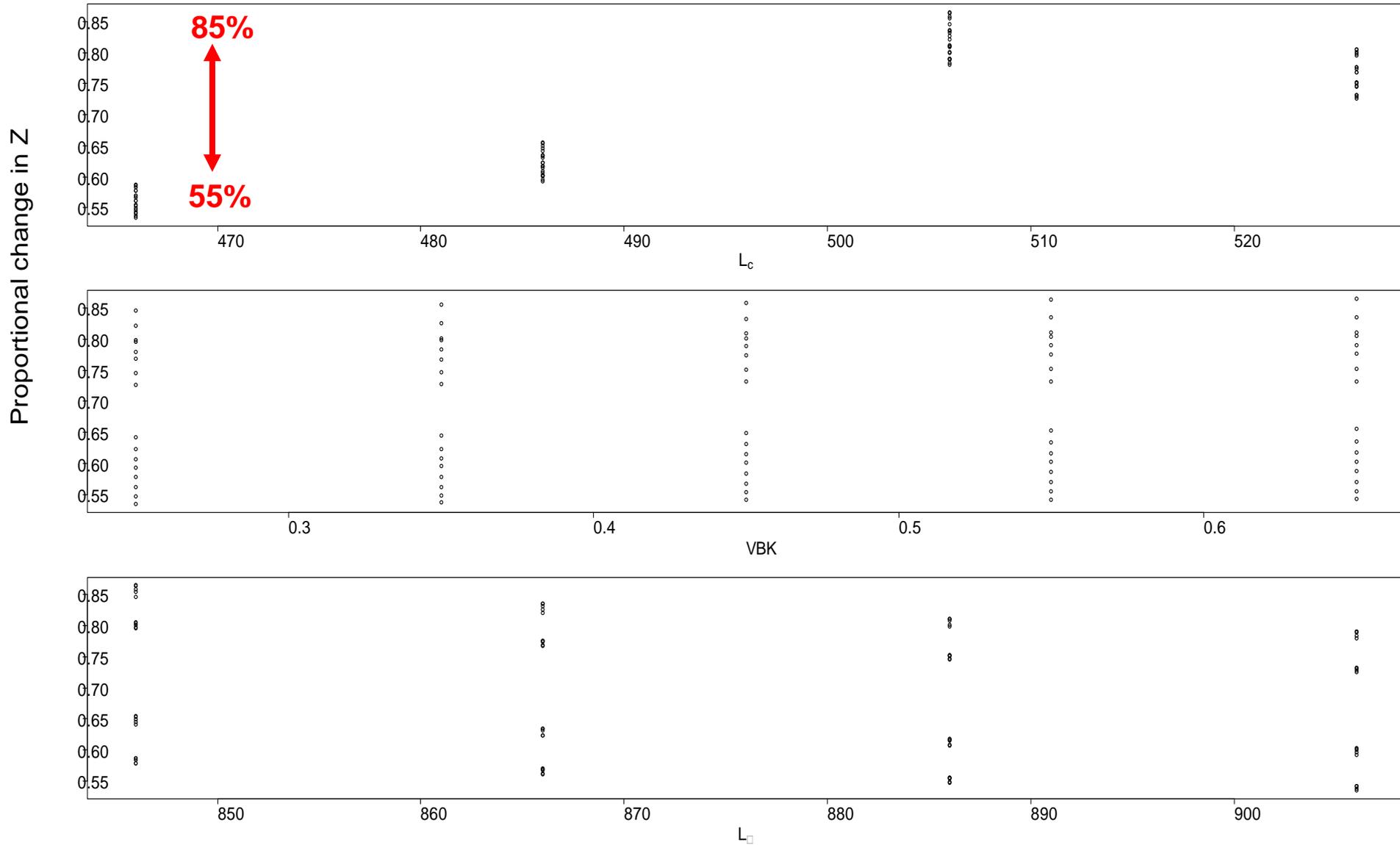
Re-arrange and Simplify  $\rightarrow$  No K  $\rightarrow Z_{\text{prop. change}} = f(L_{\infty}, L_c, \text{Mean Length})$

$$Z_{\text{prop. change}} = \frac{(L_{\infty} - \bar{L}_2) \cdot (\bar{L}_1 - L_c)}{(\bar{L}_2 - L_c) \cdot (L_{\infty} - \bar{L}_1)}$$

# Proportional Change in Total Mortality

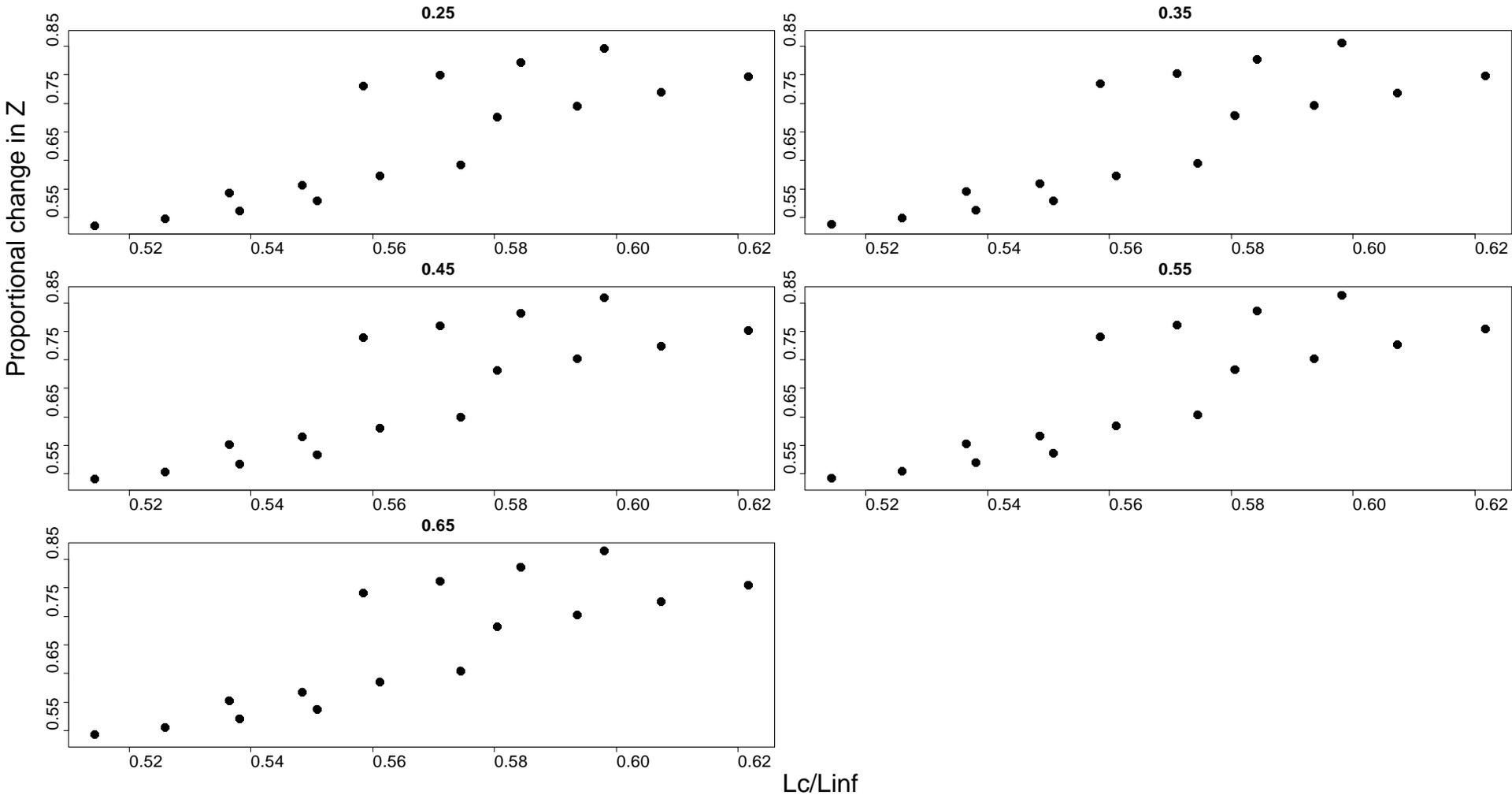
Proportion change in total mortality ( $Z$ ) as a function of length at full vulnerability ( $L_c$ ), the von Bertalanffy growth parameter (VBK) and asymptotic length ( $L_\infty$ ) for Queen snapper caught by hook and line in Puerto Rico. Strong support delta AIC>5.

QUEEN SNAPPER.HOOK AND LINE.PUERTO RICO final\_summary.txt



# Proportional change as function of ratio of $L_c$ to $L_\infty$ ratio for Queen snapper caught by hook and line in Puerto Rico.

QUEEN SNAPPER.HOOK AND LINE.PUERTO RICO final\_summary.txt



# Conclusions

Uncertainty in von Bertalanffy parameters adds considerable uncertainty in absolute estimates.

However, if we assume:

1) Fishery was lightly exploited at the start of time series (e.g. all information indicates fishery developed during time series) then

$$Z_1 \sim M$$

2)  $F_{msy} = 2 * M$

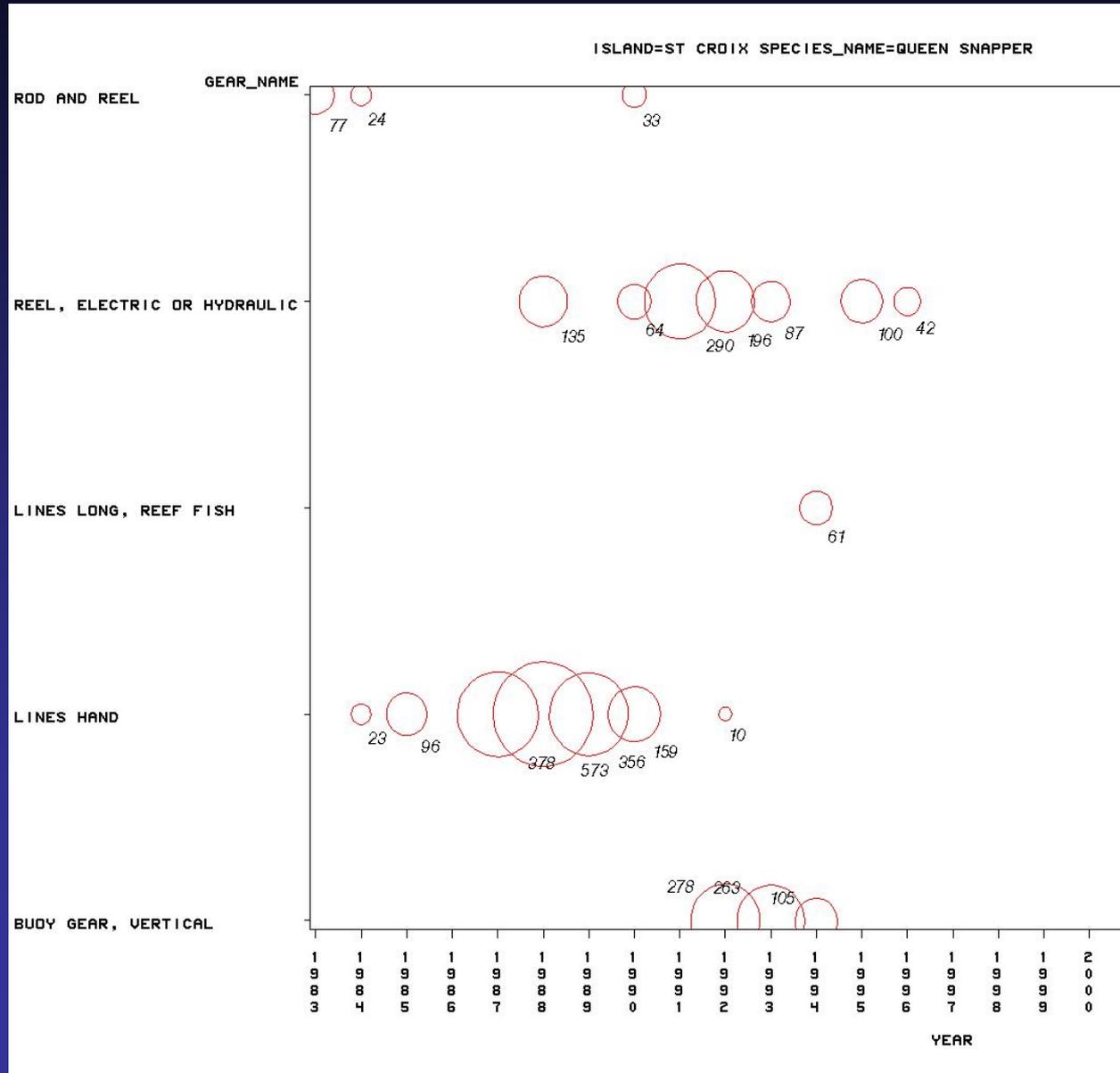
Then, given that all sensitivity runs that indicate a change show  $Z_2 < 2 * Z_1$ , the current Z should be below or near  $F_{msy}$ .

The proposed Annual Catch Limit (ACL) (2010 Amendment) have been set at  $0.85 * \underline{\text{average}}$  recent landings.

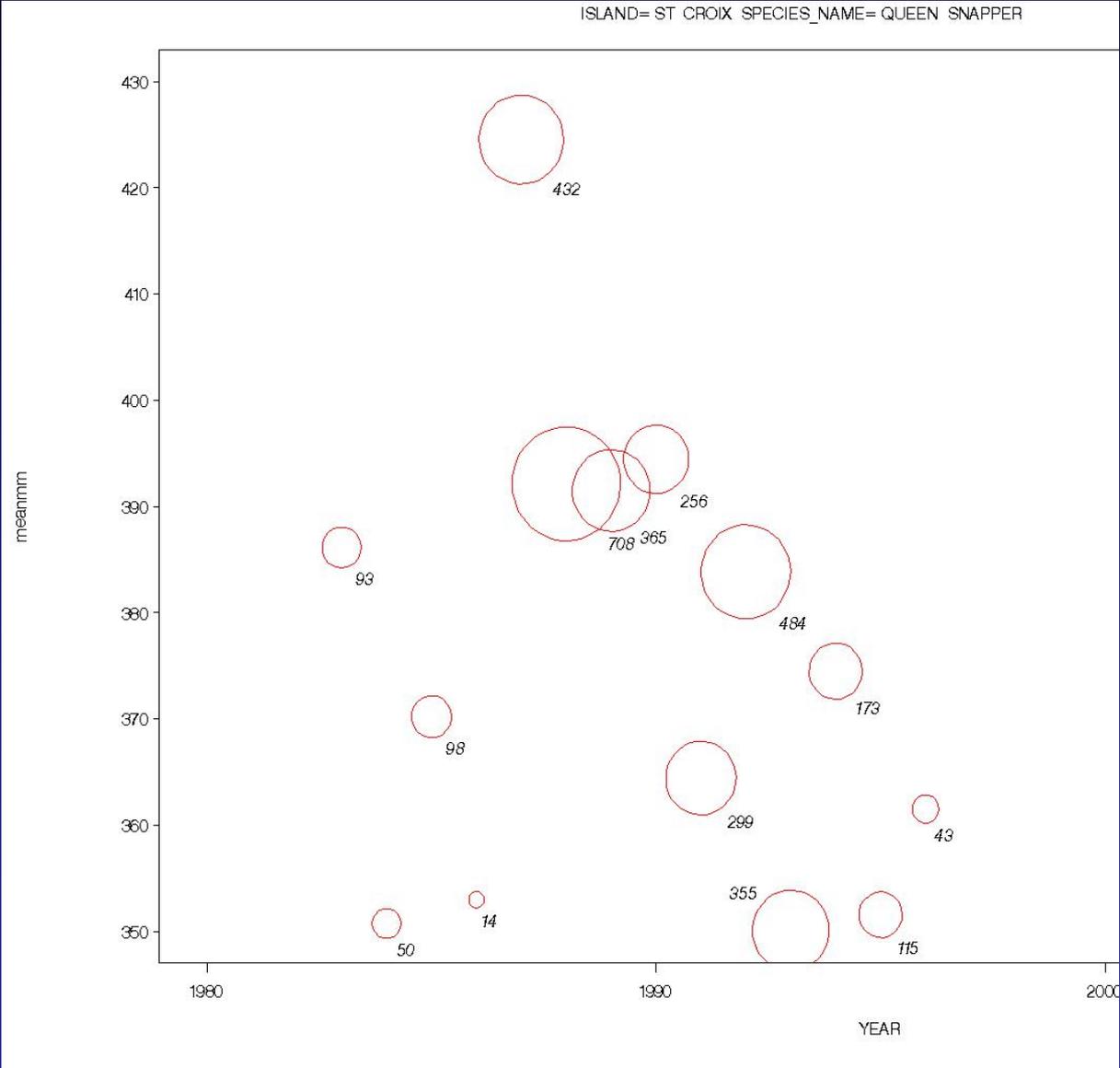
# **St. Croix**

**Hook and Line Only**

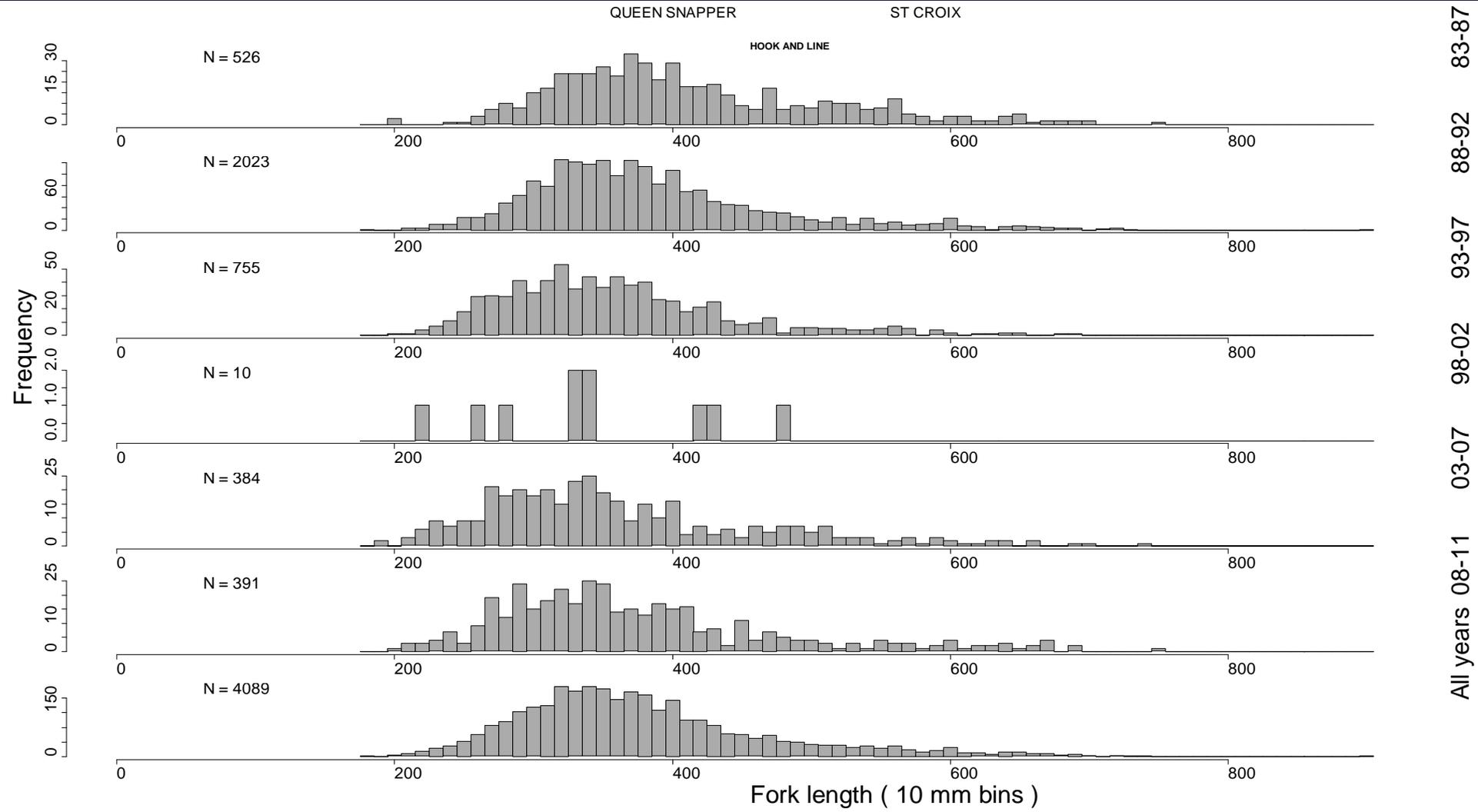
# Queen snapper number of sampled fish by specific gear type from St. Croix, 1983-2011.



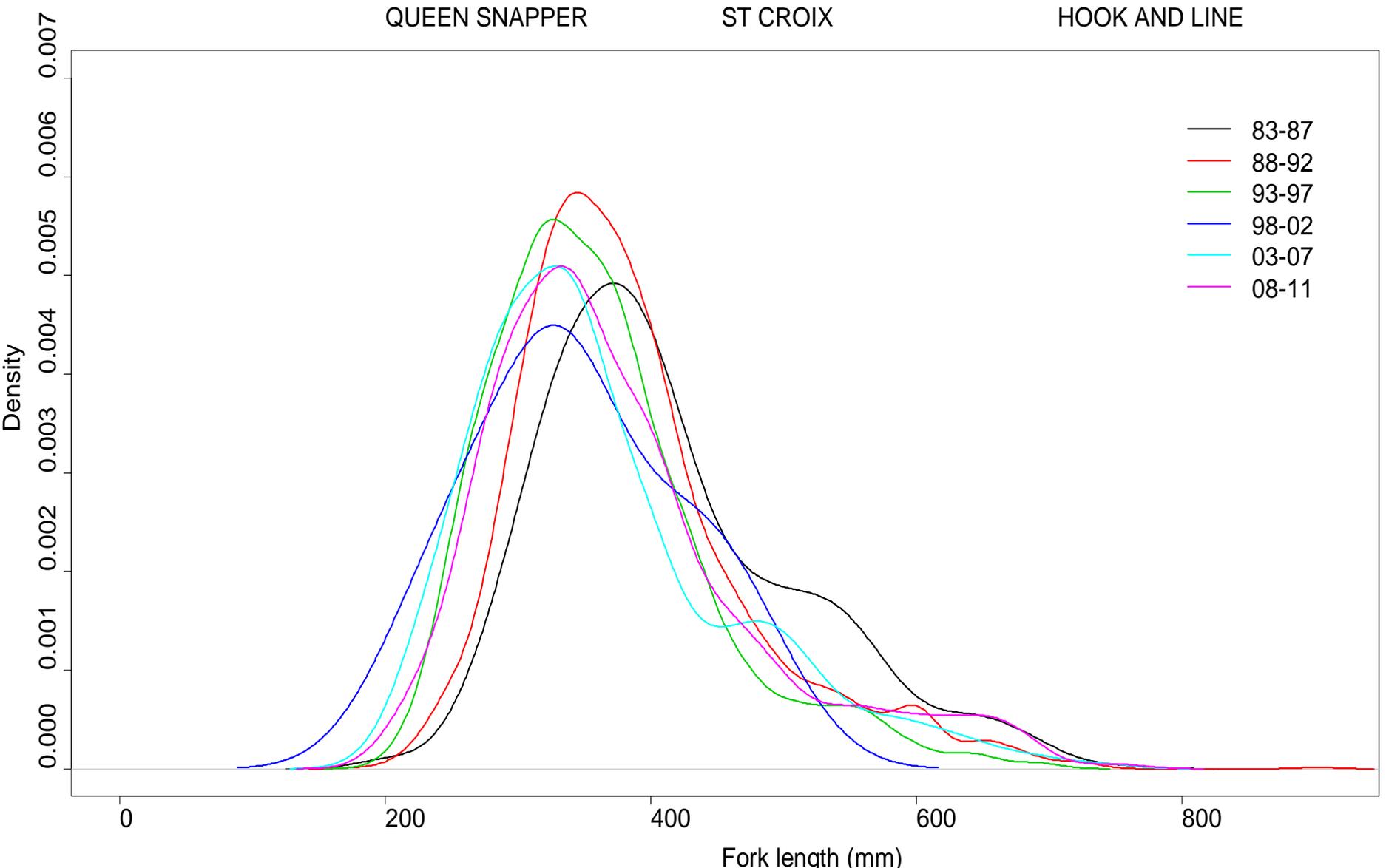
# Queen snapper mean lengths and sample sizes from St. Croix, 1983-2011.



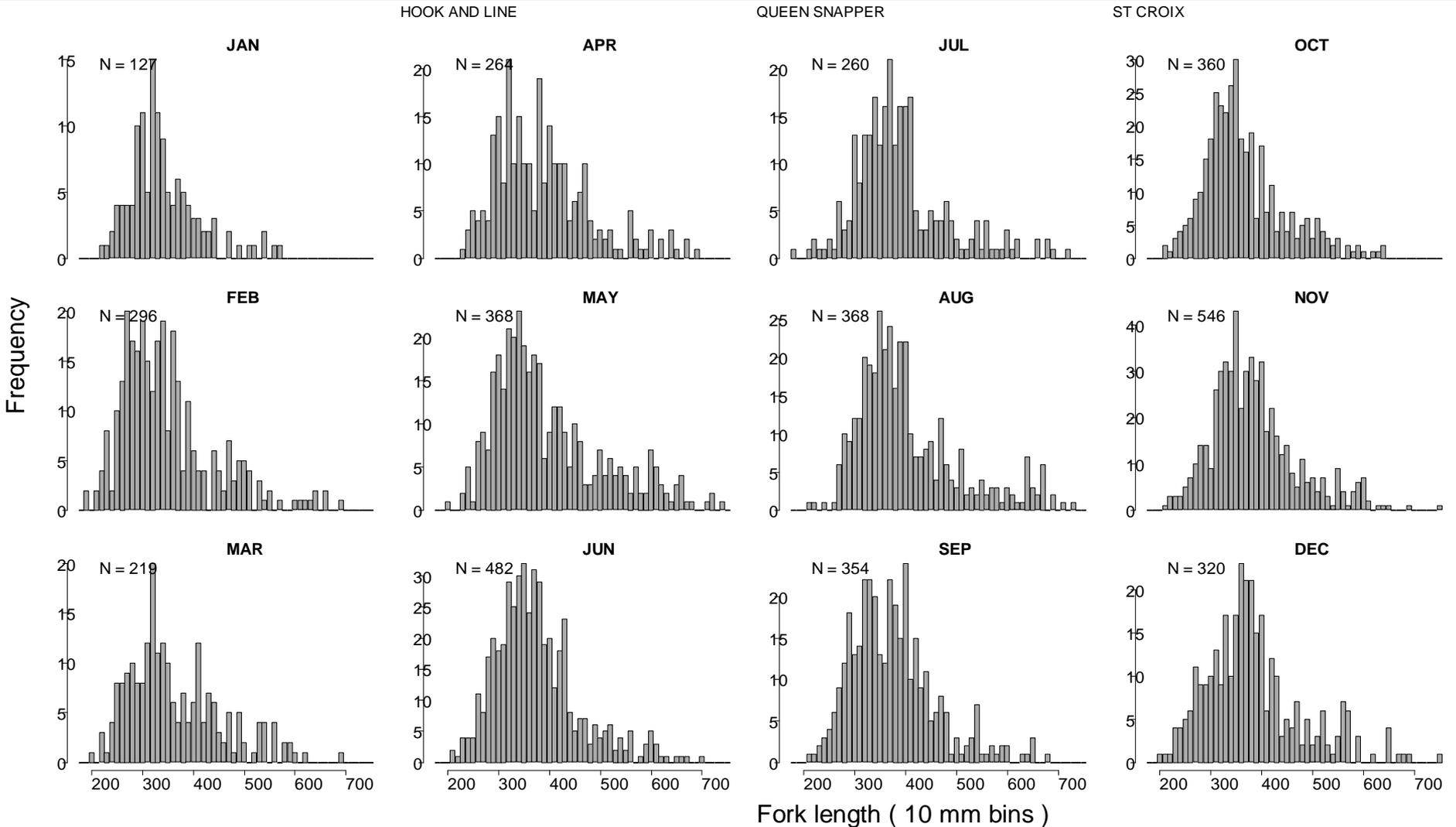
Length frequency distribution for Queen snapper caught by hook and line in St. Croix. Each panel includes data from a five-year time period, which is indicated at the right side of each panel. The bottom panel includes data from all years. Sample numbers (N) are indicated in each panel.



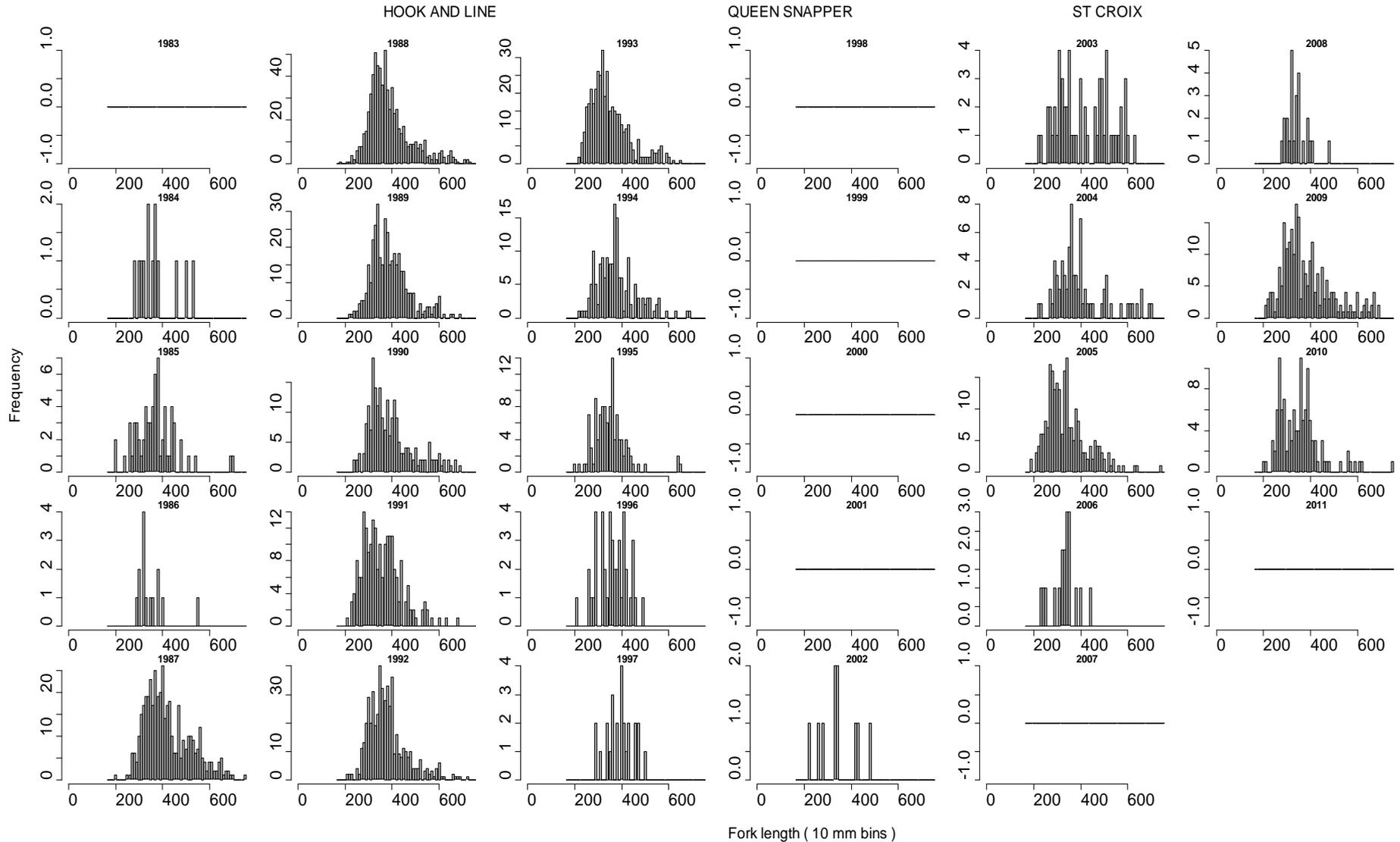
**Density plot of observed lengths from the TIP database for queen snapper caught by hook and line in Puerto Rico. Each curve represents a five-year time-period.**



# Monthly length-frequency histograms, where the length data was aggregated over years, for queen snapper caught by hook and line in St. Croix. N represents the sample size.



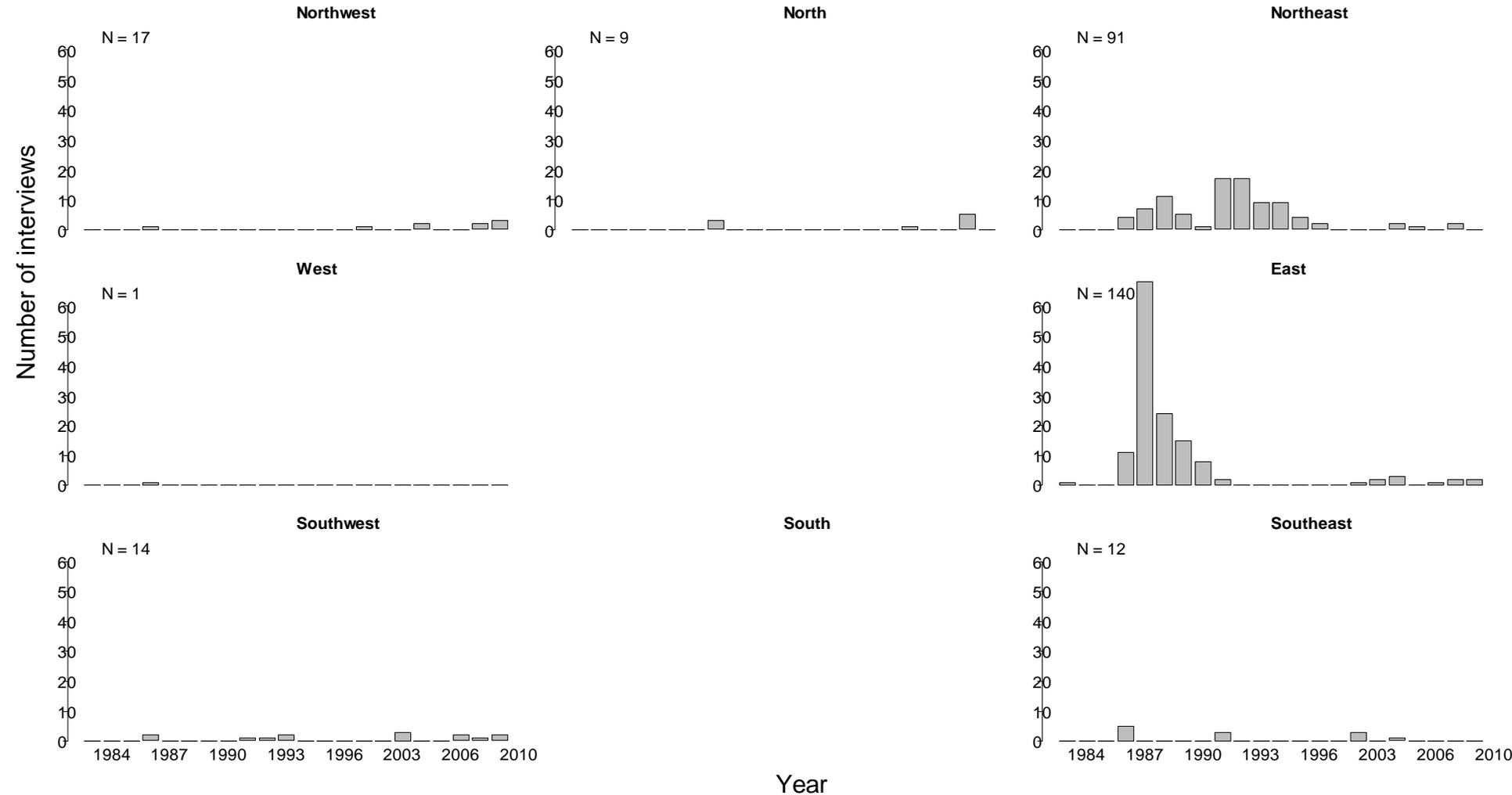
**Annual length-frequency histograms** for queen snapper caught by hook and line in St. Croix. Flat lines at zero indicate length-data was not collected in those years. Please note that the y-axis differs for each panel.



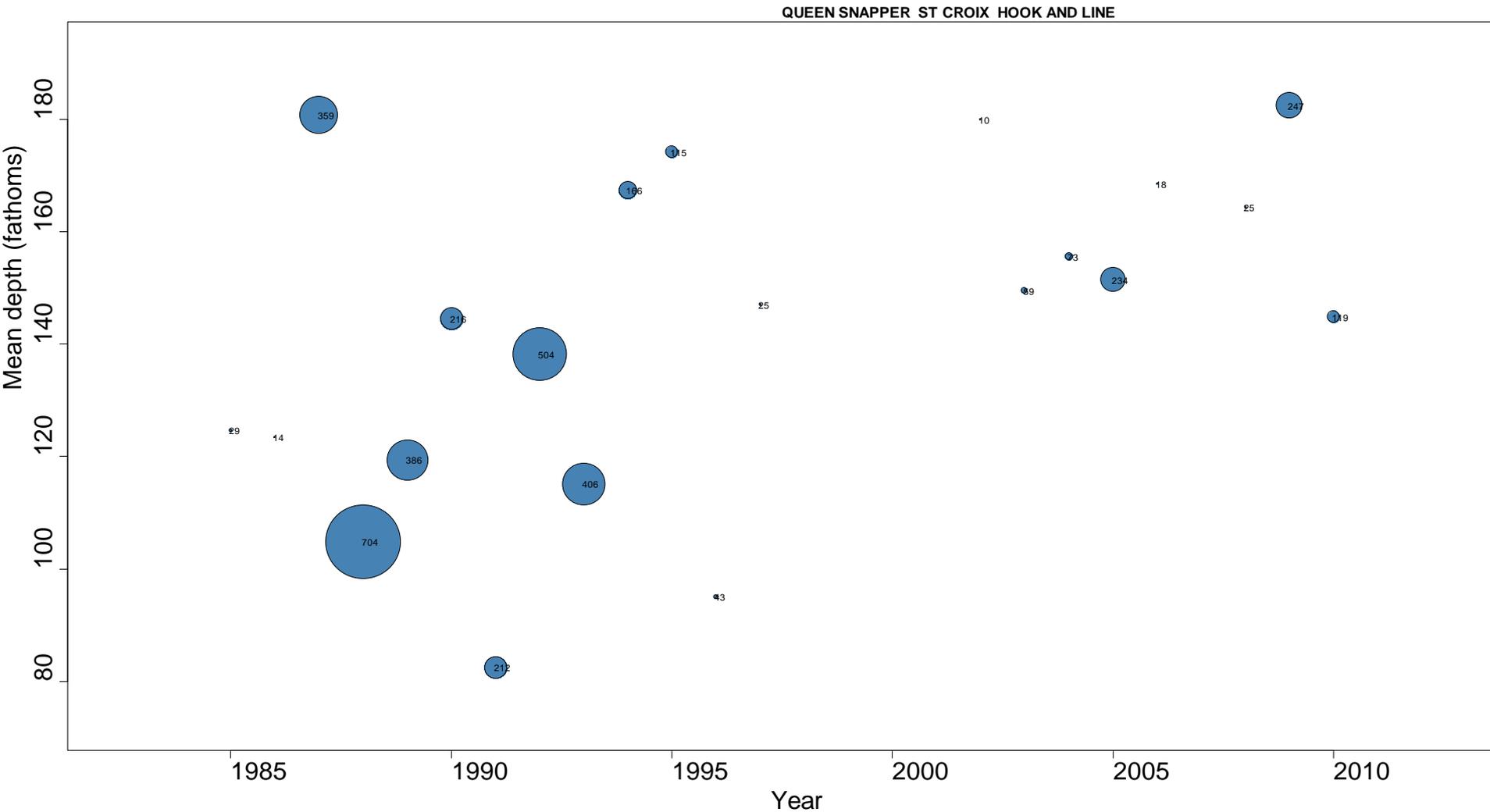
# Spatial Evaluation

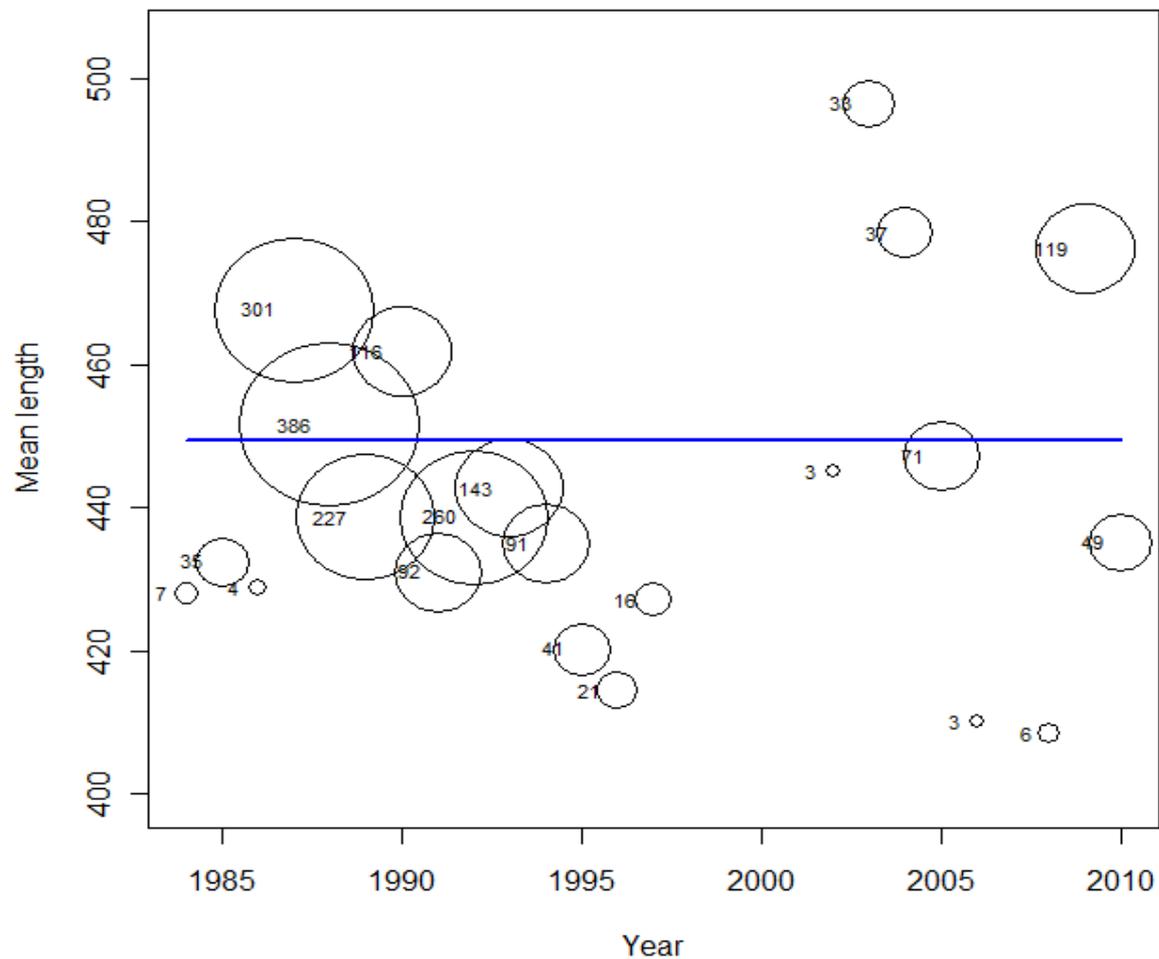
Number of interviews indicating fishing in a particular region around St. Croix where queen snapper was caught by hook and line. N is the total number of interviews indicating fishing within a given region.

QUEEN SNAPPER ST CROIX HOOK AND LINE



Mean depth (measured in fathoms) of fishing and capture of queen snapper using hook and line in St. Croix. Bubble size indicates the number of interviews from the TIP database for a given year that were used to calculate the mean and is scaled with respect to other years. The numbers plotted within the figure represent the number of interviews per bubble.





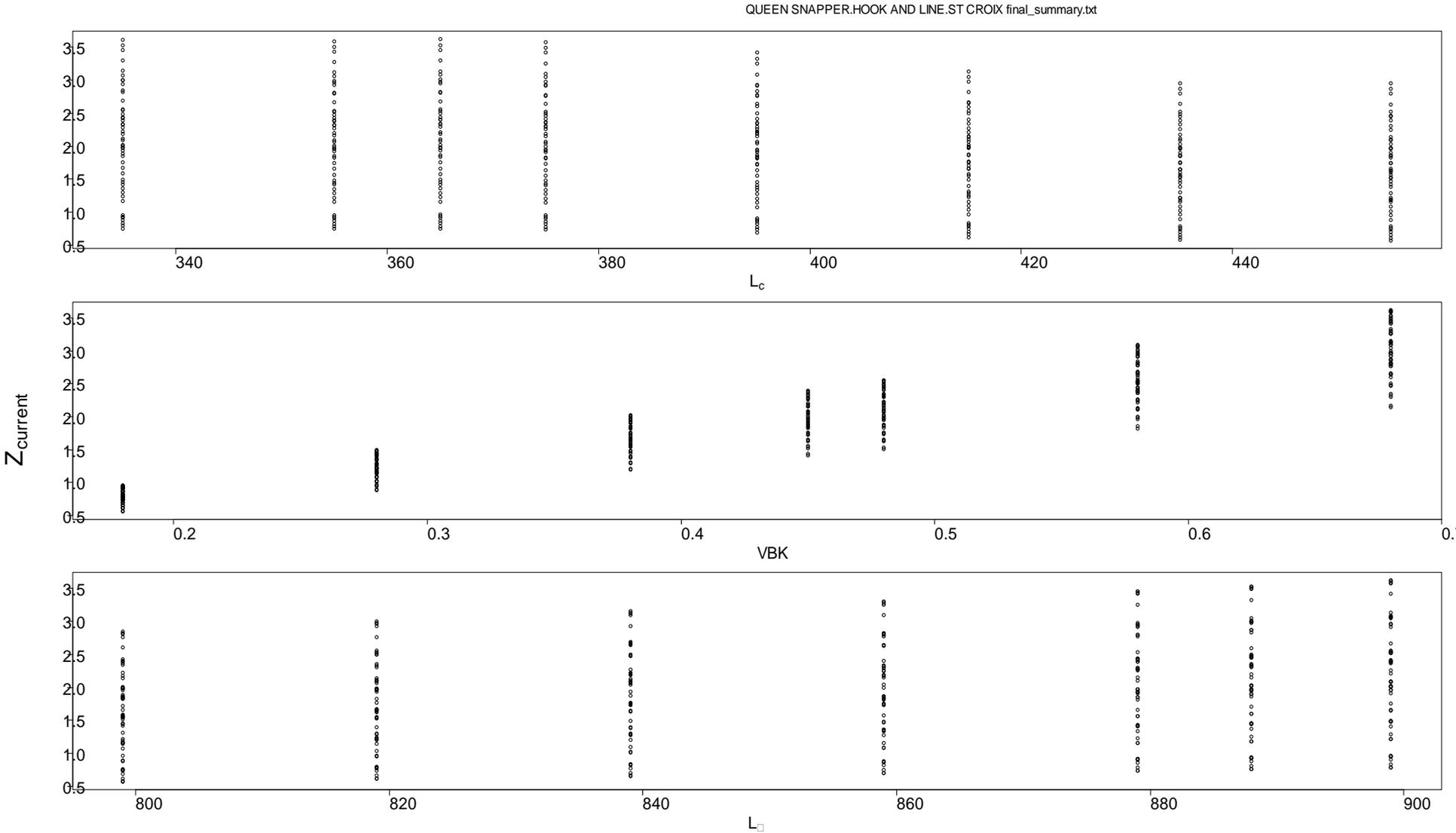
Mean length of fully-vulnerable individuals over time for the base-case time-series analysis. Bubble size indicates annual sample size relative to other years, the solid blue line represents the line of best fit.

Npar	AIC	LLIKE	Lc	VBK	L_Inf	Z	Z1	ΔYear1	Z2	ΔYear2	Z3	ΔYear3	Z4
2	207.277	101.323	365	0.45	888	2.338	-	-	-	-	-	-	-
4	209.171	99.409	365	0.45	888	-	1.948	1987	2.474	-	-	-	-
6	208.65	95.525	365	0.45	888	-	1.921	1987	2.648	1997	1.935	-	-
8	213.888	93.406	365	0.45	888	-	3.142	1985	1.738	1987	2.666	1997	1.935

**Table 5.4.2.** Input parameter ranges for sensitivity analysis.

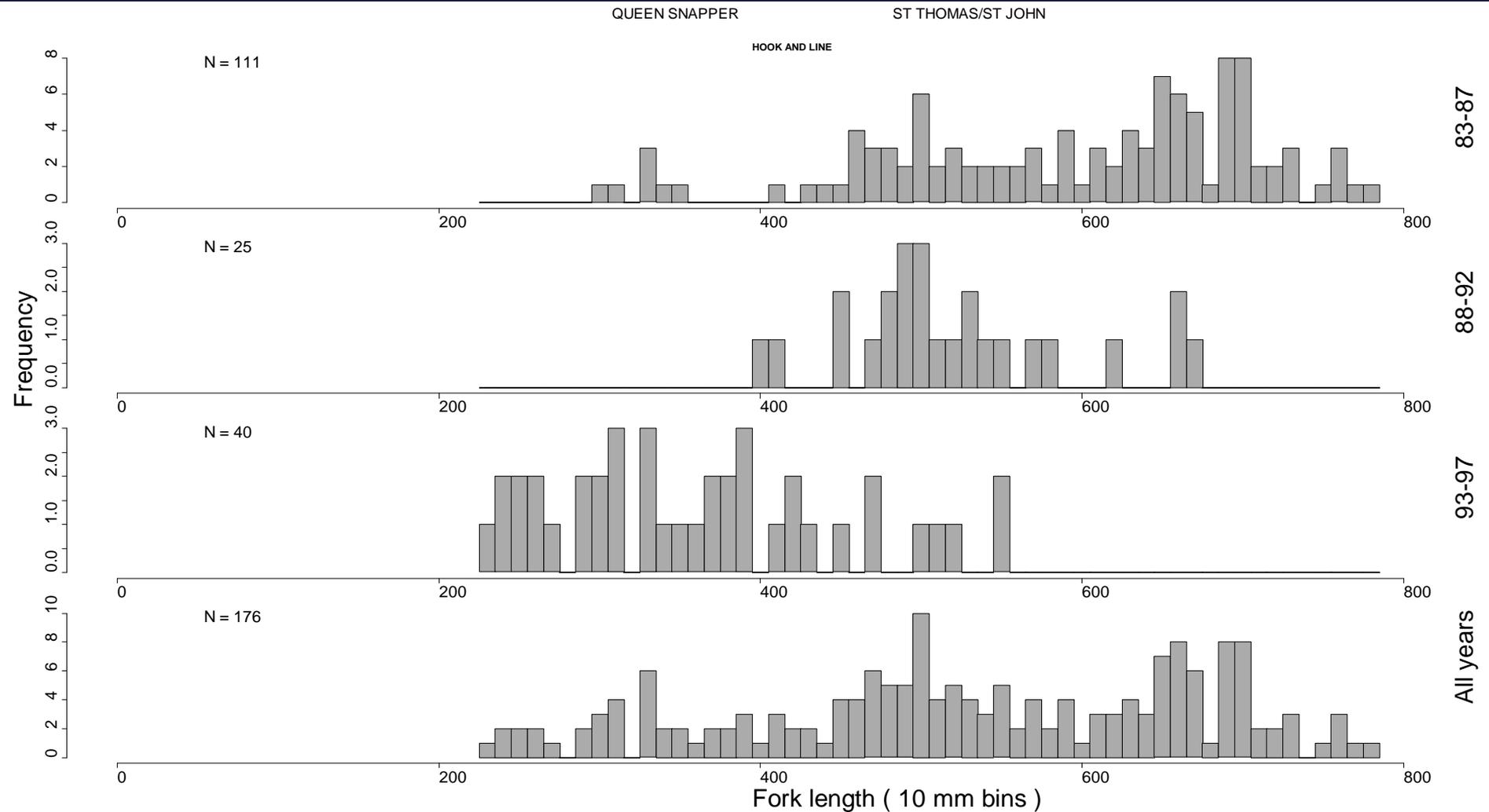
Parameter	Lower bound	Base	Upper bound
$L_c$	335mm	365mm	465mm
VBK	0.18	0.45	0.68
$L_\infty$	799mm	888mm	899mm

**Current estimates of total mortality ( $Z_{\text{current}}$ ) as a function of length at full vulnerability ( $L_c$ , top panel), the von Bertalanffy growth parameter (VBK, middle panel), and asymptotic length ( $L_\infty$ , bottom panel) all runs resulted in no strong support ( $\Delta \text{AIC} < 5$ ) for a predicted change in total mortality from the time-series analysis for Queen snapper caught by hook and line in St. Croix.**



# St Thomas/St. John

Less than 200 Queen snapper are in the TIP database  
Sample sizes too low to conduct additional analyses



THANK YOU!