

*Science, Service, Stewardship*



## GAG Life History Workgroup SEDAR 33

- Draft Working Document
- For May 2013 Data Workshop

**NOAA  
FISHERIES  
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# Stock Delineation

# Issues for stock delineation

- Last benchmark assessment used council boundaries (Gulf and Atlantic) as stock dividing line.
- But recognized that while data was inconclusive regarding degree of exchange between Gulf and Atlantic, there was evidence of exchange and more investigation was recommended (2006 Benchmark, SEDAR 10).

## New information; stock delineation

- Patterns of juvenile settlement (Gulf and Atlantic), (Bourgoin 2011, Adamski et al 2012, Switzer et al 2012)
- Otolith morphology and chemistry (Renan et al 2011, Fodrie 2012, Jones et al. 2013)
- Genetics of larval dispersal (Jue 2010, Cushman et al. 2009)
- Oceanography and larval transport (Johnson pers comm., Todd 2013, Karnauskas et al. 2013)



# Age and Growth

# Age summary

Year	n	age range		averages				
		min	max	PR HL	HB HL	CP HL	CM HL	CM LL
1991	357	1	20	2.0	3.4	4.5	6.5	6.0
1992	493	1	24	3.5	3.9	4.8	4.7	6.9
1993	827	1	22		4.0	4.4	5.0	6.1
1994	754	1	22	2.3	3.9	4.9	5.6	5.7
1995	665	2	25	2.5	3.8	5.0	6.7	7.6
1996	979	2	22	2.0	3.4	4.0	5.1	7.8
1997	284	2	17	4.5	3.8	4.3	6.3	9.3
1998	349	1	19	3.0	4.2	4.8	4.7	7.5
1999	520	2	28	3.2	5.5	4.3	6.8	6.9
2000	645	1	28	5.6	4.2	3.4	4.9	8.3
2001	1821	1	27		4.9	4.4	5.6	7.9
2002	2328	1	29	3.7	4.3	3.8	5.8	7.5
2003	2051	1	29	3.4	3.6	4.0	6.3	7.7
2004	2583	0	27	4.9	3.5	4.4	5.9	7.3
2005	1934	1	31	6.0	3.9	4.6	6.1	7.4
2006	1325	0	28	4.1	4.1	4.2	6.3	6.9
2007	1512	0	25	3.3	3.9	3.5	5.6	6.7
2008	1663	0	24	2.9	4.2	3.3	5.4	7.0
2009	2623	0	29	3.6	3.2	3.5	4.8	6.1
2010	3128	0	25	3.3	4.0	3.8	4.8	6.0
2011	2498	0	25	3.5	3.7	3.9	5.0	5.8
2012	2554	0	28	3.0	4.5	4.6	5.7	6.3



# Natural Mortality



# Reproduction



# Reproduction overview

## •Reproductive Potential

- Little new information regarding batch fecundity and spawning frequency
- Used SSB-female in last assessment
- Examine SSB-total for consistency with published analysis and SA criteria (and 2012 workshop on modeling protogynous fishes)
- Examine unity assumption with available fecundity information

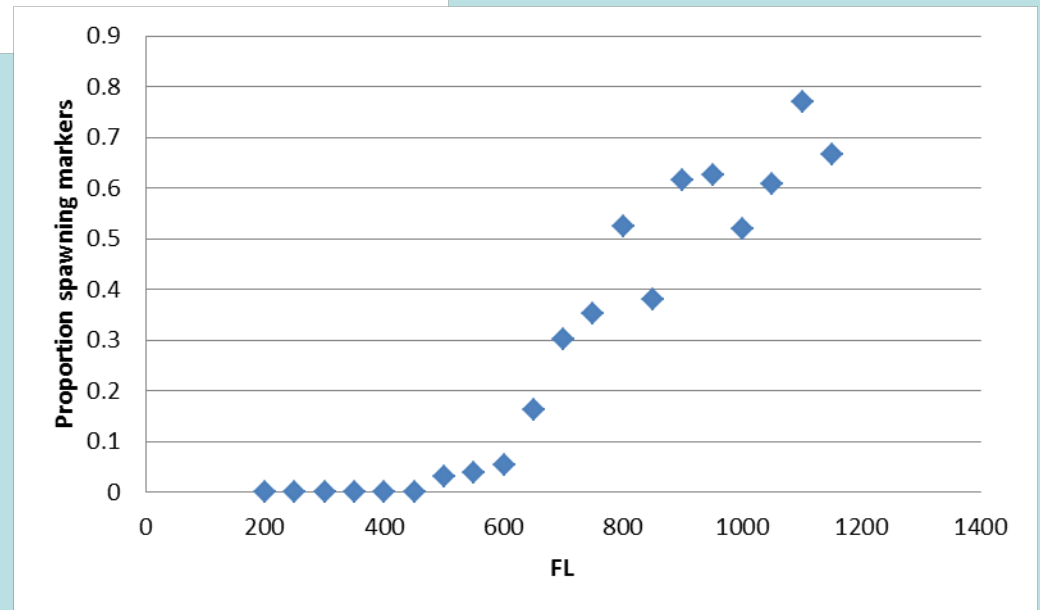
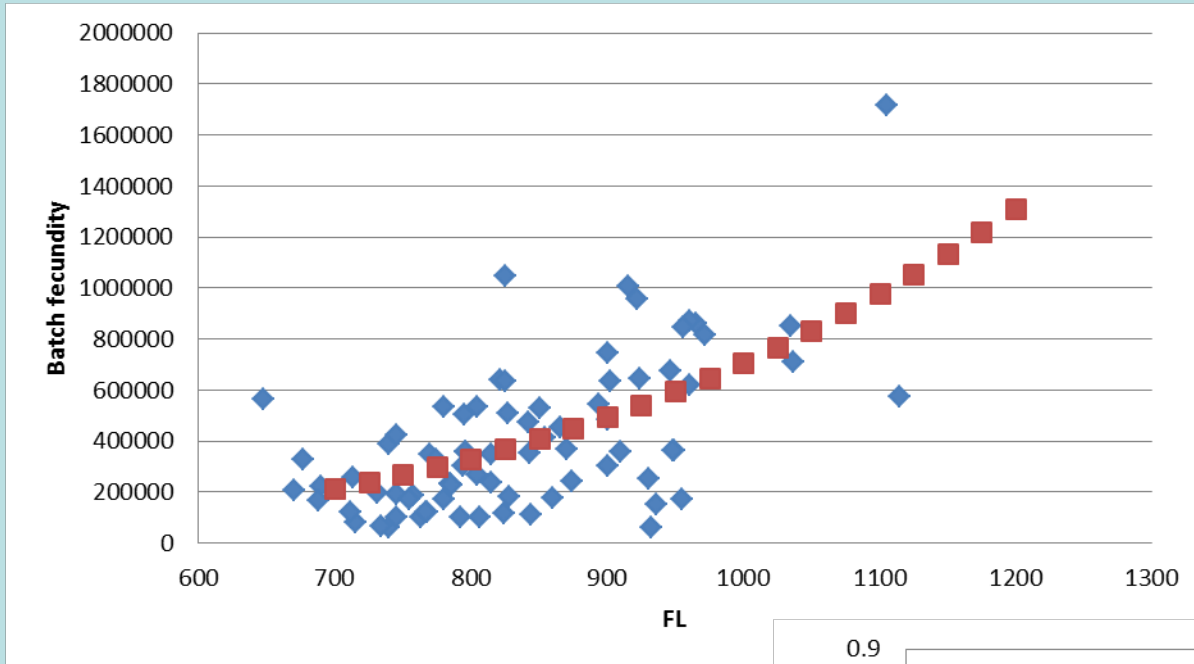
## •Maturity & Sex Transition

- Updated analysis of age/size at transition based upon records of pigmented gag vs. un-pigmented gag (port agents).
- Examination of available histological data

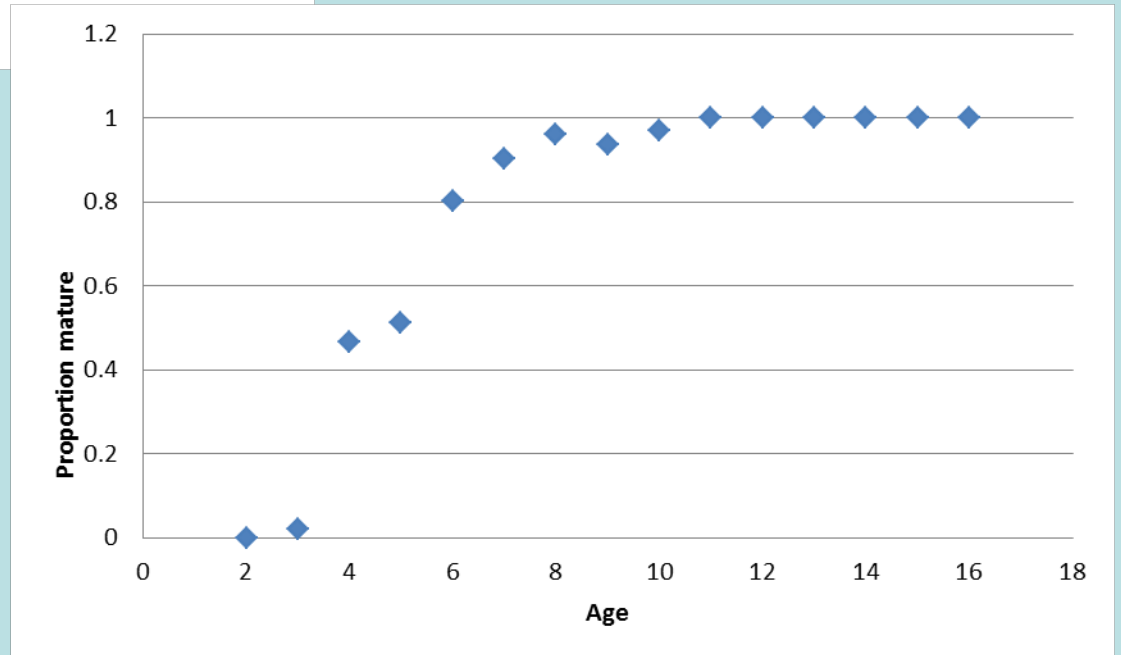
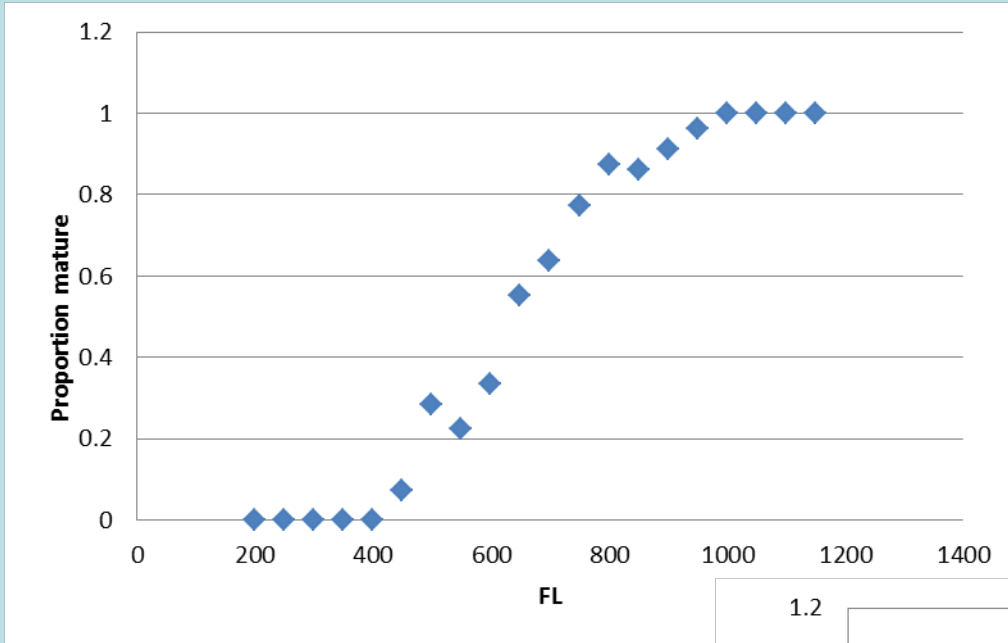
## •Sex Ratio

- TIP program; proportion of gag with ventral pigmentation
- Cooperative research and observer-based studies.
- FSU MARFIN study of marine reserves (Koenig and Coleman 2011)

# Female reproductive potential



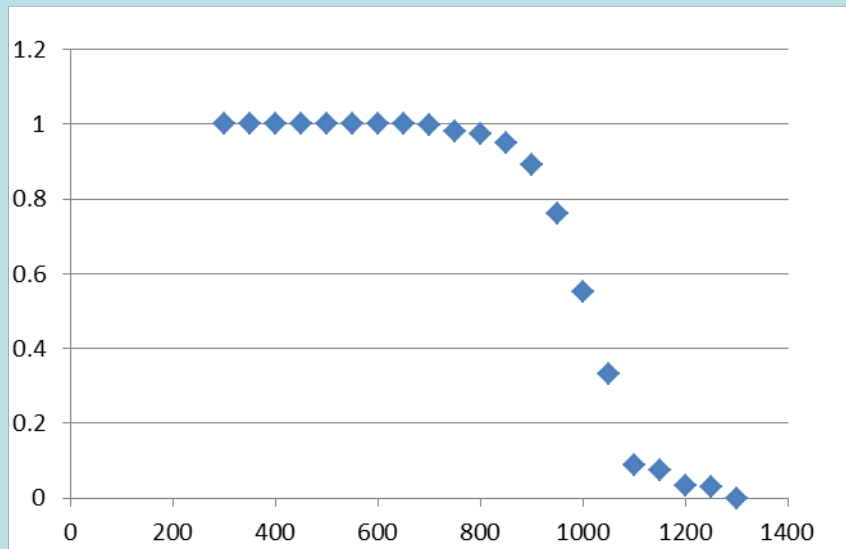
# Female maturity



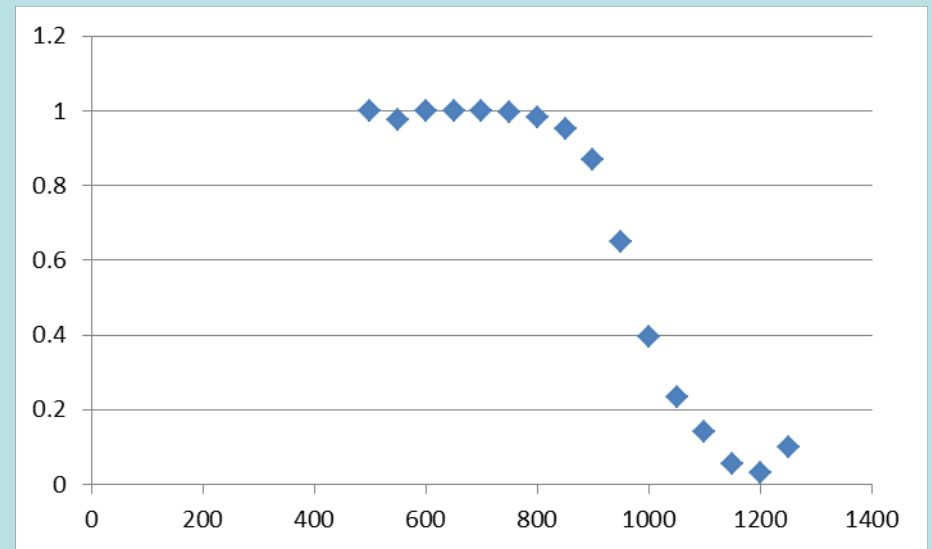
# Sex change

	total n	% female	% male and transitional			
No pigment	2506	98	2			
pigment	111	14	86			

1991-2004, n=2600



2005-2012, n=3838



Proportion female by fork length (1- proportion with ventral pigmentation)

# Sex ratio – Madison/Swanson Reserve

**Table 2.** Percent males and transitionals in the gag population inside MSMR. Fish collected from Dec. 2007 to Dec. 2010. Fish sizes standardized to 75 cm TL and larger. F=female, T=transitional, M=male.

Periods	F	T	M	total	% T	% M+T
Agg, Dec-May	19	0	1	20	0	5.0 <sup>a</sup>
Post agg, Apr-Jul	70	4	9	83	4.8	15.6 <sup>b</sup>
Pre agg, Aug-Nov	72	0	8	80	0	10 <sup>c</sup>
total	161	4	18	183	2.2	12.0 <sup>b</sup>

<sup>a</sup> Not significantly different between inside and outside MSMR ( $p>0.05$ )

<sup>b</sup> Significantly different between inside and outside MSMR ( $p<0.0001$ )

<sup>c</sup> Significantly different between inside and outside MSMR ( $p<0.003$ )

**Table 3.** Percent males and transitionals in the gag population outside MSMR. Fish collected from Dec. 2007 to Dec. 2010. Fish sizes standardized to 75 cm TL and larger. F=female, T=transitional, M=male.

Periods	F	T	M	total	% T	% M+T
Agg, Dec-May	172	0	2	174	0	1.1 <sup>a</sup>
Post agg, Apr-Jul	22	0	0	22	0	0 <sup>b</sup>
Pre agg, Aug-Nov	9	0	0	9	0	0 <sup>c</sup>
total	203	0	2	205	0	1.0 <sup>b</sup>

<sup>a</sup> Not significantly different between inside and outside MSMR ( $p>0.05$ )

<sup>b</sup> Significantly different between inside and outside MSMR ( $p<0.0001$ )

<sup>c</sup> Significantly different between inside and outside MSMR ( $p<0.003$ )

# Sex ratio – Gulf Historical

**Table 7.** Gag sex ratio: Gulf of Mexico comparison of historical 1970s (Hood and Schleider 1992) with more recent data 1990s (Koenig et al. 1996). The numbers of females: males plus transitionals and the percentage of males plus transitionals (in parentheses) in the catch data are presented.

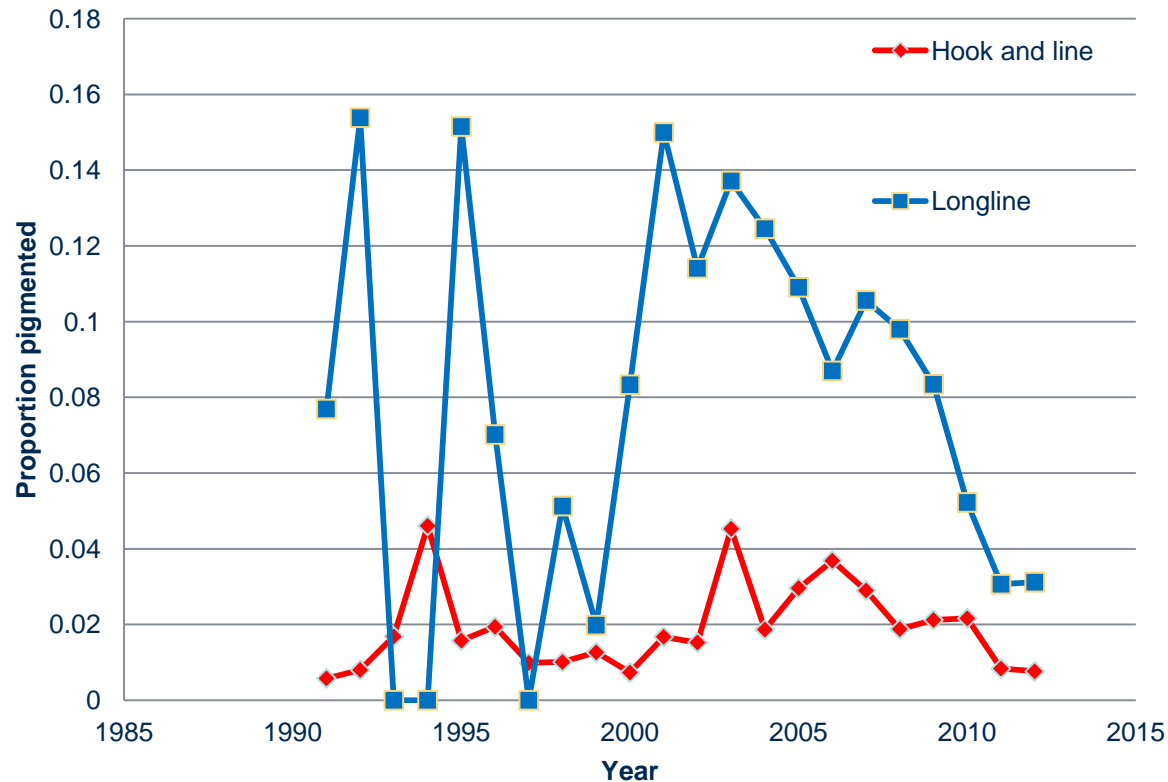
Period of Observation	1970s	Gulf of Mexico	
		1990s	p-value
Dec-Mar (Aggregation)	301:52 (15%)	311:6 (2%)	<0.001
Apr-Jul (Post-aggregation)	188:48 (20%)	119:6 (5%)	<0.001
Aug-Nov (Pre-aggregation)	163:39 (19%)	24:0 (0%)	<0.01

Koenig and Coleman, 2011

CRP study	Total n	M&T n	% M&T	Years	Season	% LL	Grids
Mote	225	4	1.8	2004-2005	May, June & Jan	100	99% (3,4,5)
Ward	114	3	2.6	2009	Year round except Feb & Mar	2.6	91% (6,7)

Data from CRP studies

# Secondary sex ratio – TIP, proportion pigmented



	LL n	HL n
1991	39	519
1992	26	375
1993	13	771
1994	3	738
1995	33	571
1996	57	825
1997	6	203
1998	117	198
1999	252	158
2000	180	409
2001	867	716
2002	1087	787
2003	1123	552
2004	1357	911
2005	761	743
2006	1575	651
2007	966	414
2008	745	692
2009	731	849
2010	938	832
2011	522	1434
2012	449	1569



# Conversions



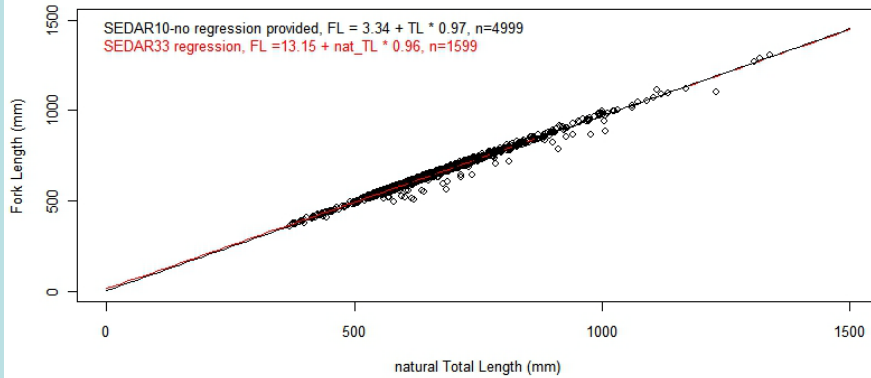
# Conversions

## Meristic regressions for gag from the Gulf of Mexico (1991-2012)

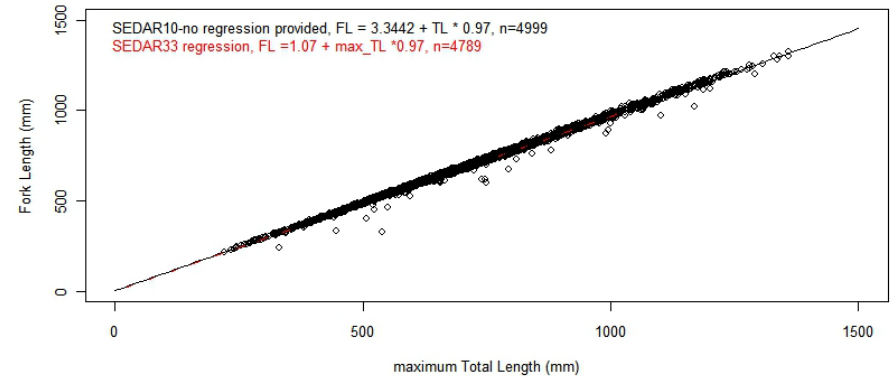
Conversion and units	Equation	Sample Size	r <sup>2</sup> values	Data Ranges
Natural TL (mm) to FL (mm)	$FL = 13.15 + \text{Natural TL} * 0.96$	1599	0.9886	FL (mm): 357 - 1304 Natural TL (mm): 370 - 1338
Maximum TL (mm) to FL (mm)	$FL = 1.07 + \text{Maximum TL} * 0.97$	4789	0.9973	FL (mm): 235 - 1240 Maximum TL (mm): 241-1287
Maximum TL (mm) to G. Wt (kg)	$G. Wt = 7.31 \times 10^{-09} * (\text{maximum TL}^{3.07})$	540	0.9460	Maximum TL (mm): 446 - 1295 G. Wt (kg): 0.99 – 27.02
Natural TL (mm) to G. Wt (kg)	$G. Wt = 3.50 \times 10^{-11} * (\text{natural TL}^{3.85})$	40	0.5902	Natural TL (mm): 551 - 1110 G. Wt (kg): 1.80 – 19.01
FL (mm) to G. Wt (kg)	$G. Wt = 7.28 \times 10^{-09} * (FL^{3.08})$	9793	0.7942	FL (mm): 394 - 1040 G. Wt (kg): 0.73 – 33.10
Maximum TL (mm) to W. Wt (kg)	$W. Wt = 1.05 \times 10^{-08} * (\text{maximum TL}^{3.03})$	4266	0.7357	Maximum TL (mm): 120 - 1360 W. Wt (kg): 0.02 – 32.74
Natural TL (mm) to W. Wt (kg)	$W. Wt = 1.36 \times 10^{-08} * (\text{natural TL}^{2.99})$	1934	0.4848	Natural TL (mm): 290 - 1332 W. Wt (kg): 0.34 – 31.30
FL (mm) to W. Wt (kg)	$W. Wt = 1.17 \times 10^{-08} * (FL^{3.02})$	5238	0.6683	FL (mm): 215 - 1321 W. Wt (kg): 0.13 – 32.74

# Length conversions

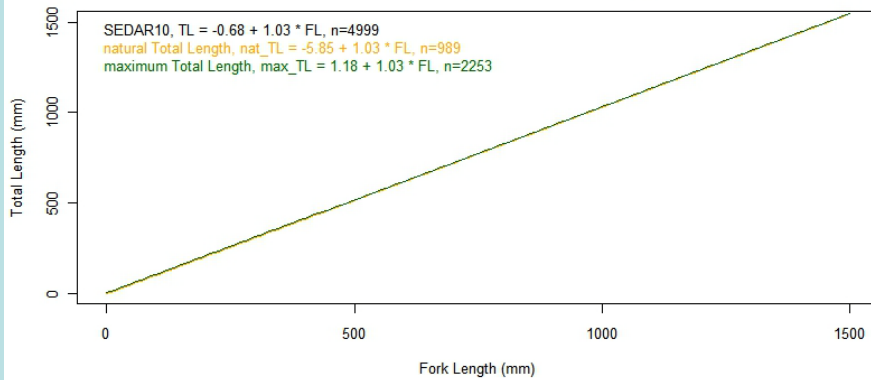
Gag Grouper Predict Fork Length



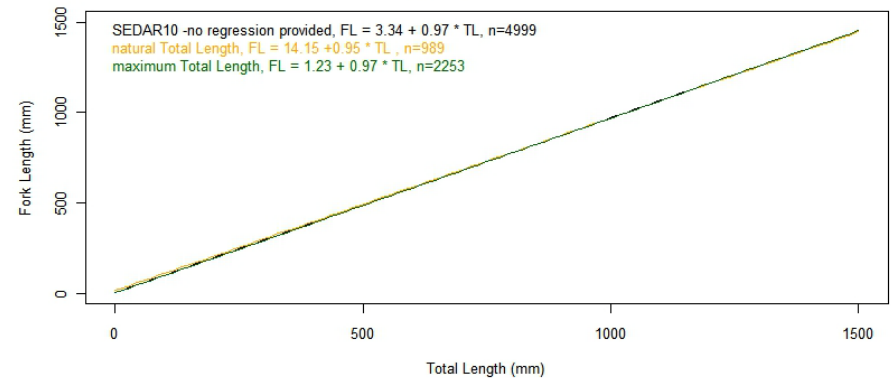
Gag Grouper Predict Fork Length



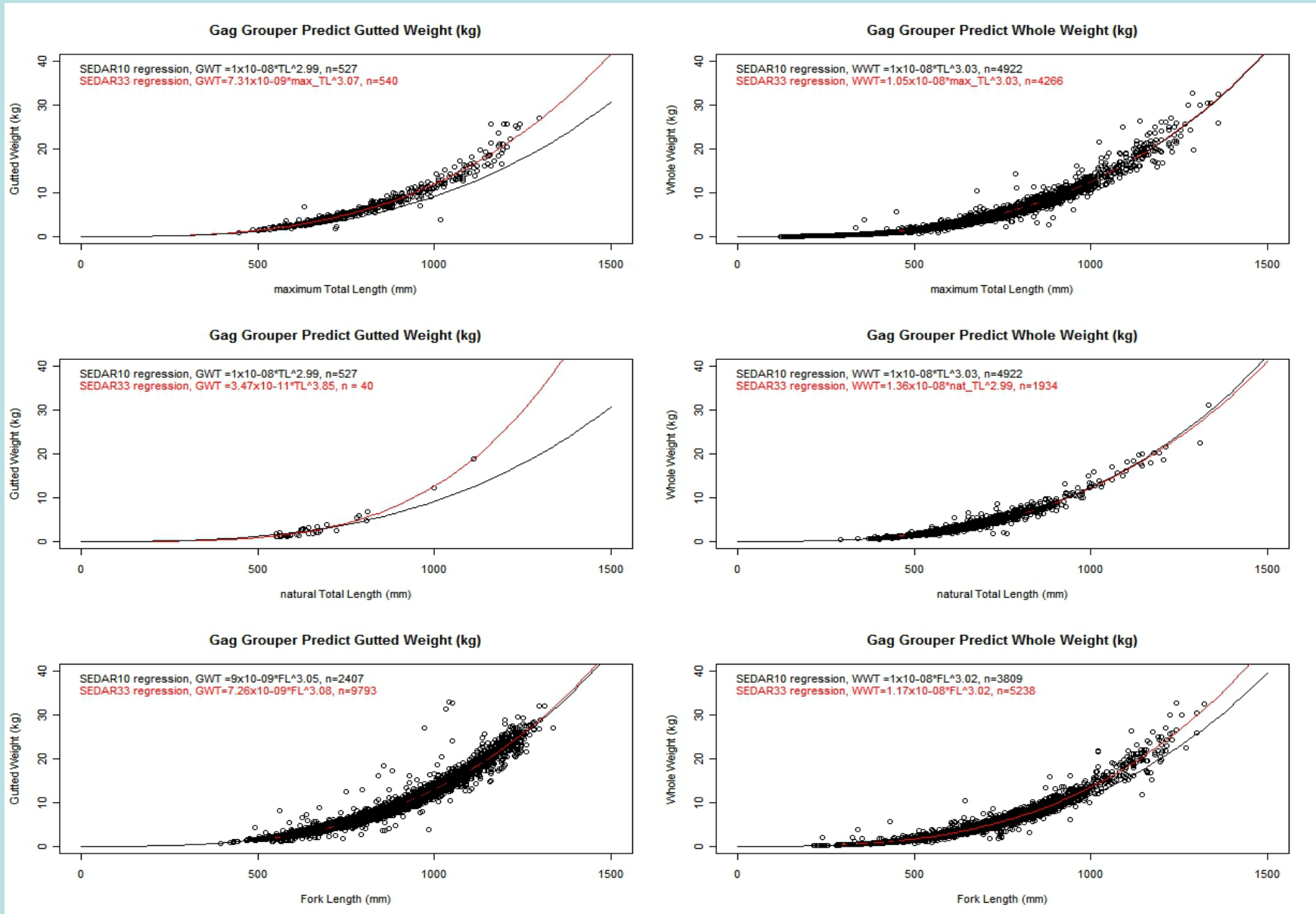
SEDAR10: Gag Grouper Predict Total Length



SEDAR10: Gag Grouper Predict Fork Length



# Weight conversions

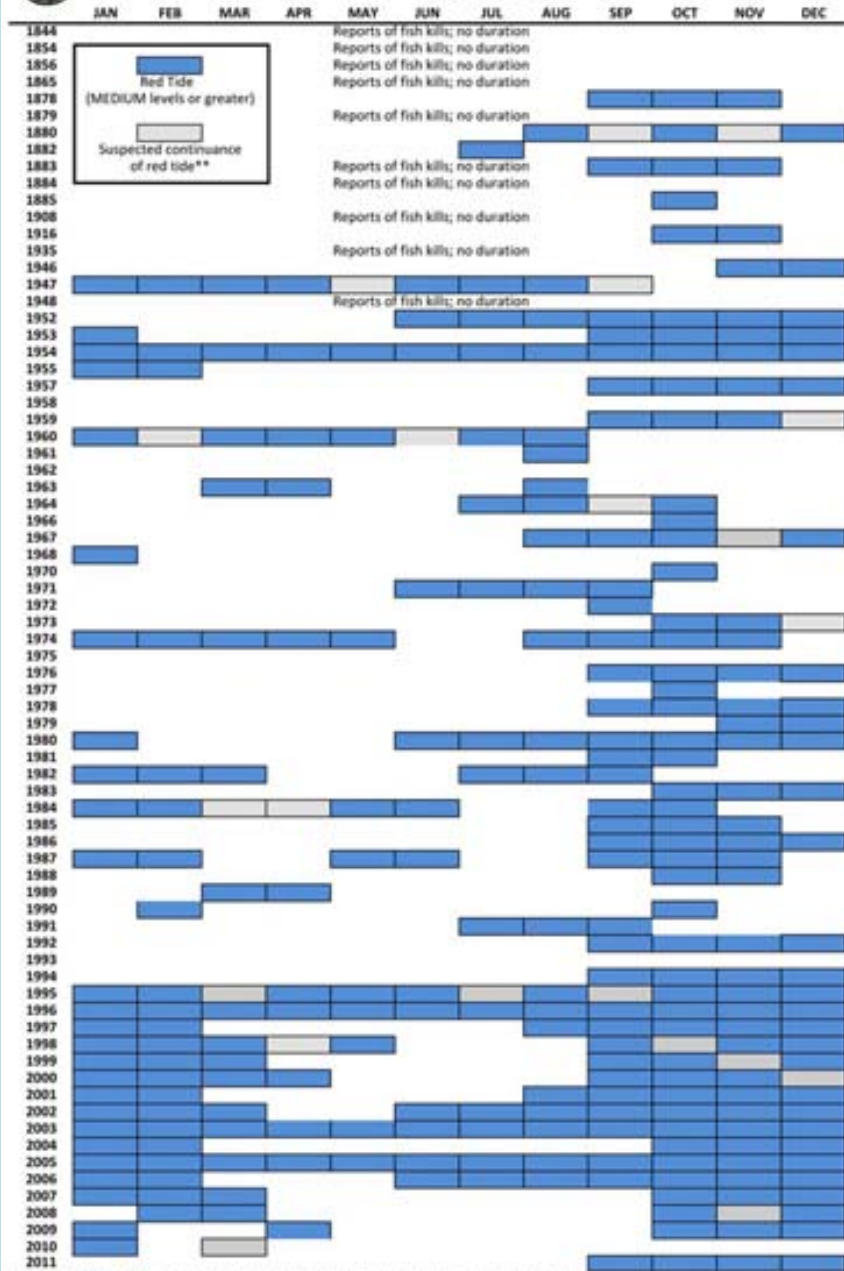




# Environmental Correlates and Episodic events



# 168\* Years of Documented Red Tides Suspected and off Florida's West Coast



Last updated 01/09/2012; \*\* Suspected continuance of red tide was not confirmed by water sampling.

Timeline of red tides off Florida's West Coast

# Hurricane timeline (recent west FL shelf landfalls)

- Hurricane Wilma (2005)



- Hurricane Dennis (2005).



- Hurricane Charley (2004).





# References

Listed as notes