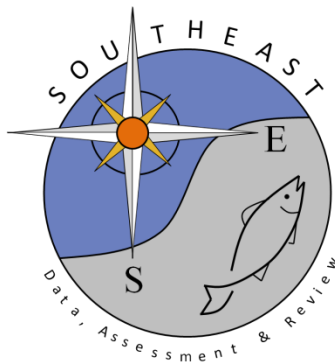# NMFS data summary for Gulf of Mexico red grouper maturity, sex transition and batch fecundity, 2014-2017

G. Fitzhugh, V. Beech, H. Lyon, P. Colson, L. Lombardi

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NMFS data summary for Gulf of Mexico red grouper maturity, sex transition and batch fecundity, 2014-2017

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Data:

- Key objective: review female maturity, sex transition and batch fecundity since SEDAR 42 (reproductive record terminal year 2013).
- N=916 histology records from years 2014-2017 for this update. Of these fish 277 were male, 630 were female and 9 were transitional, resulting in 30% male and 1% transitional.
- 65% from statistical grids 3,4 and 5; 20% from statistical grids 2,6,7,8,9,10; 15% from unassigned grid.
- 45% from commercial handline, 25% from commercial longline, 13% from scientific survey longline, 9% from scientific survey trap and handline, and 8% from recreational handline.
- Female maturity was based on reproductive phase (Brown-Peterson et al. 2011). Female histology records for maturity determination were retained for months March, April, May and June similar for SEDAR 42.
- Logistic functions were fit in EXCEL using XLSTAT software. Power functions were fit in R.

Results:

- Female reproductive phase by month is consistent with previous observations of spawning seasonality. Females in regenerating phase were observed year round which is also consistent with the supposition that some females may omit development and spawning in a given year. Actively spawning and spawning capable females were primarily observed during April, May and June.
- Tabulations and charts of histologically determined sex indicate the broad range of overlap in size and age between males and females for this protogynous species. A logistic regression of proportion female based on 2014 to 2017 records (A50 = 11.6 yrs) returns a similar result as that given in SEDAR 42 (A50 = 11.2 years).
- Tabulations are provided for female maturity at size, maturity at age (Tables 3 & 4), and numbers spawning by size and age (Tables 5 & 6). Logistic regressions for maturity were not fit due to low sample size of small/young immature females (low contrast). However it can be seen that spawning females tend to be larger/older than females considered mature; also noted in SEDAR 42.
- The addition of eleven new observations for batch fecundity resulted in no change by length (Figure 6) but there was some change in fit by age (Figure 7). This is presumably due to the addition of a few older ages where numbers at age are sparse.
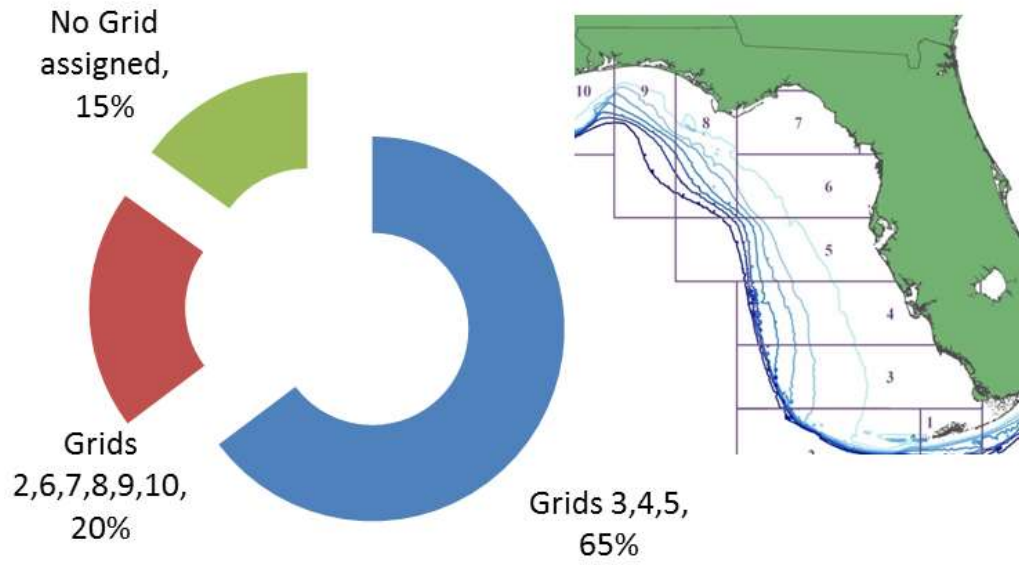
Figure 1. Source of histology samples by statistical grid.
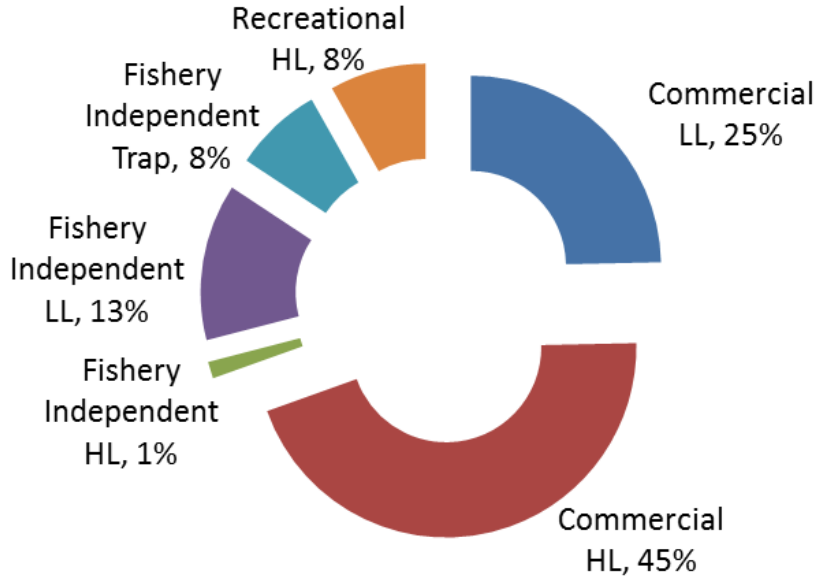
Figure 2. Source of histology samples by gear type.

Figure 3. Seasonality of female reproductive phases (2014-2017). Sample sizes by month are indicated above the chart

A.
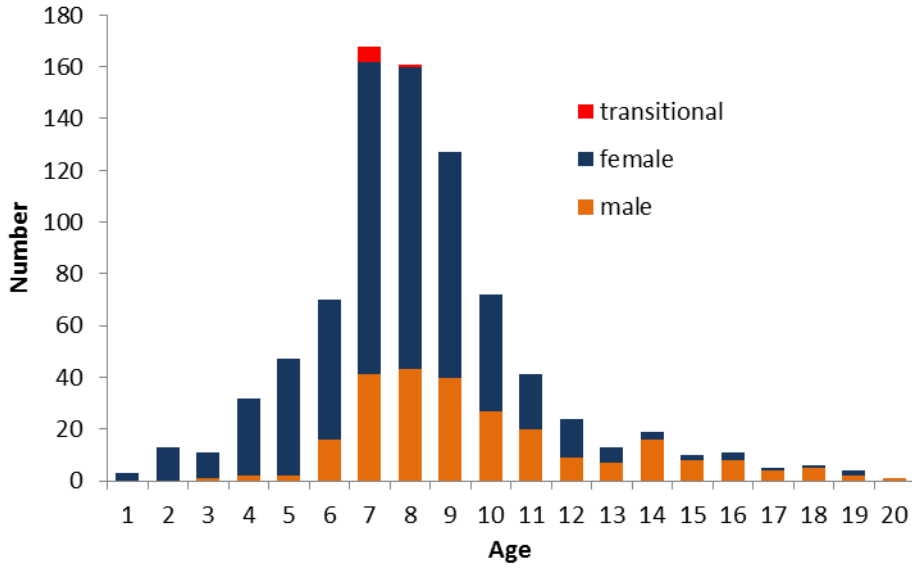
B.

Figure 4. A. Histological sex by size (mm FL) *N* = 915, and B. by age *N* = 838.
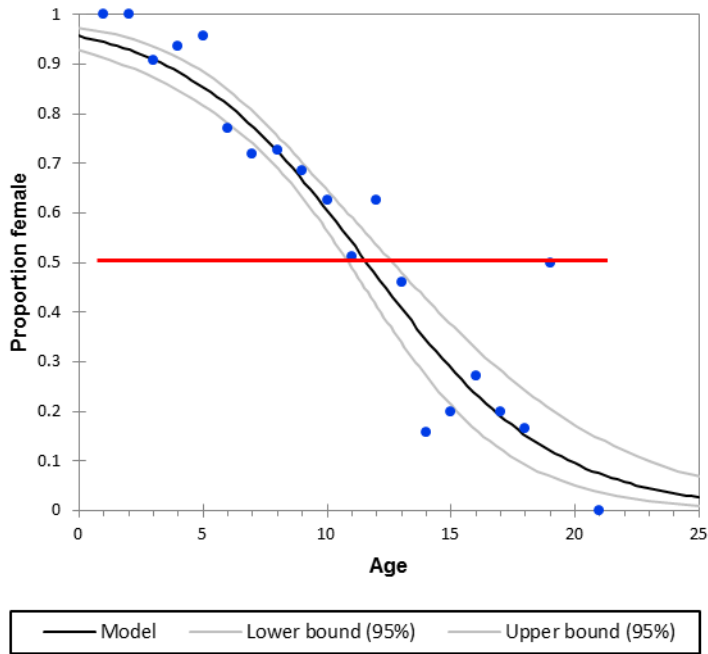
Figure 5. Proportion female by age. A50 = 11.6 years. Logistic regression, logit model (sum binary), proportion female = $1/(1 + \exp(-(3.109 - 0.268 * \text{age})))$. Shown with 95% confidence intervals. *N* = 838.

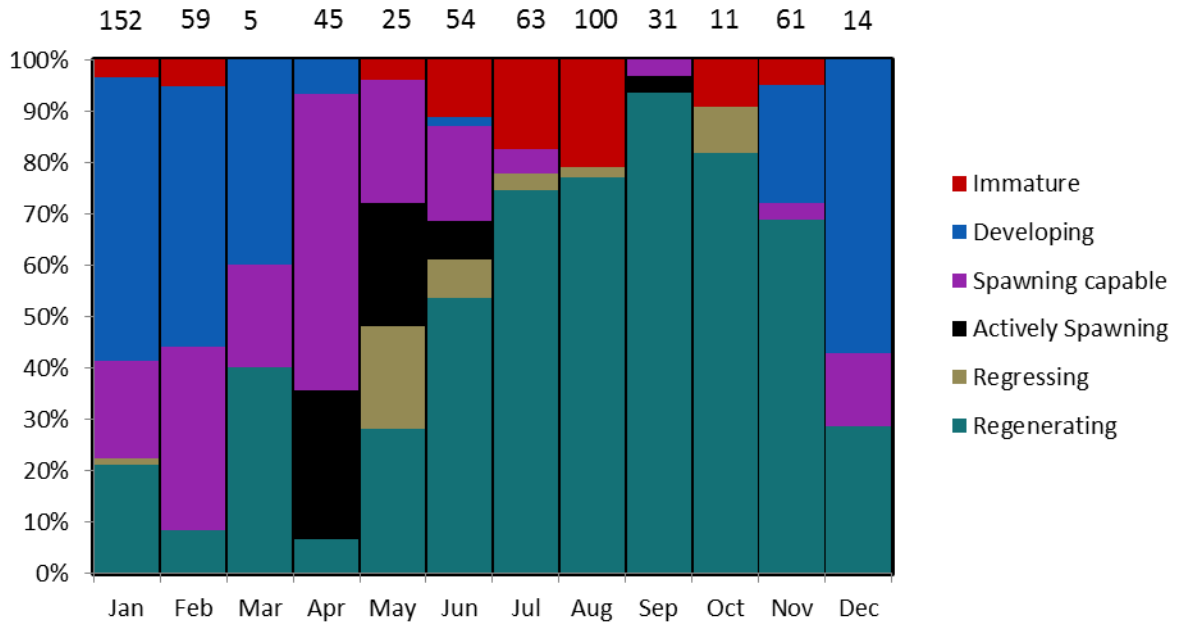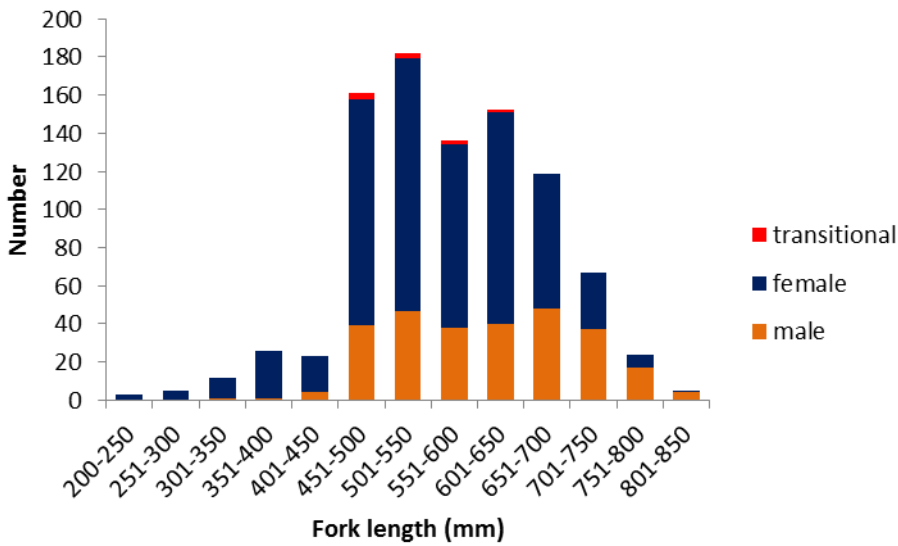**Red Grouper Batch Fecundity at Fork Length**

SEDAR12, did not use batch fecundity, n=74
SEDAR42 regression, BFE = 1.48 x 10-10 * (FL_mm^5.48), n= 103
SEDAR61 regression, BFE = 1.48 x 10-10 * (FL_mm^5.48), n = 114
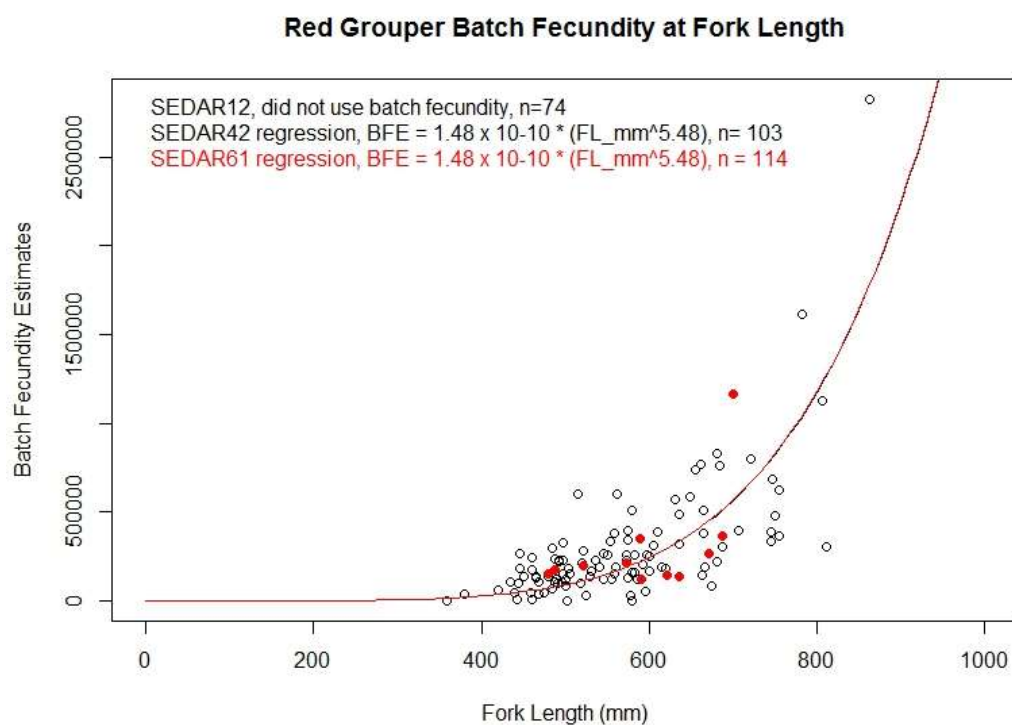
Figure 6. Batch fecundity by size.

Red Grouper Batch Fecundity at Age

SEDAR12, did not use batch fecundity, n=74
SEDAR42 regression, BFE = 3878 * (Age^2.12), n=100
SEDAR61 regression, BFE = 6672 * (Age^1.84), n = 110

Figure 7. Batch fecundity by age.

Table 1. Histological sex by size. $N = 915$.

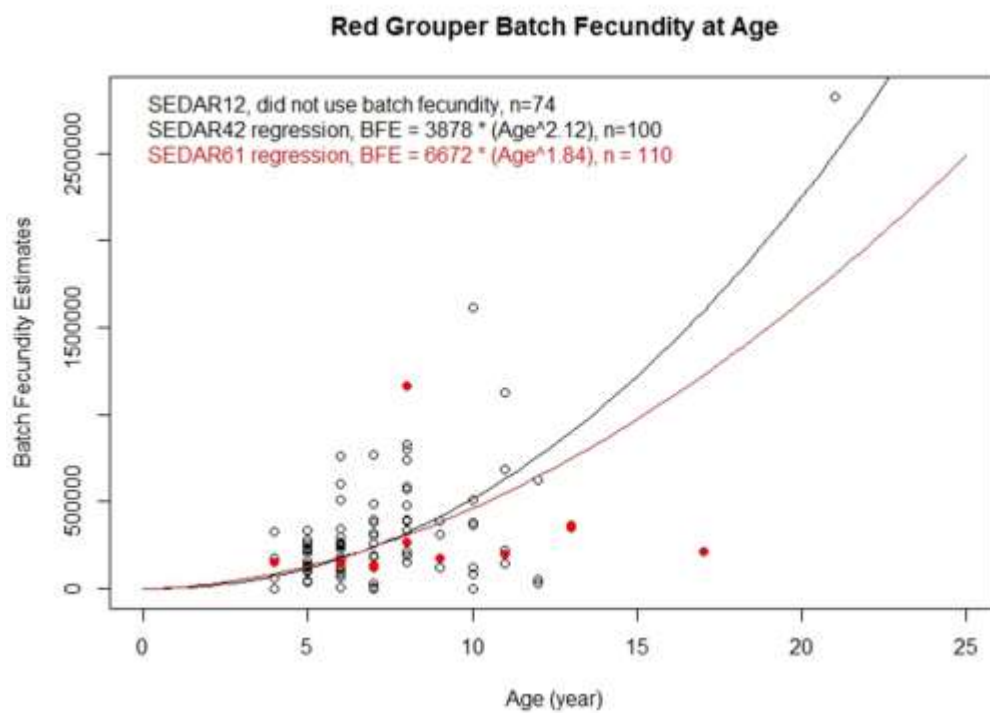| Size bin	Female	Male	Transitional	Total
200-250	3			3
251-300	5			5
301-350	11	1		12
351-400	25	1		26
401-450	19	4		23
451-500	119	39	3	161
501-550	132	47	3	182
551-600	96	38	2	136
601-650	111	40	1	152
651-700	71	48		119
701-750	30	37		67
751-800	7	17		24
801-850	1	4		5

Table 2. Histological sex by age. $N = 838$

Age	Female	Male	Transitional	Total
1	3			3
2	13			13
3	10	1		11
4	30	2		32
5	45	2		47
6	54	16		70
7	121	41	6	168
8	117	43	1	161
9	87	40		127
10	45	27		72
11	21	20		41
12	15	9		24
13	6	7		13
14	3	16		19
15	2	8		10
16	3	8		11
17	1	4		5
18	1	5		6
19	2	2		4
21	0	1		1

Table 3. Female maturity assigned by size. For months March, April, May and June. *N* = 129.

Size bin	0	1	Total
300-350	1		1
350-400	2		2
400-450		3	3
450-500	2	20	22
500-550	2	22	24
550-600		18	18
600-650		28	28
650-700		20	20
700-750		10	10
750-800		1	1

Table 4. Female maturity assigned by age. For months March, April, May and June. *N* = 128

Age	0	1	total
3	2		2
4	1	4	5
5		9	9
6	1	6	7
7		18	18
8	3	18	21
9		29	29
10		17	17
11		6	6
12		6	6
13		3	3
14		2	2
15		1	1
17		1	1
19		1	1

Table 5. Female spawning by size (females with and without spawning markers). For months March, April, May and June. *N* = 129.

Size bin	0	1	Total
300-350	1		1
350-400	2		2
400-450	3		3
450-500	15	7	22
500-550	12	12	24
550-600	8	10	18
600-650	15	13	28
650-700	6	14	20
700-750	1	9	10
750-800		1	1

Table 6. Female spawning by age (females with and without spawning markers). For months March, April, May and June. *N* = 128.

Age	0	1	Total
3	2		2
4	4	1	5
5	4	5	9
6	4	3	7
7	7	11	18
8	11	10	21
9	18	11	29
10	6	11	17
11	2	4	6
12	3	3	6
13		3	3
14		2	2
15	1		1
17		1	1
19	1		1

References:

Brown-Peterson, N.J., D.M. Wyanski, F. Saborido-Rey, B.J. Macewicz and S.K. Lowerre-Barbieri. 2011. A standardized terminology for describing reproductive development in fishes. Marine and Coastal Fisheries: Dynamics, Management and Ecosystem Science 3:1, 52-70.