# Reproductive Parameters for Gulf of Mexico Vermilion Snapper, *Rhomboplites aurorubens*, 1991-2014

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# Reproductive Parameters for Gulf of Mexico Vermilion Snapper, *Rhomboplites aurorubens*, 1991-2014

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Data:

- Update of SEDAR 09-DW03 (reproduction) used during SEDAR 09
- Data from years 1991-2014; 93% from eastern GOM (maturity)
- Logistic and gamma functions fit in EXCEL using Solver and XLSTAT software. Power function fit in R.

Results:

- There was little change in the estimate of maturity used in the previous assessment (SEDAR 09). Adoption of fork length and addition of macroscopic records from small vermilion snapper, largely from trawl surveys, enabled a fit of a logistic maturity function. Length at 50% maturity is estimated at 138 mm FL.
- An analysis of the female spawning fraction by time of year (all years combined) yields an estimate of a 219 day spawning season between the end of March and the end of October with peak spawning from May to August. The data were fit to a gamma function to graphically display the spawning seasonality.
- There is an improved fit but little change in the batch fecundity relationship used in the previous assessment as n=24 new records are added. Batch fecundity by fork length is fit to a power function with an exponent of 3.042.
- Annual fecundity should be approximately 82 * batch fecundity, based upon a 219 d spawning season and the average daily probability of spawning (0.38, all female sizes).
- Sex ratio: Females tend to dominate routine fishery sample collections accounting for about 58% of vermilion snapper sexed in the field. This result (more females than males) is consistent among commercial and recreational modes and scientific surveys.

Table 1. Maturity and fecundity equations and parameters in EXCEL format. Logistic regression (logit fit) of binary data; proportion mature (M) by fork length (FL, mm). Nonlinear power fit to batch fecundity (BF) by fork length (FL, mm). Annual fecundity (AF) = BF* 82 (expected number of spawns; see Table 2).

| Equation | Statistic | N | Data Range |
|---|---|---|---|
| M= 1 / (1 + exp(-(-9.235+0.067*FL))) | $R^2$ (McFadden): 0.735 | 1770 | FL: 69-539 |
| BF=0.003*FL^3.042 | RSE: 50800 | 147 | BF: 6106-407570, FL: 169-455 |

Table 2. Expected number of spawns. Numbers of females, all years, by 0.04 fraction of a year time bins (see Figure 3),with spawning markers either present or absent, spawning fraction (proportion of females with spawning markers) and daily probability of spawning (spawning fraction adjusted to 24 hours) estimated following Porch et al. 2015. Season duration is the fraction of a year wherein spawning markers are detected (time 0.24 to 0.84; difference = 0.6 * 365d = 219 d, approximately the end of March to the end of October). Expected number of spawns equals the daily probability * season duration (0.38 * 219 d = 82).

| Time bin (fraction of a year) | Spawning markers absent | Spawning markers present | Total | Spawning fraction | Daily probability of spawning |
|---|---|---|---|---|---|
| 0-0.04 | 7 | | 7 | | |
| 0.04-0.08 | 2 | | 2 | | |
| 0.08-0.12 | 4 | | 4 | | |
| 0.12-0.16 | 16 | | 16 | | |
| 0.16-0.2 | 32 | | 32 | | |
| 0.2-0.24 | 56 | | 56 | | |
| 0.24-0.28 | 102 | 12 | 114 | 0.11 | 0.07 |
| 0.28-0.32 | 75 | 41 | 116 | 0.35 | 0.24 |
| 0.32-0.36 | 77 | 79 | 156 | 0.51 | 0.34 |
| 0.36-0.4 | 52 | 180 | 232 | 0.78 | 0.52 |
| 0.4-0.44 | 87 | 217 | 304 | 0.71 | 0.48 |
| 0.44-0.48 | 21 | 195 | 216 | 0.90 | 0.60 |
| 0.48-0.52 | 39 | 182 | 221 | 0.82 | 0.55 |
| 0.52-0.56 | 59 | 148 | 207 | 0.71 | 0.48 |
| 0.56-0.6 | 41 | 127 | 168 | 0.76 | 0.50 |
| 0.6-0.64 | 27 | 74 | 101 | 0.73 | 0.49 |
| 0.64-0.68 | 22 | 205 | 227 | 0.90 | 0.60 |
| 0.68-0.72 | 24 | 66 | 90 | 0.73 | 0.49 |
| 0.72-0.76 | 95 | 47 | 142 | 0.33 | 0.22 |
| 0.76-0.8 | 83 | 3 | 86 | 0.03 | 0.02 |
| 0.8-0.84 | 33 | 2 | 35 | 0.06 | 0.04 |
| 0.84-0.88 | 22 | | 22 | | |
| 0.88-0.92 | 16 | | 16 | | |
| 0.92-0.96 | 8 | | 8 | | |
| Average across time bins with spawning markers present | | | | 0.56 | 0.38 |

Table 3. Sex ratio. Number of vermilion snapper records noting macroscopic (field) sex (M or F) by major sampling modes and reported to the Panama City Laboratory; all years 1994-2014. These are observations obtained during collection of hard parts for aging.

| Mode | M | F | Total | F proportion |
|---|---|---|---|---|
| Commercial | 2615 | 4334 | 6949 | 0.624 |
| Charter party | 3484 | 4459 | 7943 | 0.561 |
| Headboat | 3047 | 3838 | 6885 | 0.557 |
| Scientific survey | 4091 | 5244 | 9335 | 0.562 |
| Total | 13237 | 17875 | 31112 | 0.575 |

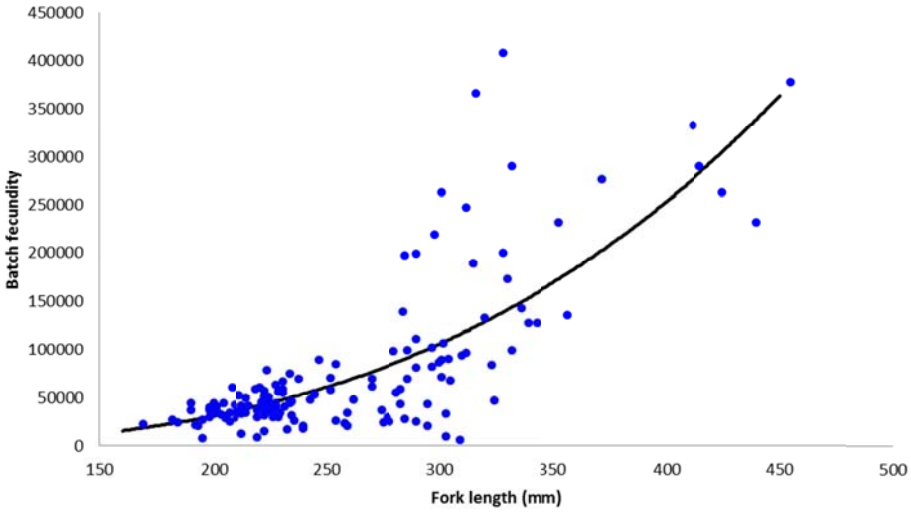


Figure 1. Batch fecundity of vermilion snapper, n = 147. Average batch fecundity =76465 (s.d. 79093) eggs. Average relative fecundity (eggs/gram of ovary free body weight) = 224 (s.d. 112).

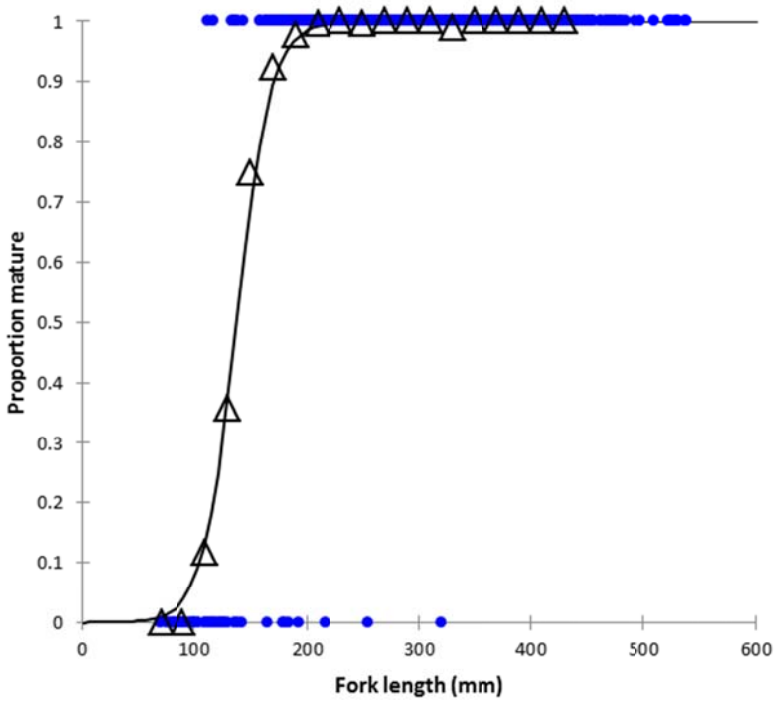


Figure 2. Maturity of female vermilion snapper by fork length. Blue circles are binary data and open triangles are proportions mature aggregated by 20 mm length bins. All females, all years (1991-2014, May - August, n = 1770. Histological criteria: maturity is primarily based upon histological readings of ovarian tissue. Females with vitellogenic or more advanced oocytes are denoted as mature. Females with primary growth oocytes and no indicators of prior spawning are denoted as immature. Females with primary growth or cortical alveolar oocytes as leading stage but displaying potential atretic yolked oocytes are of uncertain maturity and maturity class is not assigned. Macroscopic/microscopic readings are used for small females (<=200 mm FL). Macroscopic criteria: females noted as maturing, running ripe and spent are considered mature. Visually undifferentiated individuals and undeveloped females were considered immature. Macroscopically inactive females were considered to exhibit uncertain maturity and maturity class was not assigned. However, uncertain maturity records (not assigned) were minimal (n=56) due to the use of maturity records from the peak spawning months.

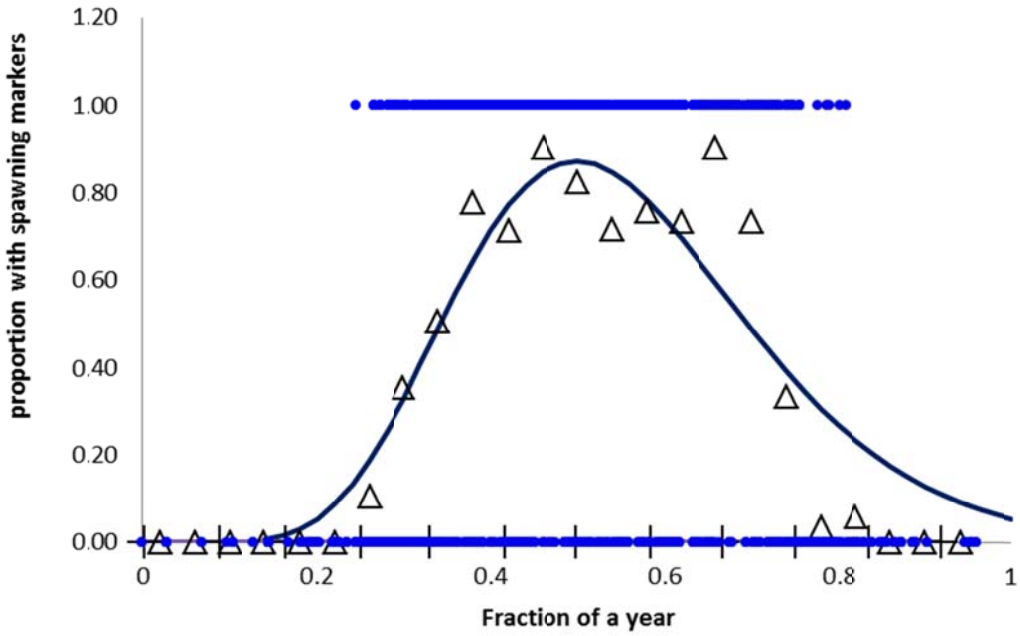


Figure 3. Seasonality of vermilion snapper spawning. Based upon n = 2578 female histology records from 1991-2014. Gamma function (solid line) denotes the proportion (P) of female vermilion snapper with spawning markers (hydrated oocytes and/or post-ovulatory follicles) by fraction of a year (T): P= 0.873*(((T + 1/365)/0.501)^(0.501/0.055)) *exp((0.501-T-1/365)/0.055), (AIC = 2679) where 0.873 represents a scaler of maximum spawning fraction, 0.501 equals the mode (fraction of a year fit to peak spawning) and 0.055 equals the dispersion coefficient (after Porch et al. 2015). Vertical ticks along X-axis denote month intervals (distinct from fraction of a year). Blue circles are binary data and open triangles are proportions aggregated by 0.04 fraction time bins. The fraction 0.04 is equivalent to about 15 d (0.04 year * 365 d/year).

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