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Studies on Reproductive Biology of the Red (Blackspot) Seabream [*Pagellus bogaraveo* (Brünnich, 1768)] from the Strait of Gibraltar (ICES IXa/SW Spain)

by

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Abstract

Reproductive biology of the Red (blackspot) seabream (*Pagellus bogaraveo*) was studied throughout monthly samples from landings of artisanal fleet ("voracera") in the fishing ports of Tarifa and Algeciras (Cádiz, Spain). For each specimen sampled, the total body length, total and gutted body weight and gonad weight were recorded. The number of males, females and hermaphrodites and its gonad macroscopic stages of maturation were recorded too. Some ovaries were dissected, fixed in formaldehyde (4%) and embedded in hydroxyethylmethacrylate for a later histological examination. Sex ratio (by month and by length class) seems to reflect a proterandric hermaphroditism. Spawning period (from GSI estimation) was located in the first quarter of the year and also maturity lengths were estimated for males and females (30.14 and 35.72 cm., respectively). On basis of the overall gonad histology, five distinct stages have been identified throught the process of ovarian maturation. Finally the fecundity of *P. bogaraveo* was calculated throught stereological methods in females with ovaries in stage III and IV.

Introduction

The Red (blackspot) seabream (*Pagellus bogaraveo*) is an sparid with a great commercial interest for the Andalusian artisanal fleet. Their fishery is carried out in the Strait of Gibraltar area with local mechanized hand lines gears ("*voracera*") during the turnover of the tides. In this work we present aspects of the reproductive biology as proportion of sexes, determination of the spawning season, length at first maturity for both sexes and fecundity that supply an essential knowledge of the biology of the species.

Materials and Methods

Reproductive biology was studied throughout monthly samples from landings of artisanal fleet ("*voracera*"), 1997-1999 (Table I), in the fishing ports of Tarifa and Algeciras (Cádiz, SW Spain). For each specimen sampled, the total body length, total and gutted body weight and gonad weight were recorded. The number of males, females and hermaphrodites and their gonad macroscopic stages of maturation were recorded too.

Spawning season *EMS I (immature)*
EMS II (development)
EMS III (prespawning)
EMS IV (spawning)
EMS V (postspawning)
GSI=(GonadW/GuttedW)*100

Length at First Maturity

L_{50} was determinated by sexes after adjusting for a log normal distribution on the curve showing the percentage of mature specimens (EMS III to V)

$$P_i=1/(1+e^{a+bTL})$$

Fecundity

From the total of adult females only 36 ovaries (EMS III and IV) were found to be suitable for the estimation of fecundity by stereological methodology developed by Laird and Pried in 1986 for Mackerel ovaries. Ovaries were weighted to the nearest 0.1 mg, subdivided in three parts (nearest, middle and distant), fixed in buffered formaldehyde (4%) and later a dehydration protocol embedded in plastic. Each one were serially sectined at 3 µm and stained with toloudine blue for its later image analysis. Stereological methods estimates the oocytes number present in the ovary independently of its development stage. Therefore it is an oocytes quantification that began the vitelogenesis. A first estimate it is obtained counting the oocytes present in each one of the nine 25*25mm sections sampled together with information regards to the area of each sampled section, histological cut thickness and gonad weight. Adding the mean diameter of the counting oocytes and the frequencies distribution of 100 oocytes randomly selected it will obtain an improved estimate that constitutes the value of the individual's potential fecundity.

Significative, or not, differences among the three parts of each ovary results obtained in 5 gonads randomly selected were tested by means of an one way ANOVA (Zar, 1984). The null hypothesis being tested is that results from the three parts are equal (level of confidence used was 5%).

Relationships between fecundity (nº oocytes) and gonad weight (g), gutted weight (g) total length (mm) have been fitted to the model which presents better R^2.

Results and Considerations

Sex-ratio

The number of males begins to be increased from the last quarter to arrive to its maximum at the beginning of year, coinciding with the spawning time (Figure 1). Females does not surpass 50% any month but the highest values were obtained during the second quarter. High percentages of hermaphrodites appears in the third quarter coinciding with the post spawning period which seems the appropriate for the sexual transition.

Otherwise, 100% of the individuals smaller than 25 centimeters were unsexed dues to imposibility of assign them a sex *de visu*. Starting from this TL high proportions of males and hermaphrodites appears (Figure 2). As the specimina go increasing their size their sexes could well defined falling the hermaphrodites proportion. Thus, the species in the study area, like in other places, seems displays a protandreus sequential hermaphroditism.

Spawning season

The reproductive season for males and females was determined by means of the GSI monthly evolution; This information was tested with the monthly trend of the different maturity stages (EMS) of males and females gonads. According to these values the spawning season seems to take place during the first quarter of the year (Figures 3 and 4).

Length at First Maturity

The smallest specimina are mainly males maturing at L_{50}=30.1 cm (Figure 5a). Later an important part of the individuals changes its sex (sexual transition) and the females maturing occurs at L_{50}=35.1 cm (Figure 5b).

Fecundity

Once tested by means of ANOVA I (p=0.98) that significative differences does not exist among the three parts of each ovary only the middle part of the remaining gonads were analyzed. Table II shows the number of eggs released per mature female (29 to 50 cm) per spawning event ranged from 25.712 to 1.821.188 with a mean value of 420.643 (SD 425.448).

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TABLE I. *P. bogaraveo*. Samples number and length range by sex (1997-1999).

Sex	Number	Size range (cm)
Unsexed	160	11-30
Males	318	24-50
Females	282	24-53
Hermaphrodites	282	20-54
Total	1042	11-54

TABLE II. Fecundity estimations of single *P. bogaraveo* individuals caught in the Strait of Gibraltar waters.

TL (mm)	Gutted w. (g)	Gonad w. (g)	Maturity (EMS)	Nº oocytes
310	400	14.10	III	243322
345	530	20.78	III	332896
336	490	24.48	III	445237
340	525	40.78	III	621076
347	610	50.00	III	545302
370	635	37.66	III	601821
480	1440	103.85	III	1821188
378	695	62.71	III	1027111
380	735	34.84	III	459275
405	946	54.79	III	1028856
397	849	24.70	III	213369
426	1072	41.92	III	583882
467	1460	21.79	III	294927
505	1705	67.39	III	829118
509	1908	102.14	III	1644593
490	1610	56.10	III	677212
459	1305	81.84	III	737973
380	665	23.50	III	227391
345	538	10.14	III	78848
346	488	10.61	III	115870
325	410	15.94	III	146812
331	430	5.50	III	63355
383	680	6.37	III	80340
366	650	10.65	IV	122323
350	532	6.94	III	73442
475	1564	20.22	IV	248489
333	450	1.50	III	29394
318	386	3.49	III	25712
403	800	10.93	III	147416
420	962	26.98	IV	381421
293	351	1.94	III	57332
290	317	3.06	III	100955
290	290	3.60	III	107442
285	299	3.18	III	162568
379	700	23.30	III	423703
383	717	32.79	III	443159

TABLE III. *P. bogaraveo*. Fecundity and gonad weight, total length and gutted weight relationships proposed.

Fecundity related to Gonad weight (g), Total length (mm) and Gutted weight (g)
Nº Oocytes = 14.855*Gonad weight - 15.285 ; R^2 = 0.91
Nº Oocytes = $3*10^{-6}$*Total length$^{4.2606}$; R^2 = 0.42
Nº Oocytes = 30.464*Gutted weight$^{1.3855}$; R^2 = 0.45

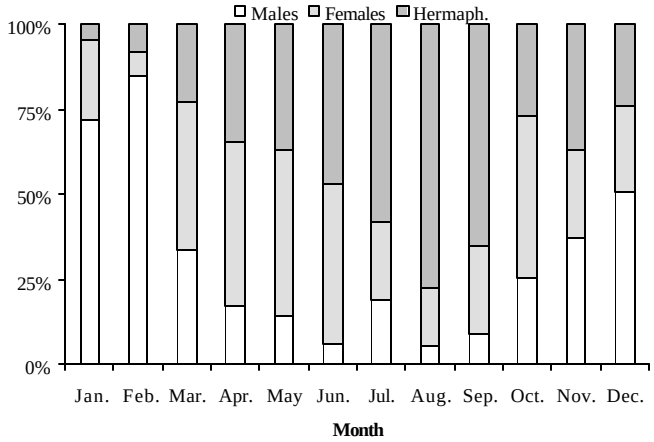


FIGURE 1. *P. bogaraveo*. Monthly sex ratio.

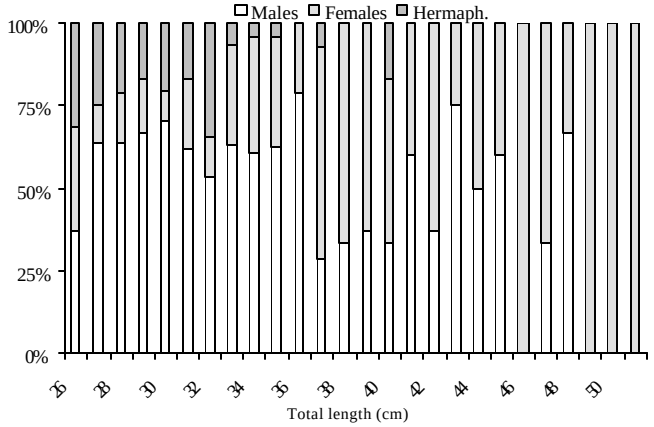


FIGURE 2. *P. bogaraveo*. Length sex ratio.

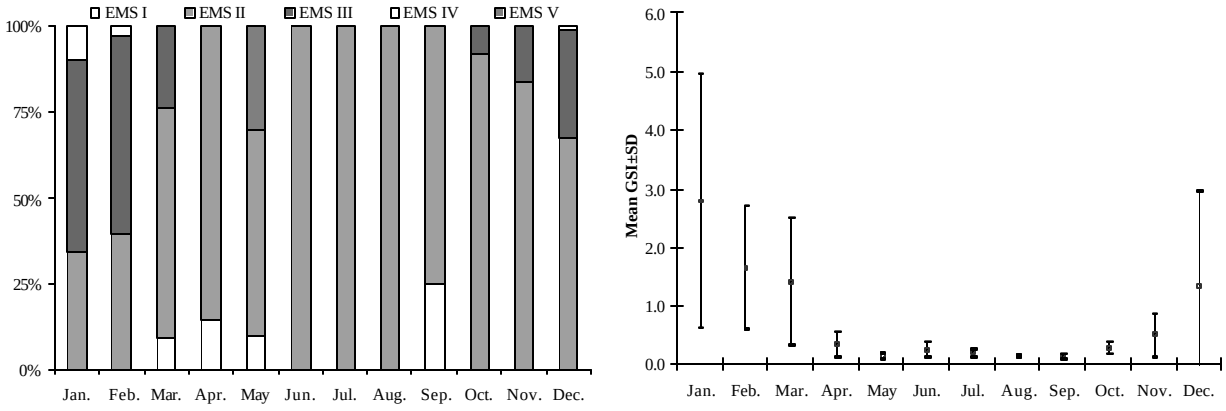


FIGURE 3. *P. bogaraveo*. Males maturity stages and GSI monthly evolution.

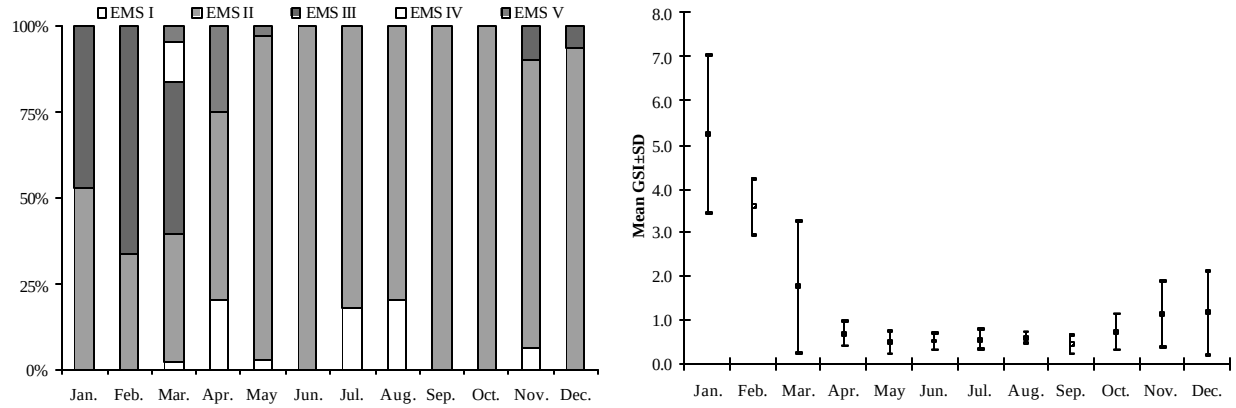
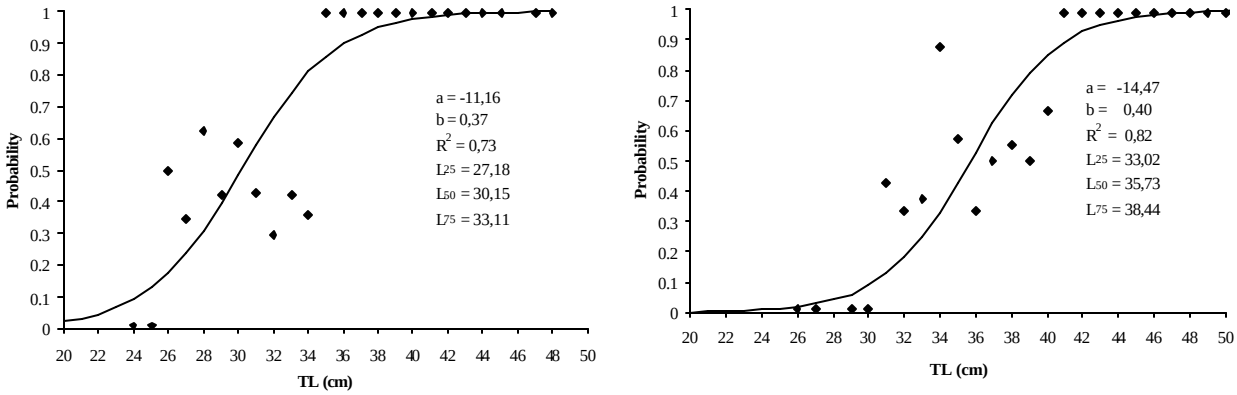


FIGURE 4. *P. bogaraveo*. Females maturity stages and GSI monthly evolution.



(a) (b)

FIGURE 5. *P. bogaraveo*. Percentage of mature individuals: (a) males (b) females.