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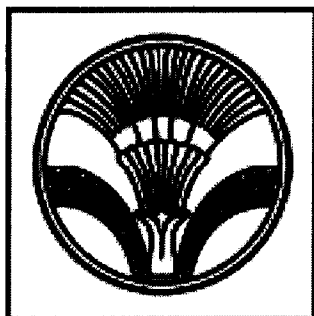
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Reproductive traits of the yellow-mandi catfish
Pimelodus maculatus Lacépède
(Osteichthyes, Siluriformes) in captive breeding

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ABSTRACT. *Pimelodus maculatus* Lacépède, 1803 is an important fish of the São Francisco river basin, where it is economically significant in both professional and sports fisheries. The fish, maintained in captivity, was subjected to hypophysation with crude carp pituitary extract. Approximately 70% of the females treated spawned viable eggs. The eggs were opaque, demersal, yellow and free. Egg stripping was performed at 213 hour-degrees (duration = 8.3 h) after the second dose injection, at water temperature of 25-26°C. Hatching occurred at 394 hour-degrees (duration = 16.3 h) after egg fertilization, at water temperature of 24-25°C. Egg fertilization rate was 64.8%. The relationship between absolute fecundity (AF), initial fertility (IF) and final fertility (FF) and body weight are expressed, respectively, by $AF = -331 + 181717 Wt$ ($r^2 = 0.62$), $IF = -16839 + 158123 Wt$ ($r^2 = 0.65$), and $FF = -9874 + 100365 Wt$ ($r^2 = 0.63$).

KEY WORDS. Siluriformes, *Pimelodus maculatus*, yellow-mandi catfish, reproduction

The yellow-mandi catfish *Pimelodus maculatus* Lacépède, 1803 [= *Pimelodus clarias* (Bloch, 1782)] is one of the principal species in the professional fisheries of the São Francisco river basin. It can reach 40 to 50 cm total length, and 1.5 to 2 kg body weight (IHERING & WRIGHT 1935). This species is widely distributed and can be found in several South American river basins (FOWLER 1951).

Despite the interest it has been sparked in several fields of the fisheries science, its reproduction is little understood. CARDOSO (1934) demonstrated the stimulating action of hypophysis administration on the sexual organs of *P. clarias*, noting a significant increase in the volume of the ovaries and testes. FENERICH *et al.* (1974) obtained spontaneous ovulation of *P. maculatus* in aquarium using human chorionic gonadotrophin (HCG) associated to a hypophysis suspension.

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This study presents data obtained with hypophysation of *P. maculatus* of the São Francisco river basin, at the Três Marias Hydrobiology and Hatchery Station, Companhia de Desenvolvimento do Vale do São Francisco - CODEVASF, during the reproduction cycles of 1995/96 and 1996/97.

MATERIAL AND METHODS

For this study 22 males and 27 females from the São Francisco River were used. They were stocked for 2 to 3 years in a 200 m² pond, at the density of 1 kg of fish/6 m². The fish were fed with pelletized feed (22% crude protein), at the proportion of 1.5% of their body weight/day, 5 days/week.

During treatment the brooders were placed in a 3 x 1 x 0.8 m brick-lined tank whose water was kept at 25-26°C. The method employed to induce spawning was the hypophysation (IHERING *et al.* 1935; IHERING 1937), using crude common carp pituitary extract (CCPE). The application of CCPE injections, the moment of oocyte extrusion (in hour-degrees), and the rate of fertilization (estimated after clousure of the blastopore) followed the methods described by WOYNAROVICH & HORVÁTH (1980). The injections were applied intramuscularly close to the dorsal fin. Fertilization was performed "dry" and the eggs placed in 20-liter, funnel type incubators.

The following data was obtained from the females: total length (Lt, cm), body weight (Wt, g), Fulton's condition factor ($K = Wt.100/Lt^3$), weight of the extruded oocytes (ova, g), number of extruded oocytes/g of ova, weight of the non-extruded oocytes (g), diameter of the fresh non-hydrated and hydrated eggs (µm), diameter of the yolk sac (µm), width of the perivitelline space (µm), thickness of the chorion (µm), rate of egg fertilization (estimated after closing of the blastopore), weight of the gonads (Wg = weight of extruded oocytes + weight of ovaries after extrusion, g), gonadosomatic index (GSI = $Wg.100/Wt$, %), absolute fecundity (AF), initial (IF) and final (FF) fertility (respectively, the number of extruded oocytes and the number of viable eggs after blastopore closing), and length of the newly hatched larvae (µm). Relative fecundity, relative initial fertility, and relative final fertility were estimated in relation to the total length and body weight of the females.

RESULTS AND DISCUSSION

The reproductive period of this species extends between November and February. Selection of brooders was not easily performed. Although the females presented a more protruding and reddish urogenital papillae, the males did not release semen or only a few droplets when subjected to abdominal pressure. The female average body weight was well above that of the males (688 g and 305 g, respectively). The main results of the present study are summarized in table I.

The females did not signaled the moment of ovulation as it often happens in other species, *i.e.*, *Schizodon knerii* (Steindachner, 1875); *Prochilodus marggravii* (Walbaum, 1792) (SATO *et al.* 1996a, b).

Of the 27 hypophysed females, 19 (70.4%) responded positively to the treatment by releasing viable eggs. The extrusion of oocytes was performed at 213

± 4 hour-degrees (duration = 8.3 h) after water temperature of 25.8 ± 0.3°C. The removed and squeezed through a fine cloth oocytes.

Table I. Reproductive aspects of yellow-mandi catfish after hypophysation at Três Marias Hydrobiology and Hatchery Station during the reproduction cycles of 1995/96 and 1996/97. (N) Number of fish, (CV) coefficient of variation, (SD) standard deviation, (CV),

Parameters	N
Males	
Total length (Lt, cm)	22
Body weight (Wt, g)	22
Single dose (mg CCPE/Kg Wt)	22
Females	
Total length (Lt, cm)	19
Fulton's condition factor (K)	19
Body weight (Wt, g)	19
Dosage (mg CCPE/Kg Wt)	
First dose	19
Second dose	19
Interval between doses (h)	19
Hour-degrees at stripping	19
Water temperature at stripping (°C)	19
Gonadosomatic index (GSI, %)	19
Ova weight. 100/Wt (%)	19
Eggs/g ova (n)	19
Size of egg (µm)	
Diameter of non-hydrated egg	120*
Diameter of hydrated egg	120*
Diameter of yolk sac	120*
Width of perivitelline space	120*
Thickness of chorion	120*
Egg fertilization rate (%)	19
Absolute fecundity (AF)	19
Initial fecundity (IF)	19
Final fecundity (FF)	19
Relative AF (eggs/kg of female)	19
Relative IF (stripped eggs/kg of female)	19
Relative FF (viable eggs/kg of female)	19
Relative AF (eggs/cm of female)	19
Relative IF (stripped eggs/cm of female)	19
Relative FF (viable eggs/cm of female)	19
Hour-degrees at hatching	19
Water temperature at hatching (°C)	19
Lt of hatched larvae (µm)	120*

(*) Refers to measurements taken from six fish

Pimelodus maculatus eggs are covered by a thick external membrane surrounding them and a thin layer of ova. IHERING & AZEVEDO (1936) reported the presence of a jelly-coat in *Pimelodus maculatus* and *Pimelodus della lateristriga* (Müller & Troschel 1845). Similar jelly-coat was also observed in *Pimelodus maculatus* (GODINHO *et al.* 1975) and in *Rhamphidodon* (ESPINACH ROS *et al.* 1984). After hydration the diameter of the eggs was 1838.15 ± 37.02 µm to 1838.15 ± 61.53 µm, com-

± 4 hour-degrees (duration = 8.3 h) after application of the second dose of CCPE, at water temperature of $25.8 \pm 0.3^\circ\text{C}$. The males were sacrificed and had their testes removed and squeezed through a fine cloth (mesh *circa* 100 μm) over the mass of oocytes.

Table I. Reproductive aspects of yellow-mandi catfish *Pimelodus maculatus* subjected to hypophysation at Três Marias Hydrobiology and Hatchery Station during the reproduction cycles of 1995/96 and 1996/97. (N) Number of observations, (CCPE) crude common carp pituitary extract, (SD) standard deviation, (CV) coefficient of variation.

Parameters	N	Mean ± SD		CV	Range	
Males						
Total length (Lt, cm)	22	32.10 ± 1.70	5.20	29.500 ± 35.00		
Body weight (Wt, g)	22	305.20 ± 50.50	16.50	216.000 ± 370.20		
Single dose (mg CCPE/Kg Wt)	22	2.80 ± 0.30	9.20	2.500 ± 3.00		
Females						
Total length (Lt, cm)	19	38.70 ± 2.00	5.20	34.500 ± 41.50		
Fulton's condition factor (K)	19	1.17 ± 0.12	10.43	0.880 ± 1.36		
Body weight (Wt, g)	19	688.00 ± 150.00	22.00	451.000 ± 938.00		
Dosage (mg CCPE/Kg Wt)						
First dose	19	0.90 ± 0.10	10.20	0.800 ± 1.00		
Second dose	19	5.70 ± 0.50	7.90	5.000 ± 6.00		
Interval between doses (h)	19	14.30 ± 0.70	4.70	13.000 ± 15.00		
Hour-degrees at stripping	19	213.00 ± 4.00	2.00	205.000 ± 220.00		
Water temperature at stripping ($^\circ\text{C}$)	19	25.80 ± 0.30	1.10	25.000 ± 26.00		
Gonadosomatic index (GSI, %)	19	5.53 ± 0.76	13.76	4.590 ± 7.19		
Ova weight. 100/Wt (%)	19	4.04 ± 0.68	16.96	3.080 ± 5.55		
Eggs/g ova (n)	19	3,276.00 ± 181.00	6.00	3,023.000 ± 3,592.00		
Size of egg (μm)						
Diameter of non-hydrated egg	120*	1,113.92 ± 37.02	3.32	1,052.520 ± 1,202.88		
Diameter of hydrated egg	120*	1,838.15 ± 61.53	3.35	1,729.140 ± 1,954.68		
Diameter of yolk sac	120*	694.13 ± 45.57	6.57	626.500 ± 776.86		
Width of perivitelline space	120*	323.71 ± 44.28	13.68	225.540 ± 413.49		
Thickness of chorium	120*	248.30 ± 32.97	13.28	200.480 ± 300.72		
Egg fertilization rate (%)	19	64.80 ± 9.50	14.70	51.400 ± 83.50		
Absolute fecundity (AF)	19	124,690.00 ± 34,457.00	28.00	80,120.000 ± 205,256.00		
Initial fecundity (IF)	19	91,949.00 ± 29,372.00	32.00	51,374.000 ± 158,462.00		
Final fecundity (FF)	19	59,177.00 ± 19,049.00	32.00	27,074.000 ± 91,324.00		
Relative AF (eggs/kg of female)	19	181,340.00 ± 28,480.00	16.00	142,824.000 ± 254,976.00		
Relative IF (stripped eggs/kg of female)	19	132,325.00 ± 24,660.00	19.00	94,265.000 ± 196,847.00		
Relative FF (viable eggs/kg of female)	19	85,377.00 ± 16,882.00	20.00	49,678.000 ± 112,468.00		
Relative AF (eggs/cm of female)	19	3,194.00 ± 765.00	24.00	2,226.000 ± 5,131.00		
Relative IF (stripped eggs/cm of female)	19	2,350.00 ± 666.00	28.00	1,427.000 ± 3,962.00		
Relative FF (viable eggs/cm of female)	19	1,513.00 ± 433.00	29.00	752.000 ± 2,283.00		
Hour-degrees at hatching	19	394.00 ± 9.00	2.00	380.000 ± 410.00		
Water temperature at hatching ($^\circ\text{C}$)	19	24.20 ± 0.40	1.70	24.000 ± 25.00		
Lt of hatched larvae (μm)	120*	2,607.84 ± 45.97	1.76	2,531.060 ± 2,706.48		

(*) Refers to measurements taken from six females (20 eggs or 20 larvae/female).

Pimelodus maculatus eggs are opaque, demersal, yellow, and free, with an external membrane surrounding them as a jelly-coat. There are 3276 ± 181 oocytes/g of ova. IHERING & AZEVEDO (1936) registered a jelly-coat on the eggs of *Pimelodella lateristriga* (Müller & Troschel, 1849), which was impregnated by detritus. Similar jelly-coat was also observed in *Rhamdia hilarii* (Valenciennes, 1840) (GODINHO et al. 1975) and in *Rhamdia sapo* (Cuvier & Valenciennes, 1840) (ESPINACH ROS et al. 1984). After hydration, egg diameter increased from $1113.92 \pm 37.02 \mu\text{m}$ to $1838.15 \pm 61.53 \mu\text{m}$, corresponding to 4.5 times the original volume.

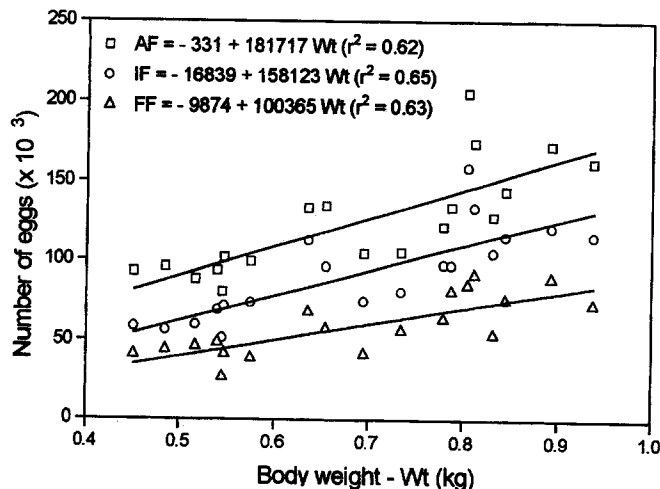


Fig. 1. Linear relationship of absolute fecundity (AF), initial fertility (IF) and final fertility (FF) rates to variations in body weight (Wt), obtained simultaneously from 19 *Pimelodus maculatus* females subjected to hypophysation at Trs Marias Hydrobiology and Hatchery Station during the reproduction cycles of 1995/96 and 1996/97.

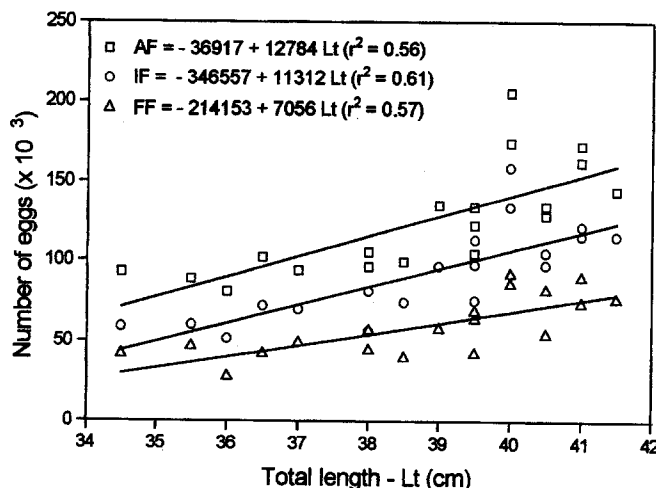


Fig. 2. Linear relationship of absolute fecundity (AF), initial fertility (IF) and final fertility (FF) rates to variations in total length (Lt), obtained simultaneously from 19 *Pimelodus maculatus* females subjected to hypophysation at Trs Marias Hydrobiology and Hatchery Station during the reproduction cycles of 1995/96 and 1996/97.

The average gonadosomatic index was 5.53% (range = 4.59-7.19%). BASILE-MARTINS *et al.* (1975) and GODINHO *et al.* (1977) recorded average gonadosomatic index values of 6.38 and 7.84% for *P. maculatus* during the reproductive period. Maximum gonadosomatic index of 9.4% was recorded by VAZZOLER (1996) from data obtained in the wild.

The relationship between absolute fecundity and body weight and total length are, respectively. When these parameters increased proportionately to total length, the values of r^2 were improved when these parameters were related to body weight. GODINHO *et al.* (1977), r^2 was also higher when related to total length.

P. maculatus larvae hatched at 39 hours after egg fertilization at water temperature of 28°C. The movements in the water column and hatching. Upon hatching, the larvae had

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The relationship between absolute fecundity, initial fertility and final fertility with body weight and total length are, respectively, shown in figures 1 and 2. These parameters increased proportionately to the body weight and total length. The values of r^2 were improved when these parameters were related to body weight. In GODINHO *et al.* (1977), r^2 was also higher when fecundity was related to body weight than to total length.

P. maculatus larvae hatched at 394 ± 9 hour-degrees (duration = 16.3 h) after egg fertilization at water temperature of $24.2 \pm 0.4^\circ\text{C}$. The larvae showed vertical movements in the water column and consumed the yolk sac 3.5 to 4 days after hatching. Upon hatching, the larvae had a total length of $2607.84 \pm 45.97 \mu\text{m}$.

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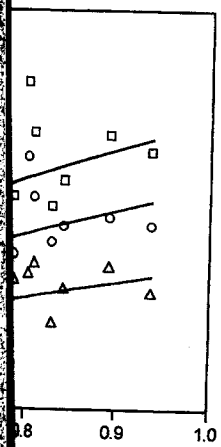


Figure 1. Absolute fecundity (IF) and final fertility (FF) versus body weight (W) from 19 *Pimelodus maculatus* during the reproductive cycle at the Biology and Hatchery Station during the study.

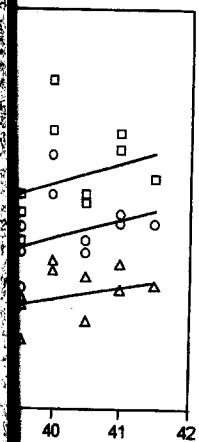


Figure 2. Absolute fecundity (IF) and final fertility (FF) versus total length (TL) from 19 *Pimelodus maculatus* during the reproductive cycle at the Biology and Hatchery Station during the study.

(range = 4.59-7.19%). BASILE-MARTINS *et al.* (1975) recorded average gonadosomatic index (GSI) of *Pimelodus maculatus* during the reproductive cycle as recorded by VAZZOLER

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Two new species of social wasps from Roraima,

ABSTRACT. The females and nests are described (Hymenoptera, Vespidae) from dry evergreen forest in northern Brazil. *Mischocyttarus* (*Monocyttarus*) *cornis* Zikán, 1935 in morphology and coloration. *M. cornis* is a member of the *P. occidentalis* (Olivier) group. KEY WORDS. Hymenoptera, Vespidae, new species, systematics

During ecological studies on social wasps in northern Brazil I collected two previously unknown species below. The Ilha de Maracá lies 205 km from the border of Brazil with Guyana and Venezuela,

Mischocyttarus (*Monocyttarus*)

Mischocyttarus (*Monocyttarus*) *maracaensis* Raw, 1998 (new description). – Raw, 1998: 317; nom. nud.

Holotype female. Length of body 2.5 mm. Coloration golden yellow with black and brown markings. Head enclosing ocelli with arm extending halfway across band narrowly linked to ocellar area and with three mesoscutal stripes joined narrowly to each other bordering each tegula yellow. Dark brown markings on scape, humeral stripe, narrow anterior margin of central line of propodeum and most of anterior apical margin and sides which are yellow. Anterior margin of the pronotal keel, apical half of anterior margin (which is yellow), stripe on upper side of hind tarsus. Orange-brown areas are found on the mandible and mandibular teeth. The wings are yellow.

Clypeus wider than high (6: 5). Diameter of eye for 2 x the diameter of an antennal segment. Genal carina lacking. Width of malar space < 1/2 width of antennal segment.

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