Iran. J. Ichthyol. (June 2017), 4(2): 162-170
© 2017 Iranian Society of Ichthyology
P-ISSN: 2383-1561; E-ISSN: 2383-0964
http://www.ijichthyol.org
Received: April 05, 2017
Accepted: June 01, 2017
doi: 10.7508/iji.2017.

## Research Article

# Contribution to the feeding habits and reproductive biology of narrow-barred Spanish mackerel, *Scomberomorus commerson* (Lacèpéde, 1801) (Teleostei: Scombridae), in the northern Persian Gulf

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**Abstract:** In this study, the feeding habits and reproductive behavior of narrow-barred Spanish mackerel, *Scomberomorus commerson*, in the northern Persian Gulf during five months from October 2011 to December 2012 have been investigated. Specimens were purchased from the fishermen at several landing sites. Feeding and nutrition results showed that sardines are the major prey items of *S. commerson*. Secondary prey species included ponyfish, halfbeak and Indian mackerel fishes. Mature females (Stages III, IV) were mostly observed between April to July. By July, most of the studied fishes were in recovery or spent stages (Stages IV, V) indicating the end of the spawning season. The result of gonado-somatic index (GSI) study in 184 male and female specimens indicated the highest reproductive activity from April to July with the peak in July. The total sex ratio of 69 males and 115 females was 0.6:1 and it was not significantly different during study periods except autumn season. The minimum and maximum cavity index (CV) for both sexes were from 22.5% in December to 68.0% in October, respectively. Sardines were the most prevalent components of the diet of *S. commerson*. Based on the obtained results, it can be suggested that that banning of the Spanish mackerel catch in the June-July, which is the peak of spawning period, may help brood stocks. Banning the sardine catch may also benefit management of *S. commerson* in the Persian Gulf.

**Keywords:** Reproductive Biology, Gonado-somatic Index, Diet, Persian Gulf.

**Citation:** Niamaimandi, N.; Kaymaram, F.; Hoolihan, J.; Mohammadi, G. & Fatemi, S.M.R. Contribution to the feeding and reproductive biology of narrow-barred Spanish mackerel, *Scomberomorus commerson* (Lacèpéde, 1801) (Telostei: Scombridae), in the northern Persian Gulf. Iranian Journal of Ichthyology 4(2): 162-170.

## Introduction

Mackerels and tunas of the family (Scombridae) comprise some of the most important commercial fishes in the Persian Gulf. *Scomberomorus*

*commerson* (Lacèpéde, 1801) is one member of this family that is widely distributed in the Indo-Pacific from the Red Sea and South Africa to Southeast Asia, north to China and Japan and south to Australia (Randall 1995).

Along the 1000km northern Iranian coast of the Persian Gulf, commercial and artisanal fishing for *S. commerson* is done using set gill nets, trolling line, and occasionally drift nets. In the southern Persian Gulf, *S. commerson* is mainly caught using encircling gillnets, trolling gears, and recreational gears (Grandcourt et al. 2005). Total annual catch from the study area (Bushehr and Khuzestan) ranged from 1900 and 5500t for the last 10 years (2003-2012) with average landings of 3130 (±1008) tones per year (Iranian Fishery Organization 2003-2012). About 535 fiberglass dhows and 600 small fiberglass boats are operating for narrow-barred Spanish mackerel. All of the catches are using for consumption of local people that living near landing sits or distributing throughout Iran. Based on the reports from studied area, some of the fish species include *S. commerson* have been heavily exploited and fishing effort is above optimum levels (Khoshidian 2000; Valinasabet al. 2012). Darvishi et al. (2011) studied on the population dynamics of narrow-barred Spanish mackerel and had some results on the spawning activity and feeding habitat of this species in the Strait of Hurmoz (Iranian waters). In this area, Kaymaram et al. (2010) has also reported, spawning season of this species showing a peak of reproductive cycle from March to September. In the neighboring Gulf of Oman, there has been a progressive 10-fold decrease in yields of *S. commerson* (Al-Oufi et al. 2002).

Study on the diet and reproductive biology of this species in the Persian Gulf is scarce. *Scomberomorus commerson* is an inshore pelagic species with large adults characteristically solitary, and juvenile and young fish often observed in small schools (Collette 2001). Prey species for this species consists primarily of anchovies, clupeids, carangids, also squids and penaeid shrimps. *Scomberomorus commerson* is a pelagic spawner (Collette 1986), and as the young larvae grow, they move from the offshore spawning grounds to the inshore and estuarine habitats where they are frequently found in the juvenile phase of their growth cycle (McPherson 1981).

In the northern Persian Gulf (Iranian waters), there are no any restricted season and gears for *S. commerson* and harvest of immature fish has been of particular concern for this species in this area. Timing of spawning is a first step and critical for setting up measures to protect the reproductive and managing the stock from an ecosystem perspective. Therefore, this study evaluates and analyzes the dietary and reproductive characteristics of *S. commerson* to improve fisheries management of the species.

## Materials and Methods

Collections of 184 specimens were undertaken during five times between October-December 2011 and March, April and July 2012. Random samples of 30-50 fish were sampled from gillnet catches available at the landing sites along Bushehr and Khuzestan provinces (Fig. 1).

Specimens were measured to the nearest 1.0cm from the tip of the snout to the fork of the tail (Fork length, FL) using a measuring board and weighed with an electronic digital balance to the nearest 1.0g. The ovaries or testes were removed, and then weighed to the nearest 0.1g to establish the gonado-somatic index (GSI). The GSI for each individual was estimated using the following equation described by Snyder (1985).

$$GSI = GW\,(g) / TW\,(g) \times 10^2$$

Where GW is the weight of the gonads in grams, and TW the total weight of the fish (non-gutted).

Reproductive maturity stages following Mackie et al. (2005) were assessed macroscopically using a five element scheme based on gonad size and appearance, including: immature (stage I), resting (stage II), developing (stage III), spawning (stage IV) and spent (stage V). For histological examination, ovaries were fixed and preserved in 4% formalin. One-forth of

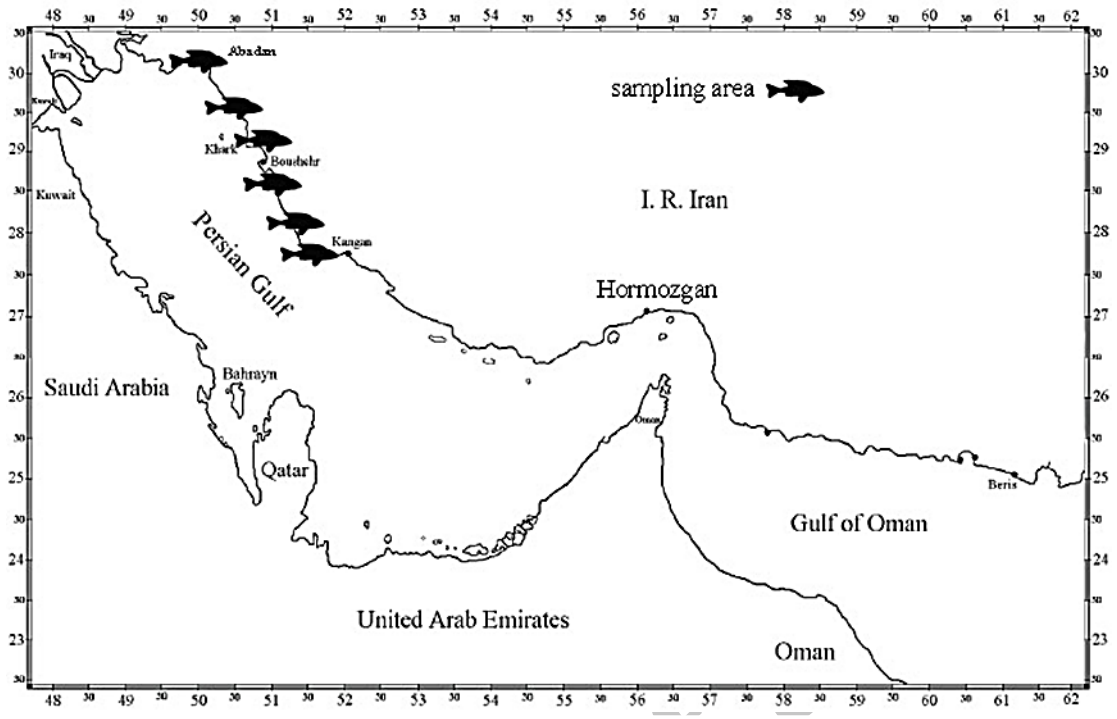


**Fig.1.** Map of the Persian Gulf showing sampling sites in the northern region (2011-2012).

every stage was selected for histology. Central sections were embedded in wax, sectioned, and stained with Hematoxylin–Eosin. For this subset, five-stage macroscopic assessments description was compared for validation.

The prey occurrence index (Fp) was estimated using the formula described by Euzen (1987).

$$FP = NsJ / Ns \times 10^2$$

Where NsJ is the number of stomachs that contained a food item J, Ns is the total number of stomachs. The obtained Fp was interpreted according to instructions by Euzen (1987). If:

Fp<10: not included in main diet (prey is eaten accidentally)

10<Fp<50: the eaten prey is secondary providing that no main prey is available

50<Fp<100: the eaten prey is the main diet

To estimate the index of vacuity (CV), we used the formula stated by Euzen (1987) as follows:

$$CV= ES / TS \times 10^2$$

Where ES is the number of empty stomachs and TS is number of total stomachs.

The obtained CV was interpreted according to instructions by Euzen (1987). If:

0<CV<20: the fish is gluttonous

20<CV<40: the fish is partly gluttonous

40<CV<60: the fish is moderately fed

60<CV<80: the fish is partly low fed

80<CV<100: the fish is low fed

## Results

**Reproductive biology:** The majority of female *S. commerson* were in spawning condition (stage IV) during the months of April to July (Fig. 2). Histological sections of ovaries collected from March to July showed growth of the ovarian stages (Fig. 3). Most females collected during the spawning periods indicated that they were reproductively active.

**Feeding habits:** Fish were found to be the main prey item during the study period. Sardines were the most prevalent, while Indian mackerel, Ponyfish (*Leiognathus* sp.) and Halfbeak (*Hyporhamphus* sp.) were less essential components of the diet of *S. commerson* (Table 1). Sardines accounted for 50-85% of the total weight of prey items in different months, followed by Indian mackerel (*Rastrelliger kanagutra*) (10-30%), Halfbeak (*Hyporhamphus* sp.)

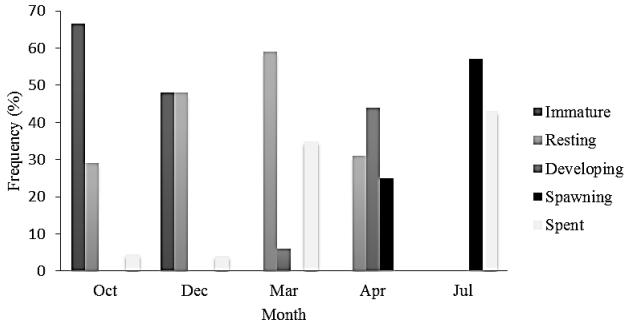


**Fig.2.** Percentage of maturity stages of *Scomberomorus commerson* by month in the northern Persian Gulf (2011-2012).

**Table 1.** Percentage of composition of prey by weight found of *Scomberomorus commerson*, in different months in the northern Persian Gulf (2011-2012).

| Prey \ Months | Oct. | Dec. | Mar. | Apr. | July |
|---|---|---|---|---|---|
| *Sardinella* sp. | 85 | 75 | 90 | 60 | 50 |
| *Hyporhamphus* sp. | 5 | 0 | 0 | 10 | 0 |
| *Rastrelligerkanagutra* | 5 | 0 | 0 | 10 | 30 |
| *Leiognathus* sp. | 5 | 0 | 0 | 0 | 0 |
| Unknown item | 0 | 25 | 10 | 20 | 10 |

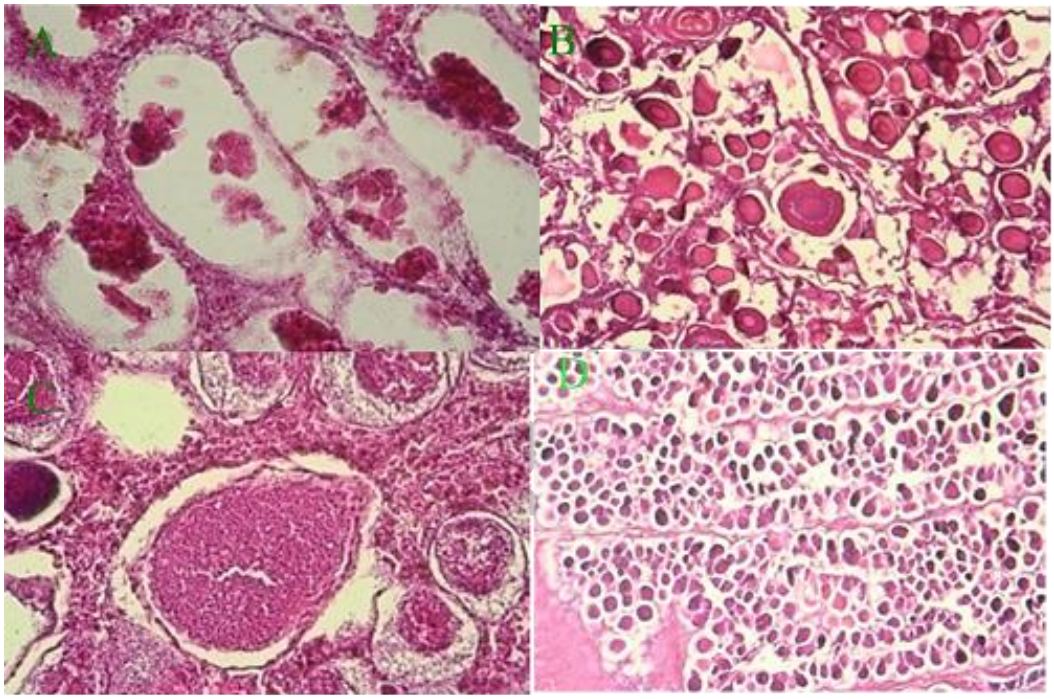


**Fig.3.** Photomicrographs of *Scomberomorus commerson* ovary sections in different stages. Stage III (B), ovary showing mostly vitellogenic. Stage IV (C), showing terminal-stage oocyte. Stage II (A) and V (D), ovary showing all oocyte Stages.

**Table 2.** Monthly estimates for index of vacuity (CV) for *Scomberomorus commerson*, in the northern Persian Gulf (2011-2012).

| Months | October | December | March | April | July |
|---|---|---|---|---|---|
| Males | 26.0 | 5.0 | 22.5 | 13.5 | 12.0 |
| Females | 42.0 | 17.5 | 9.5 | 34.5 | 13.0 |
| Total | 68.0 | 22.5 | 32.0 | 48.0 | 25.0 |

(5-10%), Ponyfish (*Leiognathus* sp.) (5%), and unidentified (10-25%).

The monthly percentage of total (males and females) index of vacuity (CV) ranged from 22.5% (December) to 68.0% (October). Males exhibited lower monthly CV values, ranging from 5.0% (December) to 26.0% (October, Table 2). In comparison, monthly CV for females ranged from 9.5% (March) to 42.0% (October, Table 2).

## Discussion

Gonad stages and the variations in GSI as well as the presence of vitellogenic oocytes between April to July suggests that this is the peak reproductive period for *S. commerson*. The main spawning peak occurred in July, characterized by 57% of ovaries found in mature stage and 43% in spent stage. During this

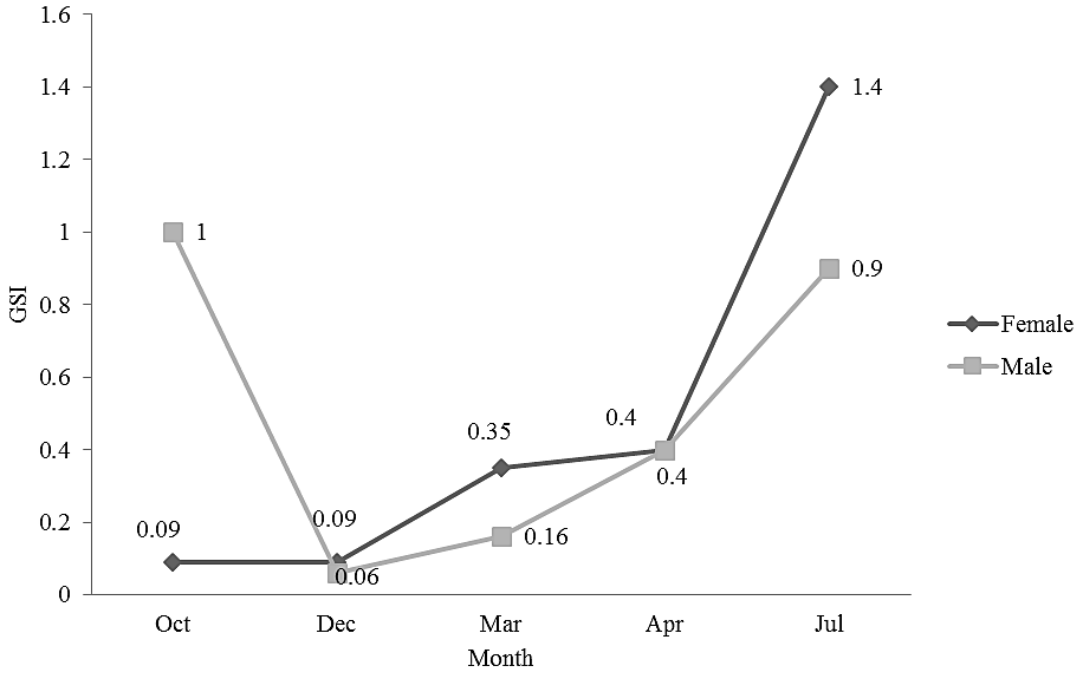


**Fig.4.** Monthly mean GSI for male and female *Scomberomorus commerson* in the northern Persian Gulf (2011-2012).

period, females and males had mean GSI values of 1.4 and 0.9%, respectively. The GSI data revealed that no spawning activity occurred between October and December that showed a single synchronous spawning period during April-July that coincides with the dry season in the study area.

In Hormozgan waters, GSI for both males and females increased rapidly during May and June but peak of spawning occurred from June to September (Darvishi et al. 2011). In this area, Kaymaram et al. (2010) reported reproductive stages and gonado-somatic index of *S. commerson* showed a single reproductive cycle beginning in March and continued with a single spawning period from August to September. A similar spawning season is noted for *S. commerson* in Oman, with peaks between April and June (Claereboudt et al. 2005). Mature and spawning stages were observed in Oman mostly in May and June, and by July most fish were in post-spawning stages, while no mature stages were observed between August and February (Claereboudt et al. 2005).

When fish spawn, they tend to be more aggregated and thus knowing the timing of spawning within the annual seasonal cycle allows the process of spawning and setting a short ban period to protect of the species. The results of the present study confirm previous observations from different areas for spawning period of this species in the Persian Gulf. Water temperature is one of the basic environmental factors affecting the spawning behavior of *S. commerson*. Jenkins et al. (1985) reported that spawning times for narrow-barred Spanish mackerel tend to be associated with higher water temperatures that promote optimal food availability for the rapid growth and development of the larvae. The mean water temperature in the study area is reported between 24-26˚C with minimum 16.8˚C to maximum 36.5˚C (Niamaimandi et al. 2007; Izadpanahi 2012). These reports indicate that higher water temperature is recorded from June to August.

The mean sizes at first sexual maturity for males and females has been reported between 70 and 85cm FL, respectively. Dudley et al. (1992) estimated size at spawning of 75-80cm FL for sex combined off Oman. Claereboudt et al. (2004) later estimated the size at first sexual maturity at 84.7cm FL for males and 80.4 cm FL for females. *S. commerson* has been

reached to mature between 70-80cm FL off Madagascar, Papua New Guinea and Fiji (Collette & Russo, 1984). In the northern Indian Ocean Devaraj (1983) estimated the mean size at first sexual maturity at 75cm FL. The reproductive activity of *S. commerson* in waters off the east coast of Australia peaked in the spring and summer months where fish attain length at first maturity at 79cm (McPherson 1993). The life history of *S. commerson* stocks in Oman comprised of two distinct phases. In the first phase from the larval stage to 18 months of age, fish has rapid growth. The start of the second phase coincides with the time at which *S. commerson* reach age at first reproduction (Claereboudt et al. 2005). In our study the mean size of fish captured was 108cm FL, with fish less than 80cm FL comprising 54% of the sample. This suggests that overfishing is occurring in the study area, and preventing *S. commerson* from reaching the age of first reproduction. It can be assumed that fishing pressure may be resulted in mesh size 9cm gill net.

Although seasonal differences in diet probably reflect seasonal fluctuations in prey abundance, overall the *S. commerson* in our study area were piscivorous, feeding largely on sardine sp. In comparison, Darvishi et al. (2011) reported that the stomach content of *S. commerson* in Hormozgan waters consisted mainly of boney fish (91.3%). Bakhoum (2007) reported that the diet of *S. commerson* along the Mediterranean coast of Egypt included *Engraulis encrasicolus*, *Sardinella aurita*, *Sardina pilchardus* and shrimps. In Solomon Islands, Blaber et al. (1990) reported that the diet of this species mainly consists of small fishes like anchovies, clupeids and carangids.

Comparing the results of the present study with the other studies confirm that *S. commerson* spawning period is taking place in warm season. It can introduce for whole of the Persian Gulf to have a closed period for this species in this area. All of the Persian Gulf countries can make an agreement for this period as a part of fishery management of narrow-barred Spanish mackerel in the area. The choice of only a 2-month closure is reasonable because a longer period may be make socio-economic hardship on fishers. The second part is attributed to feeding behavior of this species. Sardine is the main prey in diet habit of *S. commerson*. In the studied area, there is no strong investment on sardine fishery and this fish has a low price in the local markets and is not economically important. So banning of the sardine catch is helped to better feeding and reproductive of *S. commerson* and probably increase total catch and makes better conservation and basically has a bio-socio-economic impact in the region.

## Acknowledgments

This research was funded by Iranian Fisheries Science Research Institute (IFSRI). The financial support of IFSRI is acknowledged. The authors are grateful to colleagues of stock assessment division of Iran Shrimp Research Center (ISRC) that associated in sampling and data collection.

## References

Al-Oufi, H.S.; McLean, E.; Goddard, J.S.; Claereboudt, M.R.G. & Al-Akhzami, Y.K. 2002. The kingfish, *Scomberomorus commerson* (Lacèpéde, 1801) in Oman: reproduction, feeding and stock identification. In: McLean, E. & Al-Oufi, H.S. (eds.), Contemporary issues in marine science and fisheries. Hasanuddin University Press, Makassar, pp. 1-17.

Bakhoum, S.A. 2007. Diet overlap of immigrant narrow–barred Spanish mackerel *Scomberomorus commerson* and the largehead hairtail ribbonfish Trichiurus lepturus in the Egyptian Mediterranean coast. Animal Biodiversity and Conservation 30(2): 147-160.

Blaber, S.J.M.; Milton, D.A.; Rawlinson, N.J.F.; Tiroba, G. & Nichols, P.V. 1990. Diets of lagoon fishes of the Solomon Islands: predators of tuna baitfish and trophic effects of bait fishing on thesubsistence fishery. Fisheries Research 8: 263-286.

Claereboudt, M.R.G.; Al-Oufi. H.S.; McIlwain, J. & Goddard, J.S. 2004. Relationships between fishing gear, size frequency and reproductive patterns for the kingfish (*Scomberomorus commerson* Lacep`ede)

fishery in the Gulf of Oman. In: Payne, A.I.L.; O'Brien, C.M. & Rogers, S.I. (eds.), Management of shared fish stocks, Blackwell Publishing, Oxford, pp. 56-67.

Claereboudt, M.R.; McIlwain. J.L.; Al-Oufi, H.S. & Ambu-Ali. A.A. 2005. Patterns of reproduction and spawning of the kingfish (*Scomberomorus commerson*, Lacèpéde, 1801) in the coastal waters of the Sultanate of Oman. Fisheries Research 73: 273-282.

Collette, B.B. & Russo, J.L. 1984. Morphology, systematics, & biology of the Spanish mackerels (*Scomberomorus*, Scombridae). Fishery Bulletin 82: 545-689.

Collette, B.B. 1986. Scombridae (including Thunnidae, Scomberomoridae, Gasterochismatidae and Sardidae). In:Fishes of the north-eastern Atlantic and the Mediterranean, Volume 2. In: Whitehead, P.J.P.; Bauchot, M.L.; Hureau, J.C.; Nielsen, J. & Tortonese, E. (eds.), Fishes of the north-eastern Atlantic and the Mediterranean, Volume 2. UNESCO, Paris, pp. 981-997.

Collette, B.B. 2001. Scombridae. Tunas (also, albacore, bonitos, mackerels, seer fishes, and wahoo). In: Carpenter, K.E. & Niem, V. (eds.). FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Vol. 6. Bony fishes part 4 (Labridae to Latimeriidae), estuarine crocodiles. FAO, Rome, pp. 3721-3756.

Darvishi, M.; Kaymaram. F.; Salarpouri, A.; Behzadi, S. & Daghooghi, B. 2011. Population dynamic and biological aspects of *Scombermorus commerson* in the Persian Gulf and Oman Sea (Iranian coastal). IOTC. WPNTO1: 23p.

Devaraj, M. 1983. Maturity, spawning and fecundity of the king seer, *Scomberomorus commerson* (Lacèpéde, 1801), in the seas around the Indian Peninsula. Indian Journal of Fisheries 30: 203-230.

Dudley, R.G.; Aghanashinikar, A.P. & Brothers, E.B. 1992. Management of the Indo-Pacific Spanish mackerel (*Scomberomorus commerson*) in Oman. Fisheries Research 15: 17-43.

Euzen, E. 1987. Food habits and diet composition of some fish of Kuwait. Bulletin Science 9: 65-85.

Grandcourt, E.M.; Al-Abdessalaam, T.Z.; Francis, F. & Al-Shamsi, A.T. 2005. Preliminary assessment of the biology and fishery for the narrow-barred Spanish mackerel, *Scomberomorus commerson* (Lacèpéde, 1800). Fisheries Research 76: 277-290.

Iranian Fishery Organization. (2003-2012). The annual statistic of catches from southern part of country, the Persian Gulf. 74p.

Izadpanahi, G.R. 2012. Final report. The monitoring of hydrology and hydrobiology studies of the Persian Gulf (Iranian waters), Iranian Fisheries Research Organization. Tehran-Iran: 170p. (In Farsi)

Jenkins, G.P.; Milward, N.F. & Hartwick, R.F. 1985. Occurrence of larvae of Spanish mackerels, Genus *Scomberomorus* (Teleostei; Scombridae), in shelf waters of the Great Barrier Reef. Austustralian Journal of Marine and Freshwater Research 36: 635-640.

Kaymaram, F.; Hossainy, S.A.; Darvishi, M.; Talebzadeh, S.A. & Sadeghi, M.S. 2010. Reproduction and spawning patterns of the *Scomberomorus commerson* in the Iranian coastal waters of the Persian Gulf and Oman Sea. Iranian Journal of Fisheries Sciences 9(2): 233-244.

Khorshidian, K. 2000. Comparative study of fishing fleet in Bushehr province. Iranian Fisheries Research Organization. Tehran-Iran: 10-22. (In Farsi)

Mackie, M.C., Lewis, P.D.; Gaughan, D.J. & Newman, S.J. 2005. Variability in spawning frequency and reproductive development of the narrow-barred Spanish mackerel (*Scomberomorus commerson*) along the west coast of Australia. Fishery bulletin 103: 344-354.

McPherson, G.R. 1981. Preliminary report: Investigations of Spanish mackerel, *Scomberomorus commerson*, in Queensland waters. In: Grant, C.J & Walters, D.G (eds.), Northern Pelagic Fish Seminar, Australian Government Printing Series, Canberra. pp. 51-58.

McPherson, G.R. 1993. Reproductive biology of the narrow-barred Spanish mackerel (*Scomberomorus commerson* Lacèpéde, 1801) in Queensland waters. Asian Fisheries Science 6: 169-182.

Niamaimandi, N.; Arshad, A.; SitiKhalijah, D.S.; CheRoos, R. & Kiabi. B. 2007. Population dynamic of green tiger prawn, *P. semisulcatus* in Bushehr coastal waters, Persian Gulf. Fisheries Research 86: 105-112.

Randall, J.E. 1995. Coastal Fishes of Oman. Crawford House Publishing, Bathurst, Australia. 440p.

Snyder, D.E. 1985. Fish eggs and larvae. Nielson L.A. &

Johnson, D.L. (eds.), Fisheries techniques, American Fisheries Society, Bathesda, Maryland, USA, pp. 165-197.

Valinasab, T.; Dehghani, R.; Mobarezi, A.; Hashemi, A. & Darianebard, R. 2012. Biomass estimation of demersal resources in the Persian Gulf and Oman Sea by Swept area method. Final report. Iranian Fisheries Research Organization. 328p.

Iran. J. Ichthyol. (June 2017), 4(2): 162–170
© 2016 Iranian Society of Ichthyology
P-ISSN: 2383-1561; E-ISSN: 2383-0964
http://www.ijichthyol.org
Received: April 05, 2017
Accepted: June 01, 2017
doi:10.7508/iji.2017

**مقاله پژوهشی**

# عادات غذایی و زیست شناسی تولید مثل ماهی شیر، *Scomberomorus commerson* (Lacèpéde, 1801) (ماهیان استخوانی عالی: تون ماهیان) در آب‌های شمالی خلیج فارس

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**چکیده:** در این مطالعه، عادات غذایی و رفتار تولیدمثلی ماهی شیر (*Scomberomorus commerson*) طی ۵ ماه از مهر ۱۳۹۰ تا شهریور ۱۳۹۱ در آب‌های شمالی خلیج فارس مورد بررسی قرار گرفت. نمونه‌ها از صیادان در چند منطقه تخلیه صید، تهیه گردید. نتایج غذاخوری و تغذیه ماهی شیر نشان داد که ساردین ماهیان شکار اصلی این گونه به شمار می‌روند. ماهی فروکو، نیم منقار ماهیان و ماهی پشت سبز به‌عنوان دومین شکار ماهی شیر به شمار می‌روند. بیشترین درصد ماده‌های بالغ (در مراحل ۳ و ۴) در ماه‌های فروردین تا خرداد مشاهده شد. در تیر ماه بیشتر نمونه‌های ماهی در مراحل تخمریزی کرده و بازیابی تخمدان (مراحل ۴ و ۵) به سر می‌بردند. نتایج بررسی نمایه گنادی-بدنی در ۱۸۴ نمونه نر و ماده بیشترین فعالیت جنسی را طی ماه های فروردین تا خرداد با حداکثر فعالیت در خرداد ماه نشان می داد. نسبت جنسی کل در ۶۹ نمونه نر و ۱۱۵ نمونه ماده ۶:۱/. بود و این نسبت به غیر از فصل پائیز اختلاف معنی‌داری را نشان نداد. شاخص خالی بودن معده در هر دو جنس برابر با ۲۲/۵ و ۶۸ به ترتیب در ماه‌های آذر و مهر بود. بر اساس نتایج این تحقیق پیشنهاد می‌شود که صید ماهی شیر در دوره تخمریزی طی ماه‌های فروردین تا خرداد جهت حفاظت از ذخائر بالغ ممنوع اعلام گردد. ممنوعیت صید ساردین‌ماهیان در خلیج فارس نیز در مدیریت ذخائر ماهی شیر تاثیر مثبتی خواهد داشت.

**کلمات‌کلیدی:** زیست‌شناسی تولید مثل، نمایه گنادی-بدنی، رژیم غذایی، خلیج فارس.