Sri Lanka J. Aquat. Sci. 1: 53-58

Effects of Monsoonal Currents, Rainfall and Lunar Phase on the Abundance of *Amblygaster sirm* in the Coastal Waters off Negombo, Sri Lanka.

W.P.N. KARUNASINGHE[1] and M.J.S. WIJEYARATNE[2]

[1] National Aquatic Resources Agency
Crow Island, Colombo 15
Sri Lanka

[2] Department of Zoology
University of Kelaniya, Kelaniya
Sri Lanka

Abstract

The trenched sardine, *Amblygaster sirm* (Walbaum) is an abundant clupeid fish in the coastal waters of the western Indian Ocean. It contributes for about 25% of the small pelagic fish production of Sri Lanka. During the present study carried out from September 1984 to August 1987, the catch per unit effort (CPUE) of *A. sirm* in the small meshed gillnet fishery of the coastal waters off Negombo, Sri Lanka was found to vary from 4.5 to 109 kg boat^{-1} day^{-1}. CPUE was significantly higher from April to November than in other months ($P<0.05$). Since fishing mortality of this stock is proportional to the fishing effort of the gillnet fishery, the CPUE reflects its abundance in this region. Thus the high abundance from April to November may be attributed to a possible increase in productivity in these waters probably due to southwest monsoonal current. The rainfall did not have a significant effect on CPUE indicating that the abundance of *A. sirm* is not affected by rainfall. CPUE values recorded during the full moon periods were found to be significantly higher than those recorded during the quarter moon and new moon periods ($P<0.05$). Therefore, results indicate that the period from April to November is a better fishing season and full moon period is a better time for a higher catch. However, since the total catch of this stock has already been recorded to exceed the level of maximum sustainable yield, intensification of fishing during these periods will impede the sustainable utilization of this fishery resource.

Introduction

The trenched sardine *Amblygaster sirm* is a pelagic clupeid fish abundant in the coastal waters of the western Indian Ocean (Fischer & Bianchi 1984). In the western coastal waters of Sri Lanka, it is frequently caught in 2.3 - 3.8 cm stretched mesh gillnets operated from 5-7 m fibre-glass boats powered by 8-25 hp outboard engines (Dayaratne 1988, Karunasinghe & Wijeyaratne 1991a).

In some regions of the Indian Ocean, the fisheries for this clupeid species is seasonal (Radhakrishnan, 1973). In the coastal waters of Kerala, India minor fishery for *A. sirm* exists in October - November (Radhakrishnan, 1973). However, in the south,

south west and west coasts of Sri Lanka, this species is found in the commercial fish catches throughout the year (Fernando 1986; Fernando & Dayaratne 1986; Karunasinghe & Wijeyaratne 1991b). It contributes for about 25% of the small pelagic fish production of Sri Lanka (Anon. 1984).

Some studies have already been carried out on *A. sirm* inhabiting the coastal waters of Sri Lanka. These include the studies on population dynamics (Dayaratne 1985; Siddeek et al. 1985; Karunasinghe & Wijeyaratne 1991b), selectivity patterns (Dayaratne 1988; Karunasinghe & Wijeyaratne 1991a) and some

aspect of the fishery (Dayaratne 1984, 1985; Karunasinghe & Fonseka 1985; Fernando 1986; Fernando & Dayaratne 1986; Karunasinghe & Wijeyaratne 1995). The objective of the present study was to investigate the influence of monsoonal currents, rainfall and lunar phase on the abundance of *A. sirm* in the coastal waters off Negombo, Sri Lanka.

Materials and Methods

The catch of *A. sirm* in the small meshed gillnets ranging in mesh size from 2.3 to 3.8 cm stretched mesh was sampled twice a month on randomly selected days at the fish landing sites at Negombo for a period of 3 years extending from September 1984 to August 1987. Negombo is one of the major fish landing centres on the west coast of Sri Lanka. On each sampling day, the total number of boats operating for this species and the catch of minimum of 25 boats were recorded. Thus the total catch of *A. sirm* for the day was estimated. The catch per unit effort was calculated in terms of catch (kg) per boat per day. The rainfall data for the study area were obtained from the Meteorological Department. The phase of the moon on the sampling day was also recorded.

The catch per unit effort (CPUE) values during the periods of different rainfall levels, monsoonal currents and lunar phases were subjected to analysis of variance and Scheffe's multiple contrast procedure (Zar 1974) to determine whether these environmental parameters have a significant effect on the seasonal abundance of *A. sirm* in the western coastal waters of Sri Lanka.

Results

The values for CPUE during the periods of different rainfall levels, lunar phases and monsoonal currents are summarised in Table 1. The results of the analysis of variance carried out using these data are given in Table 2. It was observed that the mean values for CPUE at different rainfall levels were not significantly different from each other at 5% level ($P > 0.05$). However, the CPUE values recorded during the period from April to November were found to be significantly higher than those recorded during other months ($P < 0.05$). It was also evident that the CPUE values recorded during the period of full moon were significantly higher than those recorded during the periods of quarter moon and new moon ($P < 0.05$).

Discussion

In most tropical fisheries, CPUE values of a given species is considered as a reflection of its abundance in the area concerned (Pauly 1984). However, CPUE values are proportional to the abundance only if fishing mortality is proportional to fishing effort

Table 1 Catch per unit effort of *A. sirm* during the periods of different rainfall levels, lunar phases and monsoonal currents from September 1984 to August 1987.

	Mean (kg boat^{-1})	Range (kg boat^{-1})	Standard Error	n
Rainfall				
0-99 mm	38.00	15- 76	1.01	14
100-199 mm	38.19	14-109	1.16	16
200-299 mm	43.33	27-59	1.44	6
>300 mm	38.20	15-92	1.49	10
Lunar Phase				
new moon	25.64	10-52	0.90	14
quater moon	34.48	7-66	0.53	61
full moon	61.17	16-109	1.84	12
Monsoonal currents				
south-west	47.12	19.5-109	0.88	30
north-east	33.32	4.5-109	0.80	30

Table 2. Results of the analysis of variance of catch per unit effort of *A. sirm* during the periods of different rainfall levels, lunar phases and monsoonal currents from September 1984 to August 1987.

Rainfall levels

Source	SS	df	MS	F	P
Group	141.87	3	47.29	0.12	>0.05
Error	16061.37	42	483.42		
Total	16203.24	45			

Phases of moon

Source	SS	df	MS	F	P
Group	9191.98	2	4595.99	9.64	<0.05
Error	40044.42	84	476.72		
Total	49236.40	86			

Monsoonal currents

Source	SS	df	MS	F	P
Group	2905.11	1	2905.11	6.09	<0.05
Error	27641	58	476.57		
Total	30546.25	59			

(Rothschild 1977). In the west coast of Sri Lanka, *A. sirm* is mainly caught with small meshed gillnets (Dayaratne 1988; Karunasinghe & Wijeyaratne 1991a). Therefore, the values for CPUE calculated using the crafts operating this gear could be considered as a reflection of the abundance of this species in the western coastal waters of Sri Lanka.

Around Sri Lanka, strong currents prevail as components of larger current systems such as Indian southwest monsoonal current, Indian northeast monsoonal current and the circulations in the Bay of Bengal (Anon. 1986). From April to September/October, a strong southwest monsoonal current which originates from the Persian Gulf region passes clockwise through the Arabian sea, west coast of Pakistan and India, turns towards the southern coast of Sri Lanka and moves towards east (Anon. 1986). This is an extension of the north east Somali current which is well known for its high nutrient content. It has been observed that in the northern hemisphere, due to coriolis effect, the west coasts of the continents are more productive than the east coasts (Pond & Pickard 1983). Hence, from April to September/October, the south west monsoonal currents may also bring nutrients from highly productive western coastal areas of India to the western coastal waters of Sri Lanka where this study was carried out.

Due to these factors, it is possible that from April to October/November, the nutrient content in the western coastal waters of Sri Lanka is relatively higher than from November/December to March. Due to high nutrient content, the productivity will increase resulting in an abundance of planktonic food organisms. Thus, the abundance of fish species such as *A. sirm* which feed on these planktonic food organisms may be higher in this region from April to November than in the other months. This may possibly be the reason for the higher values observed for CPUE during this period.

Although the rainfall does not appear to have a significant effect on the CPUE values of *A. sirm* in this region, for some diadromous fish species such as grey mullets, it has been recorded that higher catches are correlated with the rainy season mainly because the reproductive migrations of such species are influenced by rainfall (Wijeyaratne & Costa 1987). Since *A. sirm* is an oceanodromous species, factors such as water currents appear to have a more significant effect on the seasonal abundance than the rainfall.

The higher CPUE values recorded during the full moon periods may be due to several reasons. During the full moon periods, the activity of *A. sirm* may be higher probably due to more visibility of planktonic food organisms and therefore may get caught in the gear in larger numbers. In addition, it may also be possible that the full moon directly affects the activity pattern of the these individuals. However, more studies have to be carried out on this aspect.

Results thus show that the period from April to November is a better fishing season for *A. sirm* in the west coast of Sri Lanka and full moon period is better time for a higher catch. However, recent studies have shown that this stock is already overexploited (Karunasinghe & Wijeyaratne 1995). Therefore, intensification of fishing during these periods may impede the sustainable utilization of this fishery resource.

References

Anon. 1984.
Administrative Report. Ministry of Fisheries, Sri Lanka. 23 p.

Anon. 1986.
West Coast of India Pilot, 11th revised edition, United States Navy, Hydrographic Office. 285 p.

Dayaratne, P. 1984.
Fisheries biology of some pelagic fish species (Clupeiodes) from the West coast of Sri Lanka. Dr. Scient Thesis, University of Bergen, Norway.

Dayaratne, N.M.P.J. 1985.
Age and growth studies of some sardines (*Sardinella* spp.) by using the primary rings in otoliths. Proceedings of the 41st Annual Session of the Sri Lanka Association for the Advancement of Science (Abstract).

Dayaratne, P. 1988.
Gillnet selectivity for *Amblygaster (Sardinella) sirm*. Asian Fisheries Science, 2: 71-82.

Fernando, W.P.N. 1986.
Fishery and length based population studies of *Sardinella sirm* (Walbaum) from the Southern Coastal Waters of Sri Lanka. Proceedings of the 42nd Annual Sessions of Sri Lanka Association for the Advancement of Science (Abstract).

Fernando, W.P.N. & P. Dayaratne 1986.
Small pelagic fisheries in the west and south coasts of Sri Lanka. Proceedings of the 42nd Annual Sessions of the Sri Lanka Association for the Advancement of Science (Abstract).

Fischer, W. & G. Bianchi 1984.
FAO Species Identification Sheets for Fisheries Purposes. Western Indian Ocean (Fishing Area 51). FAO, Rome, 229 p.

Karunasinghe, W.P.N. & M. Fonseka 1985.
A preliminary analysis of small mesh gillnet fishery in inshore waters of Sri Lanka. Journal of the National Aquatic Resources Agency, Sri Lanka 32: 34-45.

Karunasinghe, W.P.N. & M.J.S. Wijeyaratne 1991a.
Selectivity estimates for *Amblygaster sirm* (Fam: Clupeidae) in the small meshed gillnet fishery in the west coast of Sri Lanka. Fisheries Research 10: 199-205.

Karunasinghe, W.P.N. & M.J.S. Wijeyaratne 1991b.
Population dynamics of trenched sardine *Amblygaster sirm* (Clupeidae) in the Western Coastal Waters of Sri Lanka. Asian Fisheries Science 4: 329-334.

Karunasinghe, W.P.N. & M.J.S. Wijeyaratne 1995.
On the exploitation of trenched sardine, *Amblygaster sirm* (Walbaum) in the west coast of Sri Lanka. Journal of the National Science Council of Sri Lanka 23(1): 1-7.

Pauly, D. 1984.
Fish Population Dynamics in Tropical Waters: A Manual for Use with Programmable Calculators. ICLARM, Manila, Philippines. 325p.

Pond, S. & L.G. Pickard 1983.
Introductory Dynamical Oceanography. Pergamon Press, Oxford. 329p.

Radhakrishnan, N. 1973.
Pelagic fisheries of Vizhinjam. Indian Journal of Fisheries 20: 584-597.

Rothschild, B.W. 1977.Fishing effort. In: Fish Population Dynamics (J.A. Gulland ed.). 95-115 pp. Wiley, London.

Siddeek, M.S.M., L. Joseph, P.M.A. Jayasuriya & W.P.N. Karunasinghe 1985.
A preliminary analysis of length frequency data of *Amblygaster sirm* from Negombo, Sri Lanka using ELEFAN programs. Journal of the National Aquatic Resources Agency, Sri Lanka 32: 46-56.

Wijeyaratne, M.J.S & H.H. Costa 1987.
Fishery, seasonal abundance and mortality of grey mullets (Pisces: Mugilidae) in Negombo Lagoon Sri Lanka. Journal of Applied Ichthyology 3: 115-118.

Zar, J.H. 1974.
Biostatistical Analysis. Prentice Hall Inc., Englewood, Cliffs, N.J., U.S.A.