BIOLOGY AND FISHERY OF WAM *MURAENESOX TALABONOIDES* (BLEEKER)

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ABSTRACT

Medium sized Wam, *Muraenesox talabonoides* (Bleeker) belonging to 110.5-130.5 cm size groups dominated the offshore catch, while size groups, smaller and larger than these mainly contributed to the inshore catch due probably to gear selection. Small sciaenids (dhoma) appear to be the favoured food item of offshore wam. High incidence of empty stomachs was recorded in offshore wam. Significant deviation of sex ratio occured in wam larger than 135 cm. The length at first maturity in female is 120 cm and in male 105 cm. Fecundity varied in specimens of different length and significantly in specimens of the same length. Peak of spawning appears to be in May, followed by a possible secondary spawning around September. Spawning ground of wam may extend from Bombay to Kutch. Wam landings formed an average 7.5 per cent of the trawler catch. Catch and catch rate were the highest in the third quarter of all the years.

INTRODUCTION

Muraenesox eels of the Bombay-Saurashtra waters are known as "Wam" the most abundant and economactlly important being *Muraenesox talabonoides* (Bleeker), which occurs in both inshore and offshore catches landed at Sassoon Dock, Bombay. Mohamed (1955), studied the marine eels of Bombay waters. Published reports on wam are a few, and are primarily concerned with systematics (Bal and Mohamed 1957), larval studies (Nair and Mohamed 1960), and a preliminary study on the biology and fishery of offshore wam (Kagwade 1969). Information on the inshore wam is totally lacking. The present paper deals with the data collected on wam, *Muraenesox talabonoides* both from inshore and offshore.

MATERIAL AND METHODS

A total of 1059 wam from trawler catches of the Exploratory Fisheries vessels of Government of India and Commercial vessels of the New India Fisheries Co. and 1333 wam from inshore, mainly caught by longline, and all of which landed at Sassoon Dock, Bombay in 1967-1971, were studied. Catch particulars of wam were taken from the Annual Reports of Central Marine Fisheries Research Institute, Cochin.

OBSERVATIONS

Length frequency

Total length of inshore and offshore wam varied from 45-215 and 65-205 cm respectively. In almost all months, there were more than two modal size-groups in the inshore wam (Fig. 1), whereas, there is only a single dominant size-group in offshore wam in all the months, except April, May and July when two modes, a major one at 120.5 cm and a minor one at 15.05 cm and 170.5 cm were present.

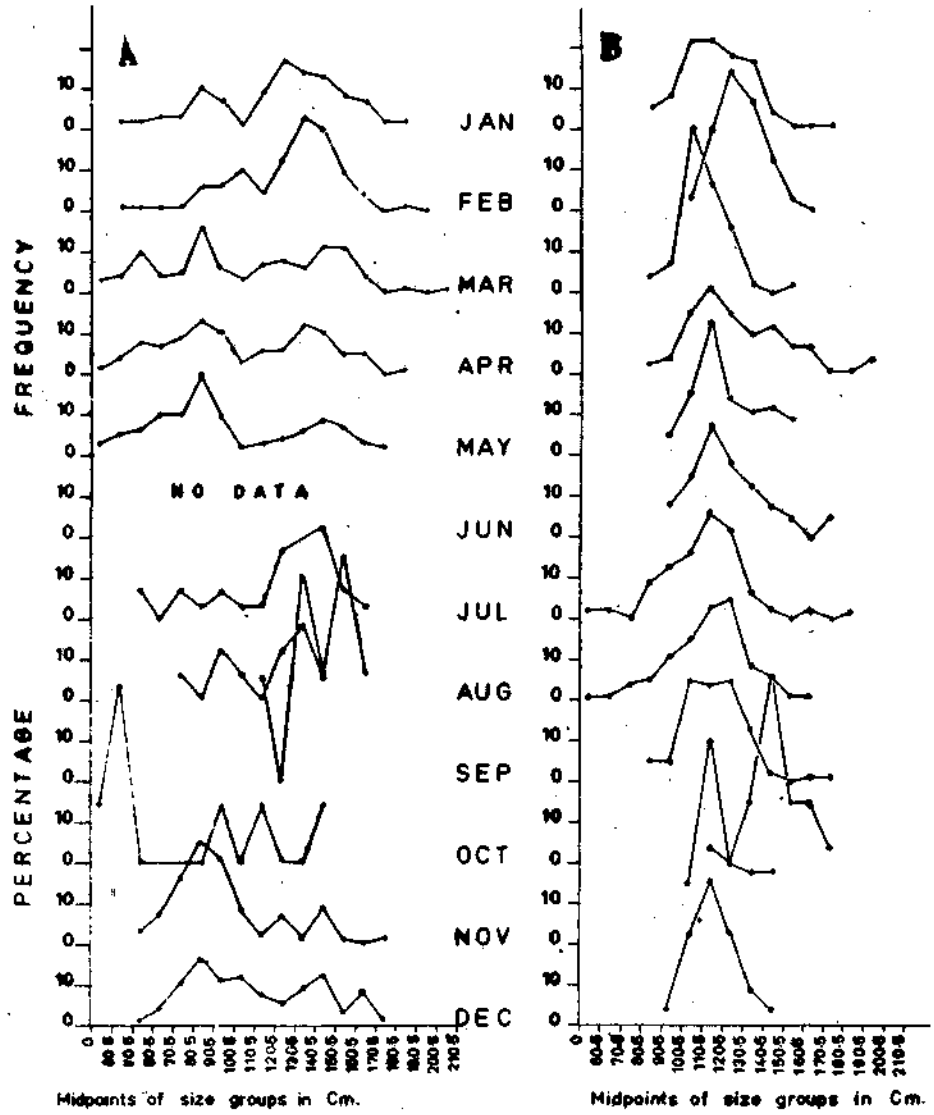

FIG. 1. Monthly length frequency of wam (Pooled data 1967-71).
A: Inshore; B: Offshore

Age and growth

Computation of age and growth in wam based on length-frequency method showed fluctuations in the monthly rate of growth and arrest of growth to such an extent that they did not fit the norms of growth in fishes. Probable reasons for the observed erratic growth rate in wam have been discussed elsewhere.

Food and feeding habits

Wam feed on fishes as well as crustaceans and cephalopods. However, small Sciaenids (dhoma) appear to be the most favoured food item. Out of 319 stomachs examined, 267 were empty. The food items with the number of stomachs (given in brackets) of offshore wams, in which the respective item is found are: Small sciaenids (23), *Coila dussumerie* (5), Bombay duck (3), *Trichiurs* Sp. (2) *Thrissocles* sp. (2), *Polydactylus* sp. (1) *Lactarius* (1), prawns (7), squilla (3), crab (2) and *Sepia* (2). It is interesting to note that about 85% of stomachs of offshore wam examined was devoid of any solid food items.

Sex ratio and size at first maturity

The size at which sexes of wam can be distinguished by detailed examination is 65 cm and they can be easily identified at about 100 cm. Table 1 indicates that the largest variation of male to female sex ratio occured in the month of May. In most of the other months except, October, November and December, the variation was comparatively little. Sex ratio in different size-groups, on the other hand, showed that there was a significant departure from

TABLE 1. *Month-wise sex-ratio of wam, data pooled for* 1967-1971.

	Number of Male	*Number of female*	*Sex-ratio*
January	59	118	1:2
February	38	108	1:3
March	16	19	1:1
April	26	44	1:2
May	8	73	1:9
June	8	19	1:2
July	14	27	1:2
August	31	33	1:1
September	22	22	1:1
October	2	8	1:4
November	5	23	1:5
December	8	33	1:4
Total	237	528	1:2

the expected 1:1 sex-ratio in size groups beyond 126-135 cm as excess females occured in these size groups, indicating probably differential mortality in older wam (Table 2).

TABLE 2. *Observed and expected (in parenthesis) number of male and female wam in different size groups.* (* Significant at 5%, ** Significant at 1%)

Size-group	*Female*	*Male*	*Total*	*Chi-square Total*
66-75	2(1)	0(1)	2	2.00
76-85	2(1)	0(1)	2	2.00
86-95	1(0.5)	0.(0.5)	1	1.00
96-105	5(4.5)	4(4.5)	9	0.12
106-115	16(15)	14(15)	30	0.14
116-125	39(38)	37(38)	76	0.06
126-135	61(55.5)	50(55.5)	111	1.10
136-145	83(69.5)	56(59.5)	139	5.24*
146-155	99(70)	41(70)	140	24.02**
156-165	88(54.5)	21(54.5)	109	41.2**
166-175	55(31.0)	7(31)	62	37.2**
176-185	28(15.5)	3(15.5)	31	20.2**
186-195	13(7)	1(7)	14	10.28**
196-205	10(5)	0(5)	10	10.00**
206-215	1(0.5)	0.(0.3)	1	1.00**
Total	503(368.5)	234(368.5)	737	99.8

Table 3 presents the percentage occurence of immature and maturing stages in different size groups of Wam. All the individuals examined below 106 cm were always in the immature stage. However, 31% of these individuals start maturing when they grow to 106-115 cm. As more than 51% of female wam in the size-groups 116-125 cm was in the maturing condition, the mid-point of which, namely 120.5 cm may be taken as the size at first maturity. Moreover, the smallest female in the running and spent condition measured only 120 and 119 cm respectively. On the other hand, males appear to mature at a smaller size, as oozing and spent males were recorded at a size as small as 105 cm.

Spawning season and the spawning ground

Table 4 gives monthly frequency occurence of female wam in three different gonadial conditions most relevant to the spawning season. The incidence of mature and running specimens from January to May indicates the spawning season of wam. The recording of the highest number of mature and

TABLE 3. *Frequency occurrence of immature and maturing stages in different size-groups of female wam (%).*

Size-groups in cm.	*Immature*	*Maturing*	*Total*
66-75	2(100)	0	2
76-85	2(100)	0	2
86-95	1(100)	0	1
96-105	5(100)	0	5
106-115	9(69)	4(31)	13
116-125	16(48.5)	17(51.5)	33
126-135	10(26.5)	28(73.6)	38
136-145	11(21.6)	40(78.4)	51
146-155	8(16.7)	40(83.3)	48
156-165	5(17.3)	24(82.7)	27
166-175	3(13.7)	19(86.3)	22
176-185	3(15.7)	16(84.3)	19
186-195	2(25.00)	6(75.00)	8
196-205	1(12.5)	7(87.5)	8

running specimens in May also suggests that the peak spawning occurs this month, and that it may continue to next month. In spite of the absence of running specimens from June to December, the presence of 34% of spent ovary in August-September indicates that spawning might have taken place again. Nevertheless, the spawning intensity faded out totally from October to December, as no mature, running, or spent specimens were observed in this period. The largest number of spawning females recorded in a single day was 9 and these specimens were caught by Akashumaru 23 and 25 from areas named A, E, K, L, M, R and Q which lie between the latitudes 21° and 23° and longitudes 67.5° and 70°, the regions covered being Porbunder, Dwarka and Kutch where the depth fished varied from 28to45 metres. Rest of the spawning females recorded came from areas extending south of Bombay to Porbunder.

Fecundity and ova-diameter studies

A comparative account of fecundity in wam as found out in the present and past studies is as below:

Total length (cm)	*Weight of gonad (g)*	*Maturity stage*	*Fecundity*	*Source of stage*
141	650	Mature	10,83,333	Present
127.5	170	Mature	1,47,900	Present
127	205	Mature	3,07,500	Present
175.8	—	—	16,65,752	Mohamed 1955
110	—	—	3,06,573	Kagwade 1969
169	—	—	9,22,033	"
126	—	—	6,39,203	"
126	—	—	3,63,228	"

TABLE 4. *Monthly frequency occurrence of mature, running and spent female wam during the period* 1967-1971.

Month	Jan.	Feb	Mar	Apr.	May	June	July	Aug	Sept	Oct.	Nov	Dec
females	118	108	19	44	73	19	27	33	22	8	24	33
mature	4	15	2	5	38	8	2	1	1	0	1	0
running	1	4	2	1	10	0	0	0	0	0	0	0
spent	0	3	0	3	7	1	3	4	5	0	0	0

The results show that fecundity varied considerably in wam of different and even the same length. Besides, fecundity also varies according to the weight of the ovary.

An apparently maturing ovary contained both immature and maturing ova, diameter of which varied from 0.09 to 1.12 mm. The maturing ova showed two distinct modes forming at 0.48 and 1.04 mm (Fig. 2A).

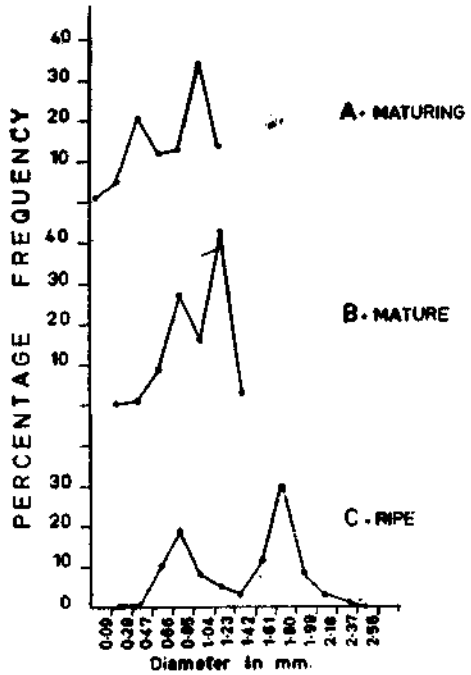

FIG. 2. Ova-diameter-frequency graphs of maturing, mature and ripe ovary of wam.

Similarly, mature and ripe ovaries also produced two distinct groups of eggs, the size of which varied from 0.28 to 2.37 mm. In the case of mature ovary, the two modes were formed at 0.85 and 1.23 mm whereas in the ripe ovary, the modes were shown at 0.85 and 1.8 mm (Fig. 2B & C). The largest ripe ovum, in fresh condition, measured 2.5 mm. The existence of two distinct ova-diameter modes in wam, therefore, may indicate, besides a well defined but short spawning, two spawning periods.

FISHERY

The size composition

A simple comparison of the percentage contribution of various size-groups of inshore and offshore wam presented in Table 5 reveals that the percentage contribution fo various size groups of wam in inshore catches gradually increased and reaches the highest in the group 90.5 cm and falls suddenly in 110.5 and 120.5 cm size groups, then slowly increasing to reach the second highest in 150.5 cm. This interesting order of change has been almost reversed in the case of offshore catch, namely, a sudden increase in the 110.5 and 120.5 cm size groups and gradual decrease in the next two size groups and a significant fall in 150.5 cm. However, the size group 140.5 cm appears to

TABLE 5. *Contribution of various size groups of inshore and offshore wam during* 67-71 (percentage in brackets).

Size group (cm)	*Inshore*	*Offshore*
40.5	14 (1.05)	0
50.5	37 (2.78)	0
60.5	58 (4.35)	4 (0.38)
70.5	64 (4.80)	4 (0.38)
80.5	89 (6.68)	7 (0.66)
90.5	176 (13.20)	38 (3.59)
100.5	122 (9.15)	74 (6.99)
110.5	61 (4.58)	181 (17.11)
120.5	74 (5.55)	260 (24.57)
130.5	127 (9.53)	222 (20.98)
140.5	159 (11.93)	132 (12.48)
150.5	170 (12.75)	76 (7.18)
160.5	96 (7.20)	30 (2.84)
170.5	58 (4.35)	18 (1.70)
180.5	13 (0.98)	7 (0.66)
190.5	12 (0.90)	2 (0.19)
200.5	2 (0.15)	4 (0.48)
210.5	1 (0.08)	0

have an equal contribution from both regions. Comparatively significant contribution of other size groups above 145 cm and below 96 cm from inshore catches suggests that immature and older wam preferably inhabit inshore waters. As the percentage contribution of 110.5 to 130.5 cm size groups of offshore wam form more than 62% in the catches, medium sized wam appears to dominate the offshore trawler catches.

The catch composition

Table 6 shows that, during 1967-1970, wam formed an average 7.5, 3.5 and 0.012 percent respectively of the trawler catches, the total eel landings, and the total marine fish landings of India. Although percentage contribution of wam showed improvement in 1969, the catch rate of wam fluctuated within the Government of India vessel's catches and that of New India Fisheries vessels and between the catches of these two groups of vessels (Table 7).

TABLE 6. *Percentage contribution of wam (inbrackets) in the trawler catches, in the eel catches and in the total marine fish landings (in metric tonnes) in India during* 1967-1970.

	Trawler catches	*Eel catches*	*Total marine fish landings*
1967	89.497 (6.05)	2534 (3.5)	849996 (0.010)
1968	124.036 (5.3)	3422 (3.6)	934611 (0.013)
1969	167.801 (9.4)	3052 (5.5)	913630 (0.018)
1970	76.151 (9.3)	4454 (1.7)	1075402 (0.007)
Average for 1967-70	114.3 (7.5)	3365.5 (3.57)	943409.7 (0.012)

Regional abundance and depth-wise distribution

As there was no regular exploratory fishing by the Government of India vessels, particularly during the monsoon season, regional abundance and depth-wise distribution of wam were found out from the catch particulars of New India Fisheries vessels, Akashumaru, 23 and 25, that too, only selected hauls of the vessels could be taken into account for the study, because majority of the hauls were realised from regions of overlapping nature. Table 8 gives an account of regional abundance and depth-wise distribution of wam. Cambay stood out as the most productive region of wam in term of total catch, highest catch and catch rate in a single haul and highest percentage contribution. The position of Veraval region is doubtful as it was represented by a single haul. Other regions to follow Cambay were Kutch, in all the respects mentioned above, Dwaraka, Porbunder, south of Bombay and Bombay in terms of highest catch rate in a single haul.

TABLE 7. *Total catch (catch rate) and percentage contribution of wam landed by Exploratory Fisheries Vessels, Government of India and New India Fisheries Trawlers in* 1967-1971, *Sassoon Dock, Bombay.*

	Govt. of India Vessels - catch (catch rate) in kg	*Percentage*	*New India Fisheries Trawlers-catch (catch rate) in kg*	*Percentage*
1967	2656 (1.58)	0.65	86841 (17.91)	8.13
1968	3490 (4.24)	1.04	120546 (16.60)	6.14
1969	72437 (38.44)	18.13	95364 (75.02)	6.94
1970	19069 (23.82)	13.16	57082 (41.65)	8.50
1971	9640 (61.59)	39.67	(data not available)	—
Total 1967-1971	107292 (25.93)	14.53	359833 (37.79)	7.42

Table 8 also reveals that the highest catch and catch rate realised in a single haul were recorded from Cambay region at a depth range of 60-78 meters in August, where as, a depth range of 32-41 meters at Kutch region produced second highest catch and catch rate in a single haul in May. It is also noticeable that the highest catch rate from other regions was realised from a depth range of 31-57 meters, although actual depth fished in various regions varied from 5-57 meters.

Seasonal abundance

Table 9 gives details of quarter-wise landings of wam in 1967-71. Although fluctuations in the catch and catch rate were indicated in each quarter of different years studied here, it is evident in the case of New India Fisheries vessels that total catch and catch rate of wam were higher in the third quarter of all the years. The seasonal abundance of wam indicated by Government of India vessels is not comparable as those vessels lacked regular operations in all the quarters. It appears that the availability of wam was poorest in the fourth quarter, and it gradually increased from the first quarter to produce the highest values in the third quarter. Moreover, the record of the highest catch rate in August, in the wam abundant region, namely, Cambay and other places (Table 8) also corroborates the above findings.

DISCUSSION

The apparent orderly differences reflected in the size composition of inshore and offshore wam (Table 5) viz. the gradual increase or decrease in the percentage contribution of certain size groups in one region could be accounted by its decrease or increase in the other region, may indicate migratory habit and habitat preferences of certain size groups of wam. Nevertheless,

TABLE 8. *Regional and depthwise abundance of wam as calculated from the catch data of New India Fisheries Co.,* 1967-70. $

	South of Bombay	*Bombay*	*Cambay*	*Veraval*	*Porbundar*	*Dwaraka*	*Kutch*
Total Catch* (Catch rate) in Kg.	1962 (1.6)	828 (2.3)	113940 (130.3)	8658 (225.8)	13824 (37.2)	12150 (79.5)	33264 (53.7)
Percentage	1.10	0.45	61.7	4.7	7.5	6.6	18
Highest catch in a single haul	1008	468	17118	8658	3582	4608	5976
Highest catch rate in a single haul	9.6	4.2	403	225.8	115.1	121.3	185
Depth range** fished in metres	—	14-57 (31-57)	27-28 (60-78)	35-47 (35-47)	5-56 (38-45)	29-56 (31-50)	22-55 (32-41)
Month operated***	—	Sept., Dec., Sept.	July August	August (August)	Jan, August (August)	Feb, May Sept., (May)	Jan., Feb, March, April, May, Sept. (Sept)
Number of hauls considered	14	5	14	1	9	4	15

$ The hauls considered here are only that could be distinguished as realised from areas not overlapped. Majority of hauls come from overlapping areas, particularly at Veraval region.

* Total catch here means total of those hauls that have been considered here for analysis as per $

** In perenthesis the depth at which highest catch rate obtained.

*** In perenthesis, the month during which the highest catch rate was obtained.

the dominance of medium sized wam in the offshore trawler catches and the significant contribution of young and larger wam in the inshore catches may also imply the role of gear selection in the observed differences in the size composition of wam from two different fishing grounds. The role of gear selection is further reflected when we consider the nature of fishing operations. The wam from inshore waters are caught by longline operated at about 20-30 meters and by bag net operated at about 15-40 meters (Kagwade 1969). Although the depth fished by offshore trawlers varied between 25-75 meters and 5-78 meters, as in the present study, it can be calculated from the table given by Kagwade (1969) that 65% of wam catches was realised from a depth range of 25-45 meters of Cambay, the most abundant region for wam. As the fishing operations of different gears are probably enacted in areas of overlapping nature, the division of the wam fishing ground into inshore and offshore may not be appropriate.

TABLE 9. *Quarter-wise catch and catch rate of wam in kg for the period* 1967-71

Govt. of India vessels.	January-March	April-June	July-September	October-December	Total
1967	642 (1,43)	1528 (4.17)	190 (0.93)	296 (0.55)	2656 (1.58)
1968	1190 (3.28)	2300 (5.39)	Vessels not operated		3490 (4.24)
1969	42320 (67.15)	26925 (31.16)	5 (0.18)	3187 (8.76)	72437 (38.44)
1970	8835 (27.13)	10234 (21.5)	Vessels not operated		19069 (23.82)
1971	9550 (73.18)	data not available	90 (3.46)	data not available	9640 (61.59)
Total (Average)	62537 (43.37)	40987 (15.55)	285 (1.52)	3483 (4.65)	10729 (20.18)
New India Fisheries Vessels.					
1967	210 (0.17)	21165 (18.53)	650052 (54.05)	414 (0.34)	86841 (17.91)
1968	4842 (2.24)	32688 (15.23)	77472 (136.90)	5544 (2.32)	120546 (16.6)
1969	22284 (47.00)	22284 (47.00)	50796 (157.22)	No operation	95364 75.02)
1970	10899 (33.53)	10899 (33.53)	17642 (49.00)	17642 (49.00)	67082 (41.65)
1971	Data not available				
Total (Average)	38235 (20.73)	87036 (28.57)	210962 (99.29)	23600 (17.22)	359833 (24.39)
Grand Total	100772 (28.81)	128023 (22.06)	211247 (66.38)	27083 (12.19)	467125 (31.20)

Probable reasons for the observed erratic growth rate in the total length-frequency analysis of wam are:

(1) Specimens of unnatural length caused by commonly occuring tail regeneration of wam (George 77, Ms.) were included in the length frequency data, (2) a true sample of the natural wam populations was not possible because of the selectivity of diffeerent gears used for catching them.

As small sciaenids (dhoma) are abundant in the offshore catch, they can naturally become an important food item of wam. Although the observation of large number of empty stomachs in offshore wam in the present study as well as in that of others (Mohamed 1955, Kagwade 1969) may be interpreted as a consequence of the process of disgorging the food items while the fish is being caught by trawlers, as in the case of ghol, *Pseudosciaena diacanthus* (Rao, 1963), other reasons, such as, the nocturnal feeding behaviour of wam (DeWitt 1967), also should be taken into consideration. As the stomachs examined in all the above cases could be from wam caught by trawlers during the day time, the chances of observing empty stomachs are high, whereas the reason for finding food items in all the wam caught by the

longline (Mohamed 1955) lies in the fact that this gear is operated mostly during night. Nevertheless, the available data imply the piscivorous habit of adult wam. But juveniles appear to prefer to feed on crustaceans (Mohamed 1955).

The significant variation in the sex ratio in certain size groups of wam showed in the present study implies differential mortality in older wam (Table 2). As information on the differential mortality in sexes is of fundamental importance in population estimate and stock assessment (Ricker 1958 and Gulland 1969), the findings should be worth while. The causes of selective mortality in sexes would be too complex to be analysed.

The size at first maturity of female wam, 120 cm indicated in the present study agrees with that of Mohamed (1955) and Kagwade (1969). The present investigation shows that spawning season of wam may be more extensive than that reported before by Kagwade (1969). Although wam appears to spawn from south of Bombay to Kutch, more data are required to find out whether there exists a major spawning ground.

The present ova-diameter studies substantiate the findings of Mohamed (1955) and Kagwade (1969) that ripe ova are separated from the general egg stocks indicating a well defined but short spawning period. However, individuals may spawn at different time. The presence of two modes in an ovary may hold potential for two spawning in a season (Hickling and Rutenberg 1936, Clark 1934 and Prabhu 1956). The occurence of two ova-diameter modes, the presence of considerable number of mature and spawning female wam in May, and the record of about 20% spent female in September also suggests that wam spawns twice yearly. Although natural variations in fecundity can occur in specimens of different length, considerable variation in two specimens of the same length, as observed in the present study as well as that of Kagwade (1969) would indicate, as suggested by Kagwade (1969), that the specimen with half the number of eggs must have already shed its first batch of eggs and the eggs remained were to be spawned later.

Although a detailed analysis of catch data for many years naturally should produce precise and valuable information on the present status of the fishery in question, the results obtained here, as Jayaraman et al (1959) rightly pointed out, may not project a true picture of the fishery. Because, the data analysed are, partly, or sometimes wholly, influenced by the pure commercial ventures or by the irregular explorotory nature of the fishing operations. However, available data confirm the findings of Jayaraman et al (1959), Rao et al (1966) Kagwade (1969) and Nair (1974) that Cambay region is the best for wam fishery. The highest seasonal abundance of wam in the third quarter was also reported by Kagwade (1969). Nair (1974), on the contrary, reported lowest seasonal abundance of wam in the third quarter. It is evident from the table 3 of Nair (1974) that fishing operations of exploratory vessels were

almost nil in the third quarter, and hence the result is not comparable. Although the highest catch and catch rate of wam were realised from a depth range of 60-78 m of Cambay region, the non-exploration of other regions beyond 60 meters does not permit one to evaluate the depth-wise distribution of wam in other regions. Further detailed studies, on comparable terms, should provide more rewarding information on all these aspects.

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