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REPRODUCTIVE CYCLES IN TWO GEOGRAPHICALLY SEPARATED POPULATIONS OF THE OYSTER *Saccostrea cucullata* FROM SINDHUDURG DISTRICT, MAHARASHTRA STATE, INDIA

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Abstract:

Two geographically separated localities at Deogad (160 23' N ; 730 23' E) and Achra (160 15' N; 780 26' E) in Sindhudurg district of Maharashtra State ,India were selected on the basis of the differences in habitat , topography ,vegetation and local market value to study the reproductive cycles of the oyster Saccostrea cucullata. The maximum sizes attained by S. cucullata in the estuaries at Deogad and Achra were 44-45 mm shell length. However, comparatively larger sized oysters are found round the year in the estuary at Deogad than at Achra.

The environmental parameters such as tidal heights, pH, temperature, dissolved oxygen and salinity existing on the oyster beds in Deogad and Achra were recorded on every new-moon and full-moon days for a period of twelve months.

The microscopic details of the gonad tissue processed on every new moon (NM) and full moon (FM) days of each month revealed following stages ; (i) Gametogenesis ; (ii) Maturing ; (iii) Mature; (iv) Partial spawning ; (v) Complete spawning ; (vi) Recovery ;(vii) Neutral . The gonads of twenty oysters were staged for males and females separately on each NM and FM days and percentage of the males and females in these different stages were calculated.

The study on reproductive cycle in male oysters of S. cucullata from Deogad showed that many oysters were in gametogenesis stage in entire June and once again on November NM. Maturing stage was seen on March NM, May FM, July NM and again on November FM and in entire December. Many oysters were in mature stage on March FM, April FM and July FM and again on January NM. Most of oysters were under spent stage on March FM, in entire August and September, and on January FM. Many oysters were under recovery stage on May NM and in entire October. Most of the samples collected in entire February and on April NM showed prominent neutral stage. The female oysters showed that the gametogenesis was dominant on March NM, in entire June and on November NM; maximum on NM of March and on November. The maturing stage was dominant in entire April and May and on July NM and December NM. Oysters under spent condition were dominant on April NM and December FM, and all the gametes were released in entire August, September and on October NM. The recovery stage was recorded in many oysters on October FM and January FM, while the neutral stage was recorded in entire February.

The male oysters from Achra showed gametogenesis stage on March NM, April FM and June NM. The maturing stage was seen in most oysters on April FM, June FM, July NM, September NM and FM. The mature stage was very conspicuous on July FM and November NM. Most oysters were in the spent stage on May FM , August NM ,October NM and December FM. Oysters under recovery stage were in high percentage on December NM , January NM and February FM. The neutral condition was most prominent in many oysters on March NM and January FM. The female oysters at Achra showed that many oysters under the gametogenesis appeared on April NM, June NM and December FM. The maturing condition in oysters was dominant on April FM, June FM, August FM, entire September and on February NM. Many oysters in mature stage occurred on October NM and November NM. The spent stage in oysters was dominant on December NM, In entire May and on July FM. The recovery stage was recorded in December NM, while the neutral stage in oysters was dominant on January FM and March NM. These different stages of the gonads have been correlated with the changes in environmental conditions over the oyster beds from the two localities. The results are discussed in the light of possible impact of the environment on reproductive events.

Keywords: S. cucullata, Deogad, Achra, FM, NM, gametogenesis.

Introduction:

Along the west coast of India the backwaters and estuaries are very extensive and play an important role for food production. These are widely scattered and have an area of 30.7 lakhs acres (Mitra, 1970) from which Maharashtra coast constitutes 3.0 lakhs acres

combining together 2.0 lakh acres for brackish water and 1.0 lakhs acre for estuaries. These backwater and estuaries are very productive along the coast and are being used for various purposes. They are the breeding grounds of various species of marine and estuarine communities (Dwivedi, 1973).An extensive literature have been reviewed by Sastry (1979), Nagabhushanam and Mane (1991) and Mane (1997) on the oysters from different geographical locations.

Two geographically separated localities at Deogad (16^0 23' N ; 73^0 23' E) and Achra (16^0 15' N; 78^0 26' E) in Sindhudurg district of Maharashtra State ,India (**Fig.1**) were selected on the basis of the differences in habitat, topography ,vegetation and local market value to study the reproductive cycles of the oyster *Saccostrea cucullata*. The maximum sizes attained by *S. cucullata* (**Fig.2**) in the estuaries at Deogad and Achra were 44-45 mm shell length. However, comparatively larger sized oysters are found round the year in the estuary at Deogad than at Achra. The estuary at Achra is comparatively deeper than at Deogad but the estuary at Deogad is wider than at Achra.

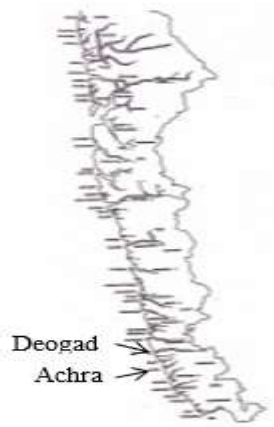


Fig. 1: Map showing the coast of Maharashtra state


Fig. 2: Shells of *Saccostrea cucullata*

The topography of the oyster beds on the rocks in these two localities in mixed soil of mud and sand. In Deogad mangrove vegetation exits near the oyster bed and at Achra it is away from the oyster bed. The oyster beds in the intertidal zone in Deogad get exposed to atmospheric air from comparatively a longer period than those at Achra, where it is situated in the subtidal zone. The oyster bed in Achra gets exposed to atmospheric air during in neap tides. Both the estuaries are free from water pollution and no mechanical fishing operation occurs. The water is fairly clean on the oyster beds. The environmental parameters such as tidal heights, pH, temperature, dissolved oxygen and salinity existing on the oyster beds in Deogad and Achra were recorded on every new-moon and full-moon days for a period of twelve months.

Materials And Methods:

Environmental parameters: Temperature, salinity, dissolved oxygen and pH on the oyster habitats at Deogad and Achra were recorded on full-moon and new-moon days. The samples of sea water were drawn just before the collection of these oysters and analysed immediately. Samples were collected for determination of dissolved oxygen in 250 ml DO bottles and oxygen was fixed by adding alkali iodide for further analysis by Wrinkler's method, azide modification. The temperature of sea water was recorded with the help of standard centigrade thermometer ^{0}C.pH was recorded with the help of standard BDH pH paper strips. Salinity was measured according to the method given by Parson *et al*. (1984). The replicates of these determinations on each fortnight were used in calculation. The height of the tide was recorded from chartdatum.

Changes in the gonads: *Saccostrea cucullata* (44-45 mm shell length) were collected from the fixed localities at Deogad and Achra in Sindhudurg district. Twenty oysters were collected on low tide of every new-moon and full-moon days for a period of twelve months. The oysters were brought to the laboratory and shucked for the flesh .The gonad was dissected and fixed in Bouin's Hollande preservatives prepared in sea water for further paraffin preparations for histological study. The paraffin blocks were cut at 7 □m thickness and stained with Mallory's triple. The observations were made under VT-20 Labo Video Scan microscope on television and whenever necessary photomicrographs were taken after measurements of the gonad contents.

Results:

The environmental parameters such as tidal heights, pH, temperature, dissolved oxygen and salinity existing on the oyster beds in Deogad and Achra were recorded on every new-moon and full-moon days for a period of twelve months (Figs. 3 and 4).

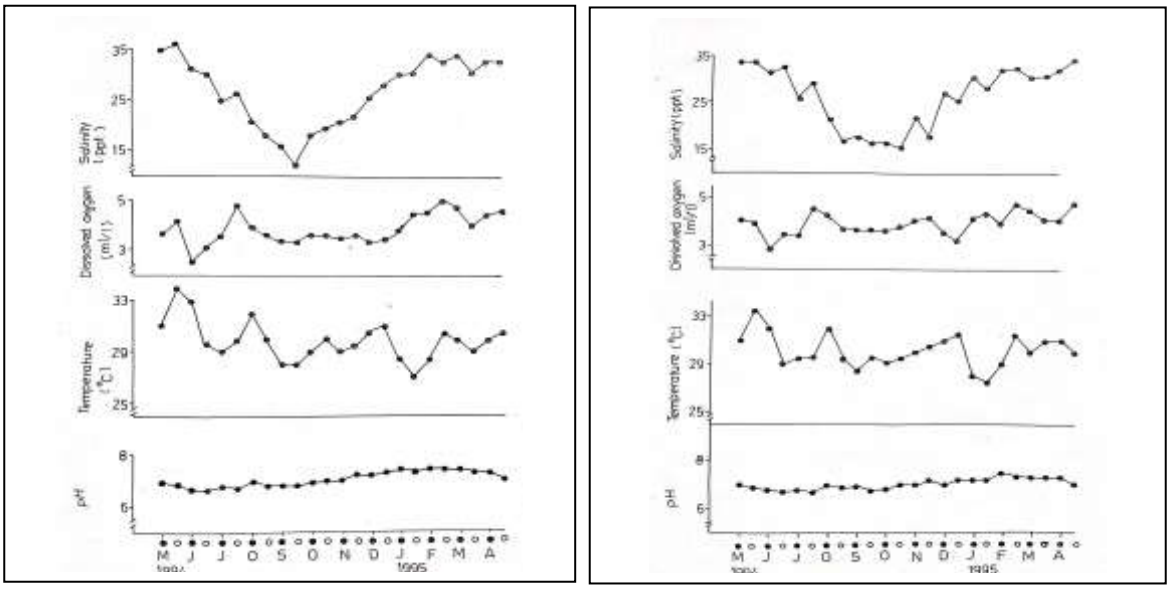


Fig. 3 and 4: Fortnight variations in the physicochemical parameters from the habitat of S.cucullata in the estuary of Deogad and Achra

The tidal heights differed in these two localities. Generally, the new-moon tidal heights were comparatively higher than the successive full-moon tides in both the estuaries during May to October and vice-versa in the remaining period. The pH of sea water for the oyster bed is from 6.7 to 7.5. Generally, the maximum pH values were recorded in summer season, whereas minimum pH values were recorded in monsoon in both localities. Fortnight variations in temperature showed almost similar patterns in both the localities, i.e. from 27.0 ^{0}C to 34.0 ^{0}C. The minimum temperature was recorded in June, whereas maximum was observed in May in both localities. The second peak of high temperature was recorded in December at both the localities. The fortnight variations in the dissolved oxygen content of sea water in the estuaries at Deogad and Achra also showed a similar pattern, at Deogad it was ranged from 2.53 to 5.07 ml/l and at Achra it was ranged between 2.81 and 4.79 ml/l. The salinity showed comparatively similar trend of variations, in Deogad it ranged between 12.84 and 35.91 ppt, while in Achra the values ranged from 15.40 to 34.63 ppt. The maximum salinity values coincided with summer season, while minimum values coincided with monsoon and influx of freshwater. The influx of freshwater in the estuary at Deogad is more than at Achra.

The oyster density is high in Deogad than at Achra in all the season (Figs. 5 and 6). The maximum density in both the estuaries was in May and minimum in January at Deogad and in August at Achra. The oyster in Deogad showed population density 98$\pm$17.14 individuals /m^2 in May. In August it was 81$\pm$19.60 individuals/m^2.In October it was 81$\pm$ 16.32 indiduals/m^2 and in January 70$\pm$13.88 individuals/m^2. In the estuary at Achra the population density of oyster was observed 62 $\pm$ 8.98 individuals/m^2 in May, i.e. in the summer season, whereas in August, i.e. the monsoon, it was 46 $\pm$ 13.88 individuals/m^2. In October, i.e. the post-monsoon season, it was recorded 52 $\pm$ 7.34 individuals/m^2 and 48 $\pm$8.98 individuals/m^2 in January, i.e. in winter season.

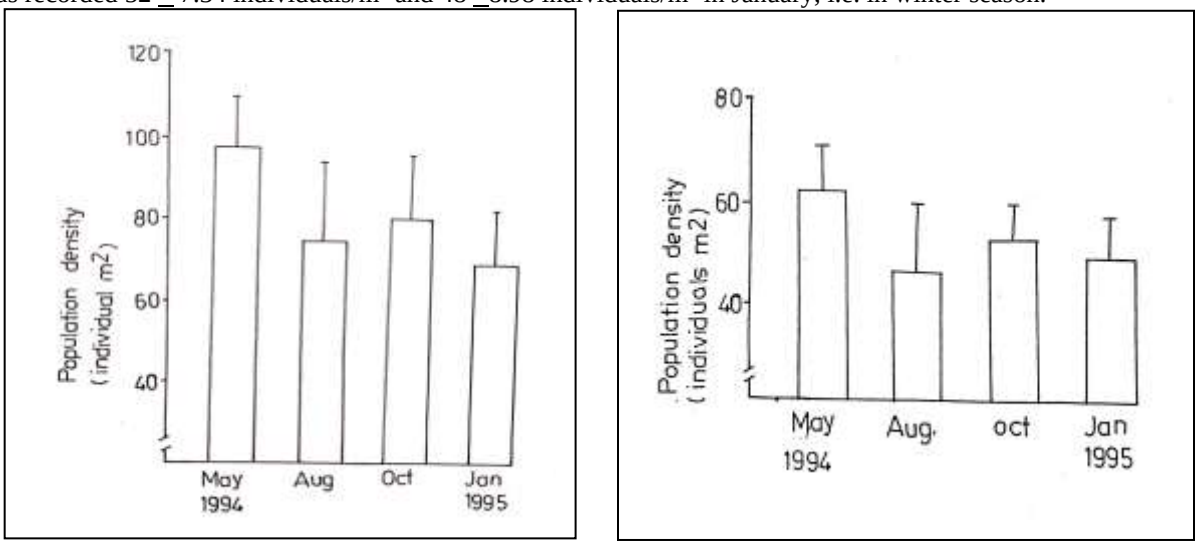
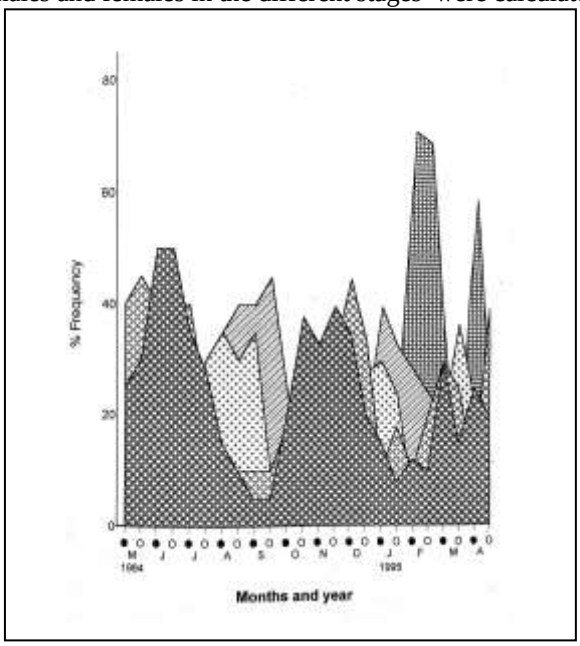


Fig. 5 and 6: Seasonal variations in the population density of *S. cucullata* from the estuary at Deogad and Achra. [Bar represents ± S.D.]

The gonads of twenty oysters were staged for males and females separately on each NM and FM days and percentage of the males and females in the different stages were calculated . The results are shown in **Figs. 7** to **10**.



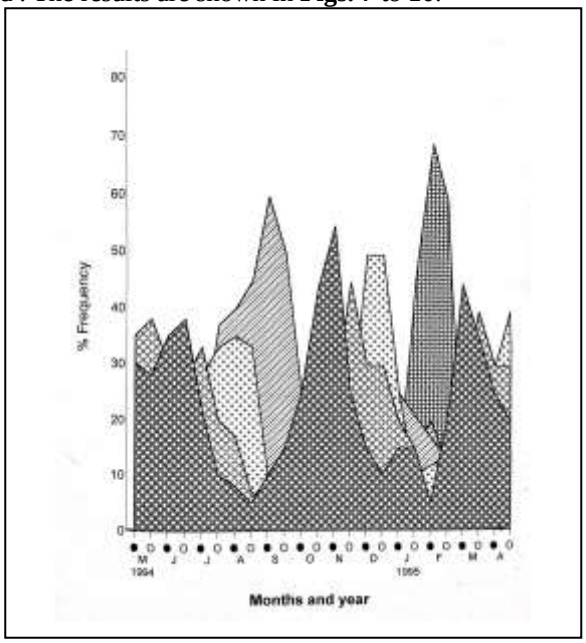
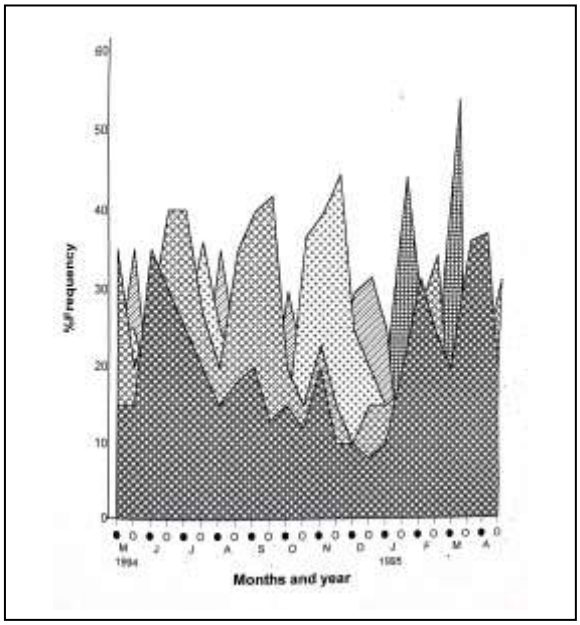


Fig. 7 and 8: Frequency polygon of male and female gonad of S. cucullata from the estuary at Deogad



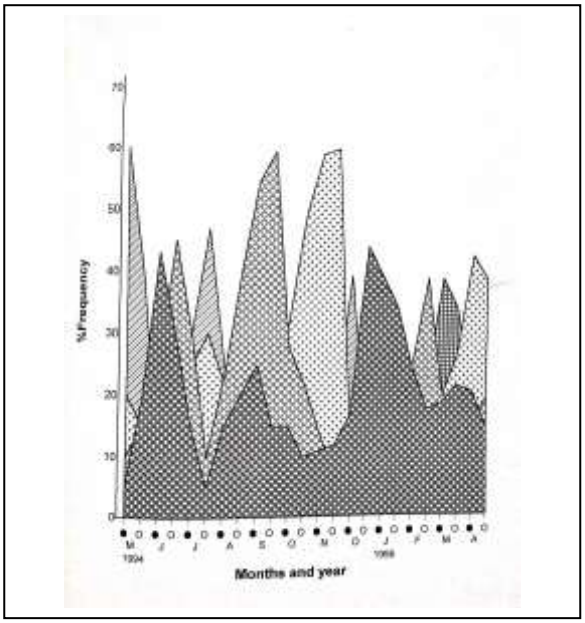
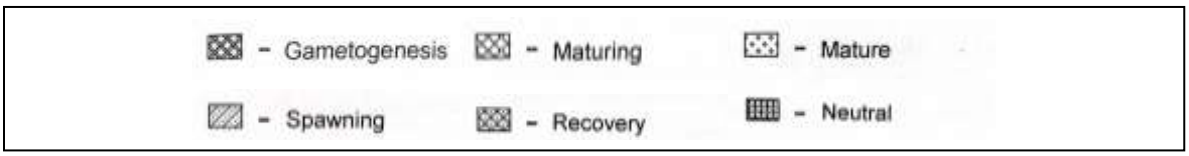


Fig. 9 and 10: Frequency polygon of male and female gonad of S. cucullata from the estuary at Achra



The microscopic details of the gonad tissue processed on every NM and FM days of each month revealed following stages ; (i) Gametogenesis ; (ii) Maturing ; (iii) Mature; (iv) Partial spawning ; (v) Complete spawning ; (vi) Recovery ;(vii) Neutral (**Figs.11** and **12**).

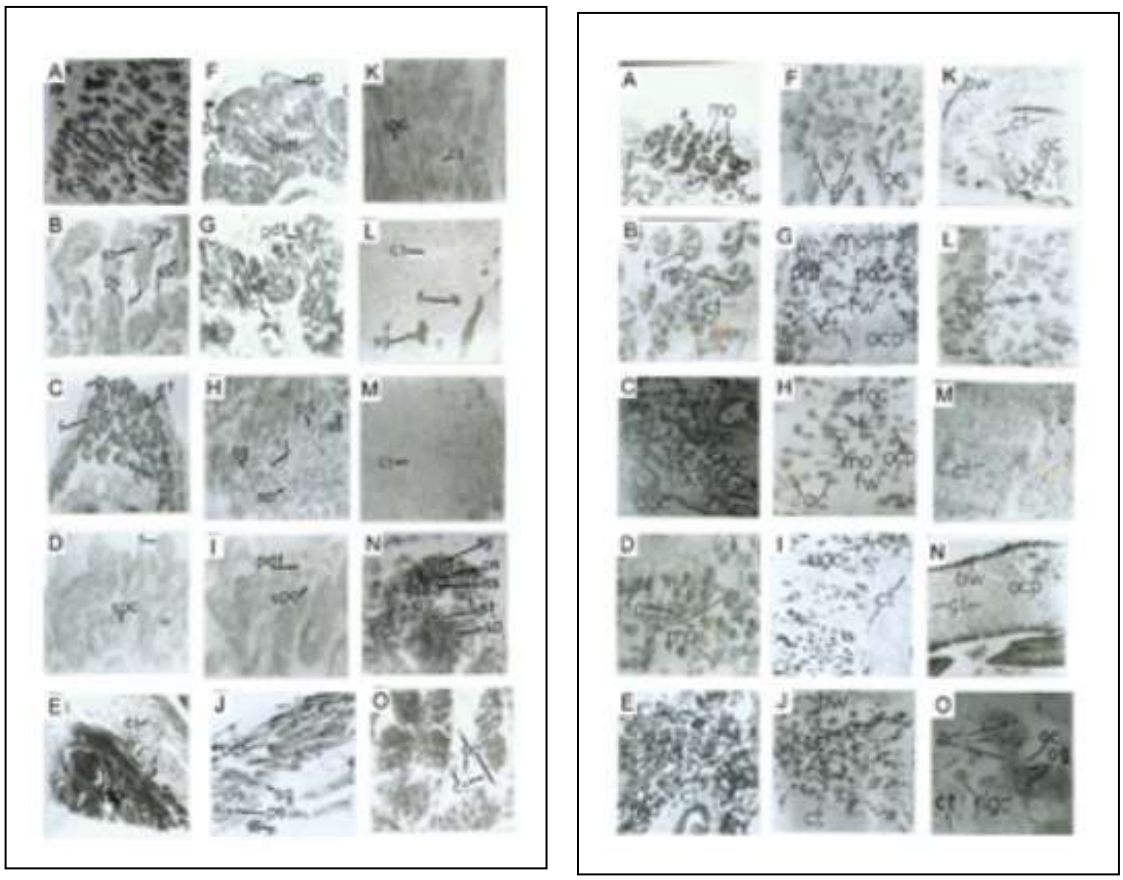


Fig. 11 and 12: Showing sections of gonad of male and female *Saccostrea cucullata* from the estuaries of Deogad and Achra

The study on reproductive cycle in male oysters of *S. cucullata* from Deogad showed that many oysters were in gametogenesis stage in entire June and once again on November NM. Maturing stage was seen on March NM, May FM, July NM and again on November FM and in entire December. Many oysters were in mature stage on March FM, April FM and July FM and again on January NM. Most of oysters were under spent stage on March FM, in entire August and September, and on January FM. Many oysters were under recovery stage on May NM and in entire October. Most of the samples collected in entire February and on April NM showed prominent neutral stage. The female oysters showed that the gametogenesis was dominant on March NM, in entire June and on November NM; maximum on NM of March and on November. The maturing stage was dominant in entire April and May and on July NM and December NM. Oysters under spent condition were dominant on April NM and December FM, and all the gametes were released in entire August, September and on October NM. The recovery stage was recorded in many oysters on October FM and January FM, while the neutral stage was recorded in entire February.

The male oysters from Achra showed gametogenesis stage on March NM, April FM and June NM. The maturing stage was seen in most oysters on April FM, June FM, July NM, September NM and FM. The mature stage was very conspicuous on July FM and November NM. Most oysters were in the spent stage on May FM , August NM ,October NM and December FM. Oysters under recovery stage were in high percentage on December NM , January NM and February FM. The neutral condition was most prominent in many oysters on March NM and January FM. The female oysters at Achra showed that many oysters under the gametogenesis appeared on April NM, June NM and December FM. The maturing condition in oysters was dominant on April FM, June FM, August FM, entire September and on February NM. Many oysters in mature stage occurred on October NM and November NM. The spent stage in oysters was dominant on December NM, in entire May and on July FM. The recovery stage was recorded in December NM, while the neutral stage in oysters was dominant on January FM and March NM.

Discussion:

In the present study it was observed that the gametogenesis in *S. cucullata* from Deogad was at peak in both the sexes with lowering of salinity to 30.75 ppt and temperature to 33^0C in June NM before commencement of monsoon and for the second time in October FM at the time of rise in salinity to 19.25 ppt and temperature to 30^0C and for the third time in March NM at the time of rise in salinity to 34.63 ppt and temperature of 30^0C. Many females on October FM and March NM and many males on June NM showed dominant gametogenic stage compared to those females occurred in sampels during pre-monsoon and males during post-monsoon. On the other hand, the gametogensis stage in *S.cucullata* from Achra was at peak in both the sexes with lowering of salinity to 30.75 ppt and the temperature to 32^0C in June NM before commencement of monsoon and again for the

second time in monsoon in August FM further lowering of salinity 21.81ppt and rise in temperature to 32^0C, for the third time in female oysters gametogenesis commenced in December FM at 25.66 ppt and rise in temperature to 31.5^0C. However, in male oysters gametogenesis occurred at peak for the second time in November NM with lowering of salinity to 21.81 ppt and temperature to 30^0C, for the third time in January FM with lowering of salinity to 28.22 ppt and temperature to 27.5^0C and for the fourth in March FM with lowering of salinity to 30.75 ppt and rise temperature to 31^0C. Many females on June NM and December FM and many males on June NM and March FM showed dominant gametogenic stage compared to those females occurred in samples during peak monsoon and those males occurred in samples during post-monsoon and winter.

The maturaing stage in *S.cucullata* from Deogad was at peak in females with lowering of salinity to 24.37 ppt and temperature to 29^0C in July NM, while in male in October FM with rise in salinity to 17.97 ppt and temperature to 29^0C and again for the second time in November FM in female oysters with rise in salinity to 21.81ppt and temperature to 29.5^0C, while in male oysters in December NM with rise in salinity to 25.66 ppt and tempeature to 30.5^0C, for the third time in female oysters in March FM with lowering of salinity to 32.06 ppt and temperature to 29^0C, while in male oysters in March NM with a rise in salinity to 34.63 ppt and lowering of temperature to 30^0C, and for the fourth time in male oysters in April FM with rise in salinity to 34.63 ppt and temperature to 30^0C. Many females on November FM and March and many males on December NM and April FM showed dominant maturing stage compared to those females occurred in peak monsoon and males during post -monsoon and early summer. On the other hand, the maturing stage in *S. cucullata* from Achra was at peak in both the sexes with a rise in salinity to 32.06 ppt and lowering of temperature to 29^0C in June FM. Again for the second time many maturing gonads were seen in monsoon, on August FM with further lowering of salinity to 16.69 ppt and temperature to 29.5^0C and for the third time this stage once again appeared with lowering of salinity to 16.69 ppt and rise in temperature to 29.5^0C in September FM. For the fourth time this stage dominated in oysters with rise in salinity to 33.35 ppt and temperature to 29^0C in February FM and for the fifth time in April FM at the time of rise in salinity to 33.35 ppt and lowering of temperature to 30.5^0C. Many females on June FM, August FM, September FM, February NM showed maturing gonad stage than those oysters collected in summer. Many males, on the other hand, on June FM and September FM, i.e. in monsoon showed dominant maturing stage compared to those occurred in samples later part of the year.

The mature stage in female *S.cucullata* from Deogad was at peak in June NM with lowering of salinity to 30.75 ppt and temperature 33^0C, while in male oysters the peak was in July FM with the lowering in salinity to 25.06 ppt and temperature to 29.9^0C, for the second time in female oysters the peak in this stage was in August NM which coincides with lowering in salinity to 20.53 ppt and rise in temperature to 32.6^0C, while in males in November FM with rise in salinity 21.84 ppt and rise in temperature to 29.5^0C, for the third time many female oysters in this stage December NM with the rise in salinity to 25.66 ppt and temperature to 30.5^0C. In male third peak observed in March FM with the slight lowering in salinity to 32.06 ppt and temperature 29^0C, and in male oysters fourth peak in mature gonad was observed in May NM with rise in salinity to 34.63 ppt and temperature to 31^0C . Many females on December NM and many males on March FM and May NM showed dominant mature stage to those females occurred in samples in peak monsoon and summer those males found in peak monsoon and early winter. On the other hand, the mature stage in both males and females *S. cucullata* from Achra was at peak on July FM with slight increase in salinity to 28.22 ppt and temperature to 29.6^0C and on October FM with lowering of salinity to 16.69 ppt and temperature to 29^0C and for the second time in females on April NM at the time of rise in salinity to 32.06 ppt and temperature to 31^0C. Many females on October FM and April NM and many males on July FM and October FM showed dominant mature stage compared to those females occurred in samples in monsoon and winter and those males occurred in winter and summer.

In the present study on *S.cucullata* from two different geographical locations viz. Deogad and Achra on the coast of Sindhudurg district it was observed that the spawning period as determined on the basis of occurrence of spent gonads of oysters was extended and differed during post-monsoon. There were differences in spawning of females and males in these estuaries. The spent stage on both the sexes of oysters from Deogad commenced from June FM and the percentage of oysters in this stage increased till September FM and later decreased. Once again a part of the population in this stage occurred on January NM and March FM. Extended period in the male oysters in this stage was seen than in females. Many males spawned than females in winter season and many females spawned in monsoon and beginning of post-monsoon than males .A small population of female oysters spawned in May but no male appeared in this stage during this period. The spawning period in both the sexes from July NM to October NM coincided with low salinity range 16.69 to 25.61 ppt and lowering of temperature to 28.5-29.5 ^{0}C. On the other hand , the spent condition in female oysters from Achra was found from October to February and again from April to August while , in male this period was from March to December. The spent gonads of males occurred for a longer period than females, the salinity ranged from 15.4 to 33.35 ppt and temperature between 27.5 and 21.5^0C during October to February and from April to August the salinity ranged from 16.69 to 33.35 ppt and temperature between 29 and 33.5^0C. Female and male oysters in spent conditions occurred almost round the year. It was found that at the estuaries of Deogad and Achra, *S.cucullata* spawned due to the drop in salinity, in the monsoon season. During July to October the salinity of the estuary at Deogad was 22.66 ppt but lowered to 19.25 ppt during the peak of spawning, while in the estuary at Achra during the peak of spawning in July the salinity was 22.55 ppt and it lowered 12.8 ppt in August. At Deogad for the second time peak of spawning was observed during December and January during which the salinity increased from 28.22 to 30.75 ppt and at Achra for the second time peak of spawning was observed in December during which the salinity was 22.66 ppt. The temperature at Deogad on oyster bed varied before 27 to 32^0C and at Achra on oyster bed it was from 29 to 33 ^{0}C.

The recovery stage in female oysters from Deogad occurred from September NM to March FM, while in males this stage was seen June NM, on August NM from September FM to November NM, on January NM, on March FM and April NM. The recovery stage was extended in females than males, wherein it was interrupted. The recovery stage in female oysters from Achra occurred from July FM to August FM, November FM to February FM and May NM to June NM , while in males it was seen from June NM to July NM and September FM to January FM. In males there was extended of this stage from post-monsoon to middle winter.

The neutral stages in female oysters from Deogad was observed August FM to November NM, December FM to March NM and in entire April, the peak was observed in entire February. This stage was observed in male from August FM to November NM, from January FM to February FM, and from March FM to April FM. Many oysters from both the localities were in this stage in February and males in April also. On the other hand , this stage in female oysters from Achra was noticed from December NM to April FM, the peak was recorded in March ,while in male oysters the neutral stage was found in August NM to May FM ,and many oysters were in this stage were found in January FM and again on March NM . The number of oysters under neutral condition was more from winter to mid-summer which exceeded the number of oysters under recovery stage.

The intrafollicular tissue in resorption of residual gametes was noticed in present study on *S. cucullata*. Large number of amoebocytes were observed around the follicles in certain periods of reproductive cycle, especially during post spawning periods. Extensive studies were carried out b Takatsuki (1934) on O. edulis and Tranter (1958a) on the amoebocytes in the former report and the phagocytes in the latter. Various types of amoebocytes and their role in gonad verginion in *S.cucullata* have been described by Yennawar (1997). In the present study, it was found that generally the amoebocytes of type A(as shown by Yennwar,1997) were in the size range 0.223 to 0.39 μm in their largest area in oysters from Deogad, while those in the oysters from Achra were in the largest size range of 0.223 to 0.376 μm. Much variation in the size range was observed in the gonads of oysters from Deogad than Achra, the largest sized amoebocytes in oysters from Deogad were 0.974 μm, while those from Achra reached 0.557 μm. The largest sized amoebocytes were found in the gonads of oysters form Deogad on February NM and FM at the time many neutral oysters appeared in the samples and some female oysters showed recovering of the gonad. Appearance of large sized amoebocytes was again observed on October NM during which time the spawning in females and males was terminated and few oysters were in the recovery and neutral stages. On the other hand, the amoebocytes occurred frequently in the gonad at various stages of spawning, recovery and neutral during different seasons. The maximum sized amoebocytes occurred in July FM during which time many female oysters were spent and few were under recovery, while a few males were spent. From April FM to September NM and from January NM to February NM generally large sized amoebocytes appeared when compared to those found during rest of the period. During April to September there were frequent appearance of gonads of males and females, either under recovery or neutral and spent gonads occurred throughout this period. Again for the second time these large sized amoebocytes appeared when the gonads of many oysters were neutral and both spent and recovering gonads of oysters also occurred. However, it is probable that because of this redevelopment of gametes the number of oysters in gametogenic and maturing stages occurred round the year. Fully mature gametes were produced by large number of individuals only during certain period of the seasons, probably revealing that oysters could have spawned almost round the year with peaks differing in the estuaries at Deogad and Achra. Many oysters after partial release of gametes showed redevelopment of fresh gametes and only a small population showed recovering of gonad, the unspawned gametes were lysed.

In the present study it has been noted that *S.cucullata* in the estuary at Deogad gets exposed to atmospheric air during each low tide due to its intertidal habitat. This makes the oysters to feed only during the high tides. On the other hand, the oysters from Achra remain submerged during the low tide; however they get exposed to atmospheric air only during the neaptide. It is most possible that these oysters get more chance to feed when compared with those from the estuary at Deogad. These differences in habitat are likely to create differences in the nutrient supply for the gonad development and maturation. It was further noticed that mangrove vegetation persists near the oyster bed in the estuary at Deogad but in the estuary at Achra such vegetation persists away from the oyster bed. It is likely that this vegetation can create impact on the nutrients richness in seawater at both the estuaries , nutrient rich seawater at Deogad than at Achra Since oysters at Deogad are exposed to each low tide, there appears to be energy demand for maintenance , metabolism and during the period of gonad growth it is possible that less energy is supplied for the gametes development and therefore, there is an extended period of post spawning to recommencement of gametogenesis when compared to those from the estuary at Achra. In oysters from Deogad this period was led down in males during entire October and again in February April NM and May NM, while in females during October FM and from January FM to February FM. On the other hand, in oysters from Achra similar period was observed in males during December NM, entire January. February FM and March NM while that in females was during December NM, January FM and March NM. This indicated that oysters from Deogad passed through a comparatively longer period of recovery and neutral condition before commencement of gametogenesis. Though the quantitative data on gametes produced by individual oyster was not obtained, the observations on histological preparations and scanning as television markedly showed less numbers of gametes being produced in oysters from Achra and Deogad. The afore mentioned longer preparatory period for oysters from Deogad probably show the buildup of body reserves and metabolic status before commencement of new gametogenic cycle. It is possible that the oysters from Deogad are more opportunists to allocate energy for reproductive efforts during a short period of favorable conditions received during high tide and exhibited a direct dependence of nutrient availability with the change in the environment.

In Kelwa back waters, Bombay (Mumbai) the south- west monsoon diluted the salinity from 28.59 to 13.51 ppt in July and

stimulated spawning in *C. gryphoides* (Durve, 1965).This spawning continued till September. The spawning in a number of oysters has been reported as a protracted phenomenon. One or two peaks within a breeding seasons lead to an extended breeding season (Mane, 1997).

Conclusion:

In the present study sorting of the oyster gonad tissue into different reproductive stages revealed that *S. cucullata* from both the localities showed simultaneous maturation of gametes as the gametogenesis was advanced. Oysters under under gametogenesis and maturation occurred round the year, however, dominance of each reproductive stage differed from one season to another. Once the matured gametes are produced spawning commenced and advanced with the response to stimuli received exogenously and endogenously from monsoon to post-monsoon period (Salunkhe, 1999). The period of spawning in males from both the localities was longer as compared to females. Many female oysters under gave neutral stage after spawning than males and period of occurrence of oysters in this condition was longer in males from Achra. It was further observed that not all the mature gametes were released by the oysters from both the localities and unspawned gametes were cytolysed in the recovery state which was longer in females than males, especially in the oyters from Deogad. However, successive events in the reproductive cycles in oysters may be affected directly by various factors, and a detailed analysis requires a separate evaluation of each phase. Our knowledge of the environmental interactions and mechanism controlling the pattern of reproductive activity in oyster population is still fragmentary. With the control of reproductive activity and stimulation of gametogenesis in oyters maintained under controlled conditions, it should be possible to determine the effect of various environmental factors singly and in combinations, and to elucidate the mechanisms coordinating the reproductive response at the whole organism level. More data on the influence of various exogenous and endogenous factors controlling the beginning of gametes growth and mechanism, coordinating maturation and spawning in oysters are essential to effectively analyse the reproductive strategy in oyster populations from the given locality.

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