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IO. POPULATION DENSITY OF THE WEDGE CLAM
DONAX CUNEATUS LINNAEUS IN AND
AROUND MADRAS COAST

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ABSTRACT

Donax cunoatus, papu\ar\y known as wedgt clam i« • small mjltiooloured p3'9cyDod molluica occuring in dense population in the intertidal zone of the three exposed sandy beaches of the Madras coast namely Marina, Thiruvanmiyur and Mahabalipuram- The population density of the dams in ihe three beaches was studied from July 1982 to August 1984. The Marina beach supports a population 16 times greater in size and 14 times more dense compared to Mahabalipuram; 2.5 times ereatar in size and 2-3 times as dense as that of Thiruvanmiyur. Among the various environmental parameters studied be^ch slope s 'ems to play s significant role in the distribution and abundance of D. cuneatus.

INTRODUCTION

Wedge clams of the genus Oonax (Bivalvia: Donacidae) are typical inhabitants of sandy beaches in both temperate and tropical zones. They are interesting animals mainly because of their special adaption to live on wave-swept sandy beaches, Individual populations *oi Donax* ^ooM/have an unique ability to develop resurgences and are subject to sudden and devastating population crashes (Johnson 1968). In 1938. the clams were sa abundant on some southern California beaches that industries were developed for producing nector from the clams. But the industry collapsed in the period of a few weeks when the clams suddenly disappeared ^Johnson 1968). *Donax gouldii* of east coast of California were collected for the preparation of broth and poultry feed (Coe 1955). Do/70x has been basis of fishery in several parts of the world (Wade 1964), In India these clams are being consumed as food by the coastal population, especially the fishermen community during the period of rough seas (Nayar 1955). Although there are many reference to *Donax \n* the literature (Nayar 1955; Coe 1955; Edgren 1959; Wade 1964; Alagarswami 1966; Ansell et al 1972; and Mikkelsen 1981) most of them described their tidal migratory behaviour and biology. Hitherto there has been no comprehensive investigation on the population densities of *Donax* species except the works of Nayar (1955), Alagarswami (1966) and Ansell et al (1972) on the Indian coasts. The present study is therefore aimed at investigating about the population structure of the wedge clam *Donax cuneatus* inhabiting the sandy beaches at and around Madras of the south east coast of India

MATERIAL AND METHODS

Donax cuneatus were collected at fortnightly intervals from July 1982 through August 1984 from the intertidal zone of the three beaches, namely Marina, Thiruvanmiyur and Mahabalipuram on the east coast of India. To determine the distribution and density of population, transect method of sampling was adopted. At each station, six transect lines were sampled, Transect A, B and C were at 10 m intervals and D, E and F were 5 m apart. On each fortnightly visit, in each transect line, an initial sample was collected at a point of maximum wave recession during low tide by driving a 28.2 cm diameter stainless steel corer into the sand to a depth of 15 cm, below which depth the species had not been found to burrow. Additional samples were taken at 2 m intervals along the transect lines to the point of maximum wave advancement mark of the high tide. When the zone of clams was sighted, cores were taken dt I m interval until the zone was completely sampled. The sand samples were sieved through a I mm screen in the surf water

and the clams retained on the sieve were counted. Beach profiles were measured by triangulatton at i m interval from the-seaward limit of extreme high water spring tide to the base of the surf zone at the time of low tide. The mean particle size of the sand and uniformity coefficient were determined by conducting standard granulometric sieve analysis (Inman 1952;. Salinity of surf and interstitial water was estimated as per method given by Strickland and Parsons (1968).

RESULTS

Table 1 shows the fluctuations in the population density of clams at the three study areas. During the study period a total of 7342 specimens of *D. cunaatus* were collected from Marina, 2935 from Thiruvanmiyur and 467 from Mahabalipuram. Following Mikkelson (1981), the ratio of density per linear meter of beach at Marina, Thiruvanmiyur and Mahabalipuram was found to be 15.8 : 6.5 :1.0. At each location, there was very little difference in numbers collected per transect between those at 10 m intervals and those at 5 m apart. However, the breadth of the belt in which the clams were dispersed differed among the three beaches. In Marina it ranged from 4-5 m, in Thiruvanmiyur it was 3-4 m whereas in Maha^balipuram the band width is only 3m. This difference is very well reflected or) the population densities of the clams. Thus, the taiio of density per square metre of beach at Marina, Thiruvanmiyur and Mahabalipuram was on an average, 1 4 : 5 : 1 (Table 1). These ratios are based on a monthly average of 452 individuals at Marina, 168 at Thiruvanmiyur and 27 at Mahabalipuram per linear meter of beach and mean densities of 135/m' at Marina, 51/m2 at Thiruvanmiyur and 9.5/m2 at Mahabalipuram (Table 1). However, at Marina the minimum and maximum densities recorded were 62/m2 (July 1982) and 495/m2 (July 1984) respectively At Thiruvanmiyur beach, while the minimum density recorded was *21 jm^* (August 1982) the maximum was 108/m^ (October 1983). At Mahabalipuram the minimum and maximum densities recorded were 4/m^ (October 1982) and 17/m^ (May 1-983) respectively (Table 1).

Observations on the vertical distribution of *Donax* have revealed that the entire population appears to occupy a relatively stable zone on the beach, which appears to be in the mid water mark. Under normal conditions the clams ware not found to live in the high watefr mark as well as in the low water mark, although occassionally, during rough seas they wer^ scattered so high on,the beach or carried into water to lower levels. Shoreward from the maximum wave recession point, Do/7ax began to appear in the cores at about 6-^0 m from the wave recession point at Marina, 5-9 m at Thiruvanmiyur ,and 4-9 m at Mahabalipuram. After first sighting, the density in subsequent cores were increased rather ra^jidly to a peak and then decreased towards zero. It is also seen that there is significant difference in the vertical distribution, whereasuhe horizontal distribution shows vary little variation for all the three beaches.

The analysis of the sand particle indicated that the sands were predominantly of medium class. However, some variation in the mean particle size is evident: the midian pai'tidle diameter ranges between- 0,179 and^.499 mm, 0.204 and 0.221 mm and 0.223 and 0.252'mm at Marina, Thiruvanniiyur and Mahabalipuram respectively. The m$a.n particle siz« at <a4 the three beaches generally decreases while progressing up the beach face. The organic carbon in the sands of Marina beach is high (950-1980 (Ag/g), whereas, it is moderate at Thiruvanmiyur (730-1460 IJig/g) and low at Mahabalipuram (330-750 (^g/g)- The seasonal changes in temperature and salinity do not shovy.muQh variation among the three beaches. The pattern of oscillation in the surf and interstitial vyatei temperature is biomadal with 2 peaks in April-May and Octpber and 2 depressions in August and Decerriber-January. The annual variation in salinity is monocyclic with one peak during south west monsoon (May- August) and one depression during north east monsoon (October January).

TABLE 1.   *Density*

	N/m² of area sampled			N/linear m of beach			MARINA Transects							
	Marine	Thiruvanmiyur	Mahabalipuram	Marine	Thiruvanmiyur	Mahabalipuram	A	B	C	D	E	F	Total	Cores
Jul. 1982	62	40	9	216	120	27	26	30	28	27	25	26	162	42
Aug.	129	27	11	387	95	32	25	26	22	20	25	27	145	18
Sep.	87	27	12	305	96	35	40	42	38	36	33	40	229	42
Oct.	66	30	4	232	107	13	35	26	28	24	29	32	174	42
Nov.	71	33	9	283	81	28	31	35	38	32	36	40	212	48
Dec.	84	34	13	336	103	40	22	18	19	26	16	25	126	24
Jan. 1983	111	37	11	333	111	32	44	45	43	36	45	37	250	36
Feb	65	45	7	291	136	21	37	34	37	40	37	33	218	54
Mar.	124	62	14	371	217	41	46	61	47	43	48	43	278	36
Apr.	126	68	12	377	176	37	48	52	43	47	49	44	283	36
May	180	70	17	541	211	51	42	35	35	30	44	27	203	18
Jun	79	59	9	315	205	27	38	42	43	34	46	35	236	48
Jul.	109	48	7	381	143	21	38	50	48	61	51	48	286	42
Aug.	85	40	9	296	141	19	43	33	40	30	35	43	222	42
Sep	154	63	11	384	188	28	47	47	42	50	56	46	288	30
Oct.	135	108	9	337	271	23	46	40	43	45	39	40	253	30
Nov	78	43	7	352	173	19	41	48	46	41	45	43	264	54
Dec.	122	67	8	428	267	20	51	54	51	54	44	67	321	42
Jan. 1984	85	46	7	381	163	19	60	57	48	41	38	42	286	54
Feb.	125	40	6	375	141	16	50	41	53	44	46	47	281	36
Mar.	65	45	8	228	159	23	26	25	30	26	34	30	171	42
Apr.	172	38	11	688	161	27	88	98	94	78	74	84	516	48
May.	266	60	8	797	151	25	107	95	102	114	88	92	598	36
Jun.	149	76	8	448	187	24	61	48	52	50	63	62	336	36
July	495	66	10	1485	261	24	105	91	87	76	96	102	557	18
Aug.	298	79	10	1192	317	29	73	79	78	73	67	77	447	24
Total							1268	1242	1236	1178	1197	1222	7342	978
Mean	135.6	61.1	9.5	452.3	188.1	26.9	48.8	47.8	47.6	45.3	46.0	47.0	282.4	38.6
S. D.	93.7	18.9	2.7	293.9	61.0	8.6	22.3	21.3	20.8	21.1	18.9	20.6	121.6	10.8
Coeff of Variation	69%	37%	29%	65%	36%	32%	46%	45%	44%	47%	41%	44%	43%	29%

DISCUSSION

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The present investigation undertal<en with
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the main poulation density of the wedge cl^m D0/7.X c/jeams has provided many interesting results. The zonation of *D. cuneatus* studied in the three beaches is similar with the clams distributed mainly in the mid water mark of the intertidal zone. In spite of such similarities in the zonation of their occurrence, the three beaches do show difference in their respective profiles. In Marina, the degree of beach slope is less and hence the intertidal expanse is more. On the other hand, the Mahabalipuram beach is more steep and hence, the intertrdal expanse is narrow, >4n intermediate condition is obtained • .u TU- • U U O •. j«
in the Thiruvanmiyur beach. Such difference in ^^^ ^^^^^^ p^^^„^^ ^^^ ^^^1^^^^^ ^^ ^^^ ^^^^^y ^f ^ooax population. Thus, Marina beach supports a population o\ *D-cuneatus* 16 times greater in size and 14 times more dense compared to Mahabalipuram beach, 2.5 times greater in size and 2.8 times and 2 8 times as dense as that of Thiruvanimiyur beach. Nayar (1955) observed that a maximum of 475 clams *(D. cuneatus)* per sq. foot, area of beach. (5113 clams/m'} from Mandapam in south east coast of India.

	THIRUVANMIYUR Transects								MAHABALIPURAM							
A	B	C	D	E	F	Total	Cores	A	B	C	D	E	F	Total	Cores
9	6	6	5	11	8	45	18	2	5	4	2	3	4	20	36
12	16	14	12	10	8	71	42	3	2	1	2	3	1	12	18
16	11	10	12	14	10	72	42	3	5	6	4	3	5	26	36
13	14	15	9	11	18	80	42	2	3	1	1	1	2	10	36
12	8	11	11	10	9	61	30	3	4	4	4	3	3	21	36
15	14	11	13	12	12	77	36	1	2	2	3	4	3	15	18
14	18	16	10	13	12	83	36	4	2	5	4	5	4	24	36
17	15	18	14	18	20	102	36	3	2	4	3	1	3	16	36
27	24	28	24	34	26	163	42	6	4	3	6	7	6	31	36
19	23	23	20	21	25	131	36	4	5	5	4	6	4	28	36
11	13	11	16	12	16	79	18	2	3	3	3	3	3	19	18
32	21	27	22	29	23	154	42	4	2	5	2	4	3	20	36
16	19	18	21	18	16	107	36	2	3	2	2	3	4	16	36
21	15	18	17	15	20	106	42	1	3	3	3	2	2	14	24
19	31	28	25	20	18	141	36	4	5	2	4	4	2	21	30
40	37	28	37	25	36	203	30	2	3	2	4	3	3	17	30
25	23	18	20	24	20	130	48	2	3	1	3	2	3	14	30
29	33	36	38	34	30	200	48	2	3	4	2	2	2	15	30
20	18	21	19	20	24	122	42	4	1	3	3	1	2	14	30
18	20	17	16	19	17	106	42	2	1	1	2	2	3	11	30
23	18	21	17	18	22	119	42	1	3	3	4	3	3	17	36
17	21	20	16	22	18	113	48	5	3	4	2	3	3	20	30
16	20	14	17	23	23	113	36	2	4	3	4	4	2	19	36
22	19	24	26	22	27	140	30	2	3	3	3	4	3	18	36
17	20	15	19	13	14	98	24	3	4	2	5	2	2	18	30
21	18	22	16	24	18	119	24	1	2	1	2	3	2	11	18
500	494	490	470	492	489	2935	948	70	80	77	82	81	77	467	804
19.2	19.0	18.8	18.1	18.9	18.8	112.9	36.5	2.7	3.1	3.0	3.2	3.1	3.0	18.0	30.9
7.0	7.0	6.9	7.6	6.9	6.9	38.9	8.5	1.3	1.6	1.4	1.1	1.4	1.1	5.2	6.5
36%	37%	37%	42%	36%	37%	34%	23%	48%	38%	48%	36%	46%	36%	29%	21%

After settlement of the spat, on the mid water mark a variety of environmental factors may influence the growing population. Essentially, the chief factors such as slope of the beach, sand grain size and wave action are interpendent Thus, the slope of the beach is decided by the wave action which in turn is responsible for the distribution of different grades of sand on the expanse of the beach. Generally, the coarser sands tend to produce steeper beaches and fine sands shallower beaches At Marina, the shallow beach and fine sand support a dense population; conversely, the coarser sand particles and steep beach at Mahabalipuram supports only a sparse population. Thiruvanmiyur beach is neither too steep nor flat, thus providing suitable conditions for settlement and growth of the population. It is seen from the foregoing observations that the density of population depends much on the slope of the beach. Accordingly, Marina with g less slopy beach favours the maximum spat settlement, whereas in the Mahabalipuram beach, the beach is steep, thus supporting only a sparse settlement of spat. Again, the Thiruvanmiyur beach is intermediary in character, thus

supporting a moderately dense distribution of spat.

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