ALGAL RESOURCES OF PAMBAN AREA

By R. Prasanna Varma* and K. Krishna Rao

(Central Marine Fisheries Research Institute)

The use of algae as food, fodder and manure dates back to many hundreds of years. Seaweeds have also been associated with important industries like agar-agar, alginic acid and iodine, to mention a few. Though Japan takes a lead in the utilization of seaweeds, other countries like China, Malaya, Indonesia, Burma, Siam, Borneo, the Strait Settlements, Indo-China, Australia, Hawaii, New Zealand, Chile, etc., use algae for food as well as in the preparation of agar-agar and other industrial products.

It was during the last World War, due to the shortage of agar, that the Board of Scientific and Industrial Research started manufacture of agar in India at the Research Department of Kerala University. Since then, much stride has been made in these lines on the economic utilization of algae and the Central Marine Fisheries Research Institute developed a cottage industry method for the manufacture of agar from *Gracilaria* spp. and *Gelidium micropterum* (Thivy, 1960).

Very little information is available on the resources of Indian waters. In this direction, the observations of Hornell (1918), Mitra (1946), Koshy and John (1948), Thivy (1951, 1960) and Chacko and Malu Pillai (1958) may be considered as of very preliminary types of seaweed surveys and the estimates given in the above references need verification. Hornell estimated about 100 tons of fresh Sargassums washed ashore annually along Kathiawar Coast, Mitra estimated about 4–5 tons of dry agarophytes annually from Chilka Lake, Koshy and John collected about 10,000 pounds of agarophytes from Kerala Coast (erstwhile Travancore Coast) during 1942–46, Thivy in 1951 estimated about 3,000 tons of fresh agarophytes per annum from Indian waters excluding the resources of Laccadive Islands, and Andaman Islands, while her estimate in 1960 indicated about 35 metric tons of dry agarophytes per annum from Indian waters (Madras State alone having about 7·1 metric tons per annum), and Chacko and Malu Pillai estimated 6,000 tons of agarophytes and 60,000 tons of brown algae for the area between Point Calimere and Cape Comorin.

* Present address: Botanical Survey of India, Calcutta.

With the view of a more systematic survey of the algal resources, work was started along the Pamban area from Dhanushkodi to Hare Island in the Gulf of Mannar. Initially, the entire area was examined to ascertain the general distribution of the weeds. It was observed from these studies that economically important algae were confined to shallow regions generally to depths less than 2–3 meters and practically none of the weeds was found deeper than 7 meters. Further, these weeds were distributed along the coral beds or on the rocky substratum covered with a thin layer of sand or clay.

Two surveys were made, a preliminary one in 1958 and the other during 1962–63. Though the stations examined were almost the same, the second survey was more elaborate, covering as far as possible the entire sound region between Hare Island on the west and Shingle Island on the east. At each station samples were taken by the quadrat method. Wherever the depth prevented normal wading, a frame with sides 12″ (30·5 cm.) was dropped and the weeds enclosed by the frame were collected by diving. Where the water was shallow the frame was placed on the coral bed and the enclosed algae were collected. It was found that the standard one-meter quadrat could not be used because it was not possible to make a complete harvesting of the area covered by such a large quadrat, particularly by diving. Hence, while the quadrat was made small, three samples were obtained from each station and the average of these was considered for analyses. The distance fixed between stations (in deeper areas) was based on a fixed running time of the launch at a regular speed, not taking into consideration slight changes that might have happened due to currents or wind. In shallow regions, the distance covered by wading was also to a certain extent arbitrary, based on a fixed time as well as on the location of coral beds. Pure sandy or sandy clay regions were omitted because the weeds were not found in such places.

Because of the peculiar location of the islands and the distinct absence of any vegetation in the Puma Channel (running between Pullivasal Island, and New Islet and close to the former), the entire area surveyed was divided into three sections, *viz.*, (1) Krusadai section consisting of beds around Shingle, Krusadai, Pullivasal and Pulli Islands, (2) Hare Island section consisting of beds around New Islet, Manoli and Hare Islands; and (3) outside section consisting of the entire sound region between the main land and the islands and to the southern side of the islands up to depths short of 7-meters not covered in the first two sections (Fig. 1).

Excepting certain portions around Krusadai and Shingle Islands, the Krusadai section was covered by live corals or dead coral stones with an

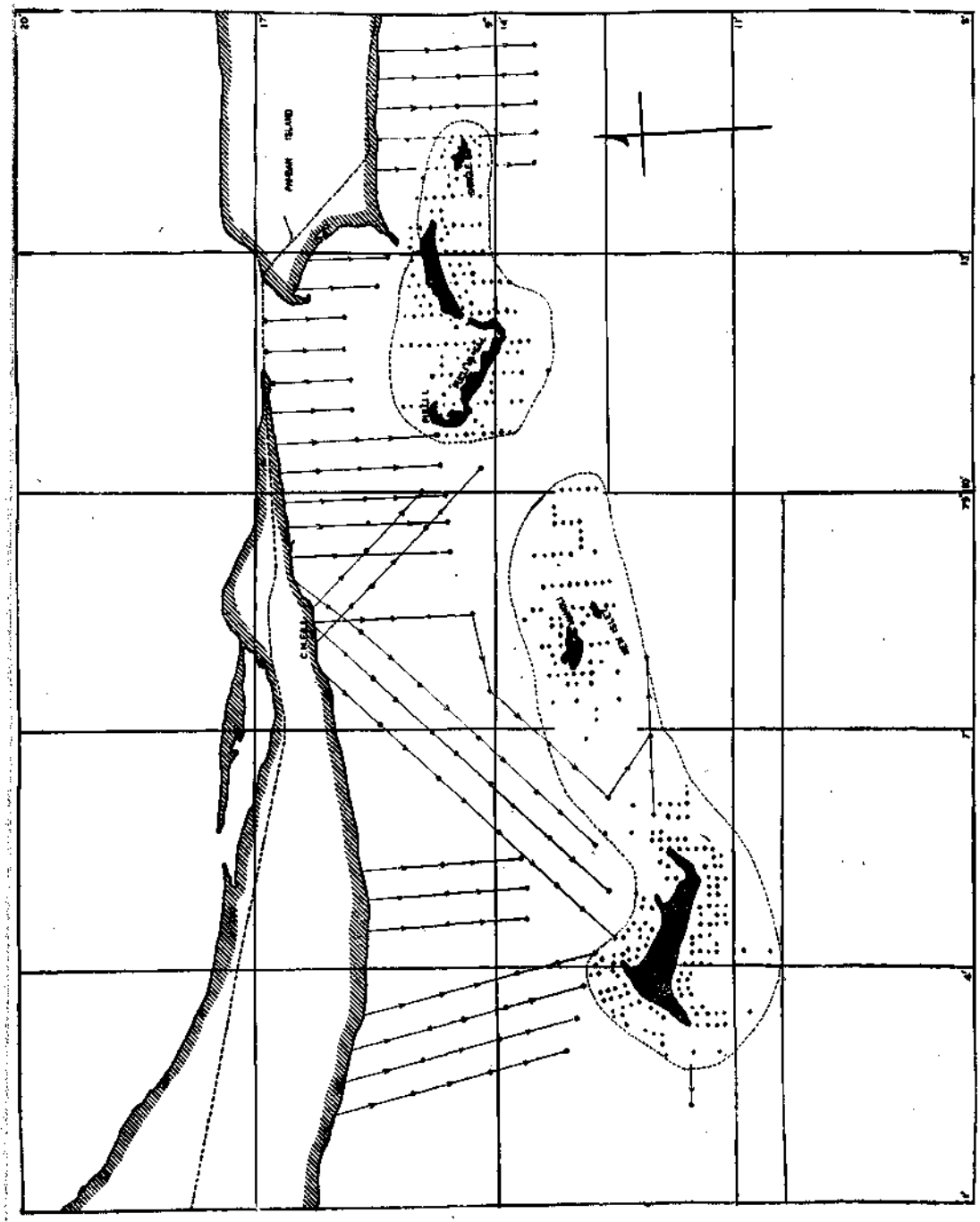

FIG. 1. Map showing the area surveyed. Dots represent the stations examined.

abundance of sand and calcareous substratum. *Gelidium micropterum* was found growing only in limited area, particularly around Shingle Island on the western side and on the open side of Krusadai Island facing Shingle Island. Brown algae, particularly Sargassums, were found more toward the open reef nearer the breakers as well as on the northern side off the islands, *i.e.*, they were deeper than *Gelidium* and Gracilarias. Gracilarias were found close to the islands and except *G. edulis*, the other species were not found associated with brown algae. More often pure beds of Gracilarias were met with and even in the case of *Gracilaria edulis*, the association was more with *Hypnea musciformis* and *H. valentiae*. Turbinaria beds were fewer in this section, yet, one could find good growths associated with actively growing branched corals around Shingle Island.

The greater portion of Hare Island section was covered with clay or sandy-clay except the southern and western sides of Hare Island. While there was a dense growth of Gracilarias on the northern and south-eastern sides of Hare Island, the major part of this section had beds of brown algae, specially *Cystophyllum muricatum* and *Turbinaria conoides*. These latter species of brown algae formed beds to the north-eastern and west-north-western sides of the section. Harvesting of algae from this section was more easy compared to Krusadai section.

In the outer section, very little algae of any economic value was met with and hence this area was not taken into consideration in the estimation of the resources. It may be pointed out here that in the region between Hare Island and Manoli, more toward the main land, very large quantities of sea-grasses were found. Further toward the islands, *Caulerpa scalpelliformis* and *C. racemosa* were met with in fair quantities. This vegetation of green algae and sea-grasses stopped at Keelakarai channel running east-west almost along the middle of the sound region up to Dhanushkodi. The area south of the channel was rather shallow and the depth decreased as one proceeded from Hare Island to Krusadai Island, and at Krusadai Island this channel merged with Kundugal channel.

In the consideration of the available resource, the weeds were treated separately as *Gelidium micropterum*, Gracilarias and brown algae comprising Sargassums, Turbinarias and *Cystophyllum muricatum*. This was because in the manufacture of agar on a cottage industry basis, all the Gracilarias could be treated together while *Gelidium micropterum* required special treatment. Similarly, in the extraction of alginic acid, all the above brown weeds could be treated together. Hence it was not felt profitable to get the data separately for the different species.

A total of 234·25 sq. km. was covered in this survey, of which Hare Island section was 40·93 sq. km. and Krusadai section was 17·89 sq. km. In all the three sections together, 441 stations were examined in the 1962–63 survey. The outside section had, in an area of 175·38 sq. km., only 14 stations with any economically important seaweeds and considering the vast area of this section to such a small number of stations having seaweeds, it was decided not to take into consideration this section in the estimation of the resources. Furthermore, the inclusion of this data would not give a true picture of the area as a whole. In the 1958 preliminary survey, the outside section was not examined but the data obtained are presented in this account, though, critical statistical analyses were done only for the 1962–63 survey.

Only 0·5 per cent. of the total area in the two sections (Krusadai and Hare Island sections) had coral or rocky reefs and based on the observations that economic seaweeds were found only on the reefs, the estimate of harvestable crop was calculated on the basis of actual reef area.

Table I shows the analysis of variance. There was no significant difference between the two sections in respect of the total harvestable crop and even Gracilarias and brown weeds did not show any significant difference

TABLE I

Analysis of variance

Variation	S.S.	D.F.	M.S.S.	
(*a*) Total weed harvest:				
Within beds ..	51·5050	362	0·1423	
Between beds ..	0·0654	1	0·0654	F = 2·1758
Total ..	51·5704	363		
(*b*) Gracilarias:				
Within beds ..	33·3825	362	0·0922	
Between beds ..	0·3184	1	0·3184	F = 3·4534
Total ..	33·7009	363		
(*c*) Brown algae:				
Within beds ..	94·1567	362	0·2601	
Between beds ..	0·5111	1	0·5111	F = 1·9650

The value of F (variance ratio) when taken with appropriate degrees of freedom shows that between bed variation in all the above cases is not significant.

between the sections. All the same, since Krusadai section alone had *Gelidium micropterum*, the estimates were made section-wise. Detailed estimates for Gracilarias, *Gelidium micropterum* and brown algae for the two sections are given in Table II. The percentage errors for the mean harvest per sample quadrat were calculated and were found to be 4·37 and 3·64 for Krusadai and Hare Island sections respectively.

TABLE II

Detailed estimates

Details		Weights in metric tons	
		1958	1962–63
Gracilarias			
Estimated wet algae	..	37,769·00	66,979·00
Harvestable wet algae	..	188·85	334·90
Harvestable dry algae	..	18·89	34·49
Yield of agar-agar	..	2·83	5·02
Gelidium micropterum			
Estimated wet algae	..	1,290·00	3,775·00
Harvestable wet algae	..	6·45	18·88
Harvestable dry algae	..	0·65	1·89
Yield of agar-agar	..	0·19	0·57
Browns			
Estimated wet algae	..	83,835·00	131,588·00
Harvestable wet algae	..	419·18	657·94
Harvestable dry algae	..	62·88	98·69
Yield of alginic acid	..	7·55	11·84

Estimated wet algae based on the entire bed area; Harvestable wet algae based on the reef area (0·5% of the entire bed area); In the case of *Gelidium* and Gracilarias 90% moisture and in the case of Brown algae 85% moisture; Gracilarias 15% agar on dry basis, *Gelidium* 30% agar on dry basis and Brown algae 12% alginic acid on dry basis.

The estimates given in this survey could not be compared with the earlier estimates of Thivy (*op. cit.*) and Chacko and Malu Pillai (*op. cit.*) for this area because they have not given any indication of the type of survey conducted or the basis of estimation of the crop.

No detailed experiment was conducted to study the rate of replenishment of the algae in harvested areas, but from the periodical observations made

during the visits to the algal beds in the Pamban area since 1955, it was found that on an average the red algae (*Gelidium micropterum* and Gracilarias) attained harvestable size in about 2–3 years while the brown algae (Sargassums, Turbinarias and *Cystophyllum muricatum*) took about 4 years. It may be pointed out that a very good bed of *Gracilaria edulis* on the south-western side of Hare Island is getting covered by sand. Similarly, the deposit of sand and clay along the north-western part of Pullivasal and Pulli Islands is on the increase and greater area is being exposed reaching almost the mud flats of Kundugal gut. These factors are likely to damage much of the vegetation in this area. Further, the beds of Gracilarias on the north-western sides of Hare Island also may be destroyed because of the accumulation of clay and the consequent growth of sea-grasses.

This survey as well as the identification of the weeds and other biological aspects were carried out by one of us (R. P. V.) while the statistical analyses of the data were by the junior author. The authors are very grateful to the Director of the Institute, Dr. S. Jones and to the Deputy Director Dr. R. Raghu Prasad for their continued interest in this work as well as for all suggestions and help rendered. For suggestions on statistical procedure, thanks are due to Shri S. K. Banerji, Research Officer of the Institute.

References

Chacko, P. I. and Malu Pillai, C. 1958 — Studies on utilization of the seaweed resources of Madras State. *Contr. Marine fish. biol. St., Krusadadi Island, Gulf of Mannar, No. 6*, pp. 12.

Hornell, J. 1918 .. *Report on the Further Development of Fishery Resources of Baroda State.*

Koshy, T. K. and John, C. C. 1948 — Survey of *Gracilaria* resources of Travancore. *Dept. Res. Univ. Travancore, Rep. for Septen.* 1939–46, pp. 53–55.

Mitra, G. 1946 .. *Development of Chilka Lake, Cuttack.*

Thivy, F. 1951 .. Investigation of seaweed products in India with a note on some properties of various Indian agars. *Proc. Indo-Pac. fish. Coun.*, Sec. II.

———. 1960 .. Seaweed utilization in India. *Proc. Symposium on Algology, I.C.A.R.*, pp. 345–64.