

CMFRI bulletin 41



DECEMBER 1987

SEAWEED RESEARCH AND UTILIZATION IN INDIA

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SEAWEED RESOURCES OF INDIA

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A review of the seaweed resources of the world has been made by Michanek (1975). Further, some information is available on the seaweed resources of Indian waters, such as of Chilka Lake (Mitra, 1946), certain areas of Tamil Nadu (Chacko and Malupillai, 1958; Thivy, 1960; Varma and Krishna Rao, 1964; Desai, 1967; Umamaheswara Rao, 1972 a, 1973; Kannan and Krishnamurthy, 1978 and Subbaramaiah *et. al.*, 1979 a), Kerala coast (Koshy and John, 1948), Gujarat coast (Sreenivasa Rao, *et. al.*, 1964; Desai, 1967, Chauhan and Krishnamurthy, 1968; Bhanderi, 1974 a; Bhanderi and Raval, 1975; Bhanderi and Trivedi, 1975, Chauhan and Mairh, 1978 and Ragothaman, 1979), Maharashtra coast (Chauhan, 1978 and Untawale *et. al.* 1979), Goa coast (Untawale and Dhargalkar, 1975),

Andhra Pradesh coast (Umamaheswara Rao, 1978) and Lakshadweep (Subbaramaiah *et. al.* 1979 b). Of these, the observations of Mitra (1946), Koshy and John (1948), Chacko and Mulupillai (1958) and Thivy (1960) are of preliminary nature, and the methods adopted for estimation are not given by them. The total quantities of agarophytes and alginophytes as estimated by these workers are given on page 52.

A detailed survey of red algae was conducted by Desai (1967) in the Gulf of Mannar, in a 10 - mile area at Rameswaram (north east of the temple) and 20-mile area north and south off Kilakarai. The estimates of dry *Gelidium* and *Gracilaria* were 300 and 3000 tons respectively per annum.

Locality	Agarophytes (Dry weight)	Alginophytes (Dry weight)	Authors
Chilka Lake	4-5 tons/annnm	-	Mitra, 1946,
Kerala coast (Travancore coast)	10,000 lbs during 1942-46	-	Koshy and John, 1948,
Point calimere- Cape Comorin	6,000 tons	60,000 tons	Chacko and Malupillai, 1958
Pamban area (Tamil Nadu coast)	7.1 tons/annum	-	Thivy, 1960

Surveys were started by Central Marine Fisheries Research Institute during 1958 to estimate the available seaweed resources in the Mandapam area. Varma and Krishna Rao (1964) made two surveys (a preliminary one in 1958 and the other detailed one during 1962-63), covering a total area of 234.25 sq km between Dhanushkodi and Hare Island. The entire area surveyed was divided into 3 sections, namely Krusadai section, Hare Island section and Outside section. Since very little algae of economic value were present, the Outside section, was not taken into consideration. The detailed estimates for species of *Gracilaria*; *Gelidiella acerosa* (= *Gelidium micropterum*) and brown algae for the other sections are given below:

Details	Fresh weight in metric tons	
	1958	1962-63
<i>Gracilaria</i> spp		
Estimated algae (wet wt)	33769	66979
Harvestable algae (wet wt)	188.85	334.90
(dry wt)	18.89	34.49
Yield of agar-agar	2.83	5.02
<i>Gelidiella acerosa</i> (= <i>Gelidium micropterum</i>)		
Estimated algae (wet wt)	1290	3775
Harvestable wet algae (wet wt)	6.45	18.88
(dry wt)	0.65	1.89
Yield of agar-agar	0.19	0.57
<i>Brown algae</i>		
Estimated algae (wet wt)	83835	131588
Harvestable algae (wet wt)	419.18	657.94
dry weight	62.88	98.69
Yield of alginic acid	7.55	11.84

The total Indian algin potential is 500 metric tonnes (refined) annually and the agar potential is 13 metric tonnes (bacteriological grade) annually, as estimated based on the possible yield of 19% (range 7-30%) of algin by dry weight and 28% (range 12-43%) of agar by dry weight (Thivy, 1964).

Sample surveys were conducted by Umamaheswara Rao (1973) in a 3.58 sq. km area between Pamban bridge and Theedai during the calm seasons of 1965 and 1966. The quantitative data obtained on the standing crop of different seaweeds are shown below.

Seaweed	Fresh wt. in metric tons	
	1965	1966
Agarophytes	233.15	47.92
Alginophytes	161.83	173.43
Edible algae	188.84	245.91
Other algae	457.87	398.51

Except in agarophytes, there was no significant variation in the standing crop of different types of seaweeds. About one fourth of the total area surveyed was covered with seagrass, standing crop of which was higher than that of marine algae. The data obtained on the area occupied by the seagrass beds and the standing crop in the two surveys are given below:

Year	Area covered by seagrass (sq. km)	Fresh weight of sea grass metric tonnes)
1965	0.75	1916.19
1966	0.88	2170.81

Thus considerable quantities of seagrass occur around Mandapam, which can be utilized for manure or as packing and insulating material.

A preliminary survey was conducted by Kannan and Krishnamurthy (1978) on the marine algae in and around Porto Novo and in the Porto Novo-Pondicherry region. *Ulva*, *Chaetomorpha* and *Enteromorpha* were more commonly found in the Pondicherry region. *Padina* was more common at Cuddalore, where *Hypnea* sp and *Enteromorpha* sp were also present. *Gracilaria* was rare, found drifting. At Porto-Novo the survey included four main biotypes, viz. neritic, estuarine, backwater and mangrove. *Ceramium*, among other algae, occurred in the neritic inlet of Vellar estuary-backwater complex, at Chinnavaikkal. The blue-green alga *Lyngbya* sp. was usually common in Porto-Novo waters.

CMFRI carried out for 5 years survey of marine algal resources along Tamil Nadu coast (1971-76) in collaboration with Central Salt and Marine Chemical Research Institute and Department of Fisheries, Government of Tamil Nadu (Subbaramaiah *et. al.*, 1979 a). The area covered was from Athankarai to Rameswaram in the Palk Bay (45 km distance) and from Mandapam to Colachel, Kanyakumari Dt. (413 km distance) and the adjoining islands in Gulf of Mannar from HWM to a depth of 4 m. The standing crop in the coastal area of 17125 ha was estimated at 22044 tons, consisting of 1709 tonne agarophytes, 10266 tonne alginophytes and 10069 tonne other seaweeds. The resources of the commercially important species are as follows:

Seaweed	wet weight
<i>Gelidiella acerosa</i>	74 tons
<i>Gracilaria</i> spp	974 "
<i>Hypnea</i> spp	798 "
<i>Sargassum</i> spp	9381 "
<i>Turbinaria</i> spp	714 "

By surveys conducted along Gujarat coast, Sreenivasa Rao *et. al.* (1964) estimated fresh *Sargassum* at 60 metric tons in 0.015 sq m area of the Adatra reef near Okha. According to the estimation of Central Salt and Marine Chemicals Research Institute, the resources of the agarophytes along Gujarat coast is 12 tons (fresh wt.). In the Gulf of Kutch 10,000 tonnes of brown algae by dry weight, 5 tons of wet *Gelidiella* and 20 tons of *Gracilaria* by dry weight can be harvested (Desai, 1967). Chauhan and

Krishnamurthy (1968) have surveyed Dera, Goos, Narara, Sika, Karumbhar and Baide areas of Gulf of Kutch, and estimated the fresh seaweeds at 18765.5 metric tons in 10.65 sq. km of coastal waters. In this, *Sargassum* spp form 12010.5 tons, of which about 4000 metric tons are harvestable each year. The resource of iodine-yielding seaweed *Asparagopsis taxiformis* in some subtidal reefs of Saurashtra coast was estimated by Bhanderi (1974 a). The surveys were conducted in places near Okha, viz. Okha, Adatra, Dwarka, Hanumandandi, Dona and Boria reefs in 1972-73, showing that only in two places, namely Okha and Boria, there was luxuriant growth of *A. taxiformis* while in other places, such as Dona, Hanumandandi and Adatra, there were hardly 1 or 2 plants and in Dwarka reef the plant was totally absent. The maximum harvestable quantity from Okha and Boria reef was found to be 12.15 m. tons(fresh). Out of this, 12.0 tons were in Boria reef, in 0.060 sq. km area in March 1973. and 0.15 tons in Okha reef, in 0.007 sq. km area in December 1972. In 1973-74, Bhanderi and Raval (1975) conducted surveys on the tidal region of Okha-Dwarka coastline and estimated fresh *Sargassum* at 1000 metric tons. Other alginophytes such as *Cystophyllum muricatum*, *Hormophysa triquetra* and *Turbinaria* spp were also found in some quantity. *Sargassum tenerrimum* was the chief species of harvestable alginophytes. According to the assessment of the authors, about 1 ton of fresh *Gelidiella* and 10 tons of fresh *Gracilaria* could be harvested from the coastline; These findings coincided with that of Central Salt and Marine Chemicals Research Institute Bhanderi and Trivedi (1975) also reported the seaweed resources of Hanumandandi reef and Vumani reef near Okha Port.

The survey of seaweed resources from Okha to Mahuva in Saurashtra coast was carried out jointly by the Central Salt and Marine Chemicals Research Institute and the Department of Fisheries, Government of Gujarat (Chauhan and Marih, 1978). The brown seaweed *Sargassum* constituted three-fourth of the algal biomass. The green alga *Ulva* was next to *Sargassum* and *Gracilaria* and *Gelidiella* were forming minor quantities. The estimated standing crops of the species are as follows

	Wet weight in tons
<i>Sargassum tenerrimum</i>	238.383-541.984
<i>Gracilaria corticata</i>	15.039- 23.086
<i>Gelidiella acerosa</i>	3.047- 5.695
<i>Ulva</i>	26.099- 39.073

Ragothaman (1979) conducted surveys at Devka, Golvad and Daman to study the distribution pattern of marine algae. The algae growing in this area were *Ulva Enteromorpha*, *Polysiphonia*, *Platysiphonia*, *Laurencia*, *Gelidiella*, *Acanthophora* and *Corallina*.

The marine algal resource of Maharashtra coast was reported on by Chauhan (1978). The total harvestable standing crops according to them are as follows:

	Weight of the fresh seaweed in metric tons	
	Lower limit	Upper limit
<i>Sargassum</i>	238.417	310.097
<i>Ulva</i>	3.483	4.516

The seaweed resources survey of the Goa coast was conducted by Untawale and Dhargalkar (1975). The total standing crop of the coast from Dona Paula to Chapora (0.150 sq. km area) was about 256.6 metric tons fresh weight per year.

The seaweed resources of Andhra Pradesh are dealt with in detail by Umamaheswara Rao (1978). In general agarophytic resources are less while *Sargassum* species are more abundant in different localities of the coastline. *Gracilaria corticata*, *Sargassum* spp., *Ulva fasciata* *Enteromorpha compressa* etc grow in harvestable quantities. Recently, Central Salt and Marine Chemicals Research Institute has

surveyed the Andhra Pradesh coastline to assess the total standing crop.

The marine algal resources of Lakshadweep was published recently (Subbaramaiah *et al.*, 1979 b). Among the 9 islands surveyed, Kavaratti, Agatti, Kadamet, Chetlat, Kiltan, Androth and Kalpeni supported marine algal growth while Bangarem was barren. Out of the total area of 2555 ha surveyed, 785 ha was found to be productive. The total standing crop of the marine algae estimated was 3645-7598 tons (wet weight). The groupwise biomass and their percentage of standing crop of the population are:

Agarophytes	961-2074 tons	27.0%
Alginophytes	9-15 tons	0.2%
Other seaweeds	2675-5509 tons	72.8%

Some attempts have been made to estimate the drift seaweeds. According to the estimate of Hornell (1918) 100 tons of fresh *Sargassum* were cast ashore per year along the 40 km Okhamendal coast of Gujarat, i.e. from Juranga to Okha, including Adatra. Krishnamurthy *et al.* (1967) estimated the different drift seaweeds at Idinthakarai and Pamban for a period of three months. The total drift weed around Idinthakarai was 61450 kg and at Pamban area was 16750 kg fresh weight. An account of the various methods used in assessing the seaweed resources has been given by Subrahmanyam (1967).

The above surveys carried out in certain areas of the east and west coasts of India clearly show the diversity and abundance of seaweed resources in our country. Intensive surveys for a long period in other areas along the Indian coast would throw much light on the resources occurring in the natural habitat and on the raw material available for expanding the seaweed industry in our country.

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