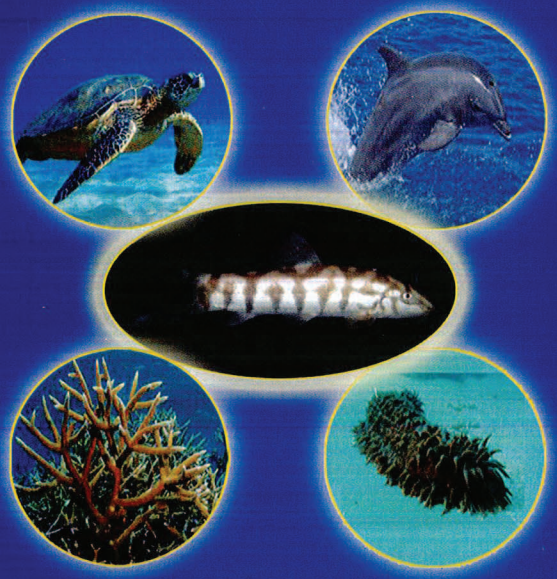
National Workshop on

BIODIVERSITY AND CONSERVATION OF AQUATIC RESOURCES

(BioCAR' 2016)

10 - 11, November 2016

PROCEEDINGS



Editors

M. Nagoor Meeran
S. David Kingston
N. Jayakumar

Organised by

Fisheries Training and Research Centre
Tamil Nadu Fisheries University
Parakkai – 629 601
Kanyakumari District, Tamil Nadu

National Workshop on

Biodiversity and Conservation of Aquatic Resources

(BioCAR' 2016)

10 - 11, November 2016

PROCEEDINGS

Editors

M. Nagoor Meeran
S. David Kingston
N. Jayakumar

Organised by

Fisheries Training and Research Centre
Tamil Nadu Fisheries University
Parakkai – 629 601, Kanyakumari District, Tamil Nadu

Sponsored by

NABARD

NFDB

Union Bank of India

Proceedings of the National Workshop on Biodiversity and Conservation of Aquatic Resources (BioCAR' 2016)

(10 -11, November 2016)

All rights reserved

Nagoor Meeran, M., S. David Kingston and N. Jayakumar (Eds.). 2016. Proceedings of the National Workshop on Biodiversity and Conservation of Aquatic Resources (BioCAR' 2016) held at FTRC, Parakkai during 10 - 11, November 2016. Fisheries Training and Research Centre, Tamil Nadu Fisheries University, Parakkai – 629 601, Kanyakumari District, Tamil Nadu, India (120 pp.)

Organised by

Fisheries Training and Research Centre,
Tamil Nadu Fisheries University,
Parakkai – 629 601, Kanyakumari District,
Tamil Nadu, India.

Copy right @ 2016, Fisheries Training and Research Centre, Tamil Nadu Fisheries University, Parakkai – 629 601, Kanyakumari District, Tamil Nadu, India

The views expressed in this proceedings are those of the author(s) and publisher does not assume responsibility for the authenticity of the findings/conclusions drawn by the author(s)

Printed at
Kasthuri Computer Works, Nagercoil - 629 001, Ph: 94431 02015

SEAWEED AND SEAGRASS BIODIVERSITY OF SOUTHWEST COAST OF INDIA

P. Kaladharan

Central Marine Fisheries Research Institute, Cochin- 682018

Introduction

Macroscopic marine algae popularly known as seaweeds and the submerged marine flowering plants commonly known as Seagrasses constitute marine primary producers. Seaweed beds along the rocky coasts and the extensive meadows of seagrasses are the most productive ecosystems in marine environment. They are immensely capable of sequestering dissolved carbon dioxide at faster rates and their role in containing ocean acidification in particular and in mitigating the climate change impacts are well understood. Seaweeds consist of taxonomically distinguished groups of Chlorophyta (green seaweeds), Phaeophyta (brown seaweeds) and Rhodophyta (red seaweeds). They are generally found attached to rocks, pebbles or other aquatic plants in the intertidal or subtidal regions of the sea. Seaweeds are valued for the natural source of phycocolloids (algal polysaccharides) such as agar-agar, algin and carrageenan. A number of tropical seaweeds including green algae (Ulva, Enteromorpha, Monostroma, Caulerpa) brown seaweeds (Dictyota, Laminaria, Cladosiphon, Padina) and red seaweeds (Gracilaria, Porphyra, Eucheuma) are eaten directly (sea vegetables) for their minerals, vitamins, proteins, essential aminoacids and low fat content. According to the FAO data base during 2008, total world production of marine algae was estimated to be 15.8 million tonnes (wet weight) equivalent to the value of 87.4 million US $ with 99.8 percent by weight and 99.5 percent by value contributed by Asian region alone (FAO., 2011).

Seaweeds in Indian Waters

Seaweeds are marine macroalgae that consist of taxonomically distinguished groups of Chlorophyta (green seaweeds), Phaeophyta (brown seaweeds) and Rhodophyta (red seaweeds). They are generally found attached to rocks, pebbles or other aquatic plants in the intertidal or subtidal regions of the sea. Seaweeds are the natural source of phycocolloids such as agar-agar, algin and carrageenan. A number of tropical seaweeds including green algae (Ulva, Enteromorpha, Monostroma, Caulerpa) brown seaweeds (Dictyota, Laminaria, Cladosiphon, Padina) and red seaweed (Gracilaria, Porphyra, Eucheuma) are eaten directly (sea vegetables) for their minerals, vitamins, proteins, essential aminoacids and low fat content. The major economic significance of seaweeds is the polysaccharides (agar, algin, carrageenan, agarose etc) that certain red and brown seaweed species contain.

Seaweed Resources

Economically important seaweed resources of the world, as per the harvests made during 1971-1973 was estimated to be 2.105 million tonnes wet weight (about 1460 million tonnes of brown algae; 261 million tonnes of red algae) dominated by brown seaweeds (Michanek, 1975).

The southeast and northwest coasts of India and the Andaman- Nicobar and Laccadive archipelagoes harbour wide variety of seaweeds with rich biomass and species diversity. Luxuriant growth of seaweeds is found in southern coast of Tamilnadu, Gujarat, Lakshadweep and Anadaman-Nicobar Archipelagos. Rich seaweed beds occur at Mumbai, Ratnagiri, Goa, Karwar, Thikodi, Varkala, Vizhinjam, Pulicat and Chilka Lakes. There are about 40 seaweed industries functioning in India producing algin and agar, depending only on natural resources. Indian coastline has 844 species of marine algae belonging to 250 genera and 64 families, of these nearly 60 species only are commercially important (Oza and Zaidi, 2001). Later in a revised checklist of marine algae 896 species were reported by and Umamaheswara Rao (2011) indicating a considerable increase in the species of seaweeds of India.

Seaweeds of Southwest coast

- A total of 37 species of seaweeds were observed and enlisted from Kerala coast during 1998 and 1999 (Baby Ushakiran, 2012).
- Out of the 37 species 13 were grouped under Class Chlorophyceae (green seaweeds), 7 under Phaeophyceae (brown seaweeds) and 17 under Rhodophyceae (red seaweeds).
- Agar yielding seaweeds were represented by seven species and the major resources were Gracilaria corticata, G. foliifera, Gelidiopsis variabilis and Gelidium pusillum during 1998 and 1999 besides the species of Pterocladia during 1999.
- Alginophytes were represented by Sargassum wightii, S. duplicatum, S. tenerrimum, Stoechospermum marginatum, Dictyota dichotoma and Padina gymnospora and Padina tetrastromatica.
- The carrageenan yielding red seaweeds were Hypnea musciformis, H. valentiae and a new resource Gracilariopsis lemaneiformis from Dhalavapuram and Kannur coasts.

Table showing the list of seaweeds collected from Kerala coast during 1998 and 1999

Sl.No	Species
	Chlorophyceae
1	*Bryopsis plumosa* C.Agardh.
2	*Caulerpa cupressoides* C.Agardh.
3	*Caulerpa peltata* Lamour.
4	*Caulerpa racemosa* Forsskal
5	*Caulerpa sertularioides* F.Brevioes
6	*Chaetomorpha antennina* (Borey.) Kuetz.
7	*Chaetomorpha linum* (O.F.Muller) Kuetz.
8	*Cladophora fascicularis* (Merteos) Kuetz.

9 *Enteromorpha compressa* (Linn.)Grev.
10 *Enteromorpha intestinalis* Kuetzing
11 *Ulva facsiata* Delila
12 *Ulva lactuca* Linn.
13 *Ulva reticulata* Forsskal

Phaeophyceae

14 *Dictyota dichotoma* (Huds.)Lamour.
15 *Padina gymnospora* (Kuetz.) Vickers
16 *Padina tetrastromatica* Hauck.
17 *Sargassum duplicatum* J.Agardh.
18 *Sargassum tenerimum* J.Agardh.
19 *Sargassum wightii* Grev.
20 *Stoechospermum marginatu* (C.Agardh.) Kuetz.

Rhodophyceae

21 *Acanthophora spicifera* (Vahl.) Boergesen
22 *Amphiroa anceps* (Lamk.) Decsne.
23 *Asparagopis taxifomis* Delila
24 *Centroceros clavulatum* C.Agardh.
25 *Chondrus* sp.
26 *Gelidium pusillum* Stackhouse
27 *Gelidiopsis variabilis* (Grev.) Schmitz
28 *Gracilaria corticata* J.Agardh.
29 *Gracilaria foliifera* (Forsskal) Boergesen
30 *Gracilariopsis lemaneiformis* (Borey) Dawson
31 *Grateloupia filicina* J.Agardh.
32 *Grateloupia lithophila* Boergesen
33 *Hypnea musciformis* (Wulf.)Lamour.
34 *Hypnea valentiae* Mont.
35 *Jania rubens* (Linn.) Lamour.
36 *Laurencia paniculata* J.Agardh.
37 *Pterocladia* sp.

- Later Nettar and Panikkar (2009) described two new species from the Family Ralfsiaceae, Hapalospongidion thirumullavaramensis and Pseudolithoderma thangasseriensis, collected from the Quilon coast of Kerala.
- Again four species of Feldmannia were added through collections from different parts of Kerala such as F. collumellaris, F. irregularis and two new species: F. sahnienii and F.

renienii (Nettar and Panikkar, 2009 a) and five more species of Hincksia collected from different parts of Kerala such as H.clavata (Krishnamurthy and Baluswami) Silva, H. rallsiae (Vickers) Silva, H. sandriana (Zanardini) Silva, H. mitchelliae (Harvey) Silva and H. turbinariae (Jaasund) Silva (Nettar and Panikkar, 2009 b).

- Hence with the addition of 11 species of new reports from the Kerala coast, the total number of seaweed wealth of Kerala coast is comprised of 48 species

Seaweed farming and carbon sequestration

There has been a 35% increase in CO_2 emission worldwide since 1990 (IPCC, 2007). Carbon fixation by photoautotrophic algae has the potential to diminish the release of CO2 into the atmosphere. Phytoplankton, seaweeds and seagrasses are excellent carbon sequestering agents than their terrestrial counterparts (Zou, 2005). It was estimated that the seaweed biomass occurring along the Indian coasts is capable of utilizing 9052 t of CO_2 / day against emission of 365 t CO2 / day indicating strong sequestration of 8687 t of CO2 / day by seaweeds (Kaladharan et al., 2009). Large scale mariculture of seaweeds along the Indian continental shelf is recommended as one of the positive anthropogenic activities to sequester CO2 that can check global warming to a larger extent.

Seagrasses

- Seagrasses are the only submerged marine flowering plants (Angiosperms).
- They have well developed root and shoot systems.
- Seagrasses in India belong to two monocot families: Hydrocharitaceae and Potomogetonaceae.
- Seagrasses, with the help of their creeping rhizomes (under ground stem) and fibrous roots they bind (stabilize) the sediment, prevent erosion and reduce siltation in coastal areas.
- Seagrass meadows help keep water clear. They absorb nutrients from coastal runoffs and from sediment.
- They provide food and shelter to variety of marine organisms and serve as feeding and nursery grounds for many a commercial fishery resources.
- Seagrasses form food for dugongs and green turtles.
- Seagrasses form underwater prairies and they are ecosystem engineers capable of modifying the environment to create ideal habitats.
- Seagrass meadows the size of one football ground can permanently store carbon equal to the quantity emitted by a car travelling for 6000 km.

- Seagrass beds are the third most valuable ecosystems on the planet next to estuaries and wetlands.
- Value of one hectare of seagrass bed is US$ 19000 per year excluding the services provided to fisheries.
- Seventy two (72) seagrass species from 12 genera and 4 families are known to science, out of them 10 are at the risk of extinction and 3 are endangered.
- Tropical waters have the highest seagrass diversity.

Temeperate:	**Tropical**
Amphibolis	*Enhalus*
Heterozostera	*Cymodocea*
Phyllospadix	*Halodule*
Posidonia	*Halophila*
Pseudalthenia	*Syringodium*
Zostera	*Thalassia*
	Thalassodendron

India is bestowed with 16 species belong to 7 genera and 2 families.

- The south west coast of India harbours 12 species from 9 genera with maximum diversity from the Lakshadweep Archipelago.
- Extensive bed of Halophila beccarii at Kumbala (Kasaragod Dist) and Kadalundi estuaries (2 ha inside Kadalundi community reserve area (Kozhikode Dist), Clay substratum) occur in Kerala coast.
- Bed of Halophila beccarrii associated with seaweeds such as Enteromorpha, Chaetomorpha and sometimes the long thalloid Gracilariopsis lemaneiformis.
- The density of Halophila palnts ranged from nil during June - July to 420 g/m2 during December-January

Further reading

Baby Ushakiran, M.S., Sr. Merlee Tereasa and P. Kaladharan, 2014. A review on resources, cultivation and utilisation of marine macroalgae in India. Seaweed Res & Utiln., 36(1&2):114-125.

FAO., 1989. Culture of Kelp in China, Training Manual 89/6 (RAS/86/024) 204 p.

Kaladharan, P. and N. Sridhar, 1999. Cytokinin production from green seaweed, Caulerpa racemosa. Fish. Technol., 36(2): 87-89.

Kaladharan, P. and N. Kaliaperumal, 1999. Seaweed Industry in India. NAGA the ICLARM Qtrly., 22(1): 11-14.

Kaladharan, P., S.V.Alavandi and V.K.Pillai, 1990. Volatilization of inorganic mercury by Isochrysis galbana Parke. from aquatic systems. Indian J. Fish., 37(2): 163-65

Kaladharan, P. and K.Seetha, 2000. Agarolytic activity in the enzyme extracts of Oscillatoria sp. J. Mar. Biol. Assn. India,42(1&2): 151-152.

Kaladharan, P., R.Gireesh and K.S.Smitha. 2003. Cost effective medium for the laboratory culture of live feed microalgae. J. Seaweed Res. Utiln., 24(1): 35-40.

Kunda, S.K. and P. Kaladharan, 2003. Agar factory discharge as fuel and manure, J. Seaweed Res. Utiln., 25(1 & 2): 165-168.

Kaladharan, P., S.Veena and E.Vivekanandan, 2009. Carbon sequestration by a few marine algae: Observation and projection. . J. Mar. Biol. Assn. India,51(1): 107-110.

Kaladharan, P and P. K. Asokan. 2012. Dense bed of the seagrass Halophila beccarii in Kadalundi Estauary, Kerala. Mar. Fish. Infor. Serv., T. & E. Ser., 212: pp. 18.

Kaladharan, P., N. Kaliaperumal and J.R. Ramalingam, 1998. Seaweeds - Products, Processing and Utilization. Mar. Fish Infor. Serv., T & E Ser., No. 157: 1-9.

Kaladharan, P and Koya, K P Said and Sulochanan, Bindu, 2012. Seagrass - Meadows and Conservation. Geography and You, 12 (75). pp. 24-27.

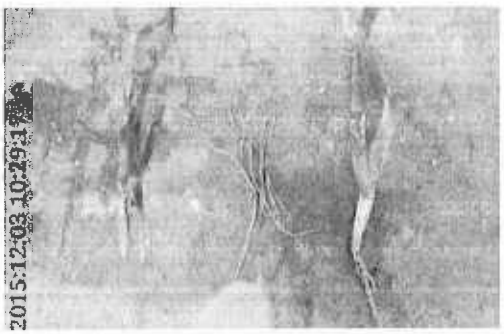
Kaladharan, P., P.U. Zacharia and K.Vijayakumaran. 2011. Coastal and marine floral biodiversity along the Karnataka coast. J. Mar. Biol. Assn.of India, 53 (1): pp. 121-129.

Kaladharan, P. and P.U., Zacharia, 2008. Seagrass, Ruppia maritima growing along backwaters of Karnataka coast- a possible source of salt tolerant gene. Mar. Fish. Infor. Serv., T&E Ser. 197: pp 11.

Kaladharan, P., 2001. Seaweed resource potential of Lakshadweep. In: Geological Survey of India Special Publication, 56. pp. 121-124

Kaladharan, P., K.A. Navas and S. Kandan .1998. Seagrass production in Minicoy Atoll of Lakshadweep Archipelago. Indian J. Fish., 45 (1): pp. 79-83.

Shoots of
Thalassia hemprichii



Bed of seagrass species: *Cymodocea*, *Syringodium* and *Halodule*

Leaves of *Syringodium*

Bed of *Halophyla beccarii*