IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 3, Issue 1, March 2023
Impact Factor: 7.301

Study of Sponges in Sapad Lake, Kalyan Maharashtra (India) and the Effect of Human Interference on Sponge Abundance

Juliya Palande[1] and Mansi Phanse[2]
Post Graduate Research Centre, Department of Zoology[1,2]
DSPM's K V Pendharkar College (Autonomous), Dombivli, Thane, Maharashtra, India
juliyac21@gmail.com[1] and mansiphanse@gmail.com[2]

Abstract: *Freshwater sponges, one of the important invertebrate fauna of aquatic ecosystem, are understudied compared to their marine forms. The infrequent records of their occurrence indicate the paucity of work on them. The study presents diversity of sponges in a lake of Kalyan, Maharashtra (India). Four species of sponges belonging to family Spongillidae were found in Sapad lake. A significant decline in sponge abundance was noted after the lake restoration. The sponge population and species number were found reduced post dredging activity. This study showed the deteriorating effect of human interference on freshwater sponges, and would thus, prove beneficial for lake management plans in future.*

Keywords: Freshwater sponge, Sapad lake, human interference, water parameters, lake restoration

I. INTRODUCTION

Lakes are standing waterbodies waterbodies and usually ephemeral, that undergo seasonal fluctuations in water levels. Of all the freshwater fauna, sponges are apparently understudied. Few handful reports are available on freshwater sponges in Maharashtra, India [1,2,3,4,5,6].

Freshwater sponges belong to phylum Porifera and are exclusively aquatic animals. They are dependent on water for their life processes such as nutrition and reproduction. They are sessile forms and feed on suspended particles brought by water currents. The sexually produced larvae are planktonic forms that swim in the aquatic medium and settle on a suitable substratum to develop into an adult sponge. In unfavourable conditions like desiccation, sponges undergo dormancy and produce asexual reproductive bodies called gemmules. To return from dormant to active phase, the gemmules require water to hatch and give rise to new sponge individuals.

Apart from the water requirement, other factors which control the sponge distribution are wave action, substrata and light availability in the waterbody [7]. Being sessile in nature, sponges are dependent on hard substrata for attachment and growth. The light availability seems important only for the algae-associated sponges.

II. MATERIAL AND METHODS

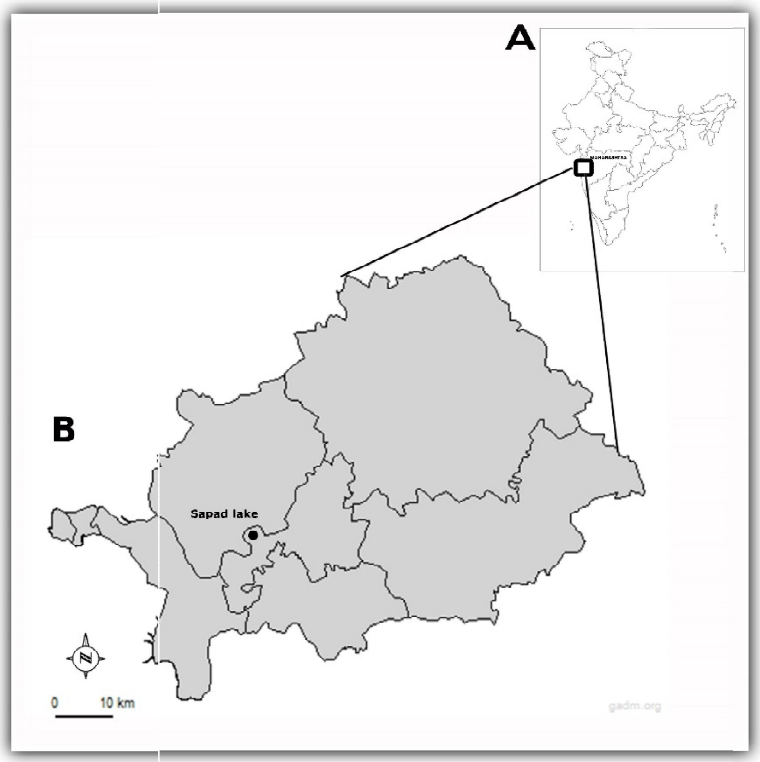
2.1 Study Area

Sapad lake is located in Kalyan taluka of Thane district, Maharashtra (India). The area of this lake is 8,677 sq.m.and its coordinates are Latitude 19°16'11" N and Longitude73°06'33" E. This lake is located at the edge of the Sapad village, and is used for fishing and agricultural purpose in the nearby farms.

2.2 Sponge Collection and Identification

Sponges were observed at shallow areas of the lake, on different substrata like large stones, branches, concrete-built steps, etc. Live sponges were observed from October to January when lake water levels were slightly receded. The substrata were fully exposed during dry season. Small amounts of sponge samples were collected and preserved dry. For identification, sponge material was processed by boiling in concentrated Nitric acid, washing the dissociated spicules with distilled water, rinsing in ethanol followed by observation of spicules on slides under Light Microscope [8]

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 3, Issue 1, March 2023
Impact Factor: 7.301



A. Map of India showing location of study area
B. Map of Thane district showing location of Sapad lake

Image of Sapad lake

Fig. 1. Map of India showing location of Study Area

2.3 Water Analysis

Water samples were collected from the surface of the lake in polyethene bottles and carried to the laboratory for physico-chemical analysis following standard methods [9]. Samples were analysed for general parameters like Temperature, pH, Total Dissolved Solids, Dissolved Oxygen, Total Hardness and Silicates. Water analysis was carried for the pre-monsoon (February- May), monsoon (June- September) and post-monsoon (October- January) period of two years, 2019 and 2022.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 3, Issue 1, March 2023
Impact Factor: 7.301

III. RESULTS

Sapad lake was found to inhabit four species of sponges belonging to family Spongillidae: *Corvospongilla lapidosa, Corvospongilla ultima, Radiospongilla cerebellata* and *Eunapius carteri.*

3.1 Description of Freshwater Sponges

Recent classification of Freshwater Sponges was checked in World Porifera Database [10]. It is as follows:

Phylum: **Porifera** Grant, 1836
Class: **Demospongiae** Sollas, 1885
Subclass: **Heteroscleromorpha** Cárdenas, Perez & Boury-Esnault, 2012
Order: **Spongillida** Manconi & Pronzato, 2002
Family: **Spongillidae** Gray, 1867

A. Corvospongilla lapidosa

Encursting sponge; Surface with spiny projections. Colour off-white, grey to light brown. Megascleres stout and slightly curved amphistrongyla (length 288-276 µm, width 24-25 µm). Microscleres are pseudobirotules with smooth shaft and recurved hooks at the tips (length 24-36 µm, diameter of rotules 5-12 µm). Gemmoscleres are stout amphistrongyles of varying dimensions, covered with blunt spines (length range 48-72 µm, width range 12-14 µm).

B. Corvospongilla ultima

Encursting sponge; Surface shows distinct radiating furrows. Colour off-white to grey in dry sponge. Megascleres stout amphioxea (length 240-276 µm, width 12-24 µm). Microscleres are pseudobirotules which are characteristic of the genus (length 22-35 µm, diameter of rotules 5-11 µm). Gemmoscleres are amphistrongyla, stout, moderately curved, irregularly spined, and of largely different dimensions(length range 36-84 µm, width 12-20 µm).Most of the specimen spicules showed mixture with those of *C. lapidosa*.

C. Radiospongilla cerebellata

Sponge with finger-like projections. Megascleres, entirely smooth oxeas (length 288-360 µm, width 12-14 µm). True microscleres absent. Gemmoscleres slender amphistrongyla, ranging from 84-96 µm in length, slightly curved, covered with abundant spines that are erect and subdivided at the centre and recurved towards the tips. Gemmules present at the base of the sponge, white in colour, large and spherical (diameter 550–648 µm).

D. Eunapius carteri

Sponge conical to roughly circular in shape. Dried specimens are pale yellow to light brown. Surface irregular with one or two large oscula. Megascleres smooth pointed amphioxeas, straight to slightly curved, (length 350-375 µm, width 14–24 µm). Microscleres absent. Gemmuloscleres resemble megascleres but comparatively smaller in size, (length 150-230 µm, width 10-12µm). Gemmules abundant and large in size (diameter 487–600 µm) scattered throughout the skeleton of sponge.

A

B

C

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 3, Issue 1, March 2023
Impact Factor: 7.301

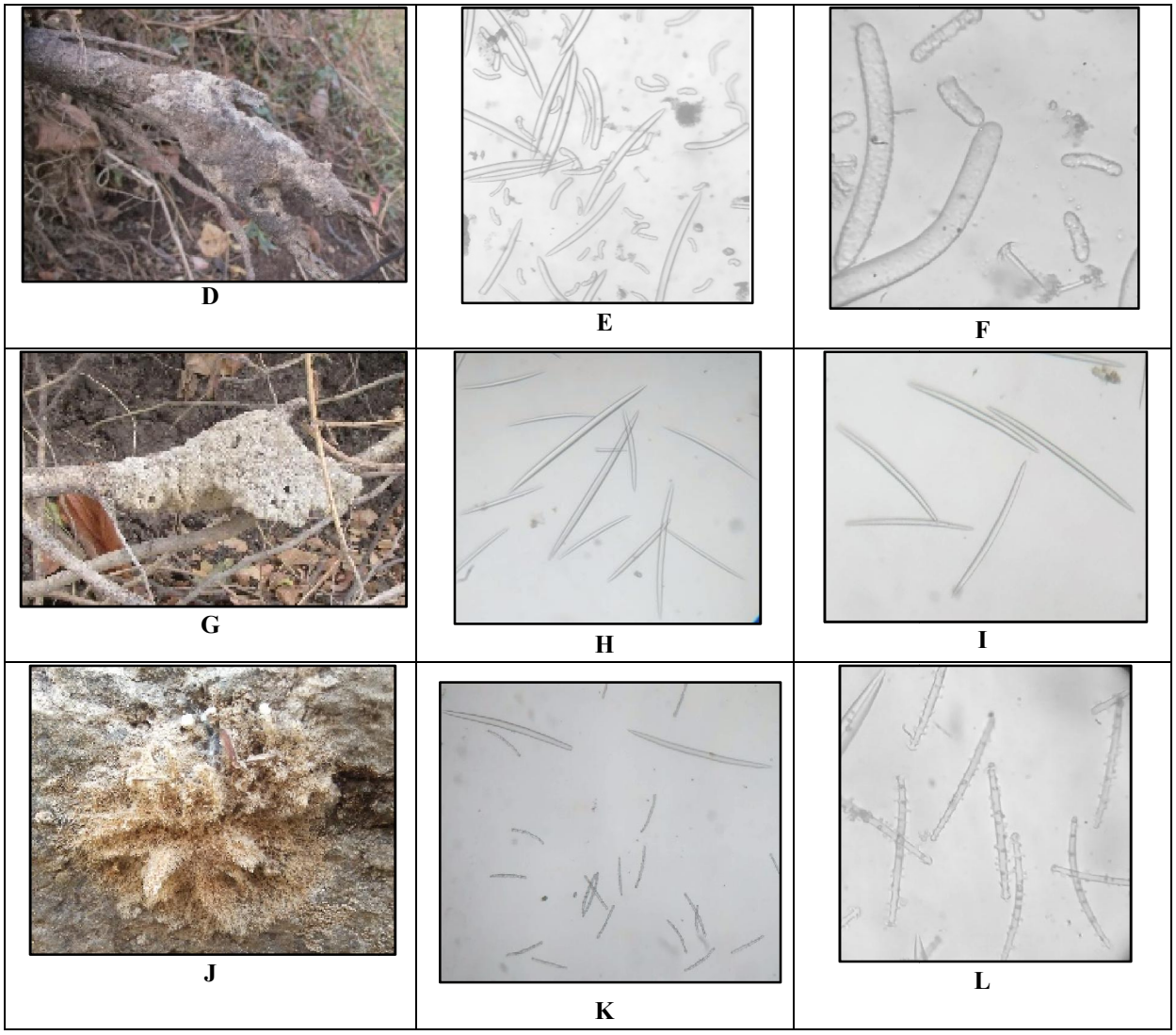


Fig. 2 Freshwater sponges and their spicules

(A) C. *lapidosa* dry sponge; (B)*C. lapidosa* spicules (LM, 10X); (C) *C. lapidosa*microsclere, gemmoscleres (LM, 45X); (D)*C. ultima* dry sponge; (E)*C. ultima* spicules (LM, 10X); (F) *C. ultima*microsclere, gemmoscleres (LM, 100X); (G) *E. carteri* dry sponge; (H)*E. carteri* spicules (LM, 10X); (I) *E. carteri* gemmoscleres (LM, 45X); (J) *R. cerebellata* dry sponge; (K)*R. cerebellata* spicules (LM, 10X); (L) *R. cerebellata* gemmoscleres (LM, 45X)

Rock fully covered with sponges in 2019	Rock sparsely covered with sponges in 2022

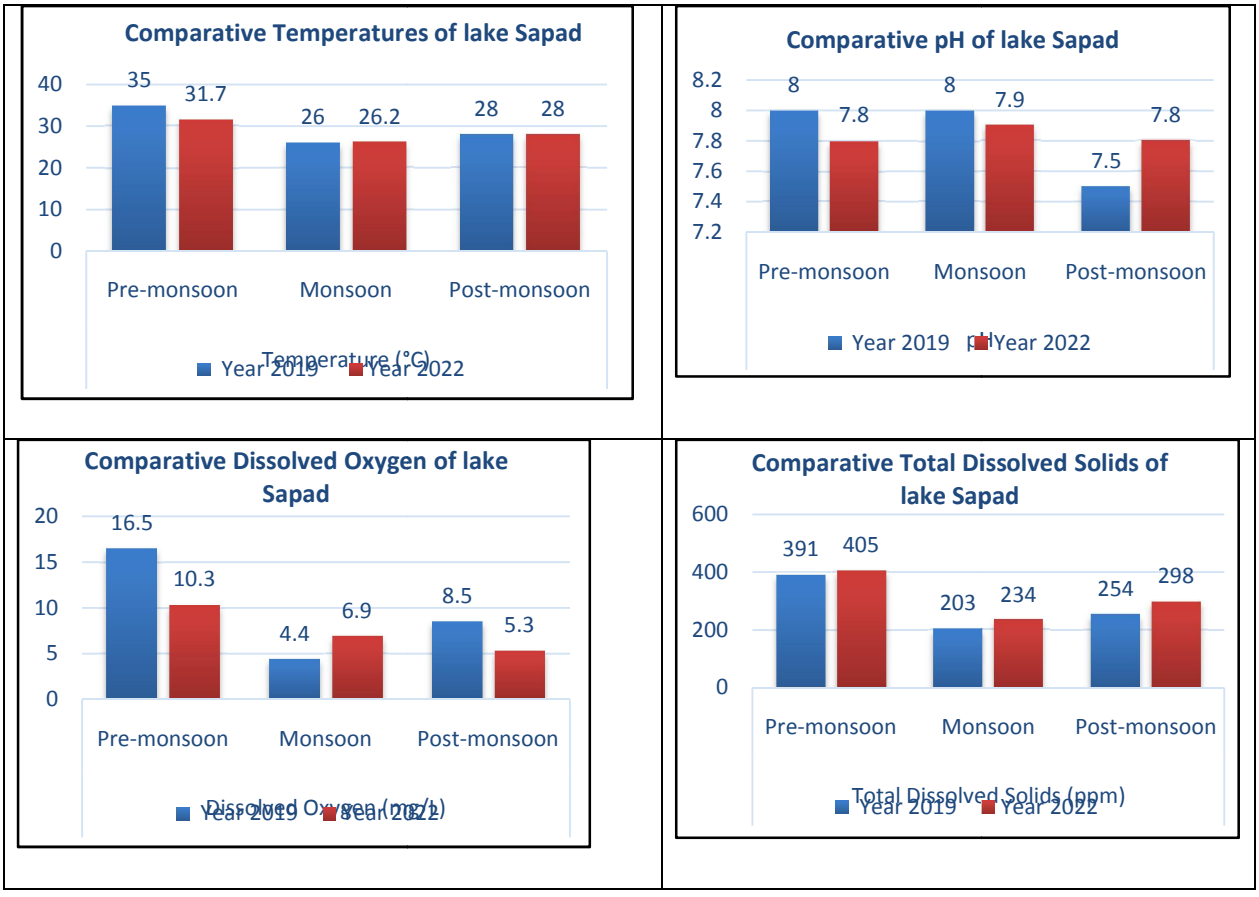
Fig. 3 Difference in sponge occurrence on the same substratum before and after dredging.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 3, Issue 1, March 2023
Impact Factor: 7.301

3.2 Water Parameters of Sapad Lake

The water parameters of lake Sapad are represented graphically.

1. **Temperature:** Temperature is a critical factor controlling the active phase and dormancy in sponges. The production of gemmules is accompanied by change in temperature [11]. Sapad lake showed highest temperature 35°C in summer and lowest 26°C in monsoon.
2. **pH:**Sponges are known to inhabit slightly alkaline waterbodies. Lakes with pH range 6.4–10.3 were known to harbour different sponge species [12]. Sapad lake showed pH range 7.5 to 8.0 which is suitable for sponge growth.
3. **Dissolved Oxygen**:Sponges were known to thrive in waters with DO ranging from 3.0 to 11.01 mg/l [12]. DO values below 3-4 mg/ L are unsuitable for aquatic life forms. In our study, DO was found to be highest 16.5 mg/L in summer and lowest 4.4 mg/L in monsoon, which are suitable not only for sponges but for all life forms.
4. **Total Dissolved Solids (TDS):**High TDS reduces the light penetration and affects photosynthetic activity and primary productivity of lakes. TDS was found to be ranging from 203- 405 ppm which is slightly high for lake waters. Also, TDS showed slight increase over four years of study.
5. **Total hardness**:Total Hardness is due to certain ions present in lake water. Studies have demonstrated that sponge development is supported by ions like calcium, magnesium, sodium and potassium even in low concentrations, whereas the absence of these ions in water have inhibited sponge growth [13]. In our study, total hardness was recorded to be 98- 161.2 mg/L indicating the availability of ions for sponge growth. However, the hardness values were found to slightly increase over four years of our study.
6. **Silicates:** Biogenic silica is required by sponges for their skeletal growth. The number and morphology of sponge spicules vary directly with lake silica concentrations [7]. Silicates were found to be in the range of 6.3-10 mg/L



IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 3, Issue 1, March 2023
Impact Factor: 7.301

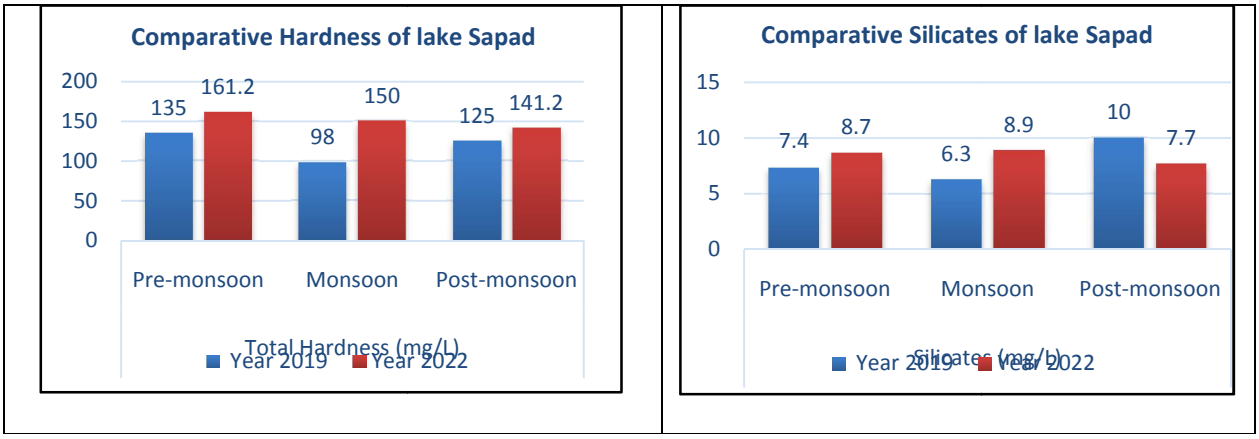


Fig. 4 Graphical representation of Water parameters of Sapad lake.

IV. DISCUSSIONS

In lentic waterbodies, the changing water levels can be the main limiting factors for sponge growth. Apart from substrata availability, the regular contact with water is important to complete the sponge life cycle. The wave action in shallow waters of lakes can limit sponge occurrence [7]. Somewhat similar observation was noted in our study.

Over the four years duration of our study, change in the freshwater sponge abundance in the lake was observed. The size of the sponge population was not estimated, but decline in the frequency of their occurrence was noted by us. The rocks on which sponges flourished, showed very few sponge individuals, while some stones showed absence of sponges.

Recently, lake Sapad was restored by dredging the bottom of the lake, probably to increase its water retention capacity and for fish culture. Such dredging activity usually disturbs the bottom sediments and the benthic fauna. Despite the presence of substrata, the sponge population was reduced. Moreover, no significant change was noted in the water parameters of lake Sapad, except for slight increase in the TDS and Hardness. This indicates that the availability of water to the sponges could have been the limiting factor. The reduced water levels at the peripheral areas of Sapad lake due to dredging activity, have possibly affected the sponge population on the substrata.

During the first year of study, large growth of sponges was observed on the rocks at the periphery of the lake which used to be completely under water during the rainy season, facilitating the growth of sponges. However, this did not happen after the digging of the lake and thus decline on the sponge population was noted.

Human interference has been long known to affect aquatic fauna, and sponges are no exception. Freshwater environments have been globally impacted by human activities resulting in the change in abundance of sponges [14]. Sponges are at risk due to environmental alterations and pollution [15]. The hazardous effect of dredging has been demonstrated in marine sponges [16], and suggest that the suspended sediments released in water column due to dredging can cause clogging of the aquiferous systems and reduce feeding in benthic sponges.

Few studies suggest that freshwater sponges show variations in the species occurrence and in their population size in response to the fluctuating water levels. The least disturbed stagnant lake showed well flourishing five sponge species, while the other one facing great fluctuation in waterlevel showed a very sparse population of a single species [12]. A fairly large sponge population was observed in the undisturbed waterbody of fort tank [6].They have also commented on the deterioration of freshwater habitats by human activities and its effect on sponge populations.

Disturbance in the habitat by dredging activity and the resulting decline in sponge population of Sapad lake was observed by the authors. The number of sponge species was also found to be reduced. Out of four species observed before dredging, we found only three species post dredging. Such impact on the sponge population and their species diversity would consequently lead to their local extinction in future. Since sponges are known to harbour some other invertebrate groups like molluscs, nematodes, insects and their larvae [17], the lake restoration might have affected these animal populations as well. The dredging activity in a lake of Kashmir, India, was known to affect macro zoobenthos community structure including effects on species richness, diversity and reduction of benthic habitat [18].

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 3, Issue 1, March 2023
Impact Factor: 7.301

V. CONCLUSION

Our study highlights the deteriorating effect of human activities on freshwater sponge abundance. Conservation of sponge fauna is imperative due to its ecological significance in aquatic ecosystems. They can be conserved if their habitat is conserved, and thus anthropogenic activities that disturb the freshwater habitats, need to be monitored. Lake restoration is an environmentally effective measure, and these activities should be carefully planned and implemented giving consideration to these neglected group of animals, sponges.

ACKNOWLEDGMENT

The authors are grateful to the Council of Scientific and Industrial Research, New Delhi for providing funds for this work under Junior Research Fellowship. We are also thankful to the management of DSPM's KV Pendharkar College for providing laboratory facility.

REFERENCES

[1]. N. Annandale, The Fauna of British India, including Ceylon and Burma. Freshwater Sponges, Hydroids and Polyzoa. Taylor and Francis, London, pp. 251, 1911.

[2]. Kakavipure and Yeragi, "Occurrence of fresh water sponge Eunapius carteri (Bowerbank, 1863) from Khativali-VehloliLake near Shahapur District, Thane, Maharashtra, India," in Sengupta, M. & R. Dalwani (Eds.) Proceedings of Taal 2007: The 12th World Lake Conference, pp. 500–505, 2008

[3]. S. Mokashe and A. Harkal, "A note on occurrence of Spongilla lacustris (Linnaeus, 1769) and Corvospongilla (Annandale, 1911) from Aurangabad, Maharashtra, India," International Journal of Pure and Applied Zoology, vol. 1 (4), pp: 344-346, 2013.

[4]. R. Jamdade and V. Deshpande, "Freshwater sponge fauna (Porifera: Spongillidae) from Satara region of Western ghats, India," Advances in Applied Science Research, vol. 5(2), pp. 347-352, 2014.

[5]. S.S. Jhakalekar and H.V. Ghate, "A note on five freshwater sponges (Porifera: Spongillina: Spongillidae) from Pune, Maharashtra, India," Journal of Threatened Taxa, vol. 5(9), pp. 4392- 4403, 2013.

[6]. S.S. Jhakalekar and H.V. Ghate, "Taxonomy of freshwater sponges of Maharashtra, India, with illustrated descriptions and notes on ecology and habitats (Porifera: Spongillida: Spongillidae)," Zootaxa 4173 (6), pp. 501–529, 2016.

[7]. T.M. Frost, Porifera, In J. Thorp & A. P. Covich (Eds.), Ecology and Classification of North American Freshwater Invertebrates, Academic Press Inc., San Diego, pp. 95–124, 1991.

[8]. R. Manconi and R. Pronzato, "Rediscovery of the type material of Spongilla lacustris (L., 1759) in the Linnean herbarium," Italian Journal of Zoology, Vol. 67 (1), pp. 89-92, 2000.

[9]. [9] R. K. Trivedy and P. K. Goel, Chemical and Biological Methods for Water Pollution Studies, Environmental publications, Navman Prakashan, India, pp. 1-96, 1986.

[10]. [10] de Voogd, N.J.; Alvarez, B.; Boury-Esnault, N.; Carballo, J.L.; Cárdenas, P.; Díaz, M.-C.; Dohrmann, M.; Downey, R.; Goodwin, C.; Hajdu, E.; Hooper, J.N.A.; Kelly, M.; Klautau, M.; Lim, S.C.; Manconi, R.; Morrow, C.; Pinheiro, U.; Pisera, A.B.; Ríos, P.; Rützler, K.; Schönberg, C.; Vacelet, J.; van Soest, R.W.M.; Xavier, J., World Porifera Database, Accessed at https://www.marinespecies.org/porifera on 2023-02-20.

[11]. T. D. Soota, "Freshwater Sponges of India," Records of the Zoological Survey of India, Occasional Paper 138, p. 14, 1991.

[12]. M. M. Saxena, "Freshwater sponge fauna (Porifera) of coastal waters of India," Wetlands Ecology and Management, Vol. 29, Springer Nature, pp. 767–774, 2021.

[13]. T. Strekal and W. Mcdiffett, "Factors Affecting Germination, Growth, and Distribution of the Freshwater Sponge, Spongilla fragilis Leidy (Porifera)," Biological Bulletin, Vol. 146 (2), pp. 267-278, 1974.

[14]. J.J. Bell, E. McGrath, A. Biggerstaff, T. Bates, C.A. Cárdenas, H. Bennett, "Global conservation status of sponges," Conservation Biology, Volume 29 (1), pp. 42–53, 2015.

[15]. R. Manconi and R. Pronzato, Phylum Porifera. In J. Thorp, J. & D.C. Rogers (Eds.), Ecology and General Biology: Thorp and Covich's Freshwater Invertebrates. Vol. 1. 4th Edition. Academic Press, London, pp. 133–157, 2015.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 3, Issue 1, March 2023
Impact Factor: 7.301

[16]. Mari-Carmen Pineda, B. Strehlow, M. Sternel, A. Duckworth, R. Jones & N. S. Webster, "Effects of suspended sediments on the sponge holobiont with implications for dredging management," Nature, Scientific reports, 7: 4925, p. 1-15, 2017.

[17]. R. Manconi and R. Pronzato, "Global diversity of sponges (Porifera: Spongillina) in freshwater," Hydrobiologia, 595, pp. 27–33, 2008.

[18]. B. Mushtaq, R. Raina, A. Yousuf, A. Wanganeo and U. Rashid, "Effect of Dredging on the Macrozoobenthos of Hazratbal Basin in the Dal Lake Srinagar Kashmir, India," Jordan Journal of Biological Sciences, vol. 6 (1), pp. 45 – 50, 2013.