International Journal of Applied
and Natural Sciences (IJANS)
ISSN(P): 2319-4014; ISSN(E): 2319-4022
Vol. 3, Issue 1, Jan 2014, 49-56

International Academy of Science,
Engineering and Technology
Connecting Researchers; Nurturing Innovations

SURVEY STUDY OF ARTEMIA IN SOUTHERN SALTPANS OF TAMIL NADU AND ITS ECOLOGICAL RELATIONSHIP WITH PHYTOPLANKTON WITH SPECIAL REFERENCE TO SEASONAL VARIATION

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ABSTRACT

The present study was conducted to observe the *Artemia* population at five different saltpans of three Sothern districts of Tamilnadu namely Kanyakumari, Rameshwaram and Thoothukudi from January 2012 to December 2012 covering three seasons Pre-Monsoon, Monsoon and Post Monsoon. The present work was carried out at Kovalam, Swamythoppu, Puthalam, Tuticorin and Rameshwaram saltpans. An extended effort was made to assess the physico-chemical and biological parameters of these saltpans and also to analyze the ecological relationship among *Artemia* and Phytoplankton with special reference to seasonal variation. Salt pan water samples were collected from five different stations and the physico-chemical parameters were recorded. The samples were concentrated by centrifugation and the cells were counted using Haemocytometer. The phytoplankton cells were observed under microscope and the photos were captured with digital camera. In addition to this, the phytoplankton recorded from these samples were also identified taxonomically. From the results obtained it is clear that Monsoon plays a positive role in the ecological relationship between the phytoplankton and *Artemia* population and at the same time the seasonal variation also plays a major role on the changes of both phytoplankton and *Artemia* population. Hence the further study on this area could demystify more details on the ecological enigmas of saltpans and the ecological relationship between Phytoplankton and *Artemia* in these saltpans.

KEYWORDS: *Artemia*, Ecological Enigma, Monsoon, Saltpans, Seasonal Variation and Phytoplankton

INTRODUCTION

Aquaculture plays a vital role in food production throughout the year. Aquaculture has enormous global economic implications for the 21st century (Leger and Sorgeloos, 1985).

Artemia is a tiny crustacean closely related to shrimp belonging to phylum Arthropoda serves as a food for more than 85% of marine organisms cultivated to date (Kinne, 1977). *Artemia* is an anostracan branchiopod measuring about 0.4 mm in length. It lives in saline lakes or coastal lagoons throughout the world. It is euryhaline animal and it is found in coastal saline and hyper saline water bodies. *Artemia* possesses several features such as small size, easy ingestion, high nutritive value, hardness, high tolerance to various culture environments from nauplii to adult, short generation time sexual maturity within 13-14 days. The case with which *Artemia* cysts can be collected stored and hatched has made them a preferred experimental animal for a variety of laboratory investigation (Sorgeloos, 1980). These features make *Artemia* is an ideal live feed organism and a suitable candidate for mass culture.

Hyper saline environments are important natural assets of considerable economic, ecological, scientific and natural value. These ecosystems span large areas worldwide, not only in salt production areas (solar salt works, slatterns or Salinas) but also in natural lakes and lagoons, and in tidal ponds (Javor, 1989). Hyper saline environments are

generally defined as those containing salt concentrations in excess of sea water - 3.5% total dissolved salts (Das sarma and Arora, 2001).

The exploration of new *Artemia* habitats has been highly motivated in the recent years. As a result, several *Artemia* populations, especially in continental Asia, have been identified and characterized (Triantaphyllidis et al., 1994, Xin et al., 1994; Pilla and Beardmore, 1994; Abatzopoulos et al., 2002).

Spitchak (1980) published a short note on USSR *Artemia* resources and stated that numerous water bodies of the arid zone of the USSR have already been surveyed for *Artemia*, which has been found in more than 40 lakes and coastal lagoons.

Solovov and Studenikina (1990) reported on a dozen *Artemia* sites in western Siberia and described the characteristics of its brine shrimp populations and the abiotic conditions of their environment. He studied in more detail; the populations were classified as *Artemia salina*, belonging to different varieties as often used in older *Artemia* literature.

India has 1, 78,848 ha of salt works in the east and west coastal length stretching about 8000 km. More than 70 % of the salt works use sea water and the remaining use underground water ranging from 30 to 130 ppt. In South India, the Kanyakumari and Tuticorin districts cover about 421.5 and 3467.2 ha of salt work area, respectively.

In Kanyakumari district the *Artemia* population of parthenogenetical species was found only in the salt works of Swamythoppu. The population density ranged between 8 to 644 per liter and the biomass ranged between 0.01 g/l to 1.43 g/l. In Chidambaranar district *Artemia* population was recorded in five salt works namely Karapad, Vaipar, Veppalodai, Melmentha and Kayalpattinam. In all these five salt works only *A. parthenogenetica* population were observed.

The number of studies that has been performed on *Artemia* and phytoplankton's ecological relationships in natural biotopes is very limited; in most of the cases these studies refer to small-sized salt lakes, or to manmade salt ponds (e.g. Herbst, 2006; Tanner et al., 1999; Warnock et al., 2002). Persoone and Sorgeloos (1980) and Lenz (1987) reviewed literature data on the productivity of *Artemia* habitats in natural environments, both inland and coastal salt lakes.

Management and protection of these changing ecosystems depend upon an understanding of the influence of salinity on biological productivity and community structure. The *Artemia* population is able to influence phytoplankton composition by feeding on them; therefore there is a continuous reciprocal interaction between *Artemia* and phytoplankton population in hyper saline environments (Persoone and Sorgeloos, 1980).

The present study was attempt to explore the new horizons on the survey study of *Artemia* and its ecological relationships with the primary producers in hyper saline environments in order to provide a better understanding of the dynamics of these unique ecosystems and the ecological role of these biological communities. This study also provides the detail on the role of seasonal variation (Monsoon) on *Artemia* population.

MATERIALS AND METHODS

Study Area

For the present study five saltpans of southern Tamilnadu namely, Kovalam, Swamythoppu, Puthalam, Tuticorin, and Rameshwaram were selected.

Kovalam Saltpan

The total area of Kovalam saltpan is about 60 acres of land. It receives water directly from the Arabian Sea.

Swamythoppu Saltpan

Swamythoppu Saltpan has a total area of 250 acres. It is bordered by Manakudi estuary on one side, and coconut farms on the remaining sides.

Puthalam Saltpan

Puthalam Saltpan has a total area of 280 acres of land. It is bordered by Manakudi estuary on one side and coconut farms on the other sides. This saltpan receives water from the Manakudi estuary.

Tuticorin Saltpan

Tuticorin is located about 590 kilometres south of Chennai and 190 kilometres north east of Thiruvananthapuram (Trivandrum). Thoothukudi has 25, 000 acres covered under salt pans.

Rameshwaram Saltpan

In Rameshwaram the saltpans are situated as Mookaiyur village. The total area used for saltpan includes 26 acres.

Sample Collection

The present study was under taken for a period of one year from January 2012 to December 2012. The water samples were collected in the sterile bottle samplers at fortnightly basis during the morning hours between 6 am to 8 am. The collected samples were packed, labeled and brought to laboratory for further analysis.

ANALYSIS OF PHYSICO-CHEMICAL PARAMETERS

Measurement of Water Temperature and Water Depth

The water temperature was measured by using a Standard Mercury Filled Centigrade thermometer where as the depth of water was measured using a meter scale.

Measurement of p^H and Salinity

The p^H was measured by p^H meter (ELICO L1613) for the sample collected from different places of saltpans where as the salinity was measured using Refractometer (ERMA-RHS10ATC).

Estimation of Dissolved Oxygen (DO)

The water samples collected for the estimation of dissolved oxygen were fixed in the field and the same were analyzed in the laboratory by Winkler´s method as described by Strickland and parsons (1972).

Concentration of Samples

The samples were concentrated by centrifugation method. Here 50 ml of sample from each bottle were transferred in to a clean centrifuge tube. The tubes were centrifuged at 4000 rpm for 20 minutes using **REMI-R 8C Laboratory centrifuge**. The supernatant was discarded and 1 ml of pellet was transferred in to a fresh eppendroff tubes and preceded further for counting.

Counting of Phytoplankton

The counting was performed by **Haemocytometer method (H-Slide).** Here 0.0001µl of concentrated and thoroughly mixed sample was transferred to the counting chamber and the cells present in each chamber were counted. The values were calculated by the following formula,

$$\text{Total no. of cells/ml} = \frac{\text{No .of cells counted}}{\text{No. of squares counted}} \times \text{Total No. of squares counted} \times 10000$$

Observation of Phytoplankton

The observation of phytoplankton was done with the help of Light microscope **(COSLAB)**. Here one drop of concentrated and thoroughly mixed sample was transferred to a clean glass slide. The sample was gently covered by applying a clean cover slip over it. Then the slide was placed on the microscopic stage and the phytoplanktons present in the sample were observed under 40X magnification. The phytoplankton observed under microscope were captured with the help of a digital camera **(MDCE-5C)** and the pictures were saved to the attached computer. These captured pictures were further analyzed for identification of phytoplankton.

Identification of Phytoplankton

The identification of Phytoplankton was carried out with the help of standard books and phytoplankton identification manuals by Mitra, Banerjee and Tomas.

Studies on *Artemia* Population from Different Saltpans

The water sample were collected fortnightly for *Artemia* population studies, here one liter of water sample was collected from each places. Then the number of *Artemia* present in each sample was calculated by pipette counting method. Finally the *Artemia* population was expressed in terms of numbers /liter.

RESULTS

Analysis of Physico-Chemical Parameters

The variation in water temperature, water depth, p^H, salinity and Dissolved oxygen with their statistical mean and standard deviation are represented in table 1.

Cell Density of Phytoplankton

The densities of phytoplankton recorded during the present study are represented in the table 1.

Identification of Phytoplankton

During the present study, 20 species of Phytoplankton were recorded and taxonomically identified. Some of them are represented in Table 2.

Effect of Seasonal Variation on Phytoplankton

The result on abundance of phytoplankton recorded during the present study covering the three seasons namely pre-monsoon, monsoon and post-monsoon are represented in table 2.

The *Artemia* Population at Different Saltpans

During the present study three types of *Artemia* were found in all these saltpans namely *Artemia nauplii,* pre-adult *Artemia* and adult *Artemia*. The population level responding the maximum and minimum numbers are represented in table 3.

DISCUSSIONS

The major goal of the present study was to conduct a survey on *Artemia* population at five different saltpans of three Sothern districts of Tamilnadu namely Kanyakumari, Rameshwaram and Thoothukudi from January 2012 to

December 2012 covering three seasons Pre-Monsoon, Monsoon and Post Monsoon. The present work covered up the five southern saltpans of Tamilnadu namely Kovalam, Swamythoppu, Puthalam, Tuticorin and Rameshwaram saltpans for this study. An extended approach was made to assess the physico-chemical and biological parameters of these saltpans and also to analyze the ecological relationship among *Artemia* and Phytoplankton with special reference to seasonal variation.

The characteristics of the shallow waters in these saltpan ecosystems are constantly charging as dictated by the requirement for salt production. During the study period, some months did not show any *Artemia* population that may be due to the changing salinity and water depths. Not only salinity and water depth but also illumination, temperature, $_{P}$H, water current, oxygen concentration, organic matter, sediment structure and temperature fluctuates the *Artemia* production in saltpans. Similar findings were made by Brown and Frank (1960).

From our study it's clear that salinity influences the Planktonic population in the saltern ecosystem. In this aspect our study supports the earlier work done by Balasubramaniam and Kannan (2005). Extending to our results we state that absence of *Artemia* may occur due to the high salinity, temperature and low food (phytoplankton) in the water. Similar findings were observed by Kuruppu and Ekarathe (1995).

The fluctuation of *Artemia* population observed in the saltpans may be due to the seasonal variation (Monsoon). This finding was also supported by Davis (1980). Their study described that the populations of *Artemia* were determined by temperature.

From the previous research, conducted on *Artemia* surveys it's established that *Artemia* population exhibit an ecological dependency with phytoplankton. This dependency is highly fluctuated by monsoonal influence. During the present study a correlation between *Artemia* and Phytoplankton were found. Similar observation was also made by Wurtsbaugh and Berry (1990).

CONCLUSIONS

From the present survey study on *Artemia* Population in five southern saltpans of Tamilnadu, *Artemia* population was best observed in Kovalam saltpan which was followed by Tuticorin and Puthalam saltpans. Extending to the conclusion it is stated that monsoonal change showed that there is an elegance ecological relationship between the phytoplankton and *Artemia* which in turn affect the quality of salt, produced during these seasons, hence further study regarding the effect of seasonal variation in these saltpans are needed. A thorough monitoring of phytoplankton in relation with season will also help to harvest the economically valuable *Artemia* population from these serene saltpans of southern Tamilnadu.

ACKNOWLEDGEMENTS

The authors are thankful to Ms. S. Saranya for her contribution during the present study.

REFERENCES

1. **Abatzopoulos, T.J., Beardmore, J.A., Clegg, J.S. and Sorgeloos, P.** 2002. *Artemia*: Basic and Applied Biology. Kluwer Academic Publishers, Dordrecht, the Netherlands.
2. **Balasubramanian, R. and Kannan, L.** 2005. Physical-chemical characteristics of the coral reef Environs of the Gulf of Manner Biosphere Reserve, India. *Int. J. Environ. Sci*., 31: 265-271.
3. **Brown Jr., Frank, A.** 1960**.** Ed. Selected Invertebrate Types, New York, New York: John Wiley & Sons, Inc.

4. **Das sarma, S. and Arora, P.** 2001. Halophiles: Encyclopedia of life sciences/ Nature Publishing group (www.els.net).

5. **Davis, J. S.** 1980. Importance of microorganism in solar salt production. Proc. Fourth symposium on salt. A.H. oagan (Ed) Cleveland, PP. 369-372.

6. **Herbst, D. B.** 2006. Salinity controls on trophic interactions among invertebrates and algae of solar evaporation ponds in the Mojave Desert and relation to shorebird foraging and Selenium risk. Wetlands, 26 (2), 475-485.

7. **Javor, B. J.** 1989. Hypersaline Environments. Microbiology and Biogeochemistry. Spriger-Verlag, Berlin.

8. **Kinne, O.** 1977. Research Cultivation. In: Marine Ecology. Vol.3, part II, kinne, O. (Ed).Wiley Interscience, New York, 579-585.

9. **Kuruppu, M. M., and Ekaratne, S. U. K.** 1995. Ecology and population structure of the *Artemia Parthenogenetica* population inhabiting a major salter in Srilanka. *International Journal of salt Lake Research*. 4:117-131.

10. **Lavens, P. and Sorgeloos, P.** 2000. The history, present status and prospects of the availability of *Artemia* cysts for aquaculture. *Aquaculture*, 181: 397–403.

11. **Leger, P.H. and Sorgeloos, P.** 1985. Nutritional Engineering improves outputs of brine shrimp *Artemia*. Aquaculture magazine, 11 (5): 24-30.

12. **Persoone, G. and Sorgeloos, P.** 1980. General aspects of the ecology and biogeography of *Artemia*. In: The brine shrimp *Artemia*. Vol.3. Ecology, Culturing, Use in Aquaculture. Persoon, G., Sorgeloos, P., Roels, O. and E.Jaspers (Eds). Universa Press, Wetteren, Belgium.

13. **Pilla, E. J. S. and Beardmore J. A.** 1994. Genetic and morphometric differentiation in old world bisexual species of the brine shrimp (*Artemia*). *Heredity*, 72: 47-56.

14. **Solovov, V. P. and Studenikina, T. L.** 1990. The shrimp *Artemia* in lakes of Western Siberia: Morphology, ecology, perspectives for economic exploitation (in Russian). (Ioganzen, B.G., Ed.) Nauka, Siberian Branch, Novosibirsk, Russia. 1–81.

15. **Spitchak, M.K. *Artemia* in the USSR,** 1980. In: The brine shrimp *Artemia*. Vol 3. Ecology, culturing, use in aquaculture. (Persoone, G., P. Sorgeloos, O. Roels and E. Jaspers, Eds.) Universa Press, Wetteren, Belgium. pp. 127–128.

16. **Strickland, J. D. H. and Parsons T. R.** 1972. A practical handbook of seawater analysis (2nd Edition), Fisheries Research Board of Canada, Ottawa.

17. **Tanner, R., Glenn, E. P. and Moore, D.** 1999. Food chain organisms in hypersaline, industrial evaporation ponds. *Water Environment Research*, 71, 494–505.

18. **Triantaphyllidis, G.V., Zhang, B., Zhu, L. and Sorgeloos, P.** 1994. International study on *Artemia*. Review of the literature on *Artemia* from salt lakes in the People's Republic of China. *International journal of salt lake research*, 3: 93-104.

19. **Warnock, N., Page, G. W., Ruhlen, T. D., Nur, N., Takekawa, J. Y. and Hanson, J. T.** 2002**.** Management and conservation of San Francisco Bay salt ponds: Effects of pond salinity, area, tide, and season on Pacific Flyway water birds. Water Birds 25 (Special Publication) 2, 79–92.

20. **Wurtsbaugh, W. A.** 1992. Food- web modification by an invertebrate predator in the Great Salt Lake (U.S.A). Oecologia 89: 168-175.

APPENDICES

Table 1: Physico-Chemical and Biological Parameters of the Saltpans Recorded During Present Study

Parameters	Level	Kovalam	Swamythoppu	Puthalam	Tuticorin	Rameshwaram
Water Depth (Cm)	Maximum	19.00±1.63	17.66 ±1.24	15.25±1.63	16.66±4.18	12.00±2.44
	Minimum	12.66±1.69	9.33±1.69	6.33±2.49	10.66±1.24	9.33±2.05
Water Temperature (ºC)	Maximum	28.67±0.23	28.67±0.31	28.75±0.31	32.16±0.23	29.15±0.48
	Minimum	27.16±0.23	28.00±0.40	27.00±0.66	27.27±0.53	27.43±0.46
Salinity (ppt)	Maximum	130.66±0.94	139.33±0.94	221.66±14.33	122.00±2.82	191.00±1.41
	Minimum	57.66±1.24	32.00±1.63	62.66±3.77	46.00±1.41	40.00±0.00
pH	Maximum	8.43±0.03	8.54±0.02	8.41±0.03	8.34±0.01	8.93±0.07
	Minimum	7.60±0.01	8.05±0.01	7.54±0.04	7.96±0.06	7.71±0.03
Dissolved Oxygen (mg/L)	Maximum	6.89±0.24	6.78±0.17	8.23±0.17	6.78±0.24	9.87±0.09
	Minimum	4.89±0.12	4.56±0.21	5.17±0.24	3.71±0.20	3.98±0.26
Phytoplankton Density (No./mL)	Maximum	1783±123	1233±85	1900±128	2383±121	1117±72
	Minimum	850±55	316±22	350±26	416±18	512±26

Table 2: Effect of Seasonal Variation (Monsoon, Pre-Monsoon and Post-Monsoon) on the Abundance of Phytoplankton in Different Saltpans

Classes	Kovalam			Swamythoppu			Puthalam			Tuticorin			Rameshwaram		
	M	PM	Pre	M	PM	Pre	M	PM	Pre	M	PM	Pre	M	PM	Pre
Bacillariophyceae															
Asterionella glacialis	+	-	+	+	-	-	++	+	-	++	+	-	+	+	-
Cylindrotheca closterium	+++ ++	+	+	++ ++	++	+	-	++ ++	+	++ ++	+	++	+	+++	++
Pinnularia gibba	-	+	-	++ +	++	-	+	++	++	+	+	+	++	+	-
Pleurosigma sp	+++ ++	-	++ +	+	-	+	+	++ ++	++	++	++	++	++	+	-
Navicula radiosa	-	+	+	++ +	-	++	-	-	-	++	++	-	++	+++ +	++
Chaetoceros sp	+++ ++	+	+	-	++	+	++	++	++	++ +	+	++	+	+++	+++ +
Nitzschia towutensis	-	-	-	++ +	+	-	-	-	-	++ +	++	+	-	-	-
Chlorophyceae															
Chlorella sp	-	-	-	-	-	-	+	++	-	++ +	++ +	-	+	-	-
Dunaliela salina	+++ ++	+	++ +	++ ++ +	-	++	++ ++	+	+	++ +	++ +	++	++ +	+++	+++
Dinophyceae															
Prorocentrum micans	++	-	+	++	-	-	++	+	+	+	++	-	+	+	-
Cyanophyceae															
Oscillatoria sp	+++ ++	++	+	++ ++	++	+	++ +	++	++	+	++	-	++	+	

Table 3: Population and Types of *Artemia* Recorded from Different Saltpans during the Present Study

Stages of *Artemia*	Level	Kovalam	Swamythoppu	Puthalam	Tuticorin	Rameshwaram
Nauplii (No/l)	Maximum	1033±68	Absent	439±21	528±23	Absent
	Minimum	537±15	Absent	315±14	307±11	Absent
Pre-adult (No/l)	Maximum	466±24	Absent	333±17	466±19	Absent
	Minimum	266±13	Absent	207±11	282±16	Absent
Adult (No/l)	Maximum	2466±95	Absent	733±28	1900±86	Absent
	Minimum	239±18	Absent	274±12	300±16	Absent