

Study of population density and morphological details of *Vorticella convallaria* in freshwater ponds of Nashik district, (M.S), India

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Abstract-

Vorticella Linnaeus, 1767 was the earliest genus name in use for a peritrich and is one of the most common and important groups of ciliates, inhabiting all marine, freshwater and terrestrial biotopes (Corliss 1979; Foissner et al. 1992; Lynn 2008; Sun et al. 2005; Warren 1986). The genus belongs to the family Vorticellidae. In the present article the morphology of *Vorticella convallaria* has been compared with the other species of Genus *Vorticella*. the population density of the present species has been calculated for the two years. As compare to other ciliates the population of *Vorticella* species is seen limited in both the years, January to December 2007 and January to December 2008. It was quite larger in August and September 2007, and it was 16.67% and 17.07%. In the rest of this year it is randomly observed. In January to December 2008 the population of the species is found randomly. The details of the number of animal species have been examined and the month wise prevalence.

Key words- *vorticella*, morphology, prevalence, population density,

Introduction-

The ciliates are one of the most important groups of Protozoa, common almost everywhere there is water (lake, pond, and oceans) and soils with many ecto and endo symbiotic members, as well as some obligate opportunistic parasites. Free living ciliates are found in fresh, marine, estuarine waters and in the soil.

An excellent source is a shallow semi-permanent pond in a farm yard. The marshes and sloughs on the shore of the lakes are often rich sources of food. Any stream large or small, or any freshwater hole, temporary or permanent, water at the base of aquatic plants is likely to be a valuable source of material. Such places as moist crotches or bark (crevices) in trees or any other moist or water containing silt, floating algal mats provide food. Cilium covering the body of the organism or a part of it is a major defining characteristic of this group and hence the phylum name "Ciliophora".

Vorticella Linnaeus, 1767 was the earliest genus name in use for a peritrich and is one of the most common and important groups of ciliates, inhabiting all marine, freshwater and terrestrial biotopes (Corliss 1979; Foissner et al. 1992; Lynn 2008; Sun et al. 2005; Warren 1986). The genus belongs to the family Vorticellidae, a morphologically distinct group within the subclass Peritrichia. *Vorticella* was erected by Linnaeus (1767) to include microscopic "animacules" with a stalk of some sort and a bell-shaped body crowned with a large oral area surrounded by cilia. Ehrenberg (1838) revised and redefined the genus, restricting it to non-colonial peritrichs with a helically contractile stalk. Over the next 100 years, many species of *Vorticella* were described and some obviously did not conform to Ehrenberg's definition of the genus. Noland and Finley (1931) removed all of the clearly unacceptable species, and Foissner and Schiffmann (1974) removed species with a reticulate pattern of silverlines to the genus *Pseudovorticella*, leaving *Vorticella* relatively homogeneous in terms of morphology. The body shape, size, appearance of the peristomial lip, features of the pellicle surface and stalk, pattern of infraciliature, and number of silver-lines are characteristics typically used to characterize and identify species of *Vorticella*. The small sizes of many

species of *Vorticella*, some of which have a cell body that is only 10-30µm long, make it difficult to isolate them and describe the morphological features essential for taxonomic analysis. As a result, less than one-third of more than 200 species, infra species, varieties or forms that were designated in the genus have been described using modern morphological methods. Historically, *Vorticella* was considered to be a well-defined group based on morphological characteristics.

Material and Methods-

For the study of free living ciliates the water samples were collected from different parts of Nashik dist (Deola, Kalwan, Nandgaon, Surgana and Satana) of Maharashtra state.

Water samples were collected in wide mouth, sterilized glass bottles. Due care was taken and the samples were collected from where the submerged plants and decaying leaves were present. Mostly the samples were collected during morning and evening. The temperature of the sample bottles were maintained with the help of ice bags.

Rapid movements of ciliates make it difficult to identify ciliate species. To immobilize their movements methyl cellulose solution was used.

Culture methods –

For cultivation various media are used such as

- Hay infusion
- Wheat infusion
- Rice infusion

Hay infusion

It is one of the methods for the culturing of free living ciliates which gives best result. Hay infusion is suitable medium which supplies nutrients and growth substances which makes ciliates faster multiplication and abundance in their population. Hay infusion (Kirby, 1950) Kasthuribai Saxena and Nasreen recommended the use of hay infusion as an intrinsic and effective culture medium for raising the population of different ciliate species.

Six gram of hay was cut in to small pieces and taken in beaker containing one litre of distilled water and boiled for 15 to 30 minutes and filtered. The filtrate was kept aside for overnight. Next day it was ready to use.

Wheat infusion-

This is also a cheapest and successful method for ciliate culture; boil the distilled water with few whole wheat grains for 10 to 15 minutes. Cool the content and add the collected sample water in the content. Now the culture was kept aside for two to three days. The result was soon showing the number of ciliates in the beaker.

Rice infusion-

Next to wheat it is also a successful method especially for stalk ciliates e.g. *Vorticella*. Whole rice grain or two three crushed rice grains directly add in sample water containing ciliates (not in the powder form).

Hay infusion was mostly in case of *Paramecia*, *Coleps*, *Chilodonella*, *Amphileptus*, *Stylonechia* and *Vorticella*. Rice grain infusion is best for the *Vorticella*, *Stylonechia* and *Coleps* species.

Water sample is obtained from different water bodies contains a mixer of organism, by adding any type of culture media (Wheat or rice infusion) can generally rise the number of certain ciliate species (by rising the bacterial population present) in the water sample, but often lower the number of species. However the rough sample containing several ciliates and unknown bacterial and algal floras can be obtained for several weeks. Selection of a particular ciliate species and culturing it in the isolation of organisms other than its prey may obtain a greater degree of control over a culture.

The choice of culture medium depends largely upon what the ciliate feeds. Many feed upon bacteria and that is why many of the media commonly used are designed to encourage the growth of bacterial

populations. Different culture media and methods published by Mackinnon and Hawes (1961), Kirby (1950) and committee on cultures, Society of Protozoologist (1958).

Culture were examined under low power and then in to high power microscope taking care to focus at all levels in the culture watching for movements of any kind. Movements of ciliates were also trapped in video camera for the proper understanding. Dry silver impregnation was used to study infra-ciliature of the ciliates. For the permanent slides the ciliates were fixed in terms of number of individuals and species composition. Methyl cellulose has been found too many advantages, as it arrest the movement, ciliates can be identified by their appearance. The species identification has been made mainly on the basis of arrangement of cilia, size and shape of body and structure of macro and micronucleus.

Topography-



Genus *Vorticella* Linnaeus, 1767

Systematics

Domain: Eukaryota

Kingdom: Protozoa Goldfuss, 1818, Rown, 1858

Subkingdom: Biciliata

Infrakingdom: Alveolata Cavalier & Smith, 1991

Phylum: Ciliophora Doflein, 1901, Copeland, 1956

Subphylum: Intramacronucleata Lynn, 1996

Class: Oligohymenophorea de Puytorac et al., 1974

Subclass: Peritrichia Stein, 1859

Order: Sessilida Kahl, 1933

Family: Vorticellidae, Ehrenberg, 1838

Genus: *Vorticella* Linnaeus, 1767

Species: *V. Convallaria* Ehrenberg, 1831

Vorticella is a member of class Oligohymenophorea and subclass Peritrichia Stein, 1859. The peritrichs show a much enlarge disc like anterior region with prominent adoral ciliature which winds counter clockwise to the cytostome. This genus belongs to order *Peritrichida* and sub-order *Sessilina*. Mature individuals of this suborder attached to the substrate with contractile or non-contractile stalk.

These ciliates are inverted bell-forms. They are usually colorless yellowish or greenish. Peristome is more or less outwardly extended. These ciliates have food vacuoles which vary in numbers. Macronucleus is band-form. One to two contractile vacuoles are present.

They are found in fresh or salt water, attached to submerged objects and aquatic plants or animals.

Following are the species of genus *Vorticella*.*V. convallaria* Linnaeus, 1767*V. microrostoma* Ehrenberg 1830*V. companula* Ehrenberg 1831*V. picta* Ehrenberg 1831*V. monilata* Tatem, 1870***Vorticella convallaria* Linnaeus, 1767****Month wise Prevalence of freshwater ciliate *Vorticella covullaria* in some common freshwater ciliates**

| Sr. No | Month | No. of water samples examined | No.of+ve water samples | % of Total Prevalence | Total no of +ve samples with <i>V. covullaria</i> | % of Total Prevalence Of <i>V. covullaria</i> +ve samples |
|----------|---------------|-------------------------------|------------------------|-----------------------|---|---|
| 1 | Jan-07 | 45 | 22 | 48.89 | 02 | 09.09 |
| 2 | Feb-07 | 55 | 23 | 41.82 | 03 | 13.04 |
| 3 | Mar-07 | 47 | 20 | 42.55 | 03 | 15.00 |
| 4 | Apr-07 | 60 | 21 | 35.00 | 03 | 14.28 |
| 5 | May-07 | 61 | 19 | 31.15 | 03 | 15.78 |
| 6 | Jun-07 | 67 | 32 | 47.76 | 05 | 15.62 |
| 7 | Jul-07 | 54 | 36 | 66.67 | 05 | 13.89 |
| 8 | Aug-07 | 57 | 42 | 73.68 | 07 | 16.67 |
| 9 | Sep-07 | 58 | 41 | 70.69 | 07 | 17.07 |
| 10 | Oct-07 | 60 | 39 | 65.00 | 06 | 15.38 |
| 11 | Nov-07 | 64 | 41 | 64.06 | 05 | 12.19 |
| 12 | Dec-07 | 49 | 25 | 51.02 | 04 | 16.00 |
| | Total | 677 | 361 | 53.32 | 53 | 14.68 |

Graph-1- SHOWING THE MONTHWISE PREVALENCE OF FREE LIVING FRESH WATER CILIATES during the period from Jan.2007 To Dec.2007

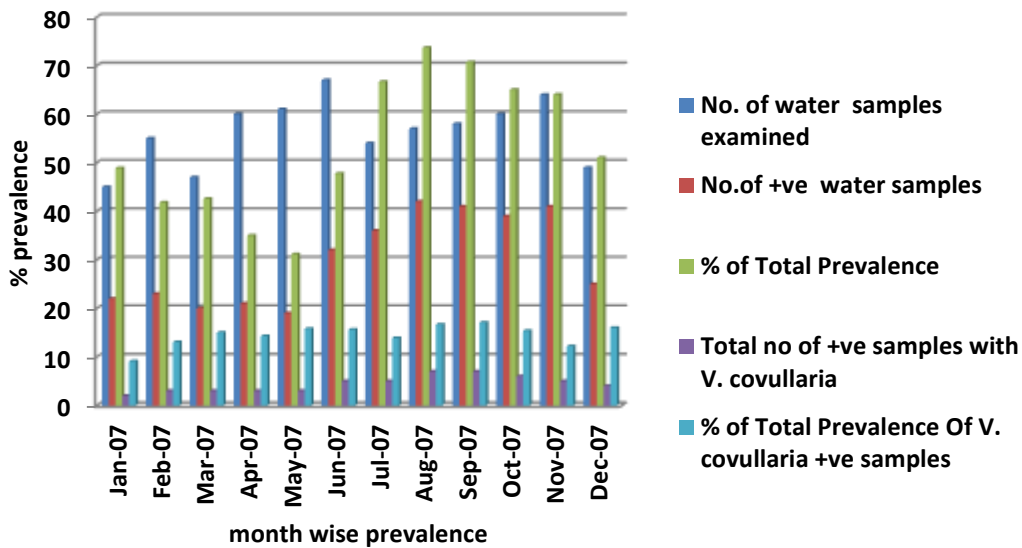
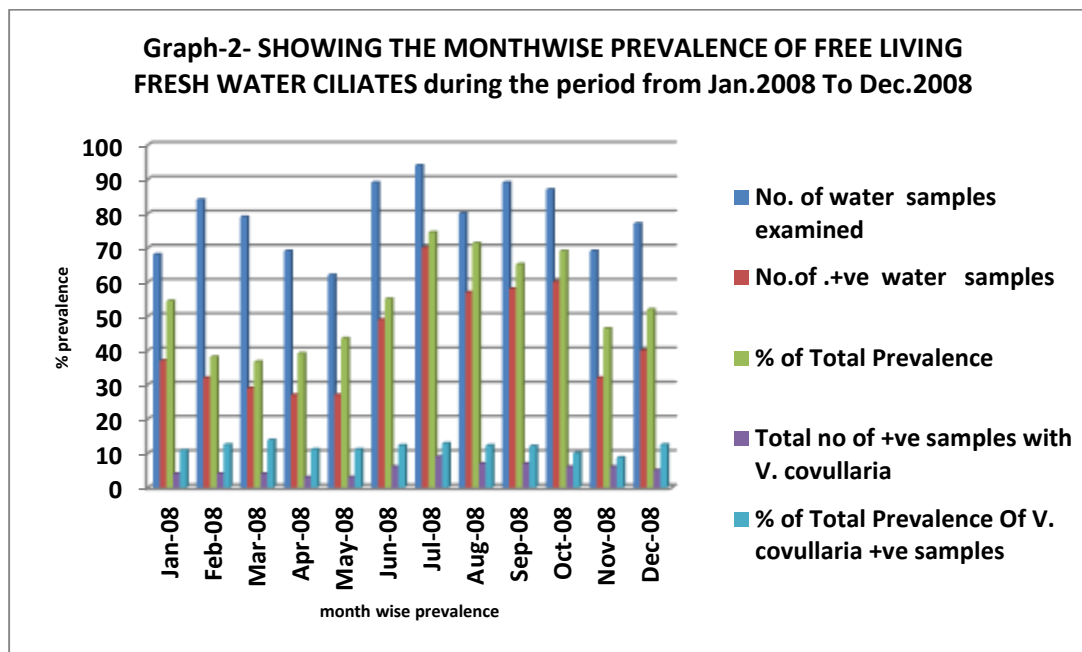


TABLE 2

SHOWING THE MONTHWISE PREVALENCE OF FREE LIVING FRESH WATER CILIATES

during the period from Jan.2008 To Dec.2008

| Sr No | Months | No. of water samples examined | No. of +ve water samples | % of Total Prevalence | Total no of +ve samples with V. covullaria | % of Total Prevalence Of V. covullaria +ve samples |
|-------|---------------|-------------------------------|--------------------------|-----------------------|--|--|
| 1 | Jan-08 | 68 | 37 | 54.41 | 04 | 10.81 |
| 2 | Feb-08 | 84 | 32 | 38.10 | 04 | 12.50 |
| 3 | Mar-08 | 79 | 29 | 36.71 | 04 | 13.79 |
| 4 | Apr-08 | 69 | 27 | 39.13 | 03 | 11.11 |
| 5 | May-08 | 62 | 27 | 43.55 | 03 | 11.11 |
| 6 | Jun-08 | 89 | 49 | 55.06 | 06 | 12.24 |
| 7 | Jul-08 | 94 | 70 | 74.47 | 09 | 12.85 |
| 8 | Aug-08 | 80 | 57 | 71.25 | 07 | 12.28 |
| 9 | Sep-08 | 89 | 58 | 65.17 | 07 | 12.06 |
| 10 | Oct-08 | 87 | 60 | 68.97 | 06 | 10.00 |
| 11 | Nov-08 | 69 | 32 | 46.38 | 06 | 8.69 |
| 12 | Dec-08 | 77 | 40 | 51.95 | 05 | 12.5 |
| | Total | 947 | 518 | 54.70 | 64 | 12.35 |



Percentage of prevalence of free living fresh water ciliates: -

During the period of two years (Jan.2007 to December 2008) a total number of water samples 1624 were examined, 879 of these were positive with free living ciliates.

In the first year (January 2007 to December 2007) 677 fresh water samples were examined, 361 of these were positive with free living ciliates. The percentage of prevalence of free living ciliates was about 53.32%.

In the second year (January 2008 to December 2008) 947 fresh water samples were examined, 518 of these were positive with free living ciliates. . The percentage of prevalence of free living ciliates was about 54.70%.

A month wise analysis in **first year** (January 2007 to December 2007) shows the maximum percentage of prevalence of free living ciliates during August and September (73.68%, 70.69%), lowest in May (31.15%) and minimum to moderate in remaining months.

In second year (January 2008 to December 2008) maximum percentage of prevalence of fresh water free living ciliates was showed again during August and September (74.47%, 71.25%), lowest in February, March and April (38.10%,36.71%,39.13 %) and minimum to moderate in remaining months.

The pattern in both the years suggests that the peak is soon after the monsoon rain. The percentage then gradually reduces at the end of the winter months and reaches a low with the onset of summer.

As compare to other ciliates the population of *Vorticella* species is seen limited in both the years, January to December 2007 and January to December 2008. It was quite larger in August and September 2007, and it was 16.67% and 17.07%. In the rest of this year it is randomly observed.

In January to December 2008 the population of the species is found randomly. The details of the number of animal species have been examined and the month wise prevalence is shown in **Table No1 and 2.**

Description of the species

The present species is collected from the different fresh water ponds of Nashik district. The species is occurred in floating and also in stagnant water bodies in the form of whitish or grayish colonies. Usually they are found attached to organic decaying matters in shallow fresh water in the form of large group but sometimes single forms are also seen.

Body is bell shaped, transparent or slightly yellow to grey in colour. It measures 52 to 97 μ in length and 40 to 54 μ in width. The thick Peristome is with peristomal border or lip which measures about 51 to 71 μ in width. They are attached to substratum with the help of long contractile and tubular stalk; the length of the stalk varies from 300 to 400 μ while width is about 4 to 6 μ .

Macronucleus is curved, band-form and situated at the anterior side. It measures about 60 to 97.5 μ in length and 7.5 to 12.5 μ in width, it is C-shaped and looking dark. There are 1 to 2 contractile vacuoles irregularly distributed in the body. The number of food vacuoles in the cytoplasm are varies from 10 to 18.

The species is usually sessile and found attached to the substratum but rarely free swimming. Present author usually found this species in stagnant shallow water of lakes and ponds.

Plate No. 4



Vorticella convallaria colony



Vorticella convallaria W.M.



Vorticella convallaria F.V.



Vorticella convallaria C.V.

Comments-

This genus *Vorticella* is first reported by Linnaeus, 1767. Later Ehrenberg (1831) reported many species of this genus. After that Tatem (1870), Noland and Finley (1931), Kahl (1935), Nenninger (1948), A. Upadhyaya et.al (2008) and Ping Sun et.al (2011) studied the taxonomy of numerous species. Hall and Dunihue (1931) studied movements of food vacuoles. Kudo (1966), Bick (1972) also studied this genus.

Body of this ciliate is inverted bell-shaped with a long contractile stalk. Peristome is more or less outwardly extended and is similar to all the previous species of genus *Vorticella*. Present species also have inverted bell-shaped body with long contractile stalk. The species has wide anterior end and resembles to *V. companula*, *V. convallaria*, and *V. picta* which also have wide anterior end. Refractile granules are absent in present species this character is differ from *V. companula* because of the dark refractile granules in the cytoplasm *V. companula* looks while present species is yellow to grey in colour. Hence present species resembles to *V. Convallaria* which also has no refractile granules in the body. Peristomal area is narrower than

in *V. campanula*, but it is broader than *V. microstoma*, *V. picta* and *V. monilata*. The dimensions of peristomal area matches with that of the *V. convallaria* (Linnaeus, 1767, Upadhyaya et.al 2008,).

Present author observed 3 to 6 contractile vacuoles in this species but the number varies in *V. campanula*, *V. convallaria*, *V. microstomi*, *V. monilata* and *V. picta*. The contractile vacuoles in Deshmukh's species are 3 to 4.

Macronucleus is band-form in the present species and hence resembles to all the previous species of genus *Vorticella* which also have band-form macronucleus.

Present author compared this species with the other species of genus *Vorticella* and found to be similar with *V. Convallaria* except some minor morphometrics difference and therefore redescribed here as *Vorticella convallaria*.

As shown in Table No.3



Table 3: Comparison of the present species with the species of *genus Vorticella*

| Sr. No. | Particulars | 1 <i>V. companula</i> Ehrenberg, 1831 | 2 <i>V. convallaria</i> Linnaeus, 1767 | 3 <i>V. microstoma</i> Ehrenberg, 1830 | 4 <i>V. picta</i> Ehrenberg, 1831 | 5 <i>V. monilata</i> Tatem, 1870 | 6 <i>V. companula</i> Shaikh, 2006 | 7 <i>V. companula</i> Deshmukh 2010 | 8 <i>V. convallaria</i> Present author |
|---------|-----------------------------|--|---|---|--|--|--|---|--|
| 1 | Body shape | Inverted bell- form | Inverted bell- form | Inverted bell- form | Inverted bell- form | Inverted bell- form | Inverted bell- form | Inverted bell- form | Inverted bell- form |
| 2 | Body dimensions | L-50-157 μ W-35-99 μ | L-50-95 μ W-35-53 μ | L-35-83 μ W-22-50 μ | L-41-63 μ W-20-37 μ | L-50-78 μ W-35-57 μ | L- 45-169 μ W- 30-79 μ | L-70.37-102.15 μ W-56.75-79.45 μ | 52-97 μ by 40-54 μ |
| 3 | Peristome dimensions | 60-125 μ wide | 55-75um wide | 12-25um wide | 35-50 μ wide | 36-63 μ wide | -- | 62-84 μ wide | 51 to 71um wide |
| 4 | Stalk dimensions | L- 50-415 μ W- 5.6-12 μ | L- 25-460 μ W- 4-6.5 μ | L- 50-415 μ W- 5.6-12 μ | L-205-500 μ W- 4-7 μ | L- 50-200 μ W- 5-6.5 μ | -- | L- 68.1-215.65 μ W- 4.54-6.81 μ | L- 300 to 400 μ W- 4 μ |
| 5 | Refractile granules | Present in endoplasm | absent | absent | Present in stalk | absent | Present in endoplasm | Present in endoplasm | absent |
| 6 | Contractile vaoules | 1-2 | 1-2 | 1-2 | 2 | 2 | 1 | 3-4 | 3-6 |
| 7 | Mcronucleus | Band-form | Band-form | Band-form | Band-form | Band-form | Band-form | Band-form | Band-form |
| 8 | Habitat | Fresh water | Fresh water | Fresh water | Fresh water | Fresh water | Fresh water | Fresh water | Fresh water |

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