CHAPTER VI

SECONDARY SUCCESSION

INTRODUCTION

Ecosystems undergo structural and functional changes as time goes by. A number of these alterations are minor and they affect only small vicinity; others are the source of major changes in the species there and affect the ecosystem as a whole (Charles Kendeigh, 1961). According to Odum (1971), succession is a consequence of the alterations and is defined as a series of progressive changes in an area with one community replacing the other until a climax community is created. The climax community as a rule provides a glimpse of the crucial development of the ecosystem (Smith, 1977).

Succession can be of two types viz: primary and secondary. According to Bentor and Wernor (1974), when the inhibitory factor is removed, secondary succession takes the ecosystem to maturity. The sequence of communities during succession is known as a sere, and the type of sere is determined by the type of colonies in the environment. For example, a hydrosere is a series of successions in an aquatic environment. During the process of succession, energy flow in an ecosystem is primarily changed and the changes are established in the extent of standing crop in the ecosystem.

In the beginning seral stages, the energy input to the system is larger than the energy output. The energy flow is at the highest during the climax stage. The accumulation of energy as biomass is most obvious in land based ecosystem. In this ecosystem, trees usually represent the form of the climax community and the standing
crop is at a maximum. In aquatic ecosystems, the climax community may be represented by phytoplankton, making the standing crop small yet the high metabolic rate gives high productivity that maximizes the energy flow in the ecosystem (Smith, 1977).

The number of species present in all successions progresses rapidly as plants and animals colonize the area (Smith, 1977). At first, the increase in diversity is very rapid. However, in later seres the rate of increase decreases. Typically, there is a decrease in the diversity towards the end of the succession. This decrease is mostly due to increasing interspecies competition, and means that it is the intermediate seres, which contain the largest number of species at any one time during the succession.

In seasonal or temporary ponds, the primary succession takes place during rainy season, or when water is pumped in from an external source. Even though the process of succession is studied in aquatic and terrestrial ecosystem, there is no work available on the physicochemical changes in such aquatic ecosystems during the process of succession. In this context, the present investigation was planned to study the physicochemical changes associated with the process of secondary succession and this study was restricted to the College pond only.

**MATERIALS AND METHODS**

The study of secondary succession was conducted in the College pond from 28 – 10 – 2003 to 28 – 11 – 2003. As there was meager rainfall after July 2003 to October 2003, there was no water in the Kaveri from July to October 2003. The pond was filled during November 2003 by pumping water from the river Kaveri and by rainwater. Integrated water samples were collected from the pond. Samples collected from the
different corners and also from the centre were pooled and analyzed. The following water quality parameters were analyzed and recorded by adopting the procedure mentioned in Chapter II.

1. Air temperature
2. Water temperature
3. PH
4. Conductivity
5. DO
6. Free CO₂
7. Acidity PA
8. Bicarbonates
9. Alkalinity TA
10. Chloride
11. Salinity
12. BOD
13. Hardness
14. Calcium
15. Magnesium

In addition to the physicochemical parameters, the pond was observed daily morning and the fauna and flora were recorded to find the means of secondary succession in the pond.
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RESULTS

A perusal on the variation of the physicochemical characteristics of the pond water reveals that the physicochemical and climatic factors have significant role in the process of secondary succession. Variations in the air and water temperature of the study pond during the period of investigation are presented in figure 6.1 and 6.2 respectively. Both the figures reveal a decrease in temperature from 1st November onwards with the onset of monsoon. Then a steady decline in water temperature was noticed until 21st November. On 22nd November, there was a sudden increase in air and water temperature and then it once again decreased to 24°C on 25th and 26th of November.

Variations in pH during the study period (figure 6.3) reveal an increasing trend with the progression of days. The pH increased from 6.7 to 8. There was an intermediate peak of 7.8 on 13th of November. The increase in pH seems to have relationship with rainfall and decrease in temperature. In contrary, there was a decline in conductivity after a slight initial increase (figure 6.4). Figure 6.5 divulges the fluctuations in dissolved oxygen level of the College pond during the study of secondary succession. The level of DO reveals an increase up to 11.34 mg/l on 14th November and then it declined. The free CO₂ was high and high value of 0.44 mg/l was recorded up to 21st of November. Then it decreased suddenly to 0.01 mg/l until the end of the study (figure 6.6).

Phenolphthalein acidity showed a typical fluctuating pattern during the period of study (figure 6.7). There was a decline in acidity on 2nd of November, whereas a sudden increase in phenolphthalein acidity on 18th November. Then once again, decreased level of acidity was recorded.
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Bicarbonates and total alkalinity showed initially a fluctuating but decreasing trend up to 16th November. Then a slight increase in total alkalinity and bicarbonate levels was recorded (figures 6.8 and 6.9). Likewise, chloride and salinity showed similar pattern of initial decrease up to 9th November. Then it increased after 10th of November and then an increase was observed till 20th November with a peak of 79.52 mg/l chlorinity and 0.1325 ppt of salinity.

The BOD was recorded once in 5 days. There was an initial increase in BOD, followed by decrease up to 20th day. Afterwards, a steady increase was found (figure 6.12). A perusal on the figure 6.13 reveals a decrease in hardness up to 8th November and from 12th November there was an increase. Calcium level showed random fluctuations (figure 6.14) during the period of investigations. Magnesium levels also showed an initial decrease up to 15th day and then showed an increasing trend (figure 6.15).

The appearances of faunal and floral communities during the experimental period are presented in figure 6.16 and 6.17 respectively. It reveals that succession started with the appearance of frog egg from 2nd day, mosquito larvae from 3rd day and tadpole from 8th day. Cyanophytes started blooming from 8th day followed by Chlorophytes (12th day), Xanthophytes, Bacillariophytes, and rooted vegetation.
Figure 6.9 Total alkalinity during the study period

Figure 6.10 Chlorides during the study period

Figure 6.11 Salinity during the study period

Figure 6.12 Biological oxygen demand during the study period

Figure 6.13 Hardness during the study period

Figure 6.14 Calcium during the study period

Figure 6.15 Magnesium during the study period

Chapter VI Secondary succession figures
Figure 6.16 Appearance of fauna during the period of investigation of succession

Fauna
- Snakes
- Snails
- Crab
- Sponges
- Tadpole
- Daphnia
- Eggs of insects
- Eggs of frog
- Anisops
- Water bugs
- Tadpole
- Mosquito larvae
- Frog egg

Days

Figure 6.17 Appearance of flora during the period of investigation of succession

Flora
- Marginal vegetation
- Ottelia
- Nymphaea
- Hydrilla
- Chara
- Bacillarophytes
- Xanthophytes
- Chlorophytes
- Cyanophytes

Days
DISCUSSION

Secondary succession is a sequential progression of events by which the plants and animals reoccupy a location after a period of unfavorable situation. The process of succession in any ecosystem begins with the pioneering community, which is consequently replaced by the higher organisms leading to biodiversity in the ecosystem. The biodiversity will, in turn, lead to the complex interactions between different trophic levels which lead to the stability of the ecosystem. It is generally accepted that succession is unidirectional and has predictable changes which results in the modification of the physical environment by the community Rastogi and Jeyaraj (1986). In a stabilized ecosystem, symbiotic functions between the organisms are maintained which results in the maximum utilization of the available energy. The progressive change in the water quality is having direct relationship with the process of succession. The nutrients carried by the water and the pH and dissolved solids in the water have significant role in the ecosystem. The progression of succession leads to an increase in biomass of that ecosystem (Odum, 1971). The initiation comes from the phytoplankton that cause the major change in the ecosystem. The phytoplankton bloom during the progression leads to the formation of scum giving a musky green cast on the surface of the water. The zooplankton feed on the phytoplankton and bits of organic matter and pave the way for the increase in the population of tadpoles by providing the food for them. During the study period, no fish fingerlings were introduced in the pond. The blooming of sponge was also found in association with the algal scum.
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The results of the present study also reveal that the water quality is much dependent on temperature. The increase in pH may be due to the dissolving of alkaline materials and leaching of minerals added during the progression of succession. The release of ammonia in the water body due to the excretion of zooplankton and tadpoles that are abundant during the middle of the study period also adds to the alkalinity. The initial increase in the conductivity followed by the decrease indicates the utilization of dissolved solids by the phytoplankton which can be used as a source of nutrients for the blooming of the phytoplankton and zooplankton. The fluctuation in the BOD may be related to the blooming of Cyanobacteria and also due to the decrease in the phytoplankton population due to the onset of appearance of the zooplankton and tadpoles in the ecosystem. The appearance of Cyanophytes followed by Chlorophytes, Xanthophytes, Bacillariophytes, and rooted vegetation shows a relationship with the evolutionary trend of the plant kingdom. The rooted vegetation, which is dominated by *Nymphaea sp* and *Ottelia sp*, filled the pond at the end of the study period. In brief, initial stages of secondary succession can be designated as a period of preparation to accommodate the higher fauna.

Mukerjee (1996) described the hydrarch succession into five stages. They are

a. plankton stage,

b. rooted submerged stage,

c. rooted floating stage,

d. reed swamp stage,
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e. sedge meadow stage,

f. woodland stage and finally,

g. forest stage.

During the present investigation it was observed that the secondary succession, led to the formation of the rooted floating stage in 40 days. This means that the secondary succession process may be faster than the primary succession, and the stage up to reed swamp stage may be a process limited to one year. Even though the woodland stage is included in the hydrarch succession, it is not taking place in the entire aquatic ecosystem owing to human intervention.