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Aquatic macrophytes biodiversity assessment from Asolamendha reservoir of Chandrapur district, Maharashtra State (India)

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Abstract
Aquatic macrophytes play important role in aquatic ecosystems functioning. In present study aquatic macrophytes biodiversity assessment recorded from Asolamendha Reservoir which is second largest reservoir of Chandrapur District of Maharashtra state, India. Total 48 aquatic macrophytes species recorded belonging to 28 families and 37 genera. These macrophytes grouped as Floating (03 species free floating and 06 species rooted floating), Submerged (06 species) and Emergent(33species). Emergent macrophytes (68.75%) showing the dominance over floating (18.75%) and submerged macrophytes (12.5%). Angiosperms shows dominance over Pteridophytes and Algae. Cyperaceae is the dominant family which contributes 05 species. For conservation and sustainable utilization of aquatic ecosystem it is necessary to carry out biodiversity assessment of aquatic macrophytes and its importance to ecosystem.

Keywords: Aquatic, Macrophytes, Biodiversity, Asolamendha Reservoir, Chandrapur District, Maharashtra, India

Introduction
Biodiversity provides all basic needs of human being for his well-being and humans indirectly or directly dependent on both terrestrial as well as aquatic biodiversity, as both biodiversities provides natural resources in all manners to humans like cultural, economic, aesthetic, educational and scientific etc. Biodiversity covers all organisms like micro-organism, plants and animals along with its all diverse genetic variations in species, varieties and populations in different habitats, ecosystems and in their natural areas, and its groups increases richness in natural environment (Kulshrestha, 2005) [23].

Aquatic macrophytes are the diverse group of naked aquatic photosynthetic organisms which includes various microalgae ranges from green algae (Chlorophyta), Yellow-green algae (Xanthophyta) and red algae (Rhodophyta) along with Cyanobacteria (Blue Green Algae), mosses and liverworts (Bryophytes), ferns (Pteridophytes) and seed bearing plants (Spermatophytes) and there vegetative plant organs seasonally or permanently grow in the vicinity of water. Macrophytes shows their importance by providing food and habitats for aquatic invertebrates, zooplankton, fishes and aquatic wild life (Lacoul and Freedman, 2006) [25]. Aquatic macrophytes includes largest plants having root, stem and leaves, which sometimes attaches to the bottom (benthic) of water body, they sometimes submerged in water body and sometimes they partly emergent (Chambers *et al*., 2008) [7]. Aquatic macrophytes play important role in aquatic ecosystem by providing food, nutrients and habitats to other aquatic organisms and thus they maintain the aquatic biodiversity. (Agostinho *et al.* 2007a, Theel *et al.* 2008) [2, 36].

If macrophytes present in large quantity also change the abundance, distribution and composition of the aquatic organisms present in aquatic ecosystem (Abubakar, 2012) [1]. Most of the of aquatic plants died and partially decomposed in detritus and now it is primarily consumed by invertebrates, insects and larger crustacean(Madsen, 2009) [27]. Aquatic macrophytes are key components of aquatic and wetland ecosystems (Rejmánková 2011) [30] playing a pivotal role in the ecosystem, like oxygenation of water (Caraco *et al*. 2006) [6], productivity and nutrient retention (Engelhardt and Ritchie 2001) [16], providing

shelter and refuge and food (Wetzel 2001) [39] for aquatic macro-invertebrates and other animals. They also provides food to fishes (Crowder and Cooper, 1982) [9] and birds (Batzer *et al*., 1993) [4]. Aquatic ecosystem provides suitable nesting and feeding habitats for migrating water fowl (Havera, 1999) [20] they play significant role in energy transfer and decomposition in aquatic ecosystem (McQueen *et al*., 1986; Dvorak, 1996) [29, 15].

Aquatic macrophytes also used as bio-indicators of water pollution as they respond to the changes in water quality and also play significant role in mineral cycling and organic components of aquatic ecosystem and because of this they also affect total biomass production in aquatic ecosystem and used as indicator to find out degree of ecosystem damage. Macrophytes having potential to accumulate the heavy metals in water bodies. (Devlin, 1967) [10]. Aquatic macrophytes also useful to evaluate and determine anthropogenic Activities and their impact on aquatic ecosystem (Solak *et al.*, 2012) [34].

But now a day's fresh water ecosystems get affected and decline in its native biodiversity by faster rate than most affected terrestrial ecosystems because of anthropogenic activities, pollution, eutrophication, acidification, invasions of alien species and unpredictable climatic change (Chambers *et al.*, 2008) [7]. Previously studies on zooplankton diversity (Shastakar and Tijare, 2012) [12] and physico-chemical status of Asolamendha reservoir (Tijare and Shastakar, 2015) [37] carried out. But no data available about the aquatic macrophytes because of the this present study was under taken in studied area to summarize the biodiversity assessment of aquatic macrophytes and their categorization which provides important basic data of species diversity for biodiversity conservation.

Materials and Methods

Study Area

The Ashwagandha reservoir is historical lake and constructed for irrigation purpose by Britishers in the year 1918, situated one kilometer away from Pathari village of Sindewahi taluka of Chandrapur district of Maharashtra, India. It is situated at coordinates 20°15'16"N, 79°49'18"E.It is near about 60 km away from Chandrapur city and it is an earth fill reservoir and built on impounds of Pathari river. Length of this reservoir is 1376.52 Meter(4516.1417 Feet) and height of reservoir above lowest foundation is 18.08 Meter (59.3175 Feet).This reservoir catchment area is 24.553 thousand hectors, Gross storage capacity is 67.015 Million Cubic Meter and live storage capacity is 56.375 Million Cubic Meter. This reservoir has ungated spillway and length of slipway is 231.6 Meter (2759.8425 Feet (Fig.01).

Chandrapur district has many coal mines and because of this Chandrapur city is known as a 'City of black gold'.In Chandrapur district there are 7 medium dams and 2497 smaller dams for irrigation purpose. In Chandrapur district largest dam is Erai dam having 225 million cubic meter capacity and made purely for supplying water to Chandrapur Super Thermal Power Station (CSTPS) and Asolamendha dam is second largest dam having the water storage capacity 67.015 million cubic meter, constructed for irrigation purpose (Dudhpachare,2012)[13].

Collection of macrophytes and identification

The Asolamendha reservoir were surveyed for its aquatic macrophytic biodiversity assessment periodically during the period of March 2014 to April 2015 and plant specimen were collected and by following usual laboratory procedures herbarium sheets prepared and collected in Herbarium of PG Dept of Botany, Janata Mahavidyalaya, Chandrapur. All collected aquatic macrophyte species correctly indentified using pertinent literature and flora Cook (1996) [8], Gupta (2001) [17] and Yadav and Sardesai (2002) [40] .These collected macrophytic plants species are classified on the basis of their habitat and morphological characteristics.

Fig 1: Location of Study Area Asolamendha Reservoir, Chandrapur District. (Photograph taken from Google map.)

Results and Discussions

All total 48 aquatic macrophyte species recorded from Asolamendha Reservoir belonging to 28 families and 37 genera. Collected 48 Aquatic macrophytes are classified according to various habitats in three types from Asolamendha Reservoir of Chandrapur District.

1. Floating macrophytes: They float over the water surface and of two kinds.

(A): Free floating macrophytes- Freely floating macrophytes and not fixed to the soil at bottom. Only three species (Table1A) namely *Pistia stratiotes* L., *Lemna minor L. Azolla pinnata* R.Br. recorded as free floating macrophytes.

(B): Rooted floating macrophytes – Floating macrophytes but they anchored down to soil. Six species from four families recorded (Table 1B) namely *Ipomoea aquatica*

Forsk, (Convolvulaceae) *Nymphoides indica* (L.) Kuntze, and *Nymphoides cristata* (*Roxb.*) Kuntz (Menyanthaceae), *Nymphaea nouchali* Burm. F. and *Nymphaea pubescence* Willd. (Nymphaeaceae) *Ludwigia adscendens* (L.) H. Hara (Onagraceae).

Table1 (A): Free Floating aquatic Macrophytes from Asolamendha reservoir, Chandrapur

S. N	Botanical name	Family name	Commonname
1	*Pistia stratiotes* L.	Araceae	Tropical duck-weed
2	*Lemna minor L.*	Lemnaceae	Duckweed
3	*Azolla pinnata* R.Br.	Salviniaceae	Water Fern (mosquito fern)

Table 1 (B): Rooted and floating aquatic Macrophytes from Asolamendha reservoir, Chandrapur

S.N	Botanical name	Family name	Commonname
1	*Ipomoea aquatica* Forsk	Convolvulaceae	Water spinach
2	*Nymphoides indica* (L.) Kuntze	Menyanthaceae	Water Snowflake, Floating hearts
3	*Nymphoides cristata (Roxb.)Kuntz*	Menyanthaceae	Crested Floating Heart
4	*Nymphaea nouchali* Burm. f.	Nymphaeaceae	Red and blue *waterlily*
5	*Nymphaea pubescence*Willd.	Nymphaeaceae	Pink *water-lily*
6	*Ludwigia adscendens* (L.) H. Hara	Onagraceae	Water primrose

2. Submerged macrophytes: These species grow, germinate, and reproduce beneath the water surface. Six species from four families recorded (Table 3) namely *Ceratophyllum demersum L.* (Ceratophyllaceae) *Chara globularis* J. L. Thuller (Characeae). *Hydrilla verticillata* (L. f.) Royle, *Ottelia alismoides* (L.) Pers. and *Vallisneria spiralis* L. (Hydrocharitaceae) *Najas minor* L. (Najadaceae) as submerged macrophytes.

Table 2: Submerged aquatic Macrophytes from Asolamendha reservoir, Chandrapur

S. N	Botanical name	Family name	Commonname
1	*Ceratophyllum demersum L.*	Ceratophyllaceae	Coontail, Hornwort
2	*Chara globularis* J.L.Thuiller	Characeae	Muskgrass
3	*Hydrilla verticillata* (L. f.) Royle	Hydrocharitaceae	Water-thyme,Indian Stargrass,
4	Ottelia *alismoides* (L.) Pers	Hydrocharitaceae	Duck-lettuce.
5	Vallisneria spiralis	Hydrocharitaceae	Tapegrass
6	*Najas minor* L.	Najadaceae	Brittle water- nymph

3. Emergent macrophytes: They grow in shallow water and existing near the wet environment. Total 33 species recorded (Table 03) as emergent macrophytes belonging to 19 families.

Table 3: Emergent aquatic Macrophytes from Asolamendha reservoir, Chandrapur

S.N	Botanical name	Family name	Commonname
1	*Hygrophila schulli* (Harm.) M.R.&S.M.Almeida	Acanthaceae	Marsh Barbel
2	*Sagittaria sagittifolia* L.	Alismaceae	Arrow Head
3	*Alternanthera sessilis* (L.)R. Br. ex	Amaranthaceae	Sessile joyweed
4	*Alternanthera philoxeroides*(Mar)Griesp.	Amaranthaceae	dwarf copperleaf
5	*Eclipta prostrata* (L.) L.	Asteraceae	Bhringraj
6	*Sphaeranthus indicus* L.	Asteraceae	East indian globe thistle
7	*Heliotropium supinum* L.	Boraginaceae	Dwarf heliotrope
8	*Commelina benghalensis* L.	Commelinaceae	Bengal day flower
9	*Commelina hasskarlii* C. Comm. Cyrt.	Commelinaceae	Carolina dayflower
10	*Ipomoea carnea* Jacq.	Convolvulaceae	Pink morning glory
11	*Cyperus rotundus* L.	Cyperaceae	Nut-grass
12	*Cyperus difformis* L	Cyperaceae	Smallflower Umbrella Sedge
13	*Eleocharis geniculata* (L.) R&S.	Cyperaceae	Canada spikesedge
14	*Eleocharis capitata* R. Br.	Cyperaceae	Spike-rush
15	*Eleocharis dulcis* (Burm.F.)	Cyperaceae	Chinese water chest nut Henschel.
16	*Eriocaulon* sp.	Eriocaulaceae	Pipewort
17	*Chrozophora rottleri* (Geisel.) A. Juss. ex. Spr	Euphorbiaceae	Suryavarti
18	*Aeschynomene indica* L.	Fabaceae	Indian jointvetch
19	*Aeschynomene aspera* L.	Fabaceae	Pith plant
20	*Rotala rotundifolia* (Roxb.) Koehne	Lythraceae	Dwarf rotala
21	*Rotala indica* Blatt. &Halb.	Lythraceae	Indian toothcup
22	*Ammannia baccifera* L.	Lythraceae	Blistering ammannia
23	*Marsilea quadrifolia* L.	Marsileaceae	Water Shamrock
24	*Mollugo pentaphylla* L.	Molluginaceae	Five Leaved Carpetweed
25	*Glinus lotoides* L.	Molluginaceae	Lotus Sweet Juice
26	*Ludwigia perennis* L.	Onagraceae	Primrose-willow, Water- primrose
27	*Coix aquatica* Roxb	Poaceae	Aquatic Job's tears
28	*Echinochloa colona* (L.) Link	Poaceae	Wild grass
29	*Cynodon dactylon* (L.) Pers.	Poaceae	Bermuda grass, Indian doob, devil's grass.

30	*Polygonum glabrum* Willd.	Polygonaceae	Marsh buckwheat
31	*Bacopa monnieri* (L.) Wettestin	Scrophulariaceae	Water hyssop
32	*Limnophila sessiliflora* L.	Scrophulariaceae	Asian marshweed
33	*Typha angustata* Bory and Chaub	Typhaceae	Elephant Grass

Out of total collected 48 aquatic macrophytes emergent macrophytes dominating and contribute 33 species(68.75%), followed by Floating weeds they contributes 09 species(18.75%). Floating weeds divides in two groups free floating contributes 03 species(6.25%) and rooted floating contributes 06 species (12.5%) and Submerged weeds contributes 06 species (12.5%). (Fig 2).

Macrophytes recorded from different groups like Algae contributes single species *Chara globularis* J.l. Thuiller (2.08%), Pteridophytes contributes two species namely *Azolla pinnata* R.Br. *Marsilea quadrifolia* L. (4.16%) and Angiosperms contributes 45 species (93.75%).Monocots contributes 18 species(37.5%) and dicots contributes 27 species(56.25%). Angiosperms shows dominance over Pteridophytes and Algae in this reservoir (Fig 3).

In this studied region dominating family is Cyperaceae contributes five species followed by Poaceae, Hydrocharitaceae, Lythraceae three species each and Amaranthaceae, Asteraceae, Commelinaceae, Convolvulaceae, Fabaceae, Menyanthaceae, Molluginaceae, Nymphaeaceae, Onagraceae, Scrophulariaceae contributes two species each. Remaining families Acanthaceae, Alismataceae, Araceae, Boraginaceae, Ceratophyllaceae, Characeae, Eriocaulaceae, Euphorbiaceae, Lemnaceae, Marsileaceae, Najadaceae, Polygonaceae, Salviniaceae, Scrophulariaceae and Typhaceae contributes one species each. Studies on Aquatic Macrophytes and its distribution and classification in India carried out by many researchers (Subrahmanyam,1962;Bhaskar and Razi,1973; Kachroo ,1984;Lavania *et al.*1990; Cook,1996; Baruah and Baruah, 2000; Kothari, 2001; Dutta *et al.* 2002; Maliya and Singh,2004; Dhore *et al.*, 2012; Dhore and Lachure,2014;Kumar and Pal,2015) [35, 5, 21, 26, 8, 3, 14, 28, 11, 12, 24]. Reports on aquatic macrophytes from Chandrpur districts also carried out by some researchers from different region (Khinchi *et al*., 2008; Wadhave *et al.*, 2010; Harney *et al.*, 2013; Sitre, 2013; Sitre *et al.*, 2014 and Harney, 2014) [22, 38, 19, 33, 32, 18].

Fig 2: Data analysis of aquatic macrophytes on the basis of life form of Asolamendha Reservoir of Chandrapur District.

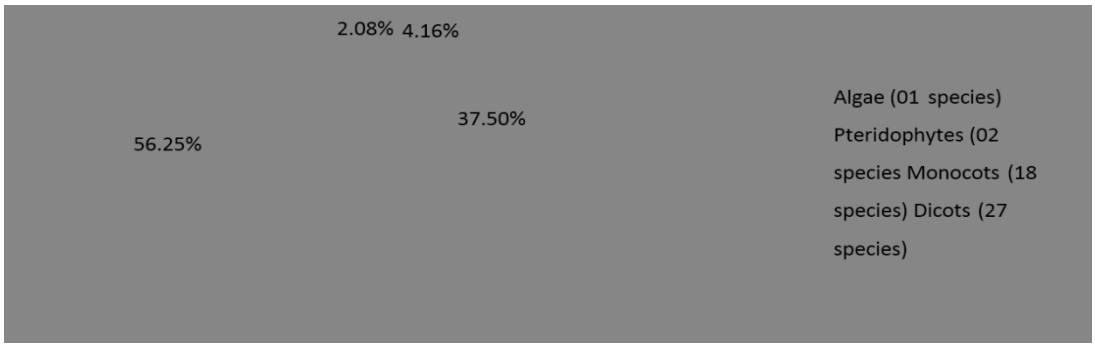

Fig 3: Data analysis on the basis Plant Divisions of Asolamendha Reservoir, Chandrapur District

Biodiversity fulfils all basic needs of human being and it is very important for proper functioning and stability of ecosystem. Aquatic ecosystems also having significant importance for human being. But now a day's these ecosystems get destroyed by many ways like pollution, invasion of alien species, habitat destruction and over-harvesting etc. For protection and conservation of native species and aquatic biodiversity we must first know about its biodiversity potential and its importance. For its conservation and sustainable utilization it is necessary to educate peoples, good management practices and strict legal actions should be taken. For biodiversity conservation and its sustainable use various Non-government organizations should also participate to educate peoples about the importance of such ecosystem to the human society.

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