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ECOLOGY AND FISHERY STATUS OF UKAI RESERVOIR, GUJARAT

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The study dealt with the ecology and fish diversity of Ukai reservoir, Gujarat, which was undertaken during July 2014 to August 2015. During the study 50 fish species belonging to 9 orders, 17 families and 38 genera were recorded. The order Cypriniformes was dominant with 22 species followed by Siluriformes with 12 species. The most abundant species in the reservoir were *Catla catla*, *Labeo rohita*, *Cirrhinus mrigala*, *Labeo calbasu*, *Wallago attu*, *Sperata aor*, *Systomus sarana*, *Clupisoma garua*, *Macrobrachium rosenbergii* and *Ompok bimaculatus*. A total 34 lakh fingerlings of Indian major carps namely catla, rohu and mrigal were stocked in the reservoir during 2013-14, which reflects in the production trend. Fish production data (2014-15) of the reservoir showed that carps contributed 50.68% of the total production followed by catfishes 10.04%, murrels 3.0%, eels 2.86 and others 33.43% with productivity of the reservoir at 279 kg ha^{-1}. Species like *Tenualosa ilisha*, *Tor tor*, *S. seenghala*, *S. aor*, *Labeo fimbriatus* and *W. attu* gradually decreased over the years after impoundment. The study indicated that Ukai reservoir is rich in fish diversity Regular stocking, fishing ban during breeding season, *etc.* would sustain the fish diversity of the reservoir.

Key words: Ecology, fish diversity, Ukai reservoir, management measures, Gujarat.

Introduction

Gujarat has 1635 reservoirs (including small irrigation tanks) with 347659 ha of water area. Ukai reservoir has 36523 ha water area. The maximum and minimum submergence level of the reservoir varied from 91.81 to 103.33 m during 2014-15. Fast-growing Indian major carps occupy a prominent place as commercial fishes in Indian reservoirs. Dam construction has adversely affected populations of species such as *Tenualosa ilisha*, *Tor* spp. *Labeo* spp. and *Cirrhinus* spp.. Major carp species of the order cypriniformis found in Indian reservoirs are *Catla catla* (catla), *Labeo rohita* (rohu), *Cirrhinus mrigala* (mrigal), *Cyprinus carpio* (common carp), *Hypothalamichthys molitrix* (silver carp) and *Ctenopharyngodon idella* (grass carp) (Piska and Rao, 2005). Considerable works have done on ecology and fish diversity of reservoirs of the country and some of them are Ray *et al.* (2014), Vyas *et al.* (2009 and 2012), Mukhopadhyay *et al.* (2004), Das *et al.* (2002), Sugunan (1995, 1997), Khan *et al.* (1996), Rao *et al.* (1991) and Jhingran (1986). This study gives baseline information on ecology and fish diversity of Ukai reservoir, which may be useful for conservation and management of the reservoir fisheries.

Materials and methods

Physical and chemical parameters of water in the reservoir were analysed bi-monthly during July 2014 to August 2015, following APHA (1995). The water samples were collected from different stations covering lentic to lotic zones and most of the parameters analysed in the field using standard procedures. For fish diversity study, fishes were

collected by using different mesh size gill net, cast net, drag net. The fish specimens were also collected from the local landing sites and fish markets for comparison of catch. The specimens were counted and majority of the species were identified on the field itself. The unidentified specimen were preserved in 10% formalin and brought to laboratory for identification. The fishes were identified using standard taxonomic keys of Jayaram (1981), Talwar and Jhingran (1991). To determine the conservation status of the fish diversity IUCN Red List of Threatened Species (2015) was followed (Froese and Pauly, 2015).

Results and discussion

Physico-chemical parameters of water collected from the reservoir during 2014-2015 were provided in Table 1. The water temperature of the reservoir ranged between 25.70-31.20 °C (27.73 ± 1.55 °C), transparency was 29-105 cm (62 ± 21.22 cm). Minimum transparency was recorded at lotic zone (29 cm) and maximum at lentic zone (105 cm). The water pH was on alkaline side ranged from 7.81-8.83 (8.48 ± 0.27). Dissolved oxygen is a critical factor in natural waters and the value was found 6.80-9.64 mg l^{-1} (7.88 ± 1.06 mg l^{-1}). The level of free CO2 ranged between Nil-14 (8.57 ± 2.53 mg l^{-1}). Total alkalinity of the reservoir ranged between 50-135 mg l^{-1} (85.23 ± 35.09 mg l^{-1}) which indicated that the reservoir is productive and mesotrophic in nature. Specific conductivity was recorded 244-294 μ S cm^{-1} (275.92±14.99 S cm^{-1}).

Table 1. Physico-chemical parameters of Ukai reservoir (surface)

Parameters	Range	Mean ± SD
Water temperature (°C)	25.70-31.20	27.73 ± 1.55
pH	7.81-8.83	8.48 ± 0.27
Transparency (cm)	29-105	62 ± 21.22
DO (mg l^{-1})	6.80-9.64	7.88 ± 1.06
CO_2 (mg l^{-1})	Nil-14	8.57 ± 2.53
Total alkalinity (mg l^{-1})	50-135	85.23 ± 35.09
Conductivity (S cm^{-1})	244-294	275.92 ± 14.99

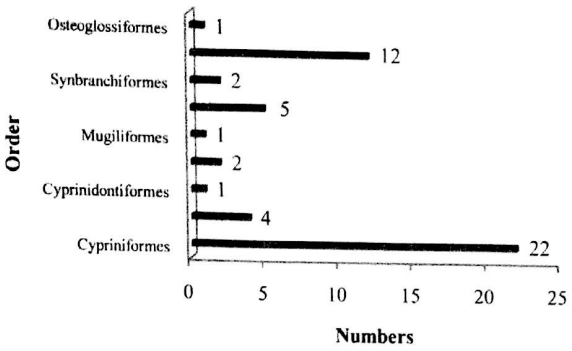

Fig. 1. Order-wise fish species distribution in Ukai reservoir

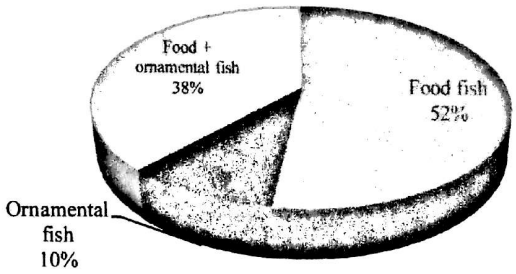

Fig. 2. Utilization of fish species of Ukai reservoir

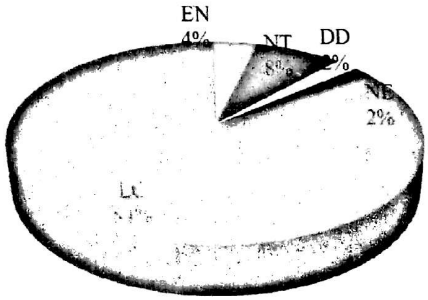

Fig. 3. Conservation status of fish diversity of Ukai reservoir

Sugunan (1995) mentioned mean water parameters of Ukai reservoir was: water temperature 26.5±3.89 OC, transparency 102±83.98 cm, pH 8.3±0.13, DO 8.3±2.97 mg l^{-1} and Specific conductivity 322.3±191.91 mhos. A total 50 fish species recorded during the present study (2014-15) of Ukai reservoir fewer than 9 orders, 17 families and 38 genera (Table 2). Order Cypriniformes dominated the groups with 22 species followed by Siluriformes

Table 2. List of fish species of Ukai reservoir and their biodiversity status

Species	Common name	IUCN Category	Utilization
Amblypharyngodon mola (Hamilton, 1822)	Mola carplet	LC	FF+OF
Barilius bendelisis (Hamilton, 1807)	Hamilton's barila	LC	FF
Catla catla (Hamilton, 1822)	Catla	LC	FF
Chagunius chagunio (Hamilton, 1822)	Chaguni	LC	FF
Cirrhinus mrigala (Hamilton, 1822)	Mrigal	LC	FF
Cirrhinus reba (Hamilton, 1822)	Reba carp	LC	FF
Cyprinus carpio (Linnaeus, 1758)			
Common carp		VU	FF
Garra gotyla gotyla (Gray, 1830)	Sucker head	LC	FF
Garra lamta (Hamilton, 1822)			
Sucker fish		LC	FF
Labeo boggut (Sykes, 1839)	Boggut labeo	LC	FF
Labeo calbasu (Hamilton, 1822)	Orange-fin labeo	LC	FF+OF
Labeo fimbriatus (Bloch, 1795)	Fringed-lipped peninsula carp	LC	FF
Labeo rohita (Hamilton, 1822)	Roho Labeo	LC	FF
Laubuka laubuca (Hamilton, 1822)	Indian glass barb	LC	FF+OF
Ostreobrama cotio (Hamilton, 1822)	Cotio	LC	FF+OF
Puntius sophore (Hamilton, 1822)	Pool barb	LC	OF
Pethia ticto (Hamilton, 1822)	Ticto barb	LC	OF
Rasbora daniconius (Hamilton, 1822)	Slender rasbora	LC	OF
Schismatorhynchos nukta (Sykes, 1839)	Nukta	EN	FF
Salmophasia bacaila (Hamilton, 1822)	Large razorbelly minnow	LC	FF
Systomus sarana (Hamilton, 1822)	Olive barb	LC	FF+OF
Tor tor (Hamilton, 1822)	Maseer	NT	FF
Channa marulius (Hamilton, 1822)	Great snakehead	LC	FF+OF
Channa orientalis Bloch & Schneider, 1801	Walking snakehead	NE	FF+OF
Channa punctata (Bloch, 1793)	Spotted snakehead	LC	FF+OF
Channa striata (Bloch, 1793)	Striped snakehead	LC	FF+OF
Xenentodon cancila (Hamilton, 1822)	Freshwater garfish	LC	FF
Tenualosa ilisha (Hamilton, 1822)	Hilsa shad	LC	FF
Corica soborna Hamilton, 1822	Ganges river sprat	LC	FF
Rhinomugil corsula (Hamilton, 1822)	Corsula	LC	FF
Chanda nama (Hamilton, 1822)	Ganges river sprat	LC	FF+OF
Parambassis ranga (Hamilton, 1822)	Elongate glass-perchlet	LC	FF+OF
Anabas testudineus (Bloch, 1792)	Climbing perch	DD	FF
Oreochromis niloticus (Linnaeus, 1758)	Mozambique tilapia	NT	FF
Glossogobius giuris (Hamilton, 1822)	Tank goby	LC	FF+OF
Mastacembelus armatus (Lacepède, 1800)	Zig-zag *eel*	LC	FF
Macrognathus pancalus (Hamilton, 1822)	Barred spiny *eel*	LC	FF+OF
Clarias batrachus (Linnaeus, 1758)	Philippine catfish	LC	FF+OF
Clupisoma garua (Hamilton, 1822)	Garua bachcha	LC	FF
Heteropneustes fossilis (Bloch, 1794)	Stinging catfish	LC	FF+OF
Mystus bleekeri (Day, 1877)	Day's mystus	LC	FF+OF
Mystus cavasius (Hamilton, 1822)	Gangetic mystus	LC	FF
Mystus gulio (Hamilton, 1822)	Long whiskers catfish	LC	FF+OF
Mystus tengara (Hamilton, 1822)	Tengara catfish	LC	OF
Sperata aor (Hamilton, 1822)	Long-whiskered catfish	LC	FF
Sperata seenghala (Sykes, 1839)	Giant river-catfish	LC	FF
Ompok bimaculatus (Bloch, 1794)	Butter catfish	NT	FF+OF
Wallago attu (Bloch & Schneider, 1801)	Wallago	NT	FF
Pangasius pangasius (Hamilton, 1822)	Pangas catfish	LC	FF
Notopterus notopterus (Pallas, 1769)	Bronze featherback	LC	FF+OF

EN-Endangered, VU-Vulnerable, NT-Near Threatened, LC-Least Concern, DD-Data Deficient, NE-Not Evaluated, FF-Food fish, OF-Ornamental fish.

(12), Channiformes (4), Clupeiformes (2), Synbranchiformes (2) and Osteoglossiformes, Mugiliformes, Cyprinidontiformes with 1 species each order (Fig. 1). Ray *et al.* (2014) reported 39 fish species from Sarani reservoir, family Cyprinid with 24 species dominated the samples. Das and Shrivastava (2003) reported only 27 species from Sarani reservoir. Vyas *et al.* (2009) encountered 52 species belonging to 28 Genera, 13 Families and 7 Orders from submergence area of Indira Sagar reservoir with dominance of family Cyprinidae. Tuli and Pande (1992) reported a total of 24 species in Indira Sagar area before impoundment. Bhatnagar (1973) reported 51 fish species from Bhakra reservoir. The present study coincides with the earlier studies by Vyas *et al.* (2012), Ray *et al.* (2014) in aspects of dominance of cyprinids in the aquatic resources.

Utilization status (based on IUCN category, 2015) of fish species indicated that, 52% of the species comes under food fish category, 10% had truly ornamental value and 38% had both food and ornamental value (Fig. 2). According to IUCN Red List category (2015) global conservation status showed that, maximum species (84%) comes under Least Concern category, fallowed by 8% Near Threatened, 4% Endangered, 2% Not Evaluated and 2% Data Deficient (Fig. 3). Fish species *Schismatorhynchos nukta* and *Cyprinus carpio* were the endangered species in the reservoir.

Stocking of major carps namely *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* at the ratio of 4:3:3 more or less followed over the years at Ukai reservoir (Sugunan, 1995). Sugunan (1997) found direct correlation between stocking rate and production potential. Stocking data for the period of 1908-09 to 2014-15 revealed that, fish stocking maintained from 18 to 77 nos. ha $^{-1}$ (Fig. 4) against estimated fish production level 261 to

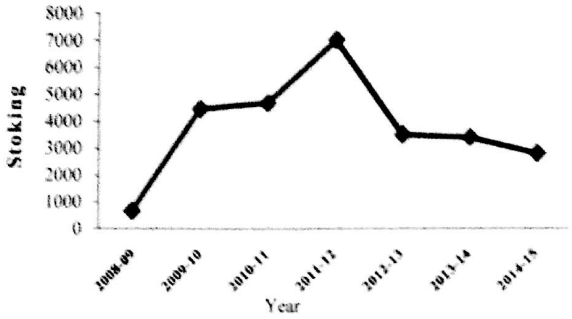

Fig. 4. Stocking density of fingerlings of Ukai reservoir during last 7 years (Source: Department of Fisheries, Ukai district, Gujarat)

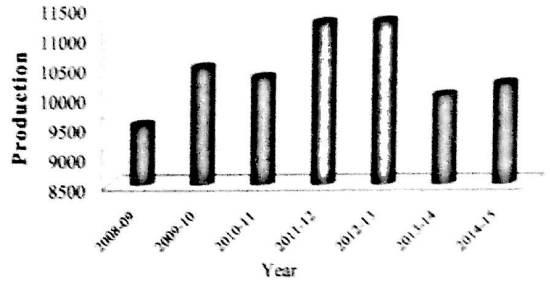

Fig. 5. Production trend of fish (t) of Ukai reservoir during last 7 years (Source: Department of Fisheries, Ukai district, Gujarat)

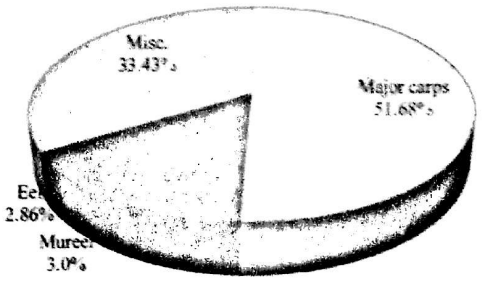

Fig. 6. Group-wise fish catch composition during the year 2014-15

279 kg ha^{-1} (Fig. 5) (Anon, 2015). Compare to other larger reservoir of the country the fish production of Ukai reservoir was found quite impressive and that too possible due to regular stocking of major carps in the system and their success of auto stocking. Time scale fish seed stocking and fish production of Ukai reservoir reported by few authors in the past. Sugunan (1995) reported fish production of 23.6 to 109.2

kg ha^{-1} against fish seed stocking of 5 to 82 nos. ha^{-1} during the year 1983-84 and 1988-89 respectively. Anon (2002) reported fish production of 125.64 to 215.91 kg ha^{-1} against fish seed stocking of 384 to 323 nos. ha^{-1} for the year 1996-97 and 2000-01 respectively.

The fish production of Ukai reservoir was much higher than other larger reservoirs of the country, which were observed by Mahapatra (2003) only 15.6 kg ha^{-1} year^{-1} in Hirakud reservoir and 5-10 kg ha^{-1} year^{-1} in other major reservoirs in Orissa. Srivastava (1985) found fish production at Pong dam 4.1 to 25.08 kg ha^{-1} year^{-1}, Rihand 3.7 to 14.24 kg ha^{-1} year^{-1}, Kangsabati 0.55 to 1. l0 kg ha^{-1} year^{-1}, Gandhisagar 0.52 to 13.3 kg ha^{-1} year^{-1}, Hirakud 10.5 kg ha^{-1} year^{-1}, Sathanur 3.5 to 11 kg ha^{-1} year^{-1}, Tungabhadra 5.54 kg ha^{-1} year^{-1}, Shardarsagar 42 to 56 kg ha^{-1} year^{-1}, Nizamsagar 7 kg ha^{-1} year^{-1}, Kolleru 107 kg ha^{-1} year^{-1}, and Panam 6 kg ha^{-1} year^{-1}.

Ray *et al.* (2014) observed 896 nos. ha^{-1} stocking of IMC in Sarni a medium sized reservoir with fish production 42 kg ha^{-1} during the year 2011-12. Piska and Rao (2005) observed impact of juvenile stocking in a minor reservoir, Bibinagar (23.8 ha) and fish production was found 503.35 kg ha^{-1} against stocking of 2000 nos. ha^{-1}. Khan *et al.* (1996) reported fish production of 101.60 and 102 kg ha^{-1} against fish seed stocking of 360 and 300 nos. ha^{-1} from a small reservoir (Baghla reservoir, 250 ha).

Group wise fish catch composition showed that, major carps contributed highest share (51.68%) of the reservoir during the year 2014-15, catfishes contributed 10.04% (Fig. 6). Piska and Rao (2005) reported that *Catla catla* was the most abundant species, followed by rohu, common carp, mrigal and grass carp at a minor reservoir, Bibinagar, India. Das and Shrivastava (2003) reported 20-70% contribution of catla from IMC groups of medium size reservoir Sarni. Khan *et al.* (1996) found major carps 41.92%, catfishes 34.04% and miscellaneous. fishes 24.02% from Bhagla reservoir during 1990-91. Sugunan (1995) reported 80-85% of Ukai reservoir catch contributed by major carps, catla, rohu, mrigala and indigenous tor. The present finding indicates that Ukai reservoir till dominated by major carps through the percentage composition reduced, which was replaced by catfishes and others minor carps.

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