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**Sauliheen Qadri**  
Faculty of Fisheries, Rangil,  
Ganderbal, SKUAST-K, Jammu  
and Kashmir, India

**FA Bhat**  
Faculty of Fisheries, Rangil,  
Ganderbal, SKUAST-K, Jammu  
and Kashmir, India

**MH Balkhi**  
Faculty of Fisheries, Rangil,  
Ganderbal, SKUAST-K, Jammu  
and Kashmir, India

**TH Shah**  
Faculty of Fisheries, Rangil,  
Ganderbal, SKUAST-K, Jammu  
and Kashmir, India

**Nasir Hussain**  
Faculty of Fisheries, Rangil,  
Ganderbal, SKUAST-K, Jammu  
and Kashmir, India

**Bilal A Bhat**  
Faculty of Fisheries, Rangil,  
Ganderbal, SKUAST-K, Jammu  
and Kashmir, India

**Maheen Altaf**  
Faculty of Fisheries, Rangil,  
Ganderbal, SKUAST-K, Jammu  
and Kashmir, India

**Syed Aalia**  
Faculty of Fisheries, Rangil,  
Ganderbal, SKUAST-K, Jammu  
and Kashmir, India

#### Correspondence

**FA Bhat**  
Faculty of Fisheries, Rangil,  
Ganderbal, SKUAST-K, Jammu  
and Kashmir, India

## Fish biodiversity, catch composition, distribution pattern of fishes in Wular Lake and their conservational measures for sustainable fish production

**Sauliheen Qadri, FA Bhat, MH Balkhi, TH Shah, Nasir Hussain, Bilal A Bhat, Maheen Altaf and Syed Aalia**

#### Abstract

Wular Lake is one of the largest fresh water lakes of Asia. It plays a significant role in the hydrographic system of Kashmir valley and acts as a huge absorption basin for the annual flood waters. Wular with its extensive surrounding marshes is the natural habitat for wild life. The present study was carried out for a period of twelve months from October 2017 to September 2018 at five different sites of the Wular Lake, Kashmir. A total of eight species of fishes were collected from the lake which include *Cyprinus carpio* var. *communis* (Punjaeb Gad), *Cyprinus carpio* var. *specularis* (Punjaeb Gad), *Carassius carassius* (Gang Gad), *Schizothorax niger* (Ale gad), *Schizothorax esocinus* (Churru), *Schizothorax curvifrons* (Satter Gad), *Crossocheilus diplocheilus* (Tethur), *Triplophysa* spp. (Ara Gurun) and *Puntius conchoniis* (Techal Gad). However, among these eight species only five species are of commercial importance in the Lake namely; *C. c.* var. *communis*, *C. c.* var. *specularis*, *C. carassius*, *S. Niger*, *S. esocinus* and *S. curvifrons*. The dominant species in all the five sites of the Wular Lake was *Cyprinus carpio* var. *communis* and contributed 39.52% by biomass and 34.01% by number followed by *Cyprinus carpio* var. *specularis* which contributed 30.57% by biomass and 27.83% by number. *Carassius carassius* contributed 5.85% by biomass and 6.1% by number. Maximum catch composition (by biomass) was recorded in the month of June from Site 4 i.e Watlab and minimum in the month of January from Site 5 i.e Sopore Ghat.

**Keywords:** Wular Lake, catch composition, conservational measures

#### Introduction

The state of Jammu and Kashmir is rich in aquatic resources ranging from ponds, pools, streams, wetlands, springs and rivers to the voluminous lakes in the plains and in the high altitudes. It covers an area of about 2,22,236 sq. km extending from 32° 17'N to 36° 58'N latitudes and from 73° 26'E to 80° 30'E longitudes (Raina, 2002) [30]. The water bodies of Kashmir valley support a wide variety of indigenous and exotic fish species. The major ichthyofauna of Kashmir is represented mainly by the Central Asiatic fauna in which *Schizothorax* group is predominant (Sunder *et al.*, 1979) [30]. Fishes belonging to families Cyprinidae, Cobitidae, Siluridae, Poecilidae, Sisoridae and Salmonidae are found in the valley (Yousuf, 1996, Balkhi, 2005; Bhat *et al.*, 2012) [31, 2].

Water bodies of Kashmir have played a great role in the social, cultural and economic status of the valley. The water system provides the most thrilling recreational spots for skiing, swimming and boating. These water systems of the valley are a great resource of natural products like fish, fodder and a variety of economically important plants. The important water bodies of Kashmir include Dal, Wular, Manasbal, Anchar, Khushalsar, Malpursar, Nilnag, Alapathar, Loolgul, Badsar, Kishansar, Vishansar, Gadsar and Gangabal and River Jhelum.

Wular Lake is one of the largest fresh water lakes of Asia. It is situated in Bandipore district at an altitude of 1,580 m A.M.S. L between 34°16' - 34° 20'N latitude and 74°33' - 74°44' E longitude (Bhat and Pandit, 2014) [3]. It is popular for adventure sports like water sports and water skiing. The lake basin has been reported to be formed as a result of tectonic activity and is fed by the Jhelum River. It plays a significant role in the hydrographic system of Kashmir valley and acts as a huge absorption basin for the annual flood waters. Wular Lake with its extensive surrounding marshes, is the natural habitat for wild life especially different bird fauna. It is also an important fish resource accounting for about 60% of the total fish production in the state (Rumysa *et al.*, 2012) [27]. It is the source of sustenance for a huge chunk of human population living along its fringes.

Based on its high biological, hydrological and socio-economic value, the lake has been declared as a wetland of national importance under the wetlands programme by the Ministry of Environment and Forests, Government of India in 1986 and has been subsequently declared as Ramsar site in 1990 to give it the status of wetland of international importance.

Wular Lake is an important habitat to numerous fish species. In commercial catches, the exotic carps (*Cyprinus carpio* var. *communis* and *Cyprinus carpio* var. *specularis*) contribute 52-67% and the local indigenous fishes like Schizothoracids with other miscellaneous fishes of less economic importance like *Puntius conchoni* (Safaid bachha), *Gambusia affinis* (Maih gad), *Carassius carassius* (Ganga Gad) have been reported to contribute 25–30% of total fish catch (Qureshi *et al.*, 2014) [25].

All the lakes and rivers of the state play a great role in the social, cultural and economic status of the valley. But due to over exploitation of the natural resources by human interferences these water bodies have come under serious threat of depletion. The unabated pollution has resulted in decline of not only some native fish species but the exotics production has also declined from this water body. Wular Lake is also undergoing rapid siltation and the water is contaminated with domestic and industrial wastes, originating mainly from the Srinagar city and entering the lake via river Jhelum thus, posing serious threat to the biological diversity of the lake and is causing great threat to livelihood of thousands of inhabitants round the lake who are exclusively dependent on the lake. Thus it is important to determine the current fish catch, distribution pattern as well as the fish biodiversity of the lake so that the exploited natural resources of the water body are recovered to its natural community structure.

## Materials and Methods

### 1. Selection of Sites

A total of 5 sites were selected in Wular Lake for sampling (Figure 1)

#### Site 1: Lankreshpora

It is in Bandipora Tehsil of Bandipore district in Jammu & Kashmir, India. It is situated at the north-east of Wular Lake about 5 km away from Bandipora.

#### Site 2: Laharwalpora

It is in Bandipora Tehsil of Bandipore district of Jammu & Kashmir, India. It is situated at north-west side of Wular Lake about 4 km away from Bandipora.

#### Site 3: Ashtangoo

It is in Bandipora Tehsil of Bandipore district in Jammu & Kashmir, India. It is situated at the north-west side of Wular Lake about 14 km away from Bandipora and 68 km from district Srinagar.

#### Site 4: Watlab

Watlab is in Sopore Tehsil of Baramulla district in Jammu & Kashmir, India. This site is situated at the centre of Wular lake almost 10 km away from sub-district headquarter Sopore, 25 km away from district headquarter Baramulla and 61 km from district Srinagar.

#### Site 5: Sopore Ghat

It is in Sopore town of district Baramulla. It is situated at the south-west-side of Wular Lake almost 45 km north-west of Srinagar, and 16 km south-west from the city of Baramulla.

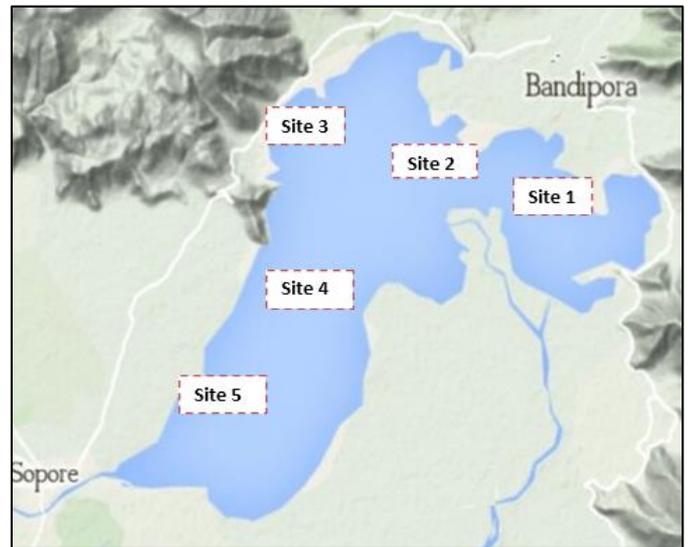


Fig 1: Location of study sites in the lake Wular

## 2. Catch Composition

Random samples were taken from operating gears for catch composition by weight, number and species. The collected catch were sorted species wise and identified with the help of standard taxonomic works (Day, 1878; Hora, 1936; Kullander *et al.*, 1999) [6, 14, 19]. The number of individual fishes of each species was counted & weighed to the nearest gms. Percentage composition of catch (by number & weight) was recorded for twelve months. 10% of fishing boats at each selected site were taken once a month.

## 3. Data Analysis

The data collected was processed, tabulated and analysed keeping in consideration the objectives of the study.

## Results

The present study was carried out for a period of twelve months from October 2017 to September 2018 at five different sites of the Wular Lake, Kashmir. The main fishing gear used in Wular Lake is the cast net. A total of eight species of fishes were identified in the lake which included *Cyprinus carpio* var. *communis* (Punjaeb Gad), *Cyprinus carpio* var. *specularis* (Punjaeb Gad), *Carassius carassius* (Gang Gad), *Schizothorax niger* (Ale gad), *Schizothorax esocinus* (Churru), *Schizothorax curvifrons* (Satter Gad), *Crossocheilus diplocheilus* (Tethur), *Triplophysa* spp. (Ara Gurun) and *Puntius conchoni* (Techal Gad) (Table 1). However, among these eight species only five species are of commercial importance in the Lake namely; *C. c.* var. *communis*, *C. c.* var. *specularis*, *C. carassius*, *S. niger*, *S. esocinus* and *S. curvifrons*. The dominant species in all the 5 sites of the Wular Lake was *Cyprinus carpio* var. *communis* contributing 39.52% by biomass and 34.01% by number followed by *Cyprinus carpio* var. *specularis* which contributed 30.57% by biomass and 27.83% by number. *Carassius carassius* contributed 5.85% by biomass and 6.1% by number. Overall contribution of the carps was recorded as 75.94% by biomass and 67.94% by number. Among Schizothoracids, *S. niger* contributed the maximum catch of 15.52% by biomass and 15.61% by number. This was followed by *S. curvifrons*, contributing 10.03% by biomass and 10.48% by number and *S. esocinus* which contributed 6.5% by biomass and 6.7% by number. In general, Schizothoracids contributed 32.05% by biomass and 32.79% by number in the lake. *Crossocheilus diplocheilus* contributed

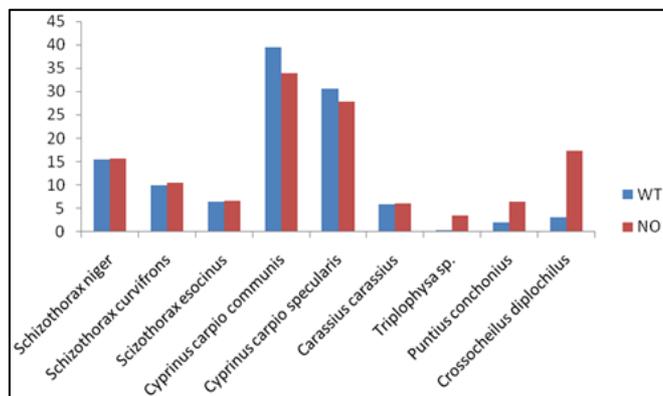
3.06% by biomass and 17.25% by number whereas *Puntius conchoni* contributed 2.01% by biomass and 6.5% by number. However, *Triplophysa* spp. contributed minimum to the overall catch i.e 0.45% by biomass and 3.42% by number. Maximum catch composition (by biomass) was recorded in the month of June from Site 4 i.e Watlab and minimum in the month of January from Site 5 i.e Sopore Ghat.

**Table 1:** Fish species presently encountered from the Wular Lake

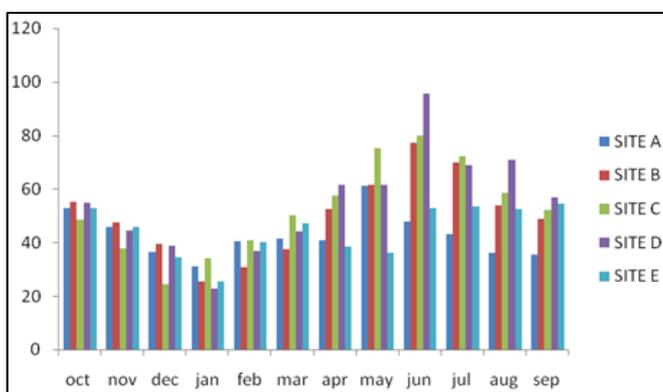
S.No	Fish Species	Local Name
1	<i>Schizothorax niger</i> - Heckel, 1838	Ale gad
2	<i>Schizothorax esocinus</i> -Heckel, 1838	Churru
3	<i>Schizothorax curvifrons</i> -Heckel, 1838	Satter Gad
4	<i>Cyprinus carpio</i> var. <i>communis</i> -Linnaeus, 1758	Punjaeb Gad
	<i>Cyprinus carpio</i> var. <i>specularis</i> -Linnaeus, 1758	Punjaeb Gad
5	<i>Carassius carassius</i> -Linnaeus, 1758	Gang Gad
6	<i>Triplophysa</i> spp. -Heckel, 1838	Ara gurun
7	<i>Crossocheilus diplocheilus</i> -Heckel, 1838	Tethur
8	<i>Puntius conchoni</i> -Hamilton, 1822	Techal Gad

**Table 2:** Percentage contribution of fishes by biomass and number

S. No.	Name of the fish	Biomass (%)	Number (%)
1	<i>Schizothorax niger</i>	15.52	15.61
2	<i>Schizothorax curvifrons</i>	10.03	10.48
3	<i>Schizothorax esocinus</i>	6.5	6.7
4	<i>Cyprinus carpio</i> var. <i>communis</i>	39.52	34.01
	<i>Cyprinus carpio</i> var. <i>specularis</i>	30.57	27.83
5	<i>Carassius carassius</i>	5.85	6.1
6	<i>Triplophysa</i> sp.	0.45	3.42
7	<i>Puntius conchoni</i>	2.01	6.5
8	<i>Crossocheilus diplocheilus</i>	3.06	17.25



**Fig 2:** Percentage contribution of fishes by biomass and number to total (mean) catch



**Fig 3:** Monthly catch composition by biomass at all the sites

## Discussion

Catch composition of any fishing operation gives an idea about the varieties of fish availability in that region, which in turn helps in better understanding of the biodiversity. In addition to this type, fish quality and quantity landed by any gear play an important role in determining its economic viability. During the present study a total of eight species of fishes were identified in the lake which included *Cyprinus carpio* var. *communis* (Punjaeb Gad), *Cyprinus carpio* var. *specularis* (Punjaeb Gad), *Carassius carassius* (Gang Gad), *Schizothorax niger* (Ale gad), *Schizothorax esocinus* (Churru), *Schizothorax curvifrons* (Satter Gad), *Crossocheilus diplocheilus* (Tethur), *Triplophysa* spp. (Ara Gurun) and *Puntius conchoni* (Techal Gad). Out of eight species of fishes *Cyprinus carpio* var. *communis* was found dominant. *Cyprinus carpio* var. *communis* seems to be well established and may pose a threat to the endemic lake dwelling species in competing for space and food. Das and Pandey, (1978) [5] and Yousuf (1996) [31] reported introduction of exotics like common carp have resulted in the decline of the catch as well as the diversity of indigenous fishes of Kashmir lakes. The introduction of exotic species have been reported to be the second leading cause, after habitat degradation, of species extinction in freshwater ecosystems (Hill *et al.*, 1997) [13]. A survey of 31 studies of fish introductions in Europe, North America, Australia, and New Zealand has resulted that 77% of cases native fish populations were reduced or eliminated following the introduction of exotic fish. Fotedar and Qadri (1974) [10] considered *Cyprinus carpio* to present serious competition to local indigenous fishes like *Schizothorax niger*, *Schizothorax esocinus*, *Schizothorax curvifrons* and *Crossocheilus diplocheilus*, and seems to be one of the reason for the dwindling of these species. The population of *Schizothoracine* fishes in Wular Lake has considerably decreased over the years particularly after the introduction of common carp in 1956 (Fotedar and Qadri 1974; Vass *et al.*, 1984) [10, 30]. The fish species like *Schizothorax richardsonii* and *Bangana diplostoma* once abundant and even caught in good quantities in commercial catches have now disappeared. The *Cyprinus carpio* has not only flourished well in the aquatic habitats of the Wular Lake but also contributes substantially to the fish catch. The dominance of Cyprinids (excluding Schizothoracids) at all sites as seen during the present study is also in accordance with the observations of Dutta *et al.*, (2002) [7]; Dutta, (2003) [8]; Dutta and Kour, (2005) [9]; Kaur, (2006) [18]; Johnson and Arunachalam, (2010) [15]; Kantaraj *et al.*, (2011) [17]; Johnson *et al.*, (2012) [16]; Murugan and Prabakaran, (2012) [23] who attributed it to their high adaptive variability to occupy all possible habitats. Another factor responsible for decline in indigenous fishes is the encroachment of the shallow areas of the lake for agricultural activities which became the most dangerous practice which causes harm to some species of indigenous fishes, used to breed in shallow areas of the lake (Yousuf, 1996) [31]. Kullander *et al.* (1999) [19] studied fishes of Jhelum River and its associated lakes including Wular in Kashmir valley and obtained fourteen native and four introduced fish species over a period of eight years, five species of *Schizothorax*, four of which are specialized lotic forms and one of which (*Schizothorax niger*) is chiefly found in lakes. Various authors have also reported that during the last few decades, fish biodiversity of India has declined rapidly due to

environmental degradation and activities like damming, water abstraction and pollution which have subjected the natural water bodies in general, lakes and rivers in particular, to severe stress with devastating effects on fish diversity (Pandey and Das, 2006; Lakra and Pandey, 2009) <sup>[24, 20]</sup>. The dwindling number of fish species has also been reported by Balkhi (2005) <sup>[2]</sup> who observed that there is a decrease in fish species with respect to environmental degradation. Leveque *et al.* (2008) <sup>[21]</sup> also reported overexploitation, flow modification, destruction of habitats, and invasion by exotic species, pollution and eutrophication as major threats to fish biodiversity. Wular Lake has achieved a high trophic status on account of nutrient enrichment from its catchment. Wular Lake is under eutrophic state as a result of human stress in the catchment area.

Due to various factors such as human modifications to the environment, overexploitation, habitat loss, exotic species and others, fish fauna of the Wular Lake is greatly threatened. Ecosystems and species are important in sustaining human life and the health of the environment is disappearing at an alarming rate. In order to preserve these threatened areas and species for future generations, immediate action in the form of aquatic biodiversity conservation strategies are necessary. In general, aquatic conservation strategies should support sustainable development by protecting biological resources in ways that will preserve habitats and ecosystems. In order for biodiversity conservation to be effective, management measures must be broad based (Anon.).

Since maintenance of fish biodiversity along with other biotic resource has been viewed as prerequisite for the well-being of even human beings, it is essential to prevent further decline of fish resources by devising all possible measures of conservation and rehabilitation. The conservation policy should promote the management practices that maintain integrity of aquatic ecosystem, prevent endangerment and enhance recovery of the threatened species (Shabir *et al.*, 2013) <sup>[28]</sup>.

#### **Suggestions to safe guard the threatened or near threatened fish species of Wular Lake are**

1. Habitat change should be carefully considered.
2. Environment Impact assessment of the exotic fish species.
3. Monitoring on pollution of the water bodies and its inlet streams.
4. Strict implementation of the laws governing the fishing activities.
5. Protection and conservation of the endemic species.
6. Public awareness programmes.

#### **Conclusion**

From the present study it was obvious that the fish catch as well as the diversity has changed and apparently got reduced in the Wular Lake. Most probably the lake ecosystem is not getting the adequate time to recover its natural community structure. Efforts need to be oriented to preserve this important fish habitat, which has tremendous economic and ecological significance. Ranching of this massive water bodies with fry/seed of the indigenous fishes will help in rehabilitation of the local commercially important fishes.

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