Indian J. Fish., 73 (3): 174-180, 2026 doi:10.21077/ijf.2026.73.3.178298-18

Available online at: epubs.icar.org.in/index.php/IJF

Note

Dominance of Nile tilapia *Oreochromis niloticus* (Linnaeus, 1758), in the Priyadarshini Jurala Project (PJP) Reservoir, Telangana, India

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Abstract

Nile tilapia (*Oreochromis niloticus*) is a successful aquatic invader with adaptable life history traits and has become dominant in irrigation tanks, reservoirs and rivers in Telangana. Monthly surveys were conducted in Priyadarshini Jurala Project (PJP) Reservoir, in the erstwhile Mahabubnagar District, Telangana, for three years (2023-2025) to assess the contribution of Nile tilapia and other major fish groups to the catch. Monthly catches were estimated using standard methods, and annual catches were calculated by summing monthly observations. The results indicated the dominance of Nile tilapia over commercial carp species. The share of Nile tilapia in the annual catch increased from 57.60% in 2023 to 63.63% in 2025, whereas the share of carps declined from 28.58 to 24.91% during the same period. These trends indicate the potential negative impact of Nile tilapia on the abundance of other commercially important fish fauna in PJP. The study shows a marked reduction in carp catches after the establishment of tilapia in the reservoir and confirms the high abundance of Nile tilapia throughout the water body.

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Keywords:
Abundance index (AI), Carps, Catfish, Cichlid, Exotic species, Invasive fish

Received : 21.04.2026
Accepted : 06.07.2026

The introduction of exotic species generally threatens ecosystem stability, causing long-term predation pressure, competition and, in some cases, the decline or extinction of native species. Accidental or deliberate introductions of dominant fish species may negatively affect biodiversity and disrupt key ecological processes in aquatic ecosystems. Consequently, studies on invasive fishes are increasingly important for assessing ecosystem health. Tilapia is the second most widely cultured fish group globally after carps. It is favoured in aquaculture as it tolerates a wide range of environmental conditions, grows rapidly, reproduces successfully and feeds at multiple trophic levels. Nile tilapia is one of the most established introduced fishes in the inland waters of India.

The Nile tilapia, *Oreochromis niloticus* (Linnaeus, 1758), is a cichlid native to Africa. It has been introduced into at least 100 countries, including India, for aquaculture because of its adaptability to diverse environmental conditions, good meat quality and high production potential. Consequently, it has established populations worldwide. Because of its potential to cause environmental and ecological problems, including changes in water quality, habitat degradation, trophic cascades and modifications of ecosystem function, *O. niloticus* is now regarded as one of the most dangerous invasive fish species in tropical and subtropical regions of the world (Shuai and Li, 2022; Stauffer *et al*., 2022). It has invaded many natural water bodies, including the Ganga River system in India (Singh and Lakra, 2011).

Mozambique tilapia, *Oreochromis mossambicus*, was first introduced into pond ecosystems in 1952 and was subsequently stocked in several reservoirs of South India for production enhancement (Sugunan, 1995). Nile tilapia, *O. niloticus*, was introduced into India in 1987 for aquaculture. Both species are now abundant in rivers, reservoirs, lakes, and reservoir-fed tanks and ponds in Telangana. In the Krishna River ecosystem, *O. niloticus* represented 48.82% of the fishery

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(Laxmappa *et al*., 2015). Tilapia now forms part of the fish fauna in the Godavari, Krishna, Cauvery, Yamuna and Ganga rivers (Lakra *et al*., 2008). Populations of indigenous fishes such as carps, catfishes and murrels have declined significantly. Tilapia, *O. niloticus* and *O. mossambicus* are the predominant established species in the aquatic habitats of Guddemdoddi Balancing Reservoir in Jogulamba Gadwal District and Ramanpad Balancing Reservoir in Wanaparthy District, Telangana. A relative decline in cultivable fish species against established tilapia populations is evident in these habitats, and Indian major carps face severe competition from this invader (Bakshi and Dharmapuri, 2023). During the past few decades, exotic fish species have been introduced to India for various reasons, adding roughly 13.6% to the country's fish diversity (Joshi *et al*., 2021).

Once tilapia populations become established, they are difficult to eradicate from natural ecosystems (Shetty *et al*., 1989). Owing to their similar ecological requirements, *O. niloticus* may compete with and pose a threat to indigenous cyprinid fishes, including Indian major carps (Kottelat and Whitten, 1996). Nile tilapia culture has expanded in South India particularly through private sector enterprises. In Andhra Pradesh, Odisha and West Bengal, populations of *O. niloticus* have increased, with the species expanding its distribution across several states, particularly in coastal India. Escapes from aquaculture facilities have been reported during recurrent floods and through inadvertent releases. Tilapia has recently appeared in the Ganga River fisheries which has also raised concerns (Tripathi *et al*., 2017). Interestingly, the species constituted a substantial proportion of the catch in certain areas where tilapia culture is rarely practised. This situation prompted researchers to investigate its population characteristics, including abundance, size range, food and feeding, gonadosomatic index (GSI) and fecundity (Singh *et al*., 2014). Population dynamics and stock assessment are important for effective fisheries management. Although established populations of *O. Niloticus* have been reported from several reservoirs in Telangana; information on its stock status in Indian reservoirs remains limited. Hence, this study assessed the population characteristics and stock status of *O. niloticus* in the Priyadarshini Jurala Project (PJP) Reservoir, Telangana State.

The Priyadarshini Jurala Project (PJP), also known as Jurala Dam, is a key multipurpose dam on the Krishna River in Jogulamba Gadwal District, Telangana, completed in 1995 for irrigation and hydroelectric power generation. The project is located near Revulapally Village in Dharoor Mandal of Jogulamba Gadwal District (erstwhile Mahabubnagar District), Telangana (Fig. 1). The catchment area of the project is 129,499 sq. km. The total water-spread area at full reservoir level (FRL) is 6,770 ha. The salient features of PJP are presented in Table 1.

Table 1. Salient features of Priyadarshini Jurala Project

Location	Revulapally (v), Dharoor (M), Jogulamba Gadwal District, Telangana State
Latitude	16.336027 N
Longitude	77.703608 E
Catchment area	129,499 sq. km (50,000 sq. miles)
FRL/MWL	+318.516 m (+1045 ft)
Gross storage at FRL/MWL	338.13 mcm (11.941 tmc)
Dead storage (below MDDL)	145.63 mcm (5.143 tmc)
Water-spread area at FRL/MWL	67.68 sq. km (16,724 acres), including river course

Courtesy: India-WRIS and Irrigation Department.

PJP is one of the important projects in Telangana, located about 30 km from Jogulamba Gadwal District headquarters and 160 km from Hyderabad, the state capital. The reservoir presently supports the livelihoods of more than 800 fisher families from about 20 nearby villages through fishing, marketing, fish based culinary activities and allied sales. The Telangana Fisheries Department regulates fishing activities, and about 800-1,000 licences are issued annually to fishers from nearby villages for fishing in PJP.

A detailed field survey was conducted by selecting 60% of the fishing villages around PJP. Fish samples were collected from 12 stations, six on the southern shore and six on the northern shore of PJP, from January 2023 to December 2025. The sampling stations were Revulapally, Narsandoddi, Upperu, Khammampadu, Garlapadu, Nagardoddi, Anugonda, Gaddampally, Mustipalle, Eerladinne, Kistampally and Nandimalla. The location map of the study area and sampling stations is provided in Fig. 1 and Table 2.

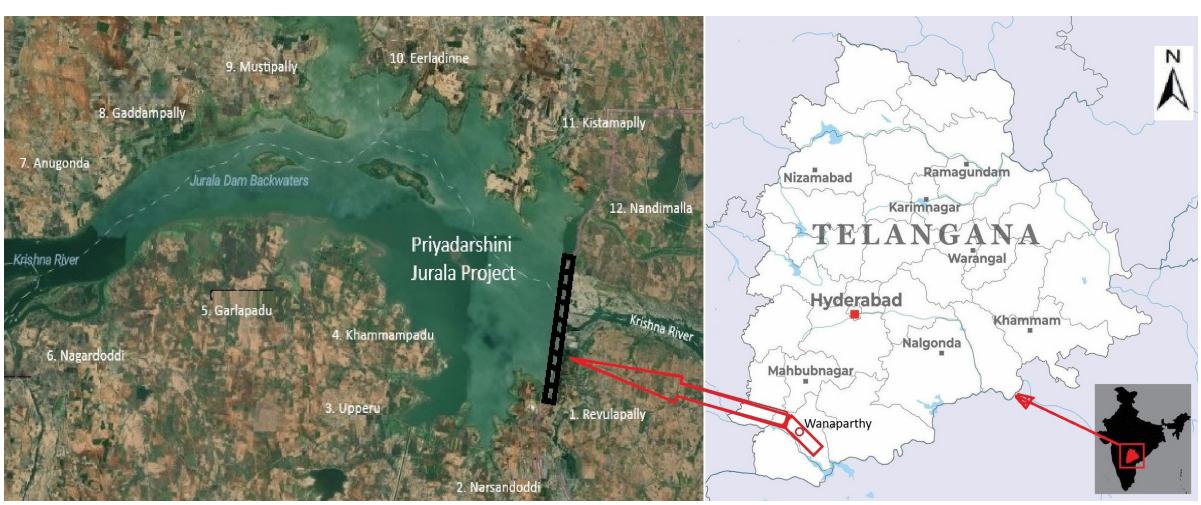

Fig. 1. Location map of Priyadarshini Jurala Project and sampling stations (Courtesy: Google Maps India)

Table 2. Fish sampling stations in Priyadarshini Jurala Project

Sample station No.	Village	Mandal	District	Station direction with respect to reservoir spread area
1	Revulapally	Dharoor	Jogulamba Gadwal	Southern shore of the reservoir
2	Narsandoddi	"	"	
3	Upperu	"	"	
4	Khammampadu	"	"	
5	Garlapadu	"	"	
6	Nagardoddi	"	"	
7	Anugonda	Makthal	Narayanpet	Northern shore of the reservoir
8	Gaddampally	"	"	
9	Mustipally	"	"	
10	Eerladinne	Amarachintha	Wanaparthy	
11	Kistampally	"	"	
12	Nandimalla	"	"	

From January 2023 to December 2025, fish samples were collected monthly from selected sampling stations and 12 landing centres of PJP, mainly from catches handled by fishers, fish collectors and fish sellers. The fishing gears used included monofilament gillnets, cast nets and box traps. Fish from commercial catches, were segregated at the landing sites, identified, and counted species-wise, and weighed (g) using a portable digital balance. Experimental fishing was also conducted with the assistance of local fishers using monofilament gillnets, cast nets and box traps to cover different areas of the reservoir. Fish species were identified based on morphometric characters using standard taxonomic keys (Talwar and Jhingran, 1991; Jayaram, 2012). The abundance index (AI) for tilapia for each year was calculated as: AI=N/S, where N is the total number of tilapia recorded and S is the total number of fish observed.

Field data were tabulated and subjected to statistical analysis. One way ANOVA was used to compare mean catch values among fish groups, based on critical and calculated F-values. The chi-square test was used to determine whether the distribution of fish groups differed significantly among years.

The important fish species harvested from PJP were identified and grouped into four commercially important categories: (i) tilapia, (ii) carps, (iii) catfishes and (iv) others. The reservoir supported a diverse fish assemblage, comprising 20 species belonging to eight families and five orders, including both native and exotic species. Native species included *Labeo calbasu*, *L. catla*, *L. rohita*, *Cirrhinus mrigala*, *Hypselobarbus jerdoni*, *Wallago attu*, *Ompok bimaculatus*, *Sperata seenghala*, *S. aor*, *Rita sp.*, *Etroplus suratensis*, *Channa striata*, *Channa marulius* and *Mastacembelus armatus*. Exotic species included *Oreochromis niloticus*, *Cyprinus carpio*, *Ctenopharyngodon idella* and *Clarias gariepinus* (Table 3).

The total fish catch recorded from PJP during 2023-2025 was 67,031 individuals. The highest abundance index (AI) was recorded for tilapia (0.612), followed by carps (0.267). Tilapia contributed the highest AI in all three years of observation (Table 4 and 5 ; Fig. 2, 3 and 4).

Table 3. Commercial fish species recorded in the catches from PJP during 2023-2025

Fish group	Family	Scientific name	Common name	Fish size (kg)
i) Tilapia	Cichlidae	*Oreochromis niloticus**	Nile tilapia	0.25-0.60
ii) Carps	Cyprinidae	*Labeo catla*	Catla	1-10
	"	*Labeo rohita*	Rohu	1-8
	"	*Cirrhinus mrigala*	Mrigal	1-6
	"	*Ctenopharyngodon idella**	Grass carp	2-6
	"	*Hypselobarbus jerdoni*	Jerdon's carp	1-3
	"	*Cyprinus carpio**	Common carp	1-4
	"	*Labeo calbasu*	Orange fin labeo	0.5-1.5
		Puntius sp.	Barb	0.3-0.6
iii) Catfish	Clariidae	*Clarias gariepinus**	African catfish	2-6
	Siluridae	*Ompok bimaculatus*	Butter catfish	0.2-0.3
	"	*Wallago attu*	Freshwater shark	1-7
	Bagridae	*Sperata seenghala*	Giant river catfish	0.5-1.5
	"	*Speratataor*	Long-whiskered catfish	0.5-4
	"	*Mystus* sp.	Catfish	0.15-0.2
	Ritidae	*Rita* sp.	Rita	0.2-0.3
iv) Others	Cichlidae	*Etroplus suratensis*	Pearlspot	0.25-0.75
	Channidae	*Channa striatus*	Striped snakehead	0.5-1.25
	"	*Channa marulius*	Great snakehead	1-4
	Mastacembelidae	*Mastacembelus armatus*	Zig-zag eel	0.2-0.5

* Exotic species

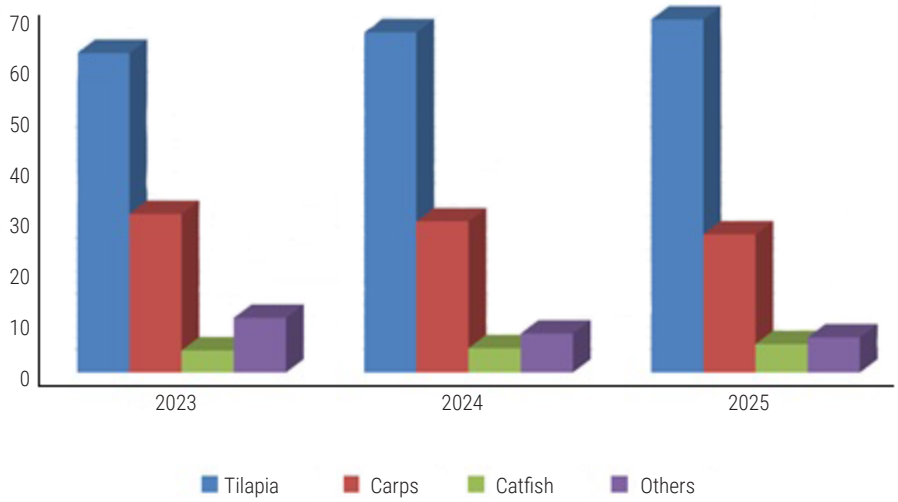

Fig. 2. Annual fish catch (%) in PJP during 2023-2025

Table 4. Fish catch quantity and percentage in PJP during 2023-2025

Year	2023		2024		2025		Total catch in (No.) 2023-2025
Fish group	Quantity in No.	Harvested %	Quantity in No.	Harvested %	Quantity in No.	Harvested %	
Tilapia	10282	57.60	13941	61.34	16829	63.63	41052
Carps	5102	28.58	6194	27.25	6590	24.91	17886
Catfish	710	3.98	997	4.39	1358	5.13	3065
Others	1758	9.85	1597	7.03	1673	6.33	5028
Total	17852		22729		26450		67031

Table 5. Abundance index (AI) of fish groups in PJP during 2023-2025.

Fish group	Quantity in No.				Abundance index (AI) during the period
	2023	2024	2025	Total	
Tilapia	10282	13941	16829	41052	0.612
Carps	5102	6194	6590	17886	0.267
Catfish	710	997	1358	3065	0.046
Others	1758	1597	1673	5028	0.075
Total	17852	22729	26450	67031	

The Abundance index (AI) = N/S, where N is the total number of individuals in a fish group and S is the total number of all fish recorded during the study period.

The calculated F value (35.51) exceeded the F critical value at 5% level (F crit=4.06 for df=3, 8), indicating a significant difference in mean catch among fish groups. The chi-square value was 341 with 6 degrees of freedom, while the critical value at the 5% level was 12.59. As the calculated chi-square value was greater than the critical value ($p<0.001$), there was a statistically significant difference in fish group distribution among years (chi-square=341.0, df=6, $p<0.001$), indicating that catch composition changed significantly from 2023 to 2025.

The commercially important fish biodiversity recorded from different sampling stations in the PJP was grouped as tilapia (*O. niloticus*), carps, catfishes and other fishes. The catch share of *O. niloticus* ranged across sampling locations from 57.60% to 63.63% from 2023 to 2025. Harvested Nile tilapia mostly weighed 250-350 g, whereas larger individuals weighing 400-600 g occurred in lower proportions. The data revealed a progressive increase in the catch share of *O. niloticus* from 2023 to 2025 (Table 5). Carps mainly consisted of larger fish weighing 2-10 kg, with smaller individuals occurring in lower proportions. Carp catch declined from 28.58% to 24.91% during the study period. Carps were mainly represented by *L. calbasu*, *L. catla*, *L. rohita*, *C. mrigala*, *C. carpio*, *C. idella*, *H. jerdoni* and *Puntius* sp. Catfishes represented by *C. gariepinus*, *S. aor*, *S. seenghala*, *O. bimaculatus*, *Rita* sp., *W. attu* and *Mystus* sp., constituted 3.98-5.13% of the total catch. Other miscellaneous fishes, including *Etroplus suratensis*, *Channa striata*, *Channa marulius* and *Mastacembelus armatus*, accounted for 6.33-9.85% of the total catch.

The present study revealed an increasing abundance of Nile tilapia in the fishery, confirming the establishment of a dominant population in PJP. Nile tilapia possesses reproductive and ecological strategies

Fig. 3. Abundance of Nile tilapia in fishers' catch in PJP

Table 6. One-way ANOVA of annual catch among fish groups in PJP during 2023–2025

Source of variation	ANOVA					
	SS	df	MS	F	p-value	F crit
Between groups	305520656.3	3	101840218.8	35.51	5.69129E-05	4.06
Within groups	22942324.67	8	2867790.583			
Total	328462980.9	11				

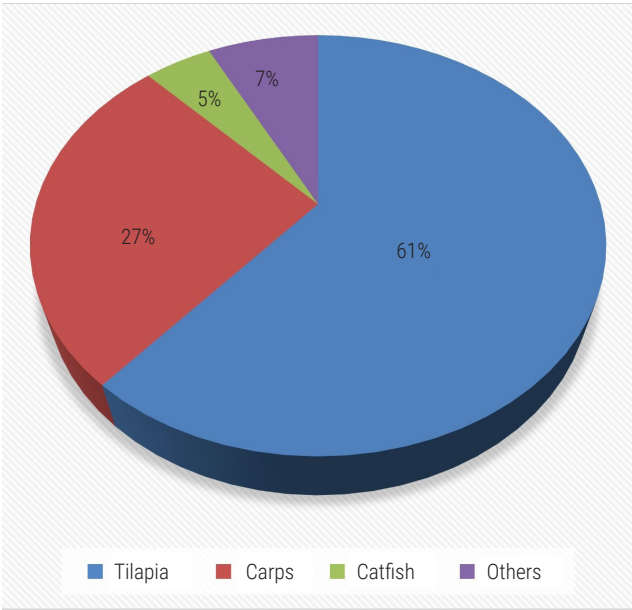

Fig. 4. Abundance index (AI) of fish groups in PJP during 2023-2025

that support its survival and population replenishment, enabling it to compete effectively with other fish species. The occurrence and establishment of alien fish species in various inland open-water resources of India have been widely reported (Singh *et al*., 2008; Joshi *et al*., 2014). Such establishment may be attributed to declining water volume and flow velocity, along with increasing pollution loads. These conditions may be unfavourable for sensitive native species, while favourable for resilient alien species such as common carp (*C. carpio*), tilapia (*O. mossambicus* and *O. niloticus*) and sucker mouth catfish (*Pterygoplichthys* sp.). The establishment of these species can have significant adverse impacts on native piscine diversity, and the catches of commercially important indigenous fish species. The The increasing occurrence of tilapia in local aquatic habitats may have contributed to higher total landings, while potentially reducing the CPUE of other commercially important fish species in the water body.

Analysis of past harvest data revealed a declining trend in carp catches in PJP. As a stock enhancement measure aimed at improving the livelihood of reservoir fishers, the Fisheries Department has stocked carp fingerlings in the reservoir for the past eight years. Significant negative effects of tilapia on piscine diversity have been reported (Lakra *et al*., 2008), along with declines in the catches of native fish species (Lakra *et al*., 2009; Laxmappa *et al*., 2015; Mahender *et al*., 2015). Discussions with PJP fishers further indicated a marked decline in carp catches and a substantial increase in tilapia catches over the past decade. The increasing dominance of tilapia suggests that PJP is undergoing a shift in its fish community, with potential implications for native fish diversity and fisheries sustainability.

Competition for food and space from the tilapia population in PJP may be a bottleneck for the revival of carp fisheries. Tilapia is an omnivore that feeds on plankton, macrophytes, insects and detritus, and this feeding habit overlaps with that of many carp species cultured in India. Prolific breeding of tilapia throughout the year may further intensify competition for food and space. Currently tilapia is the most dominant fish species in the reservoir and is available throughout the year. *O. niloticus* grows rapidly and attains larger sizes within a short period. Increasing abundance of this fish may negatively affect almost all fish groups, including Indian major carps and indigenous catfishes. The other invasive species, African catfish, also adversely affects carps and indigenous catfish populations. The results of the present study revealed an increasing abundance of *O. niloticus* in the fishery, confirming its establishment as a dominant population in PJP. Nile tilapia is widely known for its tolerance to poor water quality conditions, ecological adaptability and high reproductive capacity, which enable it to persist and compete with other fish species. Fish harvest data from 2023-2025 revealed a consistent increasing trend in total production, with the total fish catch increasing from 17,852 in 2023 to 22,729 in 2024 and 26,450 in 2025, indicating a substantial improvement in overall fish yield during the study period.

Tilapia contributed the highest share throughout the study period, increasing from more than 57% in 2023 to over 63% in 2025, whereas the share of carps declined from 28.58 to 24.91%. Catfish showed a marginal but steady increase, while the share of 'others' category declined. These patterns suggest a clear shift in species composition of the reservoir, with tilapia becoming increasingly dominant during the study period.To assess the variation in annual catch among fish groups, a one-way ANOVA was performed using catch data for tilapia, carps, catfish and other fishes during 2023-2025. The analysis showed a highly significant difference in mean catch among the fish groups ($F_{3,8}$=35.51, $p<0.001$), indicating significant differences in their contributions to the total catch. The consistently higher mean catch of tilapia confirms its numerical dominance in the reservoir during the study period, indicating its successful establishment and relatively higher contribution to fish production under the prevailing reservoir conditions.

Invasive species can affect the natural environment and biodiversity in both beneficial and adverse ways. Nile tilapia has provided direct and indirect livelihood benefits to fishers dependent on the PJP. However, its increasing dominance may have negative implications for native fish fauna. High abundance, competition for food and space, and possible alteration of ecological balance may affect the recruitment and survival of indigenous species. Tilapia may also contribute to the declines in native fish species through predation on eggs and early life stages. Consequently, the catch contribution of commercial carps in PJP appears to be declining, indicating the need for appropriate monitoring and management measures. Further research is needed to identify the factors driving the dominance of Nile tilapia in the reservoirs of Telangana and to assess its impacts on native fish communities and fisheries. Regular monitoring and evidence based management strategies are therefore essential to minimise potential ecological impacts, while recognising the livelihood benefits associated with tilapia fisheries. Better awareness among scientists, fish farmers, fishers, policy makers and the general public regarding the ecological implications of tilapia establishment would support effective implementation of appropriate regulatory and management measures. The socioeconomic benefits of tilapia fisheries should therefore be considered alongside the associated ecological risks to native fish communities and reservoir biodiversity.

Acknowledgements

The authors are grateful to the fisher folk of villages around PJP for their cooperation during field surveys and for assistance in data and fish samples collection.

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