International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 11; Issue 03 (C); March 2022; Page No.507-511
DOI: http://dx.doi.org/10.24327/ijcar.2022.511.0112

Research Article

PHYSICO-CHEMICAL PARAMETERS AND ICHTHYOFAUNAL CHECKLIST OF BUDHABALANGA RIVER, MAYURBHANJ DISTRICT, ODISHA

Sudhashree Sethi, Subhrakanta Jena* and Hemanta Kumar Sahu

Department of Zoology, Maharaja Sriram Chandra Bhanja Deo University, Takatpur, Baripada, Mayurbhanj, Odisha-757003

A R T I C L E I N F O

Article History:
Received 4th December, 2021
Received in revised form 25th January, 2022
Accepted 18th February, 2022
Published online 28th March, 2022

Key words:
Physico-chemical parameters, Budhabalanga river, fish availability, Mayurbhanj district

A B S T R A C T

The physicochemical parameters of rivers influence the aquatic species and affect their metabolism. In the case of fishes, these variations in the water parameters put an adverse effect on the fish availability, diversity and affect different organs of the fish, which may indirectly affect human health. Hence the present study was carried out to evaluate the physicochemical parameters of the Budhabalanga river and the fish availability at different sites of the Mayurbhanj district, which are frequently exposed to anthropogenic activities. The water parameters like pH, DO, turbidity, conductivity, salinity, temperature, chloride, nitrate, phosphate, and fluoride were analyzed in a periodical manner (n=3) at different sites viz. Baripada, Baruni, DangarSahi, Kuliana, Tentulidinga, Bangiriposi, Nischinta, Simila, Kaliami, and frequent sampling of the fishes were done to make a fish checklist. During the study period, the temperature varied from 23.4 to 33.1 ºC. The pH value ranges from 7.33 to 8.38 and the salinity range was 0.16 to 0.26 PSU. The DO value ranges from 6.2 to 8.75 mg/L with a turbidity range of 112.66 to 131 NTU. The conductivity value ranges from 18.66 to 36.60 µs/cm. The micronutrients chloride, phosphate, nitrate and fluoride ranges from 23 to 49.33 mg/L, 0.08 to 0.92 mg/L, 0.33 to 0.84 mg/L and 1.77 to 8.21 mg/L respectively. A total of 33 fish species belonging to 9 orders, 13 families, and 18 genera were recorded during the study period. Nowadays a wide range of pollutants from different sources are introduced to this river so periodical study on parameter estimation and fish diversity should be carried out not only to protect the river from contamination but also to secure human health.

INTRODUCTION

Freshwater bodies are the main source of potable water for most of the species on the earth. These freshwater reservoirs serve as the habitat for a wide range of aquatic animals. Freshwater bodies like ponds, rivers, lakes, lagoons and small water reservoirs are considered to be the dwelling places of different aquatic animals specifically for finfishes and shellfishes. The faunal distribution and the productivity of these water bodies depend upon various physicochemical parameters such as temperature, pH, salinity, dissolved oxygen (DO), and micronutrients like fluoride, nitrite, phosphate, silicate, etc. Several studies have been conducted on the physicochemical parameters of different rivers of India and also on the Budhabalanga river of Mavurbhanj district (Ramachandra and Solanki, 2007; Samal *et al*., 2016). The variation in the physicochemical parameters of the water directly influences the fish diversity as well as the juvenile of the fish stocks. The ichthyofaunal diversity of the river has been studied by many researchers throughout the India (Gilmore, 1995; Paunikar *et al*., 2012; Laxmappa *et al*., 2015, Kar *et al*., 2017; Sanjay and Sadguru, 2020) and in the state of Odisha (Samal *et al*., 2016; Baliarsingh *et al*., 2020; Panda and Sahoo, 2020; Koushlesh *et al*., 2021). The state of Odisha is famous for most of the agricultural practices including the aquaculture edible fishes and molluscs species. In some remote locations, the villagers of different communities catch fish in the riverside valley to fulfill the daily protein sources as most of the communities or villagers belong to the economically weaker sections. The Mayurbhanj is the largest district of Odisha, located in the northern region (Sahoo, 2011) and gifted with Budhabanlanga river along with attributes viz.Suno, Gangahara, Katra, and Palpala (Bal *et al*., 2021; Giri, 2021). This Budhabanlanga river covers 175km long (Bal *et al*., 2021), which originates from the northern side of the Mayurbhanji.e. from Barehipani waterfall of Similipal Biosphere Reserve with its attributes run towards East (Bangiriposi, Simla, and Nischinta) and go down to the South (Kuliana, DangarSahi, Kaliami) and enter to the West direction (Tentulidinga, Baripada, and Baruni) of the district and enters into Balasore district through Baisinga and finally enters into the West Bengal state to reach Bay of Bengal (Bal *et al*., 2021). The catchment area of this river is 4840 sq. km. and serves as a reservoir for the edible fishes and molluscs. The

Corresponding author:* **Subhrakanta Jena
Department of Zoology, Maharaja Sriram Chandra Bhanja Deo University, Takatpur, Baripada, Mayurbhanj, Odisha-757003

water of this river is deteriorating day by day due to the exposure of anthropogenic activities, sewage disposal, human settlement, and industrialization, which may lead to the fluctuation of the water parameters and the biodiversity of the river ecosystem. Few reports have been published on the physicochemical characteristics concerning the ichthyofaunal diversity of the Budhabalanga river, hence the present study was conducted to study the physicochemical parameters and fish diversity of the Budhabalanga river of the Mayurbhanj district of Odisha, India.

MATERIAL AND METHODOLOGY

Study sites detail of Budhabalanga river

The Mayurbhanj district (21°58'34.59"N, 86°25'24.32"E) is the largest district of the Odisha state and is located on the northern side of the Odisha (Behera, 2006). Nine sites of the Budhabalanga river were selected for the study based on the anthropogenic activities and the fish catchment area, which are Baripada (21°55'25.62"N, 86°43'5.17"E), Kuliana (22°4'6.22"N, 86°38'10.44"E), Bangiriposi (22°8'5.93"N, 86°32'51.14"E), Tentulidinga (21°57'15.46"N, 86°42'32.06"E), Nischinta (22°7'10.84"N, 86°29'51.13"E), DangarSahi (22° 0'32.62"N, 86°38'41.40"E), Simila (22° 7'57.50"N, 86°35'25.37"E), Baruni (21°54'58.77"N, 86°43'34.40"E) and Kaliami (21°35'20.13"N, 86°54'17.45"E).

Analysis of physicochemical parameters

The water temperature in Celsius (ºC) was measured directly on the site by using the potable thermometer (Labworld glass Mercury thermometer 0 to 360°C). The pH, dissolved oxygen (DO)(mg/L), conductivity (µs/cm), turbidity (NTU), and salinity (PSU) were measured in the in-vitro condition by using the Multiple parameter water quality meter (Model: WQC-24, company: TOADKK). The Mohr-Knudsen titration procedure and Winkler's method were followed for salinity and dissolved oxygen quantification respectively (Strickland and Parsons 1972). The water samples are filtered through a millipore filter and then micronutrients like Chloride (mg/L), nitrate (mg/L), phosphate (mg/L), and fluoride (mg/L) were analysed by using standard manual (Strickland and Parsons, 1972).

Statistical analysis and mapping

The statistical analysis like average, standard deviation and standard error of the mean were done by using the Microsoft Excel (Microsoft Office-2019-en-us) version and the mapping was done by using the ArcGIS 10.8.1.

Collection and identification of finfishes

Fresh fish samples were collected from different sites of the Budhabalanga river by using fishing net measuring 2.5m in length, with a mesh size varying from 7 mm at the base. The collected specimens were identified up to species level. The fin fishes were identified by using the description and key given by Hill and IUCN (Hill, 1973; IUCN, 2010).

RESULTS

Physico-chemical parameters of Budhabalangariver

The water samples were analysed in a periodical manner (n=3) from each site. The parameters viz. temperature, pH, turbidity, conductivity, salinity, phosphate, chloride, fluoride, nitrate, and DO were analysed (Fig. 2-7). The parameters of water at different study sites vary along with the seasonal changes throughout the year. The pattern of rainfall facilitates the divisions of the year into pre-monsoon (January-May), monsoon (June-September), and post-monsoon (October-December). The temperature of the water surface varies from 23.4 to 33.1 ºC (Fig.2), the minimum temperature was recorded at DangarSahi (27.23±2.80) and the maximum was recorded at Simila (31.06±1.79) (Fig. 2).

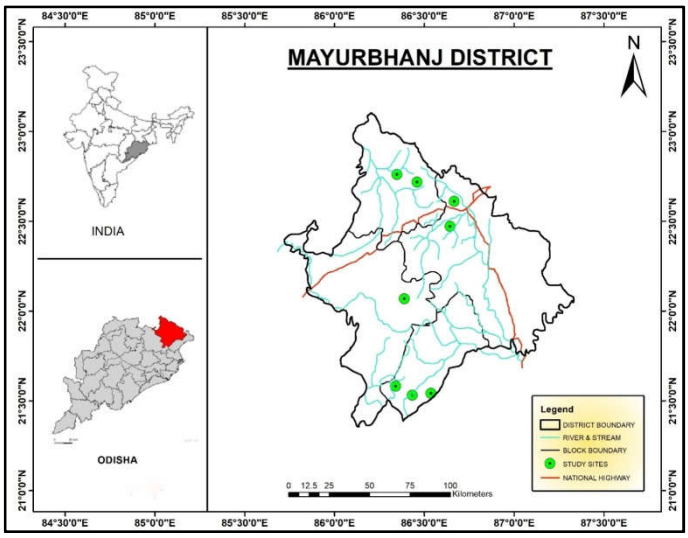

Fig 1 Study area map of Mayurbhanj district showing the water sampling sites

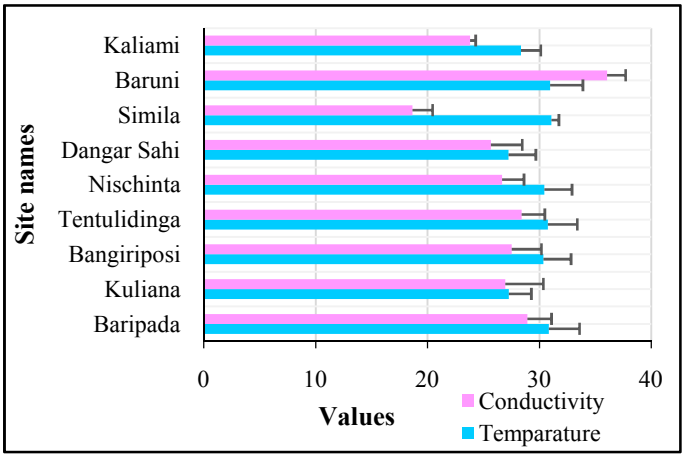

Fig 2 Temperature and conductivity of water samples (n=3) of different sites of Budhabalanga river in Mayurbhanj district

The mean values of hydrogen ion concentration of water varied from 7.33 to 8.38. The maximum value of pH was observed at Bangiriposi (8.38±0.19) and the minimum value was recorded at Kaliami (7.33±1.05) (Fig. 3). The salinity level of the Budhabalanga river ranges from 0.16 to 0.26 PSU. The salinity level was found maximum in Simila (0.26±0.05) and the lowest was recorded at Baripada, Kuliana, Bangiriposi, DangarSahi, and Baruni i.e. 0.2±0.1 (Fig. 4). The dissolved oxygen content of the Budhabalanga river ranges from 6.2 to 8.75 mg/L, while the minimum DO value was recorded at Kuliana (6.2±0.26) and a high value was recorded at Kaliami (8.75±0.35) (Fig. 3). The turbidity level ranges from 112.66 to 131 NTU, the high turbidity level was found at Baripada (131±8.88) and the lowest was at Tentulidinga (112.66±9.07) (Fig. 5). The conductivity ranges from 18.66 to 36.60 µs/cm, while the high value was found at Baruni (36.06±2.93) and the low value was found at Simila (18.66±0.68) (Fig. 2). The micronutrients like chloride, phosphate, nitrate and fluoride

ranges from 23 to 49.33 mg/L, 0.08 to 0.92 mg/L, 0.33 to 0.84 mg/L and 1.77 to 8.21 mg/L respectively (Fig 4, 6-7).

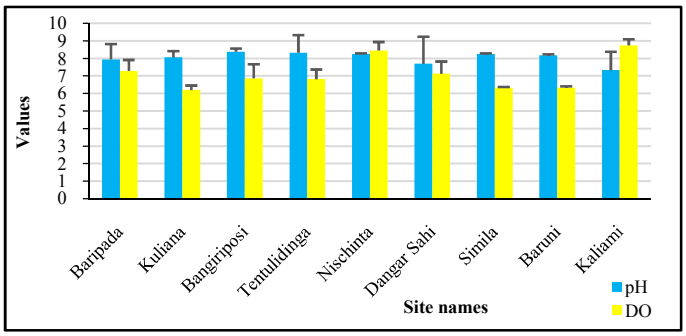

Fig 3 pH and DO values (n=3) of different sites of the Budhabalanga river in Mayurbhanj district

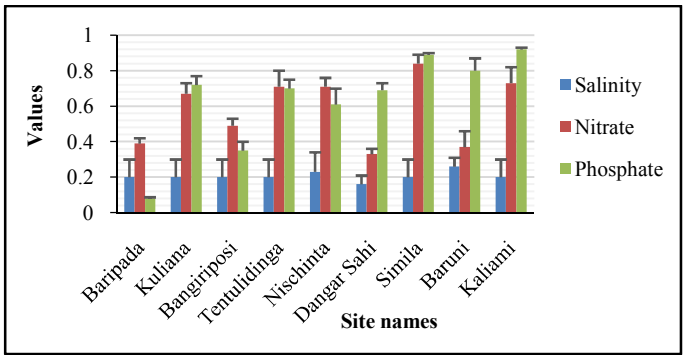

Fig 4 Salinity, nitrate, and phosphate values of water samples (n=3) of different sites of Budhabalanga river in Mayurbhanj district

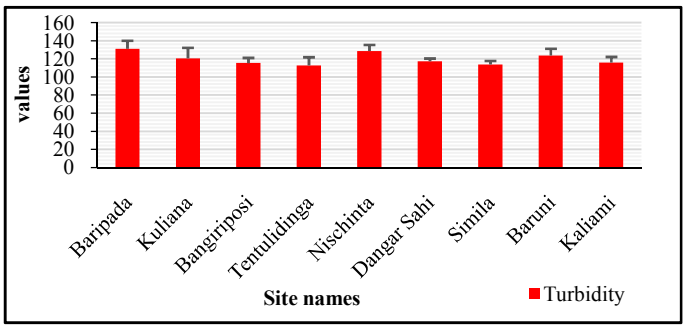

Fig 5 Turbidity of water samples (n=3) of different sites of Budhabalanga river in Mayurbhanj district

The maximum values of chloride, phosphate, nitrate, and fluoride were recorded at Simila (49.33±4.16), Kaliami (0.92±0.01), Simila (0.84±0.05), Baruni (8.21±0.028) and the minimum was recorded at Baripada (23±4.35), Baripada (0.08±0.007), DangarSahi (0.33±0.03), DangarSahi (1.77±0.62) respectively (Fig 4, 6-7).

Ichthyofauna diversity of Budhabalanga river

A systematic, updated checklist of freshwater fishes of the Budhabalanga river, Mayurbhanj district has been prepared based on the present sampling (Table1). A total of 33 fish species belonging to 9 orders, 13 families, and 18 genera were recorded during the study period. Cypriniformes has the highest diversity with 1 family, 8 genera and 12 species followed by Siluriformeswith 1 family with 2 genera and 5 species, Synbranchiformes and Anabantiformeshave 2 families, 2 genera and 4 species, Osteoglosiformesrepresents 1 family with 2 genera and 2 species each and rest of the orders each having 1 family with 1 genus and 1 species.

Table 1 Ichthyofaunal checklist of Budhabalanga river, Mayurbhanj district

Sl. No.	Scientific Name	Local name	IUCN status
	Order: **Crypiniformes**		
	Family: **Cyprinidae**		
1	*Labeo rohita*	Rohu	LC
2	*Cirrhinus mrigala*	Mirkali	LC
3	*Catla catla*	Bhakura	LC
4	*Labeo calbasu*	Kala bainsi	LC
5	*Labeo bata*	Pohola	LC
6	*Salmophasia bacaila*	Baunsapatri	LC
7	*Puntitus ticto*	Kujikerandi	LC
8	*Puntitus conchonius*	Pita karandi	LC
9	*Puntius amphibius*	karandi	DD
10	*Amblipharyngodon mola*	Mahurali	LC
11	*Rasbora daniconius*	Dandakari	LC
12	*Chela bacaila*	Jahala	LC
	Order: **Siluriformes**		
	Family: **Bagridae**		
13	*Mystus vittatus*	Kantia	LC
14	*Mystus tengara*	Mundi kantia	LC
15	*Sperata aor*	Jalanga	LC
16	*Mystus bleekeri*	Kujikantia	LC
17	*Mystus cavasius*	Baikantia	LC
	Family: **Siliridae**		
18	*Wallago attu*	Balia	NT
	Family: **Claridae**		
19	*Clarias batrachus*	Magura	LC
	Order: **Gobiiformes**		
	Family: **Gobiidae**		
20	*Glossogobius giuris*	Baligiridi	LC
	Order: **Perciformes**		
	Family: **Ambassidae**		
21	*Chanda nema*	Chandi	LC
	Order: **Osteoglosiiformes**		
	Family: **Notopteridae**		
22	*Notopterus notopterus*	Fali	LC
23	*Chitala chitala*	Chitala	NT
	Order: **Synbranchiformes**		
	Family: **Mastacembelidae**		
24	*Macrognathus aculeatus*	Tudi	LC
25	*Mastacembelus pancalus*	Gamitudi	LC
26	*Mastacembelus armatus*	Bamitudi	VU
	Family: **Synbranchidae**		
27	*Monopterus cuchia*	Kuchia	LC
	Order: **Anabantiformes**		
	Family: **Channidae**		
28	*Channa puncatata*	Gadisha	LC
29	*Channa striata*	Seula	LC
	Family: **Anabantidae**		
30	*Anabas cobogius*	Kau	DD
31	*Anabas testudineus*	Rajakau	DD
	Order: Unknown		
	Family: **Nandidae**		
32	*Nadus marmoratus*	Budusi	DD
	Order: **Belonifermes**		
	Family: **Belonidae**		
33	*Xenetodon cancila*	Gaudabadi	LC

LC: Least concern, DD: Data deficient, NT: Near threatened, VU: Vulnerable

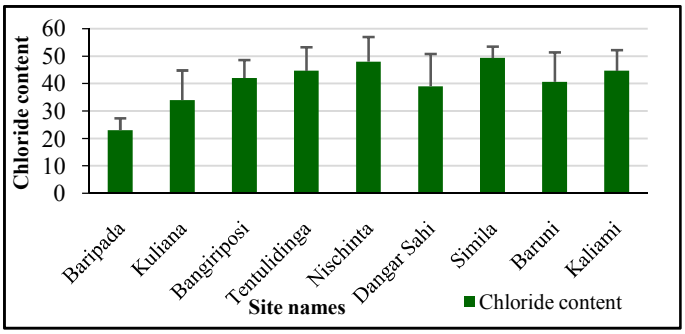

Fig 6 The chloride content in water samples (n=3) of Budhabalanga river in Mayurbhanj district

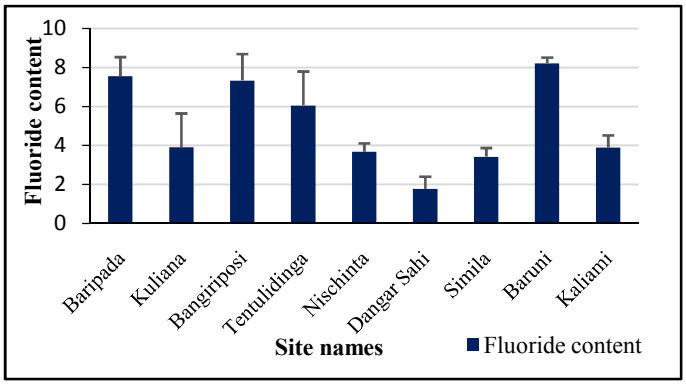

Fig 7 The fluoride content in water samples (n=3) of different sites of Budhabalanga river in Mayurbhanj district

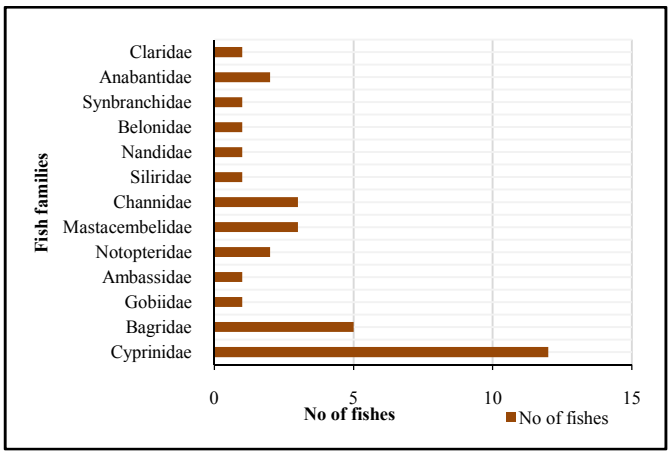

Fig8 Family wise fish species diversity of Budhabalanga river in Myurbhanj district

DISCUSSION

The variations in physicochemical parameters such as surface water temperature, pH, salinity, dissolved oxygen, phosphate, nitrate, chloride, and fluoride contents in Budhabalanga river water at different sites of the Mayurbhanj district were recorded periodically. The fluctuation of river water temperature depends upon different ecological factors like solar radiation, evaporation, freshwater influx, and cooling (Ficke *et al*., 2007). A large diversity of freshwater fishes exists in India, constituting 1027 species (Gopi *et al*., 2017) and Odisharepresents about 18.11% of the total freshwater fish fauna of India (Dutta *et al*., 1993). The fish species distribution varies over time due to deviation in the environmental parameters. As per the IUCN (Hill, 1973), most of the fish fauna recorded from the Budhabalangariver is coming under IUCN Least Concern (LC) category. Early reports suggest that there are about 45 fish species are available in the Budhabalanga river in the Baripada area of the Mayurbhanj district (Samal *et al*., 2016) and 66 species were reported from the Similipal Biosphere Reserve area (Baliarsingh *et al*., 2013).Hence, frequent studies should be conducted on fish species availability and diversity with respect to the physicochemical parameters of this river. Since a decade back few studies have been conducted on the type of fish species availability and diversity, but still there are a lot of possibilities to get more no. of fish species in the Budhabalanga river.

CONCLUSION

The present study concludes that the physicochemical parameters of the Budhabalanga river are somehow favorableto the fish species availability but still, there are a lot of chances of contamination in this river water at different localities of Mayurbhanj district through various sources like household hospitals, automobiles, and municipality drainage. During the study period, we found that some urban areas are frequently exposed to anthropogenic activities, which could be hazardous for the sustainability of the Budhabalanga river. Fish biodiversity of this river not only serves as an alternative nutritive source for the people of the Mayurbhanj district in different rural and urban areas but also helps in maintaining the integrity of the aquatic ecosystem. So, a conservation strategy should be designed to improve water quality as well as the fish diversity in the Budhabalanga river.

Authors contribution

SS assisted fieldwork, water sampling, and fish sampling, obtain preliminary data, SJ assistedwrite up, data analysis, data compiling, structuring the manuscript, manuscript correction, and graph plotting, HKS assisted in availing the academic facilities in the Dept. of Zoology (MSCB University, Baripada-757003, Odisha) and coordinating the field study in different localities of the study area.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgments

The authors are very much thankful to P.G. Department of Zoology, Maharaja Sriram Chandra Bhanja Deo University, Takatpur, Baripada, Mayurbhanj, Odisha-757003 for providing laboratory support to analyse the physicochemical parameters of water samples and preserving the fish samples for identification. Hearty thanks to Omprakash Satpathy (Pre-Ph.D. student in Zoology, MSCB University) for collecting the fish samples and Rajkishore Swain (M.Sc. in Wildlife and Biodiversity Conservation, MSCB University) to design the study area map.

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How to cite this article:

Sudhashree Sethi *et al* (2022) 'Physico-Chemical Parameters And Ichthyofaunal Checklist of Budhabalanga River In Mayurbhanj District, Odisha', *International Journal of Current Advanced Research,* 11(03), pp. 507-511.
DOI: http://dx.doi.org/10.24327/ijcar.2022.511.0112

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