ADDITIONAL REPORT AND TAXONOMIC DESCRIPTION OF COMMON PIKE CONGER *MURAENESOX BAGIO* FROM DHOLAI FISHING HARBOUR, GUJARAT, NORTHWEST COAST OF INDIA

ABSTRACT

A new species of *Muraenesox bagio* was identified and described from a minor fishing harbour on the southwest coast of Gujarat, India. It is the first geographical report of the species of the family Muraenosocidae. The species *Muraenesox bagio* resembles very closely with its sister species*Muraenesox cinereus* in terms of morphology as well as genetically. This report confirms the presence of *Muraenesox bagio* around the northwest coast of India as well as provide its taxonomy and detailed morphological descriptions

KEYWORDS: Fishing harbor, Muraenosocidae,*Muraenesox bagio,*

INTRODUCTION

Fishes account for more than 50% of total vertebrate species in the world. Frick *et al.,* (2023), reported a staggering global count of 61,628 fish species. India, recognized for its rich fish biodiversity, hosts 2,860 finfish species (Froese and Pauly, 2023). The west coast of India has rich coastal geography which includes bays, river estuaries, shores varying from muddy bottoms to rocky shores, and the famous mudbanks of Kerala, the west coast represents a little less than 50% of the total ichthyofaunal biodiversity of India. The state of Gujarat alone contributes 426 species, representing approximately 15% of the nation's total fish biodiversity (Joshi *et al.,* 2018).

There are about 106 orders globally, and the order Anguilliformes holds a significant position, encompassing 26 families, 278 genera, and 1900 species (Frick *et al.,* 2023). Whereas in India a study conducted by the Central Marine Fisheries Research Institute (CMFRI) identified 11 families, including 53 genera and 105 species of eels. (Joshi *et al.,* 2018).Family Muraenosocidae is one of the important families in order Anguilliformes, there are six genera of the family Muraenosocidae reported worldwide wiz. *Congresox*, *Cynoponticus*, *Gavialiceps*, *Muraenesox*, *oxyconger*, *Sauromuraenesox* out of which four are reported from India. Three species from Genus *Muraenesox* are reported globally, and two are reported from India (Froese and Pauly, 2023).

Recognizing the limitations in current taxonomic studies and the difficulty in distinguishing species based on morphological analysis, and the poorly studied taxonomy of eels underline the existence of numerous unrecorded species, emphasizing the necessity for a nuanced understanding of these elusive organisms.

In the current investigation, the estimation of phylogenetic relationships was undertaken as a supplementary step aimed at exploring the evolutionary history of the species. Evolutionary studies can provide strong evidence supporting the relationships between different species and their evolutionary history. Molecular data may reveal genetic variability that is not apparent through traditional morphological observation. Because of the abundance of sequence data available in public gene data banks, the use of phylogenetic analysis in taxonomy has grown in importance (Ziemertel al., 2012). The conservative nature of fish mitochondrial genomes makes them valuable for constructing phylogenetic trees and understanding evolutionary relationships among different fish species (Gong *et al.,* 2013). Mitochondrial genomes were inherited maternally, so recombination was very rare and replacement was faster than nuclear DNA (Brown *et al.,* 1979). As a consequence, mitochondrial markers have emerged as the most common inference target for molecular phylogeny of fish species. Previous research has shown that mitochondrial genome rearrangement can provide important insights into species evolution and origin (Smith *et al.,* 1993; Schierup and Hein, 2000).

Dholai is a minor fishing harbour located on the Arabian Sea coast of the south Gujarat region, majority of the vessels registered on the harbour are mechanized trawlers. (Borichangar et. al., 2023) During the survey on identifying rare fish species from the northwest coast of India, *Muraenesox bagio* was identified from a trawler boat on Dholai fishing harbour, the objective of this

study was to identify and give detailed taxonomic and morphological descriptions along witha phylogenetic tree.

Materials and Methods

The specimen of *Muraenesox bagio*was collected from Dholai fishing harbor (20º73'' N, 72º89" E, figure 1). It was brought to the College of Fisheries Science, Navsari, where morphometrics and meristic characters were recorded, linear correlation was applied and photographs were taken. FAO species identification sheets (Fisher ,1984) were used for identification. The specimen wassubmitted to the Aquatic Biodiversity Museum, College of Fisheries Science where it was preserved in 10 % formalin solution(Accession No: A 3.1.1.2).Another specimen of *M. cinereus* was also collected for comparison (Accession No: A 3.1.1.1).

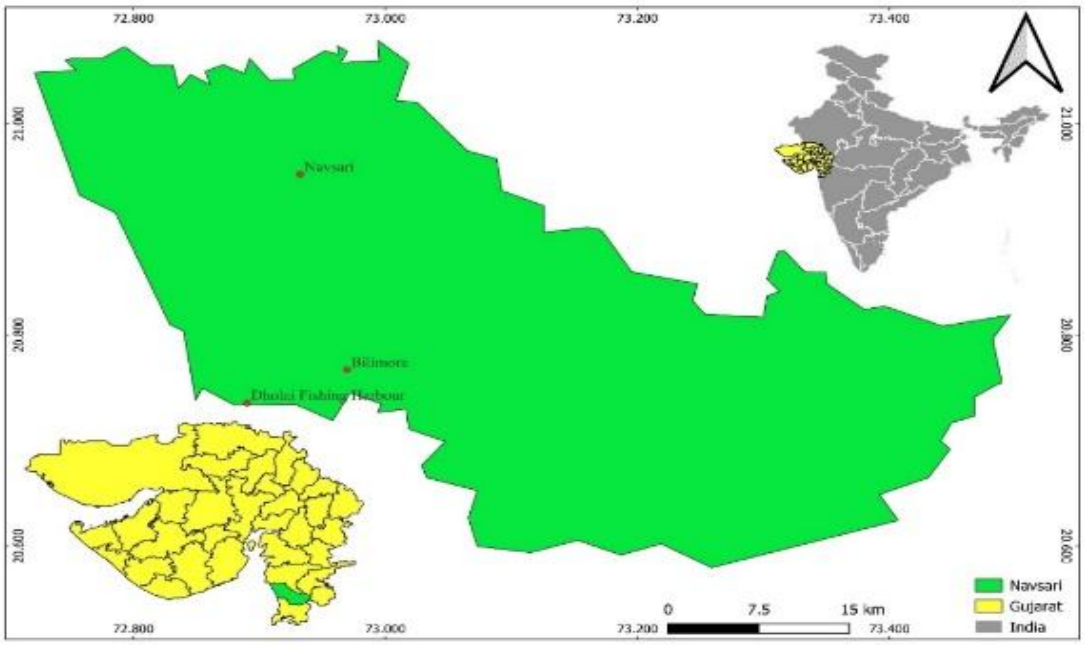

Figure 1: Location of Dholai Fishing Harbour, Gujarat

In the present study, 10 complete Anguilliformes mitochondrial genomes from 4 families were downloaded from GenBank for phylogenetic studies (Table 1). Evolutionary analyses were performed in MEGA11 software (Tamura *et al.,* 2021) using the Maximum Likelihood method after multiple sequence alignment (clusterW). The evolutionary history was inferred by using the Maximum Likelihood method and the Tamura-Nei model (Tamura and Nei 1993). The tree with the highest log likelihood (-97394.43) is shown.

Table 1: List of 10 Anguilliformes species used for phylogenetic relationship.

Family	Species	Length (bp)	Accession No.
Muraenesocidae	*Muraenesox bagio*	18,247	NC 013614.1
	Muraenesox cinereus	17,673	MT 571331.1

	Cynoponticus ferox	17,822	NC 013617.1
Congridae	*Xenomystaxcongroides*	17,897	NC 082754.1
	Xenomystaxatrarius	17,821	NC 082557.1
Anguillidae	*Anguilla interioris*	16,713	NC 006539.1
	Anguilla bicolor bicolor	16,700	NC 006534.1
Nettastomatidae	*Venefica procera*	17,899	OP056970.2
	Leptocephalus sp	18,037	NC 013615.1
	Hoplunnis punctata	17,828	NC 013623.1

Results

Taxonomical description

Kingdom: Animalia
Phylum: Chordata
Subphylum: Vertebrata
Infraphylum: Gnathostomata
Parvphylum: Osteichthyes
Gigaclass: Actinopterygii
Superclass: Actinopteri
Class: Teleostei
Order: Anguilliformes
Family: Muraenosocidae
Genus: Muraenesox
Species: Bagio

According to the Interim Register of Marine and Nonmarine Genera (IRMNG, 2023), Kaup provided the original description of the family Muraenosocidae in 1859. The species from the genera *Muraenesox* were initially known as *Muraenosox* and *Muraenisox*, and these names were revised by McClelland in 1844. The name for *Muraenesox bagio* (Hamilton, 1822) was previously misspelled as *Muraenesox baggio* (Hamilton, 1822). Additionally, the earlier synonym for *Muraenesox cinereus* (Forsskål, 1775) was *Muraenesox arabicus* (Bloch & Schneider, 1801).

During the morphological observations of *M. bagio*, several morphometric parameters and meristic characters were recorded, and linear correlation was applied. A list of morphometric parameters is presented in Table 2. The total length of the specimen was 192 cm and the eviscerated weight was 9120 g, according to sources the maximum length of this species is around 200cm(Froese and Pauly, 2023), and the sex and maturity of the specimen could not be identified as it was gutted by a fisherman onboard the boat, before landing.

Table 2: Morphometric parameters of *Muraenesox bagio*

Sr. No	Morphometrics	cm	% TL*	% SL**		Sr. No	Morphometrics	cm	% TL	% SL
1	Total length	192.8	100.00	108.31		11	Pectoral fin length	10.4	5.39	5.84
2	Standard length	178	92.32	100.00		12	Pectoral fin base	2.6	1.35	1.46
3	Head length	31.2	16.18	17.53		13	Snout length	8.6	4.46	4.83
4	Head width	8.5	4.41	4.78		14	Eye diameter	2.7	1.45	1.57
5	Body depth	5.9	3.06	3.31		15	Pre-orbital length	8.6	4.46	4.83
6	Caudal fin length	3.8	1.97	2.13		16	Post-orbital length	20.4	10.58	11.46
7	Pre-dorsal length	27.8	14.42	15.62		17	Inter orbital width	2.8	1.45	1.57
8	Post-dorsal length	165	85.58	92.70		18	Lower jaw length	13.2	6.85	7.42
9	Pre-anal length	88.2	45.75	49.55		19	Upper jaw length	15.1	7.83	8.48
10	Pre-pectoral length	32.5	16.86	18.26		20	Inter nostril distance	3	1.56	1.69

* Morphometric parameter converted to percentage of total length

** Morphometric parameter converted to percentage of standard length

Species Description:

Elongated body, conical-shaped head, mouth extending wellbeyond eyes(figure 2); head length 16.18% of total length.Jaws are very large with 3 longitudinal rows of teeth on both jaws (figure 2). 25-26 large canine teeth, which are laterally compressed with basal bulges at the front and behind.7-8 large canine teeth at the tip of the lower jaw that fits into the snout when the mouth is closed. With small gill openings, the gill arches are smooth, without gill rakers, and feature large gill filaments on the gill arches. The dorsal fin and anal fins are continuous with the caudal fin and create a pointed caudal fin.Dorsal fin with 200-210 soft rays. Very well-developed pectoral fins with 24-26 soft rays that extend beyond the origin of the dorsal fin. The anal fin has 165-170 rays. The dorsal fin originates behind the operculum, whereas the anal fin originates from thelatter half of the body. There are around 120 lateral line pores present on the whole lateral line; out of 120, 35 pores are present before anal opening. Lateral line pores have small tails giving it a look that of a comet. The head width and snout length are equal (around 4% of total length). The upper jaw is slightly more extended (7.83% of

total length) than the lower jaw (6.85% of total length) to accommodate the lower jaw's large canine teeth.

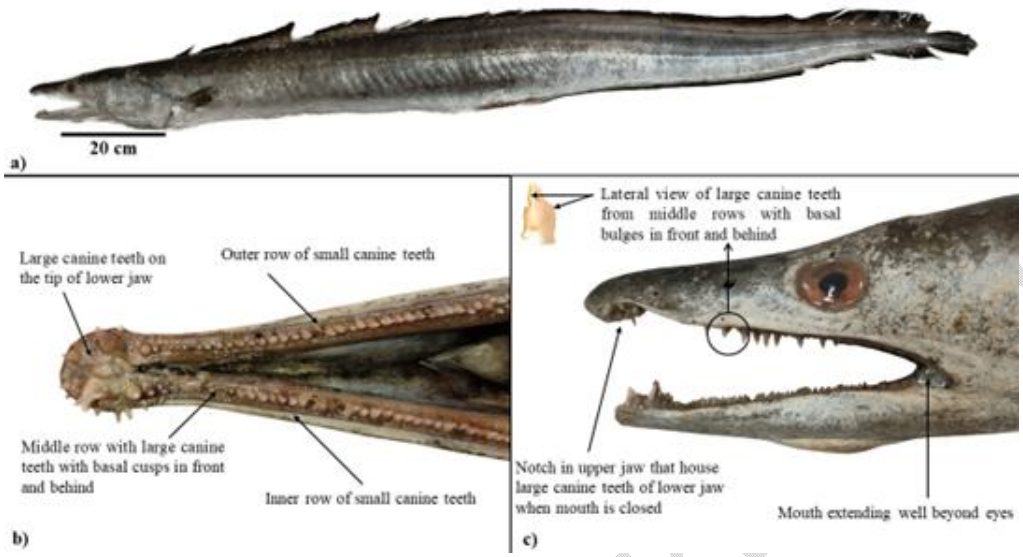

Figure 2 a) Lateral view of Muraenesox bagio b) Top view of lower jaw c) lateral view of head

Coloration:

Fresh specimens are dark grey on the dorsal side which gradually decreases to a light silver color on the ventral side. Dorsal and anal fins have narrow black edges when fully extended.

Sisterspecies found in the area:

there is another species described from this area *Muraenesox cinereus*, which is very close to this species in terms of morphometric (figure 3) and morphological characters. Both species have similar coloration, *M. bagio* is dark grey colored on the dorsal side, and *M. cinereus* is brown-grey on the dorsal side in fresh condition.

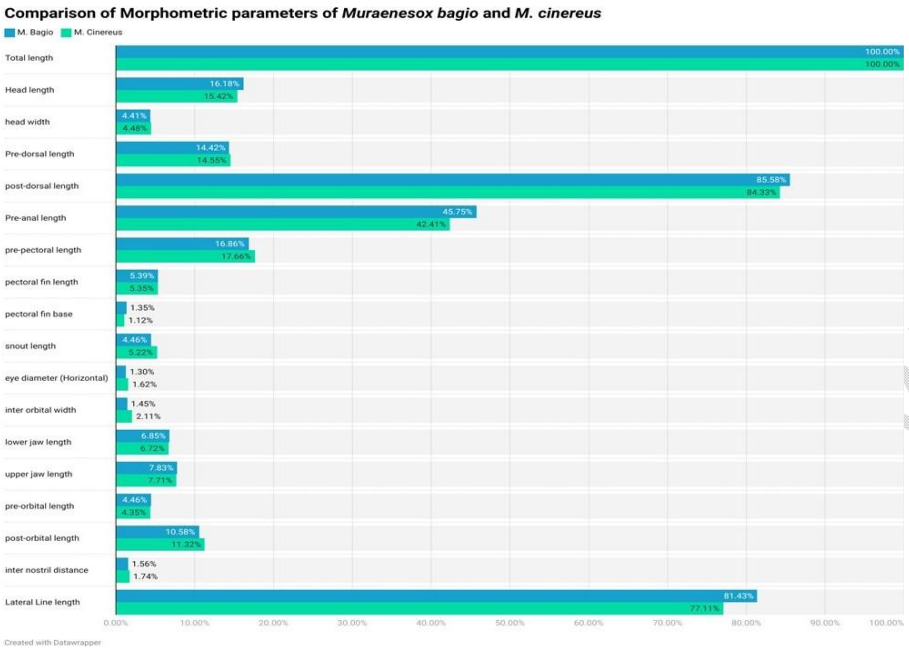

Figure 3: Comparison of Morphometric parameters of *Muraenesox bagio* and *M. cinereus*

Key to closely resembling genusof family Muraenosocidae:

The species from Genus *Congresox* and *Muraenesox* have jaw teeth in multi-serial rows and they do not possess conspicuous sensory pores on head.

Congresox spp.: Large conical teeth in the lower jaw, teeth do not possess basal bulges.

Muraenesox spp.: Large teeth in lower jaw with prominent basal cusps.

Key to Species identification:

Muraenesox bagio: Lateral line pores before anal fin 34-35, soft dorsal fin rays before anal fin 47-48. Lateral line around 81 % of the total length. Distance between two nostrils around 10% of head length. Eye diameter (2.8 cm) is 3 times in snout (8.6 cm)length. Upper jaw teeth in middle row sparsely set(figure 4).

Muraenesox cinereus: Lateral line pores before anal fin 40-41, soft dorsal fin rays before anal fin 72-73. Lateral line around 77 % of the total length. Distance between two nostrils around 21% of head length. Eye diameter is 2.3 times (1.4 cm) in snout length(3.4 cm). Upper jaw teeth in middle row densely packed.(figure 4).

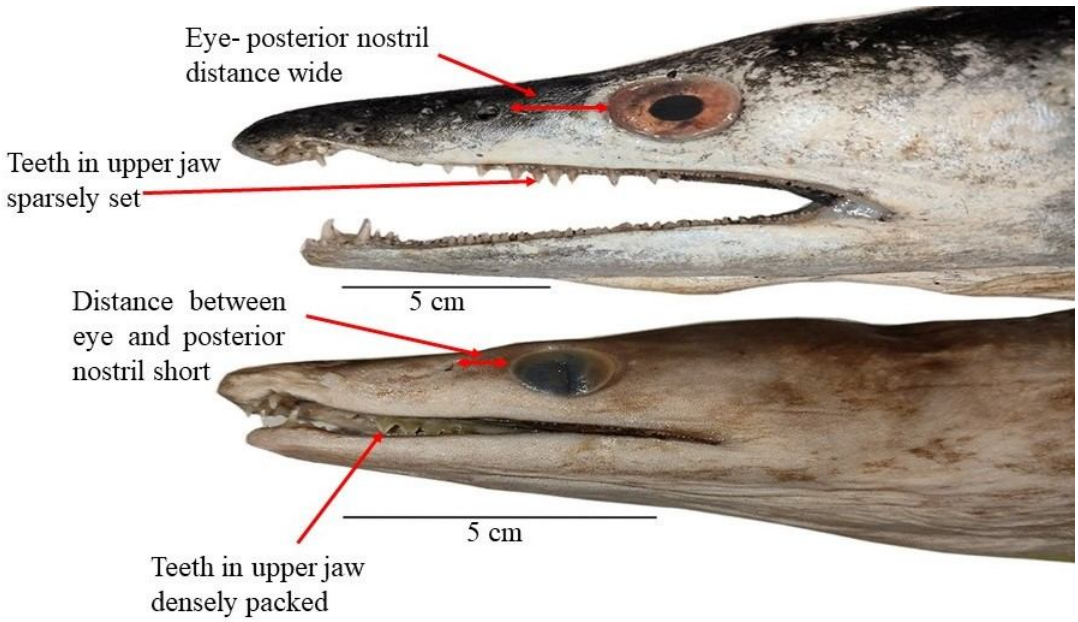

Figure 4 Lateral View of *Muraenesox bagio* (above) and *M. cinereus* (below)

Phylogenetic analysis

To further study the evolutionary status of *M. bagio*,four closely related families (including Muraenosocidae) were selected to construct phylogenetic trees (figure 5) to analyze species relationships. It clearly shows that *M. cinereus* and *M. bagio* were the closest in the relationship and that these two species form the Muraenosocidae branches are sharea common ancestor in recent. The mitochondrial genome structures of *M. cinereus* and *M. bagio* were very similar but in some places,theydiffer by gene arrangement (Zhang *et al.,* 2021).

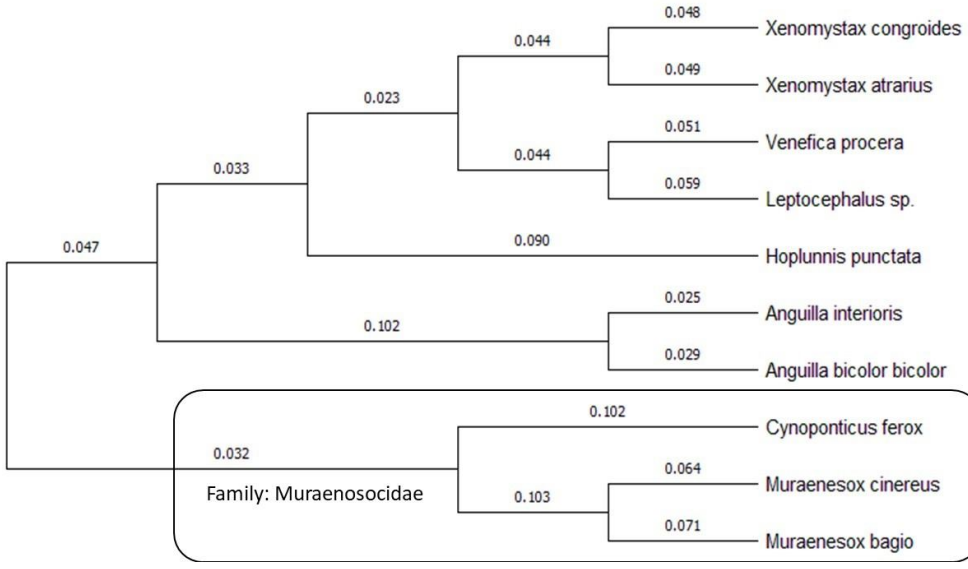

Figure 5: Phylogenetic analysis based on nucleotide sequence of a mitogenome

Discussion

A few checklists have been prepared on ichthyofaunal biodiversity from the various locationsonthe northwest coast of India, a few of them have reported *M. cinereus* from the checklist but there has been no report and taxonomic descriptions*M. bagio*(Brahmane*et al.,* 2014, Sikotariya *et al.,* 2018, Bhendekar*et al.,* 2019, Solanki *et al.,* 2020, De *et al.,* 2021, Sidat *et al.,* 2021, Singh *et al.,* 2021, Pathak *et al.,* 2022).The present study provides the first geographical report and thetaxonomic descriptions of M. bagio from the northwest coast of India. The species from the present study (FAO fishing area 51) have been compared with previous record (Figure 6) by Lin *et al.,* 2013 from Taiwan (FAO fishing area 71),The parameters of both species match with each other and species descriptions also matches with original descriptions from (Fischer and Bianche, 1984) thus proving the species from the current study is indeed *M. bagio*

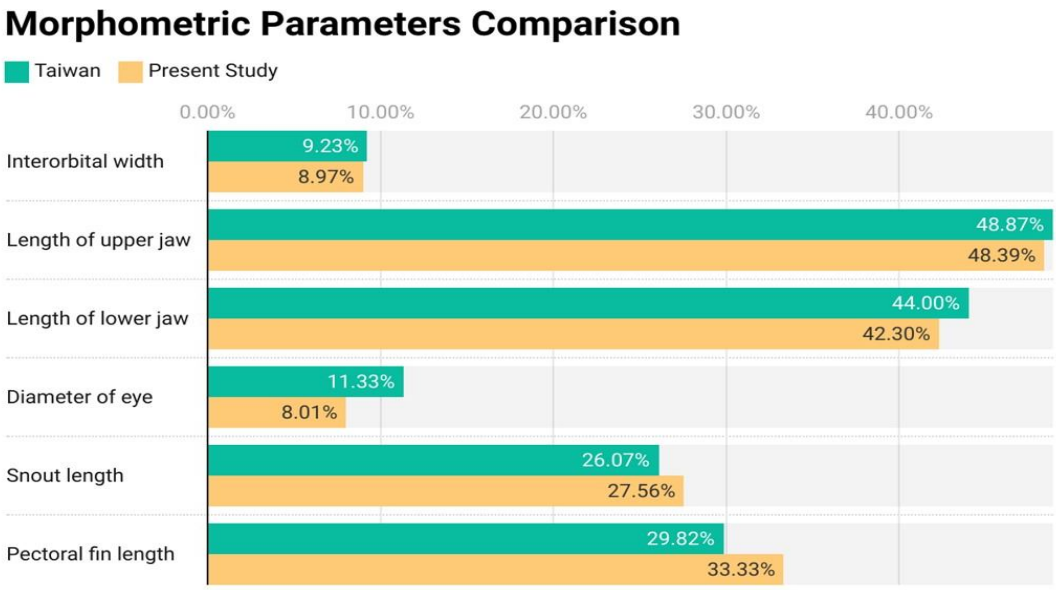

Figure 6: Comparison of Morphometric parameters between a study carried out in Taiwan (Lin et al. 2013) and the present study.

Conclusion

In conclusion, there has been no known record or taxonomic descriptions of this species being present from, the northwest coast of India, this is the first documented record with its taxonomic descriptions. This research extends the geographical range of *M. bagio* to the northwest coast of India.

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