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CHROMOSOMAL STUDIES OF THE AFRICAN DOTTED CATFISH Parauchenoglanis monkei (KEILHACK 1910)

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ABSTRACT

The chromosomal data within the genus *Parauchenoglanis* is scarce. The two main species of the genus identified in Nigeria are *P. buttikoferi* and *P. monkei*. The chromosome of *P. monkei* was assessed in this study to provide information on the diploid number and karyotype. Samples (n=40) were collected in Opa River, Ile-Ife, Osun State, Nigeria. The chromosomes of the specimen were extracted using the Giemsa staining technique. The mitotic chromosome spread has a diploid chromosome number of 2n=50. The autosomal fundamental number was 55, while the karyotype formula was 2n=2M+ 8m+40T. The diploid chromosome number of 50 obtained for *P. monkei* is within the range for catfishes.

Keywords: *Parauchenoglanis*, Chromosome, Diploid number, Karyotype.

INTRODUCTION

Catfishes belong to the order Siluriformes (Suborder Siluroidei) and currently comprise 4019 valid described species and 500 genera assigned to 39 families (Fricke *et al*., 2022). The catfishes are distributed across South America, Africa, Europe, and Asia. Globally, the population of catfishes is about one-third of freshwater fish fauna (Jayaram 2009). However, the exact number of catfish families is unclear because of conflicting views about family-level classification (Sullivan *et al*., 2006; Ferraris, 2007; Diogo and Peng, 2010). According to Sullivan *et al.* (2006), Mochokidae, Malapteruridae, Amphiliidae, Claroteidae, Lacantuniidae, and Schilbeidae were described as the 'Big Africa' catfishes.

Mo (1991) classified the family Claroteidae into two subfamilies: the Claroteinae, with seven genera, and the Auchenoglanidinae, with six genera, including *Parauchenoglanis*. The genus *Parauchenoglanis* currently comprises nine species (Ferraris, 2007). They include *P. ahli* (Holly, 1930), *P. balayi* (Sauvage, 1879), *P. buettikoferi* (Popta, 1913), *P. longiceps* (Boulenger, 1913), *P. ngamensi* (Boulenger, 1911), *P. monkei* (Keilhack 1910), *P. pantherinus* (Pellegrin, 1929), *P. altipinnis* (Boulenger, 1911), and *P. punctatus* (Boulenger, 1902). The distribution range of members of the genus *Parauchenoglanis* (particularly *P. punctatus*) includes West, Central, and Southern Africa (Geerinckx *et al*., 2004). Based on available data, *P. monkei* and *P. buettikoferi* are members of the genus *Parauchenoglanis* and are widely distributed in Nigeria. *P. buettikoferi* was first reported from the Warri River (Geerinckx *et al*., 2004), while *P. monkei* has been described from the Lower Cross River (Teugels *et al*., 1992). *P. fasciatus*, *P. monkei*, and *P. guttatus* used to have individual species statuses until recently. Geerinckx *et al.* (2004, 2013) reported no distinguishing features to discriminate the two fishes: *P. fasciatus*, and *P. guttatus*. However, Fricke *et al.* (2022) showed that *P. fasciatus* and *P. guttatus* are synonyms of *P. monkei*.

As a follow-up to the critical review of taxonomic status within the genus, this study assessed the chromosome complement of *P. monkei* as there are no reports on the underlying chromosome complement of the fish. Generally, the interest in the karyological data of catfishes is hinged on its importance in aquaculture. This study, therefore, presents the first karyological data of *P. monkei*. Such data is essential to provide further corroborative evidence(s) alongside other taxonomic evaluation methods to establish the taxonomic identity of living organisms.

MATERIALS AND METHODS

Live samples (n=40) of *P. monkei* were collected from the Opa River between November and December 2019. The fish samples were kept in a bucket with a bubble-box aerator and transported to sets of aquaria in the Department of Zoology, Obafemi Awolowo University, Ile-Ife, Nigeria.

The fishes were identified using standard identification keys (Paugy *et al*., 2003; Geerinckx *et al*., 2004). *P. monkei* can be identified with the following features. First, the preorbital head length is not greater than its head height. The barbels are relatively short, with the maxillary barbel not reaching beyond the base of the pectoral fin spine. The anterior edge of its pectoral spine is coarsely serrated, with numerous small serrations, more numerous than those along the posterior edge. Overall, the colouration is light brown to greyish brown with five or six (exceptionally four or seven) dark vertical bands on flanks that sometimes appear to consist of large, merging spots. These spots may be present between these bands, including the head and fins.

Metaphase chromosomes were prepared from the gill tissue of the specimens (n=20) and analyzed. The fishes were injected with 0.02 ml/gram of colchicine from a stock of 0.05% wt/vol to commence the chromosome extraction. The injection was administered at the muscle base of the dorsal fin. About three hours after the colchicine treatment, the specimens were sacrificed, and the gills were removed. The gill tissues were placed in a hypotonic solution of 0.56% KCl for 30 min (to open the cell membrane) and squashed to homogeneity in a mortar with a pestle. The suspension was spun at 1000 rpm for 10 min and the pellets were fixed in a freshly prepared Carnoy's fixative (ethanol/acetic acid: 3:1 dilution). The cell suspension was spread on a microscope slide at a height, air-dried, and stained with 6% Giemsa stain for 25 min. The images of the chromosome spreads were obtained using a camera (Omax A35140U model, USA) attached to a trinocular microscope (Omax G013055005, USA). Further processing of the images was done using the GNU image manipulation program, GIMP 2.10.8. Also, the length of the chromosomes with the corresponding idiogram was determined using the software Karyotype 2.0 (Altinordu *et al*., 2016). The morphological conformation of the chromosomes was classified as previously described by Levan *et al*. (1964).

Figure 1: The picture of *Parauchenoglanis monkei*.

RESULTS

The chromosome spread obtained for *P. monkei* is shown in Figure 2. The karyotype of *P. monkei* revealed a diploid number of 2n = 50 (Figure 3). The karyotype consists of four metacentric, eight submetacentric, and forty telocentric chromosomes. The corresponding autosomal fundamental number of autosomal arms (Nf) was 55 with a karyotype formula of 2n=2M+ 8m+40T. The morphology of the chromosome (idiogram) is presented in Figure 4. Table 1 describes the karyological parameters, i.e., the chromosome arm length arm ratio and the nomenclature of each of the chromosomes. The total length of the chromosomes ranged from 0.01 to 0.03 μm.

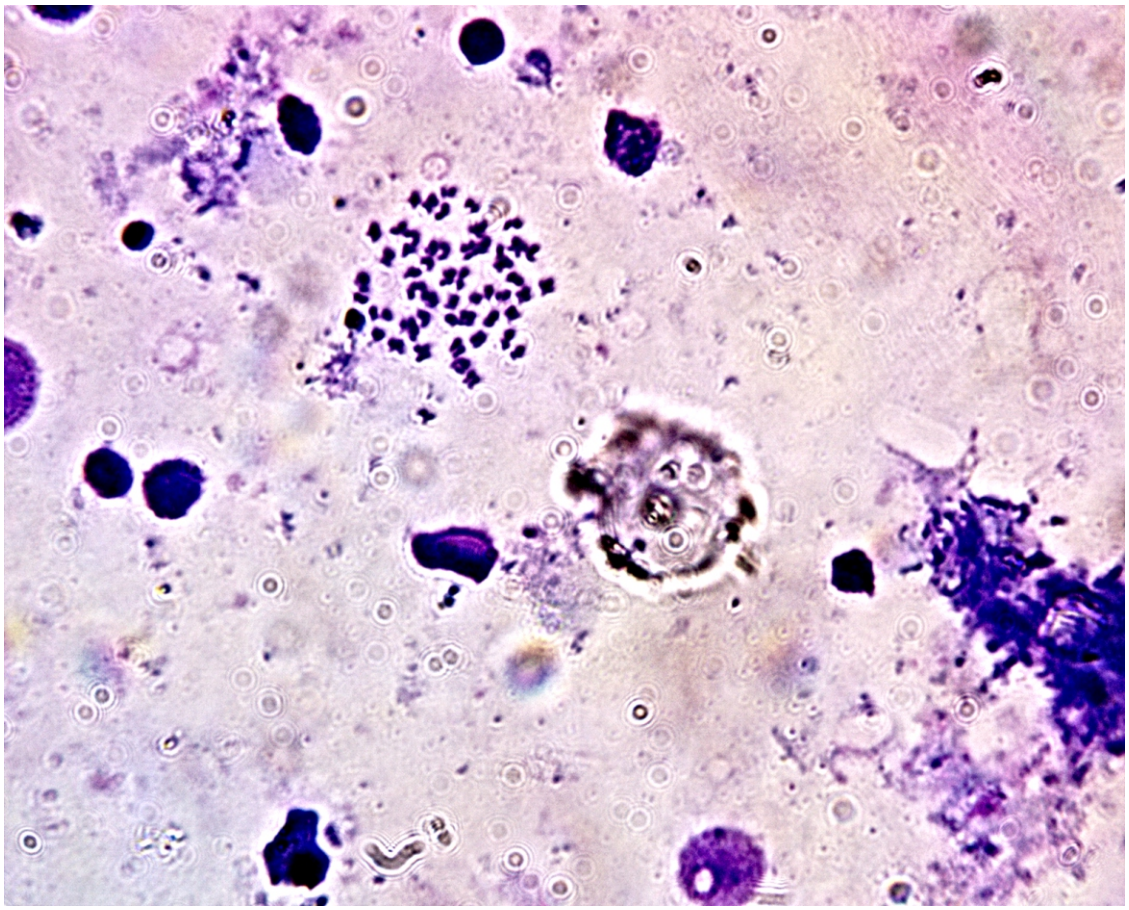

Figure 2: Mitotic chromosome spread of *Parauchenoglanis monkei* (2n =50).

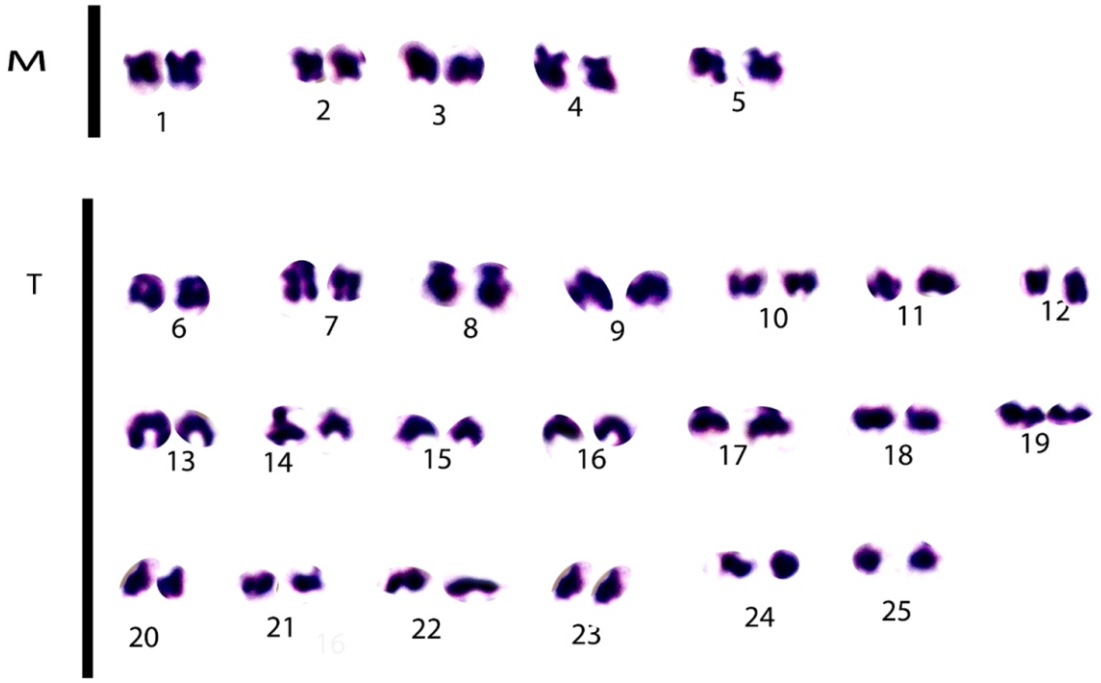

Figure 3: Karyotype of *Parauchenoglanis monkei.*

Table 1: The chromosome measurement and nomenclature of *Parauchenoglanis monkei*.

	Measurement (μm)			Relative length(%)				
Chromosome (n)	**Long Arm (l)**	**Short Arm (s)**	**Total Length (c)**	**Long Arm (l')**	**Short Arm (s')**	**Total Length (c')**	**Centromeric Index(100s/c)**	**Nomenclature**
1	0.02	0.01	0.03	8.91	0.78	9.69	8.05	Median(m)
2	0.01	0.01	0.02	6.41	0.77	6.41	12.01	Sub-median(sm)
3	0.03	0.00	0.03	4.21	0.76	4.98	15.26	Sub-median(sm)
4	0.03	0.00	0.03	4.94	0.74	4.94	15.00	Sub-median(sm)
5	0.02	0.01	0.03	4.79	0.70	4.79	14.61	Sub-median(sm)
6	0.01	0.00	0.01	4.79	0	4.79	0	Terminal(T)
7	0.03	0.00	0.03	4.53	0	4.53	0	Terminal(T)
8	0.03	0.00	0.03	3.43	0	4.21	0	Terminal(T)
9	0.02	0.00	0.02	4.19	0	4.19	0	Terminal(T)
10	0.03	0.00	0.03	3.98	0	3.98	0	Terminal(T)
11	0.03	0.00	0.03	3.98	0	3.98	0	Terminal(T)
12	0.03	0.00	0.03	3.11	0	3.89	0	Terminal(T)
13	0.02	0.00	0.02	3.1	0	3.88	0	Terminal(T)
14	0.03	0.00	0.03	3.75	0	3.75	0	Terminal(T)
15	0.03	0.00	0.03	3.75	0	3.75	0	Terminal(T)
16	0.03	0.00	0.03	2.84	0	3.61	0	Terminal(T)
17	0.02	0.01	0.03	3.3	0	3.30	0	Terminal(T)
18	0.01	0.00	0.01	2.51	0	3.29	0	Terminal(T)
19	0.03	0.00	0.03	3.23	0	3.23	0	Terminal(T)
20	0.03	0.00	0.03	2.2	0	2.97	0	Terminal(T)
21	0.02	0.00	0.02	2.65	0	2.65	0	Terminal(T)
22	0.02	0.00	0.02	1.88	0	2.65	0	Terminal(T)
23	0.02	0.00	0.02	2.51	0	2.51	0	Terminal(T)
24	0.02	0.00	0.02	2.33	0	2.33	0	Terminal(T)
25	0.01	0.00	0.01	1.55	0	1.55	0	Terminal(T)

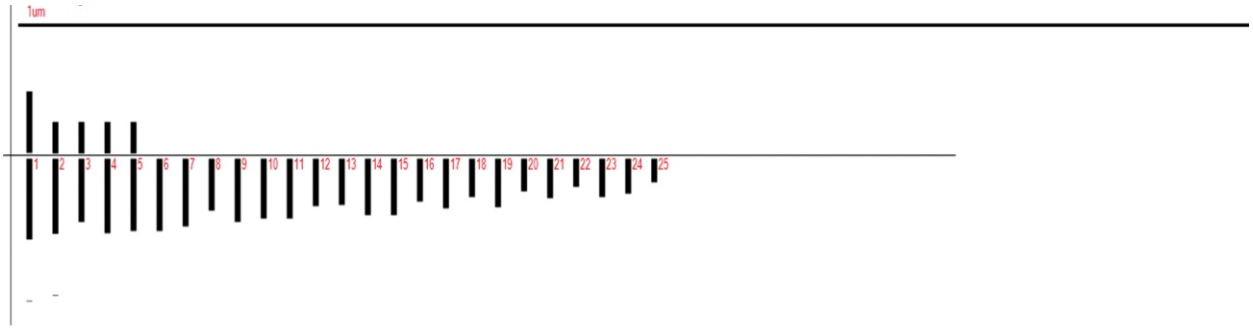

Figure 4: An idiogram of the karyotype of *Parauchenoglanis monkei* showing the morphology of the chromosome.

DISCUSSION

The dearth of karyological information among the catfishes of Africa is high (Arai, 2011), and most scientific studies have focused on the members of the family Clariidae (Oyeyemi *et al*., 2011). This is the first report of the diploid chromosome complement number of *P. monkei*, and probably the first report of chromosome complement of any species of the genus *Parauchenoglanis*. The diploid number of chromosomes of 50 observed in this study is within the range of variation in the chromosome complement number of members of the suborder Siluroidei. Unlike Cypriniform fishes with a highly stable chromosome number, the Siluroidei fishes exhibit a great diversity of chromosome numbers. In the Siluriodei, each family has a broad range of chromosome

numbers per species, so it has been difficult to establish a general pattern of chromosome diversification in phyletic lineages (Kim *et al*., 1982). For example, *Liobagrus undersoni* (Amblycipitidae) has 2n = 28 chromosomes (Kim *et al*., 1982), while *Corydoras aeneus* (Callichthydiae) has 2n = 132 chromosomes (Scheel *et al*., 1972). The situation is the same in African catfishes though few studies have been conducted. *Auchenoglanis occidentalis* (Claroteidae) has 2n = 56; *Bagrus docmak* (Bagridae) 2n = 54; *Chrysichthys maurus* (Claroteidae) 2n = 70; *C. aurutus* 2n = 72 while *Clarotes laticeps* 2n = 70 (Volckaert and Agnese, 1996). In addition, the karyotypes of *Clarias gariepinus* and *Heterobranchus longifilis* (Clariidae) are 2n = 56 and 52, respectively (Ozouf-Costaz *et al*., 1990). However, the modal frequency of chromosome number of the suborder Siluriodei is 56. The increase in chromosome numbers observed across the various karyotype of members of the suborder Siluriodei may be due to centromeric fissions which transform a chromosome with two arms into two chromosomes with one arm (Volckaert and Agnese, 1996).

Many representatives of several fish orders, such as Characiformes, Cypriniformes, Siluriformes, and Gymnotiformes have karyotypes dominated by bi-armed chromosomes (Molina *et al.,* 2014). However, the chromosome complement observed in the present study is mainly telocentric. Further, Molina *et al.* (2014), reported a prevalence of karyotypes with few (< 33%) or many (> 66%) acrocentric chromosomes and a low number of karyotypes with balanced numbers of mono- and bi-brachial elements in many orders of fishes. Also, the study observed a parallel trend toward a higher number of karyotypes with a prevalence of monobrachial chromosomes occurring in phylogenetically close orders (e.g., Perciformes and Tetraodontiformes, and in the order Mugiliformes) and in clades with a prevalence of bibrachial elements (e.g. Characiformes, Gymnotiformes, Siluriformes, and Cypriniformes).

The variation in chromosome complement is not uncommon, especially within the Siluriformes. For *Pseudoplatystoma reticulatum*, different authors reported different karyotype formulas showing different proportions of acrocentric chromosomes even for the same species (Neto *et al*., 2011). Such variation in chromosome complement could be pieces of evidence of unique biogeography history or karyotype evolution processes due to geographic isolation and an interruption in gene flow and may have no deep evolutionary or taxonomic significance compared to gross changes in chromosome number. On the other hand, these differences could also be related to methodological problems or chromosome condensation. But the spread of this chromosome complement within the group should be assessed to determine the trend and the biological importance.

In conclusion, this study is significant since karyological data have been employed in solving problems relating to chromosome number, functional arm, phyletic relationship, taxonomic status, and the possibility of speciation among the studied species.

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