

# Fishes of the Pendjari National Park (Benin, West Africa)

## Die Fische des Pendjari-Nationalparks (Benin, Westafrika)

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**Summary:** The River Pendjari is a tributary of the Volta in the savannah region of West Africa. The discharge is heavily influenced by the West African monsoon, which brings high discharge and leads to extended flooded areas during rainy season. During dry season, the river ceases to flow and the river bed desiccates into some stretches of the river. The Pendjari National Park, which is situated in the northwesternmost part of the Republic of Benin, is for a large part confined by the Pendjari River, which harbours a typical Nilo-Sudanian ichthyofauna that is only marginally influenced from the lowland ichthyofauna of coastal West Africa. Combining own records and literature concerning the fishes of the Volta basin, we expected 123 fish species out of 64 genera and 28 families to occur in the Pendjari area. Of these, 112 species out of 59 genera have been confirmed for the study area so far, and 101 of these were recorded during several own field surveys between 2001 and 2007, including the rarely recorded species *Pollimyrus adspersus*, *Campylomormyrus tamandua* and *Nematogobius maindroni*. The most diverse fish families in the Pendjari River are cyprinids with 21, mormyrids with 18 and mochokids with twelve species. The degree of endemism in the Pendjari area and the Volta basin in general is low: most species share a wide Nilo-Sudanian distribution and occur in all major sub-Saharan rivers. Notable exceptions are *Steatocranus irvinei*, a cichlid endemic to the Volta basin, and the small barb *Enteromius parablables* which probably is restricted to the Atakora chain, the origin of the Pendjari River. Our records include two potentially new species, *Syndontis* sp. 'Pendjari' and *Fundulosoma* sp. aff. *thieryii*. Besides a comprehensive species summary and a key of fish species in the Pendjari National Park, this study gives detailed information on habitat condition and relative abundance of recorded fish species in the observation period of 2001 to 2007.

**Key words:** Ichthyofauna, Pendjari River, National Park, Volta basin, freshwater, nilo-sudanian

**Zusammenfassung:** Der Pendjari ist ein Zufluss des Volta in der Savannenregion Westafrikas. Seine Wassermengen sind stark vom westafrikanischen Monsun abhängig, der zu hohen Durchflussmengen und ausgedehnten Überflutungsflächen während der Regenzeit führt. Während der Trockenzeit hört der Fluss auf zu fließen und teilweise trocknet das Flussbett aus. Der Pendjari-Nationalpark, der im Nordwesten von Benin liegt, ist zu einem großen Teil vom Pendjari begrenzt. Im Pendjari findet sich eine typisch nilo-sudanische Fischfauna mit nur geringer Beeinflussung durch das küstennahe Tiefland Westafrikas. Kombiniert man eigene Daten mit der Literatur zu den Fischen des Voltabeckens, gibt es in der Pendjariregion voraussichtlich 123 Fischarten aus 64 Gattungen und 28 Familien. Von diesen wurden 112 Arten aus 59 Gattungen bereits dort nachgewiesen, 101 davon während eigener Untersuchungen im Zeitraum 2001 bis 2007, einschließlich der seltenen Nachweise von *Pollimyrus adspersus*, *Campylomormyrus tamandua* und *Nematogobius maindroni*. Die am meisten diversen Fischfamilien im Pendjari sind die Karpfenfische mit 21, die Mormyriden mit 18 und die Fiederbartwelse mit zwölf Arten. Der Endemismusgrad im Pendjari ist, wie im restlichen Voltagebiet, eher gering: Die meisten Arten dort zeigen eine nilo-sudanische Verbreitung und sind folglich in allen größeren Subsahara-Flüssen zu finden. Ausnahmen stellen etwa *Steatocranus irvinei*, ein im Voltabecken endemischer Buntbarsch, und die kleine Barbe *Enteromius parablables* dar, die möglicherweise nur im Atakoragebiet, in dem

der Pendjari entspringt, vorkommt. Unsere Nachweise schließen auch zwei möglicherweise neue Arten mit ein: *Synodontis* sp. 'Pendjari' und *Fundulosoma* sp. aff. *thieryi*. Neben einem umfassenden Artenüberblick und einem Bestimmungsschlüssel der Fischarten des Pendjari-Nationalparks werden Informationen über Habitate und die relative Häufigkeiten der Arten im Untersuchungszeitraum 2001 bis 2007 gegeben.

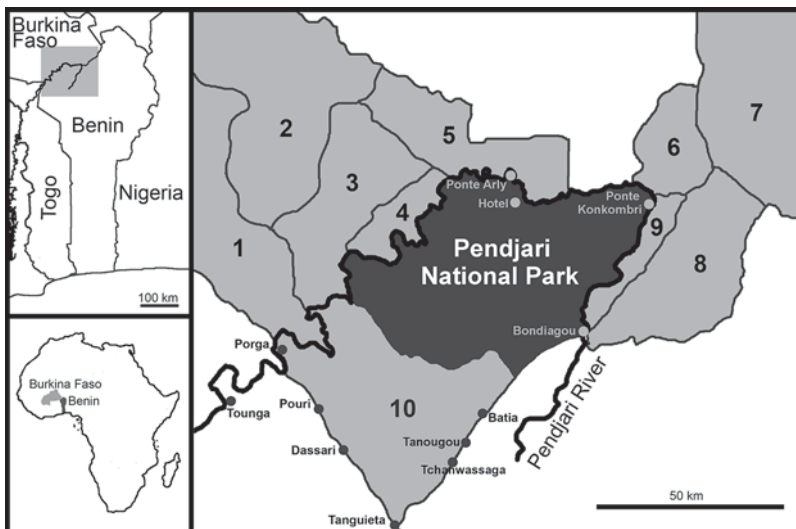
**Schlüsselwörter:** Fischfauna, Pendjari, Voltabecken, Süßwasser, Nilo-Sudan

## 1. Introduction

### 1.1. Pendjari National Park

The "Réserve de Biosphère de la Pendjari", the official name of the Pendjari National Park (PNP), is located in northwestern Benin in the Atakora department (fig. 1). The Pendjari National Park is a part of an interlinked system of protected and semi-protected areas in Benin, Burkina Faso and Niger, forming the W-Arly-Pendjari (WAP) complex that also includes the Parc National d'Arly (Burkina Faso), the Parc W (Benin, Burkina Faso & Niger) and the immediately bordering hunting zones (see fig. 1 for PNP zones). The non-hunting core zone with the highest level of protection in the PNP covers 2,750 km<sup>2</sup> and comprises about

16 % of the WAP area, which totals 17,148 km<sup>2</sup> (IUCN 2017). The PNP is roughly situated between N 11° 30' to 11° 00' and E 1° 10' to 1° 55'. Together with the associated hunting zones it covers about 5,000 km<sup>2</sup> and was originally established as game reserve by the French colonial government in Dahomey in 1954. It was subsequently converted into a national park in 1961 only one year after Benin gained independence. The W-Park in Niger is listed as IUCN World Heritage since 1996. The PNP as part of the W-Arly-Pendjari complex is an important refuge for large mammals in West Africa and is an officially enlisted UNESCO World Heritage Site as an extension of the W-Park since 2017 (IUCN 2017). The recognition under the Ramsar Convention on Wetlands of International Importance (UNEP 2013) underlines



**Fig. 1:** Protected and semi-protected areas around the Pendjari National Park. 1 – Réserve Partielle de Faune de Pama, 2 – Réserve Total de Faune de Singou, 3 – Réserve Partielle de Faune de l'Arly, 4 – Réserve Totale de Faune de Madjori, 5 – Réserve Totale de Faune de l'Arly, 6 – Réserve Partielle de Faune de la Koutiagou, 7 – Par Régional du W, 8 – Zone cynégétique de la Mékrou, 9 – Zone cynégétique de l'Atakora, 10 – Zone cynégétique de la Pendjari.

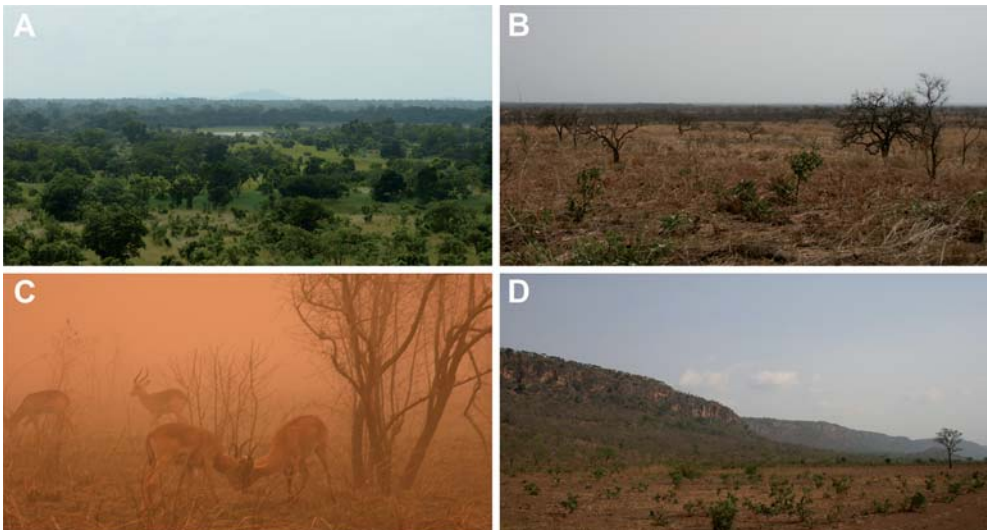
**Abb. 1:** Gebiete mit verschiedenem Schutzstatus im Umfeld des Pendjari Nationalparks.

the outstanding ecological value of the 145 km<sup>2</sup> of wetlands in the Pendjari valley.

The landscape is a mosaic of biotopes and mainly structured by West African savanna and open gallery forest woodland (fig. 2). Grassland is dominating and some weeds may reach up to two meters or more during rainy season. The pronounced shifts between dry and rainy season (fig. 2A-B) are a driving factor characterising and shaping the habitats of the PNP. The dry season starts towards end of October and usually lasts to mid-May. This season can be subdivided into a cold dry season from November to February, followed by a hot dry season usually lasting from March to mid of May. During the first part of the dry season the Harmattan, a desert wind from north-easterly direction, conveys Sahara dust reducing the visibility during the day to 100 m or less (fig. 2C). Daytime temperatures usually exceed 35 °C, but may fall to 15 °C during night. Outside Harmattan season, temperatures climb to 40 °C or more during the day and stay above 20 °C at night. After this period of virtually no precipitation, the West African

monsoon circulation brings in heavy rains from July to September with an average annual precipitation of about 900 to 1,100 mm (DELVINGT et al. 1989; MUL et al. 2015). After the first rain falls end of May, the temperature differences between day and night are much reduced and usually oscillate between 25 and 35 °C, with a relative humidity close to saturation. The monthly precipitation rate from July to September ranges between 200 and 300 mm but may sometimes reach up to 400 mm. These are, however, only approximations, as the precipitation in general is highly variable in space and time in this area (MUL et al. 2015).

Major parts of the PNP are lowlands at about 150 to 200 m above sea level (DELVINGT et al. 1989) and part of the so-called “Gourma plain”, which exceeds into Burkina Faso. Its sandstone and schist formations are part of the Voltaian, more precisely the Pendjari supergroup, which was formed in late Precambrian and early Cambrian, about 700–600 Ma ago (AFATON 1990). The Pendjari supergroup consists of massive 2,500–3,000 m clayey-sandy deposits (AFATON



**Fig. 2:** Landscape and climate in the Pendjari National Park. **A** Savanna at end of rainy season (October). **B** Savanna at late dry season (April). **C** Kob antelopes in the dust of the Harmattan in February 2005 at 10 am. **D** Atakora Chain at the southern border of the Pendjari National Park.

**Abb. 2:** Landschaft und Klima im Pendjari Nationalpark. **A** Savanne am Ende der Regenzeit (Oktober). **B** Savanne gegen Ende der Trockenzeit (April). **C** Kobantilopen im Staub des Harmattan im Februar 2005 um 10 Uhr vormittags. **D** Die Atakora-Kette am südlichen Rand des Pendjari Nationalparks.

1990), which are an impermeable layer and hold the water during rainy season. During this time of the year, the PNP is converted into a huge area of interconnected floodplains, lagoons and swamps that is accessible by car only on very few roads which are secured with laterite gravel.

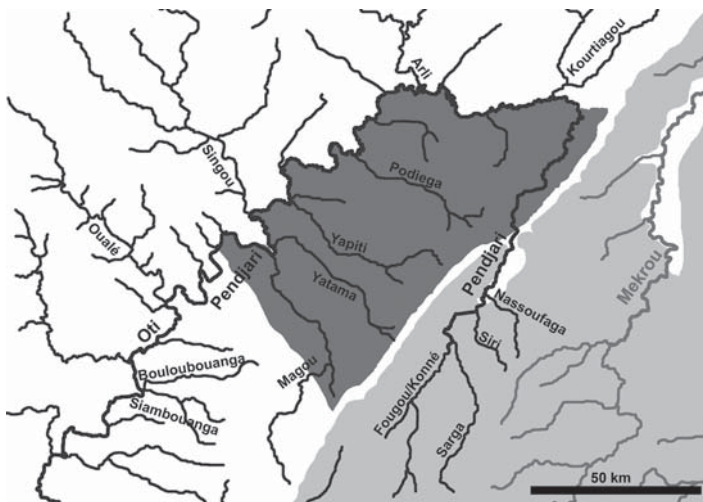
In the South, the PNP is restricted by the Atakora massif (fig. 2D), a quartzite mountain chain, which reaches an altitude of 400 to 513 m above sea level (DELVINGT et al. 1989). The Atakora chain not only is the origin of the Pendjari River, but serves also a water reservoir, feeding the river during the dry season.

The fauna of the PNP is diverse and the area is well known for its large mammals, for example ten different antelope species including Buffon's kob (*Kobus kob*), waterbuck (*Kobus ellipsiprymnus*), roan antelope (*Hippotragus equinus*) and western hartebeest (*Alcelaphus buselaphus*). Other large herbivores include buffaloes (*Syncerus caffer*), hippopotams (*Hippopotamus amphibius*) and elephants (*Loxodonta africana*). The PNP is an important reserve for the rare large predators of West Africa like lion (*Panthera leo*), spotted hyaena (*Crocuta crocuta*), leopard (*Panthera pardus*),

cheetah (*Acinonyx jubatus*) and African wild dog (*Lycan pictus*). A detailed account on the PNP's mammals is given by LAMARQUE (2004). 378 species of birds have been so far recorded in the PNP (GRELL 2003). Reptiles of the area are poorly studied and so far only 21 species are reported (GRELL 2003). The amphibians of the Pendjari area have been studied by NAGO et al. (2006) and revealed 32 species belonging to 15 genera and 8 families. Invertebrate fauna which seems to be also quite diverse has virtually not been studied up to now.

## 1.2. Pendjari River

The Pendjari, or Oti, as the river is called further downstream in Togo, drains an area of 72,900 km<sup>2</sup> of the Volta basin, which drains an area of 398,371 km<sup>2</sup> in total (VANDEN BOSSCHE & BERNACSEK 1990; LEMOALLE 1999; MUL et al. 2015). After the Niger River, the Volta is the second longest river in West Africa with 1,270 km (LEMOALLE 1999) length. Together with the White and Black Volta, the Pendjari/Oti is one of the three big affluents of the Volta, and although



**Fig. 3:** The River Pendjari and its major tributaries (black) in the area of the Pendjari National Park (dark grey, hunting zones included) in relation to the Atakora massif (light grey) and the Mekrou (grey), a tributary of the River Niger.

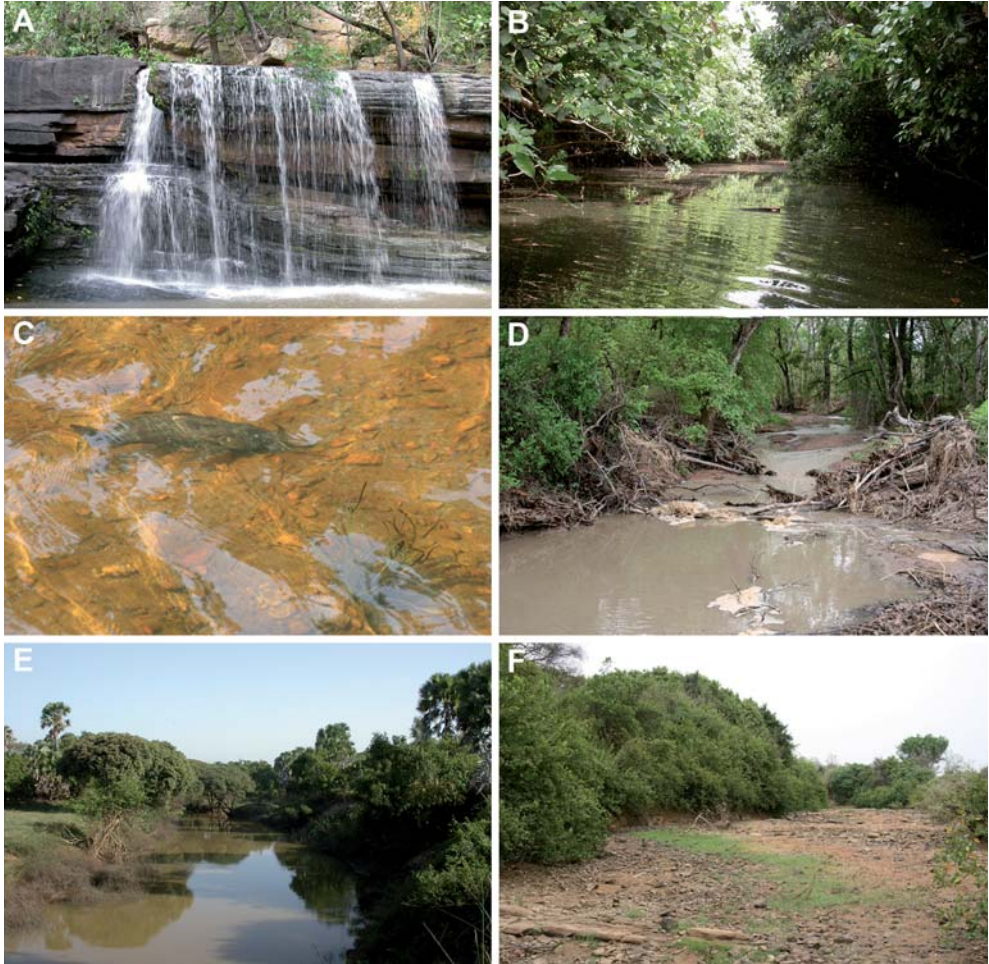
**Abb. 3:** Der Pendjari und seine größeren Zuflüsse (schwarz) im Gebiet des Pendjari-Nationalparks (dunkelgrau, einschließlich der Jagdzonen) sowie deren Lage im Verhältnis zum Atakoramassiv (hellgrau) und dem Mekrou (grau), einem Nigerzufluss.



draining only about 18% of the total catchment, it contributes between 30–40% of the total annual flow of the Volta basin (BARRY 2005). All the major affluents of the Volta contribute to Lake Volta, the world largest man-made lake

formed by the closure of the Akasombo dam in 1964.

The Pendjari/Oti River has a total length of roughly 940 km (MUL et al. 2015) and originates in the Atakora massif in north-western Benin



**Fig. 4:** The Pendjari River and tributaries. **A** Small water fall of the permanent Yatama tributary at Tanougou. **B** Pendjari River with dense gallery forest at Bondiagou close to the Atakora area. **C** Clear water at Bondiagou with *Synodontis membranaceus*. **D** This small ephemeral tributary in the eastern part of the Pendjari National Park directly after first rainfall (April 2007) was completely dry the day before. **E** Close to Mare Diwouni the Pendjari River forms the border between Burkina Faso (left) and Benin (right). **F** A dry stretch of the Pendjari River (April 2007); fresh grown grass indicates subterranean water flow.

**Abb. 4:** Der Pendjari und Zuflüsse. **A** Ein kleiner Wasserfall am Yamata, einem permanenten Zufluss, bei Tanougou. **B** Dichter Galeriewald am Pendjari bei Bondiagou kurz nach der Atakoraketten. **C** Klares Wasser im Pendjari bei Bondiagou mit *Synodontis membranaceus*. **D** Kleiner temporärer Zufluss im östlichen Teil des Pendjari Nationalparks, der einen Tag zuvor noch ausgetrocknet war, nach dem ersten Regenfall (April 2007). **E** In der Nähe des Mare Diwouni bildet der Pendjari die Grenze zwischen Burkina Faso (links) und Benin (rechts). **F** Trockengefallenes Flussbett vom Pendjari (April 2007); frisches Gras zeigt unterirdischen Wasserfluss an.

(fig. 3). This mountain chain runs in north-eastern to southwestern direction and continues into Togo and Ghana. The Pendjari River is formed by the confluence of the two smaller streams Fougou/Konné and the Sarga in the Atakora chain (fig. 3). In its upper reaches the Pendjari slopes at about 1.5 m per km (WORLD-BANK 1993), before it exits the mountain area at the Bondiagou forest (figs 1, 3, 4B-C). In its further course, the Pendjari marks the Eastern border of the PNP and the Western border of the Atakora hunting zone (Zone cynégétique de l'Atakora, fig. 1). After passing the Konkombri bridge it turns sharply eastwards and soon becomes the frontier between Burkina Faso and Benin (figs 1, 4E) for the next 150 km. It then enters Togo and becomes the Oti River, which reaches Lake Volta in Ghana. Remarkably, over 200 km of the roughly 420 km of the Pendjari in Benin (WORLD-BANK 1993) are in protected areas. Within this 200 km long stretch in the national park from the Bondiagou forest to Porga (fig. 1) the riverbed has only a slope of 40 m (DELVINGT et al. 1989). The abrupt change of flow direction after Konkombri (fig. 1) and the resulting 360° flow conversion indicates a possible former river catchment event: likely the upper Pendjari basin, i.e. the parts in the Atakora area, drained towards the Niger River. A similar diversion in the flow direction as a result of a capture of Niger affluents is described for the upper Black Volta that was formerly connected via the Sourou with the Niger basin (WRIGHT et al. 1985; BONNE 2014). Still today the groundwater resources of the Pendjari basin seem to be connected to the groundwater resources of the Niger basin (BARRY et al. 2005).

The Pendjari is the only major river of the PNP. It has a highly seasonal flow regime: during the dry season the Pendjari inside the park ceases to flow or continues only in parts as subsurface river (fig. 4F). During the rainy season, the river spreads from its river bed and inundates extensive parts of the savannah. Thus the flow rate of the Pendjari River may change from 0 to over 400 m<sup>3</sup>/sec during the year, with an estimated average flow rate of 55 to 81 m<sup>3</sup>/sec (VANDEN BOSSCHE & BERNACSEK 1990; WORLD-BANK 1993;

BARRY et al. 2005). Besides the main river, there are few smaller springs originating along the Atakora chain flowing throughout the year and maintaining important water points during dry season for men and wildlife. Those are forming for example the waterfalls in Batia, Tanougou and Tchanwassaga. The water entering the Mare Bori is entirely sourced from the Tanougou waterfall (fig. 4A). Besides the Pendjari River, there are no other affluents inside the PNP during the dry season.

## 2. Material and methods

Various methods were employed for the data recovery and sampling of the fish fauna in the Pendjari National Park. Methods of P. LALEYE and colleagues used in 2001 and results are summarised in LALEYE et al. (2001). This species account and further unpublished studies of students are either based on samples from own gill nets or evaluation of catches of local fishermen, which used gill nets and occasionally hook and lines, traps or seine nets. T. MORITZ and colleagues largely recorded fishes from own catches with small (2 m) and medium sized (15 m) seines, traps and dip nets in several field campaigns from 2003 to 2007 (May 2003, November 2003, December 2003, November 2004, January 2005, March 2005, April 2005, February 2007, April 2007, October 2007). An acoustic mormyrid detector, i.e. an electrode on a rod connected to an amplifier and loudspeaker, was sometimes used to localize weakly electric fish. The majority of fishes were recovered undamaged from the fishing gear and were released immediately after identification and measuring of standard length, total length and weight per specimen. Selected specimens were kept alive in small buckets aerated with membrane pumps and photographed to record their live colouration in a small aquarium later on the same day with a NIKON Coolpix 4500 (2003 to 2005) and a CANON EOS 400D with a SIGMA 105 mm macro lens (2007), respectively. For detailed studies of the electric discharges of mormyrids their discharges were recorded shortly after catching in a small plastic tank with

water from the sampling site (MORITZ et al. 2008, 2009). A SDS 200 digital oscilloscope (softDSP) was equipped with a ten-fold amplifier and connected to a laptop. Electric signals were recorded by placing the positive electrode close to the head and the negative close to the tail.

For preservation, voucher specimens were narcotised and euthanized in an overdosed benzocaine bath, fixed in 4% formaldehyde solution, and subsequently transferred to 70% ethanol for permanent storage. Voucher specimens are deposited in the Deutsches Meeresmuseum (DMM), Stralsund, Germany, the Bavarian State Collection of Zoology (ZSM), Munich, Germany, and in the Natural History Museum (BMNH), London, U.K. For all collection sites biotic (e.g. vegetation, accompanying fauna) and abiotic (e.g. substrate, water flow, temperature, conductivity, pH, visibility) parameters were recorded.

Own data obtained during our surveys and data obtained by colleagues working in the same area (SAYER & GREEN 1977; GREEN 1979; SCHWAHN 2002, 2003; GRELL 2003) are evaluated and critically compared, in order to provide a comprehensive and complete species list for the fishes occurring in the upper Pendjari and the PNP. Determinations in a recent study (AHOUANSOU MONTCHO 2009) are likely to be erroneous or based on questionable determinations and thus not further considered for this work. Additional data used for this study include those of LÉVÊQUE et al. (1990, 1992), PAUGY et al. (2003) and species accounts for the entire Volta basin (BLANC & DAGET 1957; ROMAN 1966; DANKWA et al. 1999). All identification keys have been refined or adapted from species keys in LÉVÊQUE et al. (1990, 1992) and PAUGY et al. (2003). Family and species names follow FRICKE et al. (2018a); number of species per family are based on FRICKE et al. (2018b).

### 3. The ichthyofauna of the PNP

Available literature data suggest the occurrence of at least 123 species (tabs 1-2) in the Pendjari area, of which 101 fish species from 27 families (tabs 1) were confirmed by our own surveys.

Additional eleven species, i.e. *Polypterus bichir*, *Distichodus brevipinnis*, *D. engycephalus*, *Chrysichthys auratus*, *Clarias camerunensis*, *Chiloglanis voltae*, *Synodontis arnoutli*, *S. filamentosus*, *Poropanchax normani*, *Ctenopoma kingsleyae* and *Coptodon dageti*, are likely to occur in the area (GREEN 1979; SCHWAHN 2002, 2003; GRELL 2003), but were not confirmed by own field work. We regard the presence of another eleven species as likely based on records from other parts of the upper Volta basin (BLANC & DAGET 1957; ROMAN 1966; LÉVÊQUE et al. 1990, 1992; PAUGY et al. 2003; own observations), i.e. *Cyphomyrus psittacus*, *Marcusenius abadii*, *Citharinops distichodoides*, *Alestes dentex*, *Micralestes occidentalis*, *Labeobarbus bynni occidentalis*, *Schilbe micropogon*, *Heterobranchus isoferus*, *Malapterurus minjiriya*, *Chromidotilapia guentheri* and *Kribia nana*.

The by far largest fish group of the PNP are the Ostariophysi (fig. 5) with seventy-five species or 61% of the ichthyofauna: 22 characiforms and 21 cyprinid species, 31 catfishes and a single gonorynchiform species. This group is followed by the osteoglossomorphs with 20 species, among which the mormyrids with 18 species are the largest subgroup (fig. 5). This dominance of ostariophyseans and the strong representation of mormyrids is typical for African rivers (LOWE-McCONNELL 1987, 1988) and confirmed in the Pendjari River. Cichlids, which typically dominate fish faunas in lacustrine systems like in the East African lakes, are represented only by eight species and only the sixth diverse fish family in the PNP.

### 4. Fish habitats in the PNP

The Pendjari National Park provides a number of different aquatic habitats, i.e. the main river, small temporal tributaries, lakes (which differ in regard to shape, vegetation, depth, permanence and history of origin), small ephemeral ponds and smaller brooks (figs 3-4, 6-8). Many of these water bodies are maintained only during few months in the year and attributed as 'temporal' (some month) or – if rather short living (some weeks) – 'ephemeral' water bodies. Mainly along the main river there are some larger perennial

**Tab. 1:** The fish species of the Pendjari National Park. Pend – Pendjari River; MaD – Mare Diwouni; MaB – Mare Bori; oMa – other lakes; MFP – marigots within the floodplain; MnF – marigots outside the floodplain. ■■■ – very common; ■■ – common/regularly; ■ – not common/rare; □ – very rare/single records; R – not recorded in this study, but reported by other authors for the area (see detailed description); \* – not yet recorded for the area, but occurrence likely or reported (see detailed description). The herein given estimations depend heavily on the used survey methods, mainly small seine and traps.

**Tab. 1:** Die Fischarten des Pendjari-Nationalparks. Pend – Pendjari Fluss; MaD – Mare Diwouni; MaB – Mare Bori; oMa – andere Seen; MFP – marigots auf der Überflutungsfläche; MnF – marigots außerhalb der Überflutungsfläche. ■■■ – sehr häufig; ■■ – häufig bis regelmäßig; ■ – nicht häufig bis selten; □ – sehr selten oder Einzelfunde; R – nicht in dieser Studie nachgewiesen, aber von anderen Autoren berichtet (siehe detaillierte Beschreibungen); \* – noch nicht für das Gebiet nachgewiesen, aber Vorkommen wahrscheinlich (siehe detaillierte Beschreibungen).

Taxon	Pend	MaD	MaB	oMa	MFP	MnF
<b>Protopteridae</b>						
<i>Protopterus annectens</i>		■■	■■	□/■■■	■	
<b>Polypteridae</b>						
<i>Polypterus endlicherii</i>	■■	■■		■■	■	
<i>Polypterus senegalus</i>	■■	■■■	■	■■	■	
<i>Polypterus bichir</i>	R					
<b>Arapaimidae</b>						
<i>Heterotis niloticus</i>	■■	■■	■	■/■■■	■	
<b>Gymnarchidae</b>						
<i>Gymnarchus niloticus</i>	■	■				
<b>Mormyridae</b>						
<i>Brevimyrus niger</i>		■■	■■■	■■	■■■	
<i>Campylomormyrus tamandua</i>	■					
* <i>Cyphomyrus psittacus</i>						
<i>Hippopotamyrus pictus</i>	■					
<i>Hyperopisus bebe</i>	■	■	■	■		
<i>Marcusenius senegalensis</i>	■■	■■	■■	■■	■	■
* <i>Marcusenius abadii</i>						
<i>Mormyrops anguilloides</i>	■					
<i>Mormyrops breviceps</i>	■					
<i>Mormyrus hasselquisti</i>	■	■	■■	■		
<i>Mormyrus macropbthalmus</i>	■					
<i>Mormyrus rume</i>	■	■	■	■	□	
<i>Petrocephalus bane</i>	■			□		
<i>Petrocephalus bovei</i>	■■	■■	■■	■■	■	■
<i>Petrocephalus pallidomaculatus</i>	■	□		■		



**Tab. 1:** Continued  
**Tab. 1:** Fortsetzung

Taxon	Pend	MaD	MaB	oMa	MFP	MnF
<i>Petrocephalus soudanensis</i>	■					
<i>Pollimyrus adspersus</i>	□					
<i>Pollimyrus isidori</i>	■■	■■	■■■	■■	■	
<b>Clupeidae</b>						
<i>Pellonula leonensis</i>	■■■	■■	-	-/■■	-	-
<b>Kneriidae</b>						
<i>Cromeria occidentalis</i>	■■			□		
<b>Citharinidae</b>						
* <i>Citharinops distichodoides</i>						
<i>Citharinus latus</i>	□					
<i>Citharinus citbarus</i>	■					
<b>Distichodontidae</b>						
<i>Distichodus brevipinnis</i>	R					
<i>Distichodus engycephalus</i>	R					
<i>Distichodus rostratus</i>	■	■		-/■■		
<i>Paradistichodus dimidiatus</i>	■	■	■	■/■■	■	
<i>Nannocharax ansorgii</i>	■■■	■		-/■■		
<i>Nannocharax fasciatus</i>	■■			■		
<i>Nannocharax</i> cf. <i>occidentalis</i>	■■■					
<i>Neolebias unifasciatus</i>	■	■■	■■■	■/■■■	■■	■
<b>Hepsetidae</b>						
<i>Hepsetus odoe</i>	□	□		-/■■	■■	
<b>Alestidae</b>						
<i>Alestes baremoze</i>	■■■	■■		■■	■	
* <i>Alestes dentex</i>						
<i>Brycinus leuciscus</i>	■■■	■■		■/■■■	■	
<i>Brycinus macrolepidotus</i>	■■■	■		■/■■	■	
<i>Brycinus nurse</i>	■■■	■■■	■■	■■	■■	■
<i>Hydrocynus brevis</i>	■					
<i>Hydrocynus forskalüi</i>	■■	■		■		
<i>Micralestes elongatus</i>	■■■			-/■■	■	
* <i>Micralestes occidentalis</i>						
<i>Rhabdalestes</i> cf. <i>septentrionalis</i>	■	■■	■■	■/■■■	■■	

Tab. 1: Continued  
 Tab. 1: Fortsetzung

Taxon	Pend	MaD	MaB	oMa	MFP	MnF
<b>Cyprinidae</b>						
<i>Chelaethiops bibie</i>	■■■	■		■		
<i>Enteromius atakorensis</i>						■
<i>Enteromius bakuwensis</i>				□		
<i>Enteromius baudoni</i>	□					
<i>Enteromius hypsolepis</i>	■■					
<i>Enteromius leonensis</i>	■	■	■■■	■		
<i>Enteromius macinensis</i>	■	■■	■■	■■	■■	■
<i>Enteromius macrops</i>	■■	■■	■■	■■	■■	■■■
<i>Enteromius nigeriensis</i>	■					
<i>Enteromius parablabe</i>						■
<i>Enteromius perince</i>	□					
<i>Enteromius pobeguini</i>	■	■	■	■	■	
<i>Enteromius punctitaeniatus</i>	■■■			□		
<i>Enteromius sublineatus</i>	■					■
<i>Enteromius stigmatopygus</i>	□					
<i>Labeo coubie</i>	■	■	■	■/■■		
<i>Labeo ogunensis</i>	■			□		
<i>Labeo senegalensis</i>	■■	■	■	■/■■		
* <i>Labeobarbus bynni occidentalis</i>						
<i>Leptocypris niloticus</i>	■■			□		
<i>Raiamas senegalensis</i>	■■			■		
<b>Bagridae</b>						
<i>Bagrus docmak</i>	■					
<i>Bagrus bajad</i>	■■					
<b>Claroteidae</b>						
<i>Auchenoglanis occidentalis</i>	■■	■		■	■	
<i>Chrysichthys auratus</i>	R					
<i>Chrysichthys nigrodigitatus</i>	■					
<i>Clarotes laticeps</i>	■					
<b>Schilbeidae</b>						
<i>Parailia pellucida</i>	■■	■		■	■	

**Tab. 1:** Continued  
**Tab. 1:** Fortsetzung

<b>Taxon</b>	<b>Pend</b>	<b>MaD</b>	<b>MaB</b>	<b>oMa</b>	<b>MFP</b>	<b>MnF</b>
<i>Schilbe intermedius</i>	■■■	■■	■■	■■	■■	■
* <i>Schilbe micropogon</i>						
<i>Schilbe mystus</i>	■■					
<i>Siluranodon auritus</i>	■	■	■	■	■■	
<b>Clariidae</b>						
<i>Clarias anguillaris</i> & <i>C. gariepinus</i>	■■	■■	■■	■■	■■	■■
<i>C. camerunensis</i>	R					
<i>Heterobranchus bidorsalis</i>	■			□		
* <i>Heterobranchus isopterus</i>						
<i>Heterobranchus longifilis</i>	□					
<b>Malapteruridae</b>						
<i>Malapterurus electricus</i>	■	■	■■	■	□	
* <i>Malapterurus minjiriya</i>						
<b>Mochokidae</b>						
<i>Chiloglanis voltae</i>	R					
<i>Synodontis arnoulti</i>	R					
<i>Synodontis clarias</i>	■	■		□/■		
<i>Synodontis filamentosus</i>	R					
<i>Synodontis membranaceus</i>	■■	■■■		■■/■■■		
<i>Synodontis nigrita</i>	■■	■■■	■■	■■	■	
<i>Synodontis ocellifer</i>	■					
<i>Synodontis schall</i>	■■■	■	■	■	■	■
<i>Synodontis</i> sp. "Pendjari"		□				
<i>Synodontis sorex</i>	■	■				
<i>Synodontis velifer</i>	■					
<i>Synodontis violaceus</i>	■					
<b>Nothobranchiidae</b>						
<i>Epiplatys bifasciatus</i>	■	■	■■■	■■	■	■
<i>Epiplatys spilargyreus</i>	■■	■	■	■	■	■
<i>Fundulosoma thierryi</i>				□	■■	■
<i>Fundulosoma</i> sp. aff. <i>thierryi</i>					■■	■

Tab. 1: Continued  
 Tab. 1: Fortsetzung

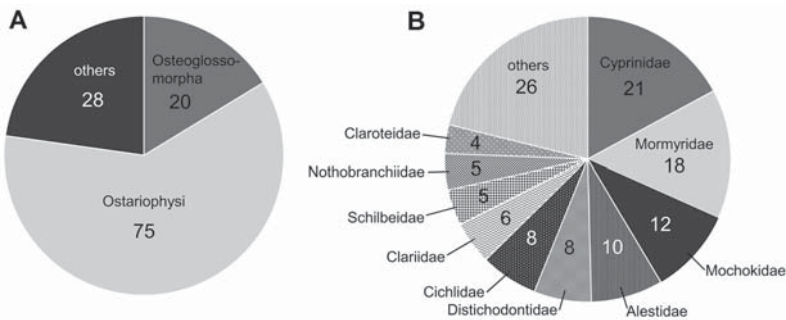
Taxon	Pend	MaD	MaB	oMa	MFP	MnF
<i>Pronotobranchius kzyawensis</i>						■
<b>Procatopodidae</b>						
<i>Micropanchax pfaffi</i>	■■	■■	■■	■/■■	■	■■
<i>Poropanchax normani</i>	R					
<b>Channidae</b>						
<i>Parachanna obscura</i>	□	■	■	■	□	
<b>Anabantidae</b>						
<i>Ctenopoma kingsleyae</i>	R					
<i>Ctenopoma pethericii</i>	■	■	■■	■	■■■	■
<b>Latidae</b>						
<i>Lates niloticus</i>	■■			□/■		
<b>Cichlidae</b>						
* <i>Chromidotilapia guentheri</i>						
<i>Coptodon dageti</i>	R					
<i>Coptodon zillii</i>	■■■	■	■	■	■	■■
<i>Hemichromis letourneuxi</i>	■■	■■	■■	■■	■■	■■
<i>Hemichromis fasciatus</i>	■	■	■	■	■	■■
<i>Oreochromis niloticus</i>	■■■	■■	■	■■	■	
<i>Sarotherodon galilaeus</i>	■■■	■■	■	■■	■	■
<i>Steatocranus irvinei</i>	■					
<b>Gobiidae</b>						
<i>Nematogobius maindroni</i>	□					
<b>Eleotridae</b>						
* <i>Kribia nana</i>						
<b>Mastacembelidae</b>						
<i>Mastacembelus nigromarginatus</i>	■					
<b>Tetraodontidae</b>						
<i>Tetraodon lineatus</i>	■	■		■		



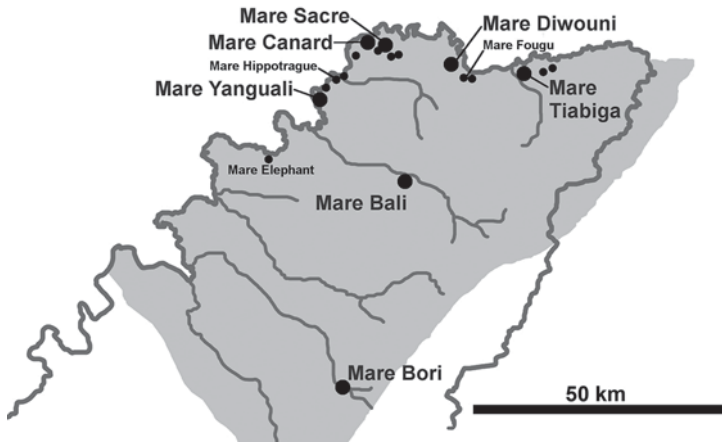
**Tab. 2:** Summary on the fishes of the Pendjari National Park. G – genera; S – species; \* – including species not yet recorded for the area, but occurrence likely.

**Tab. 2:** Zusammenfassung der Fischarten des Pendjari-Nationalparks. G – Gattungen; Arten; \* – inklusive der noch nicht für das Gebiet nachgewiesen, aber wahrscheinlich vorkommenden Arten.

Family	*G.	*Sp.	G.	Sp.
Protopteridae	1	1	1	1
Polypteridae	1	3	1	3
Arapaimidae	1	1	1	1
Gymnarchidae	1	1	1	1
Mormyridae	10	18	9	16
Clupeidae	1	1	1	1
Kneriidae	1	1	1	1
Citharinidae	2	3	1	2
Distichodontidae	4	8	4	8
Hepsetidae	1	1	1	1
Alestidae	5	10	5	8
Cyprinidae	6	21	5	20
Bagridae	1	2	1	2
Claroteidae	3	4	3	4
Schilbeidae	3	5	3	4
Clariidae	2	6	2	5
Malapteruridae	1	2	1	1
Mochokidae	2	12	2	11
Nothobranchiidae	3	5	3	5
Procatopodidae	2	2	1	1
Channidae	1	1	1	1
Anabantidae	1	2	1	2
Latidae	1	1	1	1
Cichlidae	6	8	5	7
Gobiidae	1	1	1	1
Eleotridae	1	1	0	0
Mastacembelidae	1	1	1	1
Tetraodontidae	1	1	1	1
<b>Total</b>	<b>64</b>	<b>123</b>	<b>59</b>	<b>112</b>



**Fig. 5:** Species composition of the fish fauna of the Pendjari National Park (all species likely occurring). **A** Major taxonomic groups. **B** By family; families with less than three representatives are summed up in 'others'. **Abb. 5:** Zusammensetzung der Fischfauna im Pendjari-Nationalpark (alle vermutlich vorkommenden Arten). **A** Größere taxonomische Einheiten. **B** Nach Familie; Familien mit weniger als drei Vertretern wurden zusammengefasst.



**Fig. 6:** Major lakes of the Pendjari National Park (large dots) and some selected smaller lakes and swamps (small dots).

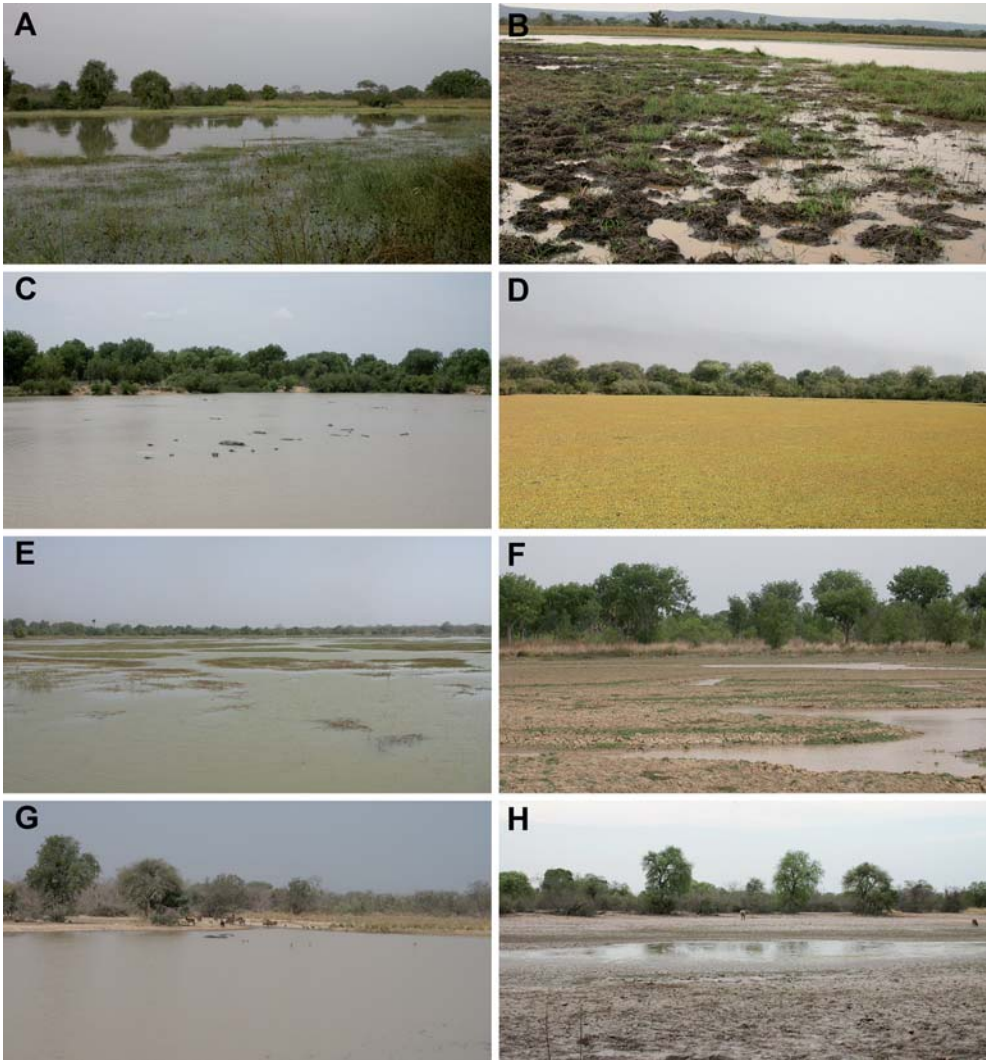
**Abb. 6:** Die größeren Seen im Pendjari-Nationalpark (große Punkte) und einige ausgewählte kleinere Tümpel und Sümpfe (kleine Punkte).

lakes (figs 6-7), several of them are oxbow lakes of the Pendjari. Nearly all aquatic habitats are inhabited by fish, except some very small or extremely short-lived ones.

#### 4.1. Habitats of the Pendjari River

The upper part of the Pendjari River inside the Atakora massif is presently only poorly known. The transparency of the water is clear when the Pendjari exits the mountain range. Here it is accompanied by the dense and extensive Bondiagou gallery forest (fig. 4B). The river bed in this stretch is mainly made of pebbles and sand and due to the continuous flow here the water remains clear throughout the year (fig. 4C). In the further course through the savannah plain its substrate is quickly becoming much finer. Nevertheless, within the Pendjari and some larger tributaries, depending on the velocity and current of the water, habitat conditions of the river bed may alter quickly between silt, sand and sometimes sand banks, schist and silt mixtures or gravel in different size. The river bed allows some subterranean water flow, providing the “isolated” river stretches with fresh water during the dry season (fig. 4F). Rocky outcrops or exposed bedrocks are rare and can be found only in few stretches of the Pendjari, e.g. close to the hotel or at Ponte Arly.

The main river is usually loosely fringed with gallery forest, especially in the east of the park at Bondiagou this forest is denser and more extensive (fig. 4B). For most of its course, however, the gallery forest is restricted to only few tree rows width and usually interspersed with shrubs such as *Mimosa pigra*. Furthermore, *Borassus* palms are good indicators for the water courses easily recognizable from afar as they prefer slightly elevated spots to avoid root damage during increased periods of inundation. Inside the river, higher aquatic plants are rare or entirely missing. Several fish species, such as the *Bagrus* and the *Citharinus* species or *Hippopotamyrus pictus*, *Hydrocynus brevis*, *Clarotes laticeps*, *Synodontis ocellifer* and *Schilbe mystus*, seem to be confined to the main river. They apparently avoid to enter the flood plains or at least quickly return to the main river and are usually not recorded in water bodies outside the main river. Some species also have a clear preference for certain habitats inside the river: both *Mormyrops* species prefer areas with many roots and drift wood where they probably hide during the day. *Petrocephalus soudanensis* and *Steatocranus irvinei* on the other hand seem to favour river stretches with at least some areas of bare stone and rocks or at least oyster banks as hard substrate. *Cromeria occidentalis*, *Nannocharax fasciatus* and *N. cf. occidentalis* are typical bottom



**Fig. 7:** Some larger lakes of the Pendjari National Park. **A** Mare Bori (Nov 2003), a permanent lake far distant from the main river. **B** At the start of the dry season (Apr 2007) shores of the Mare Bori are heavily influenced by large mammals. **C** The permanent Mare Sacre (May 2003) is home for many hippopotamuses. **D** Mare Sacre covered with *Pistia* (Jan 2004). **E**. The Mare Tiabiga (Nov 2003) is large but shallow and thus densely vegetated. **F** At the end of the dry season only the deeper canals of the Mare Tiabiga (May 2003) still contain water, but nevertheless harbours a huge amount and diversity of fish. **G** The isolated Mare Bali (Feb 2007) is an important water source for wildlife. **H** Mare Bali almost falling dry at the end of the dry season (May 2003). **Abb. 7:** Einige größere Seen des Pendjari-Nationalparks. **A** Das permanente Mare Bori ist weit entfernt vom Hauptfluss. **B** Am Ende der Trockenzeit (April 2007) wird das Ufer des Mare Bori stark von großen Säugetieren überformt. **C** Das permanente Mare Sacre (Mai 2003) gibt zahlreichen Flusspferden ein Zuhause. **D** Mare Sacre (Jan 2004) bedeckt mit *Pistia*. **E** Das Mare Tiabiga (Nov 2003) ist groß, aber flach und somit dicht bewachsen. **F** Am Ende der Trockenzeit verbleibt nur in den tiefen Kanälen des Mare Tiabiga Wasser (Mai 2003), in dem dennoch eine große Anzahl und Vielfalt von Fischen zu finden ist. **G** Das isoliert liegende Mare Bali (Feb 2007) ist eine wichtige Wasserstelle für Tiere. **H** Das beinahe ausgetrocknete Mare Bori am Ende der Trockenzeit (Mai 2003).

inhabitants and much more common on sand and pebbles, but can also be found in areas with soft bottom and vegetated areas; these species are rarely found in other water bodies than in the main river. *Leptocypris niloticus* and *Raimas senegalensis* are typical representatives of species which clearly prefer the main river as habitat and occur there in high numbers, but can also be found from time to time in flood plain lakes or also smaller flood plain remnants.

#### 4.2. Marigots – smaller tributaries

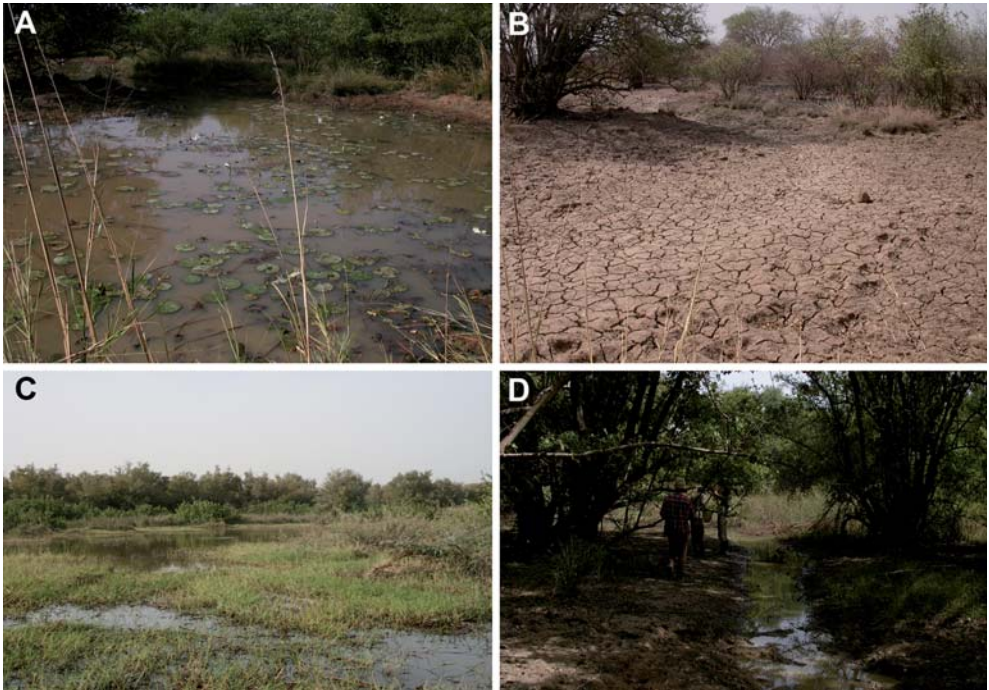
Marigot is the local name for smaller brooks and streams. Several of such smaller tributaries feed the Pendjari River inside the park during the rainy season (figs 3, 4D). The Arly coming from Burkina Faso is the only not-desiccating affluent while the Magou, Yatama, Yabiti, Tandjali, Podiéga, Pourou, Bonkada and other smaller brooks dry up entirely between January and May. Factors such as annual rain fall, catchment size, subsurface soil composition, ground water levels and sun exposure or shading influence the runoff of marigots in the course of a year. Marigots are very variable in relation to their vegetation, depth, water parameters and flow. In the end every smaller at least sometimes flowing stream, independent of its characteristics, is called a ‘marigot’ in the area. Only on the Atakora chain there are few sources which maintain a permanent water supply throughout the year which even may feed waterfalls during dry season, such as the impressive waterfalls of the stream Yatama at Tanougou (“Chûte de Tanougou”) (fig. 4A). Usually these mountain streams do not reach the main river in the dry season but may still contribute some water as subsurface streams. In general, marigots serve as active migration corridors for many fish species ascending from the main river for lateral dispersal and feasting, mating or breeding on the floodplains. All species not immediately returning to the main river get increasingly isolated when water levels fall and may become trapped. Compared to the lower course of marigots, the upper reaches of marigots, above the flood plain level, attract fish species actively ascending

upstream, such as *Enteromius macrops*, *E. sublineatus*, *Clarias gariepinus/anguillaris*, *Hemichromis letourneuxi*, *H. fasciatus*, *Micropanchax pfaffi*, *Brycinus nurse* and *Schilbe intermedius*. Other species like the mormyrids *Petrocephalus bovei* and *Marcusenius senegalensis* or the nothobranchiids *Epiplatys bifasciatus* and *E. spilargyreus* also regularly enter into such temporally limited habitats, but are less common than the aforementioned species. The few water bodies not completely desiccating until the beginning of the next rainy season form important refuges for some fish species surviving there all through the year. This holds especially true for the marigots in the Atakora chain in which *Hemichromis letourneuxi*, *Epiplatys bifasciatus*, *Ctenopoma petherici*, *Clarias gariepinus/anguillaris*, *Enteromius macrops*, *E. atakorensis* and *E. parablades* regularly occur. While *E. atakorensis* was found during our studies only inside the Atakora chain, the latter species is sometimes also found at the base of the mountains.

#### 4.3. Mares – lakes, ponds and swamps

Non-flowing, stagnant water bodies are called “mare” in the savannah region in West Africa, irrespective of their size (figs 6-8, tab. 3). Such mares have an essential ecosystem-function for the savannah as permanent aquatic habitat and water source for wildlife. Even though water levels of individual mares and their persistence may differ, most of them offer suited aquatic habitats only for specific time periods in the course of the year. Ephemeral shallow and isolated rain ponds that remain disconnected from the main river or streams are important habitats for amphibians, annual or aquatic invertebrates which require fish-free habitats. Sufficiently large or deep mares usually accommodate aquatic life for few months (fig. 8A-B) and are usually occupied by fishes, especially the annual killifishes which prefer isolated water bodies without connection to surrounding rivers or streams. Species like *Pronothobranchius kiyawensis* and *Fundulosoma* spp. hatch from their eggs at the beginning of the rainy season, and grow mate and spawn to complete their live circle within weeks. Embryos develop in the eggs, but do not hatch. When





**Fig. 8:** Ephemeral water bodies in the Pendjari National Park. **A** A small temporal pond outside the floodplain (2 Dec 2004), habitat for killies and lungfish. **B** Same ‘pond’ as in **A** less than two months later (23 Jan 2005). **C** Shallow swamp close to Camping Elephant (Feb 2007). **D** Desiccating ditch on the flood plain of the Pendjari River (Dec 2004).

**Abb. 8:** Beispiele von ephemeren Gewässern im Pendjari-Nationalpark. **A** Ein kleiner Tümpel außerhalb der Überflutungsfläche (2. Dez 2004), Lebensraum für Killi- und Lungenfische. **B** Derselbe Tümpel wie in **A** weniger als zwei Monate später (23. Jan 2005). **C** Ein flacher Sumpf in der Nähe des Camping Elephant (Feb 2007). **D** Austrocknender Graben auf der Überflutungsfläche des Pendjari (Dez 2004).

water bodies desiccate during the dry season the killifish eggs survive for several months with little moisture and hatch not before the next rainy season. Ephemeral water bodies, isolated or on the flood plain (fig. 8A-C), are also frequently occupied by lungfishes. They, in contrast, burry into the substrate building cocoons in which they aestivate until water bodies form again in the next rainy season. During rainy season, the mares, marigots, savannah floodplains and rivers form a diverse network of interconnected waterbodies. The huge habitat diversity attracts many different fish species and almost all of the riverine species enter the floodplain, which get increasingly isolated on the floodplain (fig. 8D) in restwater pools where they endure until the next rainy season. Such waterbodies are also

important for the water supply of the wildlife of the PNP (tab. 3, fig. 7) and are mostly situated close or in close vicinity to the main river (fig. 6). Some of them may also be oxbow lakes of the Pendjari, while few others such as the Mare Bori (fig. 7G-H) and Mare Bali (fig. 7A-B) are rather distant from the main river bed (fig. 6). The Mare Bori (fig. 7A-B) is quite unusual in this respect as it receives water throughout the year by the Yatama stream even though the link to the main river is disconnected for most of the year. Lakes, swamps and small seasonal streams containing water for at least several month of the year are often densely covered with submerge aquatic plants such as *Ceratophyllum* spp. and *Utricularia* spp., or, less common *Najas* sp. and *Myriophyllum* sp. *Nymphaea* spp., *Trapa* cf. *na-*

**Tab. 3:** Overview on some selected lakes in the Pendjari National Park.**Tab. 3:** Überblick über einige ausgewählte Seen im Pendjari-Nationalpark.

Name	Coordinates	Remarks
Mare Bali	N 011° 12' 16" E 001° 30' 20"	during the rainy season connected via the Podjega with the Pendjari, during dry season very isolated in the middle of the park – important water point for the wildlife of the PNP.
Mare Bori	N 010° 50' 51" E 001° 23' 56"	large lake with high proportion of swimming reeds; shallow to moderately deep; fed by groundwater from the Yatama; not desiccating during dry season; very isolated from other water bodies; connection to the main river unclear
Mare Canard	N 011° 28' 23" E 001° 26' 35"	U-shaped old branch of the Pendjari; deep with steep border on its southern side
Mare Diwouni	N 011° 25' 48" E 001° 34' 58"	large lake, shallow banks, maybe reaching 2 to 3 m depth
Mare Elephant	N 011° 15' 43" E 001° 16' 21"	very shallow and small; desiccating in some years before beginning of a new rainy season
Mare Fougu	N 011° 23' 25" E 001° 36' 12"	very shallow, rather a vegetated swamp than a lake; despite its low depth usually keeping at least some water all through the year
Mare Hippotrague	N 011° 23' 13" E 001° 22' 15"	small mare with high probability to dry out; connected to flood plain during rainy season
Mare Sacré	N 011° 28' 03" E 001° 28' 23"	round lake of moderate depth; densely inhabited by hippopotames; connected at its eastern shore by deep hippo trail with a J-shaped neighbour-mare
Mare Tiabiga	N 011° 24' 39" E 001° 42' 43"	large, but shallow lake: usually less than 1.5 m depth, but with some deeper channels; connected to the main river during rainy season
Mare Yanguali	N 011° 21' 57" E 001° 21' 31"	more or less round mare connected to a large oxbow of the Pendjari river

*tans*, *Azolla* cf. *pinnata*, *Salvinia nymphaeella*, *Lemna* sp. and *Pistia stratiotes* form floating vegetation patches, and especially *Pistia stratiotes* tends to cover sometimes entire lakes, for example the Mare Sacré in the dry season 2003/2004 (fig. 7D). The invasive *Eichhornia crassipes*, native from South America and already widely manifested in West Africa, has not reached the area until now, whereas native *E. natans* is quite common in the PNP. Shores of larger lakes are sometimes overgrown by helophytes, like those of the genera *Ludwigia*, *Sagittaria*, *Aponogeton*, *Marsilea* as well as different sedges (Cyperaceae) and grasses (mainly

Poaceae). An expanded floating mat with diverse plant community is developed around the Mare Bori, but it suffers much from large mammals during dry season (fig. 7A-B).

Mares are surprisingly diverse in their habitat structure and fish composition, even though the shallow water zones tend to heat-up to above 35 °C and thus become deprived of dissolved oxygen in full sun exposure during the day and are heavily disturbed by large watering mammals (fig. 7B, F, H). Several fish species have developed behavioural adaptations to cope with low oxygen concentrations. Some genera, such as

*Epiplatys* or *Brycinus*, use the upper-most water layers for their ventilation, also called “aerial surface respiration”, and thus profit from the oxygen diffusion of the water surface. Other genera possess specific organs enabling them to consume atmospheric air: *Protopterus*, *Polyp-terus*, *Heterotis* and *Gymnarchus* breathe via their swimbladder-lung-organ, *Clarias* and *Heterobranchus* developed a suprabranchial organ with respiratory surfaces on the second and fourth gill arch which are similar to the labyrinth organs in the branchial cavity of *Ctenopoma* and *Parachanna*. These organs are not only very efficient, but enable them to even survive in mud puddles or even moist mud for considerable time.

In some cases only large predators like *Polypterus endlicherii*, *P. senegalus* or *Clarias* spp. are able to endure the severe habitat conditions in the drying up ephemeral ponds and pools until the beginning of the next rainy season. Some large *Clarias gariepinus/anguillaris* specimens also developed hunting strategies to catch birds and jump out of the water trying to snatch them while they water (observed at Mari Bori, May 2003). A quite remarkable behaviour to escape severe habitat conditions in one of the heating up ponds was observed in the dry season on April 25, 2005 during a survey on small swampy Mare Elephant (fig. 6, 8C). At 1 pm in the noon, with water temperatures climbing to 41 °C in the sun, species like *Brevimyrus niger*, *Clarias* sp., *Parachanna obscura*, *Epiplatys bifasciatus* and *Hemichromis letourneuxi* still managed to survive in the water. Some specimens of *Clarias* and *Parachanna* even deliberately left the water to escape these high temperatures and took shelter in the moist mud below dense *Mimosa pigra* shrubs. This behaviour is well known by the local villagers and locally called ‘sleeping-fish’ and has, to our knowledge, not been reported in the scientific literature yet.

## 5. Fish and other wildlife

Fish play an important role as diet for many animals in the ecosystem of the West African savannah and is fundamental to maintain the diverse wildlife in the PNP (fig. 9). Many animals

are opportunistic or obligatory fish predators, including many aquatic insects or their larvae, which prey on smaller fish or fish fry while others are capable to capture fish up to 8 cm or larger. Among these are larvae dragonflies, various aquatic heteropterans (fig. 9J-L) larger diving beetles, and other arthropods like larger crustaceans or aquatic spiders. While predatory tadpoles are rare and aquatic frogs of the genus *Xenopus* only occasionally manage to capture single fish, the aquatic turtle species of the genera *Cyclanorbis*, *Pelusios* and *Pelomedusa* in the PNP are predominantly piscivorous. *Cyclanorbis senegalensis* (fig. 9C) and the more common *Pelusios castaneus* (fig. 9B) prefer larger lakes and river habitats, while the abundant *Pelomedusa olivacea* usually inhabits shallow savannah ponds and is also commonly observed in puddles on roads. Other reptiles feasting on fish in the ephemeral landscape include the Nile monitor, *Varanus niloticus* and the highly adapted obligatory fish-feeding colubrid *Grayia smithi* (fig. 9D). Even though this snake is rather common in the bigger lakes and the Pendjari River, it usually hides well and is only encountered when it gets entangled in fishing gear. Other piscivorous snake-like *Afonatrix anoscopus* or *Natriceres olivaceus* may be present but have not been yet recorded from the PNP.

One of the top predators is the West African crocodile (*Crocodilus suchus*) which is very commonly encountered in most aquatic habitats in the Park and spreads onto the savannah plain with the onset of the floods in the rainy season (fig. 9A). Juveniles prefer smaller ponds, whereas larger specimens are usually found in deeper waterbodies. According to literature, *Crocodilus suchus* is reportedly smaller as *Crocodilus niloticus*, however, individual *C. suchus* specimens encountered in the Pendjari River were larger than 4 meters, even though such large specimens are extremely rare.

Other top-fish-predators are the spotted-necked otter (*Lutra maculicollis*) and the African clawless otter (*Aonyx capensis*), while many other carnivorous mammals tend to diversify their diet as soon as larger fishes get trapped in the desiccating water bodies. These include among





**Fig. 9:** Some fish predators from the Pendjari National Park. **A** West African crocodile (*Crocodylus suchus*). **B** West African mud turtle (*Pelusios castaneus*). **C** Sahelian flapshell turtle (*Cyclanorbis senegalensis*). **D** African water snake (*Grayia smithii*) feeding on *Hemichromis fasciatus*. **E** Long-tailed cormorant (*Phalacrocorax africanus*). **F** Pied kingfisher (*Ceryle rudis*). **G** Saddle-billed stork (*Ephippiorhynchus senegalensis*). **H** Grey heron (*Ardea cinerea*). **I** Hammerkop (*Scopus umbretta*). Fish eating heteropterans: **J** *Poissionia* sp. feeding on *Brevimyrus niger* (Photo: V. v. VIETINGHOFF). **K** *Ranatra* sp. **L** *Nepa* sp.

**Abb. 9:** Einige Fischräuber aus dem Pendjari-Nationalpark. **A** Westafrikanisches Krokodil (*Crocodylus suchus*). **B** Westafrikanische Klappbrust-Pelomeduse (*Pelusios castaneus*). **C** Senegal-Weichschildkröte (*Cyclanorbis senegalensis*). **D** Afrikanische Wäterschlange (*Grayia smithii*), einen *Hemichromis fasciatus* verschlingend. **E** Riedscharbe (*Phalacrocorax africanus*). **F** Graufischer (*Ceryle rudis*). **G** Sattelstorch (*Ephippiorhynchus senegalensis*). **H** Graureiher (*Ardea cinerea*). **I** Hammerkopf (*Scopus umbretta*). Fischfressende Wanzen: **J** *Poissionia* sp., einen *Brevimyrus niger* fressend (Foto: V. v. VIETINGHOFF). **K** *Ranatra* sp. **L** *Nepa* sp.



others the honey badger (*Mellivora capensis*), wild cat (*Felis sylvestrus*) and leopard (*Panthera pardus*).

The third and most diverse group of fish predators are birds with more than 40 species in the PNP feeding partly or exclusively on fish (fig. 9E-I). Many of them are easy to observe, like hammerkop (*Scopus umbretta*), herons, egrets, storks, several species of kingfishers and the African river eagle (*Haliaeetus vocifer*), while others, as the anhinga (*Anhinga rufa*) or the fishing owl (*Scotopelia peli*) have a more hidden behaviour.

The impact of larger mammals on the aquatic savannah ecosystem is often underrated. They not only are important as nutrient-importers from the surrounding terrestrial habitats into the water bodies, mainly through their excrements, but have a vital role in the active shaping and forming of the water bodies. Especially the large herds of the various ungulate species are important fertilisers of ephemeral savannah pools, boosting algae and plant growth and thus giving optimal conditions for the start of the aquatic food chain. Furthermore, some species digest food only partly and provide a direct food resource for some fish species; above all elephants (*Loxodonta africana*) and hippos (*Hippopotamus amphibius*) have to be named here.

These species are also relevant for the shaping of the landscape as elephant- or buffalo-wallows. They usually are a starting point in the creation of new small savannah pools. But also the shape, the dimensions and interconnectivity of water bodies are heavily influenced by creative power of large mammals. In particular hippos entrench the landscape starting from rivers and permanent water bodies with their well-trodden paths, which convert during rainy season into dispersal-canals, or, as in the case of the Mare Sacré and its satellite, connects two mares for the most time of the year.

## 6. Fish and humans

The Pendjari area is one of the areas with lowest population density in the Volta basin with less than 2 persons per km<sup>2</sup> (BARRY et al. 2005). The native population in the Pendjari area used natural aquatic resources in the past only to a certain

degree. There exists traditional freshwater oyster collecting, but inside the protected area oyster collection is very limited in time and place (AKELE et al. 2015). Also catching fish had not played a major role in the area, although natural fish stocks have been significant. About every two to three years, however, people from the base of the Atakora chain perform their traditional fisheries at the Mare Bori (fig. 10C-D). Almost the whole village participates trying to catch some fish using cradles, spears or machetes. “Common” cradles are used to lift aquatic plants or to sieve simply the water; special fishing cradles are quickly thrown into the water to the ground and through an opening on the top the fishermen will search a probable catch by hand (fig. 10D). The exit of the Mare Bori is sometimes blocked with a barrier and wooden traps (fig. 10A-B). Harvested fish from such events is used and traded within villages and usually not used for money generation. Sometimes poisons originating from various plants are used for smaller ponds. Poisoning and massive fishing events may have a major impact on local fish communities, especially if they are largely separated from the other water bodies of the area as it is the case for the Mare Bori.

Today there is intense fishery along the Pendjari River from both sides, Burkina Faso and Benin (MORITZ & LALEYE 2017). Fishes are mainly caught by non-resident fishermen, several of them coming into the area only for the fishing season. Traders travel with trucks full of ice (fig. 11F) to the fishermen camps (fig. 11G) to replace the space of the melted ice with fresh fish (fig. 11E). The fish is then transported mainly to Burkina’s capital Ouagadougou and sold in fish stores or to hotels and restaurants. The most important and most expensive fish species is the “capitaine”, *Lates niloticus*, followed by *Gymnarchus niloticus* and *Heterotis niloticus*. Most other fish are also sold this way, as long as they surpass a certain size of about 10 cm. Smaller fish are usually smoked (fig. 11D) and sold to more local traders. Few fishes are only little used in this area, i.e. the pufferfish, *Tetraodon lineatus*, which is not eaten in the area, and bichirs, *Polyperterus* spp., which are usually not sold, but directly eaten by the fishermen.



**Fig. 10:** Traditional fisheries in the Pendjari National Park. **A** Fishing dam at outflow of Mare Bori (Dec 2003). **B** Traps of the dam from A. **C, D** Traditional fisheries with cradles on Mare Bori (Mai 2006) (Photos: W. DICKORE).

**Abb. 10:** Traditionelle Fischerei im Pendjari-Nationalpark. **A** Eine Fischblockade am Ausfluss des Mare Bori (Dez 2003). **B** Die Reusen der Fischblockade aus A. **C, D** Traditionelle Fischerei mit Körben im Mare Bori (Mai 2006) (Fotos: W. Dickore).

The modern fishermen use many different techniques: gill nets, cast nets, baited and non-baited hook-lines, traps and large seines (fig. 11A-C), although the latter are actually forbidden to be used in freshwaters of Benin. Fishery takes place usually between November and May almost all along the river, although usually stretches for fisheries and places for fishing camps are determined each year by park administration (CENAGREF) and the local wildlife utilisation organisation (AVIGREF). Also other regulations for the behaviour within the national park are given, but are usually not or rarely respected (MORITZ & LALEYE 2017).

Surrounded by protected and semi-protected areas, fish stocks in the Pendjari National Park could be undisturbed by human activities.

But aquatic resources are utilized in the area in correspondence even with official regulations (MORITZ & LALEYE 2017). Furthermore, fishermen do often not follow these regulations and illegal fishing activities can be traced not only all along the entire river in the park, but also in all larger lakes of this area, where fishing is strictly prohibited and banned. There are only few relatively undisturbed areas with very few fishing activities, but even these seem to negatively impact selected species such as *Polypterus endlicherii* (MORITZ 2017). Closed fishing areas should be secured in the area to preserve at least the most sensible aquatic habitats of the PNP, which would also offer protection for turtles or crocodiles (fig. 11H), because these regularly get entangled in the fishing gear, especially in gill nets.



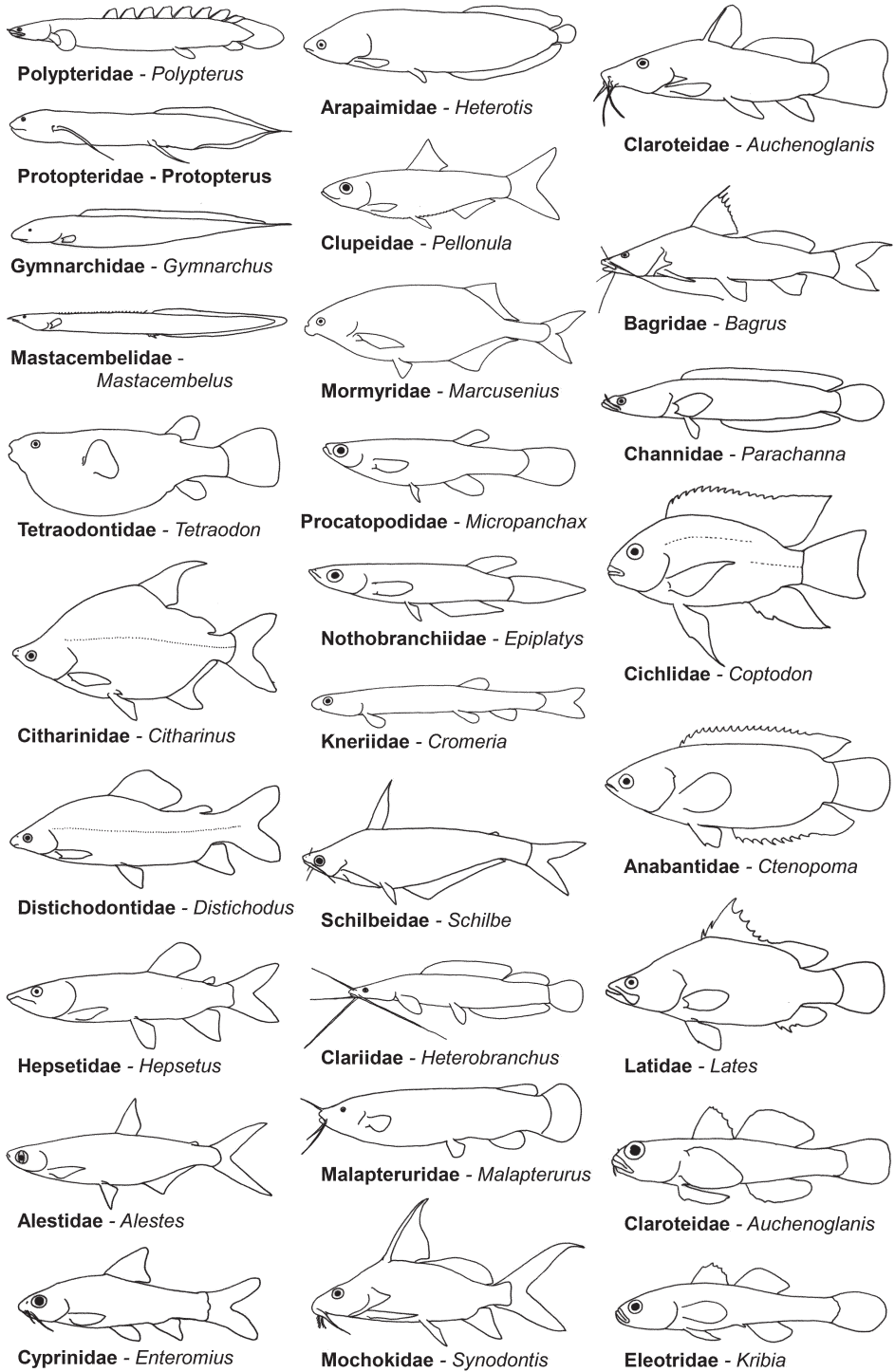


**Fig. 11:** Modern fisheries in the Pendjari National Park. **A** Hook line. **B** Trap 'nasse malinienne'. **C** Large seine. **D** Smoking fish. **E** A view into an iced fish transporter. **F** Transporter for fresh fish. **G** Fishermen camp. **H** Fishermen's catch including poached crocodile. (Photos: A, B, C & H: S. AHOANSOU MONTCHO; G: W. DICKORE)

**Abb. 11:** Moderne Fischerei im Pendjari-Nationalpark. **A** Langleine. **B** Reusen nach Mali-Bauart. **C** Großes Zugnetz. **D** Räuchern von Fischen. **E** Blick in einen eingekühlten Transporter. **F** Transporter für frischen Fisch. **G** Fischercamp. **H** Fang eines Fischers inklusive eines gewilderten Krokodils. (Fotos: A, B, C & H: S. AHOANSOU MONTCHO; G: W. DICKORE)

**8. Key to the fish families of the Pendjari National Park (fig. 12)**

1a	Body strongly armoured with interconnected rhomboid scales; anterior part of dorsal fin separated into single finlets.....Polypteridae	12a	Jaws without teeth.....Cyprinidae
1b	Body covered by elasmoid scales or scales missing; dorsal fin (if present) not divided into finlets.....2	12b	Jaws with teeth (sometimes very small).....13
2a	Caudal fin absent or confluent with dorsal and/or anal fin.....3	13a	Caudal fin clearly divided in upper and lower lobe.....14
2b	Distinct caudal fin present, not merged with other fins.....5	13b	Caudal fin never divided in upper and lower lobe, shape variable and usually rounded.....15
3a	Pelvic fins present .....Protopteridae	14a	Abdominal serration present .....Clupeidae
3b	Pelvic fins absent.....4	14b	No abdominal serration present .....Mormyridae
4a	Anal and caudal fin absent .....Gymnarchidae	15a	Caudal fin small: more than 2 times in head length.....Arapaimidae
4b	Anal, caudal and dorsal fin confluent.....Mastacembelidae	15b	Caudal fin as large as head or larger.....16
5a	Pelvic fins absent.....Tetraodontidae	16a	Body flanks without colour pattern (uniform whitish to metallic blue); dorsal fin origin clearly behind anal fin origin....Procatopodidae
5b	Pelvic fins present.....6	16b	Body flanks usually with stripes or spots and/or dorsal fin origin at the same level of anal fin .....Nothobranchiidae
6a	Pelvic fin origin clearly behind origin of pectoral fins.....7	17a	Head without barbels, pectoral fin without spine; no adipose fin present.....Kneriidae
6b	Pelvic fin origin below pectoral fin origin.....23	17b	Head with barbels, pectoral fin usually supported by pectoral spine; adipose fin usually present.....18
7a	Body with scales.....8	18a	Anal fin about half the body length or longer.....19
7b	Body without scales.....16	18b	Anal fin shorter.....20
8a	Adipose fin present.....9	19a	Dorsal fin a maximum of 6 branched rays or dorsal fin absent .....Schilbeidae
8b	Adipose fin absent.....12	19b	Dorsal fin with 20 or more branched rays.....Clariidae
9a	Lateral line straight; in the middle of the body.....10	20a	Rayed dorsal fin absent (only adipose fin present).....Malapteruridae
9b	Lateral line curved downwards, running through the lower part of the body.....11	20b	Rayed dorsal fin present (usually plus an adipose fin).....21
10a	Cycloid scales (giving the fish a smooth feeling when handled) .....Citharinidae	21a	Mandibular barbels with ramiform extensions or sucking disc present; nasal barbel absent.....Mochokidae
10b	Ctenoid scales (giving the fish a rough feeling when handled) .....Distichodontidae	21b	Mandibular barbels always simple; never a sucking disc; nasal barbels present or absent.....22
11a	Maxillary teeth present, teeth conical; upper jaw not moveable .....Hepsetidae		
11b	Maxillary without teeth; teeth with more than one cusp or upper jaw moveable.....Alestidae		



**Fig. 12:** Overview on the fish families of the Pendjari National Park.  
**Abb. 12:** Überblick über die Fischfamilien im Pendjari-Nationalpark.



22a	5 to 7 soft dorsal fin rays, nasal barbel present or absent.....	Claroteidae
22b	8 to 11 soft dorsal fin rays, nasal barbel present.....	Bagridae
23a	Dorsal fins confluent or only a single dorsal fin present.....	24
23b	Two separate dorsal fins present.....	26
24a	Dorsal fin and anal fin without spines, only with soft rays.....	Channidae
24b	Dorsal and anal fin with spines.....	25
25a	A single nostril on each side....	Cichlidae
25b	Two nostrils on each side....	Anabantidae
26a	Dorsal and anal fin spines (unbranched rays) form hard sharp spikes.....	Latidae
26b	Dorsal and anal fin spines (unbranched rays) soft, not spike-like.....	27
27a	Pelvic fins fused.....	Gobiidae
27b	Pelvic fins not fused.....	Eleotridae

## 10. Species accounts

### 10.1. Protopteridae

Six protopterid lungfishes occur in Africa. All of them are capable to aestivate during the dry season in a cocoon buried in the mud (fig. 13B). The origin of the dorsal and ventral fin is the main character to identify the very similar looking species. Within the study area, only *Protopterus annectens annectens* occurs (fig. 13A-B). The species prefers lentic habitats and is very common in all types of lakes and swamps and rarely encountered in the main river. Lungfishes are targeted for commercial fishing, while the habit of trading lungfish cocoons “living preserved food” is not practiced in this area.

### 10.2. Polypteridae

Polypterids (bichirs) are endemic to Africa and the family is represented by only 2 genera: *Polypterus* with 13 species and *Callamoichthys* with a single species (MORITZ & BRITZ in prep.). *Polypterus endlicherii* (fig. 13C) and *Polypterus senegalus* (fig. 13D) are confirmed from own records for the study area (tab. 1), and both species are very

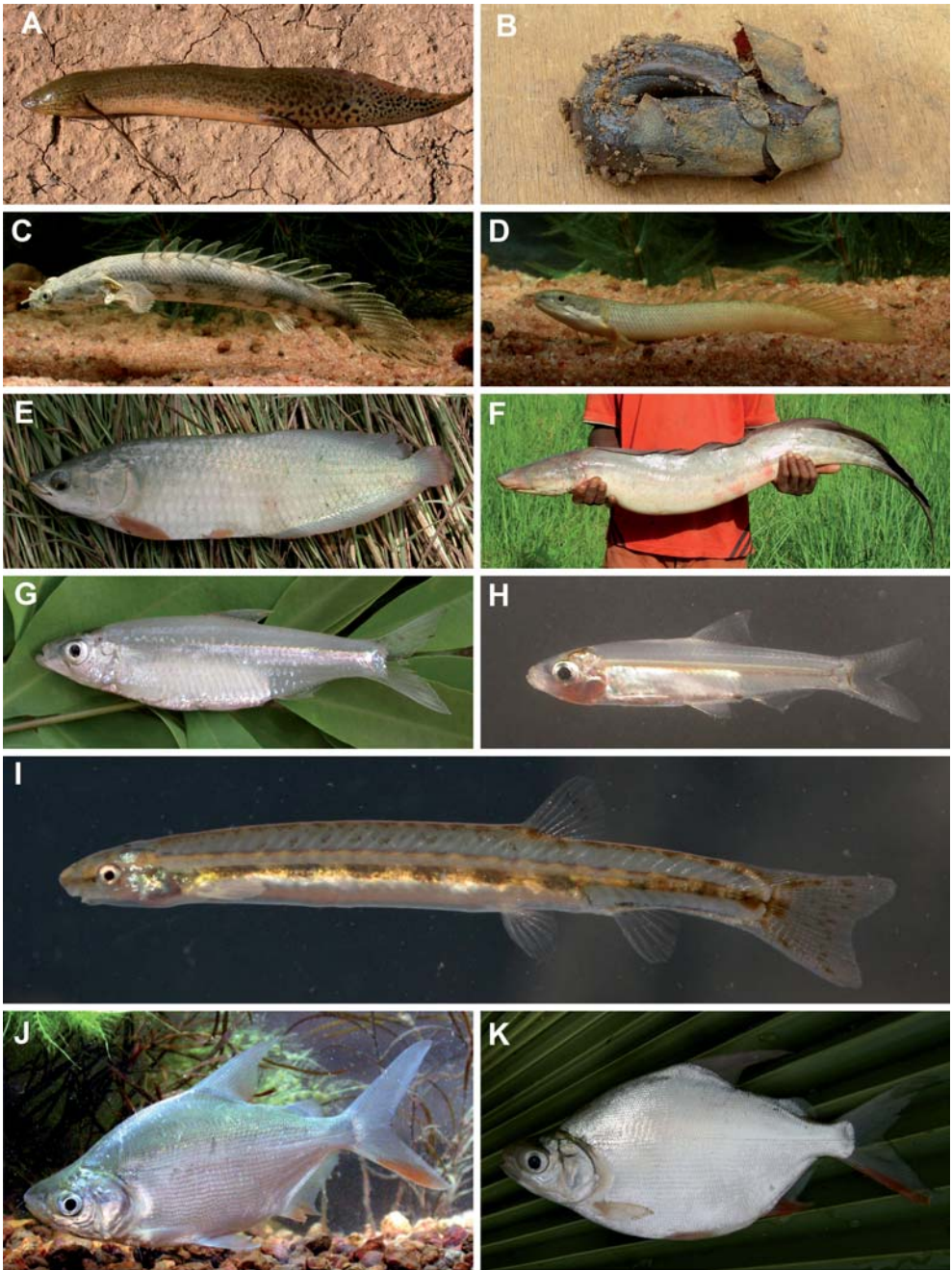
common in all available aquatic habitats, with the exception of very small brooks. A third species, *Polypterus bichir*, was reported for the Pendjari by BLANC & DAGET (1957) and is confirmed so far by ROMAN (1966) for the western part of the Volta system.

Bichirs are easy to recognize from all other fishes of the Pendjari area by their rigid body scales – which give them a snakelike appearance – and their dorsal fin, which is not confluent but separated into single finlets in its anterior part of the fin. Polypterids are not valued and rarely sold or traded in the Pendjari region, but often consumed by the local fishermen. However, the large species *P. endlicherii* apparently is heavily affected by fishing activities (MORITZ 2017).

1a	Second transverse scale row continuing to ventral midline of body; 8 to 11 finlets; first finlet at level or posterior of posterior margin of pectoral fin .....	<i>Polypterus senegalus</i>
1b	Third transverse scale row continuing to ventral midline; 11 or more finlets; first finlet anterior of posterior margin of pectoral fin.....	2
2a	11 to 14 finlets; flanks with 4 to 6 prominent black dorsolateral bars, each 4 to 5 scale rows in width .....	<i>Polypterus endlicherii</i>
2b	13 to 18 finlets; flanks uniform brownish or with dark brown horizontally elongated blotches arranged in horizontal row .....	<i>Polypterus bichir</i>

### 10.3. Arapaimidae

The bonytongues include only two genera and currently four species. In Africa, the widely distributed *Heterotis niloticus* (fig. 13E) is the only representative of this family. Among the fishes of the PNP, *Heterotis* is unique and easily recognized by its very large scales and its caudally tapering body ending in a rather small caudal fin. The species is common in all bigger lakes and in the main river in the PNP and tends to be very



**Fig. 13/Abb. 13:** Protopteridae: **A** *Protopterus annectens*, Mare Diwouni (28 Nov 2003). **B** Excavated cocoon of *P. annectens*, close to Sangou/ausgegrabener Kokon von *P. annectens*, nahe bei Sangou (Pendjari area, Jun 2007, photo by A. Chikou). Arapaimidae: **C** *Heterotis niloticus*, Mare Tiabiga (27 Nov 2003). Gymnarchidae: **D** *Gymnarchus niloticus*, Pendjari River (2007, photo by S. Ahouansou Montcho). Clupeidae: **G** *Pellonula leonensis*, large specimen, Bougouriba River, Burkina Faso (Dez 2003). **H** *P. leonensis*, juvenile, Pendjari River (Nov 2004). **I** Kneriidae: *Cromeria occidentalis*, Pendjari River (Apr 2007). Citharinidae: **J**, *Citharinus citharus*, barrage de Dissin, Burkina Faso (Nov 2003). **K** *C. citharus*, Pendjari River (Apr 2007).

common in some lakes, like the Mare Tiabiga. It is a commercially highly valued food fish in West Africa, especially in the South of Benin.

#### 10.4. Gymnarchidae

This African family is monotypic and *Gymnarchus niloticus* is the only representative, which also occurs in the PNP. It is easily recognized by its long dorsal fin and the absence of pelvic and caudal fins. Like mormyrids, it produces electric discharges for communication and orientation. *Gymnarchus niloticus* produce a unique continuous sinusoidal signal (at least for African weakly electric fishes), which is easily detectable and identifiable by using a mormyrid detector. The alveolar swim bladder enables them to breathe atmospheric air. While *G. niloticus* is still common in the PNP (fig. 13F) and frequently encountered in the main river and lakes, large specimens become increasingly rare also in other parts of Benin.

#### 10.5. Mormyridae

More than 220 mormyrid species occur in African freshwaters and a characteristic feature all mormyrids share is an electric organ derived from muscle cells in the caudal peduncle which enables them to produce weakly electric discharges (EODs). Mormyrids use these EODs for orientation, prey detection and communication. The electric discharges are very weak and usually not recognisable for humans. However, sometimes when handling large *Mormyrus rume* or *M. hasselquisti* with water soaked hands, the EODs can be sensed as weak electric pulses. The use of a mormyrid detector allows precise localization of mormyrids specimens in their natural environment, either to catch them or to collect information on their preferred habitats. The variation of EOD signals of single species under natural conditions is largely unknown and it seems that the mormyrids in the PNP share a similar variability of their EOD signals depending on specific localities, i.e. between lakes (MORITZ et al. 2008). The cause for this parallel adaptation in EOD signals is not fully

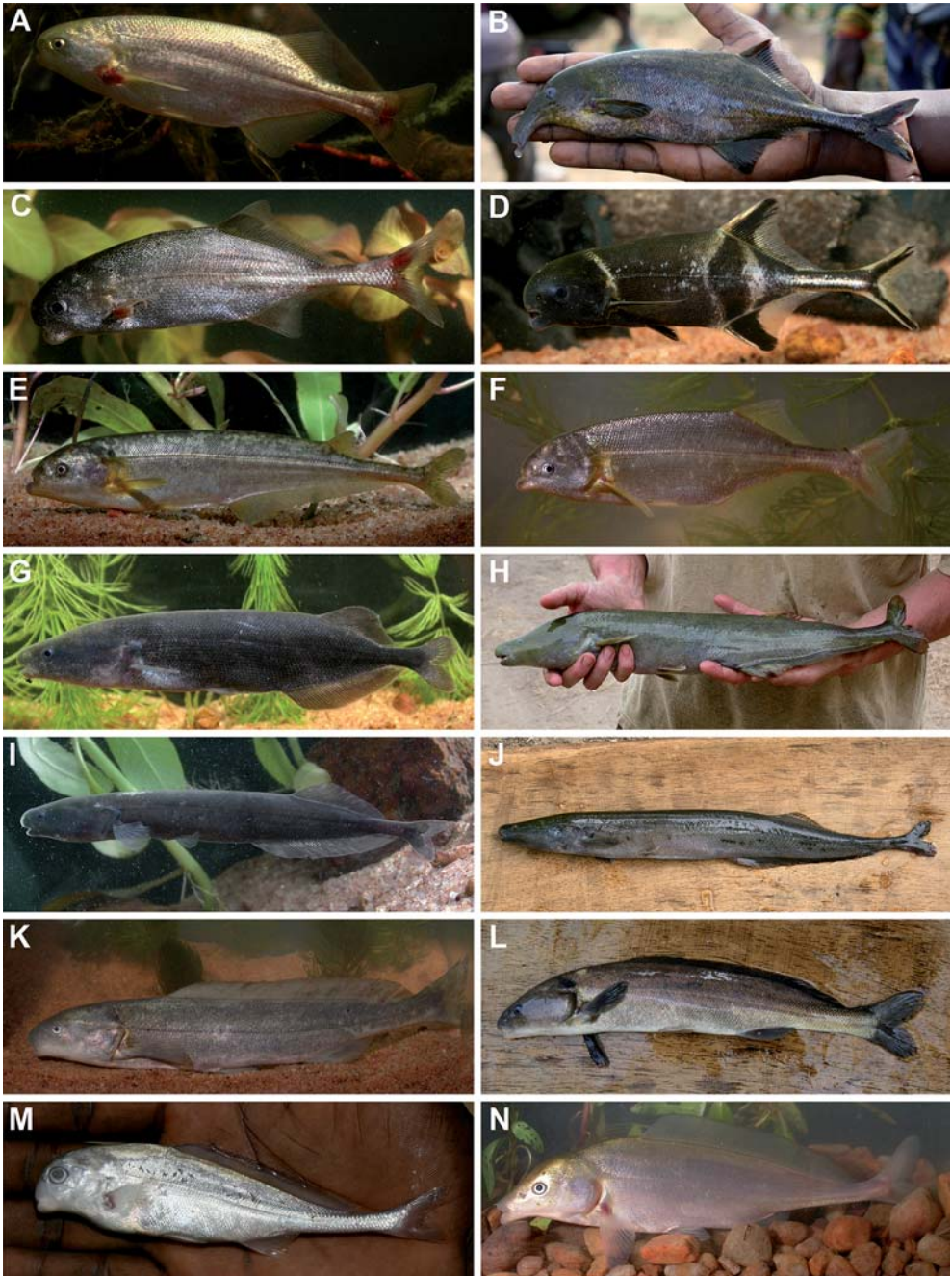
understood and remains to be investigated.

Mormyrids are a diverse and important African fish group. With 16 confirmed species (tab. 1, figs 14-15) and additional two species tentatively occurring in this area, they are the second most diverse fish family in the PNP.

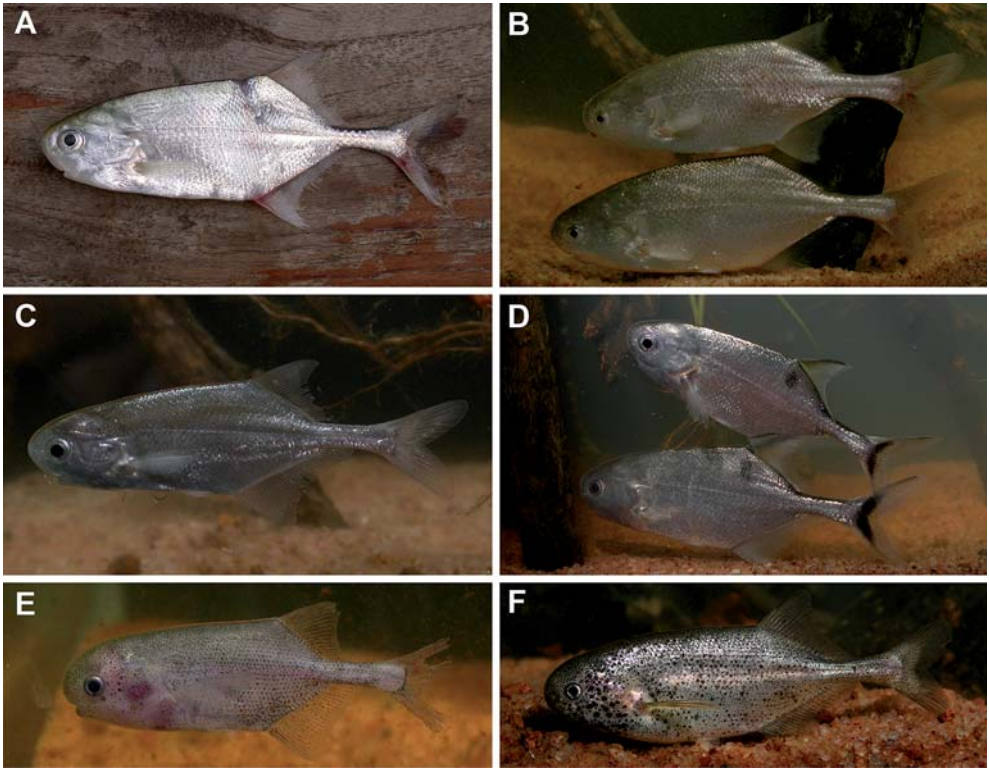
*Brevimyrus niger*, *Marcusenius senegalensis*, *Pollimyrus isidori* and *Petrocephalus bovei* are frequently encountered in the PNP and occupy most aquatic habitats in large numbers. *Hippopotamyrus pictus* and *Petrocephalus soudanensis* seem to be restricted to the main river, while *Petrocephalus bane* and *Petrocephalus pallidomaculatus* are common in the main river and occasionally enter lakes close to the main river. *Petrocephalus bovei* also enters even very small brooks and ascends into the smaller tributaries of the Atakora chain. *Petrocephalus pallidomaculatus* is a very similar species with the name giving spot not visible in specimens from the PNP. However, *P. bovei* can be distinguished by its larger eye and a different EOD signal (MORITZ et al. 2009). *Pollimyrus isidori* prefers habitats with dense vegetation, but is also present in ephemeral pools without vegetation. The body colouration of this species is very variable and likely corresponding to the habitat condition: in clearer water with shore vegetation specimens have widened melanophores giving them a very dark, dusky appearance; in open water bodies and habitats with muddy or murky water the melanophores are contracted and the specimens appear whitish to pinkish. During the surveys a single specimen of *Pollimyrus adspersus* (fig. 15E) was collected in the main river, a species occurring more frequently in coastal areas of West Africa. *Brevimyrus niger* is the only mormyrid known capable of breathing atmospheric air so far (MORITZ & LINSSENMAIR 2007); this species is capable to withstand in very hot, desiccating remnant pools. The body colouration of this species is also very variable and can range from silvery to dark lilac or brown and even almost black.

*Mormyrus rume* prefers the main river and bigger lakes and only occasionally enters smaller floodplain pools, while *Mormyrus hasselquisti* is more frequent in the bigger lakes and less abundant in the main river. *Mormyrus macrophthalmus* and *Campylomormyrus tamandua* seem to be





**Fig. 14/Abb. 14:** Mormyridae: **A** *Brevimyrus niger*, Mare Diwouni (Mar 2005). **B** *Campylomormyrus tamandua*, Niger River, Benin (Mar 2007). **C** *Cyphomyrus psittacus*, Niger River, Benin (Mar 2007). **D** *Hippopotamyrus pictus*, Pendjari River (Apr 2007). **E** *Hyperopisus bebe*, Mare Bori (Jan 2005). **F** *Marcusenius senegalensis*, Mare Bori (Dec 2013). **G** *Mormyrops anguilloides*, juvenile, Bougouriba River, Burkina Faso (Jan 2005). **H** *M. anguilloides*, Pendjari River (Apr 2007). **I** *Mormyrops breviceps*, juvenile, Bougouriba River, Burkina Faso (Jan 2005). **J** *M. breviceps*, Pendjari River (Apr 2007). **K** *Mormyrus hasselquistii*, Pendjari River (Apr 2007). **L** *M. hasselquistii*, Pendjari River (Apr 2007). **M** *Mormyrus macrophthalmus*, Niger River, Benin (Mar 2007). **N** *Mormyrus rume*, Mare Diwouni (Mar 2005).



**Fig. 15/Abb. 15:** Mormyridae: **A** *Petrocephalus bane*, Pendjari River (Apr 2007). **B** *Petrocephalus bovei*, male (above) and female (below), Mare Diwouni (Mar 2005). **C** *Petrocephalus pallidomaculatus*, Bougouriba River, Burkina Faso (Mar 2005). **D** *Petrocephalus soudanensis*, male (above) and female (below), Pendjari River (Mar 2005). **E** *Pollimyrus adspersus*, juvenile, Pendjari River (Mar 2005). **F** *Pollimyrus isidori*, Pendjari River (Feb 2007).

restricted to the main river but rare in the PNP.

The taxonomy of *Hyperopisus* and status of various subspecies has been controversially discussed in the past (DAGET 1954; BLACHE et al. 1964), and instead of recognizing *H. bebe occidentalis* for the PNP (BLACHE et al. 1964), we tend to follow BIGORNE (2003) who recognizes only one single species in the genus: *H. bebe*. The species was occasionally found in all aquatic habitats, except very small pools.

Two species of *Mormyrops* occur in the PNP and both are restricted to the main river. *Mormyrops anguilloides* is not very common but regularly encountered in sections where dense roots and driftwood offer shelter and hiding places along the river banks. The second species, *Mormyrops breviceps*, is much less frequent and was recorded only from very few specimens in the main river.

*Cyphomyrus psittacus* and *Marcusenius abadei* are

both mentioned for the Volta basin, but so far not recorded in the PNP, even though their presences in this area is likely.

The large mormyrid species are important for fisheries gaining high market prices, but also the smaller species are targeted for fishing because of their high abundance. Small mormyrids are often smoked and grinded to fish powder.

- 1a Dorsal fin longer than three times the anal fin.....2
- 1b Dorsal fin of same length or shorter as anal fin.....4
- 2a Snout shorter than eye-diameter .....*Mormyrus macrophthalmus*
- 2b Snout much longer than eye-diameter....3
- 3a Snout elongated and curving downwards; ventral fin insertion on same level as dorsal fin origin or slightly beyond.....*Mormyrus rume*



- 3b Snout short and straight; ventral fin insertion clearly behind origin of dorsal fin.....*Mormyrus basselquisti*
- 4a Dorsal fin shorter than one quarter of anal fin.....*Hyperopisus bebe*
- 4b Dorsal fin longer than one quarter of anal fin.....5
- 5a Line connecting both nostrils crosses through eye.....6
- 5b Line connecting both nostrils runs below eye.....11
- 6a Distance between posterior nostril and eye much shorter than eye diameter.....7
- 6b Distance between posterior nostril and eye longer than eye diameter.....10
- 7a First dorsal ray, base of dorsal fin and base of caudal fin black; prominent black spot below dorsal fin.....*Petrocephalus soudanensis*
- 7b Entire dorsal fin and base of caudal without black marking; black spot below dorsal fin either absent or only very faint.....8
- 8a 29 to 34 dorsal fin rays .....*Petrocephalus bane*
- 8b Less than 29 dorsal fin rays.....9
- 9a Eye small: diameter about four times in head length.....*Petrocephalus bovei*
- 9b Eye large: diameter about three times in head length .....*Petrocephalus pallidomaculatus*
- 10a Body depth 4.9 to 7.5 times in SL .....*Mormyrops anguilloides*
- 10b Body depth 8.0 to 11.7 times in SL .....*Mormyrops breviceps*
- 11a Snout very elongate and tube-like .....*Campylomormyrus tamandua*
- 11b Snout not elongate and not trunk shaped.....12
- 12a Dorsal fin origin in front of anal fin.....*Cyphomyrus psittacus*
- 12b Dorsal fin origin at same level or behind anal fin.....13
- 13a Dorsal and anal fin connected with conspicuous dark, white bordered vertical stripe .....*Hippopotamyrus pictus*
- 13b Flanks without such conspicuous marking.....14
- 14a Chin with prominent swelling.....15
- 14b Chin without prominent swelling.....16
- 15a 12 scales around caudal peduncle, 22 to 31 dorsal fin rays .....*Marcusenius senegalensis*
- 15b 16 scales around caudal peduncle, 34 to 39 dorsal finrays .....*Marcusenius abadaii*
- 16a Distance between both nostrils and posterior nostril and eye equidistant.....*Brevimyrus niger*
- 16b Distance posterior nostril and eye shorter than distance between both nostrils.....17
- 17a 14 to 16 caudal peduncle scales; dorsal fin colouration uniform first dorsal fin rays not dark; caudal peduncle depth about four times in body depth .....*Pollimyrus isidori*
- 17b 12 (rarely 14) caudal peduncle scales; first dorsal fin rays dark; caudal peduncle depth about five times in body depth .....*Pollimyrus adsperus*

## 10.6. Clupeidae

In West Africa, the family Clupeidae is represented only with few brackish and freshwater species in the subfamily Pellonulinae, and only three real freshwater species are reported for the Volta basin: *Odaxotbrissa mento*, *Sierratbrissa leonensis* and *Pellonula leonensis*. The latter species (figs 13G-H) was the only species recorded for the PNP so far, and we suppose that the other two species probably do not occur in this area. While DAGET (1954) reported that *P. leonensis* does not leave the Niger River to enter floodplains, we found this species frequently in the main river and in the bigger permanent lakes like the Mare Tiabiga, where it apparently is able to endure the dry season. *Pellonula leonensis* reaches a maximum size up to 90 mm SL, but usually grows much smaller and therefore is of minor importance for the local fishery in the PNP.

## 10.7. Kneriidae

*Cromeria* (fig. 13I) is the only genus of Gonorhynchiformes occurring in West African savannah waters. *Cromeria occidentalis* was described as subspecies of *C. nilotica* by DAGET (1954), but gained species level recently (MORITZ et al. 2006a). The genus was often placed in its own family, Cromeriidae, but osteological studies do not support their separation from Kneriidae (JOHNSON & PATTERSON 1997; BRITZ & MORITZ 2007). It was reported that specimens of the genus *Cromeria* burrow in the sand during the day (DAGET 1945, ROBERTS 1972), but own observations indicate that this species occurs on several different substrates and that burrowing is not a common behaviour (MORITZ et al. 2006b). *Cromeria occidentalis* is common in the main river, single specimens occasionally occur in bigger lakes.

## 10.8. Citharinidae

Citharinids are the sister group to distichodontids with which they share several morphological characters (VARI 1979). Three species are likely to occur in the Volta basin: *Citharinus citharus* (fig. 13J-K) is regularly recorded in the PNP, while *Citharinus latus* seems to be less common in the area. Both species prefer the main river and if present they may occur in high abundance. *Citharinops distichodooides* was reported for the Volta basin (GOSSE & PAUGY 2003) and might also occur in the PNP.

- 1a 50 to 56 lateral line scales; 7.5 to 12.5 scales between lateral line and pelvic fin insertion  
.....*Citharinops distichodooides*
- 1b 59 or more lateral line scales; 13 or more scales between lateral line and pelvic fin insertion.....2
- 2a 59 to 71 lateral line scales; 13.5 to 15.5 scales between lateral line and pelvic fin insertion.....*Citharinus latus*
- 2b 77 to 92 lateral line scales; 17.5 to 20.5 scales between lateral line and pelvic fin insertion  
.....*Citharinus citharus*

## 10.9. Distichodontidae

Distichodontids are represented with about 100 species in African freshwaters. The feeding morphology inside this family is highly diverse, including a subgroup of specialized fin and scale-eaters. This tribe, the Ichthyoborini, apparently is absent from the Volta basin, although it is present in the directly neighbouring Niger River and Ouémé River.

Probably eight distichodontids occur in the PNP (tab. 1, figs 16A-H), and the small *Neolebias unifasciatus* (fig. 16H) apparently is their most common representative. This species is abundant in most ponds and lakes but less frequent in the main river. Except for *Nannocharax ansorgii* (fig. 16E), which is also present in lakes, *Nannocharax* species are usually restricted to the main (flowing) river. Two similar species are present in the Pendjari River: *Nannocharax fasciatus* (fig. 16F) and *Nannocharax* cf. *occidentalis* (fig. 16G), which has an elongated body and head. If the determination as *N. occidentalis* is confirmed, this would be the first record from the Volta basin, but it may represent a new species which have to be investigated detailed revision. *Paradistichodus dimidiatus* (fig. 16D) is slightly larger as *Nannocharax* and occupies most lakes, ponds and the main river and sometimes reaches high local abundances.

Three large distichodontids, the only ones that have relevance for fisheries, are known from the Volta basin (figs 16A-C), *Distichodus brevipinnis*, *Distichodus enygecephalus* and *Distichodus rostratus*, but so far only the latter has been recorded in the PNP, where it occurs regularly in the river and some lakes.

- 1a Anal fin with 13 or more rays; growing larger than 75 mm SL.....2
- 1b Anal fin with 12 or less rays; less than 75 mm SL.....4
- 2a 18 to 20 scales between lateral line and axillary scale (above pelvic fin base); base of adipose fin longer than distance between dorsal fin and adipose fin.....*Distichodus brevipinnis*
- 2b 15 or less scales between lateral line and axillary scale (above pelvic



**Fig. 16/Abb. 16:** Distichodontidae: **A** *Distichodus brevipinnis*, Niger River, Benin (Nov 2004). **B** *Distichodus engycephalus*, Niger River, Benin (Nov 2004). **C** *Ditichodus rostratus*, Pendjari River (Jan 2005). **D** *Paradistichodus dimidiatus*, Bougouriba River, Burkina Faso (May 2005). **E** *Nannocharax ansorgii*, Pendjari River (Jan 2005). **F** *Nannocharax fasciatus*, Pendjari River (Mar 2007). **G** *Nannocharax* cf. *occidentalis*, Pendjari River (Dec 2004). **H** *Neolebias unifasciatus*, Pendjari River (Jan 2005). Hepsetidae: **I** *Hepsetus odoe*, juvenile, PNP (Dec 2004). **J** *H. odoe*, Pendjari River (Nov 2003).

- |  |   |
|--|---|
| <p>fin insertion); adipose fin shorter than distance between dorsal fin and adipose fin.....3</p> <p>3a Mouth inferior; 10 to 12 scales between lateral line and axillary scale; caudal lobes pointed .....<i>Distichodus engycephalus</i></p> | <p>2b Mouth subterminal; 12 to 15 scales between lateral line and axillary scale; caudal lobes rounded .....<i>Distichodus rostratus</i></p> <p>4a Dorsal fin with 16 or more rays .....<i>Paradistichodus dimidiatus</i></p> <p>4b Dorsal fin with 15 or less rays.....5</p> |
|--|---|

- 5a Tip of the pectoral fin extending behind origin of pelvic fins; dorsal body and flanks with irregular dark blotches and stripes.....6
- 5b Tip of the pectoral fin not reaching origin of pelvic fins; prominent black band on lateral flanks.....7
- 6a 7 dark marks along the mid-dorsal line; snout about equal eye diameter; upper half of eye orange .....*Nannocharax fasciatus*
- 6b 10 dark marks along the mid-dorsal line; snout longer than eye diameter; upper half of eye dark brown to grey.....*Nannocharax* cf. *occidentalis*
- 7a 39-45 scales in longitudinal line .....*Nannocharax ansorgii*
- 7b 33-35 scales in longitudinal line .....*Neolebias unifasciatus*

## 10.10. Hepsetidae

Until recently, the African family Hepsetidae was considered monotypic. Recent studies recognized six morphologically and genetically distinct populations, which have been lately described as distinct species (DECRU et al. 2017). *Hepsetus odoe* occurs in the PNP (fig. 16I-J) and is likely based on specimens originating from the Lower Volta or a smaller river in the coastal lowland of the Volta (DECRU et al. 2013). Within the PNP, *H. odoe* is commonly found on the floodplain, in lakes and less common in the main river.

## 10.11. Alestidae

With about 120 species alestids are the most diverse of the three African characiform families. They are widely distributed in Africa and occur in most freshwater aquatic habitats. In the PNP probably 11 species are present (tab. 1), but some taxonomical issues remain unsolved in this family. The taxonomic identity of *Phenacogrammus pabrensis* (ROMAN 1966) still is controversially discussed and either regarded to belong to *Micralestes* (PAUGY 2003) or is placed in its own genus *Virilia* (ROBERTS 1967; MIRANDE 2010). The overall morphological similarity with *Rhabd-*

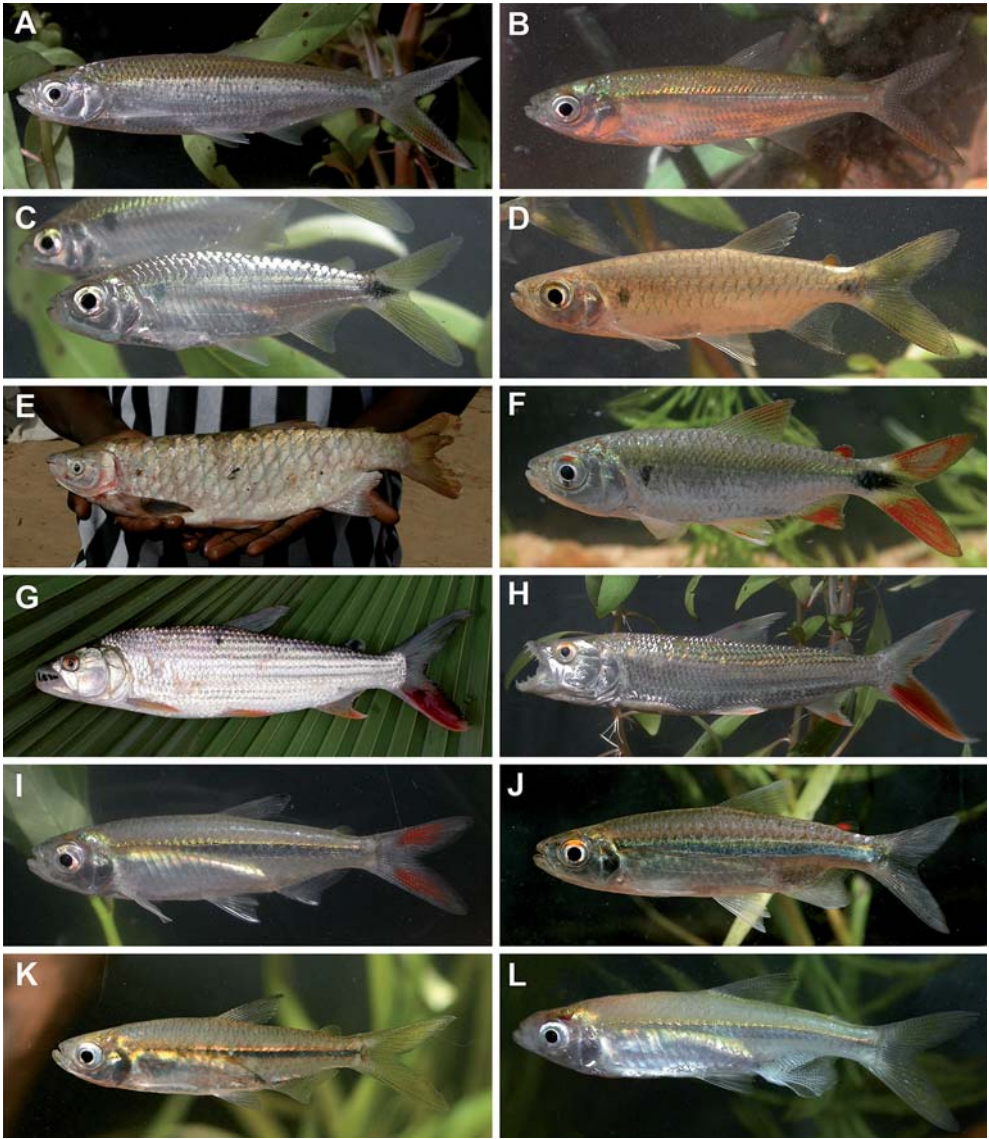
*alestes* is obvious, and *Phenacogrammus pabrensis* might in fact only be a less intensively coloured representative of *Rhabdalestes septentrionalis*. Until the taxonomic status of *Phenacogrammus pabrensis* is finally resolved, we tend to refer to these specimens as *R. cf. septentrionalis* (fig. 17K-L), a species that is widely distributed in most aquatic habitats of the PNP, but much more common in lakes and ponds. Similar in size and shape is *Micralestes elongatus* (fig. 17I), a common species in the main river that occasionally enters larger lakes that are close to the main river. Males of *M. elongatus* have enlarged anterior anal fin rays. This sexual dimorphism is shared by many male alestids and strongly pronounced in *R. cf. septentrionalis* (fig. 17L). *Micralestes occidentalis* (fig. 17J) likely occurs in the PNP, but has only been recorded in affluents to the Oti River south of the Atakora chain so far.

ROMAN (1966) described *Brycinus luteus* from the Volta basin, a species which shares many features with *Brycinus leuciscus*. Until the taxonomy is finally resolved, we refer to the PNP specimens as *Brycinus leuciscus*. *Brycinus leuciscus* (fig. 17C) and *B. nurse* (fig. 17F) are very common throughout the park, but *B. leuciscus* is rare in marigots and isolated lakes, where *B. nurse* prevails. The third species of the genus, *Brycinus macrolepidotus* (figs 17D-E), is also very common in the main river, but compared to the other two *Brycinus* species only rarely enters lakes and ponds and prefers vegetated habitats in the Pendjari, especially submerged inshore vegetation.

Three species of *Hydrocynus* have been reported for the Volta basin. *Hydrocynus vittatus* is likely restricted to the Zambezi and southern Africa and potentially absent from West Africa (GOODIER et al. 2011). *Hydrocynus brevis* (fig. 17G) is less common in the main river compared to *Hydrocynus forskalii* (fig. 17H), with the latter also entering the lakes.

*Alestes dentex* (fig. 17B) and *Alestes baremoze* (fig. 17A) should both be present in the PNP, but so far only the latter was confirmed in own field work and usually occurs in high numbers in the main river and occasionally in the lakes. In terms of biomass alestids are important for local fisheries and especially the tigerfish, *Hydrocynus* spp., are highly valued food fishes.





**Fig. 17 / Abb. 17:** Alestidae. **A** *Alestes baremoze*, Pendjari River (Jan 2005). **B** *Alestes dentex*, Niger River, Benin (Nov 2004). **C** *Brycinus leuciscus*, Pendjari River (Jan 2005). **D** *Brycinus macrolepidotus*, Pendjari River (Dec 2004). **E** *Brycinus macrolepidotus*, large specimen, Niger River, Benin (Mar 2007). **F** *Brycinus nurse*, Bapla, Burkina Faso (Jan 2005). **G** *Hydrocynus brevis*, Pendjari River (Nov 2003). **H** *Hydrocynus forskalii*, Pendjari River (Jan 2005). **I** *Micralestes elongatus*, Bougouriba River, Burkina Faso (Apr 2005). **J** *Micralestes occidentalis*, Kou River, Burkina Faso (Jan 2007). **K** *Rhabdalestes* cf. *septentrionalis*, female, Comoé River, Burkina Faso (Jan 2007). **L** *Rhabdalestes* cf. *septentrionalis*, male, Bougouriba River, Burkina Faso (Dec 2004).

- |    |  |  |
|----|--|--|
| 1a | Adipose lid present.....2  | in one row (triduspid only in small juveniles).....3   |
| 1b | No adipose lid present<br>.....5 (for live specimens)<br>.....10 (for fixed specimens) | 2b Upper jaw not moveable; teeth multicuspid; two teeth rows in upper jaw, lower jaw with at least |
| 2a | Upper jaw moveable; conical teeth  |  |

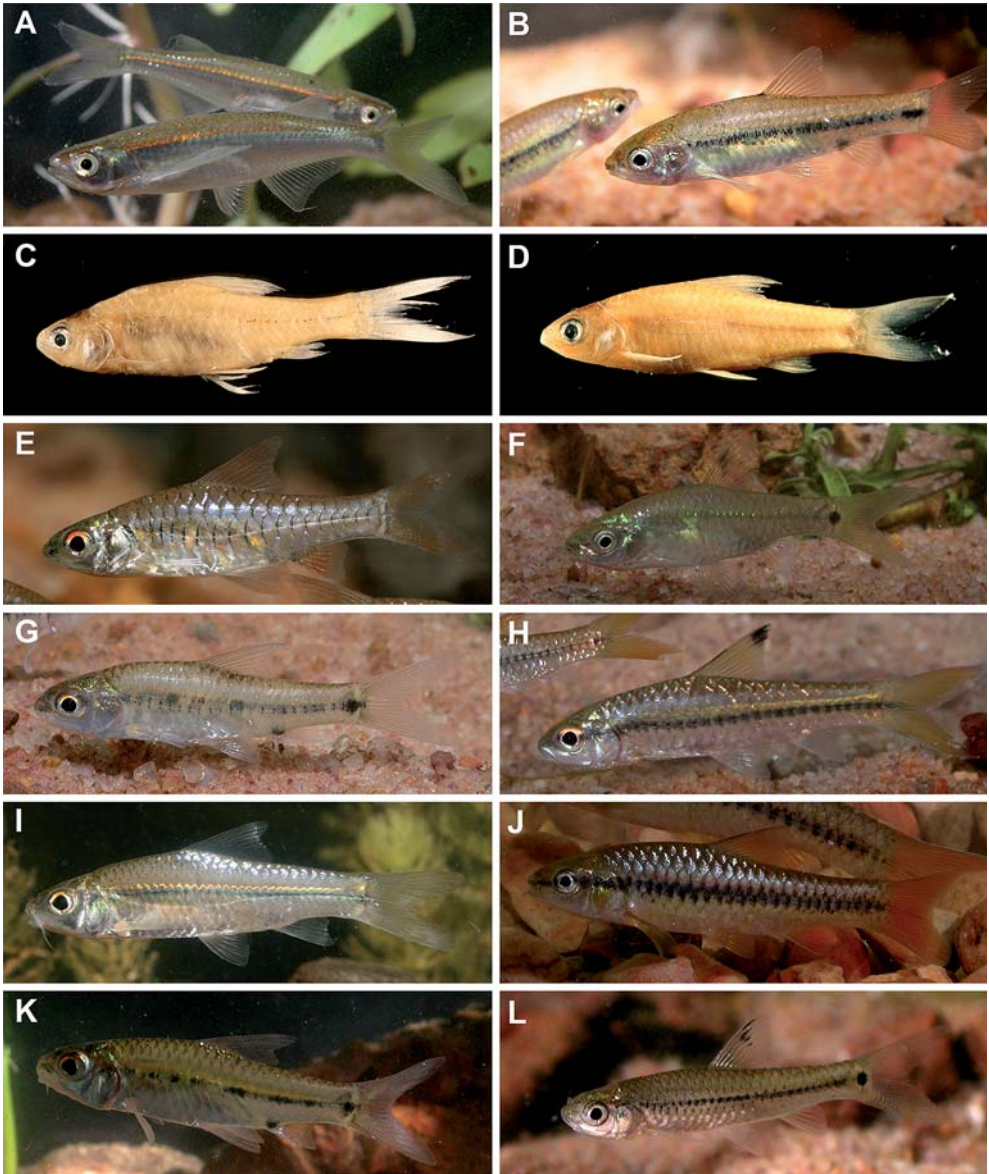


	one pair of conical teeth in the second row.....4
3a	Three rows of scales between lateral line and axillary scale ..... <i>Hydrocynus brevis</i>
3b	Two rows of scales between lateral line and axillary scale ..... <i>Hydrocynus forskalii</i>
4a	Anal fin with 23 to 26 branched rays; 30 or more gill rakers on the lower part of the first gill ark ..... <i>Alestes baremoze</i>
4b	Anal fin with 18 to 23 branched rays; 27 or less gill rakers on the lower part of the first gill ark ..... <i>Alestes dentex</i>
5	<u>Key for live specimens</u>
5a	A black spot above the pectoral fin; caudal peduncle spot exceeding on caudal fin.....6
5b	No black spots above pectoral fin or on the caudal peduncle.....8
6a	Red caudal fin..... <i>Brycinus nurse</i>
6b	Yellow caudal fin.....7
7a	5.5 rows between lateral line and dorsal fin..... <i>Brycinus leuciscus</i>
7b	4.5 rows between lateral line and dorsal fin..... <i>Brycinus macrolepidotus</i>
8a	Caudal fin yellow; distinct dark colouration near the base of the anal fin..... <i>Rhabdalestes cf. septentrionalis</i>
8b	Caudal fin red; if a dark colouration near the base of the anal fin is present, then only very faint.....9
9a	Tip of rayed dorsal fin black; adipose fin clear, grey or faint yellow..... <i>Micralestes elongatus</i>
9b	Rayed dorsal fin without colouration; adipose fin bright red ..... <i>Micralestes occidentalis</i>
10	<u>Key for fixed specimens</u>
10a	4.5-5.5 scale rows between lateral line and dorsal fin; humeral spot present; flanks uniform without horizontal stripe.....11
10b	3.5 rows of scales between lateral line and dorsal fin; humeral spot absent, black lateral stripe on

	flanks present.....13
11a	4.5 rows of scales between lateral line and dorsal fin... <i>Brycinus macrolepidotus</i>
11b	5.5 scale rows between lateral line and origin of dorsal fin.....12
12a	3 teeth in the first row of each premaxillary; fontanelle always present..... <i>Brycinus leuciscus</i>
12b	More than 3 teeth in the first row of each premaxillary; fontanelle only present in juveniles..... <i>Brycinus nurse</i>
13a	At least distal part of adipose fin dark..... <i>Micralestes occidentalis</i>
13b	Adipose fin always clear or faint grey....14
14a	Anal fin with dark mark at the base, lateral line complete or incomplete..... <i>Rhabdalestes cf. septentrionalis</i>
14b	Anal fin insertion without clear dark spot, occasionally some single dark melanophores at base; lateral line always complete ..... <i>Micralestes elongatus</i>

**10.12. Cyprinidae**

With more than 1,600 species cyprinids form an important part of the freshwater fish diversity in Africa, Asia, Europe and North America. Also in the PNP they represent the most diverse family with 20 to 21 species (tab. 1, figs 18, 19A-J). Most species are rather small and have no commercial importance for fisheries. Exceptions are the large species *Labeo senegalensis* (fig. 19F) and *Labeo coubie* (fig. 19E). Both are regularly encountered in the main river and in the lakes. A third species, the much smaller *Labeo ogouensis* (fig. 19G), seems to be restricted to the main river and is not very common. The small *Chelaethiops bibie* (fig. 19A) is omnipresent in the main river; its numbers in the lakes significantly decrease during the dry season. *Leptocypris niloticus* (fig. 19H) and *Raiamas senegalensis* (figs 19I-J) seem to be restricted to the main river, where they are common; only juveniles of both species rarely enter the lakes. *Labeobarbus bynni* is known from the Volta basin and might occur in the PNP, but has not been recorded yet.



**Fig. 18/Abb. 18:** Cyprinidae: **A** *Chelaethiops bibie*, Pendjari River (Jan 2005). **B** *Enteromius atakorensis*, Magou in the Atakora chain, tributary of Pendjari River (Dec 2003). **C** *Enteromius bawkuensis*, Mare Bali (Nov 2004). **D** *Enteromius baudoni*, Niger River, Benin (Nov 2004). **E** *Enteromius hypsolepis*, Pendjari River (Apr 2007). **F** *Enteromius leonensis*, Bougouriba River, Burkina Faso (Oct 2005). **G** *Enteromius macinensis*, Bougouriba River, Burkina Faso (Oct 2005). **H** *Enteromius macrops*, barrage de Dissin, Burkina Faso (Dec 2003). **I** *Enteromius nigeriensis*, Pendjari River (Apr 2007). **J** *Enteromius parablabe*, Tanougou waterfalls (Apr 2005). **K** *E. perince*, Bougouriba River, Burkina Faso (Apr 2005). **L** *E. pobeguini*, barrage de Dissin, Burkina Faso (Dec 2003).

*Enteromius* is the most diverse genus in the family and 14 species occur in the PNP (tab. 1). *Enteromius macrops* (fig. 18H) is the most common and

most widespread representative of *Enteromius* in the area and occurs syntopically together with *Enteromius macinensis* (fig. 18G) and *Enteromius*



**Fig. 19/Abb. 19:** Cyprinidae: **A** *Enteromius punctitaeniatus*, barrage de Dissin, Burkina Faso (Dec 2003). **B** *Enteromius sublineatus*, regular colour pattern, Mouhoun River, Burkina Faso (2003). **C** *Enteromius sublineatus*, local colour morph, Tanougou waterfalls (Apr 2005). **D** *Enteromius stigmatopygus*, Bougouriba River, Burkina Faso (Apr 2005). **E** *Labeo coubie*, Pendjari River (Jan 2005, photo by V. von Vietinghoff). **F** *Labeo senegalensis*, Pendjari River (Jan 2005). **G** *Labeo oguensis*, Bougouriba River, Burkina Faso (Nov 2004). **H** *Leptocypris niloti*.



*leonensis* (fig. 18F) in most aquatic habitats, followed by *Enteromius pobeghini* (fig. 18L) and *Enteromius sublineatus* (fig. 19B), which are less frequent. The latter shows an aberrant colour pattern in the clear waters of the Tanougou waterfall (Fig. 19C). *Enteromius hypsolepis* (fig. 18E) and *Enteromius punctitaeniatus* (fig. 19A) are predominantly found in the main river, where they are common. *Enteromius atakorensis* (fig. 18B) and *Enteromius parablades* (fig. 18J) have been found in this study only in small tributaries on or at the base of the Atakora chain. *Enteromius parablades* may be a local endemit (LÉVÊQUE 2003), although PAUGY et al. (2008) postulated a much wider distribution. Only two specimens of *Enteromius bawkuensis* (fig. 18C) were recorded from Mare Bali and also *Enteromius perince* (fig. 18K), *Enteromius stigmatopygus* (fig. 19D) and *Enteromius baudoni* (fig. 18D) were confirmed only based on very few or even single specimens from the PNP. HOPSON (1965) described *Enteromius voltae* (originally as *Barbus voltae*) from the Volta basin in Ghana, but the species was synonymized with *E. baudoni* by LÉVÊQUE & DAGET (1984), without providing any explanations. Later, LÉVÊQUE (1989) simply stated that *E. voltae* shares all characteristic features with *E. baudoni*. Specimens originating from the Niger River at Malanville and from the Volta system (Pendjari and Bougouriba rivers), however, show a slightly divergent colour pattern. Because *E. baudoni* has a quite variable colouration pattern and because LÉVÊQUE (1989) provides no further morphological details that would support his assumptions, we can neither confirm or refuse the synonymisation of *Enteromius voltae* with *E. baudoni* and refer to this species as *E. baudoni* (tab. 1) without excluding the possibility of a future revalidation of *E. voltae*. The situation for *E. perince*, *Enteromius lawrae* and *Enteromius donaldsonsmithi* is similar: LÉVÊQUE (1989) synonymized *E. donaldsonsmithi*, a species that was originally described from the Niger River, and *E. lawrae* from the Black Volta with *E. perince*, a

species that was first described from the Nile. Volta specimens clearly differ from Nile specimens at least in the colour pattern (MORITZ et al. subm.). A future revision may revalidate *E. donaldsonsmithi* and/or *E. lawrae* for the Volta basin, however, we refer to *E. perince* in table 1 for the specimens from the Pendjari until their taxonomy is finally resolved. Another small barb known from the Volta basin, *Enteromius ablabes*, seems to occur only further south in the Volta basin.

1a	Dorsal fin origin clearly behind anal fin insertion.....	<i>Cbelaethiops bibie</i>
1b	Dorsal fin origin in front of anal fin insertion.....	2
2a	Anal fin with 9 or more branched rays.....	3
2b	Anal fin with 5 (very rarely 6) branched rays.....	4
3a	Anal fin with 9 to 12 branched rays; uniform silvery....	<i>Leptocypris niloticus</i>
3b	Anal fin with 13 to 15 branched rays; vertical stripes on the sides .....	<i>Raiamas senegalensis</i>
4a	33 or more lateral line scales; mouth inferior.....	5
4b	Less than 33 lateral line scales; mouth subterminal.....	7
5a	12 to 15 branched dorsal fin rays.....	6
5b	10 (rarely 9) branched dorsal fin rays.....	<i>Labeo ogunensis</i>
6a	Body flanks silvery; ventral fins transparent or white, sometimes pinkish.....	<i>Labeo senegalensis</i>
6b	Body flanks usually dark grey; ventral fins grey or dusky.....	<i>Labeo coubie</i>
7a	9 to 10 branched dorsal fin rays; first dorsal rays converted into a strong spine (not in very small specimens); scales with parallel striae.....	<i>Labeobarbus bynni</i>
7b	7 to 8 branched dorsal fin rays, always without spines; scales with radial striae.....	8

*cus*, Pendjari River (Feb 2007). **I** *Raiamas senegalensis*, juvenile, Bougouriba River, Burkina Faso (May 2005). **J** *R. senegalensis*, large adult, Pendjari River (Nov 2003). Bagridae: **K** *Bagrus bajad*, Pendjari River (Mar 2005) (Photo: V. v. VIETINGHOFF). **L** *Babrus docmak*, Pendjari River (2007) (Photo: S. AHOUSOU MONTCHO).

8a	2.5 scales between lateral line and dorsal fin.....	<i>Enteromius hypsolepis</i>	18b	12 scales around the caudal peduncle.....	19
8b	3.5 to 5.5 scales between lateral line and dorsal fin.....	9	19a	Posterior barbel ends at the posterior border of eye or only slightly beyond.....	<i>Enteromius parablables</i>
9a	Barbels absent; 1.5 scales between lateral line and pelvic fins.....	10	19b	Posterior barbel clearly reaches far beyond the posterior border of the eye.....	<i>Enteromius ablables</i>
9b	Two pairs of barbels present; 2.5 scales between lateral line and pelvic fins.....	11	20a	Lateral line incomplete	<i>Enteromius bawkuensis</i>
10a	Dorsal fin with black spot; anal fin without spot at base	<i>Enteromius leonensis</i>	20b	Lateral line complete.....	21
10b	Dorsal fin without black spot; anal fin with black spot on base	<i>Enteromius stigmatopygus</i>	21a	Posterior barbel exceeds beyond eye.....	<i>Enteromius macinensis</i>
11a	4.5 to 5.5 scales between lateral line and dorsal fin.....	12	21b	Posterior barbel not reaching the middle of the eye.....	<i>Enteromius baudoni</i>
11b	3.5 scales between lateral line and dorsal fin.....	16	<b>10.13. Bagridae</b>		
12a	Three or more black spots along horizontal septum.....	13	Two species are present in the PNP, with <i>Bagrus bajad</i> (fig. 19K) being the more common one compared to <i>Bagrus docmak</i> (fig. 19L). Both species seem to be restricted to the main river. The distribution map in RISCH (2003a) tentatively shows <i>Bagrus filamentosus</i> occurring in the Volta basin which might be erroneous, because text exclusively mentions this species for the Niger River. Therefore, the potential presence of <i>Bagrus filamentosus</i> in the Volta basin and in the PNP should be critically evaluated in future. Due to their size, <i>Bagrus</i> spp. are important for fisheries in the area.		
12b	A continuous black stripe or band along horizontal septum.....	14	1a	Head width 3 to 1.6 times in its length; rostral margin rounded when seen from above; usually blackish; maxillary barbels usually not reaching beyond ventral fins	<i>Bagrus docmak</i>
13a	Lateral line scales posterior with black margin.....	<i>Enteromius sublineatus</i>	1b	Head width 1.6 to 1.7 times in its length; rostral margin almost squarish when seen from above; usually brown or silvery; first dorsal fin rays prolonged; maxillary barbels reaching beyond ventral fins.....	<i>Bagrus bajad</i>
13b	Lateral line scales posterior without black margin.....	<i>Enteromius perince</i>	<b>10.14. Claroteidae</b>		
14a	Caudal peduncle with pronounced black spot, confluent with black lateral stripe.....	<i>Enteromius pobeguini</i>	Likely three or four of the 90 species from this African catfish family occur in the PNP.		
14b	Caudal peduncle without pronounced black spot.....	15			
15a	Barbels long; posterior barbel exceeds beyond posterior border of the eye.....	<i>Enteromius nigeriensis</i>			
15b	Barbels short; posterior barbel not reaching not beyond the middle of the eye.....	<i>Enteromius atakorensis</i>			
16a	Pronounced black band along the horizontal septum extending onto the head including operculum, eye and snout.....	17			
16b	Differing colouration on the flank.....	20			
17a	Dorsal fin with black spot on distal tip.....	<i>Enteromius macrops</i>			
17b	Dorsal fin without black markings.....	18			
18a	8 to 9 scales around the caudal peduncle.....	<i>Enteromius punctitaeniatus</i>			



Within the genus *Chrysichthys*, only *Chrysichthys nigrodigitatus* (fig. 20C) was confirmed from own surveys for the area. According to SCHWAHN (2003), *Chrysichthys auratus* is also present in the PNP, which is not unlikely as RISCH (2003b) reported *C. auratus* for the Volta basin. *Clarotes laticeps* (fig. 20D) is restricted to the main river with only few specimens recorded. The fourth claroteid species is *Auchenoglanis occidentalis* (fig. 20A-B) (for validity of species names see GEERINCKX & VREVEN 2013). The species probably is the most common member of this family and is not rare in the main river and also frequently enters small tributaries and lakes.

- 1a Nasal barbel present; caudal fin strongly bifurcate.....2
- 1b Nasal barbel absent; caudal fin only slightly emarginate or rounded .....*Auchenoglanis occidentalis*
- 2a Maxillary barbel reaching base of dorsal fin; adipose fin rayed in large specimens; nasal barbel “long” .....*Clarotes laticeps*
- 2b Maxillary barbel not reaching much beyond pectoral fin origin, adipose fin never with rays; nasal barbel very short.....3
- 3a Rounded anterior tip of median skin fold (between left and right lower jaw, close to inner mandibular barbels); inner mandibular barbels long and slender .....*Chrysichthys nigrodigitatus*
- 3b Pointed anterior tip of median skin fold; inner mandibular barbels thick and short .....*Chrysichthys auratus*

### 10.15. Schilbeidae

This family occurs in Africa and Southeast Asia. Only 34 species are presently considered as valid, and four species are confirmed for the Pendjari with one additional, *Schilbe micropogon*, likely present in the area (tab. 1; DE VOS 1995). *Irvineia voltae* seems to be restricted to the lower reaches of the Volta River below the Akasombo dam. *Schilbe intermedius* (fig. 20F) is omnipresent in the

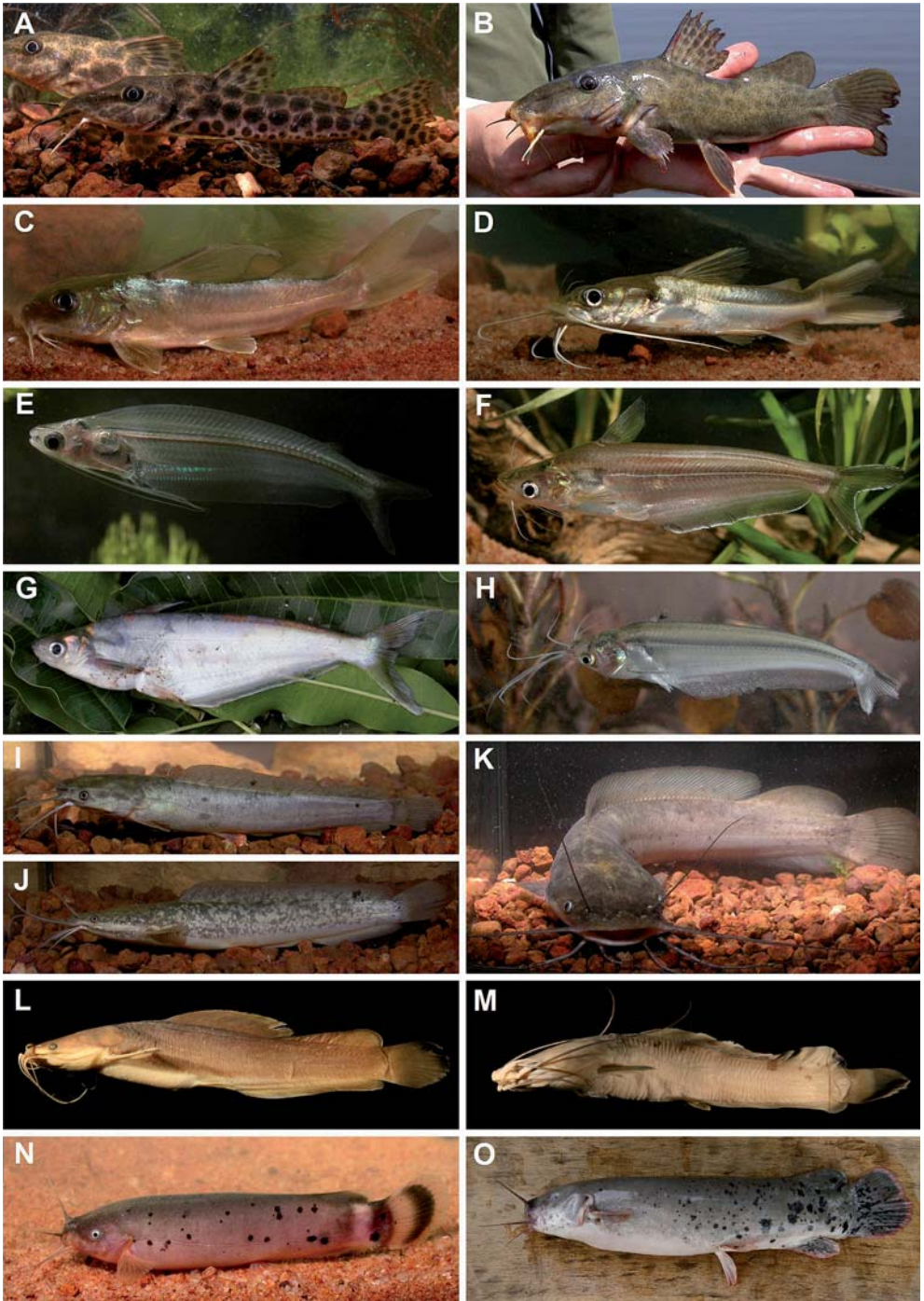
PNP and virtually occupies all available aquatic habitats. The population structure and reproductive biology of this species in the Pendjari area was studied by AHOUANOU MONTCHO et al. (2011). *Parailia pellucida* (fig. 20E) and *Siluranodon auritus* (fig. 20H) are also rather common in all water bodies and both usually prefer vegetated areas and are often encountered in large shoals. When catching several specimens in the same haul, the latter species often mingles with *Schilbe intermedius*. *Schilbe mystus* (fig. 20G) seems to be restricted to the main river and as not been recorded from the floodplain or mares.

- 1a Rayed dorsal fin absent...*Parailia pellucida*
- 1b Rayed dorsal fin present.....2
- 2a Dorsal fin without a spine .....*Siluranodon auritus*
- 2b Dorsal fin with a spine.....3
- 3a Adipose fin absent.....*Schilbe intermedius*
- 3b Small adipose fin present.....4
- 4a Anterior nostrils closer to each other than posterior ones....*Schilbe mystus*
- 4b Posterior nostrils closer to each other than anterior ones .....*Schilbe micropogon*

### 10.16. Clariidae

The air-breathing catfish family Clariidae currently includes roughly 120 species. Their main distribution area is on the African continent; some species also occur in Asia. The genus *Clarias* does not seem to be monophyletic, but apparently clariid species for each continent seem to form each monophyletic groups (AGNESE & TEUGELS 2005).

Five species of *Clarias* have been reported for the Volta basin. *Clarias agboyeiensis* and *Clarias ebriensis* seem to be restricted to the southern part of this basin. *Clarias camerunensis*, also rather typical for the southern part of the Volta basin, was recorded in the PNP by SCHWAHN (2003). *Clarias anguillaris* and *Clarias gariepinus* are very similar and the main diagnostic feature, the number of gill rakers on the first gill arch, can hardly be applied under field conditions and often is not readily recognizable in small specimens. TEUGELS (1986) first confirmed only *C. anguillaris*



**Fig. 20/Abb. 20:** Claroteidae: **A** *Auchenoglanis occidentalis*, juvenile, barrage de Dissin, Burkina Faso (Nov 2003). **B** *Auchenoglanis occidentalis*, barrage de Dissin, Burkina Faso (Nov 2004). **C** *Chrysichthys nigrodigitatus*, Bougouriba River, Burkina Faso (Dec 2003). **D** *Clarotes laticeps*, Niger River, Benin (Mar 2007). Schilbeidae: **E** *Parailia pellucida*, Mouhoun River, Burkina Faso (Dec 2004), **F** *Schilbe intermedius*, Kou River, Burkina Faso

for the northern part of the Volta basin, but later added *C. gariepinus* for this area (TEUGELS 2003). Therefore, we pooled the records for both species (tab. 1). *Clarias anguillaris*/*gariepinus* (fig. 20I-J). They are very common in all aquatic habitats and due to their ability to breathe atmospheric air, are often the last surviving fishes in desiccating pools. Especially small specimens and juveniles are very abundant in the entire area and found in all small ponds and brooks. At the end of the dry season large specimens of *Clarias* often crowd side by side in the remaining humid mud. Even under such harsh conditions still single individuals are trying to catch small birds approaching the surface in the search of water. In contrast *Heterobranchus bidorsalis* (fig. 20K) and *Heterobranchus longifilis* (fig. 20M) have been reported mainly from the main river. A third species, *Heterobranchus isopterus* (fig. 20L), is likely to occur in the PNP, but has not been confirmed yet. Clariids are of high importance for local fisheries.

- 1a Adipose fin present.....2
- 1b Long rayed dorsal fin; no adipose fin present.....4
- 2a No serration on pectoral spine; 37 or more dorsal fin rays .....*Heterobranchus bidorsalis*
- 2b Serrations on the anterior side of the pectoral spine, 35 or less dorsal fin rays.....3
- 3a Caudal fin with clearly marked light transverse band; posterior part of adipose fin generally blackish.....*Heterobranchus longifilis*
- 3b Caudal fin uniformly brownish; no black spot on posterior part of adipose fin.....*Heterobranchus isopterus*
- 4a 24 in juveniles to over 100 gill rakers in large adults....*Clarias gariepinus*\*
- 4b 12 in juveniles to 50 gill rakers

in adults on lower part of gill arch.....*Clarias anguillaris*\*  
 \*Please check also TEUGELS (1986, 2003) for differential diagnosis of both species.

### 10.17. Malapteruridae

Three species of electric catfish are known from the Volta basin, but only *Malapterurus electricus* (fig. 20N-O) was confirmed for the PNP. It frequently occurs in lakes and the main river and prefers habitats with dense vegetation, wood or root shelter. *Malapterurus beninensis* seems to be restricted to the lower reaches of the Volta basin, while *Malapterurus minjiriya* was recorded from the Oti River and potentially occurs in the PNP. Identification of malapterurids is difficult and NORRIS (2003a) offers further diagnostic details which are often helpful.

- 1a Pectoral fin placed near middle of body depth with almost vertical base.....*Malapterurus electricus*
- 1b Pectoral fin placed below middle of body depth with inclined base.....*Malapterurus minjiriya*

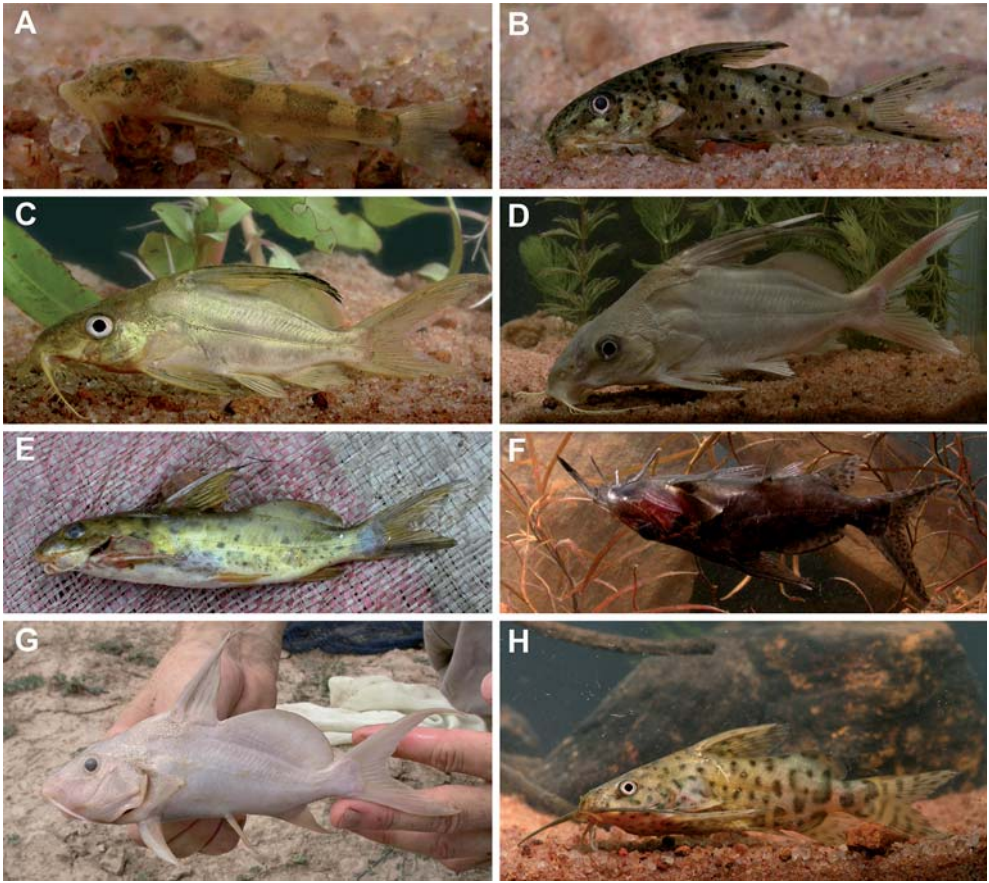
### 10.18. Mochokidae

Mochokids are a widely known African catfish family because of their striking sound producing squeaking behaviour when menaced. A second characteristic feature is the 'upside-down' swimming behaviour in many species. About 220 species are presently known and up to twelve may occur in the PNP (tab. 1). Most common are *Synodontis nigrita* (fig. 21H) and *Synodontis schall* (fig. 22F), both are abundant in all aquatic habitats of the area. While the latter is more common in the main river, the first is slightly more common in lakes. *Synodontis membranaceus* (fig. 21F-G) seems to be restricted to

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(Jan 2007). **G** *Schilbe mystus*, Pendjari River (Jan 2004). **H** *Siluranodon auritus*, Mouhoun River, Burkina Faso (Oct 2004). Clariidae: **I, J** *Clarias gariepinus* or *Clarias anguilloides*, small tributary of Mouhoun River, Burkina Faso (Oct 2003). **K** *Heterobranchus bidorsalis*, barrage de Dissin, Burkina Faso (Dec 2004). **L** *Heterobranchus isopterus*, Comoé River, Côte d'Ivoire (Jul 2002). **M** *Heterobranchus longifilis*, Comoé River, Côte d'Ivoire (Jul 2002). Malapteruridae: **N** *Malapterurus electricus*, juvenile, Pendjari River (Jan 2004). **O** *M. electricus*, large, Pendjari River (Apr 2007).





**Fig. 21/Abb. 21:** Mochokidae: **A** *Chiloglanis voltae*, Bougouriba River, Burkina Faso (Dec 2003). **B** *Synodontis clarias*, juvenile, Pendjari River (Dec 2003). **C** *S. clarias*, medium, Pendjari River (Jan 2005). **D** *Synodontis clarias*, adult, Pendjari River (Mar 2005). **E** *Synodontis filamentosus*, Bougouriba River, Burkina Faso (Jan 2004). **F** *Synodontis membranaceus*, juvenile, barrage de Dissin, Burkina Faso (Mar 2004). **G** *S. membranaceus*, adult, Mare Tiabiga (May 2003). **H** *Synodontis nigrita*, Pendjari River (Feb 2007).

the bigger lakes and to the main river, where it is common. Both *S. membranaceus* (fig. 21F) and *S. nigrita* show a pronounced upside-down swimming behaviour. All other recorded species (tab. 1) are less common in the area and with the exception of *Synodontis sorex* (fig. 22F-G) and *Synodontis clarias* (fig. 21B-D) restricted to the main river. Five more species of the genus have been reported from the Volta basin, of which *Synodontis arnouldi* and *Synodontis filamentosus* (fig. 21E) are likely to occur in the PNP. *Synodontis eupterus* and *Synodontis batensoda* are only known from single localities in the Volta basin (PAUGY & ROBERTS 2003) and need confirmation. *Syn-*

*odontis macrophthalmus* was described from the southern part of the Volta basin, but is known so far only by the holotype. An unusual *Synodontis* was recorded from a single specimen (fig. 22D) in Mare Diwouni that shares some characters as described for *S. macrophthalmus*, for example the prolonged snout, the long adipose fin and the dark borders the caudal lobes (POLL 1971). However, the eye is much smaller and the distance between dorsal fin and adipose fin is much shorter than in *S. macrophthalmus*; furthermore the maxillary barbels are bright white and the dorsal fin rather narrow and distally rounded (fig. 22D). We preliminary refer to this catfish





**Fig. 22/Abb. 22:** Mochokidae: **A** *Synodontis ocellifer*, Pendjari River (Apr 2005). **B** *S. ocellifer*, originating from Pendjari River, but kept one year in aquaria. **C** *Synodontis schall*, juvenile, Mouhoun River, Burkina Faso (Nov 2003). **D** *S. schall*, adult, Niger River, Benin (Mar 2007). **E** *S.* sp. “Pendjari”, Mare Diwouni (Feb 2007). **F** *Synodontis sorex*, juvenile, Pendjari River (Feb 2007). **G** *S. sorex*, adult, Pendjari River (Mar 2005). **H** *Synodontis velifer*, Pendjari River (Apr 2007). **I** *Synodontis violaceus*, Pendjari River (Feb 2002).

as *Synodontis* sp. “Pendjari”. More specimens are needed to clarify their identity.

The colouration of most *Synodontis* is very variable and usually changes during maturing: juveniles tend to show conspicuous dark colouration patterns on unpaired fins, body and the caudal fin or a combination of all, while most adults do not show any markings on flanks and

hardly any on their fins. For example, juvenile *S. clarias* are light brown with dark brown bands and irregular black speckles on the flanks and dark bordered caudal fin lobes (fig. 21B), whereas medium grown specimens can be plain yellow with a metallic hue (fig. 21C), and mature specimens usually are plain grey with a bright red to orange caudal fin (fig. 21D). The body

colouration of others can be rather variable in adults and especially *S. schall* which can be dark brown, light brown, yellowish or clear yellow, with many, few or no speckles on its body. The overall body colouration apparently can be adapted to the environment conditions, as in *Synodontis membranaceus*, which can turn completely white in a response to muddy dark waters (fig. 20G), white with a black belly less murky water, or is almost entirely black when in transparent water (fig. 20F).

*Chiloglanis* is the only other mochokid genus except *Synodontis* in the Volta basin. Although not recorded during our surveys in the PNP, *Chiloglanis voltae* (fig. 20A) seems to be present in this area (BLANC & DAGET 1957; PAUGY & ROBERTS 2003). Judging from own records outside the PNP, the species prefers gravel or sandy substrates and prefers increased velocity and well oxygenated water, suggesting that *C. voltae* may be restricted to the main river. This species remains small and usually does not grow larger than 27 mm SL. It has venomous glands connected to its sharp pectoral spines. All *Synodontis* species are of importance for fisheries in the area.

- 1a Short mandibular barbels without ramifications; lower lip transformed into sucker.....*Chiloglanis voltae*
- 1b Mandibular barbels long and often with ramifications; no sucking disc.....2
- 2a Maxillary barbels branched .....*Synodontis clarias*
- 2b Maxillary barbels not branched.....3
- 3a Gill openings very large almost uniting at isthmus of branchiostegal membranes .....*Synodontis membranaceus*
- 3b Lower margins of the gill openings terminating close to pectoral spines and not exceeding beyond.....4
- 4a Inner mandibular barbels with nodular short and rounded ramifications.....5
- 4b Inner mandibular barbels with slender long or short ramifications.....6
- 5a Ramifications on the inner mandibular barbels arranged pairwise;

- 5b black flanks spots smaller than eye diameter.....*Synodontis nigrita*
- 5b Ramifications on the inner mandibular barbels very regular arranged in groups of four; black flanks blotches about the same size as eye diameter.....*Synodontis velifer*
- 6a Maxillary barbels exceed beyond tip of humeral process.....7
- 6b Maxillary barbels shorter, not reaching humeral process.....9
- 7a Body with several black blotches, head without blotches.....*Synodontis ocellifer*
- 7b Body and head uniform or with numerous small speckles; a single black humeral blotch may be present.....8
- 8a Maxillary barbels reaching pelvic fins.....*Synodontis arnoulti*
- 8b Maxillary barbels not reaching pelvic fins.....*Synodontis schall*
- 9a Maxillary barbel short (reaching eye) with very broad basal membrane, several times as wide as barbel itself.....*Synodontis violaceus*
- 9b Maxillary barbel short or long with basal membrane less wide than two times diameter of barbel itself.....10
- 10a Upper jaw lips conspicuously enlarged, broader than 50 % of the mouth wideness; maxillary barbel short, barely reaching eye .....*Synodontis sorex*
- 10b Upper jaw lips slender, less than 50 % of the mouth width; maxillary barbel long, exceeding beyond eye.....11
- 11a First ray of dorsal fin elongated; body with dark blotches; maxillary barbel yellowish.....*Synodontis filamentosus*
- 11b First ray of dorsal fin not elongated; body without dark blotches, except from humeral blotch; maxillary barbels clear white .....*Synodontis* sp. 'Pendjari'

#### 10.19. Other catfishes

Additional two catfish families have been documented for the Volta basin, but not recorded in our

surveys. Subfossil fish bone findings above today's Akosombo dam dating to 2,000–1,300 years B.C. (JOUSSE & VAN NEER 2009) indicate that *Arius gigas*, a large potamodromous ariid catfish, was ascending in the Volta; if this species historically reached the Upper Pendjari is unclear, so far, no recent or subfossil findings are known from this area.

Two amphiliids are known from the Volta: *Phractura clauseni* seems to be restricted to the southern parts of the Volta basin and *Amphilius atesuensis* was found in very small hilly streams contributing to the Black Volta in Burkina Faso by TM, but not in the PNP despite intensive search in small brooks especially in the Atakora chain.

### 10.20. Nothobranchiidae

The taxonomy of nothobranchiids has changed much during the last decades: until the 1980s they have been regarded as members of Cyprinodontidae (e.g. GREENWOOD et al. 1966; SCHEEL 1972) and today they are either recognized as Aplocheilidae (e.g. PARENTI 1981; COSTA 2016) or as an own family, the Nothobranchiidae (e.g. COSTA 2004; FRICKE et al. 2018). About 290 nothobranchiids – or African aplocheilids – are currently recognized on species level. Within the the PNP, we recorded five species (tab. 1). The two *Epiplatys* species, *Epiplatys spilargyreus* (fig. 23B) and *Epiplatys bifasciatus* (fig. 23A) are very common in all aquatic habitats and the latter is more frequently encountered. Both prefer vegetated areas and usually stay directly below the surface. The other two genera, *Pronotobran-chius* and *Fundulosoma*, are annual. Both produce eggs, in which the embryo aestivate the dry season, and are found in isolated smaller water bodies outside the floodplain. *Pronotobran-chius kiyawensis* (fig. 23G) is usually present in smaller ephemeral lakes outside the flood plain. *Fundulo-soma thierryi* (fig. 23C-D) occurs in small various lakes on the floodplain, but also in the large Mare Bali. A second and likely undescribed species, *F. sp. aff. thierryi* (fig. 23E-F), has been rarely found in small ephemeral pools. In contrast to *F. thierryi* (fig. 23C) males are metallic blue with red x-shaped colour marks on the flanks (fig.

23E), the caudal fin is rounded and not lyra-shaped and all unpaired fins are transparent (vs. yellow-orange).

ROMAND (1992: fig. 35.2) erroneously mentioned *Aphyosemion banforeense* for the Pendjari but apparently the distribution point in his figure should have been further west near Banfora and was corrected accordingly in the 2nd edition of the book (WILDEKAMP & VAN DER ZEE 2003).

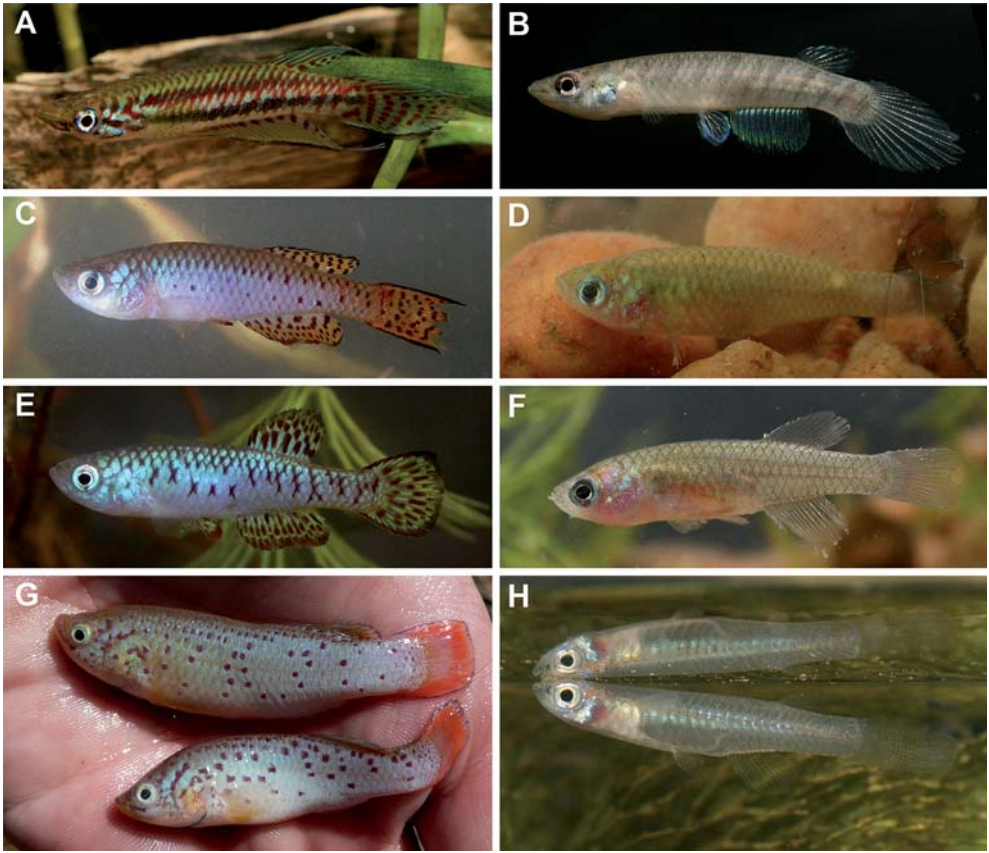
- 1a Dorsal fin and anal fin origin on the same level; snout blunt.....2
- 1b Dorsal fin origin behind and usually at insertion of anal fin ninth anal fin ray; snout pointed.....4
- 2a Dorsal fin base longer as anal fin base; caudal fin of males without spots.....*Pronotobran-chius kiyawensis*
- 2b Dorsal fin base as long as anal fin base; caudal fin of males with spots.....3
- 3a In males: caudal fin rounded; red marks on flanks x-shaped; membranes of unpaired fins transparent .....*Fundulosoma sp. aff. thierryi*
- 3b In males: caudal fin lyra-shaped; red dots on flanks irregular and few in number; membranes of unpaired fins yellow-orange .....*Fundulosoma thierryi*
- 4a Flanks with several dark vertical stripes.....*Epiplatys spilargyreus*
- 4b Flanks with two horizontal dark bands, in living specimens often with reddish reticulated colour pattern.....*Epiplatys bifasciatus*

### 10.21. Procatopodidae

Systematic and taxonomy of lampeyes is still debated. Two species of this taxon are potentially present in the PNP: It was not possible to confirm records of *Poropanchax normani* (GREEN 1979; SCHWAHN 2003), however *Micropanchax pfaffi* (fig. 23H) is very common and virtually occupies all aquatic habitats in the area.

- 1a Pelvic fins not reaching anal fin; mid-lateral line with 27-30 scales .....*Micropanchax pfaffi*





**Fig. 23/Abb. 23:** Nothobranchiidae: **A** *Epiplatys bifasciatus*, Kou River, Burkina Faso (Jan 2007). **B** *Epiplatys spilargyreus*, Mare Bori (Apr 2007). **C** *Fundulosoma thieryi*, male, small pond close to Mare Sacre (Dec 2004). **D** *Fundulosoma thieryi*, female, small pond close to Mare Sacre (Dec 2004). **E** *Fundulosoma* sp. aff. *thieryi*, male, Tiankoura, Burkina Faso (Jan 2005). **F** *F.* sp. aff. *thieryi*, female, Tiankoura, Burkina Faso (Jan 2005). **G** *Pronothobranchius kiyawensis*, males, paddle close to Mare Bori (Oct 2006). Poecilidae: **H** *Micropanchax pflaffi*, Pendjari River (Apr 2007).

- 1b Pelvic fins reaching anal fin base;  
mid-lateral line with 24-27 scales  
.....*Poropanchax normani*

**10.22. Channidae**

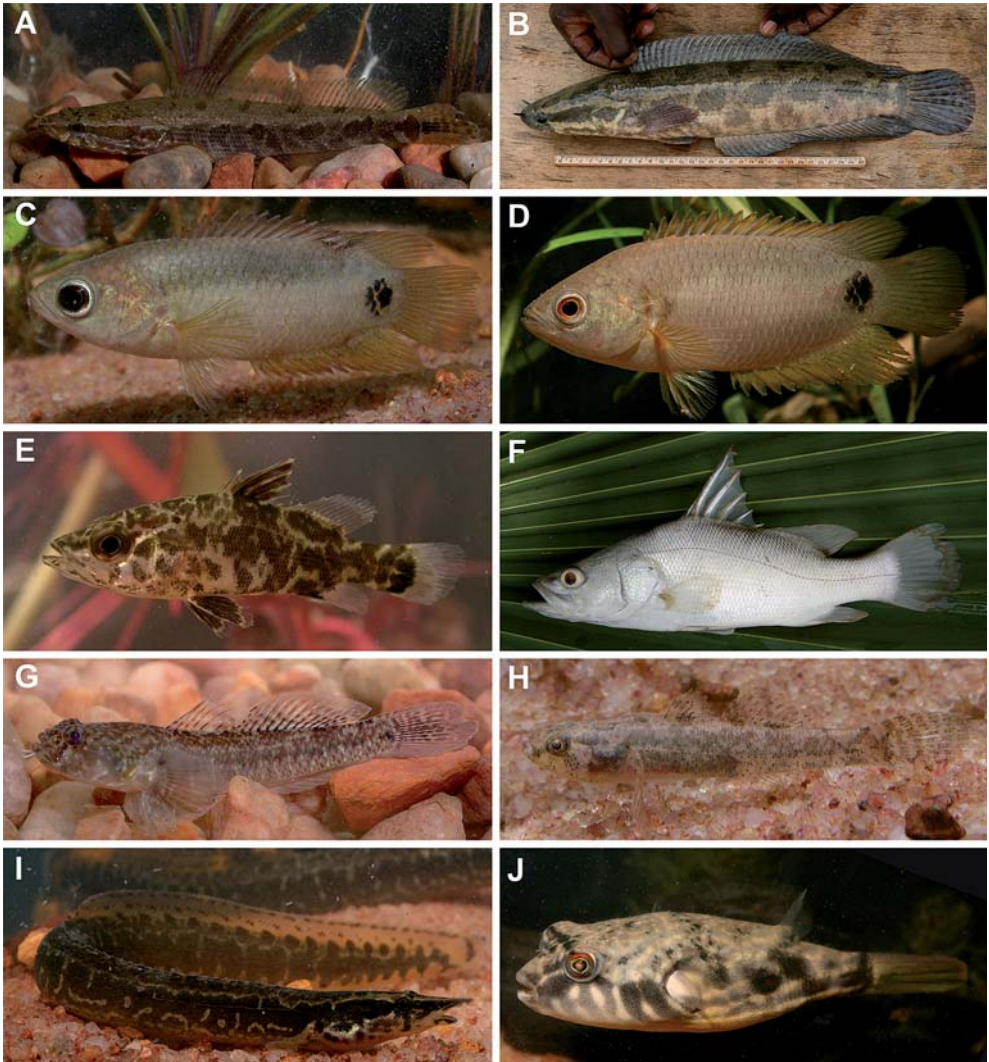
The main distribution area of the approximately 40 species of snakeheads is Asia, only three species are native to Africa. All snakeheads have a suprabranchial organ which enables them to breathe atmospheric air and surviving for considerable time in desiccating pools. *Parachanna obscura* (fig. 24A-B) is the only snakehead that occurs in the entire area of the PNP, but without

reaching high abundances locally and predominantly being confined to the bigger lakes. Records from smaller lakes and the main river are rare. A second species, *Parachanna africana* occurs in the Ouémé basin south of the Atakora Chain in Benin, without reaching the PNP.

**10.23. Anabantidae**

The name of the climbing perches or bushfish relates to their ability to quickly move over land, by using their opercular spines and fins for walking forward. Nearly all 30 species are native to Africa, with the exception of two Asian species.





**Fig. 24/Abb. 24:** Channidae: **A** *Parachanna obscura*, juvenile, Mare Bori (Dec 2004). **B** *Parachanna obscura*, large, Mare Diwouni (Apr 2007). Anabantidae: **C** *Ctenopoma petherici*, juvenile, Bouni, tributary of Mouhoun River, Burkina Faso (Nov 2004). **D** *C. petherici*, adult, Kou River, Burkina Faso (Jan 2007). Latidae: **E** *Lates niloticus*, juvenile, Niger River, Benin (Dec 2004). **F** *L. niloticus*, small specimen with adult colouration, Pendjari River (Apr 2007). Gobiidae: **G** *Nematogobius maindroni*, Pendjari River (Nov 2004). Eleotridae: **H** *Kribia nana*, Bougouriba River, Burkina Faso (May 2005). Mastacembelidae: **I** *Mastacembelus nigromarginatus*, Pendjari River (Feb 2007). Tetraodontidae: **J** *Tetraodon lineatus*, Mare Diwouni (Apr 2007).

All anabantids have a labyrinth organ in the enlarged opercular cavity that enables them to breathe air and to survive even in humid mud.

In the PNP area, two very similar species, *Ctenopoma kingsleyae* and *Ctenopoma petherici*, apparently do occur. Available identification keys for West African bushfishes have limitations

(NORRIS 1992; NORRIS 2003b) in the field. All specimens caught during our studies more or less keyed out as *C. petherici* (fig. 24C-D), but SCHWAHN (2003) reported *C. kingsleyae* from the area. Bushfish are very common in some lakes and smaller water bodies, and less common in the main river.

- 1a 8-10 (usually 9) scale rows below upper lateral line; (usually) 4 scales above the last pored scale in upper lateral line.....*Ctenopoma petherici*
- 1b 8-9 (usually 8) scale rows below upper lateral line; (usually) 3 scales above the last pored scale in upper lateral line.....*Ctenopoma kingsleyae*

**10.24. Latidae**

The Nile perch, *Lates niloticus* (fig. 24E-F), is widely distributed all over the Nilo-Sahelo-Sudan region and the only member of this family in West Africa. It is native to the PNP and probably the most commercially valued species for fisheries, gaining the highest prices on the fish market, and is traded under the name ‘capitaine’ (MORITZ & LALEYE 2017). Some growth parameters for *L. niloticus* for the PNP are reported by AHOUANSOU MONTCHO et al. (2009b).

The species is common in the main river, but also enters bigger lakes, especially at the end of the rainy season when water levels are still high. Subadults and adults are restricted to the open water in the river and to well oxygenated lakes (tab. 1); juveniles prefer dense vegetation.

**10.25. Cichlidae**

With more than 1,700 species cichlids are one of the most diverse fish families. More than 900 of them occur in Africa, and the lakes of the East African Rift Valley are a diversity hotspot for cichlids. In the PNP, only six to eight species likely occur (tab. 1). *Steatocranus irvinei* (figs 25H-I), a species endemic to the Volta, was found just downstream of the borders of the national park in the area of Tounga. Genetic studies showed that the species is not related to the genus *Steatocranus* from the Congo basin, but is a sistergroup of the genus *Coptodon* (SCHWARZER et al. 2009), and thus this species might be placed in another genus in near future. *Steatocranus irvinei* likely is present in the PNP, but may be restricted to the main river. The two *Hemichromis*, the more common *Hemichromis letourneuxi* (fig. 25B-C) and *Hemichromis fasciatus* (fig. 25D-E), are widely distributed in all available

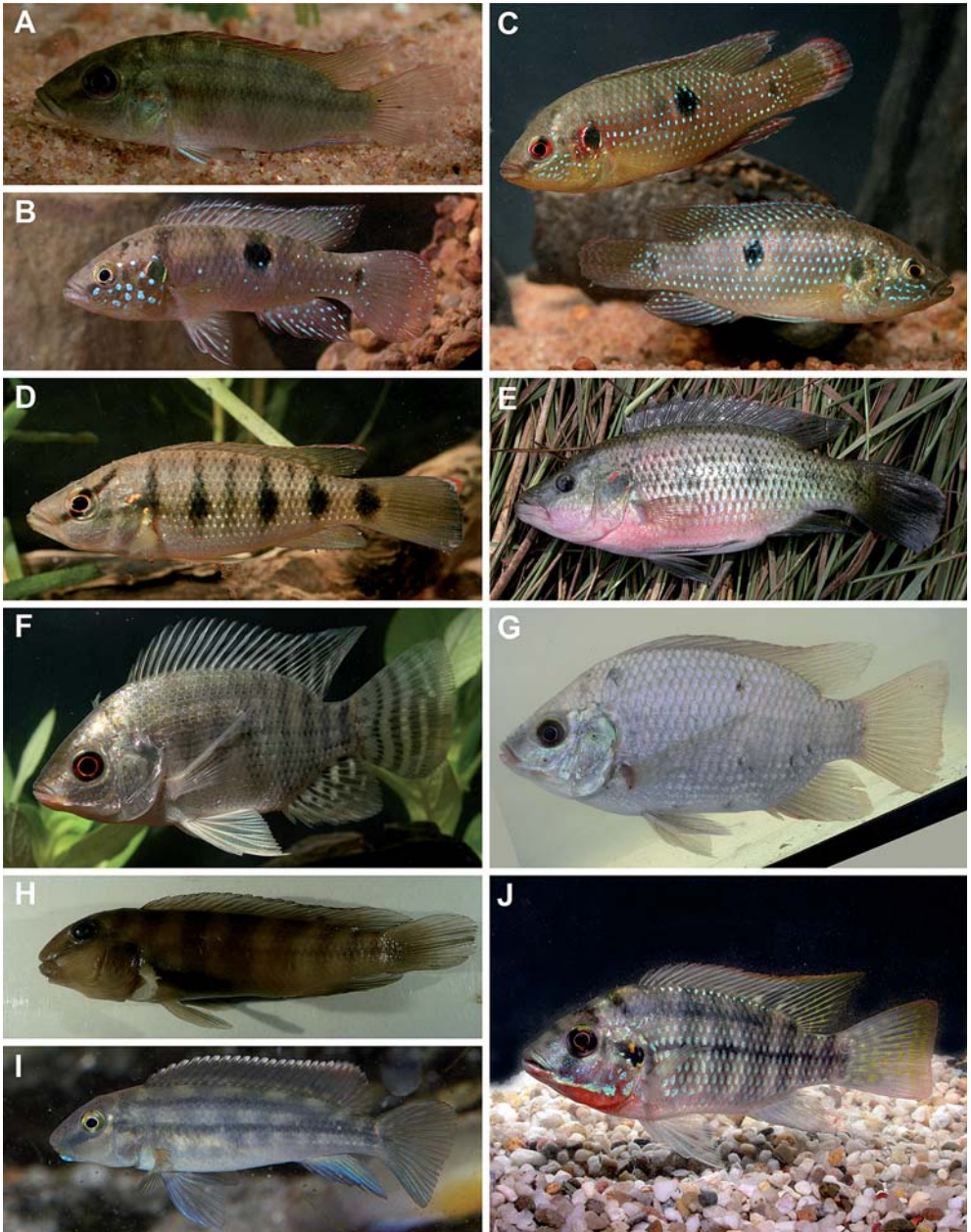
aquatic habitats and very common. *Chromidotilapia guentheri* (fig. 25A), recorded from other parts of the Upper Volta basin (TEUGELS & THYS VAN DEN AUDENAERDE 2003; own records TM), was not confirmed but likely occurs in the PNP.

*Oreochromis niloticus* (fig. 25F), *Coptodon zillii* (fig. 25J) and *Sarotherodon galilaeus* (fig. 25G), often summarized as “tilapiines”, look alike when still young and juveniles are hard to identify to species level. One of the main characters for the identification of adults is the colouration pattern, which can be variable depending on the habitat conditions and the turbidity of the water.

*Coptodon dageti* was described on the base of a divergent colour pattern compared to *C. zillii*, i.e. several of the dark vertical bands are dorsally bifurcated (THYS VAN DEN AUDENAERDE 1971). Such bifurcations should not be present in *C. zillii* following the diagnosis of the original description. The depicted specimen of *C. dageti* in the respective publication (THYS VAN DEN AUDENAERDE 1971: fig. 1) shows two bifurcated bars. But one such bifurcated bar is rather common in *C. zillii* as well, as e.g. depicted by BOULENGER (1907: plate 92). The latter image was used by TEUGELS & THYS VAN DEN AUDENAERDE (2003) to illustrate a typical representative of this species. The only other morphologically distinguishing character is an overlapping dorsal fin ray count which is 12 to 16 (13-15 in average) in *C. dageti* and 10 to 14 in *C. zillii* (TEUGELS & THYS VAN DEN AUDENAERDE 2003). Although difficult to recognize in the field, *C. dageti* and *C. zillii* seem to represent two distinct species (DUNZ & SCHLIEWEN 2013) and also *C. dageti* has been reported from the PNP by SCHWAHN (2003). Another species of the genus, *Coptodon guineensis*, is present in lower reaches of the Volta, but was not recorded upstream of Akosombo.

- 1a 20 to 21 dorsal fin spines  
.....*Steatocranus irvinei*
- 1b 18 or less dorsal fin spines.....2
- 2a External upper jaw teeth unicuspid.....3
- 2b External upper jaw teeth bicuspid.....5
- 3a 10-15 gill rakers on lower part of first gill arch; pharyngeal swelling between gill arches present  
.....*Chromidotilapia guentheri*





**Fig. 25/Abb. 25:** Cichlidae: **A** *Chromidotilapia guentheri*, Bougouriba River, Burkina Faso (Feb 2005). **B** *Hemichromis letourneuxi*, barrage de Dissin, Burkina Faso (Nov 2003). **C** *H. letourneuxi*, Pendjari River (Apr 2007). **D** *Hemichromis fasciatus*, small, Kou River, Burkina Faso (Jan 2007). **E** *Hemichromis fasciatus*, Mare Tiabiga (Nov 2003). **F** *Oreochromis niloticus*, Mare Bori (Apr 2007). **G** *Sarotherodon galilaeus*, Pendjari River (May 2003). **H** *Steatocranus irvinei*, Pendjari River (2007) (Photo: S. AHOUANSON MONTCHO). **I** *S. irvinei*, aquarium specimen. **J** *Coptodon zillii*, barrage de Dissin, Burkina Faso (Oct 2003).

- 3b 6-9 gill rakers on lower part of first arch; no pharyngeal swelling between gill arches.....4
- 4a Body flanks with prominent blue iridophores; two dark spots, at end of the opercle and at base of caudal peduncle, occasionally third (mood-related) spot at centre of flanks .....*Hemichromis letourneuxi*
- 4b No Iridophores on flanks; five or more prominent black spots or vertical stripes on the flank (juveniles with a black horizontal stripe).....*Hemichromis fasciatus*
- 5a 19 or more gill rakers on the lower part of the first gill arch; caudal fin with vertical stripes or without colour pattern.....6
- 5b 8 to 12 gill rakers on the lower part of the first gill arch; caudal fin with yellow dots.....7
- 6a Head rounded; caudal fin with conspicuous black vertical stripes; caudal fin very slightly emarginated .....*Oreochromis niloticus*
- 6b Head pointed; caudal fin colourless, sometimes with black or red posterior margin; posterior margin of caudal fin very straight .....*Sarotherodon galilaeus*
- 7a Not more than one of the dark vertical bars bifurcated dorsally .....*Coptodon zillii*
- 7b More than one of the dark vertical bars bifurcated dorsally .....*Coptodon dageti*

### 10.26. Gobiidae

Gobies are the most species rich fish family with nearly 1,900 described, mostly marine or brackish species. Few true freshwater species are described for Asia and Australasia, but not for Africa. Two records of *Nematogobius maindroni* (fig. 24G) from the PNP, both collected from the main river, likely are the first records for a gobiid freshwater population in Africa (MORITZ & LALÉYÈ 2018). Other known records so far

are from the lower reaches of West African rivers or from the upper reaches of the Niger and Comoé.

### 10.27. Eleotridae

Upstream of Akosomba, the only eleotrid that was recorded so far is *Kribia nana* (fig. 24H). This species is common in the Black Volta (Mouhoun River) and its tributaries, e.g. Bougouriba River (own observation TM), and the occurrence of *Kribia nana* in the PNP is not unlikely.

### 10.28. Mastacembelidae

Mastacembelids have an eel-like body shape and occur in Africa and Asia. Several (9-43) single spines in front of the dorsal fin are eponymous for their vernacular name 'spiny eels'. The dorsal fin may be fused with the caudal and anal fin in several species. A typical character for spiny eels is the general absence of pelvic fins and the snout that is converted into a long, tube-like appendix.

A single species, *Mastacembelus nigromarginatus*, is recorded for the PNP (fig. 24I); for the generic placement, we follow VREVEN (2003). Our records are the first for this species in the Pendjari and the PNP, where it can be occasionally encountered in the main river.

### 10.29 Tetraodontidae

Over 190 species of puffer fishes are known, most of them are described from marine environments. About 20 freshwater or brackish water species occur in South America, Asia and Africa. In Africa, most freshwater species are found in the Congo system, with the exception of *Tetraodon lineatus* (fig. 24J), a very widespread species that is abundant in the entire Nilo-Sahelo-Sudan region. The species is found regularly but not very common in the main river and in all larger lakes of the PNP. While this species is commercially exploited in single countries like the Sudan, it has a low economic importance – if at all consumed – in the Pendjari region.



## 11. Conclusions

In general, the fish fauna of the Pendjari River shares many similarities with the other rivers of the upper Volta basin, while the Volta and the Sahelian Niger faunas are closely related (LÉVÊQUE et al. 1991). River capture events in the past (WRIGHT et al. 1985; BONNE 2014) provide a good explanation for this similarity in ichthyofauna. Nevertheless, single characteristic species of the Nilo-Sudanian ichthyofauna like *Xenomystus nigri* (Notopterygidae) or *Phago loricatus* (Distochoodontidae) are absent from the Volta basin. Few rather rare species, however, indicate a connection of the upper Volta basin to the West African coastal fauna, e.g. *Petrocephalus pallidomaculatus*, *Nematogobius maindroni* or a single specimen of *Pollimyrus adpersus*. The unclear status of colour morphs, e.g. *Enteromius sublineatus* (fig. 19C), and the potential occurrence of two species new to science, i.e. *Fundulosoma* sp. aff. *thierryi* (fig. 23E-F) and *Synodontis* sp. 'Pendjari' (fig. 22E), in the area show a general need for intensified investigations on the fish fauna in the PNP. Ecological traits, e.g. importance for the aquatic and terrestrial nutrient cycle, population oscillations, specific interactions, ecosystem services and behavioural adaptations, e.g. feeding, migrations, spawning preferences, remain largely unstudied for the fishes in this area, but should be placed in the focus of future investigations. The behaviour of fish leaving deliberately very hot aquatic environments, the 'sleeping-fish', clearly deserves more attention.

A profound knowledge on the ecology and ecosystem services of an ichthyofauna actually needs to be present before establishing intensive fishing quotas for an area which actually has a status of protection and international importance for biodiversity. Thus we hope that our study promotes further investigations, is useful for the establishment of closed fishing areas, and increases the understanding of the diversity of the Pendjari National Park, which is at least as diverse below water as it is above the water surface.

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