Fish Biodiversity Assessment of the Rapids of Mboungou Badouma and Doumé Ramsar Site and Surrounding Areas in Gabon

**Joseph Cutler, Colin Apse,
Thibault Cavelier de Cuverville,
Yves Fermon, Jean-Hervé Mvé-Beh,
Marie-Claire Paiz, Brian Sidlauskas,
John P. Sullivan**

The Nature Conservancy

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Acknowledgments

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Executive Summary

The Nature Conservancy (TNC) in association with the *Institut de Recherches Agronomiques et Forestières* (IRAF) of the Gabonese *Centre National de la Recherche Scientifique et Technologique* (CENAREST) co-sponsored a fish sampling expedition for three weeks in September 2014, conducted by experts from multiple institutions. The sampling expedition took place in Gabon, on a section of the Ogooué River and some of its tributaries near Lastoursville, which included sections of the *Rapides de Mboungou Badouma et de Doumé* Ramsar site (Rapids of Mboungou Badouma and Doumé*)* (Figure 1). The main objective of the expedition was to sample and characterize fish diversity within and around the Ramsar site to provide baseline assessments of the site's biodiversity and freshwater habitat.

The findings of the expedition detailed in this report can be used by decision makers, governmental authorities, non-governmental organizations, local communities, and other stakeholders to inform and enhance freshwater ecosystem management and conservation in the Ogooué River basin. Additional research in the area is warranted and should focus on characterizing the upper sections of the Ramsar site, and better understanding seasonal changes in the river system, biogeographic patterns, local exploitation and other ecological processes. In total, the team performed 71 fishing events at 31 sites over the course of the 3 weeks. A total of 2,876 fish were collected, totaling to a minimum of 91 distinct species (known species including non-described species) representing 18 families of fishes. Significant preliminary results from the expedition include:

A partial baseline fish biodiversity survey for the Ramsar site

The sample collections provide a partial baseline fish biodiversity survey for parts of the Rapids of Mboungou Badouma and Doumé Ramsar site, and for the region more broadly. The area has historically been minimally sampled despite notable collections by early explorers. The collection of at least 91 distinct species (and a number of specimens that require further taxonomic attention) will serve as a valuable dataset for future conservation, research and management efforts.

Resampling the historically significant site at Doumé

This was the first sampling expedition in the Doumé area since 1876–1877, when Alfred Marche sampled a total of 42 species belonging to ten families. During the September 2014 sampling,

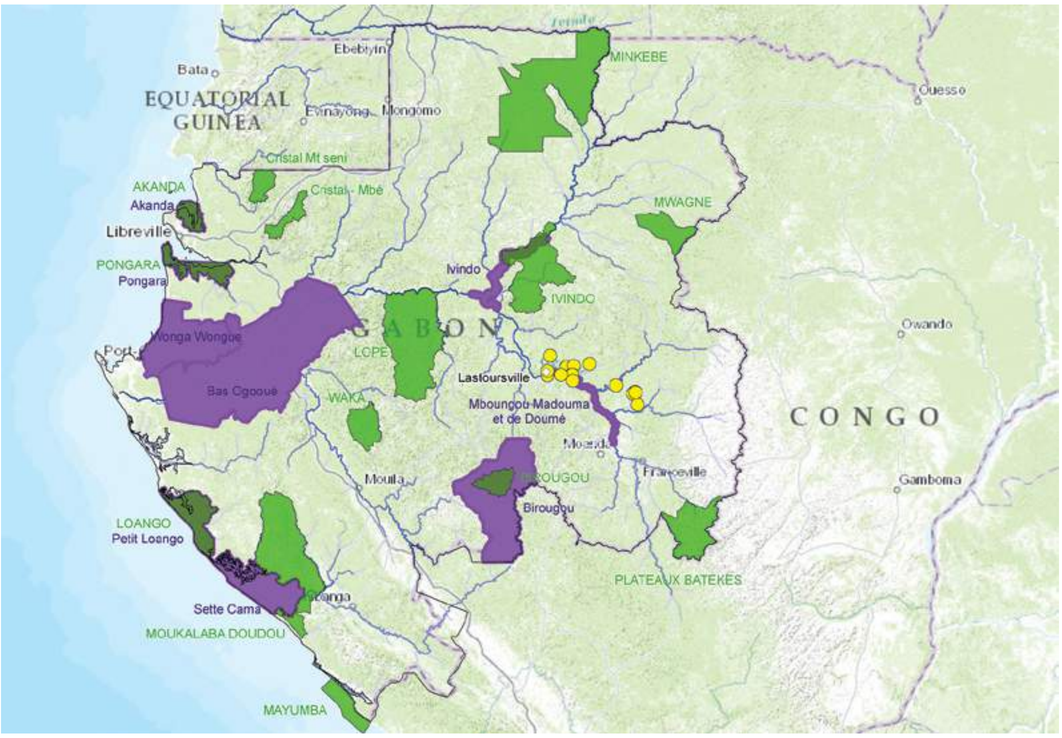

Figure 1. Context map showing Gabon and sample locations of the September 2014 expedition.

Sample locations
Ramsar sites
National parks

three specimens of an undescribed "short-headed" *Paramormyrops* species were captured; and a single individual of unknown species was also taken in the fish traps at Doumé. While these collections represent a wide taxonomic swath of the fish fauna at Doumé, they are an incomplete sample. Notably, of the twelve species Sauvage reported from Marche's Doumé collection, only two were recovered by this expedition at Doumé.

Successful electrofishing in Central African streams

Electrofishing is an effective sampling technique used in many parts of the world to collect fishes in small creeks. Electrofishing samples most taxon equally, and can produce useful results for scientific and inventory purposes. Prior to this trip, electrofishing in Central Africa has historically produced poor results, as water conductivity is often extremely low. Electrofishing is typically ineffective in habitats with conductivity lower than 20 µs/cm. However, on this expedition, we successfully electrofished in water with conductivity as low as 7 µs/cm. Unusual and hard-to-capture species were collected using this technique. In a total of 4 sampling events, 547 fishes were captured, representing 26 species, 14 families and nearly 20% of the individuals captured during all 71 collecting events. Application of this technique may change small-river sampling methodology, particularly when targeting hard-to-capture species such as mormyrids, dwarf barbs, mastacembelid eels, and killifishes; leading to improved biodiversity baselines for small rivers in this region.

Characterization of fish faunal distributions based on location and habitat type

The characterization of fish habitats by substrate and drainage allowed a rough comparative analysis of species distribution within the Rapids of Mboungou Badouma and Doumé Ramsar site. Biodiversity differs markedly between large and small rivers, and certain species are exclusive to large-river or small-stream habitat types. Though some species are ubiquitous (e.g. *Barbus holotaenia*, *Barbus guirali,* and *Bryconalestes longipinnis*) the fauna of the small creeks and rivers differs substantially from that of the main channels. In particular these small river systems harbor an exceptional diversity of small-bodied species.

It appears from this collection that the Doumé Rapids do not serve as a barrier to fish migration. However, certain groups of small fishes (including killifishes, small barbs and dwarf characiforms like *Neolebias*) seem to differ on tributaries on opposite sides of major rivers (the Ogooué and Sébé rivers). This suggests that large rivers may serve as a barrier to fish migration for small fishes.

The collection of samples of undescribed species of the genus *Paramormyrops*

Three specimens of an enigmatic, undescribed species of *Paramormyrops* "short-headed" were collected at Doumé. Prior to this expedition, only two specimens had been recorded, one from Marche's collection and one in 2011 collected by John P. Sullivan, Jean-Hervé Mvé-Beh, and Yves Fermon. These specimens will contribute to the mounting evidence for the species and will aid in its forth-coming taxonomic description.

The discovery of a mormyrid fish that may represent a new genus

One specimen of an unknown mormyrid was sampled at Doumé. This fish showed morphological differences visible immediately in the field, and electric organ discharge recordings provided further evidence of the novelty of this strange fish. Mitochondrial phylogenetic analysis suggests this specimen represents a sister group to the *Boulengeromyrus* and *Ivindomyrus* lineages, potentially representing a new genus. This would be the first new genus of mormyrid described since 1975.

The possible discovery of at least one new species of killifish

The *Plataplocheilus* from the Sébé region drainage is very likely to represent a new species. The *Aphyosemion* from the Sébé are probably *Aphyosemion cyanostictum*, though there has been some discussion about whether these might represent a new species. For this species, one way or another, it at least represents a dramatic range extension of a species previously known only from the Ivindo and Okano basins.

The collection of an enigmatic alestid fish

A single adult specimen of the characiform family Alestidae collected presents an unsolved taxonomic puzzle. It fits within either the genus *Nannopetersius* or *Phenacogrammus*, but the extent of the lateral line is intermediate for the two genera, and the coloration and pattern of scale counts do not match any known species from the Ogooué drainage. The specimen may represent either a hybrid, a range extension or an undescribed species; but with only a single specimen and no matching DNA sample, it may be impossible to determine its taxonomy without further sampling in the region.

The discovery of a potential new dwarf species of Barbus

Several specimens of an enigmatic and tiny species of *Barbus* were obtained by electroshocking in small creeks within the Sébé drainage. The specimens, all of which are less than 30 mm long, do not key out to any known species in Gabon and likely represent either an undescribed species or a substantial range extension. Sequencing of the single DNA voucher that we obtained may help resolve this question.

Overall, the discovery of several undescribed species on this expedition highlights both the biological richness, and the relative lack of documentation and sampling on the Ogooué River and the Rapids of Mboungou Badouma and Doumé Ramsar site.

Introduction

The Nature Conservancy (TNC), in association with the *Institut de Recherches Agronomiques et Forestières* (IRAF) of the Gabonese *Centre National de la Recherche Scientifique et Technologique* (CENAREST), conducted a fish sampling expedition to the Ogooué River watershed from September 6 to 21, 2014. The expedition took place in the area around Lastoursville in the Ogooué-Lolo and Haut-Ogooué provinces of southeastern Gabon (Figure 1). The primary objective of the expedition was to provide a baseline assessment of the freshwater fish diversity for the Rapids of Mboungou Badouma and Doumé Ramsar site.

In 1986, the government of Gabon highlighted the importance of freshwater ecosystems when they joined the Ramsar Convention on Wetlands, and declared three protected wetlands: *Setté Cama, Wongha-Wonghé* and *Petit Loango*. In 2007, former-President Omar Bongo declared three additional Ramsar sites, all with some overlap with three recently established national parks: *Akanda*, *Pongara,* and *Monts Birougou*. President Ali Bongo Ondimba continued this legacy with the declaration of three additional Ramsar sites in 2009. These included *Site Ramsar Bas Ogooué*, *Site Ramsar Chutes et Rapides sur Ivindo,* and *Rapides de Mboungou Badouma et de Doumé* (Rapids of Mboungou Badouma and Doumé).

The Rapids of Mboungou Badouma and Doumé Ramsar site lies on the mainstem Ogooué between Lastoursville and Moanda. This 140 km stretch of river boasts a series of rapids and rocky areas that harbor unique biodiversity and well-preserved ecosystems, both aquatic and terrestrial. This site was highlighted not only for its pristine nature, but also for its significant role in the history of European exploration in Gabon. Pierre Savorgnan de Brazza explored the upper course of the Ogooué and its relationship to the Congo River basin during two expeditions (1875–1878 and 1879–1882). During de Brazza's first expedition on the Ogooué River, naturalist Alfred Marche collected specimens of many taxa, including some fishes.

The village of Doumé, located near a cataract called the *Chutes de Doumé*, was an important field camp and re-supply point for the expedition, and Marche made his fish collections with the assistance of villagers. Subsequently described by Henri Sauvage in an 1879 publication, Marche's collections were the first fish species described from this section of the Ogooué, and Doumé became an important early type locality for the study of African fishes (see Appendix 1 for more information).

TNC launched a program in Gabon in 2013, focused on the freshwater resources of the Ogooué River basin, a vast expanse covering 72% of Gabon's land area. TNC is partnering with the government of Gabon to provide technical assistance and advice on monitoring, developing and managing aquatic ecosystems, including helping to improve the management of existing Ramsar sites. This expedition was a critical first step towards building a framework for effective management, conservation and development of the biologically and historically significant Rapids of Mboungou Badouma and Doumé site. However, as the expedition did not cover the site's complete extent, it is as yet only a partial assessment.

About this Report

This document aims at succinctly describing the methodology and summarizing the main findings of the expedition to the region around the Ramsar site in September 2014. The findings are presented as a description of diversity and distribution at a taxonomic level, but also as an initial ecological characterization of the fish biota of the Ramsar site. This report does not include more detailed scientific information (including descriptions of undescribed or new species) that is being analyzed and written up as scientific manuscripts. However, the scientific outcomes of the expedition shared in this report, along with some preliminary recommendations for management of the Ramsar site should prove valuable information for responsible managers and authorities of the Ramsar site and other managed areas in its surroundings (such as forestry concessions). Other materials for more general outreach and awareness building that document the importance of the fish diversity and associated aquatic ecosystems of this region will also be produced and shared with local inhabitants in the future.

Expedition Team

Our team included Gabonese, French and American members with significant combined expertise on Gabon's fishes and freshwater conservation:

- **Colin Apse**: The Nature Conservancy, USA
- **Thibault Cavelier de Cuverville**: Independent Researcher, Libreville, Gabon
- **Joseph Cutler**: University of California, Santa Cruz (UCSC), USA
- **Yves Fermon**: Association Aimara and Museum National d'Histoire Naturelle (MNHN), France
- **Gervais Koudauo**: IRAF/CENAREST, Gabon
- **Jean-Hervé Mvé-Beh**: IRAF/CENAREST, Gabon
- **Marie-Claire Paiz**: The Nature Conservancy, Gabon
- **Brian Sidlauskas**: Oregon State University (OSU), USA
- **John P. Sullivan**: Cornell University (Cornell), USA

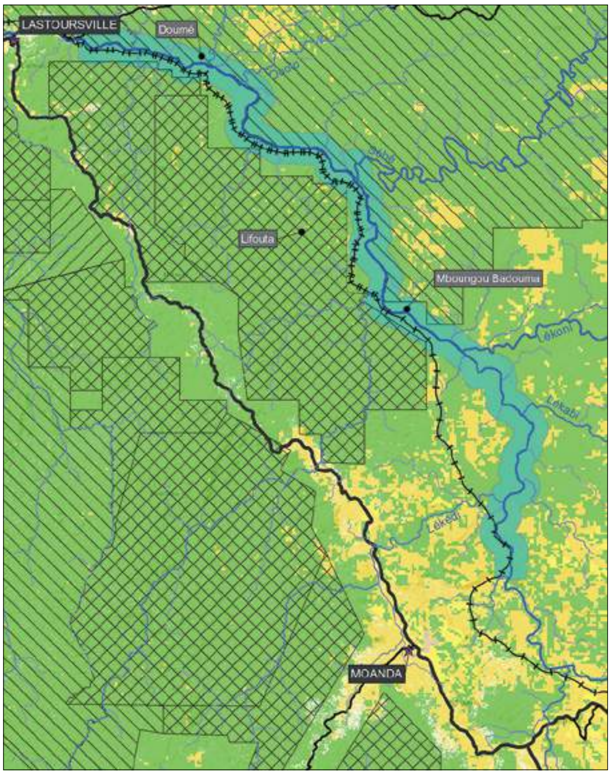

Figure 2. Map showing the Rapids of Mboungou Badouma and Doumé Ramsar site and surrounding areas. This map shows roads (both paved and unpaved), towns, the river system, forestry concessions, and the extent of the Ramsar site.

Forest
Mosaic forest/savanna
Ramsar site
Forestry concessions
Roads
Railroads

Geographic Context

The Rapids of Mboungou Badouma and Doumé Ramsar site is located within the provinces of Ogooué-Lolo and Haut Ogooué on the mainstem Ogooué River between Lastoursville and Moanda. In total, the Ramsar site is roughly 140 km long and includes a 2 km zone extending in both directions from the river, encompassing 59,500 hectares of river and riparian habitats. The area is very rugged and inaccessible, with a series of rapids inhibiting water-borne transport. Furthermore, the area lacks major public road access. However, almost the entirety of the Ramsar site is bordered by forestry concessions (Figure 2), and forestry roads permit access to the river in some areas. Convenient access in this area is by train, with primary stations in Lastoursville and Moanda, and three smaller stations in between (Doumé, Lifouta, and Mboungou Badouma).

Lastoursville and Moanda (with 8,000 and 25,000 inhabitants respectively) flank the downstream and upstream boundaries of the Ramsar site. Anthropogenic pressures on the Ogooué River in Lastoursville appear minimal and include bathing and clothes laundering, as well as potentially untreated household and commercial wastewater. Surprisingly, there is relatively little fishing pressure in the Lastoursville area. Though not surveyed on this expedition, Moanda may have a larger anthropogenic impact on the Ogooué and the Ramsar site. Moanda is a large, industrial town, fueled by manganese mining. Nearby Mounana was a thriving uranium mining town from 1958 until the mid-1990s, when rising pollution levels forced a complete halt of all mining activities. The Moulili tributary suffered from the effects of manganese mining there, and serves as an important lesson for Gabon's future and current mining practices. The industrial extraction of minerals upstream of the Ramsar site may pose a threat to its biodiversity.

Within the Rapids of Mboungou Badouma and Doumé site, the river transitions from a region dominated by a mosaic of forest-savanna to a region of pure tropical forest. The Ogooué River in this section is fed by a number of major tributaries within the Ramsar site including the Sébé, Lékoni, Lekabi, Oulou and Lekedi rivers, and countless smaller streams. During the two rainy seasons (from March to May and from September to November), the Ogooué River spills over its banks and creates large areas of flooded forest. The site is largely uninhabited and there are only two large villages on the Ogooué's left bank within the site, Doumé and Mboungou Badouma. Another village called Lifouta was historically located at the riverside, but its villagers have moved closer to the Lifouta train station further away from the river. All of these villages existed before the rail system, and were likely more widely dispersed historically. The location of the train station reflects both village location and feasibility, and most stations tend to be far from the water. This has resulted in a splitting of villages into a riverside neighborhood and a train-side neighborhood in both Doumé and Mboungou Badouma.

The forestry concession *Compagnie Equatoriale des Bois* (CEB), operated by Precious Woods, lies on the right bank of the Ramsar site and is sparsely populated by its employees in a series of three camps. River access to the Ogooué is better from that side, as CEB has been operational for 50 years and has a well-established road network. The newer forestry concessions on the left bank of the river have some roads in poor shape covering great distances within the concessions. CEB is certified through the international Forest Stewardship Council (FSC), and has been supportive of conservation-focused research and activities, and improved management practices within the concession. During the majority of this expedition, the team sampled in or around the CEB concession area, using its facilities as a base camps. All of the sampling on the mainstem Ogooué in the Ramsar site took place in the area closer to Lastoursville. The team did not have the opportunity to sample the upper portions of the Ramsar site closer to Moanda.

The Human Context

Socio-Economic Uses and Threats

As in other rural areas of Gabon, the villagers of Mboungou Badouma and Doumé rely heavily on the Ogooué River for a number of services, and thus effectively depend on the effective management of the Ramsar site and its natural resources. The site is bordered by active forestry concessions on both the left and right sides of the Ogooué River as mentioned above (Figure 2). These concessions bring an influx of outside labor into an area previously dominated by Adouma people. Therefore, exploitation within and around the site takes place both on subsistence and industrial scales.

Production forests in Gabon are managed in accordance with the Gabonese Forestry Code, and this code includes stipulations regarding local human populations within forestry concessions. Based on discussion with the people of Doumé and Mboungou Badouma villages, household economies are based on agricultural activities. The residents of villages in the Ramsar site area practice non-mechanized subsistence agriculture, producing mostly cassava, banana and palm oil. Slash-and-burn agricultural techniques help to clear the thickly forested land, and provide a short-term boost in soil nutrients, while reducing the seeds of weedy species and weeding effort. Slash-and-burn agriculture is practiced in zones identified by mutual agreement between the villagers, forest operator and the local government representative from the Ministry of Water and Forests.

Other economic activities based on the exploitation of natural resources in the area include household wood-cutting and harvesting of forest products such as wild fruits (e.g. *odika*, *moabi*), fishing, and hunting. Wood is used to meet the energy needs of families (cooking and heating), as well as for construction. Harvested wood is often used in the village itself, but is also sold in urban centers where they fetch higher prices. In addition to wood products, non-timber forest products are harvested by each of the villages and although mostly consumed within households, can also be sold (e.g. rattan, honey). These products can be found seasonally in markets in the urban centers of Lastoursville, Mounana and Moanda.

Following agriculture, fishing is the second most important household economic activity for the villagers of Doumé and Mboungou Badouma. Local people have been fishing the Ogooué River for at least 150 years, and also collect fishes from its many tributaries, which are often more easily fished. Fishing intensity varies seasonally, peaking in the core of the dry season when flows are lowest (July–August). Traditional fishing techniques include traps, nets, and hooks. Fish are an important component of the local diet and most fish are consumed within the household rather than being sold at regional markets. Some large fish are sold fresh at markets in Lastoursville, Mounana and Moanda. More remote villages, including Lifouta, smoke a large portion of their catch to avoid spoilage.

Hunting is practiced throughout the country, but because of anti-poaching restrictions its scale is undocumented. Forestry companies organize hunting parties for their own consumption and for their workers. For these hunts, the company requests approval of the local village, and often employs approved hunters within a defined area. In villages, hunting is conducted for household consumption. While some forestry companies enforce anti-poaching regulations throughout their territory, clandestine hunting continues.

The Rapids of Mboungou Badouma and Doumé Ramsar site faces a number of potential ecological threats, most importantly from forestry and mining. The site and its surroundings are fully exploited by timber companies on both sides of the river. Logging is known to pose risks to aquatic ecosystems, especially for small rivers, by modifying patterns of sediment run-off and transport and ultimately ecosystem functioning and biodiversity (Gerbersdorf *et al*. 2007).

Mining—especially large, open mines—generates pollution and erosion and is detrimental to the maintenance of biodiversity, and much of the area upstream of the Ramsar site is actively mined. *Compagnie Minière de l'Ogooué* (COMILOG) operates the manganese deposit at Moanda, and a new manganese processing plant is being developed in Franceville by the New Mining Company.

Aquatic invasive species including the fish species Nile tilapia (*Oreochromis niloticus)*, African arowana or "*sans-nom*" (*Heterotis niloticus)* and African sharp-toothed catfish or "*silure*" (*Clarias gariepinus)* all pose additional ecological pressure on the aquatic ecosystems of the Ogooué River and the Rapids of Mboungou Badouma and Doumé Ramsar site.

History of Ichthyological Exploration

The Rapids of Mboungou Badouma and Doumé Ramsar site has been very poorly sampled for fishes in comparison to other regions of the Ogooué basin. In part, this can be attributed to the fact that road access is almost completely lacking; the main southeast to northwest road R.N.3, does not closely follow this stretch of the Ogooué River. The FAUNAFRI website (http://www.poissons-afrique.ird.fr/faunafri/) indicates no fish collection sites on the Ogooué mainstem between Lastoursville and the Sébé River confluence apart from Alfred Marche at Doumé in 1876–1877, and only two other sampled localities within the Ramsar site.

One of these is at Mokaba-Ngao at the Ramsar site's upstream extremity (MNHN-1886-0401)[1]—a single *Raiamas buchholzi* collected by Pierre Savorgnan de Brazza in 1886. The other locality is at the mouth of the Sébé River where several species are recorded from collections in 1920, 1930 and 1962 [*Phractura longicauda* (MNHN 1930-044, 045), *Microctenopoma nanum* (MRAC P 20261-63)[2], *Chromidotilapia kingsleyae* (MRAC P 20222-23), *Barbus camptacanthus* (MRAC P 20398-20403 1920; MNHN 1930-0028 Baudon), *B. guirali* (MRAC P 20139-44), *B. holotaenia* (MNHN 1886-0398/0399 Savorgnan de Brazza; MNHN 1930-0238/0240/0016 Baudon), *B. miolepis* (MRAC P 20115-6), *Neolebias trewavasae* (MRAC P 20074-80) and *Paramormyrops kingsleyae* (MRAC P 20019-24)].

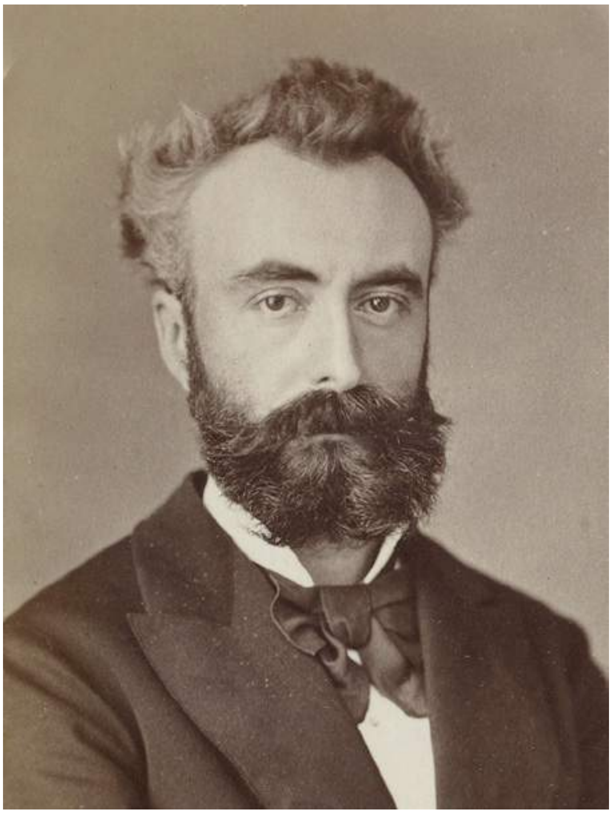

Figure 3. Henri Emile Sauvage (1842–1927).

Despite having not been revisited by ichthyologists (apart from Sullivan, Mvé-Beh and Fermon in 2011, see below), Doumé (0.843°S,12.96°E) is arguably the most important type locality for fishes on the Ogooué. Henri Sauvage described nine species of fishes from collections made at Doumé by Alfred Marche (1879, 1880), during the first expedition by de Brazza that explored the sources of the Ogooué between 1875 and 1878. Eight of these species remain valid today (Appendix 1, Table 14). An additional three species described in Sauvage (1879) came from Marche's collection at Lopé while the locality of a fourth, *Barynotus compiniei* (Sauvage 1879) = *Labeobarbus compiniei* (Sauvage 1879) was not given (Appendix 1, Table 14).

The new species Sauvage reported from Marche's Doumé collection included the first mastacembelid eels described from Africa: *Mastacembelus marchei* and *Mastacembelus niger*; two new genera and species of rheophilic (rapids-adapted) catfish: *Atopochilus savorgnani* (Mochokidae) and *Doumea typica* (Amphiliidae); a new clariid catfish, *Clarias buthupogon*; a new

1 In the collections of MNHN (Muséum National d'Histoire Naturelle), the National Museum of Natural History located in Paris, France. https://science.mnhn.fr/institution/mnhn/search

2 In the collections of MRAC (Musée Royal de l'Afrique Centrale), the Royal Museum for Central Africa, located in Tervuren, Belgium. www.africamuseum.be/collections

cyprinid, *Labeobarbus compiniei*; and three mormyrids that remain valid today: *Ivindomyrus marchei*, *Paramormyrops sphekodes*, and *Petrocephalus simus*. A fourth mormyrid, *Petrocephalus affinis*, proved to be a synonym of *Stomatorhinus walkeri* (Günther).[3] Two other siluriforms, an electric catfish *Malapterurus oguensis* and a claroteid *Parauchenoglanis balayi,* came from Marche's collection at Lopé.

Normally a careful systematist, Sauvage made one significant error in his 1879 and 1880 studies of Marche's collection. In both papers he presented a description of a fish he called *Micracanthus marchei*, an anabantoid, from Doumé, which is illustrated in Sauvage (1880). After a century of confusion as to the identity of this fish, a study by Roberts (1981) showed that the single specimen was in fact *Betta splendens*, the "Siamese fighting fish" of the Mekong basin of Southeast Asia, a popular species in the pet trade. We are left to wonder what happened (the provenance of Sauvage's specimen remains unclear), but this mistake serves as a reminder of the importance of labeling specimens correctly at all stages in which they are handled.

Sauvage's publications based on Marche's collection were only the second ichthyological study of the Ogooué River. The first had been by Albert Günther (1867) who described several fishes collected by the English trader R.B.N. Walker lower on the Ogooué. Greater precision than "River Ogome [sic]" was not given for the location of these collections, but we know from Walker's own accounts that it was not until 1873 that was he able to travel significantly upriver from Lambaréné (viz. to Lopé). Thus the Marche/Sauvage fishes are the first fishes to have been described from the upper portion of the Ogooué.

The de Brazza-Marche Ogooué Expedition of 1875–77

The de Brazza expedition was Marche's second exploration of the Ogooué. In 1874, Marche and his travel companion, Victor de Compiègne, had ascended the Ogooué farther than any European had previously—beyond Lopé to the mouth of the Ivindo River—before an attack by local Osseiba forced them back (Marche 1879). Marche's first trip—a small, self-financed expedition of two adventure-travelers—won him the attention of de Brazza who was organizing a large expedition to ascend the Ogooué under sponsorship of the French navy. Marche was added to the de Brazza expedition the following year in the capacity of naturalist, but obviously chosen for his experience with the river and the inhabitants of the country which de Brazza himself at that time lacked.

Figure 4. Pierre Savorgnan de Brazza (1852–1905).

As they ascended the Ogooué in 1876 in pirogues *(*wooden canoes*)*, de Brazza and Marche often traveled separately with their respective porters and paddlers (Marche 1878, 1879). Malaria, other maladies, and injuries were continually slowing their progress upriver. In mid-1876 de Brazza went ahead of Marche and made a camp at the village of Doumé, inhabited by the Adouma people, while Marche remained behind at Lopé with an ailing Noel Ballay, the expedition's doctor. Then in August 1876, de Brazza fell ill and returned down the river and Marche's team was given the task of scouting out the terrain and river ahead. Marche and his party continued up the Ogooué a distance of 94 km above Doumé, into territory inhabited by the Anziani (Andjicani) people.

Upon falling ill, Marche was obliged to return to Doumé where he remained for eight months. Doumé and its resident Adouma people had become indispensable for their navigation and equipment. Marche made extensive collections of anthropological artifacts and biological

3 Names reported here have been updated to their valid combinations (Appendix 1, Table 14).

specimens during this time (including the fishes that Sauvage would describe) before further deteriorating health forced his return downriver and back to France in June 1877. De Brazza's account differs; he relates that in October 1876 Marche "refused to be involved with anything other than natural history . . . leaving him an inactive spectator of our work and depriving us of help we had counted on when we left Europe"[4] (Rapport de Brazza, p. 163). De Brazza went on to say "on 16 May 1877, Marche asked to return to France, giving as pretext his ill-defined situation (a situation that he had himself asked for the previous October)." Quite obviously the two men had differences as neither have much complimentary to say about each in their respective narratives.

As for the Doumé Rapids, de Brazza describes it as a "*petite cataracte*" (Tour de Monde, p. 153) and Marche says:

Figure 5. Alfred Marche as depicted on a 19th century trading card.

> *"The falls at Doumé where Mr. Brazza stopped in 1876 is not very significant; it is barely more than 1.5 meters in height; I believed at that time it to be more than it actually is; in the high water season it becomes a natural barrage that forms a huge eddy: it is at this time no longer a fall. Right now, it blocks the river across its breadth, leaving only on a narrow passage the right bank that one can descend at certain times of the year, but which is impossible to go up, forcing us to unload the canoes and portage around it. This work is easier here than at the falls at Booué. Above the falls, the river is wide and beautiful, full to the brim, bathing wooded banks. It is framed in two curtains foliage through all shades of green, and cut here and there with trees with white flowers, which are interwoven with bright red flowering vines which open at this time to close at night. But here, as in the lower river, the banks are formed only by a narrow strip of land: the brilliant green veil conceals marshes that in places extend into long lagoons whose putrid fumes are deadly even for the Africans, who yet enter these areas to fish." (Marche 1879, p. 293)*

Observations of fishing activity by Alfred Marche

As one of the first outsiders to visit the region, Marche's observations of the fishing practices of the tribes living within the area currently within the Ramsar site are worth noting. On page 383 of *Trois Voyages*, Marche reports that "very well made" fish traps are used at Doumé that are "placed against the current so that any fish that wishes to swim up the channel is forced to enter them." Unfortunately he doesn't provide a detailed description, or relate how dependent the residents of Doumé were on fish for food. We did not observe fish traps in use at Doumé.

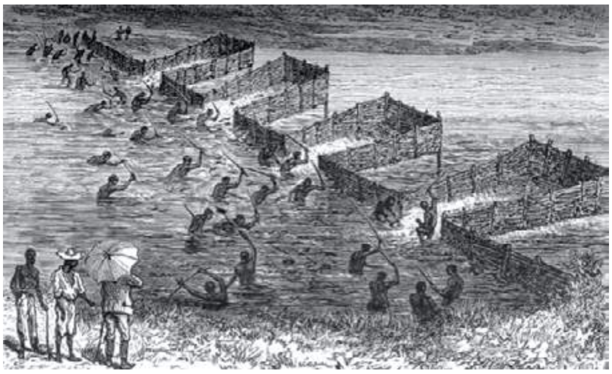

Figure 6. Fish weir described by Alfred Marche on the Léboka River near present-day Mboungou Badouma, from Marche (1879).

Later, Marche provides a much more detailed description and an illustration of an elaborate fish weir on a left-bank tributary of the Ogooué he calls the "Eboga" (probably the Léboka just above Mboungou Badouma), a region inhabited by the Anziani people (Figure 6):

> *"It was a bamboo stockade whose gaps are filled with stones and vines bar the river in its entire width, leaving only three or four narrow passages; these give access into the traps that are placed behind the openings. These operate as follows: a ramp, supported below the water against the base of the stockade and supported at its upper part by two strong poles, is held at an angle of approximately thirty degrees; the current of the river being very high, the water is violently expelled through openings in the stockade and projected onto the ramps up to a certain height. Once installed, everyone, men, women, children, jump into the water,*

4 All translations from the original French to English are by John P. Sullivan.

shouting and splashing to chase fish to the stockade walls that they follow to the openings where they are seized by the current and launched on the racks. These have raised edges high enough that the fish are unable to get back over them." (Marche 1879, p. 308)

We observed no fish weirs in use on the Ogooué, but the weir described by Marche is very similar in design to one seen in use in 1998 by John P. Sullivan on the Yobé River, a tributary of the Sangha River in southwestern Central African Republic.

Sampling at Doumé in 2011 and the identity of *Paramormyrops sphekodes*

On May 29, 2011, three members of the expedition team, John P. Sullivan, Jean-Hervé Mvé-Beh, and Yves Fermon visited Doumé en route between Franceville and Libreville, and fished with worm-baited fish traps during the evening hours with local fishermen. The primary purpose of doing so was to make new collections of *Paramormyrops* at this site in order to help resolve longstanding questions about the identity of *P. sphekodes* (Sauvage). The specimen regarded as the holotype of *P. sphekodes* (Bertin 1940) resides at the Paris Museum (*Muséum National d'Histoire Naturelle*) under catalog number A.893. Until 1998, A.893 also included a second, smaller specimen, now separately cataloged as 1998-1050. These are the only two known *Paramormyrops* from Marche's collection, and both are cataloged as *Brienomyrus sphekodes* (= *Paramormyrops sphekodes*), with the larger of the two (remaining in A.893) regarded as the holotype (Bertin 1940).

Figure 7. CENAREST researcher Jean-Hervé Mvé-Beh gathering local names for species collected in the region.

Morphometrics and meristics of these two specimens are somewhat different. The smaller specimen has a relatively shorter head with a more rounded head profile (Sullivan and Hopkins, unpublished). It is unknown whether these imperfectly preserved specimens represent a single species or two different species which coexist at Doumé, and how these two specimens correspond to entities known from new collections made in Gabon in recent years by Carl Hopkins and associates. While the name "*sphekodes*" has been applied to many specimens of *Paramormyrops* (formerly regarded as species of *Brienomyrus*), no one could say with certainty to which Ogooué specimens the name was rightfully applied.

The single evening of collecting in 2011 produced specimens of three species of *Paramormyrops*: a fish that Hopkins and associates had called "SN4" from collections from the Ogooué at Franceville and at Lambaréné (this proved to be closest to the *P. sphekodes* holotype specimen), another species (for which a manuscript is in preparation) known informally as "offouensis," and a single specimen closely resembling Marche's "short-headed" specimen. This latter specimen (JPS-1118) had an electric organ discharge (EOD) waveform shorter in duration than those of *P. sphekodes*/SN4, and study of cytochrome *b* DNA sequences from the mitochondrial genome provided additional evidence that this "short-headed" fish and *P. sphekodes*/SN4 were heterospecific.

While an interesting result, having just one "short-headed" specimen rendered a species description difficult. Thus, making additional collections of this undescribed species of *Paramormyrops*, erroneously attributed to *P. sphekodes,* was one priority of this expedition.

Field and Identification Methods

To best conduct an assessment of the fish biodiversity of the Ramsar site and surrounding watersheds, the expedition team sampled in as many habitat types as possible utilizing a variety of sampling gear.

At many sites, we employed multiple sampling methodologies. We therefore use two terms to distinguish between different sampling sites and specific sampling events. For example, we sampled a number of locations around the Doumé rapids. We set gillnets on the river's right bank and left bank, both above and below the rapids, and each of these habitats was considered a different "site." At some of these sites we employed multiple techniques (e.g. seines, traps and cast nets), these were considered as different sampling "events" at the same site.

Figure 8. Joe Cutler and Jean-Hervé Mvé-Beh set up a Porta-bote (collapsible boat) used for sampling in larger rivers.

General procedure

- Arrive at site
- Decide on appropriate fishing techniques
- Hire local assistance when necessary
- Collect physiochemical, geographical and habitat parameters
- Begin sampling (techniques and methodology varied by site and habitat type as described below)
- Keep as many fishes alive as possible in large ice chests, and immediately preserve any dead specimens in the field
- Return to base camp with live fishes
- Identify fishes
- Photograph and record EOD (electric organ discharge) of fishes
- Euthanize fishes with MS222
- Tag voucher specimens, take tissue samples
- Preserve all specimens in a 10% solution of formaldehyde with two collection identification tags within the lot bag
- After at least 3 days of fixation, reopen lots and double-check specimen identifications and count specimens for a preliminary species list.

Fish sampling and gear

In large rivers (width >20 m) including the Ogooué and Sébé, our main sampling technique included deploying a series (2–4) of experimental gill nets across habitat types. These gill nets had ten 10′ (3 m) panels with mesh sizes ranging from 1/2″–2 1/4″ (2.5–5.7 cm), for a total length of 100′ (300 m). Gill nets were deployed in slack-water areas with minimal current within the large rivers (as strong currents reduce gill net efficacy). When possible, we tried to deploy our gill nets in a variety of environments (e.g. herbaceous, rocky and sandy) in order to cover a maximum of habitat types and species.

In addition to gill-netting in large rivers like the Ogooué and Sébé, we employed additional techniques to sample along the banks of these rivers, as well as in the smaller streams. When a site had deep rocky habitats, we would deploy worm-baited so-called "Hopkins traps" during the evenings for nocturnal mormyrid fishes. These traps were made of plastic meshing, and bait

Figure 9. Collecting gear. Top row (L–R): Electroshocker; dip net; fish traps. Bottom row (L–R): Seine net; cast net; gill net.

was presented as liana-skewered earthworms dangling in the trap. We were able to use this technique in any river that was sufficiently deep (>1 m) where we could find worms, and mostly fished along the shoreline. While this methodology primarily targets mormyrid fishes, we also caught catfishes and mastacembelids.

Another sampling method we often used for all habitat types was beach-seining. We utilized two beach seines: a small 4′ x 10′ (1.2 m x 3 m) seine, and a large 6′ x 30′ (1.8 m x 9.1 m); both with 1/8″ (0.3 cm) mesh seine. In the large rivers, we identified sand banks that we could seine, and focused our seining at sunrise and sundown with the large seine, as fish move into the shallows at those times. We also used the large seine in small backwaters along the mainstem and other rivers, using the seine as a barrier net and "spooking" (i.e. alarming the fishes so they move in a desired direction) fishes into the net. In smaller rivers and streams, we employed the small seine to trap pelagic fishes along sand banks, as well as fishes in over-hanging vegetation.

Our team also opportunistically threw cast nets, both in large and small water courses. Cast nets are effective on sand banks and in the rapids, but ineffective in areas with lots of woody debris or other materials that can snag the net. Above the Doumé Rapids, for example, we used a cast net to capture the first specimen on this trip of an undescribed species of *Paramormyrops* collected by Marche in 1878, and collected again in 2011 as related above.

In the smallest creeks (depth < 1 m), we would sample either with bicycle-wheel dip nets or electrofishing. Bicycle-wheel dip nets are extremely effective in heavy brush, as the nets are reinforced, and are also effective in water slightly deeper than ideal for electrofishing. Electrofishing in Central Africa has historically had poor results, as the conductivity is often extremely low, and most electrofishing usually works best when conductivity is at least 20 µs/cm. However, our electrofisher (a Halltech HT-2000 backpack electrofisher) was powerful and effective in water with conductivity as low as 7 µs/cm. We were able to successfully electrofish in three distinct habitats and were able to collect unusual, hard-to-capture species. Utilizing this technique produced a number of species we had not yet encountered on the expedition and its utility could improve small-river sampling methodology, particularly when targeting hard-to-capture species such as mastacembelids, amphiliids, mormyrids, dwarf barbs and killifishes.

Fish processing

After fish were captured, they were kept alive when possible in large plastic bags labeled with the sampling event number. Larger collections were held in coolers with aerators to ensure minimal mortality. Specimens that were collected dead, as is often the case when gill-netting, would be placed in a bag with diluted (10%) formaldehyde directly with an identification number. All specimens were transported back to our base camp for further identification. Fish were photographed in an immersion tank, and tissue sampled, with unique or cryptic fishes receiving increased attention. We also recorded electric organ discharges from mormyrid fishes, as these are a key distinguishing feature between species of mormyrids. After 3–5 days of fixation, each lot was reopened and re-identified again for a preliminary species list.

Figure 10. Jean-Hervé Mvé-Beh places a gill net at sundown.

Field data collection

At each site, we recorded field data to supplement the specimen collection. These data included: GPS coordinates, date and time of sampling event, a unique collection event number, the river's and drainage names, stream width and depth, pH, conductivity, dissolved oxygen, temperature, turbidity, current velocity, substrate types present, fishing gear used, collectors names, and general notes.

Results from Field Sampling

Sampling Sites

Over the course of the expedition, we successfully collected samples in a number of diverse habitats, including several never-before sampled locations. We sampled the mainstem Ogooué, as well as major tributaries, forest streams, creeks and springs. In total, we executed 71 sampling events at 31 sites and collected at least 91 species. As a reference, there are 265 species of fish known to date for Gabon.

We sampled sites on the Ogooué River and some of its main tributaries including the Sébé, Lassio, Lékoni and the Ouolo (Figure 13 and Appendix 4). These sub-basins are still poorly known (with 16, 3, 7 and 0 respective sites in the scientific literature). During our sampling expedition we sampled each of these tributaries respectively 9, 1, 1 and 1 times; collecting respectively 41, 2, 5 and 1 species, and improving the knowledge of these tributaries by 16, 1, 5 and 1 species. Overall these tributaries are poorly documented, and there are likely additional species present (Table 2).

Figure 11. View of the rapids at Doumé on September 17, 2014.

Sites are classified as “major rivers” and “small rivers.” Major rivers refer to the mainstem Ogooué and Sébé, both of which are >20 m in width. “Small rivers” includes all sites on minor tributaries typically 1–10 m in width, but in few cases approaching 20 m, and includes the smaller creeks and sloughs. Sites are further lumped into “Ogooué” and “Sébé” to indicate general location within the sub-basin for later analyses of species distribution around the Ramsar site.

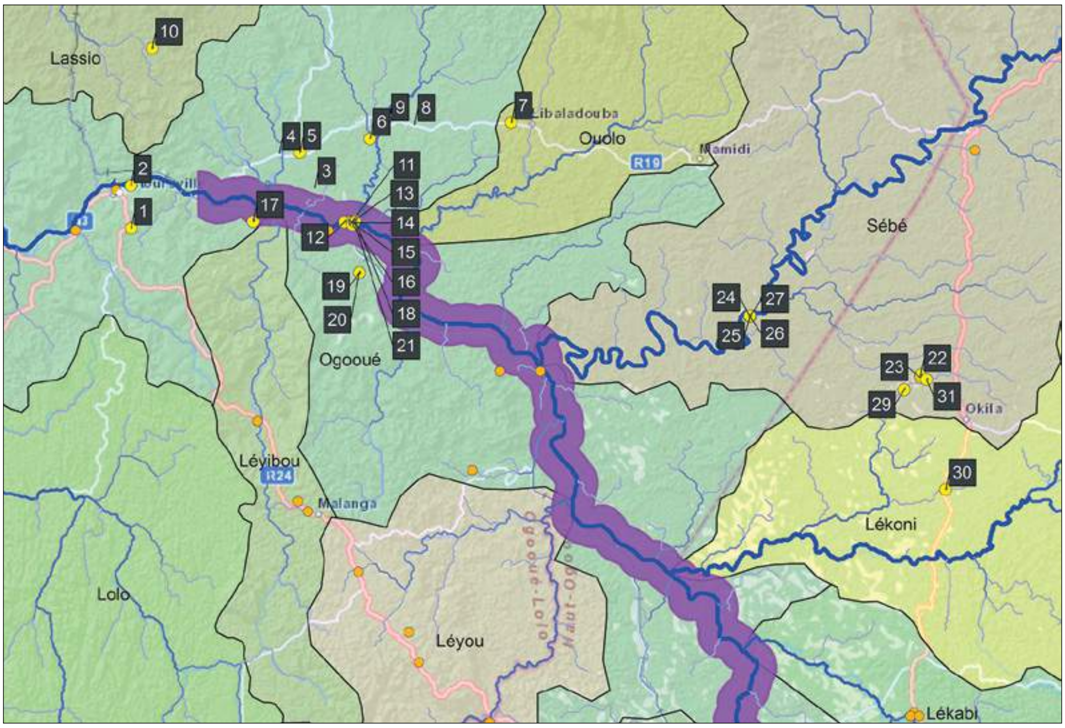

Figure 12. Location of watersheds, sites sampled, and previously sampled sites near the Ramsar site.

September 2014 sample locations

Previous sample locations

Figure 13. Collection localities. Top row (L–R): site 1, Ogooué River at Lastoursville behind motel; site 4, Bakoussou Creek at Route 19 crossing; near site 15, Ogooué River at Doumé. Bottom row (L–R): site 6, Moumba Creek at village of Moumba; site 24, Sébé River, sandy beach; site 30, Lewogo Creek.

Table 1. Sites sampled in September 2014. T = fish trap baited with earthworms, LS = large seine, SS = small seine, G = gill net, C = cast net, D = dip net, E = electroshocker.

Site #	Event #	Site Name	Drainage	Latitude (S)	Longitude (E)	River Type	Gear
1	1	Ogooué at Hotel Escale de l'Ogooué	Ogooué	0.84800	12.74488	Major River	D
2	2	Stream near Hotel Escale de l'Ogooué	Ogooué	0.80551	12.74448	Small River	D
3	3	Stagnant Creek	Ogooué	0.80776	12.92636	Small River	D
4	4	Bakoussou Creek	Ogooué	0.77313	12.8915	Small River	SS
5	5	Route CEB	Ogooué	0.77253	12.91172	Small River	D
6	6, 7, 10, 14, 15, 16, 18	Moumba Creek	Ogooué	0.75878	12.98106	Small River	LS, SS
7	8	Pont CEB entre Ndambi et Miynza	Ouolo	0.74257	13.12101	Small River	D
8	9	Concession CEB	Ogooué	0.7446	13.02508	Small River	D
9	11, 12, 13	Concession CEB	Ogooué	0.74427	12.99941	Small River	D, SS, LS
10	17	Concession CEB	Lassio	0.66884	12.76561	Small River	D
11	21, 23, 25, 29, 30, 33, 36, 38	Doumé – Rive gauche	Ogooué	0.84245	12.96249	Major River	D
12	34	Doumé – Rive droite – usine	Ogooué	0.84177	12.95582	Major River	LS
13	22, 24, 26, 29, 31, 32, 35, 37	Doumé – Rive droite	Ogooué	0.84245	12.96249	Major River	G
14	20, 27	Doumé	Ogooué	0.84245	12.96249	Major River	LS
15	19, 39	Doumé – Rive gauche	Ogooué	0.84189	12.96363	Major River	LS, C
16	40	Spring behind Doumé school	Ogooué	0.84434	12.96381	Small River	E
17	28, 44, 45	Doumé – Below rapids	Ogooué	0.84132	12.86548	Major River	T, D
18	42, 47, 49	Doumé – Rive droite – Above rapids	Ogooué	0.84043	12.96679	Major River	G
19	41	Confluence Moumba et Ogooué	Ogooué	0.89232	12.97062	Major River	G
20	46, 48	Confluence Moumba et Ogooué	Ogooué	0.89232	12.97062	Major River	G
21	43	Doumé – Rive gauche – Above rapids	Ogooué	0.84146	12.96582	Major River	C
22	51, 52, 53, 55, 56	Lélama Creek on the route (CEB)	Sébé	0.99385	13.52629	Small River	D, G
23	50, 54	Lélama Creek	Sébé	0.99613	13.52579	Small River	D, T

Site #	Event #	Site Name	Drainage	Latitude (S)	Longitude (E)	River Type	Gear
24	57, 62, 70	Plage de sable près du pont sur la Sébé	Sébé	0.934945	13.35707	Major River	LS, SS
25	58, 63	Sébé – Rive gauche	Sébé	0.93568	13.35732	Major River	G
26	59, 64, 66	Sébé – Rive droite	Sébé	0.934945	13.35707	Major River	G
27	60, 65	Plage de sable sur la Sébé – amont	Sébé	0.934945	13.35707	Major River	G
28	61, 68	Sébé – Rive gauche – Amont	Sébé	0.934945	13.35707	Major River	T
29	67	Petite rivière Est de Lélama – 2 km	Sébé	1.00853	13.50984	Small River	E
30	69	Lewogo Creek	Lékoni	1.10777	13.55104	Small River	E
31	71	Lelama Creek	Sébé	0.99832	13.53217	Small River	E

Table 2. Number of species known per basin, and collected by this expedition per basin. Data excluding known undescribed species and based on preliminary identifications.

	Known		Collected by this expedition	
	Sites	Species	Sites	Species
Ogooué	223	179	19	63
Sébé	16	61	9	41
Ouolo	0	0	1	1
Lassio	3	27	1	2
Lékoni	7	14	1	5

Taxon-Based Results

The purpose of this section is to document the findings of the fish sampling expedition by taxon. The level of detail in the documentation of different taxonomic groups reflect both the focal areas of research (both for field sampling and posterior lab work) for specific members of the expedition team, as well as certain taxonomic groups with historical significance in the region. The level of attention devoted to each group in the following section should thus not be interpreted as greater biological significance of some taxon over others.

Osteoglossiformes

Mormyridae

As for fishes in general, mormyrids (freshwater elephant fishes) in the Osteoglossiformes (an order of ray-finned fishes) have been very poorly sampled in the middle course of the Ogooué between Lopé and Franceville, including the region of the Ramsar site. According to the literature, the mormyrid fauna of the Ogooué basin consists of 20 described species in nine genera. Twelve of these are endemic to the Ogooué, or to the Ogooué basin together with the Ntem basin (Fermon 2014, Fishbase). However this figure does not do justice to this family's true diversity in the Ogooué basin as it excludes 16 known forms within the genus *Paramormyrops*, that, although determined to be distinct species in evolutionary studies (Sullivan *et al*. 2002, 2004), remain formally undescribed. There are three additional forms that may also represent new species but require more study (Hopkins and Sullivan, unpublished). All of Gabon's *Paramormyrops* (the six described species plus the 16 additional and the three questionable forms) are endemic to the Ogooué (plus in some cases also to the Ntem and adjacent coastal drainages) with the exception of *Paramormyrops kingsleyae*, a species also widespread in the Congo basin (Hopkins *et al*. 2007).

Mormyrid fishes have only been intensively collected in a few areas of Gabon, notably the Ivindo River near Makokou in the Ogooué-Ivindo Province, the Louétsi and upper Ngounié Rivers near Lébamba in the Ngounié Province, the Okano River near Mitzic in the Woleu-Ntem Province, the lower Ogooué and tributaries near Lambaréné in the Moyen Ogooué Province and the upper Ogooué and tributaries in the Haut Ogooué Province (Hopkins and Sullivan, unpublished). As new species were found in each of these visited localities, additional diversity within *Paramormyrops* likely remains to be discovered in un-sampled areas of the Ogooué basin.

All mormyrid fishes produce weak electric impulses from a muscle-derived organ in the caudal penduncle anterior to the tail. By means of specialized electroreceptors distributed over the skin, they are able to sense the presence of nearby objects in the water as distortions to their self-produced electric field (von der Emde 1998). The electric organ discharge, or EOD, also functions in communication. EOD waveforms are species-specific and often sex-specific, and sympatric species often exhibit EOD waveforms that differ substantially in duration, polarity and number of phases (Hopkins 1986). In this way, EODs serve a species-isolation and mate recognition function analogous to visual or acoustic signals in other groups of fishes.

EOD recordings and voucher specimens

EOD waveform variation among co-occuring species of *Paramormyrops* in Gabon is impressive and parallel to that seen in mormyrid genus *Campylomormyrus* of the Congo River (Sullivan *et al*. 2002). The hypothesis that EODs may in fact accelerate speciation in these "riverine species flocks" and within mormyrids generally has been proposed (Arnegard *et al*. 2010). EODs are relatively easy to record from living mormyrids and because of their species-specificity and stereotypy, are often useful aides in recognizing species and working out the taxonomy of this group. For this reason, EODs were recorded for as many individuals as feasible during the expedition.

We recorded EODs of individual mormyrids in small aquaria using water from their collection site, using chloridized-silver wire electrodes connected to an Echo 2 USB analog to digital converter (Echo Audio, Inc.) sampling at 192 kHz/16 bits. We visualized and saved signals using SignalScope virtual oscilloscope software (Faber Acoustical, LLC). Head positivity of the fish was recorded in the upwards direction and water temperature at time of recording temperature was noted. After recording, fishes were euthanized with an overdose of clove oil or the anesthetic MS222 (tricaine methanesulfonate), tagged with a permanent specimen number, and fixed in 10% formaldehyde. Specimens were transferred to 70% ethanol and are deposited in the Cornell University Museum of Vertebrates (CUMV) in Ithaca, New York under accession 2014-IX:30.

Notable findings

We collected 17 species of Mormyridae (Table 3), seven of which are formally undescribed. Five of these undescribed species are *Paramormyrops* that were included in Sullivan *et al*. (2002) and Sullivan *et al*. (2004): *Paramormyrops* "vadamans," P. "offouensis," P. "magnostipes," P. sp. "SN7," P. sp. "BN2." A sixth undescribed *Paramormyrops* is the "short-headed" species (*Paramormyrops* sp. "Doumé") that had been known only by the 1876 Marche specimen and a single specimen collected at Doumé in 2011. The seventh undescribed mormyrid is a single specimen collected by fish trap at the Doumé Rapids that cannot be assigned to an existing mormyrid genus.

We succeeded in collecting eight additional specimens of *Paramormyrops* n. sp. "Doumé" of which a single specimen was collected at Doumé in 2011. Although more study is needed, we believe that this is the same species as the second, non-type specimen, collected by Marche in 1876 and currently catalogued in the MNHN as *Brienomyrus sphekodes*. This is an undescribed species, similar to *P. sphekodes* with which it is found, but with a slightly shorter head relative to body length, and a shorter duration, biphasic EOD waveform. This new species is relatively rare where we collected it relative to *P. sphekodes*, the most common big-river *Paramormyrops* species. We collected only three specimens of this undescribed species at Doumé (events 43 and 44) and an additional five specimens at the Sébé River (events 61 and 68). DNA sequencing of the single specimen from 2011 supported the heterospecificity of this form with *P. sphekodes* (Hopkins and Sullivan, unpublished) and more recent sequencing at Cornell University of six more of *Paramormyrops* sp. "Doumé" as well as several *P. sphekodes* from Doumé and the Sébé sites collected on this trip confirm this result (Sullivan pers. comm.).

Also noteworthy is a single specimen collected by fish trap just below Doumé Rapids (event 44) that does not correspond to any known species and cannot be placed in any existing mormyrid genus. The specimen is a female and is 116 mm SL. Its EOD waveform differs from all mormyrid species known from Gabon: the waveform is short, about 0.6 ms in total duration and begins with a "P0" head-negative pre-pulse, indicating that its electrocytes have penetrating stalks (type "Pa"; Sullivan *et al*. 2000). The snout is truncate, mouth is terminal, eye is large; the chin swelling is expansive but not very protrusive and depigmented/whitish. The body is fusiform with coppery pigmentation under the head and on the belly; the caudal peduncle is long and narrow. The anal fin base is long, with its origin in advance of the dorsal fin. There is a wide, diffuse band of darker pigment between the anterior portions of the dorsal- and anal-fin bases. Study of this specimen, including DNA sequencing is underway at Cornell University.[5]

Mormyrid species distribution and habitat preferences

Interesting patterns of distribution and habitat preference for mormyrid species emerge from the collection records. The three *Petrocephalus* species all have wide habitat preferences: *P. microphthalmus*, *P. simus* and *P. sullivani* were found both in large rivers (i.e. Ogooué and Sébé) and small rivers. Unlike the other genera of mormyrids which were preferentially taken with fish traps baited with earthworms, species of *Petrocephalus* were more often captured by seine, gill net and cast net; reflecting the fact that they frequent open water and feed on insects suspended in the water column, in contrast to most other mormyrids that feed upon infaunal insect larvae and worms (Hyslop 1986, Matthes 1964).

The remaining mormyrid species were captured most efficiently with fish traps after nightfall, but five of them, including *Marcusenius moorii*—the most widespread and abundant mormyrid in our collections with 64 specimens captured at eleven collection events—were caught with other collection techniques also (Table 3).

Table 3. Collection data and habitat preference for 17 species of Mormyridae collected. T= fish trap baited with earthworms, S = seine, GN = gill net, C = cast net, D = dip net, E = electroshocker. Site and event numbers refer to Table 1. These data are based on preliminary identifications.

Family	Species name	Total Spec.	Event Nos.	Methodology	Small River – Ogooué drainage	Major River – Ogooué drainage	Small River – Sébé drainage	Major River – Sébé drainage
Mormyridae	*Petrocephalus microphthalmus*	8	16, 57, 63, 64, 65	S, GN	X			X
Mormyridae	*Petrocephalus simus*	4	02, 20, 21	D, C, GN	X	X		
Mormyridae	*Petrocephalus sullivani*	4	16, 21	S, GN	X	X		
Mormyridae	*Mormyrops nigricans*	1	44	T		X		
Mormyridae	*Mormyrops zanclirostris*	13	05, 10, 18, 68	C, T	X			X
Mormyridae	*Ivindomyrus marchei*	8	61, 63, 68	GN, T				X
Mormyridae	*Brienomyrus brachyistius*	3	06, 15	T	X			
Mormyridae	*Marcusenius moorii*	63	05, 10, 16, 18, 20, 44, 54, 60, 61, 68, 71	C, T, S, GN, E	X	X	X	X
Mormyridae	*Stomatorhinus walkeri*	7	02, 05, 06, 10, 18	C, T	X			
Mormyridae	*Paramormyrops sphekodes*	34	28, 44, 61, 68	T		X		X
Mormyridae	*Paramormyrops* sp. "Doumé"	8	43, 44, 61, 68	C, T		X		X

5 This work is not issued for permanent scientific record or for purposes of zoological nomenclature and as such is not an available work (ICZN 8.2). These details do not constitute a formal species description.

Family	Species name	Total Spec.	Event Nos.	Methodology	Small River – Ogooué drainage	Major River – Ogooué drainage	Small River – Sébé drainage	Major River – Sébé drainage
Mormyridae	*Paramormyrops* sp. "vadamans"	19	05, 06, 50, 71	D, T	X		X	
Mormyridae	*Paramormyrops* sp. "offouensis"	9	44, 61, 68	T		X		X
Mormyridae	*Paramormyrops* sp. "magnostipes"	12	02, 10, 15, 18, 61, 68	D, T	X			X
Mormyridae	*Paramormyrops* sp. "SN7"	23	10, 15, 16, 18	T, S	X			
Mormyridae	*Paramormyrops* sp. "BN2"	7	10, 15, 16, 18	T, S	X			
Mormyridae	*Mormyrinae* sp. unknown	1	44	T		X		

Species composition differed considerably at the three most productive sites for mormyrids: Moumba Creek, Doumé Rapids and the Sébé River (sites 6, 17 and 28 respectively). Moumba Creek is a minor tributary that empties into the Ogooué from the right side directly above the Doumé Rapids. The Moumba Creek sampling site was roughly 12 km north of the confluence, where the creek is about 5 m in width. Ten species of mormyrid were collected at this one site. Five of these, *Brienomyrus brachyistius*, *Stomatorhinus walkeri*, *Paramormrops vadamans*, *P.* sp.

Figure 14. *Paramormyrops sphekodes.*

Figure 15. *Paramormyrops* sp. *"vadamans."*

Figure 16. *Ivindomyrus marchei.*

"SN7" and *P.* sp. "BN2" were not taken at the big river sites (Doumé Rapids and Sébé). Conversely, *Paramormyrops sphekodes*, the most common *Paramormyrops* at both Doumé Rapids and at the Sébé, as well as *Paramormyrops* sp. "offouensis" and the undescribed "short-headed" *Paramormyrops* sp. "Doumé" were exclusively collected at the big river sites: Doumé Rapids and the Sébé. Apart from *Ivindomyrus marchei* which was only collected at the Sébé and the unknown mormyrid only taken at Doumé Rapids, the species composition in the catch at the two big river sites was quite similar.

Other mormyrids appear to be habitat generalists: *Paramormyrops* sp. "magnostipes," *Mormyrops zanclirostris* and *Marcusenius moorii* were collected both in the creek and the big river sites.

In addition to the "Mormyrinae sp. unknown" and *Paramormyrops* sp. "Doumé" collected at the Doumé Rapids, other very valuable collections were made of yet-undescribed mormyrids—the majority of which no previous records existed from the Ogooué-Lolo Province. Before these collections, *Paramormyrops* "SN7" was known only from two specimens collected in 1999 from near Franceville. *Paramormyrops* sp. "BN2" was known from a small number of specimens from near Franceville (Lékoli River drainages), and also a small number from Loa-Loa on the Ivindo River. Collections of specimens, tissues, and EODs of both of these poorly known species will greatly facilitate preparing and publishing their descriptions and represent important extensions to their known ranges.

Paramormyrops sp. "magnostipes" is a widespread species across the Ogooué and Ntem basins that exhibits polymorphism in its EOD waveforms. Examples of each of the three known forms of EOD (types I–III; Arnegard 2006) were recorded in the course of these collections. No more than two EOD types had ever been recorded before in a limited geographical area (Arnegard 2006).

Mormyrid specimens collected are archived at the Cornell University Museum of Vertebrates (http://arctos.database.museum). EOD recordings made on this expedition will be archived in the Macaulay Library at the Cornell Laboratory of Ornithology.

Notopteridae

The only other osteoglossomorph fish we encountered was the African knife fish *Xenomystus nigri* in the Notopteridae family. Notopteridae are most closely related to mormyrid fishes (Lavoué and Sullivan 2004). African notopterids have electroreceptors and a well-developed electro-sensory lobe in the brain, but lack electric generating organs and do not produce an EOD. *Xenomystus* are nocturnal and may use their electro-receptive organs in passive prey detection, feeding mainly on worms, crustaceans, insects and snails. *Xenomystus* are typically found in heavily vegetated environments with minimal current. During the expedition we captured one specimen of *Xenomystus nigri* from the herbaceous banks of the Sébé using a gill net.

Table 4. Species of Notopterids collected. T = fish trap baited with earthworms, LS = large seine, SS = small seine, GN = gill net, C = cast net, D = dip net, E = electroshocker. Site and event numbers refer to Table 1. These data are based on preliminary identifications.

Family	Species name	Total Spec.	Event Nos.	Sites	Methods	Small River – Ogooué drainage	Major River – Ogooué drainage	Small River – Sébé drainage	Major River – Sébé drainage
Notopteridae	*Xenomystus nigri*	1	64	26	GN				X

Xenomystus nigri is widely distributed throughout the coastal regions of West and Central Africa. Within Gabon, specimens have been collected from the lower Ogooué as well as in many of major tributary systems of the Ogooué including the Ivindo, Lékoni, Mpassa, Ngounié and Sébé. It is noteworthy that we encountered only one specimen in the entirety of our sampling, as the known range for *Xenomystus nigri* encompasses the entire region sampled in September

Figure 17.
Xenomystus nigri.

2014. This is likely due to the combination of our sampling gear and the ecology, behavior and morphology of the species. As nocturnal insectivores that spend much of their time hiding in thick vegetation, *Xenomystus* are rarely caught in gill nets. We did not capture any *Xenomystus* in traps, possibly because we targeted deeper habitats when trap fishing.

Characiformes

The taxonomically and ecologically diverse Characiformes (an order of ray-finned fishes) represents one of the most important components of the ichthyological fauna throughout the freshwaters of Africa (Géry 1977, Daget *et al.* 1984, Stiassny *et al.* 2007). This collection in the middle Ogooué system obtained 18 distinct characiform species (Table 5), plus several specimens identified with sp. or cf. designations that might represent additional taxa. Thus, Characiformes comprises 21% of the 91 species collected during the expedition. The characiforms present in the Ogooué span most major ecological guilds, and include piscivores such as two species of *Hepsetus* (Decru *et al*. 2013), herbivores such as two species of *Distichodus* (Daget 1959), invertivores and insectivores such as *Nannocharax* (Daget 1961), *Neolebias* (Daget 1965) and *Hemistichodus* (Géry 1977) and omnivores such as *Xenocharax* (Daget 1960) and many of the species in family Alestidae (Géry 1977). There is nevertheless a notable absence of the detritivorous characiforms (Daget 1962, Arawomo 1975) in family Citharinidae, and the fin-eating specialists (Matthes 1961) in the distichondontid subfamily Ichthyoborinae.

Thirty distinct characiform species were previously known to occur in the middle to upper portions of the mainstem Ogooué or Sébé systems, excluding a handful of species considered endemic to the Ivindo, Ngounié and Ntem tributaries (Paugy and Schaefer 2007, Vari 2007, Fermon 2014). Of those 30 species, 19 were collected during this expedition. Species known from the system, but that do not appear in the collection include *Neolebias gossei, Neolebias unifasciatus, Nannaethiops unitaeniatus, Nannocharax parvus, Nannocharax ogoensis, Alestes macropthalmus, Brachypetersius gabonensis, Nannopetersius ansorgii, Nannopetersius lamberti*, and possibly *Brycinus tholloni*. This last species has not been reported from the specific portion of the Ogooué that we sampled but has a type locality in the upper portions of the Ogooué in Congo (Pellegrin 1901). The absence of this species from our collection suggests, but does not prove, that its range is restricted to the upper Ogooué and it does not occur near Lastoursville or in the Sébé system.

Table 5. Species of Characiformes collected. T = fish trap baited with earthworms, LS = large seine, SS = small seine, GN = gill net, C = cast net, D = dip net, E = electroshocker. Site and event numbers refer to Table 1. These data are based on preliminary identifications.

Family	Species name	Total Spec.	Event Nos.	Sites	Methods	Small River – Ogooué drainage	Major River – Ogooué drainage	Small River – Sébé drainage	Major River – Sébé drainage
Alestidae	Alestidae sp.	50	2, 7,12, 27, 67, 69	2, 6, 9, 14, 29, 30	D, LS, E	X	X	X	
Alestidae	*Brycinus* cf. *intermedius*	9	2	2	D	X			
Alestidae	*Brycinus kingsleyae*	12	1, 19, 20, 27, 39, 43, 58	1, 14, 15, 21, 25	D, LS, C, GN		X		X
Alestidae	*Brycinus macrolepidotus*	70	2, 12, 20, 21, 27, 33, 34, 41, 58	2, 9, 11, 14, 19, 25	D, LS, GN	X	X		X
Alestidae	*Brycinus opisthotaenia*	44	2, 12, 19, 22, 26, 30, 32, 41, 46, 43, 55, 56, 58, 62, 64	2, 9, 11, 13, 15, 19, 20, 21, 22, 25, 24, 26	D, LS, GN, C	X	X	X	X
Alestidae	*Brycinus* cf. *opisthotaenia*	1	53	22	D			X	
Alestidae	*Brycinus taeniurus*	36	1, 27, 58, 70	1, 14, 24, 25	D, LS, GN, SS		X		X
Alestidae	*Bryconaethiops macrops*	1	34	12	LS		X		
Alestidae	*Bryconaethiops microstoma*	70	12, 19, 21, 22, 34, 43, 57, 58, 59, 60, 62, 63, 65, 70	9, 11, 12, 13, 15, 21, 24, 25, 26, 27	LS, C, LS, GN, SS	X	X		X
Alestidae	*Brycinus* cf. *kingsleyae*	5	20, 21, 32, 58	11, 13, 14, 25	LS, GN		X		X
Alestidae	*Bryconalestes longipinnis*	96	2, 5, 11, 12, 13, 16, 20, 21, 22, 25, 26, 27, 32, 33, 38, 53, 55, 69, 70	2, 5, 6, 9, 11, 13, 22, 24, 30	D, SS, LS, GN, E	X	X	X	X
Alestidae	*Bryconalestes* cf. *longipinnis*	15	3, 7, 21, 22, 27, 43	3, 6, 11, 13, 14, 21	C, LS, GN, LS, D	X	X		
Alestidae	*Micralestes humilis*	6	16, 31, 32, 43	6, 13, 21	LS, GN, C	X	X		
Alestidae	*Phenacogrammus aurantiacus*	98	2, 12, 21, 22, 43	2, 9, 11, 13, 21	D, LS, GN, C	X	X	X	
Alestidae	*Phenacogrammus urotaenia*	9	43, 53	21, 22	C, D		X	X	
Alestidae	*Phenacogrammus* sp.	1	59	26	GN				X
Distichodontidae	*Distichodus hypostomatus*	11	4, 43, 58, 69	4, 21, 25, 30	SS, C, GN, E	X	X	X	X
Distichodontidae	*Distichodus notospilus*	19	21, 22, 35, 43, 53, 54, 60	11, 13, 21, 22, 23, 27	GN, C, D T, G		X		X
Distichodontidae	*Hemistichodus vaillanti*	35	2, 7, 16, 34, 48	2, 6, 12, 20	D, LS, GN	X	X		
Distichodontidae	*Nannocharax fasciatus*	1	16	6	LS	X			

Family	Species name	Total Spec.	Event Nos.	Sites	Methods	Small River – Ogooué drainage	Major River – Ogooué drainage	Small River – Sébé drainage	Major River – Sébé drainage
Distichodontidae	*Neolebias trewavasae*	71	53, 67, 71	22, 29, 31	D, E			X	
Distichodontidae	*Xenocharax spilurus*	23	2, 12, 16, 20, 21, 27, 30, 43, 59, 60, 64	2, 6, 9, 11, 14, 21, 26, 27	D, LS, GN, C	X	X		X
Hepsetidae	*Hepsetus kingsleyae*	6	8	7	D	X			
Hepsetidae	*Hepsetus lineata*	5	21, 52, 53, 71	11, 22, 31	GN, D, E		X	X	
Hepsetidae	*Hepsetus* sp.	2	53, 60	22, 27	D, GN			X	X

The characiform fauna of the Sébé region is largely a subset of that present around Lastoursville and Doumé. For example, *Micralestes humilis, Hemistichodus vaillanti, Bryconaethiops macrops, Hepsetus kingsleyae, Nannocharax fasciatus* and a set of specimens questionably assignable to *Bryconalestes longipinnis* and *Brycinus intermedius* were not collected in the Sébé. At least two of these species (*Micralestes humilis* and *Hemistichodus vaillanti*) are widespread enough in our sample to suggest that their absence from the Sébé is real, and not an artifact of incomplete collecting effort. The others represent species collected at only a single locality, or in the case of *Bryconalestes* cf. *longipinnis*, specimens that might match a species also caught in the Sébé system. *Neolebias trewavasae* offers a counterexample of a characiform species that is widespread in the Sébé system, but apparently absent from the rivers around Lastoursville and Doumé.

Figure 18. *Neolebias trewavasae.*

Figure 19. *Hemistichodus vaillanti.*

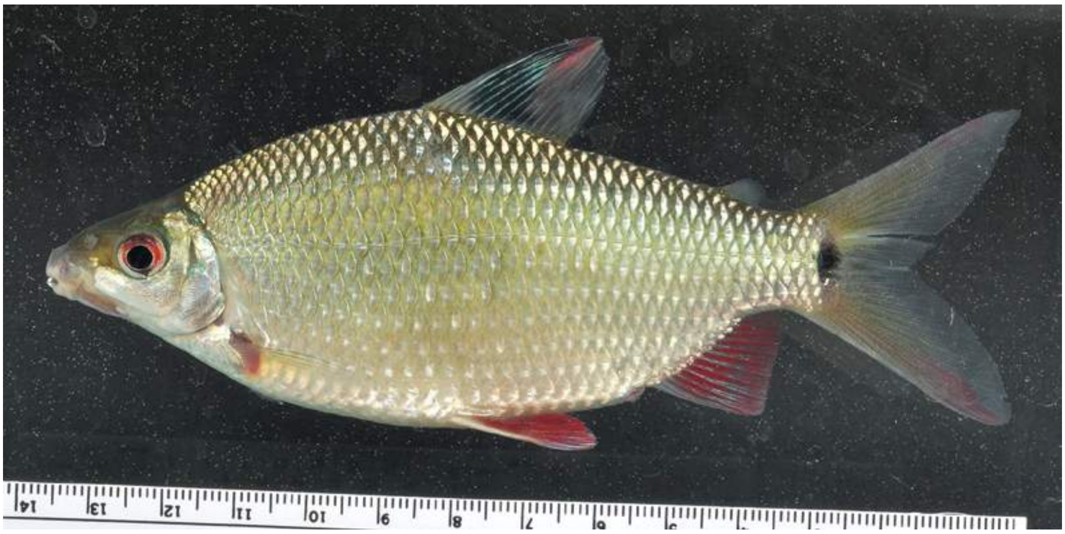

Figure 20. *Distichodus notospilus.*

Taken as a whole, characiforms inhabit all major habitat types in the Ogooué basin. However, not all species occur in all habitats. At least three well-represented characiform species appear to be restricted to main channels: *Brycinus kingsleyae*, *Brycinus taeniurus* and *Distichodus notospilus. Bryconaethiops macrops* may also fit that pattern, but with only one collection locality in this sample it is impossible to generalize. *Neolebias trewavasae* provides the best example of a characiform species that occurs only within small creeks in this region.

The lack of *Nannocharax ogoensis* from the collection is disappointing, as this is an understudied species described from a single specimen collected near Franceville (Pellegrin 1911). We did not specifically collect at Franceville and our closest collection site was approximately 100 km away from the type locality, so it is possible that we did not sample within the range of this species. The genus *Nannocharax* is otherwise represented in the collection by only a single specimen of *N. intermedius*, so our choice of gear may be partially responsible for the apparent absence. These fishes are diminutive and very narrow-bodied, and may have required nets with an even smaller mesh size. Most of the other missing characiform species are also small-bodied, and the choice of gear might also explain their absence from the collection.

The absence of *Alestes macropthalmus* is nevertheless notable, as this is a widespread and large-bodied species known to be present in the Ogooué (Paugy and Schaefer 2007). Its absence from our sample suggests that it is either rare or absent around Lastoursville, Doumé and in the Sébé system, at least during the month of September. It is difficult to know what might explain that absence, but microhabitat differences between these regions and the lower Ogooué, as well as the migratory behavior of the species, could be responsible and warrants further study.

Figure 21. *Bryconalestes* cf. *longipinnis*.

Figure 22. Juvenile *Hepsetus lineata.*

Figure 23. *Brycinus opisthotaenia.*

The specimens referred to as *Bryconalestes longipinnis* and *Bryconalestes* cf. *longipinnis* may actually represent a collection of several different species. This taxon has a geographic range that spans most of west and central Africa, and may represent a complex of closely related species (M. Stiassny, pers. comm.). There was substantial morphological diversity in coloration and fin shape among the specimens collected in the Ogooué and Sébe. We sent subsamples of relevant tissues to Melanie Stiassny at the American Museum of Natural History to sequence them for several mitochondrial genes and to include in a range-wide phylogeographic study. With results from that analysis as well as morphometric study of the specimens, we will be able to determine how many species of the *Bryconalestes longipinnis* complex occur in the Ogooué.

Lastly, a single adult characiform specimen presents an unsolved puzzle. It fits within either the genus *Nannopetersius* or *Phenacogrammus*, but the extent of the lateral line is intermediate for the two genera, and the coloration and pattern of scale counts do not match any known species from the Ogooué drainage. The specimen may represent a hybrid, a range extension or an undescribed species, but with only a single specimen and unfortunately, no matching DNA sample, it may be impossible to solve this problem without further sampling in the region.

Cyprinodontiformes

The Cyprinodontiformes (an order of ray-finned fishes known as killfishes) are small, slow-swimming epipelagic fishes that feed on the surface. These fishes are prized for their beauty and are popular in the aquarium trade. In the wild, Cyprinodontiformes are known for their dispersal ability on land, especially in the rainy season. New species have even been described from a single elephant footprint puddle. Interestingly, since these fishes are not strong swimmers, large rivers often serve as barriers to migration and gene flow between populations. This combination of dispersal ability and intrinsic barriers has, in part, led to the adaptive radiation of Cyprinodontiformes in Central Africa with over 70 described species in Gabon, and dozens more awaiting description.

Table 6. Species of Cyprinodontiformes collected. T = fish trap baited with earthworms, LS = large seine, SS = small seine, G = gill net, C = cast net, D = dip net, E = electroshocker. Site and event numbers refer to Table 1. These data are based on preliminary identifications.

Family	Species Name	Total Spec.	Event Nos.	Sites	Methods	Small River – Ogooué drainage	Major River – Ogooué drainage	Small River – Sébé drainage	Major River – Sébé drainage
Epiplatinae	*Epiplatys neumanni*	9	3, 5, 9, 67	3, 5, 8, 29	D, E	X		X	
Epiplatinae	*Epiplatys* cf. *singa*	1	3	3	D	X			
Nothobranchinae	*Aphyosemion lamberti*	38	2, 40	2, 16	D, E	X			
Nothobranchinae	*Aphyosemion* cf. *cyanostictum*	5	67	29	E			X	
Procatopodinae	*Plataplochilus* sp.1	101	1, 2, 3, 5, 7, 9, 17	1, 2, 3, 5, 6, 8, 10	D, E, LS	X	X		
Procatopodinae	*Plataplochilus* sp.2	115	53, 67, 69, 71	22, 29, 30, 31	D, E			X	

Since Cyprinodontiformes are largely restricted to small, slow moving streams, these fishes are easily caught at night, as they sleep on the surface, are visible by headlamp, and are slow swimming. During the rainy season, when rivers flood their banks, they travel out of the main channel and into the flooded forest. Notably, we collected several specimens of *Plataplochilus* from the banks of the mainstem Ogooué. These fishes may actually have been using the mainstem as a sanctuary from drying stream habitats during the dry season.

Plataplochilus fishes were collected during the expedition and classified into two populations in the field (*Plataplochilus* sp.1 and *Plataplochilus* sp.2). Both species may relate to *Plataplochilus cabindae* but also appear close to *Plataplochilus terveri* as well, both from a meristic and geographical perspective. We noted differences in coloration between populations, but a meristic analysis of morphology reveals no striking difference in the characters considered (number of rays in the anal and dorsal fins, number of scales present along the lateral line and dorsal fin inclusion from the anal fin). Moreover, the population of *Plataplochilus* sp.1 (TNC 2014-005), kept in aquariums for over a month, also developed a red color to the fins, the character that distinguished *Plataplochilus* sp.2. However, these may be two different species. Overall, specimens of *Plataplochilus* sp.2 are more colorful than *Plataplochilus* sp.1, particularly the fins (Figure 24). Some populations of *Plataplochilus* sp.1 *(*including those caught in sampling event 1 in the mainstem Ogooué) have colorless fins. DNA analysis will reveal the genetic proximity between *Plataplochilus* sp.1 and *Plataplochilus* sp.2. Nonetheless, this represents the first collection of *Plataplochilus* from the mainstem Ogooué, and is likely to result in at least one new species.

Fishes from the genus *Epiplatys* were collected in small rivers of both the Sébé and Ogooué drainages. Curiously, no more than three specimens were collected per site and no adult males were collected on this expedition, making taxonomic identification difficult. All specimen

Figure 24. *Plataplochilus* sp.

Figure 25. Female *Epiplatys neumanni.*

collected were keyed to *Epiplatys neumanni*, other than one juvenile individual which showed intermediate traits and remains classified as *Epiplatys* cf. *singa*.

Members of *Aphyosemion* are hyper-diverse in Gabon and were represented by two species in our collection. *Aphyosemion lamberti* is a widespread species that is highly prized in the aquarium trade. We also collected a small specimen that was classified as *Aphyosemion* cf. *cyanostictum,* which deserves expert attention. If indeed it is *A. cyanostictum,* this would be a dramatic range extension for the species and if not, it is likely a new species.

Figure 26. *Aphyosemion* cf. *cyanostictum.*

Cypriniformes

Cypriniformes (an order of ray-finned fishes) is a diverse and dominant freshwater group with a world-wide distribution of between 2,000–2,500 species globally. These fishes are usually active swimmers with streamlined bodies and large scales. Members of the Cypriniformes lineage have no teeth in their mouth, but have highly adapted pharyngeal jaws that allow them to consume a diverse prey assortment and occupy a wide variety of niches. Many species in this group are large and economically important. Many Cypriniformes are raised as aquaculture species, and some smaller species are popular with aquarists. In the Ogooué basin, some of the larger species are prized food fishes and are sold for high prices.

Figure 27. *Barbus camptacanthus.*

Figure 28. *Raiamas bucholzi.*

Table 7. Species of Cypriniformes collected. T = fish trap baited with earthworms, LS = large seine, SS = small seine, GN = gill net, C = cast net, D = dip net, E = electroshocker. Site and event numbers refer to Table 1. These data are based on preliminary identifications.

Family	Species Name	Total Spec.	Event Nos.	Sites	Method	Small River – Ogooué drainage	Major River – Ogooué drainage	Small River – Sébé drainage	Major River – Sébé drainage
Cyprinidae	*Barbus brazzai*	267	2, 12, 25, 30, 20, 27, 19, 43, 60, 62, 69	2, 9, 11, 14, 15, 21, 24, 27, 30	GN, LS, D, C, E	X	X	X	X
Cyprinidae	*Barbus camptacanthus*	18	2, 9, 67, 71	2, 8, 29, 31	D, E	X		X	
Cyprinidae	*Barbus guirali*	366	12, 19, 20, 21, 27, 30, 51, 53, 54, 55, 56, 57, 58, 60, 61, 62, 65, 67, 69, 70, 71	9, 11, 14, 15, 22, 23, 24, 25, 27, 28, 29, 30, 31	GN, SS, LS, T, E, D, LS	X	X	X	X
Cyprinidae	*Barbus* cf. *guirali*	14	2, 5, 22, 45	2, 5, 13, 17	D, GN	X	X		
Cyprinidae	*Barbus holotaenia*	83	1, 2, 3, 12, 19, 20, 25, 26, 27, 33, 34, 36, 43, 45, 46, 60, 62, 65, 67, 70	1, 2, 3, 9, 11, 12, 13, 14, 15, 17, 20, 21, 24, 27, 29	C, LS, SS, GN, E, D	X	X	X	X
Cyprinidae	*Barbus* cf. *holotaenia*	21	3, 5, 7, 9, 12	3, 5, 6, 8, 9	D, LS	X			
Cyprinidae	*Barbus* cf. *prionacanthus*	4	2, 3	2, 3	D	X			
Cyprinidae	*Barbus jae*	86	67, 71	29, 31	E			X	
Cyprinidae	*Barbus* cf. *jae*	1	67	29	E			X	
Cyprinidae	*Barbus* sp.	8	1, 67	1, 29	D, E		X	X	
Cyprinidae	*Barbus trispilomimus*	1	62	24	LS				X
Cyprinidae	*Labeo annectens*	6	21, 22, 32, 43, 59	11, 13, 21, 26	GN, C		X		X
Cyprinidae	*Labeo* cf. *annectens*	1	7	6	LS	X			
Cyprinidae	*Labeobarbus batesii*	1	43	21	C				X
Cyprinidae	*Labeobarbus progenys*	3	56, 58, 60	22, 25, 27	GN				X
Cyprinidae	*Labeobarbus* sp.	1	7	6	LS		X		
Cyprinidae	*Opsaridium ubanguiense*	1	16	6	LS		X		
Cyprinidae	*Raiamas bucholzi*	167	1, 2, 7, 12, 21, 25, 29, 22, 34, 26, 20, 27, 19, 45, 41, 43, 57, 62, 69, 70	1, 2, 6, 9, 11, 12, 13, 14, 15, 17, 19,21, 24, 30	GN, LS, SS, D, C, E	X	X	X	X

Cypriniform fishes are dominant in Gabon's freshwater systems, both in terms of species richness, total abundance of individuals and biomass. These diverse fishes occupy a variety of ecological niches from herbivory to predation, and many species are found in both large river and small stream habitats. We collected 12 species of cyprinid fishes representing five genera, with most of the diversity in the genus *Barbus*. Cyprinid fishes were prevalent in all habitat types and show a remarkable range of morphological diversity. Some of the small species were rapidly and effectively sampled using an electroshocker, whereas other species were rare catches in our gill nets.

Figure 29. ***Barbus guirali.***

The genus *Barbus* is extremely diverse, with 14 described species in Gabon alone. During our sampling expedition we caught just under 900 *Barbus* specimens representing at least seven species. Some species were present in all habitat types, and represent a large portion of our catch including *Barbus brazzai*, *B. guirali,* and *B. holotaenia,* while other species had more limited distributions. *Barbus camptacanthus* was only collected in small streams, but was found both in the Lastoursville area and the Sébé drainage. *Barbus* cf. *prionacanthus* was only collected in small streams in the Doumé area, whereas *Barbus jae* was only collected in small streams near the Sébe. In the field we noted a wide range of morphological variation within a number of these species and further analyses are warranted.

Figure 30. ***Barbus jae.***

Several specimens of an enigmatic and tiny species of *Barbus* were obtained by electroshocking in small creeks within the Sébé drainage. The specimens, all of which are less than 30 mm long, do not key out to any known species in Gabon and likely represent either an undescribed species or a substantial range extension. Sequencing of the single DNA voucher that we obtained may help resolve this question.

Figure 31. *Barbus* sp.

The *Labeobarbus*, or large barbus, are a monophyletic group of African fishes. Adults in many species grow to large sizes and are prized by artisanal fishermen, who call these types of fish "capitaine d'eau douce." Some *Labeobarbus* species are fish predators, including *Labeobarbus progenys*. The largest specimen we collected the entire expedition was a *Labeobarbus progenys.* We also collected a juvenile specimen of *Labeobarbus batesii*, which is another large, highly prized fish.

Figure 32. *Labeobarbus progenys.*

The genus *Labeo* is represented by five species in Gabon, one of which we collected on this expedition, *Labeo annectens.* These are medium to large cyprinids with large, often subterminal, lips and a cylindrical body. These fish are known for their fleshy "noses" which often have small tuberculate growths.

Opsaridium and *Raiamas* are similar genera of large predatory cyprinids with elongate, compressed, streamlined bodies, though *Raiamas* have larger mouths. We collected over 150 *Raiamas buchholzi* specimens and found the species in nearly every habitat. We only collected a few specimens of *Opsaridium*.

Figure 33. Juvenile *Labeo annectens.*

Perciformes

Perciform fishes (an order of ray-finned fishes) are among the most diverse groups of fishes globally and are well-represented in the Lower Guinean icthyofaunal province[6]. There are over 110 freshwater perciform species described from Gabon, including diverse groups such as cichlids and gobies. Perciformes have diversified to occupy a wide variety of habitat types and niches, and are a valuable food resource for local communities.

Perciform fishes were present but not dominant in any ecosystem we sampled. On this expedition we caught at least eight perciform species. Seven species were cichlids, and one species was an anabantid leaf fish. We collected perciform fishes in all habitat types, but they were more commonly collected in smaller streams.

Table 8. Species of Perciformes collected. T = fish trap baited with earthworms, LS = large seine, SS = small seine, GN = gill net, C = cast net, D = dip net, E = electroshocker. Site and event numbers refer to Table 1. These data are based on preliminary identifications.

Family	Species Name	Total Spec.	Event Nos.	Sites	Methods	Small River – Ogooué drainage	Major River – Ogooué drainage	Small River – Sébé drainage	Major River – Sébé drainage
Anabantidae	*Ctenapoma kingsleyae*	8	11, 46	9, 20	SS, GN	X		X	
Cichlidae	*Chromidotilapia kingsleyae*	26	2, 5, 7, 11, 16, 36, 38, 69	2, 5, 6, 9, 11, 30	D, LS, SS, GN, E	X	X	X	
Cichlidae	*Chromidotilapia regani*	2	7	6	LS	X			
Cichlidae	*Coptodon* sp.	1	12	9	LS	X			
Cichlidae	*Coptodon tholloni*	96	2, 7, 12, 13, 16, 19, 20, 21, 27, 34, 39, 43	2, 6, 9, 11, 12, 14, 15, 21	D, LS, GN, C	X	X	X	
Cichlidae	*Divandu albomarginatus*	1	36	11	GN	X			
Cichlidae	*Hemichromis elongatus*	69	1, 2, 3, 7, 9, 17, 21, 27, 34, 51, 55, 56, 69, 71	1, 2, 3, 6, 8, 10, 11, 12, 14, 22, 30, 31	D, LS, D, GN, LS,E	X	X	X	
Cichlidae	*Hemichromis* cf. *stellifer*	3	2	2	D	X			
Cichlidae	*Oreochromis schwebischi*	45	21, 29, 39, 43, 57, 58, 62, 70	11, 15, 21, 24, 25	GN, C, LS, SS		X		X
Cichlidae	*Pelmatolapia cabrae*	7	2, 39, 43	2, 15, 21	D, C	X	X		

Within *Hemichromis*, we collected the ubiquitous *Hemichromis elongatus*, found quite commonly across Gabon where they are known as "carpe rayeé," as well as the small "red" *Hemichromis* cf. *stellifer*. This "red group" shows a wide geographical range in Africa, and several authors described several species, while others consider this intraspecific variation. Three specimens of *Hemichromis* cf. *stellifer* were collected from site 2, a small river in Lastoursville that enters from the left bank of the Ogooué. The absence of this species from all other collection sites is interesting.

Chromidotilapiines are represented by *Chromidotilapia regani, C. kingsleyae*, and *Divandu albomarginatus*. Both of the *Chromidotilapia* spp. are very common in the Ogooué, but *Divandu* are more commonly known from the southern side of the Ogooué.

The third group, representing tilapiine fishes, includes eleven species known from Gabon from four genera, three of which were collected on this expedition, *Coptodon*, *Pelmatolapia* and *Oreochromis*. Some of these fishes are mouthbrooders, while others are substrate spawners. The *Coptodon* species complex is very challenging for taxonomists and keying our specimens

6 An area that comprises approximately 680,000 square kilometers along an arc of the Gulf of Guinea from the Cross River in Nigeria to the Chiloango River in the Angolan province of Cabinda. http://vivo.cornell.edu

Figure 34. *Hemichromis elongatus.*

Figure 35. *Divandu albomarginatus.*

in the field was difficult. Many species were present both in large and small streams, although *Oreochromis schwebischi* was only collected in large rivers. It is surprising that we did not collect any *Parananochromis* species, which are common in the Ivindo and Sébé rivers.

The only non-cichlid perciform species we collected during this expedition was *Ctenopoma kingsleyae.* These anabantids are commonly found in marshes, inundated forests, river margins and other oxygen-deficient waters. We collected *Ctenopoma* in both large and small rivers around Lastoursville but did not collect any in the Sébé or its tributaries. This probably reflects the more substantial fishing effort in the former region, rather than a true difference between the two sites.

Figure 36. *Coptodon tholloni.*

Figure 37. *Ctenopoma kingsleyae.*

Siluriformes

Siluriformes (an order of ray-finned fishes also known as catfishes), are one of the most diverse freshwater fish lineages and are well-represented in the Lower Guinean icthyofaunal province, and Africa as a whole. Globally there are over 2,867 described catfish species, 446 genera and 35 families (Nelson 2006). In the Lower Guinean icthyofaunal province there are 109 species, 24 genera and 8 families (Stiassny *et al*. 2007), and the Ogooué is known to hold roughly 73 species (Fermon 2013). Siluriformes are scaleless fishes with barbels. Many species are nocturnal benthic predators, but the diversity within Central African catfishes is astonishing and ranges from free-swimming pelagics, to sucker-mouth rheophilic species, to strongly electric species. Some species reach large sizes and are valuable protein sources for local populations.

From our sampling, we obtained at least 14 distinct siluriform species from six families and eleven genera (Table 9), plus several specimens identified with sp. or cf. designations that could represent additional taxa. Siluriforms represented 15% of the 91 fish species collected during the expedition. In addition to the taxonomic richness of catfishes collected on this trip, catfish likely represented the greatest biomass of any order of fishes captured on this trip.

The Siluriform fauna collected on this expedition are so diverse that results are listed by family: Schilbeidae, Amphiliidae, Claroteidae, Clariidae, Malapturidae and Mochokidae.

Table 9. Species of Siluriform fishes collected. T = fish trap baited with earthworms, LS = large seine, SS = small seine, GN = gill net, C = cast net, D = dip net, E = electroshocker. Site and event numbers refer to Table 1. These data are based on preliminary identifications.

Family	Species Name	Total Spec.	Event Nos.	Sites	Methods	Small River – Ogooué drainage	Major River – Ogooué drainage	Small River – Sébé drainage	Major River – Sébé drainage
Amphiliidae	*Amphilius* cf. *nigricaudatus*	24	2, 3, 16, 17, 67, 69, 71	2, 3, 6, 10, 29, 30, 31	D, LS, E	X		X	
Amphiliidae	*Phractura* spp.	24	2, 3, 13, 69	2, 3, 9, 30	D, E	X		X	
Clariidae	*Clarias buthupogon*	16	5, 67, 69, 71	5, 29, 30, 31	D, E	X		X	
Clariidae	*Clarias gabonensis*	8	2	2	D	X			
Clariidae	*Clarias* sp.	2	7, 69	6, 29	LS, E	X		X	
Claroteidae	*Chrysichthys nigrodigitatus*	174	2, 7, 12, 19, 20, 21, 22, 25, 27, 30, 43, 46, 57, 62, 70, 71	2, 6, 9, 11, 13, 14, 15, 20, 21, 24, 31	D, LS, C, SS, E	X	X	X	X

Family	Species Name	Total Spec.	Event Nos.	Sites	Methods	Small River – Ogooué drainage	Major River – Ogooué drainage	Small River – Sébé drainage	Major River – Sébé drainage
Claroteidae	*Parauchenoglanis* cf. *punctatus*	8	2, 41, 54, 71	2, 19, 23, 31	T, E, D, GN	X	X	X	
Malapteruridae	*Malapterurus oguensis*	1	71	31	E			X	
Mochokidae	*Atopochilus savorgnani*	3	4, 7	4, 6	LS, SS	X			
Mochokidae	*Synodontis tessmani*	1	65	27	GN				X
Mochokidae	*Synodontis batesii*	14	7, 13, 14, 16, 53, 54, 69	6, 9, 22, 23, 30	LS, D, SS, T, E	X	X	X	
Schilbeidae	*Parailia occidentalis*	2	12, 45	9, 17	LS, D		X		
Schilbeidae	*Pareutropius debauwi*	40	1, 16, 21, 43, 60, 62, 63, 65, 70	1, 6, 11, 21, 24, 25, 27	D, LS, GN, C, SS	X	X		X
Schilbeidae	*Schilbe grenfelli*	10	21, 22, 58, 60, 63	11, 13, 25, 27	GN		X		X
Schilbeidae	*Schilbe multitaeniatus*	10	21, 26, 33, 58, 60, 63, 70	11, 13, 24 25, 27	GN, SS		X		X
Schilbeidae	*Schilbe* sp. (small specimens)	2	45	17	D		X		

Schilbeidae

Schilbeid catfishes are active, often pelagic swimmers with laterally compressed bodies and dorso-ventrally compressed heads. Globally, schilbeid catfishes are catagorized into 18 genera and 45 species and are distributed throughout Sub-Saharan Africa, and some South and Southeast Asian countries. Most species are found in Africa, and the Lower Guinean icthyofaunal province has a total of 14 species, six of which are known from Gabon.

On this expedition we collected four distinct species of schilbeid catfishes from three genera: *Parailia, Schilbe* and *Pareutropius*. Each species has a broad distribution throughout the Ogooué basin. The morphological variation within this family is remarkable; *Parailia* are popular aquarium species as they are fragile, transparent fishes that school along riverbanks, whereas *Schilbe* catfishes can grow to hundreds of kilos and are active pelagic predators. There is evidence that some species of schilbeid catfishes consume whole fruits and nuts from overhanging vegetation, and may serve as a seed dispersal mechanism for forest plants. In our sampling, we encountered nearly all our schilbeid catfishes in large rivers, indicating a strong preference for larger habitats. However, different genera of schibeids seem to exploit different regions of the river, with *Parailia* along the banks and *Schilbe* and *Pareutropius* in the main channel.

Figure 38. *Schilbe grenfelli.*

Figure 39. *Parailia occidentalis.*

Amphiliidae

Amphiliid catfishes, or loach catfishes, are a highly derived clade of African rheophilic catfishes. In some species, the pectoral and pelvic fins are broad and form a weak sucking disc to help the fish cling to rocks in swift streams. There remains taxonomic confusion within the group, but there are currently roughly ten species classified into seven genera in the Ogooué basin. There are ten amphiliid catfishes known from collections in Gabon (Fermon 2013), and on this sampling expedition we caught two species from two genera, *Phractura* and *Amphilius*. As Amphiliids are found mostly in fast-flowing streams and rivers, they are therefore notoriously difficult to sample. We caught amphilliid catfishes using two techniques: dip netting in deep brush, and electrofishing. Since these techniques only work in smaller rivers, we only caught specimens from small streams, although they are likely found in the larger rivers as well.

Figure 40. *Phractura brevicauda.*

Claroteidae

Claroteid catfishes are represented globally by 90 species and 13 genera, two of which we encountered on our expedition, *Parauchenoglanis* and *Chrysichthys*. *Parauchenoglanis* is a relatively new genus and there still remains taxonomic confusion about many of the species and taxonomic groups. We caught eight *Parauchenoglanis* catfishes, all of which were tentatively assigned to *P. punctatus.* These fishes were present in effectively every habitat, but at low densities.

Figure 41. *Parauchenoglanis* cf. *punctatus.*

Figure 42. *Chrysichthys nigrodigitatus* (dorsal view).

The other claroteid genus we sampled was *Chrysichthys*, which seems ever-present, and whose serrated spines can easily cause puncture wounds to humans. We noticed considerable morphological variation within the *Chrysichthys* we captured, but the degree to which that variation represents sexual dimorphism, phenotypic plasticity across a habitat gradient, or the presence of multiple species is difficult to assess without the assistance of a specialist in this genus. In some species, males have enlarged heads during spawning season, which can make taxonomic classification challenging. Some described species have turned out to be males of a known species (Hardman and Stiassny 2008).

Clariidae

Clariid catfishes, also known as air-breathing or walking catfishes, are a diverse family of catfishes that extend from Africa to the Philippines and Java. Globally there are 14 genera represented by 90 species, while in the Lower Guinean icthyofaunal province there are five genera and 23 species of clariid catfishes. Clariid catfishes are extremely hardy fishes and are therefore popular aquaculture species. This has led to the introduction and invasion of clariid catfishes into a number of environments throughout Africa, Asia and the Americas. These catfishes can live in completely anaerobic conditions (de-oxygenated water), by breathing air. Many clariid catfishes, known locally as "silure," grow quite large and are important food fishes for local consumption and commerce. On this expedition we caught 26 clariid catfishes of at least two species, *Clarias buthupogon* and *C. gabonensis*. Further inspection of the specimens will help to resolve cf. and sp. identifications. Though *Clarias* catfishes are known to occur in both large rivers and small streams we only collected samples from small streams, and only found juvenile specimens. We likely did not encounter any large adults in the main river since they are nocturnal fish not particularly common in the main channel, except in swampy areas.

Figure 43. *Clarias gabonensis.*

Malapteruridae

Malapteruridae, the electric catfishes, are siluriforms endemic to Africa. There are three described species, but taxonomists suggest that there may be as many as 20 distinct species (Norris 2002). These fishes are fascinating examples of strongly electric fishes and are capable of producing shocks of up to 350 volts. The electric organs are derived from modified muscle

Figure 44. ***Malapterus oguensis.***

tissues that run the entire length of the body just under the skin. These electric organs are composed of numerous elements arranged in series like the plates of a battery so that the longer the fish, the greater the charge. Malapturids use their electric organs both for protection as well as hunting, and are voracious predators of cichlids, clupeids, and schilbeids. They hunt by emitting a powerful, high-frequency electric discharge in proximity to a school of fishes, and therefore can paralyze many fishes simultaneously.

During this expedition, we collected a single specimen on the final day of sampling of *Malapterus oguensis* using the electroshocker. We were surprised by its absence in our collections up until that point. Interestingly, when we caught the malapterid catfish, it had a large mormyrid dangling from its mouth. Presumably, we had shocked the mormyrid right into a hollowed-out log and into the mouth of an electric catfish. Both specimens were retained alive for processing.

Mochokidae

Mochokid catfishes are the most species-rich family of African catfishes, represented by ten genera and over 175 species, 66% of which are in the genus *Synodontis*. On this expedition we caught two species of *Synodontis* catfishes, and one other mochokid catfish in the genus *Atopochilus*. In the Lower Guinean icthyofaunal province there are approximately 30 species, most of which are endemic and have small ranges. Most mochokids are small, and many are colorful, making them popular in the aquarium trade. Some species are rheophilic algae scrapers with sucker-mouths (including *Chiloglanis*), but many mochokids have a more typical catfish morphology and sub-terminal mouth. Most mochokids have bony armor on their heads and possess robust spines, but lack armor on their bodies. Mochokid catfishes appear to live at relatively low densities in the wild

Figure 45. ***Synodontis tessmani.***

Figure 46. ***Atopochilus savorangi.***

and are infrequently caught in all habitat types. *Synodontis* catfishes spend much of their time in thick brush and are best caught using dip nets and electrofishing; however their spines are easily caught in nets and they are also captured this way. *Atopochilus* catfishes are rheophilic, but we caught our only specimens of this genus in a small, slow-moving stream with a seine. We captured one specimen of *Synodontis tessmani*, a rare Ogooué-endemic in the Sébé.

Taken as a whole, siluriforms inhabit all major habitat types in the Ogooué including small creeks, moderately-sized streams, and the river's main channel. However, not all species occur in all habitats. Pelagic schilbeid catfishes were found primarily in larger rivers, and most species were absent from small creeks. Although it is likely that they exist in many habitats, rheophilic catfishes including *Amphilius*, *Phractura*, and *Atopochilus* were only captured in small rivers. This could be a result of limitations to sampling within rapid environments in larger rivers. *Chrysichthys* catfishes were present and abundant in all habitat types, with much morphological differentiation among the *Chrysichthys* specimens.

Synbranchiformes

The order Synbranchiformes (an order of ray-finned fishes also called swamp eels) is represented by only one family in Gabon, the Mastacembalidae. These are eel-shaped fishes with 64 species widely distributed in tropical and subtropical Africa, the Middle East, South-East Asia and China. They are peculiar fishes with a tubular nostril, and confluent soft dorsal, anal and caudal fins. Mastacembelids are demersal, or bottom-dwelling fishes. But some species live in densely vegetated backwater habitats, and others are rheophilic. In the Lower Guinean icthyofaunal province, there is one genus and eight species recognized. On our sampling expedition we collected at least one species of mastacembelid, but considerable variation among specimens necessitates further assessment to identify them.

Table 10. Species of Mastacembelids collected. T = fish trap baited with earthworms, LS = large seine, SS = small seine, GN = gill net, C = cast net, D = dip net, E = electroshocker. Site and event numbers refer to Table 1. These data are based on preliminary identifications.

Family	Species Name	Total Spec.	Event Nos.	Sites	Methods	Small River – Ogooué drainage	Major River – Ogooué drainage	Small River – Sébé drainage	Major River – Sébé drainage
Mastacembelidae	*Mastacembelus niger*	23	7, 10, 61, 67, 69, 71	6, 28, 29, 30, 31	E, LS, T	X		X	X
Mastacembelidae	*Mastacembelus cf. marchei*	3	67, 69, 71	29, 30, 31	E			X	

Mastacembelids are found in many aquatic habitats, including standing water, rivers and rapids. Most species are carnivorous, feeding on zooplankton, insect larvae, worms and small fish, and mastacembelids can occasionally be caught in worm-baited traps with mormyrids. We also caught mastacembelids using a small seine, but used largely as a barrier net while kicking organic debris downstream. We had tremendous success sampling mastacembelids using the

Figure 47. *Mastacembelus* sp.

backpack electroshocker and caught more specimens in one hour with the shocker, than with all the other sampling gear combined. While this tool is only effective in small streams, in the future, it will allow us to more effectively sample mastacembelid diversity.

Rheophilic mastacembelids are absent from our collections largely due to their ecology. They wedge into rocky crevices to withstand the strong currents and are only sampled effectively using rotenone (which was not used on this expedition).

Figure 48. The Ogooué banks at Lopé National Park.

Clupeiformes

Clupeiformes (an order of ray-finned fishes) are a diverse group of marine and freshwater fishes that include the herring, anchovies and sardines. While the marine species are better known, estuarine and fully-freshwater species exist, as well as migratory species. Gabon is home to two species: *Pellonula vorax* and *Pellonula leonensis*. These species have highly overlapping ranges and are found in lagoons and rivers along the coast from the Cross River (Nigeria) to the Kouilou River (Republic of Congo). These fishes are characterized as freshwater migrants, meaning they live primarily in freshwater but visit the estuary occasionally and may breed in estuaries. Only one species, *Pellonula vorax*, was collected on this expedition.

Pellonula vorax ecology has not been studied in Gabon, but other freshwater clupiform species have been shown to eat primarily aquatic macroinvertebrates, algae and plant detritus. Like other clupiform fishes, *Pellonula* often form massive schools and are important in local food webs and for human consumption.

Table 11. Species of Clupeiformes collected. T = fish trap baited with earthworms, LS = large seine, SS = small seine, GN = gill net, C = cast net, D = dip net, E = electroshocker. Site and event numbers refer to Table 1. These data are based on preliminary identifications.

Family	Species Name	Total Spec.	Event Nos.	Sites	Methods	Small River – Ogooué drainage	Major River – Ogooué drainage	Small River – Sébé drainage	Major River – Sébé drainage
Clupeidae	*Pellonula vorax*	2	21, 22	11, 13	GN		X		

Pellonula vorax is a wide-ranging species known in most coastal rivers of Central Africa. This species has been collected in the Ogooué system before, but never so far inland. If the fishes collected on this expedition migrate to estuaries to breed, this suggests biological connectivity from the Atlantic to Doumé at least.

Fishing-Gear Based Results

A total of 71 fishing events were performed at 31 sites. A maximum of three fishing techniques, or gears types, were used for each site (Table 1, 12). All fishing methodologies (other than electrofishing) were used in larger rivers, although most techniques were limited to the littoral zone. For small streams, swamps and springs, electroshocker and bicycle-wheel dip nets were used. Table 12 provides a summary of sampling methodology and fishing effort during each sampling event. Table 13 summarizes taxonomic diversity by sampling methodology.

A total of 2,876 fish were collected during the expedition, totaling to a minimum of 91 distinct species representing 18 families of fishes. In the following analysis, pending identifications (individuals labeled with cf. or sp.) for 56 specimens have been removed, and therefore the species richness presented is a minimum.

Table 12. Fishing effort for each site. H = Time (min), N = Number of fish, N/H = Number of fish per hour, SR = Specific richness.

		Overall				Large Seine				Small Seine				Hand Net				Cast Net				Gill Net				Traps				Electroshocker		
Site	River width (in m)	H	N	N/H	SR	H	N	N/H	SR	H	N	N/H	SR	H	N	N/H	SR	H	N	N/H	SR	H	N	N/H	SR	H	N	N/H	SR	H	N	N/H
1	>100	70	27	23.14	10									70	27	23.14	10															
2	1	50	199	238.80	39									50	199	238.80	39															
3	7	56	53	56.79	16									56	53	56.79	16															
4	8–10	20	4	12.00	4					20	4	12.00	4																			
5	2.5	60	71	71.00	20									60	71	71.00	20															
6	15	469	292	37.36	26	*174*	224	77.24	26	40	1	1.50	1													255	67	15.76	18			
7	4	10	6	36.00	1									10	6	36.00	1															
8	8	40	28	42.00	5									40	28	42.00	5															
9	20	80	129	96.75	20	*30*	117	234.00	20	30	3	6.00	3	20	9	27.00	4															
10	5–10	40	4	6.00	4									40	4	6.00	4															
11	>100	2064	78	2.27	30																	2064	78	2.27	30							
12	>100	15	33	132.00	8	*15*	33	132.00	8																							
13	>100	1015	34	2.01	18																	1015	34	2.01	18							
14	>100	48	312	390.00	14	*48*	312	390.00	14																							
15	>100	47	163	208.09	9	*33*	157	285.45	9									14	6	25.71	4											
16	1	20	34	102.00	5																									20	34	102.00
17	>100	60	39	39.00	28									30	9	18.00	9									30	30	60.00	28			
19	>100	175	4	1.37	4																	175	4	1.37	4							
20	>100	634	18	1.70	4																	634	18	1.70	4							
21	>100	40	57	85.50	25													40	57	85.50	25											
22	5–10	1540	125	4.87	20									62	95	91.94	20					1478	30	1.22	5							
23	5–10	82	15	10.98	11									7	1	8.57	1									75	14	11.20	11			
24	45–100	55	413	450.55	12	*35*	358	613.71	10	20	55	165.00	12																			
25	45–100	320	56	10.50	13																	320	56	10.50	13							
26	45–100	285	10	2.11	4																	285	10	2.11	4							
27	45–100	290	33	6.83	15																	290	33	6.83	15							
28	45–100	220	70	19.09	27																					220	70	19.09	27			
29	2–5	93	175	112.90	49																									93	175	112.90
30	2–5	85	180	127.06	20																									85	180	127.06
31	2–5	125	158	75.84	38																									125	158	75.84

In sampling biodiversity, species richness directly depends on the number of fish caught, methodology utilized, and time spent sampling at different sites. Furthermore, some species are more easily captured than others. This arises, in part, due to differences in morphology (e.g. spines, shape), habitat (e.g. rapids-adapted, swamp-adapted, littoral), and ecology (e.g. schooling, nocturnal, pelagic). Some techniques produce many conspecific specimens, for example, large seines may capture 50–100 juvenile *Chrysichthys* catfishes in a single pull. Other techniques, including trapping, produce a high number of species when compared to the total number of fish captured. Some fishes, including mastacembelid eels, are difficult to capture without an electroshocker, but other fishes are caught by any methodology. In general, cyprinids, alestids, and cichlids are found in all habitats and are easily caught in their littoral habitats. However, in each of these families, some species are not easily caught. For example, *Hemichromis* cf. *stellifer* ("red" *Hemichromis*) was only caught in small streams, and *Barbus jae* was only captured by electroshocker.

Table 13. **Distribution of number of individuals collected by family based on sampling gear used (*excluding specimens with pending identifications).**

Family	Beach Seine	Cast Net	Electroshocker	Gill Net	Hand Net	Small Seine	Traps	Total Individuals
Alestidae	194	19	6	105	138	6		468
Amphiliidae	1		28		19			48
Anabantidae				7		1		8
Cichlidae	175	15	10	23	24	4		251
Clariidae	1		15		10			26
Claroteidae	154	3	3	14	5	1	2	182
Clupeidae				2				2
Cyprinidae	593	9	282	57	64	38	7	1050
Distichodontidae	22	15	60	20	39	2	2	160
Hepsetidae			1	4	8			13
Malapteruridae			1					1
Mastacembelidae	1		23				2	26
Mochokidae	3		1	1	6	3	4	18
Mormyridae	28	1	20	6	13		164	232
Nothobranchiidae			42		12			54
Notopteridae				1				1
Poecilliidae	1		55		160			216
Schilbeidae	28	1		23	4	8		64
Total of fish	1201	63	547	263	502	63	181	2820*
Number of families	12	7	14	12	13	8	6	18

Results from Data Analysis

Species Distribution Analysis

In order to capture the widest possible diversity of fishes, the expedition sampled 31 sites from a wide variety of habitats using six distinct classes of gear (Figure 9). To determine which of these sites were most similar and dissimilar to each other in their fish faunas, presence-absence data from 27 of these localities was input to a UPGMA (Unweighted Pair Group Method with Arithmetic mean) clustering algorithm in the program PAST using a Jaccard index of similarity, which excludes similarity due to paired absences. This analysis excluded specimens identified only to the level of family, and four localities at which fewer than three species were captured.

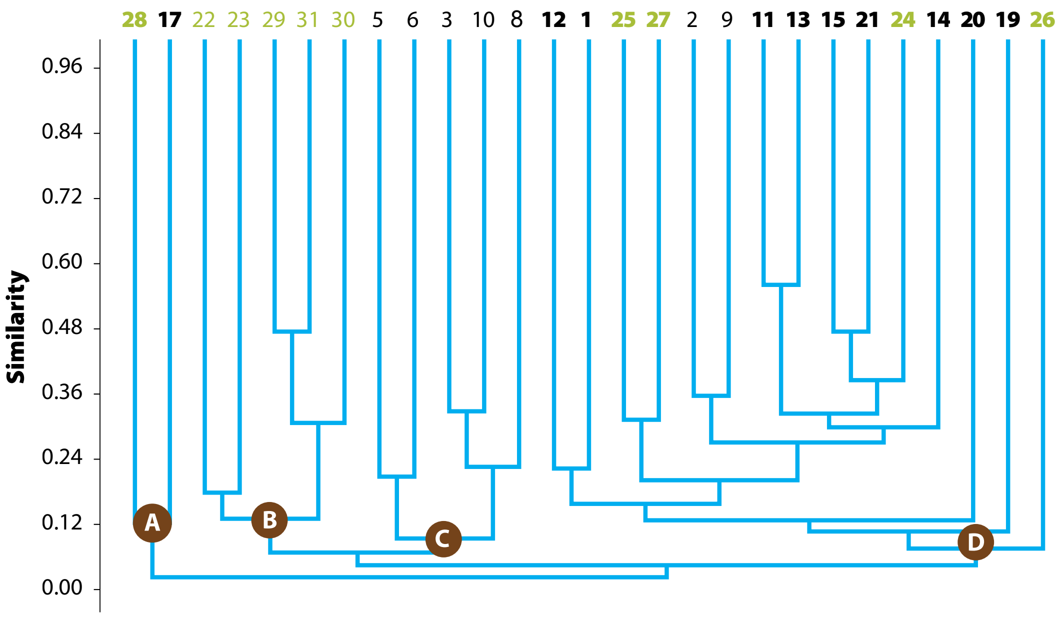

Figure 49. UPGMA dendrogram based on similarity among collection sites. Boldface numbers at the tip of the branches indicate large rivers and normal typeface indicates small rivers. Black text indicates sites around Doumé on the Ogooué mainstem sub-basin and green numbers indicates sites in the Sébé drainage. Nodes with lettered circles are discussed in the text.

While among-site heterogeneity was quite high, the UPGMA analysis reveals four clusters of localities (Figure 49). Excluding two sites (cluster A) fished exclusively or almost exclusively by worm-baited traps (at which almost all fishes collected were in family Mormyridae), the primary division occurs between the faunas typical of small streams (clusters B and C) and large rivers (cluster D). Streams in the former class are typically 1–20 m in width and frequently have abundant overhanging vegetation, leaf litter or fallen wood. Large river localities occur on the mainstems of the Ogooué and Sébé and are characterized by faster water velocities and channel widths in excess of 20 m. Both categories include sites with a variety of substrates and levels of human impact. One of the two small river sites (site 9) included in cluster D has the largest channel width (close to 20 m) in the small river class, and the other (site 2) is a small creek sampled proximate to its confluence with the mainstem Ogooué. Thus, it appears that the distinctive faunal profile of clusters B and C characterizes small rivers near the Sébé and Doumé (respectively) of 20 m width and narrower.

While no single species universally diagnoses large river from small river habitats, some generalities do emerge. Many members of Characiformes are much more prevalent in large river than in small river habitats, with *Brycinus taeniurus*, *B. kingsleyae* and *B.* sp. all abundant in the main channels, but entirely absent from small rivers. Two species of schilbeid catfishes (*Schilbe grenfelli* and *S. multitaeniatus*), the mormyrid *Petrocephalus simus*, the cichlid *Oreochromis schwebischi* and the cyprinid *Labeo annectens*, are similarly restricted to large river habitats. The cyprinid *Raiamas buchholzi*, the characiforms *Bryconaethiops microstoma*, *Brycinus macrolepidotus* and *Brycinus opisthotaenia*, and the catfish *Pareutropius debauwi* are much more abundant in large rivers than small ones.

Though some species are ubiquitous (e.g. *Barbus holotaenia*, *Barbus guirali*, and *Bryconalestes longipinnis*) the fauna of the small creeks and rivers differs substantially from that of the main channels. In particular these systems harbor an exceptional diversity of small-bodied species. The miniature characiform *Neolebias trewavasae*, the miniature cyprinid *Barbus jae*, *Barbus camptacanthus*, the rheophilic catfishes in genus *Amphilius*, *Clarias*, *Phractura* as well as *Synodotis batesii*, the nothobranchid killifishes in genus *Aphyosemion*, and *Mastacembelus* cf. *marchei* are found only in small rivers (or in the case of *Aphyosemion*, also in the single spring habitat that we sampled). Nothobranchids in the genus *Plataplochilus* are much more prevalent in small river habitats, but also occur in vegetation at the extreme margins of the main river channels.

Faunal differences between small creeks in cluster B (Sébé region) and cluster C (Doumé region) primarily involve segregation of small-bodied species. Three miniaturized fishes, *Neolebias trewavasae*, *Barbus jae*, an unidentified species of *Barbus* with dark fins and one of the two putative species of *Plataplochilus*, occur only in small rivers within the Sébé system. Our single specimen of electric catfish, *Malapterurus oguensis* was caught in this region. *Barbus guirali* and both species of mastacembelids are substantially more widespread in small creeks in the Sébé region than among stream sites near the mainstem of the Ogooué.

The mormyrid *Stomatorhinus walkeri*, several species of *Paramormyrops*, and the cyprinids *Barbus* cf. *holotaenia* and *Barbus* cf. *prionacanthus*, occur at multiple stream sites in the Doumé region and nowhere else in our sample. The nothobranchiid *Aphyosemion* cf. *lamberti* occurred at one stream and one spring site in this region. Several other species may also be restricted to the Doumé area, including the mormyrid *Brienomyrus brachyistius*, the characiform and *Nannocharax fasciatus*, the cyprinid *Opsaridium ubanguiense*, the cichlid *Pelmatolapia cabrae* and *Hemichromis* cf. *stellifer*, and the catfish *Atopochilus savorgnani*, though all these were rare in our samples and appeared only at only a single site. Further collecting would clarify their actual distributions in the region. A second species of *Plataplochilus* occurs primarily in stream habitats near the mainstem Ogooué, but was also collected in vegetation along the shoreline of the major river. This species was entirely absent from the Sébé system.

Relationship between Substrate and Species

To investigate the habitat preferences of the species we sampled, we performed a co-inertia analysis between fish species occurrences (presence/absence table) and substrate. For this analysis, we used seven variables for substrate: sand, gravel, rocks, leaves, roots and dead wood, mud, and vegetation. We used a correspondence analysis for the species tables and a multiple correspondence analysis for the substrate table using ADE4 for R software (Tucker 1958; Cazes 1980, Statzner *et al.* 1994, Castella *et al.* 1995, Thioulouse *et al.* 1997, Dray *et al.* 2007, and Dray and Dufour 2007). The results of this analysis separate species associated with rocks and sand from species associated with leaves, vegetation, mud and roots and dead wood.[7]

The species that preferred habitat dominated by leaves are the amphiliid species, the clariids, *Clarias buthupogon*, the mochokid *Synodontis batesii*, the cichlids *Chromidotilapia kingsleyae* and *Hemichromis elongatus*, the spiny eel *Mastacembelus niger* and the mormyrids *Marcusenius moorii* and *Mormyrops zanclirostris*. For mud, the main species are the notopterid *Xenomystus nigri*, the killis *Plataplochilus* sp. 2 and *Aphyosemion* cf. *cyanostictum* and *Aphyosemion lamberti*, two siluriforms, the electric catfish *Malapterurus oguensis* and *Parauchenoglanis* cf. *punctatus*, the African pike *Hepsetus lineata*, the barb *Barbus jae*, the characiform *Neolebias trewavasae*, the alestid *Phenacogrammus urotaenia*, and the climbing perch *Ctenopoma kingsleyae*. The mormyrid *Paramormyrops* sp. "vadamans" and the schilbeid *Parailia occidentalis* are associated with roots and dead wood.

On rocks and sand we find the distichondontid *Distichodus hypostomatus* and *D. notospilus*, the alestid *Bryconaethiops macrops*, the cichlid *Divandu albomarginatus*, the clupeid *Pellonula vorax* and the mochokid *Atopochilus savorgnani* and *Synodontis tessmani*. In localities with only sand

7 Details of this analysis and results can be requested from the authors.

recorded, we found the mormyrids *Petrocephalus microphthalmus* and *P. sullivani*, as well as the barb *Barbus trispilomimus*.

Associated with gravel, we find *Hepsetus kingsleyae*, the alestid *Brycinus* cf. *intermedius*, the cichlid *Hemichromis* cf. *stellifer*, and the catfish *Clarias gabonensis*. Within sites with vegetation are found the killis *Plataplochilus* sp. 1 and *Epiplatys neumani*, the mormyrid *Stomatorhinus walkeri* and the cyprinid *Barbus camptacanthus*.

Notable Fishes and Problematic Identifications

Osteoglossiformes

Mormyridae

There are several undescribed *Paramormyrops* in the collection.

Characiformes

Alestidae

One alestid specimen in the collection cannot be reliably identified to genus or species, and appears to be intermediate between the current concepts of *Phenocogrammus* and *Nannopetersius*. It may represent a hybrid, a new species, or possible a substantial range extension. With only one specimen and no DNA sample, it is impossible to be certain.

Hepsetidae

In the recent work of Decru *et al*. 2013, the genus *Hepsetus* has been split in two species which may be found in sympatry, *H. kingsleyae* and *H. lineata*. However, in the Ogooué around Doumé, we found some specimens which show mixed characteristics of both. These might be hybrids, or simply an indication that these two species are in fact synonymous.

Cyprinidontiformes

Nothobranchiidae

The *Aphyosemion* from the Sébé are probably *Aphyosemion cyanostictum*, though there has been some discussion about whether these might represent a new species. One way or another, it at least represents a range extension of a species previously known only from the Ivindo and Okano basins. Jouke Van der Zee (from the Royal Museum for Central Africa, Teruven) writes, "The geographically closest population is near Tebe in the upper Bouniandje River, a left bank tributary of the Ivindo. The distance to the Sébé is maybe 80–100 km, but is in a totally different drainage."

Poeciliidae

The *Plataplochilus* from the Sébé region is very likely to represent a new species (vouchered examples: BLS14-113, BLS14-169). Thibault Cavelier thought that it was a new species while in the field and several killifish experts online (including Jouke Van der Zee with Royal Museum for Central Africa, Tervuren) confirmed the novelty. The closest match appears to be *Plataplocheilus cabindae*, but this species lives on the coastal plains of Central Africa and has an orange eye, as opposed to the uncolored eye of the specimens from the Sébé. *Plataplocheilus terveri* is known from the Sébé region but is not a morphological match for the specimens that we collected.

Cypriniformes

Cyprinidae

Yves Fermon noted a morphologic difference in *Barbus camptacanthus* in which specimens from the middle and upper Ogooué are more elongate than previously sampled material from the lower portions of the river. Comments made on the Facebook album "Fishes of the Ogooué River" by Brian Sidlauskas posted during and after the expedition also suggested that the specimens from the upper Ogooué might represent a new species close to *Barbus* *camptacanthus*. Alternatively, this could reflect geographic variation. It would take DNA analysis and careful morphometrics to take this further.

The numerous specimens referred to *Barbus guirali* may actually represent multiple species. We observe substantial variation in body depth, and while this might represent allometric variation (with larger individuals achieving deeper bodies) some of the variation might also reflect the presence of multiple species. It will take careful study to sort this out.

There is substantial color variation among the individuals of the dwarf cyprinid *Barbus jae*, which might represent sexual dimorphism, regional variation, or the presence of multiple species.

Another miniature *Barbus* species caught in the same location with *Barbus jae* (for example, BLS14-161) with red to black fins and no bars might represent a new species or even a new genus. Specimens will be loaned to the lab of Jon Armbruster (professor of ichthyology at Auburn University, USA) for further study; this lab specializes in this group of fishes.

Perciformes

Cichlidae

According to Anton Lamboj (a cichlid expert with University of Vienna), the specimens identified as *Hemichromis stellifer* are actually undescribed, and are currently under description by another team of scientists.

Anton Lamboj also thinks that the *Coptodon* that we collected (BLS-GAB-526) is not *Coptodon tholloni*, but has not confirmed what species it is.

Figure 50. *Hemichromis* cf. *stellifer.*

Siluriformes

John Friel and Tom Vigliotta (experts in mochokid catfishes with Cornell University) re-identified BLS-GAB-514 as *Atopochilus savorgnani* (originally identified as *Chiloglanis*). This species was described by Sauvage in 1879 from a specimen collected at Doumé by Alfred Marche, and we are pleased to see it is still present in the area.

BLS14-135 was originally identified as *Synodontis albolineatus*, but is actually *Synodontis tessmanni*. Either way, this is a rare endemic fish.

A great deal of discussion about the *Chrysichthys* specimens erupted on Facebook among experts. The taxonomy of the group is unclear, and therefore it is unclear which species were collected in the Ogooué. BLS-GAB-529 from the area near Doumé has a very short head and long fins and was indicated to typify a sand-sifting morphology. BLS14-045 has a much flatter head and was suggested to be a nocturnal piscivore. One of these might be *C. ogoensis*, or these might be males and females of the same species, or alternative life history morphs.

Yves Fermon indicated some uncertainty in the identification of the specimens referred to *Parauchenoglanis*. They might be *Parauchenoglanis punctatus*, but he used a cf. designation, suggesting that he saw some differences.

Synbranchiformes

Mastacembelidae

It appears we caught both known species from the area (*Mastacembelus marchei* and *M. niger*), however several specimens show color patterns that differ from those typically seen in these species. This group needs further study in Gabon.

Notes on Use of Social Media

Many of the identifications and species-specific points of discussion above stem from extended conversations that took place among professional ichthyologists and knowledgeable amateurs on Facebook and Twitter. More than 100 high quality photographs of live, anaesthetized and/or recently euthanized fishes formed the basis of these discussions, and by posting these on occasion throughout the trip, we allowed the world's community of ichthyologists to refine our identifications and provide scientific input while we were still in the process of collecting specimens. In particular, the Facebook album "Fishes of the Ogooué River" with contributions from Brian Sidlauskas and John P. Sullivan, as well as their Twitter accounts @BrianSidlauskas and @jpsullivan65 were the primary modes of communicating during the expedition.

This external assistance greatly accelerated and improved the accuracy of our identifications and highlighted specimens of interest to the scientific community. It is particularly notable that this regular feedback afforded us the capacity to refine our focus and try to collect additional specimens of enigmatic or scientifically desirable fishes. For example, we received substantial input from the Armbruster lab at Auburn University, which is actively working on the systematics of the confusing genus *Barbus*, and the Friel lab at Cornell, which specializes in African catfishes.

This is not the first time that social media have been used to community-source taxonomic identifications (Sidlauskas *et al*. 2011) but it may be one of the first times that many of the external identifications have been provided while the expedition was still taking place. We accomplished this largely by periodically accessing a wireless connection at the headquarters of CEB, but such access was serendipitous. In the future, we recommend that expeditions plan for data access to regional cellular networks.

Figure 51. *Synodontis batesii.*

Conclusion and Initial Recommendations

The main objective of this expedition was to sample and characterize fish biodiversity within and around the Rapids of Mboungou Badouma and Doumé Ramsar site to provide baseline assessments of its biodiversity and freshwater habitat. In total, the expedition team performed 71 fishing events at 31 sites on the Ogooué River and some of its tributaries near Lastoursville and Doumé, including in and near the Ramsar site. A total of 2,876 fish were collected, totaling to a minimum of 91 distinct species (known species including non-described species) representing 18 families of fishes.

This expedition was a critical first step towards building a framework for effective management, conservation and development of the biologically and historically significant Rapids of Mboungou Badouma and Doumé Ramsar site. However, as the expedition did not cover the site's complete extent, it is as yet only a partial assessment. Also, as it was described in this report, further analysis on some of specimens are still being done, so additional results with important implications for conservation can still emerge in the coming months and would become available through specific publications.

Nonetheless, some preliminary and relevant outcomes from this expedition include:

- A partial baseline fish biodiversity survey for the Ramsar site.
- Resampling the historically significant site at Doumé.
- Successfully electrofishing Central African streams.
- Characterization of fish faunal distributions based on location and habitat site.
- The collection of samples of undescribed species of the genus *Paramormyrops.*
- The discovery of a mormyrid fish that may represent a new genus.
- The possible discovery of at least one new species of killifish.
- The collection of an enigmatic alestid fish.
- The discovery of a potential new dwarf species of *Barbus.*

While this report is not intended to serve as an exhaustive species list, it serves as a foundation for the development of resource management plans in the area. The discovery of an undescribed generic-level taxon in the Ogooué River at Doumé underscores how under-explored this region remains, and the need for this type of collecting and taxonomic study. Biological data is invaluable for newly-formed protected areas, both to catalog biodiversity, and as baselines for monitoring conservation progress. Further research should focus on seasonal changes in the river, biogeographic patterns, local exploitation and ecological processes.

The results from the biodiversity assessment presented in this (and in subsequent publications) can be used by the responsible government entities in their decision-making to improve conservation and management of the tremendous natural richness and diversity of this important region of Gabon. We also envision that other stakeholders—local communities, regional and local authorities, NGOs, industry leaders and operators, among others—can find interesting and relevant information that will encourage the sound stewardship of these resources.

As a result of these findings, we propose a list of initial recommendations to improve the conservation and management of the Rapids of Mboungou Badouma and Doumé Ramsar site. These are:

- Develop a management plan for the Ramsar site that takes into consideration the information from this report as partial baseline, and follows the management guidelines in preparation by the Ministry of Water and Forests and the National Agency for National Parks.

- Encourage Gabonese graduate students to conduct research on the seasonal dynamics of the Ramsar site, perhaps focusing on fish migrations or spawning.
- Conduct systematic fish (or multi-taxon) collection programs in all the major sub-catchments of the Ogooué River basin to discover unidentified biodiversity.
- Engage local fishermen in the sustainable management of local fisheries.
- Communicate to and increase awareness within a broader audience about the important natural and socio-economic values of the Ogooué River and its tributaries, and highlight the role of citizens in its long-term conservation.

The Nature Conservancy, as a co-sponsor of this expedition and within its capacity of providing technical advice and expertise to national leaders and institutions in support of Gabon's sustainable development priorities; is committed to supporting the implementation of the above recommendations.

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Appendix 1. Sampling at Doumé: Comparing Modern and Historic Collections

Site Characteristics

As described by Marche, the *chûtes* (falls) at Doumé are not very considerable and are much smaller than those at Booué and Poubara. They consist of a single drop of less than 2 m where the river narrows to somewhat less than 200 m between rocky outcroppings extending from both banks. As Marche notes, below the falls the river is more canalized with visible current and sandbanks, sandy beaches and emergent rocks in the dry season; while above, the river is wider without exposed sand and with areas of forest that become flooded during high water. This portion of the Ogooué flows from east to west; and the village of Doumé is situated on the left bank, just below the falls. A rocky outcropping beside the falls is accessible from the main village road. The river appears to be largely undisturbed by human activity. The population of the village of Doumé consists of a few hundred people. Local fishing activity was observed (several gill nets) but fishing pressure seems to be light. Across from Doumé on the right bank is an abandoned sawmill from which leads a road to the CEB forestry headquarters, approximately 12 km to the north. At the falls itself, we recorded a water temperature of 26.7°C, a pH of 6.89, water conductivity of 13.8 µS/cm and dissolved oxygen of 84.7% (TNC-14-44).

While the Doumé Rapids probably do not constitute any kind of barrier to fish migration or dispersal, the falls and rocky habitat surrounding it provides habitat for rheophilic and lithophilic species represented by *Atopochilus savorgnani*, *Doumea typica* and *Paramormyrops sphekodes* in the Marche/Sauvage collection.

Doumé Fish Collections

Fishing at Doumé took place during three days, September 15–18, 2014 (sites 11–21, collecting events 19–48) making use of gill nets, seines, cast nets, dip nets and fish traps baited with earthworms. Pending confirmed identification of certain specimens, we collected 42 species belonging to ten families of fishes (Table 2) in the Ogooué River near Doumé. A forty-third species, *Aphyosemion* cf. *lamberti* (site 16, event 40) representing an eleventh family, was collected with the electroshocker from a spring behind the elementary school in Doumé (event 40).

Not counting specimens of uncertain identification, family representation in order of species diversity from the Ogooué River collections at Doumé is as follows: Alestidae (10), Mormyridae (8), Cyprinidae (6), Cichlidae (5), Schilbeidae (4), Distichodontidae (4), Claroteidae (2), Hepsetidae (1), Clupeidae (1) and Anabantidae (1). These data are based on preliminary identifications.

While these collections represent a wide taxonomic swath of the fish fauna at Doumé, they are obviously an incomplete sample. Certain elements, particularly clariid, amphiliid and mochokid catfishes, are not represented at all, nor are mastacembelid eels and certain mormyrids that should be there (although these groups were sampled at other localities). Notably, of the 12 species Sauvage reported from Marche's Doumé collection, we recovered only two (*Paramormyrops sphekodes* and *Petrocephalus simus*) at Doumé and nine species (*Mastacembelus marchei*, *M. niger*, *Labeobarbus compiniei*, *Ivindomyrus marchei*, *Stomatorhinus walkeri*, *Clarias buthopogon*, *C. gabonensis*, *Atopochilus savorgnani* and *Doumea typica)* did not appear in our collections, although all but *Labeobarbus compiniei* and *Atopochilus savorgnani* were recovered at other sites during the expedition. (Neither Sauvage nor Marche specified if all Marche's species had come from the Ogooué itself, or whether some could have been from nearby tributaries.)

Each fishing technique employed proved useful at Doumé. Gill net and seine were the most productive as measured by number of individuals and species. While most species represented by multiple individuals were collected by more than one method; four species (all mormyrids) were captured uniquely with fish traps, five species were captured only by seine, seven species only in gill nets, four species only by cast net, and two species only by dip net.

While more than half the collecting effort at Doumé took place after sunset and before sunrise, most species of cyprinids, distichodontids, alestids and cichlids were collected both during daytime and night-time hours, while species of the two catfish families and the mormyrids were collected uniquely after sunset. Only a single species, *Hemistichodus vaillanti*, was collected only in daylight hours.

The numerically most-abundant species in our collections were *Barbus brazzai* and *Chrysichthys nigrodigitatus* at 172 and 127 specimens, respectively, and the two species represented in the greatest number of collection events were *Barbus holotaenia* (11) and *Raiamas buchholzi* (12). Oddly, none of these four most-common species were present in Marche's 1876 collection.

Notable Species Findings, Habitats, Threats, Other Observations

Fishing just below the falls with worm-baited fish traps after sunset was particularly effective for capturing mormyrid species, with four of the eight mormyrid species captured here taken uniquely with this technique. The cylindrical traps are made of 1 cm mesh plastic fencing material with two funnels at each end. Earthworms are threaded onto rattan skewers that extend into the trap. The traps are weighted with rocks and tethered by an eight-meter cord. One trap was set on September 16 and five were set on September 17, 2014, just below the lip of the rocky outcropping that forms the falls, submerged in two to four meters of water in calm water adjacent to areas of swift current. They were checked approximately every 20 minutes. The first three hours after sunset were the most productive.

Over two nights of fishing (events 28 and 44) *Paramormyrops sphekodes* was the most common mormyrid captured (21 individuals) followed by *Marcusenius moorii* (10 individuals). Two additional specimens of the enigmatic undescribed "short-headed" *Paramormyrops* species (*Paramormyrops* sp. "Doumé"), represented in Marche's collection were captured in the traps and a third was taken by cast net just above the falls (event 43). A single individual of an unknown species was also taken in the fish traps during event 44. It is not immediately obvious to what genus of mormyrid this specimen belongs; it does not appear to be a *Paramormyrops*, a *Marcusenius*, or an *Ivindomyrus*. Study of this specimen including DNA sequencing is ongoing.

Table 14. Species of fish collected by Alfred Marche on the Ogooué River and described or listed in Sauvage (1879, 1880).

Name in Sauvage, 1879	Current Status	Locality Given
Protopterus annectens Owen	valid as *Protopterus annectens* (Owen 1839)	Ogooué
Micracanthus marchei Sauvage (n. sp.)	synonym of *Betta splendens* Regan 1910	Doumé
Mastacembelus marchei Sauvage (n. sp.)	valid as *Mastacembelus marchei* Sauvage 1879	Chute de Doumé
Mastacembelus niger Sauvage (n. sp.)	valid as *Mastacembelus niger* Sauvage 1879	Doumé
Hemichromis bimaculatus Gill	likely *Hemichromis elongatus* (Guichenot 1861)	Doumé
Barbodes camptacanthus Bleeker	valid as *Barbus camptacanthus* (Bleeker 1863)	Lopé
Barynotus compiniei Sauvage (n. sp.)	valid as *Labeobarbus compiniei* (Sauvage 1879)	not given
Petrocephalus marchei Sauvage (n. sp.)	valid as *Ivindomyrus marchei* (Sauvage 1879)	Doumé
Petrocephalus affinis Sauvage (n. sp.)	synonym of *Stomatorhinus walkeri*(Günther 1867)	Doumé
Petrocephalus simus Sauvage (n. sp.)	valid as *Petrocephalus simus* (Sauvage 1879)	Doumé
Mormyrops sphekodes Sauvage (n. sp.)	valid as *Paramormyrops sphekodes* (Sauvage 1879)	Doumé
Clarias buthupogon Sauvage (n. sp.)	valid as *Clarias buthupogon* Sauvage 1879	Doumé

Name in Sauvage, 1879	Current Status	Locality Given
Clarias gabonensis Günther*	valid as *Clarias gabonensis* Günther 1867	Doumé
Atopochilus savorgnani Sauvage (n. sp.)	*valid as Atopochilus savorgnani Sauvage 1879*	*Chute de Doum*
Pimelodus balayi Sauvage (n. sp.)	valid as *Parauchenoglanis balayi* (Sauvage 1879)	Lopé
Malapterurus electricus var. oguensis Lin.	valid as *Malapterurus oguensis* Sauvage 1879	Lopé
Doumea typica Sauvage (n. sp.)	valid as *Doumea typica* Sauvage 1879	Doumé

Table 15. Species of fish collected during this expedition in the Doumé region. T= fish trap baited with earthworms, S = seine, GN = gill net, C = cast net, D = dip net. Site and event numbers refer to Table 1. These data are based on preliminary identifications.

Family	Species Name	Count	Method	Site No.	Event No.
Mormyridae	*Marcusenius moorii*	10	T, S	14, 17	20, 44
Mormyridae	*Mormyrops nigricans*	1	T	17	44
Mormyridae	*Paramormyrops* sp. "offouensis"	2	T	17	44
Mormyridae	*Paramormyrops* sp. "Doumé"	3	T, C	17, 21	43, 44
Mormyridae	*Paramormyrops sphekodes*	21	T	17	28, 44
Mormyridae	*Petrocephalus simus*	3	S, GN	11, 14	20, 21
Mormyridae	*Petrocephalus sullivani*	2	S	14	20
Mormyridae	unknown sp.	1	T	17	44
Clupeidae	*Pellonula leonensis*	1	GN	11, 13	21
Cyprinidae	*Barbus brazzai*	172	S, GN, C	11, 14, 15, 21	19, 20, 25, 27, 30
Cyprinidae	*Barbus* cf. *guirali*	3	GN, D	13, 17	22, 45
Cyprinidae	*Barbus guirali*	58	S, GN	11, 14, 15	19, 20, 21, 27, 30
Cyprinidae	*Barbus holotaenia*	30	S, GN, C, D	11, 12, 13, 14, 15, 17, 20, 21	19, 20, 25, 26, 27, 33, 34, 36, 43, 45, 46
Cyprinidae	*Labeo annectens*	4	GN, C	11, 13, 21	21, 22, 32, 43
Cyprinidae	*Labeobarbus batesii*	1	C	21	43
Cyprinidae	*Raiamas buchholzi*	47	S, GN, C, D	11, 12, 13, 14, 15, 17, 19, 21	19, 20, 21, 22, 25, 26, 27, 29, 34, 41, 43, 45
Distichodontidae	*Xenocharax spilurus*	16	S, GN, C	11, 14, 21	20, 21, 27, 30, 43
Distichodontidae	*Distichodus hypostomatus*	7	C	21	43
Distichodontidae	*Distichodus notospilus*	14	GN, C	11, 13, 21	21, 22, 35, 43
Distichodontidae	*Hemistichodus vaillanti*	3	S, GN	12, 20	34, 48
Alestidae	unidentified	11	S	14	27
Alestidae	*Brycinus kingsleyae*	8	S, C	14, 15, 21	19, 20, 27, 39, 43
Alestidae	*Brycinus macrolepidotus*	40	S, GN	11, 12, 14, 19	20, 21, 27, 33, 34, 41
Alestidae	*Brycinus opisthotaenia*	16	S, GN, C	11, 13, 15, 19, 20, 21	19, 22, 26, 30, 32, 41, 43, 46
Alestidae	*Brycinus* sp.	3	S, GN	11, 13, 14	20, 31, 32
Alestidae	*Brycinus taeniurus*	16	S	14	27
Alestidae	*Bryconaethiops macrops*	1	S	14	34
Alestidae	*Bryconaethiops microstoma*	15	GN, S, C	11, 12, 13, 15	19, 21, 22, 34, 43
Alestidae	*Bryconalestes* cf. *longipinnis*	11	S, C	11, 13, 14, 21	21, 22, 27, 43
Alestidae	*Bryconalestes longipinnis*	26	S, GN	11, 13, 14	20, 21, 22, 25, 26, 27, 32, 33, 36, 38
Alestidae	*Micralestes humilis*	5	GN, C	13, 21	31, 42, 43
Alestidae	*Phenacogrammus aurantiacus*	3	GN, C	11, 13, 21	21, 22, 43
Alestidae	*Phenacogrammus urotaenia*	3	C	21	21
Hepsetidae	*Hepsetus lineata*	1	GN	11	21
Claroteidae	*Chrysichthys nigrodigitatus*	127	S, GN, C	11, 13, 14, 15, 20, 21	19, 20, 21, 22, 25, 27, 30, 43, 46
Claroteidae	*Parauchenoglanis punctatus*	1	GN	19	41
Schilbeidae	*Pareutropius debauwi*	2	GN, C	11, 21	21, 43

Family	Species Name	Count	Method	Site No.	Event No.
Schilbeidae	*Parailia occidentalis*	1	D	17	45
Schilbeidae	*Schilbe grenfeli*	7	GN	11, 13	21, 22
Schilbeidae	*Schilbe multitaeniatus*	3	GN	11, 13	21, 26, 33
Schilbeidae	SCHILBEIDAE unidentified	2	D	17	45
Cichlidae	*Chromidotilapia kingsleyae*	2	GN	11	36, 38
Cichlidae	*Coptodon tholloni*	13	S, GN, C	11, 12, 14, 15, 21	19, 20, 21, 27, 34, 39, 43
Cichlidae	*Hemichromis elongatus*	5	S	11, 12, 14	21, 27, 34
Cichlidae	*Oreochromis schwebischi*	18	GN, C	11, 15, 21	21, 29, 39, 43
Cichlidae	*Pelmatolapia cabrae*	4	C	15, 21	39, 43
Anabantidae	*Ctenapoma kingsleyae*	7	GN	20	46

Appendix 2. List of Species Known and Collected from the Ogooué River and its Major Tributaries around the Ramsar Site

Table 16. List of all known fish species from the Ogooué River and its major tributaries around the Ramsar site. Species names appear in the far left column. Species collected on previous expeditions (Fermon 2013) are indicated on the left side of the table, and species collected on the 2014 expedition are indicated on the right. The "All" column represents all fishes collected on the 2014 expedition; the taxonomic certainty are indicated by the following symbols: ● indicates confirmed presence; * indicates possible new species to be verified; ** indicates presence and confirmed taxonomic novelty.

Species	From Previous Expeditions					From 2014 Expedition				
	Ogooué	Sébé	Lassio	Lékoni	RAMSAR	Ogooué	Sébé	Lassio	Lékoni	All
Polypterus retropinnis		●								
Heterotis niloticus	●									
Pantodon buchholzi	●									
Xenomystus nigri	●	●		●			●			●
Boulengeromyrus knoepffleri										
Brienomyrus brachyistius	●			●		●				●
Isichthys henryi	●									
Ivindomyrus marchei	●		●		●		●			●
Ivindomyrus opdenboschi										
Marcusenius moorii	●	●	●			●	●			●
Marcusenius ntemensis		●								
Mormyrops nigricans	●					●				●
Mormyrops zanclirostris	●	●			●	●	●			●
Paramormyrops batesii										
Paramormyrops curvifrons	●		●							
Paramormyrops gabonensis										
Paramormyrops hopkinsi										
Paramormyrops kingsleyae	●	●	●	●						
Paramormyrops longicaudatus	●									
Paramormyrops sp. "1118"						●	●			**
Paramormyrops sp. "BN2"						●				**
Paramormyrops sp. "magnostipes"	●					●	●			**
Paramormyrops sp. "SN7"						●				**
Paramormyrops sp. "vadamans"	●					●	●			**
Paramormyrops sp. (unknown)								●		**
Paramormyrops sp. offouensis						●	●			**
Paramormyrops sphekodes	●		●		●	●	●			●
Petrocephalus balayi	●									
Petrocephalus microphthalmus	●		●			●	●			●
Petrocephalus simus	●		●		●	●				●
Petrocephalus sullivani	●				●	●				●
Stomatorhinus ivindoensis										
Stomatorhinus walkeri	●				●	●				●
Laeviscutella dekimpei	●									
Odaxothrissa ansorgii	●									
Pellonula leonensis	●					●				●

Species	From Previous Expeditions					From 2014 Expedition				
	Ogooué	Sébé	Lassio	Lékoni	RAMSAR	Ogooué	Sébé	Lassio	Lékoni	All
Pellonula vorax	●									
Grasseichthys gabonensis	●									
Parakneria abbreviata	●									
Parakneria cameronensis										
Barbus brazzai	●	●	●			●	●			●
Barbus brichardi	●									
Barbus camptacanthus	●	●		●	●	●	●			●
Barbus collarti										
Barbus condei										
Barbus diamouanganai										
Barbus guirali	●	●			●	●	●			●
Barbus holotaenia	●	●	●	●	●	●	●			●
Barbus jae	●	●					●		●	●*
Barbus martorelli	●									
Barbus prionacanthus	●	●	●			●				*
Barbus rubrostigma	●									
Barbus trispilomimus	●						●			●
Labeo annectens	●		●			●	●			●*
Labeo batesii	●									
Labeo camerunensis										
Labeo cyclorhynchus	●									
Labeo lukulae										
Labeobarbus batesii	●					●				●
Labeobarbus caudovittatus	●									
Labeobarbus compiniei	●									
Labeobarbus malacanthus										
Labeobarbus micronema	●									
Labeobarbus progenys	●						●			●
Opsaridium ubangiense	●	●	●			●				●
Raiamas buchholzi	●									
Varicorhinus axelrodi	●									
Varicorhinus sandersi										
Varicorhinus steindachneri	●									
Varicorhinus tornieri										
Varicorhinus werneri										
Distichodus hypostomatus	●	●	●			●	●			●
Distichodus notospilus	●	●	●			●	●			●
Hemigrammocharax ocellicauda										
Hemistichodus vaillanti	●		●			●				●
Nannaethiops unitaeniatus	●									
Nannocharax fasciatus		●				●				●
Nannocharax intermedius	●									
Nannocharax latifasciatus										
Nannocharax maculicauda										
Nannocharax ocellicauda										
Nannocharax ogoensis										
Nannocharax parvus	●	●								
Neolebias ansorgii	●						●		●	*

Species	From Previous Expeditions: Ogooué	From Previous Expeditions: Sébé	From Previous Expeditions: Lassio	From Previous Expeditions: Lékoni	From Previous Expeditions: RAMSAR	From 2014 Expedition: Ogooué	From 2014 Expedition: Sébé	From 2014 Expedition: Lassio	From 2014 Expedition: Lékoni	From 2014 Expedition: All
Neolebias gossei	●									
Neolebias kerguennae	●									
Neolebias trewavasae	●	●			●					
Neolebias unifasciatus	●									
Xenocharax spilurus	●	●				●	●			●
Alestes macrophthalmus	●									
Brachypetersius gabonensis	●									
Brycinus bartoni	●					●				*
Brycinus intermedius	●					●				*
Brycinus kingsleyae	●		●			●	●			●
Brycinus macrolepidotus	●	●				●	●			●
Brycinus opisthotaenia	●					●	●			●*
Brycinus taeniurus	●	●				●	●			
Brycinus tholloni										
Bryconaethiops macrops						●				●
Bryconaethiops microstoma	●	●	●		●	●	●			●
Bryconalestes longipinnis	●	●	●			●	●			●*
Micralestes elongatus	●	●								
Micralestes humilis						●				●
Nannopetersius ansorgii	●									
Nannopetersius lamberti										
Phenacogrammus aurantiacus	●					●				●
Phenacogrammus urotaenia	●					●	●			●
Hepsetus kingsleyae	●					●				●
Hepsetus lineata	●					●	●			●
Parailia occidentalis	●					●				●
Pareutropius debauwi	●	●				●	●			●
Schilbe grenfelli	●	●				●	●			●
Schilbe laticeps	●	●								
Schilbe multitaeniatus	●	●	●			●	●			●
Amphilius caudosignatus	●									
Amphilius longirostris										
Amphilius nigricaudatus	●					●	●	●		*
Amphilius pulcher										
Doumea typica	●									
Paramphilius baudoni										
Phractura brevicauda	●					●	●			*
Phractura intermedia	●									
Phractura longicauda	●	●			●					
Channallabes alvarezi			●							*
Channallabes apus	●									
Channallabes longicaudatus										
Channallabes ogooensis	●									
Channallabes teugelsi										
Clariallabes brevibarbis	●									
Clariallabes longicauda										
Clarias angolensis	●									
Clarias buthupogon	●	●				●	●			●
Clarias camerunensis	●	●								●

Species	From Previous Expeditions					From 2014 Expedition				
	Ogooué	Sébé	Lassio	Lékoni	RAMSAR	Ogooué	Sébé	Lassio	Lékoni	All
Clarias gabonensis	●	●	●			●				
Clarias jaensis	●									
Clarias longior										
Clarias pachynema	●	●								
Clarias platycephalus	●	●								
Clarias submarginatus										
Gymnallabes typus	●									
Heterobranchus longifilis	●									
Chrysichthys (Chrysichthys) auratus	●	●								
Chrysichthys (Melanodactylus) nigrodigitatus	●	●				●	●			●
Chrysichthys (Melanodactylus) ogooensis	●									
Chrysichthys (Rheoglanis) thysi	●		●							
Notoglanidium boutchangai	●									
Notoglanidium macrostoma	●									
Parauchenoglanis altipinnis										
Parauchenoglanis balayi	●	●								
Parauchenoglanis punctatus	●	●				●	●			●*
Malapterurus beninensis	●									
Malapterurus oguensis	●						●			●
Atopochilus savorgnani	●					●				●
Atopodontus adriaensi										
Chiloglanis cameronensis	●					●				
Microsynodontis armatus										
Microsynodontis batesii	●	●								
Microsynodontis laevigata										
Microsynodontis nasutus										
Microsynodontis notata										
Microsynodontis vigilis	●									
Synodontis acanthoperca	●									
Synodontis albolineata										
Synodontis aterrimus										
Synodontis batesii	●	●				●	●			●
Synodontis haugi	●	●	●							
Synodontis ngouniensis										
Synodontis obesus	●									
Synodontis polyodon	●									
Synodontis punu										
Synodontis tessmanni		●					●			*
Aphyosemion (Aphyosemion) lamberti	●	●				●				●
Aphyosemion (Aphyosemion) rectogoense	●			●						
Aphyosemion (Diapteron) abacinum										
Aphyosemion (Diapteron) cyanostictum									●	●
Aphyosemion (Diapteron) fulgens										

Species	From Previous Expeditions					From 2014 Expedition				
	Ogooué	Sébé	Lassio	Lékoni	RAMSAR	Ogooué	Sébé	Lassio	Lékoni	All
Aphyosemion (Diapteron) georgiae	●									
Aphyosemion (Diapteron) seegersi										
Aphyosemion (Episemion) callipteron										
Aphyosemion (Mesoaphyosemion) aureum										
Aphyosemion (Mesoaphyosemion) australe	●									
Aphyosemion (Mesoaphyosemion) buytaerti	●									
Aphyosemion (Mesoaphyosemion) cameronense	●									
Aphyosemion (Mesoaphyosemion) caudofasciatum										
Aphyosemion (Mesoaphyosemion) citrineipinnis										
Aphyosemion (Mesoaphyosemion) coeleste	●									
Aphyosemion (Mesoaphyosemion) escherichi										
Aphyosemion (Mesoaphyosemion) exigoideum	●									
Aphyosemion (Mesoaphyosemion) gabunense boehmi	●									
Aphyosemion (Mesoaphyosemion) gabunense	●									
Aphyosemion (Mesoaphyosemion) gabunense marginatum	●									
Aphyosemion (Mesoaphyosemion) herzogi	●									
Aphyosemion (Mesoaphyosemion) hofmanni										
Aphyosemion (Mesoaphyosemion) joergenscheeli										
Aphyosemion (Mesoaphyosemion) louessense										
Aphyosemion (Mesoaphyosemion) maculatum	●									
Aphyosemion (Mesoaphyosemion) ocellatum										
Aphyosemion (Mesoaphyosemion) ogoense	●			●						
Aphyosemion (Mesoaphyosemion) ogoense pyrophore										
Aphyosemion (Mesoaphyosemion) passaroi										

Species	From Previous Expeditions					From 2014 Expedition				
	Ogooué	Sébé	Lassio	Lékoni	RAMSAR	Ogooué	Sébé	Lassio	Lékoni	All
Aphyosemion (Mesoaphyosemion) primigenium										
Aphyosemion (Mesoaphyosemion) punctatum	●	●								
Aphyosemion (Mesoaphyosemion) striatum	●									
Aphyosemion (Mesoaphyosemion) wuendschi										
Aphyosemion (Raddaella) batesii		●								
Aphyosemion grelli										
Aphyosemion hera	●									
Aphyosemion tirbaki	●									
Epiplatys (Epiplatys) sexfasciatus	●									
Epiplatys (Parepiplatys) singa	●									
Epiplatys ansorgii	●									
Epiplatys huberi										
Epiplatys multifasciatus				●						
Epiplatys neumanni	●	●				●			●	●
Epiplatys sangmelinensis										
Epiplatys spilargyreius										
Aplocheilichthys spilauchen	●									
Hypsopanchax catenatus										
Hypsopanchax zebra	●									
Plataplochilus cabindae										
Plataplochilus chalcopyrus	●									
Plataplochilus miltotaenia	●									
Plataplochilus ngaensis	●									
Plataplochilus pulcher										
Plataplochilus sp. 1						●		●		**
Plataplochilus sp. 2							●		●	**
Plataplochilus terveri	●	●								
Poropanchax stigmatopygus	●									
Enneacampus ansorgii	●									
Enneacampus kaupi	●									
Microphis aculeatus	●									
Mastacembelus marchei	●	●			●					
Mastacembelus niger	●					●	●		●	●
Polycentropsis abbreviata	●									
Chilochromis duponti										
Chromidotilapia kingsleyae	●	●				●	●			●
Chromidotilapia melaniae	●									
Chromidotilapia mrac	●									
Chromidotilapia regani	●					●				●
Coptodon guineensis	●	●								
Coptodon nyongana	●									
Coptodon rendalli	●									
Coptodon tholloni	●	●		●		●				●*

Species	From Previous Expeditions					From 2014 Expedition				
	Ogooué	Sébé	Lassio	Lékoni	RAMSAR	Ogooué	Sébé	Lassio	Lékoni	All
Divandu albimarginatus		●				●				●
Hemichromis elongatus	●	●	●	●		●	●	●		●
Hemichromis stellifer	●	●		●	●	●				●
Oreochromis macrochir										
Oreochromis niloticus	●									
Oreochromis schwebischi	●					●	●			●
Parananochromis axelrodi										
Parananochromis brevirostris	●	●								
Parananochromis caudifasciatus										
Parananochromis gabonicus			●							
Parananochromis longirostris	●									
Parananochromis ornatus		●								
Pelmatochromis nigrofasciatus	●	●		●						
Pelmatolapia cabrae	●					●				●
Pelvicachromis subocellatus	●									
Sarotherodon galilaeus	●									
Sarotherodon mvogoi	●									
Sarotherodon nigripinnis	●									
Thysochromis ansorgii	●									
Kribia kribensis	●									
Kribia nana										
Ctenapoma gabonense										
Ctenapoma kingsleyae	●	●				●				●
Ctenapoma maculatum										
Ctenapoma nigropannosum	●		●							
Microctenopoma congicum										
Microctenopoma nanum	●	●		●	●					
Parachanna insignis										
Parachanna obscura	●	●								
Protopterus dolloi	●				●					

Appendix 3. Ecology and Status of the Fishes from the Ogooué River Basin

Table 17. Fish species of the Ogooué River Basin, including brief description of ecology and status, based on the review of Fermon (2013). TL = Maximum total length published (in cm); Mi = Migratory: po = potamodromous, an = anadromous; ZN = zonation: d = demersal, hp = benthopelagic, p = pelagic; ST = Status: n = native, e = endemic to Gabon, i = introduced, q = questionable; IUCN = IUCN Red List status as of 2014, including: EN = endangered, VU = vulnerable, NT = near threatened, LC = least concern, DD = data deficient, NE = not evaluated. In red, non-described species found in this expedition.

Family	Species	Author(s)	TL	Mi	Zn	ST	IUCN
Polypteridae	*Polypterus retropinnis*	Vaillant, 1899	41.5		d	n	LC
Arapaimidae	*Heterotis niloticus*	(Cuvier, 1829)	122.0		p	i	LC
Pantodontidae	*Pantodon buchholzi*	Peters, 1876	11.9	po	p	n	LC
Notopteridae	*Xenomystus nigri*	(Günther, 1868)	36.6		d	n	LC
Mormyridae	*Boulengeromyrus knoepffleri*	Taverne & Géry, 1968	50.4		d	n	LC
Mormyridae	*Brienomyrus brachyistius*	(Gill, 1862)	15.1		hp	n	LC
Mormyridae	*Isichthys henryi*	Gill, 1863	35.0		d	n	LC
Mormyridae	*Ivindomyrus marchei*	(Sauvage, 1879)	12.0		d	n	LC
Mormyridae	*Ivindomyrus opdenboschi*	Taverne & Géry, 1975	32.0		d	n	VU
Mormyridae	*Marcusenius moorii*	(Günther, 1867)	26.1		d	n	LC
Mormyridae	*Marcusenius ntemensis*	(Pellegrin, 1927)	29.0		d	n	VU
Mormyridae	*Mormyrops nigricans*	Boulenger, 1899	34.0		d	n	LC
Mormyridae	*Mormyrops zanclirostris*	(Günther, 1867)	27.0		d	n	LC
Mormyridae	*Paramormyrops batesii*	(Boulenger, 1906)	15.2		d	n	DD
Mormyridae	*Paramormyrops curvifrons*	(Taverne, Thys van den Audenaerde, Heymer & Géry, 1977)	17.5		hp	n	LC
Mormyridae	*Paramormyrops gabonensis*	Taverne, Thys van den Audenaerde & Heymer, 1977	19.9		d	n	VU
Mormyridae	*Paramormyrops hopkinsi*	(Taverne & Thys van den Audenaerde, 1985)	19.0		hp	n	VU
Mormyridae	*Paramormyrops kingsleyae*	(Günther, 1896)	16.5		hp	n	DD
Mormyridae	*Paramormyrops longicaudatus*	(Taverne, Thys van den Audenaerde, Heymer & Géry, 1977)	29.0		hp	e/n	VU
Mormyridae	*Paramormyrops* sp. "1118"						NE
Mormyridae	*Paramormyrops* sp. "BN2"						NE
Mormyridae	*Paramormyrops* sp. "magnostipes"						NE
Mormyridae	*Paramormyrops* sp. "SN7"						NE
Mormyridae	*Paramormyrops sp.* "vadamans"						NE
Mormyridae	*Paramormyrops* sp. (unknown)						NE
Mormyridae	*Paramormyrops* sp. offouensis						NE
Mormyridae	*Paramormyrops sphekodes*	(Sauvage, 1879)	13.9		hp	n	LC
Mormyridae	*Petrocephalus balayi*	Sauvage, 1883	11.0		d	n	LC
Mormyridae	*Petrocephalus microphthalmus*	Pellegrin, 1908	5.2		d	n	LC
Mormyridae	*Petrocephalus simus*	Sauvage, 1879	12.0	po	d	n	LC
Mormyridae	*Petrocephalus sullivani*	Lavoué, Hopkins & Kamdem Toham, 2004	11.0		hp	n	LC
Mormyridae	*Stomatorhinus ivindoensis*	Sullivan & Hopkins, 2005	6.8		d	n	EN
Mormyridae	*Stomatorhinus walkeri*	(Günther, 1867)	9.0		d	n	LC

Family	Species	Author(s)	TL	Mi	Zn	ST	IUCN
Clupeidae	*Laeviscutella dekimpei*	Poll, Whitehead & Hopson, 1965	4.9		p	n	LC
Clupeidae	*Odaxothrissa ansorgii*	Boulenger, 1910	15.9		p	n	LC
Clupeidae	*Pellonula leonensis*	Boulenger, 1916	10.0	an	P	n	NE
Clupeidae	*Pellonula vorax*	Günther, 1868	14.6	an	p	n	LC
Kneriidae	*Grasseichthys gabonensis*	Géry, 1964	2.5		hp	n	VU
Kneriidae	*Parakneria abbreviata*	(Pellegrin, 1931)	8.8		hp	n	LC
Kneriidae	*Parakneria cameronensis*	(Boulenger, 1909)	11.2		hp	n	LC
Cyprinidae	*Barbus brazzai*	Pellegrin, 1901	13.4		hp	n	LC
Cyprinidae	*Barbus brichardi*	Poll & Lambert, 1959	7.8		hp	n	LC
Cyprinidae	*Barbus camptacanthus*	(Bleeker, 1863)	16.0		hp	n	LC
Cyprinidae	*Barbus collarti*	Mahnert & Géry, 1982	3.5		hp	n	VU
Cyprinidae	*Barbus condei*	Thominot, 1886	3.0		hp	n	DD
Cyprinidae	*Barbus diamouanganai*	Teugels & Mamonekene, 1992	11.0		hp	n	LC
Cyprinidae	*Barbus guirali*	Thominot, 1886	16.0		hp	n	LC
Cyprinidae	*Barbus holotaenia*	Boulenger, 1904	12.0		hp	n	LC
Cyprinidae	*Barbus jae*	Boulenger, 1903	3.8		hp	n	LC
Cyprinidae	*Barbus martorelli*	Roman, 1971	12.2		hp	n	LC
Cyprinidae	*Barbus prionacanthus*	Mahnert & Géry, 1982	11.2		hp	n	LC
Cyprinidae	*Barbus rubrostigma*	Poll & Lambert, 1964	13.8		hp	n	LC
Cyprinidae	*Barbus trispilomimus*	Boulenger, 1907	4.5		hp	n	LC
Cyprinidae	*Labeo annectens*	Boulenger, 1903	48.5		hp	n	LC
Cyprinidae	*Labeo batesii*	Boulenger, 1911	21.4		hp	n	LC
Cyprinidae	*Labeo camerunensis*	Trewavas, 1974	27.6		hp	n	LC
Cyprinidae	*Labeo cyclorhynchus*	Boulenger, 1899	16.0		hp	n	LC
Cyprinidae	*Labeo lukulae*	Boulenger, 1902	32.3		hp	n	LC
Cyprinidae	*Labeobarbus batesii*	(Boulenger, 1903)	43.5		hp	n	LC
Cyprinidae	*Labeobarbus caudovittatus*	(Boulenger, 1902)	80.0		hp	n	LC
Cyprinidae	*Labeobarbus compiniei*	(Sauvage, 1879)	73.0		hp	n	LC
Cyprinidae	*Labeobarbus malacanthus*	(Pappenheim, 1911)	15.0		hp	n	LC
Cyprinidae	*Labeobarbus micronema*	(Boulenger, 1904)	34.0		hp	n	LC
Cyprinidae	*Labeobarbus progenys*	(Boulenger, 1903)	18.0		hp	n	LC
Cyprinidae	*Opsaridium ubangiense*	(Pellegrin, 1901)	12.0		hp	n	LC
Cyprinidae	*Raiamas buchholzi*	(Peters, 1876)	14.0		hp	n	LC
Cyprinidae	*Varicorhinus axelrodi*	Getahun, Stiassny & Teugels, 2004	19.5		hp	n	LC
Cyprinidae	*Varicorhinus sandersi*	Boulenger, 1912	36.8		hp	n	LC
Cyprinidae	*Varicorhinus steindachneri*	Boulenger, 1910	40.3		hp	n	LC
Cyprinidae	*Varicorhinus tornieri*	Steindachner, 1906	22.5		hp	n	LC
Cyprinidae	*Varicorhinus werneri*	Holly, 1929	14.5		hp	n	LC
Distichodontidae	*Distichodus hypostomatus*	Pellegrin, 1900	23.8		p	n	LC
Distichodontidae	*Distichodus notospilus*	Günther, 1867	19.5		p	n	LC
Distichodontidae	*Hemigrammocharax ocellicauda*	(Boulenger, 1907)	4.3		p	a	LC
Distichodontidae	*Hemistichodus vaillanti*	Pellegrin, 1900	11.2		p	n	LC
Distichodontidae	*Nannaethiops unitaeniatus*	Günther, 1872	6.2		p	n	LC
Distichodontidae	*Nannocharax fasciatus*	Günther, 1867	8.1	po	p	n	LC
Distichodontidae	*Nannocharax intermedius*	Boulenger, 1903	6.8		p	n	LC
Distichodontidae	*Nannocharax latifasciatus*	Coenen & Teugels, 1989	5.5		p	q	VU
Distichodontidae	*Nannocharax maculicauda*	Vari & Géry, 1981	3.7		p	n	LC
Distichodontidae	*Nannocharax ocellicauda*	Boulenger, 1907	4.0		p	q	LC

Family	Species	Author(s)	TL	Mi	Zn	ST	IUCN
Distichodontidae	*Nannocharax ogoensis*	Pellegrin, 1911	4.2		p	n	DD
Distichodontidae	*Nannocharax parvus*	Pellegrin, 1906	6.5		p	n	LC
Distichodontidae	*Neolebias ansorgii*	Boulenger, 1912	3.2	po	p	n	LC
Distichodontidae	*Neolebias gossei*	Poll & Lambert, 1964	3.6		p	e	LC
Distichodontidae	*Neolebias kerguennae*	Daget, 1980	3.5		p	e	EN
Distichodontidae	*Neolebias trewavasae*	Poll & Gosse, 1963	5.3		p	n	LC
Distichodontidae	*Neolebias unifasciatus*	Steindachner, 1894	5.3		p	n	LC
Distichodontidae	*Xenocharax spilurus*	Günther, 1867	26.0		p	n	NE
Alestidae	*Alestes macrophthalmus*	Günther, 1867	73.0		p	n	LC
Alestidae	*Brachypetersius gabonensis*	Poll, 1967	8.5		p	n	LC
Alestidae	*Brycinus bartoni*	(Nichols & La Monte, 1953)	11.2		p	e	EN
Alestidae	*Brycinus intermedius*	(Peters, 1852)	9.8		p	n	LC
Alestidae	*Brycinus kingsleyae*	(Günther, 1896)	20.2		p	n	LC
Alestidae	*Brycinus macrolepidotus*	Valenciennes, 1850	64.7	po	p	n	LC
Alestidae	*Brycinus opisthotaenia*	(Boulenger, 1903)	15.6		p	n	LC
Alestidae	*Brycinus taeniurus*	(Günther, 1867)	12.0		p	n	LC
Alestidae	*Brycinus tholloni*	(Pellegrin, 1901)	64.7		p	n	LC
Alestidae	*Bryconaethiops macrops*	Boulenger, 1920	14.6		p	n	LC
Alestidae	*Bryconaethiops microstoma*	Günther, 1873	21.0		p	n	LC
Alestidae	*Bryconalestes longipinnis*	(Günther, 1864)	14.6	po	p	n	LC
Alestidae	*Micralestes elongatus*	Daget, 1957	6.0	po	p	q	NE
Alestidae	*Micralestes humilis*	Boulenger, 1899	10.6		p	n	LC
Alestidae	*Nannopetersius ansorgii*	(Boulenger, 1910)	7.5		p	n	LC
Alestidae	*Nannopetersius lamberti*	Poll, 1967	8.5		p	n	LC
Alestidae	*Phenacogrammus aurantiacus*	(Pellegrin, 1930)	10.0		hp	n	LC
Alestidae	*Phenacogrammus urotaenia*	(Boulenger, 1909)	7.0		hp	n	LC
Hepsetidae	*Hepsetus kingsleyae*	Vreven, Decru & Snoeks, 2013	26.8	po	d	e/n	NE
Hepsetidae	*Hepsetus lineata*	(Pellegrin, 1926)	34.5	po	d	n	NE
Schilbeidae	*Parailia occidentalis*	(Pellegrin, 1901)	8.5		d	n	LC
Schilbeidae	*Pareutropius debauwi*	(Boulenger, 1900)	12.7		d	n	LC
Schilbeidae	*Schilbe grenfelli*	(Boulenger, 1900)	61.0		d	n	LC
Schilbeidae	*Schilbe laticeps*	(Boulenger, 1899)	23.0		d	n	LC
Schilbeidae	*Schilbe multitaeniatus*	(Pellegrin, 1913)	32.1		d	n	LC
Amphiliidae	*Amphilius caudosignatus*	Skelton, 2007	5.0		hp	n	EN
Amphiliidae	*Amphilius longirostris*	(Boulenger, 1901)	4.0		d	n	LC
Amphiliidae	*Amphilius nigricaudatus*	Pellegrin, 1909	8.0		d	n	NE
Amphiliidae	*Amphilius pulcher*	Pellegrin, 1929	8.0		d	n	LC
Amphiliidae	*Doumea typica*	Sauvage, 1879	16.1		d	n	LC
Amphiliidae	*Paramphilius baudoni*	(Pellegrin, 1928)	9.1		d	n	LC
Amphiliidae	*Phractura brevicauda*	Boulenger, 1911	7.0		d	n	LC
Amphiliidae	*Phractura intermedia*	Boulenger, 1911	9.5		d	a	NE
Amphiliidae	*Phractura longicauda*	Boulenger, 1903	7.7		d	n	LC
Clariidae	*Channallabes alvarezi*	(Roman, 1971)	41.0		d	n	LC
Clariidae	*Channallabes apus*	(Günther, 1873)	32.7		d	n	LC
Clariidae	*Channallabes longicaudatus*	(Pappenheim, 1911)	26.0		hp	n	DD
Clariidae	*Channallabes ogooensis*	Devaere, Adriaens & Verraes, 2007	29.0		hp	n	DD
Clariidae	*Channallabes teugelsi*	Devaere, Adriaens & Verraes, 2007	17.6		hp	n	DD
Clariidae	*Clariallabes brevibarbis*	Pellegrin, 1913	29.0		d	n	DD

Family	Species	Author(s)	TL	Mi	Zn	ST	IUCN
Clariidae	*Clariallabes longicauda*	(Boulenger, 1902)	28.0		d	n	LC
Clariidae	*Clarias angolensis*	Steindachner, 1866	35.0		d	n	LC
Clariidae	*Clarias buthupogon*	Sauvage, 1879	109.8	po	d	n	LC
Clariidae	*Clarias camerunensis*	Lönnberg, 1895	46.6		d	n	LC
Clariidae	*Clarias gabonensis*	Günther, 1867	36.0		d	n	LC
Clariidae	*Clarias gariepinus*	(Burchell, 1822)	170.0	po	hp	i	NE
Clariidae	*Clarias jaensis*	Boulenger, 1909	48.3		d	n	LC
Clariidae	*Clarias longior*	Boulenger, 1907	22.5		d	n	LC
Clariidae	*Clarias pachynema*	Boulenger, 1903	35.6		d	n	LC
Clariidae	*Clarias platycephalus*	Boulenger, 1902	37.6		d	n	LC
Clariidae	*Clarias submarginatus*	Peters, 1882	16.0		d	n	VU
Clariidae	*Gymnallabes typus*	Günther, 1867	23.0		d	n	LC
Clariidae	*Heterobranchus longifilis*	Valenciennes, 1840	183.0	po	d	n	LC
Claroteidae	*Chrysichthys (Chrysichthys) auratus*	(Geoffroy Saint-Hilaire, 1809)	57.0	po	d	n	LC
Claroteidae	*Chrysichthys (Melanodactylus) nigrodigitatus*	(Lacepède, 1803)	79.3	po	d	n	LC
Claroteidae	*Chrysichthys (Melanodactylus) ogooensis*	(Pellegrin, 1900)	25.0		d	n	LC
Claroteidae	*Chrysichthys (Rheoglanis) thysi*	Risch, 1985	30.0		d	n	LC
Claroteidae	*Notoglanidium boutchangai*	(Thys van den Audenaerde, 1965)	22.5		d	n	LC
Claroteidae	*Notoglanidium macrostoma*	(Pellegrin, 1909)	24.0		d	n	LC
Claroteidae	*Parauchenoglanis altipinnis*	(Boulenger, 1911)	21.0		d	n	LC
Claroteidae	*Parauchenoglanis balayi*	(Sauvage, 1879)	39.0		d	n	LC
Claroteidae	*Parauchenoglanis punctatus*	(Boulenger, 1902)	50.0		d	n	LC
Malapteruridae	*Malapterurus beninensis*	Murray, 1855	27.2		hp	n	LC
Malapteruridae	*Malapterurus oguensis*	Sauvage, 1879	26.2		hp	n	LC
Mochokidae	*Atopochilus savorgnani*	Sauvage, 1879	10.0		d	n	LC
Mochokidae	*Atopodontus adriaensi*	Friel & Vigliotta, 2008	26.0		d	e	DD
Mochokidae	*Chiloglanis cameronensis*	Boulenger, 1904	5.5		hp	n	LC
Mochokidae	*Microsynodontis armatus*	Ng, 2004	3.5		d	e	DD
Mochokidae	*Microsynodontis batesii*	Boulenger, 1903	12.2		d	n	DD
Mochokidae	*Microsynodontis laevigata*	Ng, 2004	4.0		d	e/n	DD
Mochokidae	*Microsynodontis nasutus*	Ng, 2004	4.2		d	e	DD
Mochokidae	*Microsynodontis notata*	Ng, 2004	6.0		d	e	DD
Mochokidae	*Microsynodontis vigilis*	Ng, 2004	6.0		d	e	DD
Mochokidae	*Synodontis acanthoperca*	Friel & Vigliotta, 2006	5.6		hp	n	DD
Mochokidae	*Synodontis albolineata*	Pellegrin, 1924	21.0		hp	n	LC
Mochokidae	*Synodontis aterrimus*	Poll & Roberts, 1968	11.5		hp	n	LC
Mochokidae	*Synodontis batesii*	Boulenger, 1907	12.6		hp	n	LC
Mochokidae	*Synodontis haugi*	Pellegrin, 1906	30.2		hp	n	LC
Mochokidae	*Synodontis ngouniensis*	De Weirdt, Vreven & Fermon, 2008	19.0		hp	n	NE
Mochokidae	*Synodontis obesus*	Boulenger, 1898	37.5		hp	n	LC
Mochokidae	*Synodontis polyodon*	Vaillant, 1895	31.4		hp	n	LC
Mochokidae	*Synodontis punu*	Vreven & Milondo, 2009	6.7		d	n	NE
Mochokidae	*Synodontis tessmanni*	Pappenheim, 1911	18.6		hp	n	LC
Nothobranchiidae	*Aphyosemion (Aphyosemion) lamberti*	Radda & Huber, 1976	5.0		hp	e	LC
Nothobranchiidae	*Aphyosemion (Aphyosemion) rectogoense*	Radda & Huber, 1977	5.0		hp	e/n	VU

Family	Species	Author(s)	TL	Mi	Zn	ST	IUCN
Nothobranchiidae	*Aphyosemion (Diapteron) abacinum*	Huber, 1976	3.5		hp	e	VU
Nothobranchiidae	*Aphyosemion (Diapteron) cyanostictum*	Lambert & Géry, 1968	6.5		d	e/n	LC
Nothobranchiidae	*Aphyosemion (Diapteron) fulgens*	Radda, 1975	3.5		hp	e/n	EN
Nothobranchiidae	*Aphyosemion (Diapteron) georgiae*	Lambert & Géry, 1968	3.5		hp	e	LC
Nothobranchiidae	*Aphyosemion (Diapteron) seegersi*	Huber, 1980	3.5		hp	a	DD
Nothobranchiidae	*Aphyosemion (Episemion) callipteron*	Radda & Pürzl, 1987	4.0		hp	n	LC
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) aureum*	Radda, 1980	5.0		hp	e	VU
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) australe*	(Rachow, 1921)	6.0		hp	n	LC
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) buytaerti*	Radda & Huber, 1978	5.0		hp	a	LC
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) cameronense*	(Boulenger, 1903)	5.0		hp	n	LC
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) caudofasciatum*	Hubert & Radda, 1979	5.0		hp	a	DD
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) citrineipinnis*	Huber & Radda, 1977	5.0		hp	e	LC
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) coeleste*	Huber & Radda, 1977	5.0		hp	n	VU
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) escherichi*	(Ahl, 1924)	5.0		hp	n	LC
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) exigoideum*	Radda & Huber, 1977	6.0		hp	e	LC
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) gabunense boehmi*	Radda & Huber, 1977	5.0		hp	e	NE
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) gabunense*	Radda, 1975	5.0		hp	e	NE
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) gabunense marginatum*	Radda & Huber, 1977	5.0		hp	e	NE
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) herzogi*	Radda, 1975	5.0		hp	n	LC
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) hofmanni*	Radda, 1980	5.0		hp	e	LC
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) joergenscheeli*	Huber & Radda, 1977	6.0		hp	e	LC
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) louessense*	(Pellegrin, 1931)	4.5		hp	n	VU
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) maculatum*	Radda & Pürzl, 1977	5.0		hp	e	LC
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) ocellatum*	Huber & Radda, 1977	6.0		hp	n	LC
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) ogoense*	(Pellegrin, 1930)	5.0		hp	n	NE
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) ogoense pyrophore*	Huber & Radda, 1979	5.0		hp	n	NE
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) passaroi*	Huber, 1994	5.0		hp	e	EN
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) primigenium*	Radda & Huber, 1977	5.0		hp	e/n	VU
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) punctatum*	Radda & Pürzl, 1977	5.0		hp	n	LC
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) striatum*	(Boulenger, 1911)	6.0		hp	n	LC

Family	Species	Author(s)	TL	Mi	Zn	ST	IUCN
Nothobranchiidae	*Aphyosemion (Mesoaphyosemion) wuendschi*	Radda & Pürzl, 1985	4.0		hp	e	DD
Nothobranchiidae	*Aphyosemion (Raddaella) batesii*	(Boulenger, 1911)	9.0		hp	n	LC
Nothobranchiidae	*Aphyosemion grelli*	Valdesalici & Eberl, 2013	3.8		p	e	NE
Nothobranchiidae	*Aphyosemion hera*	Huber, 1998	4.0		hp	e	DD
Nothobranchiidae	*Aphyosemion tirbaki*	Huber, 1999	5.0		hp	e/n	EN
Nothobranchiidae	*Epiplatys (Epiplatys) sexfasciatus*	Gill, 1862	12.2	po	hp	n	LC
Nothobranchiidae	*Epiplatys (Parepiplatys) singa*	(Boulenger, 1899)	6.0		hp	n	LC
Nothobranchiidae	*Epiplatys ansorgii*	(Boulenger, 1911)	8.0		hp	n	LC
Nothobranchiidae	*Epiplatys huberi*	(Radda & Pürzl, 1981)	6.0		hp	e/n	LC
Nothobranchiidae	*Epiplatys multifasciatus*	(Boulenger, 1913)	6.0		hp	n	DD
Nothobranchiidae	*Epiplatys neumanni*	Berkenkamp, 1993	6.0		hp	n	LC
Nothobranchiidae	*Epiplatys sangmelinensis*	(Ahl, 1928)	6.0		hp	a	LC
Nothobranchiidae	*Epiplatys spilargyreius*	(Duméril, 1861)	5.0	po	bp	q	LC
Poecilliidae	*Aplocheilichthys spilauchen*	(Duméril, 1861)	70.0		d	n	LC
Poecilliidae	*Hypsopanchax catenatus*	Radda, 1981	6.0		hp	e	DD
Poecilliidae	*Hypsopanchax zebra*	(Pellegrin, 1929)	5.5		hp	n	LC
Poecilliidae	*Plataplochilus cabindae*	(Boulenger, 1911)	5.0		hp	n	LC
Poecilliidae	*Plataplochilus chalcopyrus*	Lambert, 1963	4.0		hp	n	EN
Poecilliidae	*Plataplochilus miltotaenia*	Lambert, 1963	5.0		hp	n	VU
Poecilliidae	*Plataplochilus ngaensis*	(Ahl, 1924)	5.0		hp	n	LC
Poecilliidae	*Plataplochilus pulcher*	Lambert, 1967	5.0		hp	e/n	NE
Poecilliidae	*Plataplochilus* sp. 1						
Poecilliidae	*Plataplochilus* sp. 2						
Poecilliidae	*Plataplochilus terveri*	(Huber, 1981)	5.5		hp	e	EN
Poecilliidae	*Poropanchax stigmatopygus*	Wildekamp & Malumbres, 2004	3.0		hp	n	LC
Syngnathidae	*Enneacampus ansorgii*	(Boulenger, 1910)	16.8		d	n	LC
Syngnathidae	*Enneacampus kaupi*	(Bleeker, 1863)	20.0		d	n	LC
Syngnathidae	*Microphis aculeatus*	(Kaup, 1856)	24.4		d	n	NE
Mastacembelidae	*Mastacembelus marchei*	Sauvage, 1879	32.9		hp	n	NE
Mastacembelidae	*Mastacembelus niger*	Sauvage, 1879	45.8		d	n	LC
Polycentridae	*Polycentropsis abbreviata*	Boulenger, 1901	8.0		hp	n	LC
Cichlidae	*Chilochromis duponti*	Boulenger, 1902	26.8		hp	n	LC
Cichlidae	*Chromidotilapia kingsleyae*	Boulenger, 1898	15.9		hp	n	LC
Cichlidae	*Chromidotilapia melaniae*	Lamboj, 2003	9.7		hp	e	LC
Cichlidae	*Chromidotilapia mrac*	Lamboj, 2002	11.3		hp	e	LC
Cichlidae	*Chromidotilapia regani*	(Pellegrin, 1906)	15.5		hp	e	VU
Cichlidae	*Coptodon guineensis*	(Günther, 1862)	36.6		hp	n	LC
Cichlidae	*Coptodon nyongana*	Thys van den Audenaerde, 1971	21.0		hp	n	LC
Cichlidae	*Coptodon rendalli*	(Boulenger, 1897)	45.0		hp	i	LC
Cichlidae	*Coptodon tholloni*	(Sauvage, 1884)	22.0		hp	n	LC
Cichlidae	*Divandu albimarginatus*	Lamboj & Snoeks, 2000	14.8		p	n	LC
Cichlidae	*Hemichromis elongatus*	(Guichenot, 1861)	15.0		hp	n	LC
Cichlidae	*Hemichromis stellifer*	Loiselle, 1979	10.0		hp	n	LC
Cichlidae	*Oreochromis macrochir*	(Boulenger, 1912)	43.0		hp	i	VU
Cichlidae	*Oreochromis niloticus niloticus*	(Linnaeus, 1758)	73.2	po	hp	i	NE
Cichlidae	*Oreochromis schwebischi*	(Sauvage, 1884)	36.6		hp	n	LC
Cichlidae	*Parananochromis axelrodi*	Lamboj & Stiassny, 2003	11.1		d	e	EN
Cichlidae	*Parananochromis brevirostris*	Lamboj & Stiassny, 2003	6.3		d	n	VU

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Cichlidae	*Parananochromis caudifasciatus*	(Boulenger, 1913)	12.2		d	n	LC
Cichlidae	*Parananochromis gabonicus*	(Trewavas, 1975)	9.8		d	n	LC
Cichlidae	*Parananochromis longirostris*	(Boulenger, 1903)	12.5		d	n	LC
Cichlidae	*Parananochromis ornatus*	Lamboj & Stiassny, 2003	6.3		d	e	EN
Cichlidae	*Pelmatochromis nigrofasciatus*	(Pellegrin, 1900)	14.1		d	n	LC
Cichlidae	*Pelmatolapia cabrae*	Boulenger, 1899	37.0		d	n	LC
Cichlidae	*Pelvicachromis subocellatus*	(Günther, 1872)	6.5		d	n	DD
Cichlidae	*Sarotherodon galilaeus*	(Pellegrin, 1903)	41.5		d	i	NE
Cichlidae	*Sarotherodon mvogoi*	(Thys van den Audenaerde, 1965)	24.6		d	n	LC
Cichlidae	*Sarotherodon nigripinnis nigripinnis*	(Guichenot, 1861)	22.0		d	n	NE
Cichlidae	*Thysochromis ansorgii*	(Boulenger, 1901)	10.7		d	n	LC
Eleotridae	*Kribia kribensis*	(Boulenger, 1907)	5.7		d	n	LC
Eleotridae	*Kribia nana*	(Boulenger, 1901)	4.9		d	n	LC
Anabantidae	*Ctenapoma gabonense*	Günther, 1896	20.1		d	n	NE
Anabantidae	*Ctenapoma kingsleyae*	Günther, 1896	24.5		hp	n	LC
Anabantidae	*Ctenapoma maculatum*	Thominot, 1886	20.0		hp	n	LC
Anabantidae	*Ctenapoma nigropannosum*	Reichenow, 1875	17.0		hp	n	LC
Anabantidae	*Microctenopoma congicum*	(Boulenger, 1887)	8.5		hp	n	LC
Anabantidae	*Microctenopoma nanum*	(Günther, 1896)	8.0		hp	n	LC
Channidae	*Parachanna insignis*	(Sauvage, 1884)	41.0		hp	n	LC
Channidae	*Parachanna obscura*	(Günther, 1861)	61.0	po	d	q	NE
Protopteridae	*Protopterus dolloi*	Boulenger, 1900	130.0		d	n	LC

Appendix 4. All Sampling Sites

The following maps show the sites sampled on the September 2014 expedition, as well as all previous fish sampling expeditions in Gabon (drawn from AMNH, MRAC, WWF and Association Aimara records).

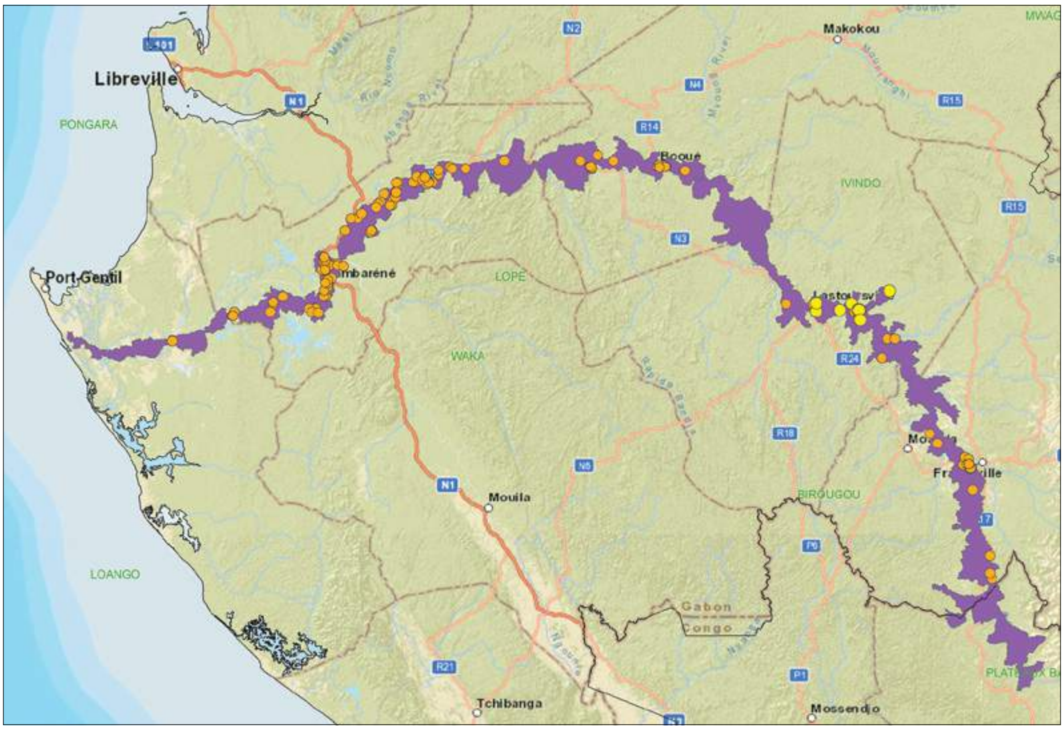

Figure 52. Sampling site locations on and adjacent to the mainstem Ogooué.

Sept. 2014 mainstem sample locations

Previous mainstem sample locations (WWF, IRAF, Cornell)

Ogooué mainstem "Valley Bottom"

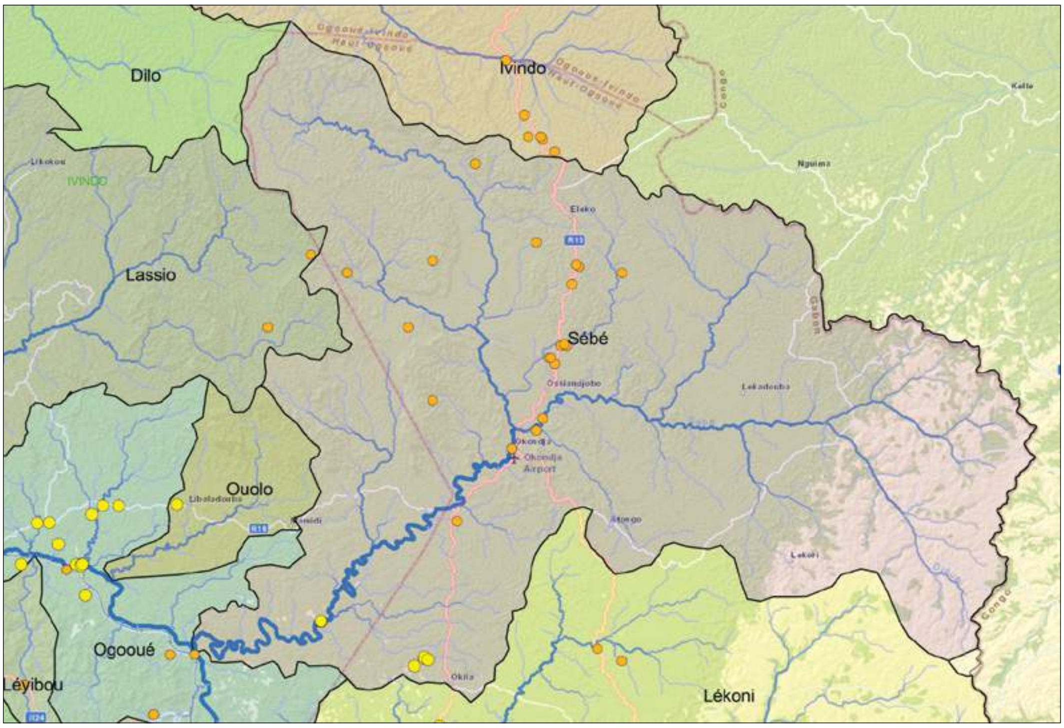

Figure 53. Sampling site locations on the Sébé and Ouolo river basins.

Sept. 2014 sample locations

Previous sample locations (WWF, IRAF, Cornell)

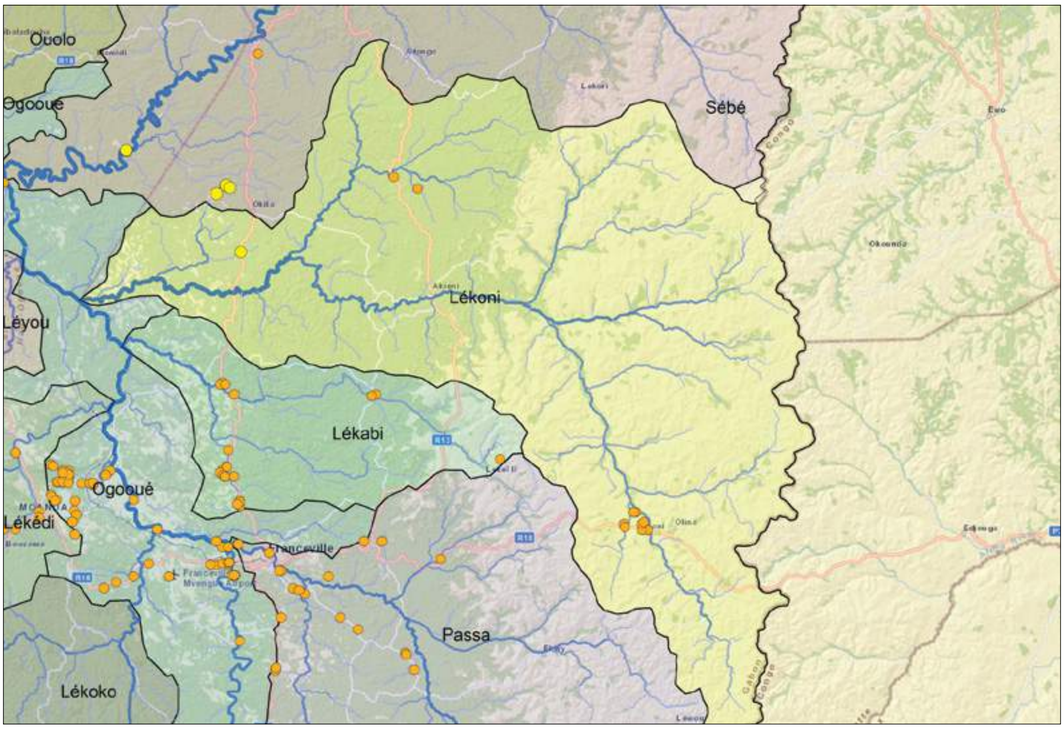

Figure 54. Sampling site locations on the Lékoni river basin.

Sept. 2014 sample locations

Previous sample locations (WWF, IRAF, Cornell)

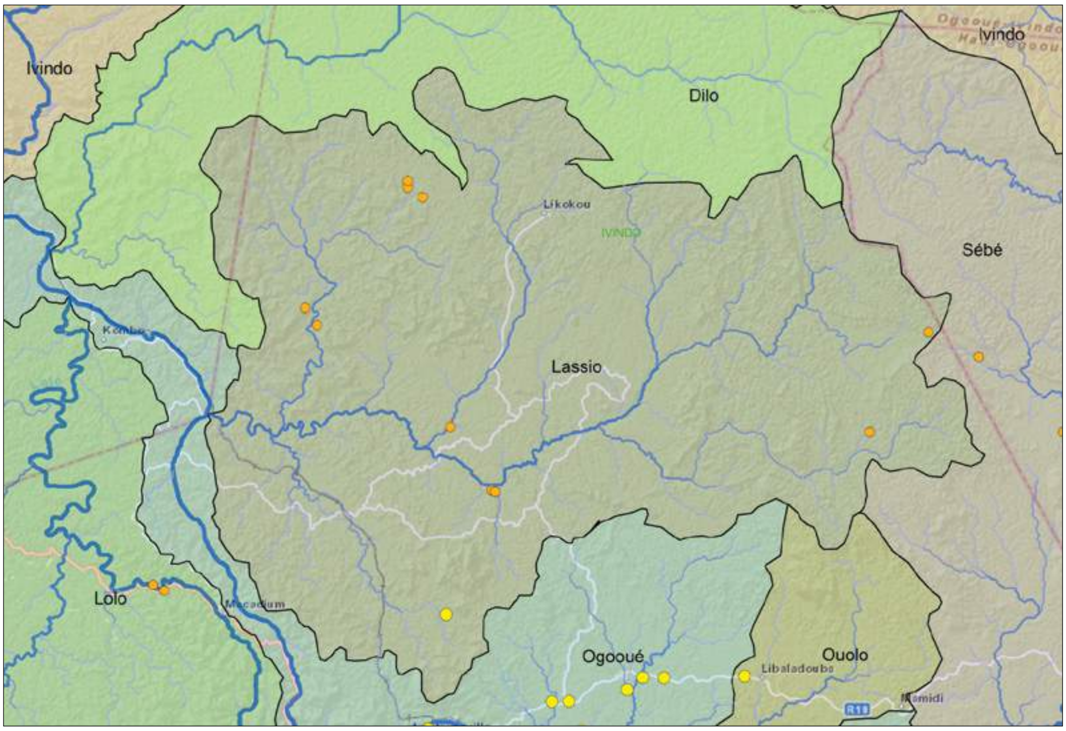

Figure 55. Sampling site locations on the Lassio river basin.

Sept. 2014 sample locations

Previous sample locations (WWF, IRAF, Cornell)

For more information contact:
Marie-Claire Paiz
Gabon Country Program Director
The Nature Conservancy
Email: mcpaiz@tnc.org

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