DNA barcoding and diversity of groundwater oligochaetes in Benin (West Africa)

Patrick Martin[1], Moïssou Lagnika[2], Gontran Sonet[3] and Moudachirou Ibikounle[2]

Abstract

Background: Groundwater is a major ecosystem in terms of biodiversity, endemism and relict species. However, its stygofauna, the obligate groundwater fauna, remains too often ignored, although present on all continents. Its knowledge is of particular interest for public health as groundwater is also the main drinking water reservoir on earth. This study aims to build a genetic database of groundwater oligochaetes at the Beninese country, which can be used as a reference for future studies based on DNA barcoding. It comes in a larger framework using the stygofauna as an indicator for water quality. **Results:** 96 wells were sampled in 2015 and 2016, and COI barcodes were obtained from 126 specimens of the genera *Aulophorus* (Naididae) and *Haplotaxis* (Haplotaxidae), the main two oligochaete components in Beninese wells. Molecular data enabled an interesting comparison between both genera, in terms of species diversity, distribution, and dispersal capacities. The numerous specimens of the stygophile *Aulophorus* proved to consist of 4 species, widely distributed, with low intraspecific genetic variability, suggesting an important dispersal capacity. In contrast, 7 potential species were identified in the rare stygobiotic *Haplotaxis*, each of them being restricted to one station, with one exception, so that each hydrogeographic basin can be characterized by its unique assemblage of *Haplotaxis* species. **Significance:** These first data suggests an interesting potential use of groundwater oligochaetes for water management in Benin: (1) the presence of *Haplotaxis* is an indicator of the phreatic origin of water in wells and, as such, suggests good water quality; (2) in contrast, the presence of *Aulophorus* species in a well gives evidence of poor protection of the latter against exogenous elements, which can have a negative impact on water quality.

Subterranean aquifer habitats: “terra incognita”

Groundwater is the main drinking water reservoir on earth, but also a major ecosystem in terms of biological diversity. Maintaining groundwater quality and conserving its biodiversity are converging goals because the healthy functioning of these systems is attested by their level of biodiversity. Groundwater biodiversity must be documented, protected and sustainably managed. Unfortunately, these habitats are still “terra incognita” in African, sub-Saharan countries.

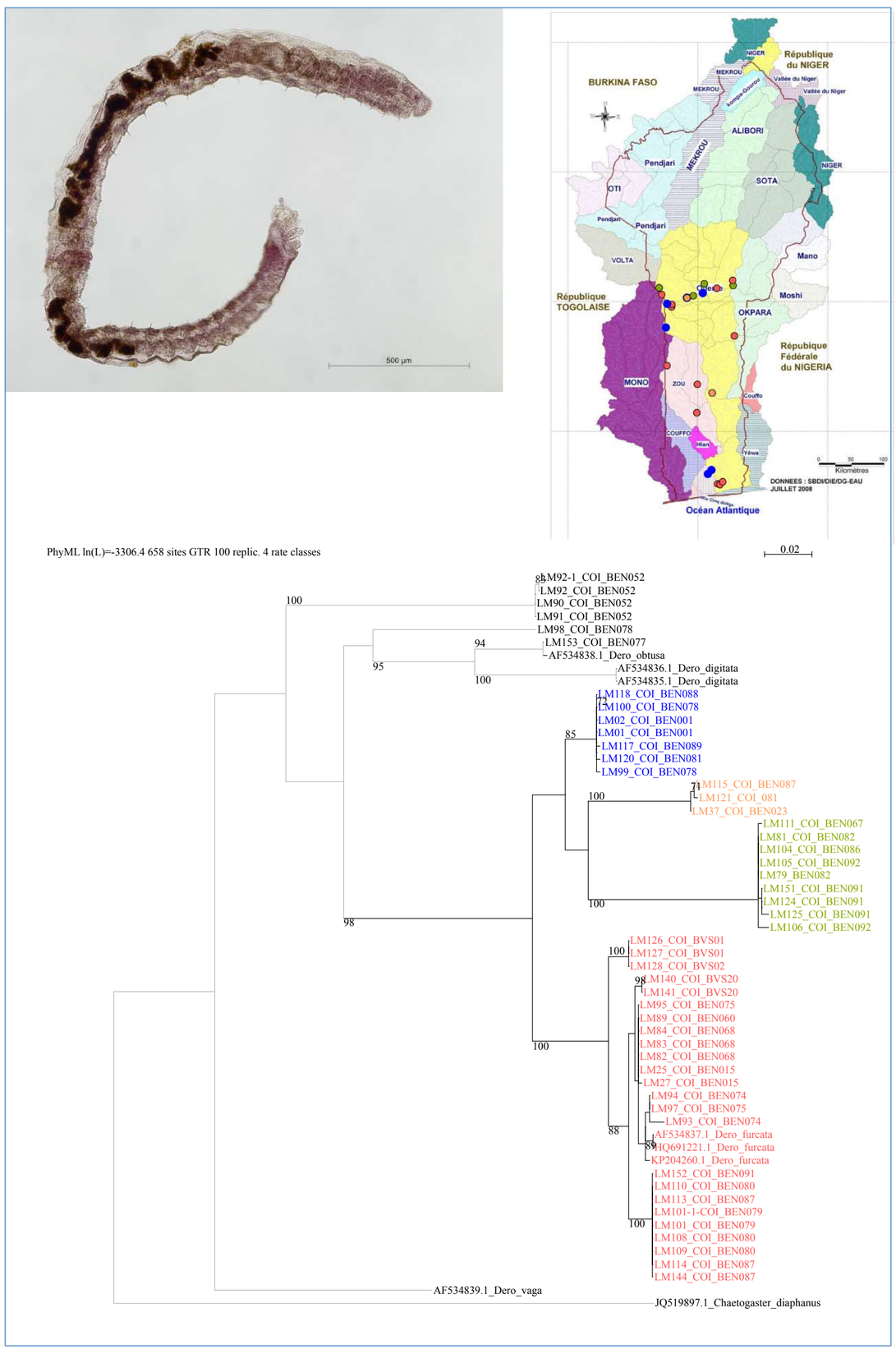

FIGURE 1: Phylogenetic relationships between 43 specimens of the stygophile genus *Aulophorus*, based on COI sequences (maximum likelihood), and location of stations within the sub-watersheds of the Ouémé basin (Benin) from which the specimens were studied. Colour codes are used in order to match specimens and stations.

An unexpected oligochaete diversity

A biodiversity inventory of about 100 Beninese wells in the large Ouémé basin, through DNA barcoding, has revealed contrasting patterns of biodiversity within the two main oligochaete components. The numerous specimens of the stygophile *Aulophorus* proved to consist of only 4 species, with a wide geographical distribution. In contrast, the obligate groundwater-dwelling (i.e. stygobiont) *Haplotaxis* genus may harbour up to 7 species, in spite of its rarity and restricted distribution, often limited to only one station. It appears that each sub-watershed of the Ouémé hydrogeographic basin can be characterized by its own assemblage of *Haplotaxis* species.

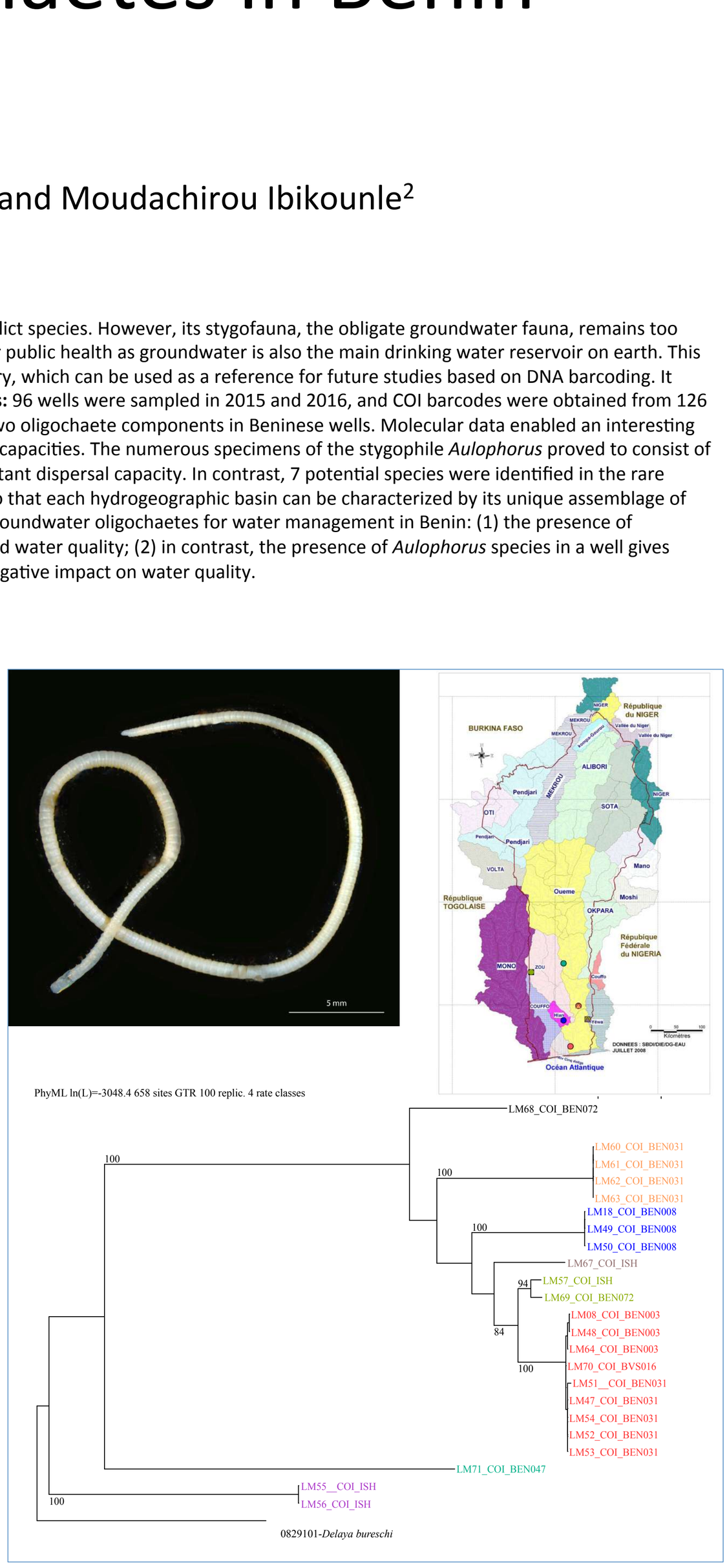

FIGURE 2: Phylogenetic relationships between 23 specimens of the stygobiont genus *Haplotaxis*, based on COI sequences (maximum likelihood), and location of stations within the sub-watersheds of the Ouémé basin (Benin) from which the specimens were studied. Colour codes are used in order to match specimens and stations.

Biodiversity and water management in Benin

This project suggests an interesting potential use for water management in Benin, as it seems possible that each underground basin can be characterized by its own assemblage of species. By sampling the water from wells we could also tell which basin it has come from, helping us map underground waterways. The project could eventually be expanded to the rest of the country, providing a complete reference for the whole of Benin.

Affiliations

1 *Royal Belgian Institute of Natural Sciences, O.D. Taxonomy & Phylogeny, 29 rue Vautier, 1000 Brussels, Belgium.*
2 *Université d’Abomey-Calavi, Département de Zoologie, Laboratoire de Parasitologie et d’Ecologie parasitaire, Faculté des Sciences et Techniques, 01BP526, Cotonou, Benin*
3 *JEMU, Royal Belgian Institute of Natural Sciences, 29 rue Vautier, 1000 Brussels, Belgium*

Funding Sources/Acknowledgements

CEBioS
Fonds Léopold III pour l’Exploration et la Conservation de la Nature
museum