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### Further observations on the distribution of *Bulinus senegalensis* Müller (Gastropoda: Planorbidae) in Cameroon

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Since 1956 when Smithers<sup>1</sup> demonstrated that *Bulinus senegalensis* Müller 1781 was an important intermediate host for *Schistosoma haematobium* in the Gambia, more information has been sought concerning its distribution. *B. senegalensis* was first reported from the type-locality Podor in Senegal by Adanson.<sup>2</sup> Its distribution range is now known to extend to Gambia,<sup>1</sup> Mauritania and Chad,<sup>3</sup> Nigeria,<sup>4</sup> and Cameroon<sup>5,6</sup> and Niger.<sup>7</sup> All the sites where *B. senegalensis* has been collected in those countries are temporary habitats located in the sub-saharan belt across Africa. In Cameroon, based on shell characters, the species was reported from two localities in the wetter sudanian region.<sup>6</sup> But as Betterton *et al.*<sup>4</sup> stated, identification

of *B. senegalensis* from the shell material alone is difficult because of its close resemblance to the related *Bulinus forskalii*.

This study was undertaken to confirm by the use of allozyme electrophoresis the occurrence of *B. senegalensis* in the sudanian region in Cameroon.

The area surveyed lies in the North Province of Cameroon, just above 9°N, from 13°33' to 13°36' East, in the valley of the river Benue (Fig. 1). Northwards, the valley is connected to the Chad Plain by the Mayo Kebi valley. Westwards, the Benue flows into the Niger, the most important river in West Africa. Southeastwards, a reservoir at Lagdo flooded most of the former valley. From Lagdo to the Niger, the

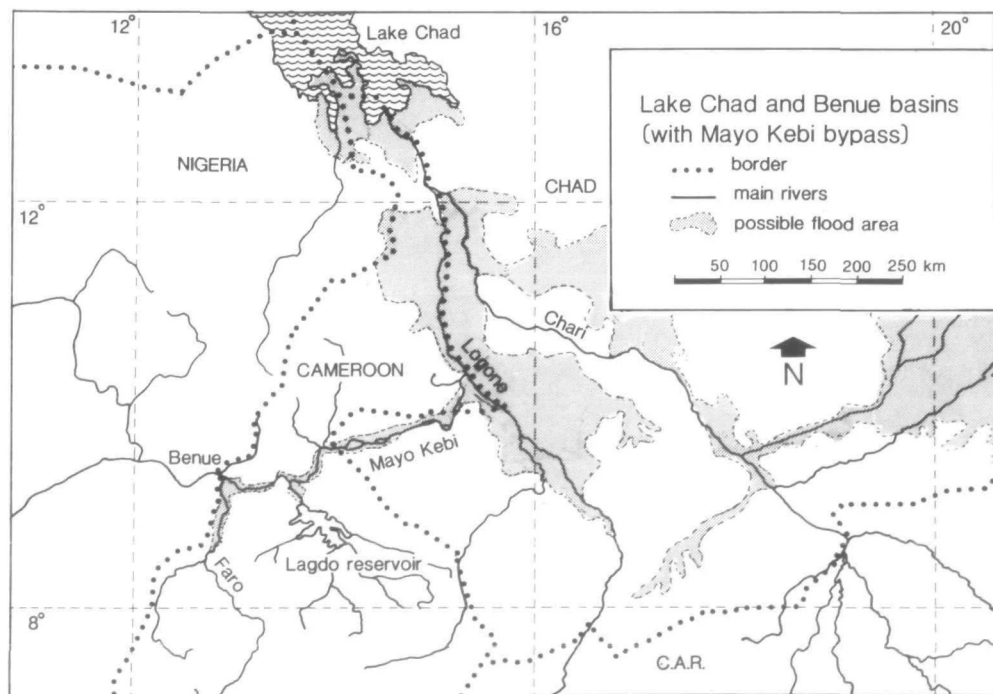


Figure 1. Map of the Lake Chad and Benue basins.

Benue valley is of alluvial deposits, flat, with an altitude less than 200 m. The climate in this area is sudanian, with an annual rainfall averaging about 1000 mm. The rainy season extends from April to October, and the mean annual temperature is 28.1°C.

Locations of villages and waterbodies are detailed in Fig. 2. Eighteen sites were visited in July 1990 and examined for the presence of *Bulinus*. The majority of villagers are farmers and fishermen. Downstream of the Lagdo dam a scheme for irrigated agriculture is under construction, with 200 hectares already in operation (mainly rice culture).

To investigate the southern occurrence of snails resembling *B. senegalensis*, some sites on the road to Ngaoundere (Fig. 2) were visited at Garwawo (16), Nahari (17) and Gouna (Mayo Salah) (18), the last site being located some 120 kilometres south of Garoua (Fig. 2), but no specimen of *Bulinus* was found.

Snails were picked from emergent vegetation in aquatic habitats with a long-handled net, and initially identified from the shell. Living snails were brought back to the Experimental Taxonomy Unit, Cameroon Schistosomiasis Project, IMPM, Yaounde, and electrophoresis of enzymes was performed on starch gels. Techniques used in enzyme analysis, allozyme systems investigated, and the expression of their mobilities are the same as in a previous study.<sup>5</sup>

Snails of the *Bulinus forskalii* group were collected from 9 sites. From allozyme mobilities observed in ACP,  $\alpha$ -GPD, HBDH and PGM (Table 1), we could identify *B. forskalii* by the allele combination of ACP<sup>80</sup>/ $\alpha$ -GPD<sup>70</sup>/HBDH<sup>70</sup> PGM<sup>100</sup> in the ponds of the fish breeding station (1), the rice fields (2), the laterite quarry near 'CTM' (3), the temporary pool near the Benue River (4), and the Mayo Bessoum (8). All those populations exhibited the GPI<sup>100</sup> allele, except for (3) where it occurred mixed with the GPI<sup>90</sup>,

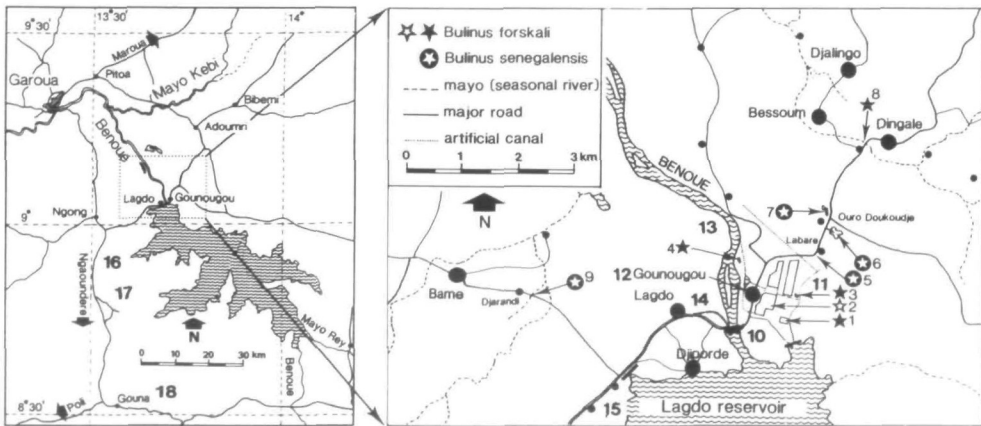


Figure 2. Map of study area showing localities where *Bulinus forskalii* and *B. senegalensis* occurred in July 1990. (Numbers correspond to Table 1).

without heterozygotes. *B. senegalensis*, identified by the allele combination ACP<sup>100</sup>/ $\alpha$ -GPD<sup>100</sup>/HBDH<sup>100</sup>/PGM<sup>80</sup> were collected near Labare (5), in the laterite quarry and temporary pool at Ouro Doukoudje (6, 7), and in the Mayo Ndjarrandi (9). Mixed populations of *B. forskalii* and *B. senegalensis* were not found in that area, nor did we find the HBDH<sup>50</sup> allele of *B. forskalii* previously reported in the extreme-north of the country.<sup>5</sup> No snail was found shedding mammalian schistosome cercariae.

Based on shell characters alone, we collected *Bulinus globosus* in locality (6), and *B. truncatus* in (1).

Information on the distribution of *B. senegalensis* is of importance, as this snail has been found to transmit *Schistosoma haematobium* in Gambia,<sup>1</sup> Nigeria,<sup>4</sup> and Cameroon;<sup>5,6</sup> undetected populations of this snail may be of epidemiological significance.<sup>3</sup> In Cameroon, this snail has been identified on shell characters alone from as far south as Poli and Tchollire,<sup>6</sup> located

just under 8°30'N. But until now the occurrence of *B. senegalensis* has been confirmed using allozyme electrophoresis only in localities north of 10°N.

In the present report, we confirm the occurrence of *B. senegalensis* in Lagdo, a village located 9°N, south of Garoua. The geographical features of that area are low altitude (<200 m), annual rainfall around 1000 mm in six months, and high temperatures (around 28°C), favouring temporary bodies of water suitable to the aestivating habits of *B. senegalensis*. Identifications performed from shells collected at Poli and Tchollire remain to be confirmed by further analysis; Tchollire is located in the Benue valley, and Poli in the Faro valley, a tributary of the river Benue. South of Lagdo along the road to Ngaoundere, the area is mostly hilly, rising rapidly to the Adamawa Plateau (1000 m). The few ponds in laterite quarries found in that area seem too temporary to be suitable to snails.

**Table 1.** Sites, numbers investigated (N) and allozyme mobilities for polymorphic loci among populations of the *Bulinus forskalii* group.

Site	N	ACP	$\alpha$ -GPD	GPI	HBDH	PGM
1a Fish breeding station, pond 21	10	80	70	100	70	100
1b Fish breeding station, pond 22	10	80	70	100	70	100
2 Rice fields	15	80	70	100	70	100
3 Laterite quarry near 'CTM'	10	80	70	100/90	70	100
4 Temporary pool near Benue	10	80	70	100	70	100
5 Ford near Labare	15	100	100	100	100	80
6 Ouro Doukoudje, laterite quarry	12	100	100	100	100	80
7 Ouro Doukoudje, temporary pool	8	100	100	100	100	80
8 Mayo Bessoum	15	80	70	100	70	100
9 Mayo N Djarandi	15	100	100	100	100	80

ACP = acid phosphatase;  $\alpha$ -GPD = alpha glycerophosphate dehydrogenase; GPI = glucose phosphate isomerase; HBDH = hydroxybutyrate dehydrogenase; PGM = phosphoglucumutase.

Migrations are expressed relative to *Bulinus forskalii* from Edea as a reference <sup>5,6</sup>. / separating alleles indicates polymorphism in the sample.

The occurrence of *B. senegalensis* at Lagdo can be explained by interconnections between the Benue valley and the Chad plain where that snail is very common.<sup>6</sup> The low altitude of those regions and general flooding during the rainy season favour temporary bodies of water and population migrations through the Mayo Kebi valley. This method of dispersal could explain the colonization of all the Benue and Faro valleys by this snail. Further investigations including all the Niger basin will be necessary to find out how far the distribution of *B. senegalensis* extends southwards. For this snail aestivation seems to be an intrinsic requirement,<sup>4</sup> which could become unfavourable as rainfall increases towards the equatorial region.

The finding of the GPI<sup>90</sup> allele in the *B. forskalii* population from site (3) is worthy of comment. In a previous study,<sup>8</sup> we found that allele only in populations collected from sites located in the evergreen forest of the equatorial and subequatorial regions where annual rainfall is higher than 1500 mm. The Benue flows into the Niger, the largest West African river linking the sahelian regions in the north to the equatorial regions in the south. We propose that snails with GPI<sup>90</sup> allele migrated from the equatorial regions to Lagdo through the Benue-Niger river system, as did *B. senegalensis* from the sahelian regions to the wetter sudanian regions.

Our theory on the distribution of *B. forskalii* in this region does not explain the absence of the HBDH<sup>70</sup> allele among populations sampled in Lagdo area,

since it is connected to the Chad Plain through the Mayo Kebi. The climate in that area is tropical semi-arid. Thus, the HBDH<sup>50</sup> allele seems limited to the sub-sahelian part of the Logone valley, or it recently derived in that area from the common HBDH<sup>70</sup>. Further investigations including snails from all the Logone valley remain necessary to better assess the geographical distribution of these alleles.

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