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# Presence of Myxosporidea (Myxozoa: Myxosporea) of the Genus *Henneguya* Thelohan, 1892 in Freshwater Fishes from Chad (Central Africa)

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**Summary.** Examination of some freshwater fishes from Chari and Logone rivers of Chad (Central Africa) revealed the presence of Myxosporidea species of the genus *Henneguya* Thelohan, 1892. They are: *H. auchenoglanii* sp. n. in *Auchenoglanis occidentalis* (Valenciennes, 1840) (Bagridae), *H. logonensis* sp. n. in *Citharinus citharus* (Geoffroy Saint-Hilaire, 1809) (Citharinidae), *H. mailaoensis* sp. n. in *Mormyrus cashive* (Linné, 1784) (Mormyridae), *H. massii* sp. n. in *Lates niloticus* (Linné, 1762) (Centropomidae), *H. mormyri* sp. n. in *Mormyrus cashive* (Linné, 1784) (Mormyridae) and *H. branchialis* Ashmawy, Abu-Elwafa, Imam and El-Otifi, 1989 in *Clarias anguilaris* (Linné, 1758) (Clariidae). All these species infected the gill filaments of their hosts and formed cysts.

**Key words:** Central Africa, Chad, freshwater fishes, *Henneguya auchenoglanii* sp. n., *Henneguya logonensis* sp. n., *Henneguya mailaoensis* sp. n., *Henneguya massii* sp. n., *Henneguya mormyri* sp. n., *Henneguya* species, Myxosporidea.

## INTRODUCTION

Myxosporidea are frequently described in fish and have an importance in ichtyopathology (Sakiti *et al*. 1990, 1996; Diamant 1992; Lom and Dyková 1992; Fomena *et al*. 1993; Voronin and Chernysheva 1993; Eiras 1994). In Africa, about 135 species of these parasites are currently known to infect freshwater, brackish and marine fishes (Bahri and Marques 1996; Kpatcha *et al*. 1996a, 1996b, 1997, 1999; Fomena and Bouix 1997; Fall *et al*. 1997; Kabre *et al*. 1997; Kostoïngue *et al*. 1998, 1999; Diebakate *et al*. 1999; Faye *et al*. 1999; Sakiti *et al*. 1999). Up to date, amongst these species, only 13 *Henneguya* Thelohan, 1892 are described in freshwater fishes. In the present paper, we described new *Henneguya* species found during our investigations in freshwater fishes from Chad (Central Africa).

## MATERIALS AND METHODS

The fishes studied were collected from Logone and Chari rivers near Ndjamena (Chad). These fishes belong to the genera *Auchenoglanis*, *Citharinus*, *Lates*, *Mormyrus* and *Clarias*. All measurements based on more twenty fresh spores, were made with an

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eyepiece micrometer. Permanent preparations were fixed with methanol and stained with Giemsa. For scanning electron microscopy, spores were fixed with glutaraldehyde, dehydrated in ethanol, critical point dried and examined with a JEOL 35 CF scanning electron microscope.

## RESULTS

The characteristics of *Henneguya* species found in freshwater fishes are as follows:

### *Henneguya auchenoglanii* sp. n.

Type host: *Auchenoglanis occidentalis* (Valenciennes, 1840) (Bagridae).

Site of infection: primary gill lamellae.

Type locality: Chari River.

Prevalence: 36,8 % (21/57).

Type specimen: one slide deposited in the parasitological collection (N° Myxo-093), Department of Animal Biology, Faculty of Sciences and Technologies, University C.A. DIOP of Dakar, Senegal.

Etymology: the specific name is given after the generic name of the host.

Description: cysts were ovoid, and their length was 1 to 1.5 mm. They were located at the base of primary gill lamellae. The spore body (Figs. 1, 8) was lanceolate, elongated and measured 12.0 ± 0.40 (11-13) x 3.2 ± 0.14 (3-4) µm. The two tails were always fused and their length was 39.42 ± 0.8 (37-40). The total length of the spore was 56.4 ± 0.9 (52-58) µm. The two polar capsules were pyriform, elongated and of equal size: 6.3 ± 0.1 (6-7) x 2.1 ± 0.1 (2-3) µm. Their polar filament was not apparent. The sporoplasm was finely granular.

Discussion: up to date, 13 species of *Henneguya* have been previously described in freshwater fishes from Africa (Fomena and Bouix 1997, Kabre *et al*. 1997, Kostoïngue *et al*. 1999). These species are mentioned in the Table 1. It appeared that by the length of its spore, the present species is only similar to *H. fusiformis;* but it is distinct from this species by the length and shape of its spore body. Therefore, we consider it as a new species and name it *Henneguya auchenoglanii* sp. n. to remember the generic name of its type host.

### *Henneguya logonensis* sp. n.

Type host: *Citharinus citharus* (Geoffroy) (Saint-Hilaire, 1809) (Citharinidae).

Site of infection: primary gill lamellae.

Type locality: Logone River.

Prevalence: 25.8 % (16/32).

Type specimen: one slide deposited in the parasitological collection (N° Myxo-094), Department of Animal Biology, Faculty of Sciences and Technologies, University C.A. Diop of Dakar, Senegal.

Etymology: the specific name relates to its type locality.

Description: cysts were ovoid, located on primary gill lamellae and their length was 0.5 to 1.5 mm. Spore body (Figs. 2, 7, 9) was oval with attenuated anterior end; its length and width was 12.03 ± 0.1 (11-13) x 3.2 ± 0,09 (3-4) µm. The length of caudal appendages was 22.5 ± 0.4 (20-25) µm and the total length of the spore was 34.6 ± 0.9 (33-37) µm. The polar capsules were pyriform and of unequal size. The big polar capsule measured 3.7 ± 0.09 (3-4) x 1.6 ± 0.09 (1-2) µm and the smaller measured 2.2 ± 0.08 (2-3) x 1.4 ± 0.09(1-2) µm. The polar filaments were not apparent and the sporoplasm was finely granular.

Discussion: amongst the *Henneguya* described in freshwater fishes from Africa, only spores of *H. nyongensis* and *H. clariae* resemble those of the present species by their morphology. However, *H. nyongensis* is distinct by the length of its polar capsule and *H. clariae* by the total length of its spores (Table 1). For these reasons, we think that the present species is new and we name it *Henneguya logonensis* sp. n. to remember the river where it was first found.

### *Henneguya mailaoensis* sp. n.

Type host: *Mormyrus cashive* (Linné, 1784) (Mormyridae).

Site of infection: primary gill lamellae.

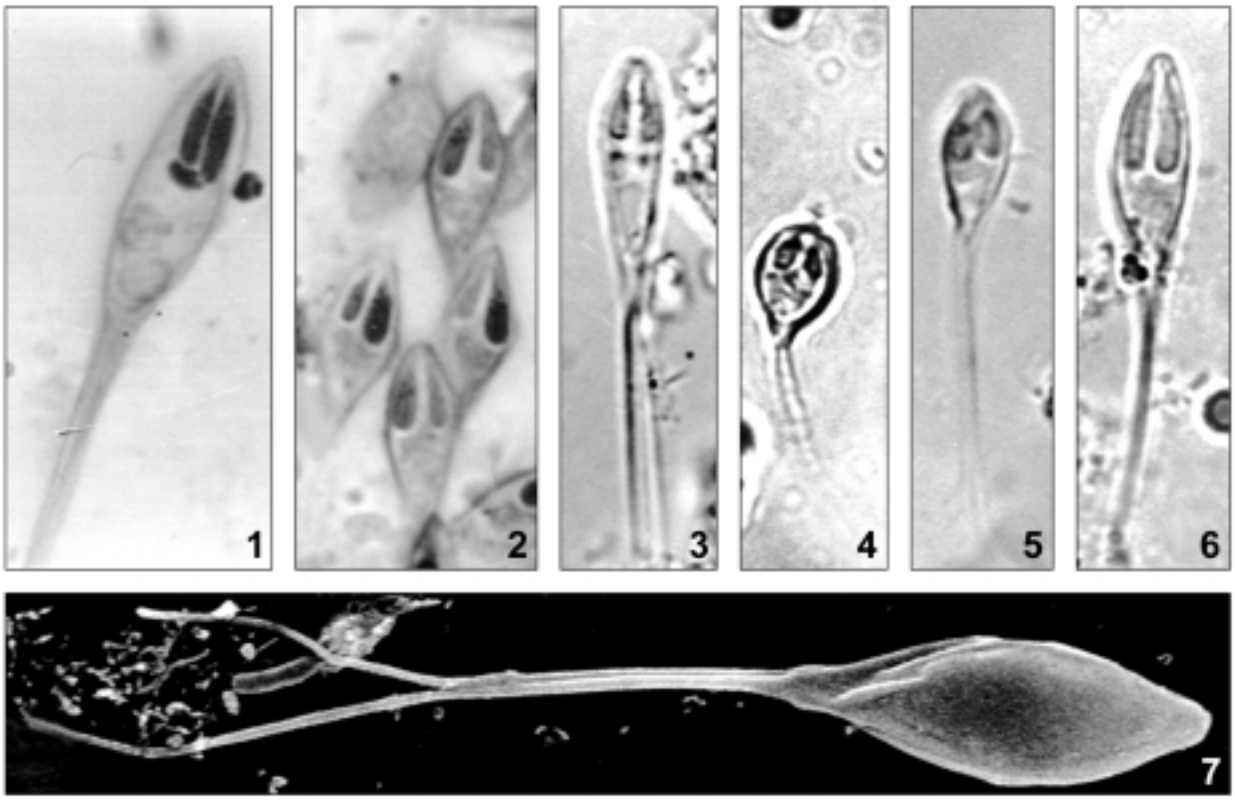
Type locality: Chari River.

Prevalence: 13.3 % (12/90).

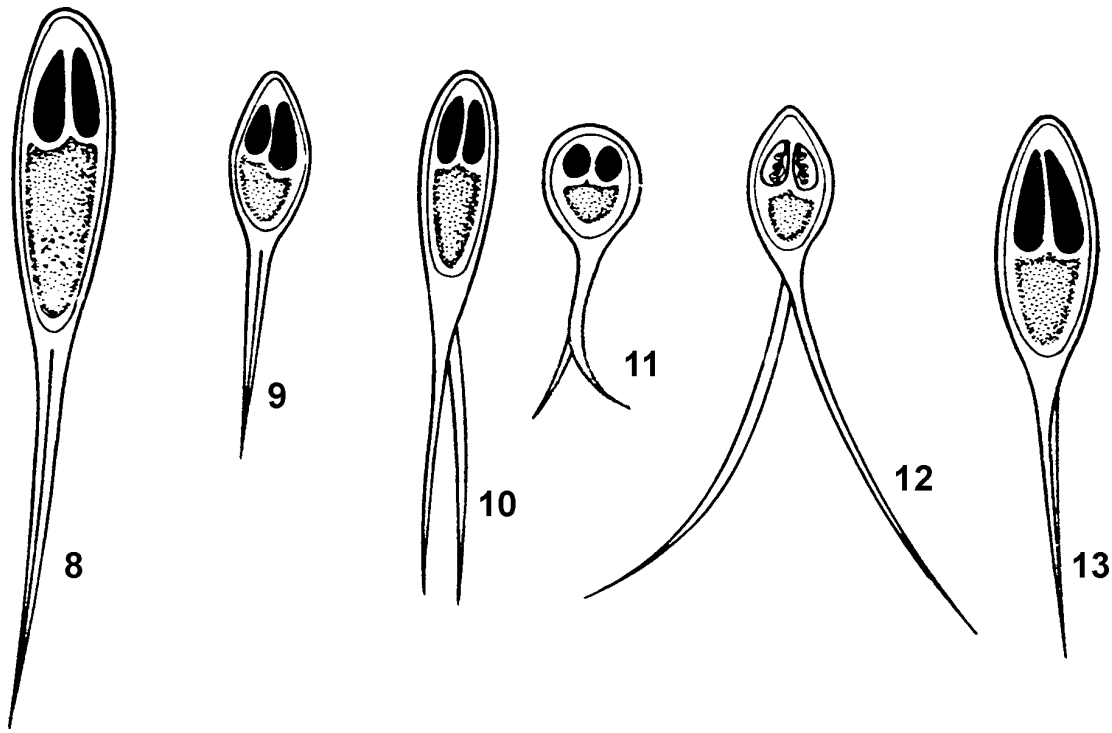
Type specimen: one slide deposited in the Parasitological collection (N° Myxo-095), Department of Animal Biology, Faculty of Sciences and Technologies, University C.A. DIOP of Dakar, Senegal.

Etymology: the specific name is given after one village of Chad.

Description: cysts where ovoid, fixed on the primary gill lamellae and measured 0.5 to 1.5 mm. The spore body (Figs. 3, 10) was lanceolate, elongated and measured 17.6 ± 0.4 (15-18) x 5.7 ± 0.1 (5-6) µm. The two polar capsules were pyriform and equal size: 5.9 ± 0.33 (5-7) x 2.2 ± 0.09 (2-3) µm. Their polar filament was not apparent. The two caudal appendages were equal, separated from their base and had 44.5 ± 1.07 (41-46) µm in length. The total length of the spore was 61.7 ± 1.3 (58-63) µm.




**Figs. 1-7.** Mature spores: **1** - *Henneguya auchenoglanii* sp. n. stained with Giemsa (x 1800); **2** - *Henneguya logonensis* sp. n. stained with Giemsa (x 1800); **3** - living *Henneguya mailaoensis* sp. n. (x 1800); **4** - living *Henneguya massii* sp. n. (x 1800); **5** - living *Henneguya mormyri* sp. n. (x 1800); **6** - living *Henneguya branchialis* (x 1800); **7** - *Henneguya logonensis* sp. n. in scanning electron microscope (x 5500)




**Figs. 8-13.** Line drawing of mature spores: **8** - *Henneguya auchenoglanii* sp. n.; **9** - *Henneguya logonensis* sp. n.; **10** - *Henneguya mailaoensis* sp. n.; **11** - *Henneguya massii* sp. n., **12** - *Henneguya mormyri* sp. n.; **13** - *Henneguya branchialis.* Scale bar - 5 μm

**Table 1.** *Henneguya* species previously described in freshwater fishes from Africa. All measures in µm

| Species | Hosts | Characteristics of spores | Sites of infections |
|---|---|---|---|
| *H. bopeleti* Fomena & Bouix, 1987 | *Chrysichthys nigrodogitatus* | Spore body: ovoid, 15-19 x 5.5-7; polar capsules: pyriform, 7-9 x 1.5-2.5; caudal appendages: fused, 22.5-32; total length: 41-48 | Gills |
| *H. branchialis* Ashmawy, Abu-Elwafa, Imam & El-Otifi, 1989 | *Clarias lazera* | Spore body: anterior end pointed, 12.5-17.5 x 4.5-6.5; polar capsules: pyriform; 6-8.5 x 1.5-3; caudal appendages: separated, 15.5-23.5; total length: 28-41 | Gills, intestine |
| *H. camerounensis* Fomena & Bouix, 1987 | *Synondontis batesii, Utropius multitoeniatus* | Spore body: ovoid, 9-11 x 4-5.5µm; polar capsules: pyriform, 4.5-6.5 x 1-2; caudal appendages: fused, 4-11.5; total length: 13.5-21.5µm | Gills |
| *H. chrysichthyi* Obiekezie & Enyenihi, 1988 | *Chrysichthys nigrodigitatus* | Spore body: fusiform, 13.5-16 x 4.5-6.5; polar capsules: unequal, pyriform, 4.5 –5.5 x 1-1.5 and 4-4.5 x 1.5-2; caudal appendages: unequal; total length: 27-32 | Gills |
| *H. clariae* Abolarin, 1971 | *Clarias lazera* | Spore body: ovoid, 17.5-28.5 x 5.5-8.5; polar capsules: pyriform, 5–13.5 x 2.5- 3.5; caudal appendages: fused; total length: 45-107 | Gills |
| *H. ctenopomae* Fomena & Bouix, 1997 | *Ctenopoma manum* | Spore body: ovoid, anterior end rounded, 13-17 x 8-10.5; polar capsules: pyriform, 5-5.5 x 2-3; caudal appendages: separated from their base, 2-10; total length: 17-25 µm | Gills |
| *H. dini* Kabre, Sakiti, Marques & Sawadogo, 1997 | *Heterotis niloticus* | Spore body: elongated, 11-12 x 3-5; polar capsules: pyriform, 3-4 x 1-1.5; caudal appendages: separated from their base, 16-20; total length: 27-32 µm | Gills |

Table 1. (contd.)

| | | | |
|---|---|---|---|
| *H. fusiformis* Kostoïngue, Fall, Faye & Toguebaye, 1999 | *Clarias anguilaris* | Spore body: fusiform, 29-33 x 5-7;<br>polar capsules: pyriform, one located behind the other, 5-6 x 3-4;<br>caudal appendages: separated, curved, 28-31;<br>total length: 59-61 µm | Gills |
| *H. laterocapsulata* Obiekezie & Schmahl, 1993 | *Clarias lazera* and *Heterobranchus bidorsalis* hybrid | Spore body: fusiform, 13.8-16 x 3.7-5.3;<br>polar capsules: pyriform to flask-shaped, one displaced laterally, 4.1-5.3 x 2.2-3.0;<br>caudal appendages: separated, curved, 15.2-20.2<br>total length: 29.0-36.2 | Body |
| *H. malapteruri* Fomena & Bouix, 1997 | *Malapterurus electricus* | Spore body: ovoid, anterior end rounded, 14-18 x 8.3-11;<br>polar capsules: pyriform, 5-7.3 x 2.8-4;<br>caudal appendages: separated, presence of bulge at the base, 24-36.5;<br>total length: 42-53 | Muscles and skin |
| *H. ntemensis* Fomena & Bouix, 1996 | *Brienomyrus brachyistus* | Spore body: ovoid, 9-12 x 7-9;<br>polar capsules: pyriform, 5-7 x 3-4;<br>caudal appendages: sometimes fused, 3-10;<br>total length: 12.5-17.5 µm | Kidney, spleen, gall-bladder wall |
| *H. nyongensis* Fomena & Bouix, 1996 | *Marcusenius moorii* | Spore body: ovoid, anterior end pointed, 10-14 x 4.5-6.5;<br>polar capsules: pyriform, with neck-like structure, 5.5-7 x 2-3;<br>caudal appendages: filiform, separated from their base, 20-23.5;<br>total length: 30.5-36.5 | Gills, muscles |
| *H. odzai* Fomena & Bouix, 1996 | *Marcusenius moorii* | Spore body: elongate, anterior end rounded, 13-16 x 3.5-4.5;<br>polar capsules: pyriform, 3-5 x 1-1.5;<br>caudal appendages: filiform, separated from their base, 15-21.5;<br>total length: 29-36.5 | Gills |

Discussion: the morphology of some *Henneguya* species described in freshwater fishes from Africa resemble to that of the present species. It concerns: *H. auchenoglanii* sp. n., *H. branchialis*, *H. dini* and *H. bopeleti* (Table 1). However, all these four species are too small. For this reason, we think that the species described here is new and we name it *Henneguya mailaoensis* sp. n. to remember one village of Chad.

***Henneguya massii* sp. n.**

Type host: *Lates niloticus* (Linné, 1762) (Centhropomidae).

Site of infection: primary gill lamellae.

Type locality: Chari River.

Prevalence: 4.4 % (3/67).

Type specimen: one slide deposited in the Parasitological collection (N° Myxo-096), Department of Animal Biology, Faculty of Sciences and Technologies, University C.A. DIOP of Dakar, Senegal.

Etymology: the name is given after the Professor MASSI from the University of NDjamena (Chad).

Description: cysts were spherical, small (0,5-1 mm in diameter) and numerous on the primary gill lamellae. The spore body (Figs. 4, 11) was oval with rounded anterior and attenuated posterior ends. It measured 8.3 ± 0.1 (8-9) x 5.6 ± 0.1 (5-6) µm. The two caudal appendages were short, equal and well separated. They measured 13.6 ± 0.3 (12-14) µm. The two polar capsules were pyriform, small and measured 2.8 ± 0.09 (2-3) x 1.6 ± 0.05 (1-2) µm. The polar filaments were not apparent. The sporoplasm, finely granular, contained two typical nuclei when stained. The total length of spores was 22.2 ± 0.4 (20-23) µm.

Discussion: by its size, the present species is similar to *Henneguya ctenopomae* (Table 1). But it differs from this species by the length of its spore body and caudal appendages (Table 1). Paperna (1973) has reported *Henneguya latesi* in *Lates albertianus* from Ouganda without data on this species. Thus, we cannot compare it with our finding.

For all these reasons, we think that the present species is new and name it *Henneguya massii* sp. n. in honor to the Professor MASSI from University of Chad.

***Henneguya mormyri* sp. n.**

Type host: *Mormyrus cashive* (Linné, 1784) (Mormyridae).

Site of infection: primary gill lamellae.

Type locality: Chari River.

Prevalence: 10 % (6/60).

Type specimen: one slide deposited in the Parasitological collection (N° Myxo-097), Department of Animal Biology, Faculty of Sciences and Technologies, University C.A. DIOP of Dakar, Senegal.

Etymology: the name is given after the generic name of the type host.

Description: this species formed in primary gill lamellae numerous small and spherical cysts measuring 0.4 to 0.8 mm in diameter. The spore body (Figs. 5, 12) was oval with a pointed anterior end and measured 8.4 ± 0.09 (8-9) x 4.5 ± 0.09 (4-5) µm. The two polar capsules were pyriform, of equal size and measured 3.3 ± 0.09 (3-4) x 1.9 ± 0.08 (1-3) µm and had 3 to 4 filament coils. The sporoplasm was small. The two caudal appendages were equal, measured 23.1 ± 0.6 (23-25) µm and separated from their base. The total length of the spore was 32.2 ± 0.7 (30-34) µm.

Discussion: the present species is dissimilar to all species previously described in freshwater fishes from Africa (Table 1) because its small spore body. Taking into account this difference, the present species is considered as a new species and designated as *Henneguya mormyri* sp. n. after the name of its type host.

***Henneguya branchialis* Ashmawy, Abu-Elwafa, Imam and El-Otifi, 1989**

Host: *Clarias anguilaris* (Linné, 1958) (Clariidae).

Site of infection: primary gill lamellae.

Locality: Chari River.

Prevalence: 9,1 % (4/44).

Specimen: one slide deposited in the Parasitological collection (N° Myxo-098), Department of Animal Biology, Faculty of Sciences and Technologies, University C.A. DIOP of Dakar, Senegal.

Description: oocysts were ovoid, whitish and measured 1 to 2 mm. The spore body (Figs. 6, 13) was lanceolate, elongated with anterior end more or less blunt and measured 14.3 ± 0.5 (12-16) x 5.1 ± 0.2 (4-7) µm. The two polar capsules were equal, pyriform and measured 5.7 ± 0.6 (4-6) x 1.4 ± 0.2 (1-2) µm. The polar filaments were not apparent. The sporoplasm was finely granular. The length of the two caudal appendages, which are of equal size was 19.1 ± 0.9 (18-20) µm. The total length of the spore was 33.7 ± 0.8 (30-36) µm.

Discussion: amongst the *Henneguya* species described in freshwater fishes in Africa, only *Henneguya branchialis* presented characteristics resembling those of the present species (Table 1). Indeed, according to Kabre *et al*. (1997) which have also mentioned

*H. branchialis* in *Clarias anguilaris* from Burkina Faso, the morphometric characteristics of the spore of this species are: total length 34.4 ±1.34 (31-39); spore body length and width 13.45 ± 0.51 (12-16) x 5.01 ± 0.5 (4-7) µm; polar capsules length and width 5.7 ± 0.47 (4-6) x 1.35 ± 0.27 (16-20) µm; caudal appendages length 18.37 ± 1.27 (16-20). The sporal body is elongated, the polar capsules and the caudal appendages are equal in size. For all these reasons, we think that the present species is *H. branchialis*.

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