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Distribution of the Entodiniomorphid Ciliate *Troglocorys cava* Tokiwa, Modrý, Ito, Pomajbíková, Petrželková, & Imai, 2010, (Entodiniomorphida: Blepharocorythidae) in Wild and Captive Chimpanzees

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ABSTRACT. Trophozoites of *Troglocorys cava* were detected in all but one of the wild chimpanzee populations from Rubondo Island (Tanzania), with a prevalence ranging between 20% and 78%. However, the ciliate was absent in all captive groups. Prevalence appeared to increase with the number of sequential samples taken from a particular individual and reached 95.5% in wild individuals sampled at least 4 times.

Key Words. Chimpanzees, Entodiniomorphida, intestinal ciliates, prevalence, *Troglocorys cava*.

THE intestine of apes is colonized by a spectrum of protists that cause no or little harm to their host and can be classified as mutualists or commensals. Among them, ciliates are the most prominent group, as they apparently participate in the hindgut fermentation (e.g. Profousová et al. 2010). Reports about the presence of intestinal ciliates in wild apes were mostly a by-product of parasitological examinations (Ashford, Reid, and Wrangham 2000; Murray et al. 2000). However, the proper classification of ciliates requires specialized techniques other than those used for the routine coproscopic detection of parasites, thus representing a serious drawback in their research (Imai et al. 1991).

Most intestinal ciliates of great apes belong to the order Entodiniomorphida and are classified in the genera *Troglodytella*, *Gorillophilus* and *Prototapirella*. In addition, a species that had been referred to as a "small" or "unidentified ciliate" (Ashford et al. 2000; Bakuza and Nkwengulila 2009; Murray et al. 2000) was named *Troglocorys cava* and assigned to the family Blepharocorythidae (Tokiwa et al. 2010); the study aimed to investigate the occurrence of *T. cava* in both wild and captive chimpanzees. Herein, we report on the prevalence, diagnostics, and geographical distribution of *T. cava* in populations of wild chimpanzees and discuss the absence of *T. cava* in captive chimpanzees in European facilities, African sanctuaries, and in an introduced chimpanzee population in Tanzania.

MATERIAL AND METHODS

The set of fecal samples of wild (n = 511) and captive chimpanzees (n = 203) largely corresponds with those discussed by Pomajbíková et al. (2010). It also includes two additional wild chimpanzee populations and one captive facility: Goualougo Triangle, Republic of Congo (DRC) (n = 20); Cantanhez National Park (NP), Guinea Bissau (n = 102); and Sweetwaters Chimpanzee Sanctuary, Kenya (n = 42). In addition, the numbers of samples from Ugalla and Rubondo Island NP were extended to 119 and 206, respectively. Samples were preserved by 10% formalin and examined by merthiolate-iodine-formaldehyde sedimentation (MIFC), following Pomajbíková et al. (2010).

We calculated the prevalence of *T. cava* differently for habituated (chimpanzees are used to being around people) and unhabituated (the opposite to previous) populations. For a habituated population, the prevalence was expressed as the percentage of individuals infected with *T. cava*; for unhabituated populations, as the percentage of samples positive for *T. cava*. To determine the effect of sequential sampling on the prevalence of *T. cava*, we calculated the cumulative prevalence for selected animals from Kalinzu Forest Reserve. We chose samples only from the wet season (n = 195) and calculated the cumulative prevalence based on number of samples per individual: (i) one sample (n = 36 animals); (ii) two sequential samples (n = 29); (ii) three sequential samples (n = 25); and (iv) four or more sequential samples (n = 22).

For scanning electron microscopy (SEM), trophozoites of *T. cava* from a chimpanzee from Kalinzu FR were obtained from a filtrated fecal sediment and were preserved with 10% formalin, following the protocol of Jirků et al. (2009).

RESULTS AND DISCUSSION

The general trophozoite morphology, determined by light microscopy and confirmed by NIC, was uniform throughout all localities and consistent with the original description of *T. cava* (Tokiwa et al. 2010) (Fig. 1).

The geographical distribution of *T. cava* includes localities in Tanzania, Uganda, and Gabon (e.g. Krief et al. 2005; Landsoud-Soukate, Tutin, and Fernandez 1995; Murray et al. 2000). We detected *T. cava* in chimpanzee fecal samples from seven of the eight studied wild populations and extended its known distribution in Uganda and Tanzania, and added localities in Nigeria, DRC, and Guinea Bissau. Its prevalence in wild populations ranged from 5% to 98% (Ashford et al. 2000; File, McGrew, and Tutin 1976; Krief et al. 2005; Landsoud-Soukate et al. 1995; Murray et al. 2000). Our

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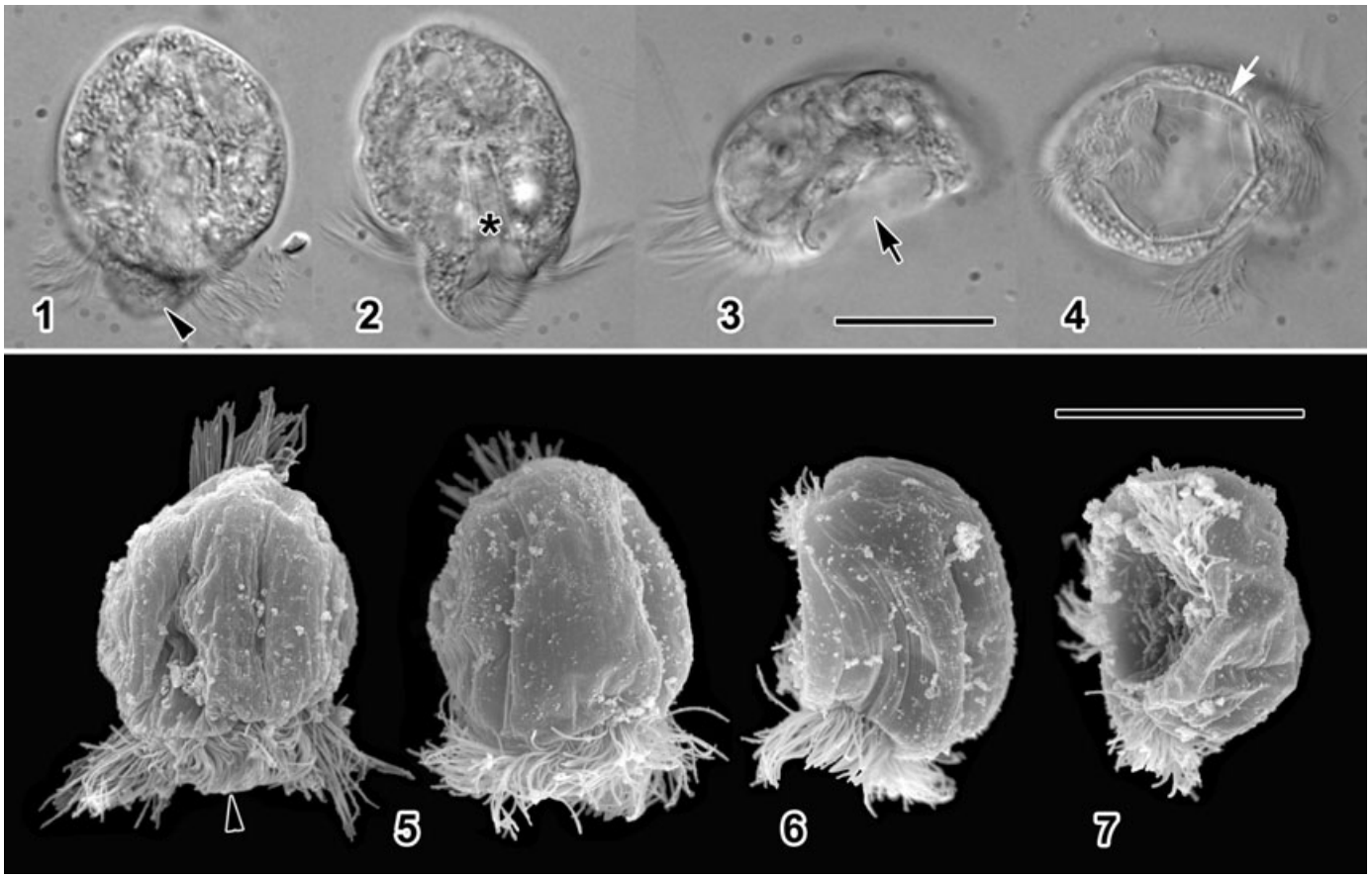

Fig. **1–7.** Diagnostic features of *Troglocorys cava* revealed by light microscopy (**1–4**) and scanning electron microscopy (**5–7**) from a formalin-fixed fecal sample from *Pan troglodytes schweinfurthii*, Kalinzu Forest Reserve, Uganda. **1.** Right side of the trophozoite showing frontal lobe (arrowhead) surrounded by adoral ciliae. **2.** Trophozoite showing vestibulum (asterisk). **3.** Left concavity (arrow) in dorso-ventral view. **4.** Left side of the trophozoite showing the concavity clearly demarcated by a hexagonal line formed by bases of lips (white arrow). **5.** Right side of two trophozoites showing typical surface longitudinal striation and both adoral (bottom) and left cilia (above). Arrowhead indicates position of frontal lobe hidden by adoral ciliae. **6.** Dorso-ventral view showing asymmetrical shape of the trophozoite. The concavity, invisible in this view, is located on the flat left side. **7**. Dorso-lateral view of the trophozoite showing the prominent left concavity possessing small round projections on its surface. Scale bars = 20 μm. Fig. **1–4** and **5–7,** respectively, are in the same scale.

results fell within this range: Budongo FR, Ugalla – 20%; Cantanhez NP – 25%; Gashaka Gumti NP – 33%; Kyambura George – 40%; Goualougo Triangle – 65%; and Kalinzu FR – 78%. In contrast, we did not find *T. cava* in any captive chimpanzees. *Troglocorys cava* was absent also in the wild population of chimpanzees on Rubondo Island, having been introduced onto the island in the 1960s using founders that had spent some period in captivity (Petrželková et al. 2010). Thus, *T. cava* apparently disappears during the captivity; this is confirmed by its total absence in zoos and sanctuaries. These findings are in contrast to the common occurrence of *Troglodytella abrassarti* in captive chimpanzees (Pomajbíková et al. 2010). Since nothing is known about the biology of *T. cava* in hindgut ecosystem, its absence cannot be unambiguously explained.

Generally, the populations of commensal ciliates fluctuate greatly, which was demonstrated both in rumen ciliates and *T. abrassarti* (Pomajbíková 2008; Williams and Coleman 1991). As a result of this fluctuation, the numbers of *T. cava* in some fecal samples can be reduced below the threshold level of detection. To address this problem we examined serial fecal samples from the same individual and calculated their cumulative prevalence. Prevalence of *T. cava* reached 55.5% in individuals sampled only once, 79.3% in individuals sampled twice, 92% in individuals sampled 3 times, and 95.5% if four and more samples were collected. These results conform to other studies suggesting that ideally three or four samples per animal are necessary to assess the real prevalence of a particular parasite/symbiont (Huffman et al. 1997; Muehlenbein 2005). Therefore, we predict that *T. cava* is present in all individuals in wild chimpanzee populations, a pattern documented previously for *T. abrassarti* (Pomajbíková et al. 2010). Despite the fact that none of previous studies included either morphological descriptions or microphotographs, we assume that also other findings of the "small ciliate" in chimpanzees by previous researchers refer to *T. cava*.

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