

First record of epizootic ulcerative syndrome from the Upper Congo catchment: An outbreak in the Bangweulu swamps, Zambia

C. F. Huchzermeyer, K. D. A. Huchzermeyer, K. W. Christison, B. M. Macey, P. A. Colly, B. M. Hang'ombe and M. M. Songe

Abstract

We report on the first outbreak of epizootic ulcerative syndrome (EUS) amongst wild fish populations in the Bangweulu swamps, an inland delta, in the north of Zambia during 2014. The area supports a large and diverse fish fauna related to, but distinct from, that of the Zambezi River system where EUS outbreaks have occurred since 2006. A sizeable artisanal fishery, based on extensive fish weirs, is sustained by the annual flooding of the swamps, and observations of the disease outbreak by fishermen were recorded. Signs typical of infection with *Aphanomyces invadans* were observed in a number of species. Clinical observations, histology and molecular diagnostic methods were used to confirm infection with *A. invadans* in two of the most commonly and severely affected species. Several features of the wetland may have contributed to the outbreak and the annual recurrence of the disease. Modes by which the disease may have been introduced into the swamps are discussed. The outbreak is of great significance as the Bangweulu swamps drain into the Congo River in neighbouring Democratic Republic of Congo, Africa's largest drainage system with an extensive and diverse fish fauna previously unaffected by EUS.

1 Introduction

Epizootic ulcerative syndrome (EUS) is a serious disease of freshwater and estuarine fish. The disease has been reported from Asia, Australia, North America and Africa (Anon 2016a; Oidtmann, 2012). The first reports from Africa followed an outbreak in the Zambezi and Chobe rivers near their confluence in 2006 (Andrew, Huchzermeyer, Mbeha, & Nengu, 2008; Anon 2009a). It remains unknown how the causative agent, *Aphanomyces invadans*, spread to Africa. The disease appears to have originated in Asia, with the first reporting of a new ulcerative disease of fish from Japan in 1971 (Egusa & Masuda, 1971). A year later, the disease was reported from Australia (Baldock et al., 2005; Callinan, Paclibare, Bondad-Reantaso, Chin, & Gogolewski, 1995), and since then has been described from many countries, particularly in Asia (Callinan et al., 1995; Das & Das, 1993; Lilly et al., 1997), but also from natural populations of estuarine and freshwater fish along the Atlantic coast of the USA (Blazer et al., 2002; Sosa et al., 2007). The spread of *A. invadans* to distinctly separate geographic regions within a relatively short period of time has been consistent with the progressive dissemination of a

- Oidtmann, B. (2012). Review of biological factors relevant to import risk assessments for epizootic ulcerative syndrome (*Aphanomyces invadans*). *Transboundary and Emerging Diseases*, *59*, 26–39.
- Pathiratne, A., & Jayasinghe, R. P. P. K. (2001). Environmental influence on the occurrence of epizootic ulcerative syndrome (EUS) in freshwater fish in the Bellanwila-Attidiya wetlands, Sri Lanka. *Journal of Applied Ichthyology*, *17*, 30–34.
- Phadee, P., Kurata, O., & Hatai, K. (2004). Detection and identification of fish-pathogenic *Aphanomyces piscicida* using Polymerase Chain Reaction (PCR) with species-specific primers. *Journal of Aquatic Animal Health*, *16*, 25–31.
- Pradhan, P., Rathore, G., Sood, N., Swaminathan, T., Yadav, M., Verma, D., ... Jena, J. (2014). Emergence of epizootic ulcerative syndrome: Large-scale mortalities of cultured and wild fish species in Uttar Pradesh, India. *Current Science*, *106*, 1711–1718.
- Sambrook, J., MacCallum, P., & Russel, D. (2000). *Molecular cloning: A laboratory manual*, 3rd ed. Long Island, New York, USA: Cold Spring Harbor Laboratory Press.
- Scott, L. (2005). Bangweulu-Mweru. In M. L. Thieme, R. Abell, M. L. J. Stiassny, P. Skelton, B. Lehner, G. Teugels, E. Dinerstein, A. Kamdem-Toham, N. Burgess & D. Olson (Eds.), *Freshwater ecoregions of Africa and Madagascar: A conservation assessment* (pp. 185–186). Washington: World Wildlife Fund, Island Press.
- Songe, M. M., Hang'ombe, M. B., Phiri, H., Mwase, M., Choongo, K., Van der Waal, B., ... Subasinghe, R. P. (2012). Field observations of fish species susceptible to epizootic ulcerative syndrome in the Zambezi River basin in Sesheke District of Zambia. *Tropical Animal Health and Production*, *44*, 179–183. <https://doi.org/10.1007/s11250-011-9906-1>.
- Sosa, E. R., Landsberg, J. H., Stephenson, C. M., Forstchen, A. B., Vandersea, M. W., & Litaker, R. W. (2007). *Aphanomyces invadans* and ulcerative mycosis in estuarine and freshwater fish in Florida. *Journal of Aquatic Animal Health*, *19*, 14–26. <https://doi.org/10.1577/H06-012.1>.
- Van Steenberge, M., Vreven, E., & Snoeks, J. (2014). The fishes of the Upper Luapula area (Congo basin): A fauna of mixed origin. *Ichthyological Exploration of Freshwaters*, *24*(4), 329–345.
- Walker, C. A., & Van West, P. (2007). Zoospore development in oomycetes. Review. British Mycological Society. *Fungal Biology Reviews*, *21*, 10–18. Willoughby, L. G., & Roberts, R. J. (1994). Loss and recovery of zoospore motility in an isolate of *Aphanomyces* from a diseased fish. *Mycological Research*, *98*, 1463–1464.