

Global Pattern of Epizootic Ulcerative Syndrome Outbreaks in Freshwater Farmed and Wild Fish from 2005 to 2012

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ABSTRACT

*Epizootic ulcerative syndrome (EUS) is an infectious disease of freshwater farmed and wild fish caused by a fungus, *Aphanomyces invadans*. This disease is an important economic disease causing huge socio-economic losses to fish farmers across the world. While this is an important fish disease, its global epidemiology is poorly understood. The objective of this study is understand the global spatiotemporal epidemiology of EUS outbreaks from 2005 to 2022. The data were retrieved from open access database of the World Organization for Animal Health (WOAH). Results showed that there were a total of 277 outbreaks of EUS reported to WOA from 2005 to 2022 from 15 countries and territories with 76% outbreaks reported from African countries. Democratic Republic of Congo reported the highest number of EUS outbreaks. Higher number of outbreaks were reported during 2014 to 2017. The observed epidemiological pattern might be biased due to the underreporting of the disease. Nevertheless, it offers important insights to understand the latest global pattern of EUS. We suggest to increase country level awareness on EUS so that outbreaks are reported in a timely manner.*

Keywords: *Aphanomyces invadans, Epidemiology, Infectious fish disease, Spatiotemporal pattern*

INTRODUCTION

Epizootic ulcerative syndrome (EUS), also known as red spot disease, mycotic granulomatosis and ulcerative mycosis, is an infectious disease of fish caused by a fungal pathogen, *Aphanomyces invadans* (WOAH, 2023). This disease is prevalent among both domestic and wild fresh water species and estuarine fish and is characterized by necrotic ulcerative lesions leading to granules (WOAH, 2023). This is a disease of international concern and is reportable to World Organization for Animal Health (WOAH) because of its widespread distribution among fish species covering more than 16 orders, 54 families and 160 species (Herbert et al., 2019).

The EUS can cause mortality up to 100% and is therefore considered an important disease of economic importance (Iberahim et al., 2018). Small and mixed fish farms are particularly prone to the infection of this disease. A study has shown that EUS has caused massive economic losses to the fish farmers from the Asia-Pacific region which estimates up to 20,000 to 100 million economic losses (cumulative losses USD 114 million) from different countries that include Australia, Bangladesh, India, Pakistan, Nepal, Thailand, Indonesia and Sri Lanka (Chong, 2022). Several factors are responsible for the spread of EUS. Studies has shown that higher stocking density, older ponds with high bottom disposition and shade, stress conditions, cultures fish connected to rice fields and flooding contributes in the spread of EUS (Kar and Aurobindo, 2021, Khan and Lilley, 1999 and Kumar et al., 2017).

This pathogen was first isolated in Japan in 1971 and has been detected in various countries from North America, Australia and African countries (Iberahim et al., 2018). However, there are limited studies describing the global epidemiology of EUS. The objective of this study is to describe the global spatiotemporal epidemiology of Epizootic Ulcerative Syndrome (EUS) among freshwater farmed and wild fish species based on the reported incidences to the World Animal Health Information System (WAHIS) of the WOAHA.

MATERIALS AND METHODS

This is a descriptive epidemiological study of Epizootic Ulcerative Syndrome (EUS) globally from 2005 to 2022.

Data collection

Open source data of EUS outbreaks reported to the World Animal Health Information System (WAHIS) were collected from the World Organization for Animal Health (WOAH) website from the year 2005 to 2022. Data reported from all the countries across the world were included in this study.

Data Analysis

The data were collected in Microsoft Excel 2016 and made graphs and pivot tables using the same Excel version.

Mapping

The maps to show the spatial pattern of EUS were prepared using the open access software QGIS version 3.28.0.

RESULTS AND DISCUSSION

Temporal pattern of EUS outbreaks

There were a total of 277 outbreaks of EUS reported to the WOA from 2005 to 2022. The highest number of outbreaks were reported in 2016 (63 outbreaks) followed by 44 outbreaks in 2015 and 27 outbreaks in 2008 (Figure 1). The pattern shows that in the earlier years from 2005 to 2007, there were only limited number of outbreaks reported while it increased to 27 outbreaks in 2008 (Figure 1). The outbreaks again decreased until 2014 and remained below a total of 10 outbreaks (Figure 1). Thereafter, the number of outbreaks rapidly increased and reached to 63 outbreaks in 2016 after which it began to decrease (Figure 1).

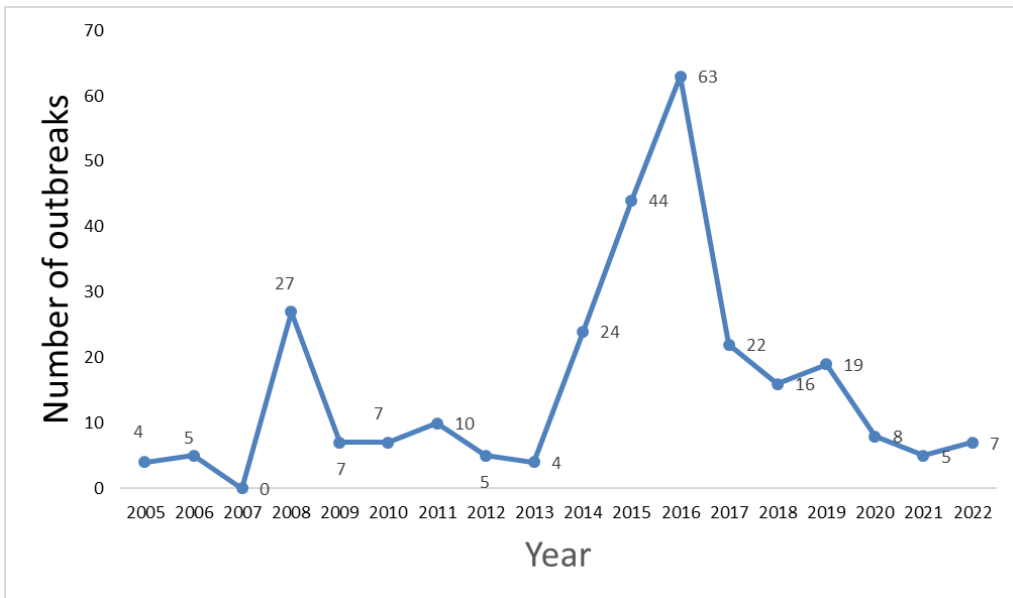


Figure 1. Temporal pattern of EUS from 2005- 2022

Spatial pattern of EUS outbreaks

The spatial pattern showed that outbreaks of EUS were reported from 15 countries from 5 continents, Australia, Americas, Asia, Oceania and Europe (Figure 2). The countries and territories that reported outbreaks of EUS to the WOA during 2005- 2022 include Cameroon, Canada, Chinese Taipei, Thailand, United Kingdom, Bangladesh, Zimbabwe, Malawi, Japan, Botswana, India, Namibia, South Africa, Australia and Democratic Republic of Congo (Figure 2). The highest number of outbreaks were reported from Democratic Republic of Congo (159 outbreaks) followed by 58 outbreaks from Australia and 27 outbreaks from South Africa (Figure 2). The highest number of outbreaks were reported from Africa (76%, 210/277 outbreaks) followed by Oceania (16%, 44/277 outbreaks) and Asia (8%, 21/277 outbreaks) (Figure 3).

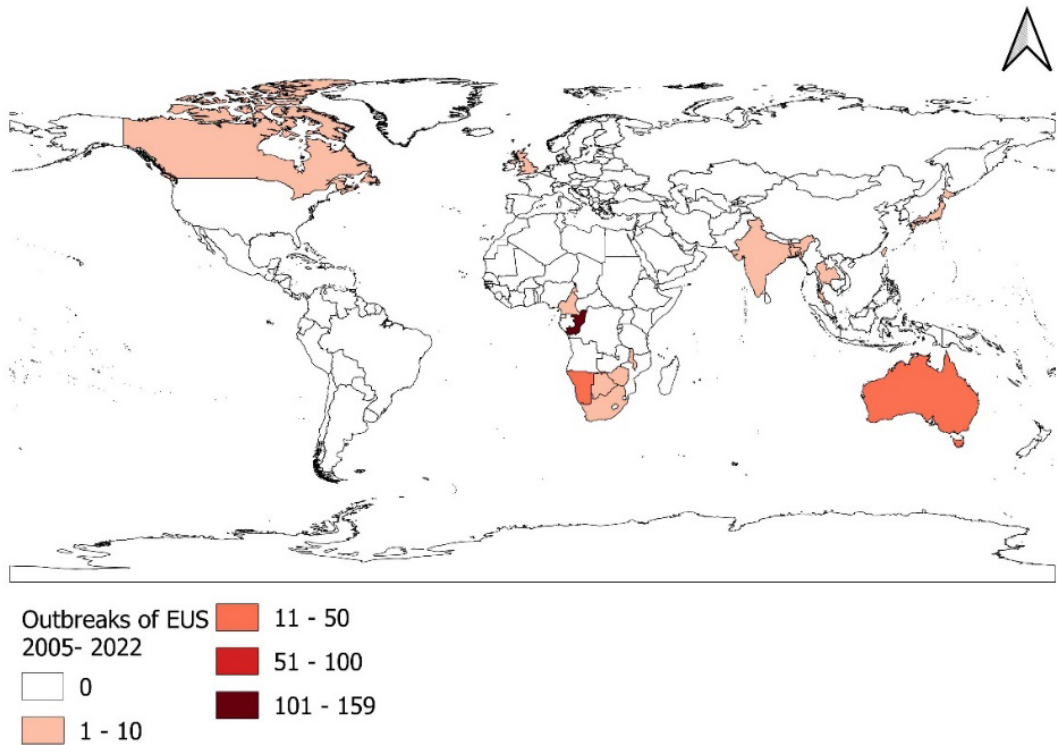


Figure 2. Spatial distribution of EUS outbreaks from 2005- 2022

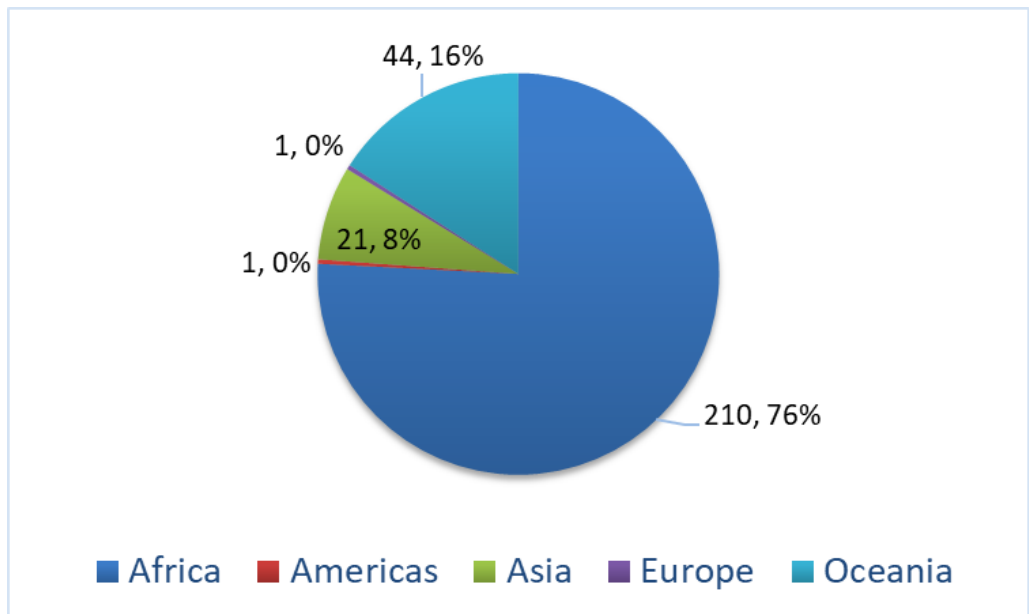


Figure 3. Continent-wise distribution of EUS outbreaks from 2005- 2022

Spatiotemporal pattern of EUS outbreaks

The spatiotemporal pattern shows that Congo, Australia, South Africa and Namibia have reported EUS outbreaks frequently with annual variations in the number of outbreaks in different countries (Figure 4). Outbreaks were reported in 1 or only few years in most of the countries.

For example, among the South Asian countries, India reported outbreaks in 2017 and 2018 while Bangladesh reported only in year 2022 (Figure 4). WOA database shows that Nepal has not reported EUS to the WOA during 2005 to 2022. However, literature review clearly indicated EUS is widely prevalent in Nepal. EUS was first reported in February 1989 (Shrestha, 1994) and has been reported from terai, mid-hills, Kathmandu and Pokhara valley (Dahal, 2002 and Dahal, 2003), eastern districts of Morang and Sunsari (Thapa and Pal, 2022) and Chitwan (Baidya and Prasad, 2013). Further, EUS was observed in fish farmed in reservoirs of Nepal that include Trishuli, Begnas and Mirmi (Shrestha et al., 2019).

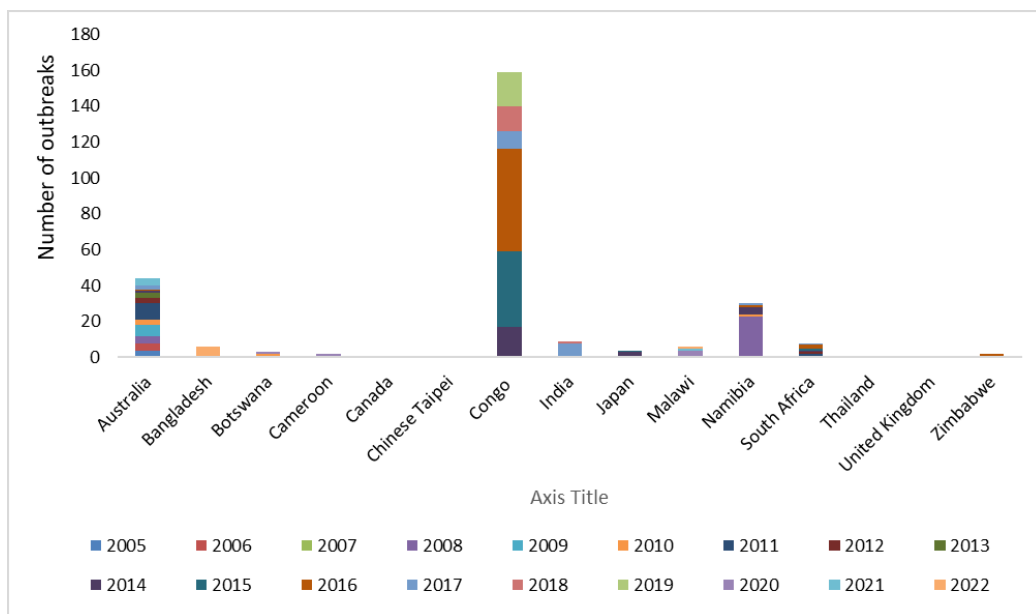


Figure 4. Spatiotemporal distribution of EUS outbreaks from 2005- 2022

Species affected by EUS outbreaks

Outbreaks were reported from freshwater farmed and wild fish species. The species in which EUS outbreaks were reported during the study period include African sharptooth, Catfish, Banded tilapia, *Clarias ngamensis*, Dashtail barb, Largemouth bass, Mochokidae, Redbreast tilapia, Sand whiting, Silver catfish, Straight fin barb and Striped mullet, Yellowfin bream and several unidentified species of farmed and wild fish species.

CONCLUSION

This study analysed the publicly available data of WOAAH to understand the pattern of EUS outbreaks from 2005 to 2022. It was found that during this study period, 277 outbreaks of EUS were reported from 15 countries and territories. Temporal pattern shows that majority of the outbreaks occurred during 2014 to 2017 while spatially, majority of the outbreaks were reported from Africa, particularly Congo and South Africa. Australia also reported significant number of EUS outbreaks. Though the number of countries reporting the disease are only 15, its spread in 5 regions indicates that the disease is globally widespread. While the epidemiological pattern might be biased due to underreporting of disease incidences, nevertheless, it provides important insights to understand the global spatiotemporal pattern of EUS from 2005 to 2022. Country level awareness need to be increased to increase the reporting of the disease outbreaks which will pave a way forward to design country specific control programs.

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