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Short Communication

Spatial and seasonal variations on *Henneguya exilis* prevalence on cage intensive cultured channel catfish (*Ictalurus punctatus*), in Tamaulipas, Mexico

Jaime Luis Rábago-Castro[1], Ricardo Gomez-Flores[2], Patricia Tamez-Guerra[2]
Jesús Genaro Sánchez-Martínez[1], Gabriel Aguirre-Guzmán[1], Jorge Loredo-Osti[1]
Carlos Ramírez-Pfeiffer[3] & Ned Iván De la Cruz-Hernández[1]
[1]Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma de Tamaulipas
Carretera Victoria, Mante Km. 5, Cd. Victoria, Tamaulipas, México. C.P. 87000
[2]Facultad de Ciencias Biológicas, Universidad Autónoma de Nuevo León (UANL)
Av. Pedro de Alba S/N, Ciudad Universitaria, San Nicolás de los Garza
Nuevo León (NL), México, C.P. 64000
[3]Departamento de Investigación, Unidad Michoacán, Universidad México Americana del Norte
A.C. Calle Michoacán 551, Col. Rodríguez, Reynosa, Tamaulipas, México, C.P. 88631

ABSTRACT. Diseases are of particular importance for aquaculture worldwide, particularly in intensive culture. In Mexico, intensive culture of channel catfish is mainly done in floating cages. The aim of the present study was to determine the presence of the myxozoan *Henneguya* and the effect of site, period and host length on its prevalence in cage-cultured channel catfish. Over a year, fish were examined on six different sites. Results showed the presence of *Henneguya exilis* in all the farms. However, no significant effects were observed for site and season on prevalence, nor was there a correlation between host length and infection prevalence.

Keywords: channel catfish, cage culture, *Henneguya exilis*, Tamaulipas, Mexico.

Variaciones espaciales y temporales en la prevalencia de *Henneguya exilis* en bagre de canal (*Ictalurus punctatus*), cultivado en jaulas, en Tamaulipas, México

RESUMEN. Las enfermedades tienen una gran importancia en la acuacultura mundial, especialmente en sistemas de cultivo intensivos. En México, el cultivo intensivo del bagre de canal se realiza principalmente en jaulas flotantes. El objetivo de la presente investigación fue el determinar la presencia del myxozoo *Henneguya* y el efecto del lugar, periodo y longitud del huésped con la prevalencia en el bagre de canal en jaulas de cultivo. Durante un año, se examinaron peces obtenidos de granjas en seis localidades. Los resultados mostraron la presencia de *Henneguya exilis* en todas las granjas, sin embargo no se observaron efectos significativos para el sitio y época en la prevalencia, ni hubo una correlación entre la prevalencia de la infección y la longitud del huésped.

Palabras clave: bagre de canal, cultivo en jaulas, *Henneguya exilis*, Tamaulipas, México.

Corresponding author: Ricardo Gomez-Flores: (rgomez60@hotmail.com)

Channel catfish *Ictalurus punctatus* is intensively cultured in earth ponds in USA, whereas in Mexico food-size fish are intensively cultured in floating cages. In 2008, the aquaculture of channel catfish in Mexico reached 970 ton (CONAPESCA, 2008) with Tamaulipas as the first producer using controlled systems. Biotic factors can affect the prevalence of pathogens in these systems, as wild fish population around cages (Beveridge, 2002), size host (Adriano *et al*., 2005), fish species (Beecham *et al*., 2010) and abiotic factors as stress by management (Lio-Po & Lim, 2002) or low levels of dissolved oxygen (Francis-Floyd, 1993). Some reports show the effect of fish age (Saksida *et al*., 2007), stress (Hammell & Dohoo, 2005), fish mean weight (Heuch *et al*., 2009), type of ecosystems (Vagianou *et al*., 2006) and temperature (Johnson *et al*., 2004; Antonelli *et al*., 2010), on outbreaks and prevalence of pathogens in fish cultured in sea water cages, but there are few studies that have examined factors affecting pathogen prevalence in freshwater cages. One of the most common protozoans likely to be encountered in freshwater culture of channel catfish belongs to the genus *Henneguya* (Myxobolidae) (Hoffman, 1999). Two species of this genus, *H. exilis* and *H. ictaluri* cause the lamellar disease and the proliferative gill disease respectively (Current & Janovy, 1976; Griffin *et al*., 2008). In USA, outbreaks of these diseases occur in catfish raised in earthen ponds, whereas in Mexico there are few reports of these pathogens. The present study was undertaken to determine the presence and prevalence of *Henneguya* species in the channel catfish *I. punctatus* cultured in floating cages, in Tamaulipas state, and to evaluate the effect of site, period and host size on its prevalence.

During one year, channel catfish were collected every two months (May 2007-April 2008) from six sites in Tamaulipas (five sites in reservoirs created by dams and one in a river). Sites located in the reservoirs were 1) Pedro J. Méndez 24º14’N, 99º33’W, 2) María Soto la Marina 24º24’N, 98º59’W, 3) La Loba 24º21’N, 98º37’W, 4) Vicente Guerrero 23º57’N, 98º44’W, 5) Emilio Portes Gil 22º57’N, 98º47’W; and the site 6) Soto la Marina was located in a river 23º57’N, 98º27’W (Fig. 1). Except for site 5, the rest of the sites belong to the same hydrological system. Fish (n = 20-40 fish/farm/sample period) were collected from rectangular floating cages of 1.2 m widex1.2 m long x 2.4 m depth (6.9 m^3 of volume). Cages are tied between them and form a battery, which are also tied with polyethylene ropes, and they are anchored to shore and water bottom. The cages are made of a rigid net, which is formed of steel embedded with hard plastic, and the mesh size has 1.27x2.54 cm. Depth of water in reservoirs ranged from 6 to 17.5 m, whereas the river depth was 2.0 m. Sampled fish were stored in plastic bags, covered with ice, and transported to the Facultad de Medicina Veterinaria y Zootecnia of Universidad Autónoma de Tamaulipas, Cd. Victoria, Tamaulipas.

Collected fish were measured (fork length in cm), externally evaluated, and dissected; external and internal organs were analyzed using standard protocols (Pritchard & Kruse, 1982; Secretaría de Pesca, 1994; Hoffman, 1999). Presumptive *Henneguya* plasmodia were measured, cysts were crushed to obtain spores, and their total length (TL), body length (BL) and width (in µm) were determined with an optical micrometer. Parasite identification was done according to Hoffman (1999) and Feist & Longshaw

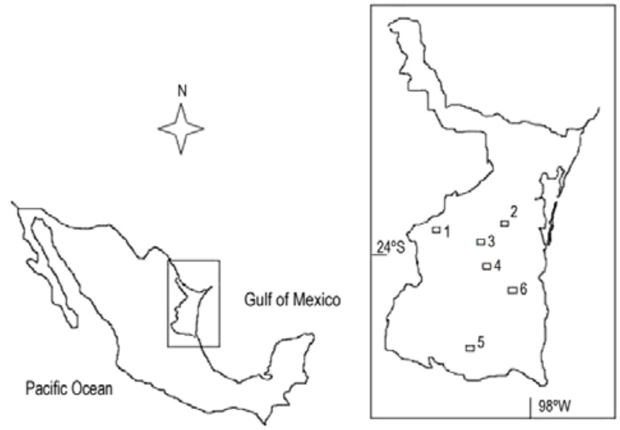

Figure 1. Reservoirs: 1) Pedro J. Méndez: 24º14’N, 99º33’W, 2) María Soto la Marina 24º24’N, 98º59’W, 3) La Loba 24º21’N, 98º37’W, 4) Vicente Guerrero 23º57’N, 98º44’W, 5) Emilio Portes Gil 22º57’N, 98º47’W; 6) Soto la Marina River 23º57’N, 98º27’W.

(2006); prevalence determined according to Margolis *et al.* (1982). Data were analyzed statistically using a MedCal* v.12.3 Statistical Software; data analyzed by the Kolmogorov-Smirnov test indicated non-normality. Kruskal-Wallis test was carried out to determine the effect of site and period on prevalence, whereas the Spearman correlation test was used to determine the relation of host size on prevalence. Differences were considered significant at $P < 0.05$. An annual average of prevalence per site and season was performed to observe variations on space and time.

A total of 954 fish were examined. Gills were the only organ affected by *Henneguya* plasmodia, which were oblong in shape and brown in color in fresh samples, and averaged 400-800 µ in length (Fig. 2); fresh mature spores were 60.29 µ (±6.34) total length, spore body length 16.46 µ (±1.76) and spore width 4.18 µ (±0.87) (Fig. 3). The site of infection and morphologic characteristics of plasmodia and spores were consistent with *Henneguya exilis* (Figs. 2 and 3). Figure 4 shows the spatial annual average prevalence at each site. Although the farm located at the river had the lowest parasite prevalence, this difference was not significant (P = 0.1407). Average prevalence by period is shown in Figure 5. No parasites were observed from any farms in the second sampling period (July-August), whereas a peak of parasite prevalence was detected in the period of March-April; however, such variations in periods were not statistically significant (P = 0.5635). Mean host size was 20.11 cm (±7.84), but there was no significant correlation between host size and prevalence of the parasite (r = -0.086).

Figure 2. Gill filaments showing plasmodia between secondary lamella. Bar = 0.5 mm.

Figure 3. Smear of crushed plasmodium showing spores of *Henneguya exilis*. Bar = 0.02 mm.

In our study, location did not affect the *H. exilis* prevalence, although the farm located in the river showed prevalence values near to zero. The cause for this low prevalence could be related to low numbers of the *H. exilis* intermediate host, the oligochaete *Dero digitata* (Feist & Longshaw, 2006). Density of *D. digitata* (Naididae) has been experimentally associated with outbreaks of proliferative gill disease in channel catfish (Belleraud *et al*., 1995). The farms located in reservoirs have several years of operation, whereas the river farm had its first period of operation during the study. In pond and cage aquaculture, faeces and unconsumed food can contribute to the accumulation of organic compounds underneath, which increases the concentration of nitrates, phosphates and decreasing dissolved oxygen, all of which has been correlated with the presence of some oligochaetes, including *D. digitata* (Krodkiewska & Michalik-Kucharz, 2009). Another factor that likely has an effect in the transmission of the parasite is the water current, which is slightly faster in the river, and could contribute to the absence of spores from cages. Aditionnally, for

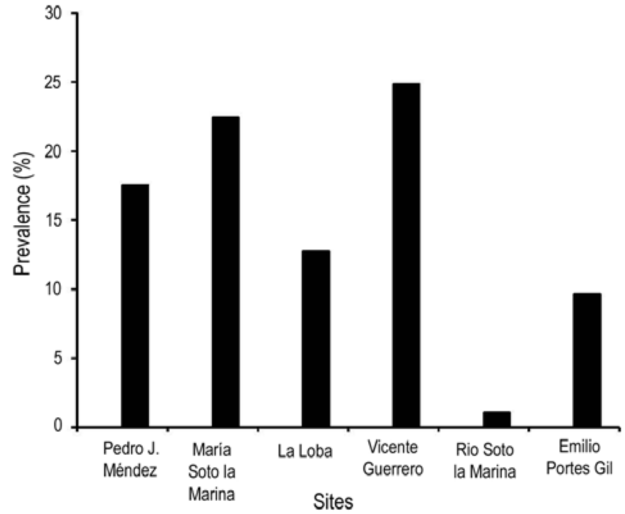

Figure 4. Annual prevalence (%) of *Henneguya exilis* by site.

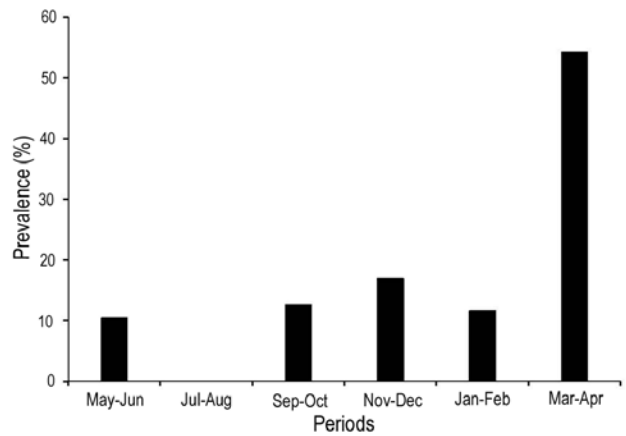

Figure 5. Annual prevalence (%) of *Henneguya exilis* by period.

whirling disease, caused by other myxosporean, an increase of water flow is suggested as a prevention practice for the control of worm populations (Brinkhurst, 1996). Sites 1 to 4 (Fig. 4), which belong to the same hydrological system, had the highest levels of *Henneguya* prevalence, with the farm examined in site 4, having the highest prevalence observed in this study. In this area there are some nearby farms, which may probably have the infection and help maintaining the high levels of prevalence among farms. The absence of *H. exilis* at all farms during July-August can be related to several factors, but it was probably due to maturation of plasmodia, and spore release. In the present study, the seasonal prevalence of the parasite was less than 18.0% for all the sampling periods in the year, except for the March-April period, where it reached 54.3%. Our observation of high *H. exilis* prevalence during March-April and absence during July-August is consistent, not with the parasite prevalence but with the proliferative gill disease in USA. Some reports indicate that April is the month with its highest seasonal occurrence, and equally July-August with a low occurrence in commercial catfish (Camus *et al*., 2004, 2005; Khoo *et al.*, 2008). In our study no correlation between prevalence and host size was observed. Adriano *et al*. (2005) found similar results with *Henneguya caudalongula* in cultured fish and Gbankoto *et al*. (2001) with other myxosporean species of wild fish. According with Griffin *et al.* (2009), closed earthen ponds and multi-batch culture is a more favorable environment for dissemination of myxozoan parasites in the catfish industry. In pond culture, the contact of fish with muddy, nutrient-rich bottoms facilitates parasite transmission, while floating cage systems may decrease the direct contact between worms and fish, helping lessening the intensity of infection and the expression of the disease. Additionally, severity of infection in proliferative gill disease is related to the number of spores in water, and a continuous release of them by intermediate host (Wise *et al.*, 2004). Fish cultured in cages have more risk of disease than those reared in ponds (Beverdige, 2002), but in our study, despite high prevalence, no mortalities associated with *H. exilis* were detected. Other considerations should be taken into account, as the severity of disease and damage caused by *H. exilis* in the hosts.

Knowledge of the prevalence of *H. exilis* in different geographical sites in channel catfish cultured in cages can further help in establishing management strategies for its control. Although no significant differences related to effect of site and times of year on prevalence were found in this study, it is likely that aquatic environment conditions have a direct effect on *H. exilis* prevalence. Further studies must be carried out to evaluate the effect of other biotic and abiotic factors on prevalence and disease of this parasite.

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