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Spinal deformities in Amazon sailfin catfish *Pterygoplichthys pardalis* (Siluriformes: Locariidae), an introduced fish in the Palizada River (Southeastern Mexico)

by

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Résumé. – Malformations de l'axe vertébral chez *Pterygoplichthys pardalis* (Siluriformes, Loricariidae), un poisson-chat amazonien introduit dans la rivière Palizada (Sud-Est du Mexique).

Le poisson-chat amazonien *Pterygoplichthys pardalis* (Castelnau, 1855) est une espèce introduite dans la rivière Palizada (Sud-Est du Mexique). Depuis 2008, nous menons des recherches sur les populations de ce poisson-chat. En juin et novembre 2012, puis en février et mars 2013, nous avons capturé dix spécimens qui présentaient une cyphose et/ou une scoliose de la colonne vertébrale, diagnostiquées par radiographie X à haute résolution. Ce sont les premiers cas de déformation de l'axe vertébral rapportés dans la littérature pour le genre *Pterygoplichthys*.

Key words. – Locariidae - *Pterygoplichthys pardalis* - Mexico - Palizada River - Vertebral deformities.

Vertebral deformities like scoliosis (abnormal lateral curvature), lordosis (excessive inward curvature), kyphosis (excessive outward curvature) and ankylosis (abnormal stiffening and immobility of joint due to fusion of bones) (Fagbuaro and Oso, 2011) are frequently recorded in cultured fish (Brown *et al*., 1998).

In the natural population such abnormalities were correlated either with wastewater from a coal-fired power plant (Lemly, 1993), sewage discharges and industrial effluents (Lindesjoo and Thulin, 1992), parasitism (Yokoyama *et al*., 2004), or short-term exposure to organophosphate insecticides (Baumann and Hamilton, 2006).

The Amazon sailfin catfish *Pterygoplichthys pardalis* (Castelnau, 1855) is an invasive species in Southeastern Mexico (Wakida-Kusunoki *et al*., 2007). The effects of its introduction led to reduction of commercial fishes species, alteration of bank structure and erosion, disruption of aquatic food chains, competition with native species, mortality of endangered shore, changes in aquatic plant communities, and damage to fishing gear and industry (Wakida-Kusunoki *et al*., 2007). In their invasion process *P. pardalis* is exposed to many physical and chemical variations of the environment linked to human activities, and to contamination in diverse ecosystems that differ from their origin place. This paper describes the first record of spinal deformities in this species.

Table I. - Various forms of deformity of the vertebral column of Amazon sailfin catfish *Pterygoplichthys pardalis*.

Month	No. of fish	Scoliosis	Kyphosis	Both
June 2012	148	–	1	–
November 2012	185	–	–	5
February 2013	133	1	1	–
March 2013	127	2	–	–

METHOD

Pterygoplichthys pardalis were caught with a cast net 3 m in diameter and 7.6 cm mesh size during June and November 2012 and February 2013 in El Mangal near Palizada, Campeche, Mexico (18°14.158'N; 92°03.643'E) (Fig. 1). All cast net deployments were made from the riverbank, with an average depth of two meters. This area is under great influence from the Palizada River tributary of the Usumacinta River.

The total length (mm) and weight (g) of fresh specimens were measured and the percentage of deformation was calculated. The

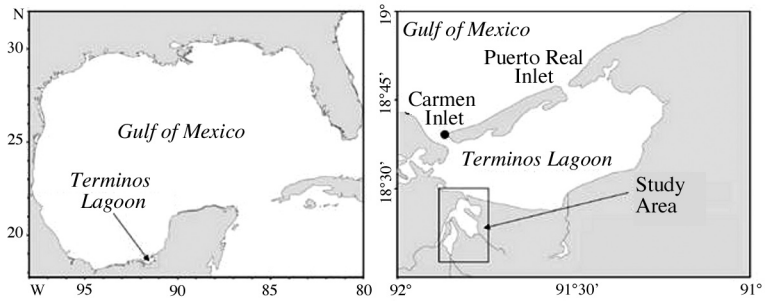

Figure 1. - Collection area of Amazon sailfin catfish in the Palizada River, Campeche, Mexico.

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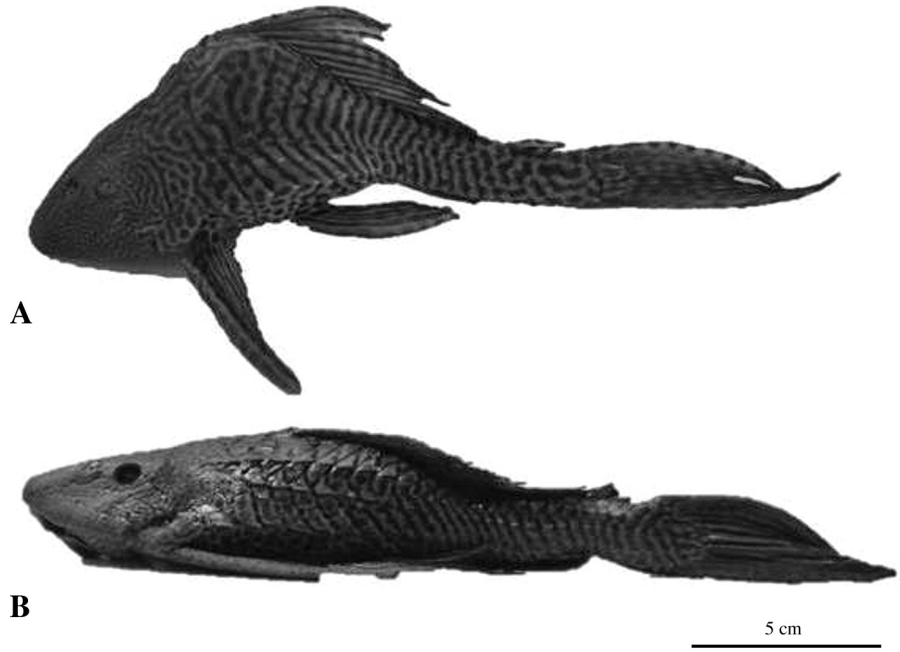

Figure 2. - Lateral view of deformed Amazon sailfin catfish *Pterygoplichthys pardalis* from the Palizada River, Campeche (Mexico). **A**: Kyphosis; **B**: Scoliosis.

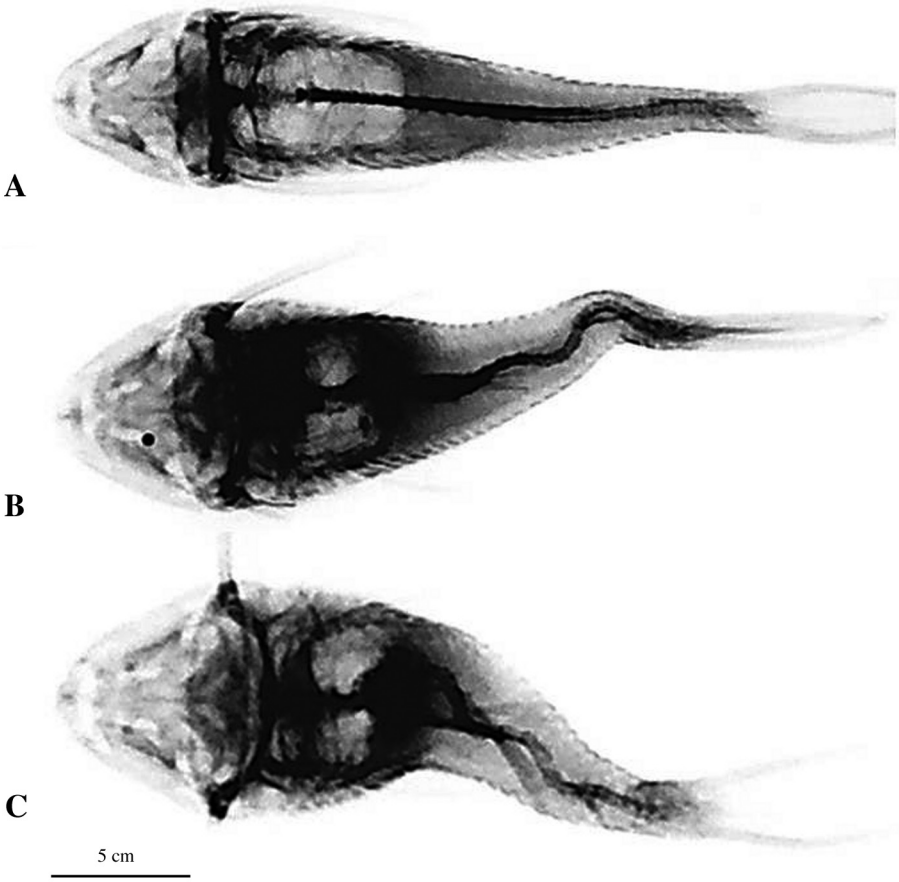

Figure 3. - Dorsal view X-ray radiographs of deformed Amazon sailfin catfish *Pterygoplichthys pardalis* from the Palizada River, Campeche (Mexico). **A**: Normal specimen; **B**: Specimen with scoliosis; **C**: Specimen with kyphosis-scoliosis.

specimens were then frozen and transported to the laboratory. The fresh specimens (lateral and dorsal aspect) were radiographed using a medical X-ray system and the radiographs were used to evaluate the anomalies observed (vertebrae and caudal bones).

RESULTS

A total of 593 individuals were caught (Tab. I). Ten of them were deformed, which represents 1.70% of the specimens. Spinal anomalies, with the spine curved in one or more places, were visible on the fish immediately after capture (Fig. 2). According to X-ray radiographs (Fig. 3), the internal body spaces and organs were normally developed.

The total length of the fish ranged from 126 to 430 mm, and the weight from 158.5 to 565 g. The specimens with spinal deformities have a total length of 250 mm.

Two types of spinal deformity, kyphosis and scoliosis, were determined (Tab. I).

DISCUSSION

Skeletal deformities can be environmentally induced in two ways (1) by alteration of the biological processes necessary for maintaining the biochemical integrity of bone, or (2) neuromuscular effects, which lead to deformities without a chemical change in vertebral composition (Raj *et al*., 2004). Pollutants can induce these deformities by these two ways. Many organic contaminations, such as organochlorines, polychlorinated biphenyls and fluorinated herbicides, alter bone metabolism and affect the biochemical composition of the vertebral column (Mayer *et al*., 1977). Metals such as cadmium, zinc, mercury and lead cause skeletal deformities in fish by altering bone metabolism and can also affect the neuromuscular system (Sauer and Watanabe, 1984).

Specifically to Siluriformes, some studies mention that the causes of skeletal deformities may be either the exposure to malathion and other chemicals (Srivastava and Srivastava, 1990), or poor immune response or fluctuations in water quality, or accidental injuries during the life cycle (Marimuthu *et al*., 2000)

Agriculture and livestock activities using different substances as herbicides and insecticides occur near the area where the specimens were collected (Fig. 1). Diaz *et al*. (2005) mentions endosulfan insecticide as the most used in this zone, at concentrations of 11.1 and 99.9 nn.g^{-1}. Several authors have experimentally reported many deleterious effects as a result of insecticide toxicity. The exposure of fish embryos and larvae to insecticides causes spinal deformities, mainly scoliosis and lordosis, and morphological abnormalities (Banaee, 2012)

In the lower catchments of the Palizada River, there are about 12,000 ha of rice fields and the use of pesticides such as chlorpyrifos, carbofuran, molinate and glyphosate as well as endosulfan, parathion, malathion, methomyl, benomyl, and dichlorophenoacetic acid has been reported (Rendón-von Osten *et al*., 2006). However, because of the isolated observations and lack of data on the aquatic environment, we cannot establish any correlation between these anomalies and industrial activities. In the present study, no single factor could be attributed as the cause of vertebral column deformities. One of the strategies for reducing the impact of non-native species like the amazon sailfin catfish is the possible use of this species as a new source of proteins. However, our first priority should be to find the causes leading to these deformities, in order to avoid public health issues.

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