

# FIRST OSTEOMYELITIS RECORDS IN NESTING FEMALE TURTLES OF *LEPIDOCHELYS OLIVACEA* (ESCHSCHOLTZ 1829) AT LA ESCOBILLA SANCTUARY, OAXACA, MEXICO

PRIMEROS REGISTROS DE OSTEOMIELITIS EN TORTUGAS HEMBRAS ANIDANTES DE *LEPIDOCHELYS OLIVACEA* (ESCHSCHOLTZ 1829) EN EL SANTUARIO DE LA ESCOBILLA, OAXACA, MÉXICO

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**Resumen.**— Proporcionamos los primeros registros de osteomielitis en el caparazón de las tortugas anidantes de *Lepidochelys olivacea* del Santuario La Escobilla, México. La osteomielitis es una enfermedad infecciosa e inflamatoria del hueso cortical, periostio y cavidad mieloide, caracterizada por la necrosis y destrucción del tejido óseo. Hasta ahora, no existían registros de esta enfermedad infecciosa del hueso en la tortuga golfina (*L. olivacea*) en aguas tropicales.

**Palabras claves.**— Arribada, infección, caparazón, comportamiento letárgico.

**Abstract.**— We provide the first records of osteomyelitis in carapace of nesting female turtles of *Lepidochelys olivacea* at La Escobilla Sanctuary, Mexico. Osteomyelitis is an infectious and inflammatory disorder of cortical bone, periostio and myeloid cavity, characterized by necrosis and destruction of bone tissue. Until now, there were no records of this infectious bone disorder in tropical waters affecting olive ridley turtles (*L. olivacea*).

**Key words.**— Arribada, infection, carapace, lethargic behavior.

Anthropogenic activities such as bycatch in fishing gear, entanglement in abandoned fishing gear, illegal trade and consumption have endangered the survival of sea turtle populations worldwide and continue to be predominant threats for sea turtles (Troëng et al., 2005; Godley et al., 2020). These activities interact with biological (predation and competence) and environmental (climate change, pollution, and habitat loss) factors that affect the sea turtle's health, producing a nonbalanced perturbation of one or more body functions (Page-Karjian & Perrault, 2021), including responses to infectious and noninfectious agents (Deem et al., 2000).

In addition, the combined effects of all these threats weaken the immune system of sea turtles, making them more susceptible

to natural diseases (Mashkour et al., 2020). To the best of our knowledge, the most significant threat to turtle mortality is bycatch, followed by targeted capture (for consumption of meat and subproducts) (Wallace et al., 2010; Work & Balazs, 2010; Cáceres-Farias et al., 2022), and as a third factor, diseases (Mashkour et al., 2020); however, their incidences are generally under-reported due to the challenges of sampling wild animals in remote areas (Alfaro et al., 2008) or the lack of specific knowledge related to conservation medicine (Alonso-Aguirre et al., 2012).

Despite this, several diseases such as spirorchiid infection (Chapman et al., 2016), fibropapilomatosis (Reséndiz et al., 2022), and dermatitis (Manire et al., 2008) have been reported

in both free-ranging and captive sea turtles (George, 1997). Currently, there have been reports of diseases affecting the olive ridley sea turtle (*Lepidochelys olivacea*) such as systemic mycosis (Orós et al., 2011), spirorchiid infection (Jerdy et al., 2016), and renal disease (Work et al., 2019). Specifically, in La Escobilla beach has been reported diseases such as fibropapillomatosis (Reséndiz et al., 2015; Buenrostro-Silva et al., 2022), poisoning for consumption of toxic substances (Ley-Quinónez et al., 2020; Buenrostro-Silva et al., 2022), and ulcerative and necrotizing dermatitis (Buenrostro-Silva et al., 2023).

Other disease reported in sea turtles to a lesser extent is osteomyelitis (Om), which is an infectious and inflammatory disorder of the cortical bone, periostio and myeloid cavity, which may affect the axial and appendicular skeleton, may be associated with discoponlitis when it involves the intervertebral discs and adjacent cartilaginous terminal plates (Sikes & Kapatkin, 2014; Nevin et al., 2020).

Osteomyelitis is characterized by necrosis and destruction of bone tissue (Llerena Freire et al., 2019). Its pathogenesis is unknown; however, two causes are attributed mainly: 1) to haematogenic spread of bacteria or fungi in affected sites (haemogenic osteomyelitis), and 2) to direct introduction of bacteria as a result of penetrating wounds adjacent to the bone or as a result of foreign body penetration, traumatic injuries, bite wounds or spread soft tissue infections (Sikes & Kapatkin, 2014; Nevin et al., 2020).

Originally, Om was described in humans and mammals, but the first evidence in reptiles was reported by Ogden et al. (1981) in a stranded leatherback turtle (*Dermochelys coriacea*). Currently, Om has been reported principally in stranded cold-stunned Kemp's ridley sea turtles (*Lepidochelys kempii*) when water temperatures decrease to < 15°C (Solano et al., 2008; Innis et al., 2009; Keller et al., 2012; Powell et al., 2021). Nevertheless, there are no records of this infectious bone disease in the olive



**Figure 1.** Figura 1. Osteomielitis en el segundo escudo pleural derecho del caparazón de *Lepidochelys olivacea* (Registro de fotografía CNAR-IBH-RF-922). Foto: Jesús García-Grajales.

**Figure 1.** Osteomyelitis in the second pleural right scute of *Lepidochelys olivacea* carapace (Photo voucher CNAR-IBH-RF-922). Photo: Jesús García-Grajales.

ridley turtle (*L. olivacea*) in tropical waters. Here, we provide the first records of Om in the carapace of nesting female turtles of *L. olivacea* at La Escobilla beach, Mexico.

While conducting a research project focused on assessing the ulcerative and necrotizing dermatitis in nesting olive ridley turtles (*L. olivacea*) at La Escobilla beach in the Mexican Pacific (15° 43' 37" N; 96° 44' 49.23" W), we found three cases of Om on the carapace of nesting turtles during the arribada events (August, September, October, and November) of the 2022 nesting season.

On September 4, 2022, at 18:41 hrs in La Escobilla beach Sanctuary (15° 43' 37" N; 96° 45' 14" W) we found a nesting female of *L. olivacea* with evidence of Om in the second pleural right scute of the carapace (Fig. 1). The osteolytic lesion had rectangular shape and irregular edges, loss of dermal tissue and presence of fibrous connective tissue bands, appearing on a rough surface, yellow-white areas and with exudate presence. Moreover, the lesion had a cross-cutting orientation, and a length exceeding 30 cm x 12 cm of width. The individual with this lesion presented lethargic behavior compared to the other nesting females around her. A photo voucher (CNAR-IBH-RF-922) was deposited at the Colección Nacional de Anfibios y Reptiles in the Instituto de Biología at the Universidad Nacional Autónoma de México.

On the same day, at 19:16 hrs in La Escobilla beach Sanctuary (15° 43' 34" N; 96° 44' 56" W) we found another nesting female of *L. olivacea* with evidence of Om in the first pleural right scute of the carapace (Fig. 2; Photo voucher CNAR-IBH-RF-923). In this case, the osteolytic lesion had a semi-circular morphology, irregular edges, with loss of dermal tissue and smooth appearance, with exudate presence, and a size of 10 x 15 cm. Likewise, the individual with this lesion presented lethargic behavior compared to the other nesting females.

On September 7, 2022, at 13:44 hrs in La Escobilla beach Sanctuary (15° 43' 34" N; 96° 44' 56" W) we found another nesting female of *L. olivacea* with evidence of severe Om ranging from the first marginal scutes to the nuchal and first vertebral scute (Fig. 3; Photo voucher CNAR-IBH-RF-924). The osteolytic lesion had thick appearance, with fibrosis and tracts with pyogranulomatous fistula, a circular morphology and a size of 25 x 20 cm. The bone gives the appearance of deformity as a product of granulomas that generate a rough appearance, with fibrous tissue bands, purulent exudate and yellow-white surfaces. In addition, this individual presented a proliferative fibropapilloma-like lesion of 5 cm diameter in the dorsal central area of the neck (Fig. 3). This individual showed poor body

condition and markedly lethargic behavior compared to the other nesting females around her.

These are the first Om records known so far for nesting female turtles of *L. olivacea* in tropical waters. Previously, in cold-stunned sea turtles, Ogden et al. (1981) describes an osteomyelitis case in adult stranded of *Dermodochelys coriacea*. Later, Powell et al. (2021) report osteolytic lesions in phalanges of cold-stunned Kemp's ridley sea turtles (*L. kempii*) in the Gulf of Mexico. Another osteomyelitis lesions have been found in non-cold-stunned sea turtles with septicemia from traumatic injuries and other resources of infection (Guthrie et al., 2010; Raidal et al., 2006; Pace et al., 2018).

Om has been found to appear either as an area of osteolytic bone degeneration or as an area of new and unstable bone



**Figure 2.** Evidencia de osteomyelitis en el primer escudo pleural derecho del caparazón de *Lepidochelys olivacea* (Registro de fotografía CNAR-IBH-RF-923). Foto: Jesús García-Grajales.

**Figure 2.** Evidence of osteomyelitis in the first pleural right scute of *Lepidochelys olivacea* carapace (Photo voucher CNAR-IBH-RF-923). Photo: Jesús García-Grajales



**Figure 3.** Osteomyelitis severa en *Lepidochelys olivacea* abarcando los primeros escudos marginales, el escudo nuchal y los primeros escudos vertebrales (Registro de fotografía CNAR-IBH-RF-924). Foto: Jesús García-Grajales.

**Figure 3.** Severe osteomyelitis in *Lepidochelys olivacea* ranging from the first marginal scutes to the nuchal and first vertebral scute (Photo voucher CNAR-IBH-RF-924). Photo: Jesús García-Grajales.

formation (Rothschild et al., 2013). It is usually associated with nodular or subcutaneous skin lesions, ulcerating or drainant infected by bacteria or opportunistic fungi, such as gram positive bacteria (*Staphylococcus*, *Enterococcus*, *Streptococcus*) or gram negative bacteria (*Pseudomonas*, *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus* and *Pasterella*). Until now, bacteria such as *Staphylococcus* have been identified as the main cause of bone infection, which usually arise in a variety of ways, including the bloodstream or injuries (Innis et al., 2014; Birt et al., 2017). Between the clinical signs associated with Om highlight anorexia, appendicular joint swelling, signs of lethargy, as well as paralysis of pelvic limbs (Paresis) (Innis et al., 2014), some of which were observed in the individuals reported here.

In cold-stunned sea turtles, lesions could occur secondary to immunosuppression and bacteremia infection, subsequent to ischemia by hypothermia (Powell et al., 2021). But, in tropical regions, warm water temperatures may contribute to favorable conditions for bacterial growth on the surface of sea turtle carapaces. Moreover, traumatic carapace lesions represent an opportunity for pathogenic bacteria to invade the devitalized

bone. In addition, the high number of turtles during nesting season and the process of reproduction could be stressful factors that can immunosuppress their system, opening the portal for bacterial invasion (Orós et al., 2005). Additionally, the pathophysiology of Om in animals is still unknown; however, vascular or neurologic insufficiency associated with osteomyelitis results from poor blood supply, local trauma and altered immune defenses (Birt et al., 2017).

Om in sea turtles can be a fatal infection, and the causes of this disease are often produced by bacteria and fungi that healthy organisms encounter in the wild every day. It is clear that further studies are required to better understand the prevalence of Om in nesting females of *L. olivacea* at La Escobilla beach.

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