



Case Report

Evaluation of the floating time of a corpse found in a marine environment using the barnacle *Lepas anatifera* L. (Crustacea: Cirripedia: Pedunculata)



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ABSTRACT

Human activities involving water may result in a crime scene. Typically, death may be due to natural causes, homicide, or mass disasters. Decomposition in water is a complex process where many factors may interplay. Human remains in water are subject to many potential interactions, depending upon the remains themselves, the type of water and the characteristics of the water. A number of studies are focused on the decomposition process of the corpse in water, on the identification of the post mortem submersion interval (PMSI) and on the diagnosis of drowning, but very few studies consider the fate of floating remains in any aquatic environment. The following case describes a corpse found on a shore of the Tyrrhenian Sea (South West of Italy, Calabria Region). The corpse and the soles of his shoes were colonized by the barnacle *Lepas anatifera* L. (Crustacea: Cirripedia: Pedunculata). The analyses of the barnacles present on the corpse aided in the evaluation of the floating time of the corpse which assisted in estimating the minimum time since death.

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1. Introduction

A crime scene may occur in a water environment as a result of suicides, homicide, or mass disasters (e.g. tsunami and boat sinking). Furthermore, natural deaths in water are also initially investigated as a crime scene and later deemed accidental. Even so, only a few studies exist in regard to crime scenes in an aquatic environment [1,2] and only a small number of experts have the training and the expertise to investigate such cases [3,4].

Human remains in water are subject to many potential actions, depending upon the remains themselves (e.g. size of the body, body covering, presence of artificial artifacts and/or trauma), the type of water (salt or freshwater) and the characteristics of the water (e.g. temperature, depth, currents, surrounding geology, flora and fauna) [5]. Depending on these factors, dead bodies in

water can initially float or sink, after which they may either remain on the surface or submerged. While in the water, a corpse may be carried by currents [6,7], colonized and/or consumed by scavengers and modified or abraded by impacts with obstructions and debris [1]. In exceptional cases, a corpse in a water environment may be more stationary such as a corpse located in a well [8] or trapped in a submerged vehicle [1].

Even though decomposition in water is a complex process where many factors may interplay (e.g. type of water body, biodiversity, presence of scavengers, wounds and garments), the body generally disarticulates over time [1,5,9–11]. Complete or partial body remains may be then found washed up along the coast or trapped in natural or artificial obstructions (e.g. dams and sewers [12]).

At present, the majority of studies on human remains in water are focused on the decomposition process of the corpse in different types of water bodies [5,9,13–15], the identification of the post mortem submersion interval (PMSI) using both insects [1,16], microorganisms [17] and algae [18,19] and on the diagnosis of drowning based on the presence of diatoms [20] or other microorganisms [21]. Currently, only a few studies consider the

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fate of floating remains [22]. These remains can be studied from both oceanographical (how water bodies move) [7,23] and biological (how animals and algae can colonize the remains) [1] perspectives. Floating remains can be colonized both on the surface exposed to air (generally by adult insects that lay eggs or larvae on them) [24] and on submerged parts of the body (generally by insects and other arthropods or by algae) [1]. Arthropods use the remains as shelter, a food source or a substrate on which to attach, while algae may provide food upon which other arthropods can graze [1]. The identification of such organisms can help to determine how long the remains have been floating as well as their provenance and movement during the time spent in the water body. At present only a few real cases concerning floating remains have been reported [1,25].

The aim of this work is to describe a case where a corpse colonized by the barnacle *Lepas anatifera* L. (Crustacea: Cirripedia: Pedunculata) was found on a shore of the Tyrrhenian Sea (South West of Italy, Calabria Region). The presence of the barnacles on the corpse was the focus of this investigation to estimate how long the corpse had been floating, which assisted in a more accurate evaluation of the post mortem interval. Part of the forensic process following the discovery of the corpse involved a medico-legal and bio-molecular investigation (not a part of this paper) to ascertain the identity and the cause of death of the person.

2. Case history

During May 2012 a male was found dead in the prone position on a shore adjacent to the Tyrrhenian Sea (South West of Italy, Calabria Region). The corpse was highly decomposed. Adipocere was present on the exposed surface of the body, the orbital cavities were empty and the nasal cartilages were absent (Fig. 1). A bilateral loss of substance from the auricles was noted and the distal phalanges of both hands were missing. At the crime scene the environmental temperature was 20 °C and the temperature of the sea water surface was 18.8 °C. The body was completely clothed with cold weather garments. No insect specimens were found on the body, but barnacles were collected from both pants (Fig. 2) and the soles of the person's shoes (Fig. 3). Only the largest barnacles were collected and fixed in 80% ethanol. The barnacles were observed under a stereomicroscope (Optika SZM-2), measured with a digital caliber (Mitutoyo CD-15CPX), and identified [26,27] as *L. anatifera*. The maximum capitulum length (size of the shelled portion) of *L. anatifera* found on the body was 12 mm with a



Fig. 2. Barnacle colonization on the pants of the deceased.

peduncle of 5 mm. Other barnacles are evident in Figs. 2 and 3. However, these are smaller barnacles, they were not collected, but they have been identified from the figures as *Lepas anatifera* L.

3. Discussion

Barnacles are crustaceans that as adults are sessile, gregarious and attached to hard substrata or hard parts of other organisms [28]. Stalked barnacles are often confused with molluscs because their body is completely enveloped in a carapace that looks like a sea-shell. Species of barnacles occur in all marine environments [29]. Within the stalked (or goose) barnacles (Order Thoracica, Suborder Lepadomorpha) is the species *L. anatifera*, a salt water primarily neustonic invertebrate, i.e. an organism that lives on or just under the water surface [30]. However, viable *Lepas* larvae have also been found at significant depths: down to 400 m in the eastern Atlantic and 500 m near Bermuda [31].

The body of stalked barnacles is divided into a shelled capitulum containing feeding appendages and other organs, and a peduncle or stalk containing the gonads which is used by the animal to attach to the substratum [29]. The specific features that are informative in aging the barnacles are the capitulum length and (to a lesser extent) the maturity of the gonads. Peduncle length is not as informative as capitulum length as the peduncle is under hydrostatic skeletal control and, as such, it expands and contracts as hemocoelic fluid is pumped in or out of the different tissues [29]. Most common forms are cross-fertilizing hermaphrodites; sperm



Fig. 1. Anterior view of the deceased showing the presence of adipocere, empty orbital cavities and absence of nasal cartilages.



Fig. 3. Barnacle colonization on the sole of the shoe of the deceased.

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