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# **PROCEEDINGS OF THE EIGHTEENTH INTERNATIONAL SEA TURTLE SYMPOSIUM**

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## NECROTIC LIMBS: AMPUTATION AND TREATMENT

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### INTRODUCTION

Loggerhead turtles, which inhabit the Greek seas throughout the year, are frequently found entangled in fishing nets and lines. Usually the fore flippers are caught, resulting in necrosis of the flipper, which may require amputation procedure. The case histories of six loggerhead turtles (*Caretta caretta*), with necrotic flippers, are discussed, concerning their treatment and rehabilitation. The survival of turtles following amputation when returned to the wild is uncertain and may prevent successful mating, nesting and survival strategies.

The Sea Turtle Rescue Centre (STRC) in Athens was established in 1994, by the Sea Turtle Protection Society of Greece with the support of the Municipality of Glyfada. Injured and sick sea turtles are brought to the STRC from all over Greece, in co-operation with the Port Authorities, Olympic Airways, the Greek Railway Organisation, the bus and ferry companies, who provide complimentary transportation. The STRC has been receiving injured sea turtles since 1994. In that time, seventy sea turtles, mostly loggerheads (*Caretta caretta*), have been admitted to the STRC. Of these, twenty-four have suffered from flipper injury as a direct result of fishing net and line entanglement, of which twenty-one have recovered.

Volunteers, from Greece and abroad, under the supervision of trained staff and associated veterinarians treat sea turtles at the STRC. The successful rehabilitation and release of the turtles is the main objective of all those working at the STRC. As a result of increasing knowledge and advice from sea turtle experts worldwide, the medical care provided by the STRC is in a constant state of improvement.

### DIAGNOSIS, TREATMENT AND PATHOGENIC INFECTION

The vast change in treatment can be observed in the six cases of loggerhead turtles discussed below.

| Name         | Admitted   | Released   | Died      | CCL/cm | Weight/kg | Sex     |
|--------------|------------|------------|-----------|--------|-----------|---------|
| Leonardos    | 22/11/1995 | 31/12/1995 |           | 22.8   | 1.15      | Unknown |
| Ioanna       | 13/7/1996  | 10/9/1996  |           | 21.5   | 1.12      | Unknown |
| Oedipus      | 14/1/1997  |            | 16/1/1997 | 52.0   | 15.0      | Unknown |
| Alanis       | 6/7/1997   | 5/9/1997   |           | 70.0   | 35.0      | Female  |
| Themistokles | 22/10/1997 | 20/12/1997 |           | 78.0   | 55.0      | Male    |
| Krystina     | 18/11/1997 | STRC       |           | 42.0   | 8.0       | Unknown |

**Leonardos**, was one of the first loggerhead turtles to be admitted to the STRC requiring flipper amputation. A

fishing line was entangled around its right front flipper, which was held to the body by two millimetres of tissue. The flipper was swollen, but there were no visible signs of secondary pathogenic infection. The flipper was removed due to necrosis.

The case of **Ioanna** indicates the possibility to save part of a flipper, if the necrotic region is localised. The left front flipper was injured from entanglement in plastic material. Necrosis was present at the tip of the dermal layer of the flipper leaving the carpal and metacarpal bones exposed. Two operations were successfully completed, removing only the localised necrotic regions, allowing the recovery of most of the flipper.

This treatment was applied to the case of **Alanis**, as both fore flippers contained areas of necrotic bone and tissue. The amputation of both flippers would have proved futile for the survival of the turtle. The left front flipper was at an advanced stage of necrosis as a result of fishing line entanglement, whereas the necrotic region of the right limb was localised to the epithelial tissue of the flipper. The tissue of the right front flipper was scraped away until healthy tissue was reached (Kapalko, 1997). The left fore limb was amputated, but due to incorrect wound management, i.e. the bone was left exposed, correctional operative treatment was required to cut back the bone and cover it with surrounding tissues (Kapalko, 1997).

**Oedipus** had extensive pathogenic infection and necrosis of his right front flipper. The secondary pathogenic infections had caused the loss of facial, carapace and plastron scutes as well as surrounding epithelial tissue, so much that bone was visible. The virulence of the pathogens, in combination with Oedipus' weakened immune system, indicate that death resulted from the rapid spread of septicæmia.

On arrival **Themistokles** had already lost most of the left front flipper, leaving the humerus bone and surrounding tissues exposed, following fishing line entanglement. This was at an advanced stage of gangrene infection. He was also suffering from an acute pathogenic infection of the jaw, facial and carapace scutes, skin and eyes. The humerus bone was cut back, to stop the spread of gangrene. After the first operation the bone was left exposed allowing gangrene to recur. A second operation was performed, but the bone and tissues still could not be properly sealed from the environment as there was very little remaining tissue masses, and

that which was present was infected with an epithelial necrotic pathogen (Kapalko, 1997).

**Krystina** suffered from a swollen right front flipper, which was severed to the humerus bone by fishing lines. There was a region of localised necrotic tissue on the flipper, which caused a progressive loss of sensitivity over the days previous to the operation (Kapalko, 1997). The injury was further complicated with the presence of a secondary pathogenic infection on the flipper and surrounding body epithelial surfaces. On admittance to the STRC, **Krystina** was in a state of severe malnutrition, with a soft carapace and shrunken plastron covered in an ectoparasitic algal colony. This may have resulted from her body converting its resources to attack invading pathogens. This depressed state would have also increased her vulnerability to such invasion, inhibiting her natural biochemical and histological defense mechanisms, preventing recovery (George, 1997; Campbell, 1996). The right front flipper was amputated, under anaesthetic, close to the humerus joint, and the bone was sealed with a triple layer; of muscle, inner soft tissue and epithelial tissue, and secured with a layer of Superglue, to prevent entry of pathogens (Kapalko, 1997).

## RECOVERY

Sea turtles with amputated fore and hind limbs are successfully rehabilitated and released into the wild by the STRC. **Leonardos**, **Alanis** and **Krystina** on arriving at the STRC used their injured flippers as an aid to swimming, buoyancy and balance. Following amputation, their ability to swim and dive was initially hindered. After about five days all three turtles were observed to swim, dive and rest on the bottom like a 'healthy' turtle. With **Krystina** and **Leonardos** it was observed that the hind left flipper in both cases was used to a much greater extent to facilitate the loss of the front right flipper. Following partial amputation of the flipper, **Ioanna** found it hard to move both fore flippers at the same time resulting in recurring rolling and yawing actions. **Themistokles** may have been without his left front flipper for a period of time before being found. This is because from arrival he had already adjusted to swimming and diving in water without the front left flipper. His swimming behaviour was very distinct; the tail and hind right flipper were used to help steer him about the pool. He used the hind left flipper to a much lesser degree.

On release, it was observed that the larger turtles, **Alanis** and **Themistokles**, had much greater difficulty in moving on land, and passing through the wave breakers. Sea turtle feeding, migratory and breeding 'success' after release remains uncertain and incidence of survival is thought to be low (Moein *et al.*, 1996). No sea turtle with this type of injury have been reported dead or returned to the STRC suffering from exhaustion and malnutrition (turtles are tagged on release for future identification). These observations indicate the need to intensively study the feeding, migratory and breeding 'success', of released sea turtles with lost flippers, to find their actual success in a free state.

## DISCUSSION

Physical and biological factors contribute in determining if a sea turtle will survive from a flipper injury. These include sea turtle age, size, stress, health, including state of nutritional and immune system, and season, sea temperature and pollution (George, 1997; Campbell, 1996).

If necrotic regions of bone and tissue on a flipper are localised, and not complicated by the presence of virulent pathogenic attack and a weak immune system (Campbell, 1996), the turtle is likely to be able to combat the flipper injury resulting in the healing or loss of the limb. It is known that sea turtles lose flippers in the wild, without needing human aid for rehabilitation, because sea turtles with lost front and hind limbs have been observed emerging onto nesting beaches (pers. comm. STPS), or are admitted to the STRC for other reasons. Four cases of flipper loss, without human interference, have been recorded at the STRC to date. However, some sea turtle injuries may be complicated, by the entry of secondary virulent pathogenic infections via wounded tissues or epithelial surfaces (Campbell, 1996). If gangrene occurs, immediate amputation is necessary, otherwise the spread of septicaemia through the blood stream is inevitable, leading to the gross destruction of internal and external epithelial surfaces (Wiles, 1987), possibly resulting in fatality.

The recovery of sea turtles admitted to the STRC for flipper damage is about 88%. The success rate is high, however this cannot compensate for the number of sea turtle entanglements. Sea turtles with flipper injuries already represent about 35% of sea turtles admitted to the STRC. The release of such sea turtles to the wild with lost flipper may not actually help to maintain the viability of the Mediterranean loggerhead population, due to potential reproductive difficulties. Their subsequent release to a wild population is preferable to a lifetime in captivity. To just treat and rehabilitate turtles to the wild with the best medical care available is not the long term solution to handle or reduce the incidence of this problem, action needs to be taken to prevent entanglement in fishing nets and lines.

The rescue, rehabilitation and release of each sea turtle from the STRC makes people become aware of the plight of the sea turtle and its plight in today's anthropogenic dominated environment. The combined effort of the work of the STPS and STRC public awareness and education schemes, with the development of the Sea Turtle Stranding Network, will influence children, the fishermen and the general public all over Greece to protect the sea turtle and its environment.

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