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GUIDELINE TO IMPROVE THE INVOLVEMENT OF MARINE RESCUE CENTRES FOR MARINE TURTLES RESCUE CENTRES

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MAP - Athens, 2003

FOREWORD

The creation of Rescue Centres, where stranded or hurt sea turtles can be cured and rehabilitated has been considered for some years as being one of the contributions in reducing their mortality rate (National Research Council, 1990). Recently, in the Mediterranean Sea, a number of rescue centres were founded, which carry out activities that focus on the rescue of sea turtles. However, not all of these centres provide adequate technical facilities and specialised personnel. Above all, they do not operate according to ethical, scientific and principle conservational criteria. Unfortunately, it has been determined that in some countries there are no specific laws that regulate the activities of sea turtles rescue centres. Thus, without governmental control, many of the existing centres are unregulated. For this reason, priority actions need to be undertaken by United Nation Environment Programme (UNEP) to implement the Action Plan for the Conservation of Mediterranean Marine Turtles. This action plan was discussed at the last meeting of experts, held in Tunisia in 1999. During that meeting, it was determined that there was an immediate need to formulate and declare common “guidelines” that would regulate activities at each centre. The guidelines will be created with respect to turtle biology and authentic conservation principles. These guidelines will also function as a base for each nation's regulation.

The scope of this document is to suggest and define guidelines, which could be adopted, for the entire Mediterranean network of sea turtle rescue organisations.

CONTENTS

I. Introduction 1
II. Organisation and Coordination of a sea turtles rescue network 3
A. Current Institutions Involved In The Recovery Of Stranded Sea Turtles In The Mediterranean 3
B. Division and Definition of Rescue Centres and Emergency Centres 3

III. Requisite Guidelines 6
A. Sea Turtle Rescue Centre 6
B. Sea Turtle Emergency Centre 9

IV. An outline of the problems most commonly found to affect sea turtles 11

V. Evaluation of the causes of injury and first aid on sea turtles 13
A. Emaciated turtles 13
B. Dehydrated turtles 14
C. Injured sea turtles 14
D. Removal of fishing hooks and foreign bodies 15
E. Buoyancy 15
F. Cold stunning 15
G. Intoxication by petroleum products 16
H. Diagnostic Testing 16

VI. Maintenance of the sea turtles in a convalescent pool 18

V. Phase preceding release 20

VII. Other function of a rescue centre 21

A. Awareness programme 21
B. Research 21

References 24

I. Introduction

The main objective of the rescue centre is to adopt all the necessary steps that are required for the release of the injured sea turtles back into their natural environment. However, to be able to make a real contribution to the numbers of sea turtles in the wild, it is fundamental that the sea turtles, that will be reintroduced into their natural habitat, are in good health (Jacobson, 1999).

A sea turtle rescue centre should be officially recognized by the assigned authorities and must undergo periodic inspection. It should also maintain proper documentation, relative to cases treated, and must be able to furnish the paperwork upon request. Furthermore, all case results, whether positive or negative, should be accurately published. In the U.S. there are specific state and federal government guidelines regulating sea turtles holding and rearing operations; these include tank dimension, feed and environmental requirements (Higgins, 2003).

The rescue centre should be fully supported by either public or private funding, because sea turtles rehabilitation is expensive. If funding cannot be guaranteed, adequate care may be difficult to provide to the injured animals. The Centre should be considered a non-profit organisation and it should operate solely for the well-being, respect and protection of the sea turtles.

The care and rehabilitation of the sea turtle cannot ignore specific scientific competence. A centre should be either associated with a University or a Research Institute or should be under the direct supervision of external experts. The scientific qualification and experience of the Centre's staff is also a fundamental prerequisite.

The rescue centre should periodically hold training sessions for people who are willing to work to provide care for the animals and/or maintain the turtle rescue facilities.

It is widely believed that sea turtles are of robust constitution and are easy to care for since they are amongst the few aquatic organisms, which are able to survive unfavourable conditions and tolerate the effects of improper care for a long period. This is due to their particular physiology and, especially, to their low metabolism. Being ectothermic animals, all the vital functions of sea turtles are affected by external environmental temperatures (Mrosovsky, 1980; Spotila and Standora, 1985; Burggren *et al.*, 1997). Low temperatures affect their immune system making them more susceptible to pathogenic infections. Other effects include poor food intake, slow digestive process and, above all, the inability to metabolise pharmaceutical drugs making them ineffective. In contrast, high temperatures result in hypothermic stress with negative consequences on metabolic functions (Glazebrook and Campbell, 1990; Zapata *et al*., 1992; Campbell, 1996; Whitaker and Krum, 1999). Consequently, the negative effects of improper care or non-specific medical prescriptions may only appear after a long time, when, unfortunately, it may be too late to save the turtle. (Warwick *et al*., 1995).

Sea turtles are sensitive to pain, and are not able to communicate their pain through sound. Therefore, it is necessary to administer anaesthesia for all operations and diagnostic testing, otherwise such cruelty can be considered a criminal offence and

punishable by law. In the case of severely injured and suffering animals, sedatives should be administered (see. Jacobson, 1987; Mautino and Page, 1993; Jacobson, 1999).

Accidental capture and the consequent trauma, physical pain, improper transportation and unfavourable maintenance conditions (temperature, salinity, poor food and water quality and inadequate treatments) cause stress (George, 1996). In stressed sea turtles, the adrenal glands release corticosterone, which may reduce the turtles' humoral and/or cell-mediated defense mechanisms, thus, inhibiting the ability of the immune system to respond to infectious agents (Morris and Owens, 1982).

In brief, the creation of a sea turtle rescue centre in the Mediterranean is a valuable initiative. To avoid mistakes and negative consequences to the animals, it is essential that all sea turtle rescue centres should:

- Respect the common guidelines
- Operate solely for the well-being, respect and protection of the sea turtles
- Hold current permits from the proper authorities and undergo periodic inspections
- Be fully supported by public or private funding
- Have specific scientific competence
- Hold periodic training sessions

II. Organisation and Coordination of a sea turtles rescue network

A. Current Institutions Involved In The Recovery Of Stranded Sea Turtles In The Mediterranean

Currently, it cannot be said with certainty how many centres exist, in the Mediterranean, that provide care for stranded sea turtles. This attempt to list those organisations and institutions involved in sea turtles rescue is very subjective and has to be considered with care. Some of the institutions known to the author and listed also by Kasparek (2001), which are involved in the rescue of sea turtles, are named in the following list. This list, however, is not inclusive and should not be taken as the final list, but as an invitation to be completed with the names of those organisations, which were not mentioned.

Croatia: Sea Turtle Rescue Centre Aquarium Pula Verudela
Greece: ARCHELON - Sea Turtle Protection Society of Greece (STPS) Athens
Hydrobiological Station of Rhodes
Libya: Marine Biology Research Centre (MBRC) Tajura
Israel: The Israeli Sea Turtle Rescue Centre.
Italy: Stazione Zoologica Anton Dohrn Napoli
Fondazione Cetacea Riccione
Fondo Siciliano per la Natura (SWF) Comiso
Centro Recupero Fauna Selvatica - Isola di Lampedusa
Centro di recupero per le tartarughe marine di Linosa
Spain : Acuicultura Ceuta, S.A. (Ceuta)
Centro de Recuperación de Especies Marinas Amenazadas (CREMA) (Andalousia)
Centro Veterinario y Recuperación de Especies “Equinac” (Andalousia)
Centro de Recuperación de Fauna Salvaje del Parque Natural “El Valle” (Murcia Region)
Instituto Cavanilles de Biodiversidad y Biología Evolutiva, Universidad de Valencia (Valencia Region)
Centro de Recuperación y Estudio del Medio Natural “El Saler” (Valencia Region)
Centro de Recuperación de Fauna Silvestre “Santa Faz” (Valencia Region)
Aqualandia España, S.A. (Mundomar) (Valencia Region)
Centre de Recuperació d’Animals Marins de Catalunya (CRAM) (Catalonia)
Fundació Marineland-Palmitos (Balearic Islands)
Tunisia: Station de Protection et de Soin des Tortues marines Monastir

B. Division and Definition of Rescue Centres and Emergency Centres

An initial step towards a Mediterranean sea turtles rescue network is proposed here by the separation of two types of turtle rehabilitation centres. The first type is a complex, well equipped and permanent structure while the other is a more simple, less costly and temporary structure. The first type is hereafter termed rescue centre and the latter will be referred to as an Emergency Centre.

A Rescue Centre is a facility, set up according to the guidelines, that is required to perform comparable to a proper hospital, must be situated in a permanent structure and have the appropriate equipment and qualified personnel.

An Emergency Centre, follows the same general guidelines as the Rescue Centre, but is a simpler structure and has less specialised facilities. It can do simple procedures such as first aid treatments but for cases that are more difficult, it will transport animals to the connected Rescue Centre.

The considerable expenses involved in the creation and maintenance of a rescue centre will undoubtedly pose a limiting factor in establishing the ultimate number of centres in the Mediterranean area. Therefore, an ideal solution would be to construct two or three strategically positioned Rescue Centres in each country. In addition, a series of Emergency Centres should be created to support the Rescue Centres, thus significantly contributing to the prevention of the decline of sea turtles in our waters (Fig A). Both Rescue Centres and Emergency Centres should follow all national regulations as well as the technical and behavioural guidelines.

An important starting point, towards the realisation of a Mediterranean-wide rescue network, would be to hold a meeting between all organisations and institutions involved in sea turtle stranding programs. This meeting is essential, as it will determine the accurate number and location of each potential Emergency or Rescue Centre.

Knowledge of the neighbouring institutions is the base for the creation of collaboration on the national level, whereby communication between the Rescue Centres within each country is a fundamental prerequisite. The Rescue Centres could communicate on the Mediterranean level via an over-looking organisation which could serve as a international coordinator, such as, Regional Activity Centre for Specially Protected Areas, (RAC/SPA, Fig B).

Apart from the national and international organisation, the common base for all interventions of all centres should be the guidelines as proposed below.

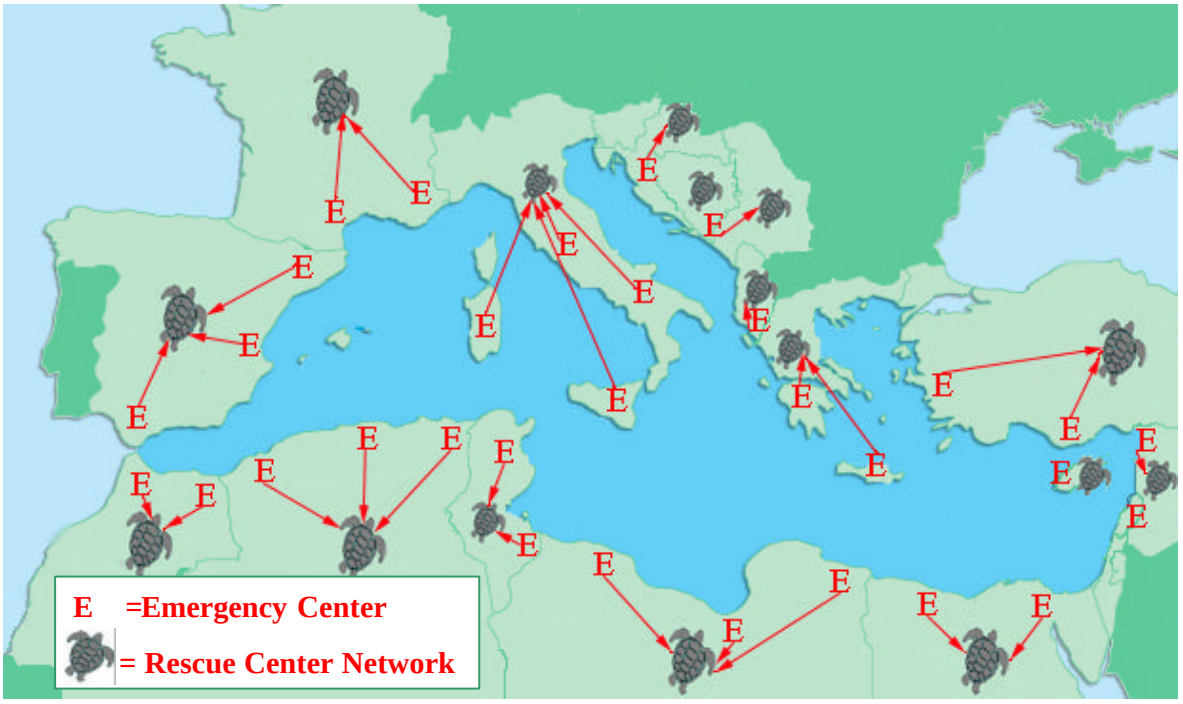


Fig. A Hypothetical distribution of Rescue and Emergency Centres

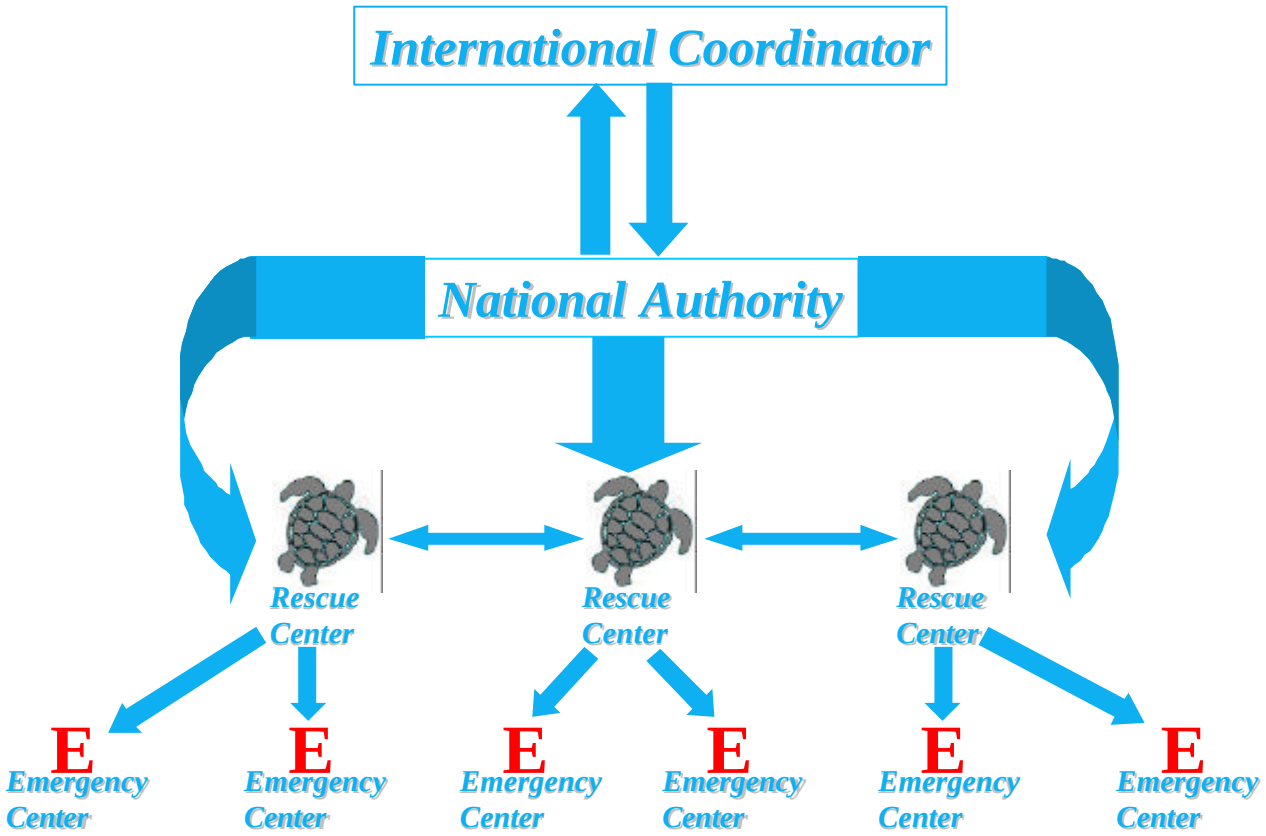


Fig. B Example of coordination of a Sea Turtle Rescue Network

III. Requisite Guidelines

A. Sea Turtle Rescue Centre

The sea turtles Rescue Centre should be structured and organised so as to carry out year-long activity. Its success will depend on: the type of equipment with which it is furnished and the methods used in the treatment and maintenance of the animals its shelters. Therefore, besides being operated by skilled staff with herpetologic experience, it should also have the following characteristics:

- the dimensions should not only be large enough to allow the predisposition of all the technical installations, but also the dimensions of the rooms and spaces to ensure proper functioning;

- the Centre's location should be easy to reach, preferably, within proximity of the coast;

- it should be closely linked with a University, a Scientific Institute or Research Centre; this would consent, when necessary, advice on what direction the scientific research should be carried out, the use of specific equipment, immediate diagnostic test results and the collaboration of a 'scientific advisor'.

From a functional point of view, the Centre should be equipped with standard fresh water, electrical, gas and telephone systems according to legal requirements, and an adequate seawater distribution circuit. If the building is near the sea, water circulation can either be open or semi-open, whereas, a closed water circulation system is required if the facility is far from the sea (Tab. I; a, b, c).

Thermostatic systems should be always present. Proper water filtration should be foreseen in both the semi-open and closed systems. An incinerator for the carcasses or a special convention with an authorised organisation are also necessary.

A rescue centre should include the following sections:

- Reception and Emergency
- Surgery Radiology
- Convalescent Pools
- Treatment Pools
- Kitchen
- Locker room and equipment storeroom
- Laboratory
- Post-mortem
- Secretariat

1. Reception and Emergency

These premises should have a wide entrance to facilitate the transportation of large containers. Animals that have been rescued will be registered in this area and then undergo initial diagnostic evaluation. It should therefore be furnished with basic equipment such as:

- 1 platform balance for medium to large-sized animals, 2-3 scales to weigh small-sized animals;
- 1 plastic, observation table whose characteristics are raised edges, a slanted surface and an opening in the centre of the table. The table should be connected to both fresh and seawater systems;
- 1 lamp (at least 100W) to illuminate the table.

2. Surgery

Surgical and endoscopic operations should be performed in this area. For these reasons, it should be separated from the other rooms to guarantee a sterile environment. This area should, at least, include:

- 1 operating table
- 1 lamp with 3 bulbs for the operating table
- a kit of surgical instruments
- autoclave with accessories to sterilise instruments
- endoscope
- laparoscope
- doppler ultra-sound

3. Radiology

In order to respect the current security regulations this area should be separated from the others. It must also be equipped with the proper radiographic equipment and a connecting room for X-ray development. Alternatively, provided they are not too distant, the Centre could use the services of other public or subsidised radiology departments in another facility.

4. Convalescent pools

Pools, functioning with seawater, which hold both active turtles and those no longer requiring topical treatment, should be placed in this area. This area should be well-lit. Both this area and the pools should be easy to clean and inspect. Roofing or shade-screening, over the pools, should be provided to minimise exposure to excessive heat and sunlight. It is, however, preferable to have air-conditioning to protect the animals from extreme temperatures. Young turtles may also benefit if half of the pool is fitted with a cover in order to permit them to hide, thereby, decreasing stress levels. The seawater that supplies the pools should be filtered if there is a closed or semi-open circulation system. Water quality should be controlled every day with special instruments in order to strictly respect the salinity and pH values of the Mediterranean. The pools should be supplied with a continuous circulation of water. Each pool should be equipped with one or two inflowing water faucets, a drainage hole in the upper portion and another drainage with a faucet on the bottom. Furthermore, the edges of the pools should be smooth and rounded, with no inside protrusions. The materials should be seawater resistant, non-toxic and easily cleanable.

It is advisable to have pools of various dimensions to permit different-sized animals to move freely and come to the surface to breathe or remain at the bottom. The minimum furnishings should be as follows:

- 10 large pools (at least 1000 liters)
- 20 medium-sized pools (at least 500 liters)
- 20 small-sized pools (at least 200 liters)

5. Treatment pools

This space should be equipped with basins for the treatment of both animals kept, temporarily, without water for therapeutic reasons (e.g. pulmonary infections, open wounds) as well as those particularly debilitated or in post-operative lapse. This area should contain dry pools and shower boxes. The pools consist of different sized basins, preferably, made of plastic for easy and quick cleaning. Their bottoms should be lined with foam pads.

Shower boxes are pools with a bottom drain or containers fitted with both bottom drainage and a continuous water spray system to wet the turtle. This keeps the weak turtle wet and the water drainage protects it from drowning. The shower box should also have a foam pad lining the bottom.

6. Kitchen

This room is used for food storage and preparation. A sink with fresh water, a refrigerator, a freezer, a cupboard for containers, a worktable with a mixer, a scale, and a kit containing scissors, knives etc. should be supplied.

7. Locker room and equipment storage room

This area should be used by staff members who are obliged to change their clothes before entering or exiting the Centre. Consequently, a sufficient number of lockers and a shower should be found in this room. The storage room should stock the necessary aquariological equipment for the maintenance of the pools (tools, a provision of faucets, tubes, siphons etc...).

8. Laboratory

Depending on the research to be conducted, the laboratory should be furnished with the proper equipment. Fundamental equipment should include a worktable, a fan, a precision scale, microcentrifuge, binoculars, a microscope and a refrigerator to store medicinal drugs. Certain types of drugs should be stored in a locked cupboard with a stock book indicating the precise use of these drugs.

9. Post-mortem

This area should be isolated to prevent contamination of the other spaces and it should be furnished with both air suction and fresh water systems. The equipment required comprehends a dissection table with the same features as the observation table in the Reception - Emergency, a cupboard to store instruments, test tubes, containers etc.

At least one kit and a thermal bag for the transportation of specimens necessary to perform necropsies on beach-stranded turtles should be available at all times.

10. Secretariat

This area will be reserved for all administrative work in relation to the staff and the technical functioning of the Centre.

The secretariat will be in charge of public relations and the filing of dossiers, compiled for each sea turtle, to be made available to the designated authorities responsible for the welfare and protection of the animals. Furthermore, they are to manage the records pertinent to the reception and use of pharmaceutical drugs.

Telephones, faxes and computers are the equipment necessary for proper functioning.

B. Sea Turtle Emergency Centre

Despite the absence of proper pools and equipment, the Emergency Centre can house injured and debilitated turtles awaiting transportation to the nearest Rescue Centre. The Centre should, at least, have:

- a surgery to receive the animals and give first aid treatment. It should also be supplied with a table for physical check ups and a locker to store first-aid medicinal drugs;
- an air-conditioned or sheltered room, respecting hygienic norms, to house the animals;
- proper and different-sized, seawater proof containers.

The staff at the Emergency Centre is to strictly avoid taking autonomous initiatives and abide by the following indications during the various phases.

After rescue:

- ensure that the sea turtle receives maximum tranquillity, protect it from the curiosity of the crowd, avoid rough handling etc.;
- before transportation, keep the turtle in the shade in summer and shelter it from the cold in winter;
- pick the turtle up from the edges of the plastron and not the pinna;
- never place the hands in front of the mouth;
- use a stretcher made from soft plastic;
- place the turtle into the container in a plastron-down position;
- use plastic containers with no corners or protrusions on the inside and line the bottom with a foam pad or beach towel;
- the turtle is not to be transported in water ;
- in summer, moist towels can be placed over the carapace without obstructing breathing;
- in winter, the shell and skin should be coated with lanolin or Vaseline to prevent from drying;
- do not attempt to remove or pull nylon threads from the mouth or cloaca;
- do not transport in open vehicles in excessive heat or cold.

Arrival at the Emergency Centre:

- no flipper is to be tagged to prevent blood loss in anaemic animals;
- no surgical operation is to be performed e.g. removal of fishing hooks;
- do not give any type of medication except for local external treatment such as stopping hemorrhages, the disinfection of wounds and the removal of net shreds, petroleum, cords etc.;
- maintain the turtle in a sheltered, if possible, air- conditioned setting.

Awaiting transportation to the Rescue Centre:

- if the sea turtle does not have deep wounds and does not appear weak, it can be put into a pool with seawater. In this case, the same maintenance criteria indicated for the convalescence pools in the Rescue Centre are to be applied (see page 19);

- if the sea turtle is either injured, debilitated, immobile or fresh water replacement in the pools is not possible, it is best to keep it in a soft-bottomed pool with no water. This pool is to be situated in an air-conditioned environment to avoid extremely low or high temperatures. To prevent dehydration the turtle is to be covered with wet towels or coated with Vaseline.

IV. An outline of the problems most commonly found to affect sea turtles

Sea turtles are naturally affected by a variety of health problems such as parasitism. Within this context, such pathologies will not be evaluated as they are considered to be dependent on natural causes. Nevertheless, some animals presenting serious symptoms of debilitation could be infested by an excessive quantity of endoparasites. In similar cases, it would be opportune to subject them to specific therapy upon arrival at the Rescue Centre (Lauckner, 1985; Campbell, 1996).

Most sea turtle injuries are provoked by: impact with water craft, accidental capture in fishing gear and nets and unfavourable environmental factors including the effects of human activities. Consequently, the most common problems that they can manifest when rescued are:

Traumatic injury, ingestion of fishing hooks and mono- filaments, entanglement in fishing lines or nets, gastrointestinal obstruction, buoyancy disorders, emaciation, hypothermia, intoxication by petroleum products.

Traumatic injury can occur when boat propellers cut into the turtle or the impact of a boat hitting the turtle can cause internal injury. Injury can also be associated with fishing activities when turtles get caught in nets, knocked against the ship's deck, harpooned and injured by fishermen or entrapped in trawl nets.

Ingestion of fishing hooks can cause severe esophageal, stomach and intestinal lesions. The ingestion of mono-filaments contribute to severe intestinal lesions.

Entanglement of sea turtles in a variety of fishing gear, cables, plastic wastes and packaging string could impede the sea turtles from eating or surfacing for air. When rescued, some trapped turtles may be found in a comatose and anoxic state. Trailing debris could cause constriction of the neck and flipper and consequent amputation of the limbs, which could lead to death from infection.

Gastrointestinal obstruction is caused by the ingestion and accumulation in the digestive tract of non- biodegradable wastes thrown into the sea by man. Various types or pieces of material such as plastic, glass, metal etc. could easily be mistaken for food and accidentally ingested when foraging occurs in dirty areas. Gastrointestinal obstruction, likewise, could be caused by the accumulation of crustacean or shell in the intestine. It appears that this could be due to the ingestion of a considerable quantity of these invertebrates found in an area where there had been a concentration of shell refuse from trawl fishing.

Emaciation could be attributed to different causes: the most common are esophageal lesions caused by hooks, ingestion of anthropogenic debris, excessive presence of ectoparasites (leeches, barnacles) and endoparasites (protozoans, helminths). Sea turtles, appearing severely emaciated and debilitated, are often affected by digenetic trematode infestation. Digenetic trematode of the family Spirochiidae are common to the cardiovascular system of the sea turtle (Wolke *et al.*, 1982; Dailey *et al.*, 1991). These cardiovascular flukes create multiple diffuse egg granulomas and vasculitis in most tissues. The liver, spleen and lungs are commonly affected by trematode-induced vasculitis, resulting in the marked debility of the

affected sea turtles (Glazebrook et al., 1981; 1989). The diagnosis of trematode infestation is usually made by the histological examination of necropsy tissues.

Buoyancy disorders, characterised by the inability to normally float on the surface or submerge, are caused by the escape of air from the respiratory tract, usually, a result of trauma to the lungs where air becomes trapped in the coelomic cavity. Abnormal buoyancy may also result from excessive gas in the gastrointestinal tract, sometimes, provoked by an obstructive lesion.

Hypothermia occurs when a turtle is exposed to cold water for a period of time. As the core body temperature of the turtle drops, it is unable to function properly. Inshore populations of sea turtles are more susceptible to cold stunning because the water temperature can rapidly change in shallow waters (George, 1996). Sea turtles, affected by this condition, become inactive and vulnerable to any type of infection like those localised in the lungs caused by a bacterial or mycotic induced pneumonia (Lauckner, 1985).

Intoxication by petroleum products can affect sea turtles when they encounter waters that contain chemical pollutants such as petroleum products left by oil spills. These sea turtles may be covered with oil or tar and may also have ingested this material and suffer from toxicosis.

V. Evaluation of the causes of injury and first aid on sea turtles

The ill or injured sea turtle, immediately after being rescued, is to be taken to the Rescue Centre. If the Centre is too far or an immediate transfer is not possible to provide, the animal can be, temporarily, transported to the Emergency facility. The transport is to be carried out by the Emergency Centre's skilled staff members or by volunteers who have been, opportunely, trained on the handling of the animal (see page 11).

A preliminary evaluation, by means of an accurate observation, is to be made upon arrival at the Centre. This will indicate what measures are to be taken. As a general rule, the animal is not to undergo an operation or medical therapy until the blood test results are known. Upon arrival, an experienced staff member is to give the turtle an accurate eye examination.

The examination of the sea turtle is to begin by recording the animal's weight and measurements. Then an assessment of the animal's general conditions (good, normal, bad) is to be made. Oral cavity should be also examined to see ulceration or presence of mucoid exudates. Blood tests and X-rays are to follow. A personal file for each sea turtle is to be compiled (Tab. II). This file has to be updated daily with the treatments carried out and the results obtained.

A. Emaciated turtles

Underweight or malnourished turtles may exhibit the following characteristics. They lack muscle mass and fat tissues beneath the pinna. The skull appears to be prominent and the occipital is particularly protruding. The eyes may appear sunken, especially, when the head is elevated. The plastron may be sunken or appear indented in the centre and if skin ulcerations are present, they are a common indication of chronically debilitated animals. The bony spicules on the plastron may perforate the skin and become evident. The carapace is soft.
Ill turtles are, generally, covered with barnacles, worms and crabs. The presence of leeches on the skin, eyes, mouth and cloaca are further signs of a state of debilitation (Lauckner, 1985; Campbell, 1996).

Emaciated sea turtles, awaiting diagnostic testing, can be given an injection of Ringer's solution (15 ml x Intra coelomatic q 24 h) (Stein, 1996). After the blood test results are obtained, the veterinarian will establish what fluid and dosage are to be administered (see: Campbell, 1996; Whitaker and Krum, 1999).

Animals that are too debilitated should be maintained out of water initially. In any case, before any sea turtle is placed in water the following conditions are to be evaluated. The animal should be able to raise its head to, at least, a 45° angle with respect to its body, move its fin in a coordinated manner and regulate its weight in a water column. The animals that do not require being kept in water can be placed in the treatment pools (page 9) and maintained according to the criteria previously elaborated (page 10).

Debilitated turtles or those covered with barnacles and marine algae should initially be placed in fresh water, maximum 24 hours (Campbell, 1996), which helps in the removal of marine organisms. Turtles that are active, showing no abnormalities and

are free of barnacles, are to be kept in salt water with a salinity level equal to that of seawater which for the Mediterranean Sea is 37-38 g/liter.

B. Dehydrated turtles

A turtle's state of dehydration is established on the evaluation of haematocrytes and other blood test parameters. Nevertheless, other observations can be indicative to assess the level of dehydration, namely, turgidness of the skin, enophthalmos level, tearing, urine production and the creasing condition of the carapace and plastron (Whitaker and Krum, 1999).

No pharmacological treatment is to be prescribed before the test results are obtained. (Mader, 2002). Animals that are able to swim can be put into pools containing fresh water for 24 hours (Campbell, 1996).

C. Injured sea turtles

Most of the injuries affecting sea turtles are caused by the crashing impact with boats. The injuries mainly involve the head, carapace and the pinna. Each wound must be carefully examined to establish both the degree of extension and the depth. Fractures or lesions, present on hard body parts, are to be treated as soon as possible. Firstly, the sea turtle is to be freed of any debris, washed in hydrogen peroxide, a physiological solution or fresh water and disinfected with Betadine 5% (Frye, 1991). Animals with serious and extended cuts on the carapace should be maintained in a clean environment in pools without water (treatment pools) for a period from 2 to 6 weeks. This will ensure that the infections caused by pathogens in the water will be limited and will make the treatment more effective. The use of hard materials such as acrylic and fibreglass to seal fractures present on the carapace is not recommended as these materials delay the healing of the wound and because the debris can cause infection to the underlying soft tissues (Walsh, 1999). The wound is to be regularly medicated. The majority of traumatic wounds respond well to the Tegaderm technique (for the procedure see Campbell,1966; Walsh, 1999). After the blood test results are obtained, the veterinarian will prescribe, if necessary, an antibiotic. It should be noted that old wounds, apparently healed, could have caused internal damage. Phenomena such as 'increased buoyancy' due to spinal cord injury or 'debilitation' caused by dead bones and debris that have remained inside the animal are signs of internal damage.

D. Removal of fishing hooks and foreign bodies

Depending on their position in the digestive tract, foreign bodies and fishing hooks can either be removed by hand, with an endoscope or by means of a surgical operation. Fishing hooks that are in the stomach or intestine are very often expelled spontaneously after some times if they are not entangled to the tissues (experienced at the Rescue Centre of the SZN). At any rate, if the object or hook is found in the bottom portion of the digestive tract and the animal is active and eats and defecates regularly, it is advisable not to subject the animal to a surgical operation. Considering that a surgical operation could cause complications or negative consequences, it is to be performed only if, strictly, necessary. The staff, involved in such an operation, should be highly experienced in similar techniques and the anesthetic dosage to be given (Pokras,1992; Ross and Ross, 1999). With regards to anesthetics, it should be

pointed out that injectable anesthetics like Ketamina and gassy ones like isofluoran should be used (see Bennet, 1996). A combination of the aforementioned anesthetics guarantees major success of the operation and prevents post-operative complications (George, 1996).

Before the operation, the sea turtle is to be kept on an empty stomach for two days and receive the proper antibiotics. Following the operation, that is to be performed in an adequate operating room and not in a haphazard setting, the animal is to be placed in a shower box in a 20°C. temperature-controlled environment until it is able to raise its head to breathe.

E. Buoyancy

A sea turtle affected by buoyancy disorders floats on the surface and cannot dive. The extreme posterior end of the carapace is often kept above the water surface.
Buoyancy disorders, not related to pathological factors (see page 12) but the result of air in the coelomic cavity caused by stress or trauma to the lungs, can regress spontaneously if the sea turtle is left peacefully in little water. Some can live in this state forever. However, they can no longer be released into their natural habitat. To help them compensate for abnormal buoyancy a belt, fitted with weights, can be applied (Campbell, 1996).

F. Cold stunning

'Cold stunning' phenomena, even if not documented, have been verified in the Mediterranean when water temperatures go below the average seasonal temperatures for fairly long periods. A recent case was recorded in southern Italy between the end of December, 2001 and the beginning of January, 2002 (Bentivegna et al. in press). These animals present symptoms of lethargy, hypothermia and other problems such as ischemic lesions on which bacteria and fungi thrive. The first remedy is to keep the turtles in a warm setting to raise body temperature and apply Vaseline to prevent dehydration. If they are able to remain in water, they should be maintained in seawater and brought slowly up to 25 C°. Blood tests will be necessary to determine the status of the animal. The lesions will be treated daily with Betadine 5% compresses. (Glazebrook and Campbell, 1990; Zapata *et al.*, 1992; Campbell, 1966).

G. Intoxication by petroleum products

The external presence of petroleum or tar can be washed away with dish detergent or vegetable oils. Oral residues of similar products in the mouth can be broken down using organic fats such as mayonnaise. If ingestion is suspected, charcoal-containing compounds, like kaolin-pectin, may decrease the absorption of hydrocarbons responsible for organ damage. Additional supportive therapy such as fluids may be helpful (Campbell, 1966; Walsh, 1999).

H. Diagnostic Testing

The formulation of a correct diagnosis is necessary to conduct through testing. An eye examination should follow a blood test that takes note of complete blood count. A serum analysis should also be taken. Despite the costs of these tests, they are

necessary to give a more accurate diagnosis and determine consequent treatment (George,1996, Campbell, 1996; Walsh,1999).

Hematologic/plasma chemistry parameters are expected to vary with age, sex, season, location, maturity and nutritional status of the turtle, however relatively few publications exist about the normal reference values in sea turtles. Therefore, it would be desirable for each Centre to develop a complete database about the variability of blood parameters analysed in order to obtain a full understanding of the blood profile (Jacobson, 1998).

Blood is taken from the supravertebral dorsal occipital venous sinus in the neck and the site is prepared with a disinfectant for venipuncture in a sterile ambient (Owens and Ruiz, 1980). Ideally, VACUTAINER® Blood Collection Tubes should be used instead of normal syringes as they are easier to handle (Esperienced by the staff of Rescue Centre of SZN).

An x-ray is essential. The radiograph is useful to evaluate the extent of external trauma, detection of foreign bodies, bone fracture, assessment of the health of the respiratory (for the methodology see Whitaker and Krum, 1999). The use of the ultrasound as a diagnostic tool is particularly well suited to evaluate soft tissues such as intestine, liver and kidneys (Whitaker and Krum, 1999). Doppler ultrasound is a useful and common method to detect blood flow and localise both arteries and venes (Hochsheild *et al.*, 2002). In critical cases a Doppler flow detector can help to realise an arterial pulse, thus to confirm that a turtle is still alive.

The laparoscopy enables the clinician to perform an internal examination and conduct biopsies in sea turtles without having to resort to major surgery.

The endoscopy provides a non-surgical alternative for foreign body extraction and inspection of the stomach. Protection of the flexible endoscope is provided by passing it through a wooden-bite block or short-padded PVC pipe widget into the oral cavity. Heavy sedation is often required to carry out a complete and successful examination (Bentivegna et al., 1995; Whitaker and Krum, 1999).

Microbiological testing is also required to establish if the origin of a lesion is mycotic or bacterial. It is also useful to diagnose a septicaemia or check for parasites in the feces (Mader, 2002).

VI. Maintenance of the sea turtles in a convalescent pool

The water temperature in convalescent pools should be maintained between 18°C to 26°C. Water temperatures should be kept stable and a weekly physiological-chemical evaluation (pH, salinity, nitrites, nitrates, ammonia) should be made during treatment.

The pools should be supplied with natural water preferably taken directly from the sea.

A seawater distribution circuit could either be open or semi-open. If the system is open and the area from which the water is taken is not polluted, a filter is not required as the water discharged will not be reused. In this type of system an accumulation basin to decant and thermostabilise the seawater, after taking it from the sea, is necessary (Tab I, a).

The semi-open system, like the open one, also necessitates a decanting basin and thermostat and filtration systems. In fact, some of the water discharged from the pools will return to the same pools after having been filtered (Tab I, c).

If the continuous use of seawater is not feasible a closed system will be adopted. In this case, effective thermostat and filtration systems to guarantee water quality will be required. The system can be centralized (Tab I, b) or separate for each pool.

In pools of, at least, 1000 litre capacity, the entering and exiting water flows will be regulated to ensure total water replacement 3 to 4 times every 12 hours, whereas, in pools, characterised by an inferior volume capacity, water replacement should occur 7 to 8 times every 12 hours.

The sea turtle is, tendentiously, a solitary animal. In a confined environment, it has great difficulty in managing to share the same pool without displaying aggressive behavior (Bentivegna and Cirino, 1987).

In spite of this aspect of the sea turtle’s nature, the animal is to be housed in the Rescue Centre in isolated tanks for hygienic reasons. To reduce the risk of contagion each pool should have its own cleaning equipment (abrasive cloth, sponges, siphons, etc.).

The staff, responsible for the care of the animals, have to learn to respect some hygienic norms such as washing their hands with a disinfectant or, better still, wearing disposable gloves after having handled an animal in a tank.

Sea turtles dirty the water a lot, especially, after eating. The dirty water could worsen their general health conditions as it could cause eye inflammation and it could favour or increase the mycotic and bacterial proliferation on wounds and lesions.

It is indispensable that the tanks are regularly cleaned, even twice a day, above all, after the animals have eaten and defecated. If the water is quite clean this operation can be carried out by partially draining the tank and with a siphon proceed to the removal of debris on the bottom. However, if the water is quite dirty and milky, it should be completely drained. In any case, the tanks should be drained completely

every two days and rinsed accurately with fresh water and then seawater. If the sea turtle is kept in the tank during the cleaning, the work should be quickly and delicately done in order not to stress the sea turtle too much.

Tank disinfection should occur once a week, using the following procedure:

- drain the tank and remove the turtle positioning it in a basin lined with a foam pad;
- accurately rinse and clean the walls and bottom of the tank with fresh water;
- rub the tank walls and bottom with its own sponge soaked in a Betadine solution
- (5 ml x 100 ml fresh water);
- let the solution stand for 30 minutes;
- rinse the tank thoroughly with fresh water, carefully eliminating any residue of the disinfectant solution;
- fill the tank with seawater and reposition the turtle when the water level is at least 20 cm;
- Moreover, once a month cleaning of the water supply pipes should be carried out to prevent possible incrustation from polluting the inflowing water. Sponges, brushes and a lot of fresh water are needed to clean the tubes.

Turtles require natural sunlight. Direct sunlight may provide certain benefits not available to sea turtles housed indoors in an artificial light setting. Full-spectrum artificial lighting that provides ultraviolet (UV) A, UV B, and infrared light may benefit sea turtles specially youngs when natural sunlight is unavailable. Weekly sunbathing is advisable when natural light is unavailable (Mader, personal communication). A regulated stable photoperiod, respecting the light and darkness rythms of the seasons, should be provided. Conditions of closely- positioned constant lighting are unnatural for turtles and likely to act as low-level chronic stressors. For general considerations on lighting see: Boyer and Boyer, 1996; Gehrmann, 1996.

During convalescence, the turtle should be correctly fed with a balanced diet that ensures the proper daily intake of protein, fat, moisture, carbohydrates, vitamins and minerals. The scientific literature can provide several examples of a correct dietary plan for the sea turtle (Stickney et al., 1973; Choromanski et al., 1987; Donoghue and Langenberg, 1996). The amount of food may vary with each turtle (Whitaker and Krum, 1999). The feeding strategy is generally to provide approximately 7% of the turtle's body weight in grams of food per day (Cambell, 1996). Weight gains and losses can be used as a guide for dietary management. For turtles that have undergone surgery or have serious injury, the food should be broken down into small pieces to make it more digestible. Fish such as anchovies and mackerel are highly recommended in these cases. Clams and squid should be avoided, as they are difficult to digest. Lettuce can be given to both omnivorous and herbivorous turtles. If frozen fish is given, make sure it has not been conserved for more than 4 months. In the aforementioned case add vitamin supplements prescribed by the veterinarian (Whitaker and Krum, 1999).

Dehydrated turtles or those suffering from hypoglycemia require injections of physiological solutions directly into the coelomic cavity (prescribed by veterinarian). Forced feeding with a tube is quite a delicate procedure that requires experience

(see Campbell, 1996; Walsh, 1999; Whitaker, 1999 for food components and procedure).

During convalescence, blood tests, weight variation, capacity to swim and surface and feces testing for the presence of parasites should be monitored. The data should be recorded daily on a personal file to assess the turtle's conditions.

V. Phase preceding release

The main focus and final step of the rehabilitation process is releasing the turtle into its natural environment. The successful treatment of traumatic problems should ensure adequate health and the turtle's consequent release. Therefore, an absolute requirement for the turtle's release is complete recovery and good health (Bentivegna, 2001).

So, before proceeding with this final phase, besides medical and regular growth evaluation, the following steps should be carried out:

- transfer the turtle to the largest pool;
- acclimatise to the seawater temperatures in the release area;
- feed with live prey to reinforce hunting instinct;
- observe for swimming and diving capacities.

In correlation with the points mentioned above, the site, period and method of release are to be established according to the following criteria:

- the release site should not be far from the location where the animal was found and it should not be too anthropic;
- water temperature should be at least 16-17 °C; although the optimum temperature is 18 °C;
- release should occur from a boat or from the shore.

The sea turtle should be tagged with an ID before being released. It is recommended that there be only one standard ID tag type and model for all turtles released into the Mediterranean. The country and rescue centre codes, progressive ID number assigned to each animal, address and the phone number of the Central Organisation (i.g. RAC/SPA) should be indicated on the tag.

To evaluate the success of the methods utilized in the care and rehabilitation of severely injured animals, the Rescue Centre should set up a monitoring programme, respecting the guidelines formulated by the IUCN (1988), to verify the health conditions and the survival of these animals.

VII. Other function of a rescue centre

A. Awareness programme

The majority of sea turtles, accidentally captured or sighted in difficulty, require care and an observation period in the Rescue Centre. Therefore, the authorities responsible for patrolling the coastline and waters, fishermen and citizens should be made aware of the existence of the Rescue Centre and contact the centre when necessary. With this objective in view, the centre should organise the distribution of didactic and informative material. A brief 'vademecum', featuring clear behavioural indications to assume in the presence of an injured sea turtle, should be given to the harbour office, coastal guard, diving and tourist centres etc. Fishermen could be supplied with a more detailed first-aid pamphlet with pictures illustrating how to reanimate a sea turtle caught in a net and the preliminary care to be given as they bring it to shore.

This awareness campaign should get support from the mass media that has a greater potential to reach the public at large. Considering the charisma that the sea turtle exerts on the public this should not be too difficult to achieve.

An educational policy promoted by articles, newspapers, seminars, conferences, school, university and social centre meetings could be facilitated by establishing a territorial cooperation network. Scientific institutions and centres, together with, wildlife associations, students and volunteers could ensure a prompt rescue of sea turtle specimens, even in locations, distant from the Centre.

Finally, an area in the Centre, destined to educating the public, could be supplied with didactic tools (computer, video, poster, books etc...).

The centre can also set up pools and aquariums exhibiting sea turtles that can no longer be released into their natural habitat owing to their injuries. These initiatives are not only valuable from an educational point of view but also incisive as a conservation message.

B. Research

The sea turtles treated in a Rescue Centre represent a biological sample that would be hard for scientists in a different context to obtain, due to the logistical difficulties involved in long-term sampling of such a migratory, solitary and wild marine population. For these reasons those involved in the protection of sea turtles both in marine and nesting habitats should be encouraged to routinely collect material, in order to avoid the loss of valuable scientific information. The absence of an ongoing project should not have to prevent these collections as they can be made with limited resources and until new questions or opportunities for the analysis develop, the samples can be stored. A Rescue Centre can be involved in genetic, biochemical or even histological research projects.

Genetic study is increasingly being used to study the biology and conservation of sea turtles (Norman et al., 1994; Bowen et al., 1993) as, in fact, the management of a sea turtle population is based on the identification of genetically and demographically

discrete stocks over the vast geographical range occupied by turtles throughout their lifetime. Knowledge of the distribution, migratory routes, and stock composition is vital to set a good management and conservation strategy, improving the understanding of some of the fundamental aspects of the biology and ecology of the sea turtle populations. The "mark and recapture" studies have been used to obtain this, however the small sample size and difficulties involved in carrying out a tagging program in all the nesting habitats, such as the ability to mark all the individuals in a population, as well as the problem of chronic tag loss prevent a full understanding of the population dynamics of these species (Laurent et al., 1998). For conservation management it is extremely important to have some molecular markers enabling the identification of the individuals treated in a Rescue Centre with respect to their origin.

For genetic study it would be possible to collect blood and tissue. For the collection of blood from live sea turtles see page 17.

Small muscle pieces provide a simple and inexpensive way to obtain samples for genetic studies from dead animals (Norman et al., 1994). This tissue is preferable to other internal organ tissue such as kidney, liver and heart as the presence of enzymes in these tissues will cause a rapid degradation of DNA following death. Muscle tissue, however, is stable for long periods of time although this does depend on the environmental conditions, and fresher samples are preferable.

Preservation and storage of blood and tissue samples are found in Bowen et al., 1994; Encalada et al., 1998; Amos and Hoelzel, 1991.

Evaluation of the Ecotoxicological Risk to Xenobiotic in Sea Turtle Tissue. Sea turtles have a long life span, and are carnivorous during at least one phase of their life cycle. They have a coastal foranging habitat, except for Dermochelys coriacea which feed on macroplancton and are pelagic throughout their lifetime. These animals, therefore, similarly to marine mammals and seabirds, have the potential to bioaccumulate chemical pollutants such as heavy metals and organic compounds which could play an important role in the decline of sea turtles, affecting both their mortality and fertility. Unfortunately, despite the numerous studies that have been carried out on marine mammals and seabirds, data on bioaccumulation and the toxic effects of persistent chemicals in marine turtles is very limited. Moreover, even if a rescue centre is not supposed to be equipped to carry out chemical analyses, it should still be involved in the collection of the samples. It is, in fact, extremely important that the analyses be performed on very fresh tissues to avoid the loss of the contaminants or a change in the chemical forms and distribution of the pollutant, which are often very difficult to obtain. Alongside and during its normal activities a rescue Centre should be prepared to select those animals that have recently died, collect and store the tissue for future study and evaluation of the hazards caused by the persistent pollutant. This can provide a baseline for future comparisons within different areas or between different turtle species, and the ability to assess, which chemical compounds are potentially harmful to these species.

Muscle, liver, kidney, lung, testis or ovary, pancreas, spleen, and brain tissues should be collected in a minimum quantity of 20 g and stored in zip lock plastic bags to prevent any contamination. The samples can then be frozen at - 20 °C and stored for several years until the chemical analysis is completed.

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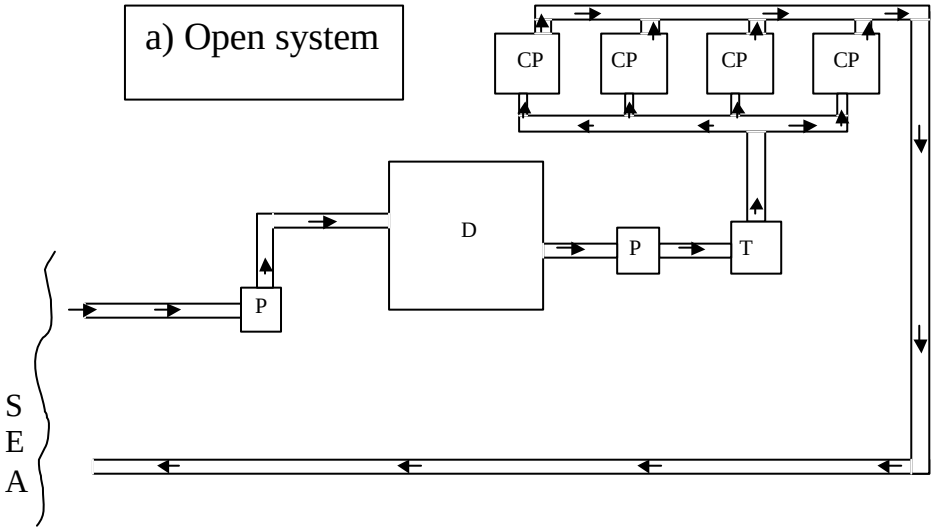
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TABLE I

a) Open system



P = Pump

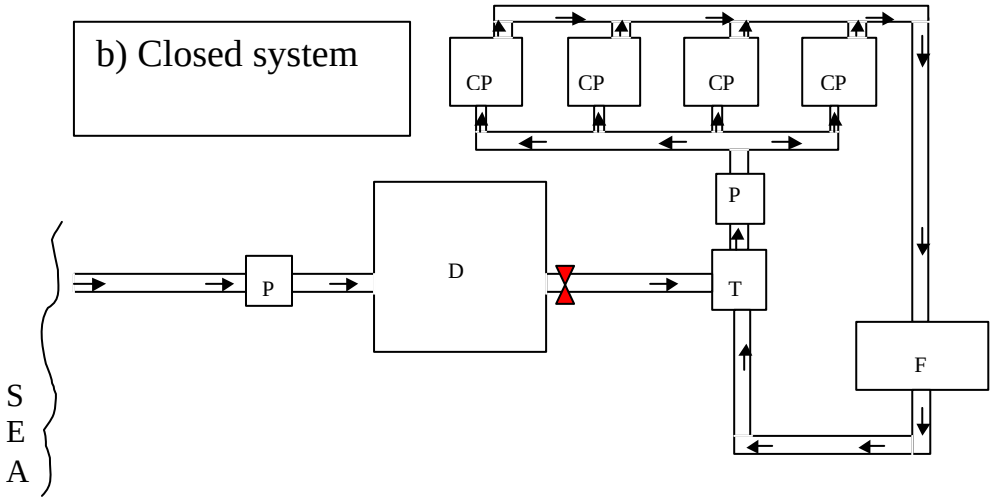
D = Decantation Tank

F = Filter

T = Temperature Control

CP = Convalescence Pools

b) Closed system



c) Semi-Open system

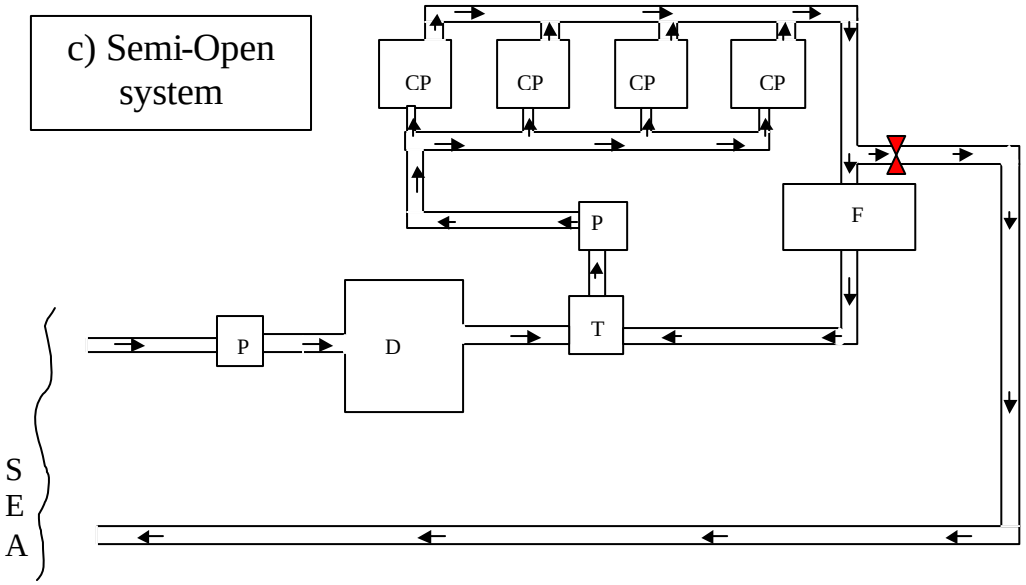


TABLE II

Name or Tag Number_____

Species_____ Date of arrival:____/____/_____

Location
_____
_____

Weight _____

Size: SCL_____ SCW_____ CCL_____ CCW_____

Condition at arrival:
_____
_____
_____
_____

Case History:
_____
_____
_____
_____
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