THE UK MARINE TURTLE REHABILITATION MANUAL

NOTES ON MARINE TURTLE REHABILITATION BASED ON A REVIEW OF EXISTING LITERATURE AND EXPERIENCE IN THE UK

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Preface

1. INTRODUCTION

Government agency staff, wardens, animal welfare and wildlife society officers, vets, aquaria staff and others may sometimes be asked for information on how to deal with live stranded or accidentally fished marine turtles. The aim of this manual is to provide general guidance on marine turtle rescue, rehabilitation and repatriation.

All marine turtle encounters should be *immediately* reported to the various agencies listed on the back cover of this manual. They will provide necessary guidance and assistance and will pass on records to a central database of marine turtles recorded in UK waters known as ‘TURTLE’. TURTLE is currently maintained by Marine Environmental Monitoring - and as of 05.02.02 held 767 records of turtles encountered in UK waters since 1748 (TIG, 2002 – see Table 1). The records in the database are only representative, as marine turtle encounters in the UK are likely to be under-recorded because turtles are hard to spot and, until recently, there has been no co-ordinated recording effort.

Table 1 Numbers of records in TURTLE database at 05.05.02 and percentage of total of marine turtle occurrence in UK waters (earliest record dated 1748, TIG, 2002).

Species	No. of records	Percentage of total
Leatherback turtle	502	65.4
Loggerhead turtle	97	12.6
Kemp’s ridley turtle	29	3.8
Green & hawksbill turtle	4 & 1	0.7
Unidentified	134	17.5
TOTAL	**767**	100

1.1 MARINE TURTLES IN THE UK

Six of the world’s seven species of marine turtle have been recorded in UK waters, including the leatherback (*Dermochelys coriacea*), the loggerhead (*Caretta caretta*), the Kemp’s ridley (*Lepidochelys kempii*), the green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*) and the olive ridley turtle (*Lepidochelys olivacea*).

The World Conservation Union (IUCN) currently lists all seven marine turtle species as critically endangered, endangered or vulnerable (Eckert et al, 1999). Overseas, turtles are increasingly threatened by human disturbance, direct harvesting for meat, eggs and, in the case of hawksbill turtles, their shells. They are also under pressure as a result of destruction and disturbance of nesting and foraging habitat and accidental capture and drowning in fishing gear (bycatch). Bycatch also threatens turtles in UK waters, as does boat strike and the ingestion of plastic marine litter and balloons, which turtles mistake for jellyfish, a favoured prey item. Once ingested, litter can block the turtle's gut and cause death by starvation (Godley et al, 1998).

1.2 THE LEATHERBACK TURTLE

The critically endangered leatherback turtle is the largest species of marine turtle and is the most widely distributed reptile in the world. It is easy to identify because of its size, and the pronounced ridges running along its carapace. Unlike other marine turtles the leatherback's carapace is somewhat flexible and consists of thousands of interlocking star shaped bones covered in a leathery skin. It is a spectacular animal and the largest specimen ever recorded stranded at Harlech, Wales in 1988. The turtle weighed 916 kg and was 2.91m long (Morgan, 1990).

Although leatherbacks are restricted to nesting on tropical rookeries (nesting beaches), they forage in tropical, sub-tropical and temperate waters, feeding mainly on jellyfish. Unlike other reptile species, the leatherback is endothermic, which means it can maintain some control of its body temperature and can therefore remain active and feed in cooler waters. The adults are regular migratory visitors to the coastal waters around the UK and Ireland where most sightings occur in late summer and autumn (Pierpoint, 2000).

1.3 HARD-SHELLED TURTLES

Unlike the leatherback, the occurrence of the 'hard-shelled' species in UK waters is probably not a normal part of their life history. Juveniles of the hard-shelled species occur as 'cold-stunned' strays. Their arrival is often associated with unusual weather conditions e.g. storms - and animals are usually in very poor health. Their poor physical condition may impact on their navigational ability. They wash up on UK shores after having been carried by currents from warmer climes into UK waters, which are too cold for them. For example, loggerhead turtles do not feed at temperatures below 20°C, become extremely sluggish below 15°C and comatose below 10°C. Even in summer, UK sea temperatures are rarely above 15°C. In 1990, when quite large numbers of loggerheads were swept into the Irish Sea during winter after prolonged south-westerly winds, several cold-stunned animals were found off Ireland (Gaywood, 1997).

1.4 MARINE TURTLES GROUPED SPECIES ACTION PLAN

In 1999, the UK Government published the Marine Turtles Grouped Species Action Plan (SAP) in recognition of the need to enhance the conservation of marine turtles in UK waters and the UK Overseas Territories. The SAP, which can be viewed at www.ukbap.org.uk, outlines 26 priority actions, including:

- the dissemination of '*information ….for conservation agencies, veterinary surgeries, relevant public bodies and other organisations, to help deal with enquiries relating to stranded marine turtles*'

- the introduction of '*a code of practice for the repatriation, where necessary, of cheloniid (hard-shelled) species which are occasionally stranded live on UK shores*'

1.4.1 Turtle Implementation Group

The SAP is currently implemented by a group of organisation known as the Turtle Implementation Group (TIG). MCS is a joint lead partner of the TIG along with the Herpetological Conservation Trust, while Scottish Natural Heritage is the Government agency contact point. The other members of the group are English Nature, Countryside Council for Wales, Environment and Heritage Service, Marine Environmental Monitoring, Marine Turtle Research Group (University of Wales, Swansea), Professor John Davenport, the Wildlife Trusts and Euroturtle (www.euroturtle.org).

The TIG has produced a UK Turtle Code and Advisory Note, which have been endorsed by the Department of Environment, Food and Rural Affairs (DEFRA) and the Sea Fish Industry Authority (SeaFish). The Code is a two-sided, laminated document, aimed at sea-users, such as fishermen, and solicits records of marine turtle encounters while giving advice on initial treatment of stranded and bycaught turtles. The Advisory Note is a larger document that expands on the information in the code and aims to advise local authorities, reserve wardens and veterinary practitioners on dealing with marine turtles in the UK. These documents are available at MCS; see back cover for contact details.

Because of the endangered and critically endangered status of the marine turtles recorded in UK waters, it is important that, where possible, all live specimens, either stranded or bycaught, are nursed to a state of health appropriate for repatriation and returned back to the wild as soon as is practical (see section 4). However, marine turtles are protected under the Wildlife and Countryside Act (1981, as amended), the Conservation (Natural Habitats, & c.) Regulations (1994), the Control of Trade in Endangered Species (Enforcement) Regulations (1997) and the Habitats Directive (Council Regulation [EC] No. 338/97). In addition to the veterinary concerns involved in rehabilitating marine turtles, there are also several legal implications that must be considered, especially when hard-shelled turtles are repatriated back to the wild beyond UK national boundaries.

As a contribution to the SAP and in order to facilitate the rehabilitation and repatriation of as many marine turtles as possible, MCS has produced this manual to advise aquaria staff and veterinary practitioners dealing with live marine turtles in the UK.

1.5 LEGISLATION FOR MARINE TURTLE REHABILITATION IN THE UK

All five species are protected by various national legislation and international agreements. The following UK legislation pertains to marine turtles:

- Wildlife and Countryside Act (1981, as amended)
- Conservation (Natural Habitats, &c.) Regulations (1994)
- Control of Trade in Endangered Species (Enforcement) Regulations (1997)

Furthermore, all seven extant species of marine turtle are listed on Appendix I of the Convention on the International Trade in Endangered Species of Flora and Fauna (CITES) 1975. All five UK species are listed on Annex A of Council Regulation (EC) No. 338/97, Appendix II of the Bern Convention 1979, Appendix I of the Bonn Convention 1979 and Annex IV of the EC Habitats Directive 1992. The loggerhead is listed as a priority species on Annex II of the EC Habitats Directive 1992.

This means that:

- turtles may not be deliberately killed or caught, or be deliberately disturbed
- live turtles may not be landed unless for the purpose of tending them or enabling their subsequent release
- dead turtles or shells obtained from turtles in UK waters may not be possessed unless the animal was lawfully acquired
- turtles and their derivatives may not be sold or offered for sale without UK Government permission unless they are worked antiques acquired before 1st June 1947 (with documented proof). Turtles and their parts and derivatives may not be imported or exported without UK Government permission

However, there is no offence under these laws if:

- turtles die as the incidental result of a lawful operation (e.g. accidental entanglement in fishing gear) and could not reasonably have been avoided;

- entangled or stranded turtles are tended to ensure their survival;
- dead turtles are temporarily held for later examination by experts.

Fishermen should not be blamed for the death of turtles due to unavoidable entanglement in fishing gear. Currently there are no Government guidelines or policy on marine turtle bycatch avoidance as it is often impractical for fishermen to avoid such mortality. Fishermen and the general public must be given reassurance that they will not be penalised if they report or retrieve stranded or dead turtles.

1.5.1 The Veterinary Surgeons Act 1966 and other relevant legislation

Further legislation applies to the care and rehabilitation of stranded marine turtles, perhaps most importantly the Veterinary Surgeons Act 1966. The following comments have been extracted from a statement issued by the Royal College of Veterinary Surgeons.

"*Under the Veterinary Surgeons Act 1966* ***only*** *a veterinary surgeon, qualified and registered with the Royal College of Veterinary Surgeons (RCVS), can carry out acts of veterinary surgery in the United Kingdom. Non-veterinarians may commit a criminal offence and can be prosecuted. The reason for this is to protect animals and their owners from people who might through ignorance or incompetence endanger an animal's health or welfare.*

The Act defines "veterinary surgery" as "the art and science of veterinary surgery and medicine… which is taken to include –

- *the diagnosis of diseases in, and injuries to, animals including tests performed on animals for diagnostic purposes;*
- *the giving of advice based upon such diagnosis;*
- *the medical or surgical treatment of animals; and*
- *the performance of surgical operations on animals"*

In addition only a veterinary surgeon and member of the College (MRCVS or FRCVS) may sign a veterinary certificate and prescribe medicine." (RCVS, 1999).

However, the Veterinary Surgeons Act 1966 is subject to certain exceptions. The exceptions relevant for the treatment of marine turtles are in Schedule 3 to the Act and Ministerial orders under section 19(4) (known as exemption orders). The relevant provisions in Schedule 3 to the Act and exemption orders are summarised below:

- minor medical treatment may be given by owners (handlers) to animals of any kind.
- physiotherapy may be carried out by anyone under the direction of a veterinary surgeon who has examined the animal and prescribed the treatment.

It is therefore essential that a veterinary surgeon is consulted before any treatment is administered to a marine turtle stranded in the UK. The veterinary surgeon should be in a position to facilitate your understanding of which treatments you are legally entitled to undertake.

Other legislation relevant to the treatment handling and husbandry of stranded marine turtles includes the Protection of Animals Act (1911), which pertains to the provision of humane captive conditions, and the Animal Health Act (1981) and The Welfare of Animals (Transport) Order 1997, which pertain to ensuring that animals do not suffer further suffering and injury during transport (see section 2.1.3).

2 MARINE TURTLE RESCUE

Prompt action can save a turtle's life. All live turtle encounters should be reported to one of the expert organisations listed on the back cover of this manual, but certain actions can be taken immediately to increase the animal's chances of survival. ***In all cases veterinary advice must be sought.***

IMPORTANT INFORMATION: Remember, a turtle's jaws can deliver a dangerous bite and the front flippers can deliver a painful blow. In the interests of personal safety and the survival of the animal, treat live turtles with caution, patience and care. Furthermore, marine turtles can harbour a number of pathogens harmful to humans, including *Mycobacterium, Salmonella, Vibrio,* and *Chlamydia* species (Acha and Szyfres, 1987). Always wear rubber gloves when handling marine turtles and ensure that appropriate facilities are available for cleaning and disinfecting all wounds suffered when treating turtles. Medical attention should be sought if such wounds become infected or a systemic illness subsequently develops after working with marine turtles. Due to the health risks involved with handling turtles, always wear rubber gloves!

2.1 RESCUING LEATHERBACKS

To the best of the authors' knowledge, there has never been a successful attempt at rehabilitation of a stranded leatherback turtle, and to date there are no available references available about successful leatherback rehabilitation. The section includes recommended advice only. If leatherback rehabilitation is attempted, remember to record every aspect of your experience, as this may prove useful to others in the future.

2.1.1 Entanglement: Most records of marine turtle bycatch in UK waters involve leatherback turtles (Pierpoint, 2000). Between 1980 and 1999, an average of just over 4 leatherback entanglements were recorded per year (n=83) and over 60% of these records (where gear type is known) involved leatherback turtles entangled in buoy ropes of bottom-set gear, such as crab pots.

Although marine turtles dive for prolonged periods, they become stressed and drown when forcibly held under water for even a few minutes. Mortality of entangled leatherbacks is believed to be approximately 60%, but if the turtle is discovered soon after entanglement, or the entanglement occurs at the surface enabling the turtle to breathe, successful release is possible.

Do not use a gaff on the turtle to haul it alongside. A leatherback entangled in fishing gear is likely to be stressed and therefore the priority when dealing with such a situation is to keep the animal's head above water to allow it to breathe. All or as much as possible of the line or net should be disentangled or cut from the animal. Do not lift the animal out of the water, as pressure from the internal organs will place pressure on the lungs, restricting the animal's ability to breathe. Avoid towing leatherbacks ashore, as this may further stress the animal or force its head underwater leading to death by drowning. If disentanglement at sea is impossible, or the turtle is alive but inactive, towing ashore should be done slowly, ensuring that the animal's head is above water. The release should then be completed in shallow water.

2.1.2 Live-stranded leatherbacks: Leatherbacks do not seem to be prone to the sort of accidental stranding that afflicts marine mammals and other turtle species. However, if a live leatherback, with no visible signs of injury, oil pollution or entanglement is found stranded on the shore, the highest priority should be to return the turtle to the water. Do not use ropes to pull the animal, or attempt to lift it because ropes will cut into the skin. The leatherback's lungs are situated close to the top of the shell. If any turtle is placed in any position other than resting on its belly, the pressure of the viscera on the lungs will suffocate it.

Seawater should be intermittently poured over the animal, including the head, to keep the external membranes moist. Leatherbacks should be moved by several people pulling on the shell rather than the flippers. The flippers should not be pulled to move the animal as they can easily break or dislocate as a result. The leathery skin is quite sensitive and prone to damage. Dragging a leatherback over sand will do little harm, but do not drag a stranded leatherback over rocks as this can cause severe damage. If the turtle is in an inaccessible or difficult situation, such as stranded on rocks, it may be best to avoid the stress of dragging the turtle by waiting for the tide to return, at the same time ensuring that the animal is kept wet.

Once the turtle is in seawater, the animal should be taken out to a depth of at least one metre and then released, and observed for possible re-stranding. If the turtle swims out to sea, no further action will be needed except reporting it, and perhaps alerting fishermen in the area so that any further sightings may be recorded.

2.1.3 Traumatised and sick leatherbacks: If the animal is listless and refuses to swim, swims in circles or thrashes its flippers in an uncoordinated movement so that it strands again, then there may be insoluble problems. Veterinary advice should be sought, although it is very difficult to rehabilitate sick or damaged leatherbacks, since little is known about their care.

If the stranding is in an accessible place, then it might be feasible to transfer the animal, by a low loader vehicle, to a willing public aquarium, which has a large tank available (i.e. greater than 4m x 4m surface area). Little is known of captive leatherback husbandry and because of their enormous size and specialised diet, dealing with leatherback turtles in captivity presents many difficulties. Captive leatherbacks may require large quantities of live jellyfish every day, seem unable to recognise boundaries and tend to continually swim into tank walls, eventually damaging the snout unless the tank walls are padded. If these facilities are not available, the traumatised leatherback should be left in shallow, sheltered seawater while veterinary attention is sought. To minimise the suffering of the animal, euthanasia should be considered in such cases.

If the necessary facilities are available, leatherbacks may be transported slowly over short distances (recommended travelling time 2 hours maximum) in covered vehicles so long as the animal is not subjected to trauma or wind chill. Be aware that Article 4(1) of the Welfare of Animals (Transport) Order

1997 states that '*No person shall transport any animal in a way which causes or is likely to cause injury or unnecessary suffering to that animal*'. Ensure the turtle is secure, protected from the hard sides of the vehicle and its body is adequately covered with dry material. Do not moisten the animal during transport as this, combined with wind chill, may severely lower the animal's body temperature. Do not transport or immediately house the animal in warm conditions (i.e. not greater than 15^{o}C) as this may lead to thermal shock.

Once in sheltered, draught free facilities, the animal should be placed on a soft floor covering so that it is not in direct contact with a cold concrete/ stone floor surface. Resuscitation should be attempted by elevating the hindquarters so that the turtle is resting at approximately 30^{o} in order to drain the lungs. The turtle must be supported below along its entire length and should then be monitored for a period of up to 24 hours for signs of movement and recovery (Norkin, 1980). Dehydration will rapidly set in, so it is important to keep the turtle moist by intermittently pouring seawater at ambient temperature over the body and using a spray for the head and eyes.

Once the turtle shows signs of activity, it should be transferred to a padded tank containing seawater no deeper than 50cm (or below the level of the turtle's nostrils when the head is at rest) and maintained at the ambient air temperature of the room in which the leatherback had previously been housed. The turtle should be constantly monitored and if the animal shows signs of vigorous, coordinated activity, the turtle must be returned to the sea as soon as possible. If the animal dies, the procedure outlined in section 3.7 should be followed.

2.2 RESCUING HARD-SHELLED MARINE TURTLES

All other turtles encountered in the UK are likely to be juvenile or sub-adult loggerhead and Kemp's Ridley turtles, as green, hawksbill and olive Ridleys are rarely recorded. The process of rescue and rehabilitation will be the same for all hard-shelled species. All live turtles should immediately be reported to the relevant organisation and veterinary advice must be sought.

Wear rubber gloves when examining a stranded turtle and ensure that all surfaces and equipment used during the examination are disinfected or disposed of immediately after use.

2.2.1 Initial health assessment: Basic information should be recorded in the field or on arrival at the rehabilitation facility (see ‘Template arrival admission sheet’, appendix 1). More detailed veterinary examinations can be performed once the turtle has been stabilised.

Species identification and approximate size: Species identification should be attempted using Figures 1-6 and if possible, a measurement of the curved length and width of the carapace should be taken (see Figure 7).

Body condition: Turtles with severe weight loss will have decreased muscle and fatty tissue. In emaciated turtles, the occipital crest at the back of the head will be prominent. Bilateral and lateral neck muscles, which are normally hidden, become more obvious, frequently accompanied by decreased soft tissue in the fore flipper and shoulder regions (Walsh, 1999). In extremely emaciated individuals, the plastron may appear to be sunken or indented centrally. Eyes may appear sunken, a symptom also displayed by dehydrated individuals. Note any oil/tar contamination, which may be around eyes, nares, mouth or covering skin and carapace.

Breathing pattern: When turtles are out of the water, respiration is visible by the lifting of the head with each respiration. Debilitated and weak animals lack this ability. Make note of any abnormal respiratory noise or discharge from mouth or nares (blood, mucus, pus).

Skin/carapace and plastron: Turtles quickly become dehydrated and the skin becomes dry and brittle. Note any injuries to the skin and shell, cuts, ulcerations or oil/ tar contamination. Chronically debilitated turtles may be covered in barnacles or crabs (Walsh 1999, Campbell 1996). Cauliflower-like fibropapilloma growths may be seen, regardless of species, mainly found around the eyes and neck.

Eyes: May be sunken in extremely emaciated and/or dehydrated individuals. Abnormalities such as fibropapillomas (if present, usually found around or covering the eyes), closure, scarring, injury and opacity of the eye should also be noted.

Demeanour: Stranded turtles on land will most likely be cold-stunned and may appear more inactive and non-responsive than they actually are. An initial assessment of their behaviour should at least determine whether or not the turtle is active.

Additional information: Position of the turtle when found (i.e. on belly, on back or stranded on rocks). Any position other than horizontal and belly down may worsen the state of the turtle, since respiration will be hindered.

2.2.2 Transport and handling: Given that UK waters are too cold for these species, it is pointless to return live hard-shelled turtles to the sea since they will simply re-strand or die at sea. Therefore, all live hard-shelled turtles should be taken into care as soon as possible and housed in suitable facilities such as public aquaria, marine mammal sanctuaries or veterinary surgeries with heated water tanks (institutions with the necessary facilities are likely to help, particularly if they gain some favourable publicity).

Always wear rubber gloves when handling turtles. Turtles should always be lifted by firmly holding the carapace, which will act as a support for the body. Do not pull by the flippers as this can result in injuries, such as dislocation or breakage. Small hatchlings and juveniles should be lifted gently using the lateral margins of the carapace. Care must be taken not to compromise respiration by exerting excessive pressure on the flexible shell (Whitaker and Krum, 1999). Larger turtles can be moved either by firmly holding the carapace just behind the head and between the hind flippers, or by holding each side of the carapace (see Figure 9).

In the rare event of an adult hard-shelled turtle stranding, lifting may require several people and in situations where available manpower is insufficient then use of equipment may be necessary. Ropes should not be used solely to lift turtles as they can inflict chafing injuries and possible dislocation; ideally a mechanical hoist and padded stretcher with drainage holes should be used. In the absences of this equipment, wrap the turtle in a strong cargo net and ensure that more than one strong person lifts the turtle in the net so that it does not drag on the ground. Remember that larger turtles are strong and can inflict a powerful blow with their limbs and a crushing bite with their beak.

Active entangled or stranded hard-shelled turtles should immediately be placed on their belly in an appropriately sized foam and canvas-lined plastic or fibreglass box (see figure 10), which can be easily cleaned and reused (Walsh, 1999). Inactive, comatose turtles (no or slight movement, limbs limp and flexible, no extensive decomposition) should also be placed on their belly in a box, but with the back end of the shell inclined so that the turtle is resting at approximately 30° (QCFO, undated, NOAA, 2001 - see Figure 11). While in this position, the comatose turtle should periodically be rocked gently by alternately lifting (and lowering) the edges of the carapace by about 8cm. This will drain the lungs of any fluid. Any fishing line or net should be disentangled or cut away as soon as possible and any foreign objects in the turtle’s mouth should be removed. Dehydration of the skin and carapace will need to be prevented as best possible by using either a spray of water, covering with seaweed or a moist towel, ensuring that the mouth and nostrils are not obstructed (Walsh, 1999).

Once in an appropriate box, hard-shelled turtles can be transported by road to an appropriate facility. Do not transport the turtle until the animal appears calm once placed in the transportation box. Use of seawater should be kept to a minimum during transport if the animal and the animal should not be subjected to extreme temperatures.

For recovering animals, the priority will be to get the animal into warm conditions. This can be achieved by placing the animal into water that is only

$1^{o}C$ warmer than the turtle’s core body temperature and by gradually increasing its surrounding temperature in increments of 3°C per day to a temperature of 25°C (Campbell, 1996). Ideally this should be in shallow, warm seawater (several centimetres deep to facilitate breathing), but warm air or warm fresh water will do at first for a few hours. Inactive turtles can drown if placed in more than a few centimetres of water and so should not be placed in water (Whitaker and Krum, 1999).

Instead, inactive turtles should be left resting in the inclined position while their ambient temperature is increased as described above. Inactive turtles in dry conditions will need water poured over the head and body at intervals to keep the eyes and body parts moist. Alternatively, the carapace and skin can be covered with petroleum jelly or lanolin to avoid drying and dehydration, especially in cold situations where continual application of water may further decrease the turtle’s temperature (Walsh, 1999).

All turtles should be monitored. Inactive turtles should be monitored over a 48-hour period for signs of recovery, whereupon the turtle becomes active. If the animal shows no signs of recovery within 48 hours it should be considered dead and placed in cold storage for collection by UKCSIP personnel (see section 3.7).

3 REHABILITATION

Keep in mind that the aim of rehabilitation is for a quick recovery and rapid return to the wild. Every effort must be made to prevent cross infection among captive turtles and other marine creatures. Rehabilitating turtles should be housed in strict isolation for the entire rehabilitation period. All equipment used should be disinfected after treatment of rescued turtles and if the compound used is toxic, disinfected equipment should be thoroughly rinsed before subsequent use. Chlorohexidine solutions and Povidine-iodine solutions are effective, show minimal toxicity and can be used to disinfect human skin as well as work surfaces (Herbst, 1999).

3.1 HOLDING FACILITIES

The following aquaria have successfully rehabilitated or kept hard-shelled marine turtles:

Blue Reef Aquarium *(R)* Contact: Richard Smith	Towan Promenade Newquay Cornwall TR7 1DU	Tel: 01637 878134 Fax: 01637 872578	info@bluereefaquarium.co.uk
Oceanarium Bournemouth *(K)*	Pier Approach, West beach, Bournemouth, Dorset, BH2 5AA	Tel: 01202 311993 Fax: 01202 311990	enquiries@oceanarium.co.uk
Brighton Sea Life Centre *(K)*	Marine Parade, Brighton, Sussex, BN12 1TB	Tel: 01273 604234 Fax: 01273 681 840	tobyf@merlinentertainments.biz
Exploris Aquarium *(R)* Contact: Tania Johnson	The Rope Walk Castle Street Portaferry, Co Down Northern Ireland BT22 1NZ	Tel: 028 4272 8062 Fax: 028 4272 8396	info@exploris.org.uk
Lahinch Seaworld *(R)*	The Promenade Lahinch Co Claire Ireland	Tel: 00353 (0)65 708 1900 Fax: 00353 (0)65 708 1901	enquiries@lahinchseaworld.com
London Aquarium *(raised loggerhead to 1yr from hatchling)* Contact: Paddy van der Merne	The County Hall London SE1 7PB	Tel: 020 7967 8000 Fax: 020 7967 8029	info@londonaquarium.co.uk
National Marine Aquarium *(K)*	Rope Walk, Coxside, Plymouth, PL4 0LF	Tel: 01752 600301 Fax:01752 600593	admin@national-aquarium.co.uk
Oceanarium *(R)*	42 New Street, St. David's, Pembrokeshire Wales, SA62 6SS	Tel: 01437 720453	enquiries@sealife.demon.co.uk
SeaLife Centres *(R)* Contacts: Mitch Hird & Julie Ions	Biological Services Weymouth Sea Life Park, Lodmoor Country Park Weymouth Dorset DT4 7SX	Tel: 01305 761465 Fax: 01305 782388	bios@merlinentertainments.biz
Scarborough Sea Life & Marine Sanctuary ***(K)*** Contact: Iain Hawkins	Scalby Mills, Scarborough, N. Yorks, YO12 6RP	Tel: 01723 373414 Fax: 01723 376285	iainh@merlinentertainments.biz
University of Southampton *(raised 4 loggerheads to 4 yrs from hatchlings)* Contact: Jenny Mallinson	School of Ocean and Earth Science, Southampton Oceanography Centre, European Way, Southampton SO14 3ZH	Tel: 023 8059 2011 Fax: 023 8059 3052	jxm@soc.soton.ac.uk J.Mallinson@soc.soton.ac.uk

However, delayed treatment can result in the death of some stranded turtles (Walsh, 1999). Therefore, if these aquaria are more than two hours by road from the site of stranding, it is preferable for distressed turtles to undergo a period of initial stabilisation before long distance travel to a fully equipped facility. This manual provides the necessary guidance to any marine aquarium willing to help.

3.1.2 Type and size of accommodation

Marine turtles are inquisitive but destructive and are inclined to bite and dig in their tanks. Tanks should be made from strong, non-abrasive materials and any objects in the tank (e.g. pipe fittings, heater cables) should be strong or protected. To reduce abrasion to the turtle's plastron, removable and strong rubber matting should be placed on the floor of the tank. The matting should be removable so that it can be cleaned and must be strong enough to resist being bitten into pieces by the turtle's sharp, strong jaws.

All glass tanks: Because of the danger of breakage, all-glass tanks should only be used for small turtles (curved carapace length less than 15cm) and as a last resort.

Plastic, acrylic or fibreglass containers: These are the ideal containers for rehabilitating juvenile turtles, as they are durable, lightweight and therefore easy to clean.

Corrugated iron, circular frame lined with durable plastic or butyl liner: Again, easy to clean and can be arranged to accommodate any size turtle. A durable liner is essential, which must be protected from potential sharp edges on the frame and the ground surface by suitable padding such as pieces of old carpet.

Concrete tanks: Concrete is best avoided because the rough surface of the concrete can cause chafing injuries to the turtle.

Holding tanks must be an adequate size for the turtle. For example, Kemp's ridleys between 25-60 cm straight carapace length have been successfully rehabilitated in flexible fibreglass tanks measuring 137cms in diameter and

127cms deep, for 3-5 months (Whitaker and Krum, 1999). Larger turtles should not be kept in depths less than 100cm, unless the animals are very sick or weak. Turtles will crawl out of a tank if they are able. Ensure that the surface of the water in the tank is approximately 30 cm below the height of the tank wall i.e. ensure that the tank is not filled to the brim. Tank sizes used at aquaria around the UK and Ireland can be found in Table 3.

Table 3. Tank sizes used by UK aquaria

	Tank Sizes	Filter system
Blue Reef	1.5m and 2m diameter, circular plastic tanks	None used, regular water changes
Exploris	$0.75m^3/6m^3/12m^3$	Under gravel filter bed and external Eheim filter
Lahinch	6m deep x 10m wide	U.V. filter system / quarantine tank
London Aquarium	250 litre - $3m^3$ - $20m^3$ (tanks used over 12 month period for one loggerhead turtle maintained from hatchling to juvenile)	100,000 litre open system with protein skimming, U.V. and biological filtration
SeaLife Centres		
Weymouth	2m diameter, circular tank, water depth 15cms to 30cms	Through flow from filtered, quarantine tank, excess waste removed
Scarborough	3m deep (330,000 litres) for non-release adults	2 sand filters and activated carbon to reduce bacterial bloom (24 hourly)
University of Southampton	11m long x 15m deep	None used, regular water changes

3.1.3 Water quality and cleaning: Active, stranded turtles should initially be placed in 25-30% freshwater to saltwater for 2 to 3 days to facilitate hydration (Smith, pers. comm.). The saltwater should have a salinity equal to that of seawater (i.e. approximately 35 parts per thousand - ppt) and should be used thereafter. Severely dehydrated sea turtles and turtles with marine organism encrustations (e.g. barnacles, marine algae etc) should initially be placed in 100% fresh water as this aids the removal of marine organisms and facilitates rehydration of the patient (Campbell, 1996).

Frequent cleaning is necessary to prevent build-up of excrement, salt crystals and bacterial blooms. Solid and light waste can be removed by ‘hoovering’ the bottom using an airlift or siphon and this should be carried out when necessary on a daily basis. Ideally the holding tank should have a bottom-set drain to a filter and a through flow of water.

Regular water changes (a minimum of every 48 hours) will be necessary where adequate filter systems cannot be used, and a tank-rotation cleaning schedule will minimise disturbance to the turtle. The turtle is transferred to an extra tank at the correct temperature, while the original tank is cleaned, water replaced and then left to heat up to the correct temperature. The turtle is then placed in the clean, original tank until the next clean is due.

For larger holding tanks with no through flow system and where entire water changes may not be possible, changing 10-20% of the water and replenishing slowly to avoid drastic temperatures changes have been found to be adequate, during stabilisation. **Never use your mouth to establish a siphon flow when cleaning out marine turtles.**

Captive marine turtles should be moved to a tank with a through flow system as soon as possible. Before the turtle is introduced to the tank, chlorine may be added to the water, at levels up to 1.0 ppm, and stirred in until it has completely dissolved/ defused into the tank water. This should reduce bacterial and algae growth, but the concentration should never exceed 1.0 ppm as this may cause irritation to the eyes (Campbell, 1996).

Various filtration systems can be used for larger tanks (see Table 3) to maintain water quality control with varying success. Particulate filters may require activated carbon to counteract potentially harmful bacterial blooms.

Sand filters **must** be backwashed daily and the sand should be stirred every two months. Activated carbon should be changed every two months and the sand changed on an annual basis. Some water quality parameters, such as temperature, chlorine and ozone concentrations may directly and rapidly affect sea turtles, whereas others such as pH and ammonia present a less immediate threat, but indicate potential problems with the water filtration system, which should be addressed.

All equipment used for cleaning and for carrying out maintenance must be disinfected immediately after use.

3.1.4 Water temperature: Most hard-shelled turtles that strand in the UK will be hypothermic (cold-stunned) and the highest priority will be to raise the turtle's body temperature to the optimum range. This ***must*** be carried out gradually and over a period of a few days (see section 3.5.1 Hypothermia). The optimum temperature range for healthy juvenile loggerheads is 21°C in winter to 24°C in summer. Low water temperatures affect a turtle's immune system and metabolism, predisposing them to infections from opportunistic pathogens, poor food intake and digestion, and the inability to metabolise medications properly (Campbell, 1996). Temperatures higher than 26°C can affect water quality, may increase the chances of infection and may cause stress and deterioration of health in stranded turtles. However, it may be necessary to maintain sick individuals at higher temperatures between 25-30°C for short periods during recovery (see section 3.5.1 on Hypothermia).

Water temperatures should be constantly monitored, to prevent the dangerous effects of heating failures. Methods of heating range from thermostat-controlled tropical fish tank heaters (cheap and easily available, as well as being a useful standby) to heating systems designed for circulated seawater in complexes of larger tanks.

3.1.5 Lighting: Ultra Violet light (UV) is essential for the synthesis of vitamin D in turtles. Wild turtles are believed to bask in the sun at the sea surface. Fluorescent tubes specifically designed for captive reptiles are commonly available at larger pet stores and should be used with a timer switch on a day/night cycle. For longer periods of captivity, this cycle can be adjusted according to seasonal changes, along with water temperature. Be aware that these tubes are functional over very short distances and should be replaced approximately every six months. Always refer to the manufacturers instructions when positioning and maintaining UV lighting equipment. Whenever possible, captive turtles should be given access to natural sunlight, as long as optimal water temperatures can be maintained.

3.1.6 The captive environment: Marine turtles are curious and will bite and ingest any small objects in their tank, which may result in gastrointestinal obstruction or other problems. Do not use gravel in the tank and ensure that all fittings in the tank are strong or protected. Behaviour is a vital guide to the progress of turtles in recovery and can provide early warning signs of potential problems. However, little is understood about behavioural enrichment in captive turtles. Anecdotal evidence suggests that captive turtles will entertain themselves by investigating, hiding in and biting larger decorations such as rocks, large sections of pipe, buoys and floating cuttlefish bones. However, cleanliness is paramount and severely debilitated turtles should be kept in a barren environment to avoid injury through contact. Where several turtles are simultaneously rehabilitated, they **must** be housed separately to prevent the possible spread of disease and to prevent potential injuries through aggression.

3.2 PRIMARY STABILISATION

On arrival at a suitable facility, clinical examination should be carried out as for any animal. Information taken at the site of rescue and on admission should all be recorded and the turtles should be cleaned, weighed, measured and photographed. All turtles should be fully examined by a veterinary surgeon, including a full physical examination and collection of blood samples (see section 3.3.3 Blood sampling and analysis).

3.2.1 Respiration: The respiratory rate of the individual should be assessed at the beginning of an examination. Movement of the head should occur with each breath, but severely debilitated and weak individuals may not exhibit this behaviour. Auscultation can be attempted by placing a wet towel on the carapace before applying the stethoscope. The towel acts as a medium for sound transmission (Andrew Routh, pers comm.). However, more information will probably be provided by radiography of the lung field. If the turtle is obviously breathing, an assessment of the animal's behaviour in water may reveal flotation abnormalities associated with respiratory infections. **Do not place turtles in water if they do not appear to be breathing**.

While the carapace limits auscultation, palpation and ultrasound, information can be obtained using the limited access available around the limbs (see figure 12). Additional radiographic and ultrasound evaluation can then be used to confirm any diagnosis. A ‘Doppler’ (veterinary pulse reader often used in chelonids) can be employed to assess the presence of a heartbeat, by placing the probe at the base of the neck. This is useful to confirm whether or not turtles are dead with inactive specimens.

3.2.2 Temperature: In cases of hypothermia, the normalisation of the turtle’s body temperature should be the highest priority (see section 3.5.1 on hypothermia). Core temperature can be measured using a traditional thermometer or preferably a flexible, rectal digital temperature probe. Correct placement is best achieved by lubricating the probe and introducing it into the cloaca while it directing slightly craniodorsally and slightly toward the left side, avoiding the opening to the urinary bladder. (Whitaker and Krum, 1999).

3.2.3 Measurement and external examination: Standard measurements include curved carapace length and width and straight plastron length (see Figure 7). These measurements can help in the assessment of body condition as well as provide useful markers for progress. Sunken eyes, lack of pectoral musculature and/or a convex plastron are all symptoms of poor body condition and dehydration. Initial examination of the entire integument should include noting any discolouration, lacerations or ulcerations, in addition to ectoparasites, barnacles or marine debris.

Turtles should be cleaned to ensure comprehensive external examination for injury or lesions. Placing turtles in shallow, fresh water for 24 hours will aid the removal of barnacles and other marine organisms from the carapace and plastron. A screwdriver or chisel can then be carefully used to gently chisel off barnacles, ensuring that tools are held in the same plane as the carapace to avoid damage to the keratinised epithelial surface (Campbell, 1996). Oil and tar-based substances can be removed using a safe detergent (e.g. Fairy Liquid), vegetable oils or oil absorbent towels.

3.2.4 Initial treatment of wounds: External wounds should be debrided and cleaned (1:10 dilution of Povione-iodine solution) and treated with topical antibiotics and/or antifungals (see Table 5 Drugs and dosages and section 3.5.10). Open wounds to the head, carapace and plastron should be bandaged using lanolin/jelly-based antibiotic ointment (e.g. triple antibiotic), gauze and tape (Campbell, 1996). Tape should be secured to the carapace using cyanoacrylate glue applied to the margins to hold the dressing in place. A semi-occlusive dressing made of thin, flexible and transparent polyurethane membrane should be used to hold the antibiotic in place, securing the margins with superglue (Campbell 1996, Whitaker and Krum 1999). Wounds in the soft tissues of the head, neck and limbs should also be debrided and cleaned. Potassium permanganate solution is a useful treatment for skin necrosis and Povidine-iodine can be tried for other skin infections. Most small wounds should be left to heal on their own. Closure of larger wounds with sutures is possible, where necessary, using a non-absorbable everting suture (for further information see Trauma section 3.5.7).

3.2.5 Oral examination: Oral examination may be possible in small individuals without sedation. Holding and applying gentle pressure to either side of the tempomandibular joint can open the turtle's mouth. Weak and emaciated turtles will show little resistance but keep in mind that they have a powerful, potentially dangerous bite. Always wear rubber gloves. An oral gag (i.e. padded plastic or wooden rod) can be used to hold open the jaws of more resistant turtles. Padding the speculum with tape will avoid damage to the edges of the mandible. Alternatively, rolled cloth strips can be looped around the upper and lower beak and gently retracted to allow a full, unobstructed view of the oral cavity (Whitaker and Krum, 1999). The oral cavity will provide information on hydration status, capillary refill time and jaundice as well as signs of oil and tar ingestion, presence of foreign bodies or diseases such as ulcerative stomatitis or obstructive rhinitis syndrome. Fibropapillomas may also be present in the oral cavity.

3.2.6 Examination of the eyes: The eyes should be flushed with a sterile, isotonic eye irrigating solution and can be examined with standard ophthalmic tools. The entire eye should be examined, noting any corneal, iridal, uveal, or lens problems. Pupillary light reflexes are of no diagnostic value in marine turtles (Whitaker and Krum, 1999). Fluorescein dye can be used to check for corneal ulcers. Uveitis may indicate systemic infection or disease and should be followed up by additional tests. Turtles with cataracts have occasionally been encountered. Any turtle with cataracts should have their vision fully assessed, since adequate vision is necessary for natural foraging behaviour and hence eventual release. If the eyes are severely damaged, refer to section 6.3 and seek veterinary advice.

3.2.7 Examination of the ears: The ear is assessed visually, laterally and from the outside. Swelling of the tympanic scute (see Figure 7) can be an indication of an ear abscess, although this condition is more common in domestic tortoises and terrapins. Such abscesses may become hard and inert or may discharge via the Eustachian tube into the back of the throat resulting in surrounding cellulitis (McArthur, 1996).

3.2.8 Examination for tags and tag scars: Several marine turtle research projects in the Atlantic basin and the Mediterranean employ tagging regimes. External tags are usually embossed with a unique identification number and the return address of the organisation that attached the tag. Plastic 'rototags', similar to those used to ear tag livestock, are attached to the trailing edge of the hind flippers or on the caudal edge of the front flippers close to the main joint (see figure 8). Metal tags are more usually attached to the latter site in hard shelled turtles. Leatherbacks are usually tagged in the hind flippers or in the skin between the hind flippers.

Always check for the presence of tags or tag scars on stranded turtles. If tags are present, remove any fouling and record all the relevant details from the tag. Report these details to the relevant contact listed on the back of this manual and send the information to the address on the tag. Tag scars, where tags have either fallen out or have been forcibly removed from the animal, are characterised by the presence of either a hole or a V-shaped notch missing from the trailing edge of the flipper. Make a note of all scars during the preliminary physical examination.

Some projects also insert internal tags, known as Passive Integrated Transponders (PIT tags), into marine turtles, which may be read by a scanning device. The PIT tag consists of small, inert microprocessor sealed in a glass capsule (11.5mm to 20mm in length) that transmits a unique identification number when activated by a hand-held scanner (Balazs, 1999). Tags and scanners are manufactured by several companies including Avid and Destron-Fearing (USA) and Trovan Ltd (Germany). These tags are also used to mark livestock and pets, therefore veterinary practices in the UK are likely to use scanners made by at least one of the companies listed above.

PIT tags are inserted at a variety of sites, including the shoulder (usually in leatherbacks), the dorsal surface of the hind flippers or the trailing edge of the front flippers (see figure 18). However, PIT tags may, over time, move away from the tagging site within the animal. If a PIT tag scanner is available, scan the entire body of the animal, paying special attention to the shoulders and limbs, to detect the presence of tags. If a tag is present, record the number and notify the relevant contact on the back of this manual who will then contact the international marine turtle research community to trace the origin of the tag.

3.3 MONITORING

Monitoring is an essential part of successful marine turtle rehabilitation and will indicate the status of the turtle’s recovery and growth. Basic monitoring should include regular measurements of turtle biometrics (e.g. length, width and weight, see below and figure 8), food intake and defecation, observations of the skin, eyes, carapace and general behaviour. Turtles should be weighed on a weekly basis and then monthly once the animal appears to have recovered. The captive environmental conditions, including temperature, water quality and lighting should also be regularly checked.

3.3.1. Measurements: Figure 7 illustrates the standard international biometric measurements of marine turtles.

Curved carapace length (CCL) and width (CCW) of hard-shelled turtles: Using a calibrated, soft tape measure, from the edge of the carapace measure the distance over the curve. For very active turtles where measurement may be inaccurate, take each measurement three times and record the average.

a) CCL = distance between the centre of the nuchal scute to the notch between the supracaudal scutes
b) CCW = width of the widest part of the carapace and perpendicular to the length measurement (note the scute locations at each end of the measurement for future reference)

Straight length and width of hard-shelled turtles: Apply appropriately sized callipers to the same distances described above, and measure the distance between the calliper points with a calibrated metal measurer.

Measuring leatherbacks: As above but use the measurements illustrated in Figure 8

3.3.2 Weight Measurement: Weighing of marine turtles is straight forward, but may present some problems and should be undertaken by two people, one to take the reading and the other to handle and watch out for the turtle. Wild turtles are not accustomed to being handled and, if active, will attempt to escape with some determination. They will flap their fore-flippers violently and may attempt to bite. Using conventional scales to get an accurate weight measurement therefore requires some restraint of the patient. Turtles can be restrained by temporarily and securely wrapping them in a towel or cloth. Larger turtles require different treatment. They should be placed on a cargo net, which should then be wrapped around the patient and hooked onto a calibrated, suspended Salter-type scale (see figure 8).

Don’t forget:

- Ensure that the weighing equipment you are using is properly calibrated
- Weigh the cloth/ cargo net immediately after weighing the turtle and subtract this weight from the total weight of the wrapped turtle each time the animal is weighed.
- make a note of the reliability of the recording as well as the make and model of the weighing equipment.

3.3.3 Blood sampling and analysis: Blood sampling provides important information on the health status of turtles on arrival as well as providing baseline data from which to judge the animal's progress during rehabilitation. Age, sex, size, health, habitat, and diet all influence haematological and serologic parameters (Whitaker and Krum, 1999). Hence, comparisons of values obtained from captive animals to those for wild populations must be treated with caution (Bolten & Bjorndal 1992, Campbell 1996, George 1996). Blood can be taken from three main sites: the dorsal cervical sinus, jugular vein and metatarsal veins (see Figure 13). The most commonly used vessel is the dorsal cervical sinus, which allows sufficient quantities of blood to be safely and rapidly collected (Whitaker and Krum, 1999).

The area should be disinfected using an antiseptic cleaner and then swabbed with 90% alcohol. 23 gauge, 1” or 1.5” needles should be used for juvenile turtles under 0.5kg weight, whereas 20 to 22 gauge needles should be used for larger turtles (Owens, 1999). In the rare event that hatchlings (approx. 20 g) are bought into captivity, 25 gauge insulin needles are adequate, although it should be noted that distortion of cells may occur using the smaller needles (Bennet, 1986, Whitaker and Krum, 1999).

Field workers at leatherback rookeries in Costa Rica have designed an alternative method for taking blood samples from leatherback turtles. They used 21 gauge, 2” needles (or 20 gauge, 2" needles) and vacutainers to get blood from the interdigital veins of the flippers. The interdigital veins run alongside the phalanges of the front and rear flippers. They were most successful when they attempted to take blood from veins near a joint in both the front and rear flippers. The needle was inserted approximately 1" from the bone and at a 30 to 45^{o} angle (Amanda Southwood, pers. comm., 2002).

When taking blood samples, place the turtle on a foam pad or edge of a table so the head can be firmly grasped and directed downward (see Figure 13); marine turtles cannot retract their heads into their carapaces like tortoises and terrapins. With the head lower than the body, the dorsal sinus fills with blood. The dorsal cervical sinuses can be located 0.5 - 3cm lateral to the midline and 1/3 to 1/2 of the way toward the head from the cranial edge of the carapace (see figure 13). The needle should be inserted at a 90°angle (vertically to the neck) and should only be moved up and down slowly, with slight suction, to find the sinus (Owens, 1999). Do not move the needle laterally as this can cause unnecessary damage to the tissues. If unsuccessful, fully remove the needle and reposition to locate the sinus. If one side of the neck does not provide blood, try the opposite sinus.

In emaciated and ill animals, lack of supporting structures in the neck may cause the vessels to deviate from their natural position. In such cases, ultrasound machines should be used to locate vessels for blood samples and for accurate placement of catheters if necessary. Once blood has been collected, do not continue to apply suction when removing the needle as this can damage your sample.

Typically, 3-5ml of whole blood is adequate for most analysis, although turtles will readily tolerate having up to 1ml of blood per 100g of body weight removed if necessary (Herbst, 1999). Lithium or sodium heparin vacutainers or syringes are the best anticoagulants for biochemistry and complete blood count samples. EDTA should be avoided as it causes haemolysis of sea turtle blood. Smears should be made in duplicate immediately after collection and mixing. Whitaker and Krum (1999) recommend the use of Wright's giemsa stains for preparing blood smears from marine turtles, as this facilitates cell differentiation. Unclotted, whole blood can be used for complete blood counts and should be examined within 24 hours for analysis.

Plasma or serum can be used for biochemical analysis, although data from plasma provides more consistent results (Whitaker and Krum, 1999). Each sample should be analysed using the same technique for accurate diagnostic comparison. If the sample is being sent to a laboratory to be analysed, then check their specific requirements before collection and sending. Samples should preferably be centrifuged and plasma removed from the whole blood immediately, to prevent artificial readings. PCV can be measured at the time of plasma separation. Low PCV (<30%) is not only a useful gauge of blood loss following trauma, but can also indicate a chronic disease problem such as parasitism, infection and anorexia/starvation (Herbst, 1999). Haematological and biochemical parameters can be found in Tables 7 and 8..

3.3.4 Faecal sampling: Faeces collected by direct, or indirect, cloacal flush can be examined for parasites. Fresh faecal samples can be examined by direct smear, floatation and sedimentation techniques for protozoan and helminth infections (Herbst, 1999). Cultures for bacteria and fungi should also be included in the investigation.

3.3.5 Endoscopy: Endoscopy is very useful for detecting the presence and removal of internal foreign bodies. Some authors advise insertion of an arm to be more productive than endoscopic manipulations when retrieving oesophageal foreign material impaled upon the oesophageal papillae of larger turtles (McArthur, pers comm. 2001). Turtles' mouths can be maintained in an open position using a padded gag, through which the endoscope can pass and be introduced into the oesophagus (see Figure 14 and section 3.2.5). Use of sedation or anaesthetic will depend on the state of the turtle and the procedure to be carried out. Gastrointestinal biopsies can also be taken with this method.

3.3.6 Radiography (x-ray) and ultrasonography: Both of these techniques are very valuable diagnostic tools providing information about the state of internal organs, which cannot be fully assessed by external physical examination.

Larger turtles present serious logistical problems for those attempting these techniques. Assessment of the respiratory tract, detection of foreign bodies (such as fishhooks), evaluation of soft-tissue granulation, nutritional deficiencies and definition of bone mineralisation and/or infection can all be monitored with radiography. Foreign bodies, such as ingested marine litter, are commonly found in stranded sea turtles. It is therefore recommended that all turtles be subject to radiographic examination as part of their initial examination, especially when there are signs of disease or floatation abnormalities and where physical examination and blood tests have not revealed anything. Captive turtles should be periodically subjected to radiographic examination as part of their monitoring program as bone densities can provide indications of nutritional status.

Whitaker and Krum (1999) recommend three views: dorso-ventral, cranial-caudal and lateral exposures. When evaluating the respiratory tract, the best images are obtained by allowing the turtles to inspire directly before exposure. Lateral and cranial-caudal views are usually taken with the animal in a dorso-ventral position with use of a horizontal beam (Morgan, 1993). The gastrointestinal tract can also be evaluated for foreign bodies and obstructions that may be causing gas build-up and peritonitis.

Ultrasound is particularly useful to evaluate the soft tissue organs in the abdomen such as the liver, kidneys and intestine, in addition to providing guidance when performing abdomenocentesis. The inguinal opening of the carapace provides a window, allowing imaging of kidneys, urinary bladder, right lobe of the liver, stomach and intestine and gallbladder (Whitaker and Krum, 1999 – see figure 12).

3.3.7 Abdomenocentesis: Fluid and gas can accumulate in the coelomic cavity as a result of various disease processes. To access the coelomic cavity in order to remove fluid for analysis or to remove gas, the turtle should be placed in ventrodorsal recumbency, extending the rear flipper caudally, and a needle should be inserted cranial to the femur in a craniomedial direction

(Whitaker and Krum, 1999). Needle size and length will depend on the size of the turtle. Any fluid samples collected should be analysed completely, including cytology and microbiology.

3.3.8 Neurological examination: A neurological examination may not be necessary in all individuals, but in cases of head and spinal damage, evaluation of the neurological system will provide essential diagnostic information. Each individual should be examined both in the water and out of water. Mental disposition, demeanour and response to stimuli can be recorded in both environments. Marine turtles tend to be more active in water. It may be difficult, therefore, to assess those individuals that cannot be placed in water tanks due to weakness or other incapacitation.

Swimming behaviour should be observed for circling, flotation abnormalities (non-neurologically based) and aimless direction. The demeanour of a turtle in water should be categorised as either 1, alert and responsive to stimuli, 2, depressed and showing inappropriate or manic behaviour or 3, comatosed.

Body posture, limb strength and mobility should also be observed during swimming behaviour. Healthy turtles swim with a level body, head level and extended and with limbs moving in a strong and co-ordinated fashion. Healthy turtles tend to be inquisitive, although stressed turtles may repeatedly swim into the tank walls before calming down. Chrisman et al. (1997) noted various behavioural details including the following: when the turtle is changing direction, the tail tends to be pulled toward the direction of the turn, thoracic limbs move together, while hind limbs act as rudders. Turtles swimming unevenly, leaning to one side or the other, usually do not have vestibular dysfunction but may be suffering from buoyancy disturbances. The most common cause of asymmetric buoyancy is an internal mass or uneven gas accumulation in the lungs, coelomic cavity or gut (Boyer, 1996).

Further neurological examination will need to take place out of the water. The cranial nerves can be tested as follows:

Olfaction – observe ability to find food when blindfolded.

Vision - Observe blink reflex when hand advanced toward head, noting eyeball position and evidence of strabismus ('crossed' eyes or abnormal alignment of eyeballs).

Palpebral reflex – Observe blink reflex when lateral or medial canthus of the eye is touched.

Vestibular system - move head to the left or right and observe for nystagmus (abnormal, 'jerky' movements of the eyeballs often associated with disruption of the vestibular system)

Motor responses - assess jaw tone and strength by observing bite reflex.

Additional cranial nerves IX, X, XII - observe turtles ability to swallow, jaw movement and tongue ability while eating.

Nociception (pain response) - can be assessed by applying a light prick from a hypodermic needle and observing response.

Flexor (withdrawal) reflexes - can be observed by pinching turtles toes and observing reflex, in addition to crossed extensor reflex. The stretch reflexes in thoracic and pelvic limbs may be inconsistent or absent in healthy turtles (Chrisman et al, 1997).

Muscle tone and presence of atrophy - palpate limbs.

Cloacal reflex – Observe for cloacal contractions when the skin surrounding the cloaca is lightly pinched.

NB: Chrisman et al's, (1997) study provides details of cases with neurological deficits. They only studied captive turtles and noted that responses to various neurological tests may be dependent on the ambient air or water temperature.

3.3.9 Biopsy Techniques: As part of the UK Cetaceans and Turtles Strandings Project, Marine Environmental Monitoring requires the collection of small skin biopsies as genetic samples from all turtles stranded in the UK. Contact Rod Penrose at Marine Environmental Monitoring (see back of manual) to arrange biopsy collection.

Such biopsies are useful for veterinary analysis of skin infections. Levels of anaesthetic needed to take samples will depend of the type of biopsy necessary and should be decided by a veterinarian, but biopsies taken for genetic sampling should not require the use of anaesthetic. Dutton and Balazs (1995) took biopsies in the field for DNA sampling and found no adverse effects.

A general procedure is outlined as follows, but always ensure that a veterinarian is present to manage any biopsy procedure. Before taking the biopsy, the area of skin must be prepared with an antiseptic cleaning solution (i.e. hibitane) and cleaned with 90% alcohol. Using a 6mm biopsy punch, a circular cut, approximately 2-3mm deep can be made by rotating the tool once or twice while applying gentle pressure. The sample is then removed from the punch with forceps and a scalpel and placed into a DMSO preservative solution (20% DMSO - dimethyl sulfoxide), in water saturated with salt (NaCl) or the necessary medium required by the laboratory. The amount of bleeding will depend on the site of biopsy but with such shallow biopsies sutures will not be necessary. If bleeding does occur, Orabase can be used on the biopsy site to promote healing

3.4 NUTRITION

All food should be high quality. Energy requirements need to be considered when choosing mixtures to be fed to turtles. With the exception of omnivorous green turtles (*Chelonia mydas*), marine turtles are carnivorous and should be fed a varied diet of fish, crabs, squid and shellfish (Whitaker and Krum, 1999). Weak and debilitated turtles require specialised feeding regimes (see section 3.4.3).

Flesh from fatty fish (e.g. herring, sand eel and mackerel) provides more calories, but provides less water than, for example less fatty fish such as capelin, smelt or other white fish. It is important to maintain the fat content of the diet in moderation. Frozen lean fish should be kept no longer than 6 months, when kept at -25°C to -30°C. Fatty fish, such as mackerel, should be kept no longer than 4 months as they have a high potential to become rancid due to their composition. Turtles fed a diet of frozen fish will need multivitamin supplementation (e.g. Mazuri/IVZG) or reptile vitamins to compensate for vitamins lost during storage (Campbell, 1996). Although fish heads provide a good source of calcium, where there is no through flow filtration system it is advisable to remove the head and guts of food fish before feeding to reduce water fouling. Cutting the fish into bite size pieces helps to avoid it being shredded in the water.

Shellfish, squid and other invertebrates are rich in water and carbohydrates, but low in calories, and must be provided in greater quantities to provide the necessary calories (Whitaker and Krum, 1999). In convalescent turtles, shelled invertebrates should be avoided until the gastrointestinal tract functions normally, as these species take longer to digest (Campbell, 1996). Jellyfish are natural prey for loggerhead turtles and can be used as food when available.

Omnivorous green turtles should be offered lettuce and other leafy vegetables, in addition to their fish diet. All turtles will benefit from a varied diet and exclusive diets should be avoided, although turtles may need encouragement to accept new items of food.

3.4.1 Methods of feeding: Stranded turtles should be released (not in UK waters, see Repatriation) as soon as they are healthy enough to survive in the wild. The less they associate humans with food, the less likely they are to be attracted to potentially dangerous situations with humans post release. Hand feeding should only be used when necessary, for example, if the turtle refuses to feed by other methods or when giving medication or supplements.

Hatchlings (20g or less) are unable to dive in the first couple of weeks of their lives and feed on jellyfish and other small, surface-dwelling species. After this period, they will begin to dive several centimetres for food they recognise. To avoid wastage and water fouling, hatchlings should therefore be initially kept in relatively shallow water so that they can access all food that is placed in their tank. The water depth should be gradually increased in depth in line with their diving abilities.

Juveniles can be fed shellfish and other items off the bottom of the tank. Juvenile loggerheads raised at the Southampton Oceanography Centre (SOC) were initially fed sand eels at the surface. Later the sand eels were weighted to the bottom to encourage diving. Within 12 days of weighting the sand eels, the turtles had learnt to dive for them.

Turtles should be fed on a daily basis, but at different times of the day, using different methods of feeding to avoid temporal stereotyping. Turtles should be fed 3% of their total bodyweight per day, which should be adjusted according to a weekly regime of body weight assessment. In order to calculate average daily intake over a month, days when turtles did not feed must be taken into account. Growth rates can be expected to range between 2% to 20% increase per month.

3.4.2 Dietary supplements:

Mazuri foods recommend both Vita-Zu Large Bird Tablet and Vita-Zu Mammal Tablet, as these formulations have proved successful with piscivorous birds and mammals respectively. They should be administered as per the instructions and depending on the amount of fish being fed. Turtles fed 50% or more shellfish “meat” or squid should be given an additional calcium supplement (Griffin, pers. com.).

IVZG (International Veterinary Zoo Group) also supply multivitamins (Aquavits and Aquaminivits), which can be used at their recommended doses. Vitamin supplements in pill, liquid and powder form are best inserted into the abdomen of sand eels (or other food items) and fed by hand, ensuring that the turtles ingest the offering. Crushing supplements with a pestle and mortar can maximise absorption.

Cuttlefish bones are rich in natural calcium and may stimulate foraging behaviour. They should be cleaned and rinsed in boiling water if collected off beaches. They are a good source of calcium and when floating, provide interest to a captive turtle in a sterile environment.

3.4.3 Nutrition of weak and debilitated turtles

Severely debilitated, hypoglycaemic and dehydrated turtles will initially need special requirements to stabilise blood glucose and electrolyte levels. Weak turtles are unlikely to feed unassisted. Hypothermic sea turtles require nutritional supplements due to the effects of decreased metabolism on their appetite. Tube feeding is often required for at least the first 24hrs (see also sections 3.5.1 & 3.5.2).

3.4.4 Tube feeding: Debilitated marine turtles can be tube fed, but the procedure involves certain complications. The turtle should be supported at an angle of 45^{o}-90^{o} with the head raised (see Figure 15). The tube must be flexible and well lubricated and the mouth should be held open with a padded bite block or section of plastic pipe. Care must be taken not to hyperextend the lower mandible. This basic technique involves placement of the tube into the distal oesophagus, avoiding the obvious glottis. The distal oesophagus turns sharply to the left as it connects to the stomach and small amounts of food should be delivered into the oesophagus. The amount of food administered in this way should be determined by the turtle's weight. As a rough guide, 3-4kg turtles may initially be able to keep down approximately 10ml of gruel/liquid (Walsh, 1999). Very weak turtles should be kept in the feeding position for at least 5 minutes after feeding and then slightly elevated to aid the downward movement of liquid into the stomach.

Turtles strong enough to swim should be placed back into the water, to prevent the risk of regurgitation and aspiration. Very weak turtles that cannot be placed in anything but shallow water may be placed in deeper water for a few minutes after eating, to allow the reflux of any excess material (Walsh, 1999). Material may be expelled in the water through the nose, but this does not necessarily indicate aspiration (Walsh, 1999). The amount, frequency and consistency of the gruel will be determined by the hydration, size and glucose requirements of the turtle. A general feeding strategy provides 7% of the turtle's weight in food per day (Campbell, 1996).

Healthy turtles can be fed three times daily, whereas weak and debilitated turtles will need their food to be given in smaller amounts more frequently. Severely hypoglycaemic turtles will need up to 6 small feeds per day to maintain blood glucose levels. Weak and dehydrated turtles must be administered dilute food solutions, as their gastrointestinal motility will be severely decreased. The ingestion of concentrated solutions may lead to gastric impaction. As the turtle stabilises, gruel can be thickened and amount per feed can be increased. Eventually food can be offered in pieces and then whole. Within the restrictions of hand feeding weak turtles, it is important to remember that once turtles are able to feed unassisted, every effort should be made to reduce human/food association by the turtle.

All individuals should be weighed throughout their treatment. Hypoglycaemic individuals will need weighing daily, while more stable individuals can be weighed twice a week. Healthy individuals can be weighed monthly in order to calculate food rationing.

The type of gruel used will depend on what is available and the state of turtle. Gruel should be made by blending fish with an oral glucose-electrolyte solution and any necessary supplements. Small fish such as smelt can be easily blended, whereas other fish may need to have their heads removed and/or be skinned before blending. The concentration of the gruel should be thickened as the turtle's condition improves (Campbell, 1996). Ensure that the tube is cleaned after each meal.

3.4.5 Fluid therapy and warmed fluid administration:

Fluid therapy should be considered in the majority of UK turtle strandings. This therapy should be based on blood profile and administered by a veterinary surgeon. All electrolyte imbalances shown by blood profiles should be addressed in conjunction with fluid therapy (see Table 5 for dosages). Whitaker and Krum (1999) recommend administration rates of 1-3% total body weight per 24 - 48 hours based on blood profile and clinical response. See below for their recommendations.

Table 5 Fluid Therapy – recommended administration (Whitaker and Krum, 1999)

Type of Fluid	Route
Lactated Ringer's	PO, SC, ICe, IV
Lactated Ringer's: 2.5% Dextrose solution @ 1:1 solution.	PO, ICe, IV
2.5% Dextrose: 0.45% Saline @ 2:1 solution	PO, ICe, IO, IV
0.9% Saline	PO
Fresh Water	PO

NB: PO = per os, SC = subcutaneous, ICe = Intracoelomic, IV = intravenous

The administration of intracoelomic (IC) fluids is relatively straightforward. Care should be taken to avoid thermal injury to the viscera by using fluids warmed to a few degrees above the core temperature, taking into account hypothermic status of the patient. Over hydration may affect respiration and buoyancy, therefore do not give fluids in excess of 3% of the body weight in ml (Page and Mautino, 1990). IC fluids should be combined with exogenous heat provision. Colonic/ cloacal enemas are relatively difficult unless the patient is severely debilitated. Therefore, only in such cases can warmed cloacal washes, administered at temperatures a few degrees above the core temperature, be considered as an alternative method of fluid therapy.

Intravenous fluids are hard to maintain without complex catherisation. The jugular or dorsal cervical sinuses are the main catheter sites. In cases of severe dehydration and emaciation, catherisation may require cut-down due to circulatory collapse and changed landmarks.

Intraosseous fluids may be administered with a needle and stylette. These are inserted into the distal quarter of the humerus at an angle of 30 – 45^{o} from the parallel (Whitaker and Krum 1999). The catheterised limb can be folded and taped in flexion within the carapace. Active turtles that are able to swim should be placed in pools of fresh water for up to 48 hours to aid rehydration (Whitaker and Krum, 1999).

3.5 COMMON CONDITIONS, INJURIES AND DISEASES OF STRANDED TURTLES IN THE UK

Marine turtles stranded in the UK are likely to be suffering from a debilitating condition, injury or disease. It is imperative to the turtle's survival to identify and treat any condition or disease as soon as possible.

3.5.1 Hypothermia (cold-stunning): Hypothermia can cause considerable damage to the body, such as necrosis of tissues and organs, which can lead to death due to slowing of metabolic centres (Turnball et al, 2000). The body responds to hypothermia by constricting blood vessels (vasoconstriction), initially in the extremities, and changing vascular permeability resulting in leakage of fluid from the vessels, which leads to oedema. When the body experiences a sudden drop in temperature, vasoconstriction is compounded by an increase in the viscosity of blood, leading to ischaemic injury and degenerative changes in peripheral nerves (Turnball et al, 2000). Tissue damage and necrosis develops, along with the various metabolic effects of slowed circulation (i.e. brachycardia and arrhythmias). In addition, turtles become immunocompromised rendering them susceptible to pneumonia and other infections.

Causes: Hard-shelled marine turtles are not adapted to survive for sustained periods in the ambient temperatures of UK seas. Cold-stunning occurs in turtles when they are swept into colder waters and the ambient water temperatures suddenly drop below 8°C. Turtles lose their ability to swim and dive, become positively buoyant and float at the surface (George 1997, Lutz 1997, Witherington & Ehrhart 1989). Juveniles are particularly susceptible to hypothermia as they have a larger surface area to volume ratio and therefore suffer a more rapid heat loss. Once hypothermic, inactivity renders turtles prone to predation, entanglement and stranding and without human intervention, cold-stunned turtles will eventually die.

Clinical Signs: Cold-stunned turtles are weak and inactive and eventually become emaciated and uncoordinated. Recently cold-stunned turtles will be in relatively good condition and will lift their head during aspiration. The condition can appear similar to diseases such as 'lethargic loggerhead syndrome', which occurred in epidemic proportions among the resident loggerhead populations of Florida in 2000 and 2001 (http://www.vetmed.ufl.edu/sacs/wildlife/loggerhead/loggerhead.htm). This condition has been attributed to a parasitic infection that affected the nervous system, causing internal lesions, lethargy and in some cases paralysis. In many cases the condition was fatal. Unlike loggerheads suffering this condition, cold-stunned turtles exhibit a corneal blink reflex (McArthur et al, in press.). When treating all cases, concurrent conditions, such as dehydration, hypoglycaemia, trauma and gastrointestinal obstruction should be considered.

Diagnosis: If the temperature can be taken (via cloacal thermometer) hypothermic body temperatures range from 4.5^{o}C – 15.7^{o}C. In UK waters, all weak and debilitated marine turtles other than leatherbacks should be considered hypothermic. The complete physiology of cold-stunning is not fully understood, but disruption of normal metabolic pathways is believed to be the primary contributing factor (Spotila et al, 1997). Hypothermic turtles have been found with decreased salt gland function, which leads to abnormal blood levels of sodium, potassium, chloride, calcium, magnesium and phosphorus (George 1997). It is therefore important that blood samples are taken to check for such imbalances, which can then be corrected by fluid therapy. Complete blood counts will also indicate symptoms of infection and dehydration if present. Complete blood counts and biochemistry profiles may need to be performed every 12 hours in order to effectively monitor the status of cold-stunned turtles (Turnball et al, 2000).

Treatment: It is essential to return the core body temperature of cold-stunned individuals to a 'normal' of 26°C. This must be done gradually to avoid damage by rapid reversal of hypothermia and the core body temperature must be monitored throughout recovery. Intubation and resuscitation may be necessary in severely chilled animals (McArthur et al, in press)

Turtles should initially be placed in an ambient temperature of 1^{o}C above their core body temperature on arrival. The ambient temperature can be then gradually increased by approximately 3^{o}C per day until the core body temperature reaches 26^{o}C. Active turtles can be placed in water, whereas weak and debilitated specimens are best placed in an incubator or temperature-controlled enclosure for the first 48 hours. To avoid further dehydration, these turtles will need to be intermittently sprayed with luke-warm water to keep their external membranes and integument moist (26^{o}C). After 48 hours, they can then be slowly introduced to shallow fresh water equilibrated to their current body temperature (Turnball et al, 2000). See section 3.1.4 and 3.2.2 for more information regarding temperature.

Additional methods for treating cold-stunned turtles include the use of basking lamps or heat pads (commonly available at pet stores) but these should only be used when no alternative is available. If this equipment is used, barrier cream or K-Y jelly should be applied to the skin and carapace to avoid severe drying of the skin and burns (McArthur et al, in press).

3.5.2 Hypoglycaemia: Weak and debilitated stranded turtles are also likely to be hypoglycaemic. Hypoglycaemia is caused by starvation, anorexia or any disease/condition that limits metabolism (e.g. internal parasites, tumours, gastrointestinal obstruction, infectious diseases etc). Captive turtles may also develop hypoglycaemia with inadequate nutrition and monitoring.

Clinical signs: Hypoglycaemic turtles are weak and exhibit a depressed demeanour. All rescued turtles, whether entangled, cold-stunned, diseased or traumatised, should be tested for low blood glucose levels.

Diagnosis: Blood glucose levels can be rapidly and easily determined with the use of blood glucose sticks intended for human use. Normal glucose values of marine turtles are 3.3-6.7 mmol/L (60-120mg/dl) (Campbell, 1996). Emaciated specimens that have glucose levels less than 3.3mmol/l (60mg/dl) TIG- SI units first should be treated with glucose supplements (Walsh, 1999).

Treatment: This will depend on the state of the turtle, its ability to swallow and its capacity to absorb glucose liquid from the gastrointestinal tract. These capacities will be limited in debilitated turtles.

Oral supplementation: This treatment is suitable for relatively stable animals with functional gastrointestinal tracts and is useful for ongoing management (McArthur et al, in press). Oesophageal or orogastric intubation should only be undertaken by trained personnel who are aware of the potential complications associated with this technique. The turtle should be placed in the vertical head up position (see Figure 15) (Walsh, 1999). Walsh (1999) recommends a dose of 1ml of 50% dextrose per kilogram of body weight administered 3-6 times daily and advises that these solutions should be diluted with Ringer's, saline or gruel to make the solution less hypertonic. This will improve the hydration status of dehydrated turtles. It is worth noting that complications with patient stabilisation may occur using this method because the blood glucose values will take longer to increase compared to other methods of supplementation. In addition, oesophageal tubing can result in upper intestinal build up, regurgitation and aspiration of food, especially in weak specimens kept out of water (Walsh, 1999). Weak turtles should be maintained in a vertical position to avoid aspiration, whereas active specimens should be placed back into water to facilitate normal digestion and absorption.

Intravenous administration: This complicated procedure should be undertaken by a vet and requires continuous monitoring of the patient (see figure 20). Catheters are difficult to place and are not tolerated by active specimens, which will attempt to remove them. A bolus IV can be administered to collapsed patients, but it is advised that this method only be used when other procedures are not successful (McArthur et al, in press).

Intracoelomic administration: Intracoelomic administration will have a more rapid effect than oral administration and can be used to treat moderate to severe hypoglycaemic turtles. The turtle will need to be placed on its back and elevated at the back end to allow the intestinal tract to slide forward away from the prefemoral injection site (Walsh, 1999 - see section 3.3.7). Walsh suggests using a 5% dextrose solution at 11-17ml/ kg body weight, to be used in conjunction with oral supplementation. NB: Intraosseous administration is another possible technique but should only be undertaken by trained and skilled medical personnel (see section 3.4.5).

All procedures should be carried out under supervision of a veterinary surgeon, and blood samples should be taken every 12-24 hours to monitor treatment response and detect possible deleterious effects, such as over-hydration and electrolyte abnormalities.

3.5.3 Floatation Abnormalities: Marine turtles with buoyancy disorders are unable to swim and float normally, and therefore their ability to forage and flee from potential threats is compromised. Buoyancy disorders result from the presence of free air in the coelomic cavity, a condition associated with a number of syndromes. Perhaps the most common cause is when infection or trauma in the respiratory tract allows air to escape into the coelomic cavity (McArthur et al, in press). Gaseous build up in the gastrointestinal tract can also cause buoyancy disorders and may be caused when foreign bodies create an obstruction. Trauma to the carapace can introduce air into the coelomic cavity as well as bacteria and foreign debris while emaciation in very weak and sick specimens may reduce and displace the viscera resulting in free air pockets in the body cavity.

Clinical Signs: Abnormal flotation, inability to dive, body held at an unusual angle when swimming (e.g. leaning to one side, front or back). Clinical signs associated with other disease or injury.

Diagnosis: A physical examination and general health profile (including haematological and biochemical testing) will highlight concurrent disease. Radiography should confirm the presence of free air within the coelomic cavity. The source and location of accumulated gas may also be evident (i.e. gastrointestinal tract). Further investigative techniques may be required, such as endoscopy of the lungs with biopsy, examination of wash material with appropriate cytology, histopathology and possibly viral/microbiological culture of any material harvested (McArthur et al, in press).

Treatment: This will depend on the source of the gaseous accumulation. Air that has entered due to injury often dissipates and the specimens often recover without the need for gaseous relief. However, in cases of respiratory infection and trauma, antibiotic and fluid therapy will be necessary and should be based on microbiological and blood profile results respectively. Aspiration of larger gas accumulations may be attempted by penetration of the coelomic cavity with a needle via the inguinal area. Severely affected specimens may need this procedure repeated several times. Weight belts can be used to compensate for the abnormal buoyancy until the problem resolves spontaneously (Campbell, 1996). It must be remembered that in a small proportion of acute cases there may be re-occurring leakage of air or irresolvable buoyancy problems. In these cases, inability to dive compromises a turtle's chances of survival, thus the specimen should not be released back into the wild (see section 4.2).

3.5.4 Parasitism: Marine turtles harbour a variety of parasites, often carrying significant parasite loads. Cardiovascular fluke infection has been reported worldwide in green, loggerhead and hawksbill turtles (Glazebrook et al. 1989, Dyer et al. 1991, Graczk et al. 1995, Wolke et al. 1985, Dyer et al. 1995). The green turtle has been subject to the majority of studies examining the effects of trematode loads. Trematodes cause illness and mortality as a result of egg migration, presence of adult worms and secondary infection (Wolke et al. 1985, Aznar et al 1998). Post-mortems of infested specimens reveal egg granulomas in the tissues, but severe cardiovascular lesions have also been reported, including mural endocarditis, arteritis and thrombosis, frequently associated with aneurysm formation (Gordon et al. 1998). Gastrointestinal helminths (*Digenea, Cestoda*, and *Nematoda spp.*) have all been recorded in loggerhead sea turtles (Aznar et al. 1998). However, there is limited information regarding the pathology caused by these parasites. Heavy parasite loads will affect the recovery of sick turtles and therefore all specimens should be treated for trematodes and nematodes.

Clinical signs: Non-specific, but emaciation may be apparent. All rescued turtles should be assumed to have parasite burdens.

Diagnosis: The presence of parasites may be determined by faecal examination and colonic washes (see section 3.3.4).

Treatment: Once the turtle is showing signs of recovery and is feeding for itself, a standard anti-parasitic "clean out" can be administered as follows:-

- for trematodes: Praziquantel 10-20mg/kg and repeat in 2 weeks
- for nematodes: Fenbendazole 50-100mg/kg and repeat in 2 weeks (Campbell 1996, Walsh, 1999).

3.5.5 Gastrointestinal obstruction/ foreign bodies: Marine turtles (particularly opportunist loggerheads and medusivorous leatherbacks) are prone to marine debris ingestion. Plastic, balloons, polystyrene, foil, bottle tops, rubber, glass, tar balls, fishhooks and line have all been found in the guts of marine turtles and it is believed that turtles mistake these items for food (Lutcavage et al, 1995, Campbell, 1996). Foreign bodies lodged in the oesophagus directly affect the intake of food. Blockages further down the gastrointestinal tract prevent absorption of nutrients. Oesophageal obstruction is particularly problematic because the caudally projecting papillae lining the oesophagus generally prevent the oral ejection and extraction of foreign bodies present. Fishhooks cause most damage in the upper digestive tract and have been found to migrate out of the digestive tract into the surrounding soft tissue structures (McArthur et al, in press). Ingested material may also penetrate and thus traumatise the gastrointestinal tract. Linear foreign bodies are often encountered in the digestive tract as a result of ingested fishing hooks anchoring proximally and attached line creating plicating lesions of the tract.

Clinical signs: All specimens should be examined for the presence of internal foreign bodies. Floatation abnormalities, anorexia and constipation may be symptoms of gastrointestinal obstruction.

Diagnosis: Radiography will usually reveal the internal presence of metal items such as fishhooks, while endoscopy facilitates the location and removal of foreign bodies and obstructions.

Treatment: Endoscopy or oesophageal/coelomic surgery may be necessary although some oesophageal obstructions can be relieved by hand in anaesthetised, gagged patients (McArthur et al, in press). Endoscopy has also been successfully used in conscious patients (Bentivengna, 1995). Whitaker and Krum (1999) have recorded difficulty going beyond the distal oesophagus, because the tract turns sharply to the turtle's left under the heart before passing through the muscular oesophageal sphincter at the entrance to the stomach. The sharp, caudally pointing papillae in the distal oesophagus complicate oral relief because they tend to snag internal items as they are withdrawn from the oesophagus.

Bentivengna (1995) describes a technique used to remove a polyethylene cord from a loggerhead turtle. She found that when air was introduced into the oesophagus, the cord could be held away from the papillae and gradually removed by a series of gentle tugs. 80cm cord was removed in this way, despite the attachment of an accumulation of putrefied faeces on the extremity of the cord. It is worthy of note that Bentivengna also describes difficulty in passing an endoscope through the cardiac sphincter (25cm from the mouth). The turtle was then placed back into an open circuit seawater tank and began feeding five days later.

Surgery to remove foreign bodies/impactions in the caudal half of the coelomic cavity can be approached through an inguinal incision made just cranial to the hind limb (Campbell, 1996). Many impactions in the lower gastrointestinal tract occur in the transverse colon, which can be externalised through an inguinal incision and removed by an enterotomy procedure (Campbell, 1996). The body wall is closed with a simple interrupted suture, followed by everting sutures in the skin. The wound can then be protected using a protective dressing e.g. Tegaderm© (3M Health Care). Mader et al (1999) and Nutter et al (2000) describe two cases of coelomic surgery.

3.5.6 Constipation: This condition is associated with emaciation, dehydration and general debility. Turtles feeding on shelled invertebrates are particularly prone due to potential accumulations of calcium rich debris in the colon (McArthur et al, in press). Constipation can also be a result of the ingestion of marine debris such as plastic and rubber (see above).

Clinical signs: Constipated turtles will not pass faeces and may suffer weight loss, anorexia and lethargy.

Diagnosis: Accumulations of debris in the gut can be detected using palpation, radiography, endoscopy and ultrasound.

Treatment: Medical therapy includes the use of intestinal stimulants and mineral oil including:-

Metaclopromide: 0.5 mg per kg body weight administered orally every 48 hours or 0.3 mg per kg body weight administered by injection daily. These doses work best when combined with mineral oil on alternate days. Mineral oil should be administered to juveniles in a dose of 2.2-3.0 ml per kg body weight and to adult turtles greater than 45kg in a dose of 1 ml per kg body weight. The oil can be mixed with gelatine to ease administration. Active turtles should be returned to water following oral administration to reduce risk of inhalation and should be monitored daily for signs of defecation (Walsh, 1999). When faeces are not observed, further investigation is necessary. Barium can be administered orally at a dose ranging from 5-15ml/kg of a 30% solution to evaluate intestinal movement by radiography (Walsh, 1999).

3.5.7 Trauma: Marine turtles are prone to trauma from a variety of sources including boat strike, marine debris and predators such as sharks, although marine turtles bearing shark bite wounds have not been documented in the UK. Boat strike can cause considerable damage to turtles, injuries resulting from both hull and propeller impact. Trauma in the form of fractures to the carapace, skull and neck vertebrae can also occur when a turtle has been dropped on to the deck of a boat (McArthur et al, in press) as occurs, for example, when the cod-end of a trawl net containing incidentally caught turtles is emptied on deck.

Clinical signs: Boat injuries commonly result in head and carapace injuries, with occasional injury to shoulders and limbs (McArthur et al, in press). Propeller impact is often characterised by a series of similar-sized and often deep lacerations across the carapace and head. Disorientation and damage to internal organs can result from severe blows without external evidence of injury. For example, trauma to the head may affect salt gland function. Floating marine debris such as discarded fishing net and line can cause severe lacerations and necrosis of the limbs and neck, and can also lead to death by strangulation. Severe laceration around a limb or the neck should be carefully examined because the offending material, which should be removed as soon as possible (e.g. fishing line), may be hidden by the granulation around the wound.

Diagnosis: Veterinary advice should always be sought when dealing with traumatised turtles. Physical and radiographic examination is essential in all cases, even in turtles exhibiting old wound scarring. Chronic injuries may partially heal leaving fistulated tracts to deeper pockets of infection and necrosis, hence the need for examination (McArthur et al, in press). It should be remembered that symptoms of trauma and damage to internal organs might be delayed due to initial shock physiology. Individuals with head trauma and carapace spinal injury should be given a full neurological examination as outlined above (see section 3.3.8).

The eventual release of turtles exhibiting symptoms of permanent neurological damage is inadvisable and euthanasia should be considered. Chrisman et al. (1997) neurologically assessed 4 turtles with carapace fractures. These turtles exhibited pelvic limb dysfunction and paraparesis or paraplegia suggestive of thoracic spinal cord damage. If limb paresis or paralysis and spinal cord injury is suspected, the prognosis for recovery is poor (Mautino and Page, 1993). Turtles with spinal injuries may also suffer consequent constipation and colitis (Walsh, 1999).

Treatment: Traumatised turtles are likely to have undergone severe stress and general debilitation, hence the need to stabilise the animal with standard glucose and fluid protocols. All external wounds should be cleaned with an antiseptic cleaner (e.g. hibitane or 10% iodine) and debrided. Dermisol© (SmithKline Beecham) and Aserbine (SmithKline Beecham) are effective debriding agents. Deep wounds should be flushed out to remove debris. Wounds should be cleaned daily until they have healed.

General anaesthesia will be required in cases that require more aggressive debridement, limb amputation, removal of deep foreign bodies or bone sequestra (see section 6.2,). Limb amputation is relatively simple and often well tolerated. While post-release data is scant, many turtles have been released back to the wild with successfully healed amputations and it is not uncommon to encounter wild nesting female turtles with missing limbs (McArthur et al, in press, Brendan Godley, pers. comm.). However, turtles subjected to multiple amputations should not be released back into the wild because their chances of survival are low, while their chances of suffering are high (see section 4.2). If suitable facilities are not available to care for these turtles in captivity then euthanasia should be considered (see section 3.6)

Soft Tissue Wounds:

Open wounds can be dressed with a lanolin/jelly-based antibiotic ointment and covered with gauze, tape and a waterproof dressing e.g. Tegaderm© (3M Health Care) or Granuflex© (ConvaTec Ltd). Wounds should, in some cases be left open, as this can facilitate a more effective healing process, allowing regular visual assessment and debridement when necessary. In such cases, it will be essential to keep tank water clean and give antibiotics systemically. Very large wounds and those penetrating the body cavity will require individual assessment to decide the best course of action. The body wall can be closed with a simple interrupted suture and everting sutures may be used to close the skin (Campbell, 1996). All cases will require systemic antibiotics based on culture and sensitivity.

Carapace wounds: Severe wounds can take up to 6 weeks to heal and in that time it will be important to keep the area clean and promote tissue healing. All wounds should be cleaned and flushed with 5% Povidine-iodine solution (as long as the wound is not penetrating the lungs), in addition to giving systemic antibiotic treatment, based on culture and sensitivity. The use of acrylic, fibreglass or other hard techniques for shell repair has decreased, as there is greater potential to trap debris and inhibit healing (Walsh, 1999). Walsh (1999) describes the following technique, where wound support may be necessary:

The shell and surrounding tissue should be cleaned and dried and any exposed soft tissues dressed with a Vaseline-based triple antibiotic ointment, avoiding the wound edges (Walsh, 1999). Tegaderm (3M Health Care) may then be used to cover the wound, overlapping the pieces as necessary. All edges are then glued in place to the carapace and each other using cyanoacrylate glue. Once the glue has dried the turtles can be returned to water. Other techniques have been described, and include the use of pre-shaped dressing such as Melolin© (Smith & Nephew) using zinc oxide tape over triple antibiotic ointments (McArthur, 1996). Whichever technique is employed, the dressing must be changed and the wound cleaned and debrided at regular intervals.

Carapace wounds can be left open, to allow monitoring of the healing process and continual debridement. Good water quality is essential and salt water, when clean, provides a good environment for wounds to heal. Turtles that are of poor body condition or are undergoing treatment for concurrent problems may take longer to heal. Do not consider the release of any turtle before open wounds have healed.

3.5.8 Petrochemical and oil contamination: Marine turtles are prone to oiling when coming into contact with spilled or dumped oil at sea and will also ingest toxic oil products directly or indirectly via their food.

Clinical signs: External oil contamination is usually obvious because the skin, carapace, eyes and/ or nares will be coated. Oral examination may reveal ingestion, as will the presence of oil, petrol or tar in the faeces. Skin may be more susceptible to secondary infection when contaminated, due to consequent inflammation. Lutcavage et al (1995) found that oiled turtles showed up to a four-fold increase in white blood cell counts and a 50% reduction in red blood counts and red cell polychromasia.

Diagnosis: Physical and oral examinations as well as examination of the faeces.

Treatment: External oil and tar can be removed by washing with detergents, vegetable oils or an oil absorbent cloth. The excretion of ingested oil and tar can be facilitated by administering fatty foods (e.g. mayonnaise) and carbon-based products, which bind oil products, decrease the rate of absorption by the gut and increase oil excretion (McArthur et al, in press). Campbell (1996) recommends a daily dose of 8gm of activated charcoal per kg body weight to facilitate the excretion of oil and tar. The long-term biological effects of oil on marine turtles are unknown (Lutcavage et al. 1995).

3.5.9 Fibropapillomatosis: This alarming condition was first reported in green turtles but has now been documented in loggerheads, hawksbills and olive ridley turtles. This condition has not been recorded in UK waters.

The aetiology of fibropapillomatosis is unknown, although it widely suspected to be caused by a herpes-like virus. Tumours have been induced in captive green turtles (Jacobson, 1991, Herbst et al. 1995). Studies have shown that it is transmissible, although the exact method is still unknown. ***It is of critical importance that turtles occurring in UK waters and exhibiting signs of this disease are immediately reported and kept in isolation (see back cover for appropriate regional contact).***

Clinical signs: See Figure 16. Turtles suffering this disease will have multiple fibropapillomas around the eyes, cornea and skin of the head, neck, limbs and tail, as well as on the hard tissues of the carapace and plastron. The appearance of the lesions can range from small ‘warts’ (a few millimetres diameter) to large, penduncaulated masses of 20 cm or more (McArthur et al, in press). Tumours involving the periorbital and orbital tissues commonly occur in infected specimens (Brooks et al., 1994). The oral cavity can also be affected. Many turtles become emaciated, weak and sometimes anaemic as a result of their compromised foraging abilities.

Fibrous tumours may also affect internal organs such as the lungs, liver, pancreas, kidney and gastrointestinal tract. These growths can lead to flotation abnormalities, bowel obstruction, renal failure and pressure necrosis of affected tissues (Herbst, 1994).

Diagnosis: The occurrence and appearance of the growths is characteristic. Internal tumours may be detected by radiograph or ultrasound, depending on size and nature of lesion. All specimens should be examined for potential internal fibropapillomas, as they may be extensive and possibly necrotic. In these cases euthanasia may be necessary. Light microscopic examination of the tumour tissue reveals a classic tumour cell structure, though no definitive test is available to diagnose sub-clinical or latent infections. For more information go to http://www.vetmed.ufl.edu/sacs/wildlife/fibpap.html

Treatment and control: While regression cases of this disease have been recorded in the wild (www.turtle.org), there is no known cure for fibropapillomatosis. There are no current control programs for wild populations and appropriate measures should be taken to avoid disease transmission. Always wear rubber gloves and change gloves if handling more than one specimen. Ensure that all equipment is cleaned and disinfected after use with individual specimens.

Once the presence of fibropapillomatosis has been confirmed in the patient, the turtle should be euthanased and the carcass should be stored for collection by the UK Cetaceans and Turtles Strandings Project for necropsy.

3.5.10 Captivity-related conditions: Skin infections may occur in captive turtles (Davenport and Gaywood, 1997). Potassium permanganate solution is a useful treatment for skin necrosis and Povidine-iodine can be tried for other skin infections. Brown skin lesions (probably fungal) may be found around the neck, tail and flipper area. These can be treated using Povidine iodine, chlorhexidine, or eniconazole as washes or clotrimazole as a cream (Roger Wilkinson pers. comm, 2002). Weymouth SeaLife Centre staff have witnessed the build-up of salt deposits on captive turtles, which can be controlled by weekly cleaning.

3.6 GUIDELINES FOR RETAINING A DEBILITATED TURTLE IN CAPTIVITY AND EUTHANASIA

There is no benefit in expending resources on the rehabilitation and repatriation of a turtle to the wild if, due to a permanently debilitating injury, its chances of survival are very low. In such cases, the following two options should be considered; a, the turtle is euthanased or b, the turtle is nursed back to relative health and maintained in captivity.

Euthanasia should always be carried out by a veterinary surgeon (see section 6.1). If the turtle is suffering from any of the following then euthanasia should be considered as a priority:

- head trauma where the brain is exposed.
- severe trauma to the plastron or carapace and the coelomic cavity has been penetrated[1].
- injury that results in recurring and serious neurological/ behavioural abnormalities after a treatment period of three months.
- the turtle is diagnosed as suffering from fibropapillomatosis
- blindness in both eyes
- floatation abnormalities that will compromise the specimen's normal behaviour and ability to survive in the wild
- full or partial amputation of the humerus on a front flipper
- amputation of both hind flippers

Debilitated turtles will survive in captivity with specialist care if suffering from the last three conditions listed. However, a marine turtle’s natural life may span for decades, perhaps centuries. The logistics and value of maintaining a permanently debilitated turtle in captivity must be carefully assessed, as must the long-term welfare of a captive turtle. Before making the decision to

- [1] **NB:** Such cases have been successfully treated in the USA, but only by highly experienced specialists over a long period of time (Mader et al, 1999). If the necessary specialised treatment is not available, euthanasia should be considered.

maintain a severely debilitated turtle in captivity, one must consider the following questions:

- Will the debilitated turtle be able to function in captivity without suffering?
- Does your facility have the necessary resources to maintain a large, long-lived marine animal for several decades under specialist care?
- Will the debilitated turtle play a useful role in enhancing the public's awareness of marine turtles and their conservation?

If the answer to any of these questions is 'no', then euthanasia is recommended. The legal requirements for maintaining wild, debilitated turtles in captivity are covered in section 4.1 of this manual.

3.7 DISPOSAL OF DEAD TURTLES

Necropsy of fresh stranded turtle carcasses can yield extremely useful biological information of direct relevance to marine turtle conservation. All dead turtles should be reported to Rod Penrose (see back cover of manual), who is contracted to collect fresh, stranded carcasses for necropsy under the DEFRA-funded UK Cetaceans and Turtles Strandings Project. Rotten carcasses have little value and while you should report them to Rod Penrose, you may be advised only to ensure hygienic disposal.

Always handle dead specimens with rubber gloves. Fresh carcasses of dead stranded turtles, or turtles euthanased either on the beach or within one week of rehabilitation, should be placed in a sealed, plastic container (e.g. a large Ziploc bag or ice-cream tub, see figure 19) and kept until collection at about 4^{o}C in a refrigerator that is **not** used to store food for human consumption.

4 REPATRIATION

The relevant organisation listed on the back cover of this manual must be contacted for assistance and advice. Returning turtles stranded on UK shores to their place of origin requires a considerable effort. All six species of turtle recorded in UK waters, are on Appendix I of CITES. Turtles moved out of the European Community must be accompanied by a UK CITES Management Authority export permit as well as an import permit from the country of final destination. Other movements within the European Community may also require an appropriate certificate under EC CITES Regulations.

Juvenile loggerheads, which may originate from rookeries on the coasts of South East USA, the Caribbean, Africa and northern South America, are swept around the Atlantic in an oceanic gyre, moving from the Caribbean to the Azores, to Madeira, Canaries and possibly the Cape Verde Islands, before returning to the Caribbean. To make matters even more complex, genetic studies indicate a degree of mixing of the Atlantic and Mediterranean populations. Purists worry about ‘genetic pollution’ if a turtle is returned to the ‘wrong’ population. The risks of this are very small, and it is recommended that loggerhead turtles are transferred to either the Canaries or Madeira for release following expert advice (they are within the EU, there are turtle specialists in both places, flight times are short, local people are sympathetic and turtles are not fished in the islands). Animals should not be sent to some other island groups, as turtle fishing has not been eliminated in all of them.

Kemp’s ridley turtles will have originated from the Gulf of Mexico and have been successfully repatriated off the coast of Florida USA. Hawksbill and green turtles may have originated from one of many populations. The relevant organisation listed overleaf will advise on an appropriate course of action to repatriate these species. In addition, special arrangements will need to be made with an airline for (preferably free) transportation. Recent cases have shown that several airlines are accommodating in this respect, not the least because they may benefit from any publicity surrounding turtle repatriation.

4.1 Legal implications of repatriation (The following information was provided by the UK CITES Scientific Authority [Fauna]).

'Rehabilitation of marine turtles stranded in the UK - legislative requirements

The information below assumes that a live marine turtle has been found, is being cared for adequately and it has been determined that it is fit to be returned to the wild. Depending on the migration patterns of the species, a likely repatriation destination for the species needs to be found. It clearly makes sense that prior contact has been made with an intended destination facility/establishment before making any application for permits. It is important to establish that the destination facility is content to receive the animal, that they have the ability to ensure a controlled release to the wild and that they will deal with the necessary regulatory controls in the country of destination.

The UK Management Authority (DEFRA) and Scientific Authority (Fauna) at JNCC (contact details on the back of this document) are willing to provide advice on any cases involving rehabilitated turtles, especially if the transfer is urgent in order to ensure the survival of an individual specimen or on other welfare grounds, but the guidance below should be followed beforehand

Legislative controls

Marine turtles are listed on Annex A of EC Regulation 338/97 on the protection of species of wild fauna and flora by regulating trade therein. This regulation governs the movement of such species and their parts and derivatives within, into or out of the community and restricts the commercial use of such species within the EC. Marine turtles are also listed on Schedule 5 of the Wildlife & Countryside Act and Schedule 2 of the Conservation (Natural Habitats, &c.) Regulations.

Movement within the EC

For movements within the European Community no CITES export or import permits are required. However, under Article 9.1 of the EC CITES Regulations, the movement of a live, wild-taken Annex A specimen requires *that the person responsible for movement be able to provide proof of the legal origin of the specimen. The most appropriate proof may be a licence issued by the Country Agency (EN, SNH, CCW, EHS) in which the turtle was taken from the wild under the relevant legislation (Wildlife & Countryside Act, The Conservation (Natural Habitats, &c.) Regulations) permitting the person to keep, possess, transport the turtle for the purposes of rehabilitation/release to the wild. NB whilst there is an exemption in the WCA and Habitats Regulations for the purposes of taking a wild animal for the purpose of releasing it when no longer disabled, this may not be recognised in other Member States - a licence may then be a useful safeguard. Whilst there are no marking requirements under the regulation if the animal is not to be used commercially, it is highly desirable for future monitoring of released animals and for enforcement purposes for the animal to be PIT tagged and the number of the tag to be entered on to the licence.*

Animal Health Regulations may still apply - check both with the recipient country and with DEFRA (http://www.defra.gov.uk/animalh/int-trde/default.htm). If air transport is being used, IATA standards will apply - it may be advisable to follow these standards regardless of whether any transport is by air or not.

Movement outside the EC

Export of any specimen outside the European Community will require both an export permit from the country of origin AND, because marine turtles are listed on Appendix I of CITES, an import permit from the intended destination. A copy of the import permit will be needed before an export permit can be issued. Applications should be made to DEFRA as UK CITES Management Authority (see http://www.ukcites.gov.uk/license/default.htm for full details of how to apply for permits etc) - full details of the specimen should be supplied with any application including date and place of acquisition, details of husbandry and any veterinary treatment since capture, intended destination (and rationale for the suggested country of release to the wild) and purpose of the transfer (for return to the wild this should be purpose code N). Failure to provide full information may delay the determination of your application.

Indeed, before any permit can be issued, the CITES authorities will have to be satisfied, amongst other things, that the specimen has been obtained in accordance with the domestic legislation in force, that the specimen will not be used for primarily commercial purposes and that there are no other factors which militate against issuing an export permit. Applications will need to be made concurrently with the CITES authorities of the country of import. The appropriate authorities are identified on the CITES website http://www.cites.org/common/directy/

Whilst there are no marking requirements under the regulation pertaining solely to export, it is highly desirable for future monitoring of released animals and for enforcement purposes for the animal to be permanently marked by means of a PIT tag. Any such permanent markings would also be entered on any export permit.

Animal Health Regulations will apply - check both with the recipient country and with DEFRA (http://www.defra.gov.uk/animalh/int-trde/default.htm) for their requirements. If air transport is being used IATA standards will apply - amongst other things, these specify the size and construction of containers to be used for different species.

Retaining specimens in captivity

A specimen stranded in the UK can only lawfully be retained in captivity if the animal is so disabled that it cannot be returned to the wild. Depending on the nature of the disability, in some circumstances euthanasia may need to be considered. If it is intended to keep the specimen in captivity indefinitely, it may be appropriate for a licence to be obtained from the relevant country agency. Any such application would need to provide strong evidence as to why the specimen could not be released to the wild. If it were intended to use the specimen commercially (e.g. in a display for which the public had to pay for access), a certificate issued under Article 10 of EC regulation 338/97 would be required. Such use would only be permitted if it met one of the exemptions listed in Article 8.3 of the same regulation, for example if it was to be used for educational purposes aimed at the conservation of the species. In *the event of such a certificate being issued, the specimen would have to be permanently marked by means of a microchip and would be subject to restrictions on its movement and other commercial uses.*

If it is proposed that the animal be retained in captivity but in an establishment/facility located in another country, the procedures above would apply, though full details of the proposed destination would be required, especially in terms of their role in promoting the conservation of marine turtles.'

4.2 Health considerations before repatriation: The health status of each individual should be assessed prior to release to ensure the greatest chances of survival for the rehabilitated individual and to prevent the introduction of disease into the wild populations.

Wild marine turtle populations are not free of parasites and disease, but it is important to screen for particular pathogens, which may have been picked up in captivity. Keeping captive turtles in isolation minimises the chance of exotic pathogen infection. A physical examination and blood profile should also be carried out and the Department of Environment, Food and Rural Affairs (DEFRA), who issue the export permit, require the results of certain blood tests. For more information go to http://www.defra.gov.uk/animalh/int-trde/default.htm or contact the UK CITES Management Authority using the contacts on the back cover of this manual.

4.3 Transportation of turtles for repatriation

Repatriation of marine turtles usually requires travel overseas via an accommodating airline. All repatriations should be dealt with in close liaison with Rod Penrose (see contact list on the back cover of this manual). Rod maintains a database of airlines and appropriate contacts willing to transport marine turtles and a list of rehabilitation centres and release sites.

Airline carriers will require specific (IATA) requirements for transporting specimens as outlined below (also, see Figure 10):

4.3.1 Preparations before dispatch: Turtles should not be fed for two days prior to transportation. To prevent dehydration of the turtle during the journey, the turtle's skin, carapace and plastron should be covered in a layer of oil-based lubricant such as 'Vaseline' (this *MUST* be cleaned off at the final destination prior to release). Specimens should be packed individually.

4.3.2 Container construction: The transport box may be constructed from medium or higher density water resistant fibreboard, 3-ply water resistant hardboard or rigid plastic. **NB: Containers must not be made out of corrugated cardboard nor corrugated board.**

The width of the box should allow a minimum of 7.5cm space between the internal walls and the turtle inside to prevent physical trauma to the turtle in the event of an external object impacting the transportation box during transport. The height of the box must allow the animals to move freely. Spacer bars must be present on the lid.

The container floor must be solid and waterproof and the lid/top must have secure means of closure but be able to be opened for specimen inspections. A suitable mesh must be fixed under the lid over the specimens so that there is no danger of any escaping when the lid is raised. Ventilation openings of a minimum 1 cm must be placed in all four sides, the top and any partitions. These openings must be screened from the inside with a fine nylon mesh or similar. The transportation box should be dry and be lined with a soft, non-toxic, absorbent and inorganic lining to minimise injury.

The box should be clearly labelled on the lid and all four sides with '**LIVE TURTLE ON BOARD**'.

4.3.3 Feeding and watering during transport: The need to feed or water specimens should not arise during transport.

4.3.4 General care and loading: Special care must be taken to avoid exposure to extremes of temperature and during transportation the turtle's ambient temperature should be maintained at approximately 20^{o}C. Containers must not be placed in direct sunlight or draughty areas. If necessary, in extreme temperatures the container must be placed inside a ventilated polystyrene container, which permits air to circulate around the inner container.

4.4 Documentary evidence required:

USA: Letter of Legal Acquisition (from Rod Penrose or regional recorder), CITES export permit, CITES import permit, veterinary letter (confirming that the animal is fit to travel), acceptance letter from receiving rehab facility.

Grand Canaria, Canary Islands: Letter of Legal Acquisition (from Rod Penrose or regional recorder), veterinary letter (confirming that the animal is fit to travel), letter of acceptance from Spanish authorities and acceptance letter from rehab facility.

5 CASE STUDIES OF SUCCESSFUL REHABILITATION

5.1 Juvenile Kemp's ridley turtle (*Lepidochelys kempii*) stranded at Broad Haven, Pembrokeshire, November 1999 - Rod Penrose, MEM

Stranding: During severe weather on the 30th November 1999 at Broad Haven, Pembrokeshire, West Wales, a live stranded Kemp's ridley was found upside down amongst seaweed on the strandline and was taken to the Oceanarium at St. David's. Veterinarian Lance Jepson checked the turtle over and it appeared fit and healthy. The animal was positively identified as a juvenile Kemp's ridley and weighed 12 kg with an overall body length measured at 40cm. The curved carapace length (CCL) measured 29cm and the curved carapace width (CCW) measured 31cm.

Rehabilitation: Following advice from Sea World in Orlando, Florida for this particular species, the Oceanarium treated the animal as follows:

Kemp's ridley turtles inhabit the Gulf of Mexico in sea temperatures of 23°C, whereas this animal was found in sea temperatures of 12.5°C. To avoid potentially fatal thermal shock, the turtle was placed in a 100-gallon tank in a heated room where the temperature was allowed to rise slowly, at the recommended temperature increase of 1.5 - 2°C/ day. After two days the tank temperature reached a plateau of 17°C, while the room temperature was 22°C. In order to gradually increase the temperature in the tank further, an infra-red bulb was placed 0.5 meter above the tank and to one side to enable the turtle to move from an area if it became too uncomfortable. This worked extremely well and enabled the tank to rise at a slow and consistent rate to 23°C.

The tank was filled to a third of its capacity and the water was changed every four days. On advice from Sea World, no attempts were made to feed the turtle until the tank water reached 23°C.

Repatriation: Kemp's ridleys should be repatriated to the Gulf of Mexico or the coast of Florida. Arrangements were made with the Sea World Aquarium Department in Florida and CITES certification was obtained to export the turtle from the UK and import it into the USA.

The Oceanarium was advised against transportation of the animal by road with the animal in water as injury can occur by constant bumping against the tank. The preferred method involved flying the turtle in a small, insulated tank with just enough water to bear some of the animal's weight, but still allow the limbs to touch the bottom (if non-pressurised light aircraft or helicopters are used they must remain under 3,000 feet altitude).

The turtle was eventually flown by RAF helicopter for 1.75 hours to Gatwick airport, where it was removed from its small, insulated tank. The turtle was then coated in petroleum jelly or 'Vaseline', including the shell, to prevent dehydration and placed in a dry box lined with soft foam rubber covered in canvas like material to prevent the turtle from eating or tearing the foam. IATA specify that live animals must be transported in a box with 75mm clearance around the turtle on all sides, to mitigate against potential trauma caused by the sides of the box being impacted by other objects in the hold. The turtle was then flown to Orlando, Florida at a temperature of 21-23°C by British Airways and then transported from the airport to the Sea World at Orlando where it arrived on the 13th December 1999. The turtle was successfully released on the 12th April 2000 into the wild at Cape Canaveral, Florida.

5.2 Juvenile loggerhead turtle (*Caretta caretta*) stranded at Holywell Bay, Cornwall, March 2001 - Richard Smith, Blue Reef Aquarium

Stranding: A juvenile loggerhead turtle, of overall length approximately 25 cm (10"), was spotted by a member of the public washed up on the beach at Holywell Bay, Cornwall in March 2001. It was immediately taken to the Blue Reef Aquarium, Newquay.

Rehabilitation: The turtle was weak and suffering from extreme hypothermia when found. The sea temperature at the time was approximately 8°C. The turtle's eyes were sunken and coated in sand, so on arrival at Blue Reef, were bathed to remove the sand before the turtle was placed in a 1.5m diameter, plastic quarantine tank in approximately 30cm of water at 8^{o}C. This depth was enough to support the body but at a level which allowed the turtle to raise its head out of the water. The water was not filtered.

The day after arrival the turtle, christened Holly, was inspected by a local vet and said to be in reasonable health but was given an antibiotic injection ('Baytril') as a precaution. Since the turtle was hypothermic, Rod Penrose, MEM, advised us that temperature increases of more than 1°C could cause thermal shock to the turtle[1]. The tank received water pumped directly from the sea and at a slightly higher temperature (8^{o}C). An electric aquarium heater was placed in the tank and the water temperature was closely monitored each day. During the first couple of days the seawater was diluted with fresh water (up to 30%) to rehydrate the turtle, a method that had apparently been successfully employed in the USA.

After approximately 12 days the water temperature had been increased to 20°C and Holly was active. During this period we were concerned about the length of time Holly had gone without food. After 12 days we tried feeding the turtle with pieces of fish and squid but it showed no interest. We decided to force-feed the turtle, which we did by prizing open the beak and inserting cockle flesh into the mouth (the turtle chewed the flesh and spat out the skin). The turtle was force-fed for a further 3 days and at 15 days after arrival the water temperature had stabilised at 22°C. We attempted hand-feeding strips of squid, which the turtle took readily. For approximately 10 days the turtle continued feeding on squid, but then lost interest and began feeding on white fish. The water was kept clean through regular water changes.

Repatriation: In preparation for repatriation of the turtle to the Atlantic Ocean around Gran Canaria, Canary Islands, Holly was inspected by a local vet and

[1] The consensus of daily raised temperature increments at the time were a maximum of 1 degree Celsius per day. This has since been raised to 3 degrees Celsius.

given a certificate of good health on the 30.04.01. The turtle was tagged with a Passive Integrated Transponder (PIT) tag injected into the front flipper for future identification. The turtle was not fed for two days prior to the flight.

Before transportation, the turtle was covered in a layer of petroleum jelly to prevent dehydration during the journey and was placed into a padded transport box, constructed by Blue Reef Aquarium staff from a lidded-plastic storage box and to IATA specifications.

Holly was flown from Newquay by RAF helicopter to Bristol airport where the turtle was loaded into the pressurised hold of a commercial chartered jet and securely fastened down. The temperature of the hold was set to 19c and controlled over the 5-hour flight to Gran Canaria.

On arrival in Gran Canaria, the turtle was transported to the Rehabilitation Centre and placed into a tank 6m x 3m, where she exhibited no apparent ill effects from the trip. Holly was released the following day from a remote beach on the south east side of the island.

5.3 Juvenile loggerhead turtle (*Caretta caretta*) **stranded at Presall, Lancashire, November 2001 -** Julie Ions, Biological Services, Weymouth Sea Life Park

Stranding: On the 29th November 2001, a walker and his dog found a small turtle on its back at the water's edge along the Wyre Estuary at Presall, just north of Blackpool. The walker took the turtle to his house and called the RSPCA, who collected the turtle and arranged for it to be taken to Blackpool Sea Life Centre. There it was positively identified as a juvenile loggerhead turtle.

The turtle was just 1.7kg with a curved carapace length (CCL) of 25cm and curved carapace width (CCW) of 22cm. The turtle was reported to Rod Penrose, UK Strandings Co-ordinator with Marine Environmental Monitoring (MEM) and was coded T2001/21 for the UK and Eire Marine Turtle Database (TURTLE).

Rehabilitation: Advice regarding rehabilitation was sought from Sue Thornton, International Zoo Veterinary Group (IZVG), Rod Penrose (MEM) and the Marine Conservation Society (MCS).

The ambient seawater temperature at the rescue location was about 11°C and the turtle was 'cold-stunned' (hypothermic). It was placed in a quarantine tank where the water temperature was allowed to increase by roughly 1°C per day until it reached 19.7°C[2]. During this time the turtle was offered food but showed no interest.

On the 05.12.01, the turtle was transferred by road from Blackpool Sea Life Centre to the facilities at Biological Services, Weymouth Sea Life Park where more suitable equipment and more experienced staff were available. The turtle was transported after being placed on a moist towel in a plastic storage box and the journey lasted about 5 hours.

On arrival, it was placed in a 2m round, black plastic tank, half of which was covered to provide shelter. The water level was kept at approximately 15cm deep. A constant supply of clean warm seawater (20°C - 22°C) was pumped through the tank 24 hours per day from an empty tropical quarantine tank.

The day after the turtle arrived in Weymouth it began to show an interest in feeding on a live crab. The turtle, now christened 'Shelley', made a few attempts to grab the crab but could not manage to break the shell. Pieces of chopped crab were then placed in front of the turtle, which the turtle took with no further encouragement.

On veterinary examination by Sue Thornton, it was noted that there were old wounds to the turtle's fore and rear flippers on the right side that did not require attention and there was slight abrasion on both eyelids. A routine blood sample was taken at this time as well as an X-ray to check for the presences of ingested foreign objects (e.g. fishing hooks, litter, stones etc). While the X-ray results showed that no foreign objects were present inside the

[2] The consensus of daily raised temperature increments at the time were a maximum of 1 degree Celsius per day. This has since been raised to 3 degrees Celsius.

turtle, there was visible evidence of the crab shell that the turtle had eaten during its first few days at Weymouth within the digestive tract. There was some concern among the staff because whilst the turtle was eating, it was not passing faeces.

As a result of this concern, Sue Thornton advised feeding the turtle 3% of its bodyweight daily on soft food (exclusively squid). This regime was maintained until the turtle finally defecated 9 days after it started feeding. After X-ray confirmation that the turtle had not swallowed any plastic (which could block the digestive tract) the turtle was given as much variation in its diet as possible. This included food items such as squid, live shore crab, live hermit crab (still in the shell), sand eel, mackerel tails, gastropods, bivalves, trout, whiting, sole and jellyfish. On the two occasions that live jellyfish were presented, the turtle approached the jellyfish, took a bite and immediately spat it out and showed no further interest. The turtle was also given regular vitamin supplements once a week, which consisted of half a crushed 'Aquaminivit' tablet (IZVG) in the mantle of a squid.

Staff noticed a warty callous developing on the skin of the back of the turtle’s neck, probably caused by the carapace rubbing on the neck during feeding. This was attributed to the shallowness of the water. The water depth was increased to a maximum of approximately 30cm. After a few days at this depth, the callous regressed.

Blood test results revealed some anomalies outside the normal range for marine turtle blood biochemistry and haematology. It was decided to do another test once the turtle had settled and began to put on weight on a regular basis. On top of daily visual checks, the turtle was given a full health check every week, including overall inspection, full body clean with fresh water and a soft cloth to remove any algae as well as weighing and measuring (CCL and CCW).

Since the turtle’s environment was fairly barren, the Bioservices staff decided to introduce some forms of enrichment. As the turtle was fed primarily on dead food, most of the food was given via a grabber, which was moved to encourage the turtle to chase its ’prey’. The feeds were not at set times and the staff ensured that the turtle rarely saw people during feeds in order to prevent association. Live invertebrates were also given as food items and encouraged the use of natural foraging behaviour.

After consulting with Jenny Mallinson at the School of Ocean and Earth Science, University of Southampton, various “turtle proof” objects were placed in the pool for the turtle to investigate. Items included thick PVC pipes, lumps of hard coral and various substrates including patches of broken cockleshell pieces. In the opinion of the staff, the turtle appeared far more active throughout the day and more responsive as a result of this enrichment and the various feeding techniques.

A second blood test was taken in February 2002 and was sent for analysis along with a sample of faeces for parasitology testing. All results were good and the turtle’s eyelids had healed. Sue Thornton agreed that the turtle was finally fit for release.

Repatriation: The turtle was PIT-tagged in the rear left thigh, one month before the estimated release date. It was taken back to the veterinary surgery 1 week prior to release to ensure the tag was still in place. A transport box was constructed from a lidded, plastic storage box bought from a local hardware store, using the IATA guidelines given to us by Rod Penrose. Rod Penrose also arranged the necessary paperwork for a release in Gran Canaria, Canary Islands.

The turtle was flown to Gran Canaria on the 18.03.02. Prior to being transported, the turtle was covered in ‘KY Jelly’ to retain moisture during the journey, before being placed in the dry transport box and driven 1.5 – 2 hours to Bristol International Airport. On arrival at the airport, the KY jelly had begun to dry. Realising that it would be impossible to reapply the KY jelly during the flight, it was decided to cover the turtle in petroleum-based jelly (i.e. Vaseline) before the turtle boarded the aeroplane.

The turtle was transported in the aircraft hold with a controlled temperature of approximately 22°C. The flight to Las Palmas Airport lasted almost 4 hours. The paperwork arranged by Rod and Sue Thornton certifying that the turtle was fit for release, and from the local vet certifying that it was fit to travel, ensured swift movement through the airports at both ends.

On arrival, we were met by veterinarian Pascal Calabuig, from Medico Ambiente and taken to his turtle rehabilitation facility. He inspected the turtle and agreed to release it at a local beach the following day, along with four other rescued loggerhead turtles (all from Gran Canaria, one of which had had a fishing hook removed from its throat, while another had had a front flipper amputated).

On the 19.03.02, Shelley weighed 2.35kg, measured 27cm CCL and 24.2cm CCW and was released onto the beach at Playa de la Saliente, Gran Canaria. Shelley’s story was covered by the Dorset Echo, Western Daily Press, Lancashire Evening News and the northern edition of the Daily Mail.

6 VETERINARY SECTION

This section provides information on treatments and practices that should only be carried out by a veterinary surgeon.

6.1 Euthanasia Techniques: Euthanasia should always be carried out by a veterinary surgeon in a safe and efficient manner, to reduce stress to the turtle. Premedication with ketamine facilitates intravenous injections in active turtles and reduces stress to all involved. A premedication dose of ketamine IM (100-200mg/kg) followed by an intravenous injection of 200mg/kg pentobarbitone solution is advised. Intracardiac injection is achieved by a cranial approach parallel to the neck, directed towards the midline. Intravenous injection into the jugular, subcarapacal or dorsal vein is straightforward after the ketamine injection (McArthur et al, in press).

Biochemical and electrical activity persists within an anoxic turtle brain for some time after euthanasia (Cooper et al. 1984, Nilsson and Lutz 1991, Fernandez et al. 1997, Lutz and Manual 1999). Hence, to prevent unexpected recovery of the euthanased specimen, McArthur (pers comm. 2001) advises pithing or brainstem injection of formalin solution in combination with lethal injection. If the brain is intended for microbiological or virus isolation neither procedure can be considered. In such cases it may be best to remove the central nervous system from the cranial vault. Intracoelomic injection is not advised as this method may prolong the time to death.

6.2 Chemical Restraint: While this is rarely required, the induction and maintenance of general anaesthesia in marine turtles is possible (Moon & Stabenau, 1996). Chemical restraint should be considered when a large or particularly active turtle must be sedated prior to surgery or intubation. Before anaesthesia, a full pre-operative clinical assessment of the turtle is required including a complete blood profile (i.e. PCV and total protein and blood glucose), measurements of respiratory rate, pulse, body temperature and body weight. This will provide a baseline reference for monitoring during and post anaesthesia. Any planned procedure is best scheduled for the morning to allow full recovery care throughout the day.

Dehydrated turtles require fluid therapy in advance of planned procedures, which should be administered either via intracoelomic, subcutaneous, intraosseous or intravenous routes, depending on the procedure and level of dehydration (Whitaker and Krum, 1999). Fluid therapy by gastric lavage or per os is not recommended, due to the likelihood of passive regurgitation and consequent complications during surgery.

Injectable agents administered by IV, IM, or IP routes have been safely used on reptiles (Bennet, 1996 & 1991). However, there are a number of drawbacks with the use of these agents and because few studies have been carried out investigating the effects of these agents on marine turtles, the use of Ketamine only is advised here. However, Ketamine should not be used in cases of severe renal or hepatic disease, or turtles suffering severe dehydration (Whitaker and Krum, 1999).

A dose of 25mg per kg body weight IV or IM of Ketamine is recommended for both induction and light sedation for minor procedures. Doses higher than this (e.g. 50 - 70mg/kg IM) can lead to unpredictable and extended recovery times (Stein, 1996). Lower doses as small as 8-12mg/kg IV provide excellent sedation and facilitate intubation (Whitaker and Krum, 1999 - an allometric dosage scale for larger individual dosages can be found in Whitaker and Krum, Chapter 29).

Inhalation agents, by facemask or direct intubation with subsequent forced ventilation, have also been successfully used for induction (Whitaker and Krum, 1999, Moon and Stabenau, 1996). Intubation is fairly straightforward as the glottis is clearly visible just caudal to the base of the tongue. Care should be made not to over inflate the endotracheal cuff, as marine turtles have complete endotracheal rings. Isoflurane can be used for maintenance of anaesthesia in Kemp's ridley, green and loggerhead turtles with a carrier gas of 100% oxygen (Shaw, 1992). Once the turtle has been induced and reached the proper plane of anaesthesia, the level of isoflurane anaesthetic can be reduced to a maintenance level of 1% or less (Campbell, 1996).

At surgical planes of anaesthesia, assisted ventilation will be necessary. Tidal volumes can be estimated at approximately 50ml/kg, but may be significantly reduced with lung compromise (Gatz, 1987, Whitaker and Krum, 1999). Ventilation pressure should not exceed 15cm H_2O and rates should be between 2-8 ventilations per minute (Moon and Stabenau, 1996). As with any anaesthetised patient, respiratory rate, heart rate and core body temperature should be monitored. Limb withdrawal and ocular reflexes diminish as depth of anaesthesia increases (Whitaker and Krum, 1999).

Anaesthetic agent should be removed and only oxygen or air provided up to 20-30 minutes prior to the end of surgery (Campbell, 1996). This, in addition to providing a warm environment at 26.9°C – 30.2°C will aid in a quick recovery. Full recovery is indicated by the turtle's ability to lift its head sufficiently while breathing and other normal responses (see section 3.3.8). Recovery usually takes approximately 2-6 hours but can take up to 24 hours (Shaw, 1992, Whitaker and Krum, 1999). A minimum of 24hrs should pass before returning the turtle to water while appropriate measures are taken to decrease dehydration (i.e. fluid therapy and skin lubricants).

6.3 Therapeutics: Procedures for IV and intracoelomic administration are described in sections 3.3.3: ‘Blood sampling and analysis’ and 3.3.7: ‘Abdomenocentesis’ respectively. Reptiles have a renal portal system, where blood from the caudal two-thirds of the animal enters the renal circulation, therefore the effects of injections into the tail area and hind limbs are unpredictable (McArthur et al, in press). Therefore, while intramuscular injections can be applied to the quadriceps or gluteals of the hind limb (see Figure 17), the proximal cranial muscle mass of the forelimb is the best route for substances that may have nephrotoxic qualities or undergo significant renal excretion (McArthur, 1996). Subcutaneous injections can be given in small volumes under the skin covering the caudal aspect of the forelimbs, or the skin covering the upper aspects of hind limbs and abdominal musculature, bearing in mind the above guidelines for nephrotoxic substances (Jenkins, 1996). In active patients, any drugs or supplements in powder, liquid or pill form should be placed into the gut area of a small prey item, such as a sand eel and fed by hand. Supplements or drugs can be crushed using a pestle and mortar, to maximise absorption. Eye infections should be treated using systemic antibiotics based on culture and sensitivity, as should any antibiotics used.

6.4 Analgesia (Stuart McArthur, pers. comm. 2001): Pain and analgesia are poorly understood in reptiles and whilst the sedative effects of opiates are questionable, it has been suggested that opiate receptors present in reptiles do modulate pain (McArthur et al, in press). Non-steroidal anti-inflammatory drugs (NSAID's) are utilised by many veterinarians to alleviate peri-operative pain in chelonians whereby Carprofen and Butorphanol are often used. Adequate renal function should be ascertained prior to the use of non-NSAID's (Malley, 1997). Normal feeding behaviour and activity give some indication of the efficacy of these treatments.

Carprofen can be administered in doses of 2-4 mg/kg IM, IV, SC or orally, followed by 1-2 mg/kg every 24-72 hours (Malley, 1997). This product has been used peri-operatively (by this author) during some surgical procedures (e.g. coeliotomy and ear abscess drainage) and appeared to reduce peri-operative pain (McArthur et al, in press). Where renal function is considered adequate it appears to be the NSAID of choice in Chelonia.

Buprenorphine can be administered in doses of 0.01mg/kg IM as post-operative analgesia (Malley, 1997). Butorphanol can be administered in doses of 0.4 mg/kg IM 20 minutes before anaesthesia to decrease the induction agent requirements and can be used as a sedative and an analgesic (Bennet, 1998). Variation in dose rate and limited data regarding efficacy suggest further research is required to determine the efficacy and pharmodynamics of this product in chelonians.

Table 6. Drugs and dosages

DRUG	DOSAGE	ADMIN.	REGIME
Antibacterials:			
Amikacin	2.5-3.0mg/kg	IM**	q72hrs for 15 days [1]
Ceftazadime	22mg/kg*	IM	Every third day [3]
Chloramphenicol	30-50mg/kg	IM	q24hrs for 7-10 days [1]
	50mg/kg	PO	q24hrs for 7-10 days [1]
Clindamycin	5mg/kg*	IM	SID [3]
Enrofloxacin	5mg/kg	IM	q48hrs for 20-60 days [4]
	2.5mg/kg	IM	Prior to surgery[5]
Triple antibiotic ointment		TOP	q24hrs as required [2]
Trimethoprim & Sulfadiazine	30mg/kg	PO	q24 hrs[1]
Antifungals:			
Fluconazole	0.75mg/kg*	SQ	q48hrs [3]
Intraconazole	5mg/kg	PO	SID [3]
Anthelminthics:			
Fenbendazole	50-100mg/kg	PO	repeat 10-14 days [1]
Praziquantal	10 -20mg/kg	PO	repeat 10-14 days [1]
Supplements - (dosages if turtle is not eating):			
Calcium gluconate	100mg/kg	IM/ICe[3]	
	5-10mg/kg	IM	BID as necessary[1]
Potassium Chloride	15-30mmol/l of fluid	ICe [3]	
Vitamin B complex	0.1 ml/kg	IM/SQ[3]	
	1-3Thiamin/kg	IM[1]	
Vitamin C	10mg/kg	IM/SQ[3]	as necessary[1]
Vitamin K1 (Phytonadione)	0.2 - 2.5mg/kg	PO /IM	as necessary[1]
Vitamin E/ selenium	0.05-0.1 mg/kg	IM [1]	
Vitamin A & D3	0.02mg/kg	IM/SQ[3]	
In anaemic turtles, Vitamin K	0.5 mg/kg		one off dose [6]
Antiseptics:			
Chlorhexidine	1:40 dilution	TOP	5 minutes contact [2]
Povidine – iodine	1:10 dilution	TOP	5 minutes contact [2]
Other supplements			
Activated Charcoal, Kaolin,	2-8 gm/kg		as needed [1]
Mineral oil	6-10 ml/kg	PO	as needed [1]

NB: PO = per os, SQ = subcutaneous, ICe = Intracoelomic, IV = intravenous, TOP = topically,

SID = once a day, BID = twice a day.

* Prophylactic antibiotic and antifungal regime used in hypothermic turtles at the New England Aquarium, Antifungal treatment (Fluconazole) was discontinued once turtles started eating again.
**All duration of treatment should be based on response to treatment and periodic blood profile evaluation.

References
1. Campbell, 1996, 2. Whitaker and Krum, 1999, 3. Turnball, 2000, 4. Krum, 1999, 5. Moon and Stabenau, 1996, 6.Walsh, 1999

Glucose	**3.3-6.7 mmol/L (60-120 mg/dl) [1-5]**
Bilirubin	μ **(<0.1mg/dl) [3,5]**
Calcium	**1.5 – 2.8mmol/ L (6-11mg/dl) [1-5]**
Chloride	**114-123mmol/L (114-123 mEq/L)[1-5]**
Cholesterol	**1-4.1 mmol/L (41-160mg/dl) [3,5]**
Creatinine	μ **(<0.3 (0.1-0.4)mg/dl) [4,5]**
Iron	μ **(20-45μg/dl) [3,5]**
Phosphorus	**1.9-3.6mmol/L (6-11mg/dl) [1-5]**
Potassium	**3-5mmol/L (3-5 mEq/L) [1-5]**
Sodium	**150-165mmol/L (150-165mEq/L) [1-5]**
Total Protein	**30-50g/L (3-5g/dl) [1-5]**
BUN	**28-64 mmol/L (79-180 mg/dl) [*1,2,4]**
Uric acid	**<119 mmol/L (<2mg/dl)[3,5]**
Alkaline Phosphatase (ALP)	**10-60 IU/L (10-60U/L) [3,4,5]**
Alanine aminotransferase (ALT)	**10-30 IU/L (10-30 U/L) [5]**
Aspartate aminotransferase (AST)	**100-350 IU/L (100-350 U/L) [2,5]**
Lactate dehydrogenase (LDH)	**50-350 IU/L (50-350U/L) [3,4,5]**

* BUN values had a large range for all species: Turnball et al. recorded values from 136.0-274.0 for *Caretta caretta* prior to release from rehabilitation.

1: Turnball et al, 2000 (Kemp's ridley and loggerhead turtles), 2: Whitaker &Krum, 1999 (Kemp's ridley and loggerhead turtles), 3:Bolten & Bjorndal, 1992 (juvenile green turtles), 4: Stamper & Whitaker, 1994 (juvenile loggerhead turtles), 5: Campbell, 1996 (all species of mature marine turtles).

	Mean	SD	Range
PVC %			
Wild juvenile loggerhead turtles [4]	29	5	24-34
Rehabilitated loggerhead turtles [1](prior to release)	35.8	4.1	29.0-40.0
Captive loggerhead turtles (weighing < 2kg) [2]	22.0	5.33	
Wild juvenile green turtles[3]	35.2	3.2	26.4-42.0
Rehabilitated Kemp's ridley turtles [1] (prior to release)	33.7	3.3	27.0-37.0
Total WBC (10^3/µl)			
Rehabilitated loggerhead turtles [1] (prior to release)	7.6	1.3	5.7 -9.5
Captive loggerhead turtles (weighing < 2kg) [2]	14.67	5.8	
Rehabilitated Kemp's ridley turtles [1] (prior to release)	3.8	0.9	2.3 - 5.1
Wild mature green turtles[6]	13.8	5.3	5.9 - 23.6

1. Turnball et al, 2000, 2. Whitaker &Krum, 1999, 3. Bolten & Bjorndal, 1992, 4. Stamper & Whitaker, 1994, 6. Work et al. 1998

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Appendices

Appendix I – Example admission sheet

ARRIVAL ADMISSION SHEET FOR MARINE TURTLES

Recorder	**ID Code**
Name and address of finder: **Post code** **Tel. no:**	**Date found** **Location found**

Turtle's position and demeanour when found

Air temperature *(if known)*	**Water temperature** *(if known)*
Species *(if known)*	**Colour of skin/carapace**
CCL (cm)	**CCW** (cm)

Dorsal diagram of turtle *(noting any damage, scars or external features)*

Breathing *(yes/ no – if yes describe)*

Evidence of severe trauma *(yes/no – if yes describe)*

Evidence of entanglement *(yes/no – if yes describe)*

Evidence of oil/ tar contamination *(yes/no – if yes describe)*

Evidence of abrasions or ulceration *(yes/no – if yes describe)*

Signs of discharge *(yes/no – if yes describe)*

Description of eyes Clear [ ] Cloudy [ ] Discharge [ ]
If discharge is present, please describe:

Evidence of tags *(yes/no – if yes describe details)*

WHO HAS BEEN CONTACTED ABOUT THIS TURTLE?

Appendix 2 - Example monthly progress report sheet

MONTHLY PROGRESS REPORT

ID Code	**Recorder**	**Date**
Weight *(g)*	**CCL** *(cm)*	**CCW** *(cm)*

Water temperature *(°C)*	**Water depth** *(cm)*
Feeding method	

		Average Daily Intake *(g/day)*			
Foodstuff & supplements	*Week Ending:*	*Week Ending:*	*Week Ending:*	*Week Ending:*	*Week Ending:*

Passing faeces *(yes/no)*

Comments

Ailments and treatments

Ailment	**Treatment**	**Dose**	**Frequency**

Comments

Behaviour

Has the turtle been tagged since its arrival? *(yes/no– if yes please record details)*

BACK COVER

PLEASE REPORT ALL MARINE TURTLE ENCOUNTERS

ALWAYS WEAR RUBBER GLOVES WHEN HANDLING MARINE TURTLES

ENGLAND/ WALES

All records

Rod Penrose

Marine Environmental Monitoring

01239 683033 (24 hrs)

www.strandings.com

Live strandings/ entanglements

RSPCA

08705 555999

NORTHERN IRELAND

All records

Lynne Rendle

Ulster Museum & Botanical Gardens

02890 383144

Live strandings/ entanglements

Ian Irvine

Portrush Countryside Centre

02870 823600

07770 570350 (24 hours)

SCOTLAND

All records

Dr Martin Gaywood

Scottish Natural Heritage

0131 447 4784

Dead strandings

Nick Davison

SMASS

01463 243030/ 0797 9245893

Live strandings/ entanglements

SSPCA

0131 339 0111

REPUBLIC OF IRELAND

Prof. John Davenport

00353 (0)21 4904140 (w)

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