
Prepared by the Wider Caribbean Sea Turtle Conservation Network (WIDECAST)

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I. OVERVIEW

Phelan and Eckert (2006) established basic guidelines and procedures for responding to sea turtles affected by a variety of natural (e.g., predator attacks, mating wounds, parasite infestations) and man-induced (e.g., boat strikes, entanglement and hooking, oil contamination, trash ingestion) traumas. In some cases the animal could be released; for example after having been cleansed of oil or released from an entanglement. In other cases the recommendation was to transport the animal to a “rescue/rehabilitation center or willing veterinarian” for observation and/or treatment.

The purpose of a rescue/rehabilitation center is to provide both immediate and longer-term care to sick and injured animals. The expected outcome is always that the animal will be returned to the sea as soon as practicable, enabling it to fulfill its ecological role. Wildlife rehabilitation is sometimes ridiculed as a waste of time by numerically minded conservationists (e.g. Stocker, 2005) who may view the effort as inconsequential in the larger scheme of things, but for endangered and threatened species, every individual, especially of (or close to) breeding age, released back to the wild is one more step towards survival.

Usually presenting severely infected injuries and/or shock not commonly seen in companion or domestic animals, wild animals appear to demonstrate a greater capacity to cope with these injuries and will often recover if given the necessary supportive treatment (Stocker, 2005). Notwithstanding, bringing a sea turtle into captivity, even for a short time, should be done only when absolutely necessary. Captivity requires special considerations with regard to the physical plant (e.g., access to running seawater, large animal capacity), human resources (e.g., attendants will require a knowledge of reptile medicine and care), and the law (e.g., sea turtles are protected in most Caribbean countries and their handling and care often requires special permits).

Sick and injured sea turtles require special medical attention. Please do not bring sea turtles home with the intention of caring for them yourself. In every Caribbean country it is illegal to capture, transport, and/or possess an endangered sea turtle during a legally enforced closed season, which for some countries is year-around.

Without proper attention to the specific husbandry needs of sea turtles, the condition of a sick or injured animal may worsen rather than improve. For example, incorrect intake of calcium and phosphorous and certain single food diets can cause metabolic bone disease and iron deficiency, respectively (George, 1997); overfeeding can contribute to floating or bloating problems (Higgins, 2003) or blockages in intestinal tracts (Norton, 2005c); and poor food quality can contribute to parasitic infections (George, 1997). Physical plant issues can also compromise proper nutrition. A lack of UV light exposure can cause vitamin D deficiency, limiting the amount of calcium uptake in the intestines (Norton, 2005a, c; George, 1997). If turtles are housed together, aggression, injuries related to aggression, and the spread of disease among turtles can decrease appetite or the ability to eat (George, 1997; Higgins, 2003). If the holding facility is poorly designed and maintained, foreign objects can be swallowed or cause physical trauma, and poor water quality can cause eye irritations, all which can contribute to malnutrition (George, 1997; Higgins, 2003).

Non-nutritional related disorders can also be acquired in captivity and are directly related to common husbandry errors and facility design. Flow-through open water systems and closed systems can introduce bacteria, fungi, viral diseases, and parasites if water quality is not properly maintained. Constant high water temperatures can cause ‘grey patch’ disease (George, 1997), and prolonged periods out of water can result in carapace desiccation and scute pealing, creating a canvas for bacteria and fungus (Higgins, 2003). Turtles housed together can develop injuries from aggression.
(such as eye infections and skin lesions) or induce stress between individuals, exacerbating their vulnerability to infection (George, 1997; Higgins, 2003). General contact between turtles and the sharing of water systems can also aid in spreading disease.

The number and variety of disorders and other problems that can occur in a disorganized or unmanaged environment can significantly hinder the ability of staff to properly rehabilitate and release sea turtles back into the wild. Therefore, correct measures must be taken to ensure the best overall practices and management, including record-keeping and documentation. With this in mind, the purpose of this Husbandry Manual is to establish basic guidelines and procedures for individuals who rehabilitate sick and injured sea turtles.

Designed to address the needs of sea turtles suffering from the effects of physical trauma or environmental stressors, the following sections will help prevent common problems associated with rehabilitation by providing guidance on handling and transport, facilities requirements, diet and feeding, enrichment, emergency procedures (including non-diagnostic treatment), and release. Appendices provide a species identification guide, documentation forms, water system diagrams, food guides and recipes, and quarantine procedures. Written for lay and professional audiences, it is the first such resource in the Wider Caribbean Region, and is intended to meet the needs of the Sea Turtle Trauma Response Corps organized by the Wider Caribbean Sea Turtle Conservation Network (WIDECAST).

WIDECAST Sea Turtle Trauma Response Corps (STTRC)

The Wider Caribbean Sea Turtle Conservation Network (WIDECAST), with Country Coordinators in more than 40 States and territories, is uniquely designed to address national and regional research, conservation, and management priorities, both for sea turtles and for the variety of habitats upon which they depend. One such priority is to reduce the negative consequences of human interactions with sea turtles, as well as to facilitate the rescue and rehabilitation of injured and traumatized turtles.

Delegates from more than 30 Caribbean States and territories unanimously agreed at the 2004 Annual General Meeting of WIDECAST that a “Sea Turtle Trauma Response Corps” (STTRC) be created to strengthen and coordinate the efforts of people throughout the Wider Caribbean Region to respond to sea turtles in crisis, whether at sea or stranded on the shoreline. The Meeting envisioned that the STTRC would embrace interested sea turtle project staff and volunteers; veterinarians; zoos, aquaria and “animal rescue” center staff; divers, fishermen and coastal residents; and park and natural resource managers. Specifically, the Meeting recommended the following:

Structure

- Each WIDECAST Country Coordinator will identify a National STTRC Coordinator to organize and maintain a national Trauma Response Network (TRN), and to link members of the TRN with the resources of the regional STTRC.
- Each National STTRC Coordinator will identify local experts, and relevant facilities, equipment and resources, to contribute to the national TRN.
- Each National STTRC Coordinator will identify a mechanism (such as an e-newsletter or listserv) to keep TRN members informed of current events, updated information and resources, training, etc.

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1 This section was excerpted from Phelan and Eckert (2006); “Marine Turtle Trauma Response Procedures: A Field Guide”.


• Each National STTRC Coordinator will identify a sponsor for a 24-hour national “Sea Turtle Hotline” (e.g. phone/fax, email, website) to facilitate emergency assistance and to invite citizen reports.

• Each National STTRC Coordinator will identify a Lead Organization to whom stranding events and information will be reported, and the information archived, in each country.

• Each National STTRC Coordinator will ensure that the TRN operates in full compliance with national permit requirements relative to conducting necropsies, collecting and storing tissue samples, holding sea turtles captive for the purposes of rehabilitation, etc.

• WIDECAST will serve as a national and regional clearinghouse for data collected from stranding events and related incidents, with the intent of using such data to assess national and regional trends in mortality and to inform management.

• WIDECAST will maintain http://www.widecast.org/trauma to feature photos of common injuries; a region-wide roster of experts; National STTRC Coordinators and Lead Organizations; field procedure manuals and veterinary guides; data forms and reporting protocols; rehabilitation centers located in the Caribbean region; training opportunities and internships; and other relevant contacts and resources.

Training

• WIDECAST, in partnership with experts, will provide professional training to STTRC members, including workshops/seminars on stranding response procedures, standardized data collection and analysis, necropsy techniques, animal transport guidelines, sample/tissue collection and storage, and maintenance of portable trauma response field kits.

• Workshop graduates will receive a certificate or plaque that identifies them as a member of the STTRC.

• WIDECAST will create partnerships with existing sea turtle hospitals and rescue centers in the Wider Caribbean Region to facilitate regular internships and mentoring opportunities, as well as liaisons with veterinarians to ensure that all STTRC materials reflect current veterinary standards and best practices.

• WIDECAST will develop (or endorse existing) communication tools, such as listservs, websites, professional task forces/working groups and/or newsletters, to facilitate information exchange between local veterinarians and more experienced “sea turtle vets”; these venues could also be used to share experiences associated with stranding/trauma events, first response, rehabilitation and release, etc.

Best Practices

• WIDECAST will prepare and distribute standard reporting forms and database management software.

• In partnership with experts, WIDECAST will develop (or endorse existing) the following essential materials:
  
  ➢ A field guide or manual to assist with first response, including photos and illustrations of common injuries (e.g. boat strikes, predator attacks, entanglement, hook ingestion, encounters with poachers, oiling, harpoon injuries, fibropapillomatosis, parasite infestation) and a description of how to help on the scene (e.g. basic procedures for resuscitation, hook removal, transporting animals, euthanasia), including what not to do.
A best practices manual for facility-based rescue and rehabilitation, including physical plant, basic husbandry and veterinary procedures, health and recovery monitoring, screening and release protocols, etc.

A necropsy manual that emphasizes proper technique (including human health and safety), explains what can be learned (e.g. health status, reproductive condition, cause of death), and provides guidelines for tissue sample collection, analysis, inventory and storage.

Want to Know More?

In developing this Husbandry Manual the author has drawn heavily from the cumulative expertise of published literature, personal interviews with rehabilitation experts, veterinarians and other professionals, and a peer-review (currently underway) by Caribbean sea turtle experts. The Internet is also a useful source of information (see boxed insert) and it is strongly encouraged that animal care staff become familiar with these resources, include them in permanent reference libraries, and share them with partners and colleagues. Complete bibliographic references for these and other cited material are provided in the “Literature Cited” section of this manual.

INTERNET RESOURCES TO HELP GUIDE HUSBANDRY PROCEDURES


Networking among rehabilitation facilities is priceless for emergency contact and comparing experiences (see boxed insert). Also helpful are interactive courses available, for example, through MARVET (http://www.marvet.org) which offers veterinary students and veterinarians a "hands-on wet lab" and lecture workshop with a primary focus on the biology, clinical care and rehabilitation of sea turtles. WIDECAST also offers annual training opportunities and peer-exchanges. Visit www.widecast.org for more information.

The rehabilitation process is both difficult and time consuming, but is extremely rewarding. The survival of every endangered sea turtle is important in today’s world, and we hope that the information provided in this manual will ensure that sick and injured sea turtles throughout the Caribbean Sea will be given a second chance to resume a normal life in the wild. We look forward to your feedback on how to improve the usefulness of this manual by providing more detailed (or different) information, or simply more clarity regarding the subjects covered. Soon, comprehensive guidelines specifically designed for veterinarians will also be available at http://www.widecast.org/trauma.

**INTERNET LINKS FOR SEA TURTLE RESCUE AND REHABILITATION FACILITIES**

Mote Marine Lab Sea Turtle Rehabilitation Hospital:
http://www.mote.org/index.php?src=gendocs&link=Sea%20Turtle%20Rehabilitation%20Hospital&category=Animal%20Care%20Programs

South Carolina Aquarium Sea Turtle Hospital: http://www.scaquarium.org/seaturtle/rescue.aspx

Karen Beasley Sea Turtle Rescue and Rehabilitation Center, A Sea Turtle Hospital:
http://www.seaturtlehospital.org/

The Turtle Hospital: http://www.turtlehospital.org/index.htm

The Loggerhead Marinelife Center of Juno Beach: http://www.marinelife.org/

Clearwater Marine Aquarium:

Volusia County Marine Science Center: http://echotourism.com/msc/msc3.htm

Virginia Aquarium and Marine Science Center Stranding Response Program:

The Georgia Sea Turtle Center: http://www.georgiaseaturtlecenter.org/?fr_id=1000&pg=entry
II. THE ESSENTIALS

Human Health and Safety

Responding promptly, compassionately and appropriately to an injured sea turtle is important, and in many cases an informed response may be sufficient to enable the animal’s quick release. That said, it is equally important to remember that responding to an injured animal carries risk. A rescue worker may be cut or bitten, slapped or knocked down by a flailing flipper, suffer sunstroke, aches, strains and bruises, or catch a face full of sand.

Sea turtles, particularly critically ill sea turtles, can harbor a variety of bacteria, viruses, and parasites. Care should always be taken to minimize all categories of risk, both to the already traumatized turtle and to the rescue workers.

The following preventive measures are recommended by Geraci and Lounsbury (1993) for marine mammals and should be applied to turtles:

- Wear latex gloves when handling sea turtles, carcasses, tissues or fluids
- Wear waterproof outerwear to protect clothing from contamination
- Cover surface wounds with protective dressings
- Wash exposed skin and clothing after handling sea turtles
- Seek medical attention for bites, cuts, and other injuries, and inform medical attendants of the injury’s source
- Protect yourself with latex gloves and a face covering, whenever possible

Staff Qualifications and Responsibilities

Rehabilitation Specialist: Persons involved in the rehabilitation of sick or injured animals must be licensed with a permit that allows them to house, feed, and/or medically treat the animals under their care.

Veterinarian: A licensed veterinarian either on staff or on call conducts initial health assessments and weekly (or other regular) exams to monitor progress, condition, diet, and medications; responds to medical emergencies; and oversees a final screening prior to release.

Life-Support Technician: A technician or maintenance expert either on staff or on call must have proper knowledge and capabilities to monitor, maintain, and repair the physical plant, including any life-support equipment.

General requirements: Rehabilitation requires handling turtles for procedures, medication (oral, injected), monitoring, food preparation and feeding, tank cleaning, etc. Staff members should be physically capable of lifting and restraining adult turtles weighing several hundred pounds, and should be dedicated to the time and attention required to care for the animal on a 24-hour basis. Patience is essential, as health progress and stability may require several days, several months or longer.

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2 This section (as well as the Sea Turtle Anatomy Guide on the next page) was excerpted from Phelan and Eckert (2006): “Marine Turtle Trauma Response Procedures: A Field Guide”.
Facility Requirements and Supplies

The success of the rehabilitation effort, like any medical care initiative, requires clean water, adequate supplies, trained staff, and proper equipment. The physical plant need not be technologically advanced, nor expensive to construct or maintain, but it must be located with care (e.g. near a clean water source, and preferably near the sea) and it must be easily accessible by technical staff, security personnel, and professional partners (e.g. veterinarians, mechanics).

In addition, the facility should:

- Operate with the proper legal authority with respect to animal care/veterinary procedures, endangered species permits, operational inspections (e.g. water quality, animal and medical waste), etc.
- Have the capacity to access (or make) and maintain running saltwater for use and storage
- Provide adequate shelter, whether it be indoors or outdoors
- Provide adequate holding tanks, including convalescent and treatment pools
- Have access to a surgical site, basic radiology equipment (including processor), and a diagnostic laboratory (i.e. blood, biopsy, fecal)
- Conduct routine water quality tests, or have access to a testing facility
- Designate a kitchen or suitable sterile area for food preparation and storage
- Guarantee access to high quality food, whether fresh or processed
- Develop animal transport and handling protocols
- Inventory the necessary supplies; e.g., measuring and weighing devices (i.e., scales, calipers, rulers, flexible tapes)
- Maintain a supply of clean towels, and disinfecting/cleaning supplies
- Have access to life support equipment
- Establish procedures for emergency preparation and response

Record-Keeping and Documentation

It is important to document the animal’s condition and progress at all stages, from stranding (or first encounter) to death or successful release. Basic record-keeping forms include stranding (or other first encounter) forms, medical records including medicines dispensed, feeding logs, veterinary charts, water quality (and other physical plant) parameters, and final release forms. Accompanying photographs are also very helpful in all cases.

An organized relational database is an essential component of professional animal care, as well as an invaluable reference for future cases and a basis for communication among colleagues or with other facilities. Samples forms which can serve as templates or models are found in Appendix B.
Sea Turtle Anatomy Guide

The identification of sea turtles to species (see Appendix A) relies on a combination of factors, mainly the scute pattern on the carapace (i.e. the number of laterals/costals and vertebrals) and the scale pattern between the eyes; e.g. Green turtles have two large scales between the eyes (pf: "prefrontal scales", see insert), whereas Hawksbills have four.

The assessment and treatment of injured sea turtles may call for a measurement of the carapace (that’s the top shell) from nuchal notch to the supracaudals, recording the distance between the edge of the plastron (that’s the lower, or belly shell) and the vent, examination of the inguinal area for leeches, examination of the axillary area for fibropapilloma tumors, and so on.

We have tried to keep the use of technical jargon to a minimum, but sometimes it is unavoidable. The following diagrams provide a simple overview. For more detailed descriptions, see Work (2000) and Wyneken (2001).

A note about photos: All uncredited photos were taken by the author. All photos credited to the South Carolina Aquarium of Charleston, South Carolina, are credited as “SCA.” All photos credited to the North Carolina Aquarium and Pine Knoll Shores, are credited as “PKS.” All photos credited to the Volusia County Marine Science Center, in Ponce Inlet, Florida, are credited as “VCMSC.” All photos credited to Mote Marine Laboratory in Sarasota, Florida, are credited as “Mote.” All photos credited to the MarineLife Center of Juno Beach, Florida, are credited as “MLC.”
III. HANDLING AND TRANSPORT

Procedures and Advice: Live Turtle Handling

Sea turtles should not be handled unnecessarily, and should not be encouraged to become habituated to human contact and interaction. If required by law, licensed rehabilitators should carry the necessary permits that allow them to handle and transport protected species, including sea turtles. Whenever handling is required, the animal must be retrieved, restrained (i.e. positioned for the procedure), kept calm, and returned safely to the holding facility.

**SITUATIONS REQUIRING HANDLING**

- Properly restraining turtles for examinations and diagnostic procedures
- Removing turtles from tanks for examinations and medical procedures
- Transporting turtles to off-site facilities for radiographs (X-rays), ultrasounds, or surgeries
- Applying topical medications
- Cleaning the turtle, as necessary, of debilitating epibiota and parasites
- Applying identification marks, including flipper and/or PIT tags
- Release

**Retrieve**

The first step in handling is to retrieve the turtle from its tank or enclosure. Turtle and tank size will determine the course of action.

1. Smaller turtles that can be handled by 1-2 people: Reach into the tank and grab the carapace securely, placing one hand just behind the head and the other at the rear. With a small juvenile you can include the front flippers in the embrace, pinning them against the sides of the carapace. Turtles out of reach can be coaxed into range using a net frame (without netting) gently positioned around the head and a front flipper. Juveniles can be caught with a net (with small mesh netting). If these methods do not work, one or two people may have to enter the tank to retrieve the turtle. To do this, slowly surround turtle and close in, grasp the carapace, move the turtle to the tank edge, and lift. Make sure there is someone on the outside of the tank to receive the animal.

2. Larger turtles requiring 2+ people: Enter the tank, as above, corner the animal and lift. *Keep your balance and watch the head – turtles bite.* The use of a holding mechanism, such as a cargo net or stretcher, in the water can be useful. Position the net or stretcher under the turtle, and slowly lift the animal to a receiving staff outside the tank. If the turtle is too large to be safely lifted out of the tank, drain the tank and hoist the turtle atop a rubber tire for the duration of the examination.
Restrain

Simple transport within a facility can be done by hand-holding the turtle or using a cargo net, stretcher, wagon, or any other safe, secure transport mechanism that will not jostle the animal or allow the flippers to flail. Whatever mechanism is used, it must be strong enough for large turtles and made of materials that will not damage the animal or cause smaller turtles to get stuck or tangled.

*Note:* turtles with open wounds may fare better with mechanisms that minimize contact with wounds and infections.

Turtles should only be restrained when necessary, usually during transport or during diagnostic procedures. Most strength comes from the front flippers, so restraint is usually focused there. To properly restrain a turtle, maintain a firm hold on the front flippers, near the shoulders. Flippers can also be held or bound to the carapace to restrict movement. During transport, holding mechanisms can aid in restricting flipper movement. For injections and blood draws, the head should be held to the opposite side (e.g. the head should be directed left for an injection in the right shoulder) or firmly held down to prevent movement.

*Hint:* a bucket placed between the head and shoulder works well to prevent sudden movements during injections.

Comfort

Be sure to use some sort of padding, such as towels or close-cell foam, during transport and on surfaces (e.g. floors, tables, flatbed truck) used for examinations. The materials used should be reusable and easily cleaned. Padding provides comfort, leverage, and a layer for sanitization. Rubber tires also make for comfortable padding and can aid in restricting movement. Occasionally a turtle may become stressed and irritable. In these situations there are two great ways to promote calm: place a towel, blanket, or t-shirt over the animal’s head, or place slight pressure on the back of the head and lean your whole body against the middle of the carapace. In either of these situations, the turtle should regain composure within several minutes.

Return

Safety for both the turtle and the handler is an important concern. When handling, all movements should be smooth and steady. When returning a turtle back into a tank after a procedure, angle the body head-first into water and slowly release the animal. Larger turtles may require personnel to enter the tank: follow similar steps as in the retrieve, but the retrieving staff will be inside the tank. Once released, personnel should exit tank immediately. Equipment used for handling should be properly sterilized between uses. Gloves should be changed and hands washed before handling a different turtle.
Concerns and Warnings

For all handling and transport, make sure the turtle is faced forward in the direction of motion. In motion, watch flippers while going through doorways. Pay careful attention and do not touch or abrade any open wounds, sores, or skin irritations.

Procedures and Advice: Live Turtle Transport

If you need to transport a sick or injured sea turtle, make every effort to keep the animal in the shade (that is, keep it from over-heating) while waiting for the vehicle to arrive. Provide a smooth ride, do your best to keep the animal moist, and protect the animal from extremes of heat and cold.

The following guidelines are intended for local ground transport, typically from the point of encounter to a rescue/rehabilitation center or veterinary clinic. They are not intended to be comprehensive with regard to shipment by air. Remember that in any international shipment will require permits, including CITES permits (see [http://www.cites.org/eng/resources/transport/index.shtml](http://www.cites.org/eng/resources/transport/index.shtml)).

1. Always place the sea turtle in a container (e.g. wooden crate, large cooler, animal kennel) for transport. Container dimensions should allow normal flipper position and head extension (including raising the head to breathe); the turtle should not be able to turn around. Containers should be handled and secured during transport in an upright position; the top should be clearly marked. Containers should be ventilated and padded (at least on the bottom), must not contain any material that could be accidentally ingested, and should accommodate the fact that turtles must be kept moist. The best range of temperature for transport is between 21ºC and 27ºC (70º-80ºF) (FWS 2000).

2. Apply a very thin layer of lubricating jelly (such as KY®, which has the advantage of being water-soluble, or Vaseline®) – except around the eyes, nose, and mouth and avoiding any open wounds – to keep the turtle from drying out during long-distance transport.

3. If wet towels are used, care must be taken to prevent the turtle from becoming too cold because of evaporative cooling. **Turtles covered with wet towels must not be kept in an air-conditioned environment** (FFWCC 2002b).

Concerns and Warnings

Make sure that containers are secured during transport, such that they do not slide around or tip over.


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3 This section is adapted from Phelan and Eckert (2006): “Marine Turtle Trauma Response Procedures: A Field Guide”.

Wooden box carrier, © Virginia Aquarium Foundation
IV. HOLDING ENVIRONMENT

The most important thing to consider about the holding environment is to encourage a natural setting that is easy to care for and is organized in a way that allows for easy handling. The following section describes all aspects of the holding environment that need to be considered, including tanks, life support equipment, “set up”, and sanitization.

Facility

The location of a rehabilitation facility is very important and several factors should be considered. The facility should be located on or near a source of clean water with minimal threat to the water supply from waste generated either by the facility or by other users. Natural salt water is preferred, but artificial seawater is a viable option and depends on the water system you create (see “Water System Set-up”). The facility should have access to nearby medical or veterinary services and local water testing centers (if these are not included in your facility design).

Indoor and outdoor rehabilitation facilities are both acceptable, but in either case the design should allow for a controlled environment with proper lighting, temperature control, predator protection, adequate space, and access to roads, parking, electricity, and water.

Maintaining Turtles in Water

Holding tanks used during rehabilitation should have an unfurnished, smooth-surface, and be large enough to allow for unimpeded and complete submersion (Higgins, 2003). Although tanks should be large enough for a turtle to move, swim and dive, they also need to be small enough to allow for easy capture. A water depth of 2-4 feet is best because the turtle can fully submerge and reach the surface again using minimal energy, and it allows for relatively easy handling. Tank diameter can range between 6-15 feet. There is no “correct” number of tanks, but there should be enough tanks available to support an expected number and variety of turtle sizes and conditions.

Considerations

- Larger tanks mean more water and more cleaning effort. On the other hand, the greater water volume promotes stable temperature and can improve water quality.
- Smaller tanks require less space and water, and will be easier to retrieve turtles from; on the other hand, less water volume can make the system more susceptible to water quality issues such as bacteria load, temperature change, and pH fluctuations.

Tanks should be free of toxic substances and non-food items which could be ingested, and they should be made with materials that cannot entangle the turtles (FWC, 2000). The tank material should withstand sea water (e.g. non-corrosive) and be durable enough to withstand impact and rubbing from the turtle’s carapace, head and flippers, smooth enough to prevent skin damage and calluses, and easily cleaned.
Materials
- Glass tanks can be expensive, heavy, and generally impractical for medium to large sea turtles; however, an advantage is that they will not get scratched from the turtle’s beaks and claws. Glass may have to be re-siliconed periodically (if the silicon peals, it could be ingested).
- Acrylic plastic tanks weigh less than glass and are easier to drill and mold into the desired shape; however, acrylic may not be practical for medium to large sea turtles because of construction cost.
- Fiberglass tanks can also be molded into a variety of shapes and sizes, they are long lasting, and they are a popular choice in the aquarium industry for a variety of animals. A disadvantage is that they can be relatively expensive and heavy to transport.
- Concrete tanks are usually used when a larger tank size is needed and are often used for permanent structures because of their weight. The disadvantage is that cement is typically rough and can cause skin irritations, harbor bacteria, and be difficult to clean.
- Polyethylene tanks, like PVC tanks, are easy to work with, inexpensive, lightweight, and easily molded into any shape and size. They are made of a flexible plastic and are reinforced with additional plastic, which is called the flange. If polyethylene tanks are over-filled the flange can break and cause the tank to bow and fittings to leak.

Separation

Ideally, there should be one turtle per tank (or per complete system) to avoid aggression, reduce contagion, and simplify feed monitoring. Nevertheless, there may come a time when multiple turtles must be accommodated together in a single tank. If this occurs, house turtles with similar ailments/trauma in the same tank to prevent any transfer of disease and health complications.

Tank barriers – constructed of plastic mesh or plastic fencing attached to PVC pipe – can be created to limit physical contact. Plastic mesh can be good for smaller turtles but, if not sturdily constructed, turtles can become entangled and drown or ingest the building materials. Larger turtles can also break through the mesh, so plastic fencing is recommended for them. If the tank is not a static system, the barrier should be constructed so that it does not inhibit flow or prevent waste from being removed from the tank.

For more detail on how to create tank dividers, see Appendix C.

Concerns and Warnings

Do not house a turtle with a transmittable disease in the same tank, or within the same system of tanks, with other turtles.

If a tank needs to be fitted with separators because of space constraints, make sure that the tank is large enough to create divided sections with enough room for turtles to freely move.

Tank separation works best with smaller turtles.
Maintaining Turtles out of Water

Sea turtles are generally hypoglycemic upon arrival to a rehabilitation facility (Michelle, Bauer, Volusia County Marine Science Center, in litt. 2008) and may need to be maintained out of water – a scenario referred to as “dry-docking” – for a period of time. In some cases this need be only for a night, in order to give the turtle time to rest and absorb fluids which may need to be administered. Occasionally turtles come into a facility with minimal eye response, fluid in the lungs, lockjaw, inability to swim, or incapability to lift their heads to breathe and may need to be maintained out of water for longer periods of time. In any case, dry-docking is used to allow weak turtles to rest on a padded surface, either in shallow water or not in water at all (Norton, 2005b), as necessary.

Once the turtle becomes more mobile, lifting its head to breathe and moving on its own, it can be placed in deeper water and be given more space for movement. When this happens, be certain that the turtle is closely monitored to ensure it does not weaken and require a return to dry-dock. Note: Most dry-docked turtles are initially placed in fresh water for hydration and epibiota control (Choy et al., 1989). Once they regain mobility, the water may be switched back to salt water to aid in buoyancy control, especially after being placed in a deeper tank. Saltwater also helps with external fungus and bacteria control, which may be exacerbated by hospital admittance or result from dry-dock rubbing.

Basic Set-Up

Small empty tanks, such as any commercially available “kiddie pool” permit easy access for care and monitoring, but consideration must be taken to make sure that the turtle cannot climb out of the tank. Regular holding tanks can also be emptied and used. In either case, turtles should be placed on a padded or soft surface to allow the turtle to expand when breathing. Lacking water, turtles must be kept misted, covered in Vaseline® or a water-based lubricant, or covered with damp towels to prevent desiccation. Severely dehydrated turtles may also need to be internally hydrated with veterinary supervision. Findings indicative of physical dehydration include sunken eyes, thick oral secretions, depression, a slow and difficult to find heart beat, and minimal to no urination (Norton, 2005a). Air temperature should be closely monitored to prevent over-heating or dangerous chilling.

Shower boxes may also be constructed to hold debilitated turtles. Shower boxes are pools with foam padding lining the bottom and drains or containers underneath that allow continuous water spray over the turtle without water accumulating in the box – keeping the turtle wet and preventing it from drowning (Campbell, 1996; RAC/SPAW, 2004).

Advanced Set-Up

For a more advanced dry-dock set-up, regular housing tanks can be used and filled with a small amount of filtered water, enough to suspend the turtle off the bottom and alleviate the weight of gravity. Misting units may also be attached overhead. In this case, make sure to secure the turtle on a padded surface, wrap a dive belt around its center, place it on a slight angle, position a towel under the head for added support (as well as to aid in breathing), and keep the animal in place with cinder blocks (see photo) or something sturdy.

For more information on advanced set-up, see Appendix D for “Advanced Dry-Dock Set-up.”
Concerns and Warnings

Dry-docking a turtle can take anywhere from one day to several weeks or months, depending on the turtle’s overall condition. During this time, the most important variable to monitor is air temperature. Be sure that if misted with water – or partially submerged in water – the temperature of the air and water is maintained as warm, stable, and free of cool drafts.

After a month of dry-docking, turtles may also form bed sores on the plastron and chin/lower jaw areas. To decrease the chance of developing these bed sores, turtles may need to be rested on inner tubes and other soft materials. The placement of these materials will also have to be rotated to change pressure points.

Lighting and Photoperiod

Lighting is an important element for sea turtles. UV from light is needed for vitamin D, which is required for proper metabolism, allowing for calcium uptake in the intestines (George, 1997). Because lighting is so important, the type or amount must be considered for all situations.

Outdoor facilities must limit the amount of direct sunlight to protect turtles from sunburn, inhibit algae growth in the tanks, and prevent water temperatures from getting too high. To limit direct light, fine-mesh (black) screening can be used to cover tanks. Indoor facilities can rely on windows, or incorporate materials such as clear fiberglass panels in the ceiling. Sheltered (hiding) areas can also be created inside the holding tanks (see Section VI, “Enrichment”) to provide cover and to limit sun exposure.

Indoor facilities must consider both type of lighting and photoperiod. Fluorescent lights are generally inexpensive and easily available, but a regular schedule of changing bulbs should be enforced because the ultraviolet (UV) output in fluorescent bulbs decreases after a few thousand hours of use (Pough, 1992). A recommended option is a full-spectrum metal halide light because it is the closest to natural light (providing UVA and UVB) and turns on slowly, resembling a sunrise. Full-spectrum lighting is most important for younger turtles and turtles held for long periods of time.

Light fixtures should have shield guards to prevent accidental breakage and should be placed high enough, and shine bright enough, as to not cause sensitivity (FWS, 2000). Closely positioned constant lighting is unnatural and can act as a low-level chronic stressor (RAC/SPA, 2004). Indoor photoperiod can be reproduced by turning lights on and off when staff arrive and leave the facility, or by setting a timer to mimic daylight hours. Photoperiod should not exceed actual daylight, which is approximately 14 hours (FWS, 2000).

Another recommendation to obtain proper lighting for indoor facilities is to physically take turtles outside. Juveniles can be taken out one time a week (or even every day if the animal is not under high stress) and older turtles anywhere from once a week to once a month. Time outside should be limited between 15-30 minutes. During this time it is suggested to keep turtles properly moistened to prevent desiccation and make sure the turtle doesn’t over heat.

If lighting is insufficient, either for lack of direct sunlight or proper lighting fixtures, a turtle’s diet may be supplemented with calcium and vitamin D.
**Concerns and Warnings**

If adding structures in tanks for cover, make sure items are positioned so turtle may not become wedged or trapped underwater (FFWCC, 2002: Section 4).

Taking turtles outside requires physical movement and can cause additional stress. It is only recommended to take turtles outside if there is enough staff to move and watch the turtle, and that the turtle is in stable condition.

Supplementing diets with vitamin D and calcium should be determined by the veterinarian and may not be necessary for short-term patients.

**Temperature Control**

Temperature is one of the most important variables to control for proper health. Like all reptiles, sea turtles are largely dependant upon ambient temperature to promote physiological norms that enable full range of movement, normal body functions, etc. The optimal temperature range for stable health, rehabilitation, and bodily function varies slightly depending on the turtle’s condition and size, but is generally 25-30 degrees Celsius (77-86 degrees Fahrenheit) (Higgins, 2003 and Campbell, 1996). Temperature kept too low can cause infection and make turtles susceptible to pathogens while too high can cause hyperthermic stress (Campbell, 1996).

To compensate for temperatures in captivity and outdoor facilities that may become warmer or colder depending on levels of air conditioning and the amount of sunlight, heat, and/or natural ambient temperature affecting the rehabilitation environment, several options are available. These include the use or adjustment of tank surface area, ambient (air) temperature, spray bars, and/or chillers and heaters.

**Surface Area**

Tank dimension and water volume are directly related to surface area, and therefore to temperature. More surface area allows for greater exchange between water and air, meaning that ambient temperature plays a greater role in water temperature. Therefore smaller tanks (filled to capacity) will undergo faster temperature fluctuations than will larger tanks (filled to capacity).

**Air Temperature**

Air temperature has a strong effect on water temperature. If holding rooms do not have proper circulation or temperature control, tank water can become too hot or too cold. Depending on the need, make sure rooms where sea turtles are housed are properly circulated with fans, air conditioning units, and/or heaters.

**Spray Bar**

Spray bars are simple extensions that can be added on to the tank return line. Made of PVC, these pipes have a series of holes drilled into them so that water will splash the surface and facilitate temperature exchange. The simple addition of surface area and circulation can increase or decrease water temperature a few degrees, depending on ambient air temperature.
Chillers and Heaters

Chillers are mechanical extensions that can be added into the water system either by in-line internal chiller coils or with a drop-in coil that can be placed into the sump or tank. Although effective at controlling and maintaining cool temperatures, they require a lot of electricity, maintenance, and expense, and they can have devastating effects if the thermostats fail and the water becomes dangerously, even fatally, chilled.

In air conditioned facilities, tanks may need to be heated. Pumps and lighting will add some heat into the system but a heater can also be added, if needed. Heaters can be plumbed in-line or added directly into the tank or sump. Heaters, like chillers, can have devastating effects if the controlling mechanism (thermostat) fails, causing water temperature to rise to dangerous, even fatal, levels. To determine the size of heater needed, the maximum temperature without a controller can be tested before a turtle is put in the system. If the temperature rises above optimal, the heater should be downsized as a precaution.

Concerns and Warnings

When adding fixtures to tanks, keep in mind that turtles may chew on them. Some turtle-proof options for adding fixtures to tanks are to put them in unobtainable locations like a sump or skimmer box.

Life Support

Basic Plumbing

Pump: A pump is the most basic requirement for a tank where water movement is desired. A pump performs a number of essential functions required for proper tank functioning, such as water in-take, circulation, and cleaning. Pumps use electricity to add energy into a system in order to move liquids from low to high pressure. Centrifugal pumps are commonly used in saltwater tank applications because of their ease of maintenance and ability to move a high volume of water with less energy. One pump can run several life support components or several pumps can be used to run components individually. The tank volume, life support components, system head, and number of housed animals for the system all need to be considered in pump size selection. Pump manufactures often provide a pump curve to help you make your selection. Pumps can be expensive, but are necessary for many applications whether the system is closed, flow-through, or features static water that needs to be moved in and out of a tank quickly.

Plumbing: Polyvinyl chloride pipe, also known as PVC pipe, is one of the most commonly used hard plastic pipes in the aquarium industry. PVC is known for its durability, light weight, low cost, versatility, and ease of use. PVC has been known to crack and crumble after long term ultraviolet exposure, so when selecting the pipe needed for a system, consider carefully the amount of direct sunlight and the amount of pressure in the lines. PVC can be painted, covered or insulated, as needed, to protect it from direct sunlight. PVC can be cut to order (using PVC cutters or a hand saw), plumbed together through the use of various fittings and PVC glue or cement, and crafted into almost any configuration.

Sump: Sumps are containers (made from materials like plastics, cement, or fiberglass) in which water is gravity fed into. Sumps are often placed under a tank for the ease of the gravity feed but can be
placed anywhere and will function as long as the water level in the tank is higher than in the sump. Adding a sump to a system will add additional water volume, provide a place for gravity driven filtration (like bag filters) to occur, and provide a place for the rest of the life support components to run from. After water is gravity fed from a tank to a sump a pump can pull water from it, send it through filtration and return it to the tank and/or back to the sump depending on the filters used. Several tanks can share one main sump, and therefore can share life support and tank water. Individual tanks may also have their own sumps and large sumps can also function as water storage basins for an incoming water supply or a place to mix synthetic salt water, in which the water may then be pumped from the basin to the systems when needed. A final benefit of having water gravity fed from a tank is to provide surface skimming of larger waste materials.

**Skimmer Box:** Skimmer boxes are similar to sumps, but they are smaller and they are physically attached to a tank. They provide surface skimming of large waste material.

**Salt Water:** Saltwater can originate from a natural water source or, if clean seawater is unavailable, can be made from freshwater mixed with a synthetic salt. There are a variety of commercially made synthetic salts available, including Instant Ocean, BioSea Marine Mix, Coralife, Tropic Marin, Reef Crystals, Red Sea, Crystal Seas Marine Mix Bioassay, and Oceanic Sea Salt. Synthetic salts can be costly and shipments often arrive in large (13-23 kg / 28-62 lb) bags or boxes that, in bulk, require large pallets that may be difficult for some facilities to maneuver or afford.

*Note:* Select synthetic salts carefully. Quality is related to the presence of trace elements in the mix, and it varies greatly between companies (Hovanec and Coshland, 2004).

Each company provides directions on how much salt mix to use per volume of water. Freshwater can be mixed with synthetic salt in a variety of water storage containers (e.g., sump, basin) and can be mixed manually or by using a pump (e.g. submersible pump, external pump). Depending on the cleanliness of the salt mix, the mixed water can then be run through mechanical filtration before it is sent to the tanks.

**Filters**

If sea turtles are kept in tanks with static saltwater (i.e., with no filtration), tank water should be changed daily, which can become very labor intensive. Adding filtration to a tank reduces labor, saves maintenance time, and provides water conditions more suitable for healing and recovery.

There are three main categories of filtration – biological, mechanical and chemical (Moe, 1992) – and all of them function by water being moved through them either by a pump or by a gravity feed. Some filters fall into more than one of these categories and serve more than one function. For the cleanest water, combine one or more filters from each category. The types of filtration and possible combinations are limitless, and depend on the needs of the animals and of the facility.
Biological Filters

Biological filtration uses living organisms (e.g. bacteria) to remove toxic compounds from the water and can also improve gas exchange. Biological filters rely on a process called “nitrification”, which can take place on a variety of substrates [note: in-tank substrate is not recommended for sea turtles because it could be ingested] and in a variety of structures, and removes harmful wastes by converting them from ammonia to a less toxic nitrate. With the correctly sized filter and amount of media (i.e., bio-balls, bio-wheels, bio-rings, bio-stars) the system will remain properly cycled and nitrogen balanced, assuming the waste carrying capacity has not been reached or disabled by becoming clogged or anoxic. Mechanical filtration (see below) should be plumbed prior to the biological filter to allow the cleanest water to move through the system and help keep the bacteria free from excess debris. Only the nitrate levels will increase once the filter is established. It is possible to use a mechanical filter as a biological filter, but the system must be run at a reduced rate and cleaning the filter may kill the “good” bacteria bed, causing the need for the system to be recycled more often than would otherwise be the case.

All biological filters generally work in the same way as described above and include fluidized beds, low space bioreactors, bio-filter tanks, and even media in a mesh bag (which can be placed in a sump or skimmer box).

Although biological filtration is vital in most aquatic systems, it is less crucial than mechanical and chemical filtration for sea turtles. Biological filtration is not necessary at all for flow-through set-ups.

Mechanical Filters

• With the use of a pump, canister filters function under pressure by forcing water over a pleated cartridge or some other media that can be cleaned and/or replaced when needed. As the media becomes clogged, the system flow may be reduced. Some canisters have a pressure gage that can monitor when the filter is clogged, and needs to be cleaned or changed. Usually the flow rate in the filter is too high for the filter to double as a biological filter; therefore, when a canister filter is used in a closed system, it is recommended that there be another source of biological filtration.

• Sand filters are one of the most common forms of mechanical filtration, and are generally used for larger volume tanks. A pump pushes water through the top of the filter and through the sand, and the waste is caught in the top layers of the sand. The filter can then be back-washed, which reverses the flow of water through the filter to suspend the waste and dumps the water out of the system. The filter can also be rinsed, which also dumps the water out of the system as waste to a sump or back to its initial source. The multiport valve on the filter controls the water direction and stays in the filter position in normal operation.

Check with the filter manufacture for the type and amount of sand/ gravel needed, recommended backwash frequency, and pump size for proper efficiency. Remember that excessive waste load in the filter will reduce flow. A pressure gauge on the filter can help determine when the filter needs to be back-washed. Over time, the sand will channel and need to be replaced. The frequencies of sand changes can be reduced with regular attention to backwashing.
Bag filters are relatively inexpensive solid waste removers and are available in a variety of materials that remove an array of different micron-sized materials. The filters can be cleaned and reused, but eventually must be replaced. As with any filter, if the bags are not maintained properly they can overflow and back up a system. Be aware that the bag filter can fall off and block the pump suction, causing the tank to overflow and possibly burn out the pump. The smaller the filtration pores in the bag the better the filtration, but the faster the bag fills up and the more often it has to be cleaned. Bag filters can be directly connected to a water pump for in-line filtering, or used in conjunction with a skimmer box, skimmer drain, or sump for gravity-induced flow through the bag.

Chemical Filters

- Activated carbon filters can be added to a system or carbon bags can be added into other (sand, cartridge) filtration, or put in the sump in order to remove dissolved organic carbon that tends to build up in aquariums. These organics can result in a yellowish water color, and can alter pH.

- A protein skimmer is both a chemical and a mechanical filter that acts to sort out organic and inorganic materials. A pump is used to mix water with air and as a result, produces foam. The efficiency of the skimmer is based on its size, pump selection, contact time, and the size of the bubbles. The bubbles rise into the collection cup with the proteins and organics attached and are removed before they can break down into the system. When the collection cup fills up, it needs to be cleaned out and this may need to be done as often as every day if there isn’t an automatic spray down. The waste bubbles created can actually be seen. The protein skimmer valves may also have to be adjusted often, especially if plumbed together on the same pump with a filter that creates flow restrictions to the protein skimmer as the filter clogs up. This can be avoided by putting the protein skimmer on its own pump.

Sterilizers

Sterilization filtration can greatly help in disease control and remove harmful bacteria, viruses, and fungi from a system, but it must not be so powerful that it removes beneficial bacteria (Moe, 1992).

- As the water is pushed through a UV Sterilizer by a pump, it is exposed to a UV bulb that interrupts the DNA of the cells and kills them. The efficiency of the sterilizer depends on the wattage of the bulb, age of the bulb, exposure time through the unit (pump size), and deposits on the quartz sleeve. The bulb needs to be periodically replaced and the sleeve needs to be cleaned often. If water is not moving through the unit, the UV must be turned off in order to not burn out the bulb and damage the sleeve. Staring directly into the bulb can be damaging to
human eyes and should be avoided. UV may not be as an efficient sterilizer as ozone but it is safer against human and mechanical error and may be a more practical choice for smaller volume systems.

- **Ozone** can be created by an ozone generator, and the oxidation ability of ozone can be exploited to kill many harmful organisms, including bacteria and viruses, by destroying their cells’ chemistry more efficiently (and more safely) than through the use of chlorine. The ozone efficiency is based on contact time and generator power, and the ozone can be injected in various locations including contact chambers or into a protein skimmer. Ozone can be very helpful for controlling infections in animals with open wounds, but must be carefully controlled to prevent damage to delicate animal tissues and, once in the air, to avoid damage to humans. Ozone alarm detectors can be used to shut off the generator if certain ORP (oxidation redox potential) numbers are reached or in case of a leak, and to notify someone that ozone has been detected in the air. Sometimes alarms fail and extreme caution should always be used, especially if the very distinct odor of ozone becomes apparent in the facility. Ozone has the ability to cause headaches, eye irritation and trouble breathing (MSDS, 2008). ORP probes can be used to constantly measure ozone, and to find trends. Ozone generators can be very costly and require trained personal to maintain.

- **Chlorine** is often used as a cleaning disinfectant and also used in water purification for swimming pools, drinking water, and sometimes aquatic systems containing marine mammals and sea turtles. This chemical should be introduced in an area where it can be mixed and even distributed to the filtration system at a point just before the water is returned to the main tank and (such as in a sump or skimmer box). A chemical injector such as a diaphragm pump or peristaltic pump may be used for injection, but may also be added by hand. *Note:* Seek qualified help and consultation prior to using chlorine for sterilization.

**Concerns and Warnings**

Keep in mind that, just because a particular piece of equipment is presented and explained in the preceding sections, every piece of equipment does not need to be used to maintain a stable environment. More equipment costs more, is more difficult to monitor, and can cause unnecessary complexity. Sea turtles have high waste production, and adding mechanical filtration to the tank may have more overall benefits than adding biological or chemical filtration. Additional levels of filtration, including biological and chemical filters, increase water quality and, therefore, can reduce open-wound healing time. The most important application of chemical filtration is carbon filtering after ozone use. UV sterilization and ozone are also not absolutely necessary, but will aide in the turtle’s rehabilitation and are recommended if possible.

**Dangers of Equipment:**

**Biological Filters:** If the media (ie: bio-balls, bio-wheels, bio-rings, bio-stars) find their way into the tank they can be ingested and cause impaction in the sea turtle.
**Mechanical Filters**: Filters such as canister filters and sand filters operate under high pressures and extreme caution should be used when maintaining these filters. Pumps should always be turned off and air vents should be opened before the filters are opened for routine maintenance.

**UV Sterilizers**: Staring directly into a UV bulb can be damaging to eyes and should be avoided. The pump should be off during maintenance and the bulb should be unplugged.

**Ozone**: Ozone has the ability to cause headaches, eye irritations and may cause breathing trouble for the caretakers and the sea turtles. Watch for leaks and do not use in excess.

**Chlorine**: Extreme caution is warranted for using chlorine in a poorly ventilated area where this toxic gas can irritate the respiratory system and eyes, as well as skin if direct contact is made (MSDS, 2008). The proper eye wear, gloves, and masks should be worn as a precaution. Also keep stored in a cool shaded area because the potency of this chemical is reduced over time with heat exposure.

### Water System Set-up

Successful rehabilitation of marine animals requires a constant flow of clean seawater. Various systems are designed to ensure this constant flow, and these systems are described as open (flow-through), semi-open, or closed. For schematic diagrams, see Appendix E.

**Open, or Flow-through System**

Flow-through systems generally use a pump to pull water from a natural water source and with the use of valves can distribute the water where it is needed. The water then drains into a common line that returns back to the water source. The advantage of a flow-through is that there may be no need for any filtration or waste water treatment system. Water passes through each tank once before it is returned to its natural source and is replaced with a constant supply of new water, 24 hours a day. If desired, filtration can be added in between the intake line and the tanks. A form of mechanical and chemical filtration would be most applicable in this situation. A biological filter has no use in a flow-through system. The disadvantage is that the incoming water conditions are hard to control, beyond filtering, and the turtle will be exposed to the same fluctuations as the natural water source. In particular, temperature is almost impossible to regulate. Consideration should also be taken in the event that the intake line is destroyed by bio-fouling [note: intake lines should be cleaned regularly] or by other natural causes.

**Semi-open System**

Semi-open systems usually have a natural water source that is brought into a basin or large tank, filtered with mechanical and/or chemical filtration, and moved into a system when needed. When water is moved back out of a system, such as during a water change or backwash, the water is either recycled in a recovery basin or returned (drained/pumped) to its natural source. Semi-open systems are basically open systems that do not run on flow-through 100% of the time. The advantage of this system is that the use of the basin allows more opportunity to control water quality parameters.

**Closed System**

Closed systems are not connected with other systems and do not require a constant incoming water source, but rather the water moves through its own set of filtration. The same water moves through the system until it is physically changed out. A closed system could be made up of several tanks that
runs off of one set of life support or could be one tank with its own life support. Closed systems are ideal for facilities with limited water access as well as are good for containing disease control. The water source for this system could still be a natural source or could be artificial salt water. The drained water from the system during maintenance water changes/backwashes could also be drained back to the natural water source or sent to a recovery basin to be filtered, sterilized, and reused.

**Concerns and Warnings**

Drains and pipes should be securely shielded to prevent turtle from getting trapped or held under water (FWC, 2000).

**Water Quality Testing**

Water quality directly affects the degree to which rehabilitation can be successful. All parameters that may affect the health and well-being of sea turtles housed in the facility should be tested and monitored as often as possible. For flow-through and semi-open water systems, the water source should be tested at least once every 1-2 weeks. Tank water for semi-open and closed systems should be monitored at least once (sometimes twice) every day, to every week depending on equipment and sterilization methods used. Documenting these parameters should result in trends that can be used to address any issues of concern. The most important variables to test are temperature, salinity, and pH. Any additional tests should coincide with water system set-up, equipment, and chemicals used for sterilization.

**Temperature**

There are a variety of ways to measure temperature including, but not limited to, digital thermometers and controllers with submersible probes, temperature pens, stick-on thermometers, infrared temperature scanners, and handheld YSI meters. The handheld meters can be very costly, but offer the advantage of also measuring other parameters including ORP, salinity, conductivity, and/or pH. Water temperature can be manipulated with water heaters, air heaters, chillers, air conditioners, and/or ventilation fans to maintain an optimal temperature of 25-30 degrees Celsius (77-86 degrees Fahrenheit) (Higgins, 2003 and Campbell, 1996).

**Salinity**

Salinity can also be measured with a handheld YSI meter or with a less expensive refractometer, hydrometer, or pinpoint salinity meter. Brackish to full strength salt water (14-32ppt) may be used (Higgins, 2003), but optimal values should range between 20-35ppt (FFWCC 2002c), except during a veterinarian-guided and temporary freshwater submersion. If the salinity gets too high, freshwater may be added for adjustment.

**pH**

pH can be measured with a handheld YSI meter or with a less expensive pH pen, pH pinpoint meters, or pH stripes (Litmus paper). Natural saltwater, varying with location and water conditions is 7.8-8.3. For turtles, the pH should be between 7.5-8.5 (FFWCC 2002c). If the pH begins to decrease, it is an indicator of declining water quality from increased bio-load and the system will need a water change and/ or buffer to increase it.
Chlorine

For health and safety, regular testing is needed to ensure proper levels are maintained, which can be up to twice a day, everyday. A DPD type test may be used to measure both free and total chlorine. The DPD test is the most common type of chlorine test and utilizes two reagents (test chemicals). The test solution will turn reddish in the presence of chlorinated water; the darker it turns, the more chlorine is in the water. Free chlorine should be maintained at a level between 0.5 and 1.0ppm. Chlorine levels greater than 1.0ppm can cause eye irritation (Campbell, 1996). Free chlorine is the level that should be targeted and maintained, total chlorine will not be readily controlled but can be used to calculate combined chlorine or chloramines levels. Combined chlorine is the total reading minus the free reading. To reduce chlorine levels, water may either be 100% changed or a sodium thiosulfate may be added as a buffer.

Sanitation

Most turtles produce solid waste at least once a day, which accumulates on the bottom of the tank along with excess food debris. Dirty water could worsen health, causing eye inflammation and exacerbating mycotic and bacterial infection (RAC-SPA, 1999). For this reason, flow dynamics need to be designed to properly remove the debris from the tank. Because of the weakened state of resident sea turtles, pushing enough flow through the tank to suspend waste may not be plausible and could cause further injury. Having a pump suction line that pulls from the bottom of the tank may remove debris but the longevity of the pump may be reduced as the debris, over time, will clog the pump impeller. Moreover, the turtle may block the suction line, causing the tank to overflow and ultimately run the pump dry (and/or burn out the pump’s motor). A screen of some sort over the suction line may help prevent a larger blockage. If the turtle is in static water, waste products are removed manually either by netting or by using a hose to siphon the waste from the tank.

The larger the water volume of the tank, the more time it will take for the water to become unsanitary. Because most rehabilitation tanks will have small water volumes for turtle accessibility and close monitoring, with varying life support and animals, the frequency of cleaning will vary with each system. A tank with filtration will probably require fewer water changes than a tank with static water. Note: Large water changes on a biologically established system may actually deprive the good bacteria of needed food and sometimes more beneficial to do small water changes and let the filters do their job.

Water Changes

Water changes can be based on many factors, but often a decline in pH and an increase in nitrates will indicate the need for a water change. In non-biologically filtered tanks, ammonia can be used as an indicator.

The condition of incoming water, including temperature variance, must be considered carefully before it is added to the tank because environmental fluctuations may cause serious stress to recovering sea turtles. For the same reason (minimizing stress), avoid unnecessary cleaning. Depending on the condition of the animal, it can be moved out of the tank for cleaning or left in the tank. If the latter, clean around the animal and take care not to spook it, or cause it to slam into the tank walls.
Cleaning Utensils

It is good practice never to use the same cleaning utensils between tanks. Always sanitize hands and utensils between tanks to minimize the risk of cross-contamination. Utensils can be soaked in a diluted bleach solution and rinsed if needed. Because the extent of a turtle's injury or illness is sometimes not completely known, it is best to always take strong precautions regarding sanitation.

Discharging Medically Treated Waste

If medically treated waste is being dumped back into a natural water way, the water should first be run through activated carbon to remove any harmful chemicals. If the water is to be recycled and is collected in a holding basin of some sort, the water can be filtered (sand filter), sterilized (ozone or chlorine), routed through an activated carbon filter, and then reused.

When a turtle is released (or dies), the tank must be properly sterilized prior to it being re-used. Chlorine bleach (sodium hypochlorite) may be used to clean/soak tanks, aquaria, and any equipment for 15-20 minutes in a 3% solution (1 oz (30 ml)/quart of water) (J. Wyneken, FAU, in litt. 2008). Rinse the tank thoroughly with clean fresh or salt water.

Concerns and Warnings

Turtles can be kept in the tanks while cleaning, but cleaning should be done quickly and delicately so as not to stress the turtle (RAC-SPA, 1999).

For more information on the holding environment see:


V. DIET

Food Selection

Significant gaps remain in our understanding of the foraging ecology of sea turtles, as well as of the development and duration of diet preferences (Bjorndal, 1996). Similarly, there are gaps in our understanding of proper nutrition regimes for sea turtles in captivity (Goldman et al., 1998).

Sea turtles are generally not discriminating in the foods they eat, and captive individuals are often fed anything that is easily available (Goldman et al., 1998). Squid has often been a choice food because turtles love it, meaning that it can be effectively used to coax them to eat and or to deliver medication (see “Oral Medications/ Vitamins”). However, squid is high in phosphorous and low in calcium and should be avoided as a long-term diet for sea turtles because it can cause metabolic bone disease (Goldman et al, 1998). The optimum values of calcium and phosphorous ratios for most sea turtles has yet to be determined, but foods ranging between 1:1 and 1:2 ratios of Ca:P are the most accepted (George, 1997). Studies documenting calcium:phosphorous plasma ratios in wild and captive sea demonstrate that imbalances in these ratios can cause metabolic bone disease (Fowler, 1986; Norton, 2005a,c).

When first presented to a rehabilitation facility, turtles are often malnourished and/or emaciated. Because weight gain is a priority, foods high in calories, fat, and protein are initially preferred over foods with proper Ca:P ratios and lower in calories. Weight gain and loss can be a general measure for dietary management (RAC/SPA, 2004). Once weight gain occurs, foods with higher nutritional value can be slowly introduced into meals to promote a well balanced, healthy diet.

It is strongly recommended that sea turtles be offered an assortment of foods – this not only promotes proper nutrition, but more closely resembles the variety of foods and prey items that they would encounter and consume in the wild. For more information on different foods that are best for sea turtles (including their calcium, phosphorous, fat, and calorie contents), please refer to the “Food Guide” in Appendix E.

Food Quantity

The amount of food given per meal is dependant on blood values and weight, and ideally should be determined by a veterinarian. As a general guide, turtles should be fed between 1% and 5% of their body weight, tending to the lower percentage for maintenance and the higher percentage for sick, emaciated and/or younger turtles. Because a diet of 5% body weight may be high for an emaciated turtle to handle at the beginning of its treatment, meals should start small and gradually be raised to the correct amount. The same goes for turtles that have gained enough weight and are in transition to a maintenance diet; meals should be slowly reduced to the proper amount.

Turtles can be fed 1-3 times a day. The number of meals is dependant on how much food a turtle is given at each meal, as well as the demands of any medication(s) that has been administered. Meals are generally associated for oral medications that need to be given more than once a day, or for medications that need to be administered at separate times. More feedings may be necessary for turtles that require more food, or to encourage picky eaters; for these and other reasons, several smaller meals are generally preferred over fewer large meals. Larger food items should be cut into
smaller pieces to minimize the risk of intestinal obstructions (Norton, 2005c). Each meal should be properly weighed and recorded for each turtle prior to feeding, and all uneaten food should be collection (and discarded). Finally, always record the amounts and types of food that are offered, how much and what has been eaten, and any notes on behaviors. Examples of documentation forms are available in Appendix B.

**Concerns and Warnings**

When feeding, always watch to make sure that turtles urinate and defecate. Giving too much food initially or at one time can cause intestinal blockages (Norton, 2005c).

**Food Storage and Preparation**

Every facility should have a designated food storage and preparation area with a functionally freezer and refrigerator. All seafood, including fresh catches, should be kept frozen prior to use to kill potentially harmful bacteria. Vegetables and certain medications may also need to be stored in a refrigerated environment.

To prepare meals, transfer one day of food from the freezer to the refrigerator for approximately 24 hours to thaw. The day of feeding, thawed food should be taken out of the refrigerator, weighed, cut, allocated to designated storage bins for individual turtles, and placed back into the refrigerator until the scheduled feeding time. Any food that is not completely thawed can be rinsed with cold (never hot) water. Any vegetables should be washed thoroughly, weighed, cut, and refrigerated prior to feeding. Never re-freeze any food that has been prepared.

Used kitchen tools – including strainers, knives, food containers, and cutting boards – should always be washed with soap and water after every use and stored properly.

**Feeding Techniques and Tips**

**Free Feeding**

The most basic feeding method is to hand-toss prepared food items throughout the tank (do not concentrate food items in one general area) in order to promote “foraging”. It is also a good idea to walk away once the food has been given; in this way, the turtle is less likely to associate your presence with food. Dispose of any seafood not eaten after 20 minutes. Vegetables can be disposed prior to new meals. Anything not eaten should be weighed and recorded. Never save any used food or throw into other tanks to be eaten.
Forced Feeding

Turtles occasionally need some coaxing before they will eat. Poles (made of wood or metal, tapered to a sharp point) and tongs are simple tools that can be used to hold food securely while waging it in front of a turtle’s mouth to encourage feeding. Once the turtle takes the food, immediately remove the pole (or tongs) from the water. If the turtle does not eat after several minutes of attempts, try again later. Always properly sanitize the pole (or tongs) between feedings, and between turtles. Generally, poles work best for turtles that remain on the bottom of the tank, while tongs work better for turtles that tend to feed at or near the surface.

Concerns and Warnings

Feeding poles are sharp – keep them away from a turtle’s eyes or any wounds. Always keep your hands safely out of bite range when feeding, and be aware that turtles can both lunge forward and turn their heads quickly. Do not attempt to hand feed a sea turtle. Never share uneaten food between turtles to prevent contamination and overfeeding.

Tube Feeding

Turtles can go several days without food, but if a turtle will not eat or is unable to eat on its own, tube feeding may be the only option. Because severely dehydrated and debilitated turtles can have a tendency to regurgitate food (Norton, 2005a), confirm that the turtle is stabilized (i.e. has received initial IV/Sub/Q fluids, x-rays, antibiotics, and is freed of parasites) prior to attempting to tube feed.

**PROCEDURES FOR TUBE-FEEDING A SEA TURTLE**

- Select an appropriately sized tube, depending on the size of the turtle.
- Prior to feeding, align one end of the tube with the turtle’s nose, then measure and mark the point on the tube where the second vertebral scute is (refer to the “Sea Turtle Anatomy Guide” in Section II, “The Essentials”). This is to know how deep to insert the tube in the turtle (to the anterior portion of the stomach).
- Position and secure the turtle against the padded board.
- Tap the nose, or gently pry the mouth open with a rope or a malleable spoon.
- Extend and straighten the head and neck, then insert the lubricated tube gently into the mouth and slide to it down to your mark. Use a bite block, if needed, to keep the mouth open.
- Hold the tube vertically. Using the catheter tip syringe, inject any medications first, and follow with a tube with water. Follow with appropriate injections of liquid food. Constantly smell the animal’s breath for signs of halitosis, which can indicate regurgitation and aspiration. If foul smell is present, immediately stop tube feeding and return the turtle to the water.
- Once feeding is done, gently remove the tube and the bite block and immediately return the turtle to shallow water. Weak turtles should also be placed in water, even if only for 1 - 5 minutes. The water allows the turtle to clear its throat and safely expel excess materials. Some material may expel from the nose, which is normal and does not indicate aspiration.
Liquids used for tube feeding vary depending on the physical condition of the turtle: less viscous ("runny") mixtures for extremely emaciated turtles or turtles that arrive with shell-impact injuries; more viscous (thicker) mixtures for turtles in better physical condition. As with other feeding methods, the number of meals and the amount of food offered will depend on measured blood values, the weight of the turtle, and any medications to be administered and should be determined by a veterinarian.

Pieces of whole food should be offered between tube feedings. Watch for and confirm that the turtle is urinating and defecating; as with any feeding, dangerous blockages can still occur. Once the turtle is able to eat on its own, tube feeding should be stopped.

See Appendix F for liquid food options and recipes for tube feeding.

The following additional information and helpful notes on supplies and methods were provided by Michelle Bauer of the Volusia County Marine Science Center in Florida, USA.

Opening the mouth: A loggerhead sea turtle has a tendency to open its mouth if you tap on its nose. Malleable metal teaspoons can be used to pry open the beak, for smaller turtles, as long as you tilt and prop different spots around the beak when trying to open. Rope threaded through heavy gauge flexible tubing can also be used, especially for large turtles. The key is smooth edges, strong enough to open the mouth, and gentle enough not to harm the beak.

Selecting a feeding tube: The best material for a feeding tube is flexible, reinforced nylon. The size of the feeding tube is related to the size of the turtle, but is typically 30-76cm (1 - 2.5 feet) long and displays a diameter somewhere between a butterfly catheter tube and a garden hose. One side of the tube should be small enough for a catheter tip syringe to fit inside, so smaller tubes can be fit into larger tubes.

Lubrication: The tube should be lubricated on the outside, prior to use, with a non-toxic lubricant such as mineral oil.

Catheter tip syringe: A catheter tip syringe, up to 100cc, is useful for injecting medication, food, and water into the tube. The size of the syringe should correspond to the size of the tube; i.e., small enough to fit inside the tube but large enough to fit snugly (to prevent leakage).

Keeping the mouth open: A bite block is necessary to prevent the turtle from crushing the feeding tube. Bite blocks can be made of flexible, reinforced nylon tubing; strength is gained by layering smaller diameter tubes inside of larger diameter tubes.

Positioning the turtle: Place the turtle on a padded board with an incline of 30° to 90°. The board can be attached to the tank, or positioned inside a holding tank. The incline is necessary to prevent regurgitation during feeding.
Concerns and Warnings

Tube feeding should only be used as a last option for a turtle that will not or is physically not able to eat on its own. Many complications can occur so we strongly suggest tube feeding under the guidance of other workers experienced with the technique or seeking advice from colleagues in the region with tube feeding experience.

For more information on tube feeding, please refer to:


Oral Medications/Vitamins

For turtles that are eating on their own, oral medications and vitamins can be given with meals. Pills and capsules can be stuffed inside the fish gills, anal hole, or muscle; or inside a squid’s mantle prior to feeding. Pills must be stuffed far enough inside so that they do not fall out. Do not stuff more than two pills per fish or per squid. To help ensure that medications and vitamins are taken, feed medicated food first. Turtles with unstable appetites can be given a piece of non-medicated food first to confirm that they are ready to eat. Medicated food is for immediate use, never store it. Green turtles that are primarily given vegetables can also be given some fish or squid for oral medications and vitamins. Always keep track of and discard any pills that are not eaten or crushed when turtle chews food.

Other Tips

- Having a variety of food is not only great for picky turtles, but variety can aid in dispensing. For example if small fish or shrimp is not a preferred food, but squid is, then the smaller food can be stuffed inside the squid mantle (see insert).

- Remove squid pens. Turtles do not digest them and they can clog pipes, drains, and skimmers.

- Inject spring water into epidermis of squid or fish for extra hydration.

- See “Food Items” in Section VI. “Enrichment.”
VI. ENRICHMENT

Captive sea turtles are often restricted to a sterile, single species environment that does not allow them to engage in many natural behaviors. Enrichment provides behavioral choices by allowing turtles to use the available space, reduces stereotypical swimming that can result in injury (such as calluses from rubbing the sides of the tank), and encourages species-specific activity related to exploration, foraging, and tactile stimulation (Cunningham-Smith et al., undated; Therrien et al., 2007). The promotion of natural behaviors aids in the rehabilitation process by stimulating appetite, building strength, and encouraging alertness.

Food Items

Food-based enrichment is best to stimulate appetite, curiosity, and movement. Each food item offered needs to be considered in the daily diet; enrichment should not result in over-feeding. To reduce the risk of cross-contamination, never re-use uneaten food items or share food (or other enrichment) items between tanks.

Live Food

Crabs and jellyfish offer excellent enrichment because they represent easy-to-catch live prey. Remove crab pinchers before placing the crab in the tank to prevent injury to the turtle’s eyes or open wounds. Use only one live food item at a time to reduce waste. Remove any crab remains. Note: Good for all species; loggerheads especially like crabs.

Ice Blocks

Fill a small container with water, several drops of food coloring (optional), and a few pieces of food (such as fish, squid, or vegetables) and freeze the container overnight. Empty the frozen block into water and let the turtle do the rest. Clean up and dispose of any uneaten food. Note: Good for all species.

Feeding Tube

Cut a 20-60 cm length of large PVC pipe and drill several holes (less than 2.5 cm in diameter) on opposite sides of the pipe. Smooth the cut ends of the pipe, or cover them with socket fittings. Insert leafy or sliced vegetables into holes, and sink to the bottom of tank. Remove tube once the food is gone or before staff members leave facility for the night. Note: Best for green sea turtles.

Feeding Mat

Secure (such as with nylon cable tie) a rubber mat to a metal or plastic grate. Insert leafy and sliced vegetables into the holes. Weights may need to be added to allow mat to sink (for example, rocks). Remove mat when the food is gone or before staff members leave facility for the night. Note: Best for green turtles.
Non-food Items

Non-food items are excellent for tactile stimulation and to promote natural exploration. These items can be left in tanks during hours of supervision. Items should never be shared between tanks unless they are sterilized between uses.

Rocks

Large, smooth-shaped rocks are simple items that can be placed on the bottom of any tank. Rocks (too large to be ingested) are one of the few items that can be left in the tank at all times. To prevent contamination, rocks should be cleaned every couple of weeks and whenever a new turtle is introduced into the tank.

Waterfalls

A simple trickle of water from circulation (see “Filters and Pumps”) or spray bars (see “Temperature Control”) provides a welcome massage!

Hiding Places

PVC pipes with a large diameter and smoothed edges are great “hiding places” for a turtle to lay its head or to go completely inside. Be mindful of the size of pipe used – a too-narrow pipe might allow a turtle to become stuck. PVC pipes can also be constructed into pyramid or rectangular shapes that allow turtles to swim in and out. Exploration areas can also be created using cement blocks and flat plastic, fiberglass, or non-corrosive metal panels. To make, layer blocks, add panels, and layer blocks again. The space should be wide enough for the turtle to swim through, and the structure should be sturdy enough to prevent collapse.

Back Scratcher

These items are easily constructed of PVC pipes and socket fitting. When designing, make sure that the finished “scratcher” can be fit snugly onto the side of the tank and that it is angled slightly up from the water. This allows the scratcher to stay in place and allows the turtle to easily get underneath.

Concerns and Warnings

Be mindful when designing enrichment items: keep the design simple and as natural as possible. Turtles may associate certain materials and objects with something they would find in the wild like parking cones, buoys, or tires. This association encourages exploration and alertness.

Enrichment items are also meant for turtles that are in better health and should not be used for debilitated turtles, unless live food is given to stimulate appetite.
VII. RELEASE

Final Assessment and Clearance

A recovered turtle should be prepared for release as soon as practicable. An assessment, conducted by a veterinarian, should meet the minimum requirements articulated in the check-list below.

**FINAL ASSESSMENT AND CLEARANCE FOR RELEASE**

To be a successful candidate for release, the turtle should be:

- Off all medications for at least two weeks, without complications
- Actively eating on its own – free feeding, diving to retrieve food
- Able to capture any live food given (in the case of a large juvenile or adult) or able to make a good attempt to capture live food (in the case of a young juvenile)
- At a stable and normal weight – not changing drastically, not emaciated, not overweight
- Disease free – no open wounds/sores, tumors, skin irritations, debilitating epibiota, or parasites
- Defecating normally and regularly
- Actively moving, swimming, diving without assistance
- Able to lift its head strongly when breathing
- Attempting to crawl when on solid ground
- Able to hold its limbs and head above the ventral surface of its body, and act as if swimming when lifted out of the water
- Display normal blood parameters for 2-4 weeks (recommended, although not required)

Once a turtle is cleared for release and tagged (see “Tagging”), it should be returned to a safe and non-polluted area, either where it was initially found or in an area where other turtles of its species and size class are known to inhabit. The most common protocol is to allow the turtle to crawl on the beach, into the sea. If individuals of its species and size class are not found in nearshore waters, release at sea from an appropriate vessel should be arranged (see “Handling and Transport”).

Releasing off rocky cove, © B. Bergwerf, SCA  
Beach release  
Boat release
Tagging

Upon release, tagging provides a way to identify sea turtles as individuals (Eckert and Beggs, 2006). The two general types of tags most often used on sea turtles are externally placed metal flipper tags and internally placed PIT (Passive Integrated Transponder) tags.

It is recommended that tagging of both flipper and PIT tags should be done a week prior to release. This is to ensure a proper amount of time to monitor for any infections that could ensue. Also, make sure to report all tags used to the Cooperative Marine Turtle Tagging Program.

The following sections on Flipper and PIT tags are adapted from Eckert and Beggs (2006) "Marine Turtle Tagging Manual, Revised Edition", which should be consulted for additional detail.

Concerns and Warnings

To reduce the possibility of infection, tagging should be a sterile, clean, and careful process. Infections can require two more weeks of antibiotics, plus an additional two weeks of observation before a clean bill-of-health is issued. We do not recommend any flipper or PIT tagging of hatchlings or neonates of any species.

Flipper Tags

Flipper tags are modified livestock tags that must be pierced through the flesh and clamped closed using tag applicators specially designed for each tag type. They are the most commonly used identification mark on sea turtles and can provide information on population trends, habitat residency, movement patterns (including international movements among range states), individual growth rates, reproductive life history (e.g. remigration intervals, nesting frequency, clutch size, and/or hatchlings produced per female), and strandings.

Tag Size Considerations

Most tags are not suitable for use on very small animals. While small tags (e.g. Monel style 1005-1) are commercially available, there are no data to evaluate their retention rates or any effect they may have on the movement or survival of very small turtles. Experience with the Monel 1005-1 used on hawksbills 20-30 cm in straight carapace length (SCL) suggests that they corrode quickly, break easily and, therefore, are not well retained.

As a general rule, we recommend that no turtle smaller than 30 cm straight carapace length (SCL) be tagged with an Inconel 1005-681 tag. Having said that, it is also worth noting that there is variation in the size of the enlarged fleshy scales at the trailing edges of the front flippers. Some hawksbills of 25 cm SCL have relatively large scales that can hold an Inconel 1005-681 tag comfortably, whilst some 30 cm SCL turtles may not. If the tag hangs too far beyond the edge of the flipper, it may impede swimming motion and causes drag that will likely result in tag loss.

Turtles larger than 30 cm SCL should be tagged with Inconel style 1005-681 tags. The larger Monel style 1005-49 can also be used for large green and loggerhead turtles.
Where Should a Flipper Tag be Applied?

Two tags, one in the trailing edge of each front flipper, should be applied to every turtle. The secure placement of two tags, referred to as “double-tagging”, increases the likelihood that a turtle will retain her unique identification over several years.

Flipper tags can be applied in one of two ways: either through or between the enlarged fleshy scales located at the trailing edge of the flipper. If through the scale, we recommend placement in the center of the first or second scale proximal to (closest to) the body of the turtle (meaning closest to the axilla or “armpit”) on both the left and the right front flippers. If between the scales, we recommend placing the tag between the first and second scales.

There is debate among experienced field scientists whether tags are retained longer when placed through or between scales. Some observe that a callous form in the scale, creating a thickening at the site of tagging that eventually pops the tag open and results in its loss. Others counter that the scale provides a solid grip for the tag, and that tags placed in the softer skin between the scales are more likely to be lost. There is no definitive answer to this debate, and we encourage you to experiment with tag placement and to identify the tagging location that works best for you and for your population of sea turtles. The tag should be applied so that there is approximately 3-5 mm of open space between the trailing edge of the flipper and the inside curve of the tag.

Rear flipper placement is also an option. Some experts contend that rear flipper placement reduces the chance that the tag will cause entanglement in nets. Notwithstanding, the long history of front flipper tagging means that a rear-placed tag is less likely to be found and read during later encounters. If, however, injury or other circumstances significantly reduce the likelihood of successful tagging on the front flipper, a rear flipper tag is best placed through (or adjacent to) the first large scale.

Concerns and Warnings

Regardless of whether your tag is placed through or between scales, it is important to remember that with increasing distance away from the body, tag retention is compromised. The further the tag is placed from the body, the more likely it is to be lost due to hydrodynamic forces, biting during courtship (or from fish), ensnarement in a fishing net, etc.
Hint: Practice tagging technique on a sheet of corrugated cardboard. It is important to become comfortable and confident with the quick, decisive action needed to penetrate the flesh and cinch the tag correctly. Slow or imprecise movements can cause discomfort to the turtle. Moreover, if the animal moves (especially in a startle response) during tag placement, the application may be ruined.

Preparation for Flipper Tag Application

Wash: During the manufacturing process the tags are covered in a lubricating oil comprised of an animal-based oil and mineral spirits, and therefore must be washed prior to being applied to a turtle. Unwashed tags quickly cause infection at the point of application. One option is to wash your tags in hot soapy water; another option is to use a biodegradable solvent or cleaning solution such as Simple Green® or BioChem SolSafe 245®. After cleaning, thoroughly dry the tags and store them in sealed plastic food storage boxes or Ziploc™ type bags.

Bend: If you consistently encounter problems with tags that do not fully cinch closed, give extra care to loading each tag correctly; that is, with the base plate flush against the pliers. You may also find it useful to adjust/bend the tag to help ensure that the point of the tag enters the hole during the application process. Bend the tag so that the pointed end meets up with the hole, but be careful not to bend the tag too frequently as this may affect the integrity of the metal (this is particularly true with the softer Monel tags). Once you have bent the tag to ensure a fit, re-open the tag so that it will be retained snugly in the tag applicator.

Examine: Before applying a tag, examine the area for tag scars. Scars are difficult to confirm, but can appear as rips in the flipper scales or skin, or lumps of scar tissue in the same areas in both front flippers. Feel along the edges of all flippers, and gently squeeze the first and second scales to identify any lumps. Record the presence of tag scars, or potential tag scars, and avoid placing new tags in these areas. Apply new tags as described below.

Flipper Tag Application Steps

- Rinse the tip of the tagging pliers and the tags (and a field knife, if used) in alcohol.
- Cleanse tagging site on the turtle with Betadine© or rubbing alcohol before tag insertion.
- Pull the tag through the grooved guides in the jaws of the applicator (pliers) until it “snaps” into place. Make sure that the base plate of the tag is flat against the bottom jaw and the “bubble” is seated in the hole. Marking one jaw of the pliers with white paint can assist in loading the tags correctly at night. Be sure to check that the tag is seated securely before proceeding to the next step.
- Position the tag and pliers so that the tag number is facing upwards, is at the proper location on the flipper, and will result in an appropriate gap between the trailing edge of the flipper and the inside curve of the tag.
• Squeeze the pliers with a firm, smooth action. Squeezing too lightly will not allow the tine to bend and lock into place, while squeezing too hard may cause the tag to flatten and pinch the flipper. *Either mistake will result in tag loss, and the latter (squeezing too tightly) can cause unnecessary and unacceptable discomfort to the turtle.* Topical anesthetics, such as for human sunburn, are sometimes recommended but should not be necessary; if tags are applied properly, the typical reaction is one of only mild discomfort.

• Confirm that the tag is properly applied and cinched. For Inconel tags, turn the flipper over and examine the bottom of the tag to confirm that the tag has penetrated and that the tip (tine) is completely bent over and secure. An Inconel tag that is not secure can often be re-crimped with the tagging pliers. If this fails, remove the tag carefully and try again with a new tag, using the same puncture hole if possible. In the case of a stirrup-style Monel tag (see insert) where the bent tine is not visible, place your thumb and index finger on either side of the tag and gently attempt to wedge your fingers under the tag; if the tag pops open, it is not secure and must be replaced.

• **RECORD THE TAG NUMBER.** It is only after you have confirmed the proper and secure placement of the tag(s) that the tag numbers are recorded on the datasheet. Record the numbers carefully, and indicate the placement site (e.g. left front flipper) if required by the datasheet. Take **GREAT CARE** in reading and transcribing the numbers. Check and **double-check** that you have read and recorded the numbers correctly (it is helpful if a second person reads the numbers to the data recorder). Always record zeros.

### Concerns and Warnings

It is noteworthy that placing a metal tag, especially a Monel style tag, through a scale in a large adult turtle’s flipper may require the pre-punching of an insertion hole for the tag. The insertion should be made quickly and cleanly with a small blade (such as a Swiss Army® knife blade) inserted perpendicular to the scale. The knife should be sterilized after each use with an alcohol wipe or dipped in disinfectant.

*Hint*: Practice the technique for applying flipper tags through a piece of corrugated cardboard until you are comfortable with decisive and successful tag insertion. “Successful” tag insertion is defined as a secure clasp (the tip of the tag is completely bent over and fastened), correct spacing between the flipper edge and the inside curve of the tag, and no pinching of the flipper flesh.

### PIT Tags

PIT tags are “small inert microprocessors sealed in glass that can transmit a unique identification number to a hand-held reader when the reader briefly activates the tag with a low frequency radio signal at close range” (Balazs, 1999). A PIT tag is cylindrical in shape, about the size of a grain of rice, and is injected under the skin or into the muscle. When a specialized reader is passed over the tag, the reader generates a low energy radio signal that energizes the tag to transmit its number. The turtle feels nothing as the reader (scanner) is passed over it. The received number, typically 9-15 digits arranged in a unique unalterable
alphanumeric code (i.e. a combination of numbers and letters), is displayed in the reader’s viewing window.

The use of Passive Integrated Transponder, or “PIT” tags, in adult sea turtles is well-tested and offers the clear advantage of superior tag retention (at least when compared to metal flipper tags), but there is less information on the long-term effects of PIT-tagging juvenile turtles. We do not discourage the PIT tagging of small juveniles, but we do urge you to contact colleagues who are experienced with these young size classes. We recommend that turtles smaller than 30 cm SCL not be PIT tagged, and that novice taggers do not try to PIT tag animals smaller than 35 cm SCL. Each turtle receives a single PIT tag.

**Concerns and Warnings**

Applying PIT (Passive Integrated Transponder) tags is considered to be more invasive than applying flipper tags and should be done only under the guidance of workers experienced with the technique. Before embarking PIT tagging, please seek advice from experienced PIT tagging colleagues in the region. PIT tagging is not a substitute for flipper tagging, but is best used together with flipper tagging so that at least one external tag is readily visible for the next encounter.

**Tag Brand Considerations**

To date there has been very little standardization among sea turtle scientists with regard to brand, excitement frequency, placement (i.e. tagging site on the turtle), or record-keeping. The challenge this presents from a data collection standpoint is that when the reader is not “matched” to the excitement frequency of the tag, the tag cannot be detected. Standardizing brand use across geographic regions would assist in ensuring that turtles PIT-tagged at one site could be de-coded and read at other project sites.

We recommend that projects intending to begin PIT tagging collaborate directly with experienced colleagues; that unencrypted tags be used so that they can be read by other scanning technologies (or brands) should your tagged turtle nest or be captured in a distant country and that you select a reader capable of detecting PIT tags made by different manufacturers.

**Where Should a PIT Tag be Applied?**

A PIT tag is injected under the skin, generally into muscle, using a needle applicator provided by the manufacturer. We suggest tag insertion into the front flipper between the radius and ulna. The major joint in the flipper is between the humerus bone and the radius and ulna bones. You should be able to feel a depression between the radius and ulna bones – this is where the PIT tag is applied.

The tag can be injected proximal to distal (i.e., point the syringe toward the fin tip) into the connective tissue of the forearm between the radius and ulna and parallel to the bone or adjacent to (as opposed to just distil to) the radius and ulna. The landmark for the distil ends of the radius and ulna is the end of the three large scales on the leading edge
of the flipper, (see arrow). Another location is the triceps muscle complex on the front and top of the humerus. The muscle is active during part of the swimming stroke, but no lameness has been detected in animals receiving a PIT tag in this location (J. Wyneken, Florida Atlantic University, unpubl. data).

Whatever location you choose, remember that PIT tags are designed to become encapsulated with fibrous connective tissue in muscle. When the tag is encapsulated, it will not migrate away from the insertion point. Experience has shown that the tags do not encapsulate as reliably in skin, tendon, ligament, connective tissue or fat.

**PIT Tag Application Preparation**

**Sterilize:** Most PIT tags and applicators are pre-sterilized and packaged for field use. If the PIT tag style you select is not pre-sterilized, it is important that each tag be soaked in a nontoxic sterilizing solution (such as alcohol) prior to use.

**Scan:** Make sure that the turtle has not already been PIT tagged! Sea turtles encountered in the Wider Caribbean Region may have already been tagged in the USA, South America, West Africa or the Mediterranean during an earlier life phase, or during a nesting or non-nesting encounter with another research project. With flipper tagging this is easy to confirm, but with PIT tags you need a reader that can give you accurate information. There is no consensus on the placement of PIT tags, and for this reason personnel should examine all possible sites (i.e. left and right shoulder muscle, left and right fore flippers, left and right rear flippers, neck) for existing tags before a new tag is inserted. Be sure to scan all areas, even if a PIT tag is found, because some turtles may already have more than one PIT tag. To scan for an existing tag: turn the reader ON, place the reader directly on the skin of the turtle to decrease the “read distance”, and then press and hold the READ button. Continue to hold the READ button while moving over the area to be scanned in a circular motion. Be sure to use the entire reading surface of the scanner when trying to detect the tag.

**Re-scan:** After you have made a number of scans of the area, re-scan the area while tilting the scanner at various angles. PIT tags read best when the tag is pointing with the small end (picture the tip of a grain of rice) pointed directly toward the scanner, but the tag is not always oriented optimally under the skin. By tilting the reading surface at different angles during a sweep, you improve your chances of detecting a tag that may be angled away from the skin.

**Record:** If a PIT tag number is identified by the reader, the number should be entered on the data sheet in the space allocated for this type of tag, and should be documented EXACTLY as it appears on the scanner display, including any hyphens that may appear as part of the code. The tag “number” is usually hexadecimal (digits 0-9 and letters A-F) and 10 bytes (125, 128, or 400 kHz tags) or 15 bytes (134.2 kHz tags) long. Double-check to make sure you have recorded the tag “number” exactly as it appears on the reader display, taking care concerning letters and numbers that can easily be confused, e.g. the letter O and the number 0 (or, Ø). If the scanner display reads “AVID” or reads inconsistently, you may have detected an encrypted AVID tag. Encrypted tags may display a 16 byte alphanumeric code (0-9 and A-Z) on non-AVID reader displays. Once you confirm that the turtle is not already carrying a PIT tag, insert new tag as described below.
Concerns and Warnings

If your reader has a low battery, or if you are attempting to read an encrypted tag that is not recognized by your reader, some readers will give bogus or “ghost” numbers. An example might be an excessively long alphanumeric code or nonsense symbols. If this occurs, turn the reader OFF, turn it back ON, and re-scan. If nonsense readings persist, try another reader or replace the batteries. If nonsense readings still persist, record them for later evaluation and make relevant notes on your data sheet.

Remember also that if the turtle, or flipper, is resting on anything iron (such as the bed of a truck), you should lift it up a few inches before reading. Iron (and certain neon lighting and electrical motors nearby) can neutralize the ability of the reader to detect a tag.

PIT Tag Application Steps

- Before application, the area where the tag will be injected should be cleaned with a Betadine® (or Povodine®) saturated swab.

- ALWAYS SCAN (AND RECORD) THE NEW TAG BEFORE YOU INSERT IT TO VERIFY THAT IT IS FUNCTIONAL.

- To inject PIT tag proximal to distal between the radius and ulna (i.e. where the syringe is pointed toward the fin tip) or adjacent to the radius and ulna (i.e. where the syringe is pointed toward toward the body, at the end of the three large scales on the leading edge of the flipper), insert the syringe under the skin and push the plunger to move the tag out of the applicator and into the connective tissue.

- To inject using the triceps muscle complex, isolate by pinching the area next to the dorsal humerus. Angle the applicator to ensure the tag is inserted into the muscle complex and not too deep into the flipper and push the plunger to move the tag out of the applicator.

- Watch for bleeding after injection. If blood flows from the wound, apply pressure with swab soaked in a broad-based topical microbicide, such as a povidine-iodine antiseptic solution (e.g. Betadine®), until the flow stops. It may be necessary, especially in small juveniles, to apply a small amount of surgical glue to close the opening.
VIII. HATCHLING HUSBANDRY

Reasons for Hospitalization

Hatchlings may be subjected to several debilitating factors during their journey between the nest and the ocean. Predator attacks from mammals, birds, crabs, and insects are common in the nest and during the journey to the sea. After a nest hatches, sometimes stragglers get trapped inside the nest and are unable to emerge and are found during excavation. Depending on the distance of the nest to the water, time of day, temperature, beach disturbances (such as beach lighting), condition of the hatchlings, as well as other factors, hatchlings may be too weak to reach the water or if they make it to the water, too weak to swim through the surf and wash back ashore. As a result hatchlings may require hospitalization for as little as several hours in a safe cool place in the shade or up to several weeks to recuperate from traumatic injuries and other health conditions.

Live Hatchling Transport

Container size for turtles should be large enough to comfortably hold the turtle, but small enough to prevent excessive motion and turning. Modified milk crates, or appropriately-sized buckets or coolers can be used (Higgins 2003). In the case of hatchlings:

1. Place a few inches of cool, damp beach sand or a damp towel in the transport container. If the material is too dry, the young turtles may desiccate (dry out). Take extreme caution if transporting sea turtles, including hatchlings, in water.

2. Avoid excessive heat or cold during transport: Because hatchlings are so small, they are more susceptible to temperature changes. Check moisture levels regularly; moisture can be added using a fine mist from a spray bottle or the turtle can be lightly coated with a water-based lubricant.

Concerns and Warnings

Make sure that containers are secured during transport, such that they do not slide around or tip over.

Holding Environment

Hatchlings kept for several hours may be kept in covered buckets or containers with a couple inches of damp beach sand or a damp towel.

Some hatchlings require more than an overnight stay and may or may not be able to swim. If the hatchlings are put into water and they showing no effort to swim or float, they should be removed from the water immediately. If too weak to swim, the hatchling can be placed on an in-water stretcher. In this type of situation, they require strict monitoring due to their greater susceptibility to environmental conditions, like temperature (see “Maintaining Turtles out of Water” in Section IV, “Holding Environment”). Hatchlings that are alert and active may be able to swim on their own but should be monitored closely when put in deeper water (water more than an inch) to make sure the turtle can float and surface to breathe effortlessly.
Tank selection can be anything from the large scale sea turtle systems (see “Maintaining Turtles in Water” in Section IV, “Holding Environment”) used for the adults that include mechanical, chemical, and biological filtration or something as small as a 38 liter (10-gallon) tank for a short-term stay. Due to the delicate status of the hatchlings, floating baskets (made of sturdy plastic) placed inside a larger tank can allow one to closely monitor them and prevent them from getting trapped in drain or suction lines. Floats attached to baskets, can be made of small buoys or trapped air in capped PVC bottles. The baskets can also be tied to the side of the tank for security.

If the hatchlings are unable to swim well, float beds (floating stretchers that can be constructed from mesh that can be cable-tied to capped PVC pipe floating frames) can also be created inside tanks or within the baskets and should be built so that the hatchling has its nostrils out of water, but can still drink. Floating stretchers allow hatchlings to thermoregulate and stay hydrated; the thin water layer helps support the body. Once the hatchling has enough energy to crawl around the mesh, they might be ready to start swimming and feeding on their own.

**Concerns and Warnings**

As for all turtles, tank and water system set-up must be “turtle proof.” Because hatchlings are small, extra concern must be taken for the size and location of outflow valves, intake pipes, or holes to prevent drowning or injuries.

Floating debris (even from the buoy floats) should be removed by either by net (“netting out”) materials or having a surface skimmer on the system.

Use caution when using chlorine for sterilization. Cleaning with chlorine bleach (sodium hypochlorite) requires extra care. Be sure to keep the bleach fumes away from hatchlings. Tanks, aquaria, baskets, floats and bowls can be soaked for 15-20 minutes in a 3% solution (1 oz (30 ml)/quart of water). Rinse thoroughly with clean fresh or salt water before reintroducing hatchlings. (J. Wyneken, Florida Atlantic University, in litt. 2008)

**Identification**

Because hatchlings are difficult to distinguish from one another, it is helpful to mark them – such as with children’s nontoxic nail polish applied as a number or combination of dots to the dry carapace – for feeding and medication records. Nail polish is not a permanent mark and reapplication may be needed depending on the length of stay. Another option is to keep hatchlings in separate, labeled, perforated baskets or other suitable floating containers in the holding environment. Photographs (top view, side view) provide an important redundant system of identification because scale (and sometimes scute) patterns can be unique (J. Wyneken, FAU, in litt. 2008).
Diet

Hatchlings (with the exception of leatherbacks) can be fed a variety of crustaceans, mollusks, and fish carefully sized so that they are easy to swallow whole or soft enough to bite off small pieces. Bones and shells should be removed until the turtle is large enough to swallow them without difficulty. Hatchlings can also be fed or supplemented with a gel or pellet food. Add additional foods or vitamins to meet nutritional needs and make the gel food more palatable. For gel recipes see Appendix D. The amount of food given depends on the species and the body weight. Hatchlings are often fed a high percentage body weight at first, between 8-15% (J. Wyneken, FAU, in litt. 2008), and may need to be fed several times a day in order to meet a target intake.

Food preparation and storage should follow the same guidelines described in Section V, “Diet.”

During the first several days of life, hatchlings obtain most of their energy and nutrition from a residual yolk sac. For this reason, it is normal for newborns not to feed for several days. Hatchlings that do not have yolk sacs attached should be eating within a few days (no more than 3). If the hatchling doesn’t start eating on its own, food will have to be forced. Gently open the mouth with the loop end of a small paper clip or a blunt toothpick. Cut solid food, such as small pieces of shrimp or fish, of a size to fill less than one quarter of the mouth. Feed less than a healthy turtle would eat in a single feeding. The target amount in hatchlings is 10-15% of body weight/day (Wyneken, FAU, in litt. 2008). Easy to swallow food can be placed in the mouth, or a liquid fish diet may be dropped in the mouth; watch to see if the turtle swallows it. The turtle may need to be placed back in the water to make swallowing easier. Tube feeding is a last resort (see “Tube-Feeding” in Section V, “Diet”).

Release

For hatchlings that remain hospitalized for several hours to a couple of days, they can be released back on the beach they were hatched or at a nearby beach. In some species, such as green turtles, it is recommended that they are released at their natal beaches as some populations have stronger nest sight fidelity than other species (Kelly Martin, Mote Marine Lab, 2007, pers. conv. and J. Wyneken, FAU, in litt. 2008). Hatchlings can be placed at or near the waters edge to allow them easy access to the water without an excessive journey across the sand. Release should take place at night to reduce predation.

Hatchlings that have been rehabilitated for several days or weeks should be able to easily swim, dive, have buoyancy control, have outgrown minor deformities, eat on their own, and be free of any wounds, lesions, or injuries prior to release. Although one does not need to provide wild prey for hatchlings, live food such as jelly fish, small shrimp and crabs may be given prior to release. Hatchlings are generally curious and will eat almost anything, and their hunting skills may be assessed using live food.

Hatchlings that have been hospitalized for a longer period of time should be taken by boat to the weed line or sargassum offshore and released in waters of an appropriate temperature, preferably without fish nearby. Hatchlings should be placed within the vegetation for protection and to provide them easy access to food items.
IX. EMERGENCY PREPARATIONS AND PROCEDURES

The Caribbean is susceptible to tropical storms, hurricanes, and other factors that can result in power loss, flooding, and other emergency situations. With this in mind, there are several precautions that can be taken prior to or in the event of an emergency.

<table>
<thead>
<tr>
<th><strong>EQUIPMENT AND PRECAUTIONS FOR EMERGENCY SITUATIONS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>□ <strong>Power Generator:</strong> Power outages can span days or weeks after a storm. Be sure to have a good generator to use for minimum filtration, water intake, and refrigeration.</td>
</tr>
<tr>
<td>□ <strong>Extra Water:</strong> If water cannot be accessed to main water source, back-up water should be available. Store fresh and saltwater reserves.</td>
</tr>
<tr>
<td>□ <strong>Food:</strong> Extra food should be stored in a powered refrigerator or freezer. If there is no power, make sure the facility has a way of obtaining food for emergency purposes.</td>
</tr>
<tr>
<td>□ <strong>Secure Shelter:</strong> In case of a storm, make sure turtles are brought inside (if holding facility is outdoors). A great idea for outdoor facilities is to have a partnership with a secure shelter that may hold turtles and/or tanks during inclement weather.</td>
</tr>
<tr>
<td>□ <strong>Prepare Building and Surrounding Area:</strong> Trim tree branches surrounding the property, bring loose items inside, and board up windows.</td>
</tr>
<tr>
<td>□ <strong>Extra Tanks:</strong> Kiddie pools are great to have on hand. They allow easy access and cleaning for temporary holding. Note: Active turtles may have to be monitored more closely to make sure they don’t escape.</td>
</tr>
<tr>
<td>□ <strong>Back-up Documentation:</strong> Flooding can be a disaster for facilities during or after a storm. Documents are most often lost due to flooding. Because of this, make sure all documentation (patient records, food, medicine, water quality) have back-ups in a safe place. Hard copies or computer copies are acceptable as long as they can be safely archived.</td>
</tr>
<tr>
<td>□ <strong>Holding Environment Design:</strong> The initial design of the facility should be set-up in a way for easy management, cleaning, and drainage. Please refer back to Section IV, “Holding Environment” for more information.</td>
</tr>
</tbody>
</table>
LITERATURE CITED


There is no “one correct way” to document the rehabilitation process, but procedures and protocols should be established in such a way that they are (i) easily understood by staff and volunteers, (ii) meet the demands of the attending veterinarian, and (iii) meet the requirements of relevant permits or policy.

The following forms can be used as templates, or models, for your use:

Each turtle should be subjected to an initial assessment (Form A) prior to admittance to the facility. Once a patient, daily logs should be kept for water quality (Form B) and medications dispensed (Form C), as well as for recording details associated with feeding, diet, and behavior (Form D). Individual charts should be available for veterinary exams (Form E and Form F).
# Form A

## Turtle Assessment Sheet

<table>
<thead>
<tr>
<th>Head</th>
<th>retract when slightly pulled:</th>
<th>Y</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>lesions or abnormalities:</td>
<td>Y</td>
<td>N</td>
<td>If Y describe:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resp</th>
<th>sound:</th>
<th>clear</th>
<th>gurgle</th>
<th>other:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength:</td>
<td>head up/mouth open</td>
<td>Y</td>
<td>N</td>
<td>If Y: weak</td>
</tr>
<tr>
<td>head down/mouth open</td>
<td>Y</td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>head down/mouth closed/throat expansion only</td>
<td>Y</td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>carapace expansion</td>
<td>none</td>
<td>weak</td>
<td>moderate</td>
<td>strong</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eyes</th>
<th>open</th>
<th>closed</th>
</tr>
</thead>
<tbody>
<tr>
<td>menace response:</td>
<td>Left: Y</td>
<td>N</td>
</tr>
<tr>
<td>Right: Y</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>palpebral reflex:</td>
<td>Left: Y</td>
<td>N</td>
</tr>
<tr>
<td>Right: Y</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>lacrimal secretion:</td>
<td>not present</td>
<td>present</td>
</tr>
<tr>
<td>lesions or abnormalities:</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nose</th>
<th>discharge:</th>
<th>Y</th>
<th>N</th>
<th>If Y describe:</th>
</tr>
</thead>
<tbody>
<tr>
<td>lesions or abnormalities:</td>
<td>Y</td>
<td>N</td>
<td>If Y describe:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mouth</th>
<th>jaw tone:</th>
<th>strong</th>
<th>moderate</th>
<th>weak</th>
<th>slack</th>
</tr>
</thead>
<tbody>
<tr>
<td>color of MM:</td>
<td>normal</td>
<td>pale</td>
<td>hyperemic</td>
<td>jaundice</td>
<td>cyanotic</td>
</tr>
<tr>
<td>lesions or abnormalities:</td>
<td>Y</td>
<td>N</td>
<td>If Y describe:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Beak</th>
<th>note any abnormalities</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Carapace</th>
<th>lesions or abnormalities:</th>
<th>Y</th>
<th>N</th>
<th>If Y describe:</th>
</tr>
</thead>
<tbody>
<tr>
<td>epitbion:</td>
<td>Y</td>
<td>N</td>
<td>type of epitbion:</td>
<td>leeches</td>
</tr>
<tr>
<td>epitbion coverage:</td>
<td>0-25%</td>
<td>26-50%</td>
<td>51-75%</td>
<td>76-100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plastron</th>
<th>sunken appearance:</th>
<th>Y</th>
<th>N</th>
<th>If Y: mild</th>
<th>moderate</th>
<th>severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>lesions or abnormalities:</td>
<td>Y</td>
<td>N</td>
<td>If Y describe:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>epitbion:</td>
<td>Y</td>
<td>N</td>
<td>type of epitbion:</td>
<td>leeches</td>
<td>barnacles</td>
<td></td>
</tr>
<tr>
<td>epitbion coverage:</td>
<td>0-25%</td>
<td>26-50%</td>
<td>51-75%</td>
<td>76-100%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flippers</th>
<th>lesions or abnormalities:</th>
<th>Y</th>
<th>N</th>
<th>If Y describe:</th>
</tr>
</thead>
<tbody>
<tr>
<td>motion of appendages appear normal:</td>
<td>Y</td>
<td>N</td>
<td>If N explain:</td>
<td></td>
</tr>
<tr>
<td>pinch/pull away reflex present:</td>
<td>Y</td>
<td>N</td>
<td>If Y: weak</td>
<td>moderate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Skin-</th>
<th>lesions or abnormalities:</th>
<th>Y</th>
<th>N</th>
<th>If Y describe:</th>
</tr>
</thead>
<tbody>
<tr>
<td>epitbion:</td>
<td>Y</td>
<td>N</td>
<td>type of epitbion:</td>
<td>leeches</td>
</tr>
<tr>
<td>epitbion coverage:</td>
<td>0-25%</td>
<td>26-50%</td>
<td>51-75%</td>
<td>76-100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Urogenital</th>
<th>cloacal tone:</th>
<th>Y</th>
<th>N</th>
<th>If Y: weak</th>
<th>moderate</th>
<th>strong</th>
</tr>
</thead>
<tbody>
<tr>
<td>lesions or abnormalities:</td>
<td>Y</td>
<td>N</td>
<td>If Y describe:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>defecation:</td>
<td>Y</td>
<td>N</td>
<td>If Y describe: amnt/type:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tail</th>
<th>lesions or abnormalities:</th>
<th>Y</th>
<th>N</th>
<th>If Y describe:</th>
</tr>
</thead>
<tbody>
<tr>
<td>pinch/pull away reflex present:</td>
<td>Y</td>
<td>N</td>
<td>If Y: weak</td>
<td>moderate</td>
</tr>
</tbody>
</table>

## Swimming Evaluation

Able to submerge and swim normally | Y | N |
If N: describe |
Floating | Y | N |
If Y: Able to submerge |
Listing | Y | N | If Y: right | left | alternates |

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### Form B

| Date       | Temp | pH    | Salinity | Alk | Magnesium | Calcium | Nitrite | Nitrate | Bicarb | 
|------------|------|-------|----------|-----|------------|---------|---------|---------|--------|--------|
Form C

<table>
<thead>
<tr>
<th>Species/Common Name:</th>
<th>Case #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical problem:</td>
<td>Location:</td>
</tr>
<tr>
<td>Medication:</td>
<td>Drug Concentration:</td>
</tr>
<tr>
<td>DOSE:</td>
<td>FREQ:</td>
</tr>
</tbody>
</table>

Special Instructions

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Treatment/Observations/Remarks</th>
<th>Initial</th>
</tr>
</thead>
</table>

**Frequency**

- QID = One time a day
- BID = Two times a day
- TID = Three times a day
- QID = Four times a day

**Route**

- SC = Subcutaneous
- IM = Intramuscular
- IP = Intraperitoneal
- IV = Intravenous
- PO = Oral
- ID = Intradermal
- IT = Intracheal
- IC = Intracardiac
## Form D

<table>
<thead>
<tr>
<th>Date</th>
<th>Temp</th>
<th>Pnsh (Type)</th>
<th>Other</th>
<th>Blue Crab</th>
<th>Vitanms</th>
<th>Teal Fed (lbs)</th>
<th>Loged medas?</th>
<th>Hydrometer</th>
<th>Pump Basker</th>
<th>Water A (%)</th>
<th>Sedb Tank</th>
<th>Scub Tank</th>
<th>Behavior/Comments</th>
</tr>
</thead>
</table>

© South Carolina Aquarium
# Form E

## Initial Sea Turtle Examination Form

<table>
<thead>
<tr>
<th>Date:</th>
<th>Species:</th>
<th>Animal Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field #:</td>
<td>Weight:</td>
<td>Examiner:</td>
</tr>
</tbody>
</table>

### Stranding Circumstances:

### Physical Examination (Circle One)

<table>
<thead>
<tr>
<th>Attitude:</th>
<th>alert</th>
<th>depressed</th>
<th>lethargic</th>
<th>non-responsive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition:</td>
<td>normal</td>
<td>thin</td>
<td>emaciated</td>
<td>obese</td>
</tr>
<tr>
<td>MM:</td>
<td>normal</td>
<td>pale</td>
<td>injected</td>
<td>jaundiced</td>
</tr>
</tbody>
</table>

### Initial Stats

<table>
<thead>
<tr>
<th>Temperature:</th>
<th>Heart Rate:</th>
<th>Heart rhythm:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Able to log:</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Downloaded data:</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>

### Samples/Diagnostics

1. **Blood:**
   - Date/Time: 
   - Amount: 
   - Initials: 
   - Tests requested: 
     - Cultures: 
     - Fecal collected: Y | N 
     - Completed smear: Y | N 
     - Stored in refrigerator: Y | N 
     - Baermann Funnel used: Y | N 
   - Radiographs taken: Y | N 
   - Primary Findings: 

   Mark wounds or abnormalities on diagrams below and describe to right

### Initial Disposition

<table>
<thead>
<tr>
<th>Water or Dry docked? Why:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Health category:</th>
<th>Intensive care</th>
<th>Recovery</th>
<th>Maintenance</th>
<th>Probable Healthy</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Behavior Assessment completed:</th>
<th>Y</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Assessment completed:</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>

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Form F

Daily Soap Sheet

Field #: ____________________ Species: ______________ Date: ______
Location: ____________________ M T W TH F S Su

Subjective:


Objective:

Weight: ___________ Heart Rate: ____/minute Respiration: ______/minute

Assessment/Problem:
1. ________________________________________________________________
2. ________________________________________________________________
3. ________________________________________________________________
4. ________________________________________________________________
5. ________________________________________________________________
6. ________________________________________________________________

Plan:
Diagnostic Procedures:
1. ________________________________________________________________
2. ________________________________________________________________
3. ________________________________________________________________
4. ________________________________________________________________
5. ________________________________________________________________
6. ________________________________________________________________

Treatment:
1. ________________________________________________________________
2. ________________________________________________________________
3. ________________________________________________________________
4. ________________________________________________________________
5. ________________________________________________________________
6. ________________________________________________________________

Comments:


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APPENDIX C

TANK DIVIDERS

The dividers are made of 5cm (2 inch) PVC pipe around the perimeter with lattice in the center. To create, attach the lattice to the PVC pipe using screws, clamps and/or nylon cable ties. Use flexible tubing for the curved area of the divider that will run along the side of the tank. Add approximately 30-45cm (1-1.5 feet) of extra PVC pipe on the top to overhang the tank.

The center pole is 7.5cm (3 inch) PVC with cement on the bottom (be sure the cement is sealed so that it doesn't break down in the salt water). Attach a bone ring for dogs to the top and bottom of the divider with hose clamps, then slip the bone ring over the 7.5cm (3 inch) PVC pipe in the center.

All photos © Virginia Aquarium Foundation
APPENDIX D

ADVANCED DRY-DOCK SET-UP

For advanced set-up, secure the turtle on a padded or foam cushion (A). A dive belt (B) may be needed that surrounds both the turtle and the padding to ensure the turtle does not slip. Cement blocks (C) may be placed around turtle for additional support. Overhead, a mister (D) may be attached to a pipe (E), hose (F), and small pump (G). Attach mister by rope to a piece of wood or PVC pipe (H) that can hang over the tank.

Note: This type of setup is for severely debilitated turtles that are not active. Once turtle becomes active, this type of setup should not be used to prevent harm from tangling or ingesting these small pipes, hoses, or cords for the pump.
APPENDIX E

WATER SYSTEM DIAGRAMS
Open System

Closed System

Design by: Michele Lamping
Illustration by: E.R. Lockhart
APPENDIX F

FOOD GUIDE

The following section is the complement to the Diet section. This contains several suggested recipes, offers nutrient content of seafood and nutrient content of vegetables and their relation to Thalassia (for green turtle diets).

Recipes

Pedialyte
(David Smith, pers. comm., Mote Marine Lab, 2007)

Made for tube-feeding dehydrated turtles. Can be used on own, mixed with gruel, or used as a flush.

1 tsp NaCl (salt)
½ tsp KCl (salt substitute)
1 tsp baking soda
½ cup dextrose
2L bottled spring water

Mix all ingredients together until everything is dissolved and mixture is clear. Place in plastic holding containers and mark with date. Can leave out in room temperature. Mix solution well before using. Discard after 24 hours.

Gruel
Recipe from personal conversation with David Smith, Mote Marine Lab, 2007

To make, fillet fish and remove skin. Need to add enough water (or pedialyte if dehydrated) so when blended, mixture is runny enough to flow easily for tube feeding. Mixture can easily thicken during day, so may need to be flushed with additional water or pedialyte prior to feeding or during. As with most food preparation, gruel should be made the morning of, properly weighed, and refrigerated prior to use.

Any fish can be used for mixture. Herring is good for emaciated turtles. Amount of fish and water mixture is determined by percent body weight. Oral-glucose electrolyte solution (ReSorb) may also be blended with fish (Campbell, 1996).

Gelatin Diet #1
(Tracy Heard, Virginia Aquarium and Marine Science Center, 2007)

Made primarily for hatchlings to ensure proper nutrients, but can also be used for other stages.

Note: Fish type may change according to region. Amount in recipe is also enough for several readings for hatchlings, so recipe may need to be doubled or tripled, or additional batches may need to be made to meet the needs of larger turtles.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Weight (g)</th>
<th>% of diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trout Chow Sinking Pellets</td>
<td>426</td>
<td></td>
</tr>
<tr>
<td>Cod Filet Pieces</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>Haddock Filet Pieces</td>
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<td></td>
</tr>
<tr>
<td>Whiting Filet Pieces</td>
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<td></td>
</tr>
<tr>
<td>Whole Smelt Pieces</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>Squid with pens removed</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>Shell on Shrimp</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>Broccoli or Bok Choy</td>
<td>142</td>
<td></td>
</tr>
<tr>
<td>Fresh Leaves</td>
<td>142</td>
<td></td>
</tr>
<tr>
<td>Chopped Carrots</td>
<td>142</td>
<td></td>
</tr>
<tr>
<td>Finely ground Tablets of Pet-Cal</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Vitamin Supplement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sea Tabs</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Unflavored Gelatin</td>
<td>227</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>750-1000ml</td>
<td></td>
</tr>
</tbody>
</table>

Soak pellets in 250ml of water. Grind up vitamins with a mortar/pestle. Add seafood, veggies, and soaked pellets in food processor and blend. Add ground up vitamins and blend again. Boil 500ml. Once boiling, remove from heat, add gelatin mixture, and mix. Mix well and remove any lumps. Add food processor mixture to pot of gelatin. Mix well and set into tray. (13x9 plastic/bendable trays work best for gel removal.) Gel can be stored in refrigerator or freezer.

Yields: With 13x9 tray, 12 blocks of 3x2x11/4 inches (but can vary with cut preference). Can be stored in the freezer for 6 months and no more than a week in the fridge.

---

**Gelatin Diet #2**
(Norton, 2005c)

<table>
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<tr>
<th>Ingredient</th>
<th>Weight (g)</th>
<th>% of diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trout chow</td>
<td>425</td>
<td>8.0</td>
</tr>
<tr>
<td>Fish (various species)</td>
<td>565</td>
<td>10.6</td>
</tr>
<tr>
<td>Squid (viscera removed)</td>
<td>282</td>
<td>5.3</td>
</tr>
<tr>
<td>Peeled shrimp</td>
<td>282</td>
<td>5.3</td>
</tr>
<tr>
<td>Spinach (fresh or frozen)</td>
<td>142</td>
<td>2.8</td>
</tr>
<tr>
<td>Carrots (fresh)</td>
<td>142</td>
<td>2.7</td>
</tr>
<tr>
<td>Gelatin (unflavored)</td>
<td>450</td>
<td>8.5</td>
</tr>
<tr>
<td>Water 2800 ml</td>
<td>2800</td>
<td>53.0</td>
</tr>
</tbody>
</table>

Supplements:
- Sea Tabs (Pacific research labs, inc., El Cajon, CA), Mazuri avian vitamins
  May be more appropriate
- Amino Acid Complex 1000
  #4 500 mg tabs 0.04
- Spiroliana (lightforce, Santa Cruz, CA)
  50 ml powder (28 g) 0.50
- Rep-Cal (Rep-Cal Research Labs, Los Gatos, CA)
  200 ml powder (180 g) 3.4
Vegetables for Green Turtles and Their Relation to *Thalassia*

It has been a common error to give green turtles in captivity strict diets of leafy vegetables such as romaine. In the wild, green turtles primarily graze off algae and sea grasses, specifically *Thalassia*. The nutrient content in romaine does not compare to the nutrients of *Thalassia*, but there are several other varieties of vegetables that do. Below is a chart taken from Cutler et al. (undated) with the nutrient contents of different varieties of vegetables in comparison to *Thalassia*.

![Image of table comparing Thalassia and some captive green sea turtle foods](image)

- **KEY**: 
  - **High in fat**: 
  - **Not measured**: 

### TABLE 1: Comparison of *Thalassia testudinum* and Some Captive Green Sea Turtle Foods

<table>
<thead>
<tr>
<th>Preps</th>
<th>Prep</th>
<th>Water (%)</th>
<th>Protein (g)</th>
<th>Fat (g)</th>
<th>Carbs (g)</th>
<th>Fiber (g)</th>
<th>Ash (g)</th>
<th>Ca (mg)</th>
<th>P (mg)</th>
<th>Fe (mg)</th>
<th>Na (mg)</th>
<th>K (mg)</th>
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</thead>
<tbody>
<tr>
<td>Thalassia</td>
<td>Raw</td>
<td>12.9</td>
<td>1.5</td>
<td>6.3</td>
<td>7.1</td>
<td>1.7</td>
<td>0.5</td>
<td>13.0</td>
<td>30.0</td>
<td>0.6</td>
<td>13.0</td>
<td>0.6</td>
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<tr>
<td>Peas</td>
<td>Raw</td>
<td>90.7</td>
<td>1.4</td>
<td>0.3</td>
<td>7.1</td>
<td>1.7</td>
<td>0.5</td>
<td>13.0</td>
<td>30.0</td>
<td>0.6</td>
<td>13.0</td>
<td>0.6</td>
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<td>Cucumber</td>
<td>Raw</td>
<td>95.1</td>
<td>0.9</td>
<td>0.1</td>
<td>3.4</td>
<td>0.6</td>
<td>0.5</td>
<td>25.0</td>
<td>25.0</td>
<td>0.1</td>
<td>9.0</td>
<td>0.1</td>
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<tr>
<td>Cabbage</td>
<td>Raw</td>
<td>95.7</td>
<td>0.6</td>
<td>0.1</td>
<td>3.2</td>
<td>0.3</td>
<td>0.1</td>
<td>17.0</td>
<td>18.0</td>
<td>0.3</td>
<td>5.0</td>
<td>0.3</td>
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<td>Broccoli</td>
<td>Raw</td>
<td>92.4</td>
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<td>0.2</td>
<td>2.5</td>
<td>0.8</td>
<td>0.7</td>
<td>49.0</td>
<td>20.0</td>
<td>0.4</td>
<td>20.0</td>
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<td>Raw</td>
<td>85.2</td>
<td>1.2</td>
<td>0.1</td>
<td>3.1</td>
<td>0.6</td>
<td>0.7</td>
<td>43.0</td>
<td>10.0</td>
<td>0.4</td>
<td>23.0</td>
<td>0.4</td>
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<td>Lactuca</td>
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<td>95.5</td>
<td>0.9</td>
<td>0.1</td>
<td>2.5</td>
<td>0.5</td>
<td>0.6</td>
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<td>25.0</td>
<td>0.5</td>
<td>9.0</td>
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<td>1.5</td>
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<td>2.1</td>
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<td>2.1</td>
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<td>3.3</td>
<td>0.2</td>
<td>1.1</td>
<td>0.7</td>
<td>0.7</td>
<td>43.0</td>
<td>6.0</td>
<td>0.7</td>
<td>13.0</td>
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<td>1.5</td>
<td>1.1</td>
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<td>81.0</td>
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<td>81.0</td>
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<td>14.0</td>
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<td>14.0</td>
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<td>1.1</td>
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<td>81.0</td>
<td>54.0</td>
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<td>14.0</td>
<td>1.7</td>
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<td>81.0</td>
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<td>14.0</td>
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<td>0.1</td>
<td>4.1</td>
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<td>1.0</td>
<td>81.0</td>
<td>54.0</td>
<td>1.7</td>
<td>14.0</td>
<td>1.7</td>
</tr>
</tbody>
</table>
APPENDIX G

QUARANTINE

All turtles should initially be treated as quarantine patients when they enter a rehabilitation facility. However, only turtles with fibropapilloma disease should carry out full quarantine procedures for the entire length of their stay at a facility. For this special case, we have provided a sample protocol from the Bermuda Turtle Project following the Basic Quarantine Guidelines below.

Basic Quarantine Guidelines

Due to the lack of specific quarantine procedures for marine turtles, the following section adapts those from the AZA Recommended Procedures (AZA, 2008). Although these precautions are general and are generally meant for collected species at zoos and aquariums, the basic ideas and themes can be adapted for sea turtle rehabilitation.

“A facility should be available which can provide for the isolation of newly acquired [turtles] in such a manner as to prohibit cross-contamination resulting from physical contact, disease transmission, aerosol spread, waste drainage, or the reuse of untreated water. [Tanks] must be located in a way that prevents the spread of any disease from animal to animal through natural water movement and at a distance from other penned animals deemed adequate by the supervising veterinarian. If a receiving institution does not have appropriate isolation facilities, the staff should arrange for quarantine at an acceptable alternate site or only receive animals which do not require quarantine…

Attendants should be designated to care only for quarantine animals or to attend quarantined animals only after fulfilling their responsibilities for [others].” If care is given to quarantine animals, a 3 day minimum should be enforced until allowable contact with non-quarantine animals. “Attendants provided with quarantine clothing and washing facilities designed to prevent disease transmission may be allowed to attend to non-quarantine animals after working with quarantined specimens if approved by the supervising veterinarian. Equipment used to feed and clean animals in quarantine should be used only with those animals or should be thoroughly cleaned and disinfected, as designated by the supervising veterinarian, before use with post-quarantine animals.

Institutions must take precautions to minimize the risk of exposure of animal personnel to zoonotic diseases that may be present in newly acquired animals if the attending veterinarian deems that such risk exists. These precautions should include using disinfectant foot baths, wearing appropriate protective clothing, and minimizing physical contact.”
**SAMPLE protocol: Bermuda Turtle Project**

Sea turtle fibropapilloma disease (FP) is a debilitating and sometimes fatal disease of sea turtles. It is seen most often in green turtles but is also known to occur in loggerheads and ridleys. It is currently unknown from Bermuda. However, because so little is known about the natural routes of transmission of FP, it is best at this time to work on the assumption that it is highly communicable and take appropriate precautions. **Researchers should make every attempt to keep the disease out of populations where it does not occur.** The following protocol has been developed to reduce the possibility of fibropapilloma becoming established in Bermuda, and is set forward to guide the handling of potentially infected turtle onboard the research vessel *Calamus*. **Note:** There is no nesting in Bermuda; thus, sea turtles are only handled following capture during organized offshore research expeditions.

**Recognizing fibropapilloma disease:** Fibropapilloma disease is most easily recognized by the external tumor-like growths that it produces. These can occur on any of the soft tissues of the turtle but are most commonly seen on the softest areas of the head and neck, especially around the eyes, and at the base of the fore and hind flippers. They will appear as pea-sized to grapefruit-sized growths, variable in color but usually pink to red, or gray to black. They often have a floral appearance, with a surface texture like a head of cauliflower, but may also be smooth. These tumors are well vascularized and will bleed readily when cut or abraded by the capture net.

**Preventing the spread of fibropapilloma disease:** Healthy turtles with no evidence of the external tumor-like growths can carry the virus that apparently causes FP, as well as other pathogenic agents of sea turtles. Turtles can also carry a tumor burden internally, with or without any external signs of infection. Thus, we must always use extreme caution with the body fluids of the sea turtles we handle. The tagging punch must be cleared of tissue and the punch and tag applicators disinfected (for 20 minutes) with mild bleach solution after every turtle. Blood or other body fluids from one turtle should not be allowed to get on another turtle during sampling or at any other time. Do not use syringe needles or other instruments that break the skin (e.g., PIT tag applicators, tagging punch) on multiple animals without disinfecting them thoroughly between animals. Use of exam gloves when performing various procedures on turtles is important; it is difficult to keep your hands clean under field conditions. When gloves are not available, frequent hand wiping with sanitizing hand wipes is mandatory. **Note:** Be aware of possible contamination to clothing or skin, and not only to hands.

**Capture of a papilloma-bearing turtle in the entrapment net:** A turtle with obvious FP should not be placed directly in the catch boat, especially with other turtles. The turtle should be handled with gloves and placed (along with the used gloves) into the equipment bucket (removing the GPS and other equipment first) in order to isolate it from other turtles and to avoid contamination of the deck surface. The bucket should be scrubbed thoroughly with a 10% Clorox solution (for 20 minutes) and rinsed thoroughly with freshwater before being used again.

Turtles with obvious FP should not be taken on board *Calamus* or to the Aquarium. The virus that is associated with the disease may survive for long periods outside of the host, especially if it is kept wet or moist. Thus, thorough treatment of all possibly infected surfaces with detergents, disinfectants, or prolonged drying would be required to make certain that the disease would not be transmitted. With this in mind, all turtles suspected to be infected with FP virus should be kept away from all areas.

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4 This section was excerpted from Phelan and Eckert (2006): “Marine Turtle Trauma Response Procedures: A Field Guide.”
where turtles are kept, including the decks of the catch-boat and Calamus, and the Aquarium, its tanks, and its water system.

A live turtle with FP should not be tagged, weighed or measured. It should be photo-documented, appropriate samples of the tumors should be taken and preserved directly in 10% buffered formalin (1:10 tissue:formalin; maximum width of tissue is 1 cm for appropriate fixation) without being frozen, and the animal should be removed from contact with all other sea turtles and kept out of any facility that houses sea turtles. If the affected turtle has a heavy tumor burden that seems clearly to be FP and the animal is very seriously debilitated, euthanization should be considered by the government veterinarian. Samples of several tumors should be preserved in 10% buffered formalin. If the tumor burden is small or there is suspicion that the tumor is not FP, the animal should be isolated and appropriate samples taken for assessment. If found to have FP, the diseased animal could be sent to an appropriate facility, such as The Turtle Hospital in Marathon Key, Florida, for further observation and possible rehabilitation.

It is very important to confirm any possible cases of FP. This can best be done by collecting biopsies for complete pathological evaluation. Thus, a biopsy kit with gloves, 10% buffered formalin, appropriate-sized vials, scalpels, a small plastic ruler, and Clorox for clean up, should be assembled. This could be used for taking samples from a badly infected individual after it was euthanized, a mildly affected individual that will remain in isolation until the samples can be examined, or a dead stranded animal with suspicious tumors.

Stranding of a papilloma-bearing turtle: If a papilloma-bearing turtle is dead when it strands, it should be photo-documented at the stranding site. Photographs should be made of all surfaces, and a description recorded of the tumors, including measurements. If the turtle is fresh, a necropsy should be performed provided that the necropsy can be done under isolation conditions to avoid contaminating facilities where turtles are kept. If a complete necropsy cannot be performed, then a sample of the suspect tumor should be preserved in formalin for pathologic evaluation and the carcass disposed of (incinerated or buried on land). Even if the carcass is too poor to necropsy, get a sample of suspect tissue and dispose of the rest.

Any time that a suspect turtle is handled, all equipment used during handling and necropsy should be disinfected with 10% Clorox (for 20 minutes) and rinsed thoroughly in freshwater before being returned to the Aquarium. Gloves must be worn at all times. Do not transport the carcass using Aquarium vehicles and do not transport to the Aquarium for necropsy or freezing.

If a papilloma-bearing turtle strands alive, isolate it in a suitable-sized container at an appropriate location and take biopsies of suspect tissue for evaluation. The turtle should remain in isolation until the evaluation of the biopsy is complete. Based on the biopsies and the extent of any infection, a decision will be made as to whether the turtle should be euthanized or sent to an outside facility for rehabilitation.

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Author notes: The Bermuda protocol is cautious and has been written for an area that does not have FP present; but, if the disease is already documented in the local area, there are options other than euthanasia. These turtles can be treated and cared for, but every effort should be made to create a containment area completely separate from other turtles, whether healthy resident turtles or other sea turtles undergoing periods of rehabilitation. The most important thing, as noted above, is not to use shared water (or anything else), meaning that every effort should be made to maintain a separate water supply and filtration system and, ideally, separate personnel. The only persons dealing with both groups of turtles should be the veterinary staff, and every effort should be made to separate those as much as possible. For example, routine procedures at Mote Marine Laboratory and Aquarium, a Florida-based sea turtle rescue center designated to care for FP turtles, require that once a veterinary staff member has handled an FP turtle, s/he will not handle a non-FP turtle for at least 72 hours (in practice, this means that the designated veterinarian handles an FP turtle just before beginning a weekend off). Also important are the following: gloves are mandatory for veterinary staff when handling FP turtles; all laundry, water supply, and equipment are entirely separate between FP and non-FP turtles; and everything is disinfected with 10% bleach solution (and rinsed thoroughly with fresh water) after having been exposed to FP turtles. At the Marinelife Center in Juno Beach, Florida, plastic bins and other plastic materials used with FP turtles are disposed of, as plastic is porous and, therefore, unsterilizable. Experience in Florida with rehabilitation suggests that all FP turtles undergoing rehabilitation should remain at the rehabilitation facility for a period of one year following removal of the last tumor to insure that regrowth does not take place.

While there are no documented cases of water-borne transmission of FP, or transmission resulting from direct contact with an infected animal, we recommend that until researchers have a better understanding of this oft-fatal disease, for which there is no known cure, strict precautions be emphasized at all levels. One strategy is to always work on non-afflicted turtles first, then FP turtles followed by decontamination.

Advice from the facilities most active in the treatment and care of FP turtles in the Wider Caribbean Region is available from the following:

The Turtle Hospital
Attn: Douglas R. Mader, DVM
Consulting Veterinarian
2396 Overseas Hwy
Marathon, Florida 33050 USA
Tel/Fax: (305) 743-6509
Email: Turtlehosp@aol.com
http://www.turtlehospital.org/

Mote Marine Laboratory and Aquarium
Attn: Charles Manire, DVM
Chief Veterinarian
1600 Ken Thompson Pkwy
Sarasota, Florida 34236 USA
Tel: (941) 388-4441 / Cell: (941) 302-4977
Fax: (941) 388-4512
Email: cmanire@mote.org
http://www.mote.org