Chapter 32

MARINE MAMMAL TRANSPORT

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INTRODUCTION

Marine mammals are cosmopolitan in distribution and are often collected hundreds or even thousands of miles from their eventual destinations in research facilities and zoological parks. Over the last 20 years, specialized marine mammal transport techniques have been developed to cope with the unique physiology of marine mammals. Safe, successful transportation can be achieved with proper attention to detail and the use of appropriate technology.

The level of technological detail necessary is determined by the type of marine mammal to be transported. Cetacean transport is much more complex and costly than that of other marine mammals such as sirenians, pinnipeds, sea otters *(Enhydra lutra)*, or polar bears *(Ursus maritimus)*. In the cases of cetaceans, pinnipeds, sirenians, and sea otters, the presence of a trained attendant is required by law.[1] Constant monitoring is necessary to detect respiratory, thermoregulatory, postural, and behavioral abnormalities, leading to early problem detection and correction.

CETACEANS

The overland transport of cetaceans has been noted at least as far back as 1558. In that year Rondelet, governing physician of the University of Medicine at Montpelier, England, wrote that fishermen transported live dolphins by carriage a distance of 130 miles inland on a regular basis. These animals were shipped for the purpose of human consumption and were kept alive in transit in order to arrive at the market with an unspoiled product.

P. T. Barnum also wrote about the 1861 and 1862 transport of a total of six white whales *(Delphinapterus leucas)* from the St. Lawrence River to New York, lying on a bed of seaweed in a box. Only one of these animals lived and was exhibited for 2 years at Barnum's Museum, with a bottlenosed dolphin *(Tursiops truncatus)*.[2]

In 1877 a white whale *(D. leucas)* was transported from New York to London, England, once again on a bed of seaweed, and lived for 4 d after arrival.[3] The route taken in the transport of this individual whale is worthy of note. The animal, collected in Labrador, was shipped by sailing vessel to Montreal and then traveled for 14 d by rail to New York. It was then put on a steam ship for the 10-d voyage to England. This same route was taken again the following year, 1878, by four Beluga whales *(D. leucas)*, of which three arrived alive.

Other early documented cetacean transport occurred in the 1870s when two white whales *(D. leucas)* were sent from Labrador to the Brighton Aquarium in England in the flooded hold of a ship. Unfortunately, both animals died.[4] More closely approximating present transport methods, the New York aquarium transported a group of bottlenose dolphins *(T. truncatus)* within water-filled boxes in 1907, while 5 years later Taylor first employed a soft litter for their transportation.[5]

Early transport of killer whales *(Orcinus orca)* occurred much later and somewhat differently, due to the size of the animals involved. In June 1965, a floating pen measuring 18 × 12 × 5 m, was used to transport an adult killer whale from Namu, B.C. to Seattle, WA. The journey took 2 weeks to transverse a distance of 675 km.[6] In October 1965, a female killer whale was transported by air from Seattle, WA to Sea World, Inc. in San Diego, CA. The animal apparently transported easily, and quickly acclimated to the zoological environment.

Cetaceans spend their entire lives in water, which provides uniform support by equal distribution of pressure over their entire body.[7] The result is an almost functional weightlessness allowing nearly effortless respiration. Furthermore, the nearly 25 times greater capacity of water to conduct heat and cold, when compared to air, rapidly dissipates cetacean metabolic heat.[7] As a result, when removed from their free-swimming state, the two primary criteria that must be met to successfully transport cetaceans are (1) adequate body support for their comfort and well being and (2) some sort of temperature control mechanism to assist with thermoregulation (Figures 1 and 2).

Addressing the first criterion, adequate body support techniques have been developed to allow normal breathing during transport. Cetaceans are now moved in fabric stretchers, suspended in water-filled transport units, more closely approximating the near weightlessness provided by water. Additionally, the widespread use of aircraft has allowed successful movement of cetaceans over vast distances by shortening the amount of time the cetacean is removed from the water environment.[8]

The second criterion, adequate temperature control, is necessary because most of the cetacean's body is enclosed within a layer of thick insulating blubber. Heavily vascularized areas are present in the cetacean's pectoral fins, tail flukes, and dorsal fin (Chapter 40). Thermoregulation is controlled through constriction or dilation of the peripheral vessels in these areas.[4] As previously mentioned, cetaceans are less able to dissipate excess heat when removed from the water due to the lower heat conductivity of air.

Thermoregulatory assistance can be provided in several ways. If the cetacean is suspended within a water-filled container, the water temperature can be lowered through the addition of ice. Additionally, during air or enclosed-truck transport, the interior cabin temperature can be lowered to assist the cetacean with thermoregulation. Overland cetacean transports in open trucks are best conducted at night or on overcast days to prevent sunburn and provide, hopefully, lower air temperatures (Chapter 40).

As might be expected during the early stages of any developing field, several of the first cetacean transports encountered difficulties, largely as a result of a lack of understanding of cetacean physiology. Many difficulties resulted from errors in human judgment. Equipment-related failures were also common in the early days of cetacean transport. Most of these failures can be avoided through proper planning and thorough preparation. In the face of the possibility of such unexpected problems, one should always have alternative plans to ensure the welfare of the animals being transported. Plans include adequate personnel and equipment to either return cetaceans to holding facilities should the transport be aborted, or to care for the animals should an emergency landing become necessary at an unexpected location.

Animal health problems resulting from early unsophisticated cetacean transports included muscular stiffness upon return to water, depression of appetite, anemia as a result of abrasions, pressure necrosis, and respiratory infections. Muscular stiffness normally disappeared within a few hours to a few days after transport and can be avoided entirely by the improved transport techniques used today, which allow the cetacean lateral and vertical flexion. Today, properly transported cetaceans normally resume feeding immediately upon release from their transport units, especially animals that have been transported previously. Abrasions and pressure necrosis are now avoided through the use of properly fitted stretchers and proper positioning within the stretcher and transport unit. Modern rapid transport has decreased or eliminated the previously common use of antibiotics and corticosteroids for the prevention and treatment of transport-related respiratory infections.

Important factors influencing the success of any cetacean transport are proper support equipment, well-trained personnel, and strict attention to logistical details. In all cases, it is advisable to have backup equipment available or to make arrangements to obtain backup equipment on short notice.

Prior to transport, a thorough assessment of the health status of the cetacean must be made.

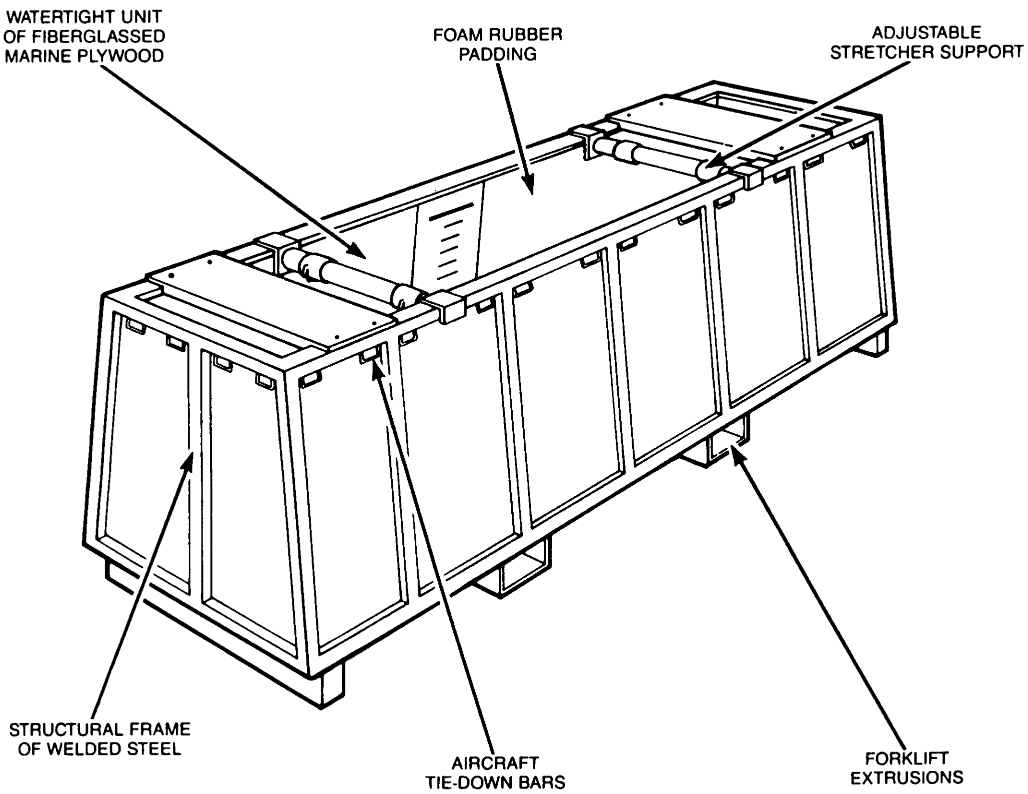

FIGURE 1. White whale *(Delphinapterus leucophrys)* transport unit.

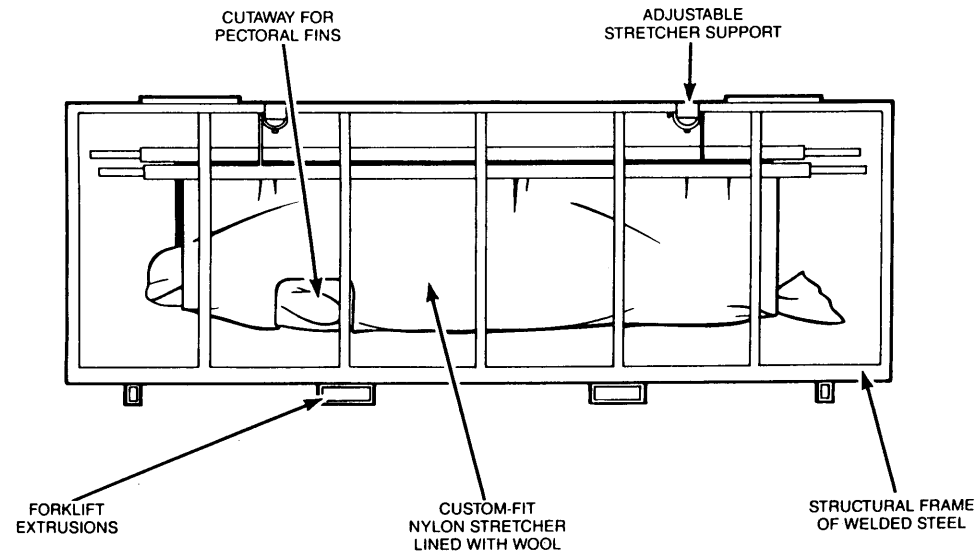

FIGURE 2. Cutaway view of white whale within transport unit.

Such an assessment should include behavioral observations, a physical examination, hematological examination, and, if possible, urinalysis. Cetaceans are generally fasted for a 24-h period prior to shipment to minimize the volume of body wastes discharged into the transport container. Fasting may also reduce the incidence of regurgitation during transit (Figures 3 and 4).

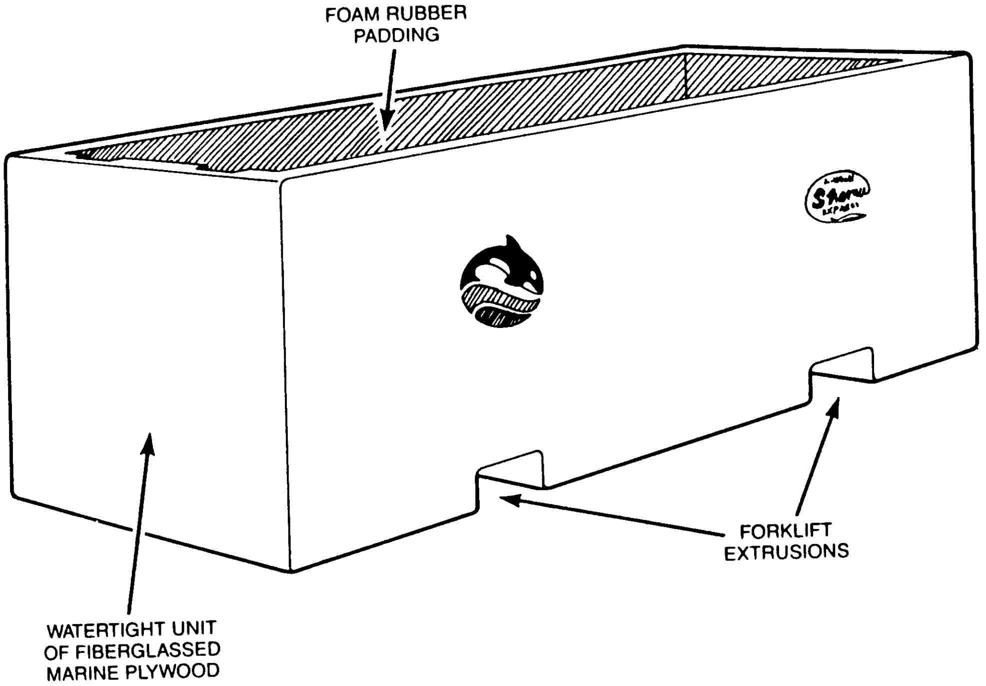

FIGURE 3. Bottlenosed dolphin *(Tursiops truncatus)* transport unit.

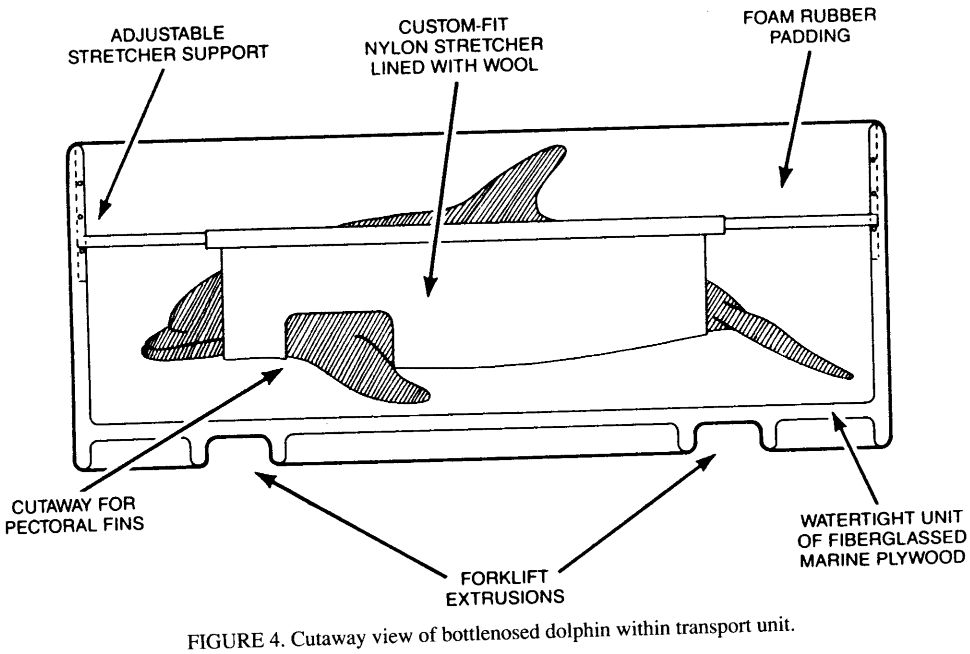

FIGURE 4. Cutaway view of bottlenosed dolphin within transport unit.

Simplistically, the cetacean transport consists of: removing the cetacean from the water in a fabric stretcher; suspension of the stretcher in a water-containing transport unit; transport; and safe release into new quarters.

The initial step in cetacean transport is the lifting of the whale or dolphin from its pool or holding facility in a custom-fitted stretcher made of soft material; generally either nylon or canvas. These stretchers can be lined with wool or chamois if desired. Stretchers must be constructed according to accurate measurements of the body of the individual cetacean to ensure

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proper fit and provide equal distribution of body weight along the stretcher. Paired openings in the stretcher allow the pectoral fins to extend in an unrestricted, natural position.[8] The animal is positioned in the stretcher such that pressure is not placed on specific points along the body or fins, which might lead to pressure necrosis or abrasion. During loading every effort must be made to avoid abrading the highly vascularized skin of the cetacean. The danger of pressure necrosis is greatest in the axillary region just posterior to the pectoral fins. Steel poles supporting the stretcher must be sturdy enough to support the weight of the cetacean, even if the weight suddenly shifts. The pole ends should be rounded or covered with caps to eliminate sharp edges. In the case of large cetaceans, metal cable connecting the stretcher poles to the lifting device should be vinyl covered. Eyebolts, from which connecting cables originate, should be padded with foam rubber to prevent lacerations and abrasions to both cetaceans and personnel. Body surfaces that are likely to be exposed to the drying effects of air should be covered with a hygroscopic ointment, such as lanolin, to prevent desiccation.[8]

Use of a crane is required to safely lift most cetaceans from the water due to their weight. Cetaceans may move when lifted from the water, and crane capacity should be specified with a 100% safety factor, based on the weight of the animal and the reach of the boom. A discussion should be held with the crane operator at the location of the cetacean to inspect the supporting surface and discuss safe practices. Hydraulic cranes are preferred over mechanical cranes due to greater operational smoothness. For safety, a cetacean should be kept as low to the ground as practical during all phases of the lift. Tag or guide lines should be attached to the stretcher, but not to the eyebolts, where they might bind with lifting tackle. Guide lines should be attended during all phases of the lift to control unwanted motion.

Fitted in its custom stretcher, the cetacean is lowered into a watertight transport unit of appropriate size. Transporters currently in use at Sea World are constructed of fiberglass-lined marine plywood, reinforced and protected by a steel frame. A lining of soft foam rubber or vinyl is installed on the inside walls of the transport unit to prevent abrasions. Lids or baffles are bolted over both ends of the unit to reduce water spillage. A stretcher support system should be incorporated into transport units to enable attendants to rapidly adjust the position of the animal by raising or lowering the stretcher poles during loading or transport.

Once positioned within the transport unit, sufficient water is added to submerge the lower 2/3 to 3/4 of the body of the animal. Suspension in water provides cooling and buoyancy, permitting exertion-free respiration throughout transport. If transported in an adequately supported posture, there is no detectable variation in respiratory rhythm during transport.[8,9]

Ice may be added either directly adjacent to the animal's skin or into various other areas within the transport unit. The melting ice keeps both the animal and the water cool. Recommended water temperature in killer whale transport units is below 7.2°C, while smaller cetaceans are more comfortably transported in 12° to 15°C water (Appendix 1).

For ground transport, the planned route of travel must be examined ahead of time with attention to road conditions, overhead clearances (i.e., trees, electrical wires, low bridges, etc.), and any special limitations such as weight or size. If the load is excessively heavy, special permits may be required and should be obtained in advance of transport. A whale transport unit is usually carried on the back of flatbed or lowboy trailers pulled by a diesel tractor. A spare tractor should accompany the transport caravan to guard against delays due to tractor malfunction. These types of marine animal movements should be done at night to avoid the heat factor and possible heavy traffic delaying the transport.

Attendants accompanying the cetacean transport unit must be briefed beforehand concerning safety. A special permit allowing attendants to ride on the back of trucks may be required in some areas. Attendants should be careful to ensure vehicle exhaust is directed away from both cetaceans and personnel. Escort vehicles should precede and follow the caravan and radio communications between all vehicles in the convoy should be maintained. In many areas, prior notification of the appropriate authorities (i.e., police, highway patrol, etc.) of the planned truck transport will facilitate ground transport.

The majority of recent long-distance cetacean transports have involved the use of aircraft. Large cargo aircraft are utilized, due to the size and weight of the cetaceans and transport units. A major problem encountered over the years has been the relatively small size of many aircraft cargo doors. Prior confirmation that the transport unit and associated equipment will easily fit through the cargo door of the transport aircraft is mandatory. The aircraft must have provisions to lock the load safely inside the plane. Only freshwater should be used within transport units due to the extremely corrosive nature of seawater on aircraft systems.

Depending upon the size, weight, and configuration of the transport unit, various types of loading and unloading equipment can be used. Platform loaders, forklift trucks, and cranes are most commonly used. Platform loaders and forklift trucks decrease loading time, but are not always available with adequate lifting capacity and must be scheduled in advance. Furthermore, mechanical failures or inclement weather might necessitate landing at an airport other than the originally scheduled destination. In consideration of these points, large cetacean transport units should be designed and constructed to be alternatively lifted by a crane, as cranes seem more readily available on short notice. Frequently, crane companies will not have proper equipment to lift large cetacean transport units safely, dictating that essential lifting tackle such as steel cables, spreader bars, and shackles accompany transport units at all times.

It is advisable for ground personnel to remain at the airport until the transport aircraft takes flight. Occasional mechanical delays have required deplaning prior to departure or precipitated prolonged delays prior to take-off.

Attendants accompanying the cetacean air transport should brief the flight crew before take-off regarding the appropriate angle of take-off, angle of descent (both of which should be as gently sloping as possible to avoid sloshing of water out of the transport unit), cabin air flow, and air temperatures. Once on board, ambient air temperature is controlled and is usually maintained between 4.4° and 10.0°C, again as an aid to thermoregulation.

Federal regulations specify animals will be attended during transport, but do not specify how many attendants are required.[1] The presence of at least one experienced attendant for each transported cetacean is appropriate (Chapter 26). Close attention to animal behavior leads to early detection of abnormalities in respiration, postures, and activity level, resulting in rapid correction of problems. Attendants must have ready access to waterproof clothing to aid in repositioning during transport should it be necessary. Attendants can prevent desiccation of the skin and the subsequent development of "hot spots", which later blister and slough, by spraying exposed skin with portable water sprayers.

Due to the long delay duration of some transports and the possibility of delays, a water supply and filtration unit has been used by Sea World for the transport of larger whales. This filtration unit eliminates solid waste produced by the animals and can be used as a reservoir to reduce the volume of water within the transport unit during takeoff and landing. Filtration pumps have been designed to operate on the auxiliary power unit of the aircraft.

Appropriate equipment for unloading and ground transport is necessary at the destination airport. Such equipment should be in position at the airport prior to the arrival of the aircraft to avoid delays.

Upon arrival at the poolside destination, the cetacean still suspended in its fabric stretcher is removed from the transport unit, lowered into a pool of water, and released. Such pools need not be shallow nor small, but plans and equipment should be available in case the transported animal needs assistance following release or in subsequent days.

Animals should remain under continual observation for at least the first 24 h following transport. Respiratory rates should be recorded hourly and frequent attempts made to feed the just transported cetaceans. Follow-up physical examinations and hematological examination are prudent within the week following arrival, or sooner if problems arise.

PINNIPEDS

Pinniped transport (Chapter 33) is less complex than that of cetaceans because pinnipeds live a semi-aquatic existence and are able to tolerate long periods removed from water if kept cool and/or moist. If transported by air, similar air temperatures (4.4° to 10.0°C) are suggested, but not mandatory, as long as the pinnipeds are attended and not demonstrating evidence of discomfort or hyperthermia. If ground transport is utilized, provisions for cooling, such as ice and cool water sprays, are necessary during transport. Ice may be placed within the transport unit, providing a freshwater source, as well as cooling. Alternatively, ice may be placed on top of transport containers to provide a cooling drip during transport. As is the case with cetaceans, pinnipeds should be fasted for 24 h prior to transport and should not be fed during transport.

Transport containers should be well ventilated, strong enough to prevent escape, with fiberglass bottoms extending at least 15 cm up the cage sides to prevent spillage of wastes and water.[7] Any wood or metal used for cage construction should be free from splinters or burrs on the interior surface. Wire or net mesh diameter should not exceed 5.1 cm to prevent possible trauma during investigation or attempts at escape.[7]

Pinnipeds can be transported singly or in groups. It is wise to avoid overcrowding, which can lead to overheating. Large or aggressive pinnipeds should be transported singly. Cage dimensions should be large enough to allow turning around and normal posturing during transport.

Again, the presence of experienced attendants is required by law and is necessary to note and correct difficulties arising during transport.[1]

SEA OTTERS

Sea otters (Chapter 36) are as temperature sensitive during transport as cetaceans, due to their high metabolic rate and primary thermoregulation through flipper contact with water. A layer of ice should be placed on the cage floor, to serve as a source of fresh water as well as cooling source.

Transport cages can be constructed of wood, fiberglass, or smooth metal with net side panels allowing good ventilation and unobscured observation. An elevated wooden rack should be placed above the waste-containing fiberglass cage bottom, allowing uneaten food, feces, and urine to fall through. Cage bottoms may be removed, allowing emptying of waste during transport.[10] Plastic "sky kennels" are not recommended because they provide inadequate ventilation, and otters may break teeth on the steel mesh door. Furthermore, sky kennels promote fur soiling by forcing the otter to lay in its own waste products. Cage size should be large enough for the otter to turn around in and groom freely.

Unlike cetaceans and pinnipeds, well-refrigerated food items such as clams and shrimp should be offered to sea otters during transport due to their high metabolic rate.

The presence of a trained attendant is required by law and is as imperative for sea otters as it is for pinnipeds and cetaceans.[1] Thermoregulatory status must be constantly monitored as hyperthermia is the greatest obstacle to successful sea otter transport. Lethargy, panting, and flippers that are warm to the touch are all signs of overheating in sea otters. If the otters become very warm, spraying with cool water is helpful.

It is important to keep the sea otter's fur as clean as possible during transport. Soiled fur should be gently rinsed with a freshwater sprayer during transport.

Close attention to appetite and behavior are mandatory following transport. Sea otters are more fragile than other marine mammals, and are more likely to develop health problems following transportation or relocation.

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