

Rescue & Intensive Care of Seabirds

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1. Introduction
2. Identification
 - a) Sphenisciformes
 - b) Procellariiformes
 - c) Pelecaniformes
3. Capture
 - a) Catching pelicans
 - b) Equipment
4. Transport
 - a) Temperature
 - b) Ventilation
 - c) Noise
 - d) Transport boxes
5. Handling
 - a) Handling guidelines
 - b) Handling techniques for specific species:
6. Admission & Assessment
 - a) Weight
 - b) Assessment
7. Nutrition
 - a) Fluids
 - b) Tube feeding
 - c) Amount, Type and Size of Food
 - d) Force Feeding
 - e) Free feeding
 - f) Salt tolerance
8. Secondary Complications and Common Diseases
 - a) Aspergillosis
 - b) Bumblefoot
 - c) Feather contamination / Oiling
 - d) Wounds
 - e) Foreign bodies
9. Intensive Care Housing
 - a) Heating
 - b) Floor covering, substrate
 - c) Ventilation
 - d) Hygiene
 - e) Housing for specific species (penguin moult)
10. Rehabilitation
11. Conclusion
12. References

Appendix A Suggested Food and Quantities for Seabirds

Appendix B Release Weight Chart for Seabirds

1. Introduction

Seabirds are often encountered with signs relating to starvation and exhaustion. Many species travel long distances during their annual migrations or when searching for food on the open ocean. Multinational fishing industries and seabirds continue to compete for depleted fish stocks resulting in many birds failing to find sufficient food. Fishing nets and long lines also pose a threat to seabirds with many thousands of birds drowning each year. Oil pollution is also a hazard and increased garbage and waste are a threat to marine and shoreline environments.

The birds included in this paper are the seabirds that inhabit or visit marine environments within Australian waters. Included are the Sphenisciformes: penguins, Procellariiformes: albatrosses, petrels and shearwaters and the Pelecaniformes: pelicans, gannets, boobies, cormorants, frigatebirds and tropicbirds. This paper will concentrate on the initial stages of encounter and treatment when birds are critically ill and require intensive care.

Due to problems caused by stress, it is important that seabirds are not under treatment or in rehabilitation longer than necessary. Timely and accurate assessment straight after encounter is essential. The window of opportunity for successful rehabilitation is very small due to the high probability of secondary complications such as aspergillosis, bumblefoot and loss of waterproofing. Preventing secondary complications is the key to successful rehabilitation of seabirds because treatment for these conditions is rarely successful.

Some seabirds come to land to rest or are blown inland in severe storms and are then unable to take flight due to their large body size. Most of the larger seabirds require an updraft of 20 knots of wind or more and become air born by flapping their wings and “running” on the surface of the ocean. Sometimes these birds are not injured but are at risk from domestic pets, particularly dogs, foxes and people. They require early assessment, temporary housing and transportation offshore for release. Some birds may be extremely weak and underweight and it is important that they are examined to establish if they have an injury that may not be obvious or an illness that has caused them to become weak and unable to obtain food.

2. Identification

Owing to the specialised needs of many seabirds species identification is necessary for appropriate handling, transport, treatment and record keeping.

a) Sphenisciformes

Penguins are easily identified with flattened feather shafts, dense waterproof plumage and flippers. Nares (nostrils) are open but covered with a flap and the three toes are webbed. Penguins become easily heat stressed and are not able to cope with external temperatures over 35°C. Penguins, like other birds, possess a uropygeal gland (preen gland) at the base of the spine which secretes oil and is used for maintaining waterproofing and keeping the feathers supple and clean.

b) Procellariiformes

Tube-nosed seabirds which have external tubed nostril openings and a highly developed sense of smell (unlike many bird species). Their bills are split into seven to nine distinct horny plates and the hooked sharp unguis is used to hold slippery food such as squid and fish. They possess a glandular stomach which produces oil and causes the musky odour. This stomach oil is a digestive residue created in the foregut of all tube-noses (except the diving petrels) and is used for defence and by

both chicks and adults as an energy rich food source during the potentially long periods without food. They also possess salt glands which allow them to drink salt water and excrete the salt. These birds are truly pelagic spending their lives on the open ocean only coming to land to mate, nest and raise young. Most have difficulty walking on land and have large webbed feet with three toes, webbing between the toes and long nails. They have a layer of fat under the skin and a specialised system of thermoregulation to their feet. They show the greatest range in body size of any avian order the smallest species, the Least storm petrel weighs 20 g and has a wingspan of 12 inches, the largest the Wandering albatross weighs 11 kg and has a wingspan of 12 feet (3.6m). Included in this order are the albatrosses, giant petrels, gadfly petrels, diving petrels, storm petrels, prions and shearwaters.

c) Pelicaniformes

This order includes the Pelicans, gannets, boobies, cormorants, frigatebirds and tropicbirds. (Darters are a member of this order but feed in freshwater environments and are not included in this paper). Because of their diving lifestyle these birds do not possess external nostrils and breathe through the sides of their bills. Pelican nares are partially blocked and they are also mouth breathers. Pelicans, gannets and boobies have a system of air pockets under the skin (physiological subcutaneous emphysema) that forms a spongy protective mattress. It is an extension of the air sac system and extends into the leg (30). This is an adaptation to cushion the shock of striking the water at high speeds (15) and when handling these birds it feels like they have bubble wrap under the skin. This group have 4 toes rather than 3 with webbing between each toe, long nails and strong legs. Gannets and boobies have extremely sharp bill edges for catching slippery fish.

3. Capture

If a decision is made that the bird needs to be rescued either to prevent harassment or due to injury it is helpful to think about the way the bird may defend itself when approached and in which direction the bird may head to get away from the catchers. If the bird is at the water's edge the catchers will need to be between the bird and the ocean. If it is late in the day waiting until dark may be helpful although many seabirds are active at night especially the petrels. Observations of the bird should be carried out before catching to try and identify possible injuries and enable catching without further injury to the bird.

If rescuing a large seabird at least two people will be required, preferably three. Two people will be needed to restrain the bird and place it in a suitable transport box. Towels or blankets can be used to wrap around the bird to restrain the wings. The towel can be removed for transport.

a) Catching Pelicans

Pelicans are often encountered near fish markets, boat ramps, and places where they can scavenge food. Unfortunately this makes them susceptible to injuries and they often become entangled in fishing line and hooks. If the birds are fully flighted and not weak they can be challenging to catch and will require trained rescuers. Encouraging them (with food) to move into a position that makes them easier to catch will be advantageous. Avoiding eye contact, moving slowly and wearing clothing that does not flap in the wind is helpful. Some birds can be lured with fish and then their bottom bill grasped and the top mandible held close to the face of the bird. The bird can be gently pulled up against the catcher's body while the wings are gathered. There are other capture methods using nets and snares that require planning and equipment (8).

b) Towels/ Blankets/ Gloves

Towels can be used to throw over the bird and the bird can then be gathered up in the towel restraining the wings and covering the head. Towels are also useful for removing birds from cages and boxes. Oiled birds can be wrapped in a towel to help absorb the oil, prevent birds preening and prevent the handler being exposed to the oil. Gloves can be worn to protect the handler from injury, oil and also to protect the bird's feathers from contamination from the handler. Birds will often defecate after being caught. Protective clothing may be necessary especially when birds are oiled.

4. Transport

Transporting seabirds even over short distances causes the bird high levels of stress. Broken and drooping wings should be strapped prior to boxing as the bird may tread on the wing during transport. Feeding before transport should be avoided as seabirds will regurgitate when being moved even over short distances. Attempting to feed birds that have just been encountered and have not been assessed can exacerbate the bird's illness and/or injury and should be avoided. Birds may require an anaesthetic for x-rays and surgery and this cannot be carried out if the bird has eaten.

a) Temperature

An ambient temperature of approx 25-27°C is preferred during transport. Travelling in the heat of the day should be avoided as the temperature inside a transport box in a hot vehicle may become much higher than anticipated. Extremes of cold must also be avoided. When transporting birds over long distances it can be useful to move them at night when they will sleep (although some species are nocturnal). Avoid sending more than one bird in each box. Even siblings and parents should be separated as parent birds can accidentally stand on or crush their offspring due to the vehicular movement.

b) Ventilation

Ensure that the vehicle and the container are well ventilated. Strong cardboard boxes are perfect for transporting smaller seabirds because they are soft and do not damage the bird's feathers. Ensure boxes are not stacked too closely together and exhaust fumes must be avoided. Birds should be transported inside the car not outside on the tray of a utility where they are exposed to the weather, noise and pollution.

c) Noise

Avoid all unnecessary noise, such as radios, loud voices and traffic noise. Birds should not be transported in a car with a domestic pet. The pet may not damage the bird but the bird does not know that and will be stressed. Avoid leaving the box on the ground at the side of the road, train track or runway. The bird may feel threatened and will be exposed to vibrations, noise and fumes.

d) Transport boxes

The size of the container should correspond with the size of the bird but not be so large as to allow the bird to be thrown around. The strength and behaviour of the species should be taken into consideration when selecting a transport box. Birds should be able to stand and stretch their necks. Wing movement will be restricted and this is often necessary to prevent feather damage. Cardboard boxes are very useful and are soft enough to prevent feather damage however the base may need reinforcing if the floor becomes saturated. Ventilation is essential.

Some birds such as pelicans and large albatrosses require large cardboard boxes like those for transporting refrigerators. Since these are not always available, birds can be wrapped in a blanket and covered if they are too ill to stand. Large sports bags with zippers or specially designed carry mats can be used to restrain the body and wings of the bird leaving the head and neck out of the bag. If this is the transport method the bird will be exposed to visual stress during transport and it is advisable that the head be covered. One person should sit with the bird to prevent it damaging itself by throwing its head around. It is more than likely that birds will regurgitate during transport so towels should be available.

Transport box floor covering:

Seabirds are very susceptible to bumblefoot (lesions or pressure sores on their feet) which can easily eventuate during transport. If the surface is abrasive or if the bird is unable to gain purchase and is sliding around, the floor covering is inappropriate. It is recommended that rubber matting be used as a base with folded towels placed on top of the rubber. Two layers of towels can be used for long distances with the top towel being removed when it becomes soiled. It is important to provide a surface that is soft on the bird's feet but also provides something for them to grip with their toes and nails. Hessian sacking and towels with frayed edges are not suitable as the bird's toes can get caught in the weave and loose material may become caught around a leg or other parts of the bird. Newspaper is not recommended as it becomes slippery with faeces. Seagrass, straw, hay, peat and shredded paper should be avoided because of the risk of aspergillosis. Aspergillosis and bumblefoot are covered at a later stage in this paper.

It is essential that the bird's feather condition and waterproofing are protected during transport. Seabirds may be successfully treated for dehydration, infections, exhaustion, fractures, oiling etc but if their feathers are damaged during transport they may require euthanasia. Pulling the damaged feathers and waiting for new feathers to grow is not an option due to the risk of secondary complications. Seabird species have many different moult cycles with some such as gannets moulting 3 or 4 primaries each year and suspending moult when breeding commences.

5. Handling

a) Handling Guidelines

When restraining a bird it is important to remember the amount of stress the bird may be under and minimise the handling time. It is essential that the handler does not try to "comfort" the bird by stroking it and talking to it. Some birds benefit from having their eyes covered. Many of the larger pelagic birds such as albatrosses and giant petrels have few predators and live solitary lives on the open ocean. These birds remain relatively calm while being handled and possess few predator avoidance skills. This, however, does not mean that the bird is not stressed.

Immobilise the dangerous parts of the bird (beak, feet) with a firm hold. The rest of the body can be restrained gently. Large birds can be held under the handler's arm and small birds in the palm of the hand. As birds do not possess a diaphragm and rely on movement of the keel bone to facilitate breathing, they can be suffocated by being held too tightly. Some species do not have external nostrils and breathe through the sides of their mouth (gannets, boobies etc). Birds should be held at waist level not near the face with the head and bill facing outwards. Protect eyes and other body parts from birds with sharp beaks and claws. Birds should not be held around the neck as breathing can be restricted and muscles damaged. Towels can be used to

protect the feathers and to wrap around the wings assisting restraint. Hands should be clean and free of moisturiser and oils.

When restraining birds for veterinary treatment/ banding or examination ensure that the hold on the bird is secure and that the handler is comfortable with the restraint. If the bird is breathing up and becoming distressed it is important to notify the veterinarian immediately. The hold on the bird should not be compromised for blood taking or other treatment. The bird should not be raised above the waist to allow the veterinarian access to the leg. The handler should remain comfortable while the veterinarian, bander, etc., squats. A secure hold on the bird is not only important to the bird's wellbeing but avoids injury to the handler and the person treating the bird.

b) Handling Techniques for Specific Species

Penguins: Penguin bills are very sharp and can inflict nasty bites. Penguins are strong and need a firm hold as they may struggle vigorously. Using a towel to wrap around the body of the bird can be helpful and placing the hand over the eyes and around the top of the bill also helps. The head of the penguin can be immobilised in the palm of the hand and the bottom jaw held firmly with the fingers. Flippers can be held against the body.

Albatrosses, petrels and shearwaters: The external nostrils allow for handling with the bill closed. Many of this order show little resistance owing to the fact that they possess limited predator avoidance skills. Gentle handling and a quiet manner are advisable. The bill can be grasped from above with the hand in front of the nostril. The feet can be tucked up and held under the body with the same hand or left unrestrained. To aid restraint it is useful to wrap the wings and body in a towel. Small seabirds can be held in the palm of the hand with the head between the first and second fingers. Shearwaters with long slender bills can be held with the bill closed and the hand positioned with the first finger on top and the thumb underneath. Ensure the external nostrils are not covered.

Pelicans: Pelican nares are partially blocked so they are mouth breathers. They will often struggle when restrained as they try to force air through the small hole in the maxilla. If they continue to struggle it is usually because they cannot breathe properly. The bill should be held loosely from above halfway down the bill leaving it slightly open. Pelicans can be held under the arm with the wings folded in against the body. They have strong legs and feet which can be held up against the body and the handler may require thick trousers to prevent scratching.

Boobies and Gannets: These birds are plunge divers and do not possess external nostrils. They breathe through the sides of their bills which should not be held shut. The point and sides of the bills are razor sharp and should be immobilised first to avoid injury. It is useful to throw a towel over the head and gloves may be needed. The feet and claws are strong and the bird can be held against the body with the wings and body wrapped in a towel. These birds have quick reflexes and will often bite the handler even as they are being released.

Cormorants: Cormorants breathe through the sides of their bills and become easily distressed during handling with rapid increases in breathing. The head can be secured with fingers under the lower mandible and thumb on top of the head. They are much more fragile than gannets and can wriggle out of the handlers grasp by twisting. They have very powerful legs and feet.

Darters: Darters are included in this order but are a freshwater species and not covered in this paper. Darters are extremely dangerous to catch and handle due to their fast reflexes and extremely sharp bill. (Handling technique as for cormorants)

Frigatebirds: These birds also breathe through sides of bill. They are aerial masters spending most of their time swooping over the water and perching in trees. They are klepto parasites – they steal food from other birds forcing them to drop their prey and then retrieving it. They have very weak legs, cannot walk and rarely swim.

Tropicbirds: Tropicbirds cannot walk and their progress on land is reduced to a shuffle. They are generally not aggressive to handlers and can be held gently with the head restrained. They also breathe through the sides of the bill.

6. Admission and Assessment

a) Weight / Records

When birds have been identified records can be initiated with information relating to the bird's encounter site and circumstances of rescue. Any observations of the bird's behaviour, injuries, illness, faecal description, etc., can be recorded. The weight of the bird is important for diagnosis, treatment doses and calculating fluid and food amounts. The bird should be weighed every day initially (when being treated) and then every second day while the bird is in intensive care. Birds should continue to be weighed at all stages of treatment and rehabilitation to monitor their progress and ensure they are at the optimum weight for that species, the sex and age of the bird. Weight loss at the critical care stage is cause for concern and the veterinarian should be notified immediately.

b) Assessment

Birds should be assessed as to their prognosis for successful release to the wild. Early assessment is vital due to the need to release these birds as soon as possible and they may require preventative medication which should start as soon as possible after encounter and diagnosis. When assessing birds it is important to think about the bird's survival chances in the wild not just whether it can be treated for an injury. The release of the bird back into the wild should always be in the best interest of the bird, the population and the ecosystem (30)

During the assessment phase there will be many considerations when making a decision about continuing treatment and rehabilitation or deciding to euthanase a bird. Each bird will require assessment on a case by case basis. Natural selection should be considered when assessing species such as Short-tailed shearwaters. These are the most numerous birds in the world and large numbers die when flying to Australia each year. These are the birds that are too weak to survive and breed and questions should be asked about whether we should be interfering with natural processes. In some cases uninjured shearwaters could be given access to food and rehabilitation pools and those that recover quickly released at sea soon afterwards.

7. Nutrition

The wild diet of the majority of seabirds consists of fish, molluscs, krill and squid. However, birds that have just arrived for treatment and are very weak may not have the energy required to digest whole fish and may need fluids or a liquid diet.

a) Fluids

Most seabirds that are presented in a debilitated state will require fluid therapy to stabilise their condition after the stress of transport (30). Although it may be difficult to

assess the degree of dehydration you can assume that the bird could be at least 10% dehydrated. The eyes may look sunken and dry and the skin wrinkled and dry. The bird may look depressed and have diarrhoea and blood loss (30). Critically ill birds that are unable to hold their head up will require intravenous fluids and intensive veterinary care and assessment.

b) Tube feeding

Birds that are able to sit up and are alert can be given oral fluids via feeding tube into the stomach. Fluids are quickly absorbed from the gastrointestinal tract (30). The bird should be warm before fluids are administered and the fluids must be warmed to 38-40°C the bird's body temperature. Plastic gastrointestinal tubing can be used and it must be of a suitable length as the tube needs to reach down into the proventriculus. Measure the tube on the outside of the bird from the bill edge to the bottom edge of the keel. If necessary the tube can be marked with pen to indicate how far down to introduce the tube. The tube should be lubricated with a gel lubricant or water. The tube can be passed over the glottis (opening to the airway) down the back of the throat and into the oesophagus (Figure 1). The glottis is easy to distinguish when the bird's mouth is open because it is quite small and opens and closes as the bird breathes (Figure 2).

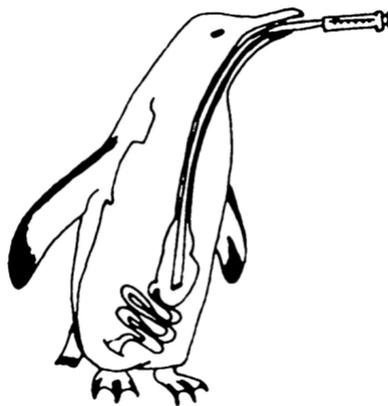


Figure 1: Tube-feeding

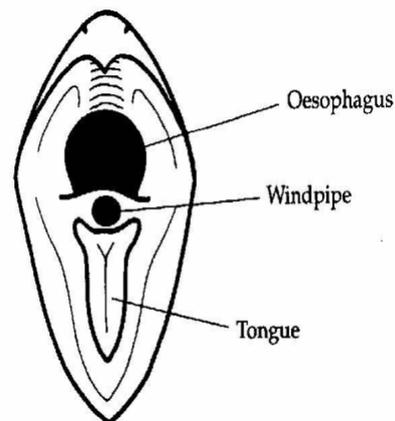


Figure 2: Anatomy of bird's mouth

The volume of fluids that can be given at one time will depend on the species and size of the bird. Sometimes the fluid may well up before this amount is reached so it is advantageous to look down the bird's throat when tubing and to stop if the fluid starts to well up. Administer the fluids slowly and this is less likely to happen. The daily fluid maintenance for birds is 50 ml/kg (if the bird is dehydrated then the normal weight for that species should be used)

Example: The bird weighs 1.2 kg and is 10% dehydrated - its normal weight will be 1.32 kg. The daily fluid requirement is $50\text{ml} \times 1.32 = 66\text{ ml}$. This amount can be divided into 3 – 4 doses over a 24 hour period. So if giving fluids 3 times daily the amount would be 22 ml each time (30).

Types of Fluids: Oral rehydration solutions are Spark Electrovet ® Lectade® Vytrate® or 50:50 Hartmann's solution with Dextrose. Fluids can be administered for the first 24 hours but beyond this the bird will require calories. However it may not be strong enough to eat whole food. (Once the bird is eating there is no need to give fluids).

c) Amount, type and size of food, and vitamin supplements

Birds that are debilitated require food that is high in calories and easy to digest. At the Taronga Wildlife Hospital we use Hills® a/d prescription diet for cats mixed with an oral rehydration fluid such as those listed above in a 50:50 solution. The tube may need to be larger or care taken to make the mix runny enough to pass through. Mixes of blended fish and fluids can also be used but the fish should be supplemented with vitamins and care taken with length of time the fish is defrosted, etc. Mixes for tubing birds should be made fresh daily and refrigerated between feeds.

Very weak birds can often recover quite quickly with warmth and a/d plus fluids. Ensure the bird gets plenty of rest. Seabirds are often exhausted after rescue and may sleep for long periods if they feel secure. Ensure that the hospital area is closed off so that people are not walking in and out because the bird will wake when there are noises in the near vicinity. It can be useful to treat very ill birds like sleeping babies with everyone sneaking around trying not to wake them.

After one day on a/d and fluids the bird may be ready to be introduced to small amounts of fish. Two a/d feeds and one fish feed one day and then the next day the a/d feeds can be decreased and replaced with fish feeds. It is important not to overload the bird with food too quickly as it may become impacted and may not have the energy to digest the fish. Ensure the optimal weight for that species, that sex and that age is known so that you can aim for correct amount of food. It is important that the bird is not overfed as this can cause a whole new set of problems. Penguins and albatross can be quite greedy and will eat as much as they are given. It is important not to assume that because the bird is still taking fish it is hungry. Birds such as penguins will continue to have a feeding response when their stomachs are full of fish. A diet plan is needed so that birds are received 20% of their body weight per day.

Fish can also be filled with Hills® a/d diet and fluids via syringe if the bird requires more vitamins and fluids. Ensure the white bait or pilchards (for example) are fresh and recently defrosted. The fish can be injected with a/d or fluids plus medication (Sporonox®) and vitamin tablets (Seatabs®) then placed in the gills or mouth of the fish. Daily checks with the veterinarian will enable the diet and medications to be adjusted as the bird improves.

Species of fish offered will depend on the species of bird, the size and condition of the bird and what is available at the time. The most commonly used fish species at the Taronga Wildlife Hospital are small medium and large pilchards, red spot whiting, white bait and squid. Bait squid can also be useful. Pilchards are fatty and excellent for gaining weight but a varied diet is essential. Small fish such as white bait can be fed initially when transferring to whole food but ensure the fish has enough food value. Very small fish can lose nutrients quickly and the bird should be weighed every second day to ensure it is gaining weight. Squid is much loved by seabirds but is very difficult to force feed and better kept until the bird is in the rehabilitation pools. Whole fish is preferred as it is a balanced diet for a seabird with the bones and skull providing calcium, the liver Vitamin A and fats present in the gonads (38).

It is recommended that frozen fish be used due to the high parasite burdens carried by many fish species. The fish may need to be frozen for 6 weeks to eliminate all parasites (6). Frozen fish should be stored in air tight packaging at -18°C for no longer than 6 months for non-fatty fish and 3 months for fatty fish. The ideal thawing conditions to maintain nutrient content and quality are either in air at 4-8°C in a sealed container or in 25% seawater (6). Other methods result in dehydration of fish or leaching of NaCl and water-soluble vitamins. Fat soluble vitamins are also rapidly lost

with inappropriate storage and thawing (30). Seabird diets must be supplemented with vitamins as listed below.

Amount of Food: It is recommended that birds receive 20% of their body weight in food per day. Depending on the species and condition, illness etc the bird can be fed 2 or 3 times daily. Feeding small amounts of food often would be more like the bird's natural diet, however, there is nothing natural about keeping a seabird in a hospital or rehabilitation environment. Ensuring the bird is not stressed by frequent feeding and allowing it to rest are vitally important. Disturbing a bird several times a day to feed it becomes counter productive especially since seabirds often defecate when disturbed thereby wasting the extra food.

Size of food: The size of the fish is very important. When force feeding, the fish needs to be smaller than the width of the bird's mouth. If the fish is too big, the fish will be squeezed down the beak and the guts and oil from the fish will run down the sides of the bird's mouth. Most fish are force fed diagonally across the bird's mouth and always head first.

Vitamins: When feeding frozen thawed fish it is recommended that a supplementary vitamins tablet such as Seabird Tabs® (Vetafarm) be given as the freezing and thawing process destroys many of the water and fat soluble vitamins in the fish. Vitamin dose rate: one tablet per kilogram of body weight of bird per day. These can be placed in the fish prior to feeding.

d) Force feeding

Many species of seabird will require force feeding at least in the early stages of treatment (although some will not free feed right through the rehabilitation process). The handling techniques outlined above will assist and care should be taken not to exacerbate any injuries the bird may have. Some experience in handling and treating seabirds will be required before force feeding is attempted. Some larger species will require 2 people, one person straddling the bird and the other feeding the fish. Care should be taken not to put any weight on the bird and a gentle approach is required. The fish should be moist but ensure there is no water running off the fish that could be inhaled by the bird. The neck of the bird should be extended and the handler or feeder should have a good view into the mouth and throat of the bird. It may be necessary to massage the fish down the bird's throat and it is important that the next fish is not introduced before the last fish is swallowed. It is important to be patient and gentle. Ensure the glottis is not obstructed and the fish is put down the back of the throat. Fish should be placed in the mouth of the bird head first and at an angle which best suits the shape of the bird's mouth. Penguins, albatrosses and gannets require the fish to be introduced slightly diagonally across the mouth. The fish should always be smaller than the width of the bird's mouth and should be slid into the throat easily. It is important that the oil and guts of the fish do not run down the sides of the bird's mouth. If this occurs the feathers that have been contaminated should be cleaned as soon as possible. Loss of waterproofing around the face of birds is very common and unfortunately birds cannot reach this area to preen. They can only scratch the head and face region and there is usually no opportunity for allo-preening. Some species will swallow the fish once it is introduced to the mouth but the restraint must allow for the bird to close its bill and swallow which will mean moving its head and bill. This is where handling experience is required so that the handler or feeder is not bitten by the bird when restraint is changed to allow for swallowing. Ensure that the bird's head is not near the handler or feeder's face. If the bird requires the fish to be forced down the throat it may be necessary to use tongs or a tool to grasp the fish and push it down the throat. Great care is required when doing this as the bird can be easily

injured. Good communication between the handler and the feeder is necessary. Ensure that the oil from the fish does not come in contact with any of the bird's feathers during feeding or that the handler does not have moisturiser or other oily lotion on their hands during handling of the bird. Gloves can be worn but examine the gloves after each fish to ensure the gloves have not become contaminated.

Penguins: Penguins can be fed by one person sitting on the ground with the bird wrapped in a towel and placed between the legs using the legs to restrain the bird, pushing flippers or wings against the bird's body ensuring no weight is placed on the bird. The bill can be opened with one hand and the other hand used to put the fish in the bird's mouth. The neck of the penguin should be extended. Two people can also be used if required. Ensure penguins are not overfed as their feeding response may continue when their stomach is full. It is good to look at the amount of food being force fed and think about the size of the bird's stomach. It is not always possible to get the full amount into the bird when force feeding. Medicated fish should be introduced first.

Pelicans: In my experience force feeding pelicans is rarely successful. Pelicans usually regurgitate a minute or more after feeding.

It is essential that the bird is not moved or disturbed after force feeding as they will often regurgitate. Ensure everyone leaves the bird quietly and does not disturb it by talking. A very quiet and secretive watch can be kept on the bird to ensure it is managing after the feeding.

e) Free Feeding

Many seabirds do not recognise dead fish as food and therefore will not feed on their own while in care, especially in the hospital environment. However, some species will take fish from small pools and this should be encouraged. It is important that the bird does not contaminate its feathers by bathing in the water that is provided for the fish as the water will become oily especially overnight. Ensure medicated fish is eaten before the bird is offered more fish. Seabirds have an excellent sense of smell and will sometimes spit out the medicated fish or not take the fish with the medication in it. If the bird is active and feeding from the water it may be time for it to be moved to the rehabilitation environment.

f) Salt tolerance

Pelagic birds drink salt water and excrete the salt via salt glands in their heads (Figure 3). The secretion can be seen running down the bill below the nares or tubes. In birds with internal nares the secretion runs down the inside of the bill from the roof of the mouth and these birds can be observed shaking their heads to excrete the salt solution. This tends to occur about 30 minutes after feeding.



Figure 3 – Bird skull with arrows pointing to position of salt glands

Salt glands are present in all of the Procellariiformes - albatrosses, petrels, shearwaters and penguins, pelicans and cormorants. The size of the gland and the need for access to salt will vary between species. Lack of access to salt does not affect pelicans, cormorants and penguins as much as pelagic species. When pelagic birds are housed in fresh water and do not have access to salt for more than 10 days the gland will atrophy. When a bird is released into the ocean with non-functioning salt glands the bird is unable to cope with the salt resulting in salt toxicity and dehydration.

Birds can be housed in salt water or water that is in 3% salt solution. However this is not always possible as 3% salt is very difficult to supply especially in a large rehabilitation pool which requires cleaning daily to avoid feather contamination.

Therefore birds should be "salted" during rehabilitation to ensure their salt glands are functioning properly prior to release. This is done by administering salt tablets at a rate of 100mg/kg body weight per day (30). If salt tablets are unavailable a salt solution can be tube fed to the bird, starting at 1% and increasing to 3%. The bird should be observed to ensure that it does not suffer from salt toxicity. Signs of salt toxicity include tremors, lethargy, convulsion and lack of appetite.

Only true pelagic species (the tube-noses) require "salting". Other species, such as pelicans and cormorants adjust easily from fresh to salt-water. There are a couple of exceptions, penguins can cope with being housed in fresh water for approximately 3 weeks, which is about the time that they spend out of the water each year moulting. Pelicans also seem to adapt quite well but each bird should be checked to ensure that the gland is functioning. Salting is usually considered after the Intensive Care phase of treatment when the bird has access to a pool and is undergoing rehabilitation.

8. Secondary Complications, Common Diseases and other Problems

a) Aspergillosis

Aspergillosis is a common fungal infection in birds. This disease is most commonly seen as a secondary infection in birds that have been brought into care for other reasons. Seabirds may be particularly susceptible to aspergillosis because they are not exposed to the fungal pathogens in their marine environment (23). Stress and other factors such as infections, malnutrition, contamination, oiling, and trauma can predispose the bird to aspergillosis (38). The *Aspergillus* fungi live in the environment and the birds become infected by inhaling the spores in contaminated food, bedding or nesting material. It is vitally important that straw, hessian sacking and shredded paper are not used in seabird enclosures.

Once clinical signs of the disease are evident the lesions may be extensive and prognosis is poor (30). The bird can sometimes be heard coughing and sneezing, has other respiratory noises, weight loss, is weak and its voice may be affected (30). Blood tests often show a raised white cell count. It is essential that birds that are high risk are started on preventative medication as soon as they are presented for treatment and that they are kept in an appropriate environment so they are not exposed to the aspergillus spores. Due to circumstances that may be unavoidable birds may go untreated for several days. For instance, a bird may be rescued, spend one day at the rescuer's house, be taken to a veterinary practice for another day, be collected by another carer and then transported to a Wildlife Hospital. During this time the bird will be stressed and may be in an unsuitable environment. By the time the bird is finally started on the preventative medication for aspergillosis the disease may be

advanced and the bird unable to be saved. Birds with aspergillosis are contagious to other birds and should be quarantined.

Different drugs are used to treat or prevent aspergillosis. The drug used at the Taronga Wildlife Hospital is Itraconazole (Sporonox®). Other drugs that have been used are ketaconazole, amphotericin-B, flucytosine, fluconazole. When a species that is at risk is admitted, and particularly if it is a threatened species such as an albatross, it may be advantageous to start the bird on Sporonox immediately. The prophylactic course of Itraconazole for 12 weeks is 50 mg/kg twice a day for 2 weeks. Systemic antibiotics and steroids should be avoided if possible because these increase the susceptibility to fungal infections (30). Unfortunately Itraconazole is quite expensive and may not be available in many veterinary practices. Therefore, birds may not be receiving medication at a time when they are most susceptible to the disease.

Aspergillosis prevention also involves minimising stress, providing flooring and bedding which is easily cleaned, maintaining very high standards of cleanliness, minimal noise and a well ventilated environment with fresh food or other appropriate nutritional supplements (30).

b) Bumblefoot (Pododermatitis)

Bumblefoot is a common problem in seabirds kept in care for any length of time. It is usually caused by inappropriate and unhygienic substrates and surfaces and perches. Seabirds are particularly susceptible due to the fact that they do not usually spend much time weight bearing as they are either swimming or flying. Apart from Pelicans most of the seabirds do not spend much time on solid surfaces (their nesting sites are often grass tussocks) and when confined to a hospital enclosure or rehab yard they develop calluses and pressure sores on their soft feet. These usually appear on the balls of their feet or along the plantar surfaces of the digits (30). The lesions along the digits usually correspond with the joints as there is more direct contact and pressure at these points (30). Lesions can easily become ulcerated and move into deeper tissue and joints. Chronic ulceration and secondary bacterial infection is not uncommon.

Treatment can be difficult and is often not successful. Some of the treatments include cleaning and flushing with antiseptics (1% Iovone) or astringents (Lotagen®) and minimal bandaging. Wound dressing such as Duoderm® can be useful (30).

Albatrosses cool themselves by losing heat through their large feet. Therefore it can be fatal to wrap their feet or make “shoes” in an effort to treat or prevent bumblefoot. Penguins and the tube-noses have a layer of subcutaneous fat for insulation (18) which means that they overheat more readily than other bird species. They can regulate their body temperature by allowing or preventing blood flow to their extremities. This is called counter-current heat retention exchange (18) and blood flowing from the feet is warmed by the retia (network of blood vessels) and in this way their feet can be at a temperature close to the environment without heat loss from the body (18). This mechanism is also used to cool the body and birds will sometimes excrete urine and urates onto their legs to increase cooling by evaporation (18).

Bumblefoot must be prevented during transport, intensive care and rehabilitation. It can develop very quickly and has been seen to affect albatrosses in the first 24 hours of care if they are housed on an abrasive surface. Seabirds require soft spongy surfaces that can be easily cleaned. The surface cannot be too hard (bathroom tiles,

concrete) or too slippery (newspaper with faeces). The surface must be kept scrupulously clean so that the bird is not standing in faecal matter.

Towels and rubber matting are appropriate materials for substrate for seabirds. There are several types of rubber matting available. Some are large squares with ribbing on one side (use the flat side) and there is also bar matting (tubes of rubber with gaps which is quite good for the birds feet but almost impossible to clean). Foam rubber can also be used and the sponge matting used for yoga mats is also useful but is slippery when wet. Suspended cage netting can also be used to alleviate joint swelling in some birds.

The rehabilitation enclosures at Taronga Wildlife Hospital have sponge rubber with sprayed rubber lining on the surface which provides a spongy substrate that is easy to clean. In the hospital environment birds are usually kept on towels which are changed frequently and sometimes blankets with towels on top.

When birds can be housed in water bumblefoot is alleviated slightly but most birds that are recovering or in intensive care will not be able to maintain their body temperature and therefore will have to be housed out of water. Prevention is the key.

c) Wounds

When birds are encountered with external wounds it is important that they are examined by a veterinarian as soon as possible. The visible wound may be only a small part of the bird's injury and a thorough examination is necessary. Many birds are attacked while debilitated and although there may be blood in one area this injury may be secondary and not the reason the bird become vulnerable. Birds often have their wings examined first and if they are functioning well the bird is mistakenly assessed as being without injury. Birds often receive injuries to other parts of their bodies and fracture bones such as the clavicle and coracoid. They can also have head injuries which may be difficult to detect and they may be concussed. Transport to a veterinarian as soon as possible for assessment is essential. Seabirds are not as susceptible as other species to trauma but generally if someone encounters a wild bird and is able to get hold of it there is usually something wrong with the bird.

d) Foreign bodies

This is one of the most common reasons why seabirds are presented for care and ingestion or entanglement in marine debris is becoming an increasing threat to marine wildlife.

Seabirds should be x-rayed to ensure that they have not ingested fishing hooks, lines and sinkers and other marine debris such as netting, balloons and plastic bags (not visible on xray). Cormorants, pelicans and penguins are often found to have fish hooks and lines in their intestines and sometimes in their necks if presented early enough. When birds are presented with fishing line injuries, or with fishing line in their mouths or near their heads, it more than likely that they have ingested the hook and sinkers. This is another reason why birds should not be fed until a thorough examination is carried out. Each case requires assessment and the veterinarian will decide whether surgery is viable. Many birds will require euthanasia if not found soon after ingestion.

Ingestion of balloons, cigarette butts, and other debris continues to be a problem for marine wildlife especially for cormorants, pelicans, penguins. Birds with intestinal foreign bodies are often thin and dehydrated when found. They may be weak,

lethargic, constipated and they may regurgitate. They sometimes have blood in their faeces.

The long line fishing industry still continues to be the greatest threat to albatrosses and petrels with many thousands of birds drowning or being fatally injured each year. Albatrosses are sometimes presented with severely damaged bills as a result of trying to free themselves from hooks. These birds are unable to be saved as attempting to make a prosthesis is not an option. Prosthetic bills have been attempted for captive bird species and have been largely unsuccessful. Releasing a bird that cannot be closely monitored is not an option and time in care for healing and adapting to the prosthesis is not possible due to the risk of secondary complications.

e) Feather contamination and loss of waterproofing

The majority of seabirds live in cold environments and the insulating property of the feathers prevents water coming into contact with the bird's skin. This enables a 38–40°C bird to survive in water that is very cold. Seabirds will often lose the waterproofing quality of their feathers due to contamination by oil from fish when being force fed. They can also become contaminated when being caught up for treatment or they may be damaged during transport or housing.

Seabird feathers also lose waterproofing when cleaning agents are used in pools and not rinsed sufficiently to remove all the soapy residue. These agents can strip the feathers of their waterproofing qualities. Oily fish left in the pool that the bird is swimming in can also lead to loss of waterproofing and when free feeding it is important that the water they have access to is clean.

Birds spend a large proportion of their day preening their feathers. This is done to realign the feather barbules and keep the feathers in perfect condition so that they remain waterproof and warm. When birds are sick they do not preen because it takes too much energy, so the feathers can become matted and disordered.

Oiling: Oil affects birds externally and internally. Oil causes feathers to clump which destroys the bird's waterproofing and insulating properties. This results hypothermia (chilling), inability to fly, inability to float and decreased ability to obtain food leading to dehydration. Oil can also burn the skin and eyes and irritate the bird's mucous membranes. Birds will preen their feathers and ingest the oil which has toxic effects on the bird's gastro-intestinal tract and other organs. Toxins in oil can cause damage to the brain, blood, liver, spleen kidneys and gonads (30). Oil fumes can also be inhaled causing pneumonia. The treatment of birds affected by oil is complex and too specific to be covered in this paper. Oiled bird treatment is covered in publications listed in the reference list.

9. Intensive Care Housing

It is always important to have a thorough knowledge of the species natural biology when caring for any animal. However, the hospital environment is a far cry from the open ocean and critically ill seabirds are not able to be housed in anything vaguely resembling their marine environment or their nesting cliff tops. However, knowledge of their diet and their roosting preferences is important for reducing stress. Critically ill birds require intensive and careful treatment, warmth, medication and an environment which avoids feather contamination so that they can be placed in pools as soon as possible.

a) Warmth

Birds that are bright and alert can be kept at room temperature. Birds that are fluffed depressed or very underweight will require a temperature of 26-30°C. Birds that are fluffed are trying to conserve heat and keep warm. Birds are hot creatures with body temperatures between 38-41°C, so they require a warm environment especially when stressed or unwell. Some species of seabird (the petrels) have lower body temperatures than most with 38°C being the average. The body feathers are very dense and waterproof and trap air against the skin. Penguins and tubenoses have a layer of subcutaneous fat for insulation. These birds do not do well in hot climates and overheating must be avoided as this will also stress the bird and make its condition worse. Heat can be provided in several ways. A “hot box” can be helpful for small species especially in the initial stages when the bird needs a warm, dark, quiet environment to rest after the stress of transport. However, it is important to remember that seabirds need housing with ventilation to help prevent aspergillosis.

While critically ill (and so not flapping and damaging their feathers) the bird can be placed in a cage with a heat lamp on the outside directing the warmth inside the cage. Ensure the bird has enough space in the cage to move away from the heat source. If well enough the bird will move away from the lamp thereby regulating their own body temperature. If the bird is sitting very close to the lamp it may not be warm enough and more heat may be required. A thermometer is always helpful to get an idea of the temperature inside the cage.

Ensure that very ill birds are not left under a lamp, and are unable to move away from the heat or the bright light. Birds that are unable to move should be monitored closely to ensure they are not overheating or stressing. They are prone to dehydration at this stage and fluids will be required. The light from the heat lamp can be very bright for an ill seabird and should not be directed so that it shines directly into the bird's eyes. Turning the bird around so that the heat is coming from the back of the bird is preferred. Birds may find it difficult to sleep with the heat lamp directed at them. Other heat sources can be provided such as wrapped hot water bottles, electric heaters (not blowers) light globes or heat pads. It is important that the environment does not become too dry when providing heat sources and a humidity range of 50-70% is preferred. Observations of the bird will enable the temperature to be modified. Essentially if the bird is shivering or fluffed it is too cold and if it is mouth breathing it is too hot.

“Donuts” can be made out of a rolled up towel so that the bird can rest without putting too much weight on the keel. Very ill birds can be propped up into a resting position with the towels. It is important to ensure the bird's feathers are maintained in good condition at this stage and that they do not become covered in faecal matter as this will affect their waterproofing qualities. Any faeces and urates in the cage should be covered with a towel so that the bird is not sitting directly on them. When placing the bird in the cage several towels can be placed under the bird and then layers removed if needed. Some species will not defecate out of water and will require short swims in warm water baths. If this is required (the bird has not passed any urates and faecal matter for 24 hours), ensure that the water is as warm as the bird, that the environment is quiet and that the bird stays in the water for as short a time as possible. Ensure that the bird is not using up too much energy during this process especially if only receiving small amounts of food or fluids only.

b) Floor covering/ Perches

Most species of seabird will require rubber matting and towels on the floor of the cage or hospital den. Due to problems associated with bumblefoot the surface cannot be too hard or too slippery. Surfaces such as concrete, floor tiles, newspaper etc are not

recommended. The flooring should be kept clean of all faecal matter and either hosed or covered so that the bird is not standing or sitting in the faeces or urates. Details of matting is covered in the section on bumblefoot. Some species (Pelicans, cormorants, boobies) will require branches or large logs for perching and these can be placed on the floor on top of the rubber matting. If birds are well enough perching will enable them to feel secure and comfortable and get off the ground so that they do not soil their feathers. The size of the perch is very important and must be appropriate for each species and correspond with the size of the bird's feet. To a sick bird a perch is the equivalent of a bed for a human patient. If the patient is to rest and recover branches and logs need to be the appropriate size. Some branches that do not have bark attached will be too slippery for a sick bird and may require towels to be wrapped around the branch to prevent bumblefoot lesions. Please refer to the section on Intensive care housing for specific species.

c) Ventilation

It is important that the hospital area is well ventilated to help reduce the possibility of the spread of aspergillosis. Although the area requires heating it is vital that there is a flow through system of air and that windows are kept open. Potentially infectious birds should be separated from well birds and air flow can help to reduce the chances of cross contamination.

d) Hygiene/Zoonosis

The environment should be kept extremely clean and should be disinfected and scrubbed daily where possible to protect the birds and humans from disease. Birds that are under stress can potentially transfer disease to humans. Humans are exposed by inhalation of airborne particles, direct skin contact with birds and fish, ingestion, through bites and scratches. Protective clothing may be required and hand washing with a disinfectant is essential.

e) Stress

It is essential that noise is kept to a minimum and people are discouraged from talking loudly in the intensive care area. Most species spend their time on their own in a pelagic environment (apart from at nesting colonies) and require quiet when they are unwell. All household pets, children and noisy people must be kept away from the bird so that when it is not being fed it can be resting.

f) Housing for specific species

Penguins: Penguins are robust birds and will survive injury and illness that would be fatal to other birds. They are not as susceptible to either bumblefoot or aspergillosis and can cope with being out of the water for longer periods. This is possibly due to the long period (3–4 weeks) that they spend out of the water moulting each year. During this time they replace all of their feathers and lose up to 50% of their body weight. The replacement of feathers consumes a lot of energy (3% of body weight per day in some penguins) (24). During this time penguins are susceptible to injuries (being attacked by dogs and sea eagles) and other illness due to the degree of weight loss and long period without food or water. Penguins may be presented in a very debilitated state during the moult. Their healthy average weight is 1 kg and they can sometimes be presented weighing 500 gms. Birds that are this weight have a poor prognosis unless they are a small female. Birds that are approximately 600 gm can recover

quite well. These birds should be fed small amounts of food initially and some will require days of fluids and Hills® a/d diet as described earlier in this paper.

When in hospital penguins like to hide under a small wooden box or similar. They also require room to stretch out and will sleep on their bellies. Privacy can be provided by hanging a towel over the cage. If critically ill they will require a donut (folded towel) that they can rest on. They can be given a swim when well enough but ensure the water is warm as they may not be waterproof and will become cold very quickly. Lowering the bird's body temperature is the last thing needed for a critically ill bird. Ensure that the penguin has access to a heat lamp if they have been given the opportunity to swim. Sick birds do not preen because preening takes up too much energy and so sections of their feathers, especially the feathers difficult to reach, may become encrusted with faecal matter. This should be washed in warm water and the bird dried thoroughly or given access to heat. It is best not to allow sea birds large water dishes in their intensive care cages as they will try to get into them and may become cold. This is the complete opposite to housing these birds in the rehabilitation environment where they require access to water at all times and should be encouraged to swim. Conserving energy is very important for critically ill birds.

Penguins that are recovering well in hospital can be given access to a small warm area with rubber matting and a pool. It is important that they are not given access to the pool at night until you are certain that they can retain their body temperature. Penguins soon become accustomed to carers and will often communicate (little penguins are the noisiest of all the penguin species and have many different calls), especially when they think they are about to be fed.

Moulting birds may be presented without injury and not in a debilitated state. These birds can be housed in a safe environment with somewhere to hide for the duration of the moult (3-4 weeks). They can be given small amounts of food during this time and their weight monitored. Two or three small fish per day can be given to birds that are in good condition. These birds would not be eating any food during this time in their natural environment. However, it is important that they do not become too dehydrated especially if in the hospital environment. They will not require access to water as they do not swim while moulting because they are not waterproof. Occasionally birds will be presented with feathers that are brown and look very dirty. These birds may be about to start moulting but may require feeding to a certain weight to allow the process to begin. Penguins spend weeks pre moult foraging so that they can gain weight prior to moult. In some cases birds can reach 1.3 kg and will not start moulting until reaching this weight. These birds should be closely monitored during this period. It is not unusual to find ticks on penguins especially those that have left the water to moult.

Pelicans: Pelicans that are well enough to stand require a perch. Thick branches should be provided or large stumps of wood. Several different sizes can be given to help prevent bumblefoot. Pelicans are not as susceptible to bumblefoot and aspergillosis as the true pelagic species. Pelicans that are not critical will often feed readily while in care and a small pool of water can be given (the size of the shell child's swimming pool) so that they can fit their large bill in the pool and manipulate the fish. Care should be taken when allowing ill birds in the hospital environment access to pools especially overnight. Birds can become cold and may even drown in the pool if too weak to get out. Intensive care is essentially bed rest and is a time when the bird is recovering and conserving energy. Birds that are unable to hold their head up will require "donuts" to be placed around them so that they can rest their heads on the towels.

Cormorants: Cormorants are notoriously difficult to treat and rehabilitate. They are easily stressed and will regurgitate food at the slightest disturbance. "Highly strung" is a term often used to describe cormorants. They should be housed where they will be least disturbed with visual barriers if possible. They require perches above water if well enough (even if it is a small pool). The smaller species seem to cope better in captivity than the larger cormorants. They enjoy heat lamps but ensure they cannot get to them as they will try to perch on the lamp and may burn themselves. They do not have much body fat and it is important that their weight is watched closely. They are very susceptible to ingesting fishing lines and hooks and should be x-rayed as soon as they are well enough to cope with an anaesthetic.

Albatrosses: These birds will require hospital dens that will allow them to stretch their wings. Albatrosses will often be found with lots of large ectoparasites in their feathers and can be dusted with a lice powder. Care should always be taken to ensure products used on or near the feathers of seabirds do not contaminate the feathers. They will require soft matting and towels or blankets as a substrate and many species will not feed on their own and will require force feeding. Albatrosses and shearwaters and some of the smaller petrels have difficulty walking. Many of the albatrosses will want to wash their face in a bowl of water after feeding and may drink it readily and clack their bills.

Giant petrels: These birds are the scavengers of the seabird world and are not as susceptible to bumblefoot as some of the other species due to the fact that they do spend some time walking on land. They usually feed very well and will eat almost anything offered. They have an extraordinarily good sense of smell. They are very messy eaters and will shake their heads and spread the fish guts around the hospital den. If a giant petrel does not eat well then it is very ill indeed. They are quite vocal when feeding. These birds will want to wash their faces after feeding and will move their heads from side to side in a water dish making lots of noise and clacking their bills.

Gannets: Most of the gannets encountered on the east coast of Australia are first year birds (black and white speckled) from nesting colonies in Tasmanian waters or New Zealand. They may be only a few months old and some may not have managed to feed at all. These birds are usually very thin and require feeding as outlined in the nutrition section of this paper. They will rarely feed on their own and require force feeding, sometimes right up until release. Some birds will eat from a pool. Gannets are very susceptible to aspergillosis and many presented for treatment die of the disease if not given medication immediately after being encountered.

Boobies: Boobies are one of the few seabirds that roost in trees and therefore require branches in their hospital cages. They will feed from a dish as long as they do not have to come down to the floor to get access to it. Those encountered in southern states will not swim in the cold water and may require water heating for the majority of their treatment period. They will require external heating in the hospital and sometimes in the rehabilitation environment.

Tropicbirds: These birds occasionally get blown a long way of course and are encountered in some very strange places. Most tropicbirds will require force feeding and will regurgitate if disturbed. They have a very wide mouth, due to the flying fish that they eat in the wild, and the food should be introduced well down the throat or they will regurgitate it.

10. Rehabilitation

As soon as possible birds that are well enough should be transferred to the rehabilitation environment where they can have access to water. There they will embark on the next stage of their treatment which will prepare them for their return to the wild. It is especially important that seabirds are well acclimatised and waterproofed before release as many of these birds live in extremely cold environments. During rehabilitation the birds will also regain body condition, regain waterproofing, regain fitness, regain salt tolerance and normal behaviour. They will require housing in water and large, deep rehabilitation pools will be required for most species. Prior to release they will require physical and behavioural assessment to ensure that they are capable of surviving. They will require a health assessment to ensure that they do not pose a disease risk to the wild population. They will also require forms of identification to enable post release monitoring. These aspects are covered in the paper Rehabilitation and Release of Seabirds (10).

11. Conclusion

Wildlife treatment and rehabilitation raises political, ethical and emotional issues. Each case requires consideration on an individual basis and the decision whether to treat or euthanase a bird will depend on many factors. The status of the animal (many of the albatross species are endangered) natural selection (shearwater migrations) educational considerations (raising awareness), moral responsibility, disease risk to wild population, ethical considerations (amount of stress the bird will experience) knowledge or skills gained, financial considerations, and prognosis for successful release and survival to breed. When seabirds are presented for treatment it is an opportunity to learn more about these birds and help raise awareness of the plight of seabirds around the world.

12. Acknowledgements

Figure 1 - Tube-feeding penguin, artist Jane Hall

Figure 2 - Anatomy of bird's mouth. Artist Rebecca Hale
Reproduced from Rescue and Rehabilitation of Oiled Birds
Erna Walraven, Zoological Parks Board of New South Wales 2004.

Figure 3 - Bird skull with arrows pointing to position of salt glands
Artist Larry Vogelnest

Appendix A and Appendix B -
Southern Ocean Seabirds Study Association 1995
Lindsay Smith.

© Elizabeth Hall, Taronga Wildlife Hospital, Taronga Zoo, 8 July 2008.
for National Wildlife Rehabilitation Conference,
21-25 July 2008 Canberra. ACT.

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