A REVIEW OF LIVE STRANDINGS OF CETACEANS: IMPLICATIONS FOR THEIR VETERINARY CARE, RESCUE AND REHABILITATION IN THE UK

A Report for the Whale and Dolphin Conservation Society

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CONTENTS

1. **Executive Summary & Recommendations** 4 9

2. **Introduction** 11

3. **Causes of live strandings** 12

Mass strandings 12
Individual strandings 14
Summary 15

4. **Assessing the state of stranded animals** 16

Behavioural Observations 16
- i) Overall demeanour 16
- ii) Respiratory rate and quality 16
- iii) Discharges 17
- iv) Physical condition 17

Clinical examination 17
- i) Reflexes 17
- ii) Body temperature 17
- iii) Cardiovascular function 18
- iv) Respiratory function 18
- v) Response to refloating 18

Blood and other sampling 18
- i) Haematology 18
- ii) Biochemistry 19
- iii) Other samples 22

Species and age 23
Stress in stranded cetaceans 23
Summary 24

5. **Treatment and care options** 27

First aid and assessment 27
- i) Positioning 27
- ii) Temperature regulation 27
- iii) Preventing further trauma 28
- iv) Crowd Control 28

Special issues for mass strandings 28
Refloating 28
Transport 29
Rehabilitation 30
Euthanasia 31
Summary 31

6. **Survival rates** 33

Refloating 33

Rehabilitation 33
Stress in captivity 34
Release from rehabilitation 35
Marking and Tagging 36
i) Natural marks 36
ii) Branding and artificial marks 37
iii) Button and bolt tags 37
iv) Roto tags 37
v) Spaghetti tags 38
vi) Radio tags 38
vii) Satellite tags 38
viii) Ribbon tags 39
ix) Electronic chips 39
Summary 39

7. **Practical implications of different options** 41

Beach treatment only 41
Beach treatment plus limited holding facilities 41
Beach treatment plus rehabilitation 42
Summary 43

8. **Discussion & Conclusions in the UK Context** 44

The distribution of strandings in the UK 44
Causes of strandings in the UK 45
Success rates with strandings in the UK 49
Improving assessment 50
Improving care 50
i) First aid 50
ii) Refloating 51
iii) Rehabilitation 51
iv) Tagging and marking 52

9. **Acknowledgements** 54
10. **References** 55

Tables:

4.1 - Changes in cetacean blood biochemistry and possible causes. 20
4.2 - Indicators of state of health in stranded cetaceans. 25
8.1 - Live stranded cetaceans in England and Wales: 1992-1995 46
8.2 - Live stranded cetaceans in Scotland: 1992-1995 47
8.3 - Conditions in stranded cetaceans: 1991-1995 48

1. EXECUTIVE SUMMARY

Whales and dolphins have been stranding alive on beaches for millennia. Largely ignored for most of this time, people increasingly wish to try and help these animals and return them to the sea. This report considers prospects for rescuing these stranded cetaceans and the veterinary aspects of their care. A fundamental assumption of this report is that the intention is that animals will be returned to the wild either in the short or medium term. Firstly it examines the situation generally before focussing on the UK.

Types of strandings

The pattern of live strandings can be divided into mass strandings of two or more individuals, or single strandings of individual animals or a female and calf. World wide, the commonest species to mass strand are sperm whales (*Physeter macrocephalus*), short-finned pilot whales (*Globicelphala macrorhynchus*), long-finned pilot whales (*Globicephala melas*) and false killer whales (*Pseudorca crassidens*) together with pelagic species of dolphin including white-sided (*Lagenorhynchus acutus*) and white-beaked dolphins (*Lagenorhynchus albirostris*). Thus coastal species of cetacean such as bottlenose dolphins (*Tursiops truncatus*) and harbour porpoises (*Phocoena phocoena*) are extremely unlikely to be involved in mass strandings events. Species of baleen whales, such as minke whale (*Balaenoptera auctorostrata*), are also not involved in mass strandings.

Mass strandings tend to occur in specific areas including long, sloping sandy beaches. Theories of mass strandings include animals becoming trapped on such beaches through disorientation or if they pursue prey close to shore. Another is that when a key member or members of a group becomes ill or debilitated and strand the whole group may accompany them. Others have suggested that animals may make navigational mistakes and find themselves onshore rather than following an appropriate migratory route.

None of these theories have been proved, and many factors may play a role in the cause of a mass stranding. The most important observation from a rescue perspective is that many of these animals are in good health and so their prospects of survival are good.

Individual strandings are mainly thought to involve animals which are sick or debilitated and this makes their prognosis more guarded. However, and very importantly, not all animals which strand do show evidence of serious disease.

Assessing stranded animals

The most important part of a veterinary response to a cetacean stranding is to evaluate the health status of the animal(s). This is critical in determining whether they are candidates for return to the sea as quickly as possible or whether rehabilitation or euthanasia are better options.

The assessment involves behavioural observations, clinical examination and analysis of blood and other samples. This is not an easy process given our inexperience and lack of knowledge about these species. There is no single indicator from which a unequivocal prognosis can be made.

The most helpful physical and clinical signs include the animal's body condition, general demeanour, body temperature and respiratory rate and character. There are no well established normal levels for haematological and blood biochemistry parameters in free-living cetaceans. However, haematology can assist in determining state of hydration and if anaemia exists. Biochemical parameters can be used to help diagnosis of underlying conditions. The use of serum iron and erythrocyte sedimentation rates show promise as prognostic indicators.

Stress leading to shock in cetaceans can arise from the disease process, the stranding itself and physical interference in a rescue attempt. It is an important determinant in the final outcome. Because stress and the development of shock is such an insidious yet life threatening process with reversible and irreversible phases, considerable care must be taken both to avoid stress and mitigate its effects.

Recorded responses to stress in cetaceans include elevated plasma cortisol, neutrophilia, eosinopaenia, raised blood glucose, lowered serum iron concentrations and increased erythrocyte sedimentation rates. Elevations in blood levels of the enzymes aspartate aminotransferase and creatinine kinase have also been reported. Respiratory rate is usually elevated and capillary refill time may be prolonged.

The species and age of the animal are also important factors in prognosis. Harbour porpoises are acknowledged to be difficult to treat even by those with success and experience. Pelagic species of dolphins may not adapt well to the stress of captivity and so rehabilitation may inevitably be less successful. Neonatal animals in apparent good health may appear attractive options for rehabilitation. However, if reared in isolation it is possible they will never be able to be released to the wild as they will not have learnt foraging and social skills.

Treatment

When animals are found stranded on a beach a number of alternative approaches to treatment will have to be weighed up depending on the outcome of the assessment. These include immediate refloating, delayed refloating after treatment or removal to a better site, being taken into captivity for rehabilitation treatment or euthanasia.

First aid will need to be provided for all stranded animals. Practical measures to help animals can be undertaken relatively easily by suitably trained people. This includes proper positioning, preventing overheating and further trauma. An important part of first aid is to ensure they are not stressed by the presence of large numbers of people.

If an animal is judged to be healthy enough for immediate return to the sea it is refloated. Refloating involves moving the animal to the water on stretchers and supporting it in the water. Animals are likely to be disorientated, possibly with stiff muscles and need time to recover during initial refloating. Response to refloating forms an important part of the overall assessment of the animal. If beach conditions are dangerous, an animal can be moved to a safer, more sheltered nearby beach for refloating.

If an animal seems too weak or ill to be refloated one option is to take it into captivity for treatment. Rehabilitation is a serious undertaking which demands proper facilities and specialised care. Basic requirements include the provision of a pool of suitable size (round or oval, minimum 9 m diameter) with padded sides, and saltwater with a filtration system to maintain good water quality. Handling facilities to examine an animal on admission and during its stay will also be necessary.

Transport to rehabilitation facilities or to another beach must only be undertaken with great care. The absence of water to provide support and allow optimal thermoregulatory control makes transport hazardous and adequate substitute(s) must be provided. This will involve the use of properly padded stretchers and cooling to avoid hyperthermia. Moist, heavy foam rubber or equivalent should be used in the bottom of the transport vehicle. If transport is not carried out well, animals may be damaged and experience muscular stiffness, inappetance, anaemia, pressure necrosis and respiratory infection as a result

Animals which are seriously ill or injured and with no prospects of surviving in the wild should be euthanased. Euthanasia should only be carried out by a veterinary surgeon using recognised techniques.

Large whales are extremely difficult to euthanase and allowing large animals to die naturally may be more humane than repeated painful and unsuccessful attempts to kill it.

Survival rates

It is impossible to give survival rates for treatment with any real confidence because there have been no studies which follow the long term fate of rescued animals once released to the sea. However, refloating has been used with apparent success worldwide, especially in cases of mass strandings, with some rescue organisations claiming success rates of 90% for animals which have been returned to the sea.

Refloating has proved to be a practical and effective response to rescuing stranded animals but needs to be carried out with care and patience. Trial refloating can also play an important role in the assessment of an animal. Refloating, like first aid, requires trained people if unnecessary harm is not to be caused to an animal. The provision of suitable equipment is also essential. Refloating probably gives animals their best chance of survival as it limits the degree of stress to which an animal is exposed especially if well trained and experienced people are assisting.

Rehabilitation survival rates are generally poor. Although there is no comprehensive published data reviewing survival rates in centres it is clear many animals die whether they originally came ashore with others or not. In the US, where rehabilitation is most widely practised, some animals although healthy are not returned to the sea. However, there are records of animals which have been successfully treated and returned to the sea in the US, Australia and the Netherlands. As with refloating, there is no data on their survival once released.

To determine survival rates once animals are put back in the sea some kind of monitoring would be beneficial. However, none of the methods currently available are perfect. Some are invasive in nature while others suffer from disadvantages such as poor likelihood of resighting.

Even if animals have to be euthenased this should not be considered a 'failure' if an accurate diagnosis and prognosis has been arrived at which indicates the prospects for survival in the wild are poor or hopeless, euthenasia will be the option which is in the best interests of the animal's welfare.

Comparison of treatment options

There is no question that the most important step is to ensure top quality treatment on the beach. It is the time when an accurate assessment of health and prognosis is vital. For the majority of animals this will give them their best chance of survival and it is therefore the most cost-effective option and arguably the most humane approach. Prolonged handling and inappropriate care all add to the stress an animal experiences and reduce its chances of survival.

Rehabilitation is a very expensive approach to treatment which, based on past experience, is of limited applicability and success. Careful evaluation of animals, including the prospects for their long-term viability in the wild following rehabilitation will be needed to justify such intervention.

The UK situation

Figures are derived from data for the 1992-1995 period which are the most reliable available. From this data it can be calculated that there are about 35 animals stranded alive around Britain each year. Around 60% of these animals strand in Scotland. Mass strandings have only occurred in Scotland during the last four years. The harbour porpoises is the species which most commonly strand individually. Striped, white-sided and white-beaked dolphins were involved in both individual and mass strandings.

It is not possible to determine exactly what causes mass strandings in Scotland. It seems as if in the UK as elsewhere, disease plays an important role in individual strandings. Conditions found on post mortem examination of animals live stranding but subsequently dying, include parasitic pneumonia, central nervous system disease, septicaemia and starvation. Although all harbour porpoises had evidence of serious disease some of the dolphins had no obvious cause of death.

In Scotland, an overall survival rate, as judged by the numbers of animals returned to the sea, of 40% (33 out of 84) was achieved. The majority of efforts were directed towards refloating with the outcome being marginally better for mass than individual strandings. It has been estimated that of the 70% considered suitable for return to the sea, refloating was successful in 65% of cases.

In England and Wales, only 14% (8 out of 57) of animals live stranded during 1992-1995 were successfully returned to the sea. The poor success rates with harbour porpoises were evident in Scotland, England and Wales.

Efforts to rehabilitate animals in the UK have been disappointing to date. In Scotland of two harbour porpoises which were taken into care one died and the other was euthanased. In England and Wales, all 7 of the harbour porpoises have died as have 2 others which died during transport. Survival has been somewhat higher with dolphins. Two of five common dolphins were rehabilitated as was one of two striped dolphins. Another white-sided dolphin also died during attempts to rehabilitate it.

Although there is now an impressive system to collect post mortem data about stranded cetaceans, there is no system to collect, collate and evaluate veterinary medical data about strandings.

No adequate cetacean rehabilitation facilities exist in the UK at the moment. The small number of strandings that occur in the UK and their wide geographical spread place pressures on the feasibility of the provision of rehabilitation facilities. Of all the stranded animals only a very small percentage will be candidates for rehabilitation. Based on the data from 1992-1995, rehabilitation was an option for about 5 animals a year in the whole of the UK.

About two thirds of animals for rehabilitation would be harbour porpoises and the rest pelagic species of dolphin. Harbour porpoises are probably among the least likely to survive as they often strand with serious disease which is not amenable to treatment. Given the constraints on transport of animals, any one facility could only serve a limited area. Therefore, in cost terms the investment in specialised rehabilitation may be difficult to justify especially as they will lie idle for prolonged periods of time. The provision of care for neonatal animals carries even greater demands in cost and commitment.

In the UK there is no interest among the authorities in supporting efforts to rescue live stranded cetaceans as there is in other countries such as the USA, New Zealand and Australia. Elsewhere regulations exist to try to ensure good quality care is given. For example, under the US Marine Mammal Protection Act, 1972, official permission has to be given to treat a stranded animal. There are many different organisations who have developed plans for dealing with stranded cetaceans in the UK. Many of these are part of the Marine Animal Rescue Coalition (MARC) which is dedicated to providing appropriate responses for stranded marine mammals. Training courses have already been run.

Currently there is no systematic tagging or marking of live stranded cetaceans in the UK. One animal has been freeze branded before release from rehabilitation (James Barnett, personal communication). Freeze branding does not cause any noticeable distress to animals and shows the potential to be a humane marking method for animals in rehabilitation.

RECOMMENDATIONS FOR THE UK

* **Beach treatment with the provision of first aid and refloating should be the primary focus of rescue attempts for live stranded cetaceans.**

* **Resources for dealing with beach treatment of mass strandings should be concentrated in Scotland. Specialised training and planning should be provided there to deal with such events.**

* **Rehabilitation should play a secondary role in rescue and will need considerable investment if it is to be attempted.**

* **Neonatal animals should not be taken into rehabilitation facilities as there is little prospect that hand reared cetaceans could be released to the wild.**

* **The use of temporary pools should be restricted to the beach head when situations where refloating at sea is not practically possible. Animals should never be held for longer than 48 hours in such pools.**

* **A central system should be established to coordinate and collect data relating to live strandings.**

* **A consistent approach to first aid, assessment and monitoring should be developed and used by all those attending stranded animals.**

* **Research to evaluate data collected at strandings should be conducted with the aim of developing reliable prognostic indicators and diagnostic aids.**

* **A system of accredited training for both lay people and veterinary surgeons in first aid treatment and refloating of stranded cetaceans should be developed.**

* **A plan should be developed for managing strandings which deals with the whole of the stranding incident. Individuals dedicated to public information and control should be part of a team to alleviate pressure on those involved in animal care.**

* **Information about the causes and treatment of strandings should be prepared and be available to the public and press at strandings and other times.**

* **Rehabilitation should only be undertaken when adequate facilities exist. As yet there are no such facilities in the UK.**

* **Essential MINIMUM requirements for a cetacean rehabilitation centre for short term (weeks) should be:-**
  - **a minimum of a 9 metre diameter oval or round pool with padded sides**
  - **support systems for animals in the water**
  - **fully treated salt water supply**
  - **a controlled environment**
  - **isolation from the public**
  - **handling facilities**
  - **24 hour observation facilities**
  - **experienced and qualified carers**

* **For longer term treatment, a sea pool for animals to gain fitness in sea conditions must be provided.**

* **Simple marking procedures should always be used when animals are released:**
  - **the dorsal fin should be photographed and a central record kept.**
  - **a biodegradable ribbon tag should be attached to the animal.**

* **Schemes should be established to search coastline and sea close to the stranding/release site point in the 48 hours following the release of an animal.**

* **Radio and satellite tagging should only be used as part of a well planned project which will generate reliable information.**

2. INTRODUCTION

Whales and dolphins have been stranding alive on beaches for millennia (Cordes 1982; Walsh et al, 1990; Geraci & Lounsbury, 1993). Largely ignored for most of this time, people increasingly wish to try and help these animals and return them to the sea. This report considers the veterinary aspects of strandings to help focus efforts most effectively so the best action in the animal's interest can be taken. A fundamental assumption of this report is that the intention is that animals will be returned to the wild either in the short or medium term. Long term maintenance in captivity without rehabilitation is not considered to be in the best interests of the animal involved. This is because prolonged captivity involves keeping animals in impoverished environments and imposes on them a chronically stressful situation. This goal of rehabilitation influences the way in which veterinary care is viewed in this report. Ensuring an animal is fit and healthy enough to survive the rigors of the ocean is different than ensuring an animal can exist in captivity.

Deciding on the best approach to take when an whale or dolphin strands is not an easy process. Firstly, there are very practical difficulties. The size of the larger whales makes their physical movement extremely difficult. Even an adult of relatively small species such as a short-finned pilot whale (*Globicephala macrorhynchus*) may require up to 30 people to move it. Some animals may resist interference and thrash around making assistance hazardous (Gage, 1990).

We also know relatively little about the natural history, physiology or diseases of cetaceans and thus many of our efforts will be made in considerable ignorance. How to share knowledge, maintain skills and have the most experience available are important issues to address.

Using experience from other areas is not always as useful as we might hope when it comes to dealing with stranded animals. For example, marine mammals are different to terrestrial mammals not only in the environment they inhabit, but also in their physiology. Direct extrapolation from one group to the other may not, therefore, be appropriate in veterinary care. This together with the enormous difficulties which are faced when trying to study marine mammals in their natural environment (including once they have been returned to the sea following stranding, for example), makes assessing the causes of an individual stranding and the appropriate course of action extremely difficult. In fact very little information exists about the success or otherwise of the past treatment of live stranded cetaceans, especially long term survival, which makes critical evaluation of options uncertain.

Despite these seemingly huge difficulties to be faced, it is clear that systems can be established and animals rescued and that this can be a very worthwhile and rewarding exercise. This report hopes to contribute to efforts to achieve that goal. Firstly, information about causes of live strandings is reviewed. The ways in which the condition of an animal can be determined and the options for care are then considered. How successful people have been with different approaches and the pros and cons of tagging as a way of monitoring animals is reviewed in section 6. The practical implications of different options is also briefly considered. Finally the situation with regard to strandings in the UK is brought together in the discussion and considered in the light of the other findings and some recommendations made.

3. CAUSES OF LIVE STRANDINGS

Live strandings come in two recognised forms, mass or individual. There are distinct differences between these types of strandings which have implications for the care of the animals involved. These differences include the species involved and their location as well as their likely causation and the prognosis for the animals involved.

Mass Strandings

Mass strandings are defined as those which involve two, three or more animals unless a pair consists of a female and her calf (Cordes, 1982; Geraci & Lounsbury, 1993). Numbers involved are very variable and may even be in the hundreds. Not all species of whale or dolphin are equally likely to be involved in mass strandings. There have been no recorded incidents of baleen whales becoming mass stranded (Cordes, 1982) for example.

The commonest species of toothed whales which mass strand are sperm whales (*Physeter macrocephalus*), short-finned pilot whales (*Globicelphala macrorhynchus*), long-finned pilot whales (*Globicephala melas*) and false killer whales (*Pseudorca crassidens*) together with pelagic species of dolphin including white-sided dolphins (*Lagenorhynchus acutus*) and white-beaked dolphins (*Lagenorhynchus albirostris*). Thus coastal species of cetacean such as bottlenose dolphins (*Tursiops truncatus*) and harbour porpoises (*Phocoena phocoena*) are extremely unlikely to be involved in mass strandings events.

There has been considerable conjecture about the possible causes of mass strandings. Theories include disorientation when pelagic species find themselves in unfamiliar circumstances or if they pursue prey close to shore. Another is that because of the social nature of cetaceans, when a key member or members of a group becomes ill or debilitated and strand the whole group may accompany them. Others have suggested that animals may make navigational mistakes and find themselves onshore rather than following an appropriate migratory route.

All of these and the other various theories have their proponents and opponents. The main difficulty comes in rigorously testing any hypothesis and is complicated further because no one single factor may be responsible (Cordes, 1982). However, understanding the reason(s) for stranding in any particular situation would help direct appropriate veterinary care and give a better guide to prognosis and so the arguments are worth considering in a little detail. For example, if animals are stranded because they cannot navigate in shallow waters it may be justified to release them well off shore as some have done (Gales, 1992). If social cohesion and key individuals are important in group behaviour better success may be achieved by using these animals to encourage the whole group to move out to sea (Project Jonah, 1995).

It has been argued that cetacean live stranding sites are related to geomagnetic field characteristics (Klinowska, 1985; Klinowska, 1986). The geomagnetic field of the earth is not uniform as it is affected by the nature of the underlying rock and physical topography. Therefore there are anomalies caused to the geomagnetic field which can be mapped. This results in a picture very much like a contour map of land, with lines close together where the geomagnetic field is changing rapidly (analogous to steepness) and further apart when there is less change (like flat ground).

Cetaceans may use the earth's geomagnetic field to help navigate in the relatively featureless environment of the sea. Klinowska (1985; 1986), believes whales and dolphins may migrate along lines of low change in the geomagnetic field (the 'flatter' areas). Her work suggests that mistakes may occur when disturbances in geomagnetic fields occur and animals take the wrong 'turning' and mistakenly follow a wrong 'path' of low geomagnetic change to the shore. Disturbances to geomagnetic fields arise through regular events such as tidal flow but they can also be affected by more sporadic events such as magnetic storms as a result of solar activity.

Evidence in support of this theory comes from the strong association she has found between sites of live strandings and geomagnetic fields in the UK. Data from the east coast of the US also shows live strandings occur at geomagnetic valleys (Kirschvink, 1990) and a recent mass stranding of white-sided dolphins in Ireland occurred at a site consistent with Klinowska's theory (Rogan *et al*, 1996). However, although this theory may seem to offer a simple explanation why pelagic species are more likely to strand that coastal species, data from elsewhere in the world does not give unequivocal support. In New Zealand, for example, mass strandings do not relate to geomagnetic topography (Brabyn & Frew, 1994).

Another theory is that pelagic species strand when they are following prey which move inshore or are searching for food father afield than normal. Post-mortem examination of stranded animals provides mixed support for this hypothesis. Stranded rough-toothed dolphins (*Steno bredensis*) did have coastal species of fish found in their stomachs (Anon, 1994) as would be expected if this theory were correct. However, no half digested food was found in the stomach of mass stranded white-sided dolphins (St Aubin & Geraci, 1979) or spinner dolphins (*Stenella longirostris*) (Mead *et al*, 1980), for example.

There are also theories that the animals involved in a mass stranding may be diseased resulting in their abnormal behaviour or movements. For example, Morimitsu *et al* (1987) have suggested that parasitic damage caused by *Nasitrema* sp to the eighth cranial nerve, which innervates the ear and is thought to play a role in location, was responsible for separate mass strandings of pilot and false killer whales. However, parasites are common in free-living animals so such findings are not unusual and may not be responsible for stranding (Walsh *et al*, 1990).

Rather than the whole group necessarily being diseased another theory is that if a member or members of a group become seriously ill and strand, the social nature of whales and dolphins leads to the whole of the group stranding. This could explain why species which are social in nature mass strand while others do not. However, not all social species of pelagic dolphin strand. Often there is no evidence of disease in the animals examined in post mortem studies, or in those for which haematological and biochemical data are available (e.g Gales, 1992; Mead *et al*, 1980; Rodriguez-Lopez *et al*, 1995). This does not necessarily mean that certain individuals in mass stranding were not ill as these may not have been post-mortemed or sampled.

Morbillivirus infection may also be a cause of illness which leads to mass stranding (Duignan *et al*, 1995). Morbillivirus infection has been the cause of mass mortalities in striped dolphins (Aguilar and Raga, 1993) and bottlenose dolphins (Lipscomb *et al*, 1994) and in these situations most stranded animals are dead or moribund and none survive. However, it seems morbillivirus infection may be endemic among short-finned and long-finned pilot whales in the western North Atlantic (Duignan *et al*, 1995) and may be a contributory cause to mass strandings.

In one recent post-mortem study of all the white-sided dolphins involved in a mass stranding in Ireland, the largest male had congestive heart failure while the rest had no diseases serious enough to cause death (Rogan *et al*, 1996). In this case the disease in an important animal in the social structure of the group could have contributed to the stranding. This is certainly a feature of strandings which is considered important by those with considerable experience in rescuing stranded cetaceans in New Zealand (Project Jonah, 1995).

The physical nature of the beach is also thought to influence strandings. Mass strandings are not evenly distributed around coasts (Mead, 1979). Sandy, sloping beaches are more common sites of stranding than steeper beaches or rocky shores and some frequent sites may be located on migratory routes (Cordes, 1982; Walsh *et al*; 1990). In New Zealand, the configuration of Hawkes Bay, a common site of mass and individual strandings, has been suggested to act as a trap for animals (Cordes, 1982). In areas such as Cape Cod Bay, in the United States where pilot whales commonly strand, illness does not seem to be a major finding (Walsh *et al*, 1990) and this finding supports the hypothesis that local topography is important. Many of these physical associations make common sense as it can be visualised how animals can become trapped by rapidly receding tides in areas with which they may be unfamiliar especially as echolocation may be difficult in areas with soft, sandy bottoms as the reflected signal may be confusing.

It is possible, of course, that the causes of mass strandings at any one site may be multi-factorial. For example, the mass stranding of white-sided dolphins in Ireland was at a site consistent with Klinowska's theories about electromagnetic gradients and one animal had serious disease whilst the others did not have life-threatening problems (Rogan *et al*, 1996). Building up a picture of where mass strandings are more likely to arise is useful for planning even though the underlying reasons may be more obscure.

Individual Strandings

Individual strandings are mainly thought to involve animals which are sick or debilitated (Cordes *et al*, 1982; Obendorf & Arundel, 1988; Sweeney, 1989; Geraci & Lounsbury, 1993).

A wide range of diseases has been seen in live stranded animals. Parasitic infestation with a wide range of parasites of the lung, liver, intestines as well as those found more widely in the body is common. Although it is difficult to determine the significance of many of these parasitic infestations as animals can survive with considerable worm burdens, at times they undoubtedly have serious effects (Geraci & St. Aubin 1987). Pneumonia is also a common condition affecting stranded animals (Nachtigall *et al*, 1990; Gage, 1990) Other reported conditions include starvation, trauma, central nervous system disorders, peritonitis (Cordes, 1982) and toxoplasmosis (Inskeep *et al*, 1990). Morbillivirus infection may also be a cause of individual strandings (Duignan *et al*, 1995).

However, and very importantly, not all animals which strand do show evidence of serious disease (Cordes, 1982). Therefore there are animals among them for whom rapid return to the sea will be a viable option.

Summary

The causes of mass strandings are unclear and no single theory can account for all circumstances that are encountered. Many of the theories will be impossible to test and it is more likely that mass strandings are a combination of physical, behavioural and health factors which vary according to the circumstances and species involved. That many animals involved in mass strandings are often apparently normal in health terms is encouraging for rescue and rehabilitation efforts.

Strandings of individual animals commonly involve diseased animals or those under some kind of stress such as difficulties during birth. Not all animals are diseased however and deciding which ones are healthy depends upon a careful evaluation of each animal which is the subject of the following section.

Clearly the appropriate response for individually stranded animals will often be different than when dealing with a mass stranding, both in logistical terms and in meeting the needs of the animals involved. However, individuals in a mass stranding may be in similar circumstances to those individually stranded if their health is seriously compromised and evaluation of all individuals can never be neglected.

Because there is no simple answer to why whales and dolphins strand, every stranding should be treated as a unique event, and data collected about all the circumstances of the stranding in order to increase knowledge for the future.

4. ASSESSING THE STATE OF STRANDED CETACEANS

The most important part of a veterinary response to a cetacean stranding is to evaluate the health status of the animal(s). This is critical in determining whether they are candidates for refloating on site as quickly as possible or whether rehabilitation or euthanasia are better options. This evaluation has to be an ongoing process as an animal's condition may change over time requiring decisions to be revised.

A successful outcome of a stranding is not necessarily that the animal survives but that the action taken is in the best interests of animal's welfare. Therefore euthanasia is not a 'failure' if it was undertaken following an evaluation of the animal's condition which indictated that the animal was suffering from a condition which meant it would not be able to survive in the wild

The assessment can involve behavioural observations, clinical examination and analysis of blood and other samples (Geraci & Lounsbury, 1993; RSPCA, 1996; Williams & Barnett, undated). Some or all of these can be used to help determine how and why an animal has stranded and the likelihood of its survival with or without treatment. This is not an easy process given our inexperience and lack of knowledge about these species.

As well as reviewing the ways in which assessments can be made, this section also considers the syndrome of 'stress' which is thought to play a critical role in the outcome of strandings.

Behavioural observations

These can be carried out by anyone with a minimum of training and should be initiated and the results carefully recorded as soon as possible after an animal is reported as being stranded. They give a very useful guide to any changes in the animals condition.

i) Overall demeanour of the animal

Determining whether the animal is bright and alert, depressed, or unresponsive is vital. The more depressed an animal the worse is its prognosis and deteriorations in general state of consciousness over time are worrying. Vocalisation is probably a sign of well-being in some of the more social species as they cease to vocalise when they become depressed (Obendorf & Arundel, 1988)

ii) Respiratory rate and quality

This is widely considered to be one of the most important guides to status in dolphins. It is less helpful in large whales because of the infrequency of respirations.

A normal respiratory rate in a dolphin would be around 4 breaths per minute but for a pilot whale this would be as low as 1 breath per minute. The normal respiratory rate for false killer whales is 8-18 breaths per 15 minutes (Walsh *et al* 1990). Since sperm whales may only breathe once in twenty minutes, observations may have to be prolonged even to determine if an animal is alive.

In dolphins, a respiratory rate over 6 breaths a minute is considered abnormal and persistent increases in respiratory rate over 10 per minute carry a poor prognosis. Temporary elevations associated with stress and movement are common but rate should return to normal when the stress is removed.

Exhalation should be 'explosive' in nature, short and sharp. Gurgling sounds have a poor prognosis.

iii) Discharges

The mouth, blow hole, anal and genital openings should be observed for signs of bleeding or discharges. Excessive bleeding from any of these sites, and frothy or foul smelling discharges from the blowhole are extremely poor signs.

iv) Physical condition

Underweight animals in poor condition are likely to have been ill for some time and have a poor prognosis. This is likely to be one of the most important decision making aids as poor condition is the clearest indication that an animal is compromised.

Weight loss can be seen as body thinning behind the head, either side of the dorsal fin and caudal to the dorsal fin (Sweeney & Ridgway, 1975). In harbour porpoises, wrinkled skin and an obvious 'neck' when the blubber layer behind the head is reduced, are considered to be characteristic of animals in poor condition (Kastelein & van Battum, 1990).

The dorsal fin may also tend to droop to one side in dehydrated animals (Gage, 1990).

Clinical examination

Clinical examinations (Sweeney, 1989; Gage, 1990; Geraci & Lounsbury, 1993) should be undertaken by a veterinary surgeon or other trained person. They rely on the normal techniques used in the examination of any animal. However, most veterinary surgeons will have little knowledge of cetaceans and specialised help is preferable.

i) Reflexes

The corneal reflex should be determined by gentle tapping at the medial canthus of the eye. Jaw tone should be assessed by attempting to open the mouth, a flaccid jaw is a poor sign. Tugging the tongue or flipper should be met with strong resistance in a healthy animal.

ii) Body temperature

Body temperature should be measured using a thermometer with a flexible probe (not glass) which needs to be inserted at least 20-30 cm into the colon. With male dolphins or whales temperature should be carefully checked because the probe may lie along side the counter-current heat exchange system thought to be responsible for keeping testicular temperature cooler than core body temperature (Rommel, *et al*, 1994). Temperatures next to this heat exchange system can be around 1.3^{o}C lower that core temperature.

Normal cetacean body temperature is between 36.5 - 37^{o}C. Hypothermia is indicated if body temperature is below 35.6^{o}C which may reflect cold weather temperatures or the onset of shock. Temperatures above 38^{o}C are abnormal, above 40^{o}C are critical and above 42^{o}C are considered terminal (Sweeney & Ridgway, 1975; Geraci & Lounsbury, 1993).

iii) Cardiovascular function

Heart rate is not very helpful in cetaceans because of the normal large fluctuations during the respiratory cycle and may range from 60 to 100 beats per minute (Walsh *et al*, 1990). In small animals (< 60Kg) the heart can be auscultated by placing a stethoscope on the left of the midline between the pectoral flippers to determine if abnormal sounds are present.

More helpful is the assessment of capillary refill time. This is determined by firm pressure on the gums. Colour should return almost immediately (<1 second) if circulation is good. Slow capillary refill (>3 seconds) and blue colouration indicate poor cardiovascular function.

iv) Respiratory function

The lungs can be auscultated cranially and ventrally to the dorsal fin, although the low respiratory rate of cetaceans makes this a longer process than in other species. As in other species, fluid sounds and adventitious noises indicate lung pathology.

v) Response to refloating

The process of refloating can be used as a very helpful guide to the condition of an animal and its likely prognosis. Animals must obviously be able to swim when released. Even though an animal may seem disorientated when first put back into the water, efforts to move and returning strength can come over time. This may take some time (hours) but should not be neglected as an important part of the assessment process.

Blood and other sampling

Blood samples should only be taken by qualified people. Their immediate helpfulness may be questionable as analysis may take some time. However, they may be invaluable in retrospective diagnosis and as an aid to improving assessment in the future. They will also be useful if an animal is brought into care as they will give a record of its progress.

Blood taken is usually a mixture of venous and arterial origin as sampling sites are on the flukes, caudal peduncle, dorsal fin or flippers where body temperature is regulated through a series of arterial venous plexuses. The best site for venepuncture is usually the midline ventral surface of one of the flukes where a clear groove can be palpated. However, this can be dangerous if an animal is thrashing its tail. In this situation the flipper or dorsal fin is a safer site. (For diagrams of blood sampling sites see Gage, 1990; Geraci & Lounsbury, 1993).

i) Haematology

Haematology results can give a guide to the status of an animal. In particular they can pinpoint anaemia, and state of hydration. It is important to remember that cetaceans have higher packed cell volumes, larger red blood cell size and smaller total numbers of red cells compared to domestic species. These differences are thought to be associated with adaptations for diving (Bossart & Dierauf 1990). A packed cell volume of >55% is considered to be abnormal and indicative of haemoconcentration (Gage, 1990).

However, normal levels are not well established for free-living cetaceans and extrapolation from captive animals may be misleading because differences have been reported between captive and wild animals. For example, in wild bottlenose dolphins, adults and juveniles had significantly higher white blood cell (WBC) counts, a lower percentage of neutrophils and a higher percentage of eosinophils than captive animals (Asper *et al*, 1990). Species difference also exist (Bossart & Dierauf, 1990) and values for the species concerned should be used to assess the significance of haematological findings.

Erythrocyte sedimentation rates (ESR) may prove to be very useful prognostic indicators in stress (see below) (Dierauf, 1990) although they have been little used to date. ESR has been reported to increase in bottlenose dolphins in the acute stages of an inflammatory response and with trauma. Since these elevations are probably linked to raised fibrinogen levels, ESRs show real promise as a diagnostic aid (Bossart & Dierauf, 1990).

ii) Biochemistry

Blood biochemistry can be a valuable aid to diagnosis and prognosis. Table 4.1 gives information on changes in blood biochemistry and their postulated causes. However, as with haematology, normal levels are not well established and the significance of changes is unclear. Differences exist between normal, wild and captive animals. In free-living bottlenose dolphins total protein, albumin and globulin levels were higher in wild than captive animals. Together with higher WBC counts these were thought to be associated with wild animals being exposed to a greater antigenic challenge (Asper *et al*, 1990).

Care should be taken in the comparison of biochemical values with those given here because these can be influenced by assay conditions such as temperature. Often these conditions are not given (e.g. Koopman et al, 1995) or reference is made to a previously used method, for which the reference was not available (e.g. Asper et al, 1990). The numbers given here should be used only as a guide.

Whilst little is known about the significance and causes of most of the changes in blood biochemistry and much is extrapolated from other species, some more specific information is emerging which may be helpful. Increases in plasma cortisol levels have been well associated with stress responses in cetaceans (Bossart & Dierauf, 1990). Recently, levels of both plasma cortisol and creatinine have been reported to be greater in harbour porpoises which are electronically tagged than those having a roto tag attached following release from herring weirs (Koopman *et al*, 1995). These changes were thought to be associated with the greater handling period involved in attaching electronic tags compared to roto tags. However, although stress following handling could explain elevated cortisol levels the reason for elevated creatinine levels in these animals was less clear as these are normally an indication of kidney disease (Bossart & Dierauf, 1990).

Table 4.1 CHANGES IN CETACEAN BLOOD BIOCHEMISTRY AND POSSIBLE CAUSES - information taken from Bossart & Dieruaf (1990) and elsewhere for comparison as indicated

PARAMETER	INCREASE/DECREASE AND POSSIBLE CAUSE	NOTES
AST (SGOT) aspartate aminotransferase	**Increased in:** liver damage heart disease skeletal muscle damage liver fluke	Normal small cetaceans (Bull & Worthy, 1995): <300IU/L Mean level in free-living bottlenose dolphins (Asper *et al*, 1990): 139IU/L
ALT (SGPT) alanine aminotransferase	**Increased in:** liver disease trauma infection parasitism neoplasia	May be liver specific in *Tursiops* and *Lagenorhynchus* spp Normal small cetaceans (Bull & Worthy, 1995): <40IU/L Mean level in free-living bottlenose dolphins (Asper *et al*, 1990): 31IU/L
Direct bilirubin	**Increased in:** liver disease bile duct obstruction hepatic or post-hepatic problems cirrhosis neonatal jaundice	
Indirect bilirubin	**Increased in:** haemolysis haemorrhage prehepatic disease fasting neonatal jaundice	
CK (CPK) creatinine kinase	**Increased in:** cardiac or skeletal muscle damage CNS disease handling stress	Normal pilot whales: 110-260IU/L
GGT (Gamma GT) gamma glutamyl transpeptidase	**Increased in:** liver disease primary obstructive liver disease cholestasis muscle disease	
BUN blood urea nitrogen	**Increased in:** dehydration renal disease urethral obstruction high protein diet **Decreased in:** liver failure starvation	High protein diets of cetaceans result in BUN levels higher than in terrestrial animals Mean level in free-living bottlenose dolphins (Asper *et al*, 1990): 61 mg/dl
Creatinine	**Increased in:** kidney disease ?stress	Elevated during handling of harbour porpoises (Koopman *et al*, 1995) Mean level in free-living bottlenose dolphins (Asper *et al*, 1990): 1.4 mg/dl
AP alkaline phosphatase	**Increased in:** liver disease primary obstructive liver or biliary disease uraemia intestinal inflammation bone growth and remodelling advanced pregnancy **Decreased in:** hypothyroidism pernicious anaemia geriatric marine mammals	Elevated in young animals associated with bone growth Mean level in free-living bottlenose dolphins (Asper *et al*, 1990): adults: 203 IU/L juveniles: 404 IU/L Sudden falls associated with illness and increases with improvement so may be useful prognostically
LDH lactic dehydrogenase	**Increased in:** cell damage or necrosis	Wide ranges seen in marine mammals as LDH leaks from muscles associated with diving Normal small cetaceans: <600IU/L (Bull & Worthy, 1995)
Glucose	**Increased in:** stress excitement anoxia diabetes mellitus **Decreased in:** severe systemic disease neoplasia starvation	Fasting levels higher than in domestic animals Mean level in free-living bottlenose dolphins (Asper *et al*, 1990): 125 mg/dl

Cholesterol	**Increased in:** hypothyroidism diabetes mellitus bile duct obstruction **Decreased in:** hyperthyroidism malnutrition malabsorption	Mean level in free-living bottlenose dolphins (Asper *et al*, 1990): 190IU/L
Amylase	**Increased in:** acute pancreatitis intestinal inflammation primary renal failure	May not be specific for pancreatitis in cetaceans Mean level in free-living bottlenose dolphins (Asper *et al*, 1990): 22IU/L
Lipase	**Increased in:** chronic pancreatitis pancreatic necrosis renal failure	May not be specific for pancreatitis in cetaceans
Total protein	**Increased in:** dehydration shock **Decreased in:** low albumin malabsorption starvation kidney disease parasitism	Mean level in free-living bottlenose dolphins (Asper *et al*, 1990): 7.6 g/dl
Albumin	**Increased in:** dehydration shock **Decreased in:** starvation liver disease kidney disease parasitism	Mean level in free-living bottlenose dolphins (Asper *et al*, 1990): 3.9 g/dl
Globulin	**Increased in:** liver disease immune stimulation **Decreased in:** immunodeficiency - primary or secondary	Mean level in free-living bottlenose dolphins (Asper *et al*, 1990): 3.7 g/dl
Sodium	**Increased in:** dehydration heart disease **Decreased in:** diarrhoea vomiting	
Chloride	**Increased in:** dehydration heart disease **Decreased in:** diarrhoea vomiting	Mean level in free-living bottlenose dolphins (Asper *et al*, 1990: 113 mEq/l

It has been proposed that serum alkaline phosphatase (AP) be used as a indication of a dolphin's health (Fothergill *et al*, 1991). In captive Atlantic bottlenose dolphins, Indian Ocean bottlenose dolphins (*Tursiops aduncas*) and Cape Dusky dolphins (*Lagenorhynchus obscurus*), AP levels fell dramatically just prior to obvious illness and rose again as the animal improved. Monitoring AP levels may be useful, therefore, if animals are in a rehabilitation centre but changes are probably too non-specific for short term diagnosis. AP levels are known to be elevated in young animals when they are in a phase of active bone growth (Fothergill *et al*, 1991; Bossart & Dierauf, 1990).

Bull & Worthy (1995) use aspartate amino transferase (AST), alanine aminotransferase (ALT) and lactate dehydrogenase (LDH) levels as key indicators of health before releasing animals from rehabilitation. Raised AST levels are indicative of liver, heart or muscle damage or disease. Raised ALT is thought to reflect liver disease and LDH is released in cases of cellular damage and necrosis (Bosart & Dierauf, 1990). Bull & Worthy (1995) consider normal levels to be: AST <300 IU/L; ALT <40 IU/L and LDH <600IU/L.

Creatinine kinase (CK) is an enzyme found in cardiac and skeletal muscle which is released when damage occurs and may be useful in its evaluation. Elevations have been associated with a suspected transport-associated myopathy in a bottlenose dolphin which was tense and excitable during transport and had strong muscle contractions (Colgrove, 1978). Elevations have also been recorded in animals struggling when stranded and during subsequent transport. Its clinical significance is that animals which have elevated CK levels will probably have stiff and sore muscles and possibly need support for longer periods than unaffected animals. In serious cases, kidney function may be compromised because other compounds released from damaged muscle such as myoglobin can cause renal damage.

Serum iron may also prove to be a useful indicator of state of health. Levels in bottlenose dolphins fall when they have inflammatory conditions, trauma or stress (Bossart & Dierauf, 1990). Like ESRs they have been little used to date but show considerable promise.

iii) <u>Other samples</u>

Occasionally it may be worth taking other samples. Faecal samples for parasitology, for example, may be helpful given the importance of parasites in cetacean disease. Swabs for bacteriology are of more questionable usefulness. It may be difficult to get useful bacteriological results from swabs taken from external orifices even when abnormal discharges exist because a great variety of flora exist, most of which is non-pathogenic (Gage, 1990). Therefore cultured organisms may be unrelated to the underlying pathology and give little assistance in choosing an appropriate antibiotic. If swabs are taken of the blowhole they must only be of the outer surface, not only is pushing objects into the blowhole likely to be uncomfortable, swabs may get broken off.

Many potentially human pathogens including *Campylobacter* sp, *Vibrio* sp, *Pasturella* sp and *Pseudomonas* sp, have been isolated from blowholes of diseased and normal animals (Gage, 1990; Nachtingall, 1990), therefore people treating stranded cetaceans should be alert to possible human health risks.

Species and age

Another important factor in assessing a stranded animal will simply be its species and age. In the UK, harbour porpoises appear to strand when they are seriously ill and debilitated whereas pelagic species of dolphins sometimes have no accompanying pathology (Paul Jepson, personal communication). This means that the prognosis for a stranded harbour porpoise is inevitably going to be guarded, whereas the outlook will be more optimistic for other species.

Species any larger than a bottlenose or Risso's (*Grampus griseus*) dolphin are unlikely to be suitable candidates for captive treatment and rehabilitation simply because of the physical difficulties in transport and the size of facilities required for their proper care. There are also differences between species in how they adapt to the stress of captivity. Some consider *Tursiops* sp and *Lagenorhynchus* sp to adapt better than others (Gage, 1990). However, others have reported that white-beaked dolphins are apparently less tolerant of human contact than bottlenose dolphins (Kastelein *et al*, 1995) and some feel white-sided dolphins do not cope well with captivity (Geraci & St. Aubin, 1979). *Stenella* sp are also considered not to fare well in captivity (Sweeney, 1989).

Old animals (indicated by worn teeth or extensive scarring, for example) are likely to be suffering from disease and carry a poorer prognosis that a younger animal.

Neonatal animals pose particular problems. They may simply be starving having lost contact with their mother and seem suitable candidates for rehabilitation. However, as will be discussed later, if release rather than long term captivity is the aim, it is questionable whether the proper conditions (both physical and social) will be able to be provided for release to be a realistic option.

Stress in stranded cetaceans

A widely recognised problem in stranded cetaceans is stress (Dierauf, 1990; Geraci & St. Aubin, 1979). Stress can arise for a variety of reasons and is probably a combination of many. It can result in the clinical syndrome of shock (Obendorf & Arundel, 1988) where an animal's response can be divided into two phases. The first is productive and reversible where changes in physiology occur in an effort to maintain normal bodily function. The second phase is a pathologic state where responses lead to irreversible and damaging effects. It is vital, therefore, to be able to recognise, treat and avoid stress in cetaceans to avoid irreversible changes arising.

There are an array of physiological responses which are triggered by stress. Monitoring them may help give a guide to the extent of harm arising through stress and aid assessing the prognosis of an animal. Responses include circulatory changes to maintain perfusion of essential organs such as the brain. However, if prolonged this can be at the expense of other organs such as the intestines, liver and kidneys. This can result in delayed effects as defences against infection will be harmed as bacteria become able to penetrate damaged intestinal lining and the liver's detoxification mechanisms are impaired. There are also well recorded changes in immune function with stress which compound the problem. Connections between the nervous and immune system exist which may explain the physical reactions to behavioural stress and pain.

Recorded responses to stress in cetaceans include elevations of plasma cortisol (Koomans *et al*, 1995; Dierauf, 1990; Bossart & Dierauf, 1990), increases in neutrophil counts, eosinopaenia, raised blood glucose, lowered serum iron concentrations and increased erythrocyte sedimentation rates (Dierauf, 1990). Elevations in AST and CK have also been reported (Bossart & Dierauf, 1990). Increased cortisol levels are part of a normal response to stress and help improve tissue perfusion and increase blood glucose levels. Increased ESRs and lowered serum iron concentration are seen as part of the acute phase response and can be a sensitive indicator of the evolution irreversible changes. Respiratory rate is usually elevated and capillary refill time may be prolonged.

Stress or shock can arise in cetaceans solely from the physical effects of being stranded. When stranded a cetaceans no longer has its weight supported by water, respiration becomes more difficult. Particularly in larger species of whale this can result in considerable damage to organs and is one of the reasons stranded animals should always be supported in sternal recumbency. Damage to muscles will also arise from unaccustomed pressure and elevations in the enzyme creatinine kinase are an indication of muscle damage and its severity.

Handling, noise, captivity and the presence of people will also cause further stress and should be minimised. In addition if the animal is diseased in any way this will pose an additional stress as will dehydration and pain.

Because stress and the development of shock is such an insidious yet life threatening process with reversible and irreversible phases, considerable care must be taken both to avoid stress and mitigate its effects. Even if stranded animals are apparently safely returned to the sea, evidence of stress may emerge at a later time. Pilot whales which were released and restranded 24 hours later showed biochemical evidence of stress and shock (Geraci & Lounsbury, 1993). This may compromise their ability to survive.

Therapeutic use of cortisone in stress or shock is to mimic the effect of natural cortisol and is useful as an animal's stores may become depleted. Although helpful in the short term, prolonged administration can inhibit immune function and compound problems in the same way that chronic stress and the release of the animal's own corticosteroids may do. Fluid therapy will also help maintain the circulation but is difficult in cetaceans as the small size of the first part of the stomach restricts the amount of fluid that can be given at any one time.

Antibiotics are also a rational approach to the treatment or prevention of shock as a result of stress, as they assist the impaired body's defence systems.

Summary

Accurate assessment of a stranded whale or dolphin's condition is a difficult undertaking. There seem to have been no published studies which have carefully gathered data on clinical signs and ultimate outcome including post-mortem studies of stranded cetaceans. Thus judging the probable condition of an animal and its prognosis has to draw on people's experience and impressions. Whilst there is no reason to suppose personal experience cannot form a very valuable and accurate guide, a systematic study would be useful, if only to make

Table 4.2. - USEFUL INDICATORS OF STATE OF HEALTH IN STRANDED CETACEANS.

PARAMETER	NORMAL	ABNORMAL	PROGNOSIS
Physical Condition	Good - Moderate	Moderate Thin	Fair Poor to Grave
Demeanour	Bright and reacts to stimuli	Dull and lethargic Unresponsive, flaccid jaw & slow reflexes Vocalisations cease	Uncertain - depends on progress Poor/Guarded Condition worsening
Respiratory Rate	Dolphins: 4 breaths per minute Pilot whales: < 1 per minute False killer whales: 8-18 per 15 minutes Large whales: maybe very infrequent (1 every 10 - 20 minutes)	Dolphins: > 6/min > 10/min Other species: no reliable information	Worrying Poor if sustained
Discharges	None	Bloody or mucopurulent from blowhole Blood from anus or genital slit	Grave Poor
Temperature	36-37.5^{o}C	> 38^{o}C > 40^{o}C > 42^{o}C	Guarded Poor Grave

the breadth of knowledge more widely available.

The parameters most widely agreed upon in the assessment of animals on the beach are those which come from careful physical and behavioural observation. Table 4.2 outlines these clinical signs and the prognosis they are thought to carry. Body temperature over 42^{o}C and, in dolphins, a sustained increase in respiratory rate over 10 breaths per minute is thought to carry a grave prognosis. Discharges of large amounts of bloody fluids are also considered to carry a poor prognosis as does an animal in poor body condition. It is unlikely, therefore, that animals with these sorts of signs will survive even with medical care.

The indications that an animal is likely to have a good prognosis include its presence as a member of a mass stranding rather than single individual. A lively animal with a normal temperature, respiratory rate and in good bodily condition is likely to be a candidate for immediate refloating and return to the sea if initial signs are good.

There are no well described blood or other samples which can give a clear indication of the likely outcome of a stranding. Erythrocyte sedimentation rates are one area which may be developed into a useful test as they are relatively easy to conduct and need little equipment (Dierauf, 1990). Otherwise, haematology and biochemistry will play only a minor role in making decisions on the beach unless animals are held for at least 12 hours which is the minimum time in which results are likely to be obtained. However, it would be difficult to justify not releasing an apparently healthy animal simply to await the outcome of blood sampling because the animal's condition may worsen simply through being stranded. Therefore, blood samples are probably most useful retrospectively and should be collected when possible if this does not compromise the animal in any way. If animals are taken into a rehabilitation centre early samples will also be useful in evaluating the progress of animals in the medium-term.

The species and age of the animal are also important. Harbour porpoises are acknowledged to be difficult to treat even by those with success and experience (Kastelein *et al*, 1990). Pelagic species of dolphins may not adapt well to captivity and so rehabilitation when such an animal has a condition which involves prolonged treatment may not be justified.

Neonatal animals in apparent good health may appear attractive options for rehabilitation. However, if reared in isolation it is possible they will never be able to released to the wild as they will not have learnt foraging and social skills.

The problem animals are those which do not clearly fall into one category or another. They may be somewhat depressed and have slightly elevated respiratory rates for example. In these situations first aid care and support is required followed by reevaluation of their response to supervised refloating. Unfortunately, as there are no unequivocal signs, each stranding will have to be treated as a unique event with an evaluation of all the available information.

5. TREATMENT AND CARE OPTIONS

When animals are found stranded on a beach a number of alternatives will have to be weighed up depending on the outcome of the assessment. These include immediate refloating, delayed refloating after treatment or removal to a better site, being taken into captivity for rehabilitation treatment or euthanasia. The procedures and requirements of each are reviewed here together with first aid which will be necessary for all animals and forms an important part of the assessment process.

First aid and assessment

When animals are stranded on a beach they will be in a compromised, life threatening position. Practical measures can be taken to reduce the stress they are under. This includes proper positioning, assisting with temperature regulation and preventing further trauma. An important part of first aid is to ensure they are not stressed by the presence of large numbers of noisy and disorganised people. There is widespread agreement in the literature about these first aid measures (e.g. Geraci & Lounsbury, 1993; Gage, 1990; Obendorf & Arundel, 1988).

i) Positioning

Animals may be lying on their side, possibly half buried in sand when found. When in water cetaceans are functionally weightless and have effortless breathing (Joseph *et al*, 1990). On land they loose this advantage and are subjected to unaccustomed pressures. Long periods of lateral recumbency will lead to pulmonary oedema in the dependent lung (Obendorf & Arundel, 1988) and thus respiratory insufficiency and predisposition to infection. It is important to ensure, therefore, that animals are supported in sternal recumbency to reduce pressure on the heart, lungs and other internal organs and to keep the blow hole clear of water, sand and debris. This may involve digging holes for the flippers and providing support so the animal does not roll over.

The pontoons developed by Project Jonah (Project Jonah, 1995) and described below can also be used to hold larger animals such as pilot whales in position on the beach.

ii) Temperature regulation

Cetaceans have a specialised thermoregulatory system which relies on heat exchange mechanisms in the flukes, dorsal fin and flippers. Water has 25 times the capacity to dissipate heat than air (Joseph *et al*, 1990). Therefore, once out of the water, cetacean thermoregulatory systems no longer function properly and animals may become either hyper- or hypothermic. In summer animals will need to be covered in wet sheets or towels and kept moist with water to help cooling. A sunshade may also be needed. A less frequent problem, but important in weak or thin animals, will be hypothermia in winter. A wind shield together with cloths soaked in mineral or vegetable oil placed over the dorsal fin and flukes will help retain heat.

iii) Preventing further trauma

The blow hole should be carefully cleaned if there is sand or debris around it and eyes gently flushed with clean water. The blow hole and uncovered parts should be protected from drying and sun or wind burn by the use of zinc oxide cream.

iv) Crowd control

Large numbers of people anxious to see or help with stranded cetaceans may impose extra stress on an animal. One of the prime concerns should be to prevent such unnecessary harm. This will involve good communication skills and enlisting the aid of organisations such as the RSPCA and police.

Special Considerations for Mass Strandings

In mass strandings there will need to be a well organised effort with a systematic approach to the care of animals. The strongest and healthiest animals with the best chance of survival should be dealt with first because they have the best prospects of survival but even these will be diminished if they are not assisted quickly. If at all possible one person should be allocated to each individual and the animal marked so that changes in its condition can be followed and each animal can be treated individually.

Refloating

If an animal is assessed to be suitable for refloating it will need to be carefully transported to the water. For small cetaceans this can be done relatively easily by rolling animals carefully onto a stretcher or tarpaulin and carrying it to the sea. For larger animals the procedure is more difficult and will require more people. Around 30 may be needed for a pilot whale or small killer whale for example (Gage, 1990). Dragging and towing animals should be avoided as this will cause tissue damage and stress.

Once in the water it is important to support the animal and assess its capabilities. Having been stranded animal's muscles will be stiff and possibly damaged. Animals also seem disorientated. Gentle rocking from side to side to help animals reorientate and to encourage blood flow to muscles has been reported to be helpful.

Special pontoons have been developed by Project Jonah (Project Jonah, 1995) in New Zealand to assist in the refloating of larger species such as pilot whales. These consist of stretchers suspended between two large inflatable tubes. These are used to support whales in the water and to move them out to deeper water. These pontoons cannot, however, be used to refloat dolphins and the development of a similar system which could be used for dolphins would be valuable.

It is important to ensure that animals can swim strongly before they are released and it may take considerable patience to determine whether an animal will be able to cope. Regaining strength and reorientation may take some time. With mass strandings, some consider it is ideal to have all the members of the pod in the water and if the 'lead' animal can be identified to have it furthest out to 'draw' the other animals out to sea (Project Jonah, 1995; Obendorf & Arundel, 1988). Once animals have been refloated it may be necessary to ensure they do not restrand by using people and small boats to push them away from shore.

For pelagic species of dolphins and if strandings occur in areas where the topography suggests that restranding is a potential problem, it may be desirable to move animals offshore by towing whilst supported using pontoons or other devices.

Countries tend to differ in whether they consider refloating to be the option of choice. In New Zealand, refloating appears to be the only option used (together with euthanasia) for stranded animals (Project

Jonah, 1995). In the United States, refloating is the commonest approach in mass strandings but individuals among a group of mass stranded animals are also regularly brought into rehabilitation facilities (e.g. Mead *et al*, 1980; Odell *et al*, 1980; Walsh *et al*, 1990). It is difficult to piece together the overall effectiveness of rehabilitation in these circumstances. Individually stranded animals in the US seem to be commonly brought into rehabilitation centres as refloating is seen as being unsuitable (Forsyth, 1995). The reasons behind this concentration on rehabiliation seem to be that no hard evidence exists about the success of refloating and a belief that intervention can have positive effects. In Australia the position lies somewhere between these two with animals also being brought into rehabilitation centres (Gales, 1992) on occasions.

Transport

If an animal has stranded in a difficult position where refloating it would be dangerous for the rescuers and animals alike, for example, if the surf is large or the shore rocky, it will be necessary to move it to a more sheltered site (Obendorf & Arundel, 1988). This may also be an option with an animal which appears healthy but has been weakened by the stranding and it is thought it would benefit from support and a recovery period in calmer waters. This also gives an opportunity for animals to be given short term treatment if this is thought necessary. If too ill to refloat in the short term the animal may need to be transported to a rehabilitation centre.

Transport poses an additional stress and should be undertaken only with proper preparation (Joseph *et al*, 1990). The absence of water to provide support and allow for optimal thermoregulatory control makes transport hazardous and adequate substitute(s) must be provided. This will involve the use of properly padded stretchers and cooling to avoid hyperthermia. Moist, heavy foam rubber or equivalent should be used in the bottom of the transport vehicle with care being taken that the pectoral fins are flat against the sides of the animal (Gage, 1990). The risk of hyperthermia will increase during transport therefore the animal must be kept covered in moist towels and the blowholes and other exposed areas kept protected from drying out. Animals must be supervised through out the journey which should be kept as short as possible.

If transport is not carried out well, animals may be damaged and experience muscular stiffness, inappetance, anaemia, pressure necrosis and respiratory infection as a result (Joseph *et al*, 1990). Some people advocate sedating animals with diazepam (0.2mg/kg) before transport (Sweeney, 1989; Kastelein *et al*, 1990). The value of this is uncertain, but sedation should never be used for animals which are to be released at the end of the journey.

Rehabilitation

If an animal seems too weak or ill to be refloated one option is to take it into captivity for treatment. Rehabilitation is a serious undertaking which demands proper facilities and specialised care. Basic requirements include the provision of saltwater with a filtration and sterilisation system to maintain good water quality. Handling facilities to examine an animal on admission and during its stay will also be necessary.

Pools should be oval or round in shape to avoid damage when animals bump into the sides of pools Especially during the first few days after animals are brought in, they seem disorientated and unable to navigate in artificial pools (Kastelein *et al*, 1990). Having pools with rounded sides and well padded can avoid considerable harm. Pools need to be designed so that they can be drained quickly or have a gently sloping bottom to facilitate handling.

Most stranded animals will need aid in swimming when they are first placed in pools. This can be done either by humans remaining with the animal and physically supporting it in the water or, preferably, using floats (Gage, 1990). Recently a new form of hoist has been developed at the Harderwijk Park in the Netherlands which allows animals to be supported in a hammock suspended from a moveable overhead support (Kastelein *et al*, 1995). This systems also allows them to swim as the overhead bar rotates easily around the central support. Even if animals are in a support or seem able to swim, they will need 24 hour supervision, especially during the early stages after admission. Once swimming unaided, animals will need room to swim and dive. A minimum of a 9 metre diameter pool has been recommended for dolphins (Gage, 1990). Larger pools are obviously desirable, especially for larger species of dolphin. Smaller pools cannot be justified even if considered a short term measure as it will not be possible to predict how long an animal will need to be held.

During the early stages of rehabilitation animals may need to be given fluids by stomach tube to aid in rehydration but the relatively small size of the cetacean fore stomach restricts the volume that can be given. Around 1 litre for a 2 metre dolphin has been suggested (RSPCA, 1996). Force feeding fish may also be needed. Such handling and feeding procedures are considered to be extremely stressful for the animal involved and should be kept to a minimum (James Barnett, personal communication). Twice daily force feeding should be sufficient when animals are rehydrated.

Artificial milks have been developed for some cetacean species including harbour porpoise and killer whale (Spotte, 1990) and the basic composition of many species milk described (Worthy, 1990). Feeding regimes for adult animals kept in commercial facilities for display are well developed. Most of the potential problems relate to deterioration of fish during storage such as the loss of the fat soluble vitamins A,D and E and thiamine deficiency if large amounts of fish containing thiaminase are fed (e.g. mackerel, herring, whiting) (Worthy, 1990). Such conditions can be avoided by the use of vitamin supplements.

Some suggest that cetaceans depend on energy produced by feeding and activity to maintain their thermal balance although blubber thickness is also likely to be important (Worthy, 1990). Being able to control water temperature is therefore a desirable feature of rehabilitation pools. This will be particularly true for animals in poor body condition whose lack of blubber will compromise their thermoregulatory capacity and neonates who will often be compromised in the same way.

Veterinary care during an animal's stay in a rehabilitation centre will obviously be determined by its condition. There seems to be no systematic study of veterinary treatment of rescued animals. Therefore there is no critical assessment of the success of various therapies or husbandry techniques to rely upon when dealing with cases. Although extrapolation from captive animals to wild ones may seem a promising approach, conditions which are prevalent in captive cetaceans may not be common in wild animals or visa versa. For example, captive animals are wormed routinely and therefore parasitic disease, which is so common in free-living animals, is not seen. Therefore therapeutic regimes to treat parasitic disease rather than as a prophylactic measure are not well developed. However, a wide array of drugs have been used to treat cetaceans in captivity. These have been recently reviewed by Stoskopf (1990) and provides a useful guide to choice of drug and dosage. The veterinary supplement to the RSPCA's guide to stranded whales and dolphins also gives a list of drugs which have been used in cetaceans (RSPCA, 1996).

Euthanasia

Animals which are seriously ill or injured and with no prospects for survival in the wild, should be euthanased. Euthanasia should only be carried out by a veterinary surgeon. Large Animal Immobilon by intramuscular injection has been recommended in the UK (RSPCA, 1992) at a dose rate of 0.5cc Large Animal Immobilon for every 1.5 metres length of a dolphin or porpoise or 4cc per 1.5 metres length of a whale. This is a very dangerous drug and proper precautions should be taken. In the US, intraperitoneal injections of pentobarbitone are more widely recommended (e.g. Geraci & Lounsbury, 1993).

Small cetaceans can be shot with a large calibre rifle (0.303 or larger) through the blow hole on a path which joins the blowhole to the centre of a line joining the cranial edges of the flippers (Obendorf & Arundel, 1988; RSPCA, 1992). This is not possible with whales due to their large size. Euthanasia becomes very difficult in large whales and allowing large animals to die naturally may be more humane than repeated painful and unsuccessful attempts to kill an animal (RSPCA, 1992).

Summary

The first steps to take when dealing with a stranded animal are to administer first aid and to ensure the animal is in as comfortable a position as possible. During this period and following it there needs to be a full clinical evaluation of the animal. This will be essential to determine what steps to take. Refloating requires sufficient people, equipment and good conditions in the water to be attempted. Carefully controlled refloating will also give important information about the likelihood of success.

Overall, there needs to be a systematic approach to dealing with strandings to ensure that appropriate first aid and refloating is carried out properly and the animal's condition accurately recorded. Training is an important requirement to ensure that a core of people are aware of the best approach to the care of stranded animals. Training will need to involve both lay people and veterinary surgeons. In other countries, including New Zealand (Project Jonah, 1995; Department of Conservation, 1995) and the United States (e.g. Cape Cod Stranding Network; David Wiley, personal communication) there are very well organised and coordinated rescue groups which have sophisticated training courses. In these countries together with Australia (Obendorf & Arundel, 1998) people involved in the rescue of cetaceans have to be given permission by the relevant authorities or national plans are in place to respond to cetacean strandings. This has probably driven the development and maintenance of training.

Transport of animals has to be undertaken with a great deal of caution to ensure the animal's condition is not made worse. Taking animals into care for treatment and rehabilitation demands that proper facilities are available. Without these animals are likely to be put under additional stress. Because it will not be possible to predict how long animals will have to held, the basic requirements have to be seen as essential not desirable.

There has been no critical evaluation of the response of animals with different conditions to treatment regimes. This is probably due to the small number of cases people have dealt with, but the information would be very valuable in improving treatment.

6. <u>SURVIVAL RATES</u>

Knowing how survival rates vary with different approaches to treatment is an important goal, not only so diagnosis and prognosis can be improved but to ensure animal welfare is given the highest priority. If efforts to refloat seem successful only for the animal to die in worse distress elsewhere, or if neonatal animals rescued and raised in specialised facilities are not able to return to the wild and survive, the best interests of the animal and its welfare will not have been taken properly into account.

This section reviews what is known about the survival rates of different approaches. It also considers the issue of tagging and marking which is often promoted as being essential to learn more about the survival rates or otherwise of treatments.

Refloating

The vast majority of efforts during mass strandings are directed towards refloating and returning animals to the sea coupled with deterring their restranding. Repeated restranding sometimes with the death of all or most of the members of a group is recorded frequently in the literature (e.g. Irvine *et al*, 1979; Anon 1994; Mead *et al*, 1980; Odell *et al*, 1980). Restranding may not occur at the same site as the original stranding. For example, a group of false killer whales stranded for a second time 3 days later and 235 km away from the original site of stranding (Odell *et al*, 1980).

However, in New Zealand where they have the highest rate of strandings in the world, of the 70% of live stranded animals which are suitable candidates for return to the sea (Department of Conservation, 1993) refloating is thought to have a survival rate of around 90-95% (Project Jonah, 1995). All animals which are successfully refloated are assumed to have survived unless they are known to restrand or are found dead. Coloured ribbons are used to mark animals. Although their estimates of survival rate are the most optimistic possible since animals could loose ribbons or die at sea without being found, the success of the scheme in New Zealand pays tribute to its considerable experience and expertise which is promoted by proper resourcing, good management and training.

The Cape Cod Stranding Network has responded to mass strandings of pilot whales, common and white-sided dolphins. They have had good success (evaluated by numbers of animals with appropriate tag not observed to restrand) with refloating and do not consider rehabilitation in captivity an appropriate response (David Wiley, Senior Scientist, International Wildlife Coalition, personal communication).

There seems to have been no collection and evaluation of data on refloating individuals although it is clear that approach can be successful (Project Jonah, 1995).

Rehabilitation

The survival rates of rehabilitation efforts are mixed and published comprehensive statistics are lacking. Animals from mass and individual strandings in the United States are regularly taken into rehabilitation facilities owned by commercial and non-profit organisations. Their success seems to have been extremely limited with animals often only surviving for short periods. For example, two spinner dolphins (*Stenella longirostis*) from a mass stranding survived up to four days (Mead *et al*, 1980). Four false killer whales from a mass stranding in Florida died with two weeks of being taken into captivity (Odell *et al*, 1980).

At Sea World in the USA, survival time of members removed from two mass strandings ranged from 2 days to eighteen months. Their treatment of nine individuals who have survived longer than one month shows "most continue to have recurrent bouts of illness" (Walsh *et al*, 1990). This is used to justify

continuing captivity as it is claimed that greater understanding is needed in case they transfer disease to healthy wild animals upon release.
A recent report of the Southeast US Marine Mammal Standing Network (Southeast US Marine Mammal Stranding Network, 1995) gives information on their recent standings work. The reports on rehabilitation are very mixed. One pantropical spotted dolphin (*Stenella attenuata*) and one sperm whale calf had died in captivity. Six out of seven Clymene dolphins (*Stenella clymene*) taken into captivity and released after 6 days were found dead the following day. One pantropical spotted dolphin was still under care and one had been released. One of three pilot whales taken into captivity had died and the other were still in captivity, two bottlenose dolphin calves were being reared in captivity.

However, the Texas Marine Mammal Stranding Network (part of the Southeast US Marine Mammal Standing Network) has reported that of 10 dolphins individually stranded, rescued and taken into care between March 1994 and June 1995, five bottlenose dolphins and one Atlantic spotted dolphin (*Stenella frontalis*) have been successfully released (Bull & Worthy, 1995; Price-May *et al*, 1995). One juvenile (species not specified) was considered too young to be released. The remaining 3 animals presumably died or were euthanased.

Between 1971 and 1985 at the Harderwijk Park in the Netherlands of 14 harbour porpoises, 3 died during transport to the centre, one was immediately released but 9 others died after 2 to 200 days in captivity. Only one other was released after 45 days treatment (Kastelein *et al*, 1990). Since that time at least two other harbour porpoises and three white-beaked dolphins have been successfully rehabilitated there (Kastelein *et al*, 1990; Kastelein *et al*, 1995). Reports from people who have visited the centre indicate that they may now have a success rate of around 50% with harbour porpoises (Alison Hutchison, Assistant manager, RSPCA wildlife hospital, East Winch, personal communication).

The recognition that morbillivirus is endemic in some populations of cetaceans (Duignan *et al*, 1995) will probably reduce the willingness of commercial institutions to care for stranded animals as there is the possibility that infection could be transfered to display animals.

Stress in captivity

Even taking healthy wild animals into captivity carries a high mortality rate during the first 30 days after capture. The estimated annual survival rate during the first 10 days after being taken captive is about 0.6 for bottlenose dolphins (Small & Demaster, 1995). In effect this means that 4 out of 10 healthy animals would be expected to die within the first 10 days. Presumably this high death rate is associated with the stress of captivity as after an acclimation period of 60 days, annual survival rates are about 0.95, equivalent to that for free-living adult dolphins. Therefore mortality in live stranded animals taken into rehabilitation centres will arise simply because animals are brought into captivity.

There may be species differences in this as pelagic dolphins may be less tolerant of captivity than bottlenose dolphins, for example (Kastelein *et al*, 1995; Geraci & St. Aubin, 1979). Experiences in the UK indicate that dolphins may appear to recover well from their initial disability to steadily decline a few days later. Those involved feel this syndrome is associated with a reaction to the stress of captivity (James Barnett, Veterinary Surgeon, Weymouth Sea Life Centre, personal communication). This suggests that animals release should not be delayed.

Gastric ulceration, which is considered to ba a sign of stress in other species such as the pig, appears to be relatively common in captive cetaceans suggesting they are similarly stressed. For example, a case study of a group of bottlenose dolphins recieving chronic cimetidine treatment for gastric ulceration has been described (Bossart & Dierauf, 1990). In addition, the use of antacids and antihistamines to treat gastirc ulceration has been described as 'relatively routine' (Stoskopf, 1990), suggesting considerable experience has been gained in the use of these drugs through necessity.

Release from rehabilitation

The decision when to release an animal may not be easy. As well as the usual requirements that an animal is eating, diving and behaving normally, some use normal blood parameters as a guide to when an animal is ready for release (Bull & Worthy, 1995). If animals are to be kept for any length of time, the provision of additional facilities may be needed. When kept in confinement, animals will have limited opportunity for exercise and time to exercise in a large enclosure before release may be helpful both to get an animal fit to survive sea conditions and to get a better idea of its preparedness for release.

With neonatal animals there will be additional problems. There has been a report that young dolphins at Monkey Mia in Australia have much lower survival rates than expected in normal wild animals (Anderson, 1994). These are a group of free-living but hand fed dolphins and the lowered survival rate is thought to associated with maternal neglect so calves do not learn normal foraging and other skills such as avoiding predators. Studies of mother calf interactions indicate the importance that learning plays in a calf's development (Cockroft & Ross, 1990). Therefore this will need to be substituted in some way. For example they will need to be in contact with animals of their own species to enable them to learn social skills, foraging behaviour and so on. Young animals will also need to have demonstrated that they can catch live fish before they can be released. Gaining strength and fitness will also be essential requirements. These findings raise serious concerns about the reality of raising neonatal cetaceans in captivity if the long term aim is rehabilitation.

Some thought is needed to decide when an animal is no longer considered a noenate and therefore able to survive on its own and a candidate for rehabilitation. This will differ for different species and will rely upon knowledge of the species natural history. All animals which are still dependant on a maternal milk supply would be included which may be a long period. A bottlenose dolphin calf in captivity did not take its first solid food until it was almost a year old (Cockroft & Ross, 1990).

There are studies following the release of dolphins which have been held captive or been bred in captivity for display and then rehabilitated for release to the wild. These studies may help evaluate what must be considered if animals are kept for long periods before being healthy enough to release especially if animals are trained in 'husbandry' techniques as they are in the US (Forsyth, 1995) and generally become habituated to humans.

Despite efforts to acclimate previously captive bottlenose dolphins to their new environment by using a sea pen and introducing live food, 3 of 9 dolphins either voluntarily returned to the sea pen or were recaptured because of serious weight loss (Gales & Waples, 1993). The calf of one of these dolphins disappeared and was presumed dead. Radio tagging information on the remaining dolphins lasted for a maximum of 47 days and only for 5 days with one animal.

Other concerns have been raised about the reintroduction of captive animals to wild populations (Brill & Freidl, 1993) which may apply to rescued animals kept for long periods in rehabilitation units. These include the possible introduction of disease to wild population, the problems for animals which have lost their fear of humans and the ability of animals to be successful once reintroduced.

Marking and Tagging

Much of the data presented above on success rates of treatment of stranded animals can be criticised because little is known about the fate of animals once they have been returned to the sea. Although reports are available to show that animals can be restored to health and released (e.g. Kastelein *et al*, 1990; Price-May *et al*, 1995; Bull & Worthy, 1995) their post-release fate is unclear. In fact there seem to be no reports evaluating the short or long-term success of releasing animals following either refloating or rehabilitation.

One of the ways which has been most commonly proposed to monitor animals once they are released is to tag or mark them in someway. Marking involves using the individual characteristics of an animal to identify in the future or branding the animal with a number. Tagging involves attaching some kind of artificial marker which may have a mechanism for remote tracking of the animals using satellite or VHF transmission.

All of these methods have different pros and cons which are described below using analyses of their effectiveness by US researchers (Irvine *et al,* 1982; Scott *et al,* 1990). Most marking and tagging studies have been developed to gather information about the natural history of animals.

i) Natural marks.

This is the most commonly used method for recognition of individual whales and dolphins. In dolphins and some whales, photographs are taken of the dorsal fin which may have characteristic colouration, nicks and scars especially along the rear edge of the fin. The flukes can be photographed in some whales when they can provide a similarly characteristic record of the animal. The main advantage to this method is that it is non-invasive, cheap and straight forward.

The disadvantages are that not all animals or species will be identifiable in this way. For example, harbour porpoises have small dorsal fins which are difficult to photograph at sea. Individual dolphins, especially young animals, may also have very few distinguishing masks. Often resighting animals relies on luck once animals have been refloated and released. Since marks may not be detected until photographs are examined (they are often too subtle to be confirmed by eye at sea) its success depends in part on a systematic approach to collection of data.

ii) Branding and artificial marks

Attempts have been made to paint marks on animals but these have been unsuccessful because the paint was not tolerated well. Although tatooing is widely used in domestic species such as pigs, it does not seem to have been used much in cetaceans and may merit investigation. It is relatively non-invasive and should leave a permanent mark which could be seen on close inspection.

Freeze-branding has been used to mark animals with a number on the dorsal fin or just at its base so it can be seen when the animal breaks the surface of the water. Liquid nitrogen or a mixture of dry ice with alcohol or acetone is used to cool the branding iron. This is then applied for around 15 seconds.

Freeze brands do not give an immediate mark. An area of depigmentation evolves over 10 days after which time it becomes readable. Although freeze branding sounds very invasive it is said not to illicit any painful reaction in the animal although skin damage may occur if the branding iron is left on for too long (Scott *et al*, 1990). However, its use in monitoring success of treatment has to be reserved for animals brought into rehabilitation centres which will be kept for at least 10 days if any immediate post-release data is to be collected.

Freeze branding, however, does not last for ever, gradually fading over time and more quickly in young animals. It also shares some of the same problems as photoidentification - resightings will tend to arise through luck, although once sighted confirmation is much easier at the time than with photoidentification.

iii) Button and bolt tags

The relatively large size and easy visibility of the dorsal fin of cetaceans has encouraged research workers to attach large tags to the fin for maximum visibility. These are usually circular or rectangular plastic tags which are bolted to either side of the fin using stainless steel pins.

There are a range of problems associated with the use of such tags. Firstly the attachment process is very invasive, requiring two or three holes to be made in the fin if they are to stay in place. This necessitates considerable handling and the use of local analgesia to prevent pain during the application procedure. Tags are often lost either because they get pulled out of the fin (or may be battered out by the animal itself) or the bolt(s) may migrate out because of the pressure of water on the tag.

In coastal waters such tags may become fouled with algae and barnacles. Resighting rates may be disappointing and although tags can be seen from up to two hundred metres away, it requires close contact to read the numbers.

iv) Roto tags

Roto tags are a type of cattle ear tag which are applied to the rear edge of the dorsal fin with a special pair of pliers. They are much smaller than button tags and so the numbers on them are too small to be read at a distance, although the colour and position of the tag can be used to identify individuals. They are much less invasive than button tags although they can be shed leaving a tear in the dorsal edge of the fin. Fouling with barnacles and algae is an uncommon problem.

v) Spaghetti tags

Spaghetti tags are plastic covered strands of wire connected to a darted tip. They have been used most frequently to mark free-living whales and dolphins as they can be shot into the animal. There seems to be very few advantages to using spaghetti tags, they are shed quite quickly and have high rates of abscess formation. Studies in captivity have shown that other dolphins may pull at tags and cause damage that way.

vi) Radio tags

Radio tags were developed to remotely track animals once they are at sea. This is the real advantage of this type of tag - it does not rely on luck, active monitoring can take place. The tag consists of a transmitter attached to the dorsal fin in some way, usually by bolts through the fin. The package is relatively large as it has to carry batteries as well as the transmitter, although size is being reduced considerably with improvements in miniaturisation.

There are two main problems with these tags. One is associated with the size of the tag and its attachment to the dorsal fin. The other is the relatively short life span of the batteries and the need to have dedicated land or sea monitoring facilities to follow the animal.

The size of the tag and the need for it to be bolted though the dorsal fin compounds the problems that were described for button tags. As well as the invasive nature of the attachment process, the fixing pins may migrate and the whole tag be shed, or if straps or harnesses are used to fix the tag it can interfere with locomotion and/or damage the underlying tissues.

Recent studies have shown that greater elevations in plasma cortisol and creatinine are seen in harbour porpoises being released form herring weirs and having a transmitter fitted when compared to those being given a roto tag (Koopman *et al*, 1995). Raised plasma cortisol and creatinine are associated with stress and this was thought to be due to the longer period out of the water being handled which was experienced by those animals having a radiotag attached.

There are many trade-offs to be made with the design of such tags - they may have longer battery life but have to have less powerful transmission ranges if size is not to become too large and so on. Radiotracking is also labour intensive and therefore expensive.

Much smaller radiotransmitters are being developed for use with roto tags. The transmitter, about the size of a biro, trails behind the animal. These may over come some of the problems of attachment.

vii) Satellite tags

Satellite tags have been used so that animals can be tracked over longer distances without the need for constant boat or land monitoring. Whilst they may give detailed information on movements and dive times they are much more expensive than radio tags. They are also larger than radiotags and therefore can cause the same, or possibly more, physical damage to the animals.

viii) Ribbon tags

Ribbon tags are strips of material or plastic tied around the caudal peduncle (tail stock) (Project Jonah, 1995). They can be marked with a number and give a short term record of the animal's movements. If they are brightly coloured they can be easily seen but they will only remain in place for a short period of time.

ix) Electronic chips

Electronic chips are now being implanted under the skin of domestic species such as dogs and wild animals. These have an individual code which are read by special readers. These could be used in cetaceans as they are simple to place, relatively non-invasive and cheap. However, there is no external evidence that they have been inserted and would have to be used with a tag to alert someone to read the electronic chip.

Summary

Much debate continues about the survival rates following rescue efforts. In general the absolute numbers of animals which appear to be successfully returned to the sea is greatest with mass strandings. This may be associated, in part, with the better general state of health of
of these animals. Evaluating the success of single strandings is made more difficult by the lack of information.

Refloating is the technique that appears to offer the best prospects overall for stranded animals. One main advantage of refloating is that it limits the degree of stress to which an animal is exposed. Not all stranded animals will be able to be refloated when the options become euthanasia or rehabilitation.

Although there is not a lot of published data about the fate of animals in rehabilitation units, it is clear that there is considerable mortality. Rehabilitation has mixed results and significant mortality occurs even at centres with considerable experience. Evaluation of survival is complicated because in some institutions in the US rescued animals are not returned to the sea even if they are fit enough to be (Natchigall et al, 1990). There is also a feeling that more needs to be known about disease in cetaceans before animals can be released (Walsh *et al*, 1990).

However, the problems of captivity and the difficulties of releasing animals which are habituated to humans means that if rescued animals are taken into care they should be kept for a short a period as possible and returned to the population they are thought to have come from it their chances of survival are to be optimised. Contact with other marine mammals must be carefully considered to avoid the transfer of pathogens in either direction, espcially with the recognition that morbillivirus infections may be endemic in some species (Duignan *et al*, 1995). Efforts must be made to ensure animals are fit enough to cope with the difficult demands of sea conditions. If captivity has been prolonged, reconditioning to undo and training and make them human averse as used for long-term captive dolphins (Brill & Friedl, 1993; Lycan & Kinsman, 1995), may also be necessary. This is a daunting undertaking.

If neonatal animals are to be raised there must not only be others of the same species in the rehabilitation centre, but also some kind of sea pen to ensure animals can forage under natural conditions and have time to acclimate. The requirements for social groups for neonates raises important questions about the interests of the other animals in the group. If there is no veterinary or other reason for them to remain in captivity, this will pose great difficulties. Whether suitable 'companion' animals are likely to come into a rehabilitation centre if they are not already there will be difficult to judge. Some research is needed to aid people involved in rescue work to decide when an animal is a neonate and unable to survive on its own as this will be difficult in juvenille animals.

The biggest problem when it comes to determining survival rates is the lack of any hard data about the long term fate of animals which are refloated or released from rehabilitation centres. To determine survival rates once animals are put back in the sea we would benefit from some kind of monitoring. However, none of the methods currently available are perfect. Some are invasive in nature while others suffer from disadvantages such as poor likelihood of resighting.

Bolting radio or satellite transmitters to dorsal fins will need to be carefully evaluated.
There is now evidence from studies with harbour porpoises that this process is stressful (Koopman *et al*, 1995) although it may have no impact on survival. The information that may be made available by the use of such techniques could greatly improve management and treatment of live stranded animals in the future.

If radio or satellite tags are to be used, the most sensible approach would be to design careful studies where the smallest possible number of animals are tagged. All these studies do not need to be undertaken in every country. Those areas having the highest incidence of any particular stranding could be used to determine short term survival rates and the results could then be used to inform treatment in other places. There seems to be no justification for *ad hoc* use of radio-tags where insufficient information will be gained about any one species or type of stranding to allow conclusions to be drawn.

7. PRACTICAL IMPLICATIONS OF DIFFERENT OPTIONS

There are three scenarios which will be considered here and their broad advantages and disadvantages discussed. These are beach treatment only; beach treatment plus limited holding facilities; beach treatment and full rehabilitation centre(s).

Beach treatment only.

In this option, animals are evaluated on the beach and a decision made whether they could be refloated and released within the next 1-2 days either at the site of stranding or a more suitable but nearby site. If animals are not able to be refloated or do not do well when refloating is attempted they are euthanased.

This approach relies on having very well trained people both to care for the animals and assess their state of health. For maximum success there needs to be an investment in training, equipment to facilitate care, such as dry suits, as well as stretchers and pontoons. The provision of proper transport is an important part of such a approach for short trips to nearby, more sheltered beaches, when necessary.

In this option efforts should also be made to deal with the whole stranding situation. In the US, on-shore response strategies include teams trained with individuals assigned to various roles (Geraci & Lounsbury, 1993). For example, one person may be dedicated to passing information to the public and the press about the progress of the animal(s). This is an approach which could alleviate pressure on those dealing with the animals and ensure that their attentions are not diverted from the animals needs. Collection of data should form another important role of the team so that a proper evaluation can be made.

The advantage of focusing efforts beach care in this way is that the available data indicates that refloating and rapid release is the way in which most animals are saved. People would become more familiar and practised at dealing with animals in this way. On-shore treatment is the primary focus of strandings work elsewhere in the world and there is considerable experience to draw on in developing appropriate programmes.

The major disadvantage of a purely beach based approach, is that animals may have to be euthanased when there may be some prospect of the their rehabilitation if taken into care.
The cost implications of such beach care are not minimal. On-going training would be needed and equipment provided and maintained. A commitment to maintaining a system only used sporadically is also necessary.

Beach treatment plus limited holding facilities

This option depends upon beach care as above but with the provision of mobile pools for controlled re-floating at the beach head or in a temporary pool at a more distant site (like the one at East Winch RSPCA wildlife hospital). The use of mobile pools sounds attractive but has several potential disadvantages. Ensuring a suitable, flat site with an adequate water supply may not be easy. Water quality may also become poor if proper filtration units are not available. The time and effort spent in establishing a temporary pool may divert attention and resources from the immediate needs of the animal. There is also the important issue of stress on the animal involved. Noise from generators, the human activity around and confined nature of such a pool are likely to add to the animals' distress.

There are also concerns about the needs of humans dealing with animals in these temorary pools. There is a risk that rather than being used for very short periods they are used for days. People caring for animals will not be undercover and without proper rest facilities. They may become tired and discouraged and the animals suffer as a result.

The situation when such a pool could, therefore, be useful is restricted to when no sheltered site exists for refloating within a reasonable distance.

Using temporary pools at centres already dealing with marine life is a different version of this option. The practical requirements for water and ensuring it is of suitable quality may be more easily met, but animals will have to be transported to such sites for what should be an evaluation stage best carried out on-shore or very close to it. Pools at centres such as this may be suitable for longer term holding and treatment facilities but they will then need to ensure that they are of an adequate size and have proper facilities for both humans and animals involved in such care.

Investing in moveable, temporary pools represents a considerable financial investment. Once such pools are available the temptation would be to use them and possibly reduce efforts to find a sheltered site for refloating. They may also change from being 'temporary' to being used in a semi-permanent situation when, in fact, their small size should not allow this. Temporary pools do not seem to be a feature of rescue efforts in other parts of the world so no information on their usefullness elswhere is available.

Beach treatment plus rehabilitation centre

This option would involve beach care as above, but rehabilitation centre(s) would be available to treat animals which were not able to be refloated quickly but which are thought likely to survive.

Rehabilitation of cetaceans cannot be undertaken half heartedly. Poor conditions will result in suffering of the animals involved. As outlined in section 5, basic requirements consist of a padded round or oval pool at least 9 metres in diameter. Salt water together with full treatment are required. The ability to control water temperature is desirable and animals need to be able to be monitored 24 hours a day. Support systems for the animal in the water and handling facilities are also needed. Therefore rehabilitation demands purpose built accommodation costing hundreds of thousands of pounds to build and operate.

If it is contemplated that neonatal animals are to be rehabilitated the scale of the operation will escalate further. Sea pens and the provision of live food will be essential. The company of other animals of the same species to help learning of foraging and other survival skills will be similarly essential. If these are not available it is difficult to envisage how a hand reared cetacean could ever be released to the wild.

The geographical siting of such a facility is debatable. Transport is stressful for cetaceans and must only be carried out in suitably equipped vehicles. How long a sick animal can tolerate even the best quality transport is not definable exactly as it will depend upon the case involved, but journeys over 2-3 hours need careful justification.

The costs of building such a centre may divert funds from other efforts to maintain an effective beach rescue effort. Decisions may be biased towards rehabilitation by the desire to use such facilities.

Of course the main advantage and justification for such a facility is that some animals will be treated and released that would otherwise have died or been euthanased.

Summary

There is no question that the most important step is to ensure top quality beach treatment of stranded animals. For the majority this will give them their best chance of survival and it is therefore the most cost-effective option and arguably the most humane approach. Prolonged handling and inappropriate care all add to the stress an animal experiences and reduce its chances of survival. Beach care would be facilitated by training and contingency planning to deal with the whole of the stranding event to ensure the animal's interests are not marginalised by pressures from the public and media for information and involvement.

Temporary pools only offer advantages in very limited situations. Efforts might be better spent ensuring good transport was available to a nearby sheltered site, rather than finding a suitable location for a temporary pool. Their use should be restricted to beach head use when conditions (such as bad weather) prevent the refloating of an animal at the site or its transfer elsewhere. Animals should not be kept in such pools for more than 48 hours.

There are certain basic requirements which should be met at any rehabilitation centre which should not only include the physical conditions but also the competence of the staff to deal with the animals. No one site would be able to deal with all animals that may be candidates for rehabilitation. The numbers of animals any one site would be dealing with would be very low and it may not be possible to maintain the quality of the care that is essential.

8. DISCUSSION AND CONCLUSIONS IN THE UK CONTEXT

The difficulties, opportunities and practices which have been outlined in the earlier parts of this report are now used as a background to consider the situation in the UK.

The Distribution of Strandings in the UK

There are some striking patterns in the strandings of whales and dolphins which should offer clues to the most appropriate distribution of resources. The data for live strandings from the beginning of 1992 and the end of 1995 is given for England and Wales in Table 8.1 and for Scotland in Table 8.2. This period was chosen as both strandings coordinators were in post during this time and therefore has the most reliable data.

There are about 35 animals stranded alive each year around the coast of Britain. Around 60% of these animals strand in Scotland. The harbour porpoise is the most common species to strand individually in the whole of the UK. Some species are surprisingly absent from the list of live strandings including bottlenose and Risso's dolphins, both of which are frequently seen in British coastal waters. The pelagic common dolphin (*Delphinus delphis*), white-sided dolphin and white-beaked dolphin are involved in both mass and individual strandings.

In the England and Wales, around half of the live harbour porpoises were found on the Welsh coast or bordering counties. The majority of the remaining live strandings of harbour porpoises occurred on the east coast of England from Northumberland to Suffolk. Live stranded common dolphins have a south-western distribution with animals most commonly found in Cornwall and Wales. No mass strandings have been recorded in England and Wales in the period 1992-1995.

In Scotland, mass strandings accounted for 18% of the number of strandings and involved some 55% of all animals stranded. The Western Isles, Orkney and Shetland were the sites of live mass strandings in the period 1992-1995. As historical data also confirms (Sheldrick, 1989), as elsewhere in the world, pilot whales, sperm whales, white-sided dolphins and white-beaked dolphins are the species most commonly mass stranding. Individual harbour porpoise strandings were widely distributed around Scotland.

Although this is only a small data set, it confirms patterns seen in the Natural History Museum's historical data of live and dead animals. Harbour porpoises were the most common individually stranded animal between 1967-1992 (Sheldrick, 1989; Anon, 1992; Anon, 1993). Mass strandings of pilot whales have been most common in Scotland, but have also been recorded on the east England coast and individual and mass strandings of pelagic dolphin species have also been recorded for long periods in Scotland (Sheldrick, 1989).

In the past there seemed to be a peak period for mass strandings between October and May although it has been suggested that this association is less marked than it was in the mid-1980s and before (Anon, 1993).

However, live and dead strandings do not parallel each other exactly. For example in 1992 there was a marked increase in the strandings of common dolphins in Cornwall (Anon, 1993) which is now considered to be due to their incidental capture in fisheries. Unsurprisingly perhaps, live strandings were not similarly increased in that area at that time.

Therefore it can be seen that there are important 'hot spots' for strandings, particularly for mass strandings which are concentrated in Scotland and the Islands in particular. This distribution could reflect the higher density of those species in the waters off the Scottish coast than elsewhere and their proximity to migratory routes (Evans, 1980).

Harbour porpoises are the most common species to strand individually and there is a concentration of these in Wales and bordering counties. The south-west of England also sees live strandings relatively frequently but has a high concentration of dead stranded common dolphins because of fisheries by-catch which will never be influenced by rescue attempts. Elsewhere in the British Isles live strandings are sporadic events which can occur almost anywhere.

These findings suggest that resources directed to dealing with mass strandings need to be concentrated in Scotland. Mass strandings there not infrequently involve larger species and thus equipment will need to be provided which can deal with these situations. An ability to deal with sporadic individual strandings will be the most important feature of strategies to assist stranded cetaceans in England and Wales.

The relatively low numbers of live strandings and their wide geographical spread poses problems in providing good quality care. It will be difficult for people to gain the same degree of experience and knowledge as in other countries where strandings are much more common.

Causes of Strandings in the UK

i) Mass Strandings

It is not possible to determine exactly what causes mass strandings in Scotland. Klinowska's data (Klinowska, 1985; 1986) would suggest that animals are affected by geomagnetic anomalies which result in mistakes in navigation. Since the west coast of Scotland and Orkney and Shetland are relatively close to migratory routes of cetaceans (Evans, 1980) this gives some support to the hypothesis. Future studies should help determine if animals in strandings are affected by disease.

ii) Individual strandings

The conditions shown in Table 8.3 have been associated with live strandings of individual harbour porpoises and dolphins in the UK which have subsequently died or been euthanased. It seems as if in the UK as elsewhere, disease plays an important role in individual strandings. Similar conditions have been recorded as causes of death in harbour porpoises

Table 8.1. LIVE STRANDED CETACEANS IN ENGLAND AND WALES - 1st January 1992 - 31st December 1995

SPECIES	MASS	INDIVIDUAL	OUTCOME
Harbour porpoise	0	28	15 died on beach 7 died in rehabilitation 3 euthanased 2 died during transport 1 thought to be refloated OK
Common dolphin	0	12	7 died on beach 3 died in rehabilitation 2 rehabilitated
Striped dolphin	0	6	2 died on beach 1 died in rehabilitation 1 euthanased 1 refloated, restranded & died 1 rehabilitated
White-sided dolphin	0	2	1 died on beach 1 died in rehabilitation
White-beaked dolphin	0	2	1 died on beach 1 refloated
Bottlenose dolphin	0	1	died on beach
Unidentified dolphin	0	3	3 refloated
Sperm whale	0	1	died on beach
Killer whale	0	1	refloated, restranded and euthanased
Pygmy sperm whale	0	1	died on beach
TOTALS	0	57	**29 died on beach** **12 died in rehabilitation** **4 euthanased on beach** **2 refloated, restranded, & euthanased or died** **2 died in transport** **5 successfully refloated** **3 successfully rehabilitated**

The data in this table is derived from the British Natural History Museum's data base, Paul Jepson, of the Institute of Zoology, and James Barnett, veterinary surgeon at the Weymouth Sea Life Centre who has attended many live stranded animals. It is possible not all live strandings have been included especially if they are successfully refloated because information may not have been passed on. The table also includes animals which are not recorded as live stranded on the Natural History Museum's data base, but which post mortem evidence indicated the animal had live stranded (Paul Jepson, Strandings coordinator for England & Wales, personal communication).

Table 8.2. LIVE STRANDED CETACEANS IN SCOTLAND - 1st January 1992 - 31st December 1995 (From data supplied by Bob Reid, Scottish Strandings Coordinator)

SPECIES	MASS	OUTCOME	INDIVIDUAL	OUTCOME
Minke Whale	0		5	2 euthanased 3 refloated
Common dolphin	0		4	2 died on beach 1 refloated, died later 1 refloated
Long-finned pilot whale	2 (7 & 3 animals)	7 died on beach 2 euthanased 1 refloated	1	died
Northern bottlenose whale	0		2	2 refloated
White-sided dolphin	1 (7 animals)	1 died 6 refloated	2	1 died (by-catch) 1 refloated
White-beaked dolphin	1 (2 animals)	2 refloated	5	3 died on beach 2 refloated
Sowerby's beaked whale	1 (3 animals)	3 died on beach	0	
Killer whale	1 (11 animals)	1 died 7 refloated 3 stayed in water	1	died in water
Harbour porpoise	0		9	5 died at site 1 died & 1 euthansed in rehabilitation 2 refloated
Sperm whale	1 (11 animals)	11 died on beach	3	3 died on beach
Striped dolphin	0		3	2 died on beach 1 euthanased
Cuvier's beaked whale	0		1	refloated
Unidentified	1 (2 animals)	2 refloated	1	refloated
TOTALS	**8 (46 animals)**	**23 died 2 euthanased 21 refloated or stayed in water**	**37**	**18 died at site 3 euthanased at site 2 died/euthanased in rehabilitation 1 refloated, died later 13 refloated**

which were found dead in British waters (Baker & Martin, 1992). If drowning in fishing nets is ignored (as these will not live strand) causes of death included parasitic and bacterial bronchopneumonias, starvation, trauma, enteritis, pulmonary oedema and septicaemia. In dolphins found dead, bacterial pneumonia was the commonest cause of death (Baker, 1992).

Therefore there are no clear differences in diseases between animals found dead and those live stranded. There is also no one single cause of disease that can be picked as being particularly prevalent in individual animals which live strand. However, there is not enough data in the UK yet to be confident about this conclusion. Such information would help in diagnosis and prognosis.

Table 8.3 - CONDITIONS THOUGHT TO BE RESPONSIBLE FOR DEATH IN INDIVIDUAL STRANDED CETACEANS IN THE UK BETWEEN 1991-1995 (data from Paul Jepson, Strandings coordinator, England & Wales & Harry Ross, Scottish strandings network)

SPECIES	PROBABLE CAUSE OF DEATH
Harbour Porpoises	Central nervous system disease - encephalitis, abcessation etc
	Septicaemia - Streptococcus canis
	Septicaemia - Salmonella sp
	Pneumonia - parasitic
	Congenital defect - Tetralogy of Fallot
	Heart disease
	Dystocia
	Starvation and/or hypothermia in neonates
	Bottlenose dolphin attack (Scotland)
Dolphins	Bacterial pneumonia
	Hydrocephalus
	Renal failure
	Strangulated hernia
	No Abnormalities Detected

Nevertheless, in the UK as elsewhere (Obendorf & Arundel, 1988) it is also clear that not all animals individually stranding are diseased. As Table 3.1 shows, even though all harbour porpoises live stranded in the UK between 1992 and 1995 have evidence of disease or starvation, this is not true for some dolphins (Paul Jepson, Strandings coordinator England & Wales, personal communication). Therefore, it is not possible to simply assume that all individually stranded animals are seriously diseased or compromised in some way.

These findings suggest that there is considerable scope for assisting animals involved in mass live strandings in Scotland. For individual animals which strand there will need to be careful evaluation of their condition. The prognosis for harbour porpoises is probably worse that for pelagic dolphins.

Survival Rates of Strandings in the UK

Tables 8.1 and 8.2 show the outcome of live strandings in England, Wales and Scotland between 1992-95. In Scotland, an overall survival rate as judged by the numbers of animals returned to the sea, of 40% (34 out of 84) was achieved. The majority of efforts were directed towards refloating with the outcome being marginally better for mass that individual strandings. It has been estimated that of the 70% considered suitable for return to the sea, refloating was successful in 65% of cases (Ross & Reid, 1995). This is a lower survival rate than in New Zealand which may be to lack of experience or differences in the causes of the strandings.

The rather different nature of strandings in England and Wales is probably responsible for the very poor survival rate in rescuing live stranded animals in these areas. In contrast to Scotland there were no mass strandings seen in England and Wales so only individual stranded animals were seen and these carry a poorer prognisis. Overall only 14% (8 out of 57) of animals live stranded during 1992-1995 were successfully returned to the sea. The poor survival rates with harbour porpoises were evident in both Scotland and England and Wales.

Efforts to rehabilitate animals in the UK have been disappointing to date. In Scotland 2 harbour porpoises which were taken into care either died or were euthanased. In England and Wales all 7 of the harbour porpoises have died as have 2 others which died during transport. Survival has been somewhat higher with dolphins. Two of five common dolphins were successfully rehabilitated as was one of two striped dolphins. Another white-sided dolphin also died during attempts to rehabilitate it.

The poor survival rate associated with harbour porpoises may be because this species is more likely to be suffering from serious disease when they strand than dolphin species (Paul Jepson, personal communication). Husbandry of harbour porpoises has also proved difficult in rehabilitation. One feature has been marked ventral flexion apparently as kind of muscle spasm (Ian Robinson, Veterinary Manager, RSPCA wildlife hospital, East Winch, personal communication) which has not resolved with laxatives given because similar signs have been attributed to constipation elsewhere (Kastelein *et al*, 1990).

Refloating animals has already proved to be a practical option in the UK and should be pursued. The prospects for mass stranded animals should be good if resources and expertise are effectively deployed. Investment in developing and refining refloating techniques would be useful. Refloating also has the potential to be successful for animals individually stranded if assessed to be suitable candidates. Harbour porpoises have been particularly poor prospects for return to the sea to date. If rehabilitation is to be contemplated there needs to be investment in improving the UK's ability to undertake such care.

Improving Assessment

Making the difficult decision about prognosis is not easy. None of the approaches outlined in Section 4 give unequivocal answers. There is little data available about how these parameters have been used in the UK and their reliability. Although there is now an impressive system to collect post mortem data about stranded cetaceans, there is no system to collect, collate and evaluate veterinary medical data about strandings.

To allow reliable prognostic indicators to be developed, a system is needed to ensure a common collection system of data from the clinical and physical examinations of stranded animals. This should be centrally collected together with data on progress and outcome for critical evaluation.

Improving Care of Stranded Cetaceans

i) <u>First aid</u>

The initial care given to a stranded cetacean is likely to be critical in the final outcome for the animal. Experience in other countries provides a good approach to dealing with animals in the first instance. However, only very few people in the UK have experience of dealing with strandings and mistakes can arise out of good intention but ignorance. Cetaceans have specific needs which may be neglected but could make a significant difference to the outcome including positioning in sternal recumbency and keeping an animal cool. Improving the level of knowledge of about care of cetaceans is an important goal.

In the UK there is no interest among the authorities in supporting efforts to rescue live stranded cetaceans as there is other countries such as the USA, New Zealand and Australia. Elsewhere regulations exist to try to ensure good quality care is given. For example, under the US Marine Mammal Protection Act, 1972, official permission has to be given to treat a stranded animal. There are many different organisations who have developed plans for dealing with stranded cetaceans in the UK. Many of these are part of the Marine Animal Rescue Coalition (MARC) which is dedicated to providing appropriate responses for stranded marine mammals. Training courses have already been run.

The promising start which has been made on training in the UK should be extended. The development of a system of accredited training for both lay people and veterinary surgeons in first aid treatment and refloating of stranded cetaceans would be beneficial in improving care of stranded cetaceans.

Planning and training should not just be directed to the animals' care but also to deal with the whole of the stranding incident. Individuals dedicated to public information and control should be part of a team to alleviate pressure on those involved in animal care. Information about the causes and treatment of strandings and details of the species involved should be prepared in advance and be available to the public and press.

ii) <u>Refloating</u>

Refloating has proved to be a practical and effective response to rescuing stranded animals but needs to be carried out with care and patience. Trial refloating can also play an important role in the assessment of an animal. Refloating, like first aid, requires trained people if unnecessary harm is not to be caused to an animal. The provision of suitable equipment is also essential.

Whilst much criticism has been made that refloating may result in animals simply dying out at sea unobserved as a justification for animals being taken into care (e.g Walsh *et al*, 1990), there is no evidence that animals fare any better in rehabilitation centres where the mortality rates are high. There is no data about the fate of animals released from rehabilitation. The animal's best chance is likely to come through rapid refloating as handling and captivity will add to the animal's stress and reduce it's survival prospects.

The use of mobile inflatable pools will only have advantages in situations where refloating at the site of stranding or at a nearby beach is not possible.

Training of people to assist in refloating will be an important feature of a rescue plan. Large numbers of people will be required to assist with mass strandings and even with individual animals, many people may be needed.

Test refloating should be used in animals whose clincinal signs are equivocal and must not be rushed. Proper equipment in term of floatation systems for the animals and protective gear for the cares will be needed.

iii) Rehabilitation

The Report of the Working Party on Training, Equipment and Rehabilitation Facilities described the centres available for UK cetacean rehabilitation in Appendix 2 of their report to the Marine Mammal Rescue/British Divers Strandings Meeting, 27th February 1994, University of Greenwich. It is evident that none of these can fulfil the essential requirements for a short term rehabilitation centre at the current time.

The small number of strandings that occur in the UK and their wide geographical spread place pressures on the feasibility of the provision of rehabilitation facilities. Of all the stranded animals only a very small percentage will be candidates for rehabilitation. Based on the data from 1992-1995, rehabilitation was an option for about 5 animals a year in the whole of the UK.

About two thirds of animals for rehabilitation would be harbour porpoises and the rest pelagic species of dolphin. Harbour porpoises are probably among the least likely to survive as they often strand with serious disease which is not amenable to treatment. Given the constraints on transport of animals, any one facility could only serve a limited area.Therefore, in purely cost terms the investment in specialised rehabilitation may be difficult to justify especially as they will lie idle for prolonged periods of time. The provision of care for neonatal animals carries even greater demands in cost and commitment.

Problems also arise when people are dealing with only a very few cases on a sporadic basis. They do not become expert and knowledge can be lost with changing staff. Poor care means additional distress for an animal. However, there undoubtedly are animals which could be successfully treated if suitable facilities exist. With good facilities and increasing experience success rates are likely to increase as they have elsewhere (Kastelein *et al*, 1990).

Captivity stress is a well recognised problem in cetaceans. Bringing animals into care adds an additional stress that must be minimised. Using unsuitable facilities will cause an animal's health to deteriorate. Therefore rehabilitation should only be undertaken when it is known that adequate facilities exist.

If the financial investment can be made in a rehabilitation centre essential requirements for short term (weeks) care include:- a minimum of a 9 metre diameter oval or round pool with padded sides; support for animals in the water; fully treated salt water supply; a controlled environment; isolation from the public; handling facilities; 24 hour observation facilities; experienced and qualified carers.

Longer term treatment demands better facilities including a sea pool to gain fitness in sea conditions. Neonatal animals should not be taken into rehabilitation facilities. There is little

prospect that hand reared cetaceans could be released to the wild as they will not have learnt basic foraging, survival and social skills.

iv) Tagging and Marking

A well recognised problem with the rescue of stranded cetaceans is that there is no reliable data about the post-release fate of these animals. There is no one single method which combines a non-invasive technique with reliable information gathering.

Causing stress to animals which are already in distress when stranded is undesirable and therefore methods with unjustifiable degrees of intervention on the beach cannot be justified. Using natural marks may seem the ideal approach, but since many of the species which strand in the UK are either pelagic or harbour porpoises, the likelihood of resighting is slim in any event. Bottlenose dolphins for which the technique is best developed and used in the UK, are rarely found live stranded in the UK.

Currently there is no systematic tagging or marking of live stranded cetaceans in the UK. One animal has been freeze branded before release from rehabilitation (James Barnett, personal communication). Freeze branding does not cause any noticeable distress to animals and shows the potential to be a humane marking method for animals in rehabilitation.

When refloating or releasing animals from rehabilitation, there are some simple marking procedures which should always be used. Firstly the dorsal fin should be photographed and a central record kept. Secondly, biodegradable ribbon tags like those described by Project Jonah (1995) should be attached to the animal. In the 48 hours following the refloating of a stranded animal, schemes should be established to search coastline and sea close to the stranding point to try and increase the likelihood of finding animals in immediate difficulty.

The use of radio and satellite tagging may provide useful data but is invasive. It should only be contemplated if part of a well planned project which will generate reliable information. *Ad hoc* use of such tags cannot be justified.

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