LIFE
ilhas
barreira

DELIVERABLE

Protocol for best-practices on seabird rehabilitation (action E5)

Olhão | January | 2024

COFINANCIAMENTO
COORDENAÇÃO
PARCEIROS

Protocol for best-practices on seabird rehabilitation (action E5)

Project LIFE Ilhas Barreira

RIAS/ALDEIA – Centro de Recuperação e Investigação de Animais Selvagens

RIAS/ALDEIA Project coordination
Juliana Menezes, Soraia Guerra

Technical / scientific team
María Casero, Vera Marques

Authors
María Casero, Paulo Martins

COFINANCIAMENTO

COORDENAÇÃO

PARCEIROS

www.lifeilhasbarreira.pt

Table of contents

Summary / Resumo

Wild birds' rehabilitation is a complex process due to the great diversity of characteristics between species. In the case of seabirds, their adaptations to the marine environment bring particularities and special needs to their rehabilitation process.

This protocol presents the knowledge and experience in seabird recovery obtained by the RIAS team during the LIFE Ilhas Barreira project. The entire seabird rehabilitation process is presented in general terms, covering topics such as seabrids special needs, admission process, pools maintenance, rehabilitation in dry conditions and in water, as well as some nature return and euthanasia considerations.

A reabilitação de aves selvagens é um processo complexo devido à grande diversidade de características entre espécies. No caso das aves marinhas, a sua adaptação ao meio marinho traz particularidades e necessidades especiais ao seu processo de reabilitação.

Este protocolo apresenta o conhecimento e a experiência na recuperação de aves marinhas obtidos pela equipa do RIAS durante o projeto LIFE Ilhas Barreira. Todo o processo de reabilitação de aves marinhas é apresentado em termos gerais, abrangendo tópicos como as necessidades especiais dos seabrids, o processo de admissão, a manutenção das piscinas, a reabilitação em seco e na água, bem como as considerações a ter em conta aquando da devolução à natureza e eutanásia.

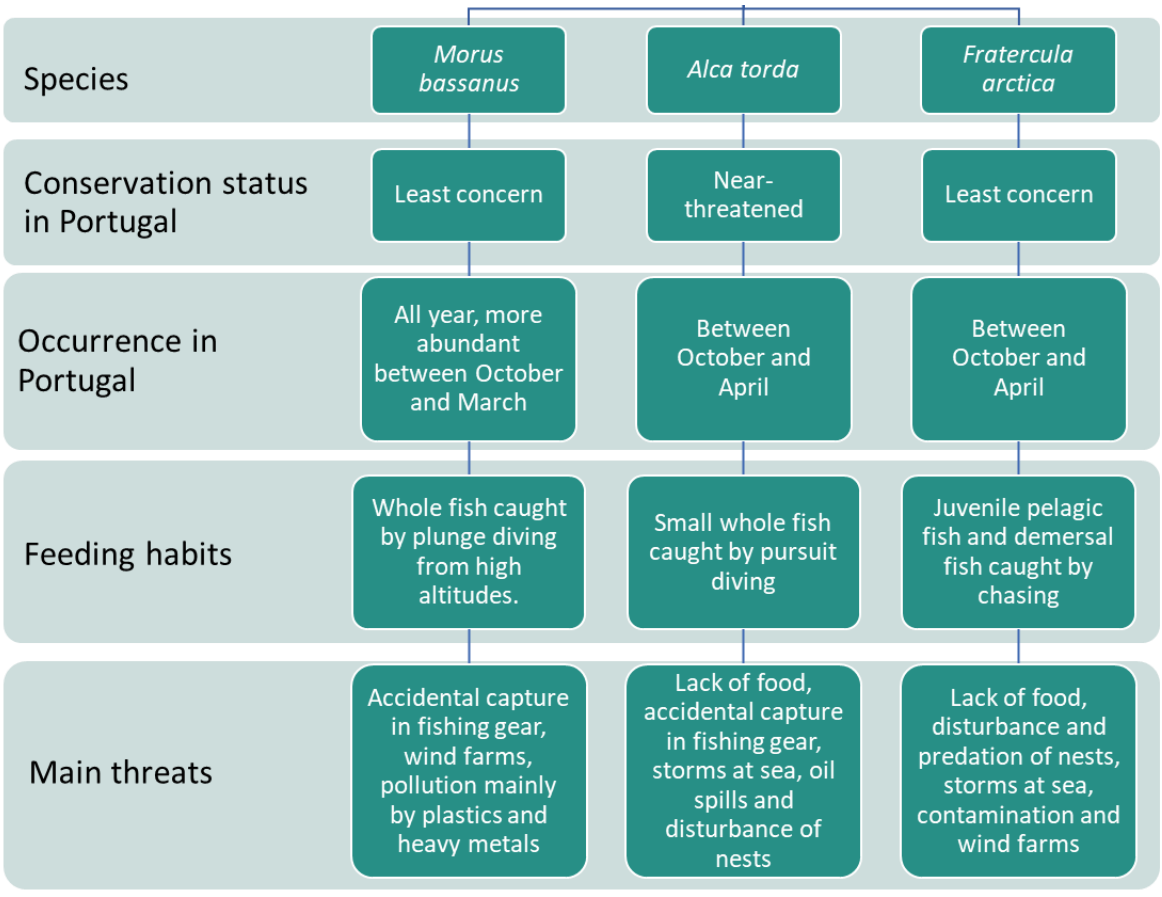
1| Introduction

The concept of “seabird” doesn’t have a taxonomic representation, but it refers to a group of species that inhabit or feed in the sea (Mullineaux & Keeble, 2017). The seabirds can also be distinguished has pelagic or coastal. The pelagic seabirds inhabit the high sea and usually just come ashore during the nesting season. The coastal seabirds inhabit the sea close to the shore and some of them can even rest on land. In this document, we will focus on pelagic seabirds regarding its special needs and difficulties in rehabilitation. Once the rehabilitation procedures are the same, in this document we will consider as “pelagic” the seabirds that don’t rest on land.

Considering that weakness is the main cause of seabirds in RIAS, this protocol places special attention on the recovery of these birds based on the previously developed emaciated seabird recovery protocol (Deliverable C6.2: Emaciated marine birds recovery protocol).

1.1. Seabirds’ species admitted in RIAS

The most common seabirds’ species admitted at RIAS hospital are summaryze in the next figure:



1.2. Seabirds' particularities

To survive in the adverse sea environment, the seabirds have some anatomophysiological adaptations. These characteristics have an important implication on the management during their rehabilitation process.

Possibly the most important one is the **waterproof** plumage. The presence of contaminants such as oil, algae, feces, blood and other debris can also lead to a reduction in surface tension and consequent penetration of water into the feather. Also, the integrity of the feather microstructure can be compromised by damaged feathers or by weak birds unable to preen. The loss of waterproofing can lead to hypothermia, loss of buoyancy or death (Bill et al., 2012; Morandin & O'Hara, 2014).

Another important adaptation is the well-developed **salt gland**, which is located in the supraorbital region and complements the kidney in the excretion of excess electrolytes. In the wild, the transition between high and low salinity environments occurs gradually, allowing the gland to adapt. During rehabilitation, the animal should be exposed to a salinity appropriate to that at the release site, in order to maintain the correct activity of the gland and avoid dehydration due to the bird's inability to excrete excess electrolytes (Mullineaux & Keeble, 2017).

Seabirds are adapted to spending most of their time at sea, where the pressure exerted on their bodies is minimal. That's also an important adaptation because, on land, the pressure exerted is much greater and these birds can devolope pressure sores on plantar pads, tarsus and keel when they spend long periods on land. In order to avoid the appearance of sores, during the rehabilitation, the birds should be kept in suitable boxes and transferred to the pools as soon as possible.

When planning the rehabilitation process or assessing the possibility of recovery, it is equally important to consider and respect the species' bioecology and its adaptations to it. Some species feed on the water surface, while others dive to catch their food, which means that some will be better at diving than others. The way they swim while diving also varies from species to species, with some birds swimming with their feet, others with their wings and others with both.

1.2. Main admission causes of seabirds at RIAS

The main cause of pelagic seabirds' admission at RIAS is *emaciation* due to lack of food, sea storms, inexperienced juvenils, among others that can lead to their malnutrition. There is an increase in the admission of emaciated juvenile *Morus bassanus* between September and November, given their inexperience on their first migration south.

The second most important cause of admission is the presence of *nets*, *fishing lines or hooks*. Considering their exclusively marine nature, by-catch in fishing gear is one of the main threats to this group. Both longline hooks and capture in nets.

Also important is the *unknown* cause of admission, often associated with beached carcasses found in a severe decomposition state or, rarely, birds with no clear signs of the cause of death. There are other less frequent causes of admission in RIAS, such as *trauma* of unknown origin, *disease* or *feather contamination*.

2 | Seabirds in rehabilitation

2.1. Rehabilitation steps

- **Admission procedures and stabilitation**

Considering that weakness is the main cause of seabirds in RIAS, we will focus on the admission procedures of caquectic seabrids developed in the Deliverable C6.2: Emaciated marine birds recovery protocol (Appendix I).

On admission, the species, age and sex will be identified, as well as the background when possible. The animal will then be weighed and a physical examination will be carried out. Starting with the assessment of body condition, dehydration state and body temperature, rectifying hypothermia before carrying out any intervention (> 37ºC). During the physical examination, it is necessary to pay special attention to the state of the plumage and possible contaminations, as well as to the presence of fishing lines or hooks, which may have already been removed or may be hidden among the feathers. These procedures are extremely stressful for the animal so, it may be necessary to restrict the physical examination to screening and preliminary diagnosis if the bird is very weak or stressed (Kolesnikovas et al., 2020).

If the animal's condition allows it, it is possible to carry out complementary tests, being the most performed hematology (hematocrit, total plasma proteins) and radiography (Mullineaux & Keeble, 2017). Blood values of PT < 1 to 2g/dl and/or Htc < 15 to 20% are consider critical points and the animal should be euthanized (see euthanasia criteria).

Based on the information from the anamnesis, physical examination findings and the results of the complementary tests, a diagnosis and therapeutic plan should be determined. For a weak animal, the admission procedures include:

- Subcutaneous rehydration with fluids (30 to 40ml/kg);
- Intravenous rehydration with fluids (2.5ml/kg) if it's very weak;
- Vitamine and mineral suplementation intramuscular or intravenous if it's very weak;
- Oral rehydration (50ml/kg) (starting on admission day if the bird arrives early, or in the next day if it arrives at the end of the day);

All birds will receive prophylactic treatment for aspergilosis (Itraconazol, 20mg/Kg, oral route, once a day, for 3 weeks) and deworming (Prazitel Plus©, ¼ pill/kg, once).

Even though in the wild seabirds spend most of their time in the water, it is often not possible to keep them in the water at the beginning of the rehabilitation process due to severe debilitation and/or lack of waterproofing. In these cases, it will be necessary to keep the birds in dry conditions at the beginning, for as short a time as possible to avoid secondary complications (Hall, 2008; Miller, 2012; Hernandez et al., 2020).

• Rehabilitation in dry conditions

Dry recovery allows an easier handling, better monitoring (Mullineaux & Keeble, 2017; Ward, 2019) and the use of heat sources to correct hypothermia.

It is carried out in boxes, which can be of two types: solid-bottomed (animal carriers or modified plastic boxes) or net-bottomed. The first type can lead to the appearance of pressure sores and the loss of waterproofing due to contamination of the plumage with feces. This can be prevented by using cushioned substrates and changing the substrates frequently (Bill et al., 2012; Thomas, 2016; Mullineaux & Keeble, 2017; Ward, 2019). The second type, boxes with a net bottom, is described as being better at preventing pressure sores and loss of waterproof (Miller, 2012; Thomas, 2016; Hernandez et al., 2020). This type of box is not commercially available, so it must be built.

• Rehabilitation in water

Water is the most effective way of preventing pressure sores and loss of waterproofing, so the rehabilitation process should progress as quickly as possible to the stage where they remain in the water (Hall, 2008; Miller, 2012). To have access to water, the bird must be hidratated, strong and alert, not need frequent handling and not have any other limitations, such as big wounds or fractures (Ward, 2019).

Once the bird is ready to go into the pool, the veterinary and rehabilitation team will assess whether a prior bath is necessary or whether it will be placed directly in the pool according to the state of the waterproofing. If the team chooses the second option, the bird will be placed in a tank of water at 32 to 35ºC for 10 to 90 minutes to assess its degree of waterproofing. If the bird shows signs of permeability and discomfort, such us trying to get out of the water, is exhausted, shivering, very wet or sinking, it should be taken out of the water immediately (Bill et al., 2012; Thomas, 2016). Progressively, water and drying cycles will be repeated, allowing the bird to gradually restore its waterproofing until it is able to stay permanently in the water. Drying periods can be carried out inside the tank on a platform or ramp that allows the bird to get out of the water on its own when it feels uncomfortable. Once total waterproofing has been confirmed, the bird can remain in the water all day without supervision.

2.2. Feeding

The type and frequency of feeding will depend on the animal's condition. In the initial phase of recoery, debilitated birds are fed with liquid formula by orogastric intubation (Hall, 2008; Thomas, 2016; Ward, 2019; Kolesnikovas et al., 2020), starting with fluids only and gradually introducing formula diluted with fluids until the concentration of 100% liquid formula is reached (Thomas, 2016; Ward, 2019; Kolesnikovas et al., 2020). If undigested formula is observed in the feces, it will be necessary to take a step back to fluids or more diluted formula for the next intubation. This formula can be commercial preparations (EmerAid® piscivore, AD Hills®) or a "homemade" preparation with blended fish, whole or without bones.

The transition to solid food should be gradual, when the bird is strong, shows interest in the food and/or there is no undigested food in the feces (Thomas, 2016; Mullineaux & Keeble, 2017). Self-feeding with whole fish is the best way, because it reduces the stress of handling and increase the speed of recovery and weight gain. Fish should be offered two or three times a day, in a size suitable for the patient having in consideration its condition (Hall, 2008; Thomas, 2016; Ward, 2019; Kolesnikovas et al., 2020). In some cases, in the initial phase of the transition to solid food, it may be necessary to force feed and help the bird to swallow (Mullineaux & Keeble, 2017; Ward, 2019; Kolesnikovas et al., 2020). To prevent the feathers contamination with fish oils, after the feeding, the beak should always be cleaned with a damp cloth or water spray (Ward, 2019; Kolesnikovas et al., 2020).

In the final phase of rehabilitation, feeding should be as natural as possible. Swimming and diving can be encouraged by throwing the fish into the water (Thomas, 2016) or providing live fish.

All fish should be supplemented to provide a balanced diet. The basic supplements include:

- Specific supplemtns for piscivorous animals (Aquaminivits©) every two days;

- Salt 100mg/kg every day starting when the animal is in the pool. Salt won't be necessary if the pool is salt water;
- Oil fish every two days.

2.3. Pools maintenance

The pools can be made of different materials: plastic, metal, fiberglass, cement or natural ponds (Bill et al., 2012; Miller, 2012; Thomas, 2016) and their size will depend on the resources of each center, but it must be taken into account the size of the individual, the injuries it presents and the number of animals in recovery. While the depth must be appropriate for the species' feeding and diving habits (Miller, 2012; Mullineaux & Keeble, 2017; Kolesnikovas et al., 2020). For environmental enrichment and bird rest, platforms, rocks or perches can be placed, depending on the species (Bill et al., 2012; Miller, 2012; Ward, 2019). In the case of platforms, they should ideally have a net bottom and be placed just below the surface of the water, so that the bird doesn't get wet, but also so that droppings don't accumulate. (Thomas, 2016; Mullineaux & Keeble, 2017).

The pools can have fresh or salt water, but it is essential to keep a perfect quality of the water, which can be done in an open or closed circuit. The open circuit requires a constant new water inflow and dirty water outflow. The closed circuit requires a strong sand filtration system capable of filtering four times the volume of the pool every hour.

To prevent waterproofing problems, it's also essential to keep the water surface free of oil and debris. For that, in the opposite side of the water inlet, the pool must have a constant overflow or strong skimmers, devices that drain the water surface. The bottom should also be vacuumed regularly to be kept free of feces, food scraps and other debris.

2.4. Secondary conditions

The various complications that can arise during the seabird rehabilitation process are mainly related to stress and the fact that they have restricted access to water.

The most common are **pressure sores** on the keel, tarsus and plantar pads which result from the fact that these birds are not physiologically adapted to standing on solid surfaces for long periods of time (Bill et al., 2012; Ward, 2019). As already mentioned, these injuries can be prevented by using fluffy substrates or boxes with net bottoms, applying padded dressings when necessary and reducing the time they spend on dry conditions (Hall, 2008; Bill et al., 2012; Mullineaux & Keeble, 2017; Ward, 2019; Hernandez et al., 2020). When birds become more active and agitated, but still need to remain in the box, attempts to flap their wings can lead to injuries such as sores on the carpals or degradation

of the primary and tail feathers (Bill et al., 2012; Ward, 2019). It is important to prevent these injuries by using suitable boxes.

Another frequent condition is the loss of plumage **waterproofing**, which can happen in the wild before admission or during recovery, due to inability to preen or contamination of the plumage with feces or fish oil. This situation can be prevented by properly cleaning the facilities, keeping the bird's feathers clean after each feeding and filtering the water surface.

Seabirds are more susceptible than others to **aspergillosis**, a fungal infection caused by fungi of the *Aspergillus* genus. This is due to a lack of exposure to the fungus in the marine environment, the immunodepression caused by the stress of captivity and the debilitated state in which most birds arrive at rehabilitation centers (Hall, 2008; Mullineaux & Keeble, 2017). This condition can be effectively prevented with the prophylactic treatment described before.

In addition to aspergillosis, the stress of captivity can also lead to other complications. One example is the mortality due to capture myopathy, a common complication in RIAS.

2.5. Feather cleaning

Some seabirds may arrive with contaminated plumage, but many will also suffer contamination during the rehabilitation process, mainly due to feces, oils and debris from the fish they feed on (Bill et al., 2012; Morandin & O'Hara, 2014). For this reason, it is common for seabirds to need to be washed in order to recover their waterproofing. This procedure is very stressful, so it is necessary to stabilize the animal beforehand.

Washing is carried out with a minimum of two people (one for restraint and one for washing), immersing the bird in a bath of water at 39 to 42ºC and Fairy® detergent at a concentration that varies depending on the condition of the feathers (between 0,5% and 4%). The plumage is washed by vigorously agitating the water near the feathers, without direct contacting them and covering the entire body. Once the whole body has been washed, it is rinsed with running water, also at 42ºC, with as much pressure as possible so that it is repelled when it hits the feather and in the opposite direction to the feathers to disorganize them and stimulate subsequent preening. Washing and rinsing were appropriate when the water forms droplets on the surface of the feathers without penetrating them and the deeper feathers regain their fluffy appearance (Mullineaux & Keeble, 2017; Finlayson et al., 2018; Hernandez et al., 2020).

Finally, the animal should be placed for a few hours in a well-ventilated drying room at 32-35ºC to prevent hypothermia and stimulate preening. It is recommended to use a pet air dryer with warm wind blowing from the bottom of the box to the top, in order to encourage the preening.

3| Release criteria

For proper post-release survival, the following criteria must be taken into account:

- Full recovery from the cause of admission and absence of any infectious diseases or chronic injuries;
- Conclusion of any treatment and medication;
- Totally waterproof after a minimum of 48 hours in water;
- Hematocrit and total proteins at normal values (35-40% and 4g/dl respectively);
- Good body condition and normal weight for the species;
- Flying or with strength in the wings, in species that cannot fly inside the facilities;
- With feeding, swimming, diving, preening, fighting and escape behaviors appropriate to the species.

4| Euthanasia criteria

A wild animal should be euthanized whenever treatment or survival after release is impossible (Hall, 2008; Bill et al., 2012; Kolesnikovas et al., 2020), but each case will always be assessed individually. When the decision may be uncertain, it is important to discuss the matter with other colleagues from the center, from other centers or specialists who can bring new inputs to the decision.

To help with this decision, there are euthanasia criteria published in the literature:

- Open or segmented fractures with bone degeneration, periarticular fractures, multiple fractures of the radius and ulna, joint injuries, among others (Quirós, 2002; Bill et al., 2012);
- Extreme emaciation: skeletal body condition (level 1 on a scale of 1 to 5), hematocrit < 15 to 20% or total plasma proteins < 1 to 2 g/dL (Thomas 2016);
- Severe pododermatitis or keel and/or tarsus pressure sores (Bill et al., 2012; Thomas, 2016);
- Blindness and pathologies that require chronic treatments (Thomas, 2016).

REFERENCES

- Bill, J. O., Corsiglia, L., Masvidal, V., Merrick, M., & Riggs, S. M. (2012). An Introduction to Aquatic Bird Rehabilitation. Bird Ally X.
- Finlayson, G. R., Louise Chilvers, B., Pearson, H., White, B. J., Finlayson, S. T., Sievwright, K., van Zyl, N., Morgan, K. J., & Clumpner, C. (2018). Efficacy of seawater for washing oiled birds during an oil spill response. Marine Pollution Bulletin, 126, 137–140. https://doi.org/10.1016/j.marpolbul.2017.10.080
- Hall, E. (2008, julho). Rescue & Intensive Care of Seabirds. National Wildlife Rehabilitation Conference, Canberra.
- Hernandez, S. M., Barron, H. W., Miller, E. A., Aguilar, R. F., & Yabsley, M. J. (Eds.). (2020). Medical Management of Wildlife Species: A Guide for Practitioners (1st edition). Wiley-Blackwell.
- Kolesnikovas, C. K. M., Saviolli, J. Y., Reisfeld, L., Mayorga, L. F. S. P., Uhart, M., Serafini, P. P., Vanstreels, R. E. T., Hurtado, R., Heredia, S. R., & Neves, T. (2020). Reabilitação de Procellariiformes: (Albatrozes, petréis, pardelas) (R. Hurtado, J. Y. Saviolli, & R. E. T. Vanstreels, Eds.). Editora Comunnicar.
- Lista Vermelha das Aves de Portugal Continental (2022). ICNF
- Martins, P. (2023). Reabilitação de aves marinhas – Traços gerais e relato de casos. Relatório estágio Mestrado Integrado em Medicina Veterinária, Universidade de Évora.
- Miller, E. A. (2012). Minimum standards for wildlife rehabilitation (4th ed.). National Wildlife Rehabilitators Association; International Wildlife Rehabilitation Council.
- Morandin, L. A., & O'Hara, P. D. (2014). Fish oil disrupts seabird feather microstructure and waterproofing. Science of The Total Environment, 496, 257–263. https://doi.org/10.1016/j.scitotenv.2014.07.025
- Mullineaux, E., & Keeble, E. (2017). BSAVA Manual of Wildlife Casualties. British Small Animal Veterinary Association.
- Quirós, J. R. (2002). TRAUMATOLOGIA EN AVES. Canis et felis, 59, 7.
- RIAS (2022). Centro de Recuperação e Investigação de Animais Selvagens (RIAS) – Relatório de Actividades 2022. Olhão
- Thomas, T. (2016). EUROWA Module Part B Animal care during an oiled wildlife response: Vol. 1.1. Sea Alarm Foundation.
- Ward, J. (2019). Rehabilitation guide for pelagic seabirds. New Zealand Department of Conservation.

Appendix I: Emaciated marine birds recovery protocol

Emaciated marine bird recovery protocol

- **Admission procedures**
  - Measure the temperature and **rectify hypothermia** before doing any intervention (>37ºC).
  - Collect a blood sample to do the hematocrit (Htc) and total protein (PT). Blood values of **PT <2g/dl** and/or **Htc <20%** are consider critical point and the animal should be euthanized.
  - To rehydrate, administrate intravenous (IV) 2.5ml/kg and subcutaneous (SC) 30-40ml/kg fluids **on the back and do not lay it belly up.**
  - Duphafral© intramuscular (IM)
  - Itraconazol 20mg/Kg q24h oral route (PO) for 3 weeks. This treatment is only prophylactic. In confirmed cases of aspergillosis, the dose and duration will be different.

Day 0	Day 1	Day 2	Day 3	Day 4	Day 5
Fluids SC and IV	Fluids PO[1] q3h Fluids SC	Fluids PO q3h Fluids SC	Alternating fluids with diluted tube food [2] Fluids SC Deworming[3]	Alternating fluids with diluted tube food Fluids SC	Offer Fish[4] / try to force Go back to tube food if the fish is not accepted
		This process can take several days till the next step.			

[1] The amount for oral administrations is 50ml/kg. This amount can be smaller if the animal is very weak. If the bird vomits, let him rest for 30 minutes and try again with a smaller amount. Next day return with the goal dose.

[2] The tube food is prepared with Hills a/d© diluted with fluids. See table attached for instructions of the concentration of the dilution.

[3] Deworming with **Prazitel Plus**©. Dose: ¼ pill/kg

[4] It will only be offered solid food if the animal is strong and hydrated. Start with 1 or 2 fishes and increase bit by bit the quantity and frequency. When the fish is well accepted, the daily quantity will be divided in 3 times a day.
Shower the beak with water after each feed to clean the oil. Do not force the fish to an animal that does not swallow by himself, regurgitates or vomits. If that happens, return to tube food and try again the next day. Fish can be forced if the animal is active and with PT >2.5g/dl and Htc >20%.

Emaciated seabirds protocol | RIAS 2021

Feeding and supplements

- Preferably use fresh low-fat fish. Clean the beak and face with water after each feeding.
- Supplements:
  - Aquaminivits© q48h
  - Salt 100mg/kg/day. Starting when the animal is in the pool
  - Oil fish q48h

- **Pool**
  - When the animal is stable and the body temperature controlled, it can be put in the pool for a few hours for feeding and bathing.
  - Before going to the pool permanently, the animal should have Htc >30% and be completely washed to clean the feathers, using warm water and Fairy© .

- **Release criteria**
  - Stable normal weight for the species
  - Strong, muscle and good body condition
  - Htc > 40%
  - 100% impermeable

- ***Morus bassanus* reference values**
  - Fluids SC 50ml/administration and IV 5ml/administration.
  - Oral administrations between 100 and 200 ml/administration.
  - The amount of fish is between 300g and 600g of whole fish/day. The dose of maintenance when the animal has the normal weight is 300 to 400g/day.
  - Normal weight is 2 500g to 3 000g.

Appendix II: Emaciated marine birds patient file

Emaciated marine bird patient file

Admission nº: Admission date: Weight:	Htc: PT: Comments:

Day	Time	Food	Comments	Check
1	9am	Fluids PO Fluids SC **Itraconazol**		
	12pm	Fluids PO		
	3pm	Fluids PO		
	6pm	Fluids PO		
2	9am	Fluids PO Fluids SC **Itraconazol**		
	12pm	Fluids PO		
	3pm	Fluids PO		
	6pm	Fluids PO		
3	9am	Fluids PO Fluids SC **Itraconazol**		
	12pm	Tube food 25% **Prazitel Plus©**		
	3pm	Fluids PO		
	6pm	Tube food 50%		
4	9am	Fluids PO Fluids SC **Itraconazol**		
	12pm	Tube food 75%		
	3pm	Fluids PO		
	6pm	Tube food 100%		
5	9am	Fluids PO Fluids SC **Itraconazol**		
	12pm	Tube food 100%		
	3pm	Fluids PO		
	6pm	Tube food 100%		

Emaciated seabirds protocol | RIAS 2021