

Husbandry Guidelines for



Little Penguin *Eudyptula minor* (Aves: Spheniscidae)

Compiler: Lydia Williams

1 June, 2009

Western Sydney Institute of TAFE, Richmond

Certificate3 in Captive Animals, RUV 30204

Lecturer: Graeme Phipps, Jacki Salkeld, Brad Walker

Disclaimer

This Manual has been prepared as part of the requirements for the Certificate III in Captive Animals offered at Richmond TAFE. This subject is listed under RUV3405A

This Manual is intended to be used as a guide only and not as an authoritative statement of every conceivable issue or aspect relating to the species describe.

Captive Animal keepers should use this Manual as a guide to the care, management, and development of the *Eudiptula minor* within the proper facility and not to use it as a complete or authoritative research document on the species.

TABLE OF CONTENTS

1	Introduction	6
2	Taxonomy	8
2.1	NOMENCLATURE	8
2.2	SUBSPECIES.....	8
2.3	RECENT SYNONYMS	8
2.4	OTHER COMMON NAMES	8
3	Natural History	9
3.1	MORPHOMETRICS.....	9
3.1.1	<i>Mass And Basic Body Measurements</i>	9
3.1.2	<i>Sexual Dimorphism</i>	9
3.1.3	<i>Distinguishing Features</i>	10
3.2	DISTRIBUTION AND HABITAT	10
3.3	CONSERVATION STATUS	10
3.4	LONGEVITY	10
3.4.1	<i>In the Wild</i>	10
3.4.2	<i>In Captivity</i>	11
3.4.3	<i>Techniques Used to Determine Age in Adults</i>	11
4	Housing Requirements.....	11
4.1	EXHIBIT/ENCLOSURE DESIGN.....	11
4.2	HOLDING AREA DESIGN	12
4.3	SPATIAL REQUIREMENTS	12
4.4	POSITION OF ENCLOSURES	13
4.5	WEATHER PROTECTION	13
4.6	TEMPERATURE REQUIREMENTS	13
4.7	SUBSTRATE.....	14
4.8	NESTBOXES AND/OR BEDDING MATERIAL.....	14
	NESTING AREA.....	14
	WWW.PENGUIN.NET.NZ	14
4.9	ENCLOSURE FURNISHINGS.....	15
5	General Husbandry	15
5.2	RECORD KEEPING	15
5.3	METHODS OF IDENTIFICATION.....	16
5.4	ROUTINE DATA COLLECTION.....	16
6	Feeding Requirements.....	16
6.1	DIET IN THE WILD.....	16
6.2	CAPTIVE DIET	18
6.3	SUPPLEMENTS	18
6.4	PRESENTATION OF FOOD	20
7	Handling and Transport.....	21
7.1	TIMING OF CAPTURE AND HANDLING.....	21
7.2	CATCHING BAGS.....	21
7.3	CAPTURE AND RESTRAINT TECHNIQUES	21
7.4	WEIGHING AND EXAMINATION	22
7.5	RELEASE	22
7.6	TRANSPORT REQUIREMENTS	23
7.6.1	<i>Box Design</i>	23
7.6.2	<i>Furnishings</i>	24
7.6.3	<i>Water and Food</i>	24
7.6.4	<i>Animals per Box</i>	24
7.6.5	<i>Timing of Transportation</i>	24

7.6.6	Release from Box.....	24
8	Health Requirements	24
8.1	DAILY HEALTH CHECKS	25
8.2	DETAILED PHYSICAL EXAMINATION.....	25
	(JOHNS AND SHELLAM. 1999).....	25
8.2.1	Chemical Restraint.....	26
8.2.2	Physical Examination	26
8.3	ROUTINE TREATMENTS	26
8.4	KNOWN HEALTH PROBLEMS.....	27
8.5	QUARANTINE REQUIREMENTS	28
9	Behaviour	29
9.1	ACTIVITY	29
9.2	SOCIAL BEHAVIOUR	30
9.3	REPRODUCTIVE BEHAVIOUR.....	30
9.4	BATHING	31
9.5	BEHAVIOURAL PROBLEMS	31
9.6	SIGNS OF STRESS	32
9.7	BEHAVIOURAL ENRICHMENT	32
9.8	INTRODUCTIONS AND REMOVALS	33
9.9	INTRASPECIFIC COMPATIBILITY	33
9.10	INTERSPECIFIC COMPATIBILITY	34
9.11	SUITABILITY TO CAPTIVITY	34
10	BREEDING	34
10.1	MATING SYSTEM	34
10.2	EASE OF BREEDING	35
10.3	REPRODUCTIVE CONDITION	35
10.3.1.	Females	35
10.3.2	Males	35
10.4	TECHNIQUES USED TO CONTROL BREEDING	36
10.5.	OCCURRENCE OF HYBRIDS	36
10.6	TIMING OF BREEDING	36
10.7	AGE AT FIRST BREEDING AND LAST BREEDING	36
10.8	ABILITY TO BREED EVERY YEAR	36
10.9	ABILITY TO BREED MORE THAN ONCE A YEAR	36
10.10	NESTING, HOLLOW OR OTHER REQUIREMENTS	37
10.11	BREEDING DIET	37
10.12	INCUBATION PERIOD	37
10.13	CLUTCH SIZE	37
10.14	AGE OF FLEDGING	37
10.15	AGE AT REMOVAL OF PARENTS	38
10.16	GROWTH AND DEVELOPMENT	38

11	Artificial Rearing.....	41
11.1	INCUBATOR TYPE	41
11.2	INCUBATION TEMPERATURES AND HUMIDITY.....	41
11.3	DESIRED % EGG MASS LOSS	42
11.4	HATCHING TEMPERATURE AND HUMIDITY	42
11.5	NORMAL PIP TO HATCH INTERVAL.....	42
11.6	BROODER TYPES/DESIGN.....	43
11.7	BROODER TEMPERATURES.....	43
11.8	DIET AND FEEDING ROUTINE	44
11.9	SPECIFIC REQUIREMENTS.....	45
11.10	PINIONING REQUIREMENTS.....	46
11.11	DATA RECORDING.....	46
11.12	IDENTIFICATION METHODS	46
11.13	HYGIENE	46
11.14	BEHAVIOURAL CONSIDERATIONS.....	47
11.15	USE OF FOSTER SPECIES.....	47
11.16	WEANING.....	47
11.17	Rehabilitation.....	47
12	Acknowledgements.....	51
13	References	52
14	Bibliography	56
15	Glossary.....	58
16	Appendix	60

1 Introduction

The Little Penguin is the smallest in the world, barely weighing 1 kilogram. Little Penguins, are also called "Little Blues" because of the striking indigo-blue or slate-gray colour of their feathers on the top side of their body. Their underside, however, is a bright white colour. The Little Penguin is a very vocal bird, able to make a variety of sounds that range from cackling to quacking to screaming sounds--and even sometimes sounds that seem very similar to that of a cat's meow as well as barking, bleating, braying, cackling, growling, hissing, mooing, quacking, screaming, sneezing, and trumpeting.

Little Penguins are southern hemisphere penguins, living along the coasts of southern Australia as well as Tasmania, New Zealand, and the Chatham Islands. They can also be found in sub-antarctic regions south of New Zealand.

The Little Penguin was first observed for science and history by a German naturalist named Johann Reinhold Forster, who wrote down descriptions of them for journals in 1781. The scientific name for Little Blue Penguins is "*Eudyptula minor*." Their lifespan is about 7 years if conditions are suitable for proper feeding and nesting. They are day hunters, swimming out into the ocean to hunt small fish, squid, krill and crustaceans. At night they return to their nests, made in rock crevices or burrows lined with plant material. Like several other species of penguin, the Little Penguins mate for life. Both the males and females incubate the eggs and care for the young, which can include up to six chicks in a year.

Little Penguins live much closer to human settlements than most species of penguins, and therefore they suffer population loss more from human interference. They have been hit by cars while trying to cross busy roads, and have also been hunted by domesticated pets such as dogs and cats. Oil spills, fishing and loss of habitat have also caused a decrease in their population numbers. Their natural predators include killer whales, seals, sharks and seagulls, as well as introduced species such as foxes and snakes. Some colonies of Little Penguins have declined into actual extinction, and a subspecies of these penguins--known as the White Flipped Penguin because of the white along the edge of its flippers--has been placed on the endangered species list.

The Little Penguin spends its days at sea, fishing; it comes to shore in the evenings, and is the most nocturnal of all the penguins. It is not migratory and is very agile on land, and is a good climber, using its bill, flippers, and feet to scramble up steep cliffs.

At Phillip Island, near the city of Melbourne, Australia, crowds of people gather in the evenings to watch the Fairy penguins come ashore. It has become a famous attraction. Flood lights have even been set up, to allow better viewing. The penguins have gotten so use to the attention that they carry on as if no one was there.

OH&S Rating: Low Risk

- **There is no threat to safety during capture or care of the Little Penguin.**
- **There is no potential of transferral zoonotic diseases to humans.**
- **There is the potential of avian diseases such as:**
 - aspergillosis,
 - avian malaria
 - Oral trichomoniasis
- **There is a need to maintain a high standard of hygiene and care while maintaining Little Penguins as is required in a facility in general.**

2 Taxonomy

2.1 Nomenclature

Class: Aves
Order: Sphenisciformes
Family: Spheniscidae
Genus: *Eudyptula*
Species: *E. minor*

2.2 Subspecies

Eudyptula albosignata The White-flipped penguin. (Williams, 1995).

2.3 Recent Synonyms

The Maori use the name 'korora.'

2.4 Other Common Names

Some of the other common names are Fairy Penguins and Little Blue Penguins



Taken by Lydia Williams at NZA.

Canberra.

3 Natural History

Little penguins are only found in the Southern Hemisphere preferring the warmer waters along the shores of Southern Australia, Tasmania, and New Zealand. They are the smallest of all the penguins. Very little is known about their populations. However, Tasmanian estimates range from 110 000–190 000 breeding pairs of which less than 5% are found on mainland Tasmania, where ever-increasing human pressure will probably result in their extinction. The most abundant populations are found on Australia's offshore islands. Adults weigh about a kilogram, grow to a height of 40 cm and live, on average, 6 years. In one instance, an age of 21 years has been recorded.

The little penguin's streamlined shape and the efficient propulsion of its flippers (used underwater in a similar manner to that of birds in the air) enable it to seek prey in shallow short dives, frequently between the 10–30 m range and very occasionally extending to 60 m. Its diet varies in different locations but consists mainly of small school fish, some squid or krill (shrimp-like crustaceans). Occasionally items will be taken from the sea floor, such as crab larvae or sea horses. Prey is swallowed whole. Some little penguins return consistently to their burrows year round but most stay at sea throughout the autumn-winter period.

Seasonal changes in natural food supplies from year to year cause many young birds to be washed up dead or in weak condition on our beaches. Thoughtless activities create extra problems for little penguins. Some are drowned when the amateur fisherman unknowingly sets gill nets near a penguin colony. Oil spills spell disaster for penguins and other sea birds. Not only is oil toxic when ingested, but also the buoyancy and insulation of penguin plumage is damaged. Plastics are mistakenly swallowed or bottle packaging becomes a noose around a penguin neck. Uncontrolled dogs or feral cats wreak havoc on penguin colonies (more than the penguin's natural predators) and may kill many individuals. The effects of human habitation, such as road kills, direct harassment, vegetation burn-off and housing development continue to threaten fairy penguin colonies.

The Little Penguin is often a great tourist attraction in Australia, where people watch the colonies of these amazing creatures.

1.1 *Morphometrics*

1.1.1 *Mass and Basic Body Measurements*

On average the Little Penguin grows to 33-45cm tall and weighs between 0.9 -1.1 kg with annual variations of 200g (Williams, 1995).

1.1.2 *Sexual Dimorphism*

The sexual dimorphism for the Little Penguin is displayed in the bill shape and size. Using a simple measure of bill depth, those greater than 13.33mm were classed as males. (Arnould, 2004)



1.1.3 Distinguishing Features

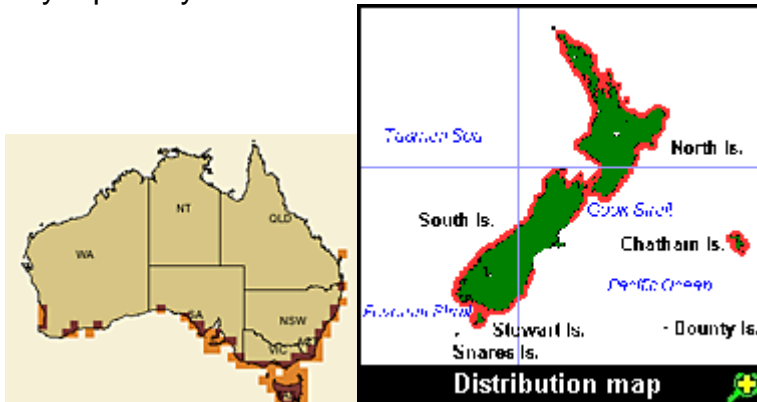
They are the smallest of the Penguin species and they have indigo-blue plumage which distinguishes them from other Penguin species. The forehead, crown and dorsal surface of this penguin are indigo blue in colour, the chest and throat are lighter. They have slate-blue to black feathers. They also have bluish-grey eyes. Chicks are blue-grey on the underside and brown on top.

1.2 Distribution and Habitat

The Little Penguins are only found in Australia and New Zealand. Their Australian habitat ranges from Fremantle in Western Australia across the southern coastline up to Sydney and also including Tasmania. Little Penguins spend most their time out at sea in shallow waters hunting for food, then at dusk they return to their burrows or rock crevices along the shoreline to sleep.

In terms of population, Tasmanian estimates range from 110,000 to 190,000 breeding pairs of which less than 5 % are found on mainland Tasmania. The most abundant populations are found on the offshore islands.

Journeys of more than 1000km from the birth area have been recorded. Little Penguins in Victoria travel up to 700 km from the burrow and stay within 20 km of the coast. On day trips they remain within 15 km of the burrow and 9 km of the coast. (Reilly, 1994).



The red markers show the distribution of the Little Penguin in Australia and New Zealand. (Map at Birds Australia Birdata).

1.3 Conservation Status

Low Risk/least concern (BirdLife International 2004)

1.4 Longevity

1.4.1 In the Wild

The Little Penguin longevity on average is 6 years but some flipper ringing experiments on Little Penguins have recorded that some individuals have lived to 21 years. (Stahels & Gales, 1987).

1.4.2 In Captivity

The Little Penguin usually lives longer in captivity, average of 10-15 years, and also a few up to 20 or so years.

1.4.3 Techniques Used to Determine Age in Adults

There is no technique for aging the Little Penguin except to tag them. This has been done in order to study the swimming distances, feeding areas and life expectancy.

2 Housing Requirements

4.1 Exhibit/Enclosure Design

Penguins are gregarious and should be kept in groups. So exhibits should be designed to accommodate a minimum of six birds. This conforms to the 1976 AAZPA resolution (Sladen, 1978) which recommended that penguins be kept in groups of no less than six birds of a single species.

A penguin exhibit is a complex facility, requiring rigorous preventative and regular supportive maintenance programs. Upon completion of a new or renovated exhibit, it is prudent to test all systems for a period of five to seven days prior to the introduction of any birds. Keepers should test surfaces for abrasiveness and remove all ingestible material left by construction crews, such as bolts, brush bristles, wire, etc.

A penguin exhibit should include the following components:

- 1) Land space - enough land mass to accommodate the number of birds housed in the exhibit which allows for territorial disputes and provides areas for nesting during the breeding season;
- 2) Pool for swimming and bathing;
- 3) Isolation area - separate area to house birds that need to be isolated for forced pairing, behavioural, both parent and hand rearing of chicks, and non-contagious health problems.
- 4) Quarantine area - separate facility to accommodate newly-acquired birds or birds that must be separated from the group for health-related reasons. This area should provide separate air and water systems from the main exhibit.

A quarantine area can serve as an isolation area if not in use for its intended purpose, or if one commits and treats the isolated birds as quarantine birds whenever quarantine is active. An isolation area without separate air and water

systems should not be considered as an appropriate quarantine area.

Attempts at defining a standardised formula to calculate optimal housing dimensions for penguins, taking into account all parameters, has been difficult in the best of conditions. The Penguin TAG adopts a minimum standard approach to housing dimensions. The guidelines discussed here provide enough space for every penguin within the facility to be able to lay down and turn in a complete circle. This is also true for the pool surface area and allows sufficient space for all birds to be present in the pool at the same time.

If a facility is thinking of renovating an exhibit, emphasis should be given to adding space and pool depth. (Beall and Branch, 2005)

4.2 Holding Area Design

There can be two holding areas for when the Little Penguin is not on exhibit in the facility. These areas keep them protected at night from any predators such as small foxes or dogs. One area is for the non-breeding birds in a large box type structure with Lucite covering on a frame. It is closed during the night.

The other area for holding is for the breeding penguins. There are nest boxes with pvc piping with a large enough opening for the penguin to go into and build their nest.



National Zoo and Aquarium, 2008

4.3 Spatial Requirements

There is not an absolute spatial requirement for an individual bird, but with twelve penguins, an area of about 300 square metres is a good size to include all necessary habitats for them.



4.4 Position of Enclosures

The aspect of the enclosure should get a good amount of sunlight for most of the day. It should not be on a hill or in an area that is over-exposed to weather conditions. There also needs to be a fair amount of shade with shrubbery and trees.

4.5 Weather Protection

Weather protection is provided for by trees, shrubbery, a number of large boulders placed in groups together so that the little penguin can burrow. Areas are needed where the penguin can build their dens or dig holes, perhaps under grass tussocks as well.

Ref. National Zoo and Aquarium, Canberra, ACT.



Little penguin burrowed in sand under rocks at NZA, June 2008.

4.6 Temperature Requirements

There are no strict temperature requirements for the little penguin, except to avoid extremes. A large body of water is needed for the penguin to keep cool. Shade

provided and when it is very hot, sprinklers over the area will keep it at a comfortable temperature.

4.7 Substrate

The enclosure would normally have a substrate of fine beach sand to allow for digging and burrowing of the penguin. The pond in most cases will not have a substrate but will have a lining of concrete to allow for easier cleaning. The pond contains fresh water.

Ref. www.AustralianooKeeping.org

4.8 Nestboxes and/or Bedding Material

The nest site is normally a rocky burrow or shelter, and can also be under dense vegetation. Artificial burrows can successfully be made for little penguins. In the National Zoo, the nest boxes are wooden and wire with smaller boxes inside where the penguin can build its nest. Nesting materials such as grasses, long leaves, or any type of long, stringy grass can be placed there. The penguin likes to make its own nest.

The boxes are designed to be partially or completely buried, however they can be used as free-standing units. They should be placed with the tunnel entrances pointing slightly downhill (for drainage) and around 2m apart. Boxes that are too close to others may not be used due to the territorial nature of blue penguins.

Ref. National Zoo and Aquarium, Canberra, ACT.

Ref. www.AustralianZooKeeping.org



Nesting area.

www.penguin.net.nz

4.9 Enclosure Furnishings

- Groupings of boulders, large pond for swimming area, visual barriers from the public so that the little penguin can hide if they want and seek shelter.
- Low shrubs and a few leafy trees to provide shade.

Ref. ZooLex, WAZA, www.bristolzoo.org.uk

5 General Husbandry

5.1 Hygiene and Cleaning

Each day the holding areas for the little penguins need to be hosed out. This is done at night time. Also the sand around the pool area needs to be raked daily in order to smooth out the diggings of the penguins.

Twice a week the pool is emptied and hosed out using bleach to destroy any harmful bacteria and then the pool is refilled again.

5.2 Record Keeping

Records of the Little Penguin need to be kept which can include:

- Date of acquisition and disposal with the circumstances
- Origin and details of the wild population or parents
- The scientific name, common name, and personal name if given, individual identification and any distinctive markings
- Clinical data with any health issues and/or treatment given
- Diet and feeding routine
- Weight
- Breeding records
- Nesting habits
- Any other necessary details

5.3 Methods of Identification

5.3.1 Visual identification

The Little Penguin is the smallest of the penguins and adult birds have steel blue feathers on the back, head and wings with white underneath. The feather bases are coated with thick down for insulation in the water.

5.3.2 Banding

Penguins are banded on their flippers in order to keep track of them and study breeding, adult survival and increases in penguin population. Even though other methods are also used, bands and tags are still very widely used to allow easy recognition.

5.3.3 Microchip

Now many new penguins to be recorded are identified with microchip. With this method only a scanner is needed to pass over the penguin in order to do the identification.

5.4 Routine Data Collection

Health and condition of captive little penguins should be routinely monitored. The birds should be checked on a regular basis and the following data should be collected and kept:

- Any name or identification number of the penguin
- Changes in diet
- Weight
- Behavioural changes or problems
- Other physical changes

The collection of information on individual physical and behavioural patterns can help the care and husbandry of the Little Penguin.

6 Feeding Requirements

6.1 Diet in the Wild

In the wild, little penguins eat a variety of food types, but the most prevalent are fish, squid and krill. The diet for the little penguin has been researched by analysing the stomach contents and there is mostly 76% fish and 24% squid. (Stahel & Gales, 1987).

In a study undertaken at Phillip Island in Victoria by Thomas L Montague over a period of time it was found that the 76% fish diet consisted of mostly pilchards from July to November, then mostly anchovies from January to June. In December the fish diet also included leather jackets. 24% of the diet included squid along with a few stones and shells which possibly provide phosphate and calcium. (Montague, 1982).

Sea conditions affect the feeding of the little penguin in the wild. The mostly feed at about 20 m out from shore, but can go to 70m. The average dive for food is 40m in depth. They forage for food mostly from dawn to an hour before dusk. They usually feed singular, not communally. (Little Penguin Factsheet, http://www.austmus.gov.au/factsheets/little_penguin.htm)

Adult penguins may travel 14 - 20 km per day when foraging, covering shorter distances when breeding. A foraging bird can dive from 6 - 69 m (average about 30 m), with a sprint speed of 1.5 - 2 m/second, and remain submerged for over a minute. After feeding, Little Penguins approach the colony in tight groups, remaining offshore until dusk. At dusk they come ashore, cross the beach, and head to their own burrows. (Little Penguin Fact sheet, http://www.austmus.gov.au/factsheets/little_penguin.htm)

Little penguins can feed from the sea floor eating crab larvae, sea horses and crustaceans, and they swallow their food whole.



Penguin food

Table on the wild diet for little penguin.

Little Penguin	squid	fish	pilchard	anchovy
-----------------------	-------	------	----------	---------

Krill: Euphausiid crustaceans primarily in the genera *Euphausia*, *Thysanoessa*, and *Nyctiphanes*

Squid: Cephalopods in the genera *Loligo*, *Heteroteuthis*, *Argonauta*, *Nototodarus*, *Sepioteuthis*, *Teuthowenia*, *Psychroteuthis*,

Pilchard: *Sardinops ocellata*, *S. neopilchardus*

Anchovy: *Engraulis capensis*, *E. australis*, *E. ringens*

Ref: **Crissey, S. and McGill, P.** (1994) Diet and Nutrition. In: *Penguin Husbandry Manual*. American Association of Zoos and Aquariums

6.2 *Captive Diet*

In captivity it is easily possible to provide a similar diet as that in the wild. A little penguin eats between 160g and 240g of food per day. This can be up to 6-8 krill per day. Fish can be readily available depending on geography, but also the use of frozen fish enables each facility to have the needed diet.

When formulating diets for captive penguins, flexibility is needed to account for animal preferences, weight, exercise, physical condition, environment, and behavioural considerations as well as food availability.

Since reliable availability of fish is critical to the success of captive programs, most fish purchases are made in bulk. This necessitates that the items are frozen and stored until use. Given the perishable nature of fish and seafood, food handling procedures are critical.

Captive programs depend on reliable availability of fish and it is critical to store and handle the fish properly. Generally, a variety of fish is desirable, however, in the National Zoo the diet is mostly pilchards, as is the case at the Melbourne Zoo.

The selection of fish species should be made to meet probable requirements for protein, fat and energy. Generally, any fish will meet the protein requirement and a combination of low-fat and high-fat fish is optimal for meeting the penguins' need for fat and energy.

Both marine and fresh-water fish can be used in captive diets. Given current problems with commercial fish availability, it is becoming more common to offer fresh water fish as food to penguins. It is good to always feed a variety of fish to penguins and it may be necessary to include one or more species of marine fish in the diets at some level.

Water. Penguins get their water requirement through both their foods as well as free water. Because of their nasal salt glands, penguins can consume salt water. However, they can also easily take in fresh water to meet their needs. If the birds are held in only fresh water, salt can be added to the diet to ensure development of the nasal glands

6.3 *Supplements*

Supplementation of vitamins and minerals may not be necessary, but most institutions provide additional multi-vitamins and minerals to ensure adequate nutrients. Special attention is given to adequate intake of vitamin E and thiamin.

Limited information is available on the nutrient content of whole fish fed to penguins (Gailey-Phipps, et al., 1982). It must be noted when examining the nutrient data for these items that nutrient content can vary radically among species, among individual lots within a species, among individual fish within a lot, as well as during storage. Thus,

published values may/may not reflect the nutrients actually fed to penguins at any one specific time.

Types of fish selected can be chosen for specific nutrient content, availability and price, and for animal preference.

It also is wise to consider quality a major factor. The facility holding penguins must make certain their food is of the highest quality. Human quality items should be insisted upon and the holding conditions must be monitored. Any item that the facility receives, if it appears to have undergone degradation or shows evidence of thawing, should not be accepted.

The supplements can be provided in pill form, hidden inside the fish and hand fed to each animal. Most institutions employ this method. (Crissey & McGill, 1994).

Seabird tablets are given once a day usually at the dose of one tab per kilo of weight. There are a few brands. One is from Vetafarm and the tablet may be inserted into the gills of the fish that are fed to the birds, or added to a food based on 1 tablet per Kg of body weight.

Active Constituents: Each tablet contains: Vitamin A, B2, B6, C, E, Biotin, Thiamine, Folic Acid, Calcium Pantothenate.

<http://www.vetafarm.com.au/products/SEA-BIRD-TABLETS-20-Tablets.html>

Table, Nutrients in a variety of fish used for penguins.

Nutrient Requirement	capelin	pilchard	anchovy	smelt	
Dry matter %fresh weight	18.77	27.72	29.7	22.69	-
Energy (kcal/g)	5.55	6.33	3.69	7.01	4-5
Protein (%)	59.77	45.43	55.9	43.92	20-25
Fat (%)	14.83	34.00	16.16	42.88	20-30
Calcium %	1.69	1.66	?	1.09	0.6-2.0
Phosphorus	0.37	0.39	?	0.31	0.3-0.4
Vitamin A (IU/gm)	44	56	15	277	1.67
Vitamin E (IU/gm)	0.024	0.034	-	16	0.4

(Ref: (Bernard & Ullrey, 1989, and Sidwell, 1981.) (Crissey, 1994)

6.4 *Presentation of Food*

The recommended method of feeding is to hand feed to individual animals. This will ensure each bird obtains adequate nutrients and allows the institution to monitor consumption.

Other methods of feeding must ensure that fish remain cool, clean (no faeces or other debris) and are consumed within a short time frame.

In exhibits that are held below 4C, fish could be kept out in trays for several hours as long as birds are not defecating nor walking in the tray. However, care should be taken to avoid leaving fish in standing water.

If the animals are fed outside in hot, humid or sunny weather, it is important to feed only the amount that will be consumed immediately or while still iced to avoid bacteria build-up, nutrient loss or contact by disease-spreading pests.

The feeding schedule for adults used by most institutions is to feed twice per day, early and late. Some institutions increase the number of feedings during pre- moult and breeding. An increase in intake should be expected pre-moult and a decrease during molt.

The size of food items should be appropriate for easy manipulation and swallowing. Use whole fish or every portion of the fish.

In the National Zoo, one and a half bags of fish are used for a dozen little penguins. The bags weigh approximately 6 kgs. The fish are put into a container filled with water and then the feeder pulls them out one at a time running their hands downward from the head to remove any extra scales or debris. The little pilchards or fish are then put in a bucket to feed the penguins.

The little penguins are only hand fed, their names are called and they come running over and eat one at a time out of the keeper's hands. Each penguin has a name and a number is recorded in a feeding log. The fish are offered head first, usually held just above their head and the penguin reaches for it and then gulps it down little by little. On average the little penguin eats about four fish at each feed.

Hand feeding little penguins



7 Handling and Transport

7.1 Timing of Capture and Handling

Thorough planning needs to precede any attempt to capture, handle or transport any animal. If you are well prepared, you should be able to minimise the stress and threat of injury to the animal and to yourself and other handlers. The best time to capture the little penguin is either early in the morning before they are fed, but capture can happen any time.

7.2 Catching Bags

Little penguins can actually be captured by hand, but also can be captured using a bag on a long handled loop. The bag should be made of a light-proof fabric (black). Take the bird from the bag by first securing the legs with one hand and with the other gathering the body.

More often than not, a carry box is used, rather than a bag.

Ref. National Zoo and Aquarium, Canberra, ACT.

7.3 Capture and Restraint Techniques

Do not handle the penguin by the neck, wings, or by just one foot. Reduce handling times by having equipment organized and procedures streamlined. There are a variety of restraint techniques for penguins. Non-invasive procedures may necessitate only minimal restraint. However, medical procedures, such as drawing blood, which need the bird to be still, mean there should be stronger restraint.

One method used successfully involves placing the penguin between the handler's legs such that the flippers are held secure. In this way the handler's hands are free to restrain and position the head and neck to facilitate blood removal, rebanding, or the dictated procedure.

Gloves should be used when capturing the little penguin and the head held so it won't bite. It's also wise to restrain the little wings or flippers.

If a penguin needs to be moved a short distance, it is recommended that the handler carry the bird close to his/her body with the head at their side facing their back.

If the bird needs to be moved to a different location, such as the hospital or a

different holding area, it can be placed in an appropriate container such as an air kennel or tub.

Ref. 'Animal Research Guidelines', Australian Antarctic Division, 10/05/04.
www.aad.gov.au



7.4 Weighing and Examination

Weights are important for monitoring the health of individual penguins. Weighing of the Penguin should be carried out whenever possible. This can be done on a routine basis if exhibit design and bird behaviour allows it. The birds should always be weighed when they are handled for other reasons. Individual weight records should be maintained over time and utilized for comparison when a bird appears sick. The little penguin weighs an average of 1.1 kg.

To weigh the penguin, it is placed in a small plastic box called a pet pack, and then weighed. The penguin is then taken out of the box, the box is weighed and the penguin's weight is calculated and recorded. Normally a weigh platform is used as the penguins walk across it.

Medical examination records should be kept, times of blood sampling, and checking for disease.

Ref. Penguin Taxon Advisory Group.

7.5 Release

There is no concern about the timing of release into the enclosure. Little penguins are nocturnal and so they would not be stressed regarding time. The holding container or box is just opened at one end and the penguin walks out. If they are turned around for any reason, the keeper then takes it out by hand. The box should face toward the pond area so the penguin sees something that it relates to. Also make sure that the area is safe and enclosed so there is no danger to the penguin.

7.6 Transport Requirements

7.6.1 Box Design

IATA regulations indicate a cage style 'R' for carrying the penguin. It is made of wood, metal and burlap (Hessian).

The principles of design:

- a) One penguin only should be packed in a container.
- b) The container may be constructed of plywood on three sides with one wire mesh side and top, plywood base. The access for loading should be a hinged opening at top. The latch should be secure. Meshing at top of container to be covered inside by burlap.
- c) Dimension should be approximately 40 x 51 x 40 cms.



Sea World

<http://www.aza.org/AZAPublications/2005ProceedingsReg/Documents/2005ConfProckansasCity8.pdf>

7.6.2 Furnishings

The box is lined on the bottom with treated wood shavings, sterilized peat, and/or soft board. Artificial grass can also be used in the bottom of the box. There should be no hay or straw used.

7.6.3 Water and Food

If the transport is only one day in duration, then no food needs to be provided. Some water should be provided in a tray fastened to the side of the box. If the transport is longer, the little penguin will have to be fed by hand with small fish.

Ref. National Zoo and Aquarium, Canberra, ACT.

7.6.4 Animals per Box

Normally only one penguin per box, but it is not a problem to have two or three since they are very communal birds.

7.6.5 Timing of Transportation

Day or night does not worry the penguin. Anytime is appropriate. It is important that the temperature in the box or transport area is of a proper temperature, especially not too warm. The transport truck or flight should be air conditioned.

7.6.6 Release from Box

Same as 7.5.

8 Health Requirements

Penguins are adapted for survival. Initial symptoms or signs of illness may be hidden or inconspicuous, unless the condition is acutely serious. So, it is important that staff working with penguins be highly-trained and attuned to subtle changes in behaviour and physical conditions.

Besides diseases such as aspergillosis, avian malaria, and bumblefoot, keepers should

keep in mind that penguins experience a wide range of infections and conditions which can go undiagnosed.

The most important contributing factors to penguin health are maintaining a clean, stress-free environment, a proper plane of nutrition, good swimming habits, and early detection and treatment of illness. Animal care staff must constantly be aware of the normal physical and behavioural characteristics of the individuals in their care and the environmental conditions in which they live. (Penguin Taxon Advisory Group. 2005).

8.1 Daily Health Checks

Little penguins need to be checked daily during the cleaning and feeding times and the information recorded for comparison over a period of time.

These visual health checks would include:

- Distant examinations of the eyes and the beak
- Signs of disease including unusual behaviour.
- Behaviour such as listlessness, lack of balance, limping, restlessness, shivering, head down, isolation from others
- Changes in food and water consumption
- Appearance of faeces
- Overt signs of trauma
- Too much time spent in either the water or on the land
- Discharges from eyes or other orifices

8.2 Detailed Physical Examination

It is very important in treatment to have early diagnosis of any abnormalities by the keeper and those who care for the penguins. Records need to be kept on each illness that include:

- Initial symptoms and clinical signs
- Closer physical exam
- Blood analysis
- Serology
- Culture – tracheal, oral and cloacal
- Cell Cytology – faecal exam



Taronga,2008

(Johns and Shellam. 1999)

Blood can be collected from the inter-digital, medial tarsometatarsal, flipper and jugular veins. Some facilities prefer the jugular since it is quicker and easier to withdraw the

appropriate amount of blood for testing. Blood count profiles should include glucose, alanin, calcium, urea, uric acid, aminotransferase and asparagine (ast). (Penguin Taxon Advisory Group.)

8.2.1 Chemical Restraint

Most of the examination can be handled physically as the little penguin is small and able to be inspected. However, in order to draw blood, the penguin can be put head first into a tube that is open at one end. The tube has a slit in the side that enables the bird to breathe and the vet can also take a blood sample with a disposable needle through the slit. This can usually be done quite quickly so that the bird is not stressed and can be released into a safe area.

When anaesthesia is needed for a more thorough examination, isoflurane is the most commonly used gas anaesthetic. Induction can be accomplished by use of a facial cone with a tube inserted to follow. This is called intubation and keepers use an endotracheal tube. This needs to be done carefully in order to protect the trachea.

8.2.2 Physical Examination

Each bird needs to be weighed regularly, including pre- and post- moult periods. This can be used for comparison in periods of illness. Things to look for during physical examination are:

- Body weight
- Visual signs of weight loss in areas like the back, pelvis and shoulders.
- Pale mucous membranes
- Difficulty in breathing
- Decreased response when handled
- Feet abnormalities
- Depression
- Check their keel
- Look at feather condition



(Diebold, Branch, Henry. 1999)

8.3 Routine Treatments

Penguins receive thorough vet checks particularly at introduction into the new

environment. This provides a base of comparison in later daily and periodic physical examination to detect any changes.

These normal checks include x-rays, blood tests and worming medication. Vets treat the birds for internal parasites. Faecal samples are collected bi-annually. The vet may also recommend Sea Tabs which are described in the nutrition section. (Taronga. 2008).

8.4 Known Health Problems

Aspergillosis

Aspergillosis is a common illness in penguins. It is a fungal disease that is caused by mould fungus. This fungus occurs in rotting or moist vegetable material. If containers or bags with rotting material is damp then the spores can grow. The disease is spread through the penguin inhaling the spores of the fungus which lodge in the lungs or air sacs. The spores grow quickly and create a network of mucous type membranes. The birds start to wheeze and gasp and can die quite quickly. (Obendorf DL and McColl K. 1980).

A complete blood count is necessary and cultures are taken from the throat. The treatment can vary but antifungal drugs are usually prescribed. Some are given orally, such as itraconazole and fluconazole. Amphotericin can be nebulised into the air sac, as can enilconazole.

Prevention is supported by making sure the air quality in the exhibit is sufficient and that regular fungal air cultures are taken from the exhibit area. (Obendorf DL and McColl K. 1980).

Malaria

Avian malaria is caused by blood parasites. It affects mostly the young birds and the old ones. It does not usually spread from bird to bird, but a penguin is infected by a mosquito that has fed on a host bird with the disease. The parasite makes its way through the blood stream and affects the tissues. The clinical signs can be lethargy, regurgitation, not eating, and solitary behaviour. (EWDA)

The only way to diagnose the disease is through thin blood smears.

Infected birds are immediately put on anti-malarial drugs. This is usually a combination of chloroquine and primaquine, to attack the blood phase and then the tissue phase.

(Graczyk TK, Cockrem JF, Miller JD, Court GS. 1995)

The prevention of this can be supported by bringing penguins inside during mosquito season and test regularly for the disease. The environment can be changed by using fans, water sprays, not leaving stagnant water.

Pododermatitis (bumblefoot)

Bumblefoot is a bacterial infection of the foot starting in the epithelium of the plantar surface. It occurs when the penguin becomes more sedentary, not spending as much time in the water, or walking on hard surfaces that could have bacteria, fecal contamination and moisture. When the epithelium has been damaged then other bacteria can enter and the penguin can suffer deep soft tissue infection. (Harrigan, 1992).

Keepers should be alert to the penguin having a limp, the way it lays down, and also by examining the foot pads. Clinical observation can reveal drainage, swelling, increased heat or redness, and lacerations.

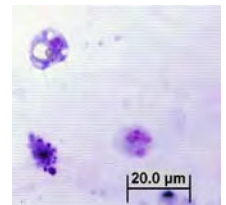
Treatments have included systematic antibiotics and also local antibiotics. There can also be surgical removal, as well as ointments and wrapping.

Long term preventative measures are used to encourage swimming and avoiding rough surfaces.

Oral trichomoniasis

Oral trichomoniasis is most common in captive wildlife that are undergoing treatment for various injuries. Little penguins are sporadically affected by trichomoniasis. Trichomonads are common commensal agents within the avian alimentary tract.

Trichomonads are ovoid protozoa that have four anterior flagella and an undulating membrane. These organisms are spread through either direct or indirect contact. The factors that predispose a bird to develop trichomoniasis are unknown. (Rose, 2005)



8.5 Quarantine Requirements

Sick birds, as well as those in the preclinical stages of illness, will be shedding virus into their environment; therefore, birds that are suspected of being infected should be segregated from other birds and quarantined for 30 days.

Any birds noticeably ill should be isolated from the rest of the contact group. A high level of sanitation should be imposed and maintained for the full quarantine period where birds are housed.

Decontamination procedures are needed to lessen disease transmission from virus that is shed in faeces and by other means.

Personnel should follow good hygiene methods and should not have any contact with other birds for 7 days to prevent mechanically carrying contamination from the quarantine site. All the birds should be tested for virus and virus specific antibody. All birds with antibody are probably virus carriers and they pose a risk as a source for future virus infection. (Penguin Taxon Advisory group)

A recent avian import review concluded the importation of penguins should be permitted subject to test results confirming freedom from avian influenza, Newcastle disease and infectious bursal disease. The review took into account the good health status of New Zealand, the closely controlled source flock in New Zealand and that they will be housed in a closed, controlled facility in Melbourne.

A quarantine facility must provide isolation of the penguin(s) and containment of body fluids. Penguins transferred between zoos or sanctuaries, for the purpose of breeding and display, must enter a quarantine environment for a minimum period. Quarantine duration depends on many factors and average around 30 days, or until treatment for any illnesses or disease is considered successful.

Isolating a social animal like the Little Penguin from others for an extended period of time may be excessively stressful. , In such cases, consideration is given to quarantining social animals with companions of the same species. If a single penguin is arriving, a decision may be made to offer a companion from the zoo's collection, with both animals quarantined together.

9 Behaviour

Little Penguins are highly specialised birds whose behaviour and physical adaptations have been moulded by the harsh climates of the Antarctic and surrounding areas.

All penguins are flightless but use their flippers to 'fly' in water; their webbed feet serve as rudders. Torpedo-shaped bodies facilitate penguins' movement through water. On land or ice, penguins walk upright with a waddling posture. (Ellis, 2005)

9.1 Activity

Throughout most of the year, the behaviour of captive penguins is fairly predictable, primarily consisting of eating, swimming, and general social interaction. The onset of the breeding season may create a rise in activity and movement.

Most little penguins in the wild return from the sea after dark. They can often be heard calling from out in the water and usually come ashore in small groups pausing briefly before heading off to individual burrows. Due to their movements on land penguins are often mistakenly thought of as nocturnal. They do in fact feed at sea during the day returning to the colony to rest. Much communication occurs as the penguins return from the sea, such as, calls from the sea, calls on land, greeting and communication with other birds, territorial disputes and so on. (DEH SA, 2005)

Penguins sleep for only about four minutes at a time, either standing up or lying down, and they can sleep during the day. Sleep patterns at night are more frequent and a bit longer during the day.

9.2 Social Behaviour

Little Penguins are highly social, colonially-nesting birds. In most facilities, there is a desire to have a minimum social group of three pairs to five pairs. They tend to display cautious behaviour as a group coming from the water. All of them bunched in a group tend to scurry up the beach all at once as a protection from predators.

During a study on Philip Island to see what sort of groups Little Penguins formed in the wild, they concluded that a penguin group was composed of 5-10 individuals within 40 sec intervals as they crossed from the sea to the land. Penguin groups were formed nonrandomly in years of high breeding success (2002 and 2003), but not in years of low breeding success (2001 and 2004). Age of birds was a significant factor in composition of groups. Little penguins with higher association values shared similar characteristics or 'quality' which in turn may increase the functional efficiency of their groups, especially if they were also foraging together. (Daniel, 2007).



(By L. Williams, NZA, 2009)

9.3 Reproductive Behaviour

During the breeding season, there is a rise in movement and activity, with nest building, more vocalising and foraging for food.

They exhibit intricate courting and mate-recognition behaviour, and elaborate visual and vocal displays help establish and maintain nesting territory, even in the exhibit enclosures.

Males often find the old nest and repair it to accommodate the new season's crop of chicks.

The male advertises for a partner by stretching his flippers outwards and pointing his bill skyward. Mated birds greet each other with half-trumpet songs, described as a 'weird note produced by alternate inspirative and expirative moans'. Both birds stand erect, with flippers spread and head bowed, and walk in tight circles around the nest site, calling loudly as they go.



(Sea World, 2005)

9.4 Bathing

Little penguins preen their feathers frequently. Their feathers must be maintained in prime condition to ensure waterproofing and insulation.

They preen with their bills. There is a gland near the base of the tail that secretes oil that the penguin distributes throughout its feathers. The penguins will preen for several minutes in the water by rubbing their bodies with their flippers while twisting and turning.

There are about 10,000 feathers on a Little Penguin at three to four times the feather density of flighted birds. The feather bases are very downy which traps air providing an effective insulation when the penguin is in the water. (ARAZPA).



<http://www.eriezoo.org/assets/pdfs/Penguin%20Behaviors.pdf>

9.5 Behavioural Problems

Aggressive behaviour or problem situations can arise mostly around the breeding time, courtship and when chicks are hatched.

There can be cases of unmated birds trying to steal eggs from nests or show excessive competition.

Harassment by groups is not common in penguins, as most aggressive behaviours take place between individual birds or pairs.

9.6 Signs of Stress

Little penguins mostly experience stress through human interference, predators, and heat stress. The response to such stress is through vocalising, and isolation from others.

If a parent penguin is going through stress, they can vomit up their food that they are carrying for the little chicks. Parents become stressed with the presence of rats in the exhibit, as rats remove eggs and can remove chicks. The presence of rats can impact on breeding cycles and success. Active rodent bait programs are crucial.

After the chicks have fledged, the adults are hungry and have lost condition, and so they will eat more for several weeks to fatten up. During this time, they can nearly double their weight and it's a common sight to see fat penguins waddling around the enclosure. There is considerable urgency in this short term weight gain, for the penguins are about to moult – a very stressful experience which requires them to be in peak condition if they are to survive.

Adults moult over about three weeks, and can neither eat nor drink during this time. It's very important that they are left alone during moulting. This is a very stressful time for them. Any human interference during moulting can greatly upset them. (Ellis, 2003).

9.7 Behavioural Enrichment

Behavioural enrichment for penguins is a relatively new concept. In general, penguins respond with curiosity to anything introduced into their environment.

Seaworld of Florida has had good success with brightly-coloured balls, sprinklers, and blocks of frozen fish placed into pools.

Other items that penguins find stimulating are varying water currents and sawhorses with securely fixed strips of fabric under which the birds can run.

Underwater visual barriers may also provide enrichment. Also variable feeding like multiple feedings, extended feedings and scatter feedings are useful. (SeaWorld, 2005).

Other enrichment aspects include fast flowing water, diving platforms, and high vantage viewing points.

9.8 Introductions and Removals

Introduction of new birds to a social group of penguins is met with curiosity and investigation. Staff should closely monitor the introduced bird and the social group for signs of stress and aggression. Introduction can be done in three ways:

- Gradual introduction – birds are introduced to an exhibit for a few hours at a time, with close monitoring over a several-day period. The time the birds are left in the enclosure is gradually increased until the birds appear acclimated. This technique can be the most successful.
- Group introduction - many penguin keepers feel that it is not advisable to introduce only a single bird, but rather in pairs or groups.
- 'Hello' cage introduction – this is when birds are placed in a small enclosure within the exhibit for several hours daily and slowly acclimated to the exhibit and other penguins.
- Immersion introduction – birds are placed in the exhibit and regularly monitored by the staff.

When there is a large colony of birds, the removal of individual birds does not seem to have a detrimental effect on social dynamics, except for ones whose mates have been removed.

If this is the case, birds can show some signs of lethargy or look around as if searching for their mate.

In smaller colonies, removal of a dominant individual may cause a shift in the hierarchy and lead to short-term increase in aggressive behaviour as the social group is re-established. (Ellis, 2003).

9.9 Intraspecific Compatibility

Because the Little Penguin is such a social bird, there is little problem with intraspecific compatibility. In the wild, they live in large broods, with mates that can last their life time and are quite social together.

9.10 Interspecific Compatibility

Many facilities successfully house and breed several species of penguins in one enclosure and in some cases they have mixed penguins with other species such as Inca terns (*Larsosterna inca*) or blue-eyed cormorants (*Phalacrocorax atriceps spp*).

When deciding on presenting a mixed-species exhibit there may need to be some gradual introductions to check for compatibility, as well as knowledge of:

- Requirements for sustaining life and breeding
- Uses of the habitat by the individual species
- How to avoid hybridisation

If the exhibit can sustain different seasons of nesting and reproduction then there is a greater chance of success.

Avoidance of hybridisation is a key factor in the facility deciding on whether or not to develop mixed-species exhibits. (Ellis, 2003).

9.11 Suitability to Captivity

The Little Penguin (*Eudyptula minor*) is quite suited to captivity if the exhibit is sensitively designed to accommodate the needs such as water, shade, and nesting sites.

There needs to be enough birds to encourage a variety of mating selection and facilitation of successful reproduction.

10 Breeding

10.1 Mating System

The Little Penguin matures at 2 or 3 years. It was always thought that penguins mated for life, however, studies of the St Kilda penguins indicate otherwise. Our current understanding is that St Kilda's penguins may change partners each year or even within a season. Others stay with the same partner at the same nest from year to year.

Courtship generally begins with both visual and auditory displays. Most of the time the male starts to display first to establish a nest site and then to attract a mate. There are three general types of displays in the Little Penguin.

- Ecstatic – this also called trumpeting and head swinging. The male may dip its head low and then stretch its head and neck upward with its flippers outstretched and there is loud squawking.
- Mutual – when the male and female have paired, then they both display which seems to strengthen the bond. They stand facing each other and dip their heads and squawk. These displays occur throughout the breeding season, even after the eggs are laid and also when the chicks are feeding.
- Bowing – The male and female exhibit a dipping or bowing of its head and pointing its beak toward the partner or to the nest.

One study concludes that female little penguins may recognise their partners' calls (or at least familiar male calls) and appear to maintain mate fidelity even when larger, potentially more successful, strangers are on offer. (Miyazaki, 2005).

Mate selection is up to the female and it is the females that compete for the males. In most cases, the female selects the same male from the preceding season to mate with. (Seaworld, 2005).



Establishing the nest site. (Seaworld, 2005)

10.2 Ease of Breeding

When the supply of food is plentiful, the breeding seasons of the Little Penguin are usually successful, especially if the exhibits are close to imitating the natural habitat of the species. In some facilities, there has been difficulty in breeding the Little Penguin, especially in North America. However in most facilities and Little Penguin areas around the world, there has been a lot of success. (Reilly, 1994).

10.3 Reproductive Condition

10.3.1 Females

When there is plenty of food available and the female penguin has been able to store some fat, there is more chance of successful breeding.

10.3.2 Males

The same is true of the males. Even in their natural habitat, the penguins start to eat more in preparation for breeding and will store food in their bodies as fat. Also the temperatures of the environment can affect the breeding success.

10.4 Techniques Used to Control Breeding

Some studies have shown that photoperiod (day length) is one of the important clues that penguins use to determine when to breed. So that could mean that the breeding season can vary from place to place. (Newton, 2006).

The availability of food and good body condition is also a factor.

If these factors can be monitored, then preparations can be made (i.e., provision of nesting boxes and materials) for the breeding season to be successful.



Oamaru Blue Penguin Colony. 2005.

10.5 Occurrence of hybrids

No known hybrid.

10.6 Timing of breeding

Between June and August male penguins begin to dig new burrows or renovate old ones. Some clutches will appear as early as May or as late as October. In captivity, if the conditions are good, Little Penguins can breed all year around. (Stahel, 1987).

10.7 Age at First Breeding and Last Breeding

Little Penguins reach maturity between two and three years old. They can continue to breed throughout their lifetime which averages about 6-7 years with some living up to 20 years.

10.8 Ability to breed every year

Little Penguins are good breeders given the proper conditions and will breed every year.

10.9 Ability to Breed More than Once Per Year

If breeding has begun toward the beginning of the season, or if the first clutch is lost for some reason, some birds produce a second clutch, and even a third one. Such second clutches can also be reared successfully. (Reilly, 1994).

10.10 Nesting, Hollow or Other Requirements

Burrows are typically dug into soft, easily dug soils. Burrow entrances are about two metres across since both birds sometimes defend the area in front of the burrow. The use of artificial nest boxes has been prominent in Little Penguin colonies for a number of years. (Houston, 1999).

Nest boxes are most commonly constructed of wood with adequate height and width for two penguins. It also includes a removal lid for monitoring purposes, ventilation holes , ventilation holes for air movement, and enough room in the nesting chamber to accommodate two nesting penguins. Lids are held in place with stoppers and are weighted down with rocks. (Houston, 1999).

The best placement of the nest boxes should be into a slope. In most instances, breeding success can be increased with the use of artificial nest boxes. (Houston, 1999).

Nests are often lined with vegetation and other materials to give warmth and comfort. These materials can be small leaves, twigs and grass. Little Penguins appear to use whatever materials is close to the nesting area. (Williams, 1995)

10.11 Breeding Diet

The diet for the Little Penguin during breeding does not need to change tremendously, but mainly to be increased. It has been shown that an abundance of pilchards, krill and anchovy has aided in early successful breeding. (National Parks, NSW)

10.12 Incubation Period

Partners take turns incubating eggs, allowing each mate to leave in order to feed. The incubation temperature for penguins is about 36 degrees C. (Seaworld, 2005). The incubation period is approximately 36 days. (Reilly, 1994).

About 60% of the eggs successfully hatch. (Parks and Wildlife, Tasmania, 2003).

10.13 Clutch size

The normal clutch size is two eggs.



10.14 Age at Fledging

At hatching the chicks are sooty black and weigh little more than 25 g. Both parents feed the chicks which eat up to half their weight per day and at 40 days old they can be heavier than their parents.

When the chicks are 5 weeks old, they are very active and even stay outside burrows waiting to be fed by their parents. Within another two or three weeks, they are ready to go out on their own, searching for food. In captivity, they can look after themselves at that time, and in the wild, they will move out to the sea. (Parks and Wildlife, Tasmania, 2003).

10.15 Age of Removal from Parents

At eight weeks old, the chicks can be removed from their parents and ready to look after themselves.

10.16 Growth and Development

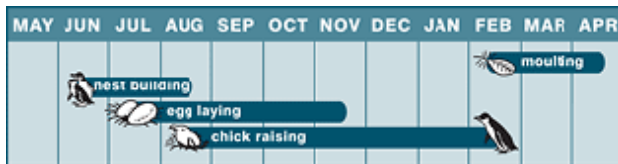
A newly hatched chick is covered with dark grey or black down, which is soon replaced by a second coat, chocolate brown in colour. Their eyes are just open at one day and are fully open at one week. Feathers start to emerge at four weeks, and by eight weeks, only a few patches of down remain. Young penguins are more blue than adults.

The logistic growth model best described *E. minor* growth with feet showing most rapid growth, followed by weight, flipper and bill respectively. It is suggested that the reason for rapid growth rates of feet and flippers in penguins is the necessity to maintain thermal balance. (Gales, 1987).



Taken by L. Williams, NZA

Life Cycle



July-August-September

- Re-establishing pair bonds
- Nest building & Mating
- Egg laying



August – September – October

Incubating eggs — 35 days

Guarding and feeding chicks 2 – 3 weeks



October – November – December

Both parents returning daily to feed chicks 5-6 weeks

Chicks banded at 5 weeks

8 weeks chicks fully grown

Parents abandon fledglings - 2 weeks at sea

Fledglings leave nest go to sea for 6 months to a year

Early season breeders start the process again

December – January – February

2nd clutches started

Or adult birds come and go, doubling body weight in preparation for moulting



March – April

Moulting

Adult and juvenile birds return to nest boxes for 2 – 3 weeks whilst old feathers fall out and new ones grow. It is a very stressful time as birds are unable to go to sea. Fasting, body's puff up and they get very dehydrated and grumpy.



All photos here taken by L. Williams, NZA

11 Artificial Rearing

There has not been a lot of success around the facilities in hand rearing the little penguin, but some research and captive animal facilities are beginning to experiment with this. In many areas there is a need to produce more chicks and hand rear them in order to stock other facilities that have had disease or other problems causing a dearth of little penguins in their exhibits.

11.1 Incubator Type

Considerations in choosing the type of incubator to hold the penguin eggs are:

- Incubator room
- Size of eggs to be incubated
- Number of eggs to be incubated at one time
- Turning requirements

The following incubators have been used successfully:

- Petersime Models 1 and 4
- Humidaire Model 20, 50 and 120
- Grumbach
- Roll-X

(‘Little Penguin-Latrobe)



Kimano Incubator

11.2 Incubation Temperatures and Humidity

Artificial incubation temperatures vary from 35.2 degrees C to 37.5 C on dry bulb.

Wet bulb temperatures should average between 26.6 C and 30 C. Depending on the area of the country and rainfall, additions of water to the incubator reservoir can be varied. (Henry, 2005)

The type of incubator and the number of eggs being held there will affect overall humidity.

Eggs need to be set flat and most facilities manually turn the eggs five to seven times in a twelve hour day. This helps a more even development of vascularisation in the egg.

11.3 *Desired % Egg Mass Loss*

Penguin eggs are smaller than any other bird species when compared proportionally to the weight of the parent birds; at 52 grams, the Little Penguin egg is 4.7% of its mothers' weight. The relatively thick shell forms between 10 and 16% of the weight of a penguin egg, presumably to minimize risk of breakage in an adverse nesting environment. The yolk, too, is large, and comprises 22–31% of the egg. Some yolk often remains when a chick is born, and helps sustain it in the first two days of life. (Little Penguin. Wikipedia.)

Weight loss occurs as the water content of the egg starts to evaporate and be replaced by the air cell as hatching nears. (Bolton,2005)



National Zoo and Aquarium. Canberra.

11.4 *Hatching Temperature and Humidity*

At the time pip the temperature needs to be increased and the wet bulb reading should be between 31 and 32 degrees C. (Henry.2005)

11.5 *Normal Pip to Hatch Interval*

Eggs need to be candled more frequently in the week prior to expected hatch. At the time of the first pip, the egg can be moved to the hatcher and humidity should be increased by 1-2 degrees C.

Hatching eggs should be checked four to five times a day, and the area misted with distilled water. Average pip to hatch interval for the little penguin is from 48-56 hours.



(www.seaworld.org)

11.6 Brooder Types/Design

When chicks hatch, they need to be dried in the hatcher for at least 12 to 24 hours. After hatching the umbilical area should be swabbed with a disinfectant and the absorption of the yolk should be monitored.

When the chicks are dry, the chicks can be moved to an open brooder which has a heat source. Some types of brooders are:

- Human infant incubator modified with top kept open.
- Painted plywood box
- Plexiglass box
- Ice chest type plastic cooler
- Plastic box
- Plastic wash basin

There needs to be:

- Adequate air circulation
- Ease of maintenance and disinfection. Clean area twice daily
- Size and temperature gradient. There should be about 5 degrees C temperature difference between one side of the brooder and the other so that the chick can move to where it is most comfortable.
- Should only have about 2-5 chicks reared together.

The area dimensions should average 40 cm wide by 83 cm long by 38 cm High. (Henry, 2005 and Ecocentre Newsletter).

11.7 Brooder Temperatures

Temperature should be maintained at about 26.6 to 32.2 degrees C in the brooder for the first 14 days after the hatching. The temperature can be gradually decreased as the 14 days approaches. (Henry,2005)

The keeper can normally observe when it is too hot when the chicks lay flat and start to pant. Some other indications of overheating are slight dehydration and unexplained loss of desire to feed.

11.8 Diet and Feeding Routine

It is best to wait about 12 hours after hatching before giving the penguin chick its first feeding. The first feeding should just be water in order to assess the chick's feeding response and ability to feed. Only water should be given while the yolk sac is being absorbed.

Some institutions use a 3cc syringe with a feeding tube. The formula needs to be completely blended so it goes smoothly through the tube.

Chicks need to have five feedings a day at every three hours. Records of weight need to be recorded. For the first 10 days, weight can be taken before each feeding session in order to monitor the weight properly.

Day 1 – Administer one or two 1cc water feedings and then formula that is diluted by 50%. Amount depends on record of weight. The amount per feeding should be slightly less than 10% of that weight.

Day 2 - Give formula diluted by 25% at each feeding and slightly less than the 10% of the first daily weight.

Day 3 – Give full strength formula at each feeding slightly less than 10% of first daily weight.

Day 4 – Full strength formula and volume equal to 10% of first morning weight record.

Day 5 – Use '10%' rule for total intake per feeding.
(Henry, 2005)

Chicks should be weighed each morning before feeding and then that weight is used to calculate the amount of food given at each feeding that day.

Generally, a 10-15% daily weight gain is expected during the first few weeks. When chicks get overfed they can show lethargy, spitting up and no interest in food. If that happens, then the keeper should withhold food until the chick seems hungry.

As the chicks grow after that, they can eat up to 50% of their weight per day. The Penguin Milkshake Formula devised by Sea World, Inc is as follows:
Ingredients:

- 220 g whole herring (with head, tail, fins and skin removed before weighing)
- 220 g krill (squeeze off excess water)
- 0.420 litres boiling water
- 4 Brewers yeast tablets
- 0.275 g Vitamin B1
- One seabird multivitamin
- Two calcium carbonate tablets
- 600 IU Vitamin E
- 1 ml liquid paediatric multivitamin drops with iron

Directions:

Blend ingredients. Strain and discard large particles. Mark container with date and time then refrigerate and use within 24 hours.

Before feeding, warm formula in double boiler to 32.2 degrees C. Fill feeding syringe. Slowly give formula and make sure the chick swallows it as you give it. (SeaWorld, 2001)



National Zoo and Aquarium. Canberra.

11.9 Specific Requirements

The most commonly used diet for rearing penguins was developed by Sea World of California, called the “Penguin Milkshake”.

Day 1 is the first day of feeding (not the first day of hatching).

The ‘10% Rule’. As far as the amount of food given, the chick should not have a volume of formula greater than 10% of its first morning weight. Over feeding is a common rearing problem.

Chicks at 1 to 3 days of age should receive a volume slightly less than 10% of the daily weight. Then when the chicks are older and eating fish as well as formula, the volume is still 10% of daily weight from all sources of food.

Feeding responses in the chick can be encouraged by placing two fingers forming a ‘V’ over the chick’s bill. Gently position the syringe over the chick’s mouth and start to feed.

Another issue concerns the furnishings of the brooder area. The brooder substrate needs to have enough texture so that the chick's legs do not slip out from under it. This will help prevent a splayed leg condition which can be serious. (Reilly.

11.10 Pinioning Requirements

Pinioning does not apply to penguins since they are flightless birds. It is thought that the name penguin comes from 'pin wing' used first in Newfoundland.

There are no quills in their wings, which are incapable of flexure, though they move freely at the shoulder-joint, and some at least of the species occasionally make use of them for progressing on land. In the water they are most efficient paddles. The plumage, which covers the whole body, generally consists of small scale-like feathers, many of them consisting only of a simple shaft.

11.11 Data Recording

The entire process of incubation, brooding, and feeding needs to be monitored and recorded. Records need to be kept including:

- Egg weight, dimensions, date and time
- Egg weight loss
- Temperature and humidity that is maintained in the incubator and brooder
- Changes in the egg along with times of turning
- Any candling done
- Observations about the membrane
- Time of pip to hatching
- Feeding diary
- Weight of chick on a daily basis as it grows
- Behaviour notes
- Fledging

(Henry, 2005)

11.12 Identification Methods

Eggs should be marked with date and time laid and which egg is laid first from the nest. When the chick is hatched and at the time of fledging, the penguin then can be identified with a flipper tag using a plastic cable tie.

11.13 Hygiene

It is important that the substrate in the brooding and growing area not be so smooth that the chick's feet slide out from under it. Temporary or permanent damage to muscles, tendons, and joints can result from improper footing.

Brooders should be cleaned at least twice daily. Cleaning can be combined with feeding to reduce overall handling of the chick. Special care should be used when handling chicks that have just been fed since they may regurgitate. Additionally, towelling can be replaced as needed between scheduled cleanings.

Disinfectants should be thoroughly rinsed and allowed to dry before the chick(s) are returned to the brooder. Betadine sprayed directly on towelling and allowed to dry before adding the chick may reduce fungal spores. (Henry, 2005)

11.14 Behavioural Considerations

As chicks grow older and more timid, it may be useful to supply some type of shelter or cover. One method is to provide half of an air-kennel or a sheltered area can be built right into the brooder design. The shelter should be removed for portions of the day to help the penguins get used to their surroundings and being on display at times. ('Love to Know' 1911 Encyc)

11.15 Use of Foster Species

The fostering of eggs to another species pair is sometimes used to help in chick survivability. The pair chosen for this would ideally have earlier success in rearing chicks. The timing of laying the eggs should be within two weeks of each other. The eggs of the surrogate pair are replaced with dummy eggs immediately after laying and then the eggs to be fostered are placed under them a few days before hatching time. (Henry, 2005)

11.16 Weaning

Little Penguins fledge between 33 and 34 days, and their approximate peak weight is between .831 and .891. The birds sometimes go through a timid stage at this time and can even act aggressively toward the keeper. (Seaworld. 2005)

11.17 Rehabilitation

One of the most common issues in rehabilitating the Little Penguin and then preparing for release is because of oil spills. External effects include feather disruption leading to hypothermia, reduced buoyancy, impaired flying ability and reduced ability to hunt for food and to escape from predators. Blindness can also occur if oil contacts with birds' eyes.

Internal effects include pneumonia from oil inhalation, anaemia following absorption of toxic chemicals via the skin, acute toxicity to the gastro-intestinal tract and other organ

systems. Also impairment of the immune system and disruption of thermal balance can be results of oil. Poisoning of birds can also occur due to oil ingestion by preening. (

Secondary and long-term effects include the reduction of reproductive success, decreased growth rate and body weight, decreased fertility of eggs, increased mortality of embryos, behaviour and weight changes.

In the rehabilitation of oiled birds the objectives are the rescue, treatment, cleaning and, hopefully , the release of the healthy animals to the natural environment .

There are several basic steps involved in the rehabilitation of a contaminated little penguin. These are:

- (i) stabilisation of the oiled bird
- (ii) cleaning of oil from the bird
- (iii) removal of the cleaning agent from the bird's feathers
- (iv) restoration of its water proofing ability, and finally
- (v) acclimation of the bird for release

Stabilisation of the oiled bird. The objective of stabilising an oiled bird is to reduce the toxic effects of ingested oil and to prepare the bird for cleaning.

Within 2-4 hrs of capture, general information about the bird, such as date and location of capture, sex and species of the bird, clinical status of the bird and degree of oiling is recorded.

Secondly, the bird is given a physical examination and its weight and temperature is recorded. If the penguin is found to be hypothermic or hyperthermic, further examination needs to be postponed and measures taken to solve the problem such as using warm water bottles to reduce hypothermia. Part of the stabilisation treatment also involves the removal of excess oil from nares, mouth and vent - usually employing cotton swabs.

The penguin's eyes are then flushed with a special solution such as sterile saline 0.9%.

Subsequent steps involve the administration of a suspension of activated charcoal that will absorb ingested oil (Holcomb and Russell, 1999). If the bird is dehydrated then rehydration solutions such as Pedalyte, Lactated Ringers and 2.5% Dextrose, are administered.

Oral administration of fluids to birds is very important and has been demonstrated to lead to an increase in their survival rate.

Subsequently, the bird is housed in a well-ventilated, newspaper-lined cardboard container in a quiet place before starting anything else. When the penguin seems calm and stable, it is given some high protein bird chow with vitamins and minerals and then fed some fish. This is to start the recuperation and prepare it for the washing procedure.

After the penguin is stabilised, there is the removal of oil from its feathers, using cleaning agents and water. Since cleaning is very stressful, it needs to be strong enough. The most common method for cleaning oil from penguins is the use of warm water and detergents. There are normally two persons involved in the cleaning process.

It takes a lot of water, around 350 litres for a 20-minute wash. The detergent is around a 10-15% concentration. The warm water and washing liquids are prepared in a tub, then ladles of water are poured over the penguin and its feathers are stroked in the direction of their growth. The penguin's eyes should be flushed with sterile water. When the water in the tub gets oily, then the penguin is taken to another tub. This procedure is repeated until there is no sign of oil on the penguin or in the water. It could take up to 10-12 tubs of water.

Following the cleansing, the penguin is rinsed of all the detergent and then it needs to be waterproofed again.



http://intbirdrescue.blogspot.com/2007_12_01_archive.html

The next step is to dry and restore the feathers. This is very important since if the feather structure is disrupted or cannot be restored, the penguin is not ready to be released. After washing and rinsing, the bird is then padded with clean towels. It is then placed in a drying room with the temperature between 35 to 40 °C. Suitable equipment for drying birds can include heat lamps or pet dryer. The penguin is kept in a clean area and given access to food and water.

The medical situation of the penguin is also monitored and treatment provided as required. After 24 hours, it is usually permitted to access water pools where it can gradually restore its feather structure by swimming, diving and preening. Softened fresh water is strongly recommended as it keeps salt crystals from forming and disrupting the feather alignment. The time for cleaning the penguin and restoring its plumage varies from 48 - 96 hrs.

The final step is acclimation and evaluation of the penguin prior to release. This is achieved by exposing it to outside weather conditions for a 24 – 48 hr period prior to release. The penguin is also provided with a solution of 2.0% saline to stimulate and evaluate the salt gland function. A ready-to-release penguin must meet all standard medical requirements such as being active, waterproof and healthy.



Photograph by Andres Stapff/Reuters

References

Frink, L & Crozer-Jones, B 1986, 'Oiled bird rehabilitation: Fact and fallacy', *J. Wild. Rehabil.*, vol. 5, pp. 68-79.

Frink, L & Crozer-Jones, B 1990, 'Rehabilitation of oil contaminated birds', *J. Wild. Rehabil.*, vol. 8, pp. 23-34.

Giese, M, Goldsworthy, SD, Gales, R, Brothers, N, Hamill, J 2000, 'Effects of the Iron Baron oil spill on little penguins (*Eudyptula minor*). III. Breeding success of rehabilitated oiled birds', *Wild. Res.*, vol. 27, pp. 583-591.

Acknowledgements

The compiler of this guide would like to thank the teachers and staff of TAFE Richmond in giving feedback and support in putting the material together. There has also been help and support from librarians at the National Library of Australia in Canberra in locating journals and books needed to research the Little Penguin. The compiler would also like to thank the senior keeper staff of National Zoo and Aquarium in Canberra for hands-on experience with the Little Penguin and taking the time to share their experiences and expertise.

13 References

'Antarctic and Other Penguins.' Northumbrian University.
www.communigate.co.uk/ne/penguins/page20.phtml

ARAZPA. 'Little Penguin Fact Sheet.'
www.arazpa.org.au/Little-Penguin/default.aspx

Arnould, J.P.Y., Dann, P & Cullen, JM. 2004. 'Determining the sex of Little Penguins (*Eudyptula minor*) in northern Bass Strait using morphometric measurements. *Emu* 104 (3) 261-265.
<http://www.publish.csiro.au/paper/MU04035.htm>

Australian Antarctic Division 'Animal Research Guidelines: Movement around breeding wildlife'. 2004.
www.aad.gov.au

AZA Publications. 'Penguins & Publications'
www.aza.org/AZAPublications/2005ProceedingsReg/Documents/2005ConfProcKansasCity8.pdf

Bolton, Duane. 2005. Bristol Zoological Gardens. 'Some Cracking ideas on egg incubation'.
www.math.leidenuniv.nl/~vivi/finrep_penguins.pdf

Crissey & Slifka. 2002. "Penguins: Nutrition". Nutrition Advisory Group Handbook.
www.nagoline.net/Technical%20Papers/NAGFS01201PenguinsAPR4.2002.pdf

Daniel, R. 2007. 'Synchronised group association in little penguins (*Eudyptula minor*)' *Animal Behaviour*, Vol 74, Issue 5, November 2007
www.sciencedirect.com

DEH Department, 'Kangaroo Island Information,' Little Penguin.
www.environment.sa.gov.au/parks/pdfs/PARKS_PDFS_LITTLE_PENGUINS.PDF

Del Hoyo et al. 1992. 'Diet and Eating Habits'. Seaworld Adventure Parks.

Diebold, E.N, Branch, S. & Henry, L. 1999. Management of penguin populations in North American zoos and aquariums. *Marine Ornithology* 27:171-176.
www.marineornithology.org/PDF/27/27_21.pdf

Diets of Little Penguins.
www.nationalparks.nsw.gov.au/PDFs/TSprofile_Little_penguins_ManlyCove_pop.pdf

DuBois, Lauren & Turner, Wendy. 1999. 'Penguin Shipments' .
www.aza.org/AZAPublications/2005ProceedingsReg/Documents/2005ConfProcKansasCity8.pdf

Ellis, Sue. 2003 'Behaviour and Social Organisation', Penguin Taxon. Chapter 3.
www.aviansag.org/Penguin.pdf

European Wildlife Disease Association (EWDA)
<http://www.ewda.org/OIE%20Working%20Group%20Rep%202001.pdf>

Field Manual of Wildlife Diseases:Birds
http://www.nwhc.usgs.gov/publications/field_manual/chapter_18.pdf

Fortescue, M. 1999. 'Temporal and spatial variation in breeding success of the Little Penguin *Eudyptula minor* on the east coast of Australia. *Marine Ornithology* 27:21-28.

Foundation for National Parks & Wildlife. 'Little Penguin'.
www.fnpw.org.au

Gales, RP. *EMU Austral Ornithology: 'Growth Strategies in Blue Penguins'*. Vol.87 (4), 212-219. www.publish.csiro.au/paper/MU9870212.htm

Graczyk TK, Cockrem JF, Miller JD, Court GS. 1995. Avian malaria seroprevalence in wild New Zealand penguins. *Parasite*. 2: 401-405.
<http://www.wildlifedisease.org/Documents/Supplements/Jul01Sup.pdf>

Harrigan KE (1992) Cause of mortality of little penguins *Eudyptula minor* in Victoria. *Emu* 91, 273 – 277.
www.publish.csiro.au/paper/MU9910273.htm

Henry, Linda and Sirpenski, Gayle. 2005. 'Chapter 4. Reproduction'. Penguin Taxon Advisory Group. American Zoo and Aquarium Association.
www.aviansag.org/Penguin_HB.pdf

Houston, D. 2006. Blue Penguin,
<http://www.penguin.net.nz/research/index.html>

Houston, Dave. 'Blue Penguin Nestbox'. Department of Conservation. Oamaru, NZ.
www.penguin.net.nz/species/blue/bluenest.html

International Penguin Conservation Work Group. 'Penguins of the World'.
www.penguins.cl

Jones, H.L. and Shellam, G.R. 1999. Blood parasites in penguins, and their potential impact on conservation. *Marine Ornithology* 27:181-184.
www.marineornithology.org/PDF/27/27_23.pdf.

Kinley, Rickey . 'Conditioning Sedentary Captive Penguins for Increased Swimming Time'.

Dept. of Aviculture, Cincinnati Zoo & Botanical Gardens.

'Little Penguin'

www.everything2.com/e2node/Little%2520penguin

'Little Penguin – Life History and Thermoregulation'

www.zoo.latrobe.edu.au/Third_year_enrolment/KI%20field%20course/KI%20Tutorial%2005a.pdf

Lindsey, T.R. 1986. *The SeaBirds of Australia*. Angus & Robertson. Sydney.

'Love to Know- Penguin'

www.1911encyclopedia.org/Penguin

Miyazaki, M & Waas, J. 2005. '*Effects of male call pitch on female behaviour and mate fidelity in Little Penguin,*' *Journal of Ethology*, vol 23, No. 2, July 2005.

www.springerlink.com/content/r5t056725836376u

Newton, Nadine. 2006. *Natural Foraging and Breeding Behaviours of the Little Blue Penguin*. University of Canterbury.

www.anta.canterbury.ac.nz/documents/GCA5%20electronic20%projects/Nadine%20newton20%project.pdf

NSW Dept of Environment & Climate Change. 'Little Penguin'. Sept. 2002.

www.environment.nsw.gov.au

Obendorf DL and McColl K (1980) Mortality in little penguins (*Eudyptula minor*) along the coast of Victoria, Australia. *J. Wildlife Disease*. 16: 2, 251 – 259.

www.marineornithology.org/PDF/27/27_23.pdf.

Oamaru Blue Penguin Colony. 2005.

www.penguins.co.nz/?lifecycle

Parks and Wildlife Tasmania, 2003. Nature Conservation Branch.

www.parks.tas.gov.au

Ozwildlife. 'Fairy Penguin.'

www.ozanimals.com/A-Z/common.html

Penguin Index, 2005, Penguin Behaviour

www.seaworld.org/animal-info/info-books/penguin/index.htm

Penguin Taxon Advisory Group. AZA. 2005.

<http://aviansag.org>

Penguins: A Sea World Education Department Publication
www.seaworld.org/Animal-info/info-books/penguin/pdf/ib-penguin.pdf

Pizzi, R, Gibbons, Wood, Mackenzie, & Garcia-Rueda, 2006. 'Using mortality and reproduction data to evaluate captive penguin nutrition'. 03 October 2006.
Royal Zoological Society of Scotland, Edinburgh Zoo, UK
www.eznc.org/PrimoSite/show.do?ctx=7795,169951,115901

Reilly, PN. 1974. *The Biology of Penguins*. 'A breeding study of the Little Penguin.'
London. Macmillan.

Reilly, PN. 1995. *Penguins of the World*. OUP. Oxford.

Rose, K. Common Diseases of Urban Wildlife: BIRDS. June 2005
http://www.arwh.org/ARWH_Admin/ManageWebsite%5CCommonDisease%5CUploadedFiles/194/Common%20Diseases%20of%20Birds_Part%201.pdf

Seaworld Penguin Infobook. 2005.
www.seaworld.org/animal-info/info-books/penguin/reproduction.htm

Stahel, C. & Gales, R. 1987. *Little Penguins*. NSW University Press. Sydney.

Taronga, 2008.
<http://www.taronga.org.au/taronga-zoo/news/media-releases/taronga-releases-rescued-little-penguin-at-north-curl-curl.aspx>

Tasmania Animal Tracks. 'A Sweater for Survival'.
www.discoverychannel.ca

'The Eco' Newsletter: Little Penguin. Ecocentre.
www.ecocentre.com/lp_facts.html

'Things to Know about the Little Penguin'
www.seaworld.org/just-for-teachers

Williams, Tony D. 1995. *The Penguins*. OUP. Oxford.

Wilson, Rory. 1997. 'Method for Restraining Penguins'. *Marine Ornithology* 25:72-73 (1997).

14 Bibliography

Birdlife International (2006) Species Factsheet: *Eudyptula minor*.
www.birdlife.org

'Birds in Backyards': Little Penguins. 2005. Australian Museum.

Brossy, J., Plos, A., Blackbeard, J.M. & Kline, A. 1999. Diseases acquired by captive penguins; what happens when they are released into the wild? *Marine Ornithology* 27: 185-186.

Coats, Judith. 2001. *Penguins: Flightless Birds of the Southern Hemisphere*. Seaworld Education Dept.

Cullen, J.M., Montague, T and Hull, C. 1992. *Food of Little Penguins Eudyptula minor in Victoria*. *Emu* 91: 318-341.

Dann, Peter. 1994. 'The Vulnerability of Australian seabirds to oil spills.' Penguin Reserve Committee of Management, Phillip Island, Vic.

Lindsey, T. 1986. *The Seabirds of Australia*. London: Angus & Robertson Publishers.

Little Penguin (*Eudyptula minor*) – Life history and thermoregulation.
www.zoo.latrobe.edu.au/Third_year_enrolment/KI%20field%20course/KI%20Tutorial%2005a.pdf

Madden, Catherine. 2007. '*The Secret Life of our Little Penguins*'. Dept of Environment and Conservation, Fremantle, WA
www.sciencewa.net.au

Merchant, S and Higgins, P.J. (eds) 1990. *Handbook of Australian, New Zealand and Antarctic Birds. Vol. 1*. Oxford University Press. Melbourne.

Nuzzolo, Debbie. 2002. *Penguin March*. Seaworld Education Department.

Quick, H. 2001. "Eudyptula minor" (On-line) Animal Diversity Web. Accessed March 31, 2009 at:
http://animaldiversity.ummz.umich.edu/site/accounts/information/Eudyptula_minor.html

Stull, Daniel. 2005. '*The annual cycle of Eudyptula minor, its phases and major effects.*' Abstract.
www.biology.iastate.edu/InternationalTrips/1Australia/05PAPERS/DANSTULLPENGUIN.htm

'The Eco' Newsletter. 1996. St.Kilda.
http://www.ecocentre.com/lp_facts.html

'Wildlife of Tasmania: Birds: *Little penguin*. 2004. Parks and Wildlife Service
<http://www.parks.tas.gov.au/wildlife/Care/penwatch.html>

15 Glossary

Candling - is a method used to study the growth and development of an embryo inside an egg. The method uses a bright light source behind the egg to show details through the shell, and is so called because the original sources of light used were candles

Clutch – all the eggs produced by a bird or reptile at a single time, particularly those laid in a nest.

Fledging - the stage in a young bird's life when the feathers and wing muscles are sufficiently developed for flight. It also describes the act of raising chicks to a fully grown state by the chick's parents.

Hybridisation - in genetics, hybridisation is the process of combining different varieties or species of organisms to create a hybrid, a different species altogether.

Isoflurane – is an ether used for inhalational anesthesia, and still used in veterinary medicine.

Keel – in bird anatomy it is an extension of the sternum (breastbone) which runs axially along the midline of the sternum and extends outward, perpendicular to the plane of the ribs. The keel provides an anchor to which a bird's wing muscles attach, thereby providing adequate leverage for flight. Keels do not exist on all birds; in particular, some flightless birds lack a keel structure.

Medial tarsometatarsal – joint in the foot of the penguin

Morphometrics – studying variation and change in the form (size and shape) of an organism. This includes measurement of lengths and angles, shapes and forms.

Nocturnal – an animal which is more active at night than during the day.

Pinioning – act of surgically removing the pinion joint, which is the joint of a bird's wing farthest from the body, to prevent flight.

Pip – the small knocks with the beak that a baby bird gives to the shell when it is hatching.

Preening – grooming of a bird, fluffing its feather and cleaning itself.

Pre-moult – usually after the breeding season, the bird starts to get new, duller down and feathers before the top layer comes in later.

Serology – study of blood serum to see what antibodies are present.

Sexual dimorphism – the difference in form between individuals of different sex in the same species. Examples include colour , size, and the presence or absence of parts of the body used in courtship displays or fights, such as ornamental feathers, horns, antlers or tusks.

Substrate – the earthy material that exists in the bottom of a marine habitat, like dirt, rocks, sand, or gravel. Also material that is similar to the native habitat of a species.

(Ref. Wikipedia, Dictionary).

16 Appendices

Appendix 1

SEAWORLD PENGUIN FORMULA QUARTER BATCH

110 grams 5-7 inch whole herring with
head, tail, fins & skin removed

110 grams krill (squeeze water out after
defrosting and before
measuring)

200 ml bottled drinking water

2 each 7 grain brewers yeast tablets

150 mg B-1

1+1/4lb Mazuri SeaBird vitamins

1 each 10 grain calcium gluconate tablet

300i.u. Vitamin E

½ ml Children's multi-vitamin drops

Blend ingredients thoroughly. Strain through large colander.

Refrigerate formula, mark with date & time; use within 24 hours.

Warm formula to 95F (35C) before serving.

Appendix 2

Daily Maintenance And feeding	<ul style="list-style-type: none">• Feed twice daily• Record each penguin's intake in notebook• Observe health of penguins, taking note of items listed in Section 8.1• Rake around the pond and sand area• Hose out holding areas• Check holding areas for latches and safety
Weekly maintenance	<ul style="list-style-type: none">• Drain pond• Clean with bleach solution• Refill with water• Clean holding areas and disinfect
Monthly maintenance	<ul style="list-style-type: none">• Maintenance check on holding and nesting areas• Check containers for any areas needing repairing•