

Husbandry Guidelines for



FUNNEL WEB SPIDERS WITH PARTICULAR REFERENCE TO THE SYDNEY FUNNEL WEB

Atrax robustus

(Arachnida : Hexathelidae)

Compiler: Vanessa Battishill

Date of Preparation:

Western Sydney Institute of TAFE, Richmond

Course Name and Number: Certificate 3 in Captive Animals.

RUV30204

Lecturer: Graeme Phipps, Jackie Salkeld, Brad Walker,

DISCLAIMER

These husbandry guidelines were produced by the compiler/author at TAFE NSW – Western Sydney Institute, Richmond College, N.S.W. Australia as part assessment for completion of Certificate III in Captive Animals, Course number 1068, RUV30204. Since the husbandry guidelines are the result of student project work, care should be taken in the interpretation of information therein, - in effect, all care taken but no responsibility is assumed for any loss or damage that may result from the use of these guidelines. It is offered to the ASZK Husbandry Manuals Register for the benefit of animal welfare and care. Husbandry guidelines are utility documents and are ‘works in progress’, so enhancements to these guidelines are invited.

OCCUPATIONAL HEALTH AND SAFETY RISKS

Risk category: **HIGH RISK = DANGEROUS**

The Sydney Funnel Web spider *Atrax robustus* is considered to be one of the most venomous spiders in the world! Although no one has died from the bite of The Northern Tree Funnel Web *Hadronyche formidabilis*, they are still highly venomous and the venom is considered to be closely as lethal as The Sydney Funnel Web. (FORD, N. tashwa7_13@hotmail.com, 30 April 2009).

There is much debate as to which spider is *the* most venomous spider in the world and the debate includes *Atrax robustus* and The Brazilian Wondering Spider *Phoneutria nigriventer*.

Funnel-Web spiders have fangs that deliver powerful venom. The venom contains a powerful combination of neurotoxins including atraxotoxin. Atraxotoxin is one of the most dangerous toxins in the animal kingdom.

Venom is delivered from two (approximately) 5mm long venom glands through 4mm long ducts to the base of the 2 downward pointing fangs, approximately 6mm long in *Atrax robustus* males.

A bite from these spiders will cause serious illness and can even lead to death.

Immediate symptoms include: puncture marks from the fangs, local pain and numbness at the bite area. The pain and numbness usually occur within 10 minutes of being bitten.

Other symptoms that follow vary with each occasion but can include:

Twitching of the facial muscles and tongue, numbness in the mouth, nausea followed by vomiting, stomach pain, cramps, perspiration, swelling, excessive saliva, frothing at the mouth and breathing difficulties. In cases where the victim has not received the antivenom sometime after the bite, the victim can become delirious, their eyes will not respond to light and twitching can affect the whole body. (Simon-Brunet 1994)

The venom enters the nervous system and acts quickly and in most cases, the venom of males is more toxic than females. This is the case for Sydney Funnel Web spiders *Atrax robustus*.

To minimise chances of being bitten, firstly, be extremely alert and focused when dealing with these spiders.

Move carefully but confidently at all times and use tweezers to handle and/or maneuver spider.

If bitten, **seek immediate medical attention** by calling emergency services. Do not panic and keep as still as possible. Do not try to get the venom out of the bitten area in any way as doing so can hasten the venom into the bloodstream. (Simon-Brunet 1994)

Contain spider if possible by placing a jar or other container over spider so spider can be taken to the hospital, positively identified and correct antivenin can be given.

Apply a crepe bandage to the bitten limb (start from the bitten area then work your way down to the toes or fingers then up as far as possible to the upper thigh/groin area or armpit), with the same amount of pressure and support as for a sprained limb and then use a splint to restrict the movement of the limb. By doing this, it can aid the body to naturally breakdown the venom. **This bandaging approach is only to be used in the case of a funnel web spider bite.** (Simon-Brunet 1994)



(Sydney Funnel-Web spider in strike position with fangs clearly visible <http://en.wikipedia.org>).

TABLE OF CONTENTS

1.	INTRODUCTION.....	8
1.1	ASMP CATEGORY	9
1.2	IUCN CATEGORY – SEE ALSO 2.3	9
1.3	EA CATEGORY	9
1.4	NZ AND PNG CATEGORIES AND LEGISLATION	10
1.5	WILD POPULATION MANAGEMENT	10
1.6	SPECIES CO-ORDINATOR	10
1.7	STUDBOOK HOLDER	10
2	TAXONOMY	11
2.1	NOMENCLATURE	11
2.2	SUBSPECIES	11
2.3	RECENT SYNONYMS	11
2.4	OTHER COMMON NAMES	12
3	NATURAL HISTORY	12
3.1	MEASUREMENTS	13
3.1.1	<i>Mass And Basic Body Measurements</i>	13
3.1.2	<i>Sexual Dimorphism</i>	13
3.1.3	<i>Distinguishing Features</i>	13
3.2	DISTRIBUTION AND HABITAT	15
3.3	CONSERVATION STATUS	16
3.4	LONGEVITY	17
3.4.1	<i>In the Wild</i>	17
3.4.2	<i>In Captivity</i>	17
3.5	TECHNIQUES USED TO DETERMINE AGE IN ADULTS	17
4	HOUSING REQUIREMENTS.....	18
4.1	EXHIBIT/ENCLOSURE DESIGN (FOR BOTH LARVAL AND ADULT STAGES).....	18
4.2	HOLDING AREA/ OFF EXHIBIT DESIGN (FOR BOTH LARVAL AND ADULT STAGES).....	18
4.3	SPATIAL REQUIREMENTS	20
4.4	POSITION OF ENCLOSURES	20
4.5	WEATHER (AND OTHER) PROTECTION	21
4.6	TEMPERATURE AND MICROCLIMATE REQUIREMENTS	21
4.7	SUBSTRATE	21
4.8	NESTBOXES AND/OR BEDDING MATERIAL	21
4.9	ENCLOSURE FURNISHINGS	22
5	GENERAL HUSBANDRY.....	22
5.1	HYGIENE AND CLEANING	22
5.2	RECORD KEEPING	23
5.3	METHODS OF IDENTIFICATION	23
5.4	ROUTINE DATA COLLECTION	23
6	FEEDING REQUIREMENTS.....	24
6.1	WILD DIET	24
6.2	CAPTIVE DIET	24
6.3	SUPPLEMENTS	25
6.4	PREPARATION AND PRESENTATION OF FOOD	25
6.5	DIETARY CHANGES	26
6.6	FEEDING REGIME	26
6.7	PLANT PROPAGATION; FOR EACH SPECIES, NOTE:	26
7	CAPTURE, RESTRAINT, HANDLING AND TRANSPORT	26
7.1	TIMING OF CAPTURE AND HANDLING	26
7.2	CAPTURE EQUIPMENT	26
7.3	CAPTURE AND RESTRAINT TECHNIQUES	26

7.3.1	<i>The best handling method for the safety of the animals as well as the handler</i>	27
7.3.2	<i>The best method of luring and trapping stray animals</i>	28
7.3.3	<i>The best method for collecting in the field</i>	28
7.4	WEIGHING AND EXAMINATION	28
7.5	RELEASE	29
7.6	TRANSPORT REQUIREMENTS	29
7.6.1	<i>Box Design</i>	30
7.6.2	<i>Furnishings</i>	32
7.6.3	<i>Water and Food</i>	32
7.6.4	<i>Animals per Box</i>	33
7.6.5	<i>Timing of Transportation</i>	33
7.6.6	<i>Release from Box</i>	33
8	HEALTH REQUIREMENTS	34
8.1	DAILY HEALTH CHECKS	34
8.2	DETAILED PHYSICAL EXAMINATION	34
8.3	ROUTINE TREATMENTS	35
8.4	KNOWN HEALTH PROBLEMS	35
8.5	QUARANTINE REQUIREMENTS	35
8.6	VET PROCEDURES	36
8.7	EUTHANASIA	36
8.8	POST MORTEM RESULTS	36
9	BEHAVIOUR	36
9.1	GENERAL BEHAVIOUR	36
9.2	ACTIVITY	37
9.3	SOCIAL BEHAVIOUR	37
9.4	REPRODUCTIVE BEHAVIOUR	38
9.5	BATHING	38
9.6	BEHAVIOURAL PROBLEMS	38
9.7	SIGNS OF STRESS	38
9.8	BEHAVIOURAL ENRICHMENT	38
9.9	INTRODUCTIONS AND REMOVALS	39
9.10	INTRASPECIFIC COMPATIBILITY	40
9.11	INTERSPECIFIC COMPATIBILITY	40
9.12	SUITABILITY TO CAPTIVITY	ERROR! BOOKMARK NOT DEFINED.
10	BREEDING	41
10.1	MATING SYSTEM	41
10.2	EASE OF BREEDING	41
10.3	REPRODUCTIVE CONDITION	41
10.3.1	<i>Females</i>	<i>Error! Bookmark not defined.</i>
10.3.2	<i>Males</i>	<i>Error! Bookmark not defined.</i>
10.4	TECHNIQUES USED TO CONTROL BREEDING	41
10.5	OCCURRENCE OF HYBRIDS	42
10.6	TIMING OF BREEDING	42
10.7	AGE AT FIRST BREEDING AND LAST BREEDING	42
10.8	ABILITY TO BREED EVERY YEAR	42
10.9	ABILITY TO BREED MORE THAN ONCE PER YEAR	42
10.10	NESTING, HOLLOW OR OTHER REQUIREMENTS	43
10.11	BREEDING DIET	43
10.12	INCUBATION PERIOD	43
10.13	CLUTCH SIZE	43
10.14	AGE AT WEANING	43
10.15	AGE OF REMOVAL FROM PARENTS	44
10.16	GROWTH AND DEVELOPMENT	44
11	ARTIFICIAL REARING	44
11.1	INCUBATOR TYPE	44
11.2	INCUBATION TEMPERATURE AND HUMIDITY	44
11.3	DESIRED % EGG MASS LOSS	44

11.4	HATCHING TEMPERATURE AND HUMIDITY	45
11.5	NORMAL PIP TO HATCH INTERVAL	45
11.6	DIET AND FEEDING ROUTINE	45
11.7	SPECIFIC REQUIREMENTS	45
11.8	DATA RECORDING.....	45
11.9	IDENTIFICATION METHODS	45
11.10	HYGIENE	46
11.11	BEHAVIOURAL CONSIDERATIONS	46
11.12	WEANING.....	46
12	ACKNOWLEDGEMENTS.....	47
13	REFERENCES.....	48
14	BIBLIOGRAPHY	49
15	GLOSSARY	50
16	APPENDIX.....	51

1. Introduction

For most other husbandry manual guidelines, particularly mammal, bird and reptile species, a calendar showing months January through to December with specific important tasks that need attention and action accordingly (e.g. change in diet for breeding season) would be an important aspect of the husbandry manual guidelines.

As keepers and animal care attendants have a busy daily schedule and an individual using these guidelines on a temporary basis would not have the time to read every page, a calendar would supply the reader with a quick guide reference of what important duties need to be performed in the month(s) they are to attend to the particular species.

This annual calendar however, is not required for funnel web spiders.

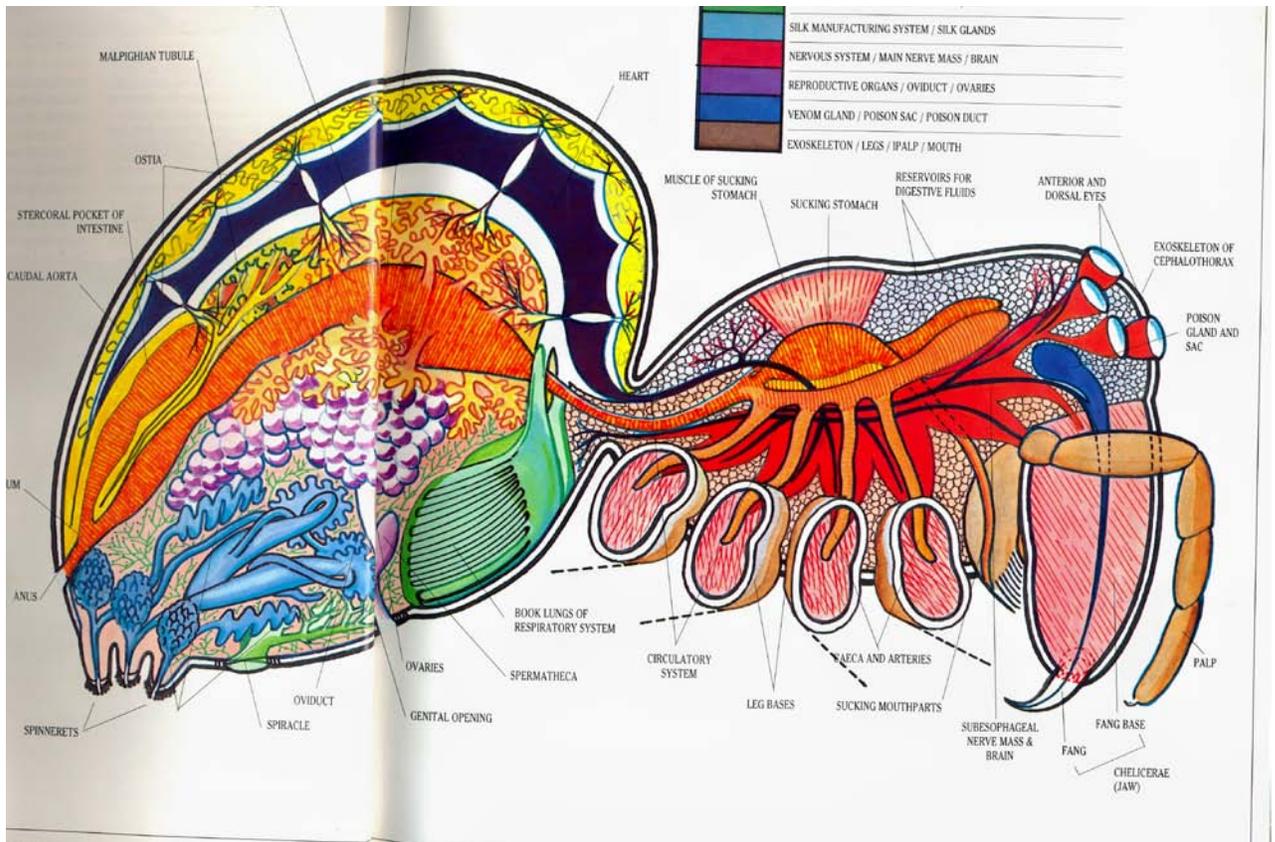
Of all the animal groups, we know the least about the invertebrates. Everyday we are discovering more and more about particular species and the group in general.

Our lack of knowledge is shown particularly in regards to keeping invertebrates in captivity and this husbandry manual highlights the gaps in our knowledge of Funnel Web spiders.

The venom of Funnel Web spiders makes this group of spiders a valuable species for education and research. Being of the most deadly spiders in the world, the need for an antivenom is undeniable and the only way to produce an antivenom is to research the species. Education is very important to inform people of the danger these spiders can pose and to help them to understand a significant creature in the animal kingdom.

Spiders have been kept in laboratory environments longer than they have been kept in captivity in zoos and wildlife parks. More and more institutions are exhibiting spiders as they become increasingly popular every year with many spider enthusiasts.

Spider anatomy is very different, interesting and surprising. Spiders have many body parts that are unique to them and they have organs familiar to us but in different places than we are used to seeing, particularly in mammals. Their heart is on the second part of their body and it seems like they are carrying it on their back and their 'nose' is on the underside of the second part of their body...



Above: Typical Female Spider Anatomy (Simon-Brunet)

1.1 ASMP Category

N/A

1.2 IUCN Category – see also 2.3

Not Evaluated.

1.3 EA Category

Status is common.

1.4 NZ and PNG Categories and Legislation

N/A

1.5 Wild Population Management

N/A

1.6 Species Co-ordinator

Not currently applicable for invertebrates.

1.7 Studbook Holder

Not currently applicable for invertebrates.

2 Taxonomy

2.1 Nomenclature

Funnel-Web spiders include 35 species in 2 genera – *Atrax* and *Hadronyche*.
The Sydney Funnel-Web spider:

Class: Arachnida
Order: Araneae
Family: Hexathelidae (note: previously Dipluridae)
Genus: *Atrax*
Species: *robustus*

Other species include:

Atrax spp. (2 undescribed species)
Hadronyche adelaidensis
Hadronyche cerberea
Hadronyche eyrei
Hadronyche flindersi
Hadronyche formidabilis
Hadronyche infensa
Hadronyche meridiana
Hadronyche modesta
Hadronyche pulvinator
Hadronyche valida
Hadronyche venenata
Hadronyche versuta
Hadronyche spp. (at least 20 undescribed species)

(Gray, 1988)

2.2 Subspecies

None.

2.3 Recent Synonyms

None.

2.4 Other Common Names

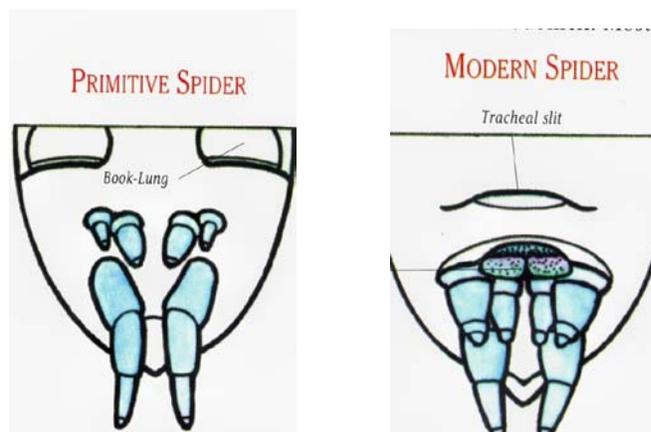
Deadly Funnel-Web spider.

3 Natural History

Funnel-Web spiders are included in the group of spiders known as mygalomorphs. Mygalomorph spiders are also known as ‘ancient’, ‘primitive’ or ‘old world’ spiders as these spiders are the first spiders that roamed the earth. Before insects took to the skies they lived on the ground and the mygalomorph spiders hunted them. Then when new insect species took to the skies spiders followed. These spiders are known as araneomorph spiders, also commonly known as ‘modern’ or ‘new world’ spiders. Mygalomorph spider species still exist today. Other than the Funnel Web spiders, Trapdoor spiders, Mouse spiders and Wolf spiders are some of the other mygalomorphs. (Simon-Brunet 1994)

Features that distinguish mygalomorph spiders from araneomorph spiders are the mygalomorph spiders have large chelicerae with large fangs that move in an up and down motion and they have book lungs. They are nocturnal and most species live in burrows on or in the ground.

The araneomorph spiders have fangs that move in a pinching motion. They breathe like mygalomorph spiders with book lungs but have an extra part to their respiratory system known as a tracheal system. Many modern spiders construct advanced webs off of the ground; these species have modified body parts that replace the spinnerets. (Simon-Brunet 1994)



Above Left: Primitive spider spinnerets. Above Right: Modern spider spinnerets (Simon-Brunet)

Funnel Web spiders were named for the shape of their home, however, this name is misleading as their home is constructed in more of a wishbone shape rather than a funnel.

3.1 Measurements

3.1.1 Mass And Basic Body Measurements

Atrax robustus - Total length: 25mm – 30mm for mature males, 35mm –40mm for mature females.

Width: 8mm for mature males, 12mm for females.

Fang length: approximately 5mm

Hadronyche formidabilis – Total length: 35mm for mature males and 50mm for mature females

3.1.2 Sexual Dimorphism

Males are smaller in overall size than females; they have large palpal bulbs and spurs on the second pair of legs used in most species to hold up females or her fangs when mating.

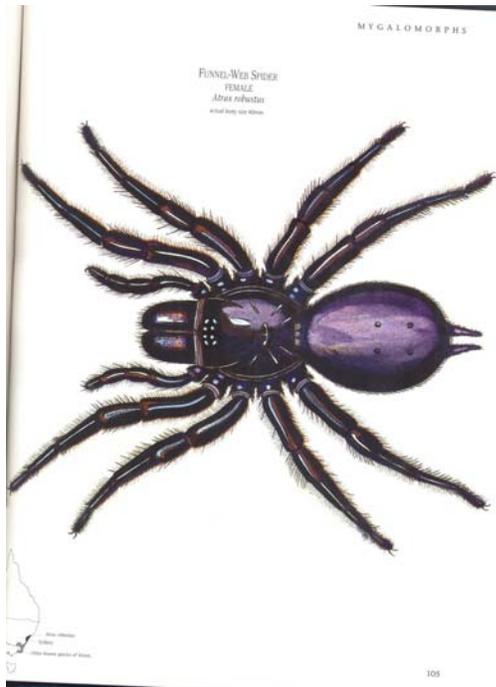
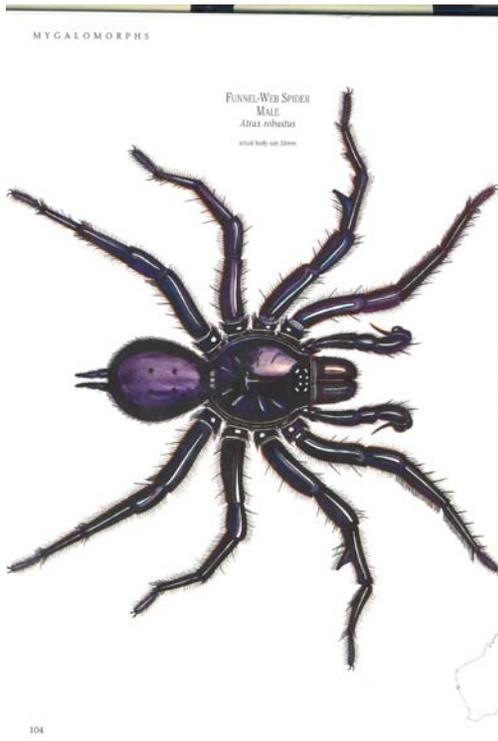
The leg length of the male Funnel-Webs is longer proportionally compared to the body.

Mature males live approximately one breeding season where as females will live through several. (Simon-Brunet 1994)

3.1.3 Distinguishing Features

All Funnel-Webs have a glossy carapace ranging in colour from brown to black to blue-black. Colour can vary with species, and consideration of age and moulting stage needs to be taken into account. The abdomen is dark brown to dark plum with a red underneath, which is seen when spider is reared in a strike position. Another distinguishing feature is their long spinnerets.

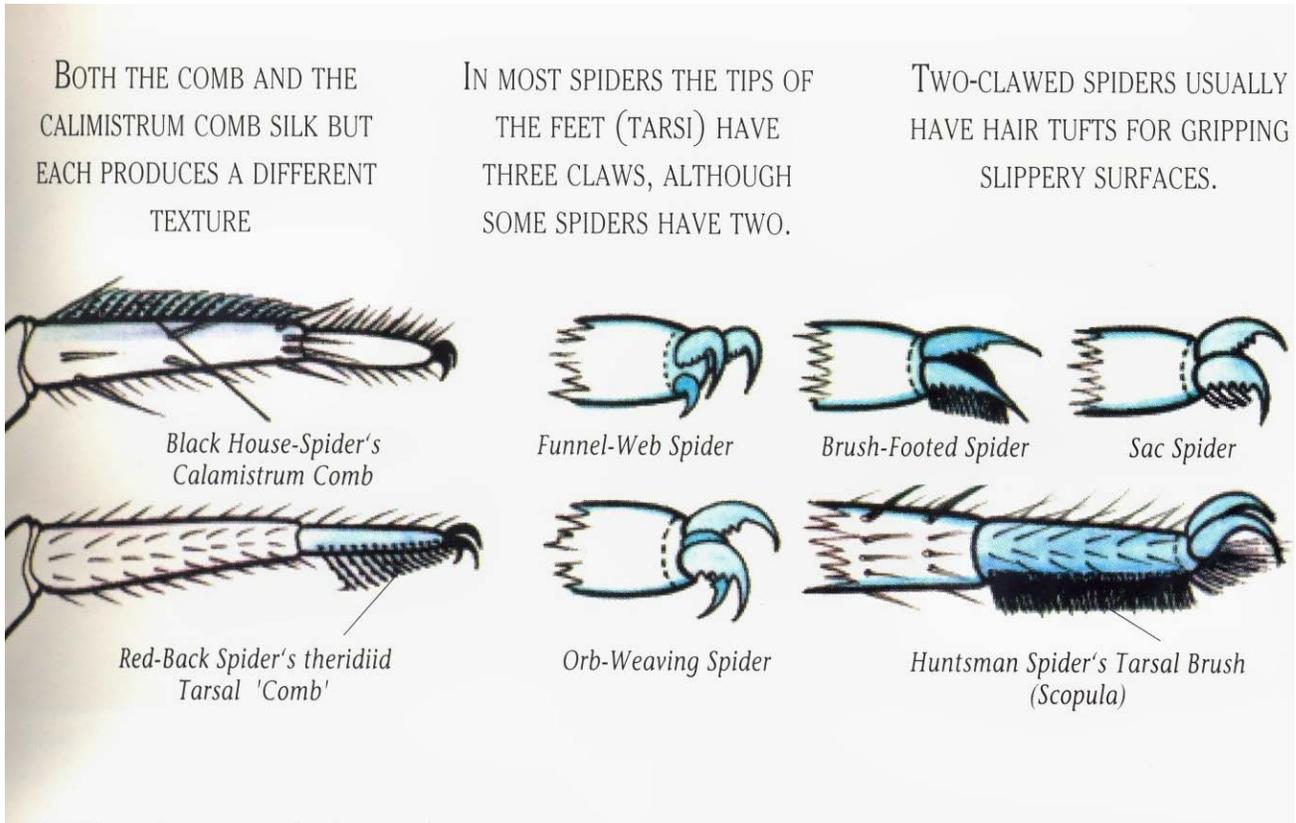
Atrax robustus is smaller in size than the Northern Tree Funnel-Web *Hadronyche formidabilis*; the carapace of the Sydney Funnel Web is not as raised, as the Northern Tree Funnel Web and the spurs of the male Sydney Funnel Web are more noticeable compared to the Northern Tree Funnel Webs. (Simon-Brunet 1994)



Above Left: Male Sydney Funnel Web, Above Right: Female Sydney Funnel Web (Simon-Brunet)



Right: Female Northern Tree Funnel Web (Simon-Brunet).



Above: Spider feet, including Funnel Web spider. (Simon-Bruent)

3.2 Distribution and Habitat

The Funnel-Web species are found from north-eastern QLD to Victoria.

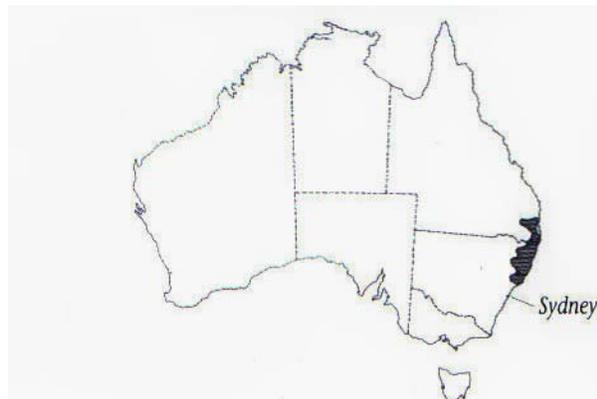
Atrax robustus is found in central Sydney, up to Newcastle down to Nowra and in west as far as Lithgow. Due to transportation of soils and rocks, *Atrax robustus* has also been found in south-eastern Victoria.

Most species are terrestrial though a few species (such as *Hadronyche formidabilis* and *Hadronyche cerberea*) are tree dwellers. Most prefer moist conditions in forests and rainforests; however, some species can be found in drier areas.

Funnel-Web housing is usually a tube of silk in a Y or T shape, giving the funnel-webs an escape route when needed or just another opportunity to catch food. This tub is also constructed with a pouch-like chamber where the spider mainly resides (when not waiting at tube entrances to ambush prey).



Above: Map of Australia showing the distribution of deadly funnel web species (Simon-Brunet).



Above: Map of Australia showing the distribution of The Northern Tree Funnel Web spider (Simon-Brunet).



Above: Map of Australia showing distribution of Sydney Funnel Web spiders (<http://www.environment.gov.au/cgi-bin/species-bank/sbank-treatment.pl?id=75618>)

3.3 Conservation Status

No true status has been identified; however, it would be a low risk species, which is of least concern and in abundance.

3.4 Longevity

3.4.1 In the Wild

The life span of Funnel-Webs in the wild is uncertain.

3.4.2 In Captivity

Females have a life span of 2-10 years. Most males have a short life span of only 6-9 months after maturity and an average of only 3 months for males that are milked weekly.

3.5 Techniques Used to Determine Age in Adults

Measurements of length and width are the best indicators in determining the maturity of Funnel-Web spiders.

4 Housing Requirements

4.1 Exhibit/Enclosure Design (for both larval and adult stages)

Glass would be the ideal material for constructing funnel web exhibits as it gives the visitors a clear view.

Dimensions can vary, as funnel webs do not need much space. A glass square or rectangle shape container of approximately 30cm x 21cm (roughly the size of an A4 piece of paper) is desirable and recommended. This size offers more than sufficient space for the spider and also allows plenty of opportunity for aesthetically pleasing exhibit design creativity. Breathing/air holes must be present.

There is no specific height size, as funnel web spiders cannot climb. A height of approximately 20cm would be sufficient and recommended.

With the container materials and dimensions set, see sections 4.7 Substrate, 4.9 Enclosure Furnishings and be creative with arrangement.

Important Note: Always use tongs or large tweezers to remove exhibit furniture and sight the spider before removing to minimize any chance of being bitten.

When positioning the exhibit for public view, try placing the spider into the exhibit and waiting a few hours to 24 hours to see where the spider chooses to construct its burrow. Position the exhibit so that the burrow is facing the front, where public are able to see it better.

Another option which is used by Sydney Wildlife World in Darling Harbour, Australia is the use of pre molded substrate so that the burrow is pre molded and against the glass – this allows the public the best viewing opportunities, even when the spider is in the burrow.

A LED red light can be used to help the public to locate and see the spider. This is done at Sydney Wildlife World in Darling Harbour, Australia.

4.2 Holding Area/ Off Exhibit Design (for both larval and adult stages)

Where a number of off exhibit funnel-web spiders are housed, a plastic drawer unit (diagram below) can be used. Each drawer must be clearly marked with species identification, sex and safety signage. First aid signage, instructions and emergency numbers can be displayed above drawers as room is off exhibit and designed for keepers. (B. Finlayson, personal communication 2008). Plastic drawers are much cheaper than glass cabinets and easier to access for feeding, cleaning and other purposes. As this form of housing is off-exhibit, there is no need to focus on aesthetic design and dimensions can be smaller to the size the species requires rather than larger dimensions for public viewing.

Funnel-webs, due to their nature and natural solitary status should be housed separately. Only house one funnel-web to each drawer.



Above: Funnel Web Spider off exhibit housing at Taronga Zoo, Backyard To Bush section.



Above: Individual housing for Funnel Web spider at Taronga Zoo, Backyard To Bush section in the off exhibit invertebrate room.

4.3 Spatial Requirements

Clause 18 of the Department of Primary Industries' General Standards for Exhibiting Animals indicates the following spatial requirements:

- 1) The size and shape of enclosures must provide freedom of movement, both horizontally and vertically.
- 2) An enclosure must be of sufficient size, and the animals in the enclosure must be so managed, as to:
 - a) avoid undue domination of a herd or group by an individual or individuals; and
 - b) avoid the risk of persistent and unresolved conflict between herd or group members or between different species in enclosures containing different species; and
 - c) make it possible for an animal to avoid, or withdraw from, contact with other animals or with people; and
 - d) ensure that the carrying capacity of the enclosure is not exceeded; and
 - e) prevent an uncontrolled accumulation of parasites and other pathogens; and
 - f) encourage and permit exercise and behavioural enrichment.

General Standards for Exhibiting Animals in NSW

13

- 3) Each animal must be provided with sufficient space in all directions to enable it:
 - a) to take exercise; and
 - b) to be protected from undue dominance and conflict; and
 - c) to be provided with its social, breeding and husbandry needs.
- 4) With the approval of the Director-General, a bird rendered flightless may be kept in an enclosure smaller than that which would be required if it could fly.

4.4 Position of Enclosures

As funnel-webs are nocturnal, their housing is best positioned in dark conditions with minimal sunlight. A funnel-web will die after a sort amount of time in direct sunlight according to B. Finlayson (personal communication, 2008).

4.5 Weather (and other) Protection

Glass or plastic housing with little ventilation is best suited to spiders (Grey, 1988). Due to the dangers of the species, the housing must be completely enclosed to prevent escape and ensure safety.

In laboratory conditions, the funnel-webs are usually housed in 500mL glass jars with 4cm of moistened soil. Females can be housed in 20x30cm containers. (Grey, 1988)

On display to public at zoos and other similar facilities, glass constructed exhibits are used.

Protection from sun exposure is important. A thin curtain over the room window to block and filter most of the sun is ideal during the hottest hours of the day in the summer season.

4.6 Temperature and microclimate Requirements

Funnel-webs do best in cooler to slightly humid conditions despite being found in the warm areas of N.S.W. They require very minimal sunlight and will not survive a long period of exposure to direct sunlight. Housing temperature should range anywhere between 10°C to mid 20's. Though heating is not required, a bar heater can be used to keep an off exhibit room, housing a number of funnel-webs and a variety of other invertebrates, mildly humid, according to B. Finlayson (personal communication, 2008).

4.7 Substrate

4cm of moistened soil (Grey, 1988) or peat moss (also referred to as coco peat) should be used as substrate in funnel-web housing. Soil or peat moss needs to be moistened but not wet. A handful of substrate squeezed in the hand should not have water dripping out but be moist or damp, according to B. Finlayson (personal communication).

In laboratory conditions where funnel-webs are used for milking, it is advised that a combination of approx. 2cm of moistened or damp soil (hand squeezing test as above) with approx. 1cm of clean coarse sand be used as the substrate. The sand aids in keeping the fangs clean during milking (Grey, 1988).

4.8 Nestboxes and/or Bedding Material

Nest boxes &/or bedding material is not required for funnel-webs or other spider species as spiders create their own using their silk. In the case of funnel-webs, silk is used to make a burrow. Furnishings play a part in funnel-web burrows as they provide a construction site.

4.9 Enclosure Furnishings

For public exhibits and number of furnishings would be suitable for funnel-webs. Exhibits could show educational themes of where funnel-webs can be found (eg. in a household environment or in a shoe), however, viewing visibility consideration needs to be taken into account. An exhibit with a lot of furnishings would look aesthetically pleasant but may provide too many places for spiders to hide in or behind and thus, become viewing obstacles for the public.

Nice pieces of bark, small rocks, twigs, small half pots and small hollow logs (positioned so that the public can see into the log) would be ideal furnishings for public exhibits and create a more natural environment for the spider.

For off exhibit housing, a single piece of concaving or indented bark is best as it is safer for the keeper when working with the funnel-webs – there are limited areas where the funnel-web would be within the housing and it would also provide an assisting structure for the funnel-web to construct its burrow, according to B. Finlayson (personal communication, 2008).

Below is a number of plant species that funnel webs are found around in the wild. Cuttings of these plants can be used to enhance their exhibits.

Common Names and other names

Scientific Names

Rosy Maidenhair, Five Fingered Jack, Rough Maidenhair
Common Maidenhair, Bush Maidenhair
Swamp Mahogany
Sydney Red Gum, Smooth Barked Apple
Blue Berry Ash, Fringe Tree
Prickly Leafed Paperbark
Yellow Bloodwood
Rough Tree Fern, Australia Tree fern
Soft Tree Fern
Sydney Blue Gum

Adiantum hispidulum
Adiantum raddianum
Eucalyptus robusta
Angophora costata
Elaeocarpus reticulat
Melaleuca stypheloides
Corymbia eximia
Cyathea australis
Dicksonia antarctica
Eucalyptus saligna

5 General Husbandry

5.1 Hygiene and Cleaning

Spot cleaning is required to remove any uneaten food.

Removal and replacement of bark, peat moss substrate and any other furnishings is usually only done if required due to mites or every 4 months. Care is taken not to disturb burrow.

No chemicals are to be used in cleaning of housing, just water, according to S. Brown (personal communication, 2008).

5.2 Record Keeping

Usage charts should also be used in these institutions to identify how often an individual is used (usage should not be more frequent than once a month). Usage charts should also be used in farming for milk and/or laboratory use.

Medical records would be kept to monitor any health issues such as blisters on the abdomen.

5.3 Methods of Identification

In a captive institution, specimens should be given individual numbers for identification; this information should also be recorded on cage cards with sex of each specimen.

5.4 Routine Data Collection

Information on feeding, breeding cycles, usage in keeper talks and health will prove useful and valuable to the institution and others in the long term future.

6 Feeding Requirements

6.1 *Wild diet*

In the wild, Funnel-webs will eat whenever prey items find themselves stuck on the sticky silken lines just outside the burrow entrance. The spider detects the vibrations of the struggling prey and emerges from the burrow to apprehend and kill its meal. Funnel-webs 'will eat almost anything they can kill' (Terence, 1998) and therefore, have a wide variety of prey items, mainly invertebrates.

Wild diets of most funnel-webs include crickets, insect larvae, earthworms, ants and small snails.

The Northern Tree Funnel-web, which unlike other funnel-web species is arboreal and found in trees. This species eats a variety of tree dwelling invertebrates, frogs and small geckos. (Brunet, 1996)

The Blue Mountains Funnel-web spider's wild diet consists of insect larvae, earthworms, snails and other invertebrates. (Brunet, 1996)

Sydney Funnel-web spiders eat a larger variety of prey items including beetles, cockroaches, insect larvae, native land snails, millipedes and occasionally skinks, frogs and small vertebrates. (Brunet, 1996)

6.2 *Captive Diet*

Institutions use different items in the spider's diets. One institution may only use crickets where another may use pinkie mice, according to B. Finlayson (personal communication, 2008).

The different feed items used by each institution may vary due to the fact that funnel-webs have such a broad variety in their wild diets and therefore, each institution is feeding their spiders a natural prey item. Another reason for variations amongst institutions may be due to access to their choice of feed. Institutions often breed one or a variety of the funnel-webs natural prey and may find it feasible to feed out the items that they breed onsite.

The captive diet of funnel-webs should reflect their natural diet and it would be best to feed a variety of items rather than just one to further simulate their natural environments, though, as above with the mealworms, feed should be monitored to ensure it is eaten and does not bury itself or move into the next stage of its life cycle.

If feeding pinkie mice and/or frogs, euthanasia standards must be followed.

(www.dpi.nsw.gov.au).

In some laboratory institutions, it has been found that after trying various food items, the common mealworm, *Tenebrio molitor*, has been the best. (Grey, 1988).

Though Grey has found mealworms to be a good feed choice, consideration must be given to the fact that mealworms bury themselves and are a larval stage, which means they will turn into beetles (FORD, N. tashwa7_13@hotmail.com, 11 April 2009). This

particular feed choice should be monitored to ensure it is eaten and does not bury itself and/or move into the next stage of its life cycle.

Museum Victoria uses and recommends crickets and cockroaches as feed items. Prior to feeding, they keep the crickets and cockroaches in the refrigerator at 17 degrees Celsius (which may add to longevity). (FORD, N. tashwa7_13@hotmail.com, 11 April 2009).

Natasha Ford from Museum Victoria advised me that their institution was feeding every week but found that most spiders were not eating every week so they changed their feedings to once a fortnight. Natasha also added that spiders, like snakes, do not need to be fed all the time, they just won't eat.

Below is a table of a possible weekly feeding plan over a recycling monthly period.

Make observations daily by checking to see if food has been consumed or if only some food has been consumed. Feeding plan may need to be adjusted to subtract the number of food items offered if some items are consistently left behind or if seasonal conditions change spider's appetite.

WEEK 1	WEEK 2	WEEK 3	WEEK 4
1 large cricket or cockroach (feed given any day of the week)	Nothing	1 large cricket or cockroach (feed given any day of the week)	Nothing

6.3 Supplements

Funnel-webs (like all spiders) are carnivores and eat whole prey items. If the spiders survive in the wild on a diet mainly consisting of whole invertebrates and their captive diets are the same as their wild diets, there are no supplements required as the spiders are living on a diet where all nutritional value is present.

6.4 Preparation and Presentation of Food

Live food is best placed in funnel-web housing once a week, according to B. Finlayson (personal communication, 2008). This ensures food is fresh and unspoiled when spiders eat, it will set a natural environment and provide environmental enrichment.

6.5 Dietary changes

There are no known dietary changes for Funnel Web spiders. Adjustments should be made if and when a pattern is observed occurring in the weekly feeding regime.

6.6 Feeding Regime

See 6.2 Captive Diet

6.7 Plant propagation; for each species, note:

N/A

7 Capture, Restraint, Handling and Transport

7.1 Timing of Capture and Handling

Capture of funnel-webs is best done during the coolest periods of the day, however, due to housing requirements (indoors and lack of sun) capture can take place at any time of day. Reasons for capture may need to be taken into account. If spider is to be used in a public presentation during the middle of the day, caution must be taken to ensure spider is not exposed to prolonged periods in the sun. Spider in container should be placed under shelter at the presentation location, according to B. Finlayson (personal communication, 2008)

7.2 Capture Equipment

A small clear, hard plastic container with a hard plastic snap lock lid that has small ventilation holes or a clear glass jar with a secure lid will be used along with long tweezers (PPE) (B. Finlayson, personal communication, 2008)

7.3 Capture and Restraint Techniques

7.3.1 The best handling method for the safety of the animals as well as the handler

For safety precautions read **OHS Risks on page 3** of this document.

Institutions must have competent staff receive 3 training periods with an authorised handler and be signed off as authorized to handle the dangerous species.

For quick reference to handling (extracted from OHS Risks on page 3):

To minimise chances of being bitten, firstly, be extremely alert and focused when dealing with these spiders.

Move carefully but confidently at all times and use tweezers to handle and/or maneuver spider.

If bitten, **seek immediate medical attention** by calling emergency services. Do not panic and keep as still as possible. Do not try to get the venom out of the bitten area in any way as doing so can hasten the venom into the bloodstream. (Simon-Brunet 1994) Contain spider if possible by placing a jar or other container over spider so spider can be taken to the hospital, positively identified and correct antivenin can be given.

Apply a crepe bandage to the bitten limb (start from the bitten area then work your way down to the toes or fingers then up as far as possible to the upper thigh/groin area or armpit),

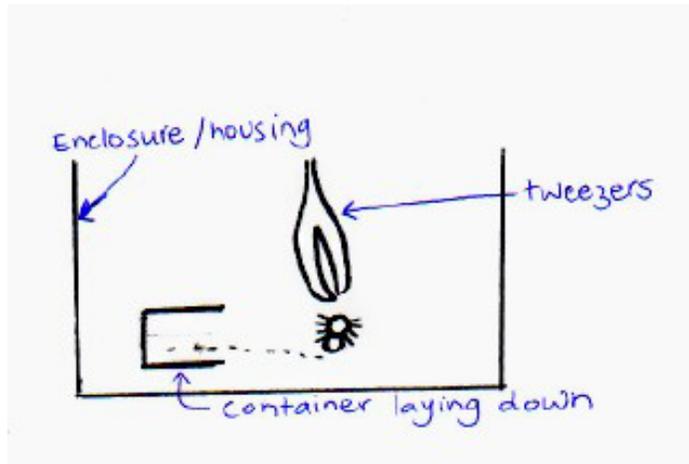
with the same amount of pressure and support as for a sprained limb and then use a splint to restrict the movement of the limb. By doing this, it can aid the body to naturally breakdown the venom. **This bandaging approach is only to be used in the case of a funnel web spider bite.** (Simon-Brunet 1994)

Along with the above, the first step to capture the funnel-web is to plan and prepare. Have capture equipment (container and tweezers) ready. (It will be a good idea to weigh the empty container before capture to assist in weighing the spider).

Open the drawer (or other type of housing) slowly.

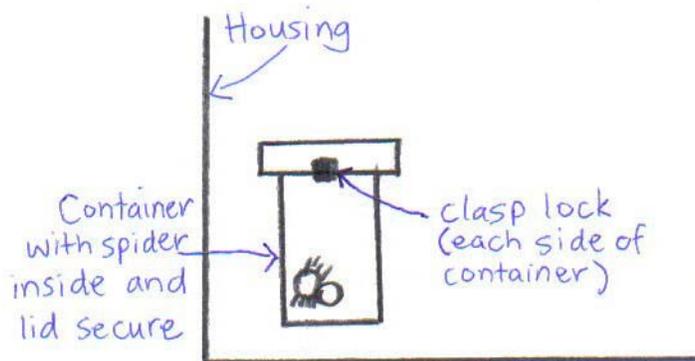
Using the tweezers, lift bark and turn over to ensure spider is not on the other side before removing.

With all obstacles removed, remove container lid and lay container inside the housing. When the spider has been located, use tweezers to entice and maneuver spider into the container.



Above: Diagram 1 of capturing a Funnel Web spider.

When spider is completely inside the container, stand the container up (with hand on the outside of the container) and replace container lid securely.



Above: Diagram 2 of capturing a Funnel Web spider

7.3.2 The best method of luring and trapping stray animals

Same technique as in captivity (above 7.3.1)

7.3.3 The best method for collecting in the field

Same technique as in captivity (above 7.3.1)

7.4 Weighing and Examination

Due to the dangers of the species, the spider will need to be placed in a container for weighing and examination. The container will need to be weighed prior to the spider being placed inside. Subtract the weight of the container with the spider inside from the weight of the empty container to get the spiders weight.

Most examinations on the spider can be conducted by observing the spider through the clear hard plastic or glass container and a benefit of this is that the container can be lifted to see the underneath of the spider. The benefit is that observations can be made without risk of injury. Tweezers can also be used to maneuver spider or pick spider up for closer examination.

7.5 Release

When releasing the funnel-web back into its enclosure follow all safety advice. **Read OHS Risks on page 3** of this document or refer to previous page (page 16).

Release of funnel-web is fine at any time of day as their housing is indoors and protected from most sunlight.

Open drawer (or other type of housing), place container inside housing.

Remove lid, lay down container and if need be carefully use tweezers to entice or maneuver spider out of container and into housing.

Once spider has moved away from container, carefully remove container, gently close housing and secure.

7.6 Transport Requirements

Spiders can be sent by post domestically through Australia Post.

Visit: <http://austpost.com.au/Pdfs/DangerousGoodsGuide.pdf> and refer to pages 41 to 43.

Care and consideration towards temperature needs to be taken into account (IATA. Pg. 26. 5.1.9. Environmental) during travel and at the destination.

‘To protect animal from temperature extremes, blankets or other suitable means may be placed partially over the container, as a temporary measure, for a short period of time.

Care must be taken to avoid suffocation. One the other hand, animals must not be exposed to direct heat, such as placing them in sunlight or near radiators’ and ‘the different climatic factors prevailing during a journey must always be considered when arranging the routing and carriage of live animals’. (IATA. Pg. 26. 5.1.9. Environmental).

Environmental).

‘Animals known to be for laboratory use must not be stored adjacent to other animals in order to reduce any risk of cross-infection or contamination’. (IATA. Pg. 26. 5.3. Segregation).

‘Due to the frequent disinsecting of aircraft holds and the residual nature of the insecticides used, insects cannot be carried other than in airtight containers in certain aircrafts (consult the airline). (IATA. Pg. 261. Container requirement 62).

Along with being placed on appropriate and authorized carriers, care must be taken in handling live animal containers and be placed on craft as close to the departure time as possible.

(IATA. Pg. 303. 10.3.2 Particular loading requirements for certain species, 10.3.3 Loading of live animals with foodstuffs and 10.3.4 Loading live animals with dangerous goods) Animals labeled, as ‘Laboratory Animals’ cannot be placed near other animals. Animals cannot be placed near foodstuffs or near dangerous goods such as dry ice or crynogenic liquids.

‘The captain must be advised of the species, location and quantity of all live cargo on board the aircraft’ and ‘flight crew must be notified of any live animal load and of the required actions (i.e. Hold temperature or ventilation).’ (IATA. Pg. 305. 10.6 Advice to captain).

(IATA. Pg. 305. 10.7 Health and hygiene). Veterinary treatment for injured or sick animals and/or removal of dead animals when placed with other animals must be sought as soon as possible.

7.6.1 Box Design

(IATA. Pg. 261. Container requirement 62). Outer container.

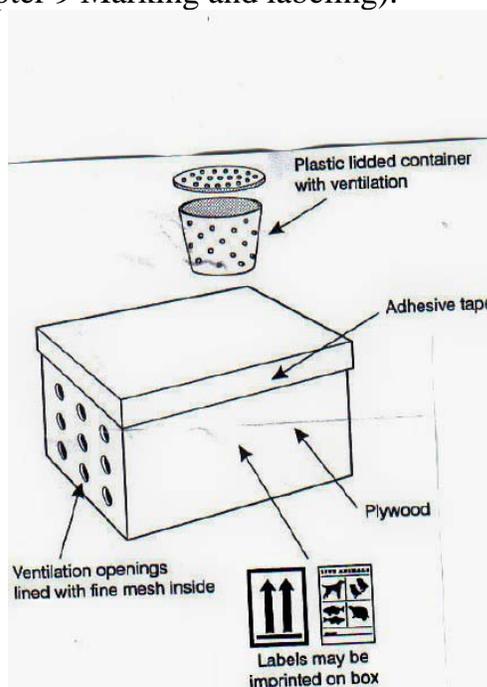
‘Must be constructed of fiberglass, wood, wood products or any plastic material of adequate strength. The container must have solid sides, top and base. The sides shall have ventilation openings and the interior of the sides shall be lined with fine mesh so that there can be no escape by the occupants’.

Inner container

‘Plastic container(s) are preferred. Plastic or polyethylene bags must not be used for insects with biting/chewing mouthparts’.

Ventilated plastic cups/containers must be firmly closed and packaged securely into the outer container so that they are not thrown about during handling or transport’.

(IATA. Pg. 299. Chapter 9 Marking and labeling).



Above: Example from IATA Container Requirement 62.

‘The shipper is responsible for all necessary markings and labeling on each live animal container. Each container must be of such size that there is adequate space to affix all required markings and labels’.

‘Marking must be durable and printed or otherwise marked on or affixed to the external surface of the live animal container’.

‘English must be used in addition to the language which may be required by the state of origin’ (if applicable).

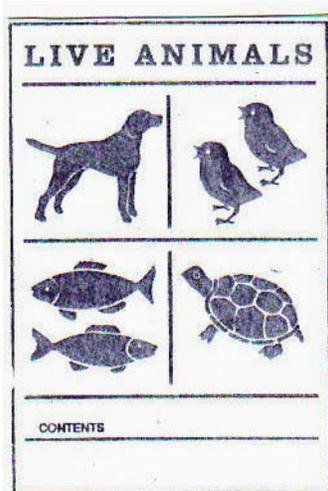
‘Containers carrying animals which can inflict poisonous bites or stings must be boldly marked ‘POISONOUS’.’

‘The material of every label, the printing and any adhesive thereon, must be sufficiently durable to withstand normal transport conditions and to ensure that the label remains recognizable and legible during transportation’.

‘All labels used on live animal containers must conform, in shape, colour, format, symbol and text to the specimen’.

‘Any labeling, especially on small containers, must not occlude or block ventilation openings’.

The following labels **MUST** be on all relevant containers. (containing funnel-web spiders).

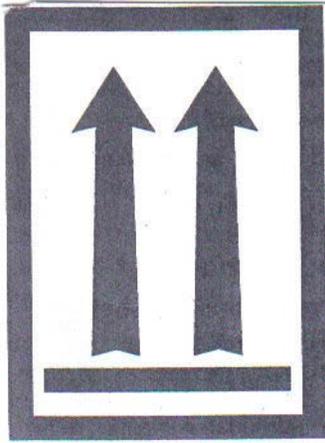


Left: ‘Live Animals’ label. (from IATA)

‘Live Animals’ label. Colour: bright green on a light background.

Minimum dimensions - for label: 10x15cm

- for lettering: 2.5cm high



Left: 'Package Orientation This Way Up' label. (from IATA)
'Package Orientation This Way Up' label. Colour: bright red or black on light background.
Minimum dimensions: 10x15cm



Left: 'Laboratory Animals' label. (from IATA)

'Laboratory Animals' label. Colour: bright red on light background.
Minimum dimensions: 10x15cm

A 'KEEP OUT OF DIRECT SUNLIGHT' label should also be used, using IATA label requirements.

Refer to the current IATA Live Animal Regulations edition at time of transportation needs.

7.6.2 Furnishings

Furnishings should include peat moss or soil substrate and a small piece of bark.

7.6.3 Water and Food

Funnel-webs only require feeding once a week. Depending on the length of travel time, feeding should not be required. Long durations of transportation and travel

should be organised for the day after feeding. This will give plenty of time for transportation before spider needs to be fed again.
Soaking cotton wool or gauze material in water and placing in a peitree dish is a suitable way of providing water.

7.6.4 *Animals per Box*

Only one funnel-web spider can be placed each a container due to their solitary nature, however, the outer box can hold more than one container – this will depend on the box dimensions and the dimensions of the individual containers. This may be useful in minimizing container movement within the box.

7.6.5 *Timing of Transportation*

For short distance transportation, either early morning or late afternoon is recommended to minimize overheating and death from exposure to sun.
For longer periods of transportation and travel, funnel-webs should be loaded and unloaded in the cooler times of the day and time spend on aircrafts or in cars/trucks/vans should be in the warmer times of day with plenty of ventilation and airflow to reduce humidity where possible.

7.6.6 *Release from Box*

Refer to above, 7.5 Release.

8 Health Requirements

8.1 Daily Health Checks

A number of visual observations should be made on a WEEKLY basis when feeding. These observations include:

- All limbs present and appear to be moving freely – touch each limb with tweezers or forceps to check/test limb movement
 - Normal body shape and abdomen size
 - A normal resting posture - legs not curled under spider
 - Showing normal defensive behavior such as running away or rearing up
 - Normal body colour - take molting into consideration and all other health checks and observations
 - No signs of mites
 - No signs of blistering in abdomen
 - Consider appetite by checking if food has been eaten a few hours – days after food is offered
- (T. Bell, personal communication, 2008 & HENDERSON, A.)
- Spending most of the time in a silk lined burrow. (HENDERSON, A.)

8.2 Detailed Physical Examination

- As above in Daily Health Checks
- Weighing

As well as checking for signs of good health, check for signs of ill health:

- Low activity including slow movement (lethargy)
- Not eating for an extended period of time (note that this can also be due to pre moulting)
- Not showing normal defensive behavior such as rearing up
- Very small abdomen
- Lumps or blisters in abdomen
- Sighting of mites on spider.

(T. Bell, personal communication, 2008 & HENDERSON, A.)

- Spending more time on the surface rather than in burrow
 - Shriveled abdomen
- (HENDERSON, A.)

Laelaptid mites only appear to be a problem in large infestations. (Grey, 1988)
Faecal matter is ‘white droplets with brown speckles – very much like miniature bird faeces’ according to HENDERSON. A.

8.3 Routine Treatments

There are no known routine treatments for funnel-web spiders; however, remedies can be used to treat mite infestations (see 8.4 Known Health Problems)

8.4 Known Health Problems

Cause – Laelaptid mites (genus *Ljunghia Oudemans*) (Grey, 1988)

Signs – Visual sighting of mites.

Treatment – Mites can be washed off using water or 70% ethanol, though, great care must be taken with the ethanol – this should only be done by a veterinarian or experienced invertebrate keeper.

The Hypoaspis species of mite can be introduced to the enclosure to clear infestations as this species of mite eats other mites and fungus gnats. (T. Bell, personal communication, 2008)

Prevention – Good hygiene and changing of substrate when infestations occur, otherwise unknown

The fruiting body of Cordyceps sp. (a fungal internal parasite) has been found on a dead *Atrax robustus* specimen (Grey, 1988), though the cause, signs, treatment and prevention is unknown.

Abdominal blisters have been found on spiders, however, the cause is unknown.

Mermethid worm larvae (internal parasite) have been found in species of funnel-webs (Grey, 1988), though, again the cause, signs, treatment and prevention is unknown.

In situations of over crowding, funnel-webs will eat each other. Unless breeding, specimens should always be housed individually.

When growing, both sexes molt, females will continue to molt when fully grown, however, no evidence has been found of de-formation due to molting. (T. Bell, personal communication, 2008). Low humidity or interruptions caused by feed (insects) may cause moulting problems. (HENERSON, A.)

8.5 Quarantine Requirements

As transportation would go hand-in-hand with quarantine, section 7.6 Transport Requirements and sections 7.6.1 – 7.6.5 in this document should be referred to and considered when moving or transporting species.

No formal quarantine information has been found regarding funnel webs, however, for overseas destinations it is imperative to check quarantine information for the exportation of funnel-webs from Australia and for importation to other countries.

As a precaution, '4 weeks of quarantine may be advisable to allow time to allow any internal parasites or mites to show themselves'. (HENERSON, A.)

As a precautionary measure, mentholated spirits can be used to clean forceps and tools used according to T. Bell (personal communication, 2008).

8.6 Vet Procedures

Other than veterinarian using ethanol for treatment of mites (mentioned in 8.4 Known Health Problems), there are no known vet procedures required for funnel-web spiders. Most vets will not be familiar with spider anatomy and treatment.

8.7 Euthanasia

There are no formal regulations or legislation regarding invertebrate euthanasia, however, the Department of Primary Industries General Methods of Euthanasia should still be followed.

Euthanasia option can include:

- Cooling by refrigeration followed by freezing (HENDERSON, A.)
- Placing into 70% ethanol or
- Placing into boiling water.

(T. Bell, personal communication, 2008)

8.8 Post Mortem results

Dr. Michael Grey and others have examined and studied many dead funnel web spiders, this is the way most individuals and their body parts are assessed to determine species and this is also how new species are discovered.

Post mortem studies allow insight into causes of death and can help indicate possible health problems including diseases within species.

The fruiting body of *Cordyceps* sp. (a fungal internal parasite) has been found on a dead *Atrax robustus* specimen (Grey, 1988).

9 Behaviour

9.1 General Behaviour

All species of funnel webs spend the majority of their lives in the burrows. Some species will leave their burrows to hunt for prey at night while others will wait for prey to stumble across the trip lines constructed by the spiders with silk and ambush them.

Other than leaving their homes briefly to apprehend prey, the only other times they will leave is to emerge just outside to clean and in the case of males, to find females to reproduce with.

It is not known what these spiders do exactly within their burrows or how much time is spent in any activity, though; it is suspected that they do spend most of the time in torpor.

Funnel web adults will moult annually - in captivity this can happen at various times throughout the year. Juveniles moult more frequently and may moult monthly during the early stages of life if feeding well. The frequency of moults will decrease with age until it becomes more or less annual. (HENDERSON, A.)

9.2 Activity

The funnel web spiders, like all primitive spiders, are almost strictly nocturnal (Brunet 1996), they may leave their burrow at dawn before the sun rises and/or if the morning is overcast. (Hadlington & Johnston, 1998).

The time spent bathing and constructing burrows is unknown but bathing usually takes place at dawn before the sun rises just outside the burrow entrance. Hadlington & Johnston, 1998)

When hungry, hunting species will venture out to hunt at night. (Hadlington & Johnston, 1998)

Wondering of both males and females if they are flooded out of their burrow or if they are disturbed. (Hadlington & Johnston, 1998).

9.3 Social Behaviour

Funnel Web spiders are not social. Only during mating season when male funnel web spiders seek females do they encounter each other, this is a highly risky act for the males who may be eaten by a female if he is not successful in courting her or even if he is, directly after mating he may be eaten if he is not quick to escape. (Hadlington & Johnston, 1998)

Female funnel web spiders will care for her spiderlings for a limited time, though; the spiderlings can be cannibalistic, eating their kin. This is the cue to leave their mother's burrow and construct their own.

9.4 Reproductive Behaviour

Like all primitive spiders, the funnel web species mate during the night (Hadlington & Johnston, 1998). In the spring and summer months (breeding season) the male funnel webs will leave their burrows indefinitely and begin their search of females to mate with (Hadlington & Johnston, 1998). Once the male finds a female's burrow he will begin to 'drum' a beat on the silken lines at her burrow entrance. The female will greet him with an aggressive rearing stance to strike at him but will fall into a trance to his 'drumming'. The male will continue to 'drum' and in the case of *Atrax robustus*, he will rear up with her and hook her second pair of legs with the spurs on his second pair of legs and hold her while he continues to 'drum' and transfer his sperm from his palps to the female's genitals. In other subspecies, the male will hold the female up by her fangs with his spurs. (Grey, 1988)

If a males 'drumming' is not successful and does not put the angry female a trance and if he is not fast enough to retreat she will advance on him to strike and kill him. (Grey, 1988).

9.5 Bathing

Funnel webs emerge and clean themselves just outside their burrow. Lying on one side, the other side will be cleaned with their legs, and then they will lie on the other side and clean the side they were laying on. (Levitt, 1961)

No water body needs to be provided for bathing as spiders clean themselves with their legs.

9.6 Behavioural Problems

There are no reports of stereotypic behavior in funnel web spiders.

Aggression is shown towards keepers due to their natural aggressive nature.

9.7 Signs of Stress

There are no apparent signs of stress for funnel web spiders, though; a male funnel web unable to seek a female due to the confinements of his housing may become slightly stressed.

9.8 Behavioural Enrichment

There are many enrichment options for funnel web spiders, mainly in a variety of food and housing furniture or design, though; these spiders spend the majority of their lives in their burrow.

Due to the amount of time funnel webs spend in their burrow and that they only eat once a week, there is no need to provide enrichment everyday.

The table below shows a possible enrichment calendar plan, which can be recycled each month. Due to the above mentioned inactivity of funnel web spiders, enrichment in the below calendar may not be effective, however, the aim is to provide the spiders with choice and variety in their feeding and environment.

MONTHLY ENRICHMENT CALENDAR:

1st	2nd	3rd	4th	5th	6th	7th
Mealworms and a pinkie mouse	nothing	nothing	Fresh soil clumps with plant material attached	nothing	nothing	Add/remove rocks of various sizes and textures
8th	9th	10th	11th	12th	13th	14th
nothing	nothing	Change substrate soil to peat moss	nothing	Change bark or use another type of bark	nothing	nothing
15th	16th	17th	18th	19th	20th	21st
Give snails	nothing	nothing	nothing	Try scent sprays (eg eucalyptus)	nothing	Place in larger container or box with running water
22nd	23rd	24th	25th	26th	27th	28th
nothing	Add thin layer of sand on top of substrate	nothing	Provide cockroaches	nothing	Place small hollow log inside	nothing
29th	30th	31st				
nothing	Try scent sprays (eg mint)	nothing				

9.9 Introductions and Removals

Funnel web spiders must always be housed separately as they are highly territorial. Only during breeding seasons can a male be housed with a female. The male should be introduced into the females housing and should then be observed until he has found the female's burrow and mated with her. If the female does not eat him after mating (Hadlington & Johnston, 1998) or, if he is unsuccessful in his courtship to her he should be removed immediately, however, if he does mate he will die soon after.

See section 7, Handling and Transport, of this husbandry manual for additional information.

9.10 Intraspecific Compatibility

Funnel web spiders must be housed separately; they are highly aggressive and cannibalistic (Grey, 1988), (Ternece, 1998). See section 4 Housing Requirements, of this husbandry manual for additional information.

9.11 Interspecific Compatibility

Funnel web spiders cannot be housed with other species or with their own kind for that matter, as they are highly aggressive and will strike out from their burrow at any creature moving past either to eat or defend themselves. (Grey, 1988), (Ternece, 1998).

10 Breeding

10.1 Mating System

There is no evidence of funnel web spider's mating system, however, it is likely that the males would be classified as being polyandrous (mating with more than one female in a breeding season) as, if he is able to mate with a female and retreat before being eaten he will surely try to mate again with another female. This is because males do not survive more than one breeding season (Hadlington & Johnston, 1998) and their desire to procreate would lead them to have as much success as possible. Whether or not he is successful in mating, a male will not eat during or after a breeding season and die. If a male is unsuccessful in courting a female he will continue to seek females until his death.

10.2 Ease of Breeding

A consistent rise in temperature (spring and summer months) will trigger males to begin 'wondering' in search of females to mate with. (Brunet, 1996). Breeding is quite easy to achieve. Only one successful mating between a male and a female is needed to produce plenty of offspring and many captive institutions will have experienced success (Grey, 1988).

10.3 Reproductive Condition

A good general health is important for both males and females to have the best chances of reproduction and survival, this is more so in the males who will not eat during the breeding season, spending all their time dedicated to procreation. See section 8, Health Requirements, for further information on good general health.

10.4 Techniques Used to Control Breeding

For the case of funnel web spiders, the control of breeding is very easy as these spiders must be housed individually and a decision to place a male in the female's housing for breeding is the only way reproduction is possible for them in captivity. Mating can be observed and monitored as this occurs outside the burrow entrance. There is not need to destroy an egg sac if breeding takes place as this mating would be planned, however, individuals can be culled if not all are needed. See section 8.7, Euthanasia, for further information on culling.

10.5 Occurrence of Hybrids

There is no evidence of hybridization within funnel webs. In the wild it is possible that subspecies that are in close range of one another may hybridize, though; it is likely that the males of each species would only 'wonder' and come across females of the same subspecies.

In captivity where they must be housed individually and breeding must be planned, it is possible that hybrids may accidentally occur if a male or a female is incorrectly identified and placed with another subspecies for breeding. Perhaps it is possible that either sex may be aware of the difference in subspecies and not breed.

10.6 Timing of Breeding

Funnel webs are seasonal breeders (Brunet, 1996). The breeding season of funnel web spiders occurs in the warmer months of spring and summer. (Brunet, 1996)

Male funnel webs (in captivity) should be observed for signs of leaving their burrow and 'wondering' around their housing. This is a clear indicating that he is ready to search for a female and reproduce.

10.7 Age at First Breeding and Last Breeding

Males reach maturity in their 5th year (Brunet, 1996) and have their only breeding season in this year.

It is unclear what age a female will have her first and last breeding years, she can live up to around 20 years.

10.8 Ability to Breed Every Year

Once females reach maturity they are able to breed every year but males only survive one breeding season.

10.9 Ability to Breed More than Once Per Year

There is no evidence to suggest that funnel webs are able to reproduce more than once a year. All evidence shows one breeding season (spring and summer months).

10.10 Nesting, Hollow or Other Requirements

There is no evidence of any particular requirements for the raising of young. See section 4, Housing Requirements, for further information.

10.11 Breeding Diet

There is no evidence of any changes to the females diet in the breeding season. It is not even clear if the female goes off food in any stage of the breeding season, however, more food should be offered prior to a male being introduced and up until she has laid an egg sac with results of food consumption being monitored, recorded and results studied.

10.12 Incubation Period

The female will lay a white egg sac in late spring or summer (Grey, 1988), (Hadlington & Johnston, 1998) and will guard the sac until the spiderlings leave to construct their own burrows in late summer (Grey, 1988), (Hadlington & Johnston, 1998).

10.13 Clutch Size

The egg sac is about 20 mm in diameter and round and has 80-250 eggs inside (Grey, 1988), (Hadlington & Johnston, 1998). The weight of the egg sac has not been recorded or has any evidence of sex ratio.

10.14 Age at Weaning

Spiderlings leave to construct their own burrows in the late summer (Grey, 1988), (Hadlington & Johnston, 1998) of the same breeding season they were produced in and though there is not certain evidence, it is suspected that females will be ready to breed again in the following breeding season in the next year.

There is no evidence or recordings of mortality rate except that cannibalism will eventually occur before spiderlings leave their mother's burrow. (Brunet, 1996).

10.15 Age of Removal from Parents

Spiderlings leave to construct their own burrows in late summer (Grey, 1988), (Hadlington & Johnston, 1998) of the same breeding season they were produced.

10.16 Growth and Development

There is no specific evidence or records of growth and development other than that funnel webs will go through several moultings before they reach maturity. There is no evidence or records of the size of spiderlings to compare to the average adult size.

11 Artificial Rearing

11.1 Incubator Type

There is no known specific type of incubator for Funnel Web spiders. Institutions would have the mother care for her young and do not feel the need for any reason to artificially rear Funnel Web spiderlings.

Funnel Web spiders are in abundance and therefore, a new spider would easily be obtained without the need to artificially rear spiderlings. Besides this fact, funnel web spiders are highly dangerous and hand rearing is not an option.

11.2 Incubation Temperature and Humidity

As above in section 11.1 Incubator Type.

11.3 Desired % Egg Mass Loss

There is no known desired egg mass loss; this would be the decision of each institution. Unwanted spiderlings or eggs can be given to other institutions that wish to keep Funnel Web spiders and are looking to acquire individuals. Any eggs or spiderlings that are not desired can be euthanased as per section 8.7 Euthanasia.

11.4 Hatching Temperature and Humidity

There is no known hatching temperature or humidity for Funnel Web spiders. As per 11.1, there is no known desire to artificially rear Funnel Web spiderlings.

11.5 Normal Pip to Hatch Interval

N/A

11.6 Diet and Feeding Routine

The diet and feeding of spiderlings is unknown other than they have the same feed as an adult (in a captive situation) and will probably feed a little more than an adult as they are growing. The mother will care for her young but in a captive situation; offer the same feed as for an adult but a little more, maybe an extra cricket. Spiderlings are known to become cannibalistic.

11.7 Specific Requirements

There are no known specific requirements for Funnel Web spiders.

11.8 Data Recording

Any information that can be recorded should be recorded. This would greatly benefit the institution as well as other institutions and laboratories keeping Funnel Web spiders in captivity.

Number of eggs, number of spiderlings (recording each day to establish if any have possibly been eaten or died), growth rate, any behavior of the mother or spiderlings, other general observations, food amounts offered, food amounts consumed by the mother and by spiderlings (if possible) and regularity or number of feedings (frequency).

11.9 Identification Methods

As Funnel Web spiders are solitary and need to be housed individually, identifying the mother of the spiderlings is easy as they are within her housing and with her in her

burrow. Identifying specific individuals is very difficult due to the sheer number of individuals, the fact that there are no distinguishing markings or features and the fact that spiderlings are very small.

Identification of individuals may need to wait until spiderlings become independent and can be placed in their own housing in which an identification number should be given (placed on front of housing).

This method of placing an allocated number on a funnel web spider's housing is the best method of identification as spiders are small and the number of them would make micro chipping not only expensive but also generally 'not suitable'. Leg bands and all other forms of identification are also unsuitable for funnel web spiders.

11.10 Hygiene

Standard hygiene requirements should be practiced. Washing of hands before touching and using tools and equipment. Tools should be cleaned after each use.

11.11 Behavioural Considerations

The same behavioural considerations apply for young as for adults. See section 9 Behaviour for further information.

11.12 Weaning

There are no known weaning requirements for Funnel Web spiders.

12 Acknowledgements

Many thanks to the staff at Taronga Zoo who have given their time to provided very useful information. Simon Brown, Brett Finlayson and Tamara Bell.

A very big thank you to Natasha Ford from Museum Victoria for all her time, a wealth of information and endless help and support.

Thank you to Alan Henderson from Museum Victoria also for his time, valuable information and guidance.

Thank you to Lyn Abra for her time and sharing her knowledge.

Thank you to Andrew Titmuss from Richmond TAFE, NSW for providing a wonderful and important source of information.

Thank you to Brad Walker from Richmond TAFE, NSW for providing a very useful source of information, helping to point me in the right direction and providing feedback on the manuscript.

Thank you to Jacki Salkeld of Richmond TAFE, NSW for reviewing the manuscript and providing feedback.

Thank you to Graeme Phipps from Richmond TAFE, NSW for endless motivation and inspiration.

Thank you to Vanessa Phillips for completing a peer review and supplying me with feedback on the manuscript.

13 References

BELL, T. (tamara.bell@zoo.nsw.gov.au), 10 September 2008. RE: FW: G'day. Email to V. BATTISHILL (v_battishill@hotmail.com).

Brown, Simon, 2008, Pers. Comm.

BRUNET, B., 2000, *Spider Watch*. 4th ed. Australia: Reed New Holland

Finlayson, Brett, 2008, Pers. Comm.

FORD, N. (tashwa7_13@hotmail.com), 30 April 2009. RE: more questions. E-mail to V. BATTISHILL (v_battishill@hotmail.com).

GREY, Dr M., 1988-1993, *Funnel-webs*. (publishing details unknown)

http://images.absoluteastronomy.com/images/encyclopediainages/a/at/atrax_robustus.jpg
(Accessed 1 April 2009) (Funnel Web in strike position photo)

http://tachinid.files.wordpress.com/2009/01/victorian_funnelweb021.jpg (Accessed 1 April 2009) (Cover Photo)

<http://www.environment.gov.au/cgi-bin/species-bank/sbank-treatment.pl?id=75618>
(Accessed 1 April 2009)

<http://austpost.com.au/Pdfs/DangerousGoodsGuide.pdf> (Accessed 12 June 2009)

2000. *IATA Live Animal Regulations*. 27th ed. Montreal – Geneva: International Air Transport Association

LEVITT, V., 1961. The funnel web spider in captivity. *In*: S. SUTHERLAND, ed. *Australian Animal Toxins*. South Melbourne, Australia: Oxford University Press, 408.

LINDSAY, T., 1998, *Spiders of Australia*. Australia: New Holland Publishers (Australia) Pty Ltd

14 Bibliography

BEVERLY, C. & PONSONBY, D. 2004. *The Anatomy of insects and spiders*. 2nd ed. Victoria: Penguin Group (Australia)

2000. *IATA Live Animal Regulations*. 27th ed. Montreal – Geneva: International Air Transport Association

JACKSON, S.M. (2002) *Standardizing captive-management manuals: guidelines for terrestrial vertebrates* revised, in *International Zoo Yearbook* (2003) 38: 229-243, The Zoological Society of London, London.

MASCORD, R. 1970. *Australian spiders in colour*. Sydney, Melbourne & Auckland: A.H. & A.W. Reed.

PRESTON-MAFHAM, K., MARVEN, N. & HARVEY, R. 1998. *Bugs, beetles, spiders snakes*. Leichhardt: Quintet Publishing Limited.

<http://en.wikipedia.org>

http://www.reptilepark.com.au/venom_spider.asp

15 Glossary

Abdomen –	The rear segment of a spider's body.
Araneomorph –	A spider classed as being a modern spider.
Atraxotoxin –	The lethal component of a Funnel Web spider's venom.
Book lungs –	The organs used to breath.
Carapace –	Dorsal plate of the forward segment of a spider.
Cheliceral (pl. chelicerae) –	Often referred to as the jaws.
Moult –	A process of shedding.
Mygalomorph –	A spider is classed as being a primitive spider.
Palps –	The second pair of 'legs' located on either side of the mouth.
Spinnerets –	The silk producing organs.
Toxin –	A chemical substance that causes illness in bitten victims.
Venom –	Fluid that contains numerous chemicals including those that break don the prey's body for consumption.

16 Appendix

The Australian Reptile Park, located in Somersby, NSW, Australia, houses an abundance of Sydney funnel web spiders (and other spider species) for venom production which is then used to produce antivenom.

For information regarding venom production, contact the Australian Reptile Park (details below).

AUSTRALIAN REPTILE PARK

PO Box 737

Gosford NSW 2250

Tel: +61 2 4340 1022 Fax: +61 2 4340 2990

Email: admin@reptilepark.com.au

Website: <http://www.reptilepark.com.au/>