



**Australian Government**  
**Rural Industries Research and  
Development Corporation**

# **Breeding and Growing Snails Commercially in Australia**

RIRDC Publication No. 00/188



## **New Animal Products R&D Program**

**RIRDC** Innovation for rural Australia





RURAL INDUSTRIES RESEARCH  
& DEVELOPMENT CORPORATION

# **Breeding and Growing Snails**

commercially in Australia

**A report for the Rural Industries Research and  
Development Corporation**

By B. Murphy

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# Foreword

Escargot (Snails) have been eaten by humans for thousands of years. Today they are consumed by millions of people world wide. Snails as a food source at present are under utilised in Australia.

This report investigates the feasibility of establishing an economically viable edible snail industry in Australia. The focus of this pre-feasibility study is directed towards the commercial production and management along with the establishment costs that will be encountered with the development of a large scale commercial snail farm.

The report also includes information on growing and breeding snails on a commercial level, detailing appropriate husbandry and stock control.

This project was funded from RIRDC Core Funds which are provided by the Federal Government.

This report, a new addition to RIRDC`s diverse range of over 600 research publications, forms part of our New Animal Products program, which aims to promote and accelerate the development of viable new animal industries.

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**Peter Core**

Managing Director

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# Executive Summary

This report investigates the feasibility of establishing a commercial snail farm within Australia. Snails have been and still are a much sought after food source and come to the table as a gastronomic delight. Recipes by the dozen are available to the chef for the enjoyment by the consumer.

Escargot is eaten throughout the world and many countries have large internal markets and a great deal of them export this product to those that do not produce snails for their own domestic markets.

France, Italy and many European countries produce and export snails in quantities that are measured by the ton. China and other Asian countries also grow and produce snails in large numbers and export their product around the world including to Australia.

North America and South America now have established commercial snail farms and produce top quality restaurant ready escargot for their own domestic markets.

The industry also extends its market profitability by offering technical information about how to grow, produce and market snails. They also supply the equipment and materials that are required to set up a commercial snail farm including the snails needed to start the new snail farmer on his way to financial independence.

The economic benefits obtained by these countries has given them the ability to generate revenue calculated in the millions whether it be dollars, francs or yen.

These animals are not grown in Australia on a commercial level at this time and 99% of the Escargot consumed in this country are imported from those that as mentioned have the export potential to do so.

This fact facilitated the need to investigate the possibility of establishing our own commercial snail farms and create an employment opportunity for those that may wish to venture into a economic and sustainable industry with potential for export capabilities in the future.

The information presented in this report has been gathered and collated over a period of some three years and also included a fact finding trip to France where a great deal of the technical and practical information was obtained.

Many experts involved in the biological aspects of the snails life cycle were consulted and numerous publications detailing information about snail farming (Heliculture) were sourced from all around the world so that this report would have the most recent data that are available today.

This report provides readers with information that should enable them make informed choices about their desire to embark upon a project that has never been attempted on a large scale before in Australia. Commercial snail farming involves a commitment by the grower that will

have to be a full time one as it is with any intensive agricultural industry that uses animals as the primary source of income.

The program(s) outlined within the report give the potential snail farmer the ability to successfully embark on a project that will result in a profitable and sustainable business. It includes a brief description of the biology of the snail and its life cycle as well as its nutrient requirements.

The report details the construction and start up costs involved with the development of a commercial snail farm. The nursery area and the growing out area which are the main capital cost components are described in depth with various options or systems for growing snails.

As snails are not readily accepted as a food source in Australia today the need for a comprehensive education and marketing programme will have to be incorporated into any snail farming venture. This aspect of the snail farmers business will be of paramount importance in the ability to succeed financially as most of the market today is dominated by snails imported from various countries overseas.

A full time commitment and a positive attitude to succeed where no one else has in Australia will be the prerequisite for future commercial snail farmers that are going to create not only a domestic market for their product but also in time an export one in which they will and Australia itself will benefit socially and economically.



# 1. Introduction

For thousands of years edible snails have had a place upon the menu in various European countries but it is France we think of when someone mentions Escargot, where snails are consumed in vast quantities.

However snail culture did not originate in the above mentioned country, for Pliny the elder tells us that a certain Fulvius Hirpinus first instituted snail preserves at Tarquinium, a Tuscan city not far from Rome at about 50 BC.

There the snails were kept in enclosures and fed on grain meal and boiled wine until fat enough to eat. By a combination of careful breeding, selection and feeding very satisfactory results were obtained.

During the expansion of the Roman Empire snail culture was introduced into the countries that came under its control. In Switzerland and in the provinces bordering on the Danube snail farming was still being practiced during the middle ages.

From Ulm, in the Swabian Alps 10,000,000 snails were sent annually down the Danube to Vienna and the Austrian convents, where they were eaten under the name of fish during the season of lent.

With the ultimate demise of the cheap water transport this market was slowly lost, but the industry still persisted through many small snail farmers until a sure market was found in France during the latter part of the eighteenth century.

The introduction of the snail as a food source in France was in a rather haphazard manner. French wine merchants who went to Burgundy each year on buying trips had to stay at the local inns where they were frequently served snails that had been gathered from the surrounding vineyards.

This to them was an unusual but savoury dish and was commented upon by the merchants when they returned to their homes in Paris. Enough interest was gradually aroused to the point where one of the coaches that travelled between Auxerre and Paris was hired to bring the first baskets of snails to the markets of the French capital.

About 1850 the trade in Burgundy of snails was greatly increased with the advent of the railroad for they could now be transported greater distances while still fresh. In this way new markets were developed in France, Italy and Spain. Snail farms now exist in almost every country in the world.

The common garden snail that we find in abundance through out Australia is the species *Helix Aspersa* and is known as the Petit-Gris (small grey).

It is not a native gastropod of this country but an introduced species of snail that made its way into Australia as some of our other well known agricultural pests did. People bought them here because they wanted to eat them.

The snails also arrived via the confines of freight that originated from the many European countries that valued the snail as a fine food fit for the gourmet.

At the present time in Australia the only commercial source of *Helix Aspersa* available to the chefs of this country comes in a can. There are a few individuals scattered around Australia who are growing snails for the restaurant trade but their stock levels indicate they are operating on the basis of a cottage industry. By all accounts their product is of the highest quality and much sort after but as mentioned in limited supply and the demand for their escargot is far greater than the amount available to the market.

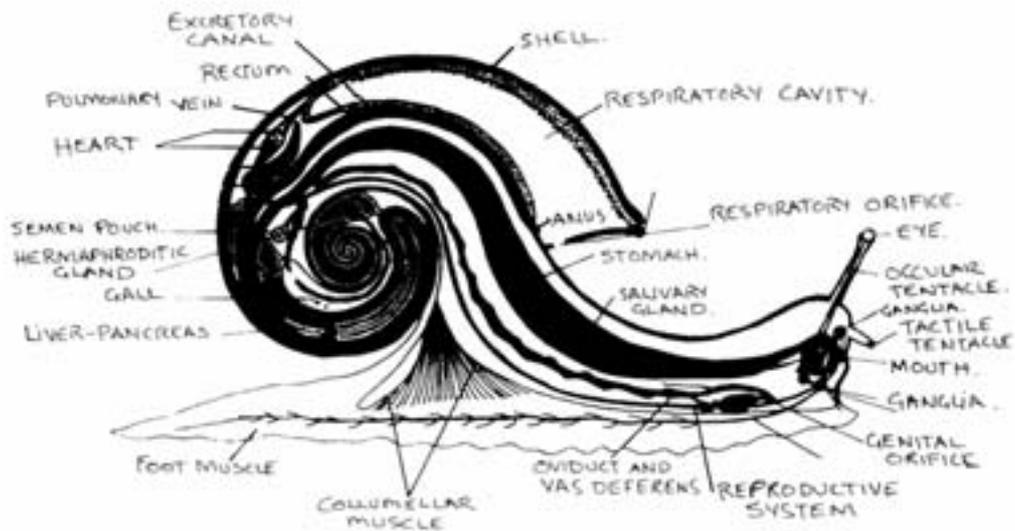
## 2. Production and Management

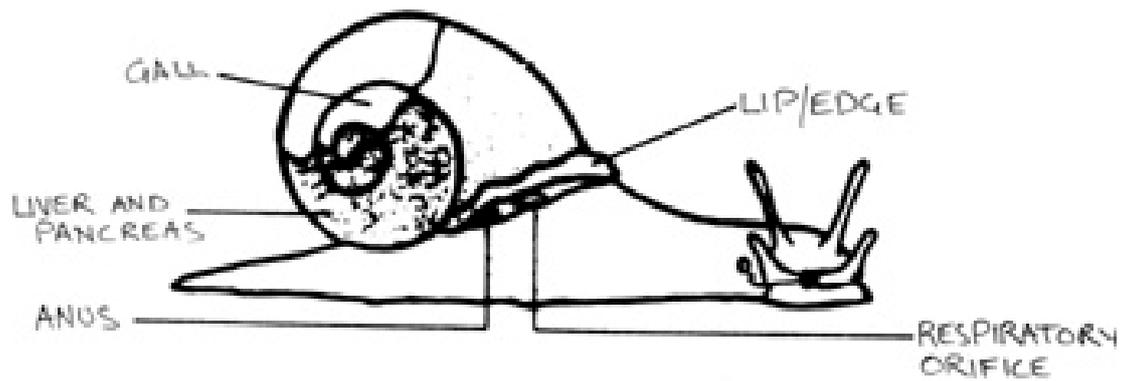
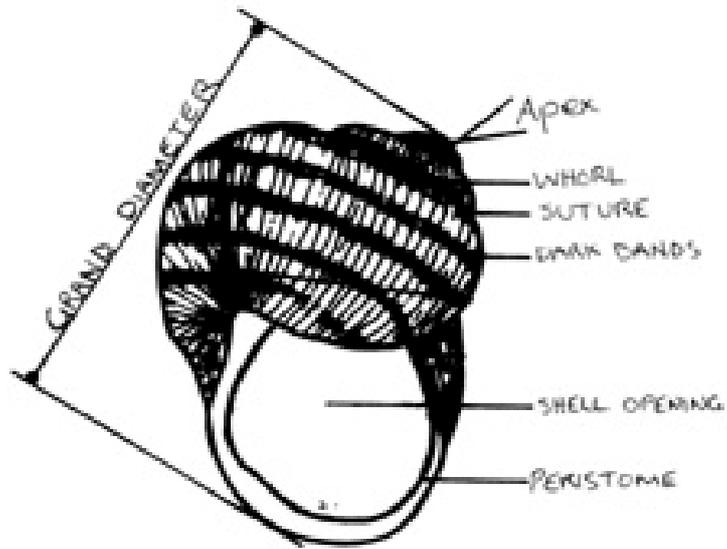
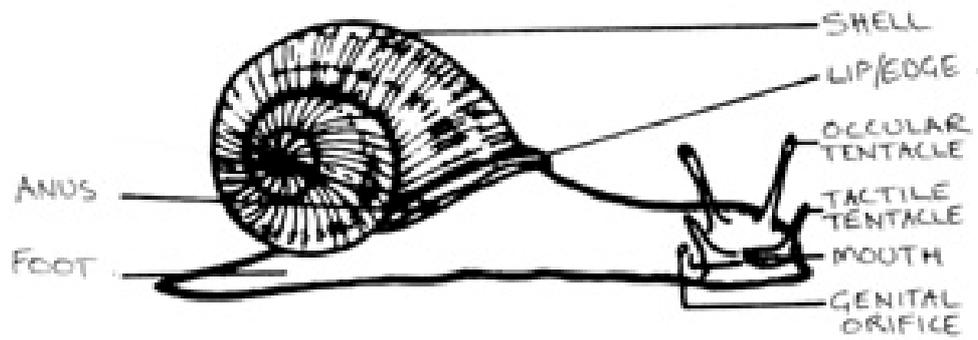
### 2.1 Biology and Anatomy

Snails are classified as follows:

MOLLUSK	(Branch)
GRASTROPOD	(Class)
PULMONE	(Order)
STYLOMMATOPHORE	(Sub-Order)
HELIX	(Genius)

- The (species) *H. aspersa* is the snail that is referred to in this feasibility study.





## 2.2 The Shell (and its contents)

The shell is a calcareous concave cone coiled clockwise in three or four whorls. The shell is covered by a thin coating called the cuticle or periostracum which gives it its colour. The shell is secreted by glands located along the edge of the mantle, the *tegument*, which covers the visceral mass.

The shell is made up of three main layers, the thin outer periostracum which consists of an organic compound known as conchiolin, the second much thicker layer is made up of three layers of a crystalline calcium carbonate based on an organic matrix.

The innermost layer called nacre is the mother of pearl colouring seen mostly in marine molluscs.

The structure of the shell is a proteinic web 1-2 mm thick which is impregnated with calcium carbonate(98-99%). It has one opening, of which the edge is called the *peristome*, which is not that well formed nor calcified until the snail becomes an adult. Upon adulthood this forms an edge or lip. The shell represents approximately one third of the total weight of the snail.

The shell opening is at times covered by a membrane called the operculum. This membrane can be observed when the snail is in a period of aestivation (at rest) or in hibernation.

The growth of the shell is not regular or even. The shell formation itself is influenced by a number of factors.

These factors included food type and availability, temperature and relative environment, growth hormones and the basic colour(s) and design are determined genetically.

Variations can develop and will be influenced by the food intake and temperature along with the genetic predisposition which the snail farmer is able to manipulate.

Large snails mated with other large snails will produce even larger snails. The shell also indicates the age of the snail and the maturity of the animal.

When the snail forms the distinctive lip or edge at the front of the shell as previously mentioned it will have attained a size that becomes the maximum for its whole life.

Once this lip is observed the snails (shell) will not grow any larger.

### **The Body**

The body is divided into three parts; the head, the foot and the visceral mass:

### **The Head**

The head carries two pairs of tentacles, the two large ocular tentacles are located above and the two smaller tentacles which have the sense of touch are below. The mouth is located beneath the tentacles. The mouth contains one tooth shaped in a circular arc and the tongue or the radula which is covered with small horn shaped teeth.

The upper jaw being the one continuous tooth is used to cut and scrape the food into its mouth.

Snails eat their food by using a rasping action of the radula, the file like tongue that contain the many teeth as previously described grinds its food by moving the tongue in a backward and forward motion.

The genital orifice is located on the right hand side behind the head. The scrotum, containing the vagina, the penis and the calcareous dart, is inside this orifice.

### **The Foot**

The foot supports the body and enables the snail to achieve locomotion. There are two openings that are located on the upper part of the foot near the edge or lip of the shell; one being the respiratory opening and the other being the anus. The form of locomotion achieved by the snail is a regular, continuous gliding motion.

Snails produce slime (a water/muco protein mix) to keep their bodies moist and also assists with locomotion. This slime also helps to protect itself against parasites and irritants. This mucous is produced all over the body surface allowing irritants to be sloughed off. The production of this mucus also reduces the amount of surface evaporation from the animals body.

Slime is mostly made up of water and that is why snails appear more active during or after rain or when conditions are moist. This environment being the most conducive for the snail to move about easily.

### **The Visceral Mass**

The visceral mass contains the organs of respiration, circulation, digestion and reproduction. The visceral mass is totally enclosed by the shell to protect these vital organs from any damage.

The respiratory system involves the lung which is made up of a capillary system that provides the oxygen for the circulatory system.

The circulation of the snail is an open blood system that has blood spaces instead of veins. This type of system allows the blood to circulate in the general body cavities.

The digestive system commences at the head with the mouth and continues along the oesophagus then into the crop and on to the stomach and finally the intestine and terminates at the anus which is located at the front of the mantle cavity.

The snail has a nervous system that is very well developed. The brain of the snail is composed of many fused ganglia that surround the buccal mass.

A system of peripheral nerves radiating from the brain mass connect with sensory organs, those being the eyes and the organs of taste, these also involve the sense of smell and controls the animals sense of equilibrium.

The nervous system also reaches out to the body wall of the snail.

## **2.3 Snail Management**

### **Snail farming systems.**

Snail farmers throughout the world have been experimenting with different types of production arrangements for a good many years. The search for the system that incorporates minimising labour input and greater economic returns for the amount of financial outlay is constantly under review by those directly involved with the day to day farming of the snails themselves, to highly qualified members of the scientific community.

☒ There are three systems in use at the present time.

#### **1. Outdoors.**

This type of snail farming is conducted completely outside in open parks, the snails are placed in areas enclosed by snail proof fences. The enclosures are planted out with various vegetation selected for its suitability as snail food. Snails are left to breed, reproduce and grow though out the season virtually unattended until harvested. This system has been adopted by the Italians and almost all the snails produced for the market are farmed this way.

Italian snail farms cover very large areas ( 2.5 hectares or more).

The amount of labour and materials is kept to a minimum and therefore has economic advantages when compared to the other types of snail farming described below. Unfortunately the snails are only harvested during the few months of the growing season and the amount of product available to the market is limited.

#### **2. Indoors.**

This system incorporates climate controlled buildings in which the snails spend their entire time under set parameters to facilitate the optimum environment for snail reproduction and growth.

The snails are fed a formulated mixture prepared by commercial feed producers that include all the nutritional requirements needed for each stage of the snails development. Snail farming at this level requires a high capital investment initially and the snail's and their environment need to be monitored constantly requiring the presence of human supervision seven days a week.

The indoors method has been researched in France extensively for approximately 20 years.

This type of snail farming arose because the winters in the northern hemisphere can be quite severe and the production of snails ceased at this time.

Growing the snails indoors enabled the farmer to produced snails all year round and therefore supply the markets with the fresh product on demand.

### **3. Indoors/Outdoors**

As the name suggests this system incorporates some of the management practices of both the above mentioned types of snail farming. Reproduction and the nursery environment use the indoor method, whilst the growing out phase is conducted outdoors.

This system enables the snail farmer to grow and produce snails all year round and therefore has the product available to the market at all times. This type of snail farming is now widely adopted in France and has been practiced for some time.

The Indoor/Outdoor method has been adopted by this study as it appears to be the one that will give the snail farmer in Australia a proven system on which to build a profitable and sustainable business.

The Indoor/Outdoor method is suitable for Australia because the climate along the southern end of the east coast is fairly mild and temperature extremes are not a great concern as they are in Europe.

The breeding greenhouse gives the snail farmer the ability to control the environment to such a degree that outside air temperatures do not interfere with the breeding program.

The same is applicable to the nursery greenhouse where the juvenile snails are able to feed and grow without any detrimental adverse weather conditions interrupting the desired growth rate.

The growing area is completely covered by shade cloth giving the snails protection from the sun, wind and hail, it also provides the snail farmer with an area that assists with the protection of the plants that the snails are to feed upon. The Indoor /Outdoor method of snail farming and management gives the grower in Australia the best of both systems that have been developed and proven overseas over many years.

#### **Environmental Factors.**

Humidity and temperature control as well as lighting needs to be constantly regulated. These factors and the correct environment are crucial for the reproductive process of the snail. They also play a very important role in the hatchability of the snails eggs.

#### **Humidity.**

The snail must maintain a constant equilibrium between the water in its tissues and the relative humidity of the environment for optimum reproduction activities as well as growth. The snail is capable of absorbing or excreting water out through the pores of its skin, this behaviour is determined by its immediate environment. The failure or success in raising snails depends on this factor and must be regulated accordingly.

#### **Temperature.**

Temperature control is also a critical factor that will determine the activity of the snail. The *Helix aspersa* prefers and functions very well at around 20C, above a temperature of 30C the snail will “shut down” by secreting mucus to seal its shell with a temporary covering called the operculum. This behaviour also occurs when temperatures fall below 6 degrees Celsius and at 0 degrees Celsius the snail will cease to function altogether and die.

## **Light.**

Light influences snail behaviour in conjunction with the seasons of the year, therefore in relation to reproductive processes it is an important factor that also needs to be controlled.

Many years of observation and research by eminent professors and zoologists have determined the light regimes and also the temperature and humidity levels for optimum breeding and reproduction processes.

This table represents a proven formula for optimum atmospheric conditions used in reproduction.

	<u>DAY</u>	<u>NIGHT</u>
Light Duration:	18 hrs	6 hrs
Temperature:	20C	17C
Humidity:	75%	90%

## **Regulating humidity within the reproductive environment.**

As humidity plays a vital role in the life cycle of the snail a system that delivers the correct levels is crucial. A system of overhead sprinklers designed to have an output that will provide the recommended misting capability of 130 micron droplets into the environment is required.

A hydrometer must be installed with the sprinkler system to monitor the relative humidity along with an automated water delivery control apparatus to ensure the required level of humidification. There are a number of these systems available on the market and their approximate costs are included in the section entitled Economic Analysis.

## **Regulating temperature within the reproductive environment.**

As previously mentioned temperature control is of great importance for determining the activity of the snail. Temperature control can be achieved by various methods. Heating the greenhouses by gas is the preferred method of achieving the desired temperature. The area of the greenhouse will of course determine the size and type of gas heater to be installed. A monitoring system to maintain the desired temperature must also be included with the heating system. Gas heating systems are used because of their portability and reliability. The materials used in the construction of the greenhouse also contribute to the regulation of the temperature inside the reproductive environment. These materials will be described in detail and also the construction of the necessary other environments in the following chapter.

## **Lighting control within the reproductive environment.**

Providing the correct amount of light the snail will need for their reproductive purposes can be achieved by natural or artificial means. Intensive snail rearing requires the application of artificial light to prompt the snails into their natural reproductive cycle.

The snails mating habits depend on the amount of daylight hours, the temperature and the level of humidity.

A proven system is one that uses watertight fluorescent tubes that have a capacity to deliver a 40 watt power output and spaced at distances that will obtain a homogenous diffusion of light within the reproductive environment.

To control the amount of light required a simple timing device that can be set for the desired time lengths will need to be incorporated into the environmental control systems.

## **2.4 Management of farmed snails**

Snails live by the seasons, so management within a controlled environment must manipulate those seasons to produce snails that grow quickly and reproduce when it's convenient for the grower to obtain a constant supply of the end product (Escargot).

Time frames for the production and growing of snails are important for the grower as the market will and does demand high quality snails all year round.

The statistical information for a sustainable and profitable snail farm contained in this report is based on an annual output of finished stock at the rate of approximately 300,000 snails that will be available to the market.

The figure of 300,000 snails is not that many when compared to the numbers that are produced in other countries where the yearly total output for some snail farms is measured in tonnes.

### **Start up livestock requirements**

Initially stock will have to be collected from the wild. The most suitable time for collection is during moist conditions. After or during rain in the spring time is most likely the best time to collect snails as the temperature is increasing and the snail has become active after the cold winter. Also new growth and the need to mate will make the snails more visible as they go about their business.

The snails collected need to be the largest ones available as they can be selected for the breeding program and also as stock that can be prepared for immediate sale.

The collected snails will be required to be kept in quarantine for a minimum 30-day period. This action should be also taken if the snails are for immediate sale.

The 30-day time period is considered a safe margin to make sure that any contaminants or toxins that they may have ingested prior to collection be expelled from all their biological systems.

The implementation of a controlled nutritional program to coincide within this time frame is also recommended.

Snails collected from the wild to stock the snail farm may encounter a high mortality rate as they adjust to their new environment.

The snails as mentioned may have recently consumed poisoned baits or have been subject to spraying of agricultural chemicals.

Also snails do feed on plants that contain alkaloids that are poisonous to humans.

## **Harvesting**

Snails can be harvested from almost any area where people have been practicing horticulture and of course the home garden always has its community of unwanted snails. The owners or custodians of these gardens are very obliging and often helpful when asked to assist with the eradication of this pest.

The best times to collect snails is late evening and at night when the snails are active in their search for food and depending on the season their search for a mate. Snails can also be harvested during or just after rain in daylight hours.

The equipment required for a successful snail hunt is suitable clothing for the weather conditions at the time, a powerful torch and a 10 - 15 litre plastic bucket complete with a fitted lid that has been perforated with small holes to allow for adequate ventilation.

The lid is necessary because the snails will escape over the sides of the container. They are very quick at doing this even though they appear to move slowly.

Once collected the snails are transferred as soon as possible to the previously prepared area(s) and distributed evenly over their new environment.

They are kept for the required 30-day period and fed a nutritionally based food, the composition of this food will be discussed in detail in the nutrition section of this study.

## **2.5 Breeding snails on a commercial level**

The correct selection of snails is paramount to the success of the breeding program, only the largest mature snails are selected from the initial collection of wild snails and this also applies to future selection criteria in obtaining the largest snails for subsequent breeding programs.

The genetic factors that determine what size the snail will grow to also show themselves after two years by producing larger snails that have been successfully bred beforehand from the largest snails from the previous breeding season.

Once collected the snails selected for breeding are placed in the reproduction area where they will stay for approximately three weeks to copulate and lay eggs. Snail densities of no more than 60 per square metre is recommended within the breeding area. Most of the snails mate during the night and this process can take from between 3 to 15 hours. Once fertilisation is complete the snail will proceed to seek a suitable spot in which to deposit its eggs.

The snail farmer provides plastic pots for this purpose. These containers are filled to a depth of 7cm with a top quality potting mix or very clean fine river sand. The laying medium must be kept moist but not wet. Keeping the egg filled containers in the breeding greenhouse will maintain the laying medium at the required moisture level.

Upon observing that a snail has positioned itself within a container the container is placed in a selected area in the greenhouse.

The snail should not be touched or disturbed while carrying out this activity.

It is advisable not to keep the snails that are used for any one breeding season but to select the next years breeding stock from the offspring of the previous season.

Mating and breeding takes it toll on the snail and many will die after laying eggs. Leave the snail in the container for 2 or 3 days then check the soil for eggs. After laying the eggs the snail is removed from the container and the container(s) are covered with a clear rigid plastic sheet which is required to allow the newly hatched snails to attach themselves to once they emerge from the laying medium.

It is advisable to keep accurate records during the mating and egg laying periods, also incubation times should be noted for future reference.

The relevant incubation times are given in section 2.7.

A variety of diseases will affect the snails ability to breed successfully and so it is very important to decrease the chances for any pest or disease to occur within the area designated for reproduction. A constant flow of fresh air within the snails environment will assist with keeping the occurrence of pests and diseases to a minimum. The installation of an insect control device is recommended if the cost is not to prohibitive

Hygiene within the breeding greenhouse must be maintained to the highest standards. Regular cleaning programs should be implemented and carried out along with any other management practices that are conducted during the breeding season.

The reproduction table is the area where the snails will mate and lay their eggs. This table can be placed in the nursery greenhouse but needs to be excluded from the nursery area itself by the addition of a partition separating the two areas. If economically feasible a separate greenhouse for the mating area is advisable as certain environmental conditions may be needed that do not coincide with the nursery program.

The reproduction table is made from constructing a timber framework that is designed to control and contain the snails while they are mating and laying their eggs. (see diagrams on pages 15 and 16).

The base of the table is made by attaching bird netting wire and then a timber laying pot strip is placed along the inside of the framework on top of the wire netting. Concave plastic strips that are used to transport fresh water and also act as feeding trays are put into position on top of the wire netting.

The application of the wire netting is to allow for maximum airflow over and around the table and to also assist with the reduction of snail waste that once expelled from the animal falls to the floor of the greenhouse.

The table needs to be sloped (only slightly) to allow the water to flow slowly from one end of the table to the other. This allows a continuous supply of fresh water for the snails to drink and the inclusion of the concave plastic strips provides a smooth surface that facilitates ease of movement for the snails when they are searching out a mating partner.

Food is placed along the outside edge of the plastic strip so that it is not washed away by the running water. The residual food will need to be removed periodically and the plastic strip cleaned regularly to maintain the appropriate hygiene levels.

The electric fence that is added to the inside top edge of the entire framework will prevent the snails escaping from the table during the reproduction period.

## **2.6 Mating**

The snail is said to be a monotreme because it possesses both the male and female genital parts together in the one opening. Even though the snail is a hermaphrodite fertile eggs are only produced by cross fertilisation when two snails mate. After mating, both may be capable of laying fertile eggs.

During the mating season which begins in spring the snails seek each other, smell and nibble each other and then join themselves for a very long coition of several hours, side by side over the horizontal plane. They prick each other with a calcium dart and after numerous pricks with this dart the pouch containing the vagina and the penis turns in on itself.

There is a reciprocal introduction of the male organ into the female conduit and the sperm received is then stored. At this time the genital gland issues no eggs.

Once mating is completed and the two snails separate the male part is absorbed and the female part develops. The spermatozoa leave the copulative pouch and move toward the top of the genital tract in order to impregnate the eggs that are discharged by the hermaphroditic gland.

If the snails are placed in conditions for reproduction that have optimum temperature, lighting and humidity the average time between mating and egg laying is 5-10 days.

The snail is able and does mate and lay more eggs during the season as long as favourable conditions and nourishment are provided.

*Helix Aspersa* while under scientific observation were found to mate again after a period of about 15 days.

## **2.7 Egg laying**

In order to lay its eggs the snail will dig a hole and burrow to a depth of between 4-9cm deep. It then deposits its eggs and leaves. The ideal soil conditions need to be friable and moist but not saturated and the provision of small plastic garden pots filled with a top quality potting mix prove most suitable for this purpose.

The eggs are spherical and translucent, white in colour and have a diameter of between 3-4mm. The snail lays its eggs in batches the number can range from 40-130 the average, being approximately 70-90.

Hatchability of eggs depends on soil temperature, soil humidity and soil composition. If these conditions are available the baby snails which are very small but fully formed will emerge within 18-21 days.

☒ Table No 1 gives an indication on how temperature effects the time for incubation of the eggs.

The eggs are extremely fragile and need to be handled and transported with great care.

Snail eggs can and are eaten. They are marketed under the name of French Caviar.

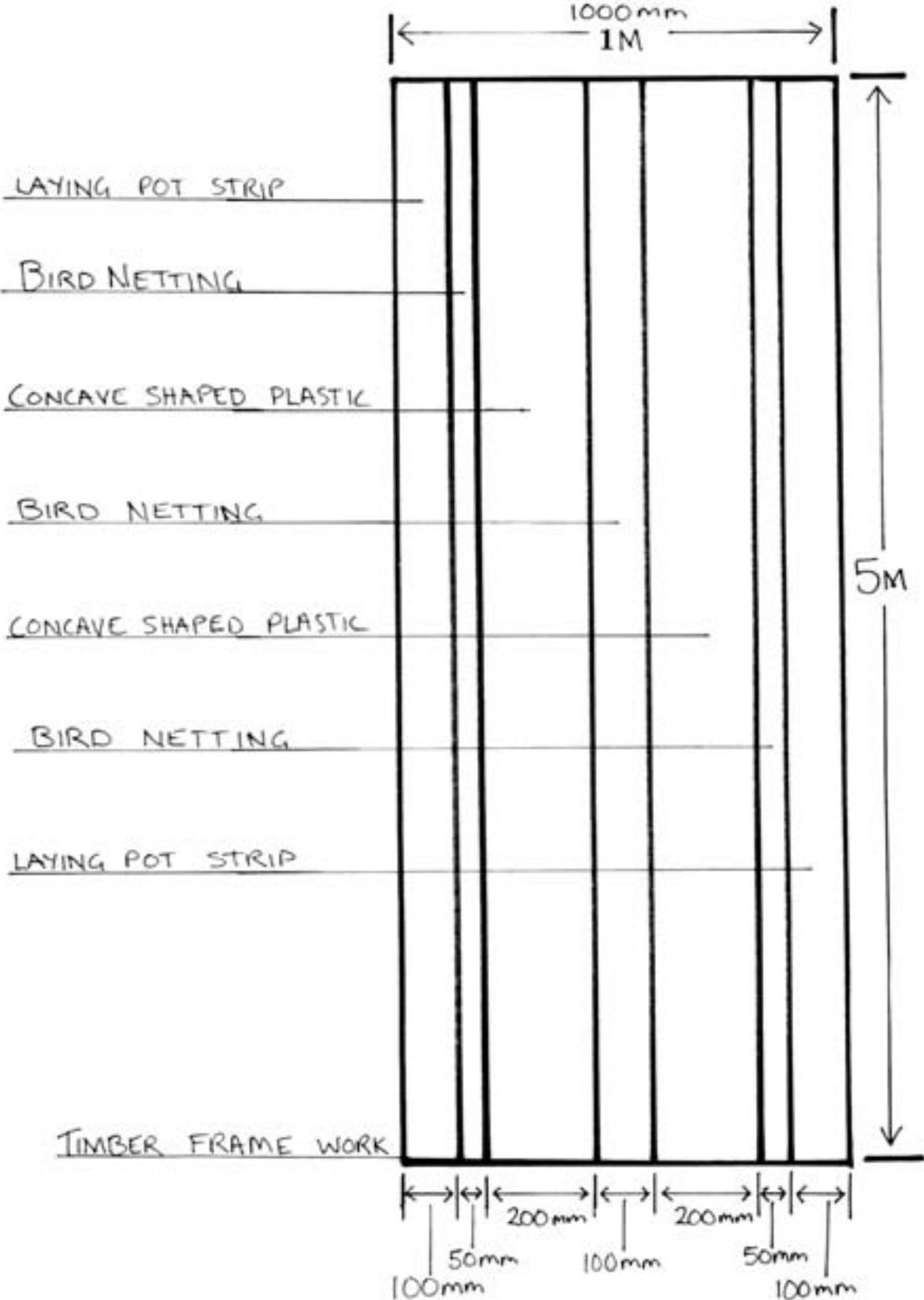
**Table 1.**

TEMPERATURE. @	INCUBATION TIME.
10 C .....	35 Days.
15 C .....	26 Days.
18 C .....	24 Days.
20 C .....	18 Days.

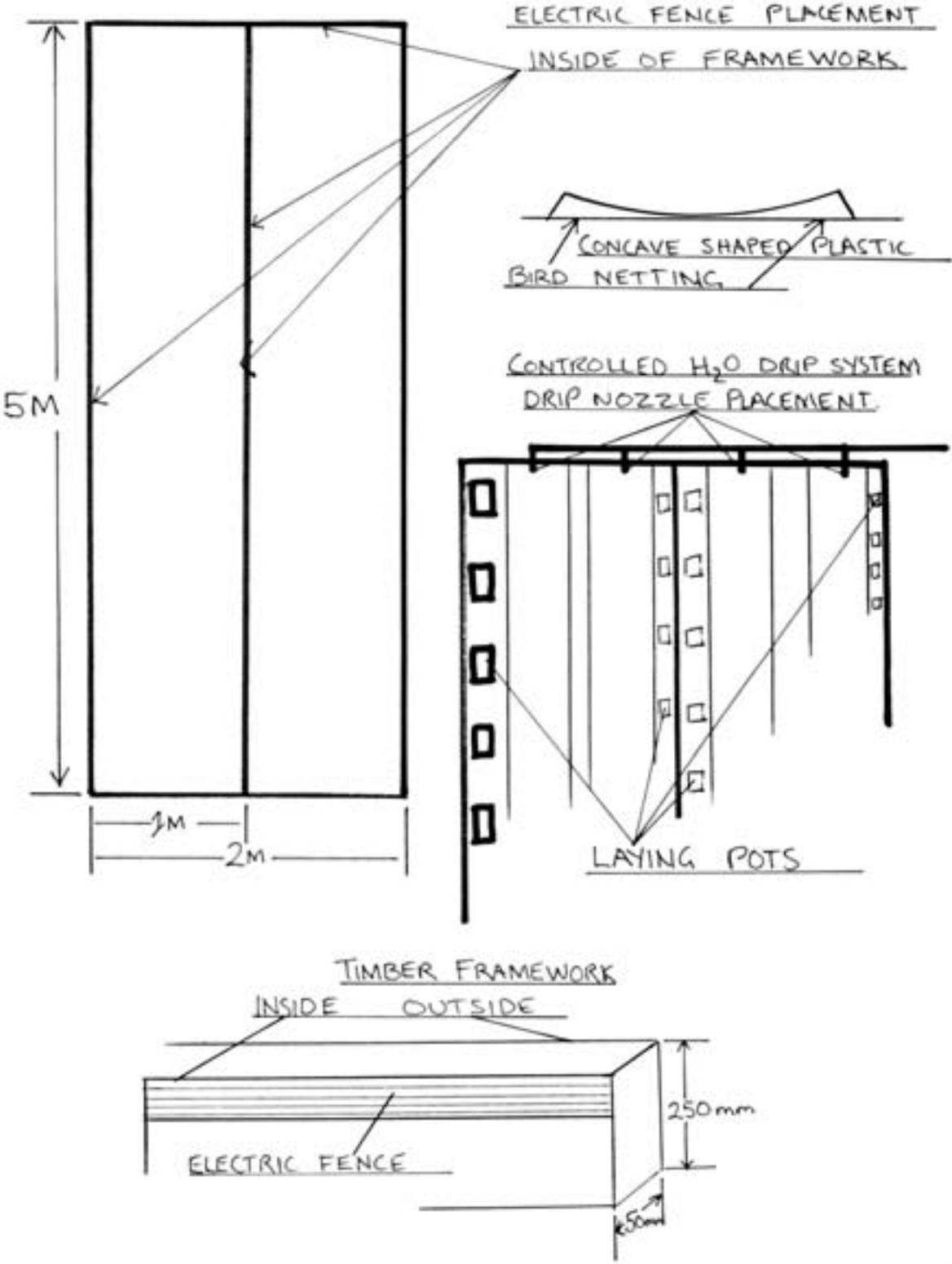
The above table represents a fairly reliable guide to incubation times for the *Helix Aspersa*, although other studies have observed these snails hatching within the relative short time span of 10 days. The eggs laid by the individual snail do not all hatch at the same time. It appears that some eggs will hatch within 1 day of each other while others may take up to 14 days for the last of the young snails to emerge.

The reasons for this variability are unknown at this time.

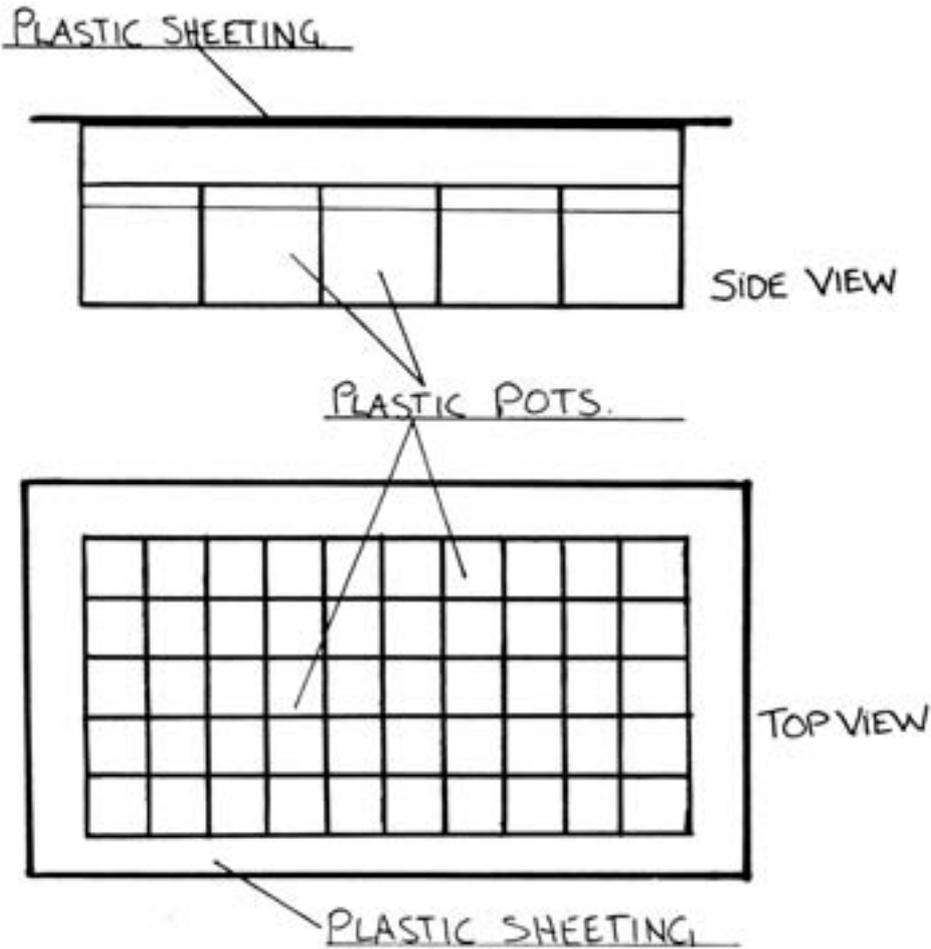
**The Reproduction Table (Dimensions)**



**The Reproduction Table (Details)**



**Incubation Box**



## **2.8 Incubation**

Two methods of incubation are available to facilitate the hatching of the juvenile snails.

### **Method. 1**

This method involves perhaps the easiest and less time consuming way of incubation. The egg filled containers that have been covered with the rigid sheet of plastic are kept in the breeding greenhouse in a suitable area that has been arranged for ease in the observation of the hatching snails.

In order to facilitate the hatching of the snails the top two or three centimetres of potting mix or river sand are removed without going down far enough as to uncover the nest of eggs. Once the snails emerge from their shells they spend about one to two days near the nest before coming to the surface where they will then proceed to attach themselves to the underside of the plastic covering that has been placed on top of the containers.

### **Method. 2**

The second method of incubation of the snail eggs is to remove the eggs from the laying medium by flushing them with luke warm water. The eggs are extremely fragile and must be handled very carefully. Once collected the eggs are placed into transparent dishes and transferred to an incubation box until the snails hatch. The recommended amount of eggs to be placed in these dishes is 15 grams. A diagram and design features of the incubation box is set out below.

With the correct environmental conditions the coefficient of incubation for both methods is: number of snails born to number of eggs laid is approximately 80%. This method is time consuming and more expensive than the first but it gives the grower a more controlled environment in which to hatch the snail eggs.

## **2.9 Egg removal**

To facilitate the removal of the newly hatched snails from the plastic sheets that covered the laying containers a soft brush can be used to transfer the snails into suitable containers. Also a plastic scraper can be used to remove the snails. This activity needs to be carried out on a daily basis while the snails are hatching as they may and do eat each other if left for an extended time.

The baby snails are extremely fragile also and can easily be damaged and destroyed during this operation. Careful and unhurried removal from the plastic covers is recommended to reduce the mortality rate during transfer.

Containers suitable for the storage and transfer to the nursery area should be made of a material that will allow for gas exchange. Some snail farmers overseas successfully use a very thin veneer (timber) container that are transported quickly and easily into the nursery.

The containers are placed on to floor of the nursery at regular intervals and then the lids are removed to allow the snails to escape into their new environment at their own pace.

It is advisable to transfer the baby snails to the nursery area as quickly as possible after collection to reduce stress and avoid the chance of suffocation.

## **2.10 Hibernation.**

The life cycle of the snail includes a period of hibernation. When temperatures fall to between 6 - 7 degrees Celsius and a lessening of natural light occurs the snail will cease all activity and prepares itself for the long sleep over the winter.

The combination of a shortening day length and decreasing temperatures are the natural triggers that tell the snails it is time to shut down and prepare themselves for the cold months ahead.

The snail (*Helix aspersa*) will bury itself into the soil to a depth of 3 - 6 cm or hide in crevices or under rocks etc; covers its shell opening with a membrane and shuts down going into a state of hibernation.

This shell covering membrane is called the operculum.

The operculum is a secretion that hardens on contact with the air and covers the entire opening of the shell. During this period digestion ceases by the absence of food and gas exchange becomes minimal.

The snail's metabolism is slowed to such a degree that it is able to remain in a state of hibernation for a period of up to six months. During this period the snail draws on its food reserves and loses weight increasingly as the period of hibernation continues.

Some snails because of their age and condition do not survive their long sleep and die whilst hibernating.

In Australia, temperatures along certain sections of the East Coast are not as severe as that of the Northern Hemisphere and snails can remain active and do grow during the winter months. The *Helix Aspersa* is found in sub tropical Queensland where temperatures during the winter months should enable the snails to breed and grow but Australian information (Simpson 1990) indicates that this is not the case.

Hibernation appears to play a significant role in the snail's ability to breed, grow and reproduce. (Jean-Claude Bonnet 1990). Overseas studies have indicated that a period of hibernation is mandatory to the success of breeding good quality large snails.

The snails that have been selected as breeders for the coming breeding season are placed in perforated plastic baskets and stored in a cool room that maintains the temperature at a constant 5 degrees Celsius with the humidity set at 85%. A lighting system needs to be incorporated and a timing cycle set to 6 hours of daylight and 18 hours of darkness.

The baskets can be stacked upon each other with timber slats placed between each row to allow for ventilation. Maintaining good ventilation is paramount to the survival of the snails that have been placed into hibernation. A good airflow around the baskets assists in maintaining the humidity level and helps keep down the pests and diseases that will occur within a closed environment.

## 2.11 The Nursery

This environment is a climate controlled structure specifically designed for raising snails in their juvenile stage. The nursery area is designed to allow for optimum growth and to provide a safe environment for the young snails when they are most vulnerable.

The Igloo type of greenhouse is the most commonly used structure for the mating and reproduction of the snails and it is also used for the nursery area.

The floor of the nursery is soil based. The soil is prepared before the introduction of the juvenile snails by means of a hand operated rotary hoe; there are many different companies that produce these machines and they are a necessary piece of equipment for the snail farmer.

Before using the rotary hoe to prepare the soil prior to seeding the ground an application of agricultural lime (calcium carbonate) must be incorporated to give the soil a pH value of between 6.0 and 7.5.

The pH soil test kits are available from most produce stores or farm equipment outlets. They are easy and simple to use and give instant results.

The test kits are inexpensive and the purchase of this invaluable tool is recommend.

The application of a complete fertilizer to the soil during the preparation period is also advisable to ensure adequate plant nutrition.

The introduction of worms into the soil of the nursery area to assist with the aeration and drainage of the soil should be included in the preparation stage. These animals are necessary to help keep the nursery clean as they process snail waste and also add nutrients back into the soil.

- Once the soil has been prepared correctly seeding can take place. The following list given below is an indication of what type of plants are suitable for the snails to consume while they spend their required time in the nursery.

A monoculture type of agricultural should not be practised within the nursery environment as this will lead to the crop planted being more susceptible to pest and disease infestations. Inter planting of a variety of the suitable plant types recommended will not only give the snails a greater selection of plants to consume but decrease the chance of the planted crop becoming infected with the unwanted pests and diseases

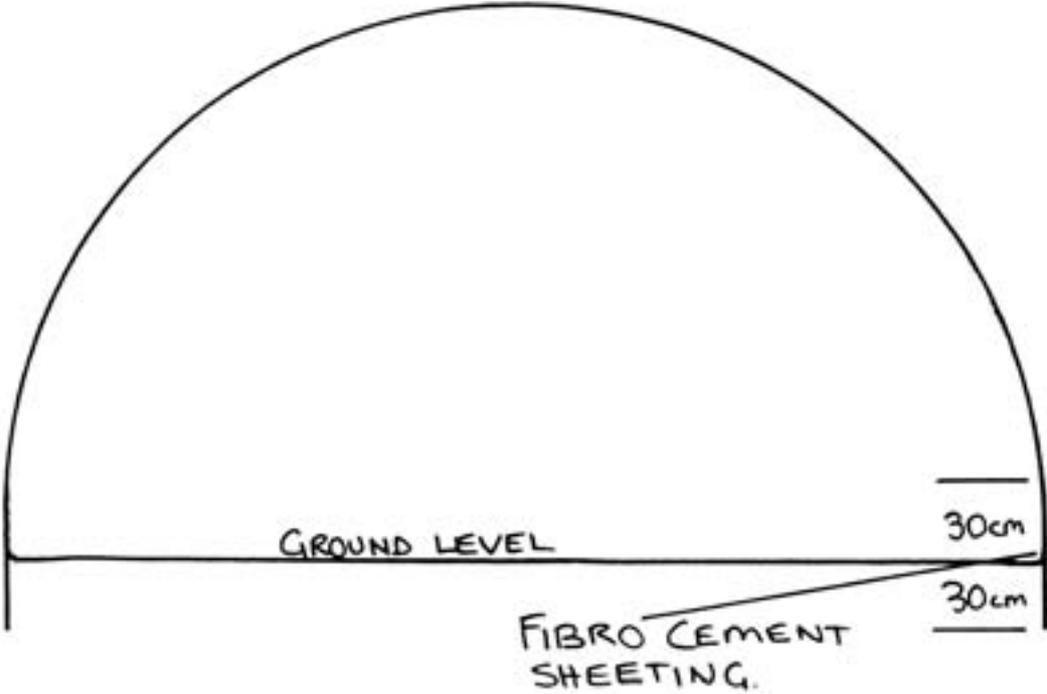
- Rye grass, Lucerne, clover, white cress, lettuce (all types), oats, parsley, wheat, peas, silver beet, cabbage, kale, beans, and spinach. Also any soft foliage type plant that does not contain high levels of alkaloids can be used and incorporated into the crop selection.

The nursery can be any type of structure that will enable the snail farmer to have an area where they can control the environment with various means of mechanical applications. The description of a snail nursery and all its components that have proven to be very successful is outlined in the following pages;

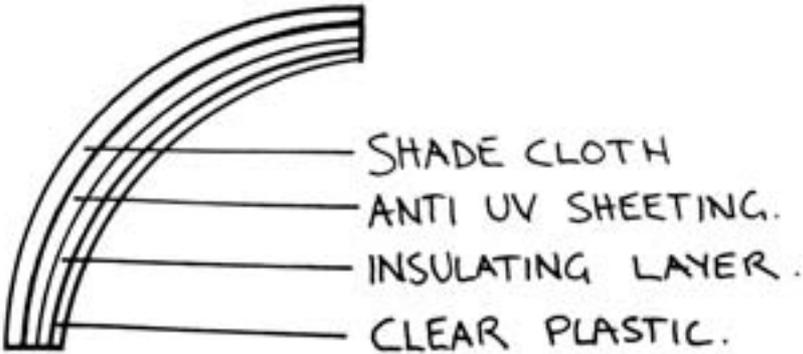
Materials required for construction of the snail nursery are as follows;

- Galvanised piping. (framework).
  - Clear plastic sheeting. (inner layer of greenhouse). Thermo plastic of 150 microns.
  - Bubble type insulation sheeting. (middle layer of greenhouse). 32mm diameter bubbles.
  - Anti UV plastic sheeting. (outer layer of greenhouse). Anti UV plastic of 200 microns.
  - Shade cloth rated @ 70%. (final covering of greenhouse).
  - A sprinkler system that can achieve the recommended droplet size of 130 microns.
  - A hygrometer.
  - Non treated timber planks 2m long by 30-40cm wide.
  - Half bricks or concrete blocks. 12cm by 8cm.
  - 100mm diameter PVC piping cut into quarters length ways and into 1m long sections. To be used as feeding troughs.
  - Heating system; (if applicable). If the temperature falls below 8 degrees C during the time period that the snails are in the nursery.
  - A timing system to control and monitor the watering /sprinkler systems.
  - Electric fencing. (ribbon type). This type of fencing consists of 4 to 6 ribbons of stainless steel, that is spaced 3 to 4 mm apart. An effective anti escape device is maintained between 4 and 12 volts with 4 to 6 volts sufficient for smaller snails.
  - Concrete paving blocks 30cms sq. (if required). To be used as a pathway along the length of the nursery. Saw dust is also a suitable material that can be used for pathways.
  - Fibro cement sheeting 60cms in width.
- \* There are companies that produce commercial size greenhouses that come in kit form and would be suitable for the nursery area.

The Nursery



GREENHOUSE COVERING



## **2.12 The Growing Area.**

This area is designed specifically for the growing out and fattening of the snails after they have spent their two-month period in the nursery.

The soil of the growing out area is prepared in the same manner as that of the nursery. The inclusion of the earthworms and the planting of a suitable type of vegetation are also required.

The non-treated timber boards and the placement of the feeding troughs are also similar except they are spaced at greater intervals.

The snails selected to be placed in this area will ideally need to have attained a weight of between 3 to 5 grams, although they can be placed into the growing area at a weight of 1 gram if insufficient space is available in the nursery.

The recommended density of snails for the growing/fattening area is between 250 to 350 snails per square meter.

Overcrowding will inhibit and slow down the growth rate of the snails and also cause health problems for them, which can and does have disastrous results for the snail farmer.

The bases of the walls for this area commences with either fibro cement or some other suitable similar material i.e.; tin sheeting or even concrete.

This material is placed into the ground to a minimum depth of 30 cm, which will act as a barrier for the animals that are known to eat the snails.

The main predator that will invade this environment are rodents, other predators include carnivorous birds also reptiles such as snakes, lizards and frogs. Insects including some ants and beetles will attack and eat snails. (The nursery area is also susceptible to these predators)

These predators will become quite prevalent if this measure is not utilised.

From the ground level to the top of the sheeting on the inside of the structure heavy-duty black plastic is used to cover the sheeting. At the top of the sheeting an electric fence is attached to the entire inside perimeter to prevent the snails escaping.

This anti escape system described in the nursery section should be set to run at between 6 and 12 volts.

Shade cloth with a 50% to 70% rating is then used to complete the fence which needs to be at least 2 meters high above ground level to provide ease of movement when the snail farmer is attending to the stock or working within the growing area itself.

The roof of this area will need to be covered with either shade cloth (recommended) or bird proof netting as birds will and do eat vast amounts of snails if they are able to catch them. Also the roof of shade cloth or netting will help to decrease the wind velocity passing over the enclosure.\_

Snails are susceptible to strong winds, which make the environment uncomfortable for them, and they will stop feeding and seek shelter to escape adverse climatic conditions.

The roof (shade cloth) needs to be added also to prevent or decrease the incidence of hail reaching the ground.

Hail when falling as large enough pieces of ice will injure the snail and is also capable of smashing their shells, which will lead to their ultimate demise.

The sprinkler system is the same as the one used in the nursery, using a timer and a hygrometer to measure the relative humidity with the growing out enclosure.

A watering regime can be organised to coincide with the prevailing weather conditions; i.e. wet and cold, hot and dry, warm and moist. The watering programme used will depend upon these factors and also taken into account will be the time of day. i.e.; in very dry conditions the sprinkler system can be activated early in the afternoon to maintain the humidity/moisture levels.

Depending on what time darkness occurs the sprinkler system needs to be activated 1 to 2 hours beforehand. This will ensure that sufficient moisture is available to the ground surface to facilitate ease of movement for the snails when they come out to feed after dark. It will also provide moisture for the snails to drink.

The amount of water released from the sprinkler system at any one time should not be as excessive to leave large pools on the ground that will not drain away within five to ten minutes. Snails seem to dislike direct or prolonged contact with water.

*Helix Aspersa* does not appear to be a good swimmer and will certainly drown if unable to extract itself from a pool or a not very deep (2cm in depth) container filled with liquid. A continuous stream of water over their bodies will stress them to the point where they will retreat into their shells.

As with the nursery the non-treated timber boards that will also act as a shelter and resting place for the snails during the day.

The snail food provided in this area also needs to be covered well so that no moisture can spoil it and make it unpalatable to the snails.

The plastic feeding troughs need to be cleaned and thoroughly rinsed between each feeding as previously mentioned in the section describing the nursery.

The snails contained in the growing out area will consume approximately 1 gram of dry food per day and feeding can be carried out on a weekly basis once a feeding regime has been established by observing the snails feeding habits and consumption levels.

If the food provided is becoming spoilt or appears inedible it will need to be removed and replaced and an adjustment of the feeding regime instigated. i.e.; every 3 to 5 days instead of weekly.

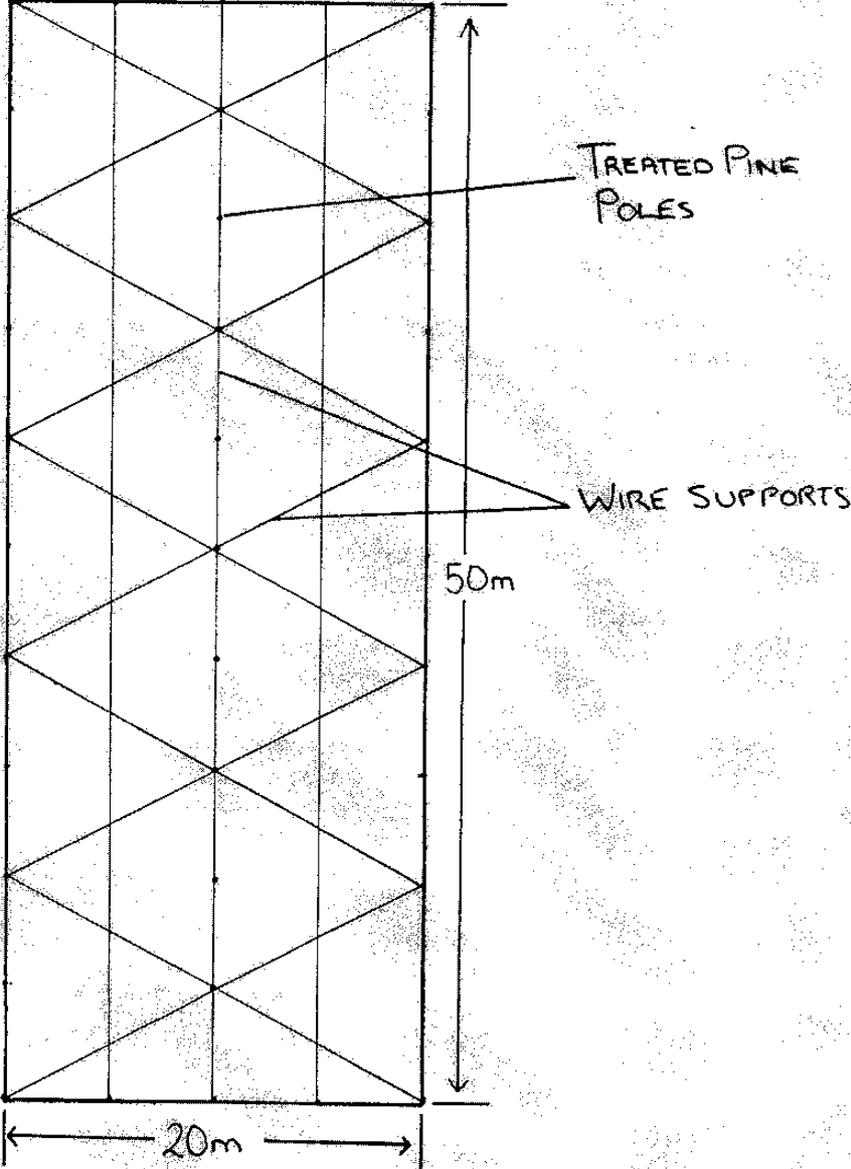
The necessary calcium that must be included in the snails diet can also be distributed around the enclosure in the form of rock calcium, as the snails will soon exhaust the calcium that is made available in the soil itself.

The snails will eat small amounts of soil in their diet to extract the available calcium. The rock calcium can be spread onto the ground surface at the rate of 100 grams per square meter. The less interference the snails are subject to the better as they are easily stressed by any disturbance to their environment and also by handling them too much.

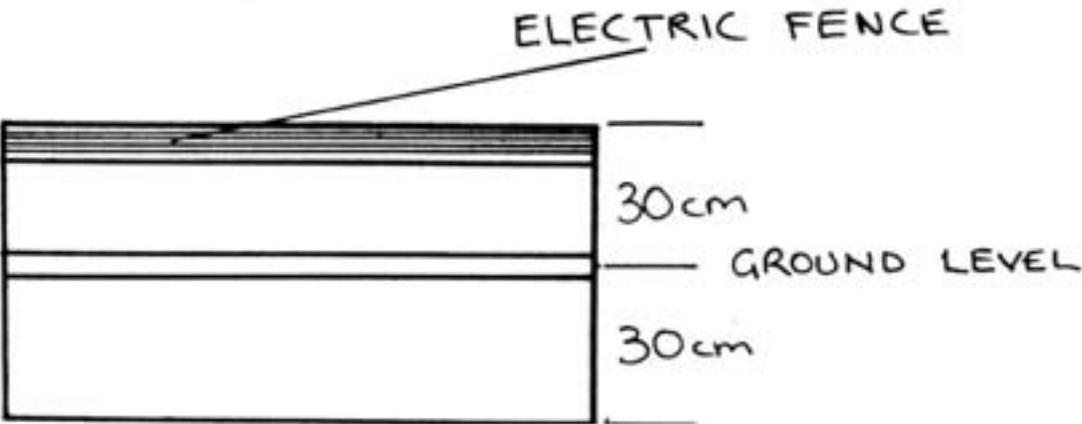
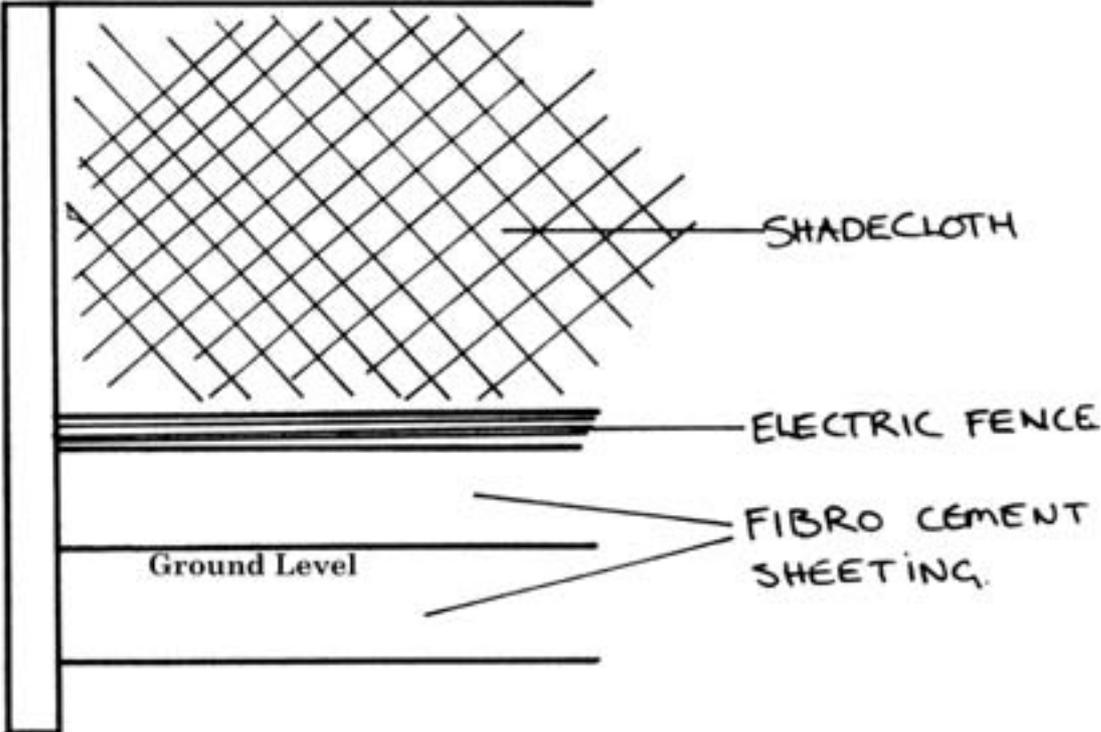
It is advisable to regularly examine the snails for any signs of disease or malformations that indicate sickness within the snail colony.

Clean or washed hands and even gloves are recommended when handling the snails at any time.

Growing Area. (Top View)



Growing Out Area. (Side View)



## 2.13 Nutrition

Snails consume a large quantity of food; up to 40% of its total weight within a 24 hr period especially when it is being active. They will eat a great deal if the food is available in the springtime in order to compensate for the weight loss that occurs during hibernation.

Snails are territorial and will stay in their own area if sufficient food is available.

The snail farmer provides this food to the snails so that the animals are able to stay in the one spot as it were and so decrease the amount of energy the snail would require to travel to obtain enough food to sustain itself and in doing so promotes a much faster growth rate than would be normally achieved in the wild.

Commercial snail farmers overseas use a specially prepared snail food that is manufactured by various companies that cater for the industry. It is a product similar to the chicken feeds that are available in pellet form here in Australia.

## 2.14 Nutritional requirements and feeding regimes

For the commercial grower of snails a formula that provides all the necessary nutritional requirements is imperative to facilitate rapid growth and maximum body weight.

Many formulae have been used and tried throughout the world and after many years of extensive research it has been found that the main ingredients for a balanced diet that will enhance and promote the animals ability to transform its food into the maximum food intake to weight ratio is as follows:

**Protein levels between 10% - 16%.**

**Vitamins: A. 4000 International units per kg.**

**B1. 3.75 mg/kg.**

**D. 900 UL/kg.**

**E. 11 mg/kg.**

**Calcium carbonate (30% -40% Ca) in the form of limestone flour**

**Phosphate bicarbonate**

The protein levels in the food will indicate the amount of nutrition to weight ratio ie. the higher the protein levels the faster the snail will put on weight. The inclusion of the vitamins and minerals in the snail food formula is to assist growth and protein digestion and the calcium carbonate level is crucial to the development of the snails shell and growth rate.

### **Food Intake of (Helix aspersa).Average Daily Consumption.**

Stage	Weight(g).	Grams of food daily.
Growth period.	0.5	0.04
	3.0	0.07
	5.0	0.10
<b>Hibernation.</b>		
Start of laying.	10.0	0.36
laying period.	10.0	0.10

**NB:** Not all snails will eat the same amount of food per day, some eat more while others will eat less. The above table gives the grower an accurate average amount that a snail will consume over a 24 hr period.

## 2.15 Types of feeds

The commercial snail farmer is able to make their own snail food by following the nutritional guide lines but there are some commercially produced agricultural products available on the market at the present time that are suitable as a base for the required formula.

Chicken pellets produced in Australia are fairly close to the food requirements for the snails but they must be crushed into a coarse powder form so that the snails do not expend too much energy masticating the food. The chicken pellet formula once crushed can be used for both the juvenile and the adult snails.

The snails should not be fed any manufactured food products that contain antibiotics or growth hormone stimulants.

Two proven snail food formula using the chicken mash/pellets are listed below;

1. Broiler finisher mash consisting of 7% broiler concentrate, 52% corn, 16% Soya meal, 18% sorghum, 7% and limestone flour (40% Ca).
2. Chicken pellets (crushed) for layers consisting of 5% layer concentrate, 10% corn meal, 15% Soya meal, 20% sorghum, 43% barley, 7% limestone flour (40% Ca).

The two formula mentioned above will need to be crushed and mixed thoroughly before feeding to the snails.

The snails should only be fed the amount of food they will eat over a 2 - 4 day period. Trial and error will determine the amount to be given per feeding and the previous table will give the snail farmer an indication of the amounts required. Hygiene within the snails environment is paramount in keeping pests and disease under control so the feeding troughs must be cleaned after each feeding

A weak solution of sodium hypochlorite (bleach) is recommended for cleaning the troughs but they must be rinsed thoroughly during the cleaning process to eliminate all traces of the sodium hypochlorite or else any residue left on or in the feeding troughs will kill the snails.

A precise estimate determined by research conducted in France have found that to produce 1 kg of snails they will need to consume 1.7 kgs of dry snail food over the period of their harvestable life. This estimation will assist the snail farmer with costings when calculating expenses over the snail growing period i.e.; from birth to harvest time. The snails will also consume the vegetation throughout their time spent in both the nursery and the growing out area. A combination of different plants instead of practising monoculture in the various growing areas will give the snails a varied diet and also provide shelter if the plants selected are of varying height.

No agricultural chemical sprays or dusting powders should be used on the planted vegetation as these are detrimental to the health of the snails and may cause death.

The snails will come out at night to feed as the humidity and the decreased temperature suits their activity level and also protects them from daytime predators. The feeding troughs should be well covered by the timber boards that the snails will rest on during the day because any moisture landing on the snail food will spoil it and make it unpalatable to the snails.

## **2.16 Preparation and processing snails for the market**

The first stage in preparing snails for human consumption is to purge them on wheat bran or corn meal; rolled oats can also be used. These products have been found to be the most effective purging agents as the high percentage of roughage contained within them will hasten the process of ridding the digestive system of any soil or other food stuffs.

The snails need to be purged for a period of three days followed by two days of starvation to completely clean out the snails digestive system.

During the starvation stage water via the automated watering system is provided on a regular basis to allow the snails to continue being active and so complete the purging process.

### **Snail purging system**

After selecting and harvesting the snails suitable for the market (between 30 mm and 40 mm) they are placed in very clean containers (large plastic buckets with a tight fitting lid are suitable for this process). These containers will need to have several holes drilled into the bottom edge to allow drainage of any waste materials.

The containers are mounted in a frame work of a material suitable to hold the weight and size of the containers.

The waste materials that are drained from the containers are collected by a system of guttering that is sloped to facilitate the drainage for easy disposal.

The containers themselves need to be positioned on an angle also. Approximately 15 to 20 degrees will be a suitable incline to allow good drainage of any excess water and waste materials.

The containers held within the frame work need to be secured appropriately to prevent them from rolling around and also to allow for ease of removal for cleaning and restocking purposes.

The lids are cut out in the centre to leave a large hole that is then covered with a plastic mesh that has a mesh diameter of 1 cm. The mesh needs to be secured in such a way as to prevent the snails escaping as a number of them pushing against the mesh could dislodge it and the snails will climb out and disappear.

When the containers become slimy and dirty because of the snails purging themselves they will need to be removed and cleaned thoroughly before returning them back to the frame work.

The purging system will need to be housed in a suitable area where the climate can be controlled (if the inside temperature rises above 28 degrees Celsius or falls below 6 degrees Celsius the snail will cease all activity). Also the humidity will need to be kept around 80% for optimum feeding activity.

The inclusion of an automated misting system should be installed and timed to activate just before dark to encourage the snails to commence feeding. This watering system will also aid in keeping the humidity at the desired level. The watering system also acts to deliver moisture for the snails to drink.

The food for the snails is given after the watering system is activated at night.

Stocking rates used within the containers will depend on the size of the container. It is recommended that for a 25 litre container the amount of snails held for the normal purging period be between 70 to 90.

Overcrowding will be detrimental to the snails ability to feed and it also creates a problem with hygiene in the purging containers.

### **Turning Snails into Escargot**

To prepare live snails for cooking all the equipment used must be constructed of stainless steel and the area used will need to be built with the necessary requirements that are provided by the National Code for the Construction and Fit out of Food Premises.

Two systems of preparing and processing the snails are given below.

#### **No 1.**

1. remove the membrane if any, over the opening of the shell
2. soak the live snails in enough water to cover them completely.
3. add ½ a cup of salt or ¼ cup of vinegar for every 50 snails.
4. soak the snails in this solution for 4 hours. (the mucus released will turn the water white)
5. change the water several times during the 4 hour period.
6. rinse the snails under running water until no mucus remains.
7. put snails into cold water and bring to the boil.
8. boil the snails for eight minutes
9. plunge the snails into cold water and drain.
10. with a cocktail fork or some other similar shaped implement remove the snail from the shell. (push implement down into the snail but not right through so that it touches the shell on the other side)
  - The snails are now ready to refrigerate (a shelf life of six days under refrigeration) or they can be frozen for a period of three months.

**No. 2.**

1. Place snails into a container of boiling water.
2. add 100 ml of vinegar or 200 ml of lemon juice per 50 snails.
3. boil the snails rapidly in this solution for three minutes.
4. drain snails.
5. rinse the snails under cold water until cool.
6. once completely cooled the snails are ready to be removed from the shell.
7. with a cocktail fork or some other such implement remove the snail from the shell.(twist and pull the snail out of the shell in one continuous movement).
8. place snails in a container of cold water until all the snails required are processed in the above manner.
9. place shelled snails back into fresh boiling water with same quantities of vinegar or lemon juice.
10. boil for eight minutes.
11. plunge snails into cold water.

- The snails are now ready to refrigerate or freeze.

The snails can be stored in appropriately sized plastic containers and labelled accordingly.

**NB:** As with all food preparation personal hygiene is of paramount importance. Hand washing and protective clothing with the inclusion of hair nets is advisable. A no smoking policy must be included in all areas of the work place as per government regulations.

**Nutritional composition of Snail Meat**

*Helix aspersa* is an excellent source of nutritious food. The meat contains very little cholesterol or fat and its composition also includes many of the vitamins and minerals required for a healthy and well balanced diet.

The nutrient composition of raw snails given below have been provided by the nutrient data bank in France and is based upon 100 grams of edible snail meat.

- Energy (kcal) 80.5.
- Protein (g) 16.
- Water (g) 79.
- Fibers (g) 0.
- Fat (g) 1.
- Available carbohydrates (g) 2.
- Magnesium (mg) 250.
- Calcium (mg) 170.
- Iron (mg) 3.5.
- Vitamin A 1.5%
- Vitamin C 1.5%
- Traces of zinc, copper, potassium and iodine.
- The snail meat also contains 9 of the essential 10 amino acids needed for the human body.

Recipes for cooking snails can be counted by the hundred from soup to pate. Some producers overseas collect the snails eggs and also use them as a form of caviar. The versatility of the snail meat as a component of food for the chef to incorporate into the cooking process is only limited by the imagination and availability of the desired snail product.

How the snails are fed, prepared and cooked can alter the above described nutritional composition. For example, the liver and the hepatopancreas contain most of the vitamins and minerals and are considered by the Europeans as the most flavoursome part of the snail and so in the act of processing the snail before they are canned these organs are removed and used in other aspects of the finished product.

### 3. Market potential

The market potential was obtained by a telephone survey that provided data on the volume of escargot that was sold by restaurants over a given period. Also information was obtained on the price of the product to the consumer and the attitudes of the chefs and restaurant owners.

The questions asked were as follows;

1. Do you serve snails at your restaurant?

(A) YES (B) NO

2. Are snails on the menu all the time?

(A) YES (B) NO (C) SOMETIMES

3. How many snails (Dozen) would you serve each week?

4. What type of snails do you use?

(A) Fresh (B) Frozen (C) Canned

5. Would you purchase Australian grown snails if they were available?

(A) YES (B) NO

6. Would you purchase the snails?

(A) Alive (B) Prepared (already cooked and chilled) (C) Canned

7. When buying snails do you consider the;

(A) Price (B) Quality (C) Both

The survey results are as follows;

1. (A) 36. (B) 14.

2. (A) 16. (B) 14. (C) 20.

3. The restaurants indicated that they served between 10 dozen a week to 100 dozen per week.

The average being 38 dozen snails being served each week.

- 4. (A) 1. (B) 5. (C) 30.
- 5. (A) 41. (B) 9.
- 6. (A) 2. (B) 40. (C) 8.
- 7. (A) 18. (B) 12. (C) 6.

The restaurants contacted indicated that they would be willing to try and to purchase Australian grown snails if there was a continuous supply available through out the year. A commitment by the snail producer to supply the market on a regular basis with a consistent high quality well presented product was also indicated.

The figures below represent approximate parameters that can be envisaged for the successful snail farmer based on the point of sale market price of \$5.00 per dozen for prepared snails.

**Quantities Of Snails Required.**

Prepared Snails @ \$5.00 per dozen.			Expected Income.	
Dozen:	per week. (snails)	per year. (snails)	per week.	per year.
100	1200	62400	\$500	\$26,000
200	2400	124800	\$1000	\$52,000
300	3600	187200	\$1500	\$78,000
400	4800	249600	\$2000	\$104,000
500	6000	312000	\$2500	\$130,000

A mortality rate of up to 10% can be expected over the growing period throughout the year so it is necessary to include this statistic into the figures above.

## 4. Economic analysis

### Indicative cost of production.

Approximate estimates for Australia of the cost of production for a well managed and intensive snail farm (producing 300,000 snails per year) are given below. The total cost of production, defined as fixed costs plus variable costs but not including the labour costs are also included in the table.

<b>Capital requirements</b>	<b>Value in \$ AUS</b>
Green house ( 27m by 4.1m) and associated equipment	2,960
Shade house (20m by 50m) and associated equipment	5,950
Processing equipment (boilers and preparation area)	4,750
Cool room and refrigeration equipment	3,480
Freezer	1,500
Rotary hoe	1,200
Snail purging shed and associated equipment	2,750
<b>TOTAL</b>	<b>\$22,590</b>
<b>Variable costs (annual production estimates)</b>	
Feed	450
Electricity	150
Water	380
Seed	250
Rock Calcium	220
Fertiliser	165
Maintenance	300
Transport costs	1,820
Marketing and advertising	500
Processing costs	2,600
Other variable costs	750
<b>TOTAL</b>	<b>\$7,585</b>
<b>Fixed costs (per year)</b>	
Insurance	975
Market development	1000
<b>TOTAL</b>	<b>\$1,975</b>

- All costs quoted above are estimates only. Prices based on current year (2000) and will change in relation to where and when the materials are sought.

## 5. Conclusion

It is now evident that the advent of a viable snail farming industry will be through the efforts and perseverance of those individuals who will be prepared to take on the challenge of developing a new form of agriculture within Australia.

As with all new forms of agricultural enterprises a great deal of research and development will need to take place so as to facilitate a detailed knowledge base upon which to expand and add to the already existing information that is now available from certain individuals living in Australia today who have or still do carry out snail farming even though their operations are on a small scale compared to those industries in Europe.

Their time spent in close observation and their daily interaction over the life cycle of the snails kept in captivity will be a valuable resource that should be closely monitored and the information collected and then imparted to others who will make use of it for the advancement of a snail industry in Australia.

The obvious economic benefits will become apparent from the inclusion of a centralised library/data base that is accessible when needed for any occasion where relevant information is required by the snail farmer in their day to day work activities. Down time in any new business venture due to lack of relevant problem solving information becomes economically detrimental and also frustrating on a personal level.

A positive approach coupled with the correct and proven technical know how is paramount to the success and growth of establishing a new industry that has not yet been attempted in Australia.

The marketing and promotional aspects appear to be of the utmost importance to gaining inroads into the existing restaurant and food outlets that now sell Escargot or who will do so in the future and to gain a greater market share of the now import orientated trade in Escargot.

Education and a market specific promotion will need to be implemented and pursued vigorously to make the consumer more aware of the health and taste benefits associated with eating Escargot and to include them in their everyday eating habits.

With Australia's now extensive multicultural population the acceptance of different foods and the greater choice available today will assist with the consumers perception of what is socially acceptable to eat and enjoy. This fact along with a consumer directed education programme will be of great value when the time comes to market a wholly owned Australian produced meat product that could become with only slight modifications to the annual operational protocols be presented as an organically grown and processed health food.

The figures presented in the chapter on economic analysis give a clear indication that not a great deal of money will need to be injected into a project that has obvious economic incentives to entice the agricultural entrepreneur to proceed with the establishment of a commercial snail farm. As this type of farming on such a large scale has not been attempted in Australia before there may be some trepidation in taking on such a new and untried alternative agricultural venture and would be completely understandable and an expected reaction to the unknown. It is also necessary that to take a calculated risk and succeed economically as well as technically will boost the confidence and acceptance of introducing new and alternate successful agricultural based industries.

# Appendix

Observations made whilst in France in October 1999 in regard to snail farming and all its aspects have led the author of this report to believe that with a commitment and a positive approach to the marketing side of snail production the commercial farming of snails will eventually culminate into a viable domestic industry here in Australia.

The French snail farmers take their farming practices and approach to the marketing of their products very seriously. The growers are organised into grower groups who are then organised into co-operatives for their particular area and share snail farming practices for the advancement of their own businesses and that of the industry in general.

The French government provides through its agricultural programmes, research and development focused on snail farming and provides the grower with practical and technical support and information.

The industry also has many organisations that provide courses enabling anyone to obtain a recognised degree in competency as a (snail engineer) or heliciculturist who with these qualifications are deemed capable of carrying out any and all aspects of snail farming.

The consumer of escargot and its related products in France are well taken care of when it comes to choice and availability. Snails are readily available straight from the grower or from small retail stores and also the large supermarket chains that operate though out France.

The snails are presented in a number of ways and come fresh, frozen, canned and also come in jars flavoured with certain herbs and spices. Snail pate is also available and snail eggs presented as caviar command very high prices.

The French consumer can go into the supermarket and select ready to eat or ready to cook snail preparations at any time of the year. The author was able to buy one dozen snails (frozen) in their shells flavoured with garlic butter presented on an aluminium foil tray ready to put straight into the oven and heated for approximately six to eight minutes. This entree size meal accompanied by the large selection of the always fresh French breads and of course a glass of the local red wine was a very popular snack.

Snails are available on almost every menu and are presented in various forms from soups to pies and are also included in some salad dishes.

The authors fact finding mission to France gave an insight into a food industry that appears to have a great deal of potential of also becoming a reality here in Australia as long as we approach the area of snail farming in a professional manner that incorporates all the information and proven work practices that are currently being used by the successful snail farmers in France.

## References

Jean-Claude Bonnet et al. 1990, *Escargot biologie-elevage* Publication by the Institut National de la Recherche Agronomique. Paris. France.

Snail Farming Research Vol. V 1994, (various authors) Associazione Nazionale Elicicoltori - Via Vittorio Emanuele 12062 Cherasco Italy.

Snail Farming Research 1986, (various authors) Associazione Nazionale Elicicoltori - Via Vittorio Emanuele 12062 Cherasco Italy.

Herb, F. 1988. *Les Escargots*. Illuminations Press. California. USA.

Davis, P, and Widmer, M. 1995. *Commercial Snail Farming*. Agriculture Protection Board of Western Australia. Bulletin 4277.

Begg, S. 1992. *Farming Snails in Australia*, Orange, NSW 2800.

Thompson, R. 1996. Raising Snails. Alternative Farming Systems Information Center. Reference Series no. SRB 96-05. National Agricultural Library. Beltsville. Maryland 20705-2351.

Simpson, R.D. 1990. Investigation of biological factors of snails in relation to commercial snail farming and the marketing of snails in Australia as food. Project No. UNE 9A. University of New England, Armidale. NSW.



# Breeding and Growing Snails Commercially in Australia

by B. Murphy

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Escargot (Snails) have been eaten by humans for thousands of years. Today they are consumed by millions of people world wide. Snails as a food source at present are under utilised in Australia.

This report investigates the feasibility of establishing an economically viable edible snail industry in Australia. The focus of this pre-feasibility study is directed towards the commercial production and management along with the establishment costs that will be encountered with the development of a large scale commercial snail farm.

The report also includes information on growing and breeding snails on a commercial level, detailing appropriate husbandry and stock control.

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