

PART I INTRODUCTION

The Roman snail (escargot) *Helix pomatia* L. has a long history of being used as food by humans and is still much sought after as a gastronomic delight. Some of its biological patterns such as slow maturity and recruitment, high mortality among juveniles coupled with low fecundity along with their propensity for high spatial aggregation make this species vulnerable to exploitation. Compared to other exploited species of edible land snails, it has suffered a serious decline in most of the countries where it has been intensively used for food, being a more preferred species because of its high protein, aminoacid and mineral salt content (Rădulescu, 1980; Wells and Chatfield, 1992). In Moldova, this species is distributed all over the country (Figure 1), but it is mostly concentrated in the northern and central parts, where more suitable

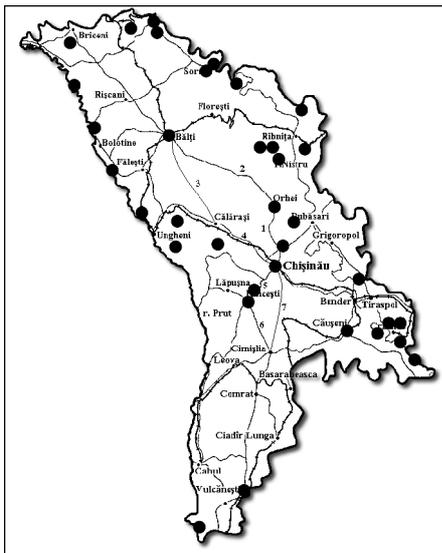


Figure 1. Distribution map of *Helix pomatia* in Moldova

conditions exist.

Traditionally in Moldova the Roman snail was not used for food, however some data (Chijac, 1837) indicate that Moldovans consumed it during Lent. Each year a quantity of about 100 -200 tones of snails collected from the wild is exported abroad. An extended survey on population density, shell size and age distribution of Roman snail conducted in Moldova during summer 2003-2004, revealed a considerable impact of exploitation on snail populations, for example the density in non-exploited areas exceeded much more those in exploited. Moreover, in two exploited sites no live snails, but only shells were found. This could be an indicator that collection has probable exterminated the

populations in these places and there is a negative impact of exploitation on wild populations.

Having a high commercial value, the Roman snail should be subject to rational and sustainable exploitation. In order to avoid resource depletion, a systematic survey on status of the populations is necessary. Development of snail breeding enterprises would add as well as species conservation as it can provide the necessary amount of snails required for the market and there will be a decrease in pressure on the snail populations.

PART II ON THE ECOLOGY AND ROLE OF *HELIX POMATIA*

Roman snail in Moldova is active from March-April through September-October, when it enters hibernation. Mating extends over the whole active periods, but its peak occurs during May-July, depending on and temperature conditions. Drought restricts significantly snail activity, and may lead to complete inactivity and aestivation, and thus to reduced egg laying success. Because of their tendency to aggregate, there is a higher risk of overexploitation during reproduction period.

Egg laying is very much dependant on soil humidity conditions, it starts few days immediately after the rainfall in soil cavities made by functional female. The egg laying cavities are of a flask-shape type with its size varying between 2,6-5 cm breadth and 3,5-5,5 cm depth. Egg laying takes place around 31-36 days after mating, usually in June-July.

The Roman snail plays an important role in terrestrial ecosystems. They provide food and shelters for a large number of invertebrates and vertebrates (Uvalieva, 1990). Together with other species of land snails and depending on their biomass and environmental factors, they can speed up litter degradation 3-8 times (Striganova, 1975, 1980). Turček (1970) has estimated that a population of *Helix pomatia* with a biomass of 34 kg/ha can consume up to 650 kg/plant of fresh and senescent plants during an entire active period. Unlike other invertebrates, the Roman snail has a very high food assimilation rate (81%) (Turček, 1970) and is therefore a crucial contributor to organic matter decomposition. Its significant role in ecosystem functioning should lead to a particular an increased concern for its conservation.

PART III PROJECT OBJECTIVES

3.1 Short term objectives

1. Establishing an experimental outdoor snail farm for revealing the main growth patterns of this species under economic and physico-geographical factors of Moldova.
2. Assessing the starting up costs and main aspects of snail raising in Moldova, with a focus on outdoor breeding.
3. Presentation of the results in electronic format (website) and in written form (scientific articles and guidelines) that will contribute to dissemination and replication of good practices

3.2 Long term objectives

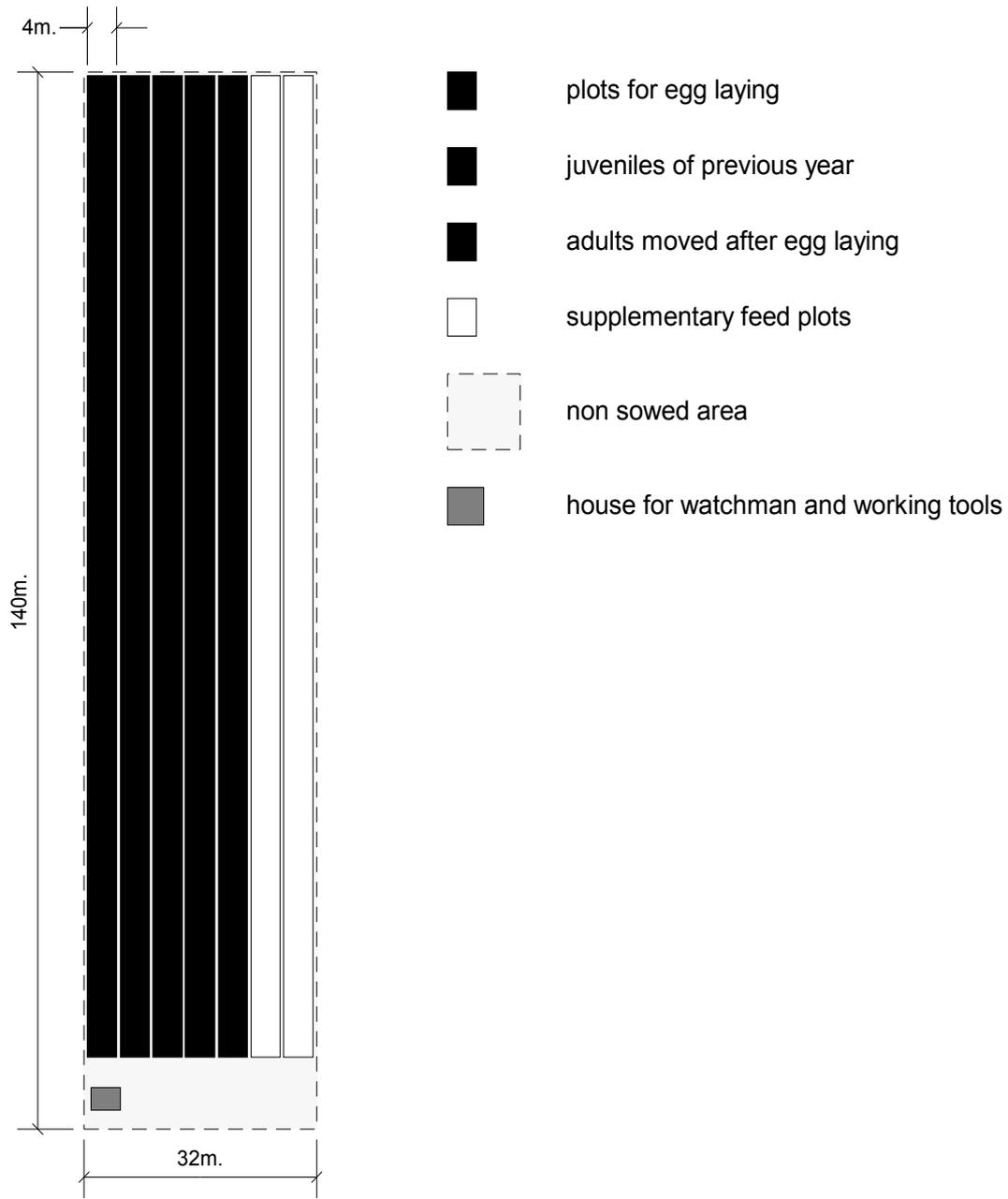
1. Providing of both conservation benefits for the recovery of the wild populations (snail growing would supply the necessary amount of snails required for the demand of the market) and income generation benefits for farmers.
2. Establishing of a Conservation Foundation with an aim to invest the income for promoting biodiversity conservation in Moldova and adjacent countries (Romania, Ukraine).

PART IV PROJECT ACTIVITIES:

4.1 Organizational activities

During first days of November I have met with members of NGO WISDOM and IE “Mihail Butuc” and informed them briefly about the project and the main aspects to be done in the following months. During January few meetings were organized for planning activities and design of snail farm as well defining of responsibilities within the project. The total snail farm area provided by the Individual Enterprise “Mihail Butuc” accounted for 4480 square meters (140x32 m). We made the calculations for the external and internal fences as well as for the plots. During January-February some materials were bought for electricity/irrigation system and also all the necessary contacts for water and electricity connections were sought. In addition, during this time, an overview of main references on snail growth was made (online and paper based). Also, soil samples (surface layer and 10 cm depth) were analyzed for calcium content in the Laboratory of Hydrobiology and Ecotoxicology. An optimal level of total calcium content required for snail growth was found (2-3%).

During February-March, all the materials for electricity/irrigation system were procured and prepared for work. The electricity was connected and also the ditch for water hose was dug up. The sowing material was bought and sowing scheme was selected. At the end of March-beginning of April all the plants were sowed. According to the advice of the farmer Mihail Butuc we also considered to use some money for building a small house for the watchman and keeping the working tools and the snails containers.



Snail farm map

4.2 External and internal fences

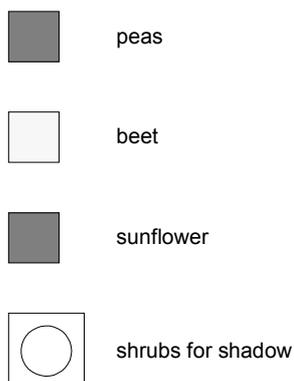
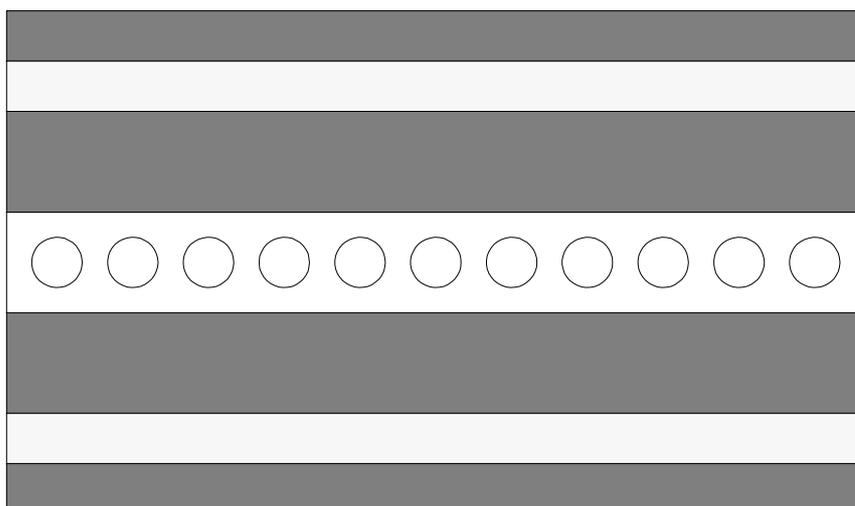
The external fences were important to limit access to domestic animals (such as cows and sheep) into the area. For this purpose, we have used wire fence, supported by ferro-concrete pillars. The internal fences were made of weather resistant polyethylene net (mosquitoes net) of a height of 1,40 m. Metal posts were placed at each 3 m intervals to support the net, that was buried into the ground at about 20 cm. In order to prevent snail crawling out of the enclosure, the top of the polyethylene net was folded inward.



Snail farm inner and outer enclosures.

4.3 Sowing scheme

For the main areas, where the snails were placed, the following sowing scheme was used:



1. Peas (*Pisum sativum*).

Is a annual vine from Fabacea. Not eaten by snails, however if established well can grow rapidly, creating a dense canopy and out-competing most annual weeds. It is also be a cheap source of nitrogen for crops planted in the subsequent years. Can also be a companion crop undersown with alfalfa (lucerne). During July-August during dry spells will offer suitable shelter for the juveniles and even adults.

2. Beet (*Beta vulgaris*)

It is a perennial plant from Chenopodiacea. In the references on heliculture (International Snail Farming Association, 1998) this plant is given as a specifically alimentary plant, mainly during the summer period. However, our two year experience demonstrated this this plant is mainly used by snails as shelter during hot periods in June and July as it has broad leaves that permit a

good protection from UV radiation. Rarely is eaten in the summer by juveniles and only later, when other plants are not available it becomes a precious source of nutrition for the juveniles.

3. Sunflower (*Helianthus annuus*)

It is a plant easy to cultivate. Owing to its broad leaves, tall and thick trunk it is valuable plant in snail farming as it can serve both as a shelter and also as a food resource. However, since it is highly enjoyable by adults, it is recommended to sow mainly the fattening areas (where the adults will be moved after they lay eggs). This is necessary to consider because, when introducing the first snail stock, the plants are not well established and they are eaten rapidly by snails, while later in the fattening areas they will be fully grown and flowering, therefore providing an excellent food resources for the adults. The snails eat all part of the plant (seeds, stem and leaves). During summer and autumn the juveniles will be also fed on them and use it as a shelter. It is recommended that sowing of this plant is done several times a year.

4. Shrubs (supplementary shade)

The previous year experience demonstrated that during the first time of introduction the breeding stock, open areas, without shadow can provoke high mortality. Therefore, to avoid this problem, shrubs were planted in the middle of each plot. Such species as *Ligustrum vulgaris*, *Syringa* and *Crataegus* can be used for this purpose.

5. Other feeds

In the supplementary feed plots a mixture of above mentioned plants and other additional were used (alfalfa, spinach and bur). Bur leaves from wild places were also collected early in the season to supplement snail diet, when other plants were not grown enough. During July-August we also offered supplementary dry food, either chicken pellets or the following composition:

35% - debris (calcium carbonate)

20 % - soya meal

40% - wheat flower

5 % - ash (calcium phosphate) or bone meal

4.4 Plant management and watering

Maintaining the general weed control is done manually, picking up the weeds, where possible. During June-July in the plots where snails lay eggs such operation should be avoided as weeds can be removed together with snail eggs. During late autumn, when snails are less active and after they enter hibernation, the weeds are collected and removed from the area. The supplementary food areas are maintained clean by hoe. The use of herbicides for weed control is not recommended since snails tend to accumulate toxic elements in their meat.

The paths between plots should be maintained clean and ungrassed as this will prevent snail escaping and their migration into other areas (they usually move to the places covered by vegetation) and also they can be easily seen in the early morning or immediately after rainfall, when they need to be collected and placed back in the plots.

Watering

During growth, breeding and maintenance, the snails were watered with a short burst of water one time a day (in the evening) for a period of 15-20 minute. No watering was supplied during rain period. During dry spells watering was done two times a day (morning and evening). The capacity of water pump (Hidropompa) was 2,8 KW/hour.

4.5 Snail stock

Since there were some difficulties in procuring the snail stock we have prepared all the documents for applying for a collection permit at the Ministry of Ecology and Natural Resources. The permits were obtained for snail collection and snail growth in captivity (Appendix 1 and 2). In order to obtain the permit, the authorization from the local authorities (mayoralty) was also necessary. Before obtaining the authorization, a preliminary survey on the state of the populations in the collecting areas was made. The snail stock was collected from the wild from parks and forest edges of Chisinau during moist conditions, after rain. The snails were kept in plastic containers in shaded places. In order to avoid intense mucus elimination and snail suffocation, leaves were placed between snail layers. Four assistants helped to collect the necessary snail amount.

Snails collected from the wild have encountered a high mortality rate as they needed to adjust to the new environmental conditions. In our case, we had a high mortality only in the beginning because of the lack of shade. We have added some plants (alfalfa) from the last year territory and this helped to prevent drying of snail bodies and keep high humidity.

In addition, adults from previous year were collected from garden where they have hibernated. The mortality of the adults was much lower. Therefore, it is recommended for those who start a snail farm in order to decrease mortality of snail stock to collect snails during autumn, so they have enough time to adapt to changes in environmental conditions.

MINISTERUL
ECOLOGIEI
ȘI RESURSELOR NATURALE
AL REPUBLICII MOLDOVA

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tel. 20-45-07, tel/fax 22-68-58
E-mail: egreta@mediu.moldova.md

МИНИСТЕРСТВО
ЭКОЛОГИИ
И ПРИРОДНЫХ РЕСУРСОВ
РЕСПУБЛИКИ МОЛДОВА

MD 2005 мун. Кишинэу, ул. Космонавтов 9
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AUTORIZAȚIE

Seria 003

Numărul 006/2005

Agentul Economic

AO "WISDOM"

Sediul sau domiciliul

Chișinău MD - 2028, str. Academiei, 1

Înregistrat

Nr. 2939 din 29.03.2004

Genul de activitate

Dobândirea melcilor viței-de-vie Helix-Pomatia L.

Cota prevăzută

300 kg

Condiții de autorizare

1. Colectarea se va efectua raza Or. Chișinău

2. Beneficiarul se obligă:

- să informeze Agențiile Teritoriale Ecologice despre începutul colectării melcilor
- să prezinte darea de seamă privind cantitatea melcilor colectați
- pentru operațiunile de export să obțină Acord de mediu la MERN și să-l prezinte autorităților vamale în modul stabilit de legislația în vigoare
- pentru operațiunile de creștere a melcului în captivitate să obțină Acord de mediu de la MERN.

Eliberată la

18 mai 2005

Valabilă în perioada

18 mai – 1 iunie 2005

Viceministru



Petru SILIVESTRU

Permit for snail collection

ORIGINAL

REPUBLICA MOLDOVA

MINISTERUL ECOLOGIEI
ȘI RESURSELOR NATURALE



REPUBLIC OF MOLDOVA

MINISTRY OF ECOLOGY
AND NATURAL RESOURCES

ACORD DE MEDIU PENTRU IMPORT
PLANTE ȘI/SAU ANIMALE SĂLBATICE

valabil pentru specii non-CITES*)

ENVIRONMENT PERMIT FOR IMPORT
OF WILD PLANTS AND/OR ANIMALS

valid for non – CITES species*)

Nr. 066/05 Data **22 iunie 2005**

valid from **22 June 2005** till **066/05**

Cu avizul Academiei de Științe
a Moldovei

According to the Notification of
the Moldova Academy

Se autorizează agentul economic _____

The following company _____

A.O. "WISDOM", Chișinău,
str. Academiei, 1

A.O. "WISDOM", Chișinău,
I, Academiei Str.

să crească/cultive în Moldova _____

artificiality propagated in Moldova _____

următoarele resurse biologice naturale
non – CITES:

the following non-CITES wild biological
natural resources:

Specia (plantă/animal)	Starea	Cantitatea (kg/bucăți)
Helix pomatia	Vie	300 Kg

Species (plants/animals)	Condition	Quantily (kg/pieces)
Helix pomatia	Live	300 kg

Prezentul acord a fost eliberat în 2 exemplare, unul
pentru exportator, celălalt pentru emitent, ambele
cu ștampilă originală

This Permit has been issued in two copies, one for
the exported, the other for the issuing authority,
both of them with original stamp.

Viceministru



Petru SILIVESTRU

L.Ș.

*) Pentru speciile de floră și faună sălbatică
prevăzute în anexele Convenției CITES
este valabil numai Permisul CITES.

*) For the species of wild flora and fauna which are
listed in the annexes of the CITES Convention,
only the CITES Permit is valid.

Ex. Ala Rotaru
Tel. 204 535 E-mail: cites@mediu.moldova.md
9, Cosmonautilor Str., Chisinau, Republic of Moldova

Permit for snail growing in captivity

4.6 Snail production

During June the juveniles from previous year were collected and placed on the snail farm. The average density of the juveniles was 52,9-90 snails per square meter that accounted for a biomass of 92 g/square meter. Such a production was obtained using an initial stock density of 20-25 snails/square meter. The vegetable available in the plot was enough to cover the juveniles feed requirements. Except late autumn, no supplemental feeding was offered to them.



Collection of the juveniles

Mortality rate in the second year juveniles is lower than in the first year juveniles. Mortality is caused by predators (lizards, rodents, slugs, beetles) or sometimes due to body desiccation (during dry spells). Adult mortality after first introduction reaches about 10 %. Even though mating occurs along the whole active period, the peaks were observed during end of May, mid of June. Sometimes in the mating process three to four snails were involved. In addition subadults were observed to mate, however they did not observed to lay eggs. Egg laying starts when suitable humid and temperature conditions occur. Before egg laying snails stop feeding or feed only insignificantly.

During 2005 two peaks of snail egg laying were observed: end of May-beginning of June and first decade of July. Hatching occurs approximately 20 days after egg laying. The clutch size varies between 23 to 65 eggs, marking of snail shells demonstrated that specimens with bigger shells laid bigger eggs than those with smaller shells.

A density stock of 12 snails per square meter gave approximately a production of juveniles during end of July of 107 to 120 snails per square meter (160-180 g/square meter). Comparing the data from previous year a lower snail stock density favored a higher snail production.

During August, after egg laying was finished the adults were replaced on other plots. Mortality rate during this period of time was usually high due to loss of energy resources during egg laying.

4.7 Calendar of activities in a snail farm

January-February Purchase the required materials and equipment for snail farm: (materials for internal and external enclosures, sowing material, irrigation sprinklers) and design the snail farm. If necessary, apply for collection permit for start up reproduction stock or contact the collection company in your area.

March- April Check with authorities for collection permit, contact the local Ecological State Inspectorate, inform them about the collection quantity required for starting up stock. Start sowing peas (if peas is replaced by alfalfa, sowing of the last is done during autumn) sunflower, beet, salad. Construct the enclosures and external fences, set up the irrigation system. Plant small shrubs for shadow. Sow the supplemental food.

May Collect and introduce the first breeding stock. Collection should be done early in the morning or immediately after the rain. Report the state of population after collection to the Ecological State Inspectorate. Apply for permit that allow growing snails in captivity. Add supplemental food (dry food, leaves of salad, alfalfa sown during autumn or leaves of bur, which are already well grown during May and can be found in many places in the rural areas). Maintain general control of structures and devices, check periodically for holes in the net, keep the paths clean, do irrigation (it is recommended mainly in the evening, pick up or cut the weeds. In the early morning collect the snails that escape from the enclosures and place them back. Monitor snail mortality, it is important they have enough shadow, if this is becoming a problem, add leaves of alfalfa or bur during the day. Snail collected from the wild may encounter a high mortality rate as they adapt to the new environment. In addition, during May they when suitable rain and temperature conditions exist they start laying eggs during May. During this time they stop feeding and also egg laying is energy expensive, therefore replacing them into a new environment may cause high mortality. It is recommended to introduce snails during September-October as they have enough time to adapt to the environment and during spring give a better production.

June-July

Minimal disturbance is recommended, as this time is reproduction period. Snails are gathered together for mating and egg laying, becoming vulnerable to stepping. As it is hot during this time, weathering is recommended two times a day (early morning and evening).. The rate of migration from the enclosures is also high during this time, collect them and place back after the

irrigation take place. During early or mid June, if the weather conditions are suitable snails start to lay eggs. They find suitable places (usually near grass or shrub roots), dig holes in the ground and lay their eggs (20-60). The process may extend from one to two days. Do not pick up grasses during this time, if they are too high, cut the top of them. Do not walk inside the plots. After reproduction and snails start feeding again, add supplemental green food.

August

The time when juveniles appear. Check every morning the nets and collect them, as during early morning they will try to escape. They usually can be found down, at the net basis. Pick up the adults and replace them into other plots, give supplemental food. Cut the top of weeds (if it is higher than 25 cm), where possible pick them up. Ungrass the paths. Irrigate 1 time a day (after sunset). Check for and collect predators such as toads, lizards, slugs or beetles.

September –October

Give supplemental food (one-two times a week): cabbage, sunflower, spinach, topinambour or dry food. Sunflower is more preferred snail food, they eat all parts of the plant, during September it is the last available green plant. Topinambour lasts later than the sunflower. The snails will eat the trunk and also the bulbs (if they are grated). Collect the snails that escape. Sow supplemental food (alfalfa, rapeseed). Continue vegetation cleaning. Irrigation is done rarer, depending on the rainfall. End of October – snails enter hibernation. Ungrass and clean the area as much as possible.

November-December

The snails enter hibernation. Repair the internal fences.

4.8 Costs and Revenues

Estimated costs for establishing an outdoor snail farm¹ (for 5000 square meters)

Internal-external enclosures	2500-3000 Euro
Snail stock (including obtaining collecting permit, snail transportation and containers)	250-350 Euro
Electricity/wetting system	550-700 Euro
Snail food	110-150 Euro
Snail care, research assistantship	1800-2000 Euro
Accommodation, food, transportation	250-300 Euro
Total costs	5460-6500 Euro (this did not include land taxes)

Potential revenues (during the 3rd year of production)

For a territory of 4860 of a snail farm the total area used exclusively for growing of snails is 2800 square meter. Considering the obtained production of 107-120 snails per square meter and the mortality rate of 10 % per year, the total production can reach approximately 13000 kg x 2,5-3,0 Euro/kg

32500-39000 Euro

Such estimations are however are theoretical, this did not included the estimated losses from predators, any illnesses or other things that may affect the population. Since the snail market in Moldova is not yet developed there might be associated customary and export costs.

4.9 Recommendations

- Results of this project, the estimated initial costs and the potential revenue of a snail outdoor farm indicate that such an activity might be profitable if raised at commercial scale.
- For a better adaptation to the environmental conditions of the farm as well as for lowering mortality of the reproductive stock it is recommended the snails are introduced into the area during September.
- A density of 10-12 snails is recommended for an optimal production system
- Supplemental food is more extensively needed during May, end of July-August and September-October
- During June-July when snails are laying eggs least disturbance is recommended
- A workable procedure of combining indoor and outdoor methods is recommended in order to shorten the hibernation period and decrease hatchling mortality (adults can be

¹ The prices in Moldova are changing constantly, that is why a range of costs is shown here

kept in the greenhouses to lay eggs and then replaced outside, after hatching, the juveniles are also replaced into outdoor plots)

- Further research is required for developing indoor growing technologies under the conditions of the Republic of Moldova
- A business plan and a marketing study should be developed is necessary in order to explore the potential for commercialization of snails at local and international level (necessary quantity, prices and perceptions in the market

Result dissemination

1. During November-December, 2004 I have visited Swedish Biodiversity Centre (CBM), Uppsala within Tempus IMG program. During this visit I have organized a seminar with CBM staff and presented shortly the proposed activities of the project.
2. A webpage on snail farming was elaborated and designed. The current stage is information content management. The process of redesign and content management will be further developed and changed with project progress. It is planned that the webpage will become the main information resources in the field of snail growing, including snail biology, growth technologies, snail and plant management, types of food, illnesses, potential for marketing etc. For all the required information collaborations will be sought with the Ministry of Ecology and Natural Resources as well as Agricultural University (Veterinary Department).
3. Two research publications will be prepared and submitted (one in an international journal – Journal of Molluscan Studies and one in a local scientific journal)
4. One scientific seminar on the potential for developing snail growing enterprises will be presented during February