The non-marine mollusk fauna of the Pu Luong, Cuc Phuong, Phu Ly, and Ha Long regions in northern Vietnam.

A survey for the Vietnam Programme of FFI (Flora and Fauna International)

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All terrestrial mollusk species mentioned in this report species have been identified by the authors according to their best knowledge, as derived from the relevant literature concerning northern Vietnam in the first place, and the whole of E and SE Asia in the second. Type material of species, or reference material other than material present in the collections of the authors, has not been studied. Sometimes, unpublished taxonomic combinations have been used; more information about these is available upon request. A set of the material collected during this survey has been added to the reference collections of the authors. Some samples may be re-identified as new taxonomic information becomes available; revised species lists are available upon request.

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1 - SUMMARY

The terrestrial mollusk fauna of a number of limestone regions in the northern part of Vietnam has been surveyed. The regions are: the Pu Luong Nature Reserve, the Cuc Phuong National Park, the limestone ranges near Phu Li, Cat Ba National Park, the Ha Long Bay Heritage Site, and the limestone ranges in the Ha Long-Campha region.

In this report, terrestrial mollusks are regarded as an indicator group for the whole of the invertebrate fauna. Invertebrates constitute the largest part of the biodiversity of most environments, limestone areas included. It is assumed that observations on the terrestrial mollusk fauna hold true, to an extent, for the invertebrate fauna as a whole.

General conclusions

- The northern Vietnam limestones harbour a rich and varied snail fauna, different from that of adjacent China as well as the rest of Indochina. We estimate that about 75% of the species occurring in northern Vietnam do not extend their range beyond its borders: they are endemic to northern Vietnam.
- Altogether 310 species were found during the present survey, which is approximately as many as were previously known from the whole of northern Vietnam. However, 142 of these (about 46%) could not be identified to species level and are probably new to science. Extrapolating from these numbers the total number of snail species in northern Vietnam would be around 1000. The surveyed areas would provide protection for about 30% of this fauna.
- The land snail fauna of the surveyed areas are not in need of special protective measures beyond general measures to keep the vegetation cover intact and to prevent bushfires.
- Future studies could include a survey including more limestone areas in northern Vietnam to identify areas particularly rich in species and endemics. Some species that indicate disturbance have been identified in this report; some precise sampling could add a few more species to this list. Once this is done, baseline studies could be conducted to enable future monitoring of environmental changes. The local counterpart, supported by the foreign consultants, could do these studies.

Pu Luong and Cuc Phuong regions

These are situated at the Southeastern extreme of a long limestone range starting not too far from the Vietnamese coast and continuing in Northwestern direction all the way to the Chinese border.

- Both regions are rich in species and rich in local endemics: in both regions together 162 species were found, 25 of which (15.4%) are endemic.
- The faunas of the two regions differ considerably from one another: only 57 species are found in both regions (35.2% of the total number). This partly reflects insufficient collecting, but a true difference between the regions also exists.
- Extrapolating, it is certain that the whole limestone range, of which both regions are part, can be divided in a number of smaller units, each including a suite of endemic species. Further surveys are needed to identify the most important areas. The possibility of protective measures for such areas should be investigated

Ha Long region, including Cat Ba and Ha Long-Campha.

In order to establish faunal differences between the various parts of the region it was divided in 5 sectors.

- Cat Ba has the richest snail fauna, comprising 149 species and no fewer than 24 endemic species.

- The limestone ranges West of Campha include several cores of relatively little disturbed vegetation. Although the survey was restricted to the heavily disturbed perimeter of the area, an unexpectedly rich fauna was found, including 91 species. The number of site endemics is low, only two, but we expect this number to rise sharply with continued investigation. The Ha Long-Campha limestones harbour a rich biodiversity, within the region second to Cat Ba only, with several unique elements. The area deserves protection, perhaps best achieved by including parts of in the Ha Long Bay Heritage site.
- The Ha Long Bay Heritage site is very exposed to the elements, and generally a harsh environment for snails. The area, which was thoroughly surveyed, yielded only 86 species, including 3 endemic species.

2 - INTRODUCTION

2.1 - General

This report includes two datasets:

- The dataset obtained by J.J. Vermeulen and A.J. Whitten during their survey in October 1998 (see Vermeulen & Whitten, 1998b).
- The dataset obtained by W.J. M. Maassen during his survey in September 2003.

The two datasets cover the following regions in northern Vietnam

- The Pu Luong Nature Reserve (surveyed in 2003), referred to as **PuLu** in the tables in this report.
- The Cuc Phuong National Park (surveyed in 1998) referred to as **CuPh**.
- The limestone ranges near Phu Li (surveyed in 1998), referred to as **PhLi**.
- Cat Ba National Park (surveyed in 1998) referred to as **HaLo, sector 1** (see fig. 1).
- The Ha Long Bay Heritage Site (surveyed in 1998 and 2003, referred to as **HaLo, sectors 2, 3, 4**.
- The limestone ranges in the Ha Long-Campha region (surveyed in 1998), referred to as **HaLo, sector 5**.

During the 2003 survey, a local counterpart, Mr. Duong Ngoc Cuong, from IEBR, accompanied the surveyor.

2.2 – Limestone biodiversity and terrestrial mollusks

The major part of biodiversity consists of invertebrate biodiversity. This holds true for most ecosystems, including limestone hills in Southeast Asia. Yet invertebrates are conspicuously absent from most local biodiversity inventories. These tend to concentrate on the vertebrate fauna as well as, sometimes, on some plant groups. The number of invertebrate species living in most ecosystems is so large, and the taxonomical knowledge of most invertebrate groups so sketchy that it is virtually impossibly to draw up reliable lists for a given area. Besides, comprehensive collecting is often time consuming and complicated.

Terrestrial mollusks (snails and slugs) can be used as an indicator group for invertebrate biodiversity in limestone areas. Comprehensive collecting is possible if one concentrates on the empty shells rather than on living animals. A consequence is, of course that a minor group of slugs and semi-slugs, without shell or with a rudimentary shell, are under-represented in the resulting collections. Processing samples and identification on shell characters is well possible

with the assistance of a specialist. Mollusks occur in sufficiently large numbers of species in limestone areas to render statistics derived from the lists significant. Next to that, terrestrial mollusk species often display patterns of very narrow endemism, and some species can be used as indicators of disturbance.

Terrestrial mollusks occur most abundantly in limestone areas, both in numbers of species as well as in numbers of individuals. They need the limestone to build their shells. Some species occur entirely restricted to limestone areas, others do occur elsewhere but in very low numbers of individuals. It is unknown to what extent the limestone populations of such species were crucial to the survival of the species in the past, when Vietnam was still largely forest covered. At present, the limestone populations are probably crucial, for the simple reason that most forest in Vietnam has been destroyed.

Faunistically, northern Vietnam is a transition zone between the Palearctic fauna of Mainland China, and the SE Asiatic fauna in Indochina, and extending all the way South to Malaysia and Indonesia. Such transition zones are often rich in species and endemics, and northern Vietnam is no exception to this. Undoubtedly, its humid climate and varied topography and geology have added to the local wealth of biodiversity.

Numerous species of terrestrial and freshwater mollusks occur in the area. However, the inventory of the local mollusk fauna is far from complete. During the period from 1860 until 1910 the work of French, Belgian and German authors covers about 300 species, most of them large in the sense that they are easily to spot in the field. Small species (1 to 5 mm large) are grossly underrepresented in this body of literature. After 1910 very little has been published on the Vietnamese snail fauna. Another indication of our sketchy knowledge of the northern Vietnamese snail fauna is that no summarizing studies have been published; the last checklist – now very incomplete and virtually useless- for the area was published in 1891. It is therefore impossible to shortlist literature that would give access to the whole corpus of publications on this matter.

Not surprisingly, 142 out of the 310 species included in this report (c. 46%) could not be identified down to species level. Most of these are probably new to science, but a more extensive literature survey is needed to ascertain this before they can be formally described. In the tables in this report, such species have a provisional code to identify them instead of a specific name, preceded by ‘sp.’, or they have the specific name of the, assumedly, nearest relative species, preceded by ‘aff.’

Snail taxonomy is largely based on shell characters. While shell characters suffice in most cases to distinguish between species, they are generally of little value for the grouping of species into genera and families. Existing taxonomic groupings above species level, therefore, are of practical use only and do not indicate phylogenetic relationships between species. Anatomical characters do, but only a few percent of the thousands of species found in Asia have been dissected, and a new, phylogenetic classification is still too incomplete to serve as a framework in which the species can be slotted that are only known from their shells.

2.3 – Reference collections for future research

Information on the Vietnamese terrestrial mollusks lies scattered over a hundred papers in journals that are often only available in libraries of large natural history museums. This makes the study of the Vietnamese snails difficult, and the input of specialists as well as the availability of a reliably identified reference collection indispensable. To enable local workers to do inventories based on the local snail fauna, a reference collection assembled from the material collected during the 1998 and 2003 surveys by the authors will be repatriated, and two other sets of the same collection will be retained by the consultants. Corresponding samples in the sets will bear the

same number, to facilitate future discussion about the species between local workers and consultants.

3 - PURPOSE OF THIS SURVEY

The survey was done for various purposes:

- To list the terrestrial mollusk species occurring in selected regions in northern Vietnam.
- To establish differences between the faunas of the regions studied.
- To establish the existence of different snail faunas in various parts of the Ha Long region and in the limestone range that Cuc Phuong and Pu Luong are part of.
- To assess the fauna of the regions studied for their biodiversity value (number of species, presence and number of site endemics).
- To train local workers to do the future monitoring.

4 - COLLECTING METHODS

4.1 - Introduction

In order to quickly gain an insight in the local snail fauna, large amounts of material were collected during both surveys.

One of the aims of the present survey is to compile comprehensive lists of the snail species occurring in the selected regions. Traditional collecting methods, such as patiently picking up individual shells, are not effective to this end:

- It takes a long time and a lot of crawling around in the field before a representative collection is gathered.
- It is difficult for the human eye to concentrate on the largest (8 cm) and smallest (0.8 mm) species simultaneously.
- It is impossible to spot and collect the smallest species with the naked eye.
- It is impossible to cover all habitats in which snail species can be expected.
- It is likely that habitats in which snails occur in low densities (but in different species than elsewhere) receive less attention than habitats rich in snails.

The collecting protocol described below will, after some hands-on training of the worker, definitely yield a representative, if not entirely complete, sample of the local snail fauna. Following this protocol, only snail species with shells of about 6 mm and larger are spotted in the field and picked up individually. This is still quite a strain; even a 6 mm large shell, well-camouflaged by its color among earth particles, is not easy to spot; shells of this size class easily end up under-represented in the final collection. All smaller shells are not individually spotted and picked up in the field, but collected by sampling handfuls of soil from as many different micro-habitats as possible. Together, all the collected soil constitutes a soil sample from the locality under investigation. Some handfuls will be poor in individuals and species (but may include species that do not occur in other handfuls); others will be very rich. Together, they will yield a representative collection of the locality under investigation.

To facilitate the extraction of the shells from the samples in the laboratory, the samples are processed. The method aims at separating an enriched fraction from the sample. This enriched fraction, usually far less than half of the original sample in volume and down to a tenth of it in weight, will be checked for shells in the laboratory, the rest will be discarded.

Picking the shells out of the enriched fraction is not done randomly. To facilitate the procedure the material is sieved over a cascade of sieves of increasingly fine mesh. Each fraction, now with particles of about the same size, is sorted separately, the finer fractions with the aid of a dissecting microscope.

4.2 - Equipment

Equipment needed for this method of collecting is simple, and includes the following:

- Sieves, ranging from 8 mm mesh to 0.5 mm mesh. Five sieves (for instance 0.5, 1.2, 2.5, 5 and 8 mm mesh) are minimally required; a cascade with more sieves makes the picking of shells from the samples easier. Calibrating sieves are excellent for this goal but expensive. However, mesh wire is readily and cheaply available for various industrial purposes (the finest, for instance, for the straining of fuel). This can be mounted on wooden frames. The finest and the coarsest sieves should have meshes as given above.
- Cloth bags, c. 40 cm high and 30 cm wide.
- A plastic bucket.
- Strong polythene bags, c. 80 cm high and 50 cm wide.
- Newspaper.
- Some small, sealable plastic boxes.
- Rope and plastic tape.
- Felt-tipped pen.
- Notebook etc.

4.3 - Where and how to collect

For a general survey, it usually suffices to regard a single limestone hill as a sampling locality. In case of larger hill ranges, or a field of more or less interconnected hills, one may choose to sample various localities, preferably well separated from each other. In the Cuc Phuong N.P. limestone complex, for instance, four localities scattered throughout the Park, have been sampled.

On each locality, all shells of about 6 mm and larger lying around are picked up and stored in the plastic boxes. Make sure to store very fragile shells separately, in order to avoid breakage.

Handfuls of soil are taken from as many different spots as possible, covering as many microhabitats as possible. Spots to pay special attention to are:

- 'Deathtraps' below slightly overhanging limestone cliffs. Snails falling from the top of the cliff may bounce towards the rock face. Sheltered from rain, this is often very dry, so that the animals die. Accumulations of soil mixed with calcareous particles may contain numerous empty shells in a near perfect state of conservation.
- Soil accumulated around the root systems of plants growing on cliff faces.
- Accumulations of soil in rock crevices, in shallow depressions on the rock surface, on rock ledges, or in between rocks on scree slopes. Deep crevices (sometimes several meters deep) can also act as deathtraps and may contain large numbers of individuals.
- Leaf litter at the foot of limestone outcrops.

Sampling is continued until some 10-20 l of soil (two buckets full) is collected. When sampling a soil deposit, any coarse leaf litter lying on top is removed. Then the uppermost few centimeters of a soil are scraped together and bagged. Generally, deeper soil contains only old and partially dissolved specimens. Soil deposits in the above-mentioned 'deathtraps' are an exception. Often, these are thick accumulations of very dry soil; it may be useful to collect the whole body of soil.

Generally, this type of collecting is best done during dry weather. It is very difficult to spot the right places to collect when the forest is soaking wet with rain.

The samples should be carefully labeled. Writing on the plastic bags in which the samples are stored will not work, because the sample will be taken out of the bag for processing. Paper labels will rot in the damp soil, or be eaten completely by small organisms always present in the soil. The best way to label a sample is to write the sample number and a key word indicating the locality on the sticky side of a piece of plastic tape with a marker pen. The sticky side is then covered with another piece of tape, protecting the writing. This label will stay with the sample until the end of the processing. It is waterproof; it will not rot or be eaten.

Of course, each collecting locality should be described extensively in a separate notebook: position, soil type, vegetation, altitude, date and collectors.

4.4 - Effectiveness of collecting method in non-limestone areas

Basically, this collecting method is effective in most areas, provided that the soil is not too acid. It is based on the assumption that even rock dwelling or arboreal species will, sooner or later, end up on the floor and, therefore, in soil samples. However, if the soil is chemically aggressive to shells because of its acidity, the method looses effectiveness. Although, peat swamp forests, with acid soils, may be home to a modest fauna of species living on vegetation, the shells will rapidly dissolve in the soil, rendering the method described above ineffective.

5 - PROCESSING COLLECTED SAMPLES

5.1 - A first processing in the field

If the samples are moderately dry, or at least not soaked with water, flotating the soil sample is very useful to concentrate most of the shells present in a small fraction of the soil. It is done as follows:

- Fill a bucket for three quarters with water.
- Pour the soil over the 8 mm sieve into the water. After stirring until all the particles are wet, rock fragments and soil will sink to the bottom, fine leaf litter and snails, however, will float. The floating fraction can be skimmed off by hand or with the 0.5 mm sieve, or by pouring the water carefully – without disturbing the mud on the bottom – over the same sieve.
- Wash the floating fraction with a garden hose or a tap with a strong jet. This is necessary because some small species will cover their shells with mud, and thus may escape detection later.
- Put the washed material in the 0.5 mm sieve in a cloth bag and swing the cloth bag around with force to remove as much water as possible.
- Spread the material over a thick stack of newspaper. After an hour or two, replace the newspaper. The material will dry fairly quickly.
- Pick the shells out of the 8 mm sieve that was used before flotating the sample.

After drying, the sample is ready for transport to the laboratory.

5.2 - Further processing in the laboratory

In the laboratory, each sample is sieved over a stack of sieves, the coarsest having approximately 5 mm mesh, the finest with 0.5 mm mesh. If all the handpicked, larger shells have been added to the soil sample, it is best to add to more sieves to the stack with 8 and 12 mm mesh respectively.

If the sieving is done carefully, each fraction will contain particles of approximately similar size. This facilitates the picking of the shells from the fraction. The coarse fractions can be picked with the naked eye, for the finer fractions a dissecting microscope at lowest magnification is needed. For the finest fraction one a slightly higher magnification is advisable. Keep in mind that some species tend to cover their shells with soil particles; they resemble small lumps of mud and are easily overlooked.

This results in a number of petri dishes with shells. It is advisable to keep the larger shells separate from the smaller, in three or four different size classes, to prevent small shells getting wedged into the aperture of larger shells. The snails can now be split up into species; the shells belonging to one species from one locality are stored together in a glass tube.

If permanent storage of the material is considered, this is best done in special sample tubes as are available commercially. For this purpose, tubes 5 cm long are most suitable. Several different diameters are available. The 12 mm diameter type is used for the smallest shells. Larger shells can be stored in wider types, the largest in small plastic boxes of various sizes, but with one side always of 5 cm long. This enables efficient, space-saving storage of the collection.

For the administration of a permanent collection, for making labels, and for printing species lists per locality, a simple Windows-ACCESS application named 'Mollusca labels' is available upon request.

6 – RESULTS OF THE SURVEY

Table 4 gives a full checklist, systematically arranged, of all the species found during both surveys. Apart from its precursor published in Vermeulen & Whitten, 1998b, it is the first recent checklist available for any part of northern Vietnam and will be useful for future studies.

Species classified as site endemics or local endemics ('range cat.' 1 and 2) may be found elsewhere in future, and then must be deleted from the list of endemics. However, our experience is that other, newfound species will take their place on the list of local endemics, and that the rates of local endemism presented here, based on the amount of collecting done, will prove to be more or less accurate.

Freshwater and brackish water ('habitat' f and b) species are excluded from analysis: they would skew the results because all species found are widespread, and the brackish water species do not occur in the inland regions. Table 5 and 6 provide the data on which the analysis below is based.

6.1 – Comprehensiveness of collecting

The goal of the report written by Vermeulen and Whitten (1998b) was basically to demonstrate faunal differences between the Ha Long Bay karsts (including Cat Ba island) and the Cuc Phuong karsts. The goals for the present survey were more detailed, but the survey was hampered by bad weather (the effectiveness of our collecting method decreases during wet weather because we find it impossible to locate the best spots to take soil samples), and inaccessibility.

Cat Ba Island: Visited twice, in 1998 and 2003. Altogether 8 localities, all clustered around the N.P. headquarters and the lake Ao Ek were sampled. This is sufficient to assess the fauna of the island as a whole, but not to determine spots on the island of particular biodiversity importance.

Ha long Bay: This area is very extensively surveyed in 1998 and 2003; 42 samples from 31 localities scattered throughout the area have been taken.

Ha Long-Campha: During a visit in 1998, altogether 5 samples were taken, all from the periphery of the limestone range as well as from a few isolated outcrops, all from heavily disturbed environments. Collecting did not cover the relatively little disturbed core areas, as these were inaccessible to us. A provisional assessment of the fauna of the area as a whole is possible; a more detailed analysis is not because we have not sampled the relatively undisturbed centre.

Phu Ly: 2 soil samples have been collected quickly on our way to Cuc Phuong in 1998, from small limestone outcrops at some distance of the main range. These are not even sufficient to give an impression of the local snail fauna.

Cuc Phuong: was only briefly visited in 1998, and access was difficult. The 4 collecting are all situated in solid primary forest and are therefore likely to fairly represent of the local snail fauna. A general assessment and comparison is possible, but a more detailed zonation of the area is not.

Pu Luong: The Pu Luong survey in 2003 was less lucky: hampered by bad weather and difficult access, the collectors did not even touch the primary forest on the ranges. Four samples were taken at the foot of limestone cliffs covered with secondary growth. This only suffices for a provisional comparison with the faunas from the other sampled areas.

6.2 – The inventory of the regions Pu Long, Cuc Phuong, Phu Ly and Ha Long (the last including Cat Ba and Ha Long-Campha)

The results are summarized in table 2.

Pu Luong and Cuc Phuong together:
These regions are part of a limestone range that runs from the Vietnamese coast to the Northwest, all the way up to the Chinese border. Both regions are situated on the southeastern extreme of this range. It is therefore relevant to compare the fauna of the two together with the other regions investigated.

Our sampling serves to give an impression of the local snail fauna, but is far from comprehensive. Nevertheless the yield has been impressive, including no fewer than 162 species. 25 of these (15.4%) are regarded as local endemics. Undoubtedly, more sampling localities will reveal numerous more species in all range size categories including local endemics. The fauna of the two regions differs considerably from that of the other regions investigated, with 83 species (31.1% of 267, being the total number of terrestrial species found during the survey) that the consultants have not found elsewhere.

Pu Luong and Cuc Phuong compared
The total numbers of species secured is 96 and 124 respectively. However, the collections of both areas differ considerably in species composition: altogether 162 species have been found, but only 57 of these (35.2%) have been found in both. This is, indeed, partly reflecting inadequate collecting, but we assume that the faunas are truly different. An indication is that the few samples that we have from Pu Luong yielded 39 species that were not found in Cuc Phuong, where sampling was much more thorough.

From areas further to the Northwest on the same limestone range, more species have been described in the past, very few of which have been recovered from our samples. Apparently, the whole of the mountain range, from the Vietnamese coast up to the Chinese border, can be divided in an unknown number of faunistically different areas, each with its own suite of endemic species.

Phu Ly
Because of insufficient collecting, we prefer not to include the area in this analysis. Nevertheless, among the 24 species collected were two that we have not found elsewhere.

Ha Long, including Cat Ba and Ha Long-Campha
The fauna of the area is distinct and fairly unique: 178 species have been found. 99 species have not been found in the other areas under investigation; we assume that 51 of these (28.7% of the total number species found in the region) are endemic to Ha Long.

6.3 – The inventory of the sectors of Ha Long, including Cat Ba and Ha Long-Campha

In order to identify faunal differences between parts of the Ha Long region the area has been into 5 sectors. The sectors are outlined on the map in fig. 1; the data are summarized in table 3.

Sector 1 (Cat Ba National Park, including the archipelago off its Northeast coast, down to the main shipping lane)
Collecting was comprehensive but localized, restricted to a number of localities fairly close together on the island itself, as well as a few clusters of localities on the smaller islands. Nevertheless, the little disturbed, well-sheltered parts of the island appear to harbour a unique fauna that differs considerably from other sectors of the Ha Long region. Altogether, 149 species were found, 60 of which (37% of the 178 species found in the Ha Long region) occur only in this sector of the Ha Long region. 24 of these are even supposed to be site endemics (16.1% of the total number of species in the sector). One of these endemics is ***Oospira pycnosoma*** Gittenberger & Vermeulen, a recently described giant clausiliid snail. It is based on shells found during the 1998 survey.

Sector 2, 3 and 4 (Ha Long Bay Heritage Site)
On the whole, the environment is much harsher here than in sector 1: the numerous small islands are exposed to sea, wind and sun. The vegetation is often scarce, and there are relatively few inland valleys that offer shelter from the elements. This is reflected in the fauna. In spite of the far more extensive sampling than in Cat Ba or any other area visited, the total number of species is only 86, and only 9 of these (5% of the 178 species found in the Ha Long region) occur only in this sector of the Ha Long region. No more than 3 site endemics are among these.

Sector 5 (Ha Long-Campha area)
Here and there, from a vantage point, one can see the inner core of the limestone area. This appears to be largely pristine, but virtually inaccessible. In spite of the insufficient collecting, entirely restricted to the degraded periphery of the limestone area, 91 species were found. 14 of these (8.6% of the 178 species found in the Ha Long region) occur only in this sector of the Ha Long region, and only two among them are site endemics (2.2% of the total number of species in the sector).

With more extensive surveys in the pristine interior we expect the total number of species to rise sharply, and in particular the number of site endemics. We are confident that the sector is rich in species and endemics, second only to Cat Ba, and far richer in species that the Ha Long Bay Heritage site.

6.4 – The surveyed areas compared to the fauna of northern Vietnam as a whole

With 149 out of the 267 collected species of land snails (56%) endemic to northern Vietnam as a whole (149 cat. 3 species; ‘regional endemics’; excluding all the site and local endemics, cat. 1 and 2), the faunas of the surveyed areas are typical for the region. Next to this component, each

area has a suite of narrower endemics (cat. 1 and 2); in total 230 out of the 310 species (74%) found during our survey have a range not extending beyond northern Vietnam. We expect the rate of endemism among snails for northern Vietnam as a whole to be a similar figure.

In fact the surveyed areas figure as somewhat randomly chosen examples of the wealth of the snail fauna of northern Vietnam. Extrapolating from the results of our survey, it is likely that every limestone range in northern Vietnam would yield a series of regional endemics, next to a fair number of species that are site- or local endemics. Based on the number of species found by us, the number of species described earlier from northern Vietnam, and the number of unidentified (and therefore possibly new) species found during the survey, a very rough estimate of the total number of terrestrial mollusc species in northern Vietnam would be around 1000. Protection of the surveyed areas would provide safety for some 300 of these.

7 – GENERAL CONCLUSIONS RESULTING FROM THIS SURVEY

7.1 – Terrestrial mollusks as indicators of disturbance

Theoretically, disturbance could be best measured by local extinction of native species as well as by invasion of other species that are more tolerant to disturbance. This, however, cannot be done without baseline studies, and without a precise knowledge as to the environmental tolerance of at least a number of species. Both are lacking in Southeast Asia, including Vietnam.

In Malaysian Borneo, however, a number of species indicating environmental disturbance have been identified. Drawing from ample field experience, indicator species are species:

- That are generally regarded as recent introductions, by mankind, to the local snail fauna, and
- That have never been found in inland, undisturbed primary forest during numerous excursions in the area.

These introduced species have in common that they are

- Tolerant to periodical drought, and
- To the high dynamism of disturbed environments.

The species identified as disturbance indicators are:
*Achatina fulica**
Bradybaena similaris
*Gulella bicolor**
*Lamellaxis gracilis**
*Lamellaxis clavulinus**
*Paropeas achatinaceum**
Subulina octona
Some are illustrated in fig. 2. A few more illustrations of widespread species can be found in Vermeulen & Whitten, 1998a, and in Naggs and Raheem, 2000. Again drawing from field experience, but yet unsupported by statistical studies, it has been observed that both *Lamellaxis* species appear first following disturbance. However, their presence in large numbers is probably indicative for a specific disturbance rather than for disturbance in general: they thrive in large numbers in nutrient-enriched soils, for instance along paths used by local people to carry guano. Samples including *Lamellaxis* in not too large numbers can still be fairly rich in native species. *Achatina* and *Bradybaena* appear only in advanced stages of environmental degradation; samples including these two are generally poor in numbers of species.

This, however, applies only to inland environments. Coastal areas in are generally inhabited by a suite of native species that are adapted to periodical stress of the kind mentioned above. The introduced species identified as disturbance indicators tend to mingle happily with the

local fauna, and of a number of species we are even unable to determine whether they are native or introduced. The invasive capacity of the coastal native species on the whole appears not impressive: they do not appear in degraded inland environments. An isolated inland occurrence of one of these, *Kaliella doliolum*, is best explained by the fact that the limestone hill concerned was surrounded by mangroves some 30.000 years, rather than by invasion following recent disturbance.

The species marked with an * in the list above have been found during our Vietnam survey. They could be used as indicators of disturbance in inland environments. However, *Bradybaena similaris* should be excluded if ever found. Numerous *Bradybaena* species occur in nearby China and several more in Indochina; *Bradybaena similaris* may be native here. The species list includes two more species in Category 5 (Introduced Species): *Kaliella doliolum* and *Videna timorensis*. The first is a species of the coastal facies; the second is a species of uncertain taxonomic status and with a poorly known distribution. Provisionally we regard it as introduced, but its status needs further study.

In northern Vietnam, some careful sampling in undisturbed environments as well as in nearby degraded environments could possibly identify a few more species that could be used locally as indicators of disturbance.

Ha Long Bay consists of an archipelago of mainly small islands. Most of the area is exposed, directly or indirectly, to the sea. The dynamism is naturally high, and not readily distinguishable from human impact in many cases. Species from the list above occur locally, in small numbers. Environmental disturbance, either natural or caused by mankind, may be apparent from skewing of the fauna on a site: a few species occur in very large numbers, all others occur only in very small numbers.

7.2 – Threats, and protective measures

Terrestrial mollusks should be regarded as an indicator group only, and not as a group of exceptional biodiversity value worthy of special attention. The snail fauna is only a minor part of the total invertebrate fauna of the Vietnam limestones. Undoubtedly other groups show a similar, or even a much larger diversity, and more interesting patterns of endemism.

Threats to the terrestrial mollusc fauna are the same as to most limestone flora and fauna: habitat destruction caused by clearing the vegetation for agriculture or forest products, destruction caused by mining and fire. Therefore, specific measures to protect the snail fauna are irrelevant. General measures from which the snail fauna, together with most fauna and flora, would benefit are so well known that they barely need to be mentioned here: keep the vegetation cover intact. Fire is often particularly devastating in limestone areas; fire prevention is therefore very important.

7.3 – Future studies

In order to provide protection of a larger part of the terrestrial mollusc fauna in special, and of the invertebrate fauna in general, a survey covering the whole of northern Vietnam to identify limestone areas with a particularly rich fauna would be useful.

Next to this, baseline studies could be conducted in established nature reserves. This way, land snails could be used to monitor environmental changes and degradation. Particularly in areas and along paths frequented by tourists or local people this could be useful. A decline in numbers of species found along a transect, or the appearance of new or introduced species could be indicative of undue impact of the exploitation on the local environment. Similar permanent plots in little frequented areas could reveal environmental changes on a larger scale, such as changes in climate.

Preferably, the local counterpart should undertake such surveys. The foreign consultants could assist him methodologically, with assembling a reference collection, and with identifying species.

Literature cited:

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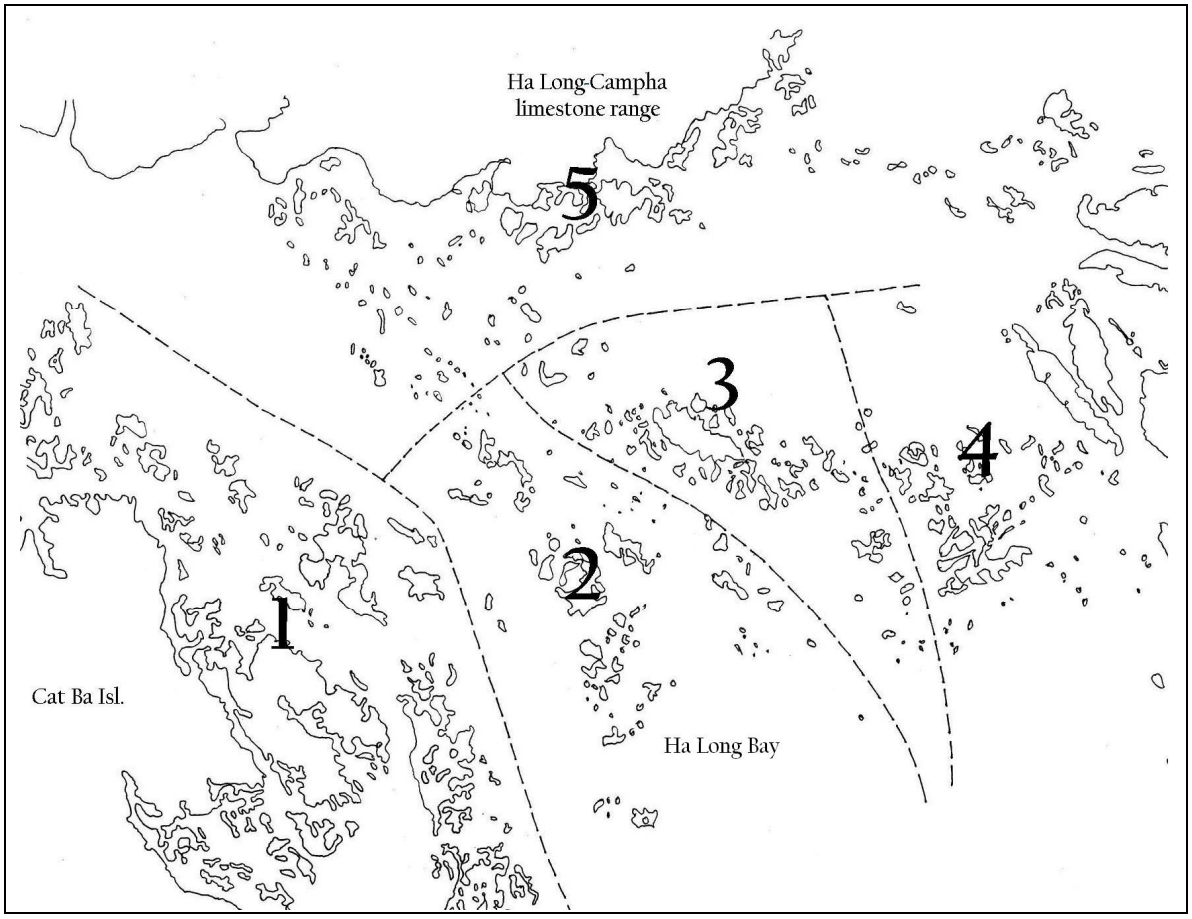

Fig. 1: The Ha Long region divided into the sectors 1 to 5.

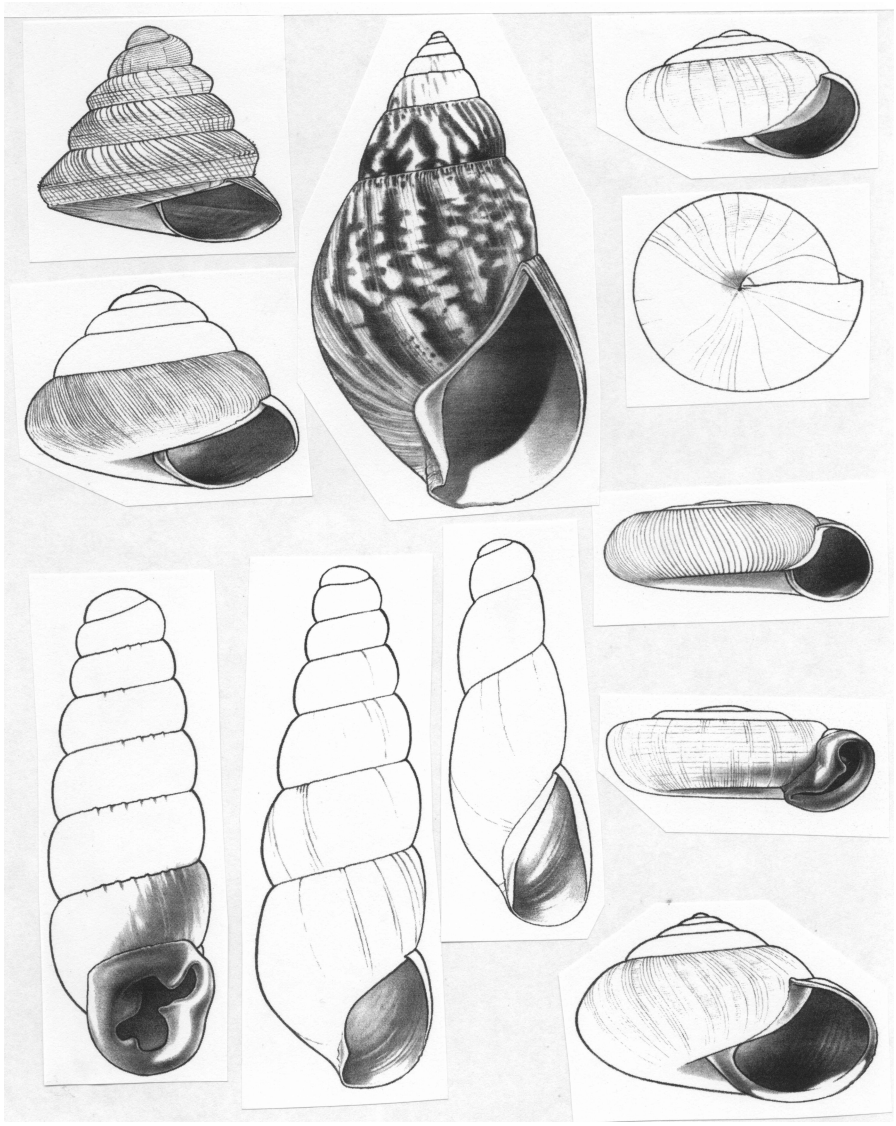

Fig 2: Some introduced species (cat. 5) identified as indicators of disturbance, and some widespread species (cat. 4) of the coastal facies.

1 = *Queridomus conulus* (widespread)
2 = *Achatina fulica* (introduced)
3 = *Microcystina sinica* (widespread)
4 = *Liardetia scandens* (widespread)
5 = *Discocharopa aperta* (widespread, not in Vietnam)
6 = *Stenopylis coarctata* (widespread, not yet found in northern Vietnam)
7 = *Gulella bicolor* (introduced)
8 = *Lamellaxis gracilis* (introduced)
9 = *Ceciloides caledonia* (widespread, not yet found in northern Vietnam)
10 = *Bradybaena similaris* (introduced, possibly native in northern Vietnam)

Table 1: Range size classes

1 – Site endemic: a species having a range of <100 km2, e.g. restricted to one of the sectors of the Ha Long region

2 – Local endemic: a species having a range of more than 100 km2 but less than 10.000 km2, e.g. restricted to each of the regions in this report.

3 – Regional endemic: a species having a range of more than 10.000 km2 but less than 1.000.000 km2, e.g. restricted to the whole of northern Vietnam (Tonkin).

4 – Widespread: a species having range larger than 1.000.000 km2, e.g. occurring in the whole of the Indochinese peninsula

5 – Introduced: a species not indigenous to Vietnam.

Table 2: Summary of the data on the terrestrial snail fauna of the regions surveyed (freshwater and brackish water species excluded) based on table 5.

Meaning of the columns (all numbers refer to species found by consultants during the 1998 and 2003 surveys only):

A – Region name, see list in Chapter 2.1.The Cat Ba and the Ha Long-Campha region are included in **HaLo.**

B – Total number of species found in the region by consultants.

C – Number of species found in that particular region only by consultants (including species that are known to occur in areas not covered in the survey).

D – % of the total number of the terrestrial species found in all the regions together (= 267).

E – Number of species assumedly endemic to the region (= excluding species that are known to occur in areas not covered in the survey).

F – % of the total number of species found in that particular region.

A	B	C	*D (%)*	E	*F (%)*
PuLu + CuPh	162	83	*31.1*	25	*15.4*
PuLu	96	18	*6.7*	12	*12.5*
CuPh	124	38	*14.2*	13	*10.5*
HaLo	178	99	*37.1*	51	*28.7*

Table 3: Summary of the data on the Ha Long terrestrial snail fauna (freshwater and brackish water species excluded), based on table 6

Meaning of the columns (all numbers refer to species found by consultants during the 1998 and 2003 surveys only):

A – Sector number; see fig. 1 for the division of the Ha Long region in sectors.

B – Total number of species found in the sector by consultants.

C – Number of species found in that particular sector only by consultants (including species that are known to occur in areas not covered in the survey).

D – % of the total number of terrestrial species found in Ha Long Bay (= 178).

E – Number of species assumedly endemic to the sector (= excluding species that are known to occur in areas not covered in the survey).

F – % of the total number of species found in that particular sector.

A	B	C	*D (%)*	E	*F (%)*
1	149	60	*37.0*	24	*16.1*
2	55	2	*1.2*	1	*1.8*
3	62	4	*2.5*	2	*3.2*
4	56	0	*0*	0	*0*
5	91	14	*8.6*	2	*2.2*

Tables 4 to 6:

The column 'Species' gives the scientific name of the species. For a number of species no specific name is available; several of these are probably new to science. Instead of a specific name, such species are indicated by provisional codes to identify them:

'aff.' – after a name indicates that the species is more or less similar to the species mentioned, but not identical with it

'sp.'- indicates that no specific name is available for the species. The code usually present after 'sp.' is an informal reference to uniquely indicate the species

Table 4 -- Tonkin: list of snail species collected during the 1998 and 2003 surveys in the areas Pu Luong, Cuc Phuong, Phu Ly, and Ha Long

Meaning of the columns:

PuLu, CuPh, PhLi, and HaLo – region names, see list in Chapter 2.1

Range cat. – See table 1

Habitat – b = a species from brackish environments; f = from freshwater environments; l = terrestrial species

	species	PuLu	CuPh	PhLi	HaLo	range cat.	habitat
Bivalvia							
Pisidiidae							
1	**Pisidium sp.**				x	4	f
Gastropoda Prosobranchia							
Ampullariidae							
2	**Pila scutata**				x	4	f
Assimineidae							
3	**Acmella sp. 1**				x	1	l
4	**Acmella sp. 2**				x	3	l
5	**Acmella sp. 3**			x	x	3	l
6	**Acmella sp. 4**		x	x		3	l
7	**Anaglyphula minutissima aff.**	x			x	3	l
8	**Assiminea borneensis**				x	4	b
9	**Assiminea javana**				x	4	b
10	**Assiminea quadrasi**				x	4	b
11	**Assiminea sp. vi-02**				x	4	b
12	**Cyclotropis sp.**				x	4	f
Cyclophoridae							
13	**Alycaeus vanbuensis**		x		x	3	l
14	**Chamalycaeus fimbriatus**	x	x			3	l
15	**Chamalycaeus fractus**	x	x		x	3	l
16	**Chamalycaeus fraterculus**	x	x		x	3	l
17	**Chamalycaeus heudei**	x	x			3	l
18	**Chamalycaeus sp. vi-01**				x	1	l
19	**Cyathopoma sp. vi-01**				x	1	l
20	**Cyclophorus cambodgensis**	x	x	x	x	4	l
21	**Cyclophorus malayanus**	x	x			4	l
22	**Cyclophorus trouiensis**				x	3	l
23	**Cyclophorus volvulus**	x	x		x	4	l
24	**Dioryx dongiensis**		x			2	l
25	**Dioryx messageri**	x	x		x	3	l
26	**Dioryx pocsi**		x			3	l
27	**Japonia diploloma**	x			x	3	l
28	**Japonia hypselospira**	x	x			3	l
29	**Japonia insularis**				x	2	l
30	**Japonia mariei**				x	4	l
31	**Japonia scissimargo**				x	3	l
32	**Japonia sp. vi-01**		x			2	l
33	**Japonia sp. vi-02**				x	1	l
34	**Japonia sp. vi-03**				x	2	l
35	**Japonia sp. vi-04**		x			2	l
36	**Japonia sp. vi-05**		x			2	l
37	**Japonia sp. vi-06**		x			2	l
38	**Japonia sp. vi-07**	x			x	3	l
39	**Japonia sp. vi-08**				x	1	l
40	**Platyraphe leucacme**	x	x			3	l
41	**Platyraphe vatheleti**				x	2	l
42	**Pterocyclos berthae**	x			x	3	l
43	**Pterocyclos danieli**		x		x	3	l
44	**Pterocyclos fischerianus (?)**		x		x	4	l
45	**Pterocyclos sp. vi-01**	x	x	x	x	3	l
46	**Scabrina hirsuta**		x		x	4	l
47	**Scabrina sp. vi-01**		x		x	3	l
Diplommatinidae							
48	**Arinia sp. vi-01**				x	1	l
49	**Diplommatina debilis**		x		x	3	l

	species	PuLu	CuPh	PhLi	HaLo	range cat.	habitat
50	**Diplommatina demangei**		x	x		3	l
51	**Diplommatina fulva**				x	2	l
52	**Diplommatina herziana**		x		x	4	l
53	**Diplommatina rotundata**				x	3	l
54	**Diplommatina scolops**		x		x	3	l
55	**Diplommatina sp. vi-a1**	x	x			3	l
56	**Diplommatina sp. vi-a2**	x	x			3	l
57	**Diplommatina sp. vi-a3**		x			2	l
58	**Diplommatina sp. vi-a4**		x			2	l
59	**Diplommatina sp. vi-a5**				x	2	l
60	**Diplommatina sp. vi-r1**		x		x	3	l
61	**Diplommatina sp. vi-r2**				x	3	l
62	**Diplommatina sp. vi-r3**				x	2	l
63	**Diplommatina sp. vi-s1**	x			x	3	l
64	**Diplommatina sp. vi-s2**				x	3	l
65	**Diplommatina sp. vi-s3**	x			x	3	l
66	**Diplommatina sp. vi-sp1**	x	x			3	l
67	**Diplommatina sp. vi-sp2**	x				2	l
68	**Diplommatina sp. vi-sp3**	x				2	l
69	**Helicomorpha scalarioides**				x	3	l
	Helicinidae						
70	**Aphanoconia hungerfordiana halongensis**				x	2	l
71	**Geotrochatella jourdyi**				x	2	l
72	**Geotrochatella mouhoti**		x			4	l
	Hydrobiidae						
73	**Bithynia sp. 1**				x	4	f
74	**Bithynia sp. 2**				x	3	f
75	**Tricula (?) sp.**		x			2	f
	Hydrocenidae						
76	**Georissa chrysacme**		x		x	3	l
77	**Georissa decora**	x		x	x	3	l
78	**Georissa sp. vi-1**	x				3	l
79	**Georissa sp. vi-2**	x	x	x	x	3	l
80	**Georissa sp. vi-3**	x			x	3	l
81	**Georissa sp. vi-4**	x	x			3	l
82	**Georissa tongkingensis**				x	3	l
	Pupinidae						
83	**Pollicaria gravida**		x		x	4	l
84	**Pseudopomatias fulvus**		x		x	3	l
85	**Pseudopomatias sp.**	x	x			3	l
86	**Pupina brachysoma**	x	x		x	3	l
87	**Pupina dorri**	x	x	x	x	3	l
88	**Pupina exclamationis**	x	x		x	3	l
89	**Pupina flava**		x		x	3	l
	Stenothyridae						
90	**Stenothyra moussoni**				x	4	b
91	**Stenothyra sp. 1**				x	4	b
92	**Stenothyra sp. 2**				x	4	b
93	**Stenothyra sp. 3**				x	4	b
94	**Stenothyra sp. 4**				x	4	f
	Thiaridae						
95	**Brotia costula**				x	4	f
96	**Melanoides tuberculatus**				x	5	f
97	**Sermyla riqueti**				x	4	f
98	**Tarebia granifera**				x	4	f
99	**Thiara scabra**				x	4	f
	Truncatellidae						
100	**Truncatella guerinii**				x	4	b
	Viviparidae						
101	**Filopaludina javanica**				x	4	f
102	**Paludina sp.**		x			3	f
	Gastropoda Pulmonata						
	Achatinellidae						
103	**Elasmias manilense**				x	4	l
	Achatinidae						
104	**Achatina fulica**				x	5	l
	Ariophantidae						
105	**Austenia messageri**		x			3	l
106	**Elaphroconcha denserugata**	x	x			4	l
107	**Euplecta sp. vi-01**				x	2	l
108	**Hemiplecta platytaenia**	x				3	l
109	**Hemiplecta sp. vi-m1**	x				2	l
110	**Macrochlamys despecta**	x	x	x	x	3	l
111	**Macrochlamys douvillei**		x			3	l

	species	PuLu	CuPh	PhLi	HaLo	range cat.	habitat
112	**Macrochlamys douvillei aff.**	x				2	l
113	**Macrochlamys malaccana aff.**	x				2	l
114	**Macrochlamys sp. vi-1**				x	3	l
115	**Macrochlamys sp. vi-2**	x	x			4	l
116	**Macrochlamys sp. vi-3**		x			3	l
117	**Macrochlamys sp. vi-4**				x	2	l
118	**Macrochlamys sp. vi-5**	x				2	l
119	**Megaustenia fragilis**		x			3	l
120	**Megaustenia imperator**	x	x	x	x	4	l
121	**Microcystina sinica**	x	x		x	4	l
122	**Microcystina sp. vi-b01**		x			3	l
123	**Microcystina sp. vi-b02**		x		x	3	l
124	**Microcystina sp. vi-b03**		x			3	l
125	**Microcystina sp. vi-b04**		x			3	l
126	**Microcystina sp. vi-b05**		x			3	l
127	**Microcystina sp. vi-b06**		x			3	l
128	**Microcystina sp. vi-b07**		x		x	3	l
129	**Microcystina sp. vi-b08**				x	3	l
130	**Microcystina sp. vi-b09**				x	3	l
131	**Microcystina sp. vi-b10**		x			3	l
132	**Microcystina sp. vi-b11**				x	3	l
133	**Microcystina sp. vi-b12**				x	3	l
134	**Microcystina sp. vi-w1**		x		x	3	l
135	**Microcystina sp. vi-w2**				x	3	l
136	**Microcystina sp. vi-w3**		x			3	l
137	**Microcystina sp. vi-w5**				x	1	l
138	**Microcystina sp. vi-w6**				x	2	l
139	**Microcystina sp. vi-w7**				x	1	l
140	**Microcystina sp. vi-w8**				x	2	l
	Bradybaenidae						
141	**Bradybaena jourdyi**	x		x	x	4	l
142	**Chalepotaxis infantilis**	x	x		x	4	l
143	**Nesiohelix vorvonga**		x			3	l
144	**Pseudiberus lamyi**				x	3	l
145	**Pseudiberus mellea**	x		x		3	l
146	**Pseudobuliminus productus**				x	3	l
147	**Pseudobuliminus sp. vi-01**		x			2	l
148	**Pseudobuliminus sp. vi-02**				x	1	l
	Camaenidae						
149	**Camaena billeti**	x	x			3	l
150	**Camaena choboensis**				x	3	l
151	**Camaena duporti**	x	x	x		3	l
152	**Camaena gabrielae**	x	x			3	l
153	**Camaena hahni**				x	1	l
154	**Camaena lavezzarii**	x				3	l
155	**Camaena vayssierei**	x	x			3	l
156	**Chloritis cincta**				x	2	l
157	**Chloritis insularis**				x	2	l
158	**Chloritis sp. vi-1**		x			3	l
159	**Chloritis sp. vi-2**	x			x	3	l
160	**Ganesella acris**				x	4	l
161	**Ganesella coudeini**	x	x			3	l
162	**Ganesella diplogramma**			x		4	l
163	**Ganesella fulvescens**	x	x			3	l
164	**Ganesella onestera**				x	3	l
165	**Ganesella oxytropis**		x		x	3	l
166	**Ganesella subperakensis**				x	3	l
167	**gen. ? sp.**				x	1	l
168	**Landouria ptychostyla**		x			4	l
169	**Moellendorffia blaisei**				x	2	l
170	**Moellendorffia loxotata**				x	3	l
171	**Neocepolis merarcha**	x	x			3	l
	Clausiliidae						
172	**Euphaedusa sp. vi-1**		x			2?	l
173	**Formosana miranda**		x			2	l
174	**Hemiphaedusa sp. vi-1**				x	3	l
175	**Leptacme sp. vi-1**		x			2	l
176	**Leptacme sp. vi-2**	x				2	l
177	**Liparophaedusa rhopaloides**				x	3	l
178	**Oospira pyknosoma**				x	1	l
179	**Oospira sp. vi-1**	x				2	l
180	**Oospira vanbuensis**	x	x			3	l
181	**Phaedusa backhanensis**		x			3	l
182	**Phaedusa stenothyra**				x	3	l
183	**Tropidauchenia ardouiniana**				x	2	l
184	**Tropidauchenia proctostoma**	x	x			3	l
185	**Tropidauchenia sp. vi-1**				x	1	l

	species	PuLu	CuPh	PhLi	HaLo	range cat.	habitat
Ellobiidae							
186	**Allochroa layardi**				x	4	b
187	**Auriculastra brachyspira**				x	4	b
188	**Auriculastra nevillei**				x	4	b
189	**Blauneria quadrasi**				x	4	b
190	**Carychium javanum**		x			4	l
191	**Cassidula nucleus**				x	4	b
192	**Cassidula plecotrematoides**				x	4	b
193	**Ellobium chinense**				x	4	b
194	**Laemodonta minuta**				x	4	b
195	**Laemodonta typica**				x	4	b
196	**Marinula sp.**				x	4	b
197	**Melampus adamsianus**				x	4	b
198	**Melampus fasciatus**				x	4	b
199	**Melampus phaeostylus**				x	4	b
200	**Melampus pulchellus**				x	4	b
201	**Melampus siamensis**				x	4	b
202	**Microtralia alba**				x	4	b
Endodontidae							
203	**Charopa sp. vi-1**				x	2	l
204	**Philalanka nannophya aff.**	x				4	l
205	**Philalanka sp. vi-1**				x	4	l
206	**Philalanka sp. vi-2**				x	4	l
207	**Philalanka tricincta**		x			4	l
Enidae							
208	**Mirus tenuistriatus**	x	x			3	l
Euconulidae							
209	**Kaliella doliolum**				x	5	l
210	**Kaliella microconus**	x			x	3	l
211	**Kaliella scandens**		x		x	4	l
212	**Liardetia haiphongensis**	x	x		x	3	l
213	**Liardetia micula**	x			x	4	l
214	**Liardetia sp. vi-k1**		x			3	l
215	**Liardetia sp. vi-k2**		x			3	l
216	**Liardetia sp. vi-k3**		x		x	3	l
217	**Liardetia sp. vi-k4**		x		x	3	l
218	**Liardetia sp. vi-k5**		x		x	3	l
219	**Liardetia sp. vi-o1**		x		x	3	l
220	**Liardetia sp. vi-o2**				x	3	l
221	**Liardetia sp. vi-o3**		x			3	l
222	**Liardetia sp. vi-r1**		x			3	l
223	**Liardetia sp. vi-r10**				x	2	l
224	**Liardetia sp. vi-r2**		x		x	3	l
225	**Liardetia sp. vi-r3**		x		x	3	l
226	**Liardetia sp. vi-r4**				x	3	l
227	**Liardetia sp. vi-r5**				x	3	l
228	**Liardetia sp. vi-r6**				x	3	l
229	**Liardetia sp. vi-r7**	x			x	3	l
230	**Liardetia sp. vi-r8**	x	x		x	3	l
231	**Liardetia sp. vi-r9**				x	1	l
232	**Liardetia subelongata**	x	x		x	3	l
233	**Liardetia tonkingensis**	x	x			3	l
234	**Queridomus conulus**				x	4	l
235	**Queridomus sp. vi-01**	x		x	x	3	l
236	**Rahula jucunda**		x			3	l
fam. ?							
237	**gen. ? sp.**				x	4	l
Helicarionidae							
238	**Helicarion sp. vi-1**	x	x		x	3	l
239	**Helicarion sp. vi-2**		x			3	l
240	**Sesara sp. vi-01**	x	x		x	3	l
241	**Sesara sp. vi-02**	x				2	l
Planorbidae							
242	**Gyraulus heudei**				x	4	f
243	**Hippeutis umbilicalis (?)**				x	4	f
244	**Segmentina hemisphaerula**				x	4	f
Plectopylinidae							
245	**Plectopylis phlyaria**	x	x			3	l
246	**Plectopylis schlumbergeri**				x	3	l
Siphonariidae							
247	**Siphonaria guamensis**				x	?	b
Streptaxidae							
248	**Gulella bicolor**	x		x	x	5	l

	species	PuLu	CuPh	PhLi	HaLo	range cat.	habitat
249	**Haploptychius blaisei**			x		3	l
250	**Haploptychius costulatus**				x	4	l
251	**Haploptychius diespiter**	x	x			3	l
252	**Haploptychius dorri**				x	1	l
253	**Haploptychius fischeri**				x	2	l
254	**Haploptychius sp. vi-1**	x			x	3	l
255	**Haploptychius sp. vi-2**				x	1	l
256	**Haploptychius sp. vi-3**				x	1	l
257	**Haploptychius sp. vi-4**				x	2	l
258	**Haploptychius sp. vi-5**				x	1	l
259	**Haploptychius sp.6**	x				2	l
260	**Indoartemon prestoni**				x	4	l
261	**Perrottetia cristatellus**	x				3	l
262	**Perrottetia daedalus**	x	x			3	l
263	**Sinoennea atomaria**				x	1	l
264	**Sinoennea calva**				x	1	l
265	**Sinoennea plagiostoma**	x			x	3	l
266	**Sinoennea sp. vi-1**				x	2	l
267	**Sinoennea sp. vi-2**				x	1	l
268	**Sinoennea sp. vi-3**		x			2	l
269	**Sinoennea sp. vi-4**				x	1	l
270	**Sinoennea sp. vi-5**	x				2	l
271	**Sinoennea sp. vi-6**				x	1	l
272	**Tonkinia mirabilis**				x	2	l
	Strobilopsidae						
273	**Eostrobilops sp. vi-1**	x				2	l
	Subulinidae						
274	**Curvella sp. vi-1**	x	x		x	3	l
275	**Curvella tonkiniana**	x	x		x	3	l
276	**Glessula paviei**	x	x			3	l
277	**Lamellaxis clavulinus**	x	x	x	x	5	l
278	**Lamellaxis gracilis**	x	x		x	5	l
279	**Opeas striatissum**			x	x	3	l
280	**Paropeas achatinaceum**	x	x	x	x	5	l
281	**Prosopeas excellens**			x	x	3	l
282	**Prosopeas macilentum**				x	3	l
283	**Prosopeas ventrosulum**				x	3	l
284	**Subulinidae indet.**	x				3	l
	Trochomorphidae						
285	**Videna paviei**	x	x		x	3	l
286	**Videna sapeca**				x	3	l
287	**Videna sp. vi-1**	x	x	x	x	3	l
288	**Videna timorensis**	x			x	5	l
	Vertiginidae						
289	**Acinolaemus sp. vi-01**				x	1	l
290	**Acinolaemus sp. vi-01a**				x	1	l
291	**Aulacospira sp. vi-01**				x	1	l
292	**Aulacospira sp. vi-02**		x			2	l
293	**Boysidia sp. vi-01**	x	x		x	3	l
294	**Gastrocopta pediculus**				x	4	l
295	**Gastrocopta servilis**				x	4	l
296	**Hypselostoma crossei**			x	x	3	l
297	**Ptychopatula miccyla**	x	x			4	l
298	**Ptychopatula orcula**	x	x	x	x	4	l
299	**Systenostoma defixa**				x	2	l
300	**Systenostoma pauperrima**				x	3	l
301	**Systenostoma sp. vi-02**	x	x		x	3	l
302	**Systenostoma sp. vi-03**		x		x	3	l
303	**Systenostoma sp. vi-03a**				x	3	l
304	**Systenostoma sp. vi-05**				x	1	l
305	**Systenostoma sp. vi-06**		x		x	3	l
306	**Systenostoma sp. vi-06a**				x	3	l
307	**Systenostoma sp. vi-07**	x	x		x	3	l
308	**Systenostoma sp. vi-09**	x			x	3	l
309	**Systenostoma sp. vi-10**				x	1	l
310	**Systenostoma sp. vi-11**				x	1	l

Table 5 -- Tonkin: distribution of snail species over the regions Pu Luong, Cuc Phuong, Phu Ly, and Ha Long

Meaning of the columns:

Pulu, CuPh, PhLi, and HaLo – region names, see list in Chapter 2.1

Range cat. – See table 1

Habitat – b = a species from brackish environments; f = from freshwater environments; l = terrestrial species

Freshwater and brackish water species (habitat cat. 'f' and 'b') excluded

PuLu	CuPh	PhLi	HaLo	nr	species	Range cat.	Habitat
x	x	x	x	277	Lamellaxis clavulinus - Subulinidae	5	l
x	x	x	x	280	Paropeas achatinaceum - Subulinidae	5	l
x	x	x	x	20	Cyclophorus cambodgensis - Cyclophoridae	4	l
x	x	x	x	120	Megaustenia imperator - Ariophantidae	4	l
x	x	x	x	298	Ptychopatula orcula - Vertiginidae	4	l
x	x	x	x	79	Georissa sp. vi-2 - Hydrocenidae	3	l
x	x	x	x	110	Macrochlamys despecta - Ariophantidae	3	l
x	x	x	x	45	Pterocyclos sp. vi-01 - Cyclophoridae	3	l
x	x	x	x	87	Pupina dorri - Pupinidae	3	l
x	x	x	x	287	Videna sp. vi-1 - Trochomorphidae	3	l
x	x	x		151	Camaena duporti - Camaenidae	3	l
x	x		x	278	Lamellaxis gracilis - Subulinidae	5	l
x	x		x	142	Chalepotaxis infantilis - Bradybaenidae	4	l
x	x		x	23	Cyclophorus volvulus - Cyclophoridae	4	l
x	x		x	121	Microcystina sinica - Ariophantidae	4	l
x	x		x	293	Boysidia sp. vi-01 - Vertiginidae	3	l
x	x		x	15	Chamalycaeus fractus - Cyclophoridae	3	l
x	x		x	16	Chamalycaeus fraterculus - Cyclophoridae	3	l
x	x		x	274	Curvella sp. vi-1 - Subulinidae	3	l
x	x		x	275	Curvella tonkiniana - Subulinidae	3	l
x	x		x	25	Dioryx messageri - Cyclophoridae	3	l
x	x		x	238	Helicarion sp. vi-1 - Helicarionidae	3	l
x	x		x	212	Liardetia haiphongensis - Euconulidae	3	l
x	x		x	230	Liardetia sp. vi-r8 - Euconulidae	3	l
x	x		x	232	Liardetia subelongata - Euconulidae	3	l
x	x		x	86	Pupina brachysoma - Pupinidae	3	l
x	x		x	88	Pupina exclamationis - Pupinidae	3	l
x	x		x	240	Sesara sp. vi-01 - Helicarionidae	3	l
x	x		x	301	Systenostoma sp. vi-02 - Vertiginidae	3	l
x	x		x	307	Systenostoma sp. vi-07 - Vertiginidae	3	l
x	x		x	285	Videna paviei - Trochomorphidae	3	l
x	x			21	Cyclophorus malayanus - Cyclophoridae	4	l
x	x			106	Elaphroconcha denserugata - Ariophantidae	4	l
x	x			115	Macrochlamys sp. vi-2 - Ariophantidae	4	l
x	x			297	Ptychopatula miccyla - Vertiginidae	4	l
x	x			149	Camaena billeti - Camaenidae	3	l
x	x			152	Camaena gabrielae - Camaenidae	3	l
x	x			155	Camaena vayssierei - Camaenidae	3	l
x	x			14	Chamalycaeus fimbriatus - Cyclophoridae	3	l
x	x			17	Chamalycaeus heudei - Cyclophoridae	3	l
x	x			55	Diplommatina sp. vi-a1 - Diplommatinidae	3	l
x	x			56	Diplommatina sp. vi-a2 - Diplommatinidae	3	l
x	x			66	Diplommatina sp. vi-sp1 - Diplommatinidae	3	l
x	x			161	Ganesella coudeini - Camaenidae	3	l
x	x			163	Ganesella fulvescens - Camaenidae	3	l
x	x			81	Georissa sp. vi-4 - Hydrocenidae	3	l
x	x			276	Glessula paviei - Subulinidae	3	l
x	x			251	Haploptychius diespiter - Streptaxidae	3	l
x	x			28	Japonia hypselospira - Cyclophoridae	3	l
x	x			233	Liardetia tonkingensis - Euconulidae	3	l
x	x			208	Mirus tenuistriatus - Enidae	3	l
x	x			171	Neocepolis merarcha - Camaenidae	3	l
x	x			180	Oospira vanbuensis - Clausiliidae	3	l
x	x			262	Perrottetia daedalus - Streptaxidae	3	l
x	x			40	Platyraphe leucacme - Cyclophoridae	3	l
x	x			245	Plectopylis phlyaria - Plectopylinidae	3	l
x	x			85	Pseudopomatias sp. - Pupinidae	3	l
x	x			184	Tropidauchenia proctostoma - Clausiliidae	3	l
x		x	x	248	Gulella bicolor - Streptaxidae	5	l

PuLu	CuPh	PhLi	HaLo	nr	species	Range cat.	Habitat
x		x	x	141	Bradybaena jourdyi - Bradybaenidae	4	l
x		x	x	77	Georissa decora - Hydrocenidae	3	l
x		x	x	235	Queridomus sp. vi-01 - Euconulidae	3	l
x		x		145	Pseudiberus mellea - Bradybaenidae	3	l
x			x	288	Videna timorensis - Trochomorphidae	5	l
x			x	213	Liardetia micula - Euconulidae	4	l
x			x	7	Anaglyphula minutissima aff. - Assimineidae	3	l
x			x	159	Chloritis sp. vi-2 - Camaenidae	3	l
x			x	63	Diplommatina sp. vi-s1 - Diplommatinidae	3	l
x			x	65	Diplommatina sp. vi-s3 - Diplommatinidae	3	l
x			x	80	Georissa sp. vi-3 - Hydrocenidae	3	l
x			x	254	Haploptychius sp. vi-1 - Streptaxidae	3	l
x			x	27	Japonia diploloma - Cyclophoridae	3	l
x			x	38	Japonia sp. vi-07 - Cyclophoridae	3	l
x			x	210	Kaliella microconus - Euconulidae	3	l
x			x	229	Liardetia sp. vi-r7 - Euconulidae	3	l
x			x	42	Pterocyclos berthae - Cyclophoridae	3	l
x			x	265	Sinoennea plagiostoma - Streptaxidae	3	l
x			x	308	Systenostoma sp. vi-09 - Vertiginidae	3	l
x				204	Philalanka nannophya aff. - Endodontidae	4	l
x				154	Camaena lavezzarii - Camaenidae	3	l
x				78	Georissa sp. vi-1 - Hydrocenidae	3	l
x				108	Hemiplecta platytaenia - Ariophantidae	3	l
x				261	Perrottetia cristatellus - Streptaxidae	3	l
x				284	Subulinidae indet. - Subulinidae	3	l
x				67	Diplommatina sp. vi-sp2 - Diplommatinidae	2	l
x				68	Diplommatina sp. vi-sp3 - Diplommatinidae	2	l
x				273	Eostrobilops sp. vi-1 - Strobilopsidae	2	l
x				259	Haploptychius sp.6 - Streptaxidae	2	l
x				109	Hemiplecta sp. vi-m1 - Ariophantidae	2	l
x				176	Leptacme sp. vi-2 - Clausiliidae	2	l
x				112	Macrochlamys douvillei aff. - Ariophantidae	2	l
x				113	Macrochlamys malaccana aff. - Ariophantidae	2	l
x				118	Macrochlamys sp. vi-5 - Ariophantidae	2	l
x				179	Oospira sp. vi-1 - Clausiliidae	2	l
x				241	Sesara sp. vi-02 - Helicarionidae	2	l
x				270	Sinoennea sp. vi-5 - Streptaxidae	2	l
	x	x		6	Acmella sp. 4 - Assimineidae	3	l
	x	x		50	Diplommatina demangei - Diplommatinidae	3	l
	x		x	52	Diplommatina herziana - Diplommatinidae	4	l
	x		x	211	Kaliella scandens - Euconulidae	4	l
	x		x	83	Pollicaria gravida - Pupinidae	4	l
	x		x	44	Pterocyclos fischerianus (?) - Cyclophoridae	4	l
	x		x	46	Scabrina hirsuta - Cyclophoridae	4	l
	x		x	13	Alycaeus vanbuensis - Cyclophoridae	3	l
	x		x	49	Diplommatina debilis - Diplommatinidae	3	l
	x		x	54	Diplommatina scolops - Diplommatinidae	3	l
	x		x	60	Diplommatina sp. vi-r1 - Diplommatinidae	3	l
	x		x	165	Ganesella oxytropis - Camaenidae	3	l
	x		x	76	Georissa chrysacme - Hydrocenidae	3	l
	x		x	216	Liardetia sp. vi-k3 - Euconulidae	3	l
	x		x	217	Liardetia sp. vi-k4 - Euconulidae	3	l
	x		x	218	Liardetia sp. vi-k5 - Euconulidae	3	l
	x		x	219	Liardetia sp. vi-o1 - Euconulidae	3	l
	x		x	224	Liardetia sp. vi-r2 - Euconulidae	3	l
	x		x	225	Liardetia sp. vi-r3 - Euconulidae	3	l
	x		x	123	Microcystina sp. vi-b02 - Ariophantidae	3	l
	x		x	128	Microcystina sp. vi-b07 - Ariophantidae	3	l
	x		x	134	Microcystina sp. vi-w1 - Ariophantidae	3	l
	x		x	84	Pseudopomatias fulvus - Pupinidae	3	l
	x		x	43	Pterocyclos danieli - Cyclophoridae	3	l
	x		x	89	Pupina flava - Pupinidae	3	l
	x		x	47	Scabrina sp. vi-01 - Cyclophoridae	3	l
	x		x	302	Systenostoma sp. vi-03 - Vertiginidae	3	l
	x		x	305	Systenostoma sp. vi-06 - Vertiginidae	3	l
	x			190	Carychium javanum - Ellobiidae	4	l
	x			72	Geotrochatella mouhoti - Helicinidae	4	l
	x			168	Landouria ptychostyla - Camaenidae	4	l
	x			207	Philalanka tricincta - Endodontidae	4	l
	x			105	Austenia messageri - Ariophantidae	3	l
	x			158	Chloritis sp. vi-1 - Camaenidae	3	l
	x			26	Dioryx pocsi - Cyclophoridae	3	l
	x			239	Helicarion sp. vi-2 - Helicarionidae	3	l
	x			214	Liardetia sp. vi-k1 - Euconulidae	3	l
	x			215	Liardetia sp. vi-k2 - Euconulidae	3	l
	x			221	Liardetia sp. vi-o3 - Euconulidae	3	l
	x			222	Liardetia sp. vi-r1 - Euconulidae	3	l
	x			111	Macrochlamys douvillei - Ariophantidae	3	l

PuLu	CuPh	PhLi	HaLo	nr	species	Range cat.	Habitat
	x			116	Macrochlamys sp. vi-3 - Ariophantidae	3	l
	x			119	Megaustenia fragilis - Ariophantidae	3	l
	x			122	Microcystina sp. vi-b01 - Ariophantidae	3	l
	x			124	Microcystina sp. vi-b03 - Ariophantidae	3	l
	x			125	Microcystina sp. vi-b04 - Ariophantidae	3	l
	x			126	Microcystina sp. vi-b05 - Ariophantidae	3	l
	x			127	Microcystina sp. vi-b06 - Ariophantidae	3	l
	x			131	Microcystina sp. vi-b10 - Ariophantidae	3	l
	x			136	Microcystina sp. vi-w3 - Ariophantidae	3	l
	x			143	Nesiohelix vorvonga - Bradybaenidae	3	l
	x			181	Phaedusa backhanensis - Clausiliidae	3	l
	x			236	Rahula jucunda - Euconulidae	3	l
	x			172	Euphaedusa sp. vi-1 - Clausiliidae	2?	l
	x			292	Aulacospira sp. vi-02 - Vertiginidae	2	l
	x			24	Dioryx dongiensis - Cyclophoridae	2	l
	x			57	Diplommatina sp. vi-a3 - Diplommatinidae	2	l
	x			58	Diplommatina sp. vi-a4 - Diplommatinidae	2	l
	x			173	Formosana miranda - Clausiliidae	2	l
	x			32	Japonia sp. vi-01 - Cyclophoridae	2	l
	x			35	Japonia sp. vi-04 - Cyclophoridae	2	l
	x			36	Japonia sp. vi-05 - Cyclophoridae	2	l
	x			37	Japonia sp. vi-06 - Cyclophoridae	2	l
	x			175	Leptacme sp. vi-1 - Clausiliidae	2	l
	x			147	Pseudobuliminus sp. vi-01 - Bradybaenidae	2	l
	x			268	Sinoennea sp. vi-3 - Streptaxidae	2	l
		x	x	5	Acmella sp. 3 - Assimineidae	3	l
		x	x	296	Hypselostoma crossei - Vertiginidae	3	l
		x	x	279	Opeas striatissum - Subulinidae	3	l
		x	x	281	Prosopeas excellens - Subulinidae	3	l
		x		162	Ganesella diplogramma - Camaenidae	4	l
		x		249	Haploptychius blaisei - Streptaxidae	3	l
			x	104	Achatina fulica - Achatinidae	5	l
			x	209	Kaliella doliolum - Euconulidae	5	l
			x	103	Elasmias manilense - Achatinellidae	4	l
			x	160	Ganesella acris - Camaenidae	4	l
			x	294	Gastrocopta pediculus - Vertiginidae	4	l
			x	295	Gastrocopta servilis - Vertiginidae	4	l
			x	237	gen. ? sp. - fam. ?	4	l
			x	250	Haploptychius costulatus - Streptaxidae	4	l
			x	260	Indoartemon prestoni - Streptaxidae	4	l
			x	30	Japonia mariei - Cyclophoridae	4	l
			x	205	Philalanka sp. vi-1 - Endodontidae	4	l
			x	206	Philalanka sp. vi-2 - Endodontidae	4	l
			x	234	Queridomus conulus - Euconulidae	4	l
			x	4	Acmella sp. 2 - Assimineidae	3	l
			x	150	Camaena choboensis - Camaenidae	3	l
			x	22	Cyclophorus trouiensis - Cyclophoridae	3	l
			x	53	Diplommatina rotundata - Diplommatinidae	3	l
			x	61	Diplommatina sp. vi-r2 - Diplommatinidae	3	l
			x	64	Diplommatina sp. vi-s2 - Diplommatinidae	3	l
			x	164	Ganesella onestera - Camaenidae	3	l
			x	166	Ganesella subperakensis - Camaenidae	3	l
			x	82	Georissa tongkingensis - Hydrocenidae	3	l
			x	69	Helicomorpha scalarioides - Diplommatinidae	3	l
			x	174	Hemiphaedusa sp. vi-1 - Clausiliidae	3	l
			x	31	Japonia scissimargo - Cyclophoridae	3	l
			x	220	Liardetia sp. vi-o2 - Euconulidae	3	l
			x	226	Liardetia sp. vi-r4 - Euconulidae	3	l
			x	227	Liardetia sp. vi-r5 - Euconulidae	3	l
			x	228	Liardetia sp. vi-r6 - Euconulidae	3	l
			x	177	Liparophaedusa rhopaloides - Clausiliidae	3	l
			x	114	Macrochlamys sp. vi-1 - Ariophantidae	3	l
			x	129	Microcystina sp. vi-b08 - Ariophantidae	3	l
			x	130	Microcystina sp. vi-b09 - Ariophantidae	3	l
			x	132	Microcystina sp. vi-b11 - Ariophantidae	3	l
			x	133	Microcystina sp. vi-b12 - Ariophantidae	3	l
			x	135	Microcystina sp. vi-w2 - Ariophantidae	3	l
			x	170	Moellendorffia loxotata - Camaenidae	3	l
			x	182	Phaedusa stenothyra - Clausiliidae	3	l
			x	246	Plectopylis schlumbergeri - Plectopylinidae	3	l
			x	282	Prosopeas macilentum - Subulinidae	3	l
			x	283	Prosopeas ventrosulum - Subulinidae	3	l
			x	144	Pseudiberus lamyi - Bradybaenidae	3	l
			x	146	Pseudobuliminus productus - Bradybaenidae	3	l
			x	300	Systenostoma pauperrima - Vertiginidae	3	l
			x	303	Systenostoma sp. vi-03a - Vertiginidae	3	l
			x	306	Systenostoma sp. vi-06a - Vertiginidae	3	l
			x	286	Videna sapeca - Trochomorphidae	3	l
			x	70	Aphanoconia hungerfordiana halongensis - Helicinidae	2	l

PuLu	CuPh	PhLi	HaLo	nr	species	Range cat.	Habitat
			x	203	Charopa sp. vi-1 - Endodontidae	2	l
			x	156	Chloritis cincta - Camaenidae	2	l
			x	157	Chloritis insularis - Camaenidae	2	l
			x	51	Diplommatina fulva - Diplommatinidae	2	l
			x	59	Diplommatina sp. vi-a5 - Diplommatinidae	2	l
			x	62	Diplommatina sp. vi-r3 - Diplommatinidae	2	l
			x	107	Euplecta sp. vi-01 - Ariophantidae	2	l
			x	71	Geotrochatella jourdyi - Helicinidae	2	l
			x	253	Haploptychius fischeri - Streptaxidae	2	l
			x	257	Haploptychius sp. vi-4 - Streptaxidae	2	l
			x	29	Japonia insularis - Cyclophoridae	2	l
			x	34	Japonia sp. vi-03 - Cyclophoridae	2	l
			x	223	Liardetia sp. vi-r10 - Euconulidae	2	l
			x	117	Macrochlamys sp. vi-4 - Ariophantidae	2	l
			x	138	Microcystina sp. vi-w6 - Ariophantidae	2	l
			x	140	Microcystina sp. vi-w8 - Ariophantidae	2	l
			x	169	Moellendorffia blaisei - Camaenidae	2	l
			x	41	Platyraphe vatheleti - Cyclophoridae	2	l
			x	266	Sinoennea sp. vi-1 - Streptaxidae	2	l
			x	299	Systenostoma defixa - Vertiginidae	2	l
			x	272	Tonkinia mirabilis - Streptaxidae	2	l
			x	183	Tropidauchenia ardouiniana - Clausiliidae	2	l
			x	289	Acinolaemus sp. vi-01 - Vertiginidae	1	l
			x	290	Acinolaemus sp. vi-01a - Vertiginidae	1	l
			x	3	Acmella sp. 1 - Assimineidae	1	l
			x	48	Arinia sp. vi-01 - Diplommatinidae	1	l
			x	291	Aulacospira sp. vi-01 - Vertiginidae	1	l
			x	153	Camaena hahni - Camaenidae	1	l
			x	18	Chamalycaeus sp. vi-01 - Cyclophoridae	1	l
			x	19	Cyathopoma sp. vi-01 - Cyclophoridae	1	l
			x	167	gen. ? sp. - Camaenidae	1	l
			x	252	Haploptychius dorri - Streptaxidae	1	l
			x	255	Haploptychius sp. vi-2 - Streptaxidae	1	l
			x	256	Haploptychius sp. vi-3 - Streptaxidae	1	l
			x	258	Haploptychius sp. vi-5 - Streptaxidae	1	l
			x	33	Japonia sp. vi-02 - Cyclophoridae	1	l
			x	39	Japonia sp. vi-08 - Cyclophoridae	1	l
			x	231	Liardetia sp. vi-r9 - Euconulidae	1	l
			x	137	Microcystina sp. vi-w5 - Ariophantidae	1	l
			x	139	Microcystina sp. vi-w7 - Ariophantidae	1	l
			x	178	Oospira pyknosoma - Clausiliidae	1	l
			x	148	Pseudobuliminus sp. vi-02 - Bradybaenidae	1	l
			x	263	Sinoennea atomaria - Streptaxidae	1	l
			x	264	Sinoennea calva - Streptaxidae	1	l
			x	267	Sinoennea sp. vi-2 - Streptaxidae	1	l
			x	269	Sinoennea sp. vi-4 - Streptaxidae	1	l
			x	271	Sinoennea sp. vi-6 - Streptaxidae	1	l
			x	304	Systenostoma sp. vi-05 - Vertiginidae	1	l
			x	309	Systenostoma sp. vi-10 - Vertiginidae	1	l
			x	310	Systenostoma sp. vi-11 - Vertiginidae	1	l
			x	185	Tropidauchenia sp. vi-1 - Clausiliidae	1	l

Table 6 -- Ha Long Bay: distribution of snail species over sectors 1 to 5

Meaning of the columns:

1, 2, 3, 4, 5 – sector numbers, see fig. 1

Range cat. – See table 1

Habitat – b = a species from brackish environments; f = from freshwater environments; l = terrestrial species

Freshwater and brackish water species (habitat cat. 'f' and 'b') excluded

1	2	3	4	5	nr	species	Range cat.	Habitat
x	x	x	x	x	278	Lamellaxis gracilis - Subulinidae	5	l
x	x	x	x	x	142	Chalepotaxis infantilis - Bradybaenidae	4	l
x	x	x	x	x	20	Cyclophorus cambodgensis - Cyclophoridae	4	l
x	x	x	x	x	250	Haploptychius costulatus - Streptaxidae	4	l
x	x	x	x	x	211	Kaliella scandens - Euconulidae	4	l
x	x	x	x	x	53	Diplommatina rotundata - Diplommatinidae	3	l
x	x	x	x	x	54	Diplommatina scolops - Diplommatinidae	3	l
x	x	x	x	x	77	Georissa decora - Hydrocenidae	3	l
x	x	x	x	x	82	Georissa tongkingensis - Hydrocenidae	3	l
x	x	x	x	x	296	Hypselostoma crossei - Vertiginidae	3	l
x	x	x	x	x	212	Liardetia haiphongensis - Euconulidae	3	l
x	x	x	x	x	226	Liardetia sp. vi-r4 - Euconulidae	3	l
x	x	x	x	x	230	Liardetia sp. vi-r8 - Euconulidae	3	l
x	x	x	x	x	123	Microcystina sp. vi-b02 - Ariophantidae	3	l
x	x	x	x	x	279	Opeas striatissum - Subulinidae	3	l
x	x	x	x	x	43	Pterocyclos danieli - Cyclophoridae	3	l
x	x	x	x	x	87	Pupina dorri - Pupinidae	3	l
x	x	x	x	x	235	Queridomus sp. vi-01 - Euconulidae	3	l
x	x	x	x	x	286	Videna sapeca - Trochomorphidae	3	l
x	x	x	x	x	70	Aphanoconia hungerfordiana halongensis - Helicinidae	2	l
x	x	x	x	x	157	Chloritis insularis - Camaenidae	2	l
x	x	x	x	x	138	Microcystina sp. vi-w6 - Ariophantidae	2	l
x	x	x	x	x	140	Microcystina sp. vi-w8 - Ariophantidae	2	l
x	x	x	x	x	272	Tonkinia mirabilis - Streptaxidae	2	l
x	x	x	x	x	183	Tropidauchenia ardouiniana - Clausiliidae	2	l
x	x	x	x		288	Videna timorensis - Trochomorphidae	5	l
x	x	x	x		65	Diplommatina sp. vi-s3 - Diplommatinidae	3	l
x	x	x	x		165	Ganesella oxytropis - Camaenidae	3	l
x	x	x	x		182	Phaedusa stenothyra - Clausiliidae	3	l
x	x	x		x	23	Cyclophorus volvulus - Cyclophoridae	4	l
x	x	x		x	298	Ptychopatula orcula - Vertiginidae	4	l
x	x	x		x	219	Liardetia sp. vi-o1 - Euconulidae	3	l
x	x	x		x	246	Plectopylis schlumbergeri - Plectopylinidae	3	l
x	x	x		x	308	Systenostoma sp. vi-09 - Vertiginidae	3	l
x	x	x		x	51	Diplommatina fulva - Diplommatinidae	2	l
x	x	x		x	107	Euplecta sp. vi-01 - Ariophantidae	2	l
x	x	x		x	41	Platyraphe vatheleti - Cyclophoridae	2	l
x	x	x		x	266	Sinoennea sp. vi-1 - Streptaxidae	2	l
x	x	x			31	Japonia scissimargo - Cyclophoridae	3	l
x	x		x	x	254	Haploptychius sp. vi-1 - Streptaxidae	3	l
x	x		x	x	307	Systenostoma sp. vi-07 - Vertiginidae	3	l
x	x		x	x	29	Japonia insularis - Cyclophoridae	2	l
x	x		x		61	Diplommatina sp. vi-r2 - Diplommatinidae	3	l
x	x		x		227	Liardetia sp. vi-r5 - Euconulidae	3	l
x	x		x		265	Sinoennea plagiostoma - Streptaxidae	3	l
x	x		x		300	Systenostoma pauperrima - Vertiginidae	3	l
x	x			x	169	Moellendorffia blaisei - Camaenidae	2	l
x	x				228	Liardetia sp. vi-r6 - Euconulidae	3	l
x	x				135	Microcystina sp. vi-w2 - Ariophantidae	3	l
x		x	x	x	121	Microcystina sinica - Ariophantidae	4	l
x		x	x	x	60	Diplommatina sp. vi-r1 - Diplommatinidae	3	l
x		x	x	x	216	Liardetia sp. vi-k3 - Euconulidae	3	l
x		x	x	x	203	Charopa sp. vi-1 - Endodontidae	2	l
x		x	x	x	71	Geotrochatella jourdyi - Helicinidae	2	l
x		x	x		117	Macrochlamys sp. vi-4 - Ariophantidae	2	l
x		x		x	277	Lamellaxis clavulinus - Subulinidae	5	l
x		x		x	150	Camaena choboensis - Camaenidae	3	l
x		x		x	225	Liardetia sp. vi-r3 - Euconulidae	3	l
x		x		x	305	Systenostoma sp. vi-06 - Vertiginidae	3	l
x		x		x	253	Haploptychius fischeri - Streptaxidae	2	l

1	2	3	4	5	nr	species	Range cat.	Habitat
x		x			205	Philalanka sp. vi-1 - Endodontidae	4	l
x		x			49	Diplommatina debilis - Diplommatinidae	3	l
x		x			285	Videna paviei - Trochomorphidae	3	l
x			x	x	16	Chamalycaeus fraterculus - Cyclophoridae	3	l
x			x	x	76	Georissa chrysacme - Hydrocenidae	3	l
x			x	x	156	Chloritis cincta - Camaenidae	2	l
x			x	x	34	Japonia sp. vi-03 - Cyclophoridae	2	l
x			x	x	299	Systenostoma defixa - Vertiginidae	2	l
x			x		80	Georissa sp. vi-3 - Hydrocenidae	3	l
x			x		62	Diplommatina sp. vi-r3 - Diplommatinidae	2	l
x				x	248	Gulella bicolor - Streptaxidae	5	l
x				x	280	Paropeas achatinaceum - Subulinidae	5	l
x				x	52	Diplommatina herziana - Diplommatinidae	4	l
x				x	83	Pollicaria gravida - Pupinidae	4	l
x				x	234	Queridomus conulus - Euconulidae	4	l
x				x	274	Curvella sp. vi-1 - Subulinidae	3	l
x				x	275	Curvella tonkiniana - Subulinidae	3	l
x				x	22	Cyclophorus trouiensis - Cyclophoridae	3	l
x				x	63	Diplommatina sp. vi-s1 - Diplommatinidae	3	l
x				x	166	Ganesella subperakensis - Camaenidae	3	l
x				x	27	Japonia diploloma - Cyclophoridae	3	l
x				x	217	Liardetia sp. vi-k4 - Euconulidae	3	l
x				x	218	Liardetia sp. vi-k5 - Euconulidae	3	l
x				x	88	Pupina exclamationis - Pupinidae	3	l
x				x	301	Systenostoma sp. vi-02 - Vertiginidae	3	l
x				x	303	Systenostoma sp. vi-03a - Vertiginidae	3	l
x				x	59	Diplommatina sp. vi-a5 - Diplommatinidae	2	l
x					294	Gastrocopta pediculus - Vertiginidae	4	l
x					213	Liardetia micula - Euconulidae	4	l
x					120	Megaustenia imperator - Ariophantidae	4	l
x					206	Philalanka sp. vi-2 - Endodontidae	4	l
x					44	Pterocyclos fischerianus (?) - Cyclophoridae	4	l
x					46	Scabrina hirsuta - Cyclophoridae	4	l
x					13	Alycaeus vanbuensis - Cyclophoridae	3	l
x					293	Boysidia sp. vi-01 - Vertiginidae	3	l
x					15	Chamalycaeus fractus - Cyclophoridae	3	l
x					159	Chloritis sp. vi-2 - Camaenidae	3	l
x					25	Dioryx messageri - Cyclophoridae	3	l
x					64	Diplommatina sp. vi-s2 - Diplommatinidae	3	l
x					164	Ganesella onestera - Camaenidae	3	l
x					238	Helicarion sp. vi-1 - Helicarionidae	3	l
x					69	Helicomorpha scalarioides - Diplommatinidae	3	l
x					174	Hemiphaedusa sp. vi-1 - Clausiliidae	3	l
x					220	Liardetia sp. vi-o2 - Euconulidae	3	l
x					224	Liardetia sp. vi-r2 - Euconulidae	3	l
x					229	Liardetia sp. vi-r7 - Euconulidae	3	l
x					114	Macrochlamys sp. vi-1 - Ariophantidae	3	l
x					129	Microcystina sp. vi-b08 - Ariophantidae	3	l
x					130	Microcystina sp. vi-b09 - Ariophantidae	3	l
x					132	Microcystina sp. vi-b11 - Ariophantidae	3	l
x					134	Microcystina sp. vi-w1 - Ariophantidae	3	l
x					170	Moellendorffia loxotata - Camaenidae	3	l
x					282	Prosopeas macilentum - Subulinidae	3	l
x					283	Prosopeas ventrosulum - Subulinidae	3	l
x					146	Pseudobuliminus productus - Bradybaenidae	3	l
x					84	Pseudopomatias fulvus - Pupinidae	3	l
x					45	Pterocyclos sp. vi-01 - Cyclophoridae	3	l
x					47	Scabrina sp. vi-01 - Cyclophoridae	3	l
x					240	Sesara sp. vi-01 - Helicarionidae	3	l
x					306	Systenostoma sp. vi-06a - Vertiginidae	3	l
x					287	Videna sp. vi-1 - Trochomorphidae	3	l
x					289	Acinolaemus sp. vi-01 - Vertiginidae	1	l
x					290	Acinolaemus sp. vi-01a - Vertiginidae	1	l
x					48	Arinia sp. vi-01 - Diplommatinidae	1	l
x					291	Aulacospira sp. vi-01 - Vertiginidae	1	l
x					153	Camaena hahni - Camaenidae	1	l
x					18	Chamalycaeus sp. vi-01 - Cyclophoridae	1	l
x					19	Cyathopoma sp. vi-01 - Cyclophoridae	1	l
x					167	gen. ? sp. - Camaenidae	1	l
x					255	Haploptychius sp. vi-2 - Streptaxidae	1	l
x					258	Haploptychius sp. vi-5 - Streptaxidae	1	l
x					33	Japonia sp. vi-02 - Cyclophoridae	1	l
x					231	Liardetia sp. vi-r9 - Euconulidae	1	l
x					137	Microcystina sp. vi-w5 - Ariophantidae	1	l
x					139	Microcystina sp. vi-w7 - Ariophantidae	1	l
x					178	Oospira pyknosoma - Clausiliidae	1	l
x					148	Pseudobuliminus sp. vi-02 - Bradybaenidae	1	l
x					263	Sinoennea atomaria - Streptaxidae	1	l
x					264	Sinoennea calva - Streptaxidae	1	l

1	2	3	4	5	nr	species	Range cat.	Habitat
x					267	Sinoennea sp. vi-2 - Streptaxidae	1	l
x					269	Sinoennea sp. vi-4 - Streptaxidae	1	l
x					304	Systenostoma sp. vi-05 - Vertiginidae	1	l
x					309	Systenostoma sp. vi-10 - Vertiginidae	1	l
x					185	Tropidauchenia sp. vi-1 - Clausiliidae	1	l
x					79	Georissa sp. vi-2 - Hydrocenidae	3	l
x					38	Japonia sp. vi-07 - Cyclophoridae	3	l
x				x	86	Pupina brachysoma - Pupinidae	3	l
	x	x	x	x	30	Japonia mariei - Cyclophoridae	4	l
	x		x		103	Elasmias manilense - Achatinellidae	4	l
	x			x	302	Systenostoma sp. vi-03 - Vertiginidae	3	l
	x			x	223	Liardetia sp. vi-r10 - Euconulidae	2	l
	x				295	Gastrocopta servilis - Vertiginidae	4	l
	x				310	Systenostoma sp. vi-11 - Vertiginidae	1	l
		x	x	x	144	Pseudiberus lamyi - Bradybaenidae	3	l
		x	x		160	Ganesella acris - Camaenidae	4	l
		x	x		257	Haploptychius sp. vi-4 - Streptaxidae	2	l
		x			237	gen. ? sp. - fam. ?	4	l
		x			133	Microcystina sp. vi-b12 - Ariophantidae	3	l
		x			256	Haploptychius sp. vi-3 - Streptaxidae	1	l
		x			39	Japonia sp. vi-08 - Cyclophoridae	1	l
			x	x	4	Acmella sp. 2 - Assimineidae	3	l
			x	x	7	Anaglyphula minutissima aff. - Assimineidae	3	l
				x	104	Achatina fulica - Achatinidae	5	l
				x	209	Kaliella doliolum - Euconulidae	5	l
				x	141	Bradybaena jourdyi - Bradybaenidae	4	l
				x	260	Indoartemon prestoni - Streptaxidae	4	l
				x	5	Acmella sp. 3 - Assimineidae	3	l
				x	210	Kaliella microconus - Euconulidae	3	l
				x	177	Liparophaedusa rhopaloides - Clausiliidae	3	l
				x	110	Macrochlamys despecta - Ariophantidae	3	l
				x	128	Microcystina sp. vi-b07 - Ariophantidae	3	l
				x	281	Prosopeas excellens - Subulinidae	3	l
				x	42	Pterocyclos berthae - Cyclophoridae	3	l
				x	89	Pupina flava - Pupinidae	3	l
				x	3	Acmella sp. 1 - Assimineidae	1	l
				x	252	Haploptychius dorri - Streptaxidae	1	l

Appendix: List of localities sampled during the 1998 and 2003 surveys.

locality nr	**2**	**date of sampling**	03/10/1998
locality code	1998.25	**coordinates**	20.53.12N 107.12.12E (map)
locality	VIETNAM. Quang Ninh Prov., Halong Bay area. Da Mai Isl., damp, secluded limestone slope in bay with grass and woodland. Handpicked and soil sample. Leg. JJV and A.J. Whitten.		
locality nr	**3**	**date of sampling**	03/10/1998
locality code	1998.26	**coordinates**	20.53.48N 107.17.51E (GPS)
locality	VIETNAM. Quang Ninh Prov., Halong Bay area. Cong Tai Isl., W coast. Coastal woodland on quartzite soil. Soil sample. Leg. JJV & A.J. Whitten.		
locality nr	**4**	**date of sampling**	03/10/1998
locality code	1998.27	**coordinates**	Coord. unknown
locality	VIETNAM. Quang Ninh Prov., Halong Bay area. Mo Da Isl. Steep, sea-facing limestone slope with dense partly succulent vegetation (Euphorbia). Handpicked + soil sample. Leg. JJV & A.J. Whitten.		
locality nr	**5**	**date of sampling**	03/10/1998
locality code	1998.28	**coordinates**	20.52.29N 107.18.15E (GPS)
locality	VIETNAM. Quang Ninh Prov., Halong Bay area. Unnamed isl. 1.8 km W of S point Cong Tai Isl. Steep limestone slope bordering beach, dense vegetation. Handpicked + soil sample. Leg. JJV & A.J. Whitten.		
locality nr	**6**	**date of sampling**	03/10/1998
locality code	1998.46	**coordinates**	20.52.29N 107.18.15E (GPS)
locality	VIETNAM. Quang Ninh Prov., Halong Bay area. Unnamed isl. 1.8 km W of S point Cong Tai Isl. Beach drift sample. Leg. JJV & A.J. Whitten.		
locality nr	**7**	**date of sampling**	04/10/1998
locality code	1998.29	**coordinates**	20.52.44N 107.12.10E (GPS)
locality	VIETNAM. Quang Ninh Prov., Halong Bay area. Cong Do Isl., NE Coast. Limestone ridge leading to inshore lake. Dense vegetation. Handpicked + soil sample. Leg. JJV & A.J. Whitten.		
locality nr	**8**	**date of sampling**	04/10/1998
locality code	1998.48	**coordinates**	20.52.44N 107.12.10E (GPS)
locality	VIETNAM. Quang Ninh Prov., Halong Bay area. Cong Do Isl., NE Coast. Freshwater lake. Handpicked material. Leg. JJV & A.J. Whitten.		
locality nr	**9**	**date of sampling**	04/10/1998
locality code	1998.30	**coordinates**	20.51.50N 107.13.11E (GPS)
locality	VIETNAM. Quang Ninh Prov., Halong Bay area. Unnamed small isl. E of Cong Do Isl. Sparsely vegetated limestone rocks. Handpicked + soil sample. Leg. JJV & A.J. Whitten.		
locality nr	**10**	**date of sampling**	04/10/1998
locality code	1998.31	**coordinates**	20.51.50N 107.13.11E (GPS)
locality	VIETNAM. Quang Ninh Prov., Halong Bay area. Unnamed small isl. E of Cong Do Isl. Beach drift sample. Leg. JJV & A.J. Whitten.		
locality nr	**11**	**date of sampling**	04/10/1998
locality code	1998.32	**coordinates**	20.46.14N 107.07.42E (GPS)
locality	VIETNAM. Quang Ninh Prov., Halong Bay area. Hang Tai Isl., S end. Woodland on dry sandy soil and limestone rock bordering beach. Handpicked + soil sample. Leg. JJV & A.J. Whitten.		
locality nr	**12**	**date of sampling**	04/10/1998
locality code	1998.33	**coordinates**	20.46.14N 107.07.42E (GPS)
locality	VIETNAM. Quang Ninh Prov., Halong Bay area. Hang Tai Isl., S end. Beach drift sample. Leg. JJV & A.J. Whitten.		
locality nr	**13**	**date of sampling**	04/10/1998
locality code	1998.34	**coordinates**	20.43.45N 107.05.08E (GPS)
locality	VIETNAM. Haiphong Prov., Halong Bay area. Cat Dua Isl. Woodland bordering beach, on sand and limestone boulders. Handpicked + soil sample. Leg. JJV & A.J. Whitten.		
locality nr	**14**	**date of sampling**	04/10/1998
locality code	1998.35	**coordinates**	20.43.45N 107.05.08E (GPS)
locality	VIETNAM. Haiphong Prov., Halong Bay area. Cat Dua Isl. Beach drift sample. Leg. JJV & A.J. Whitten.		
locality nr	**15**	**date of sampling**	04/10/1998
locality code	1998.36	**coordinates**	20.49.24N 107.05.17E (GPS)
locality	VIETNAM. Haiphong Prov., Halong Bay area. Small unnamed limestone island, with some grass and shrubs. Handpicked + soil sample. Leg. JJV & A.J. Whitten.		
locality nr	**16**	**date of sampling**	09/10/1998
locality code	1998.37	**coordinates**	20.33.55N 105.51.41E (GPS)
locality	VIETNAM. Ha Nam Prov., nr Dong Son, 8 km WNW of Phu Ly. Small isolated limestone hill with depleted primary forest. Handpicked + soil sample. Leg. JJV & L. Deharveng.		
locality nr	**17**	**date of sampling**	09/10/1998
locality code	1998.38	**coordinates**	20.33.55N 105.51.41E (GPS)

locality VIETNAM. Ha Nam Prov., nr Dong Son, 8 km WNW of Phu Ly. Small isolated limestone hill with depleted primary forest. Soil sample from cave. Leg. JJV & L. Deharveng.

locality nr **18** **date of sampling** 10/10/1998
locality code 1998.39 **coordinates** 20.21N 105.54E (approx.)
locality VIETNAM. Ninh Binh Prov., Cuc Phuong Nat. Park. 1 km WNW of Xom Bong. Primary forest. Small limestone outcrops in clayey soil. Handpicked + soil sample. Leg. JJV & L. Deharveng.

locality nr **19** **date of sampling** 10/10/1998
locality code 1998.40 **coordinates** 20.21N 105.54E (approx.)
locality VIETNAM. Ninh Binh Prov., Cuc Phuong Nat. Park. 2 km road Xom Bong to HQ. Primary forest. Limestone outcrops in thick clayey soil. Handpicked + soil sample. Leg. JJV & L. Deharveng.

locality nr **20** **date of sampling** 10/10/1998
locality code 1998.41 **coordinates** 20.21N 105.54E (approx.)
locality VIETNAM. Ninh Binh Prov., Cuc Phuong Nat. Park. Prehist. Man Cave. Steep limestone slope with disturbed forest. Handpicked + soil sample. Leg. JJV & L. Deharveng.

locality nr **21** **date of sampling** 10/10/1998
locality code 1998.42 **coordinates** 20.21N 105.54E (approx.)
locality VIETNAM. Ninh Binh Prov., Cuc Phuong Nat. Park. Path to fairy cave. Primary forest. Limestone outcrops in shale bedrock. Handpicked + soil sample. Leg. JJV & L. Deharveng.

locality nr **22** **date of sampling** 09/1998
locality code 1998.50 **coordinates** 20.48N 107.00E (approx.)
locality VIETNAM. Haiphong Prov., Cat Ba Isl., near Nat. Park HQ, Podocarpus forest near Trung Trang. Soil sample. Leg. L. Deharveng.

locality nr **32** **date of sampling** 24/09/1998
locality code 1998.01 **coordinates** 20.47.38N 106.59.26E (GPS)
locality VIETNAM. Haiphong Prov., Cat Ba Isl., near Nat. Park HQ, limestone cliff with woody regrowth, grassland and gardens at its foot. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **33** **date of sampling** 25/09/1998
locality code 1998.02 **coordinates** 20.47.47N 106.59.41E (GPS)
locality VIETNAM. Haiphong Prov., Cat Ba Isl., near Nat. Park HQ, Trung Trang Cave. Steep limestone cliff, woody regrowth at foot. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **34** **date of sampling** 25/09/1998
locality code 1998.03 **coordinates** 20.47.45N 107.00.45E (est.)
locality VIETNAM. Haiphong Prov., Cat Ba Isl., path from Nat. Park HQ to lake Ao Ek. Primary forest on limestone. Mainly handpicked. Leg. JJV & A.J. Whitten.

locality nr **36** **date of sampling** 26/09/1998
locality code 1998.05 **coordinates** 20.48.05N 107.01.33E (GPS)
locality VIETNAM. Haiphong Prov., Cat Ba Isl., lake Ao Ek, lakeside. Exposed limestone with little soil and vegetation of herbs. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **37** **date of sampling** 26/09/1998
locality code 1998.06 **coordinates** 20.48.05N 107.01.33E (GPS)
locality VIETNAM. Haiphong Prov., Cat Ba Isl., lake Ao Ek, high and damp primary forest around lake, on limestone soil. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **38** **date of sampling** 27/09/1998
locality code 1998.07 **coordinates** 20.47.45N 107.00.45E (GPS)
locality VIETNAM. Haiphong Prov., Cat Ba Isl., half-way path lake Ao Ek and Nat. Park HQ. Primary forest on limestone slope with rock outcrops. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **39** **date of sampling** 28/09/1998
locality code 1998.08 **coordinates** 20.57.00N 107.04.43E (GPS)
locality VIETNAM. Quang Ninh Prov., Halong-Campha area. Limestone hill S of Halong, with mainly regrowth and bamboo thickets. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **40** **date of sampling** 28/09/1998
locality code 1998.09 **coordinates** 20.56.32N 107.07.28E (GPS)
locality VIETNAM. Quang Ninh Prov., Halong-Campha area. Hong Na, limestone hill near main road, with degraded regrowth (Lantana). Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **41** **date of sampling** 29/09/1998
locality code 1998.10 **coordinates** 20.58.59N 107.11.50E (GPS)
locality VIETNAM. Quang Ninh Prov., Halong-Campha area, 4.5 km SW Quang Hanh. Limestone hill with regrowth. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **42** **date of sampling** 29/09/1998
locality code 1998.11 **coordinates** 20.59.45N 107.12.45E (GPS)
locality VIETNAM. Quang Ninh Prov., Halong-Campha area, 2.5 km SW Quang Hanh. Foot of limestone cliff with degraded regrowth, near gardens. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **43** **date of sampling** 29/09/1998

locality code 1998.12 **coordinates** 20.58.15N 107.11.00E (GPS)
locality VIETNAM. Quang Ninh Prov., Halong-Campha area. 3 km NE Ha Tu. Limestone slope with woody regrowth. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **44** **date of sampling** 30/09/1998
locality code 1998.13 **coordinates** 20.50.08N 107.05.28E (GPS)
locality VIETNAM. Quang Ninh Prov., Halong Bay area. Dao Bo Hon, SW point. Exposed sea-facing limestone cliff with few shrubs and grass, about 1 m above max. high tide. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **45** **date of sampling** 01/10/1998
locality code 1998.14 **coordinates** 20.49.25N 107.04.15E (map)
locality VIETNAM. Haiphong Prov., Halong Bay area. NE Coast Cat Ba Isl. Overhanging sea-facing cliff, with little vegetation. In rock crevice, about 2 m above max. high tide. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **46** **date of sampling** 01/10/1998
locality code 1998.15 **coordinates** 20.49.25N 107.03.45E (map)
locality VIETNAM. Haiphong Prov., Halong Bay area. NE Coast Cat Ba Isl. Dry limestone scree slope with low woodland. In rock crevices. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **47** **date of sampling** 01/10/1998
locality code 1998.16 **coordinates** 20.47.32N 106.06.33E (GPS)
locality VIETNAM. Haiphong Prov., Halong Bay area. E Coast Cat Ba Isl. Limestone rocks bordering small beach. Small shrubs and some grass only, very dry. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **48** **date of sampling** 01/10/1998
locality code 1998.17 **coordinates** 20.45.08N 107.04.28E (GPS)
locality VIETNAM. Haiphong Prov., Halong Bay area. Unnamed island off E Coast Cat Ba. S. facing bay with beach and densely vegetated limestone scree slope. Beach drift sample. Leg. JJV & A.J. Whitten.

locality nr **49** **date of sampling** 01/10/1998
locality code 1998.18 **coordinates** 20.45.08N 107.04.28E (GPS)
locality VIETNAM. Haiphong Prov., Halong Bay area. Unnamed island off E Coast Cat Ba. S. facing bay with beach and densely vegetated limestone scree slope. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **50** **date of sampling** 02/10/1998
locality code 1998.19 **coordinates** 20.50.50N 107.05.40E (map)
locality VIETNAM. Quang Ninh Prov., Halong Bay area. Dao Bo Hon, Song Sot Cave, path to cave. Steep limestone slope with dense disturbed vegetation. Handpicked + soil sample from crevices and rock ledges. Leg. JJV & A.J. Whitten.

locality nr **51** **date of sampling** 02/10/1998
locality code 1998.20 **coordinates** 20.50.50N 107.05.40E (map)
locality VIETNAM. Quang Ninh Prov., Halong Bay area. Dao Bo Hon, Song Sot Cave, drift material washed together over sinkhole in cave. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **52** **date of sampling** 02/10/1998
locality code 1998.21 **coordinates** 20.50.50N 107.05.40E (map)
locality VIETNAM. Quang Ninh Prov., Halong Bay area. Dao Bo Hon, Song Sot Cave, guano enriched sediments in cave. Soil sample. Leg. JJV & A.J. Whitten.

locality nr **53** **date of sampling** 02/10/1998
locality code 1998.22 **coordinates** 20.50.50N 107.05.40E (map)
locality VIETNAM. Quang Ninh Prov., Halong Bay area. Dao Bo Hon, 300 m NW Song Sot Cave, sea facing limestone race with some shrubs, cycads and orchids. Handpicked + soil sample from crevices and rock ledges. Leg. JJV & A.J.

locality nr **54** **date of sampling** 03/10/1998
locality code 1998.23 **coordinates** 20.52.15N 107.07.15E (map)
locality VIETNAM. Quang Ninh Prov., Halong Bay area. May Den Isl., Tam Cung Cave. Densely vegetated limestone hill, near cave. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **55** **date of sampling** 03/10/1998
locality code 1998.24 **coordinates** 20.52.51N 107.07.38E (GPS)
locality VIETNAM. Quang Ninh Prov., Halong Bay area. Small (c. 150 m longest axis), sparsely vegetated limestone rock island. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **56** **date of sampling** 03/10/1998
locality code 1998.47 **coordinates** 20.52.51N 107.07.38E (GPS)
locality VIETNAM. Quang Ninh Prov., Halong Bay area. Small (c. 150 m longest axis), sparsely vegetated limestone rock island. Beach drift material. Handpicked + soil sample. Leg. JJV & A.J. Whitten.

locality nr **501** **date of sampling** 06/09/2003
locality code 2003.27 **coordinates** 20.52.07N 107.12.06E
locality VIETNAM. Quang Ninh Prov., Halong Bay area. Thay Cave on Cong Do Isl., collected inside cave. Leg. W.J.M.

locality nr **502** **date of sampling** 06/09/2003
locality code 2003.28 **coordinates** 20.48.96N 107.07.33E
locality VIETNAM. Quang Ninh Prov., Halong Bay area, Tien Ong Cave on Hang Trai Isl., collected inside cave. Leg. W.J.M. Maassen.

locality nr **503** **date of sampling** 06/09/2003
locality code 2003.29 **coordinates** 20.48.96N 107.07.33E
locality VIETNAM. Quang Ninh Prov., Halong Bay area, Tien Ong Cave on Hang Trai Isl., collected near the entrance of the cave. Leg. W.J.M. Maassen.

locality nr **504** **date of sampling** 06/09/2003
locality code 2003.30 **coordinates** 20.50.09N 107.04.53E
locality VIETNAM. Quang Ninh Prov., Halong Bay area, W-side Loum Bo Isl. Leg. W.J.M. Maassen.

locality nr **505** **date of sampling** 07/09/2003
locality code 2003.31 **coordinates** 20.50.23N 107.16.62E
locality VIETNAM. Quang Ninh Prov., Halong Bay area, unnamed island [hon 224] in Va Song area. Leg. W.J.M. Maassen.

locality nr **506** **date of sampling** 07/09/2003
locality code 2003.32 **coordinates** 20.50.55N 107.16.23E
locality VIETNAM. Quang Ninh Prov., Halong Bay area, unnamed island in Ky Da isl. Leg. W.J.M. Maassen.

locality nr **507** **date of sampling** 11/09/2003
locality code 2003.33 **coordinates** 20.49.80N 107.08.32E
locality VIETNAM. Quang Ninh Prov., Halong Bay area, Phao Trong Isl. Leg. W.J.M. Maassen.

locality nr **508** **date of sampling** 12/09/2003
locality code 2003.34 **coordinates** 20.49.67N 107.09.90E
locality VIETNAM. Quang Ninh Prov., Halong Bay area, Luoi Liem Isl. Leg. W.J.M. Maassen.

locality nr **509** **date of sampling** 12/09/2003
locality code 2003.35 **coordinates** 20.49.89N 107.10.23E
locality VIETNAM. Quang Ninh Prov., Halong Bay area, Vun Ha Isl. Leg. W.J.M. Maassen..

locality nr **510** **date of sampling** 13/09/2003
locality code 2003.36 **coordinates** 20.52.56N 107.11.14E
locality VIETNAM. Quang Ninh Prov., Halong Bay area, Cay Chanh Isl. In Cong Do area. Leg. W.J.M. Maassen.

locality nr **511** **date of sampling** 13/09/2003
locality code 2003.37 **coordinates** 20.52.47N 107.11.72E
locality VIETNAM. Quang Ninh Prov., Halong Bay area, unnamed island [hon 244] in Cong Do area. Leg. W.J.M. Maassen.

locality nr **512** **date of sampling** 13/09/2003
locality code 2003.38 **coordinates** 20.55.69N 107.09.40E
locality VIETNAM. Quang Ninh Prov., Halong Bay area, unnamed island in Dau Moi Temper area. Leg. W.J.M. Maassen.

locality nr **513** **date of sampling** 15/09/2003
locality code 2003.39 **coordinates** 20.47.61N 107.08.05E
locality VIETNAM. Quang Ninh Prov., Halong Bay area, Ang Du Isl. Leg. W.J.M. Maassen.

locality nr **514** **date of sampling** 15/09/2003
locality code 2003.40 **coordinates** 20.54.78N 107.01.17E
locality VIETNAM. Quang Ninh Prov., Halong Bay area, Dau Be Isl. Leg. W.J.M. Maassen.

locality nr **515** **date of sampling** 16/09/2003
locality code 2003.41 **coordinates** 20.54.78N 107.01.17E
locality VIETNAM. Quang Ninh Prov., Halong Bay area, Dau Go Isl. Leg. W.J.M. Maassen.

locality nr **516** **date of sampling** 19/09/2003
locality code 2003.42 **coordinates** 20.31.84N 105.04.76E
locality VIETNAM. Thanh Hoa Prov., Pu Luong National Park, NW-point park near Hang village; limestone area near village. Leg. W.J.M. Maassen.

locality nr **517** **date of sampling** 20/09/2003
locality code 2003.43 **coordinates** 20.26.86N 105.11.57E
locality VIETNAM. Thanh Hoa Prov., Pu Luong National Park, limestone hill opposite Naca village. Leg. W.J.M. Maassen.

locality nr **518** **date of sampling** 21/09/2003
locality code 2003.44 **coordinates** 20.27.39N 105.13.65E
locality VIETNAM. Thanh Hoa Prov., Pu Luong National Park, limestone hill near small native village of Am. Leg. W.J.M.

locality nr **519** **date of sampling** 22/09/2003
locality code 2003.45 **coordinates** 20.26.95N 105.10.93E
locality VIETNAM. Thanh Hoa Prov., Pu Luong National Park, limestone hill behind ranger station. Leg. W.J.M. Maassen.