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SNAILS OF THE HELICELLINAE (GASTROPODA) SUB-FAMILY IN CSSR*)

I. INTRODUCTION

Owing to the large number of species included in this sub-family there are differences regarding some taxones as to their place in the system. During the description of new species the anatomical differences were not always taken into consideration even though they often faciliate determination which may be difficult because of the great similarity between the shells. Neither was the considerable variability and plasticity of shells always correctly assessed which lead to the description of ill justified species. This shortcoming could have been eliminated only partially so that the question of validity of many systematic units remains open. On the territory of CSSR these problems are related to the species of the *Candidula* genus even though in this case anatomical differences in the genital apparatus were taken into consideration.

Most species are found in full territorial expansion which may be directly observed, e. g. in the populating of artificially created biotopes. As the distribution of *Helicellinae* was described in our literature only individually I have made an attempt to make a survey of their accurate distribution in CSSR.

I also tried to make an assessment of the variability of shells and of the genital apparatus which have also received little attention.

Some members of this sub-family show a remarkable relation to sites affected by man and often to farm cultures. Expansion through farm

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crops or means of communication can be demonstrated on species of the *Helicellinae* sub-family. Therefore I determined soil conditions.

All these problems require detailed research; especially the biology of these species is presented in literature only marginally. Snails of this sub-family have the advantage that they are more available for these purposes than most others. *Helicellinae* therefore may serve as a model group through which it would be possible to penetrate deeper into the biology of terrestrial molluscs.

At this point I would like to thank doc. RNDr. Miroslav Kunst, CSc., for reading through the work and for his valuable comments regarding form and contents, RNDr. Vojen Ložek, DrSc., for the topic, for reading the work and for his comments and help with compiling the list of sites of *Helicopsis striata*. I wish to thank also all those who gave me their lists of the sites of different species from their personal collections (V. Ložek, Jar. Brabenec, I. Hrubý, M. Lisický, S. Mácha, J. Ponec, B. Zvarič). Last but not least I must thank Ing. J. Slabecius and Mrs. Z. Slabecius for their help in processing the material and completation of supplements.

II. SURVEY OF LITERATURE

Species of the *Helicellinae* sub-family were followed in taxonomical literature already since MÜLLER'S times (1774). It is important to name at least ROSSMÄSSLER 1835—1877), PFEIFFER (1846), ALBERTS (1860), WESTERLUND (1876, 1887), KOBELT (1878), CLESSIN (1887, 1884), GOLDFUSS (1900), GEYER (1927), GERMAIN (1930), EHRMANN (1933, 1962), WAGNER (1933), SOÓS (1943), LICHAREV (1952), GROSSU (1955). Most of the earlier authors based their findings only on shell features attributing excessive importance to shell variability and so created a large number of taxones which were later withdrawn as synonyms; while the converging members of different genera were replaced by shells.

Though the first anatomical works on these species are quite old (SCHMIDT, 1855) anatomical features were not used in taxonomy until by HESSE (1926). In this sub-family he recognised only two genera with many sub-genera. Later (1934) he supplemented his work and pointed out the convergence in the shape of shells in forms that, according to the organization of the genital apparatus, belong in different places of the sub-family system. At the same time he was aware of the bias of his view of the group taxonomy and pointed out other important studies of the anatomy of the nervous system, biology and distribution of the different species.

Many papers also dealt with the effect of calcium carbonate on the occurrence of snails, e. g. REICHERT (1927), LAIS (1943), TRÜBSBACH (1943, 1947), A. H. SCHMIDT (1955).

The biology and ecology of some species of the *Helicellinae* sub-family was studied mainly by SCHMID (1930, 1934, 1968), HORST (1959) and FRÖMMING (1954, 1962).

A comparative study of the morphology of the genital apparatus *Stylommatophor* is presented by NORDSIECK (1966).

In Czech literature SLAVÍK (1868) and ULIČNÝ (1892—5) deal with the species of the sub-family from the faunistic aspect.

Data about this group are also contained in faunistic and ecological papers by many authors such as: ROHLENA (1920), REMEŠ (1922), HLAVAČ (1933, 1937, 1949), PETRBOK (1919, 1936a, 1936b, 1936c, 1936d, 1938a, 1938b, 1938c, 1938d, 1945, 1947), JANDL (1949).

Later it would be mainly LOŽEK (1946, 1947a, 1947b, 1948a, 1948b, 1949a, 1949b, 1951a, 1951b, 1952, 1953a, 1953b, 1954, 1955a, 1955b, 1955c, 1955d, 1955e, 1955f, 1956, 1957, 1959, 1962, 1963), BRABENEC (1954), MÁCHA 1960), HRUBÝ (1957, 1966), HUDEC (1957, 1960, 1961, 1962), HOŘÍNEK (1966).

HUDEC (1964, 1966) gave more attention to the *Candidula soosiana* and *Helicopsis striata* species and their distribution in Czechoslovakia.

III. WORKING METHOD

Species of the *Helicellinae* sub-family are sufficiently large and visible enough to be manually collected. Material designed for processing at some later time can be preserved in a dry place in a cardboard box where it stays alive for half a year and more.

I obtained the bodies of snails for anatomical purposes by suffocating the animals in distilled water. I did the fixation in 2 % formol and permanently stored them in 80 % alcohol. Some preparates are made from fresh material, when the snails were suffocated in water and immediately dissected.

Prior to the actual dissection I dissolved the shell in 10 % hydrochloric acid. I used only shells with a developed lip containing sexually mature specimens. I arranged the extracted genital apparatus on a wax tray with pins in order to be able to measure the different parts. Then I fixed the preparate in 5 % formol. A larger part of the genital apparatus is firm and is not significantly affected by conservation. The mucoid spermoviductus (SO) which is the softest part (the size of which I am not giving) decreases only in width after conservation.

I placed the preparate prepared in this way onto a Petri dish containing water, inserted in the magnifying apparatus and copied, 10× magnified, on to paper. In this way I obtained drawings of 187 sets of genital apparatuses of all species of the sub-family *Helicellinae* from the most different localities.

I did the actual measuring of the genital apparatus on the drawings. The results are given in the tables of the different species in millimeters. These data I used to construct graphs by which I could determine intraspecies variability and differences in the size of the genitals between the species.

The measured object I stained with a 1 % solution of pale-green water paint, dehydrated in ethylene glycol monomethyl ether (instead of the conventional time-consuming dehydration by the alcohol series) and after half to one hour transferred it into xylol where the preparate can be left for as long as necessary (but for at least one hour). Finally I embedded the genital apparatus in Canada balsam. Ethylene glycol makes the preparate highly translucent and causes it to contract (dissolves fat) and therefore is suitable only for tougher objects and only for overall morphology.

I obtained the jaws by direct extraction with preparation needles under a binocular microscope or by disrupting the head tissues and gullet in a 1 % solution of NaOH which also releases the radula. In this way, however, if the hydroxide is carelessly heated, the jaw can be damaged and so it is suitable only for the extraction of the radula which is more resistant. The jaw and the radula can be obtained very easily from the disintegrating gullet. I embedded both the jaw and the radula in Canada balsam.

I proceeded in the same way to obtain the dart. The extracted dart sac I put into ethylene glycol and after 24 hours into xylol. Here it very soon becomes clear (depending on the species in 20—30 minutes) so the dart can be clearly seen.

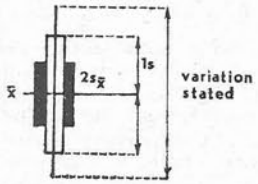
Together with the shells I collected samples for the determination of plant cover of some sites and samples of soil from depths of 0—10 cm, ofr assessing $CaCO_3$ contents in the soil. I determined the percentage of calcium carbonate in the sample by using the JANKO calcimeter on the basis of the volume of CO_2 released after the disintegration of the carbonate by hydrochloric acid in a 20 % concentration. Instead of water in the eudiometric tubes I took the advice of the late dr. K. Komárek and used a saturated solution of sodium chloride to prevent the carbon dioxide from being absorbed by the water. For analysis I used soil sieved through a 0.8 mm sieve, dried at 105 °C and in the tables I recorded the average of three readings from each site. The principle and the procedure of the whole work is described by KLIKA, NOVÁK, GREGOR (1954).

All material and protocols used in the work are deposited in the Zoological Department of the National Museum in Prague.

Explanation to symbols used in figures and tables

All data given in milimeters

No. = number of microscopic preparation
b/h = shell breadth / shell height
P = penis (lenght / width)
MR = musculus retractor
E = epiphallus (lenght / width)
F = flagellum (lenght)
VD = vas deferens (lenght)
BT = bursa telae (lenght / width)
1 = part grown together with vagina
2 = free part of bursa telae
GM = glandulae mucosae (lenght)
TR = truncus receptaculi (lenght / width)
RS = receptaculum seminis (lenght / width)
SO = spermoviductus (lenght)
GA = glandula albuminalis (lenght)
DH = ductus hermafroditicus (lenght)
n = number of specimens examined
x = mean
s = standard error
v % = coefficient of variation
var. l. = lenght extent of variation
var. b. = breadth extent of variation



In localities marked by + known as Candidula soosiana from recent literature.

IV. SYSTEMATICAL SURVEY

Family: *HELICIDAE*

The family includes the most advances members of the *Helicacea* super-family which occurs in the Palearctic region. The mucous glands of the dart apparatus are formed by firm, cylindrical tube organs connected with the vagina. They are simple, bifid or branched. The dart sac contains a rod shaped, in different species differently adjusted calcium carbonate formation, the dart. Differences in the genital apparatus as well as in the shell design are the basis for differentiating eight sub-families five of which live in central Europe.

Sub-family: *Helicellinae*

The sub-family has a wealth of representatives mainly in the Mediterranean and the more southern states of western Europe. Central Europe is inhabited only by some of the species; five species, which systematically (ZILCH, JAECKEL, 1962) belong into four genera (formerly sub-genera), are found in CSSR. All are adapted to life on steppe or semi-steppe sites; they occur in both original biotopes and secondary biotopes which they rapidly invade either directly or indirectly and often with the help of man. In favourable years reproduction may be violent. Their place in the system depends mainly on the anatomy of the animal while in shell formation numerous convergences exist.

According to SCHILEYKO (1978) this sub-family represents a group of heterogenous polyphyletic taxones which as such lack systematic status. On the basis of comparison of the morphology of the genital apparatus of *Helicellinae* and *Hygromiinae* and the evaluation of the adaptive significance of the retractor of the right ommatophore in *Helicellinae,* SCHILEYKO considers each taxone of this group to be only a derivate of the appropriate taxone of the *Hygromiidae* family. Species of the *Helicellinae* sub-family are thus just xerophilous *Hygromiidae* which appeared on Earth in connection with the creation of open arid sites. According to the number and distribution of the dart sacs in the vagina SCHILEYKO places them either into the sub-family *Trichiinae* (*Helicopsis, Helicella*) or *Hygromiinae* (*Candidula, Cernuella*).

Shell: medium sized to small, mostly with thick wall, wiht narrow to broad umbilicus. Very variable, from quite flat ones sometimes with a sharp keel to spired shapes. The basic colour is opaque white or yellowish, most often with numerous dark bands or spots. The surface is almost smooth, finely to sharply striate, sometimes with a fine, often with a coarse, wrinkled or granular sculpture.

The aperture is round, lunate or ± oblique (in keeled forms). The lip is sharp, without teeth, often with a conspicuous internal rib set not far from the edge, slightly extended in only some species (*H. itala*).

Genital apparatus: the retractor of the top right antenae (ocular) lays freely next to the genital apparatus. The penis is short, the epiphallus usually longer, slender, cylindrical, the musculus retractor is usually joined to the front end of the epiphallus. The flagellum is rarely as long as the penis and epiphallum taken together, most often it is much shorter and even rudimentary. The glandulae mucosae are almost always fusiformly distributed around the vagina or connected to form 2—4 bundles which are simple, bifid or rarely more branched out. One, two or four dart sacs with or without a dart often grown together along the whole length to the vagina. The dart has ± conspicuous crown, it is smooth, round, straight or slightly bent, sometimes broader at the tip with thin appendages. The dart sac and glandulae mucosae are rarely absent, however, in that case the appendicula is developed. Truncus receptaculi is straight, slender, of varying length. Receptaculum seminis is lancetted, oval or triangular. Many species possess a comparatively large spermatophor.

Cytological data: according to the research of RAINER (1967) the number of chromosomes in species of this sub-family is interesting. *Candidula unifasciata* (n = 27) differs from the *Helicella* genus (*H. itala, H. obvia* both with (n = 26) in special features of the chromosome set. The *Candidula* genus has one large and four particularly small bivalents while the *Helicella* genus possesses three large and no small elements. Thus, current division into different genera is, from the cytological particularly small bivalents while the *Helicella* genus possesses three large and no aspect, justified. Species of the *Helicella* genus cannot be distinguished on the basis of chromosome pattern.

Jaw: mostly ontognath, rarely aulacognath with 4—20 flat, broad, narrowly compressed or broadly divided lamellae which form a bedenticled margin.

Radula: the central tooth is three-pointed, the lateral teeth are two-pointed, the marginal teeth have two or more often 3—5 points.

Genus: **CANDIDULA** KOBELT, 1871

Synon.: *Xeroalbina* MONTEROSATO, 1892

Shell: smaller, striate to ribbed, with regularly increasing whorls, the last one is slightly predominant. The whorls are from above and from bellow sightly depressed, sometimes with a suggestion of a blunt edge on the periphery.

Genital apparatus: one large unpaired dart sac, glandulae mucosae in two bundles with 2—4 branches in each.

Candidula unifasciata (POIRET, 1801)

Synon.: *Helix unifasciata* POIRET, 1801, Coquilles fluv. et terr., Prodrome, pp. 14 (France, type ?).
Helix candidula STUDER, 1820, Syst. Verz. der bis jetzt bekannt geword. Schweiz. Conchyl. p. 87 (Switzerland, type ?).
Helicella (Candidula) soosiana J. (H.) WAGNER, 1933, Állat, Közl., 30, 3, p. 151 (Hungary, Hüvösvölgy near Budapest, typ. mat. destroyed), syn. n.

Shell: depressed globose, walls rather thick, opaque, with fine to coarse ribs (especially on the last whorl). Basic colour is whitish, horn yelow with a well developed broader band on the periphery. Bellow it there are four or five narrow bands which may be absent. The bands are black or brownish, often interrupted or fused and often completely absent. The shell has four or five whorls vaulted from above and from below slightly depressed. The whorls grow regularly and relatively slowly the last one may slightly predominate; the suture bends very shortly, often conspicuously downwards, near the aperture. The aperture is slightly slanting, transverse short, elliptical to round. The lip is straight, sharp, only near the columella is it a little

broader. The internal rib is strong and raised to slightly flat, sometimes completely absent. The parietal callus is unmarked. The narrow umbilicus accounts for up to 1/5—1/7 of the breadth of the shell. Shell breadth is 6.2 mm, height 3.5 mm (the average of 1446 specimens from Czechoslovak populations I measured).

All the given diagnostical features are subject to considerable changes among the different populations.

Colour of animal: the foot is pale, head and mantle gray to dark gray.

Genital apparaus: one large dart sac (3.6—4.0 mm long) is by more than half of its length fused with the vagina, the free end is oval (0.9—1.3 mm long). The dart is thin, slightly bent. At the end of the truncus receptaculi which bears a spherical or lance receptaculum seminis there are two bundles of glandulae mucosae usually split up into more branches (3—9). The penis is short, fusiform or globose, inflated, the epiphallus is thin, cylindrical. The flagellum is very short (0.5—0.7 mm).

Jaw: odontognath, I determined 12—14 flat lamellae.

Radula: (LÁSKOVÁ, 1969) in animals with shells of 6.2—8.7 mm (breadth) and 3.9—5.6 mm (height) in size the radula length ranges from 1.59 to 2.31 mm and its breadth from 0.48 to 0.69 mm.

The number of teeth set in serial rows: 85—104

The number of teeth set in transverse rows: 35—49

The central part is formed by one serial row of teeth which are three-pointed and symmetrical. Largest is the central point (mesocone) adjoined from either side by one ectocone. The teeth are smaller in the lateral part.

The lateral part comprises 7—12 serial rows af teeth on either side. The teeth have two points, the mesocone is larger than the neighboring ectocone.

The marginal parts on either side of the radula comprise 9—12 serial rows. The teeth usually have three points, towards the edge of the radula they become lower and broader. The mesocone is largest of the points, the inner endocone is smaller than the outer point — ectocone. Closer to the edge of the radula the ectocones on the teeth split into more than 2—3 points. Most often they are single-pointed. The last row of teeth has already an irregular shape (Fig. 1).

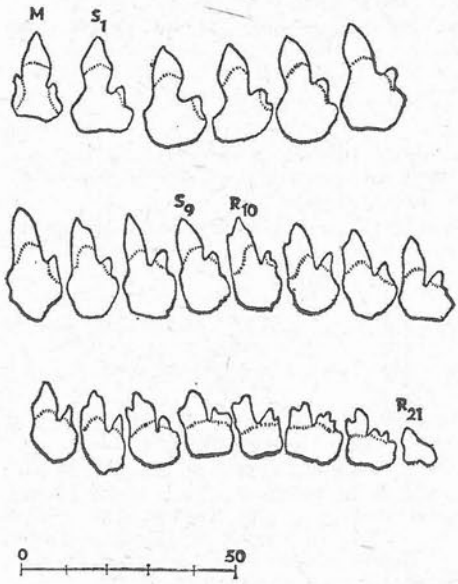


Fig. 1.
Candidula unifasciata — radular teeth (after Lásková, 1969)
1 central tooth M
9 lateral teeth S_1—S_9
12 marginal teeth R_{10}—R_{21}

Biotope: it inhabits slopes facing east to south and windrows on a calcareous substrate. Settles on secondary, xerothermous biotopes created by deforestation, calcium quarry spoil banks, railway and road trenches. All these are substitution sites.

Overall distribution: west European — central European. Pyrenees, France, Belgium, Netherlands, Denmark, north of Italy, Sardinia, south and west Alps, Jura; quite numerous in the Highlands of the FRG, in Austria, Poland (south), CSSR.

Vertical distribution: in the Alps up to an altitude of about 2,000 m, in CSSR up to 650 m at most.

Distribution in CSSR: (Fig. 2). CSSR is the easternmost border of distribution of this species. The oldest occurrence is known from the last century from the vicinity of Opočno (lgt. J. Kopecký). Another small island in Bohemia is around Tachlovice u Nučic. In Moravia it is found in the area between N. Jičín and Těšín. In Slovakia it inhabits the north-west.

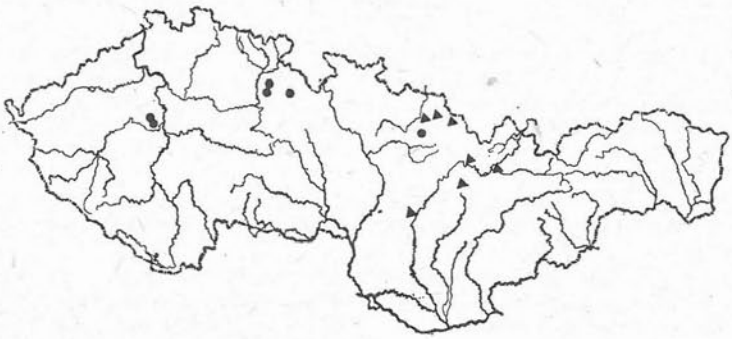


Fig. 2.
Distribution of *Candidula unifasciata* (Poiret) in Czechoslovakia
▲ population known as *Candidula soosiana* (J. Wag.)

Fossil distribution: there are only few data available about the distribution of this species in the quartery. They are from the travertines and loess in the southern part of FRG and Thuringia. Authentically recent findings on our territory are not old. It seems that this species is subrecent in Czechoslovakia. Populations in Slovakia could have appeared on their present sites after deforestation. According to research of V. LOŽEK (1963) this took place some 200 to 300 years ago as proved by the occurrence on holocene travertine near Kralovany.

Genus: **HELICOPSIS** FITZINGER, 1833

Synon.: *Helicella* FÉRUSSAC, 1821
Striatella WESTERLUND, 1876 (partim)
Martha A. J. WAGNER, 1915

Shell: conspicuously lamellaed with rapidly growing whorls the last one of which is very predominant, they are well arched even on the under side.

Genital apparatus: 4 symmetrical dart sacs of which only the two external ones contain a dart each; four glandulae mucosae each of which splits to form 2—3 branches.

Helicopsis (Helicopsis) striata (O. F. MÜLLER, 1774)

Synon.: *Helix striata* O. F. MÜLLER, 1774, Verm. terr. et fluv., II, 33, No. 238 (Saxonia, type ?).
Helix costulata (ZIEGLER) C. PFEIFFER, 1828, Naturg. deutsch. Land- u. Süssw. Moll., III, p. 32, tab. VI, fig. 21, 22 (Austria near Vienna, type ?).

Shell: depressed globose to depressed round with broadly conical ± raised disc, rather thick walled, strong, not translucent, opaque, ± irregularly strongly and bluntly ribbed, less so on the under side. The basic colour is whitish with 1—8 dark brown bands which are often interrupted appearing to be lines of spots, or are fused or absent, sometimes without bands in which case they are of an irregular brownish

tinge. Four-and-a-half to five whorls are well arched, regularly growing, the last clearly predominating; the suture at the aperture bends down only slightly. The aperture is a little ablique, round, slightly cut out by the parietal wall. The lip is sharp, straight in the lower and slightly broadened in the columella section. The whitish internal rib is flat, broad and strong, usually slightly elevated. The parietal callus is hardly distinguishable. The umbilicus is open, not too broad (it is 1/7 to 1/5 of the shell breadth). Shell breadth ranges from 7.0—9.0 mm, height 5.0—6.0 mm (LOŽEK, 1956).

A considerably variable species: the smallest shapes range around 6.0 : 4.0 mm and are sometimes even smaller, the breadth rarely exceeds 10.0 mm and the height 7.0 mm. Also colouring varies considerably. Purely white specimens are found frequently, specimens with bands of various patterns are common, while specimens completely and mostly brown are rare (LOŽEK, 1956).

Colour of animal: white foot and the rest of the body and gray mantle.

Genital apparatus: two dart sacs on either side of the vagina the inner ones are smaller and fused with the vagina. Ony the two outer ones each contain one short and smooth, straight or slightly bent pointed dart. Truncus receptaculi is of medium length with 4 fusiform glandulae mucosae at the base each of which splits to form 2—3 branches.

Jaw: odontognath, 5—6 broad ribs slightly protrude and form a slightly toothed margin. Size: length 0.4—0.5 mm, breadth 0.08—0.09 mm (according to my own measurings).

Radula: the lateral and marginal teeth are two-pointed.

Biotope: inhabits grass steppe slopes on unfirm substrate (loess, marl, calcareous sands) at low altitudes. It belongs to the typically pedophilic elements, rare on rocky or stony sites (LOŽEK, 1974a).

Overall distribution: central European — west European. Portugal, southern foothills of eastern Pyrenees, north and east France, sporadically in FRG and the north German lowland, CSSR, western region of USSR, Austria, Hungary.

Data from the west (France, etc.) are not reliable however, for confusion with other simillar species, especially *Trochoidea geyeri* (SOOS), cannot be excluded. Also data from eastern Europe require anatomical verification. The species *Trochoidea (Xeroclausa) geyeri* (SOOS, 1926) was systematically sought for on the territory of CSSR but in vain.

In 1969 E. GITTENBERGER described a new species from Austria — *Helicopsis (Helicopsis) austriaca* — which differs from *H. striata* particularly by more conspicuous striation and smaller shell dimensions, also by a relatively short epiphallus, strong glandulae mucosae and two long bent darts.

All these species connected with *H. striata,* including the *Helicopsis hungarica* (SOOS et WAGNER, 1935) ought to be approached with caution, while a thorough analysis of the whole problem based on the study of variability within the sub-family would be expedient.

Vertical distribution: CSSR — 150 to 500 m (Děvín).
Most localities are found on sites lower than 300 meters.

Distribution in CSSR: it is limited to original steppe, low altitude regions in Bohemia, south Moravia and south Slovakia (Fig. 3).

Fossile distribution: a frequent species in some pleistocene sediments, especially in loess, sometimes far from the range of their current occurence (England). Fairly frequent also in holocene, especially in strata of the dry sub-boreal period, mainly within the region of their current area of occurrence, as a rule occurs more frequently than today. A comparison revealed that since the end of pleistocene *Helicopsis striata* is in permanent recession.

This species belongs among the most common molluscs in our loess and pleistocene chernosem, not often in other sediments. In the loess regions of central Bohemia it belongs among the most frequent snails of the pleistocene fauna. The distribution area in this country used to be much larger and in places also with denser populations. It was frequent even in regions where it is no longer found or only very rarely (Kutná Hora district, Bohemian karst, inside of Polomené Mts.). Still more conspicuous is the difference in the loess regions of Moravia, west and south Slovakia where it is

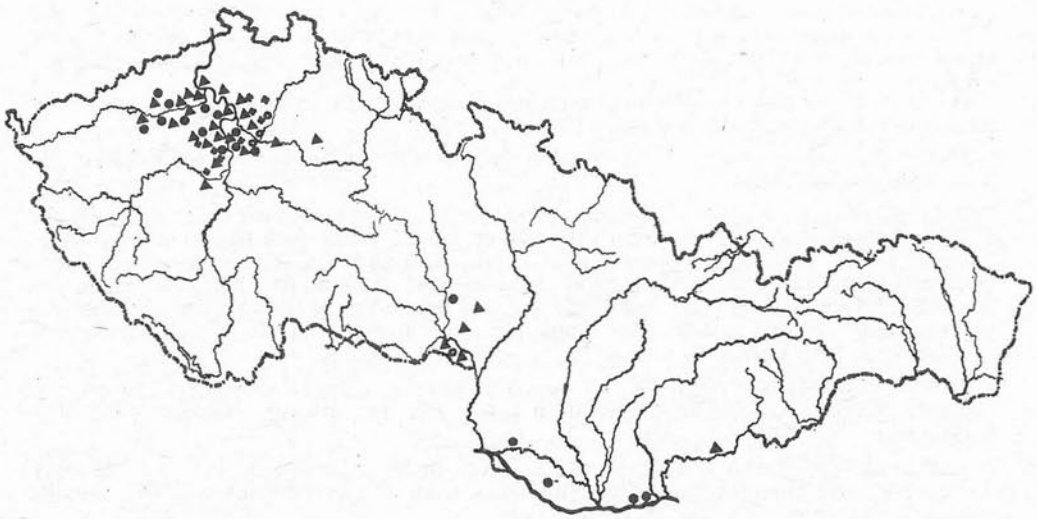


Fig. 3.
Distribution of *Helicopsis striata* (Müll.) in Czechoslovakia
● recent occurrence (animal recently collected)
▲ recent occurrence probable (shells recently collected)
+ undefined occurrence (subfosil?)
○ suspected of displacing from loess (pleistocene)

now found but rarely. In the Dunaj basin region (arround Štúrovo, Trnava, river Váh basin to Trenčín) recession started apparently already during würm. The *Helicopsis striata* on this territory is important as a stratigraphic element (LOŽEK, 1955f).

Genus: **HELICELLA** FÉRUSSAC, 1821

Synon.: *Xerophila* HELD, 1837
Planatella CLESSIN, 1876

Shell: larger, 12.0—20.0 mm broad, depressed, round, with a very flattened conical to completely flattened disc and very broad umbilicus.

Genital apparatus: on the vagina there are two large symmetrical dart sacs each containing one dart, the glandulae mucosae form two bands with 4—6 branches in each.

Helicella (Helicella) itala (LINNAEUS, 1758)

Synon.: *Helix itala* LINNAEUS, 1758, Systema Naturae I
Helix ericetorum O. F. MÜLLER, 1774, Ver. terr. et fluv., II, 33, No. 236 (Italy, type ?)
Helix cespitum DRAPARNAUD, 1805 (partim), Hist. Moll., 109, tab. VI, fig. 16, 17.

Shell: very depressed, round with a low flatly conical disc, thick walls, quite strong, ± slightly translucent, slightly shiny, delicate irregular striation. The basic colour is whitish — yellow to skin with translucent light to darker brown bands (sometimes colourless). The bands sometimes almost disappear, however, they are rarely completly absent. There are five-and-a-half to six whorls, well arched, quite slowly and regularly growing; the suture close to the aperture turns downwards suddenly and rather sharply. The aperture is oblique, round or very short and somewhat obliquely transversally elliptical, the parietal wall slightly cut out; its edges are very close together on the parietal wall. The is is sharp, on the side, on the under

side and near the columella markedly broaded with a very thin brownish internal rib and a very thin but clear parietal callus. The umbilicus is broadly opened (it is almost one-third of the shell breadth). Shel breadth is 15.0—16.0 mm, height 7.5—8.5 mm.

The size is variable, the breadth fluctuates between 11.0—18.5 mm, the ratio of the dimensions is also variable (LOŽEK, 1956).

Animal colouring: the whole body has little pigmentation hence appears to be light (SCHMID, 1968).

Genital apparatus: two dart sacs are fused symmetrically and far with the vagina and are thus close to each other. Each contains one tusk-like bent dart, flattened at the tip and with two short blades. The glandulae mucosae consist of 4 bands (SCHMID, 1968). HESSE (1926) states 4 bands with 2—4 finger-like blind branches in each. The penis is rather short only a little thicker than the cylindric epiphallus, the flagellum is rather short, the penis retractor attached at the beginning of the epiphallus, atrium is short.

Jaw: odontognath. Comprises 7—8 broad protruding lamellae which form a clearly toothed concave margin. Size: Length 0.6—0.7 mm, breadth 0.2—0.3 mm (my own measuring).

Radula: (LÁSKOVÁ, 1969), in animals with shells of sizes 13.2—17.2 mm (breadth) and 7.2—9.5 mm (height) the length fluctuates from 2.76 to 3.60 mm and the breadth from 0.99 to 1.29 mm.

The number of teeth in the serial rows: 109—154.
The number of teeth in transverse rows: 53—67.

The central part is formed by one serial row of three-point teeth in the middle of the radula, symmetrical small points (ectocones) are attached to the main point (mesocone) at the same height, they are smaller and shorter than teeth of the lateral part.

The lateral part comprises 10—18 serial rows. Closer to the central part the teeth are larger and broader, towards the lateral part they slightly decrease in size, and they are somewhat slimmer, two-points. The mesocone is higher than the ectocone.

The lateral part comprises 14—22 serial rows on either side of the radula. It differs from teeth of the lateral part by the appearance of another point (endocone) which is oriented towards the centre of the radula. At first the teeth are three-point, towards the edge of the radula the ectocone cleaves to form more points (2—5). In most specimens a sporadical cleaving of the endocone to form two points can be seen. The shape of the last tooth in this part is irregular. From the lateral part direction the teeth become lower but also wider.

Biotope: inhabits grass steppe slopes, windrows and fields. Occassionaly it occurs on railway and roadside ditches.

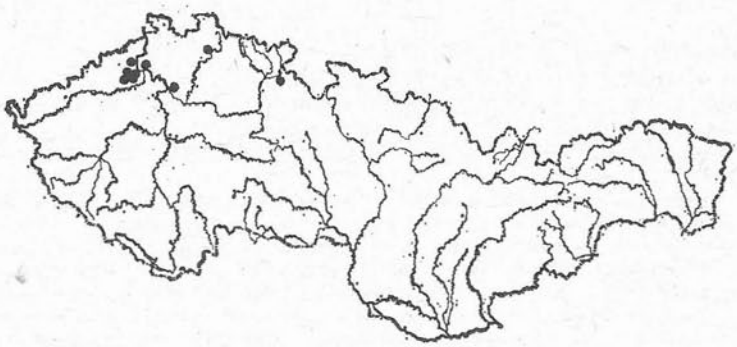


Fig. 4. Distribution of *Helicella itala* (L.) in Czechoslovakia

Overall distribution: west Europe to central. Whole of western Europe, parts of the western Alps, Jura, FRG, south-west GDR, Austria, Bohemia.

Vertical distribution: Pyrenees up to 2,000 m, Bohemia up to 400 m.

Distribution in CSSR: rare and only in the north of Bohemia (Fig. 4).

Fossile distribution: occurs only in pleistocene — French and English, sporadically in the Federal Republic of Germany; more frequently in holocene within the region of the current area.

In CSSR findings are rather young and therefore this species may be considered as typical for the sub-recent period. It is possible that it is a relatively recent (new age) introduction (LOŽEK, 1955f).

Helicella (Helicella) obvia (MENKE, 1828)

Synon.: *Helix neglecta,* HARTMANN, 1821, Neue Alpina (Winterthur) 1:226 (Augsburg, Frankreich, Strassburg, Wien). —, Hartmann, 1824, in Sturm Deutschlandes Fauna 6 (7) Würmer: No. 9. No *Helix neglecta,* DRAPARNAUD, 1805.
Helix obvia MENKE, 1828, Synopsis Methodica Molluscorum... (Ed. 1) : 13. Nomen novum for *Helix neglecta* HARTMANN, 1821, not DRAPARNAUD, 1805. Locus typicus, restr. nov.: Wien.
Helix obvia HARTMANN, 1842, Erd und Süsswasser-Gastropoden der Schweiz, 5 : 148, tab. 45, fig. 1—6 (type locality and type ?).
Helix candicans L. PFEIFFER, 1841, Arch. Naturgesch. 7 (1) : 220. Locus typicus: Ungarn: Szigliget near lake Balaton.

Shell: rather depressed and round with a slightly domed disc, thick walled, firm, non-translucent, opaque to sligthly shiny. Very finely and irregularly ribbed, smoother on the under side. The basic colour is white with dark brown to almost black bands, which often split, fuse or disintegrate in numerous varieties, sometimes they are completely absent while at others they predominate. There are five-and-a--quarter to five-and-a-half whorls, from the top slightly and otherwise well vaulted, growing regularly and rather fast, the suture bends down slowly and gradually at the aperture. The aperture is mildly oblique, ± round, slightly cut out by the parietal wall. The lip is sharp, straight; the deeply set internal rib is broader, flat, slightly elevated, parietal callus is weak but clear. The umbilicus is open wide (it is more than 1/4 of the shell breadth). Shell breadth: 15.0—17.0 mm, height: 7.8—9.5 mm (LOŽEK, 1956).

Markedly variable: small populations and different specimens have dimensions 11.0—11.5 mm and 6.5—6.8 mm; larger specimens and populations reach up to 19.0 : 11.0 mm. The height and shell colour are very variable; different populations usually show a certain character but more permanent deviations cannot be asserted.

Animal colour: pigmentation is within borders, the front part of the body is light, the mantle convexity is very dark (SCHMID, 1968).

Genital apparatus: 2 dart sacs stand out symmetrically from the vagina (as oposed to *H. itala*). Each contains one almost straight or slightly curved dart which is at the tip unclearly square with two short blades (SCHMID, 1968). Glandulae mucosae are formed by four bands. The rest is simillar to *H. itala.*

Jaw: odontognath. Is formed of 8—10 lamellae which form a teethed concave edge. Size: length 0.6—0.7 mm, breadth 0.2—0.3 mm (my own measuring).

Radula: (LÁSKOVÁ, 1969) in animals with shell sizes of 12,1—15.1 mm (breadth) and 6.1—9.6 mm (height) the length of the radula ranges from 2.49 to 3.27 mm and its width from 0.93 to 1.29 mm.

Number of teeth in serial rows: 102—131
Number of teeth in transverse rows: 55—71

The central part is formed by one serial row width regular three-point teeth. On both sides of the largest central point, mesocone, set at the same level are two smaller points, ectocones. The teeth are smaller than in the lateral part.

The lateral part comprises 10—16 serial rows on either side of the radula. The teeth are two-point, the mesocone is larger and higher than the ectocone. Closer to the central part they are broader than those closer to the marginal part.

The marginal part consists of 16—24 serial rows of teeth on either side of the radula. It differs from the teeth of the lateral part in having an additional point,

ectocone, which is attached to the mesocone at the somewhat higher level than the ectocone. Even in this part there occurs a split mesocone. This phenomenon is more frequent than in *H. itala* but is also variable. The ectocone does not cleave either and has one-point or splits into 2—4 points, it is slimmer than in *H. itala.*

Biotope: inhabits dry steppe slopes, fields, windrows. Secondarily it inhabits railway and roadside ditches. In cooler forest regions it lives only on calcareous substrates.

Overall distribution: Moldavia, Doburdja, Bulgaria, central Balkan, Carpathian countries, Alps up to Switzerland, CSSR, south Poland, Scwabian Jura, upper Rhineland, Thuringia, lower regions of Harz, sporadically in the north-German lowlands.

Vertical distribution: Alps 1,350—1,400 m, Switzerland up to over 2,000 m. CSSR maximum 800—900 meters.

Distribution in CSSR: in forestless, dry and warm regions of steppe character it belongs among the most common snails. In Bohemia very common in the central and north-western part and in the wide region of the Elbe river basin, island occurrence in south Bohemia where it is limited to metamorphosed lime. In Moravia it is dispersed at lower altitudes throughout the region. In Slovakia it inhabits the lowlands in the south up to Turna u Košic, in the west it is found in the Váh river basin up to the vicinity of Ružomberok, in places it penetrates the inner Carpathian districts (the region between Poprad and Sabinov u Prešova (Fig. 5).

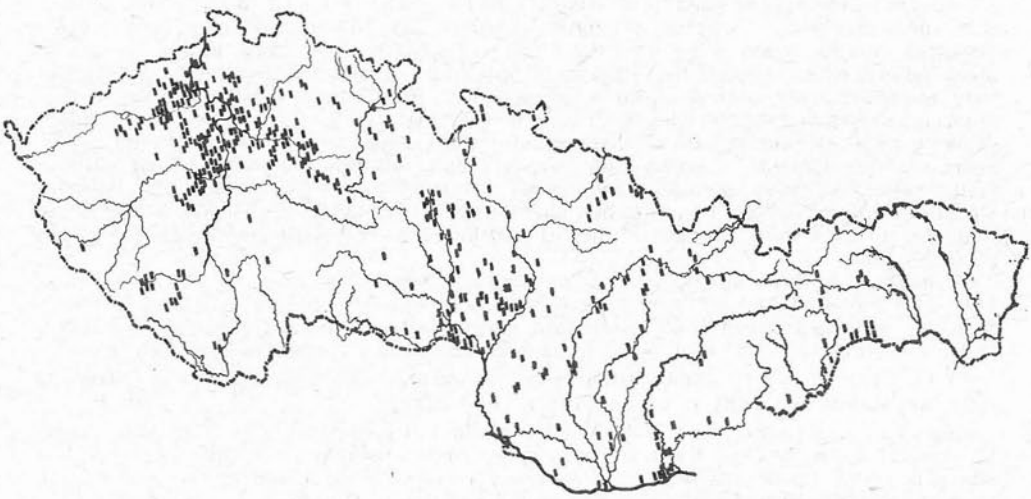


Fig. 5. Distribution of *Helicella obvia* (Menke) in Czechoslovakia

Fossile distribution: in central Europe found in the youngest holocene, in lower Danube river basin, even on the Black Sea coast and allegedly also in pleistocene loess (according to PETRBOK).

In CSSR this species is an important component of the subrecent layers. In south Slovakian karst it appeared only in the post-Halstadt period. *Helicela obvia* is a typical example of a steppe species which spread to this territory from south-east Europe. It flooded central Europe in large areas so that today it determines the nature of whole snail communities and is one of our most common species. The time of its arrival is not exactly determined, however, the main invasion was apparently at a very late, probably medieval date, and still continues. Data from older layers are not reliable (LOŽEK, 1955f).

Genus: **CERNUELLA** SCHLÜTER, 1838

Sub-genus: *Xerocincta* MONTEROSSATO, 1892

Shell: depressed, globose but higher than in the genus Helicella which it closely resembles.

Genital apparatus: differs conspicuously from genus *Helicella* by two dart sacs located on one side of the vagina.

Cernuella (Xerocincta) neglecta (DRAPARNAUD, 1805)

Synon.: *Helix neglecta* DRAPARNAUD, 1805, Hist. moll., p. 108, tab. 6, fig. 12, 13 (France: Lauserte, le Sorézois, type ?).

Shell: brown bands are usually brighter than in *H. itala* but no so dark as in *Helicella* obvia. Characteristic is the brownish red to violet tinge of aperture edge especially on the under side. Also the sharp lip is inside brownish to strong brown-violet even in the rather frequently occurring shells without bands. The porcelaine white internal rib gradually turning into a violetish shade (SCHMID, 1968) is conspicuous. The umbilicus is obviously narrower than in *Helicella itala*. The shell breadth is 9.0—14.0 mm, height 6.9—10.0 mm (ZILCH, JAECKEL, 1962).

Animal colour: as oposed to the two mentioned species the body of this one is gray to dark.

Genital apparatus: Two dart sacs on one side of the vagina, the inner one, which is fused with the vagina, is larger. The outer one contains one dart which is strongly club-like, slightly curved, with 4 sharp edges at the tip, the horisontal ones being leaf-like broadened (SCHMID, 1968). At the base of the long and thin truncus receptaculi are two bands of glandulae mucosae with 5—7 simple or bifid glands. The receptaculum seminis is longitudinally ovate or lancet-like. The penis is short, a little swollen; the epiphallus is long, thin, cylindric; the flagellum is much shorter than in *H. itala* and *H. obvia*. The musculus retractor is, as opposed to the other two species, attached closely on the tip of the penis; the atrium is also conspicuously longer.

Jaw: odontognath. Comprises 9—14 lamellae which form a clearly teethed edge. Size: length 0.6—0.7 mm, breadth 0.2—0.3 mm (my own measuring).

Radula: (LÁSKOVÁ, 1969) in animals with shells 14.1—18.9 mm (breadth) and 8.1—11.4 mm (height) the length of the radula ranges from 2.94 to 3.51 mm and its width from 1.11 to 1. 38 mm.

Number of teeth in serial rows: 116—137

Number of teeth in transverse rows: 63—83

The central part is formed by one serial row of three-point symmetrical teeth which are only slightly smaller than teeth on the lateral part. The largest point, mesocone, is adjoined by two smaller ectocones.

The side field comprises 13—20 serial rows. The teeth are two-point, almost all are the same but those closer to the marginal part are lower.

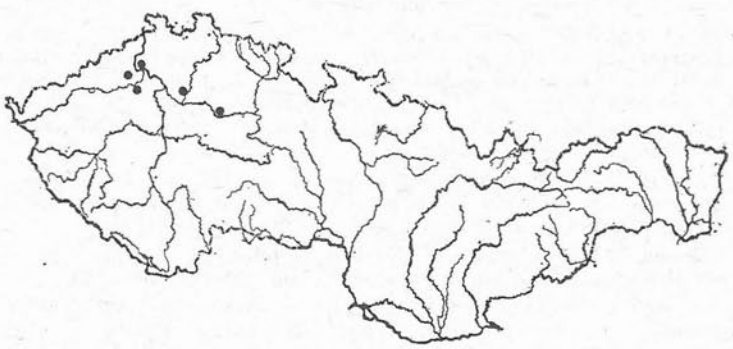


Fig. 6. Distribution of *Cernuella neglecta* (Drap.) in Czechoslovakia

The marginal part on either side of the radula comprises 13—22 serial rows of mostly three-point teeth. The middle point (mesocone) is adjoined higher by a smaller endocone which does not cleave and has one point. The ectocone is attached lower. It is usually one-point and only close to the edge of the radula does it cleave to form 2—4 points.

Biotope: southern and eastern warm steppe slopes, field paths but also railroad trenches. Rapidly penetrates cultured areas (fields of clover, lucerne and cereals).

Overall distribution: western Mediterranean (originally). Eeastern Spain, southern France, Italy, islands of the Mediterranean Sea. From where in the past thirty years it is spreading rather quickly into other European countries. In France up to the bonder with Belgium, England, FRG, GDR, Switzerland, Bohemia (LOŽEK, 1957, SCHMID, 1968).

Vertical distribution: sites at low and medium altitudes. CSSR: 200—300 m.

Distribution in CSSR: rare and only in the Elbe region (Fig. 6).

Fossile distribution: in CSSR *C. neglecta* is only a recent species which appeared in this country as isolated introductions after 1950.

V. GENITAL APPARATUS OF SPECIES OF THE HELICELLINAE SUB-FAMILY

Just as all the other pulmonate snails even members of this sub-family are hermaphroditic with a genital apparatus consisting of a male and female section. As the organization of the apparatus is an important systematic feature, in particular determining the genus, it should be given special attention. In many cases determination is only possible on the basis of the morphology of this apparatus, especially of the copulation organs, for the shels of some representatives of different genera might converge almost perfectly.

The genital system consists of the gonad (germinative gland) and gonoducts (duct to the exterior).

1. The **gonad** is not paired and is located in the back section of the intestinal pouch and is surrounded by hepatopancreas. In hermaphrodites gametes are created in the reproductive gland of hermaphrodites (ovotestis) from the germinative epithelium. It may create male and female cells in separate sections of the organ or next to each other. The production of both kinds of gametes may be successive or simultaneous. Besides the reproduction cells the epithel produces interstitial cells which took over the nutritive function and phagocytosis.

2. **Gonoduct of** hermaphrodites consists of hermaphroditic male and female sections. The proximal part of the gonoducts is a simple hermaphroditic passage (ductus hermaphroditicus). While the pallial and cephalopodial part of the gonoduct have independent male and female passages and copulation organs. The pallial section is known as the spermoviduct (in literature presented as "uterus + prostate") because the male and female parts are not isolated.

For copulation there is the male copulation organ (penis and accessory organs) and the female copulation organ (vagina and accessory organs). In species of the *Helicellinae* sub-family the genitals consist of the following parts:

a) male — penis (**P**), epiphallus (**E**) and flagellum (**F**), which serve to transfer the sperm into the spermatophore, if developed, and vas deferens (**VD**).

b) female — vagina (**V**) to which 1—4 dart sacs (bursa telae, **BT**) with darts are attached. The upper art of the vagina, where the truncus receptaculi (**TR**) carrying receptaculum seminis (**RS**) separates from the free part of the oviduct (**O**), is adjoined by a lager or smaller number of dart glands — glandulae mucosae (**GM**).

c) comon sections — spermoviductus with prostate (**SO**) which is entered by the ductus, hermaphrodicus (**DH**) from the hermaphroditic gland — glandulae hermaphroditica (**GH**).

At the point where the ductus hermaphrodicus enters the spermoviductus also the glandulae albuminalis (**GA**) is attached. The common genital outlet is the atrium (**A**).

During copulation the specimens are joined to each other with their right sides, from the genital opening of each of the two the vagina, penis and dart sac are extended and interconnected. The accepted sperm pases through the vagina and truncus receptaculi into the receptaculum seminis where it is stored until the eggs are fertilized.

The genital apparatus is described in literature only sporadically or the data are based on the different observations. Due to the variability of the different species this is quite unsatisfactory and therefore I tried to measure a somewhat larger number of specimens of the different species. The results of measuring 187 specimens are recorded in tables and graphs. In order to determine the progress and when the growth of genital apparatus is terminated (in relation to the size of the shell) I dissected also juvenile secimens, of which I give the measurements only for comparison with a mature genital apparatus.

Candidula unifasciata (POIRET)

To determine the variability of the genital apparatus I used 38 specimens of typical populations *C. unifasciata* (Fig. 7) and 69 specimens of

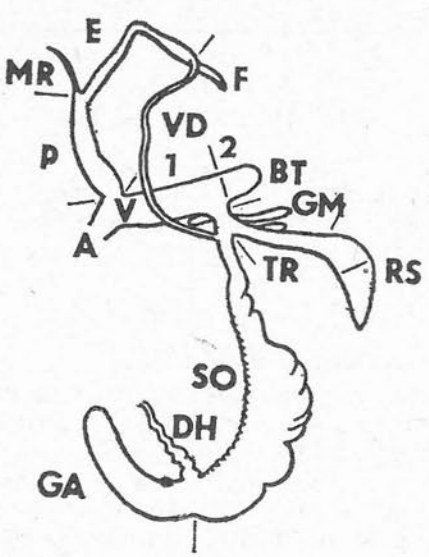


Fig. 7.
Genital apparatus of *Candidula unifasciata* (No. preparation 11g), Chýnice - Dubecký mlýn, 20. 10. 1968, enlarged 6times
Shell size: breadth = 5.2 mm, height = 3.0 mm

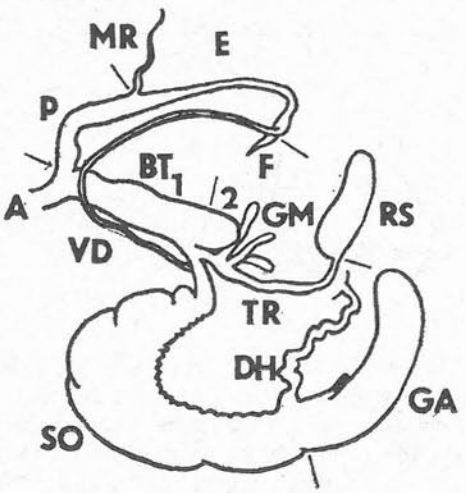


Fig. 8.
Genital apparatus of *C. unifasciata* (population *S. soosiana*), Vreten u Sněžnice, 11. 10. 1968, (No. preparation 9e), enlarged 6times
Shell size: breadth = 6.4 mm, height = 3.7 mm

populations formarly denoted as *C. soosiana* (Fig. 8) in text and tables marked with +). The localities involved are as follows.

No. 11. Chýnice u Nučic, Dubecký Mlýn, 20. 10. 1968
17. Štramberk u N. Jičína, Staré lomy, 10. 10. 1968
33. Štramberk u N. Jičína, Staré lomy, 8. 10. 1970
35. Drahelčice u Nučic, 16. 6. 1970
36. Čánka u Opočna, 23. 9. 1972 (lgt. J. Brabenec)
\+ 8. Rájecká Lesná - Šuja u Žiliny, 11. 10. 1968
\+ 9. Vreten u Sněžnice, 11. 10. 1968
\+ 30. Branná u Hanušovic, 6. 10. 1970
\+ 37. Branná u Hanušovic, 10. 10. 1972
\+ 31. Soběšovice u Žermanické přehrady, 8. 10. 1970
\+ 32. Stankovany u Kralovan, 8. 10. 1970
\+ 34. Drietoma u Trenčína, 9. 10. 1970

Average measurings of all localities are recorded in table I.

The size of the genital apparatus in juvenile specimens is given in table II and fig. 9, 10. In specimens with a shell breadth of 5.2 mm and height of 3.3 mm it is about half developed .

Fig. 9.
Candidula unifasciata (young, No. preparation 26a)
Chýnice - Dubecký mlýn, 29. 6. 1968, enlarged 6times,
Shel size: breadth = 5.2 mm, height = 3.3 mm

Fig. 10.
Candidula unifasciata (young, No. preparation 26b)
Chýnice - Dubecký mlýn, 29. 6. 1968, enlarged 6times
Shell size: breadth = 4.0 mm, height = 2.4 mm

The dart sac with dart 2.5 mm long is shown in Plate V/1, 2.

Questions of the relation between species *Candidula unifasciata* and *Candidula soosiana* were investigated in this country mainly by HUDEC (1964). Though he considers *C. soosiana* to be a justified species he points to some differences among different populations and to common features with *C. unifasciata.* I based my study of these populaitions mainly on this work. Therefore, for the sake of clarity, and better orientation, I present the anatomical differences between the two species just as HUDEC presented them in his publication.

In my opinion a mere verbal description of the distinguishing features is in many cases insufficient and often just subjective. All data, if possible and expedient, ought to be presented also in numeric form. I have the following comments to the noted anatomical differences.

Table I. Candidula unifasciata (and population „soosiana")
Mean value shells and genital apparatus from 12 localities

	shell b/h	P	E	F	VD	BT_1	BT_2	BT_{1+2}	GM	TR	RS	TR + RS	SO	GA	DH
n	104 104	105 104	104 96	106	97	96 107	99 107	104	105	100 105	98 101	100	100	94	60
var. 1	5.2 - 8.1	1.4 - 3.0	3.0 - 6.0	0.5 - 0.8	4.3 - 12.3	1.9 - 3.8	0.7 - 1.5	2.9 - 4.8	1.0 - 2.5	1.7 - 6.2	1.0 - 4.2	3.0 - 10.0	5.0 - 12.2	2.2 - 7.1	3.2 - 9.1
var. b	3.0 - 5.0	0.3 - 0.6	0.2 - 0.3			0.6 - 1.2	0.4 - 0.9			0.2 - 0.4	0.5 - 1.3				
x	6.3 3.5	2.1 0.5	4.4 0.2	0.6	7.1	2.8 0.8	1.1 0.7	3.8		3.5 0.25	2.0 0.8	5.7	8.5	4.3	4.6
s	0.6 0.4	0.3 0.07	0.4 0.05	0.09	0.8	0.5 0.7	0.1 0.03	0.2		0.6 0.07	0.6 0.2	1.0	1.3	0.9	0.8
s_x	0.06 0.04	0.03 0.007	0.04 0.005	0.009	0.08	0.05 0.07	0.01 0.003	0.02		0.06 0.007	0.06 0.02	0.1	0.1	0.09	0.08
v %	9.5 11.4	14.3 14.0	9.1 25.0	15.0	11.2	17.9 8.6	9.1 4.3	5.3		17.1 28.0	30.0 25.0	17.5	15.3	20.9	17.4

Table II. Candidula unifasciata (young), Chýnice, Dubecký mlýn, 29. 6. 1968

No.	shell b/h	P	E	F	VD	BT_1	BT_2	BT_{1+2}	GM	TR	RS	TR + RS	SO	GA	DH
26a	5.2 3,3	1.6 0.5	2.5 0.2	0.4	3.0	2.0 0.6	0.9 0.4	2.9		1.7 0.2	1.0 0.3	2.7	3.8	1.3	1.5
26b	4.0 2.4	1.5 0.3	1.7 0.1	0.3	1.5			1.5		1.0 0.1	0.8 0.2	1.8	2.5	0.8	0.8
26c	3.4 1.9							0.7					2.5	0.3	1.0

Anatomical differences in the genital apparatus (HUDEC, 1964)

	Candidula unifasciata	*Candidula soosiana*
A	The finger-shaped flagellum is rather long	The flagellum is very short
B	The free end of the dart sac (**BT**$_2$) accounts for at least 1/4 of the entire **BT** length	The free end accounts for less than 1/5 of the entire **BT** length
C	**TR** is the same width all along its length, the width reaches about 1/3 to 1/2 of **RS** width	**TR** in the lower third is wider than in the upper 2/3 and the width of the upper end reaches only about 1/4 at most 1/3 of the **RS** width
D	**GM** are mostly formed so that each of the two is cleaved lengthways or only in the top part (some of the branches in **TR** may be exceptionally cleaved even further, or, most frequently not cleaved at all, as well as not in **GM** in the free oviduct).	**GM** are mostly formed so that each of the two is longitudinally cleaved to form two branches and very often one of the two **GM** branches is again cleaved near **TR** (excetionally sometimes both GM are cleaved near **TR**).

Ad A. Length of flagellum (F)

The length of F (Table VI) is different in populations from Bohemia and Slovakia. In populations denoted as *C. unifasciata* it fluctuates from 0.5 to 0.7 mm; in populations formerly denoted as *C. soosiana* from 0.45 to 0.54 mm. The length of 0.45 mm is related to the population from Drietoma where the internal rib has only started to form. *C. unifasciata* from Štramberk, 1968, with its F length (0.5 mm) is close to *C. soosiana.* The population denoted as *C. soosiana* from Branná, 1970, with its F legth (0.54 mm) approaches the *C. unifasciata* species, but the material from Branná, 1972, (0.5 mm) is in this feature identical with *C. soosiana.* The facts indicate that in this feature the Moravian populations are on the border line of Bohemian and Slovakian populations and at the same time that this feature slightly changes even within the same locality. The given values are the average of the localities, differences between the different specimens are often much greater.

The flagellum is the smallest section of the genital apparatus and therefore it is not surprising that its variability ranges only in terms of tenths of millimeters.

Ad B. Length of the free end of the dart sac (BT_2)

In populations *C. unifasciata* BT_2 = 1.1—1.3 mm and in populations denoted as *C. soosiana* 0.9—1.2 mm. From this the length of 1.1 and 1.2 mm relates to specimens from Branná which brings them closer to populations *C. unifasciata.* The length of the free end is to a certain extent a distinguishing feature between Bohemian and Slovakian populations (Table VII). However, in this feature populations from Štramberk

and Branná form a gradual transition from western populations of *C. unifasciata* to eastern population denoted as *C. soosiana.* Also in this feature it is possible to observe its variability on the same locality in different years.

The free end of the dart sac is also a small section of the genital apparatus and therefore what has been said about the flagellum applies even here.

Ad C. Ratio of TR to RS

On the basis of measuring RS and TR belong to those parts of the genital apparatus which show the greatest percentage of variability (v), Table I, IX, X, XI.

$$v\ \%\ TR\ \frac{l}{b} = \frac{17.1 - 27.5}{20.0 - 30.0} \qquad v\ \%\ RS\ \frac{l}{b} = \frac{15.0 - 34.6}{11.1 - 20.0}$$

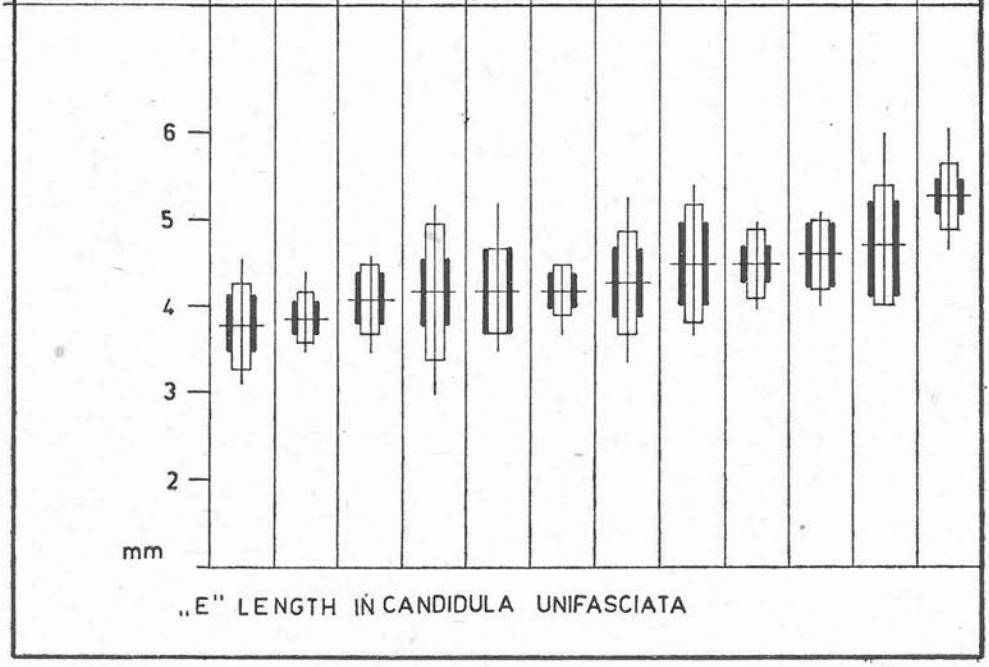
During the preparation of 187 pieces of genitalia I found that the breadth TR = 0.2—0.3 mm and the breadth RS = 0.6—1.1 (measured at the broadest points). The RS is almost in every specimen different, often deformed and so even the breadth ratio TR : RS fluctuates considerably. It is true that the lower part of TR is wider (roughly by 0.05—0.1 mm) in populations denoted as *C. soosiana* but this is not true of the majority. For a descriptive comparison I present a table with the TR : RS ratios in populations from the following localities (+ marked populations formerly presented as *C. soosiana*):

locality	diameter	different specimens
Chýnice, 20. 10. 1968	1/3	1/4, 1/3, 1/2
Čánka, 23. 9. 1972	1/4 — 1/3	
Drahelčice, 16. 6. 1970	1/5 — 1/4	
+Branná, 6. 10. 1970	1/3	
+Branná, 10. 10. 1972	1/3	
Štramberk, 10. 10. 1968	1/2	
Štramberk, 8. 10. 1970	1/4	
+Soběšovice, 8. 10. 1970	1/4	1/8, 1/5, 1/4, 1/3
+Drietoma, 9. 10. 1970	1/4 — 1/3	
+Vreten, 11. 10. 1968	1/3	1/5, 1/4, 1/3, 1/2
+Rájecká Lesná, 11. 10. 1968	1/2	1/5, 1/4, 1/3
+Stankovany, 8. 10. 1970	1/4 — 1/3	1/4, 1/3, 1/2

This feature, like most others, differs in a population from a single locality in different years (Štramberk). If this feature were to be decisive for distinguishing the two species such an absurd situation would arise when the population of 1968 (Štramberk) would represent *C. unifasciata* and the population from 1970 would be *C. soosiana*! Also the population from Rájecká Lesná so far denoted as *Candidula soosiana* is in this feature identical with a typical *C. unifasciata* population. Under such conditions it is impossible to accept this feature as a species distinguishing criterion.

Table III.

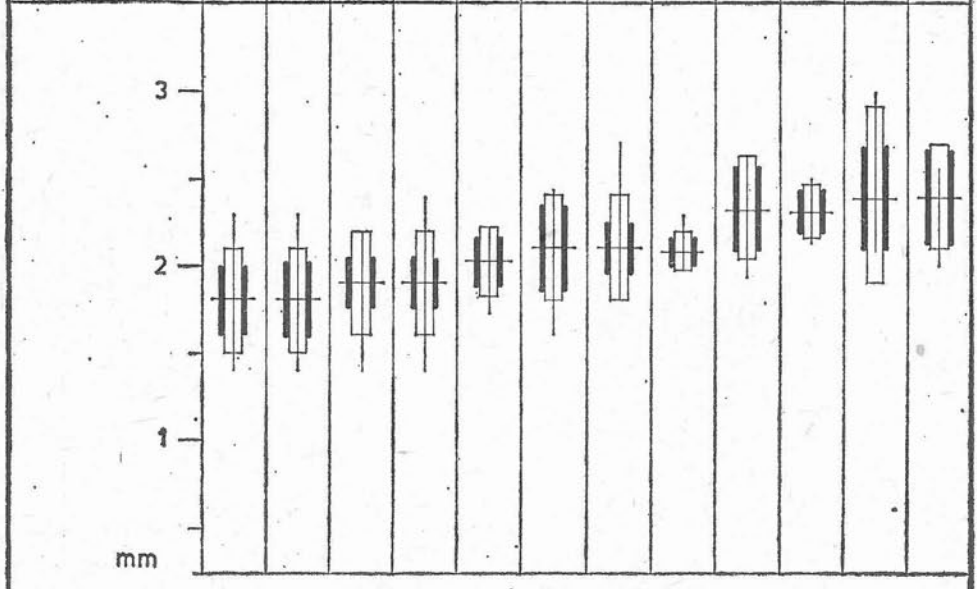
LOCALITY	DRIETOMA	DRAHELČICE	ŠTRAMBERK	STANKOVANY	RÁJECKÁ LESNÁ	VRETEN	ŠTRAMBERK	BRANNÁ	SOBĚŠOVICE	ČÁNKA U OPOČNA (lgt. J. BRABENEC)	CHÝNICE	BRANNÁ
DATE	9.10. 1970	16.6. 1970	10.10. 1968	8.10. 1970	11.10. 1968	11.10. 1968	8.10. 1970	10.10. 1972	8.10. 1970	23.9. 1972	20.10. 1968	6.10. 1970
NO. OF PREPARATION	34	35	17	32	8	9	33	37	31	36	11	30
n	9	7	6	13	4	6	11	8	13	6	7	14
POPULATION	+			+	+	+		+	+			+



„E" LENGTH IN CANDIDULA UNIFASCIATA

Table IV.

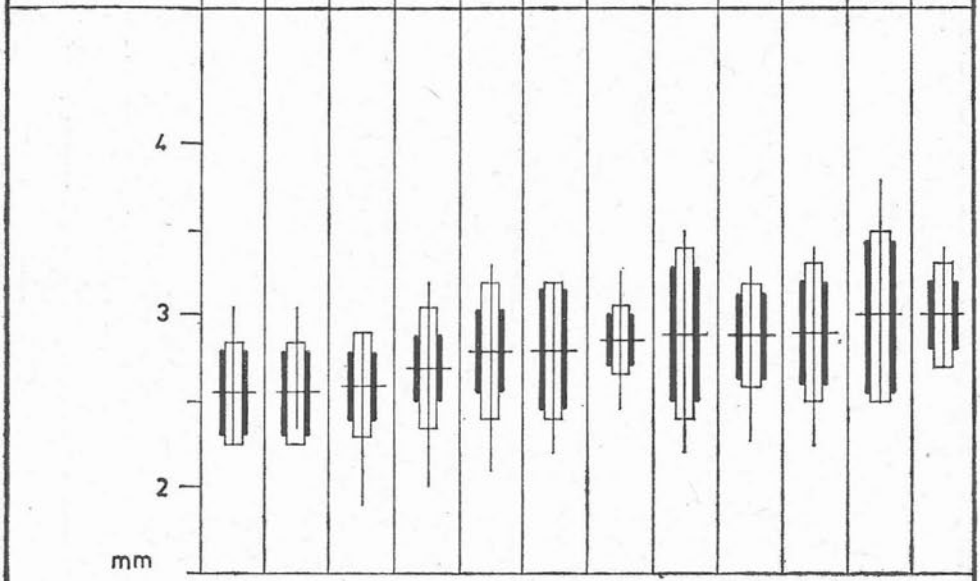
LOCALITY	DRIETOMA	BRANNÁ	SOBĚŠOVICE	STANKOVANY	DRAHELČICE	VRETEN	BRANNÁ	CHÝNICE	ŠTRAMBERK	ČÁNKA U OPOČNA lgt. J. BRABENEC	ŠTRAMBERK	RÁJECKÁ LESNÁ
DATE	9.10. 1970	10.10. 1972	8.10. 1970	8.10. 1970	16.6. 1970	11.10. 1968	6.10. 1970	20.10. 1968	10.10. 1968	23. 9. 1972	8.10. 1972	11.10. 1968
NO.OF PREPARATION	34	37	31	32	35	9	30	11	17	36	33	8
n	9	7	13	13	7	6	15	7	6	6	11	5
POPULATION	+	+	+	+		+	+					+



P." LENGTH IN CANDIDULA UNIFASCIATA

Table V.

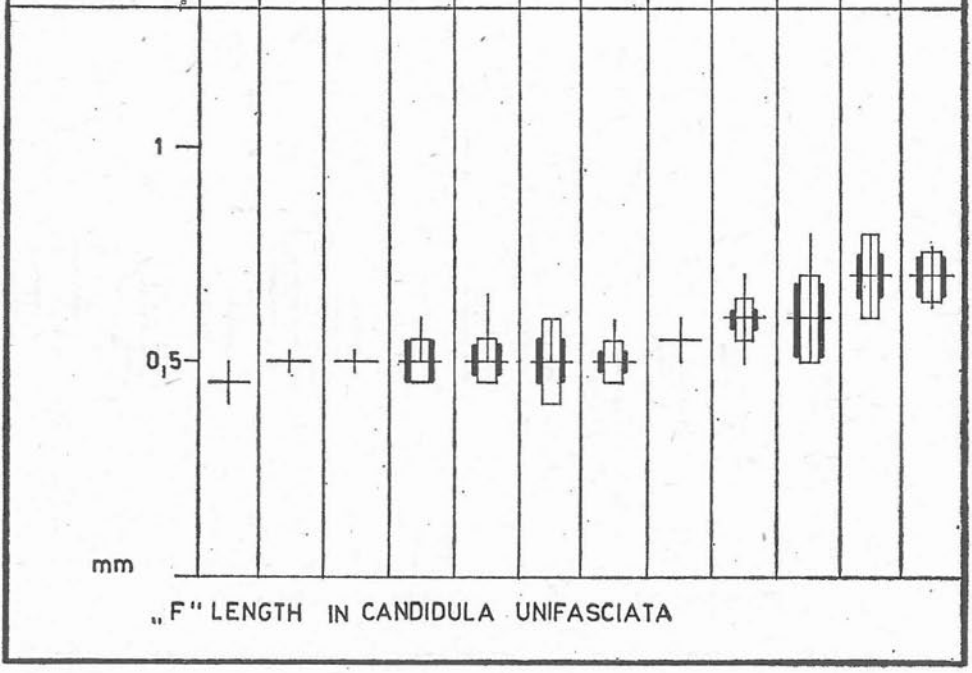
LOCALITY	CHÝNICE	DRAHELČICE	BRANNÁ	SOBĚŠOVICE	DRIETOMA	ČÁNKA U OPOČNA lgt. J. BRABENEC	ŠTRAMBERK	BRANNÁ	VRETEN	ŠTRAMBERK	RÁJECKÁ LESNÁ	STANKOVANY
DATE	20.10. 1968	16.6. 1970	6.10. 1970	8.10. 1970	9.10. 1970	23.9. 1972	8.10. 1970	10.10. 1972	11.10. 1968	10.10. 1968	11.10. 1968	8.10. 1970
NO. OF PREPARATION	11	35	30	31	34	36	33	37	9	17	8	32
n	7	7	9	13	9	6	11	8	6	6	5	9
POPULATION			+	+	+			+	+		+	+



„BT_1" LENGTH IN CANDIDULA UNIFASCIATA

Table VI.

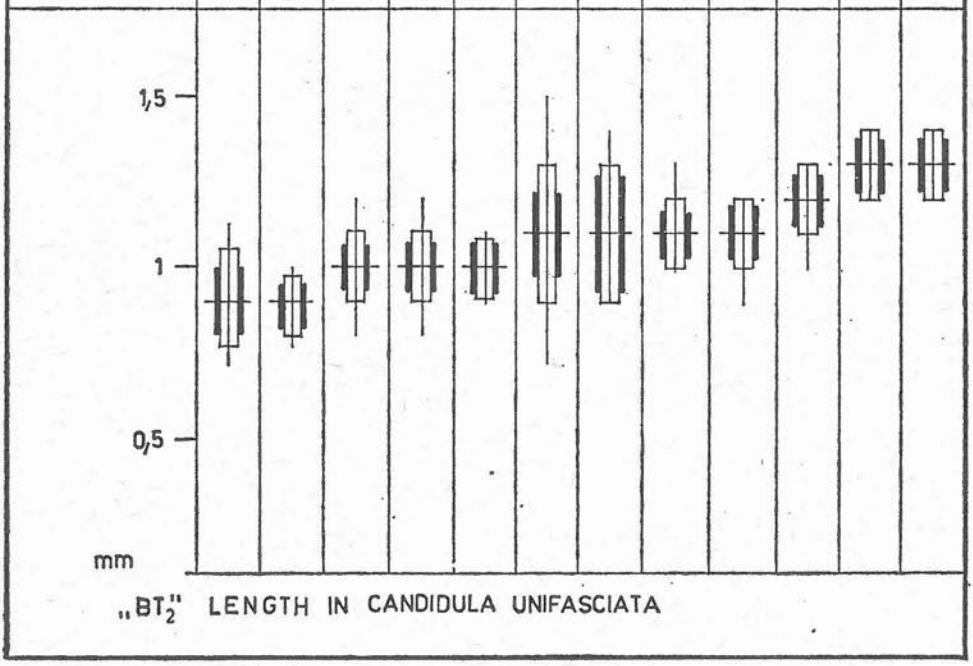
LOCALITY	DRIETOMA	SOBĚŠOVICE	STANKOVANY	VRETEN	RÁJECKÁ LESNÁ	BRANNÁ	ŠTRAMBERK	BRANNÁ	ŠTRAMBERK	DRAHELČICE	CHÝNICE	ČÁNKA U OPOČNA lgt. J. BRABENEC
DATE	9.10. 1970	8.10. 1970	8.10. 1970	11.10. 1968	11.10. 1968	10.10. 1972	10.10. 1968	6.10. 1970	8.10. 1970	16.6. 1970	20.10. 1968	23.9. 1972
NO.OF PREPARATION	34	31	32	9	8	37	17	30	33	35	11	36
n	9	13	13	5	6	8	6	15	11	7	7	6
POPULATION	+	+	+	+	+	+		+				



„F" LENGTH IN CANDIDULA UNIFASCIATA

Table VII.

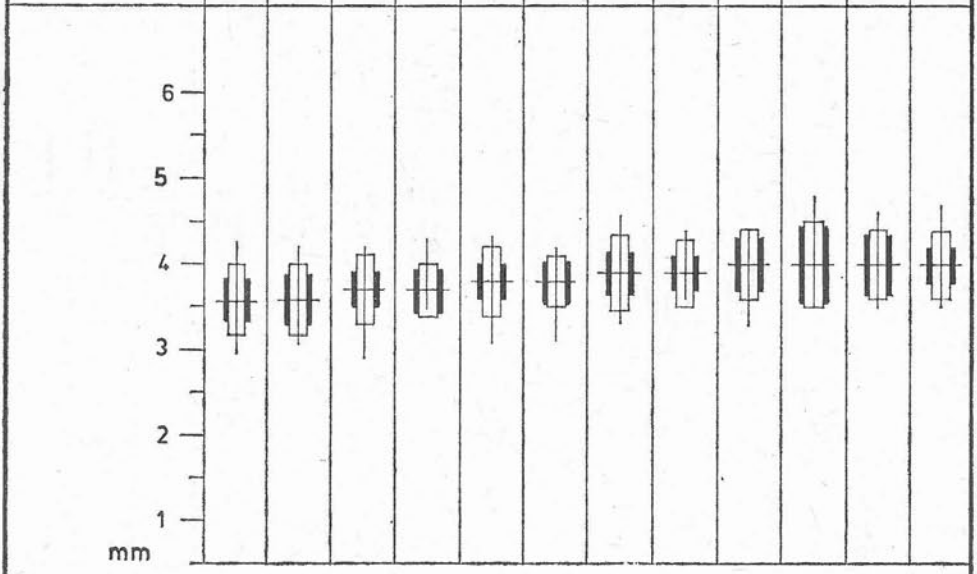
LOCALITY	DRIETOMA	VREŤEN	SOBĚŠOVICE	STANKOVANY	RÁJECKÁ LESNÁ	ŠTRAMBERK	ŠTRAMBERK	BRANNÁ	CHÝNICE	BRANNÁ	DRÁHELČICE	ČÁNKA U OPOČNA lgt. J.BRABENEC
DATE	9.10. 1970	11.10. 1968	8.10. 1970	8.10. 1970	11.10. 1968	8.10. 1970	10.10. 1968	6.10. 1970	20.10. 1968	10.10. 1972	16.6. 1970	23.9. 1972
NO. OF PREPARATION	34	9	31	32	8	33	17	30	11	37	35	36
n	9	6	13	9	5	11	6	12	7	8	7	6
POPULATION	+	+	+	+	+			+		+		



„BT_2" LENGTH IN CANDIDULA UNIFASCIATA

Table VIII.

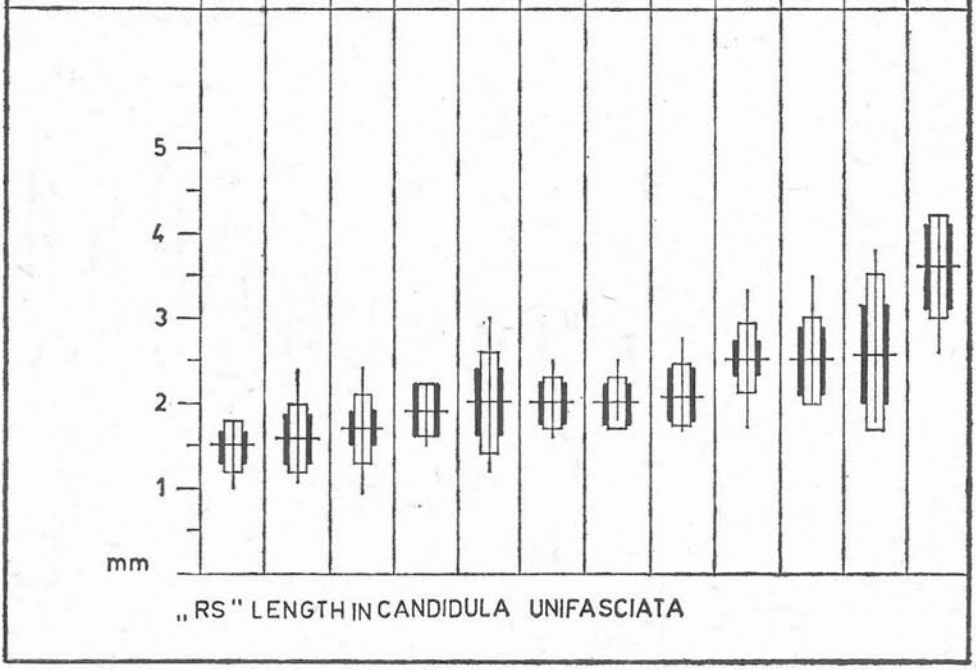
LOCALITY	DRIETOMA	CHÝNICE	BRANNÁ	DRAHELČICE	SOBĚŠOVICE	VRETEN	ŠTRAMBERK	STANKOVANY	ŠTRAMBERK	RÁJECKÁ LESNÁ	ČÁNKA U OPOČNA lgt. J. BRABENEC	BRANNÁ
DATE	9.10. 1970	20.10. 1968	6.10. 1970	16. 6. 1970	8.10. 1970	11.10. 1968	8.10. 1970	8.10. 1970	10.10. 1968	11.10. 1968	23. 9. 1972	10.10. 1972
NO. OF PREPARATION	34	11	30	35	31	9	33	32	17	8	36	37
n	9	7	12	7	13	6	12	13	6	5	6	8
POPULATION	+		+		+	+		+		+		+



„BT(1+2)" LENGTH IN CANDIDULA UNIFASCIATA

Table IX.

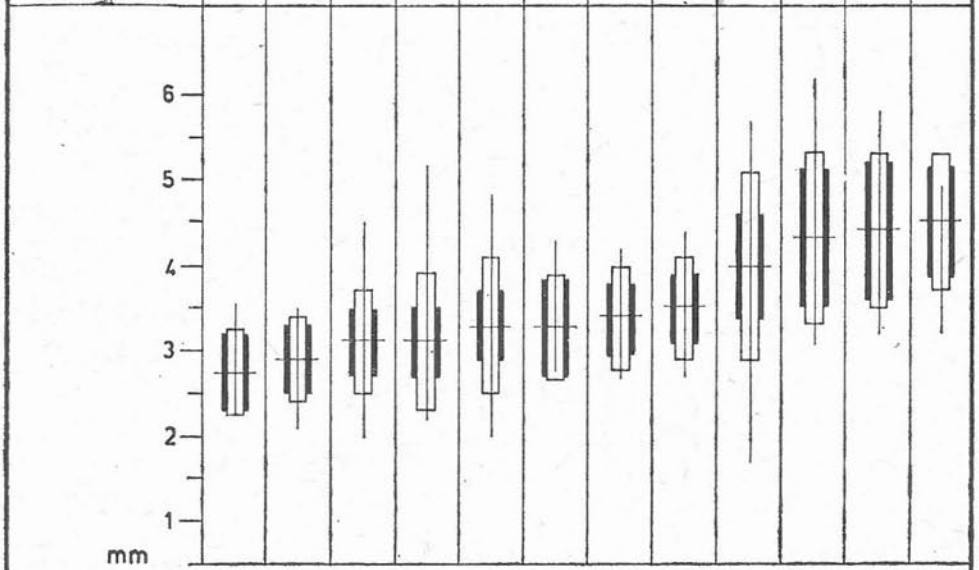
LOCALITY	ŠTANKOVANY	DRIETOMA	BRANNÁ	ŠTRAMBERK	SOBĚŠOVICE	DRAHELČICE	VRETEN	RÁJECKÁ LESNÁ	ŠTRAMBERK	CHÝNICE	BRANNÁ	ČÁNKA U OPOČNÁ lgt. J. BRABENEC
DATE	8.10. 1970	9.10. 1970	6.10. 1970	10.10. 1968	8.10. 1970	16.6. 1970	11.10. 1968	11.10. 1968	8.10. 1970	20.10. 1968	10.10. 1972	23.9. 1972
NO. OF PREPARATION	32	34	30	17	31	35	9	8	33	11	37	36
n	12	7	13	4	11	7	6	5	12	7	8	6
POPULATION	+	+	+		+		+	+			+	



„RS" LENGTH IN CANDIDULA UNIFASCIATA

Table X.

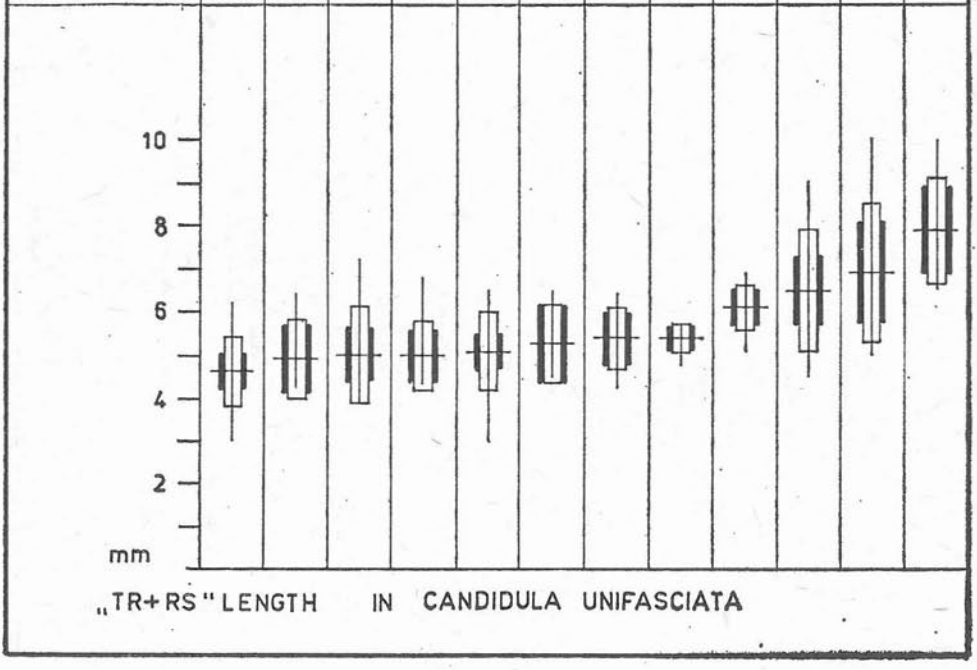
LOCALITY	RÁJECKÁ LESNÁ	CHÝNICE	STANKOVANY	SOBĚŠOVICE	BRANNÁ	ŠTRAMBERK	DRAHELČICE	DRIETOMA	ŠTRAMBERK	BRANNÁ	ČÁNKA U OPOČNA lgt. J. BRABENEC	VRETEN
NO. OF PREPARATION	8	11	32	31	30	17	35	34	33	37	36	9
n	5	7	13	13	13	5	7	7	11	8	6	5
DATE	11.10. 1968	20.10. 1968	8.10. 1970	8.10. 1970	6.10. 1970	10.10. 1968	16.6. 1970	9.10. 1970	8.10. 1970	10.10. 1972	23.9. 1972	11.10. 1968
POPULATION	+		+	+	+			+		+		+



„TR" LENGTH IN CANDIDULA UNIFASCIATA

Table XI.

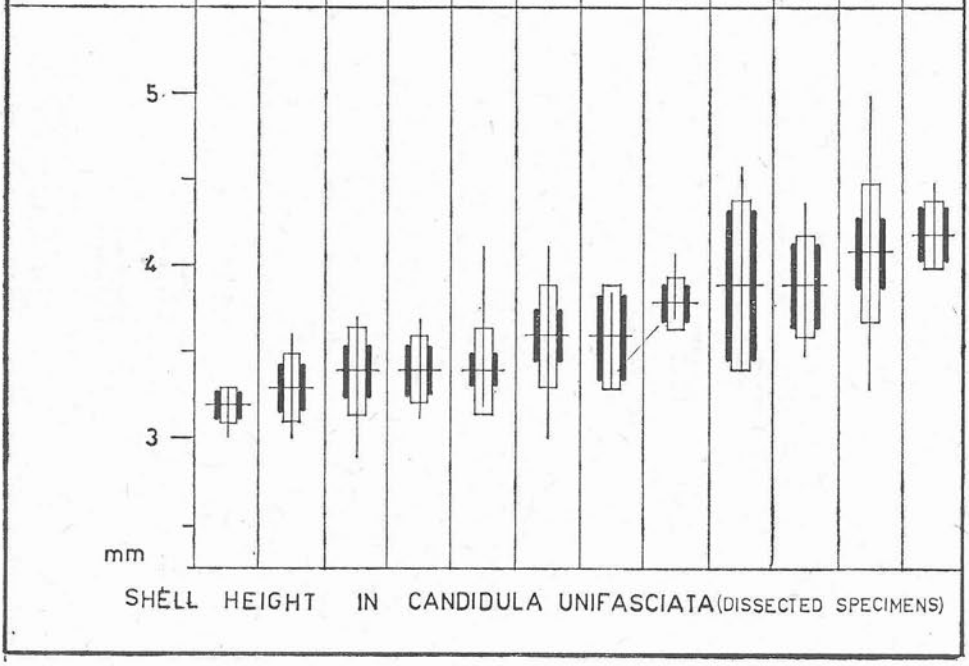
LOCALITY	STANKOVANY	RÁJECKÁ LESNÁ	SOBEŠOVICE	DRIETOMA	BRANNÁ	ŠTRAMBERK	DRAHELČICE	CHÝNICE	VRETEN	ŠTRAMBERK	BRANNÁ	ČÁNKA U OPOČNA Lgt. J.BRABENEC
DATE	8.10. 1970	11.10. 1968	8.10. 1970	9.10. 1970	6.10. 1970	10.10. 1968	16.6. 1970	20.10. 1968	11.10. 1968	8.10. 1970	10.10. 1972	23.9. 1972
NO.OF PREPARATION	32	8	31	34	30	17	35	11	9	33	37	36
n	12	5	11	9	15	4	7	7	5	11	8	6
POPULATION	+	+	+	+	+				+		+	



„TR+RS" LENGTH IN CANDIDULA UNIFASCIATA

Table XII.

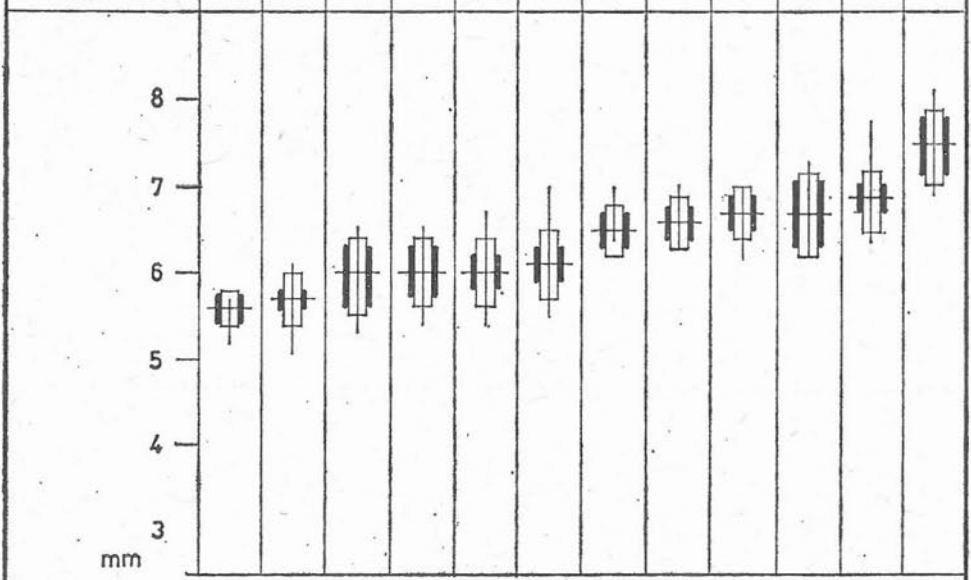
LOCALITY	CHÝNICE	DRIETOMA	ŠTRAMBERK	ŠTRAMBERK	SOBĚŠOVICE	STANKOVANY	DRAHELČICE	BRANNÁ	RÁJECKÁ LESNÁ	VRETEŇ	BRANNÁ	ČÁNKA U OPOČNA lgt. J. BRABENEC
DATE	20.10. 1968	9.10. 1970	8.10. 1970	10.10. 1968	8.10. 1970	8.10. 1970	16.6. 1970	10.10. 1972	11.10. 1968	11.10. 1968	6.10. 1970	23.9. 1972
NO. OF PREPARATION	11	34	33	17	31	32	35	37	8	9	30	36
n	6	9	11	6	13	12	7	8	5	6	15	6
POPULATION		+		+	+	+		+	+	+	+	



SHELL HEIGHT IN CANDIDULA UNIFASCIATA (DISSECTED SPECIMENS)

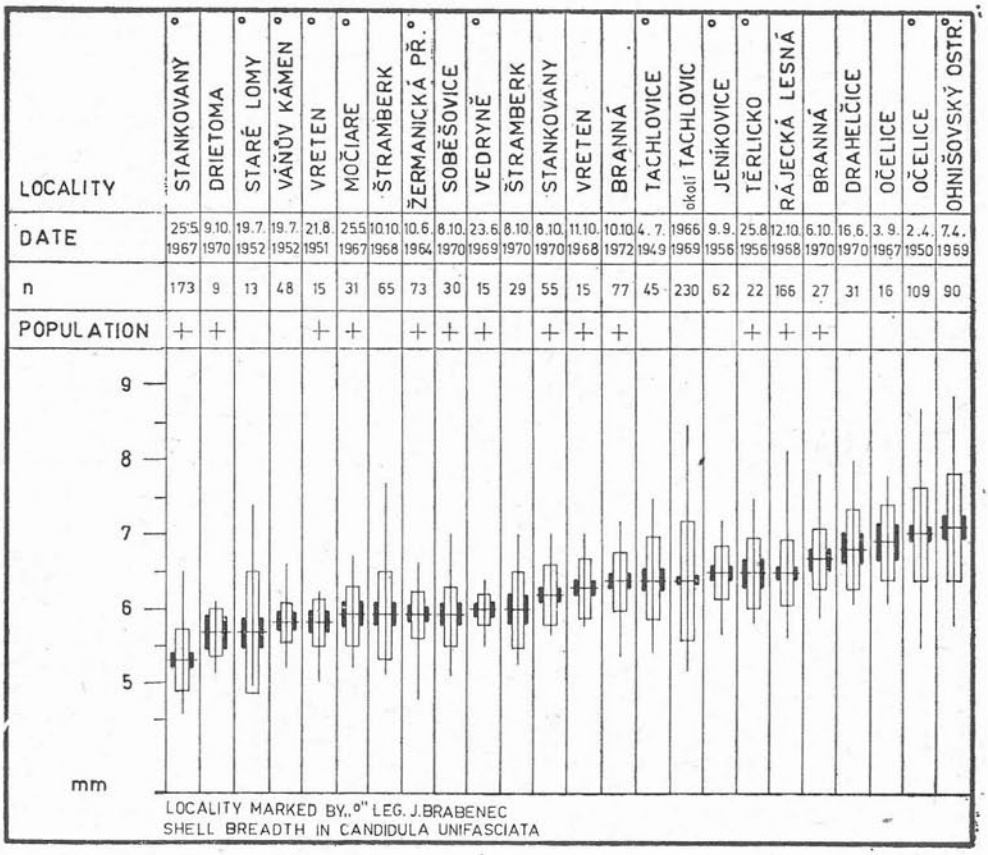
Table XIII.

LOCALITY	CHÝNICE	DRIETOMA	ŠTRAMBERK	ŠTRAMBERK	STANKOVANY	SOBĚŠOVICE	VRETEN	DRAHELČICE	BRANNÁ	RÁJECKÁ LESNÁ	BRANNÁ	ČÁNKA U OPOČNA lgt. J. BRABENEC
DATE	20.10. 1968	9.10. 1970	8.10. 1970	10.10. 1968	8.10. 1970	8.10. 1970	11.10. 1968	16.6. 1970	10.10. 1972	11.10. 1968	6.10. 1970	23.9. 1972
NO. OF PREPARATION	11	34	33	17	32	31	9	35	37	8	30	36
n	6	9	11	6	12	13	6	7	8	5	15	6
POPULATION		+			+	+	+		+	+	+	



SHELL BREADTH IN CANDIDULA UNIFASCIATA (DISSECTED SPECIMENS)

Table XIV.

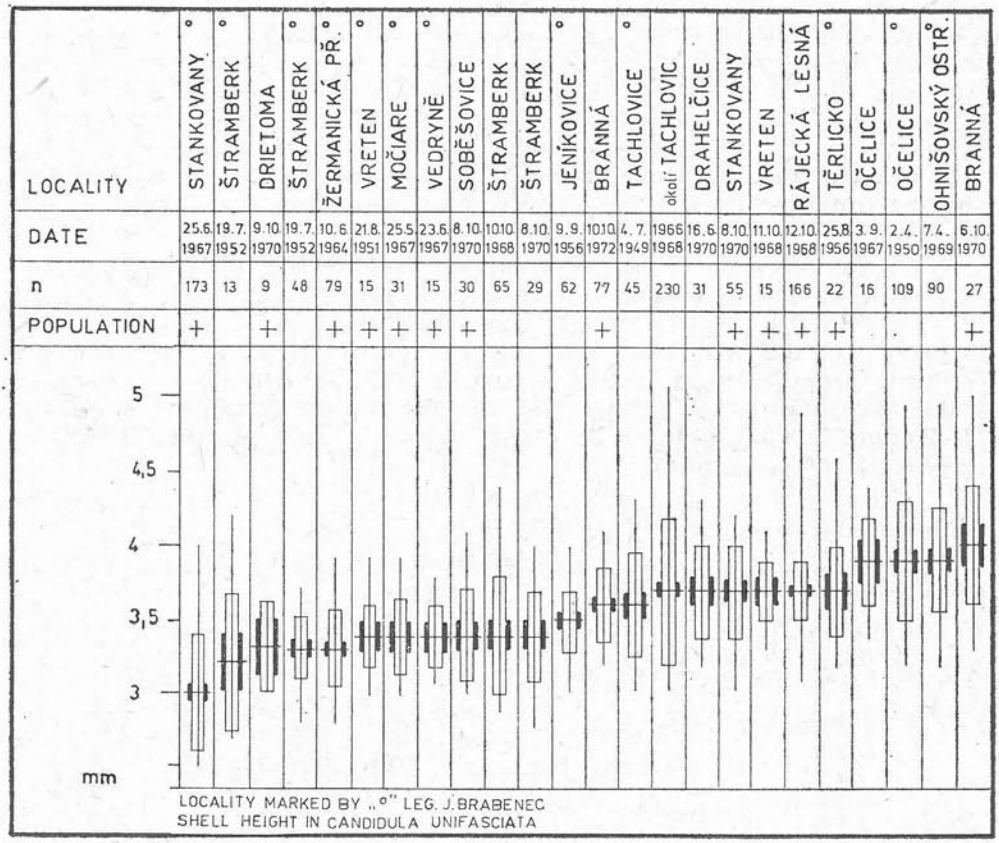


Ad D. Branching of gladulae mucosae (GM)

During the study of material from different localities I determined the following patterns of branching:

+ Branná, calc. quarry, 10. 10. 1972: 2 bads, 3—7 branches (2+1, 3+3, 2+1, 4+3, 2+3, 4+3, 3+2, 3+3).
+ Branná, overgrown slope near quarry, 6. 10. 1970: 2 bands, 5—9 banches (4+3, 4+2, 4+2, 3+2, 4+2, 3+2, 5+4, 3+2, 4+2, 3+3, 3+3, 4+3, 3+3 4+2 3+2).
Čánka, 23. 9. 1972: 2 bands, 3—6 branches (2+2, 3+3, 2+2, 3+2, 2+2, 2+1).
+ Soběšovice, 8. 10. 1970: 2 bands, 4—7 branches (3+2, 3+2, 3+2, 3+2, 3+1, 3+4, 2+3, 4+3, 3+3, 3+2, 3+1, 1+3, 2+2).
+ Stankovany, 8. 10. 1970: 2 bands, 5—8 branches (4+4, 3+2, 2+3, 4+2, 3+4, 3+3, 3+3, 3+3, 4+2, 4+3, 4+2, 4+2, 3+2, 3+2).
Štramberk, Staré lomy, 8. 10. 1970: 2 bands, 3—6 branches (3+3, 3+2, 2+1, 3+2, 3+2, 3+2, 2+1, 3+2, 3+2).
Štramberk, Staré lomy, 10. 10. 1968: 2 bands, 3—5 branches (1+2, 1+2, 4, 2+3, 1+3, 1+3).
+ Drietoma, 9. 10. 1970: 2 bands, 3—8 branches (2+3, 2+2, 2+2, 3+4, 2+2, 2+1, 3+2, 5+3, 3+2, 4+3, 4+3, 4+3, 3+3).

Table XV.



Drahelčice, 16. 6. 1970: 2 bands, 5—9 branches (4+3, 5+4, 4+3, 4+3, 4+2, 3+2, 4+2).
+ Rájecká Lesná, 11. 10. 1968: 2 bands, 4—8 branches (2+3, 3+5, 2+4, 2+2).
+ Vreten, 11. 10. 1968: 2 bands, 6—7 branches (3+4, 3+4, 2+4, 2+4, 3+4, 2+4, 3+4).
Chýnice, 20. 10. 1968: 2 bands, 3—6 branches (1+2, 2+3, 1+2, 2+3, 1+2, 2+3, 1+2, 2+4, 2+2).

The number of GM branches is so variable, not only among specimens from different localities but also in specimens from one locality, that the two species cannot be distinguished according to this feature.

The other parts of the genital apparatus

All the other measured parts of the genital apparatus (penis, epiphallum, vas deferens, truncus receptaculum, receptaculum seminis, spermoviductus, glandula albuminalis, ductus hermaphrodicus) are so variable, not only on different localities but also within one locality, that they could not be even considered as diagnostical features (Table I, III, IV, IX, X, XI).

CONCLUSION

On the basis of currently available data I find that features of the genital apparatus regarded as reliable for distinguishing *Candidula unifasciata* from *Candidula soosiana* (length of the flagellum and of the free end of the dart sac) are not quite constant. They are subject to changes not only on different localities but even within one site in different years though, understandably, not too much. **In populations towards the east both the flagellum and the free end of the dart sac become shorter** (on average F by as much as up to 0.2 mm and BT_2 by up to 0.4 mm).

From the presented findings it ensues that not even the genital apparatus is always a reliable lead in determining closely related taxones. In many cases there is a greater variability than in the shell which is in direct contact with the environment. Results of the investigation of the genital apparatus in species of the *Candidula* genus on our territory make me inclined to believe that the denotation **Candidula soosiana (J. Wagner, 1933) ought to be considered as a synonym for Candidula unifasciata (Poiret, 1801).**

Helicopsis striata (O. F. MÜLLER) (Fig. 11)

For determining variability 15 specimens from the following localities were measured:

No. 3. Chlumín u Neratovic, 22. 6. 1968
No. 6. Mužla u Štúrova, 13. 10. 1968
No. 21. Kopeč u Neratovic, 24. 9. 1967

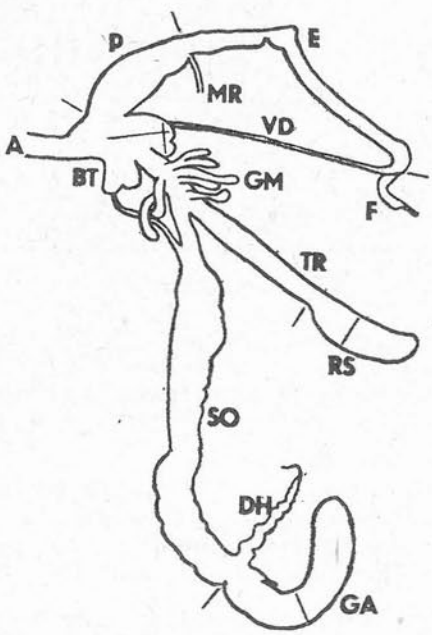


Fig. 11.
Genital apparatus of *Helicopsis striata* (No. preparation 3c), Chlumín u Neratovic, 22. 6. 1968, enlarged 3times
Shelle size: breadth = 9.4 mm, height = 5.1 mm

Averages of the measuring from all localities are presented in table XVI.

The variability coefficient of the different sections range from 7.7 to 26.6 %.

Table XVI. Helicopsis striata, mean value shells and genital apparatus from 3 localities

	shell b/h	P	E	F	VD	BT	GM	TR	RS	TR + RS	SO	GA	DH
n	15	16	16 15	9	14	16	16	12 14	12 14	16	16	12	6
x	8.3 4.8	2.7 1.1	7.7 0.4	2.6	9.6	1.9		4.9 0.5	3.5 1.2	8.6	11.6	5.7	4.7
var. 1	7.0 - 9.5	2.1 - 3.2	5.0 - 9.7	2.3 - 3.0	6.1 - 12.5	1.3 - 2.4	1.5 - 2.5	3.2 - 8.0	1.9 - 4.7	5.1 - 11.7	7.5 - 14.1	4.0 - 8.0	3.5 - 5.8
var. b	4.0 - 5.9	0.8 - 1.5	0.2 - 0.5			0.5 - 1.1		0.4 - 0.8	0.8 - 1.7				
s	0.8 0.6	0.3 0.2	1.3	0.2	1.5	0.3		1.3 0.1	0.7 0.3	1.6	2.1	1.3	0.8
s_x	0.2 0.15	0.07 0.05	0.3	0.07	0.4	0.07		0.4 0.03	0.2 0.08	0.4	0.5	0.4	0.3
v %	9.6	11.1	16.9	7.7	15.6	15.8		26.5	20.0	18.6	18.1	22.8	17.0

Helicella itala (L.) (Fig. 12)

For the statistical assessment I used 16 specimens from the folowing localities:

No. 22. Čížkovice u Lovosic, 28. 4. 1968
No. 38. Lovoš u Lovosic, 11. 8. 1971 (lgt. Zvarič)

Averages of measurings from these localities are presented in table XVII.

The coefficient of variation of the different sections of the genital apparatus range from 4.0 to 22.2 %.

The growth of the genital apparatus in juvenile specimens is described in table XVIII and fig. 13.

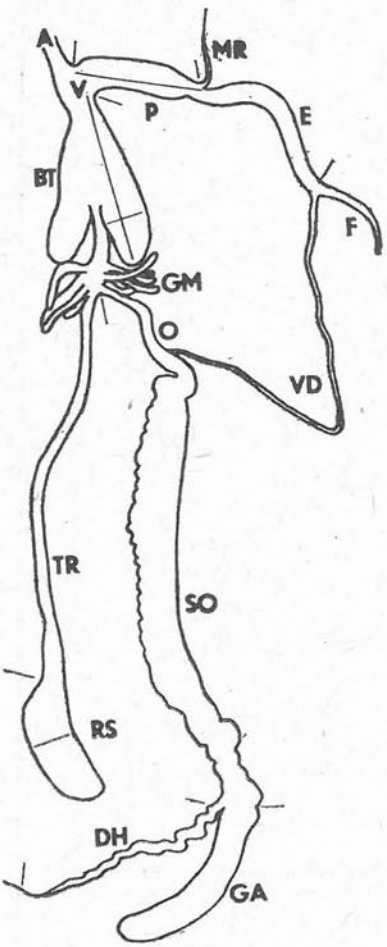


Fig. 12.
Genital apparatus of *Helicella itala* (No. preparation 22b)
Čížkovice u Lovosic, 28. 4. 1968
Enlarged 6times
Shell size: breadth = 16.4 mm,
height = 6.9 mm

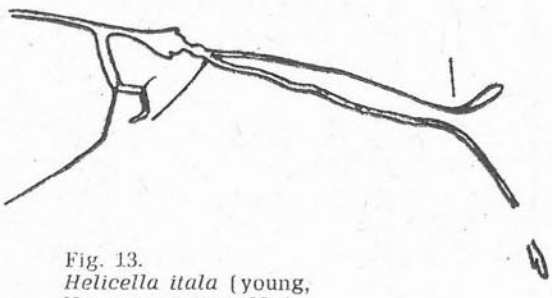


Fig. 13.
Helicella itala (young,
No. preparation 22g)
Čížkovice u Lovosic,
28. 4. 1968, enlarged 6times
Shell size: breadth = 8.0 mm,
height = 3.9 mm

Table XVII. Helicella itala, mean value shells and genital apparatus from 2 localities

	shell b/h	P	E	F	VD	BT	GM	TR	RS	TR + RS	SO	GA	DH
n	16	16	16	16	16	16	16	10 16	10 16	16	14		9
x	14.7 6.5	4.6 0.9	8.9 0.5	3.2	16.4	6.1 1.2		9.3 0.5	4.1 1.6	12.5	19.9		10.6
var. 1	13.7 - 16.7	3.6 - 5.6	6.0 - 11.2	2.8 - 3.7	11.4 - 19.5	4.5 - 7.0	2.5 - 4.5	6.5 - 12.4	3.2 - 5.8	8.3 - 16.6	13.7 - 27.0		8.8 - 13.0
var. b	5.8 - 7.3	0.5 - 1.1	0.5			1.0 1.5		0.4 - 0.6	1.0 - 2.3				
s	0.9 0.45	0.5 0.2	1.5 0	0.3	2.3	0.8 0.1		1.7 0.02	0.7 0.35	2.3	3.6		1.2
s_x	0.2 0.1	0.1 0.05	0.4 0	0.08	0.6	0.2 0.03		0.5 0.005	0.2 0.09	0.6	0.9		0.4
v %	6.1 6.9	10.9 22.2	16.9	9.4	14.0	13.1 8.3		18.3 4.0	17.1 21,9	18.4	18.1		11.3

Table XVIII. Helicella itala (young), Čížkovice u Lovosic, 28. 4. 1968

No.	shell b/h	P	E	F	VD	BT	GM	TR	RS	TR + RS	SO	GA	DH
22g	8.0 3.9	1.2 0.2	1.1 0.1	0.5	2.7	1.5 0.3		5.8	1.3 0.2	7.1	8.2	0.8	1.2
22h	8.9 4.5	1.0 0.2				1.6 0.3		4.8	1.3 0.2	6.1	9.6	0.2	2.3

Helicella obvia (MENKE) (Fig. 14)

I measured 38 specimens from the following localities:

No. 5. Tobolka u Berouna, 7. 9. 1968
No. 7. Mužla u Štúrova, 13. 10. 1968
No. 13. Býchory u Kolína, 30. 10. 1968
No. 14. Znojmo - Pohořelice, 16. 10. 1968
No. 18. Perná, Pavlovské kopce, 15. 10. 1968
No. 19. Kamenice u Štúrova, 13. 10. 1968
No. 20. Očelice u Opočna, 5. 11. 1968

Averages of the measurings from all the localities are presented in table XIX and graphically expressed in tables XXI—XXVI.

The results indicate that the size of the genital apparatus and the size of the shell are positively corelated.

The coefficient of variation ranges in the different sections of the genital apparatus from 8.2 to 24.7 %.

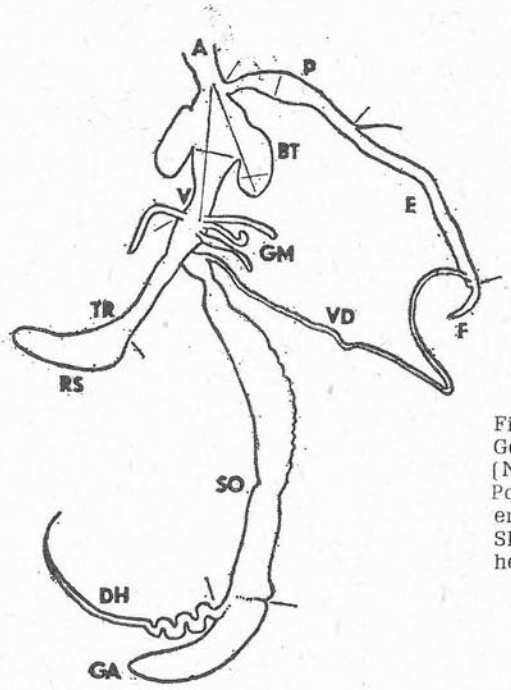


Fig. 14.
Genital apparatus of *Helicella obvia*
(No. preparation 25a)
Popluží u Jiz. Vtelna, 14. 7. 1968,
enlarged 2times
Shell size: breadth = 14.1 mm,
height = 6.7 mm

The size of the genital apparatus in juvenile specimens is shown in table XX and fig. 15, 16. In specimens from Popluží u Mladé Boleslavi the genital apparatus is almost developed in shells which are about 14.0 to 15.0 mm broad.

Table XIX. Helicella obvia — mean value shells and genital apparatus from 7 localities

	shell b/h	P	E	F	VD	BT	GM	TR	RS	TR + RS	SO	GA	DH
n	38	37	38	36	34	38	38	38	37	37	36	38	19
x	14.6 6.9	3.9 1.1	8.5 0.6	2.6	16.8	4.5 1.5		6.7 0.8	4.4 2.1	11.4	24.8	8.9	9.8
var. 1	10.6 - 18.3	2.8 - 5.0	4.5 - 12.3	1.7 - 3.6	10.5 - 24.0	3.2 - 5.8	2.5 - 5.5	4.5 - 11.0	3.5 - 6.0	8.0 - 16.8	16.9 - 33.0	5.4 - 14.0	7.7 - 13.0
var. b	5.0 - 8.5	0.8 - 1.7	0.5 - 0.8			1.2 - 2.0		0.5 - 1.1	1.4 - 3.0				
s	1.9 0.9	0.5 0.2	1.7 0.1	0.5	2.8	0.7 0.2		1.4 0.1	0.6 0.3	1.8	4.5	2.2	0.8
s_x	0.3 0.14	0.08 0.03	0.3 0.02	0.08	0.5	0.1 0.03		0.25 0.02	0.1 0.05	0.3	0.75	0.35	0.2
v %	13.0 13.0	12.8 18.2	20.0 16.7	19.2	16.7	15.5 13.3		20.9 12.5	13.6 14.3	15.8	18.1	24.7	8.2

Table XX. Helicella obvia (young), Jiz. Vtelno u Ml. Boleslavi, 14. 7. 1968

No.	shell b/h	P	E	F	VD	BT	GM	TR	RS	TR + RS	SO	GA	DH
25a	14.1 6.7	4.8 1.0	7.0 0.5	1.5	16.5	3.6 1.0	3.0	4.2 0.7	4.0 1.5	8.2	14.0	5.2	11.0
25b	15.4 7.0	3.2 1.0	10.4 0.5	2.5	17.5	5.0 1.3	2.5	5.5 0.5	5.0 1.0	10.5	14.8	4.7	16.0
25c	11.7 5.3	2.4 0.3			6.7	2.2 0.5	0.5	6.6 0.1	1.7 0.4	8.3	10.6	1.5	6.0
25d	8.0 4.0	1.4 0.2	0.8 0.1	0.3	1.5			4.9 0.05	0.9 0.2	5.8	7.9	0.8	2.5

Table XXI.

LOCALITY	TOBOLKA u BEROUNA	MUŽLA u ŠTÚROVA	BÝCHORY u KOLÍNA	ZNOJMO-POHOŘELICE	PERNÁ, PAVL. KOPCE	KAMENICE u ŠTÚROVA	OČELICE u OPOČNA
DATE	7. 9. 1968	13.10. 1968	30.10. 1968	16.10. 1968	15.10. 1968	13.10. 1968	5.11. 1968
NO. OF PREPARATION	5	7	13	14	18	19	20
n	5	5	5	5	6	6	6

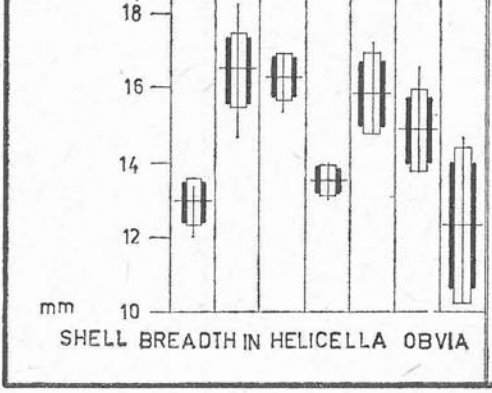
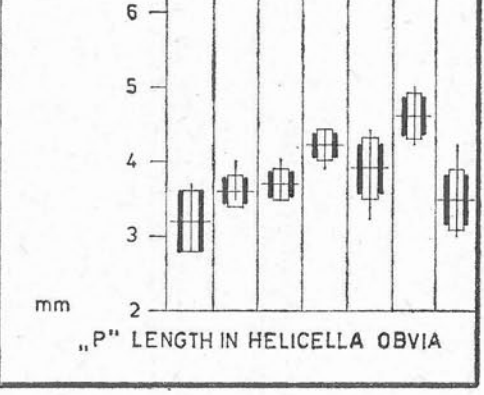


Table XXII.

LOCALITY	TOBOLKA u BEROUNA	MUŽLA u ŠTÚROVA	BÝCHORY u KOLÍNA	ZNOJMO-POHOŘELICE	PERNÁ, PAVL. KOPCE	KAMENICE u ŠTÚROVA	OČELICE u OPOČNA
DATE	7. 9. 1968	13.10. 1968	30.10. 1968	16.10. 1968	15.10. 1968	13.10. 1968	5.11. 1968
NO. OF PREPARATION	5	7	13	14	18	19	20
n	4	5	5	5	6	6	6



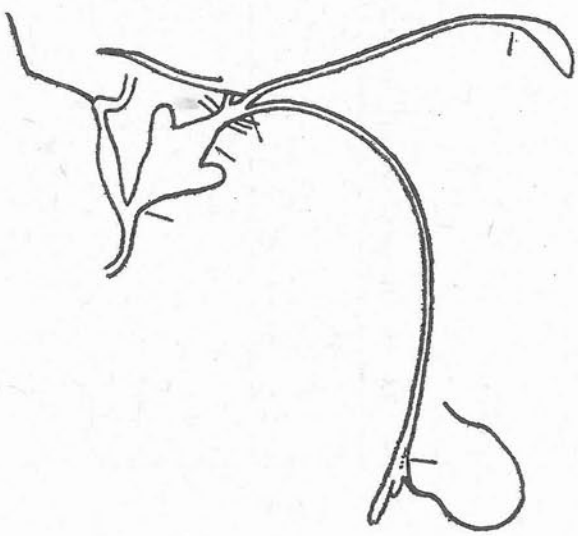
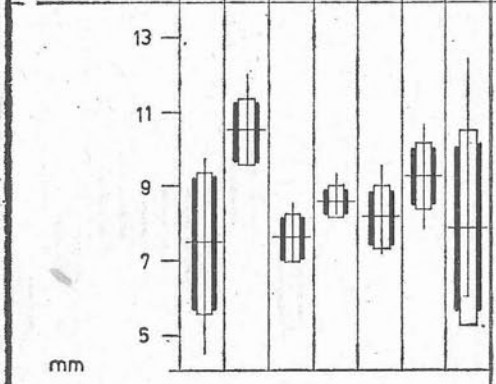


Fig. 15.
Helicella obvia (young, No. preparation 25c) Popluží u Jiz. Vtelna, 14. 7. 1968, enlarged 6 times
Shel size: breadth = 11.7 mm, height = 5.3 mm

Table XXIII.

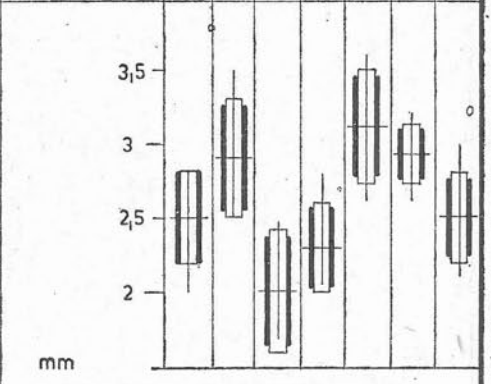
LOCALITY	TOBOLKA u BEROUNA	MUŽLA u ŠTÚROVA	BÝCHORY u KOLÍNA	ZNOJMO-POHOŘELICE	PERNÁ, PAVL. KOPCE	KAMENICE u ŠTÚROVA	OČELICE u OPOČNA
DATE	7. 9. 1968	13.10. 1968	30.10. 1968	16.10. 1968	15.10. 1968	13.10. 1968	5.11. 1968
NO. OF PREPARATION	5	7	13	14	18	19	20
n	5	5	5	5	6	6	6



„E" LENGTH IN HELICELLA OBVIA

Table XXIV.

LOCALITY	TOBOLKA u BEROUNA	MUŽLA u ŠTÚROVA	BÝCHORY u KOLÍNA	ZNOJMO-POHOŘELICE	PERNÁ, PAVL. KOPCE	KAMENICE u ŠTÚROVA	OČELICE u OPOČNA
DATE	7. 9. 1968	13.10. 1968	30.10. 1968	16.10. 1968	15.10. 1968	13.10. 1968	5.11. 1968
NO. OF PREPARATION	5	7	13	14	18	19	20
n	4	5	5	5	5	6	6



„F" LENGTH IN HELICELLA OBVIA

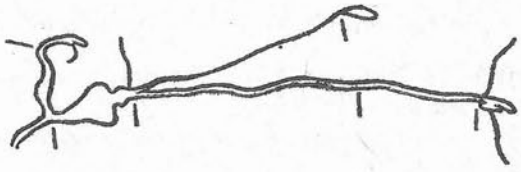
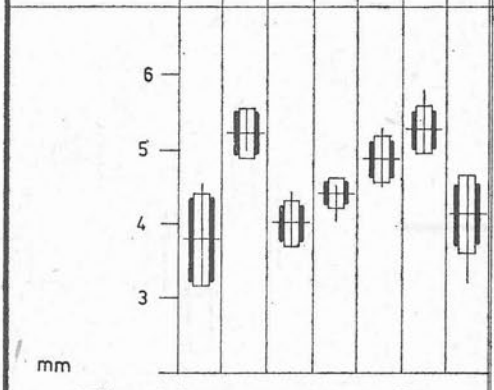


Fig. 16.
Helicella obvia (young,
No. preparation 25d)
Poplužĺ u Jiz. Vtelna, 14. 7. 1968,
enlarged 6 times
Shell size: breadth = 8.0 mm,
height = 4.0 mm

Table XXV.

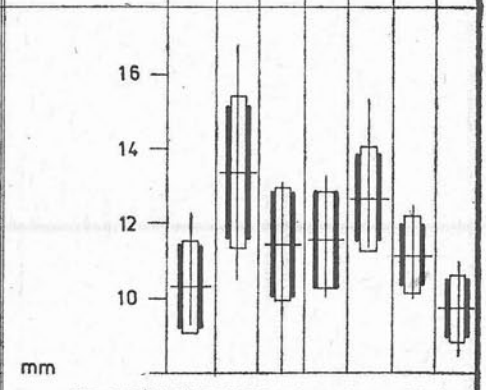
LOCALITY	TOBOLKA u BEROUNA	MUŽLA u ŠTÚROVA	BÝCHORY u KOLÍNA	ZNOJMO-POHOŘELICE	PERNÁ, PAVL. KOPCE	KAMENICE u ŠTÚROVA	OČELICE u OPOČNA
DATE	7. 9. 1968	13.10. 1968	30.10. 1968	16.10. 1968	15.10. 1968	13.10. 1968	5.11. 1968
NO. OF PREPARATION	5	7	13	14	18	19	20
n	5	5	5	5	6	6	6



„BT" LENGTH IN HELICELLA OBVIA

Table XXVI.

LOCALITY	TOBOLKA u BEROUNA	MUŽLA u ŠTÚROVA	BÝCHORY u KOLÍNA	ZNOJMO-POHOŘELICE	PERNÁ, PAVL. KOPCE	KAMENICE u ŠTÚROVA	OČELICE u OPOČNA
DATE	7. 9. 1968	13.10. 1968	30.10. 1968	16.10. 1968	15.10. 1968	13.10. 1968	5.11. 1968
NO. OF PREPARATION	5	7	13	14	18	19	20
n	5	5	5	4	6	6	6



„TR+RS" LENGTH IN HELICELLA OBVIA

Cernuella (Xerocincta) neglecta (DRAPARNAUD) (Fig. 17)

11 specimens from the following localities were measured:

No. 12., 13d Býchory u Kolína, 30. 10. 1968
No. 15. Kochánky u Benátek n. J., 20. 10. 1968

The averages of measurings from both localities are presented in table XXVII.

The coefficient of variation of the different sections of the genital apparatus ranges from 9.3 to 26.6 %.

The size of the genital apparatus in juvenile specimens is depicted in table XXVIII and fig. 18, 19.

In some specimens with a shell of 11.3 mm broad (preparate No. 24a) the genital apparatus is completely undeveloped, while in others — specimens with a small shell but with a developed internal rib (b = 8.7 mm, preparate 12 b) it is completely developed, however, the proportions are smaller, relative to the size of the shell.

The dart sac with dart 2.5—3.5 mm long can be seen in Plate V/4.

Fig. 17.
Genital apparatus of *Cernuella neglecta* (No. preparation 16c), Třebenice - Košťál, 23. 10. 1968, enlarged 2times
Shell size: breadth = 14.8 mm, height = 7.4 mm

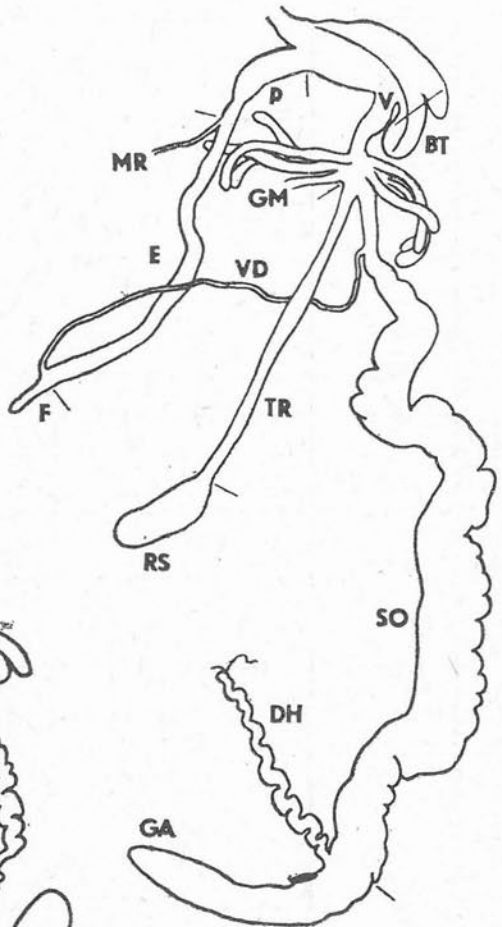
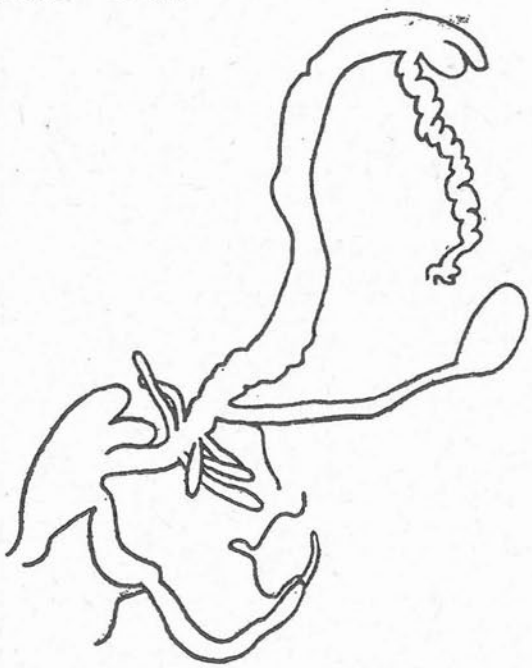


Fig. 18.
Cernuella neglecta (young, No. preparation 24a), Býchory u Kolína, 16. 7. 1967, enlarged 6.5times
Shel size: breadth = 11.3 mm, height = 5.7 mm



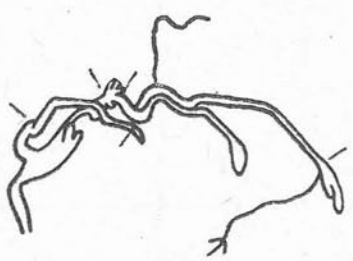


Fig. 19.
Cernuella neglecta (young, No. preparation 23b), Košťálov u Třebenic, 7. 8. 1966, enlarged 6.5times
Shell size: breadth = 7.00 mm, height = 3.6 mm

Table XXVII. Cernuella neglecta — mean value shells and genital apparatus from 3 localities

	shell b/h	P	E	F	VD	BT	GM	TR	RS	TR + RS	SO	GA	DH
n	11	11	11	11	11	11	11	11	10 11	10	8	8	6
x	15.7 7.8	3.8 0.9	9.6 0.5	1.5	15.8	5.3 1.9		10.7 0.4	4.5 1.9	15.1	29.1	9.7	9.4
var. 1	12.0 - 18.3	2.7 - 4.5	7.0 - 12.3	1.0 - 2.2	12.5 - 20.0	4.2 - 7.5	4.0 - 6.0	8.5 - 12.2	3.2 - 6.1	13.5 - 16.7	22.5 - 33.5	8.0 - 11.2	8.5 - 11.5
var. b	6.0 - 9.0	0.6 - 1.0	0.4 - 0.6			1.6 - 2.3		0.3 - 0.5	1.2 - 2.4				
s	1.6 0.8	0.7 0.1	1.7 0.05	0.4	2.5	1.0 0.3		1.2 0.08	0.8 0.4	1.4	3.3	1.2	1.2
s_x	0.4 0.2	0.2 0.03	0.5 0.02	0.12	0.8	0.3 0.09		0.4 0.02	0.25 0.12	0.4	1.2	0.4	0.5
v %	10.2 10.2	18.4 11.1	17.7 10.0	26.6	16.8	18.8 15.8		11.2 20.0	17.7 21.0	9.3	11.3	12.4	12.8

Table XXVIII. Measurements of Cernuella neglecta in adult and young snails — Třebenice, 23. 10. 1968

No.	shell b/h	P	E	F	VD	BT	GM	TR	RS	TR + RS	SO	GA	DH
16b	13.0 6.1	4.0 0.9	12.2 0.5	1.2	14.8	4.9 2.0	4.0	11.3 0.4	3.3 1.3	14.6	18.5	8.0	9.4
16c	14.9 7.4	3.3 1.0	11.5 0.5	1.5	13.5	6.0 2.0	5.0	10.5 0.4	3.2 1.4	13.7	25.0	8.5	10.5

Košťálov u Třebenic, 7. 8. 1967, leg. Zvarič

23a	7.8 4.0	1.8 0.4	5.2 0.2	0.6		2.1 0.8	0.9	4.0 0.2	1.2 0.6	5.2	6.8	1.4	3.7
23b	7.0 3.6	1.1 0.3	2.5 0.1	0.4	3.2	1.7 0.3	0.4	3.2 0.1	0.6 0.3	3.8	5.0	1.1	2.3

Býchory u Kolína, 16. 7. 1967

24a	11.3 5.7	2.5 0.6	4.3 0.5	1.2	6.7	3.5 1.3	2.0	5.4 0.3	2.0 1.1	7.4	14.5	2.7	9.5

Averages of the measurings of the different parts of the genital apparatus of all species of the *Helicellinae* sub-family found in CSSR are depicted in cumulative graphs (Tables XXIX — XXXIX).

Table XXIX.

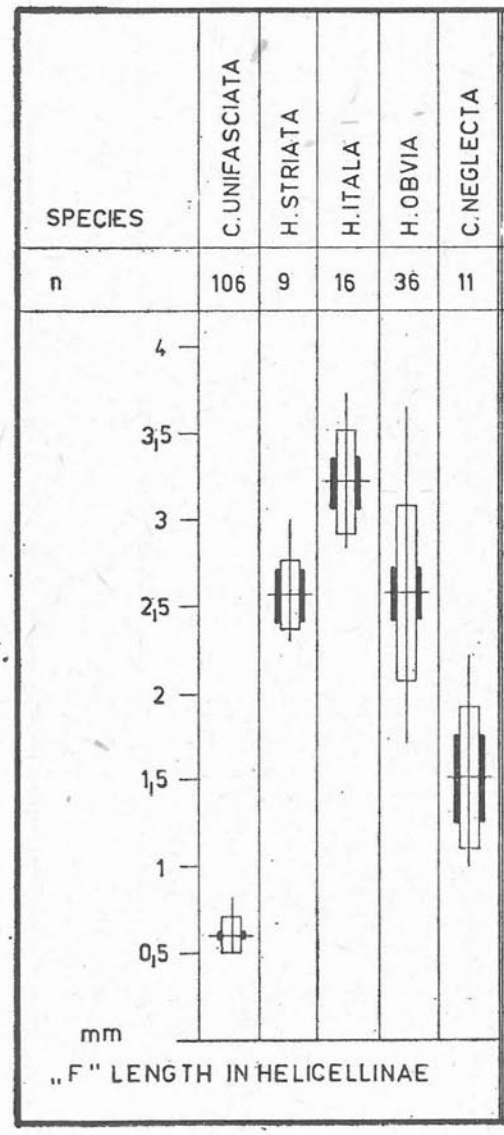


Table XXX.

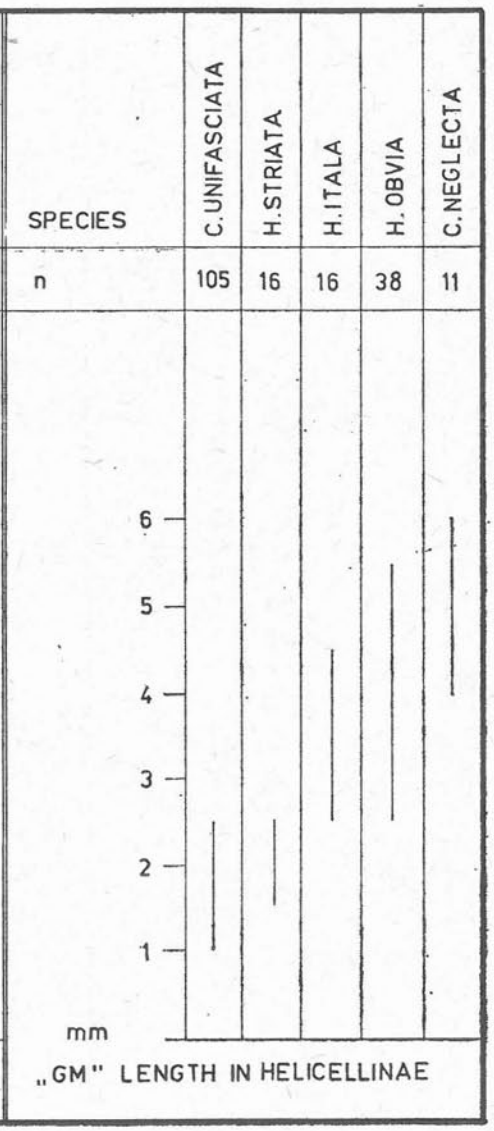
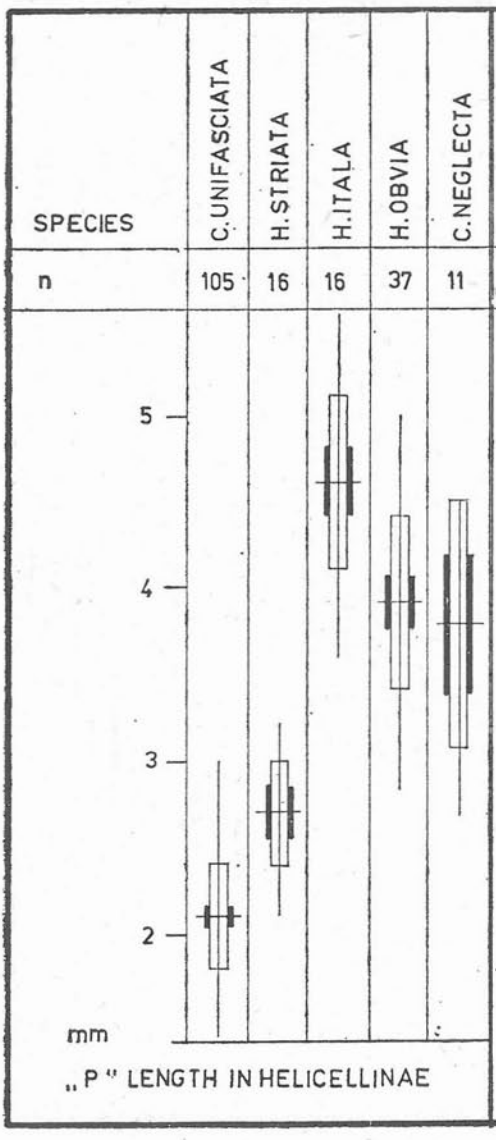
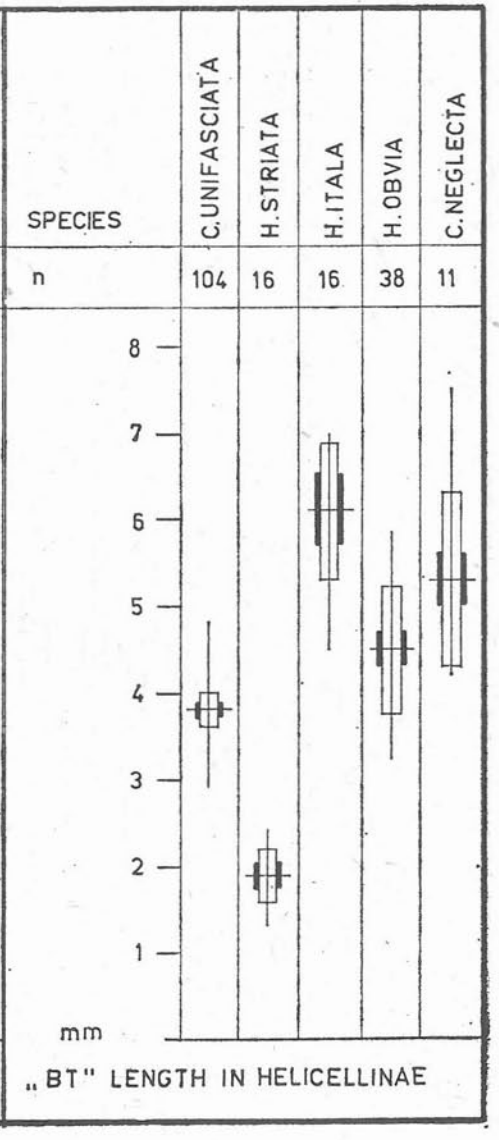


Table XXXI.



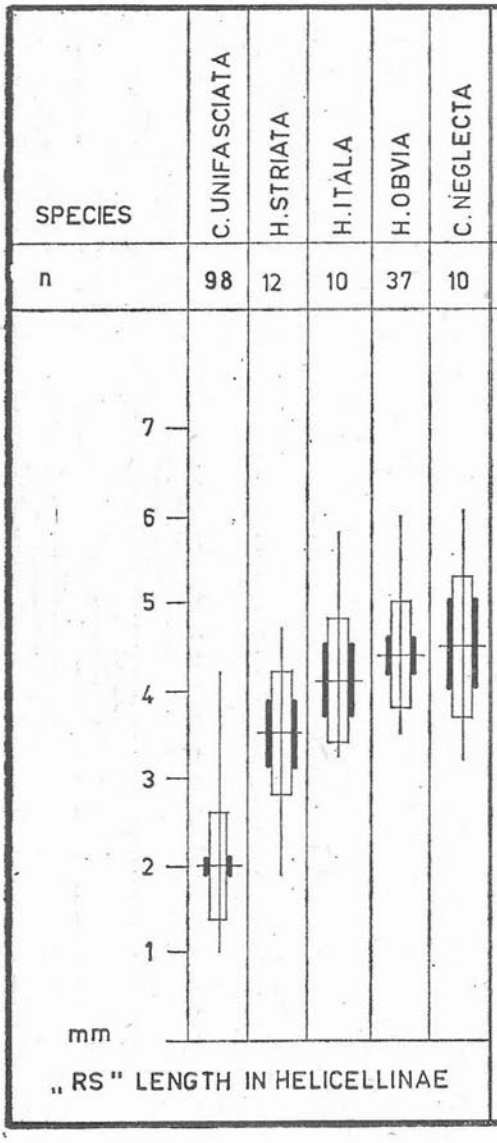
„P" LENGTH IN HELICELLINAE

Table XXXII.



„BT" LENGTH IN HELICELLINAE

Table XXXIII.



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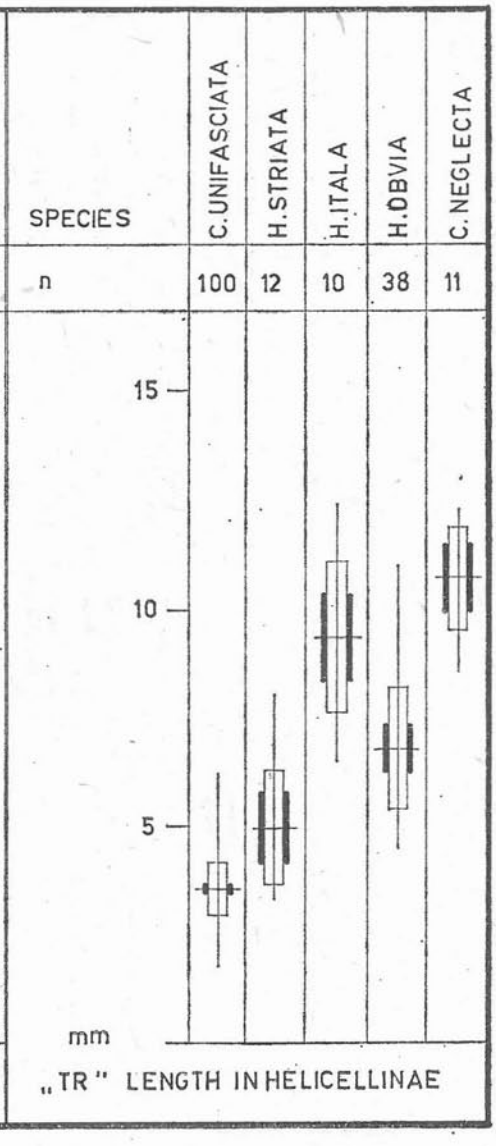


Table XXXV.

Table XXXVI.

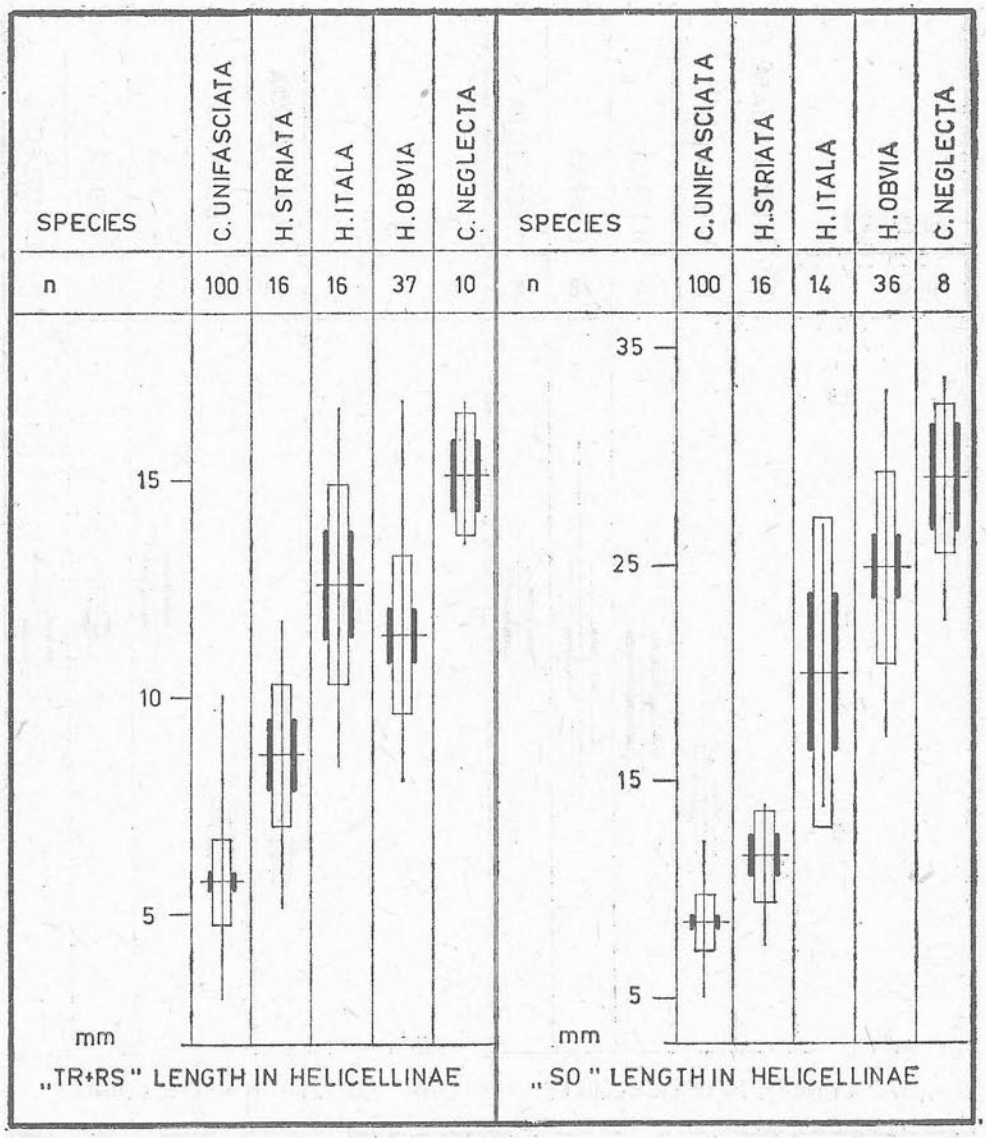


Table XXXVII.

Table XXXVIII.

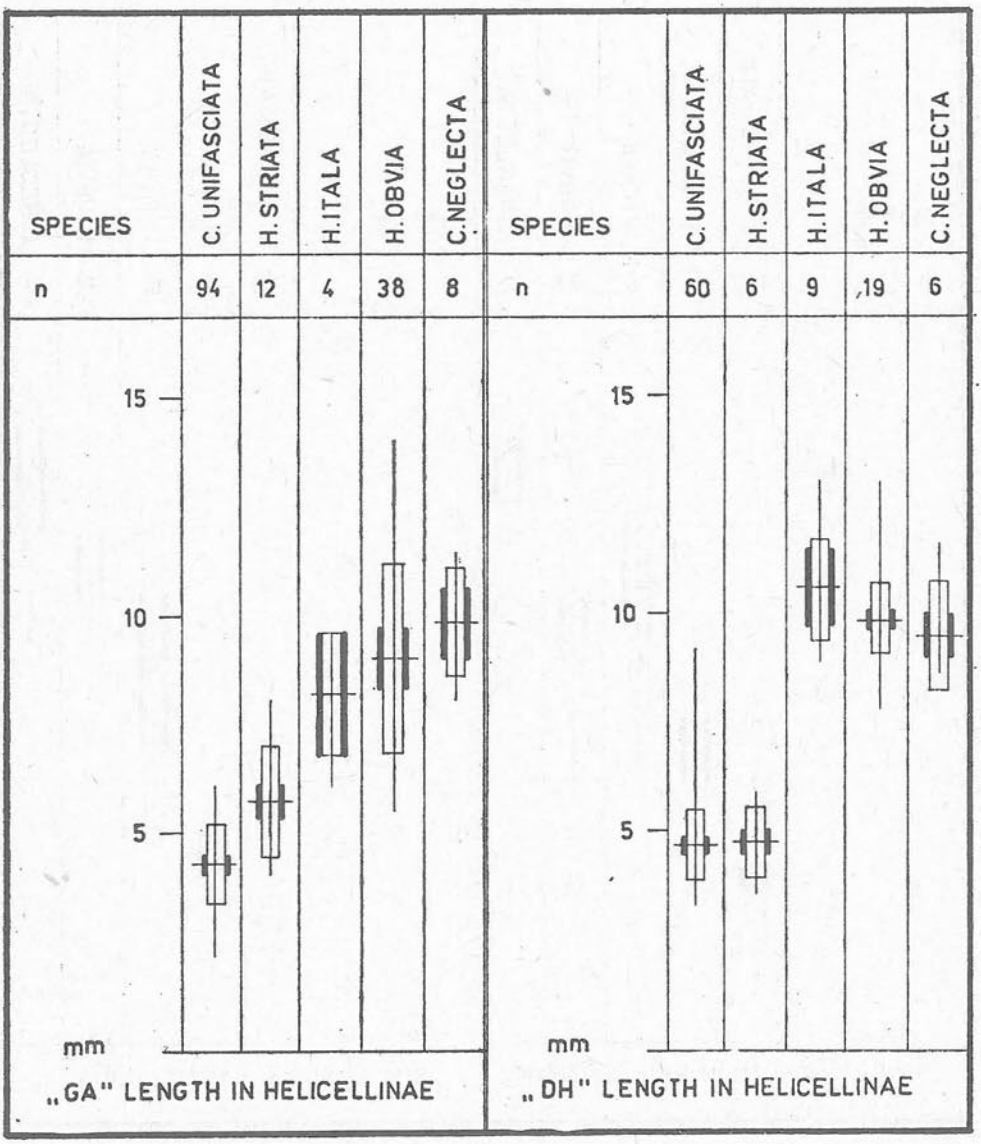


Table XXXIX.

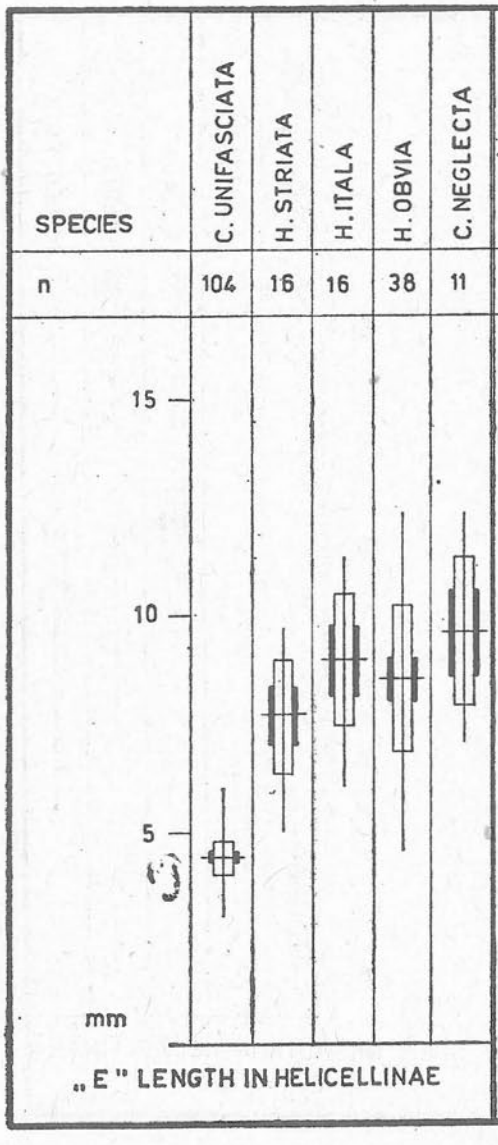


Table XXXX.

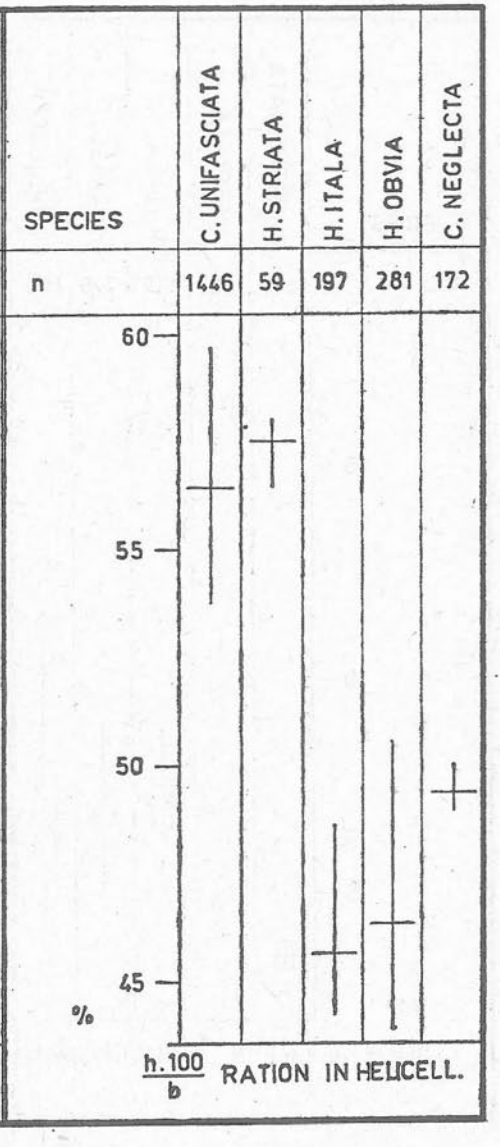


Table XXXXI.

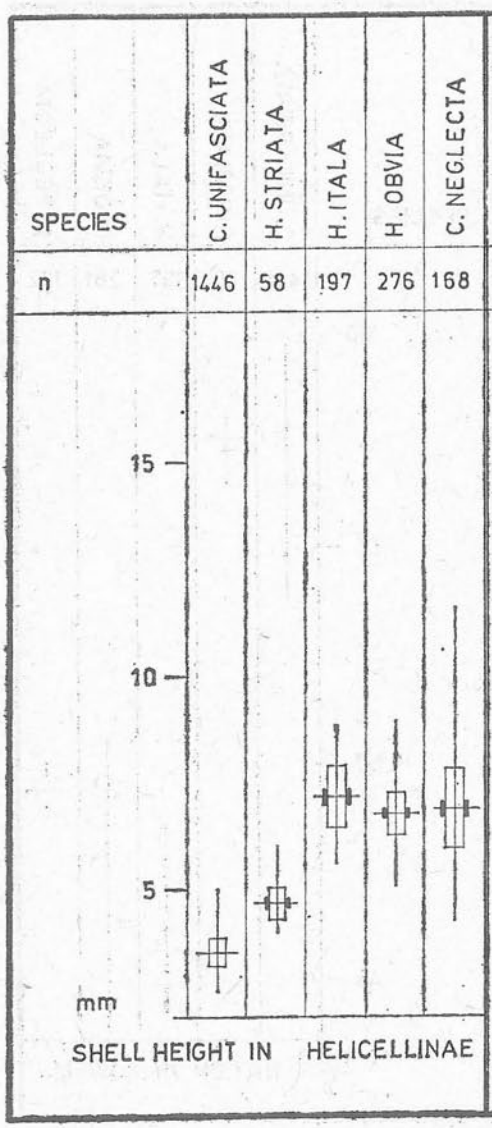
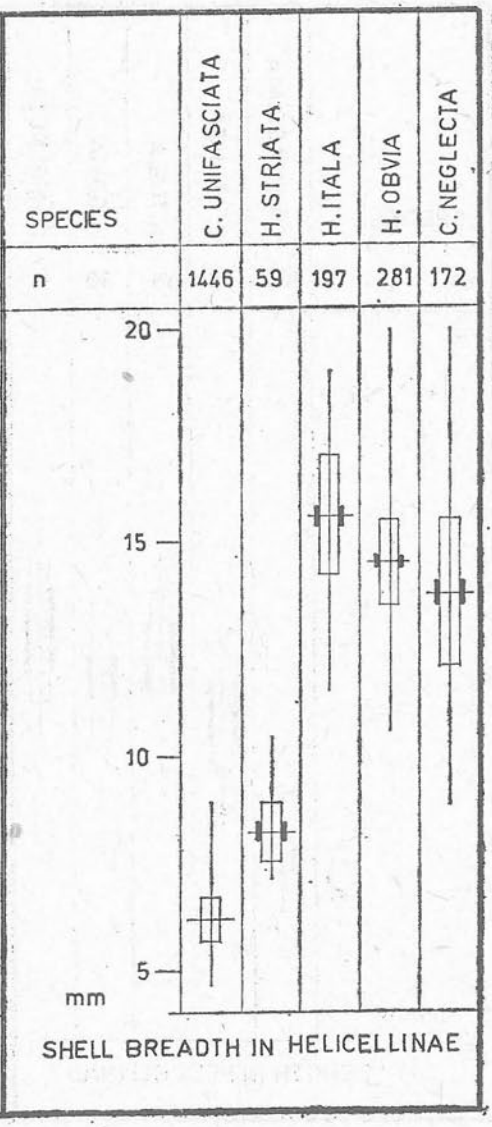


Table XXXXII.



VI. PIGMENTATION AND SIZE OF SHELLS

Bands on shells are typical for Czechoslovak representatives of the *Helicellinae* sub-family. This feature, though, is most subject to changes, also in size, and therefore the variability of shells of this species is so great and causes frequent difficulties in determination. This variability is also why so many forms and aberrations have been described over the years (in Czechoslovakia mainly PETRBOK). But these units have hardly any systematic value and ought to be regarded as a natural variation scale which is the result of the changing environment and is characteristic for each developing species.

Candidula unifasciata (POIRET)

For determining shell variability I used 11 samples (738 specimens) from typical populations *C. unifasciata* and 13 samples (708 specimens) from populations currently denoted as *C. soosiana* (in text and supplements marked +). The following localities are involved (table XII —XV):

1. Tachlovice u Nučic and a broader vicinity including the locality Dubecký mlýn u Chýnice, 1966—7, lgt. V. Pfleger.

The most of *C. unifasciata* shells are noted for a typical first broad band, about 10—20 % have this band very weak or interrupted, especially those on the warm southern slope near Dubecký mlýn u Chýnice. On the other more humid biotopes in roadside ditches more than 95 % of the shells have the typical coloring. The height of the shell (in 230 shells from 12 localities from the vicinity of Tachlovice) ranges from 55. 7 % to 59.4 % of the breadth, average: shell height = 57.8 % of breadth.
Values determined on examined material:

x =	6.4 mm (breadth)	3.7 mm (height)
s =	0.8 mm	0.5 mm
s_x =	0.02 mm	0.01 mm
v =	12.5 %	13.5 %
Extent of variation:	breadth	5.2 — 8.5 mm
	height	3.0 — 5.1 mm

The smallest dimensions were determined on shells from the slope near Chýnice — Dubecký mlýn and the largest from the locality Choteč - Ořech (roadside ditch).

Interesting is the ratio of the shell height to the shell breadth in specimens which are typically colored and in shells with a weak to unclear band. In 27 specimens with a typical band (Chýnice) the height of the shell = 55.7 % of the breadth. In 17 specimens with a faint first band from the same locality the height ranges from 56.5 to 57.8 % of the breadth.

In my opinion the weakening of pigmentation and increasing height of the shell at the expense of its breadth is typical for dry and thus warm localities.

Even within one population shells with the typical band are more finely striate, shells with an interrupted are on the back side more conspicuously striped.

2. Tachlovice u Radotína, 4. 7. 1949, lgt. J. Brabenec. 45 shells from this collection have typical coloring, the height of the shells is 56.3 % of the breadth.
The following values were determined on the examined shells:

x =	6.4 mm (breadth)	3.6 mm (height)
s =	0.55 mm	0.35 mm
s_x =	0.08 mm	0.05 mm
v =	8.6 %	9.7 %
Extent of variation:	breadth	5.4 — 7.5 mm
	height	3.0 — 4.3 mm

3. Drahelčice u Nučic, abolished railway bank south of the village, 16. 6. 1970, lgt. V. Pfleger.

Altogether examined 31 adult specimens, among them 24 pale shells with faint band or without band and 7 shells with a typical first band. Height of the shell is 54.4 % of breadth. The following values were determined on the material:

x =	6.8 mm (breadth)	3.4 mm (height)
s =	0.5 mm	0.3 mm
s_x =	0.09 mm	0.05 mm
v =	7.4 %	8.1 %
Extent of variation:	breadth	6.1 — 8.0 mm
	height	3.2 — 4.3 mm

4. Očelice u Opočna, railway trench, 3. 9. 1967. lgt V. Pfleger. Measured 16 shells which are almost white with a very faint and unclear main band. Height of shell is 56.7 % of breadth. The following values were determined on the material:

x =	6.9 mm (breadth)	3.9 mm (height)
s =	0.5 mm	0.3 mm
s_x =	0.12 mm	0.07 mm
v =	7.2 %	7.6 %
Extent of variation:	breadth	6.1 — 7.8 mm
	height	3.4 — 4.4 mm

5. Očelice u Opočna, 2. 4. 1950, lgt. J. Brabenec. From 109 shells 12 with a clear band, the others are white with a faint interrupted band or completely white. The internal rib is mostly narrow and relatively sharp; less often it is flat. The shell height is 5.7 % of breadth (average). The following values were determined on the material:

x =	7.0 mm (breadth)	3.9 mm (height)
s =	0.6 mm	0.4 mm
s_x =	0.06 mm	0.04 mm
v =	8.6 %	10.3 %
Extent of variation:	breadth	5.5 — 8.7 mm
	height	3.2 — 4.9 mm

6. Jeníkovice u Třebechovic, 9. 9. 1956, lgt. J. Brabenec. Measured 62 pale shells with a interrupted bands. Shell height is 53.8 % of breadth. The following values were determined on the material:

x =	6.5 mm (breadth)	3.5 mm (height)
s =	0.35 mm	0.2 mm
s_x =	0.04 mm	0.03 mm
v =	5.4 %	5.7 %
Extent of variation:	breadth	5.7 — 7.2 mm
	height	3.0 — 4.0 mm

7. Ohnišovský ostrov u Opočna, 7. 4. 1969, lgt. J. Brabenec. From 90 shells 7 with a typical main band the others are white with a faint and interrupted band. Shell height is 54.9 % of breadth. The following values were determined on the material:

x =	7.1 mm (breadth)	3.9 mm (height)
s =	0.7 mm	0.35 mm
s_x =	0.07 mm	0.04 mm
v =	9.9 %	9.0 %
Extent of variation:	breath	5.8 — 8.9 mm
	height	3.2 — 4.9 mm

Finely striate but more clear than in material from the vicinity of Tachlovice.

8. Štramberk u N. Jičína (old quarries), 10. 10. 1968, lgt. V. Pfleger. On this locality I found 65 specimens of which three had a typical shell like *C. unifasciata*, the others are pale without a band or the band is very unclear or interrupted. Height of the shell is 57.6 % of breadth. The following values were determined on the examined material:

x =	5,9 mm (breadth)	3.4 mm (height)
s =	0.6 mm	0.4 mm
s_x =	0.07 mm	0.05 mm
v =	10.2 %	11.8 %

Extent of variation: breadth 5.1 — 7.7 mm
height 2.9 — 4.7 m

Many shells are more roughly ribbed on the last whorl compared with material from the same locality from 1952 (lgt. J. Brabenec).

9. Štramberk (old quarries), 8. 10. 1970, lgt. V. Pfleger. 29 pale shells with a thin band has been collected (only one specimen with a typical main band). Hight of shells is 56.7 % of breadth. The following values were determined on the examined material:

x =	6.0 mm (breadth)	3.4 mm (height)
s =	0.5 mm	0.3 mm
s_x =	0.09 mm	0.05 mm
v =	8.3 %	8.8 %

Extent of variation: breadth 5.2 — 7.0 mm
height 2.8 — 4.0 mm

10. Štramberk (old quarries), 19. 7. 1952, lgt. J. Brabenec. From 13 shells one specimen with a typical main band, one specimen is brown colored, the rest are white. Height of shells is 56.1 % of breadth. The following values were determined on the examined shells:

x =	5.7 mm (breadth)	3.2 mm (height)
s =	0.8 mm	0.45 mm
s_x =	0.2 mm	0.1 mm
v =	14.0 %	14.0 %

Extent of variation: breadth 5.0 — 7.4 mm
height 2.7 — 4.2 mm

11. Štramberk, Váňův kámen, 19. 7. 1952, lgt. J. Brabenec. Altogether examined 48 shells, of these six brown specimens, the others with the typical band. The height of the shells is 56.9 % of breadth. The following values were determined on the material:

x =	5.8 m (breadth)	3.3 mm (height)
s =	0.25 mm	0.2 mm
s_x =	0.04 mm	0.03 mm
v =	4.3 %	6.0 %

Extent of variation: breadth 5.2 — 6.6 mm
height 2.8 — 3.7 mm

+ 12. Rájecká Lesná - Šuja, south of Žilina, 9. 8. 1967, lgt. V. Pfleger. After four months of drought in this region I found very few live snails and shells on a slope near a roadside ditch. Almost all shells were white with a very weak, interrupted band or a dispersed band (mosaic pattern).

+ 13. Rájecká Lesná - Šuja, 12. 10. 1968, lgt. V. Pfleger. After a very rainy summer I found in the same place a great number of live specimens (in some places of the roadside ditch 100 — 150 specimens per m^2). This population contained specimens of a most varied age composition and shells with pigmentation of most different pigmentation degrees.

Out of 166 adult live specimens 18 (i. e. 10.9. % of the total) had a clear first band, typical of the *C. unifasciata* and the shell height was 54.7 % of breadth. Another 67 specimens (i. e. 40.6 %) had a shell with faint interrupted bands, and shell height was 56.7 % of breadth. 56 specimens (33.9 % of total) had a shell with a mosaic pattern — highly interrupted and bands fused until completely fading, the height is 57.8 % of breadth. The fourth group consisted of 24 specimens (14.6 %) with white shells all mostly without a pattern, in this case shell height is 58.4 % of breadth.

Of course, there are transitions among these groups so the clasification into these four groups is purely subjective. However, it is clear that coloring and shell height are correlated, the lighter the specimen the higher it is.

The following values were determined on the examined material:
shell height is 56.9 % of breadth

x = 6.6 mm (breadth)		3.7 mm (height)
s = 0.4 mm		0.2 mm
s_x = 0.03 mm		0.015 mm
v = 6.1 %		5.4 %
Extent of variation:	breadth	5.6 — 8.1 mm
	height	3.1 — 4.9 mm

+ 14. Sněžnice u Žiliny, foot of Vreten hill, 11. 10. 1968, lgt. V. Pfleger. On the southern foot of the hill I found a weak population of live specimens of which five had a weak band 10 were light colored (without clear bands), one specimen had a typical band.

The ribbing of shells without bands is coarser than in those with bands. Overall ribbing is still more clear than in material from Rájecká Lesná. Hight of shells is 58.8 % of breadth. The following values were determined on the examined shells:

x = 6.3 mm (breadth)		3.7 mm (height)
s = 0.4 mm		0.2 mm
s_x = 0.1 mm		0.05 mm
v = 6.3 %		5.4 %
Extent of variation:	breadth	5.8 — 7.0 mm
	height	3.3 — 4.1 mm

+ 15. Sněžnice u Žiliny, foothill of Vreten, 21. 8. 1951, lgt. J. Brabenec. Altogether 15 shells examined; all except one with a quite clear band almost white with unclear band. One specimen with two developed clear internal ribs. Shell height is 58.6 % of breadth. The following values were determined in the material:

x = 5.8 mm (breadth)		3.4 mm (height)
s = 0.3 mm		0.2 mm
s_x = 0.08 mm		0.05 mm
v = 5.2 %		5.9 %
Extent of variation:	breadth	5.0 — 6.2 mm
	height	3.0 — 3.9 mm

+ 16. Drietoma u Trenčína, southern slope of Bolovica, 9. 10. 1970, lgt. V. Pfleger. Of the shells I collected 9 were quite mature. The shells were mostly gray with interrupted bands all over the area. Shell height is 57.9 % of breadth. The following values were determined in the material:

x = 5.7 mm (breadth)		3.3 mm (height)
s = 0.3 mm		0.2 mm
s_x = 0.06 mm		0.03 mm
v = 5.3 %		6.1 %
Extent of variation:	breadth	5.2 — 6.1 mm
	height	3.0 — 3.6 mm

Shell ribbing is similar to that of the samples from Vreten, only the ribs are narrower.

+ 17. Soběšovice u Žermanické přehrady (near Ostrava), southern slope above the shipyard, 8. 10. 1970, lgt. V. Pfleger.

From this locality I examined 30 pale to gray colored shells with interrupted main band (mosaic pattern). Shell height is 57.6 % of breadth. The following values were determined:

x = 5.9 mm (breadth)		3.4 mm (height)
s = 0.4 mm		0.3 mm
s_x = 0.07 mm		0.05 mm
v = 6.8 %		8.8 %
Extent of variation:	breadth	6.1 — 7.0 mm
	height	3.0 — 4.1 mm

+ 18. Žermanická přehrada u Havířova, 10. 6. 1964, lgt. J. Brabenec. From a total of 73 adult specimens seven have a banded shell, the others are pale with interrupted bands. Shell height is 55.9 % of breadth. The following values were determined:

x = 5.9 mm (breadth)		3.3 mm (height)
s = 0.3 mm		0.25 mm
s_x = 0.03 mm		0.03 mm
v = 5.1 %		7.6 %
Extent of variation:	breadth	4.8 — 6.6 mm
	height	2.8 — 3.9 mm

+ 19. Těrlicko u Ostravy, 25. 8. 1956, lgt. J. Brabenec. Altogether 22 shells examined four of which have a faint band, the others are white with a completely interrupted barely visible band. Shell height is 56.9 % of breadth. The folowing values were determined:

x = 6.5 mm (breadth)		3.7 mm (height)
s = 0.45 mm		0.3 mm
s_x = 0.1 mm		0.06 mm
v = 6.9 %		8.1 %

+ 20. Vedryně u Třince, Vružná slope, 23. 6. 1969, lgt. J. Brabenec. Examined 15 developed shells eight of which have main band, the remaining shells are gray with disturbed bands (mosaic pattern). Shell height is 56.7 % of breadth. The following values were determined:

x = 6.0 mm (breadth)		3.4 mm (height)
s = 0.2 mm		0.2 mm
s_x = 0.05 mm		0.05 mm
v = 3.3 %		5.9 %
Extent of variation:	breadth	5.5 — 6.4 mm
	height	3.1 — 3.8 mm

+ 21. Stankovany u Kralovan, around the stream near the railway, 8. 10. 1970, lgt. V. Pfleger. White shells without band or grayish with an unclear or interrupted band. Shell height is 59.7 % of breadth. The following values were determined on the 55 examined shells:

x = 6.2 mm (breadth)		3.7 mm (height)
s = 0.4 mm		0.3 mm
s_x = 0.05 mm		0.04 mm
v = 6.5 %		8.1 %
Extent of variation:	breadth	5.4 — 7.0 mm
	height	3.0 — 4.2 mm

In appearance this material was similar to that from Soběšovice.

+ 22. Stankovany u Kralovan, Močiare reservation, lgt. J. Brabenec, 25. 5. 1967. The shells are light, yellowish, banding very unclear, only four specimens with clear main band. The following values were determined on the 31 examined shells:

Shell height is 57.6 % of breadth.

x = 5.9 mm (breadth)		3.4 mm (height)
s = 0.4 mm		0.25 mm
s_x = 0.07 mm		0.04 mm
v = 6.8 %		7.4 %
Extent of variation:	breadth	5.2 — 6.7 mm
	height	3.0 — 3.9 mm

+ 23. Stankovany, Škuta valey, 25. 5. 1967, lgt. J. Brabenec. Shells from this locality are small, mostly white without a band (147 specimens), the band is clear on 27 shells. Shell height is 56.6 % of breadth. The following data were determined on 173 shels:

x= 5.3 mm (breadth)		3.0 mm (height)
s = 0.4 mm		0.25 mm
s_x = 0.03 mm		0.02 mm
v = 7.5 %		8.3 %
Extent of variation:	breadth	4.6 — 6.5 mm
	height	2.5 — 4.0 mm

+ 24. Branná u Hanušovic, steppe slope near limestone quarry, 6. 10. 1970, lgt. V. Pfleger. 24 shells from this locality have a light to gray colour with a mosaic pattern (two of them are light with a fine band and are distinctly lower). Shell height is 59.7 % of breadth and thus it is distinctly higher than in specimens from the limestone quarry (cf. below). The following values were determined:

x =	6.7 mm (breadth)	4.0 mm (height)
s =	0.4 mm	0.4 mm
s_x =	0.08 mm	0.08 mm
v =	6.0 %	10.0 %

Extent of variation: breadth 5.9 — 7.8 mm
height 3.3 — 5.0 mm

Some shells are more roughly striate than specimens from the vicinity of Opočno but finer than shells from the vicinity of Těšín (Soběšovice). The shells are higher than those from around Opočno, and in this feature they are similar to shells from Soběšovice.

+ 25. Branná, limestone quarry, 10. 10. 1972, lgt. V. Pfleger. Among the 77 examined specimens some with a typical main band as well as white shells without bands or interrupted ones. The following values were determined:
Shell height is 56.3 % of breadth.

x =	6.4 mm (breadth)	3.6 mm (height)
s =	0.35 mm	0.25 mm
s_x =	0.04 mm	0.03 mm
v =	5.5 %	6.9 %

Extent of variation: breadth 5.8 — 7.2 mm
height 3.2 — 4.1 mm

These shells (directly from the abandoned quarry - chrystallic calcium) are more roughly striate than shells from the grass-covered slope about 200 m west of the quarry (6. 10. 1970). This locality (650 m above sea level) is the highest place of occurrence of the *Candidula unifasciata* snail in CSSR.

Average values for all localities

I determined the following values on the examined material (1446 specimens) of *Candidula unifasciata* (including those formerly denoted as *C. soosiana*) from all places of occurence in Czechoslovakia:
Shell height is 56.4 % of breadth.

x =	6.2 mm (breadth)	3.5 mm (height)
s =	0.5 mm	0.3 mm
s_x =	0.004 mm	0.003 mm
v =	8.1 %	8.6 %

Extent of variation: breadth 4.6 — 8.9 mm
height 2.5 — 5.0 mm

Graphically described in tables XIV, XV.

DISCUSSION

I based my study of variability of conchyological features in populations *Candidula unifasciata* and populations so far denoted as *C. soosiana* mainly on the work of Hudec (1964). For better orientation I present the conchyological differences between the two species in the same way as HUDEC does in his publication.
These determined differences between the two species are, in my opinion, valid only for expressing differences among populations. Due to

their variability (as I explain further), however, they cannot be used as suitable diagnostical traits.

I have the following comments to make some of the conchyological differences.

Ad 1. Percentage of expansion of the last whorl compared with the one before

On the following localities I determined the following values in the different specimens:

Tachlovice, 18. 9. 1966	175 %	
Chýnice, 3. 9. 1967	166 %	
	170 %	
+ Branná, 6. 10. 1970	138 %	
	142 %	
Štramberk, 10. 10. 1968	143 %	(light shell)
+ Vreten, 11. 10. 1968	130 %	(light shell)
Rájecká Lesná, 12. 10. 1968	130 %	(white, higher shell)
	164 %	(typically banded lower shell)

The expansion of the last whorl compared with the one but last depends on the height of the shell. In higher shells the % of expansion of the last whorl is smaller than in specimens with a lower shell. This difference is most conspicuous in shells from Rájecká Lesná (on one locality this value fluctuates from 130 to 164 % — cf. distribution of this material on p. 109). Were this difference to be a diagnostical one the banded specimens would then have to belong to the *C. unifasciata* species and the specimens without the typical band to the *C. soosiana* species! In population from Štramberk and Branná this percentage is on the transitional level between Czech and Slovakian populations. Therefore, in my opinion, this feature is not suitable for discriminating between species.

Ad. 2. Internal rib development

It is a fact that the internal rib, as noted by HUDEC (1964), in populations denoted as *C. soosiana* is weaker and often even absent compared with *C. unifasciata.*

According to the examined material I had investigated, internal rib development is different on different localities. HUDEC (1964) himself states that the population from Vreten has a clearer internal rib compared with data given by WAGNER (1933). It seems that towards the east the internal rib becomes flatter and in many specimens it is very unclear or completely absent.

Ad. 3 + 9. Ribbing and shell colour

In studying the material I determined that ribbing is partially subject to changes even within one locality. It is manifested especially on the Štramberk locality. Already HUDEC (1964) determined that shells of *C. unifasciata* from Štramberk (ltg. Hrubý, 1963) are, compared with shells from Bohemia, "after all more clearly striate and coarser on the last whorl". And this feature is presented as one of the main discriminative

	Candidula unifasciata	*Candidula soosiana*
1	The last whorl near the aperture, compared with the one before, is so broadened that it forms 155—175 %	The last whorl, compared with the one before, forms 130—140 %
2	The internal rib in the aperture is relatively narrow, always strong and elevated	The internal rib is flat, faint and often almost absent
3	The whorl surface is more or less regular, clearly striate and ribbed	The surface is ± regularly ribbed, ribbing near the last whorl is particularly rough and irregular
4	The aperture is transversal, shortly eliptical	The aperture is shortly transversally elliptical to round
5	On the periphery of the last whorl there is a slight suggestion of a blunt edge	The edge is very unclear to almost absent
6	The shell is depressed, globose with a broadly conical disc, the surface is opaque	The shell is depressed, globose with a broadly cylindrical disc which is usually elevated, the shell surface is, as a rule, opaque or slightly shiny on top, and more so on the under side
7	The umbilicus is open and accounts for about 1/7 to 1/6 of the shell breadth	The umbilicus is open and accounts for about 1/6 to 1/5 of the shell breadth
8	Shell size: breadth 5.0 — 8.5 mm, height 4.0 — 5.5 mm	Breadth 5.5 — 7.5, height 3.7 — 5.5 mm
9	Whitish is the basic shell colour	Horn yellow to whitish
10	Number of whorls: 4.5 — 5.5	4.5 — 5.25
11	Suture near aperture bends very shortly but clearly down	The suture near aperture bends down unclearly
12	The one but last whorl and the last one form an obtuse angle in the suture near the aperture	The one but last and the last whorl form a less obtuse to almost right angle in the suture near the aperture

features between *C. unifasciata* and *C. soosiana.* I may state that the roughter ribbing is positively correlated with light shells without typical bands or shells with interrupted bands.

The comparative material further indicates that ribbing increases (is coarser) in populations towards the east.

Locality	Opočno	+ Branná	+ Soběšovice	+ Vreten
m above sea level	250	650	350	500
shell height (mm)	3.9	4.0	3.4	3.7
$CaCO_3$ cont. (%)	15.3	0.06	30.5	8.0
geogr. location south to west	14°15′	17°	18°30′	18°50′

This ribbing may be conditioned by the chemical composition of the substrate of the different localities. This, however, is not suported by the findings from Štramberk (Staré lomy) where on the same locality some specimens are currently (in 1968) more clearly ribbed than shells from 1952 (lgt. J. Brabenec).

On the grounds of the fact:

a) that in more arid places lighter and higher shells are more frequent than in more humid locations,

b) that in populations so far denoted as *C. soosiana* light shells without bands are more coarsely ribbed than those with bands;

I conclude that this ribbing, presented as a characteristic feature of *C. soosiana,* is affected by climatic factors. On the territory of CSSR this species is apparently on the border of the more humid oceanic and more arid continental climatic effects. According to current research the snail *Candidula unifasciata* appears to be a very plastic species which is able to colonise other suitable territories (not, however, the original steppe biotope) towards the east and to adapt relatively quickly to the microclimate of new biotopes.

Pigmentation of shells differs on localities which are sufficiently far from each other but also differ just as markedly within the same locality. ULIČNÝ (1893) states that this snail was introduced to this country. According to the appearance of the comparative material it seems that its distribution over the territory of Czechoslovakia has different origins. Firstly, there is the typical population *C. uniasciata* from around Tachlovice and the similar population (at least material from 1952) from Štramberk. The next group is formed by populations from around Opočno, north Moravia and Slovakia, some of which resemble Polish material. Already POLINSKI (1924) and URBANSKI (1933) pointed out the stronger ribbing of *C. unifasciata* shells from Těšín and Poznan districts compared with the typical *C. unifasciata* from Germany and Switzerland. This difference is to be seen even in comparison with our material from Tachlovice.

On the basis of these facts I cannot regard pigmentation, ribbing and the other shell features as sufficiently diagnostical for good species determination. All these change not only among populations from different localities but also within one locality over a series of years.

This variability led J. PETRBOK (1936c) so far as to determine two species on Tachlovice site; in reality he identified just two generations

or possiblly even variable specimens of the same population. From the photos published in his work (1936c) it is clear that he identified shells without clear bands and with marked ribs as *Candidula* sp. cf. *intersecta* Poiret var. *heripensis* Mabille, while shells with clear bands and fainter ribs as *Candidula* cf. *unifasciata* Poiret. In fact only variable specimens of a single species — *Candidula unifasciata* (Poiret) — are involved! This example is descriptive enough as a warning against premature determination and applies to the description of new taxones. The basic prerequisite of all systematic work is thus, even today, a through knowledge of species variability.

Ad. 8. Shell size

On the basis of material from all localities in Czechoslovakia it is impossible to distinguish, according to the shell dimensions (breadth, height), between populations *C. unifasciata* and *C. soosiana.* If we compare the coefficient of variation (v) of breadth and height we find that the coefficient regarding height of shells is in most cases greater (from 25 investigated localities this is true of 21). Shell size changes not only according to locality but it differs conspicuously even in populations from the same locality but of different years (tables XII — XV). For purposes of comparison I present the following examples:

locality	year	breadth (mm)	height (mm)
Vreten u Sněžnice	1951	5.7	3.4
	1968	6.3	3.7
Stankovany	1967	5.3	3.0
	1970	6.2	3.7
Branná u Hanušovic			
(grass slope)	1970	6.7	4.0
(limestone quarry)	1972	6.4	3.6

In typical populations of *C. unifasciata* from around Tachlovice and Opočno the fluctuations of size are not so marked. As oposed to HUDEC (1964) I must state that the variability of populations so far denoted as *C. soosiana* is rather big. This is, however, clear not until after a comparison of a larger number of shells from more localities and even in the study of material from one location in different years (cf. material from Rájecká Lesná, p. 109).

Ad. 11. Slope of the suture near the last whorl

The slope of the suture near the aperture is not a reliable distinguishing feature. In most shells from the vicinity of Opočno the slope is unclear though it is a population always denoted as *C. unifasciata.* Some population from the vicinity of Tachlovice (typical *C. unifasciata*) have a short clear slope in only about 50 % shells. This comparison is interesting in shells from around Štramberk. Shells from Váňův kámen usually have a clear slope while shells from Staré lomy (about 500 m from

Váňův kámen) have this slope almost invisible or very slight. Still other Moravian material from Branná has in half the cases a clear suture slope near the last whorl (just as in typical *C. unifasciata* populations) and in the other half of cases it is unclear (as in populations denoted as *C. soosiana*).

Even this feature like all others is not stable, it changes depending on the changes of other features in the different localities. The inconspicuous slope of the suture near the last whorl is typical for all l i g h t s h e l l s regardless of whether in populations denoted as *C. unifasciata* or *C. soosiana.*

Ad 12. Size of the angle near the aperture

From the comparison of shells of *C. unifasciata* and *C. soosiana* I conclude that this angle changes in relation to the height of the shells. In lower shells the last but one and the last whorls near the aperture form in the suture an obtuse angle. Whereas in higher shells (usually found among populations formerly denoted as *C. soosiana*) this angle is less obtuse to right. This is manifest even in material from a single locality.

CONCLUSION

Some of the allegedly distinguishing features for the two species (HUDEC, 1964) change depending on the height of the shell and, therefore, cannot be regarded as diagnostic. The following features are included: percentage of the size of the last whorl in relation to the one but last, shape of the aperture, shape of the shell, angle of the last and one but last whorl, slope of the suture near the last whorl.

It is not then surprising that J. (H.) WAGNER, not knowing these fact when describing *C. soosiana,* during the comparison of type material from Hungary with *C. unifasciata* shells from Germany, found different features and used them for diagnostic a new species.

I tried to obtain, for comparison, type material *Candidula soosiana* from the museum in Budapest. The Hungarian malacologist, Laszlo Pinter, however informed me by letter, as of October 25th, 1973, that in their zoological collection there is just one shell from the type locality collected on February 22nd, 1966. I had this shell borrowed and determined the following data: the shell is completely white, found already without the animal, filled with sand. The internal rib was undeveloped, on the last whorl (there are 4¾) there is clear coarse ribbing similar to that of shells from Vreten. The umbilicus accounts for 1/5 of the shell breadth; shell breadth = 5.8 mm, height = 3.3 mm. Shell height is 56.9 % of breadth. Unfortunately one specimen is not enough to get an idea about the population. This specimen was determined by the Hungarian malacologist as *C. unifasciata.* In his letter he wrote that this species is now probably extict in Hungary. It was probably introduced to the vicinity of Budapest (Hüvösvölgy valey) some 40 years ago. I personally believe it came there from one of the Slovakian localities. So far this species has not been found anywhere else in Hungary.

On the basis of findings regarding our populations which were determined as *C. soosiana,* and, due to the fact that these populations were determined according to the original description from the type locality in Hungary, I consider also the population from Hungary identical with the species *Candidula unifasciata* and the **taxone Candidula soosiana J. H. Wagner (1933) I denote as its synonym.**

After six years of studying this problem I must state that the features given as diagnostic for the *Candidula soosiana* species have no taxonomical value (they change with the climatic conditions). Though the Moravian and Slovak populations differ from the typical populations I may regard them only as the **easternmost form of the Candidula unifasciata species** (i. e. infrasubspecific form).

Helicopsis striata (MÜLL.)

Pigmentation

This species has 1—8 differently strong brown to dark brown bands which may be fused, interrupted or absent. Sometimes the shell is dark brownish-violet (Kopeč and Chlumín u Neratovic).

Size

Also the size of the shells is slightly variable. I collected the largest shells around the railway in Chlumín (19. 10. 1968) were the dimensions of the biggest specimens were: b = 10.4 mm and h = 5.6 mm without internal rib. As a matter of fact the internal rib was not developed in many other specimens, or it was very flat, indistinct.

Already HUDEC (1966) noted the size of the shells from this locality and believes that large shells of *H. striata* occur most often on the edges of fields of lucerne or in places where nitrogen fertilizers were applied. HORST (1960) is of a similar opinion.

On the southern slope of a hill near Kopeč I found smaller shells and despite than their internal rib was very clear. I believe this will have been caused, among other things, also by the microclimate; this slope is very warm and dry (evidence of this is, besides the recorded temperatures, also the xerophilous flora), while around the railway near Chlumín it is more humid and colder. Even in *H. striata* I determined slight growth of the shell after the internal rib was formed.

The height of the shells (59 specimens from three localities) ranges from 56.4 % to 58 % of the breadth, the average of all localities: height of shells is 57.5 % of breadth. The following values were determined on the examined material:

x =	8.2 mm (breadth)	4.7 mm (height)
s =	0.7 mm	0.4 mm
s_x =	0.09 mm	0.05 mm
v =	8.5 %	8.7 %

Extent of variation: breadth 6.9 — 10.4 mm
height 3.9 — 6.0 mm

Graphically depicted in tables XXXX — XXXXII.

Helicella itala (L.)

Pigmentation

This species, compared with *H. obvia* and *C. neglecta,* is less variable in pigmentation. The shells have 4—6 pale bands which show through the wall of thinner shells. Less often they are unclear or completely absent (especially on the top side) and the shell is then yellowish white or whitish and almost opaque. The internal rib, compared with *H. obvia,* is less clear and closer to the lip, hence even the bonds appear almost right to the end of the last whorl.

Size

Compared with *H. obvia* and *C. neglecta* it is most flat. In terms of per cent the height of the shell (197 specimens from four localities) ranges from 44.2 to 48.6 % of the breadth; average shell height is 45.5 % of breadth. The following values were determined on the examined material:

x =	15.6 mm (breadth)	7.1 mm (height)
s =	1.4 mm	0.7 mm
s_x =	0.1 mm	0.05 mm
v =	9.0 %	9.8 %

Extent of variation: breadth 11.5 — 19.0 mm
height 5.5 — 8.8 mm

Graphically depicted in tabes XXXX — XXXXII.

Helicella obvia (MENKE)

Pigmentation

According to ULIČNÝ (1895) the basic number of bands is four, however, these are often split into more or may disappear completely.

Shells xithout bands are denoted by WESTERLUND (1899) as f. *alba* HELD further presents f. *usta* under the following diagnosis: small with black-brown often fused bands and frequently with brown to blackish--brown "flames" on the top side.

PETRBOK (unpublished notes) mentions f. *usta* from the locality Plešivec u Měňan. In Rychnov n. Kněžnou he found shells where all the bands were not only fused but pigmentation was so strong that it penetrates the shell wall. This form he denotes as an aberration *nigricans* ab. n. He notes that this aberration was formed in Bohemia, i. e. in the northern part of Northern Europe and not in the more southern regions (Slovakia or even the Black Sea region). In the abundant material from Bohemia he did not find a single shell that would lack at least a suggested first band. Even if such a shell would be found, Petrbok sais, it could never be the f. *alba* West. but the line *efasciata* l. n. The *alba* form belongs to the more southern locations and also the bright white coloring is starting to be predominant in shells from Moravia.

PETRBOK collected completely white shells on the Balkan and therefore he is of the opinion that in the Czech lands brownish pigmentation is beginning to appear through the broadening of the bands (f. *usta* Held) ending with the *nigricans* aberration. This finding is, according to PETRBOK, proof of the effect of the climate on pigmentation.

Size

In the course of studying material *H. obvia* I found that the bands do not run right up to the end of the last whorl but end 2—5 mm before the lip of the developed internal rib. In juvenile specimens it runs to the end. This section is also much thinner, translucent and indicates that under favourable conditions the shell may increase in size even after achieving maturity. In some shells I also determined two developed internal ribs.

Therefore I believe that in some cases the shell size is limited only by the length of life. There are more factors affecting the shell size and therefore even the breadth and height of shells from different localities is different and the ratio of height to breadth also changes. If we express the height of the shell in percent of its breadth then this value, in *H. obvia,* (280 shells from 12 localities) ranges from 43.8 to 50.4 %, the average beig 46.2 %. The following values were determined on the examined material:

x =	14.5 mm (breadth)	6.7 mm (height)
s =	1.0 mm	0.5 mm
s_x =	0.03 mm	0.06 mm
v =	6.9 %	7.5 %

Extent of variation: breadth 10.5 — 20.0 mm
height 5.0 — 8.9 mm

Graphically depicted in tabes XXXX — XXXXII.

Crenuella (X.) neglecta (DRAP.)

Pigmentation

The shells have a different number of relatively broad brown bands which run right up to the end of the last whorl. In some specimens they are often fused thus creating 2—3 very broad stripes and, in this case, the shell is almost completely brownish. The variability of pigmentation is similar as in *H. obvia.* Sometimes the bands on the upper side are absent or unclear and on the top such shells are almost white. The banding ceases near the brownish to wine-red aperture which is the most conspicuous conchyological trait of this species. This coloring is clear even inside the aperture and therefore the narrow and higher porcelain internal rib is clearly outstanding usually 1—2 mm from the edge. In this species I found shells with two internal ribs very close to each other with the space betwen them typically coloured.

Size

The shell of this species is subject to the greatest changes of all species of this sub-family. I found extreme differences on the locality of Košťálov u Třebenic: The smallest specimen measured 8.8 mm : 4.2 mm and the biggest 20.0 mm : 11.5 mm. The height of the shells (172 specimens from four localities) ranges from 48.9 to 50.0 % of the breadth, the average being 49.3 %. The following data were determined on the examined material:

x =	13.8 mm (breadth)	6.8 mm (height)
s =	1.7 mm	0.9 mm
s_x =	0.13 mm	0.07 mm
v =	12.3 %	13.2 %

Extent of variation: breadth 8.8 — 20.0 mm
height 4.2 — 11. 5 mm

This species has the highest shell of all species living in Czechoslovakia. I noticed that even here the white specimens are higher and darker colored. This is especially so in material from the Mediterranean where the shells were much higher than material from Bohemia.
Graphically depicted in tables XXXX — XXXXII.

During the preparation of the genitalia I found in one large specimen from locality Kišťálov u Třebenic (almost white shell, internal rib developed, shell breadth = 17.5 mm and height 8.5 mm) atrophied genitalia (glandulae mucosae absent, dart sacs small, spermoviductus weak). The snail's body was, however, abnormally large. On the other hand in a shell with dimensions 8.7 : 4.5 mm and a clearly developed internal rib (Ovčáry - Býchory, 3. 10. 1968) I extracted completely developed genitalia though smaller but in keeping with the size of the small shell.

CONCLUSION

Pigmentation and shell size in species of the *Helicellinae* sub-family are affected very much by climatic factors. They change not only according to locality but differ considerably also within a population from one locality in the different years. On markedly warm sites larger and lighter colored shells can be found more frequently. Whereas on more humid sites, or during longer wet periods, the shells are lower but broader and rather dark in colour.

VII. POPULATION DYNAMICS

1. Time of mating

According to experiments and observations in nature BRUGGEN (1957) stated that mating of *Helicella itala* takes place on September 22nd (in captivity) and on October 4th (in nature). Mating of *Candidula unifasciata* takes place on September 12th (in captivity).

I personally observed the mating of the following species:

a) *C. unifasciata* in captivity on September 6th, 1967, at 22.00 hrs. during a thunderstorm. Involved were specimens whose internal ribs were starting to develop. Then in populations denoted as *C soosiana,* in captivity 18. 11. 1968 after moistening the specimens in a laboratory — snails collected on 26. 10. 1968 near Soběšovice (ltg. S. Mácha). The internal rib was not yet developed, shell breadth reached 5.1 mm.

b) *Helicella obvia* in nature on 13. 10. 1968 on the locality Kamenný Most u Štúrova (road). Involved were specimens with a developed internal rib and mating took place after it had been rannig almost all day.

2. Occurrence of juvenile and adult specimens

In detail I followed the growth of *Candidula unifasciata* from the Chýnice - Dubecký mlýn (cf. ecology) locality. The following conclusions

ensued from the observations in the different seasons of the year. According to climatic conditions the first juvenile specimens appear in the period from the end of March to early May (spring generation). The number of juvenile specimens of the same size is about (average) 10 % per area of 20 cm^2. Due to the occurence of snails of varying sizes (on an experimental area of 1 m^2) it may be assumed that eggs are laid successively. It is either the egg yield from one specimen or yields from different hybernating snails in keeping with their growing up.

In 40 days the shell breadth increased by approximately 2 mm and the height by 1 mm (from 18. 5. to 29. 6. 1968). In early June the second generation (summer) appears, in which the shell breadth increased by 0.9 mm and height by 0.5 mm in a period of 18 days (from 29. 6. to 17. 7. 1968). At the same time the shell breadth of the spring generation increased by 0.6 mm and height also by 0.6 mm. Thus at the beginning the shell grows faster, especially breadthwise, growth in this direction slows down and the shell grows higher. The juvenile specimens have a very thin shell, almost transparent. Not until growth starts slowing down do the shells start growing stronger and thus also change colour to white.

The internal rib starts to develop in the spring generation in mid-June. Accordingly the internal rib of the summer generation should begin developing towards the end of August or in early September. And this was really the time when I ascertained a developed internal rib in the biggest specimens.

In climatically favourable regions or in exceptionally favourable years yet another, autumn generation is found. This is how I determined the occurence of juvenile specimens of a population denoted as *C. soosiana* in Rájecká Lesná still on 11. 10. 1968.

In Bohemia, usually due to the earlier drop in temperature, development ceases, the spring generation apparently dies out completely and from the summer generation mainly the juvenile specimens hybernate (specimens without a clearly developed internal rib).

On 3. 7. 1967 I found a larger number of juvenile specimens of *Helicella obvia* on the Pečky - Radim locality. The size of the smallest shells was about 4 mm.

16. 7. 1967 I found larger juvenile specimens of *Cernuella neglecta* and small ones, about 3—5 mm in size, on a field path near Býchory.

On 23. 6. 1968 juvenile specimens of *Helicella obvia*, 8—9 mm in size, were found near Mšené Lázně (the size obviously indicates hybernating specimens from the autumn population).

On 30. 6. 1968 I found three sizes of juvenile snails *Helicela obvia* on a field path near Vítězov (Bedřichov u Kolína):

small	b = 4.6 mm	h = 2.6 mm
medium	b = 8.2 mm	h = 4.0 mm
larger	b = 11.0 mm	h = 5.0 mm

The last size represents yesteryear's hybernating specimens because I found about medium size juvenile specimens also on other localities. I estimated the age of the small juvenile snails to be 4—5 weeks.

On the same day I found juvenile specimens of only two different sizes (small and medium) and one immature specimen from last year near the village Ohrada in the Kolín district. On an area of about 20 — 30 cm^2 there were 10—16 young specimens (probably from one nest).

On 14. 7. 1968 I found the following sizes of juvenie specimens near Popluží (Mladá Boleslav):

a)	breadth = 5.6 mm	height = 2.8 mm
b)	breadth = 8.4 mm	height = 4.1 mm
c)	breadth = 12.0 mm	height = 5.9 mm

From the occurrence of the young specimens it may be derived that the egg laying of *H. obvia* and *C. neglecta* probably takes place from mid- or late May to the end of June. It happens at least twice and probably three-times when 10—20 eggs are layed at a time in one place.

The first juvenile specimens emerge probably from the last year's adults, the later ones probably from hybernated immature specimens which mature not until the spring. The laying of eggs is probably bound to rainy seasons.

The occurrence of stronger populations on bare, fallow or edges of fields is probably related to the physical condition of soil. In loose not overgrown soil it is much easier for the snail to dig a hole for depositing its eggs. In this way the eggs are better protected against drying up. In places where the snail is unable to make a hole (due to sod cover) it lays its eggs into the vegetable detritus close to the ground. In such places the eggs may be more easily damaged or dried out.

The occurrence of adults with a developed internal rib is most frequent from the end of summer (September) and in early autumn (October) until the arrival of the first mild frosts when most adults perish while only the immature specimens continue to hybernate.

3. Length of life

According to HORST (1929) species of the *Helicellinae* sub-family live to be about two years old.

On the basis of observations (cf. ecology *C. unifasciata*) in the course of which I recorded extensive dying of these snails in autumn (October) and in spring (May) I believe that this species lives about seven months (April — October), and a maximum of 12 months (10 % of those hybernating). The developed spring and possibly even some summer populations perish in autumn. Only immature specimens which hatched in summer (or autumn) hybernate.

I assume (according to the years of my observations) that the larger specimens of *Helicella* and *Cernuella* live longer than *C. unifasciata.*

This problem will in future require more attention. The results of this study will depend on an expedient marking method in nature because breeding of these species is unsuccessful under laboratory conditions.

In *Helicopsis striata* I found a large number of dying specimens on 19. 10. 1968 (Chlumín, railway) whose internal rib was not yet developed. On a section of about 100 m I found only few live specimens and therefore believe that the number of those which hybernate is still smaller than in *C. unifasciata.* This small number of hybernating animals is also the reason for the weak population in the following year while the 30 % of hybernating specimens of *C. neglecta* provides the foundation for a much larger population. In *C. neglecta,* compared with the others, I also found almost always the strongest populations.

4. Population densities

The density of populations of species of the *Helicellinae* sub-family vary widely in different biotopes. Conditions in Central Europe do not provide for the creation of massive populations which are known from south Europe. In the biotope they form islands. Once only I found a population of *H. obvia* where the number of specimens reached about 50—60 per m^2 (Popluží u Mladé Boleslavi) and a population of *C. unifasciata* (a population denoted as *C. soosiana*) where the number of

specimens reached about 100—150 per m^2 (Rájecká Lesná - Šuja) but on a small area.

Most populations I found were weak (i. e. 1 — 5 specimens per m^2), medium (5 — 20 m^2) and less often strong (20 — 50 specimens per m^2). I consider populations of over 50 specimens per m^2 to be very strong. The representation of these values is given in tables XXXXIII — XXXXVII.

5. Speed and ways of spreading

In Czechoslovakia this question was studied by HUDEC (1950) and LOŽEK (1955f) who made the following conclusions from the available data:

a) Though snails are not very mobile animals they are able to spread fairly quickly, indirectly (water, wind, through man and various animals).

b) This alows them to penetrate suitable sites, though often just isolated islands often vary from the areas of their consistent distribution.

c) The speed with which some species spread is so great that it is apparently sufficient for them to react directly to changes in the climate and site.

d) different species reach optimal vagility in certain time limited period. This spreading may vary widely in time even among ecologically close species (*Helicella obvia* is currently in the optimal stage of distribution, *Helicopsis striata* is in recession).

e) Due to this fact mollusc communities as regards vagility and spreading do not behave as a whole but may consist of species with completely opposite properties.

f) The question whether one species may have more periods when it is advancing and/or receding is not yet settled.

In my own experience the speed of spreading from the original site of their occurrence may be quite well followed in species of limited incidence.

So, for example, *Candidula unifasciata* was discovered by PETRBOK in 1934 near Tachlovice (slopes above Horní mlýn). At the end of World War II when V. LOŽEK made a detailed investigation of this site, the population was wery weak. Control collections made again by V. LOŽEK (1956) and then by J. BRABENEC and HUDEC in 1949—1962 revealed populations of growing numbers. *C. unifasciata* inhabited suitable sites in the close vicinity of Horní mlýn up to the stone quarry near Chýnice.

During a detailed investigation of the distribution of this species around Tachlovice in 1966—1972 I found other localities (PFLEGER, 1974). Marginal places of occurrence are 2—5 km as the crow flies from the original locality. The whole area of current occurrence now reaches about 30 km^2. This area was inhabited by the species in the last thirty years. However, I believe, this could not take place indirectly. This is suggested by the fact that almost all localities are close to the Radotín stream (they were carried by the water current). One empty shell was found (the material which is in the collection of the National Museum is marked coll. Petrbok) at the beginning of the war in the sediment of the Radotín stream near Radotín.

Other localities are distributed around the roads along which men used to carry cut grass and hay from the slopes surrounding the stream and from the road ridges (this I could personally witness near Horní mlýn).

The case is similar near Rájecká Lesná, where the stream running from Horky to the road distributed *C. unifasciata* (this population has been

up to now denoted as *C. soosiana*) and man assist this process along the road. Here I found live specimens on the very bank of the stream near the road.

Water may carry specimens to great distances because the snail can survive in it for up to 24 hours. Also floods after strong rain could be taken into consideration.

Besides this still other possible ways of spreading should be sought. LOŽEK (1955f) suggests the possibility of spreading by wind (for only shorter distances — several km — by means of ripped off parts of plants — steppe runners, e. g. *Eryngium,* which these species ascend.)

Many times I found these species on railways. It is feasible that they reached these places from road and rail crossings. Further they could be distributed with goods transported by rail (packed with farm produce). These species survive for several months withdrawn in their shells. For example, HOŘÍNEK (1966) links the occurrence of *C. neglecta* near Benátky n. Jiz. with the supply of potato planting stock from Býchory.

Interesting about the *Cernuella neglecta* species is how it reached the territory of Bohemia in the last twenty years. Except for the location in Kochánky u Benátek the other three sites where they live are close or directly on the railroad (Třebenice). Close to Býchory there is a rail trench out of use for some ten years. It is possible that this species came to this country with goods from the original site of its occurrence around the Mediterranean or from some of the advanced individual sites in Western Europe. An interesting point is that all localities in this country where *C. neglecta* occurs lie on a line (a strip about 10 km broad), which even in GDR intersects findings of this sepcies in Thuringia and the Harz (Naumburg). This locality was noted as early as 1927. It is therefore possible that even in this country its occurrence is of an older date but, due to similarity with *H. obvia,* it could have been missed, although nowhere was it found in collections. It wil be then more probable to connect its occurrence in this country with findings in GDR. Localities in Czechoslovakia and GDR are for some time being supplemented by findings in the FRG (Schmid, 1968) which supplement the loose link of these localities with findings in north France. According to all available data *C. neglecta* is in the earliest period actively but and especially spreading passively, and therefore attention should be given to this phenomenon.

This spreading may be an indication of a changing climate which would favour more than the Mediterranean species.

In this connection, regarding the spreading of species of this sub-family to great distances, birds could be considered, LOŽEK (1955f) explains in this way their spreading against water currents to great distances.

Already LOENS (1890) reported about finding live specimens of *Helicella itala* in the crop of pigeons. OPATRNÝ (1958) lists species which are eaten by thrushes. Among others a juvenile snail *Cepaea nemoralis* with an intact shell was found in the stomach.

It is not, however, only the fact of the snails being swallowed by birds but also of young specimens adhering to the bodies of birds or even small mammals as noted in literature.

6. Irregular occurrence and its causes

Species of the *Helicellinae* sub-family are found predominantly on their places of occurrence very irregularly. There are years when a species is very numerous on a site and shortly after it almost disappears from the same place. Nowhere in literature did I encounter an explanation of this phenomenon and therefore I would like to give reasons based on my own observations.

The size and the dynamics of a population is affected by many factors. From the example from Rájecká Lesná it is obvious that for the violent reproduction of these snails besides a certain temperature also a rather wet year is important. This is pointed out by HOŘÍNEK (1966) in connection with an extensive collection of *C. neglecta* near Benátky n. Jiz. in 1965. Especially during the egg-laying period high humidity is inevitable for the development of young snails. In wet and warm years several populations develop and in early autumn the populations are, in places, strong or very strong.

According to my own experiment *C. unifasciata* is very sensitive to wetness of the terrain, while it does not tolerate long-term drying up of the biotope either. Therefore the slope of the terrain affects the development of a population so much as in the case in the valley of the Radotín stream near Chýnice. Excessive water is rapidly drained off to the lower sites and the permeability of the calcareous substrate is high.

Excessive drought dries up the eggs which are laid on the sod substrate at about the soil level. This may diminsh or eliminate the entire future generation. However, it is probable that species of the *Helicellinae* sub-family lay eggs only during the rainy season.

Besides these purely climatic factors also local factors are of great importance. Especially the activity of enemies which may destroy both the eggs and the snails in all stages of development. These would be mainly birds and larvae of predatory insects (*Carabidae*) which can destroy a whole isolated population in a short time.

Various parasites by which they are often infested have a great effect on the mortality of these snails. Connected with them are also many diseases which have been investigated only insuffciently so far (SZABO, 1930).

We are also not familiar with the effect of chemicals the crops are treated with in the vicinity of habitats of these species. If they are deadly for the snails they too would weaken or destroy a population.

Under favourable conditions the size of the population is also affected by the number of hybernating specimens.

Obviously indirect spreading is important for the development of populations at places distant from the original locality. In case of *C. unifasciata* around Tachlovice this function is carried out by the stream and by man. The first populations reproduce on the new site with the newcommers which help to freshen and develop a new population. On

the Chýnice locality the size of the population has been the same for at least eight years (1967—1974).

Isolation and degeneration apparently occurs most frequently in the *Helicopsis striata* species. In Czechoslovakia the gradual extinction of this, the longest living, species of the *Helicellinae* sub-family continues at a rather fast rate and I believe that the time is not far when it will completely disappear from the lists of Czechoslovak fauna. An important point in this respect is undoubtedly that it is a species which, as opposed to its relatives, does not occupy new biotopes so easily and on the contrary is often destroyed by human activity.

The dynamics of the *Helicellinae* sub-family is in our regions subdued by the winter season while the development of some species in places of their original distribution takes place all the year round (except in periods of severe drought).

Research implies that the dynamics of these snails (and probably of the others too) is — besides genetical factore — in my opinion related mainly to ecological factors. The different factors cannot be extracted from their complex in order to explain the frequency of occurrence and quantity of the given species.

VIII. PARASITES AND ENEMIES

1. Parasites

In literature numerous examples are described of parasites in species of the *Helicellinae* sub-family and in snails in general. Most frequently they are nematodes (*Nematoda*) which are able to penetrate the bodies of snails as the food with plant tissues and directly from the environment through the skin.

Obviously strong infestation by parasites can affect the development of individuals so that there appears a weaker shell development, slower depositing of $CaCO_3$ and possibly even an unbalanced development of the different parts of the genital apparatus. This is supported by the collected *H. obvia* from a limestone quarry in Votice (10. 9. 1967). Specimens were infested by nematodes and their shells were light and 11.6 mm in diameter which is much below the average size.

Snails of this sub-family may be attacked even by he larvae of flies. So it was that a larvae crawled out of a live *H. obvia* specimen (Chlumín u Neratovic) collected on 22. 6. 1968 and freely pupated. I was unable to identify the hatched fly.

From common parasitological literature it is known that snails of this sub-family are hosts of gourd-worms especialy of the *Dicrocoelium dendriticum* species.

2. Enemies

Already LOENS (1890) reports about pigeons destroying *Helicella itala* on a site. In the crop 67 snails and nine empty shells were found. Some snails were still alive after several days when they were turned over for identification.

Even in this country PETRBOK (1932) observed birds eating snalis.

In the course of colecting these species I also recorded the disappearance of shells from some localities. For example, on 24. 9. 1967 on the hills near Kopeč I found a weak population of *H. striata* and on a field path north of the village, between the hills, a number of live *H. obvia*. On 4. 5. 1968 I found on the same place only two *H. striata* specimens and several shells of *H. obvia*. During the next control, on 28. 7. 1968,

I did not find a single shell. Here the snails were probably destroyed by hens which wandered around the house next to this locality. In other places, too, I often found crushed shells. Besides feeding on the snails birds in this way satisfy their need of calcium and the white colour of the snails obviously gives the snails up.

Besides birds also predatory larvae of insects are great enemies of species of this sub-family. In the laboratory I was able to witness by chance how the larvae of carabids can attack the shelled snails. In a glass I kept about a 15 mm large larvae to which in gave live specimens of *Cernuella neglecta*. The larva immediately crawled into the adult shell and within half and hour it ate the halves of two snails.

Last but not least man should be named among the enemies of species of this sub-family. Man destroys the biotopes (the burning of windrows and railway trenches) of these animals.

Effective are probably also various chemicals for which, however, data are not yet available.

IX. ECOLOGY

All species of this sub-family are found on dry, warm sites often with very high temperatures. Even these xerothermous snails, just as snails in general, require certain humidity. In steppe regions there is of course a shortage of water and therefore these species became adapted. This is manifested mainly in the massive, opaque, white shell with dark bands. In dry periods snails abandon the warm surface of the ground and crawl up platns to which they attach themselves by the thin closing membrane at the aperture of the shell. In humid periods they crawl, as do all other snails, on the ground amidst plants. This is especially typical for sites in the centre of distribution of this sub-family — Pontic and Mediterranean regions. On the territory of CSSR they live mainly on steppes transformed by human activity. I observed that most species survive much better on sites affected by cultivation than on the original steppes. Most important among the ecological factors affecting the biology of these species are: humidity, temperature, vegetation which is largerly determined by the kind of substrate and relief.

1. Candidula unifasciata

I made a detailed study of the ecology of this species on a locality around Tachlovice, near Prague, where at the same time I determined the exact distribution (PFLEGER, 1974). Available reports about this region noted only the part Tachlovice — stone quarry Chýnice (HUDEC, 1964). Therefore I present below only these findings which are not included in the mentioned publication.

15. 11. 1970 — I collected 30 live specimens close to the ground in grass. They are immature specimens, some rather small, about one month old. Probably even on this locality it is the autumn generation. Daytime temperatures 8—9 °C, night temperature 3—4 °C.

12. 7. 1972 — in different places I found 10—55 live shells per m^2. The strongest population in recent years. Throughout the spring and summer it is raining all the time. The snails include two sizes without internal rib (the smaller are about half the size). Nowhere did I find a specimen with a developed internal rib. This only started to develop among the bigger ones. The shells with a weak interrupted band are higher and more roughly ribbed than those with typical banding. In order to determine

the area over which the snails live I marked 100 of them with red varnish and placed them onto an experimental area of 1 m² (on the same locality).

11. 11. 1972 — on the experimental area I did not find a single marked specimen. Otherwise I found only dead specimens around the area. The varnish had probably rubbed off over such a long time or the marked specimens were destroyed in an unknown way. It will be necessary to change the method of marking or to make controls more often.

11. 9. 1973 — I determined about 50 *C. unifasciata* on an area of 1 m², all were collected on the experimental area and 50 specimens were marked with a black felt pen.

7. 3. 1974 — immature specimens are very close to the ground where the plant cover is very thin. Live specimens occur in islands, always a few in one place, about 5—10 per m². Compared with the previous years the number of live animals is larger. This is apparently the result of a very temperate and humid winter. Many specimens have a transparent growth zone of 1 mm in size. The snails have been obviously active for a longer period of time and their shell is growing. The internal rib is starting to develop in several specimens.

On the place where the last time I marked 50 animals I found just empty shells with no traces of marking.

On the place where the last time I marked 50 animals I found just empty shells with no traces of marking.

4. 4. 1974 — noon temperature, close to the ground, is 27 °C, 1 m above ground it is 19 °C. The slope is very dry, it has not been raining for a fortnight. I found 18 almost adult specimens which I marked with blue paint and placed in the centre of an experimental area. When I placed the snails on a stone they started to move (in full sun), they lifted their shell so that they pressed the aperture against the stone and immediately started to secret the translucent closing membrane by which they attached themselves firmly to the stone. On this locality I found only juvenile snails close to the ground, there were 5—9 on an area of about 10 cm². I assume they hatched 14 days ago, i. e. around March 20th. Due to the mild winter it is about a month sonner than in the previous years. I determined the following dimensions:

4 specimens	(shell breadth	2.0 — 2.4 mm
	height)	1.1 — 1.2 mm
9 specimens		2.4 — 2.8 mm
		1.3 — 1.5 mm
4 specimens		2.8 — 3.0 mm
		1.5 — 1.6 mm
4 specimens		3.4 — 3.8 mm
		1.9 — 2.0 mm

In these specimens it is already possible to see that the pale ones (the band is very fine and interrupted) have considerably coarser ribbing than the darker shells and in appearance they resemble the population so far denoted as *C. soosiana.*

18. 4. 1974 — Not a single marked animal was found on the experimental area. I again marked 18 specimens with red stamping ink and placed them into the centre of the area. All specimens were collected from the experimental area. I determined 30 specimens of different sizes per m².

6 specimens	(b = 2.4 — 3.1 mm; h = 1.3 — 1.6 mm)
15 specimens	(b = 4.0 — 4.7 mm; h = 2.2 — 2.6 mm)
9 specimens	(b = 4.9 — 5.2 mm; h = 2.8 — 3.0 mm)

The last size probably represents the juvenile hybernating specimens. Some specimens resemble the *"soosiana"* populations — in height, more clear ribbing and in the interrupted banding. At this time night frost reached -1 to -5 °C, it was dry, morning mist and hoarfrost, slight precipitation in the valley.

14. 5. 1974 — morning fog until 8.30 hrs. The snails stay quite close to the ground in grass, sporadically on dry herbs 10 cm above ground. From a marked area of 1 m² I collected 46 live specimens and seven shells which had been probably ovelooked while cleaning the area. No traces of marking. About ten specimens found around the central stone up to a distance of 10 cm. Other specimens found in different places over the area up to the edges of the marked area; these were specimens

which invaded the area from the outside. The following sizes without internal rib were determined:

30 specimens (b = 4.9 — 5.6 mm; h = 2.9 — 3.2 mm)
5 specimens (b = 4.3 — 4.6 mm; h = 2.4 — 2.8 mm)
10 specimens (b = 3.0 — 3.8 mm; h = 1.8 — 2.1 mm)
1 specimen (b = 2.6 mm h = 1.5 mm)

I again placed 20 larger specimens (b = 5.0 mm) marked with blue felt pen on the apex of the shell (snails from another place of the locality) on the cleared experimental area.

6. 6. 1974 — I did not find any of the marked specimens. On the cleared area, where the last time I had placed 20 snails, I found 42 live specimens (and 17 shells from specimens which had perished or had not been collected previously). On the same area I placed 18 specimens and marked on the umbilicus with felt pen. Around the marked area cleared some 40 cm in all directions to increase the area and prevent rapid invasion from its surroundings. On the border of the experimental area there were most snails. 42 without a developed internal rib and divided into the following size groups:

5 specimens (b = 2.9 — 3.3 mm; h = 1.6 — 1.8 mm)
16 specimens (b = 3.5 — 4.1 mm; h = 2.0 — 2.4 mm)
21 specimens (b = 4.4 — 5.4 mm; h = 2.7 — 3.1 mm)

For further observations it was necessary to find a suitable means of marking and to make the control much more often. May be it will be realistic to follow how long it takes the snails to invade the cleared area from the outside.

Candidula unifasciata occurs around Opočno on the southern slope of the overgrown railway trench near Očelice. During revision in 1967—1968 I found only shells. Only near the road leading from the railway station to the village of Očelice I found just one juvenile specimen and several shells of mostly long dead snails.

Ecological findings concerning populations so far denoted as *C. soosiana* were summarized from familiar locations by HUDEC and BRABENEC (1964). They state that all finds on the territory of CSSR are located on clearly secondary xerothermic sites which were created through human activity (deforestation). These are the warm sun-flooded slopes, usually covered with rocks, but also around limestone quarries.

During the control, which I made in October 1968 on the foot of the Vreten hill near Žilina, I found only a very weak population.

In late August 1967 on the locality Horky near Rájecká Lesná which was discovered by LOŽEK (1962) I found only a few shells. A pine forest is being planted here. On the basis of verbal reports of the local people this species used to be found here, in large numbers in cereal stands. I found about 10 live snails — all in the roadside ditch close to where the road meets the stream which runs down from the hills. That year the place had had no rain for about four months, so the snails were probably able to survive only in the damper ditch. In 1968 (mid-October) I found a very strong population in the same places on the southern slope of the roadside ditch. This summer was very rainy which probably was the reason for such strong reproduction.

Biotopes in the other localities where I made a revision of the populations and collected samples for a statistical assessment (Drietoma u Trenčína, Stankovany u Kralovan, Soběšovice u Žermanické přehrady) are described by HUDEC and BRABENEC (1964).

The occurrence of *C. unifasciata* near Branná (Hrubý Jeseník) is interesting. This locality was suggested to me by S. Mácha (the first find was made by A. Pakrt, 20. 6. 1967) who determined this population as *C. soosiana*. I made my first collection there in October, 1970. On the overgrown southern slope about 200—500 m west of the limestone quarry I found a weak population of snails with a conspicuously high shell. In October 1972 I found a strong population right on the bottom of the abandoned quarry with very thin vegetation cover.

I assume that this find may be connected with the occurrence of *C. unifasciata* in Poland (arround Opole). It is certainly not the last find-

ing place in CSSR and when, later on, others will be discovered it will most likely be possible to determine the spreading of this species over large distances.

2. Helicopsis striata

In Bohemia the ecology of this species was thoroughly studied by LOŽEK (1947a). During the revision of the locality Kopeč u Neratovic (24. 9. 1967) after a fortnight of rain I found a weak population of *H. striata.* On the grass there were light specimens; dark specimens were to be found close to the ground in clusters of vegetation. At 13.00 hours using a normal thermometer I recorded a temperature in full sun of 33 °C about 10 cm above ground on the southern slope and 21 °C in the soil. On 4. 5. 1968 at 15.00 hours (sunny, southly breeze) I recorded 33 °C about ten cm above the ground and 20 °C seven cm deep in the soil. On 28. 7. 1968 at 13.00 hours (overcast, fresh northly wind): 23 °C one meter above the ground, 32 °C at ground level and 18 °C ten cm deep in the soil. The temperatures and the composition of the xerophilous vegetation indicate that the locality is very warm. Therefore *H. striata* could have survived here had it not been for the other adverse factors.

The ecology and occurrence in Moravia and Slovakia was studied by LOŽEK (1952, 1953, 1959) and HUDEC (1953, 1966).

In 1968 I did not find a single shell in the Pavlovské hills. On. 13. 10. 1968 I visited the well known finding place in Mužla u Štúrova in Slovakia. Though the summer was very rainy I found only a weak population in the acacia and plum gorge west of the village — on the clayey southern side. At thet time it was very warm there.

Of all the species of this sub-family, *Helicopsis striata* is obviously most warmth demanding and sensitive to a certain soil condition and type of vegetation.

3. Helicella itala

According to Ložek's collections most localities are found on the southern slopes of the western wing of the Bohemian Highlands (České Středohoří). They are mostly the densely overgrown steppe slopes and windrows with uncut grass, slopes and roadside ditches (as I have ascertained near Čížkovice) but also railway trenches (Třebenice, Přeplatilov u Mělníka, Hrubý Rohozec) and lucerne fields. With the exception of Hrubý Rohozec near Turnov I always found live specimens though in weak populations. All places face the east to south.

4. Helicella obvia

In our country *Helicella obvia* it the most widespread species of this sub-family and we may say it is one of the most common snails. According to LOŽEK (1949b), it is an indicator of cultivated steppe. It spreads to all biotopes which even slightly meet the ecological requirements of this species. Therefore we find it so often on the sides of roads, railways, cultivated soil and so on. But it can be found also far from the areas it systematically inhabits (fig. 5) in the middle of forest areas on islands of transformed lime or close to castle ruins. Such island occurrence is particularly typical for southern Bohemia. As with all the other species of the *Helicellinae* sub-family it is found mostly on sites facing east to south.

Its vertical distribution, in view of the location of the steppe sites, is mainly concentrated at an altitude of 200—400 m above sea level. On suitable southern limy slopes in this country it ascends altitudes of 850 m (Vršatecká skaliska u Trenčianské Teplé, Bílé Karpaty — HUDEC, 1955).

In warm periods of drought some specimens climb up to the tops of plants (150 cm).

Helicela obvia is active until the autumn frosts. So I found a rich population on the southern slope of the Říp (Ctiněves) on November 2nd, 1967, when the snails were crawling on grass completely covered with hoarfrost.

In the spring I found the earliest specimens on 26. 3. 1967 (Nučice). This month it was already very warm (around noon I recorded an air temperature of 21 °C and 10 °C in the soil).

The responses of this snails to optical and thermal differences were studied under laboratory conditions by SCHMID (1930) .

The occurrence of *H. obvia* in winter is mentioned by ANKERT (1917).

5. Cernuella (X.) neglecta

LOŽEK (1956) and HOŘÍNEK (1966) report about the occurrence of this rare specimen.

During the revision of localities of *C. neglecta* on 23. 6. 1968 in Lázně Mšené on the southern densely overgrown slope near the Močidlo pond, I found only one live adult specimen and a larger number of empty shells. I found also shells an the left bank of the Vrbecký stream up to Martiněves railway station. This slope is quite steep and in the side depression facing the south I found a number of shells. The substrate is similar to the one near Kochánky and Třebenice (arenaceous marl). On the railway trench near the road from Vrbka to Martiněves I found six well preserved shells of *C. neglecta* together with *H. obvia.*

On the Býchory locality near Kolín on 16. 7. 1967 on a field path from Ovčáry to Býchory I found only shells, but I found live snails on the field path from Býchory in the southern direction. There they occured also in lucerne, clover and wheat. The place is located on the southern slope of the Homole hill.

Another finding place discovered by Brabenec and Zvarič in 1967 is one the southern slope of the Košťál hill near Třebenice. When I visited this place I found a *C. neglecta* right on the railway trench near the Třebenice-city railway station. It also occurs on cultivated places of the eastern and southern slope under Košťál 250—300 m high. It does not reach into the densely overgrown steppe slope.

In an experiment with overwintering I kept 230 specimens from Ovčáry — Býchory locality (collected on 30. 10. 1968) in a cardboard box behind the window. After wetting on 27. 5. 1969 seventy specimens, i. e. 30.4. % of the original stock, awoke from their winter sleep. Of the 42 specimens (Košťálov, 7. 9. 1966, lgt. B. Zvarič) owerwintering behind the window in a glass jar 15 specimens awoke after wetting on 28. 3. 1967, i. e. 30.6 % of the original stock.

This species is very expansive, its populations are usually medium to very strong and most of all species of this sub-family it inhabits cultivated places.

X. PLANTS AND THE FOOD OF SNAILS

The bond of the species of this sub-family to different biotopes is also given by food relations. Available data in literature about the food of *Helicellinae* are very sporadic (FRÖMMING, 1954, 1962).

According to SCHMID (1930) *Helicella obvia eats* in nature both dry and dead parts of plants (*Sisymbrium sophis* and *Achillea millefolium* in a moist condition after rain or dew) and live plants (*Atriplex hastatum, Lactuca scariola, Ballota nigra, Daucus carota, Convolvulus arvensis, Medicago sativa*).

Helicella itala apparently eats, according to SCHMID (1934), only dead and dry parts of plants, especially *Bupleurum falcatum* in moist condition.

There are reports in literature stating that some species of this sub-family occur also in coniferous forests. In this country PETRBOK (1938a, 1938c) wrote about the penetration of *H. obvia* into spruce, pine and lowland forests. I personally believe this not at all proof of adaptation of this species to completely different biotopes. When shells only were found in such places they were probably introduced there. It is also possible that these places had been afforested shortly before and this species continued to live on larger open places.

As I was unable to determine in laboratory the eating of certain plant species, I noted like other authors, on which plants *Helicellinae* did settle most frequently.

1. Candidula unifasciata

On the Chýnice - Dubecký mlýn locality I found most specimens on dry stands of *Cichorium intybus* and *Calamagrostis epigeios.* Therefore, I assume that this species lives mostly on the dead moist parts of plants.

In the Slovakian localities (populations denoted as *C. soosiana*) near Rájecká Lesná, the foot of Vreten hill, I found the snails mostly on *Cichorium intybus, Plantago* sp., *Achilea millefolium, Fragaria* sp., *Carlina* sp.

2. Helicopsis striata

On the locality Kopeč u Neratovic which has a very xerophilous flora, I found *H. striata* most often on *Festuca* sp. and *Agropyrum repens.*

3. Helicella itala

I believe that SCHMID'S (1934) assumption stating that these snails live mostly on disintergrating herbs, is corect. I myself used to find this snail most frequently in places with a sufficiency of dry to decaying plants (Košťál, Lovoš u Lovosic). In view of reports that it also occassionally occurs close to or right in cultivated areas it is still unexplained whether in such places the snails also feed on the dried parts of such plants or whether they eat them fresh.

4. Helicella obvia

I used to find this species most often in roadside ditches and railway trenches on various grass species (*Poaceae*).

I used to find numerous populations in places where the steppe biotope (or windrows, field paths, trenches) neighboured on cultivated fields (especially lucerne, mixtures, clover, autumn fields not ploughed in): Ctiněves pod Řípem, Slatina pod Házmburkem, Vítězov u Kolína, Tobolka a Jarov u Srbska, Mužla u Štúrova, Perná, Znojmo - Pohořelice. I also found it frequently in the occassionally cultivated cherry or morello cherry tree orchards: Házmburk u Lovosic, Dubany u Libochovic, Kamenice nad Hronom u Štúrova.

Altogether the strongest population I found on the locality Poplužĺ u Mladé Boleslavi (14. 7. 1968). It was very loose fallow land near the railway with typical rubble vegetation including mainly *Lactuca scariola* (up to 15 specimens on one plant), *Artemisia vulgaris, Taraxacum* sp., *Verbascum* sp. and so on.

5. Cernuella (X.) neglecta

This species is found on steppe slopes but very fast penetrates cultivated areas from there. In Třebenice it is found mostly along the railway tracks from where it spread to the south, to the eastern slope below the Košťál ruins, onto fields paths, windrows, lucerne fields and cultivated orchards. It does not reach places with consistent stands of thick uncut grass (there only *H. itala* can be found).

On the Ovčáry - Býchory locality I found this species on field paths cultivated on both sides, where it reached into stands of wheat, clover and lucerne. By a laboratory experiment I found that this species very intensively eats fresh grass from the locality, which I placed together with the sod into the bottle. At first they ate only the epidermis and part of the mesophyl, later they consumed the grass leaves leaving only the venation and tissue mechanism. In the end only individual fibres remained.

It is probable that in a massive occurrence this species could become an occassional pest even to young cereals.

In conclusion of this chapter it is necessary to state that even in future it will be important to give more notice to the composition of plant cover on the sites of *Helicellinae species* and to determine the plants which they eat. Maybe even the food composition will explain the differences in the occurrence of these species on the different localities.

XI. $CaCO_3$ CONTENT ON THE LOCALITIES

This problem has been given much attention by earlier authors who were aware of the dependence of snails on the content of calcium in the soil or food for the construction of their shell.

According to data in literature not only the content of calcium is decisive but also the physical condition in the biotopes.

According to LAIS (1943) and SCHMIDT (1955) snails need not take in $CaCO_3$ just with their food but also through the mucous glands in the foot.

According to FRÖMMING (1962) the contents of this compound in their food is sufficient.

Species of this sub-family all have a ± strong, thick-walled shell and according to literary data and actual collections they live on only such substrates which contain calcium mostly in form of calcium carbonate. All these species are thus calciphilous. LOŽEK (1956) divides the species according to their relation to the substrate into pedophilous which prefer soft substrate, and petrophilous which require bare, stone eroding substances. The first group would include mainly the *Helicopsis striata* from the *Helicellinae* sub-family.

Due to the contradictory opinion of many authors on the effect of calcium in soil on the incidence of snails I tried, through observations of the occurrence of the different species of this sub-family and through analyses of soil samples, to form an opinion of my own regarding this whole problem. Therefore I present a list of localities (tables XXXXIII — XXXXVII) on which I determined the percentage of calcium carbonate content in soil. First of all, however, I must point out that the calcium carbonate content is different in the different though nearby sites of one locality. Therefore in the interest of accuracy it is necessary to compute an average of several samples from one locality. The calcium carbonate percentage is determined most accurately in the locality Chýnice - Dubecký mlýn where I made a number of tests from different places and from different depths (table XXXXIII).

1. Candidula unifasciata

The substrate in localities of typical *C. unifasciata* populations is disturbed lime, diabase tuff (Chýnice - Dubecký mlýn), sandy marl or loess (around Opočno). *C. unifasciata* can be found alongside roads, railway trenches and on steppe secondary slopes (deforested). $CaCO_3$ content (table XXXXIII) ranges from 2 to 32.3 %. I found live snails in localities with 2 - 4.5 % of calcium carbonate (i. e. weakly limy soil).

The most stable and relatively strong population is on the diabase tuff near Chýnice. In comparison with the population so far denoted as *C. soosiana* it occurs on biotopes with a much lower $CaCO_3$ content. Even here, however, the shell is broader in the roadside ditches than on the undisturbed steppe slope (Chýnice).

The substrate of populations so far denoted as *C. soosiana* are limes, dolomites, travertines and marl rocks of secondary xerotherm biotopes created through the activity of man. They are usually disturbed restrati-

Table XXXXIII. $CaCO_3$ contents on the localities in Candidula unifasciata

(o - population known as C. soosiana)

locality	population density	shells only	% $CaCO_3$
o Branná u Hanušovic, hillside near limestone - breaking (6. 10. 1970)	+		0.06
o Branná, limestone - breaking	+++		
o Drietoma u Trenčína (9. 10. 1970)	++		8.3
Choteč - Ořech (IV. 1967)		+	10.6
Chýnice - Dubecký mlýn (IV. 1967)	++		5.2
(29. 6. 1968)	++		0.4
(17. 7. 1968)	++		
1st site 0— 5 cm 1.0 %			
5—10 cm 1.1 %			
2nd site 0— 5 cm 2.0 %			
5—10 cm 3.2 %			
3rd site 0— 5 cm 9.2 %			
5—10 cm 11.2 %			
10—15 cm 10.0 %			
20—25 cm 11.4 %			
30—35 cm 10.9 %			
Mean value in this locality			3.5
Ledce - Očelice u Opočna (IX. 1967)		+	21.0
Nučice u Rudné (near village) (17. 7. 1968)		+	
0— 5 cm 5.0 %			
5—10 cm 5.3 %			
10—15 cm 7.9 %			
30 cm 2.4 %			
Mean value			5.7
Nučice - Krahulov (III. 1967)		+	32.3
Očelice u Opočna, near station (IX. 1967)	+		2.6
(5. 11. 1968)			1.4
Opočno - Očelice, railway (IX. 1967)		+	14.3
Tachlovice u Horního mlýna (V. 1967)		+	16.1
Tachlovice - Kuchař (V. 1967)	+		4.5
o Rájecká Lesná - Šuja (VIII. 1967)	+		
(11. 10. 1968 — 1st site	++++		15.8
2nd site	+		65.0
o Sněžnice u Žiliny, Vreten (11. 10. 1968)	+		8.0

Table XXXXIII. (continue)

locality		population density	shells only	% $CaCO_3$
° Soběšovice u Frýdku	(X. 1968)	++		3.8
	(8. 10. 1970)	++		30.5
° Stankovany u Kralovan, near railway	(8. 10. 1970)	+		14.2
Štramberk u N. Jičína	(11. 10. 1968)	+		29.0

Explanation:

+	population density - low
++	population density - medium
+++	population density - high
++++	population density - very high

fied materials. $CaCO_3$ content on the examined localities (table XXXXIII) ranges from 0.06 to 65 %. The strongest population I found was near the Rájecká Lesná - Šuja road in places where the calcium carbonate content reaches about 15.8 %. On the limy substrate which I determined some 200 m further up (65 % $CaCO_3$) the snails occurred only sporadically. The substrate consist of dolomite made — up ground from the surrounding hills.

2. Helicopsis striata

The substrate of the localities of this species consists mainly of loess, marl, less often lime or basalt breccia and that especiall where it is at least partly covered with loess or hill clay (Kopeč, Srbsko). According to LOŽEK (1949b) it prefers soil steppes to rock steppes. The soil sample on which I found *H. striata* contains 0.1 — 14.0 % calcium carbonate (table XXXXIV). I found live specimens on soil with 1.4 — 7.9 % $CaCO_3$. It is probably more difficult to acquire lime on the hills near Kopeč (7.9 %) where the shells are smaller though there is a sufficient amount of calcium in the soil, than around the railway near the road close to Chlumín where the shells are considerably larger (though there is less $CaCO_3$ — 1.4 %). This is apparently connected with the cultivated field (next to the railway) and probably with nitrate fertilizing (HUDEC, 1966). In 1966 Brabence and Zvarič found here many live specimens in the farm culture. This would suggest a certain degree of adaptation to secondary (cultivated) biotopes though LOŽEK (1947a, 1956) states that they are unable to penetrate to such places. This of course makes no difference to the fact that in Czechoslovakia this species is in recession, no matter what the reason are.

3. Helicella itala

The substrate of localities of this species are arenaceous marl, marl, limy sandstone and in the Bohemian Highlands also limy gravel and

Table XXXXIV. $CoCO_3$ contents on the localities in Helicopsis striata

locality		population density	shells only	% $CaCO_3$
Dubany u Libochovic, Rohatec	(13. 7. 1968)		+	14.0
Chlumín u Neratovic	22. 6. 1968)			
	near road		+	3.5
	station	++		1.4
Kopeč - plateau of Špičák	(VII. 1968)		+	0.1
Kopeč u Neratovic, near village	(IX. 1967)	+		7.5
	(4. 5. 1968)	+		12.3
	(28. 8. 1968)		o	4.8
	(19. 10. 1968)		o	6.9
	Mean value			7.9
Malý Újezd u Mělníka, railway	(25. 4. 1968)		+	6.0
Mužla u Štúrova	(13. 10. 1968)	+		6.0
Odolena Voda - Špičák	(28. 7. 1968)		+	12.0
Straškov u Roudnice n. L., railway	(13. 7. 1968)		+	0.3

loess. The localities (table XXXXV) contain 1.8 % (Mělnická Vrutice) to 23 % $CaCO_3$ (Třebenice, railway). I never found *H. itala* on cultured areas while Ložek collected it around Posedlice (Bohemian Highlands) frequently on fields of lucerne. For a general conclusion there are in CSSR too few localities of this species, as well as a small number of analyses made.

Table XXXXV. $CaCO_3$ contents on the localities in Helicella itala

locality		population density	shells only	% $CaCO_3$
Čížkovice u Lovosic	(28. 4. 1968)	+		14.0
Dolánky u Turnova	(20. 5. 1969)		+	8.5
Mělnická Vrutice, Přeplatilov	25. 5. 1968)	+		1.8
Sulejovice u Lovosic	(28. 4. 1968)	+		12.0
Třebenice - Košťálov	(23. 10. 1968)	+		11.0
Třebenice - railway	(28. 4. 1968)		++	23.2

4. Helicella obvia

This species is found in places where the substrate is limestone, basic igneous rock (especially basalt and its derivatives), marl, limy sandstones. Soil samples (table XXXXVI) on which I found *H. obvia* contained 0.2 % (Kamenný Most u Štúrova) to 45 % $CaCO_3$ (Černčice u Loun, railway). Live snails I found on localities with 0.2 — 24 % calcium carbonate. I present a table showing the size of the population and $CoCO_3$ quantities in the soil.

Population density			
low	medium	high	very high
0.2 %	0.2 %	2.8 %	13.5 %
0.3	2.2	7.9	
1.4	3.4	9.3	
1.7	3.5	9.5	
3.5	5.9	13.5	
4.2	8.0	20.0	
5.2	9.0		
11.7	9.3		
12.0	12.0		
14.0	12.5		
14.0			
17.0			
24.0			

Most localities with stronger populations are found next to fields close to roads, along field paths or railway trenches. The strongest population of *H. obvia* (60 specimens per m^2) I found on a piece of fallow land adjoining the railway close to Popluží u Jezerního Vtelna (13.5 % $CaCO_3$).

On natural steppe biotopes I found larger populations but rarely (Kopeč u Neratovic — 7.9 %, Spiš castle — 9.5 %, Bišanský Chlum u Loun — 5.5 % $CaCO_3$ /here only a number of shells/).

This difference is very conspicuous on the Dubany u Libochovic locality. On the southern slope of the Rohatec hill there is a permanent grass stand (probably never cut) — there I found, 13. 7. 1968, only several old shells of *H. obvia.* On the eastern side of the hill, in an occasionally cultivated morello tree orchard I found six times as many shells of snails not long dead (14.0 % $CaCO_3$). Also on the railway near the fallow land near Popluží, where there was a very strong population of various ages, I found no shells at all. Near Votice I found *H. obvia* on a cattle run in a cherry orchard in places where limestone comes up to the surface.

The given findings indicate that *H. obvia* occurs much more frequently and in greater numbers around or right on place which are irregularly cultivated. Such places are fallow land, fields with mixtures or clover, stubble that is not immediately ploughed in. For the occurrence of *H. obvia* loose, disturbed soil is then more suitable than soil which is not covered with consistent vegetation.

Table XXXXVI. $CaCO_3$ contents on the localities in Helicella obvia

locality		population density	shells only	% $CaCO_3$
A) Low calcareous soil (0—5 % $CaCO_3$)				
Byškovice u Neratovic	(4. 5. 1968)		++	3.8
Chlumín u Neratovic	(22. 6. 1968) 1st site 2nd site	+	 ++	 3.5 1.4
Chotětov u Benátek n. Jiz.	(14. 7. 1968)		+	3.0
Kamenný Most u Štúrova	(13. 10. 1968)	+		0.2
Koda u Srbska	(7. 9. 1968)	++		3.5
Kochánky u Benátek n. Jiz.	(31. 5. 1968)	+		4.2
Kolín - Ovčáry	(VII. 1967)	++		3.4
Kralovany u Žiliny	(VIII. 1967)		+	0.5
Lysá n. L. - Benátecká Vrutice	(VII. 1967)		+	4.2
Malý Újezd u Mělníka	(25. 4. 1968)		+	5.0
Malý Újezd - Jelenice	(25. 4. 1968)		+	5.0
Mělnická Vrutice	(25. 4. 1968)		+	4.2
Mělnická Vrutice, Přeplatilov	(25. 4. 1968)		+	1.8
Neratovice, railway	(4. 5. 1968)		+	0.0
Netřeba - station	(IX. 1967)		+	3.3
Obříství - Chlumín - Korycany	(22. 6. 1968)	+		1.7
Očelice u Dpočna	(13. 10. 1968)	+		1.4
Ohrada u Kolína	(30. 6. 1968)	++		0.2
Ořech - Choteč	(IV. 1967)		+	1.2
Přeplatilov u Mělníka	(25. 4. 1968)		++	0.4
Radvaň u Komárna	(14. 10. 1968)	+		0.3
Straškov u Roudnice n. L., railway	(13. 7. 1968)		+	0.3

Table XXXXVI. (continue)

locality		population density	shells only	% $CaCO_3$
Tobolka u Berouna	(7. 9. 1968)	++		2.2
Veliká Ves - Kopeč	(28. 7. 1968)		++	0.8
Velim u Vítězova	(30. 6. 1968)		+	3.8
Zlončice u Kralup	(IX. 1967)		+	0.1
Znojmo - Pohořelice	(X. 1968)	+++		2.8
B) Middle calcerous soil (5—10 % $CaCO_3$)				
Býchory u Kolína	(VII. 1967)	++		8.0
	(30. 10. 1968)	++		9.3
Ctiněves pod Řípem	(2. 11. 1968)	+++		9.3
Chlumčany u Loun - Blšany	(13. 7. 1968)		+	6.3
Kochánky - Benátky n. Jiz.	(VI. 1967)		+	10.0
Kopeč u Neratovic	(IX. 1967)	+++		7.5
	(4. 5. 1968)		+	12.3
	(28. 7. 1968)		+	4.8
	(19. 10. 1968)		o	6.9
	Mean value this locality			7.9
Křesín u Libochovic	(VII. 1968)		+	7.3
Launy, Blšanský chlum	(VII. 1968)		+++	5.5
Mužla u Štúrova	(13. 10. 1968)	++		6.0
Spišský hrad u Spiš. Podhradie	(VIII. 1967)	+++		9.5
Stará Lysá - Čihadla	(VI. 1967)	+		5.2
Telnice u Slavkova	(14. 8. 1967)	++		9.0
Vítězov u Kolína - Bedřichov	(30. 6. 1968)	++		5.9
Vrbka u Libochovic	(23. 6. 1968)		+	8.1
C) Highly calcareous soil (10—20 % $CaCO_3$)				
Čížkovice u Lovosic	(28. 4. 1968)	+		14.0
Dol. Věstonice - Hor. Věstonice	(VIII. 1967)	+		14.0

Table XXXXVI. (continue)

locality		population density	shells only	% $CaCO_3$
Dubany u Libochovic, Rohatec	(13. 7. 1968)		++	14.0
Chotěšov pod Házmburkem	(5. 5. 1968)		+	19.0
Jarov u Berouna	(7. 9. 1968)	++		12.5
Kamenice u Štúrova	(13. 10. 1968)		+	20.0
Mšené Lázně u Budyně n. O.	(23. 6. 1968) 1st site 2nd site		++ +	 10.1 13.4
Netřeba (station) u Neratovic	(IX. 1967)	++		12.0
Odolena Voda - Špičák	(28. 7. 1968)		+	12.0
Opočno - Očelice	(IX. 1967)		+	15.3
Ovčáry - Býchory	(30. 10. 1968)	+		17.5
Perná - Pavlovské vrchy	(15. 10. 1968)	+++		13.5
Popluží u Jiz. Vtelna	(14. 7. 1968)	++++		13.5
Slatina pod Házmburkem	(5. 5. 1968)		+	15.0
Sulejovice u Lovosic	(28. 4. 1968)	+		12.0
Štítary u Kolína	(30. 6. 1968)	+		11.7
Tuřice - Sobětuchy	(VII. 1967)		+	10.6
Votice, limestone - breaking	(IX. 1967)	+++		
D) Very highly calcareous soil (20—50% $CaCO_3$)				
Býchory, Homole	(30. 10. 1968)	+		24.0
Černčice - Blšany	(13. 7. 1968)		++	24.0
Černčice - Veltěže	(VII. 1968)		+	45.0
Diel u Kralovan, limestone	(VIII, 1967)		+	
Házmburk	(5. 5. 1968)		++	28.5
Křesín u Libochovic, Viselec	(13. 7. 1968)		+	21.0

Table XXXXVI. (continue)

locality		population density	shells only	% $CaCO_3$
Ledce - Očelice	(IX. 1967)		+	21.0
Nučice - Krahulov	(III. 1967)		++	32.3
Třebenice - railway	(28. 4. 1968)		+	23.2

This occurrence close to cultivated areas could support the assumption of HORST (1960) and HUDEC (1966) that nitrogen (used in fertilizers) breaks down the $CaCO_3$ producing the easily soluble $Ca(NO_3)_2$.

5. Cernuella neglecta

The substrate of these localities in CSSR is mainly chalk sediment. On all localities medium to very strong populations are being found in recent years.

The content of calcium carbonate in soil ranges (table XXXXVII) from 4.2 % (Kochánky) to 26 % (Třebenice). The strongest populations

Table XXXXVII. $CaCO_3$ contents in the localities in Cernuella neglecta

locality		population density	shells only	% $CaCO_3$
Býchory u Kolína	(VII. 1967)	+++		8.0
Homole	(30. 10. 1968)	+		9.3
Kochánky u Benátek n. Jiz.	(31. 5. 1968)		++	4.2
	(X. 1968)	++		
Mšené Lázně u Budyně n. Ohří	(23. 6. 1968)			
	1st site		++	10.0
	2nd site	+		13.4
Ovčáry - Býchory	(30. 10. 1968)	++++		17.5
Třebenice - railway	(28. 4. 1968)	+++		26.0
Třebenice - Čížkovice (railway,	24. 10. 1968)	+		4.8
Třebenice, Košťál	(28. 4. 1968)	++		3.2
	(23. 10. 1968)	+		11.0
Vrbka u Libochovic	(VI. 1968)	+		8.1

are on soil with high calcium content (10—20 % $CaCO_3$). Save for one, truly steppe locality (Mšené lázně) all the others are close to intensively cultivated places (field paths).

Most of all species this one penetrates cultivated areas. Therefore even for *C. neglecta* the same conclusion applies as for *H. obvia,* but to a greater extent.

XII. MOLUSC COMMUNITIES

Species of the sub-family *Helicellinae* are accompanied in their biotopes by typical steppe, semi-steppe, or even other admixed species. The composition of the mollusc community on xerothermic localities is influenced by both physical and chemical properties of the substrate. According to this LOŽEK (1949b, 1955f) discriminates between soil steppe, rock steppe (subdivided into calcareous and non-calcareous), cultured steppe and secondary biotopes (railway tracks and roadside ditches, castle ruins, deforested places). Mollusc communities more or less correspond with this division (LOŽEK, 1949b).

According to LOŽEK (1947a, 1948b, 1951a, 1952, 1953a, 1955d), PETRBOK (1947), HRUBÝ (1957), HUDEC (1953, 1966), HOŘÍNEK (1966) the following species most often accompany species of this sub-family:

Pupilla muscorum (L.)
Cepaea vindobonensis (FÉR.)
Chondrula tridens (MÜLL.)
Vallonia pulchella (MÜLL.)
Vallonia costata (MÜLL.)
Oxychilus inopinatus (ULIČ.)
Granaria frumentum (DRAP.)
Cecilioides acicula (MÜLL.)

It depends on whether the steppe is of the soil, rock or cultivated type. Of course, there are many localities where species of this sub-family live temporarily alone.

XIII. SUMMARY

The submitted paper was worked out at the Zoological Department of the National Museum in Prague. It is the result of a six-year (1968—1974) field and laboratory study of all five representatives of the *Helicellinae* sub-family living on the territory of CSSR. An indispensable component of the text are maps of distribution of Czechoslovak *Helicellinae,* lists of localities, tables giving biometric data about the genital apparatus, photographs of the genital organs, graphs and drawings.

Due to the large number of described species of this sub-family and to their great variability the opinions on the systematical status and the justification of some taxones often lack uniformity. In describing new species the variability of shells and the genital apparatus was not always taken into consideration. This sphere of problems occured on the territory of CSSR in conection with species of the genus *Canudidula* KOBELT, 1871, and therefore greater attention was given to the taxonomy of this genus.

The following results were obtained through the study of extensive material:

1. On the basis of actual research, material from the collections of the Zoological Department and literary data a comprehensive determination of the distribution of species of the sub-family in CSSR was made and drawn into maps. CSSR is the easternmost border of distribution of the *Candidula unifasciata* (POIRET, 1801) species. The oldest findinding places are known from the end of the last century in the vicinity of Opočno. Another small island in Bohemia is around Tachlovice u Nučic. In Moravia it is found between N. Jičín and Těšín. In Slovakia this snail inhabits the north-western part.

The occurrecne of *Helicopsis striata* (O. F. MÜLLER, 1774) is limited to the original steppe regions at low altitudes of Bohemia, south Moravia and south Slovakia. *Helicella itala* (L., 1758) is in this country a rare species and can be found only in north Bohemia.

The most common Helicella in Czechoslovakia is the *Helicella obvia* (Menke, 1828) which can be commonly found in forestless, dry and warm regions of steppe character on a calcareous substrate. In Bohemia it is very frequent in the central and northern parts, in the broad region of the river Elbe basin, and in islands in southern Bohemia where it is limited to metamorphosed calcites. In Moravia it is dispersed in the lower parts of the whole region. In Slovakia it occurs in the lowlands of southern Slovakia up to Turna u Košic, in the west in Váh river basin up to the vicinity of Ružomberok, in places it penetrates into the inner Carpathian area (the region between Poprad and Sabinov u Prešova).

Cernuella (*Xerocincta*) *neglecta* (DRAP., 1805) can be found but very rarely and then only in the river Elbe basin. This is a species which has appeared only recently in this country.

2. The genital apparatus of 187 specimens and five species was examined and its variability determined. Tables and graphs contain dimensions of the different parts of the genital apparatus (penis, epiphallus, flagellum, vas deferens, bursa telae, glandulae mucosae, truncus receptaculi, receptaculum seminis, spermoviductus, glandula albuminalis, ductus hermaphroditicus) including standard deviation, mean error and coefficient of variation.

3. Biometrical measurements of shells were taken 2155 specimens and their size and pigmentation depending on the different sites were examined. Pigmentation and shel size in species of the *Helicellinae* sub-family were found to be greatly affected by climatic factors. They change not only from locality to locality but also clearly differ in populations on one locality in different years. In dry and warm localities higher and lighter shells are more frequent whille in the more humid and cooler localities the shells are broader and lower but much darker in colour.

4. The importance of the work rests in the revision of species of the *Candidula* genus on the territory of CSSR. After a detailed assessment of a larger amount of material it was found, contrary to the statement of HUDEC (1964), that both anatomical and conchyological features

given as specific for discrimination between *Candidula unifasciata* and *Candidula soosiana* (J. WAGNER, 1933) are not quite constant. They are subject to changes not only in different localities but even on the same place in different years. The main diagnostical features of the genital apparatus — the flagellum and the free end of the dart sac — become shorter in the populations towards the east (flagellum F by up to 0.2 mm and the free end of the dart sac BT_2 by up to 0.4 mm on average). The other findings, too, indicate that the morphology of the genital apparatus is not always a reliable lead for the determination of closely related taxones. In many cases it is more variable than the shell which is in direct contact with the environment.

Also the conchyological features given as diagnostical for both these species are without taxonomical value.The main diagnostical feature — ribbing — is partially subjected to changes on the same locality. This was manifested most clearly on animals from Štramberk (most conspicuous in shells from 1968 compared with material from 1952). Already HUDEC (1964) determines that *C. unifasciata* shells from Štramberk (lgt. Hrubý, 1963) are, compared with shells from Bohemia, more striate and coarser on the last whorl. I may state that the coarser ribbing is positively correlated to light shells without typical banding and to shells with interrupted banding. It also ensues from the comparative material that ribbing increases (is coarser) in populations towards the east and is affected by climatic factors.

This species lives in CSSR (Moravia) apparently on the border of the oceanic more humid and continental more arid climate. According to current research the snail *Candidula unifasciata* appears to be a very plastic species which is capable of inhabiting other suitable territories (but not the original steppe biotope) in the eastern direction and of becoming adapted fairly quickly to the microclimates of new biotopes. ULIČNÝ (1893) assessed that this snail was introduced into this country. According to the appearance of comparative material it seems that the distribution over Czechoslovak territory is not of identical origin. On the hand there is the typical *C. unifasciata* population from around Tachlovice and a similar one (at least the 1952 material) from Štramberk. Then there is the group consisting of the population from around Opočno, northern Moravia and Slovakia, some of which already resemble Polish material. Already POLINSKI (1924) and URBANSKI (1933) pointed out the stronger ribbing of *C. unifasciata* shells from the Těšín and Poznaň districts compared with typical *C. unifasciata* from Germany and Switzerland. This difference is clear even in comparison with our material from Tachlovice. Some other features given as typical for the two species (HUDEC, 1964) change depending on the shell height, and therefore cannot be regarded as such. This applies to the size percentage of the last whorl in relation to the one but last, the shape of the aperture shape of the shell, the angle formed by the last and one but last whorl, the slope of the suture near the last whorl.

Again it is necessary to emphasise that all the noted features change not only among the populations from different localities but also on the

same place in different years. This variability accounted for PETRBOK (1936c) determining two species on the locality Tachlovice u Prahy; in reality probably two different generations or even variable specimens of the same population were involved. The photographs published in his work (1936c) show clearly that he determined shells without clear banding and with clear ribbing as *Candidula* sp. cf. *intersecta* POIRET var. *heripensis* MABILLE, while shells with clear bands and fainter ribs he identified as *Candidula* cf. *unifasciata* (POIRET). In reality only variable specimens of the same species — *Candidula unifasciata* (POIRET) — are involved! This example may be a descriptive warning not only against premature determination, it is also valid for the description of new taxones. And so, thorough knowledge of species variability is the basic prerequisite of all systematic work.

Being unfamilar with these facts it is not then surprising that J. WAGNER in describing *Candidula soosiana*, when comparing type material from Hungary with *C. unifasciata* shells from Germany, identified different features which he used to diagnose a new species. I tried to obtain the type material *C. soosiana* from the Museum in Budapest for comparison. The Hungarian malacologist, L. Pinter, wrote me on October 25th, 1973, that there is only one shell, collected on 22. 2. 1966, in their collections. I had had this shell borrowed; it is roughly ribbed and is similar to shells from Vreten in Slovakia. Unfortunately one specimen is not enough to get an idea about the whole population. This specimen was determined by the Hungarian malacologist as *C. unifasciata.* L. Pinter further notes that this species probably introduced into Hungary 40 years ago, is now most likely extinct there. I personally believe that it came there from one of the localities in Slovakia.

During the examination of the variability of the shell and genital apparatus no constant diagnostical features were found (all change due to climatic conditions) and as the members of the Slovakian populations were identified as *Candidula soosiana* according to the original description from the type locality in Hungary I drew the conclusion that all the populations under investigation belong to one species *Candidula unifasciata* (POIRET, 1801). Therefore, I regard the taxone *Candidula soosiana* (J. WAGNER, 1933) as a synonym. Though the populations so far denoted as *Candidula soosiana* differ from typical populations of *Candidula unifasciata* they cannot be given the status of a separate species. I may regard them only as the easternmost form of the *Candidula unifasciata* species (i. e. infrasubspecific form).

The results of this study are not valid only in this case but may be applied also to other cases within this sub-family outside Czechoslovak territory. It would thus be expedient to take a critical stand in view species *Helicella obvia - macedonica* and *Helicopsis striata - hungarica - - austriaca - cereoflava.*

5. Some biological aspects — the way of hybernating, mating, egg--laying, shell growth and methods of spreading from the original locality were studied on the model species of *Candidula unifasciata* on the locality Chýnice u Prahy.

6. Investigation of the $CaCO_3$ content on localities of species of the *Helicellinae* sub-family revealed that the strength of populations of the different species is not directly related to the calcium content in the soil; however, the soil must contain a certain minimum amount of calcium. It appears though that the size of the population of species *Helicella obvia* and *Cernuella neglecta* is affected by the physical condition of the soil. Both species are much more frequent and in greater numbers around or directly on places which are not cultivated regularly. Such places are fallow land, fields with mixtures and clover and stubble which is not ploughed in.

7. Also some factors influencing the population dynamics of species of the *Helicellinae* sub-famiy were followed. Length of life differs in the different species, the shortest living species is *Candidula unifasciata,* 7—12 months (about 10 % of the hybernating specimens). Population densities differ largely on different biotopes. Central European conditions are not conductive to the formation of the massive populations which are known to exist in southern Europe. Their occurrence in the biotope is irregular. Only once I found a population of *Helicella obvia* with 50—60 specimens per m^2 and *Candidula unifasciata* population with about 100—150 specimens per m^2. Most populations I found were weak or of medium strength.

The strong development of a population is affected, besides temperature, also by longer periods of rain. In such weather lasting the whole year several generation emerge with a locally strong or very strong population in early autumn. Besides purely climatic factors local ones are also very important. In this connection the effect of enemies of these snails (birds, larvae of predatory insects), parasites and possibly chemical sprays would be included. The *Helicopsis striata* species is rapidly becoming isolated, degenerate and extinct in this country. In this case it is important to note that as oposed to the other *Helicellinae* this species does not invade artificial biotopes so easily but, on the contrary, is supressed by human activity.

The dynamism of species of this sub-family is last but not least affected in this country by the winter season. In comparison, some species develop in regions of their original distribution all the year round (except for periods of drought). Research indicates that the dynamics of populations of these snails (and probably of the others, too) is — besides genetical factors — dependent mainly on ecological factors. The different influence cannot be extracted from their complex and used to justify the incidence and number of the given species.

All protocoles and material used in this work are deposited at the Zoological Department of the National Museum in Prague.

EXPLANATIONS OF THE PLATES

Plate I.

1. *Candidula unifasciata* (Poiret), orig. Jar. Brabenec
   Tachlovice u Prahy, 4. 7. 1949
   Shell size: breadth = 7.0 mm, height = 4.6 mm
2. *Candidula unifasciata,* population *C. soosiana*
   Vreten u Žiliny, 21. 8. 1951, orig. Jar. Brabenec
   Shell size: breadth = 6.8 mm, height = 5.0 mm
3. *Helicopsis striata* (Müll.), orig. Jar. Brabenec
   Velkovský vrch u Neratovic, 26. 10. 1958
   Shell size: breadth = 8.4 mm, height = 5.6 mm

Plate II.

1. *Helicella itala* (L.), orig. Jar. Brabenec
   Hrubý Rohozec u Turnova, 21. 8. 1927
   Shell size: breadth = 14.5 mm, height = 7.9 mm
2. *Helicella obvia* (Menke), orig. Jar. Brabenec
   Prokopské údolí u Prahy, 8. 2. 1926
   Shell size: breadth = 16.3 mm, height = 9.1 mm
3. *Cernuella neglecta (Drap.),* orig. Jar. Brabenec
   Budyně nad Ohří, Močidla, 3. 5. 1955
   Shell size: breadth = 12.6 mm, height = 7.7 mm

Plate III.

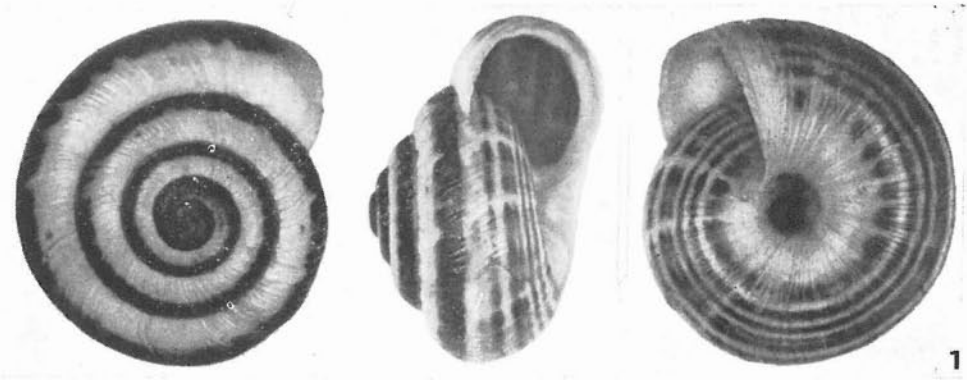
1. Genital apparatus of *Candidula unifasciata* (No. preparation 11f),
   Chýnice - Dubecký mlýn, 20. 10. 1968
   Enlarged 5times
   Shell size: breadth = 5.6 mm, height = 3.2 mm
2. *Candidula unifasciata,* population known as *C. soosiana*
   (No. preparation 4c), enlarged 5times
   Rájecká Lesná - Šuja, 9. 8. 1967
   Shell size: breadth = 6.00 mm, height = 3.5 mm
3. Genital apparatus of *Helicopsis striata* (No. preparation 21c)
   Enlarged 3.7times
   Kopeč u Neratovic, 24. 9. 1967
   Shell size: breadth = 7.9 mm, height = 4.6 mm
4. Genital apparatus of *Helicella itala* (No. preparation 22b)
   Enlarged 3.7times
   Čížkovice u Lovosic, 28. 4. 1968
   Shell size: breadth = 16.4 mm, height = 6.9 mm

Plate IV.

1. Genital apparatus of *Helicella obvia* (No. preparation 18b)
   Enlarged 3.5times
   Perná - Pavlovské vrchy, 15. 10. 1968
   Shell size: breadth = 17.0 mm, height = 8.0 mm
2. Genital apparatus of *Cernuella neglecta* (No preparation 15a)
   Enlarged 3.7times
   Kochánky u Benátek n. Jiz., 20. 10. 1968, leg. V. Hořínek
   Shell size: breadth = 16.7 mm, height = 8.4 mm

Plate V.

1. Dart sac with dart of *Candidula unifasciata,* enlarged 10times,
   Chýnice - Dubecký mlýn, 20. 10. 1968
2. Dart sac of *Candidula unifasciata,* population of *C. soosiana,*
   enlarged 20times, Rájecká Lesná - Šuja, 11. 10. 1968
3. Dart sac of *Helicopsis striata* (young), enlarged 10times.
   Kopeč u Neratovic, 24. 9. 1967
4. Dart sac of *Cernuella neglecta,* enlarged 8times,
   Kochánky u Benátek n. Jiz., 31. 5. 1968



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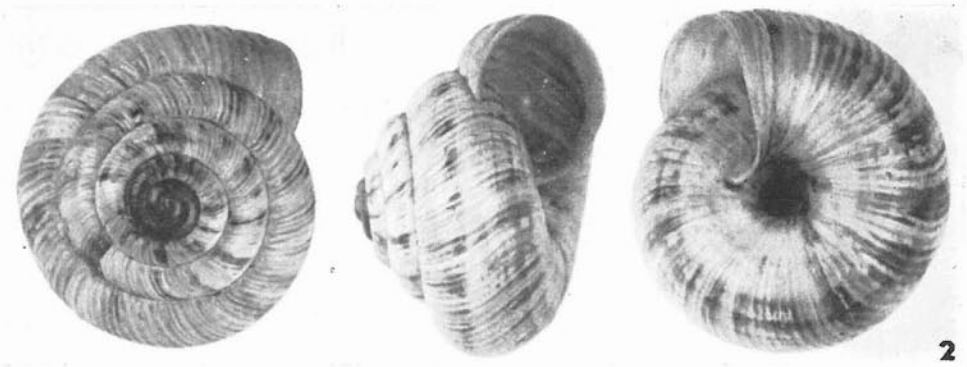

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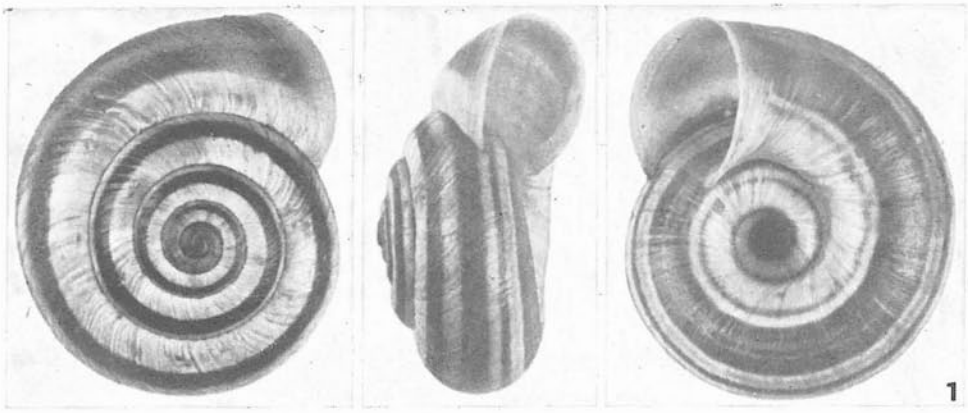

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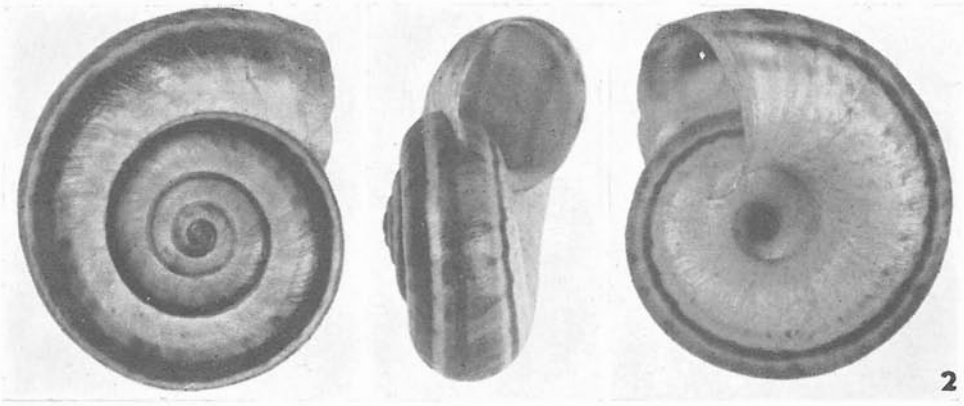

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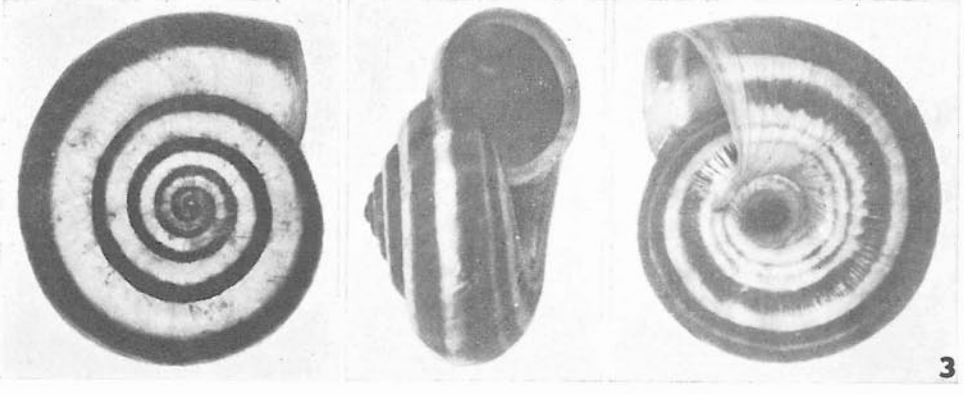

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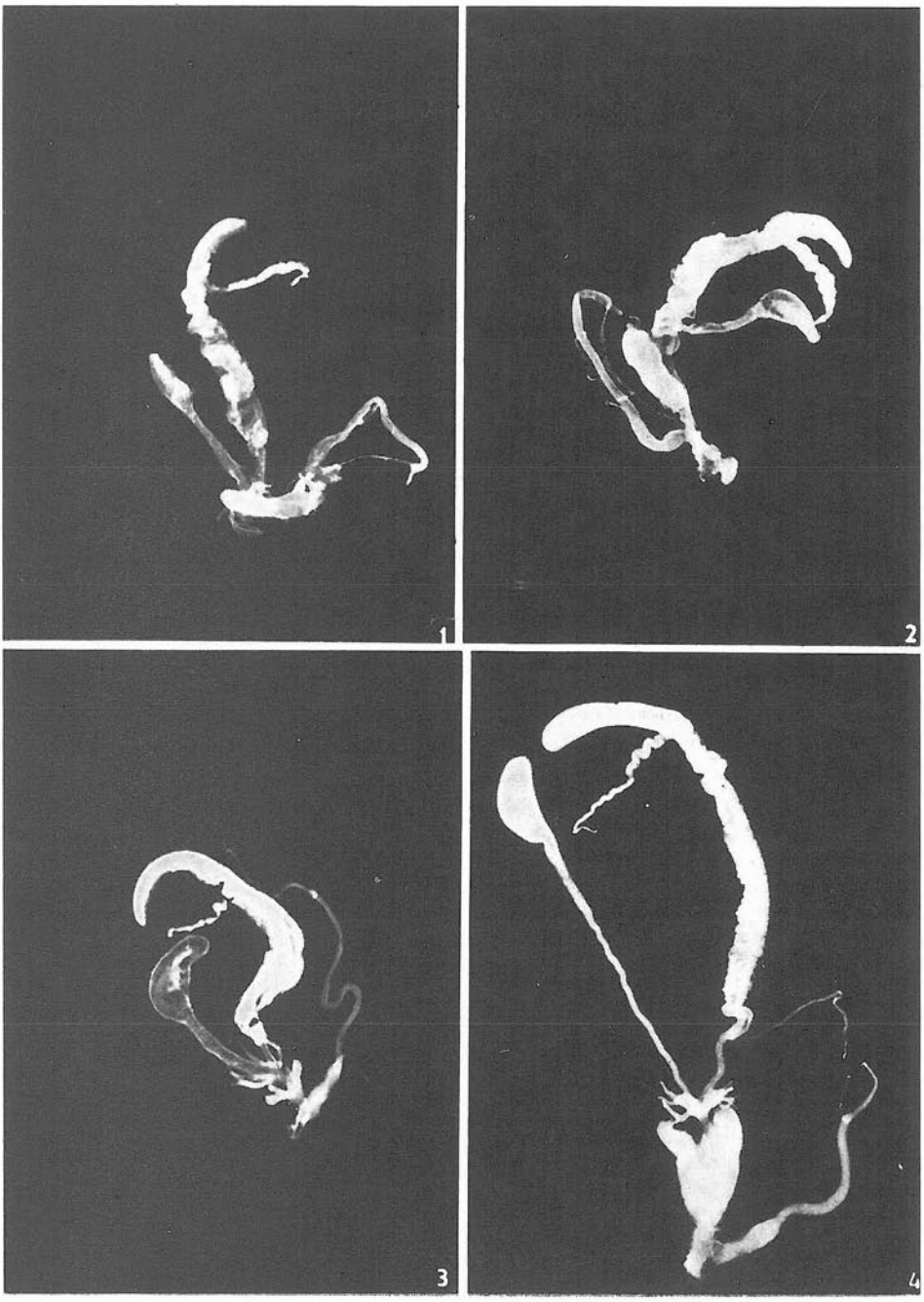
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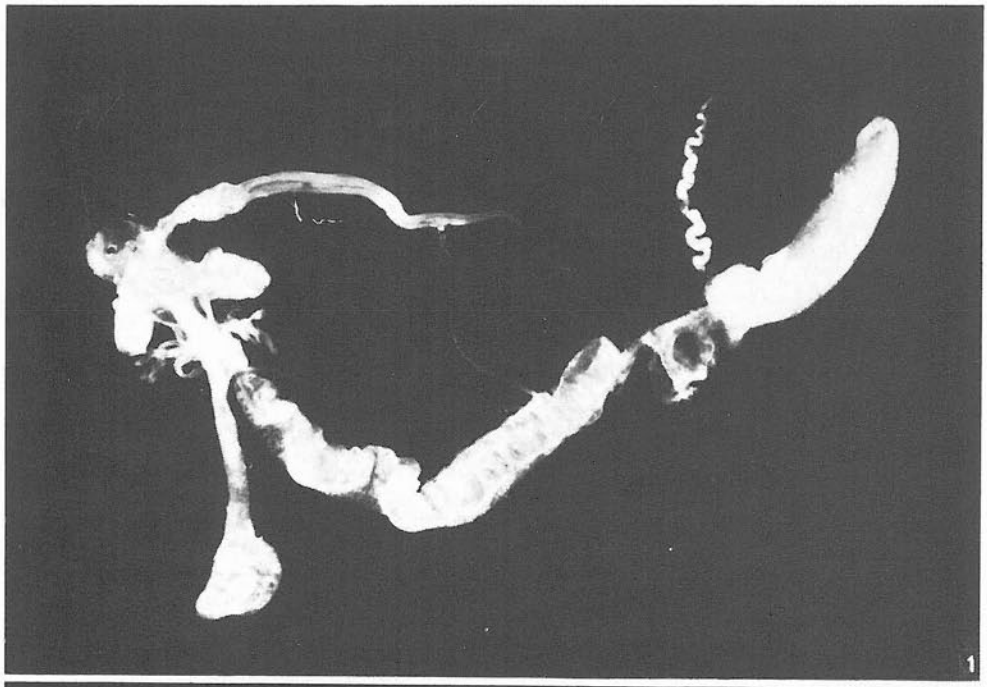
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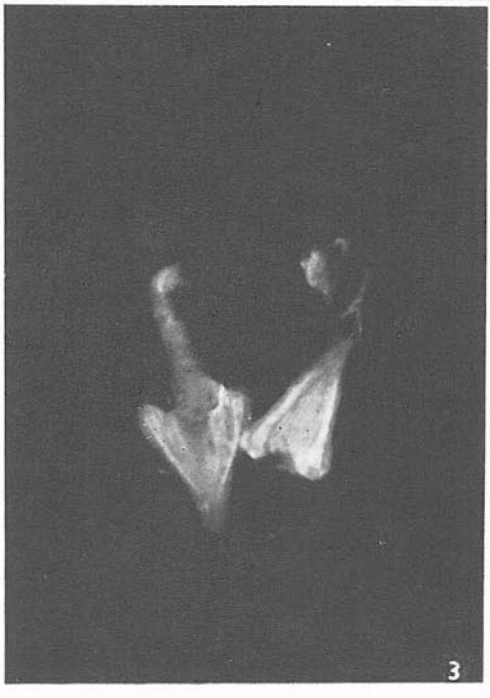
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LIST OF LOCALITIES IN CANDIDULA UNIFASCIATA
(+ population known as Candidula soosiana)

+ Branná u Hanušovic (650 m, leg. A. Pakrt, V. Pfleger)
+ Brušperk u Ostravy, Sovinec (350 m, leg. S. Mácha)
Čánka u Opočna (220 m, leg. Brabenec)
+ Černá Zem u Sedliště u Frýdku (leg. V. Ložek, Mácha)
+ Dolní Lištná u Třince (leg. Mácha)
Drahelčice - Úhonice u Rudné (300 m, leg. Pfleger)
+ Drietoma u Trenčína, Bolovica and Skaličky (300 m, leg. Vl. Hudec, Pfleger)
Chýnice u Tachlovic, Dubecký mlýn (320 m, leg. Pfleger)
Choteč u Tachlovic - Ořech (300 m, leg. Pfleger)
Jeníkovice u Třebechovic, Pavlovský rybník (250 m, leg. Brabenec)
Krahulov - Mezouň (300 m, leg. Pfleger)
+ Kojkovice u Třince (leg. Mácha)
Mezouň u Rudné - V. Újezd (300 m, leg. Pfleger)
Městec nad Dědinou u Opočna (250 m)
Nučice u Prahy (300 m, leg. Pfleger)
Ohnišovský ostrov u Opočna (250 m, leg. Brabenec)
Očelice u Opočna (250 m, leg. Kopecký, Hlaváč, Brabenec, Pfleger)
+ Rájecká Lesná - Šuja u Žiliny (500 m, leg. Ložek, Pfleger)
+ Rájec u Žiliny (leg. L. Kalaš)
Rudná u Prahy (300 m, leg. Pfleger)
Rychnov nad Kněžnou (300 m, leg. Kopecký)
+ Sněžnica u Žiliny, Vreten (500 m, leg. J. Brabenec, Pfleger)
+ Soběšovice u Havířova (300 m, leg. Ložek, Mácha, Pfleger)
+ Stankovany u Kralovan, Škutova dolina (450 m, leg. Ložek, Brabenec)
+ Staříč u Místku, Kamenná (leg. Ložek, Mácha)
Štramberk u Kopřivnice (350 m, leg. Brabenec, Hrubý, Pfleger)
Tachlovice u Nučic (250 m, leg. Jar. Petrbok, Ložek, Brabenec, Hudec, Pfleger)
+ Těrlicko - Kostelec u Havířova (leg. Mácha, Ložek, Brabenec)
+ Třinec, Babí hora (leg. Mácha)
+ Vendryně u Třince, Vružná (leg. Mácha, Brabenec)

LIST OF LOCALITIES IN HELICOPSIS STRIATA

Bohemia

2 Bechlín u Roudnice nad Labem (200 m)
2 Běloky u Buštěhradu (300 m, leg. Ložek)
2 Blevice u Kralup n. Vlt. (leg. Ložek)
1 Brloh u Loun (leg. Ložek)
2 Brňky u Prahy (270 m, leg. Ložek)
2 Břvany u Loun, Písečný vrch (318 m, leg. Ložek)
2 Brzánky u Roudnice n. L. (190 m, leg. Ložek)
2 Bučina u Velvar (240 m, leg. Ložek)
3 Buštěhrad - Zájezd u Kladna (leg. Ložek)
2 Čečemín u Všetat (220 m, leg. Ložek, Petrbok)
1 Ctiněves pod Řípem (250—300 m, leg. Ložek)
2 Debrno u Kralup n. Vlt. (220 m, leg. Ložek)
3 Děvín u Prahy (280 m, leg. Ložek)
2 Dobroměřice u Loun, „Na rybníku" (leg. Ložek)
2 Dolánky u Kralup n. Vlt. (200 m, leg. Ložek)
1 Dolní Šárka u Prahy (250 m, leg. Ložek)
2 Drchkov - Běřovice u Slaného (250 m, leg. Ložek)
2 Dřemčice u Třebenic, Kuzov (leg. Ložek)
2 Dřetovice u Kladna (260 m, leg. Ložek)
2 Dřínov u Kralup n. Vlt. (210 m, leg. Ložek)
1 Dubany u Libochovic, Rohatec (leg. Pfleger)
2 Evaň u Libochovic (240 m, leg. Ložek)
2 Hajnice u Velkých Přílep (320 m, leg. Ložek)
3 Hlubočepy u Prahy — Sv. Prokop (leg. Ložek, Petrbok)

2 Hnojnice u Loun, res. Kamenná (leg. Ložek)
2 Hoblík u Loun, Oblík (leg. Ložek)
2 Horní Chabry (Ládví) u Prahy (320 m, leg. Ložek, Petrbok)
1 Horoměřice u Prahy (260 m, leg. Ložek)
1 Horoměřice u Prahy, Kozí hřbety (300 m, leg. Brabenec, Ložek)
2 Hořenec u Loun, Čičov (350 m, leg. Ložek)
2 Hoštka u Roudnice n. L. (leg. Ložek)
2 Hrádek u Břvan - Louny (leg. Ložek)
2 Hrdlív u Slaného (leg. Ložek)
2 Husinec n. Vlt. u Prahy (240 m, leg. Ložek)
1 Chlumín u Neratovic (200 m, leg. Brabenec, Zvarič, Pfleger)
1 Jeřetín u Libochovic n. O. (250 m, leg. Ložek)
2 Jeviněves pod Řípem (230 m, leg. Ložek)
1 Kamenný Most u Kralup n. Vlt. (220 m, leg. Ložek)
1 Klecany n. Vlt. u Prahy (260 m, leg. Ložek)
2 Koda u Srbska (300 m, leg. Ložek)
1 Kopeč u Neratovic (220 m, leg. Brabenec, Ložek, Pfleger)
2 Košťálov u Třebenic (310 m, leg. Ložek)
2 Koštice (Dobročka) u Libochovic n. O. (leg. Ložek)
1 Kozly u Loun, Tobiášův vrch (350 m, leg. Ložek)
2 Krabčice - Vesce u Roudnice n. L. (270 m, leg. Ložek)
2 Královice u Slaného (250 m, leg. Ložek)
2 Křešov u Štětí — údolí Obrtky (leg. Ložek)
3 Kropáčova Vrutice u Benátek n. Jiz., Hluboká strouha (leg. Ložek)
2 Kuzov u Třebívlic (350 m, leg. Ložek)
2 Kystrá n. Ohří u Loun (leg. Ložek)
2 Kyškovice u Roudnice n. L. (180 m, leg. Ložek)
2 Lenešice u Loun (180 m, leg. A. Culek, Ložek)
2 Letky n. Vlt. u Prahy (230 m, leg. Ložek)
2 Libčice n. Vlt. (220 m, leg. Ložek)
3 Liběchov - Zimořský důl (220 m, leg. Ložek)
2 Liběchov - Rokelský důl (190 m, leg. Ložek)
3 Líbeznice u Prahy (230 m, leg. Petrbok)
3 Líbeznice - Zdiby u Prahy (leg. Ložek)
2 Libkovice pod Řípem (230 m, leg. Ložek)
2 Libochovičky u Kladna (250 m, leg. Ložek)
3 Lobeč u Kralup n. Vlt. (leg. Petrbok, Ložek)
2 Louny - vrch Stříbrník (leg. Ložek)
2 Lukavec u Lovosic (leg. B. Zvarič)
2 Lukov - Jarpice u Peruce (leg. Ložek)
2 Lysá n. L., Na Viničkách (210 m, lgt. Ložek)
2 Lysolaje u Prahy (300 m, leg. Petrbok, Ložek)
2 Malý Újezd u Mělníka, Na stráni (leg. Ložek)
3 Malý Újezd - Mělnická Vrutice, Přeplatilov (220 m, leg. Ložek, Pfleger)
1 Martiněves u Libochovic (210 m, leg. Ložek)
2 Mrsklesy - Vlastislav u Třebenic, Modla (leg. Ložek)
1 Měcholupy u Žatce (leg. Ložek)
2 Mělník (180 m, leg. Ložek)
2 Miškovice u Čakovic - Zabitý kopec (230 m, leg. Ložek)
2 Nabdín u Velvar (200 m, leg. Ložek)
1 Nelahozeves u Kralup (200 m, leg. Ložek)
1 Neratovice u Prahy, Velkovský vrch (leg. Brabenec, Ložek, Pfleger)
1 Netřeba u Neratovic, U hráze (leg. Ložek)
2 Nová Ves u Velvar, Škacherov (240 m, leg. Ložek)
2 Nové Úholice u Kralup n. Vlt. (170 m, leg. Ložek)
1 Odolena Voda u Neratovic, Špičák (leg. Ložek, Pfleger)
2 Okořské údolí u Kralup n. Vlt. (260 m, leg. Ložek)
2 Olovnice u Kralup n. Vlt. (190 m, leg. Ložek)
2 Podhájí u Budyně n. Ohří (200 m, leg. Ložek)
2 Podlešín u Slaného (260 m, leg. Ložek)
2 Podmoráň n. Vlt. (240 m, leg. Ložek)

2 Poustka u Lenešic u Loun (leg. Ložek)
1 Praha - Hloubětín (270 m, leg. Ložek)
1 Praha - Mariánské hradby (leg. Jar. Winter, Brabenec, Petrbok, Ložek)
1 Přemýšlení u Klecan u Prahy (260 m, leg. Ložek)
2 Přerov n. Lab. u Čelákovic (220 m, leg. Ložek)
1 Přezletice u Prahy (leg. Ložek)
2 Přívory u Všetat (210 m, leg. Ložek)
2 Radouň u Štětí n. L. (leg. Brabenec)
2 Raná u Loun (leg. Ložek)
2 Rohatce u Roudnice n. L. (leg. Ložek)
2 Roudnice n. Lab. (180 m, leg. Petrbok)
3 Řepín u Mělníka (leg. Ložek)
2 Řporyje u Prahy (300 m, leg. Ložek)
2 Řež n. Vlt. u Prahy (240 m, leg. Ložek)
2 Saky u Kladna (250 m, leg. Ložek)
2 Sedlec u Prahy (leg. Ložek)
2 Skalka u Vlastislavi (300 m, leg. Ložek)
3 Skalsko - Pod Hrádkem u Ml. Boleslavi (300 m, leg. Petrbok)
4 Skorkov n. Jiz. u Brandýsa n. L. (200 m, leg. Ložek)
2 Slaný - Slánská hora (300 m, leg. Ložek)
2 Slaný - Netovice (leg. Ložek)
2 Slavětín u Loun, Dolejší mlýn (leg. Ložek)
3 Srbsko u Berouna, „Na Velké hoře II" (250 m, leg. Petrbok, Ložek)
3 Srbsko, skály ke Karlštejnu (230 m, leg. Ložek)
2 Straškov u Roudnice n. L. (leg. Pfleger)
3 Strážnice u Liběchova (240 m, leg. Ložek)
3 Středokluky u Prahy (310 m, leg. Ložek)
4 Sušno - Kropáčova Vrutice u Benátek n. Jiz. (leg. Ložek)
? Sutom u Třebenic, Holý vrch (450 m, leg. Ložek)
2 Třebenice u Lovosic, Vršetín (leg. Ložek)
1 Třtěno u Loun, Syslík (285 m, leg. Ložek)
2 Tuchoměřice u Prahy (300 m, leg. Ložek)
1 Únětice - Černý Vůl (280 m, Ložek, Petrbok)
2 Úpohlavy u Třebenic (leg. Zvarič)
4 Veleň u Brandýsa n. L. (240 m, leg. Ložek)
2 Velké Žernoseky u Litoměřic, Kalvarie (200 m, leg. Ložek)
2 Velvary, Sazená (200 m, leg. Ložek)
2 Vepřek n. Vlt. (190 m, leg. K. Žebera, Ložek)
2 Vodochody u Prahy (leg. Ložek)
1 Vraný - Horní Kamenice u Peruce (leg. Ložek)
2 Vrbice - Opočnice u Poděbrad (leg. Ložek)
3 Vysoká Libeň - Kropáčova Vrutice (leg .Ložek)
2 Zájezd u Lenešic u Loun (leg. Ložek)
2 Žatec - Bukovina (leg. Ložek)
1 Železná u Měcholup u Žatce (leg. Ložek)

Moravia

2 Dambořice u Kyjova (leg. Vl. Hudec)
2 Děvín, Pavlovské vrchy (500 m, leg. Hudec, Ložek)
2 Horní Bojanovice u Hustopeče (leg. Ložek)
2 Horní Věstonice, Pavlovské vrchy (300 m, leg. Ložek)
2 Kotelná, Pavlovské vrchy (leg. Brabenec, Hudec, Ložek)
3 Perná, Pavlovské vrchy (350 m, leg. Brabenec, Hudec, Ložek)
1 Rebešovice u Brna (250 m, leg. Ložek)
2 Tabulová hora, Pavlovské vrchy (leg. Brabenec, Hudec, Ložek)

Slovakia

3 Bernolákovo u Bratislavy (160 m, leg. Ložek)
1 Čenkovská step u Štúrova (leg. Brabenec, Ložek, Mácha, M. Deyl)
1 Mliečany u Gabčíkova (118 m, leg. Brabenec)
1 Mužla u Štúrova (120 m, leg. Brabenec, Ložek, Pfleger)

2 Opatovská Nová Ves, dolní Ipel (248 m, leg. Ložek)
1 Štúrovo, Boží vrch (leg. Brabenec, Ložek)
1 Štúrovo - Nána (leg. Brabenec)

Explanation:

1. recent occurrence (animals recently collected)
2. recent occurrence probable (shells recently collected)
3. undefined occurrence (subfosile?)
4. suspected of displacing from loess (pleistocene)

LIST OF LOCALITIES IN HELICELLA ITALA

Blešno - Chrášťany u Třebenic (leg. Ložek)
Bukovina - Loužek u Turnova (280 m, leg. Ložek)
Čížkovice u Lovosic - Třebenice (250 m, leg. Pfleger)
Dolánky u Turnova (280 m, leg. Slavík, Klika, Winter, Blažka, Babor, Jandečka, Petrbok, Ložek, Táborský, Culek, Brabenec, Pfleger)
Chrastná - Teplá u Třebenic (leg. Ložek)
Košťálov u Třebenic (300 m, leg. Brabenec, Pfleger)
Lovosice, vrch Lovoš (300 m, leg. Ložek, Brabenec, Pfleger, Zvarič)
Malý Újezd - Mělnická Vrutice, Přeplatilov (220 m, leg. Ložek, Pfleger)
Mrsklesy - Lhota u Třebenic (leg. Ložek)
Mrsklesy - Vlastislav u Třebenic, Modla (leg. Ložek)
Nové Hěsto n. Metují? (300 m, coll. Jandečka)
Páleč - Milešov, Č. Středohoří (400 m, leg. Ložek, Zvarič)
Pnětluky u Podsedic (350 m, leg. Ložek, Brabenec)
Podsedice u Třebenic, silniční příkop (350 m, leg. Brabenec, Ložek)
Pokratice u Litoměřic, Bílá stráň (200 m, leg. Brabenec)
Sulejovice u Lovosic - Čížkovice (200 m, leg. Ložek)
Třebenice u Lovosic, trať (leg. Pfleger, Brabenec)
Třebenice - Sutomský vrch (300 m, leg. Ložek, Brabenec)
Ústí nad Labem (150 m, leg. Wiesner)
Velemín u Lovosic, Ostrý (leg. Ložek)
Zálezly u Ústí n. Lab. (leg. Wiesner)

LIST OF LOCALITIES IN HELICELLA OBVIA

Bohemia

Bášť u Prahy (leg. Ložek)
Báštěk u Prahy (leg. Ložek)
Bedřichov u Kolína (240 m, leg. Pfleger)
Bechyně u Tábora (400 m, leg. Ant. Frič)
Běleč u Hlásné Třebáně (250 m, leg. Petrbok)
Běloky u Středokluk (250 m, leg. Petrbok)
Benátecká Vrutice u Lysé n. L. (150 m, leg. Petrbok, Pfleger)
Benátky n. Jiz. (200 m, leg. Petrbok, V. Hořínek, Pfleger)
Beroun (250 m, leg. Petrbok, Pfleger)
Beškov u Dubé (leg. Ložek)
Bílina u Mostu (150 m)
Bílinka u Lovosic (leg. Pfleger)
Bítov u Králova Dvora (350 m, leg. Petrbok)
Blevice u Kralup n. Vlt. (leg. Ložek)
Blšanský chlum u Loun (200 m, leg. Pfleger)
Bojanovice u Horažďovic (450 m, leg. Ložek)
Boreč, Č. Středohoří (300 m, leg. Brabenec)
Bořeň u Bíliny (500 m, leg. J. Wiesner)
Bořislav u Milešovky (leg. Ložek)
Bousov u Čáslavi (250 m, leg. A. Culek)
Brandýsek u Slaného (250 m, leg. K. Žebera)
Brandýs nad Labem (150 m, leg. Ložek, M. Jankovský, Petrbok)
Brloh u Loun (200 m, leg. Ložek)

Brloh - Chlumčany u Loun (leg. Ložek)
Brňky u Klecan (200 m, leg. Ložek)
Brzánky u Roudnice n. L. (160 m)
Břvany u Loun (250 m, leg. Ložek, Vl. Zázvorka)
Břve u Prahy (250 m, leg. Petrbok)
Bubovice u Lodenic (250 m, leg. Petrbok)
Budňany, Karlštejn (250 m, leg. Trsek, Petrbok)
Buštěhrad - Zájezd u Kladna (leg. Ložek)
Býchory u Kolína (250 m, leg. K. Táborský, Pfleger)
Bykoš u Berouna (350 m, leg. Petrbok)
Byškovice u Neratovic (200 m, leg. Ložek, Pfleger)
Cítov - Hliniště u Mělníka (leg. Ložek)
Ctiněves pod Řípem (250 m, leg. Ložek, Pfleger)
Cvrčovice u Kladna (leg. Ložek)
Čakovičky u Neratovic (leg. Ložek)
Čečelice u Mělníka (250 m, leg. Petrbok)
Čelákovice n. Lab. (150 m, leg. Táborský)
Čepičná u Rábí, Horažďovice (450 m, leg. Ložek)
Černčice u Loun - Veltěže (leg. Pfleger)
Černíkov u Strakonic (400 m)
Černíky u Č. Brodu (200 m, leg. Petrbok)
Černošice n. Ber., „Na Sulavě" (leg. Petrbok)
Černožice, Holohlavský ryb. (250 m, leg. Brabenec)
Černý Důl, Krkonoše (600 m, leg. Brabenec)
Černý Vůl u Prahy (250 m, leg. Petrbok)
Červené Pečky u Kolína (200 m, leg. Petrbok)
Česká Skalice - Starkoč (300 m, leg. Brabenec)
Český Brod (250 m, leg. Petrbok)
Český Krumlov (500 m, leg. Petrbok, Brabenec, Táborský)
Český Krumlov, Lazecký vrch (680 m, leg. Ložek)
Český Krumlov, Vyšenské kopce (400—500 m, leg. Ložek, Táborský)
Čilec u Nymburka (200 m, leg. A. Culek)
Čížkovice u Lovosic (250 m, leg. Pfleger)
Debř u Mladé Boleslavi (leg. Petrbok)
Děčín (150 m)
Deštná u Dubé (300 m, leg. E. Sprenger)
Dobrkovice u Č. Krumlova (450 m, leg. Petrbok, Táborský)
Dobroměřice u Loun (leg. Ložek)
Dobršín u Sušice (500 m, leg. Ložek)
Dolánky u Podbořan (leg. Ložek)
Dolany u Čkyně u Vimperka (leg. Petrbok)
Dolní Roblín - Mořina (300 m, leg. Pfleger)
Dolní Slivno u Benátek n. Jiz. (leg. Ložek)
Dolní Záležly u Ústí n. L. (200 m, leg. Wiesner, Pfleger, K. Hruška)
Doubrava u Nymburka n. L. (200 m, leg. Petrbok)
Drahelčice - Úhonice u Kladna (350 m, leg. Pfleger)
Dřemčice, vrch Kuzov, Č. Středohoří (400 m, leg. Ložek)
Drchkov u Slaného (250 m, leg. Ložek)
Drchkov - Beřovice u Slaného (leg. Ložek)
Drnek - Přelíc u Kladna (leg. Ložek)
Dřevčice - Lhotecký důl, Polomené hory (350 m, leg. Ložek)
Drouzetice u Strakonic, vrch Tisovník (500 m, leg. Ložek)
Dubá u Mělníka, Svinský důl (leg. Ložek)
Dubany u Libochovic n. O., Rohatec (200 m, leg. Pfleger)
Evaň u Libochovic n. O. (250 m, leg. Ložek)
Hájek - Jeneč u Kladna (350 m, leg. Pfleger)
Hajnice u Velých Přílep (250 m, leg. Ložek)
Heřmanův Městec u Chrudimi (300 m, leg. Zázvorka)
Hlásná Třebáň u Karlštejna (250 m, leg. Petrbok)
Hněvice n. L. u Roudnice (150 m, leg. Petrbok)
Hnidousy u Kladna (leg. Ložek)

Hnojnice u Loun, Kamenná (leg. Ložek)
Hoblík u Loun, Oblík (250 m, 1 sinistral specimen)
Holedeč u Žatce (250 m, leg. Ložek, M. Šnajdr)
Holedeček - Veletice u Žatce (leg. Ložek)
Holyně u Prahy (250 m, leg. Petrbok, Pfleger)
Horní Beřkovice u Roudnice n. L. (200 m, leg. Ložek)
Horní důl pod Horoměřicemi (300 m, leg. Ložek)
Horní Měcholupy u Prahy (190 m, leg. Táborský)
Horní Nová Ves u Lázní Bělohrad (300 m, leg. F. Hlaváč)
Horní Počaply u Roudnice n. L. (leg. Ložek)
Hořátev u Nymburka (200 m)
Hořenec u Loun, hrad Čičov (400 m, leg. Ložek)
Hostím u Berouna (300 m, leg. Ložek, Petrbok)
Hoštka u Roudnice n. L. (leg. Ložek)
Hrádek u Břvan u Loun (leg. Ložek)
Hradsko u Kokořína (250 m, leg. Ložek)
Hrdlív u Slaného (leg. Ložek)
Hrdlořezy u Ml. Boleslavi (leg. Ložek)
Hubenov u Strakonic (leg. Ložek)
Chaby u Řeporyjí (250 m, leg. Petrbok)
Chleby u Nymburka (leg. Petrbok)
Chlumčany u Loun (lgt. Pfleger)
Chlumín u Neratovic (200 m, leg. Brabenec, Zvarič, Pfleger)
Chlustina - Šibenec u Hořovic (300 m, leg. Petrbok)
Choťánky u Poděbrad (200 m, leg. J. Šachl, Žebera)
Chotěbudice u Podbořan (300 m, leg. Ložek)
Chotěšov u Třebenic (200 m, leg. Pfleger)
Choťovice u Žehuňského rybníka (leg. Pfleger)
Chotětov u Ml. Boleslavi - Jiz. Vtelno (leg. Pfleger)
Chožov u Loun (250 m, leg. Ložek, Pfleger)
Chraberce u Loun, Srdov (480 m, leg. Ložek)
Chrastná - Teplá u Třebenic (leg. Ložek)
Chuchle u Prahy (200 m, leg. Petrbok, Trsek, Pfleger)
Chýně u Hostivic u Prahy (250 m, leg. Petrbok, Pfleger)
Chýnice u Nučic (250 m, leg. Petrbok, Pfleger)
Chýnov u Kralup n. Vlt. (250 m, leg. Žebera)
Chýnov u Tábora, Pacova hora (500 m, leg. Ložek)
Jarov u Berouna (300 m, leg. Pfleger)
Jarpice - Šlapanice u Peruce (leg. Ložek)
Jelenice - Liblice u Mělníka (250 m, leg. Ložek)
Javorka u Karlštejna
Jeviněves u Roudnice (200 m, leg. Ložek)
Josefův Důl u Ml. Boleslavi (A. Slavík, Petrbok, Ložek)
Kalvarie u V. Žernosek (200 m, leg. Ložek)
Kamenný Most u Kralup n. Vlt. (250 m, leg. Pfleger)
Kaňk u Kutné Hory (lgt. Culek)
Karlštejn u Berouna (350 m, leg. Táborský)
Keblice - Lukavec u Lovosic (200 m, leg. Petrbok)
Kladno - Vinařická hora (lgt. Ložek)
Klapý u Libochovic n. O. (350 m, leg. Pfleger)
Kleneč u Roudnice n. L., „Na Kavčinách" (200 m, leg. Ložek)
Klukovice u Prahy (300 m, leg. Petrbok, Pfleger)
Kocourov pod Milešovkou (leg. Zvarič)
Koda u Srbska (300 m, leg. J. Koliha, Táborský)
Kochánky - Benátky n. Jiz. (150 m, leg. Hořínek, Pfleger)
Kojetice u Neratovic (190 m, leg. Petrbok, Ložek)
Kokořín u Mělníka (leg. Ložek)
Kolín - Ovčáry (leg. Táborský, Pfleger)
Koněprusy u Berouna (400 m, leg. Petrbok, Ložek)
Konětopy u Mělníka (200 m, leg. Petrbok)
Kopeč u Neratovic (200 m, leg. Brabenec, Ložek, Pfleger)

Korycany u Neratovic (leg. Ložek)
Kosoř u Prahy (250 m, leg. Petrbok Pfleger)
Kosořín u Chocně (300 m, leg. Brabenec)
Kost (hrad) u Turnova (350 m)
Kostelec n. L. u Brandýsa n. L. (200 m, leg. Petrbok)
Kostomlaty pod Řípem (leg. Ložek)
Kostomlaty u Nymburka (200 m, leg. Petrbok, Táborský)
Košátky u Mělníka (250 m, leg. Petrbok)
Košťál u Třebenic (250 m, leg. Wiesner, C. Mell)
Košťálov u Třebenic (250 m, leg. Wiesner, Brabenec, Pfleger)
Koštice (Dobročka) u Libochovic (leg. Ložek)
Kotýs u Koněprus (400 m, leg. Petrbok)
Koudelov - Vrdy u Čáslavi (250 m, leg. Culek)
Kováry u Kralup n. Vlt. (250 m, leg. Petrbok)
Kozly u Loun, Tobiášův vrch (leg. Ložek)
Kozovazy u Čelákovic (200 m, leg. Petrbok)
Kozí Horka u Třebenic (leg. Zvarič)
Krahulov u Rudné (250 m, leg. Petrbok, Pfleger)
Královice u Slaného (250 m, leg. Ložek)
Kralupy n. Vlt. (250 m, leg. F. Hájek)
Krásné Březno u Ústí n. L. (200 m, leg. Táborský, Hruška)
Krásný Dvůr u Podbořan (leg. Ložek)
Kropáčova Vrutice u Benátek n. Jiz., Hluboká strouha (leg. Ložek)
Krušiny - Sušno u Benátek n. Jiz. (leg. Ložek)
Křesín u Libochovic, Rohatec (200 m, leg. Pfleger)
Křešov u Štětí n. L., Obrtka (leg. Ložek)
Křinec u Nymburka n. L. (200 m, leg. J. Štroff)
Ktová - Libuň u Turnova (leg. Ložek)
Kutná Hora (250 m, leg. Šachl)
Kuzov u Třebívlic, Č. Středohoří (400 m, leg. Ložek)
Kvíc u Slaného, „Nad močidly" (leg. Ložek)
Kystrá u Loun (200 m, leg. Zázvorka, Ložek)
Lázně Bělohrad (250 m, leg. Fr. Hlaváč, Petrbok)
Ledeč nad Sázavou (350 m, leg. Petrbok, Ložek)
Lenešice u Loun (200 m, leg. Petrbok)
Lhota u Dubé (leg. Ložek)
Liběchov u Mělníka (250 m, leg. J. Kopernický, Sprenger, Petrbok)
Liběšice u Úštěka (200 m, leg. C. Mell)
Liběšovice - Libořice u Žatce (leg. Ložek)
Liblice u Mělníka (250 m, leg. Táborský)
Libochovice u Lovosic (200 m, leg. Sprenger)
Libochovička u Kladna (250 m, leg. Petrbok)
Librantice u Třebechovic (300 m, leg. Ložek)
Lichnice (zříc.) u Čáslavi (350 m, lag. Culek)
Lichnice (zříc.) u Čáslavi (350 m, leg. Culek)
Lišná u Rábí u Horažďovic (leg. Ložek)
Liteň u Berouna (300 m, leg. Winaržik, Petrbok)
Litoměřice, „Kočka" (leg. Zvarič)
Litoměřice, pod Bílou strání (leg .Brabenec, Zvarič)
Libomyšl u Hořovic (300 m, leg. Petrbok)
Litovice u Hostivic (300 m, leg. Ložek)
Lobeč u Kralup n. Vlt. (leg. Ložek)
Lobkovice u Neratovic (200 m, leg. Petrbok)
Loděnice u Berouna (350 m, leg. Petrbok, Táborský)
Lounín u Berouna (400 m, leg. Petrbok)
Louny, cihelny (leg. Ložek)
Louny - Mělce (220 m, leg. Ložek)
Louny, meze J Stříbrník (leg. Ložek)
Louny, Velký vrch (300 m, leg. Ložek)
Lovosice u Litoměřic (250 m, leg. Pfleger, Zvarič)
Lovoš u Lovosic (300 m, leg. Pfleger)

Lubná u Rakovníka (350 m, leg. Petrbok)
Lukavec u Lovosic (200 m, leg. Petrbok)
Lukov - Jarpice u Peruce (leg. Ložek)
Lukov - Radovesice u Bíliny (leg. Ložek)
Luštěnice - Horky u Mladé Boleslavi (Ložek)
Lysá nad Labem (200 m, leg. Žebera, Táborský, Pfleger)
Lysá nad Labem - Benátecká Vrutice (200 m, leg. Pfleger)
Lysolaje u Prahy (200 m, leg. Petrbok, Ložek)
Makotřasy u Kladna (250 m, leg. Petrbok)
Malé Zboží u Paděbrad (200 m, leg. Žebera)
Malé Žernoseky u Lovosic (leg. Pfleger)
Málkov u Zdic (400m, leg. Petrbok)
Malnice u Loun, údolí Hasiny (200 m, leg. Ložek)
Malý Újezd u Mělníka (leg. Ložek)
Malý Újezd - Přeplatilov (200 m, leg. Ložek, Pfleger)
Medonosy u Dubé, údolí Liběchovky do Osinalic (leg. Ložek)
Měcholupy u Žatce (250 m, leg. Ložek)
Mělnická Vrutice u Mělníka (250 m, leg. Ložek, Pfleger)
Mělnické Vtelno - Sušno u Benátek n. Jiz. (leg. Ložek)
Měňany - Liteň u Berouna (300 m, leg. Petrbok)
Mezihoří u Chrasti (400 m, leg. Brabenec)
Mezouň u Rudné (leg. Pfleger)
Milešov, vrch Lhota v Č. Středohoří (leg. Ložek)
Milošice u Žatce (leg. Ložek)
Milovice u Lysé n. L. (200 m, leg. Petrbok)
Mířejovice u Litoměřic, Knobloška (250 m, leg. Zvarič)
Mlčeň u Kokořína (leg. Ložek)
Močovice u Čáslavi (250 m, leg. Culek)
Mochov u Čelákovic (leg. Ložek)
Mořina u Karlštejna (350 m, leg. Petrbok)
Mrsklesy - Vlastislav u Třebenic, Modla (leg. Ložek)
Mrzky u Českého Brodu (250 m, leg. Petrbok)
Mšené u Budyně n. O. (200 m, leg. Brabenec, Pfleger, Zvarič)
Nebušice u Prahy - Jenrálka (leg. Ložek)
Nedomice u Kostelce n. L. (200 m, leg. Petrbok)
Nelahozeves u Kralup n. Vlt. (200 m, leg. Petrbok)
Nenačovice u Rudné, Kačák (300 m, leg. Zázvorka)
Neratovice u Prahy (200 m, leg. Pfleger)
Neratovice, Velkovský vrch (leg. Brabenec)
Nerestec u Mirotic u Písku (450 m, leg. Koliha, Ložek)
Netřeba u Neratovic, trať (200 m, leg. Pfleger)
Nesvačily u Berouna (350 m, leg. Petrbok)
Nišovice u Volyně (500 m, leg. Ložek)
Nová Huť u Berouna (350 m, leg. Petrbok)
Nová Ves u Kolína (330 m, leg. Pfleger)
Nová Ves u Chotěboře (450 m, leg. Petrbok)
Nové Třebčice - Široké Třebčice u Kr. Dvora (leg. Ložek)
Nové Úholice u Veltrus (250 m, leg. Ložek)
Nučice u Prahy (300 m, leg. Pfleger)
Obora u Krabčic u Roudnice n. L. (leg. Ložek)
Očelice u Opočna, trať (250 m, leg. Brabenec, Pfleger)
Odolena Voda u Neratovic (leg. Pfleger)
Odřepsy u Poděbrad (leg. Ložek)
Ohrada u Kolína (leg. Pfleger)
Olšany - Brandýsek u Kladna (350 m, leg. Ložek)
Opočno, trať na Očelice (250 m, leg. Brabenec, Pfleger)
Ořech - Choteč u Rudné (250 m, leg. Pfleger)
Ostrov u Poděbrad, dvůr Blato (200 m, leg. Ložek)
Oškobrh u Poděbrad (280 m, leg. Šachl)
Otvovice u Kralup n. Vlt. (250 m, leg. Pfleger)
Ovčáry u Kolína (250 m, leg. Brabenec, Táborský)

Pavličky u Dubé, Saidlova kaluž (leg. Ložek)
Pavlov u Kladna (300 m, leg. Petrbok)
Pečky - Radim u Kolína (250 m, leg. Pfleger)
Perštejnec - Neškaredice u Kutné Hory, Křenovka (leg. Ložek)
Písková Lhota u Sadské (200 m, leg. Petrbok)
Písty u Nymburka (200 m, leg. Duchoň)
Plaňany - Nové Město u Peček (leg. Ložek)
Plešivec u Třebenic (450 m, leg. Ložek)
Pnětluky, Třešňovec, Č. Středohoří (380 m, leg. Zvarič)
Poděbrady (200 m, leg. Táborský)
Poděbrady - Vrčeň (leg. Ložek)
Podlešín u Slaného (250 m, leg. Petrbok, Táborský, Pfleger)
Podlusky - Chvalín u Roudnice n. L. (200 m, leg. Ložek)
Podolanka (Cvrčovice u Brandýsa n. L., 250 m, leg. Petrbok)
Podolí u Bělé pod Bezdězem (250 m, leg. Ložek)
Podsedice u Třebenic (250 m, leg. Ložek)
Pokratice u Litoměřic, Bílá stráň (leg. Brabenec)
Popluží u Ml. Boleslavi (200 m, leg. Pfleger)
Popovice u Králova Dvora (400 m, leg. Petrbok)
Poustka u Lenešic - Louny (200 m, leg. Ložek)
Prackovice u Ústí n. Lab. (leg. Pfleger)
Praha - Barrandov (300 m, leg. Koliha, Petrbok, Pfleger)
Praha - Bílá Hora (300 m, leg. Ložek)
Praha - Braník (200 m, leg. Koliha, Petrbok)
Praha - Břevnov (leg. Ložek)
Praha - Hlubočepy (leg. Petrbok, Koliha, Pfleger)
Praha - Hodkovičky (lgt. Koliha, Petrbok)
Praha - Konvářka (leg. Koliha)
Praha - Michle (leg. Koliha)
Praha - Modřany (leg. Pfleger)
Praha - Podolí (leg. Fr. Jandečka)
Praha - Smíchov (leg. Koliha, Ložek, Petrbok)
Praha - Střešovice
Praha - Vyšehrad (leg. Koliha, Petrbok)
Praha - Zlíchov (leg. Zd. Frankenberger, Jandečka, Táborský)
Praskolesy - Žebrák (450 m, leg. Petrbok)
Předboj - Kojetice u silnice na Mělník (200 m, leg. Ložek)
Přemýšlení u Klecan u Prahy (250 m, leg. Ložek)
Přepychy u Opočna (250 m, leg. Brabenec)
Přistoupim u Č. Brodu (250 m, leg. Petrbok)
Rábí u Horaždovic (500 m, leg. P. Kubeš, Culek)
Radičeves - Trnovany u Žatce (250 m, leg. Ložek)
Radotín u Prahy (250 m, leg. Koliha, Petrbok)
Radouš u Hostomic u Zdic (400 m, leg. Táborský)
Raná u Loun, vrch (250 m, leg. Petrbok, Ložek, Pfleger)
Rohatec u Libochovic (240 m, leg. Ložek)
Rochov n. O. u Litoměřic (200 m, leg. Petrbok)
Ronov n. Doubravou (250 m, leg. Culek)
Rovná u Strakonic, váp. lom (450 m, leg. Ložek)
Rudná u Prahy (leg. Pfleger)
Rychnov n. Kněžnou (350 m, leg. Petrbok, Pfleger)
Rychnovek u Jaroměře (250 m)
Řepín u Mělníka (250 m, leg. Ložek)
Sadská u Nymburka (200 m, leg. Petrbok)
Sazená u Kralup n. Vlt., Škarechov (250 m, leg. Ložek)
Sebuzín u Ústí n. Lab. (250 m, leg. Ložek)
Sedlec u Kutné Hory (300 m, leg. Petrbok, Culek)
Semice - Velenka u Čelákovic (200 m, leg. Ložek)
Sířejovice, Humenský vrch, Č. Středohoří (200 m, leg. Zvarič)
Skalsko - Pod Hrádkem u Ml. Boleslavi (300 m, leg. Ložek)
Slaný (leg. Žebera, Petrbok)

Slaný - Blahotice (250 m, leg. Ložek)
Slaný - Netovice (leg. Ložek)
Slatina pod Házmburkem - Černiv (250 m, leg. Pfleger)
Slavětín u Loun (200 m, leg. Ložek)
Slavíky u Zdic (350 m, leg. Petrbok)
Slivenec u Prahy (300 m, leg. Petrbok)
Sobín u Prahy (300 m, leg. Petrbok)
Sobín - Chrášťany u Hostivic (leg. Petrbok)
Solopysky u Černošic (leg. Petrbok)
Srbsko u Berouna (400 m, leg. Petrbok)
Srby u Kladna (400 m, leg. Ložek)
Stará Lysá u Lysé n. Lab. (200 m, leg. Petrbok)
Stará Lysá - Čihadla (200 m, leg. Pfleger)
Starý Brázdim u Brandýsa n. L. (200 m, leg. Zázvorka)
Stašov, silnice u Litávky u Berouna (300 m, leg. Petrbok)
Statenice u Prahy (250 m, leg. Petrbok)
Strační - Střekov u Roudnice n. Lab. (150 m, leg. Sprenger)
Strakonice, Šibeniční vrch (450 m, leg. Ložek)
Straškov u Roudnice n. L. (200 m, leg. Pfleger)
Strážnice u Mělníka (250 m, leg. Ložek)
Struňkovice u Strakonic, lom (400 m, leg. Ložek)
Střekov u Ústí n. L. (200 m)
Sulejovice - Čížkovice u Lovosic (200 m, leg. Pfleger)
Sušice, vápencový ostrov k Horažďovicům (500 m, leg. Ložek)
Sušno - Kropáčova Vrutice u Benátek n. Jiz. (leg. Ložek)
Sutomský vrch u Třebenic (400 m, leg. Ložek)
Svádov u Ústí n. Lab. (300 m, leg. Wiesner)
Svatý Jan pod Skalou u Berouna (300 m, leg. Táborský)
Svatý Prokop u Prahy (300 m, leg. J. Košťál, Brabenec, Petrbok)
Šanový Kout u Srbska (350 m, leg. Petrbok, Ložek)
Škarechov - Jeviněves u Roudnice n. L. (250 m, Ložek)
Štětí u Roudnice n. L. (200 m, leg. M. Vedralová)
Štítary u Kolína (250 m, leg. Pfleger)
Tachlovice u Nučic (300 m, leg. Petrbok, Pfleger)
Teplice u Ústí n. L. (200 m, leg. Rossmany)
Teplice Lázně, Doubravská hora (350 m)
Tobolka u Berouna (350 m, leg. Pfleger)
Touchovice u Loun (200 m, leg. Ložek)
Toušeň u Čelákovic (180 m, leg. Petrbok)
Třebechovice - Opočno (250 m)
Třebenice, vrch Vršetín u Lovosic (460 m, leg. Ložek)
Třebešice u Kutné Hory (250 m, leg. Culek)
Třebnice u Meclova, Horšovský Týn (450 m, leg. Petrbok)
Třebonice u Řeporyjí (200 m, leg. Petrbok)
Třebotov - Kuchařík u Černošic (350 m, leg. Pfleger)
Trmice u Ústí n. Lab. (200 m, leg. Žebera)
Třtěno u Loun, vrch Syslík (280 m, leg. Ložek)
Tuchoměřice u Prahy (250 m, leg. Petrbok, Ložek)
Tuchořice u Loun, travertinový lom (250 m, leg. Ložek)
Tuchořice u Loun, vrch Veselá (360 m, leg. Ložek)
Tupadly u Mělníka, Liběchovka (200 m, leg. Sprenger)
Tuřice u Brandýsa n. L. (250 m, leg. Táborský)
Tuřice - Sobětuchy u Lysé n. L. (150 m, leg. Pfleger)
Úhonice u Kladna (300 m, leg. Pfleger)
Újezd pod Troskami u Turnova (350 m)
Únětice u Prahy (200 m, leg. Petrbok)
Úpohlavy u Třebenic (200 m, leg. Zvarič)
Úštěk u Litoměřic (200 m, leg. Mell)
Ústí nad Labem (150 m, leg. Wiesner, Žebera, Hruška)
Úžice - Netřeba u Neratovic (200 m, leg. Ložek, J. Moc)
Valečov, hrad u Mnichova Hradiště (250 m)

Valtíře u Ústí n. L. (200 m, leg. Wiesner)
Vápensko u Nymburka (200 m)
Vědlice, Úštěcký potok (200 m, leg. Ložek)
Velenka - Horky u Čelákovic (200 m, leg. Petrbok, Ložek)
Veletice - Trnovany u Žatce (leg. Ložek)
Veliká Ves - Kopeč u Neratovic (leg. Pfleger)
Velka Ves u Žatce, pískovna (250 m, leg. Ložek)
Velké Přílepy u Prahy (leg. Petrbok)
Velké Žernoseky u Lovosic (150 m, leg. Ankert, Ložek, Zvarič)
Veltěže — Obora u Loun (200 m, leg. Ložek)
Vestec u Lysé n. L. (200 m, leg. J Beran)
Vinaře u Čáslavi (250 m, leg. Culek)
Vinařice u Kladna (400 m, leg. Petrbok)
Vinařice u Koněprus, vrch Bacín (490 m, leg. Petrbok)
Vítězov - Bedřichov u Kolína (250 m, leg. Pfleger)
Vlkov pod Oškobrhem u Poděbrad (200 m, leg. Šachl)
Volyně u Strakonic (500 m, leg. Petrbok)
Votice, třešňovka (450 m, leg. Ložek, Pfleger)
Vraný - Horní Kamenice u Peruce (300 m, leg. Ložek)
Vrbice - Opočnice u Poděbrad (200 m, leg. Ložek)
Vrbičany n. O. u Lovosic (150 m, leg. Petrbok)
Vrbka u Libochovic n. O. (200 m, leg. Pfleger)
Vrchovany u Dubé, Vlčí rokle (300 m, leg. Ložek)
Všenory u Karlštejna (250 m, leg. Petrbok)
Všeradice, vrch Telín u Hostomic (400 m, leg. Petrbok)
Vykáň u Č. Brodu (250 m, leg. Petrbok)
Vysoká u Mělníka (250 m)
Vysoká Libeň - Kropáčova Vrutice (250 m, leg. Ložek)
Vysoký Újezd u Loděnic (400 m, leg. Táborský)
Zadní Kopanina u Radotína (300 m, leg. Petrbok)
Záboří - Kelské vinice u Mělníka (250 m, leg. Ložek)
Zájezd u Buštěhradu u Kladna (300 m, leg. Petrbok)
Zájezd u Lenešic - Louny (200 m, leg. Ložek)
Zákolany u Kladna (250 m, leg. Petrbok)
Zálezly u Ústí n. L. (250 m, leg. Wiesner)
Zdice u Berouna (leg. Petrbok)
Zeměchy u Kralup n. Vlt. (250 m, leg. Pfleger)
Zlatá Koruna u Českého Krumlova (450 m, leg. Petrbok)
Zlešice u Volyně, vrch Betaň (650 m, leg. Ložek)
Zlončice u Kralup n. Vlt. (250 m, leg. Pfleger)
Zlonice u Slaného (300 m, leg. J. Jindra)
Zlonín u Neratovic (200 m, leg. Ložek)
Zlovědice u Velké Vsi - Žatec (250 m, leg. Ložek)
Žabokliky u Žatce, pískovna (250 m, leg. Ložek)
Žalhostice u Litoměřic (200 m, leg. Zázvorka)
Žatec - Bukovina (230 m, leg. Ložek)
Žehuňský rybník u Poděbrad (200 m, leg. Šachl)
Železná u Měcholup, Žatec (200 m, leg. Ložek)
Železnice, Jičínsko (300 m, leg. Hlaváč)
Želkovice u Hořovic (400 m, leg. Petrbok)
Židovice u Roudnice n. L. (180 m, leg. Ložek)
Židovice u Třebívlic u Loun (250 m, leg. O. Klement)
Žitenice u Litoměřic (350 m, leg. Zázvorka)

Moravia

Archleby u Kyjova (250 m, leg. Ložek)
Babice - Spytihněv u Uh. Hradiště (185 m, leg. Vl. Hudec)
Blatnice - Dlouhé Klíny u Veselí na Moravě (200 m. leg. Ložek)
Bločina u Židlochovic (200 m, leg. Zázvorka)
Bohuslavice u Kyjova, kopec „Hrad" (260 m, leg. Hudec)
Boskovice (450 m, leg. Hudec)

Božice, náplav Jevišovky (200 m, leg. Zvarič)
Bradlné - Študlov u Svitav (400 m, leg. I. Hrubý)
Brno (250 m, leg. J. Uličný, Petrbok, Skutil)
Brno - Stránská skála (300 m, leg. Petrbok)
Březov nad Svitavou, okr. Svitavy (450 m, leg. Hrubý)
Bzenec, les Doubrava, Dolnomoravský úval (190 m, leg. Hudec)
Cetkovice u Jevíčka, udolí Lipinského ryb. (450 m, leg. Hudec)
Červený kopec u Jevíčka u Mor. Třebové (400 m, leg. Hrubý)
Čejč u Hodonína (150 m, leg. J. Mařan, O. Šustera)
Čtyřicet Lánů - Kamenná Horka u Svitav (420 m, leg. Hrubý)
Dambořice u Kyjova (300 m, leg. Hrubý)
Děvičky, zříc. Pavlovské kopce (leg. Brabenec)
Děvín, Pavlovské kopce (350 m, leg. Táborský)
Dlouhá u Březové n. Svit. (400 m, leg. Hrubý)
Dolní Věstonice, Pavlovské kopce (150 m, leg. Petrbok)
Hanušovice, Jindřichovská stráň (500 m, leg. V. Jílek)
Hodonín, břeh Moravy (160 m, leg. Hudec)
Holice u Olomouce (230 m, leg. Brabenec)
Horní Bojanovice u Hustopeče (250 m, leg. Ložek)
Horní Němčí u Uherského Brodu, rezervace (250 m, leg. Hudec)
Horní Věstonice (leg. Pražan)
Hostice u Šumperka (400 m, leg. Pfleger)
Hradec n. Svit. - Sklené u Svitav (450 m, leg. Hrubý)
Hřebeč - Hřebečský hřeben u Svitav (500 m, leg. Hrubý)
Jaroměřice u Jevíčka (300 m, leg. E. Baudyš, Hrubý)
Jedovnice u Blanska, Suchý žleb (400 m, leg. Brabenec)
Jesenec u Jevíčka, vápencový lom (470 m, leg. Hudec)
Jevíčko (leg. Brabenec)
Ketkovický hrad, údolí Oslavy (300 m, leg. Culek)
Klentnice, Pavlovské kopce (300 m, leg. Petrbok, Brabenec)
Koclířov - Hřebeč u Svitav (450 m, leg. Hrubý)
Kojetice u Olomouce (200 m, leg. Hudec)
Komořany u Vyškova (300 m, leg. Hudec)
Kostice u Lanžhota (160 m, leg. Hudec)
Kotelná, Pavlovské vrchy (leg. Petrbok, Brabenec)
Krhov u Boskovic, Malý Chlum (480 m, leg. Ložek)
Kudlovice u Uh. Hradiště, vrch Hrubý (200 m, leg. Hudec)
Kurovice u Holešova, vrch Křemenná (317 m, leg. Hudec)
Lednice (150 m, leg. Hirst)
Lechovice, u silnice na Znojmo (200 m, leg. Pfleger)
Líšeň u Brna (250 m, leg. Petrbok, Žebera)
Ludmírov, skalisko Průchodnice (500 m, leg. Hudec)
Macocha u Blanska (leg. Culek, Petrbok)
Maloměřice u Brna (250 m, leg. Skutil)
Měnín u Slavkova (170 m, leg. B. Pražan)
Mikulčice, les Skařina, Dolnomoravský úval (160 m, leg. Hudec)
Mikulov, Sv. hora (250 m, leg. Brabenec)
Milotice u Kyjova (200 m, leg. Hudec)
Milotice - Mistřín (195 m, leg. Hudec)
Mistřín u Kyjova (150 m, leg. Hudec)
Moravská Chrastová u Svitav (400 m, leg. Hrubý)
Moravská Ostrava (250 m, leg. V. Zoufal)
Moravské Prusy u Vyškova (300 m, leg. Mácha)
Moravský Písek (190 m, leg. Hudec)
Nektavské údolí pod Dzbelem, Drahanská vrch. (450 m, leg. Hudec)
Nesovice u Bučovic (250 m, leg. Zázvorka)
Ostrava, Na skalkách - Ještěrčí údolí (leg. B. Kostrz, Mácha)
Ostrý Kámen u Svitav (450 m, leg. Hrubý)
Pasohlávky u Pohořelic (150 m, leg. Ložek)
Perná u Klentnice, Pavlovské vrchy (350 m, leg. Pfleger)
Pohansko u Břeclavi (160 m, leg. Hudec)

Pohořelice u Brna (150 m, leg. Zvarič)
Polešovice - Salajka, Dolnomoravský úval (180 m, leg. Hudec)
Předmostí u Přerova (250 m, leg. Petrbok)
Punkva u Blanska, údolí říčky (leg. Petrbok)
Příbor u N. Jičína, Honěova hůrka
Radiměř - Banín u Svitav (450 m, leg. Hrubý)
Raškov u Hanušovic (400 m, leg. Brabenec)
Rebešovice u Brna (200 m, leg. Ložek, Pfleger)
Říčka, Ochozské údolí, Moravský kras (300 m)
Sedliště - Černá Zem u Frýdku (300 m, leg. Ložek, Mácha)
Senice na Hané (250 m, leg. Petrbok)
Sirotčí (zříc.), Pavlovské vrchy (400 m, leg. Brabenec)
Skalka u Kyjova (200 m, leg. Hrubý)
Skoronice u Kyjova, Kukly (230 m, leg. Hudec)
Staříč u Místku, svahy Kamenné (350 m, leg. Ložek, Mácha)
Svitavy na Moravě (420 m, leg. Hrubý)
Štramberk, vrch Kotouč (500 m, leg. Brabenec, Mácha)
Tabulová hora, Pavlovské vrchy (350 m, leg. Brabenec)
Telnice u Slavkova (leg. Pražan)
Těrlicko u Frýdku (250 m, leg. Ložek, Mácha)
Tišnov u Brna (250 m, leg. P. Gícha)
Třinec u Ostravy, vápenka (leg. Mácha)
Tvrdonice u Břeclavi (200 m, leg. Petrbok)
Uherský Brod, Sídliště (leg. Hrubý)
Uhřice u Kyjova, údolí pod obcí (250 m, leg. Ložek)
Uničov u Olomouce (250 m, leg. V. Zoufal)
Vacenovice u Kyjova (150 m, leg. Hudec)
Valtice, u ryb. Nesyt (150 m, leg. Brabenec)
Vápenná (Zighartice), Jeseníky (250 m, leg. Šimek, Táborský)
Velké Meziříčí u Jihlavy (450 m, leg. Wondreys)
Vendryně u Třince (400 m, leg. Mácha)
Vítějeves u Svitav (450 m, leg. Hrubý)
Vojkovice u Rajhradu u Židlochovic (200 m, leg. Ložek)
Vracov u Kyjova (150 m, leg. Hrubý)
Vranovice u Břeclavi (200 m, leg. O. Hirst)
Vřesovice u Kyjova (250 m, leg. Hrubý)
Vysoká - Jindřichov, Osoblažský výběžek (300 m, leg. Mácha)
Vyškov, vrch Větrník (350 m, leg. Petrbok)
Zborovice u Kroměříže (250 m, leg. Baudyš)
Znojmo (200 m, leg. Culek)
Žadovice u Kyjova (200 m, leg. Hrubý)
Žulová u Javorníka, Rychlebské hory (350 m, leg. Brabenec)

Slovakia

Banka u Piešťan (200 m, leg. A. Culek)
Bánov nad Cetínkou u Šuran (100 m)
Beckov (hrad) u N. Mesta n. Váhom (300 m, leg. Culek, Pfleger)
Belá u Štúrova (150 m, leg. A. Hoffer)
Benešová u Ružoberoka (500 m)
Bernolákovo (Čeklís) u Bratislavy
Bodíky u Dunajské Stredy (náplav), 120 m, leg. M. Lisický
Bojnice (300 m, leg. Petrbok, Táborský)
Bratislava, hrad (leg. Petrbok, Culek)
Bystrica u Žiliny, Považský hrad (450 m)
Čáčov u Senice (150 m, leg. E. Baudyš)
Čachtický hrad u Trenčína (300 m, leg. J. Ponec, Pfleger)
Čenkov u Štúrova (100 m, leg. Brabenec)
Čierný Brod u Galanty (120 m, leg. Lisický)
Dechtice, Malé Karpaty (200 m, leg. Ponec)
Děvínská Kobyla, Malé Karpaty (leg. Petrbok, Brabenec, Ponec)
Diel, údolí ř. Zázrivé u Žiliny (500 m, leg. Pfleger)

Dobšinská ladová jaskyňa (400 m, leg. Lisický)
Domica, Domický vrch u Rožňavy (400 m, leg. Ložek)
Drevenik u Spišského Podhradí (550 m, leg. Brabenec)
Dvorníky u Turni u Košic (300 m, leg. Táborský)
Gánovce u Popradu (650 m, leg. Petrbok)
Háj u Turni n. Bodvou (350 m, leg. Petrbok)
Hajnáčka u Filakova (350 m, leg. Petrbok)
Hradiště p. Vr. u Senice (300 m, leg. Ponec)
Hrhov u Turni, Okrúhle (400 m, leg .Brabenec)
Hričov, zříc. u Žiliny (leg. Brabenec)
Hrušov u Šah, náplav (150 m, leg. Lisický)
Chtelnická dol. mezi Myjavou a Trnavou (250 m, leg. Ponec)
Jabloňov u Turni (450 m, leg. Petrbok, Brabenec)
Jatov u Nových Zámků (110 m, leg. Lisický)
Jur pri Bratislave (200 m, leg. Lisický)
Kamenica n. Hr. u Štúrova (200 m, leg. Petrbok, Táborský, Brabenec)
Kamenica u Sabinova - Kyjov (400 m, leg. Pfleger)
Kamenný Most u Štúrova (150 m, leg. Pfleger)
Karlova Ves u Bratislavy (200 m, leg. Petrbok)
Komáro (106 m, leg. Brabenec)
Kovarce - Sv. Anna u Topolčan (200 m, leg. Mácha)
Kralovany u Žiliny (500 m, leg. Pfleger)
Krásná Horka u Rožňavy (400 m, leg. Culek)
Levice (150 m, leg. Petrbok)
Lietava, zříc. u Žiliny (400 m, leg. Brabenec)
Malinovec u Šah (150 m, leg. Petrbok)
Manětínské úd. u Dol. Kubína (500 m, leg. Táborský)
Mliečany u Gabčíkova (100 m, leg. Brabenec)
Moravany u Piešťan (250 m, leg. Petrbok)
Nezbudská Lúčka u Žiliny (350 m)
Nitra (leg. Petrbok)
Nitranský Hrádok u Šuran, Zámeček (120 m, leg. Ložek)
Nová Stráž u Komárna (110 m)
Opatovská Nová Ves u Šah (248 m)
Oslany u Partizanské (250 m, leg. Táborský)
Pálkovičovo u Gabčíkova (leg. Pfleger)
Pastovce u Želiezovce (200 m, leg. Petrbok)
Piecky u Hrabušic, Slovenský ráj (600 m, leg. Brabenec)
Piešťany (200 m, leg. Petrbok)
Plavecký hrad u Plaveckého Sv. Mikuláše (410 m, leg. Ponec)
Plešivec u Ražňavy, stráň Koňartu (350 m, leg. Táborský, Pfleger)
Podunajské Biskupice (160 m, leg. Lisický)
Radvaň n. Dunajem, silnice na Komárno (100 m, leg. Pfleger)
Rájecká Lesná u Žiliny (450 m, leg. Ložek, Pfleger)
Rakáreň u Malacek (200 m, leg .Brabenec)
Rájecké Teplice, skály u sil. na Žilinu (450 m, leg. Pfleger)
Ratnovce n. Váh. u Piešťan (200 m, leg. Petrbok)
Ružomberok, vrch Mnich (550 m, leg. Brabenec)
Sabinov u Prešova (350 m)
Sivá Brada u Spiš. Podhradie (450 m, leg. Brabenec, Lisický)
Sliač, Borová hora (400 m, leg. Daněk)
Smrdáky u Senice (250 m, leg. J. Kocourková)
Sněžnica u Žiliny, úpatí Vretenu (500 m, leg. Brabenec, Pfleger)
Spišský hrad u Spišského Podhradie (450 m, leg. Brabenec, Pfleger)
Stankovany u Kralovan (500 m, leg. Ložek, Brabenec, Pfleger)
Starý Kláštor u Svätuše u Šuran (100 m)
Strečno u Žiliny (400 m)
Šafarikovo (180 m, leg. Florián)
Šárovce n. Hr. u Želiezovce (150 m, leg. Petrbok)
Štúrovo, silnice na Nové Zámky (leg. Pfleger)
Štúrovo (150 m, leg. Petrbok, Šustera, Brabenec, Táborský)

Šurany u Nových Zámků (100 m)
Trenčianská Teplá, Strážovská hornatina (300 m, leg. Petrbok)
Trenčín (220 m, leg. Petrbok)
Turňa, hrad u Košic (leg. Brabenec)
Velké Kršteňany u Partizánského, Velký vrch (450 m, leg. Ložek)
Vršatecká skaliska u Trenč. Teplé (850 m, leg. Hudec)
Vyšné Ružbachy u Staré Lubovni (650 m, leg. Petrbok)
Zadiel - Turňa u Košic (350 m, leg. Táborský)
Zalaba u Čata u Želiezovce (leg. Petrbok)
Zamarovce u Trenčína (200 m, leg. Petrbok)
Zobor u Nitry (500 m, leg. Táborský)
Zvolen, pod hradem (300 m, leg. Brabenec)
Želiezovce u Levice (150 m, leg. Petrbok)

LIST OF LOCALITIES IN CERNUELLA NEGLECTA

Býchory u Kolína, třešňovka (250 m, leg. Brabenec, Táborský, Pfleger)
Hrabanov u Lysé n. Lab. (?), 200 m, leg. Koubková
Kochánky u Benátek n. Jiz. (200 m, leg. V. Hořínek, Pfleger)
Košťálov u Třebenic, pod zříc. (250 m, leg. Brabenec, Ložek, Pfleger)
Litoměřice, pod Bílou stráni (300 m, leg. Brabenec, Zvarič)
Mšené u Budyně n. O., u ryb. Močidlo (250 m, leg. E. Baudyš, Brabenec, Ložek, Pfleger)
Mšené - Podolí, cihelna (leg. Ložek)
Ovčáry u Kolína - polní cesta na Býchory (250 m, leg. Brabenec, Táborský, Pfleger)
Třebenice - město, traf (leg. Brabenec, Pfleger)
Vrbka u Budyně n. O., křižovatka silnice a trati (250 m, leg. Pfleger)

VÁCLAV PFLEGER

PLŽI PODČELEDI HELICELLINAE (GASTROPODA) V ČSSR

Předložená práce byla vypracována v zoologickém oddělení PM NM v Praze. Je výsledkem šestiletého (1968—1974) terénního i laboratorního studia všech pěti představitelů podčeledi Helicellinae, žijících na území ČSSR. Nedílnou součástí textové části jsou mapy rozšíření československých suchomilek, seznamy lokalit, tabulky biometrických údajů pohlavního aparátu, fotografie pohlavních orgánů, grafy a kresby.

Vzhledem k velkému počtu popsaných druhů této podčeledi a jejich značné variabilitě, jsou názory na systematické postavení a oprávněnost některých taxonů značně nejednotné. Při popisu nových druhů často nebyla brána v úvahu velká variabilita ulit i pohlavního aparátu. Na území ČSSR se taková problematika projevila u druhů rodu *Candidula* KOBELT, 1871 a proto byla taxonomii tohoto rodu věnována zvýšená pozornost.

Studiem obsáhlého materiálu bylo dosaženo následujících výsledků:

1. Na základě vlastního výzkumu, materiálu ze sbírek zoologického oddělení NM i literárních údajů bylo souhrnně zpracováno rozšíření druhů podčeledi v ČSSR a vyneseno do map. ČSSR tvoří nejvýchodnější hranici rozšíření druhu *Candidula unifasciata* (POIRET, 1801). Nejstarší naleziště z konce minulého století je v okolí Opočna. Druhý ostrůvek v Čechách je v okolí Tachlovic u Nučic. Na Moravě se nachází v prostoru mezi N. Jičínem a Těšínem. Na Slovensku je tato suchomilka rozšířena v severozápadní části.

Výskyt *Helicopsis striata* (O. F. MÜLLER, 1774) se omezuje na původní stepní, nízko položené oblasti Čech, jižní Moravy a jižního Slovenska. *Helicella itala* (L., 1758) je na našem území vzácným druhem a vyskytuje se pouze v severních Čechách.

Naše nejběžnější suchomilka *Helicella obvia* (MENKE, 1828) se běžně vyskytuje v bezlesých, suchých a teplých oblastech stepního rázu na vápnitém podkladu. V Čechách je velmi hojná ve střední a severozápadní části a v široké oblasti Polabí, ostrůvkovitě v jižních Čechách, kde se omezuje na metamorfované vápence. Na Moravě žije roztroušeně v nižších polohách celé oblasti. Na Slovensku se vyskytuje v nížinách jižního Slovenska až k Turni u Košic, v západní části v povodí Váhu až do okolí Ružomberoku, místy proniká do vnitrokarpatských pánví (oblast mezi Popradem a Sabinovem u Prešova).

Cernuela (Xerocincta) neglecta (DRAP., 1805) se velice vzácně vyskytuje jen v Polabí a je u nás pouze druhem recentním.

2. Byl proměřen genitální aparát u 187 jedinců 5 druhů a stanovena jeho variabilita. Do tabulek a grafů jsou vyneseny hodnoty rozměrů jednotlivých úseků pohlavního aparátu (penis, epiphallus, flagellum, vas deferens, bursa telae, glandulae mucosae, truncus receptaculi, receptaculum seminis, spermoviductus, glandula albuminalis, ductus hermafroditicus) včetně směrodatných odchylek, střední chyby a variačního koeficientu.

3. Byla provedena biometrická měření ulit (2155 kusů), sledována jejich velikost a pigmentace v závislosti na různých stanovištích. Bylo zjištěno, že pigmentace i velikost ulit u druhů podčeledi *Helicellinae* je výrazně ovlivňována klimatickými faktory. Mění se nejen na různých lokalitách, ale liší se výrazně i u populací na stejném stanovišti v různých letech. Na suchých a teplých místech se vyskytují se zvýšenou frekvencí ulity vyšší a světleji zbarvené, zatímco na lokalitách vlhčích a chladnějších se vyskytují ulity širší a nižší, ale tmaveji zbarvené.

4. Hlavní těžiště práce spočívá v revizi druhů rodu *Candidula* na území ČSSR. Při podrobném hodnocení většího množství materiálu se ukázalo, na rozdíl od tvrzení HUDCE (1964), že jak anatomické, tak konchylologické znaky, uváděné jako specifické pro rozlišení *Candidula unifasciata* a *Candidula soosiana* (J. WAGNER, 1933) nejsou zcela konstantní. Podléhají změnám nejen na různých stanovištích, ale dokonce na stejném místě v různých letech. Hlavní rozlišovací znaky genitálního aparátu — flagelum a volný konec šípového vaku — se u populací směrem na východ zkracují (flagellum **F** až o 0,2 mm a volný konec šípového vaku $\mathbf{BT}_2$ až o 0,4 mm v průměru).

I z ostatních poznatků vyplývá, že morfologie pohlavního aparátu není vždy spolehlivým vodítkem k určování blízce příbuzných taxonů. V mnoha případech vykazuje větší proměnlivost než ulita, která je v přímém kontaktu s okolním prostředím.

Rovněž konchyliologické znaky udávané jako diagnistické pro oba druhy nemají taxonomickou hodnotu. Hlavní diagnostický znak — žebírkování — částečně podléhá změnám i na stejné lokalitě. Projevuje se to především na nalezišti Štramberk (nejnápadnější je to u ulit z r. 1968 ve srovnání s materiálem z r. 1952). Již HUDEC (1964) zjišťuje, že ulity *C. unifasciata* ze Štramberka (lgt. Hrubý, 1963) jsou ve srovnání s ulitami z Čech, výrazněji rýhované a hrubší na posledním závitu. Mohu konstatovat, že hrubší žebírkování je v pozitivní korelaci ke světlým ulitám bez typického páskování nebo k ulitám s rozrušeným páskováním. Ze srovnávacího materiálu dále vyplývá, že žebírkování se zvětšuje (je hrubší) u populací směrem na východ a je ovlivňováno klimatickými faktory.

Na území ČSSR (Morava) je tato suchomilka zřejmě na rozhraní vlivů oceánského vlhčího a pevninského sušší ho podnebí. Podle dosavadních výzkumů se plž *Candidula unifasciata* jeví jako velmi plastický druh, který je schopen osídlovat další vhodná území (nikoliv však původní stepní biotop) směrem na východ a poměrně rychle se přizpůsobovat mikroklimatu nových biotopů. ULIČNÝ (1893) uvádí, že se k nám tento plž dostal zavlečením. Podle vzhledu srovnávacího materiálu se zdá, že rozšíření na na našem území není stejného původu. Jednak je zde typická populace *C. unifasciata* z okolí Tachlovic a jí podobná (aspoň materiál z r. 1952) ze Štramberka. Druhou skupinu tvoří populace z okolí Opočna, severní Moravy a Slovenska, z nichž některé upomínají na polský materiál. Již POLINSKI (1924) a URBANSKI (1933) poukazují na silnější žebírkování ulit *C. unifasciata* z Těšínska a Poznaňska ve srovnání s typickou *C. unifasciata* z Německa a Švýcarska. Tento rozdíl je vidět i při srovnání s naším materiálem od Tachlovic. Některé další znaky uváděné jako rozlišovací pro dva druhy (HUDEC, 1964) se mění v závislosti na výšce ulity a nelze je proto uznat za diagnostické. Jedná se o procento velikosti posledního závitu s předposledním, tvar ústí, tvar ulity, úhel posledního a předposledního závitu, sklon švu u posledního závitu.

Je nutné znovu zdůraznit, že všechny uvedené znaky se mění u populací nejen na různých lokalitách, ale i na stejném místě během různých let. Tato proměnlivost vedla J. PETRBOKA (1936c) tak daleko, že na stanovišti Tachlovice u Prahy determinoval dva druhy; ve skutečnosti asi jen dvě různé generace nebo dokonce variabilní jedince téže populace. Z fotografií, uveřejněných v jeho práci (1936c) je vidět, že ulity bez výrazného páskování a s výrazným žebírkováním determinoval jako *Candidula* sp. cf. *intersecta* POIRET var. *heripensis* MABILLE; zatímco ulity výrazně páskované a slaběji žebírkované určil jako *Candidula* cf. *unifasciata* (POIRET). Ve skutečnosti se jedná jen o variabilní exempláře jediného druhu — *Candidula unifasciata* (POIRET)! Tento příklad je názorným varováním nejen před unáhlenou determinací, ale platí i pro popisování nových taxonů. Základním předpokladem každé systematické práce je tedy i dnes důkladná znalost druhové variability.

Při neznalosti těchto faktorů není ovšem divu, že J. WAGNER při popisu *Candidula soosiana*, když srovnával typový materiál z Maďarska s ulitami *C. unifasciata* z Německa, zjistil odchylné znaky a použil je pro diagnózu nového druhu. Snažil jsem se získat na srovnání typový materiál *C. soosiana* z muzea v Budapešti. Jak mi písemně sdělil maďarský makolog L. Pinter, 25. 10. 1973, nachází se v jejich sbírkách pouze 1 ulita z typové lokality sebraná 22. 2. 1966. Tuto ulitu jsem měl vypůjčenou; je hrubě žebírkovaná a připomíná ulity z Vretenu na Slovensku. Bohužel z jediného kusu si nelze udělat představu o populaci. Tento kus byl determinován maďarským malakologem jako *C. unifasciata*. L. Pinter dále poznamenává, že tento druh asi v Maďarsku, kam byl pravděpodobně před 40 lety zavlečen, již vyhynul. Osobně se domnívám, že se tam dostal z některé slovenské lokality.

Studiem variability ulit i pohlavního aparátu nebyly nalezeny žádné konstantní diagnostické znaky (všechny se mění vlivem klimatických podmínek) a protože představitelé slovenských populací determinovaní jako *Candidula soosiana* byli určeni podle originálního popisu z typové lokality v Maďarsku, dospěl jsem k názoru, že všechny studované populace náleží k jedinému druhu *Candidula unifasciata* (POIRET, 1801). Proto taxon *Candidula soosiana* (J. WAGNER, 1933) považuji za synonymus. I když se populace označované dosud jako *C. soosiana* liší od typických populací *Candidula unifasciata*, nemůže jim být přiznán statut samostatného druhu. Mohu je

hodnotit jen jako nejvýchodnější formu druhu *Candidula unifasciata* (tzn. forma infrasubspecifická).

Výsledky tohoto studia neplatí jenom v tomto případě, ale lze je aplikovat i na jiné případy v rámci této podčeledi mimo naše území. Bylo by proto potřebné zaujmout kritický postoj i v okruhu druhů *Helicella obvia - macedonica* a *Helicopsis striata - hungarica - austriaca - cereoflava.*

5. Na modelovém druhu *Candidula unifasciata* na stanovišti Chýnice u Prahy byly sledovány i některé biologické aspekty — způsob přezimování, páření, kladení vajíček, růst ulity i způsoby šíření z původní lokality.

6. Při studiu obsahu $CaCO_3$ na lokalitách druhů podčeledi *Helicellinae* bylo zjištěno, že síla populací jednotlivých druhů není přímo úměrná k velikosti podílu vápna v půdě; ta však musí mít aspoň určitou minimální zásobu vápna. Zdá se však, že na velikost populace druhů *Helicella obvia* a *Cernuella neglecta* má vliv fyzikální stav půdy. Oba druhy se vyskytují mnohem častěji a ve větším množství v okolí nebo přímo na místech, která jsou občas obdělávána (nikoliv pravidelně kultivována). Takovými místy jsou právě úhory, směsková a jetelová pole a strnišťata, která se nezaorávají.

7. Byly sledovány i některé faktory ovlivňující populační dynamiku druhů podčeledi *Helicellinae.* Délka života je rozdílná u jednotlivých druhů, nejnižšího věku se dožívá *Candidula unifasciata,* 7—12 měsíců (asi 10 % přezimujících kusů). Hustota populací je značně rozdílná na různých biotopech. Podmínky ve střední Evropě nedovolují vznik masových populací, známých z jižní Evropy. Jejich výskyt na biotopu je nepravidelný. Jen jednou jsem našel populaci *Helicela obvia,* kdy se počet jedinců na 1 m^2 pohyboval kolem 50—60 kusů a populaci *Candidula unifasciata,* kdy se počet jedinců pohyboval okolo 100—150 ks/m^2. Většina populací, které jsem našel byla slabá nebo střední.

Na silný rozvoj populace má vedle teploty značný vliv delší deštivé období. Při takovém počasí během celého roku dochází k rozvoji několika generací a na začátku podzimu je místy silná nebo velmi silná populace. Kromě čistě klimatických faktorů mají velký vliv i místní faktory. Především je to činnost nepřátel těchto plžů (ptáci, larvy dravého hmyzu), parazitů, popř. i chemických postřiků. U druhu *Helicopsis striata* se uplatňuje isolace a degenerace, jeho vymírání u nás pokračuje velmi rychle. Významnou úlohu zde nesporně hraje i ta okolnost, že jde o druh, který na rozdíl od ostatních suchomilek, neosazuje tak snadno umělé biotopy, ale je naopak lidskými zásahy potlačován.

Dynamika druhů této podčeledi je v neposlední řadě ovlivněna v našich oblastech zimním ozdobím, zatímco rozvoj některých druhů v oblasti původního rozšíření probíhá celý rok (kromě období velkého sucha). Z výzkumu vyplývá, že dynamika populací těchto plžů (a pravděpodobně i ostatních) je — kromě genetických faktorů — závislá především na ekologických faktorech. Jednotlivé vlivy nelze z tohoto komplexu vyčleňovat a zdůvodňovat jimi výskyt a množství uvedených druhů.

Všechny protokoly a materiály použité k této práci jsou uloženy v zoologickém oddělení PM NM v Praze.

CONTENTS

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