SNAIL — an interactive computer program for the determination of Central European freshwater gastropods

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A b s t r a c t : In this work, a computer program, termed SNAIL (version 1.0), is introduced which enables the determination of freshwater gastropods colonizing Central European lakes and rivers. The program was developed with a HTML editor, thereby offering a user-friendly menu system and an easy navigation through specific windows. Besides a comprehensive key for the determination of sampled gastropods, SNAIL additionally includes a record sheet system with ecological data for all relevant gastropod families, a help window describing main characteristics of the shells, and a window with useful links to the World Wide Web. Finally, also interesting literature citations dealing with the systematics and ecology of the molluscs are included. The handling of the program is demonstrated by using the pond snail *Lymnaea stagnalis* as example.

K e y   w o r d s : Computer program, gastropod, determination, ecology, HTML editor.

Introduction

In the past decades, increasing scientific attention was devoted to indigenous freshwater molluscs, because many species represent valuable bioindicators, which are thrown upon specific structures of the colonized biotopes (e.g., FALKNER 1990, GLÖER & MEIER-BROOK 2003, STURM 2007, 2012, 2016). Additionally, half the species belong to the Red List of endangered animals (FRANK & REISCHÜTZ 1994), with some representatives being already attributable to category 1 ('threatened by extinction'). In the county of Salzburg, a comprehensive recording and mapping of aquatic gastropods and bivalves was started in the 1990s (PATZNER 1995). Besides the distribution of single species in waters of the Alpine foreland and the county capitol, also their possible occurrence in diverse regions of the Northern and Central Alps was subjected to a detailed investigation. As demonstrated in numerous publications (e.g., STURM 2000a, 2000b, 2001, 2003, 2004, 2005, 2006, 2007, 2012, 2013a, 2013b, 2016), indigenous freshwater molluscs may be subdivided into generalists and specialists, in the course of which some species belonging to the first group have the ability to colonize waters of the montane and subalpine altitude level.

For the determination of indigenous freshwater molluscs several authoritative works were published in the past decades, among which particularly the determinative key of GLÖER & MEIER-BROOK (2003), which has already come out in its 13th edition, has to be pointed out due to its easy handling and its detailed description of single species. However, the amply available determinative literature is conflicted by a complete absence of respective interactive computer software fulfilling the same intention. This determinative

software could find its meaningful application in schools and universities. In addition, it would establish a connection between new media on the one side and malacological research on the other. For a partial elimination of this deficit, the present contribution pursues the main goal of introducing a computer program, which offers the determination of freshwater gastropods via the computer screen.

Material and Methods

Systematics of Central European freshwater gastropods

Beforehand, it has to be noted that a high number of gastropod species colonizing Central European waters is rather easy to survey. As illustrated in the flow diagram of Fig. 1, indigenous freshwater gastropods may be assigned to two subclasses, the Prosobranchia and Pulmonata, which contain three orders (Archaeogastropoda, Mesogastropoda, and Basommatophora). These orders include 11 families with a total of 33 genera and 72 species. As outlined by GLÖER & MEIER-BROOK (2003) and STURM (2005, 2016), some species like *Bythinella austriaca*, *Bythinella badensis* or *Sadleriana bavarica* are characterized by a rather strict endemic occurrence, so that they cannot be evaluated as representative for the whole Central-European region.
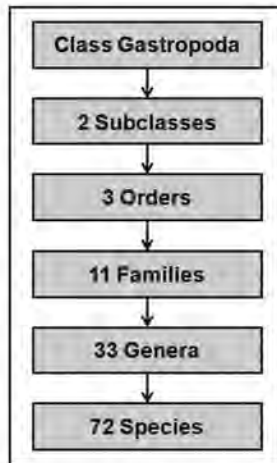

Fig. 1: Systematic organization of the class Gastropoda (GLÖER & MEIER-BROOK 2003).

Shell characteristics of freshwater gastropods

In order to guarantee a successful determination of single gastropod species, several determinative characteristics of the shells have to be kept in mind (Fig. 2). In principle, the shell of a freshwater snail is composed of the whorl and the mouth, which are separated by the so-called umbilicus. Shell height and shell width are clearly distinguishable from mouth height and mouth width. Each shell consists of several whirls that have to be numbered from the top to the bottom. Since the shell habit of planorbid snails completely differs from that of viviparid or lymneid snails, proper care with regard to the analysis of the length parameters mentioned above has to be exercised (Fig. 2). Another essential

property of gastropod shells concerns the direction of the whorl. Whilst shells of the Physidae are marked by left-handed whorls, shells of the Lymnaeidae and most other gastropod families are distinguished by their right-handed whorls.
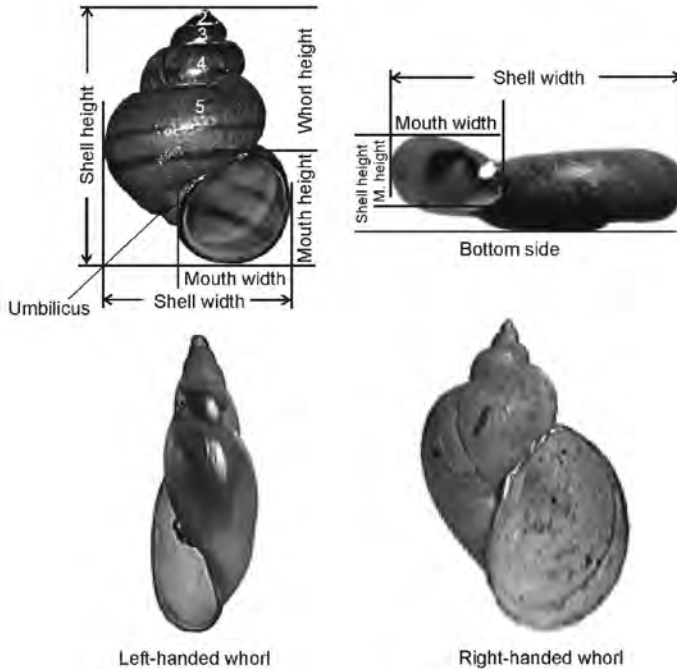
Fig. 2: Main characteristics of gastropod shells, which are essential for the determination of single species (GLÖER & MEIER-BROOK 2003).

Brief description of the computer program SNAIL

After opening the program, the user immediately gets to the entrance window, where several options such as selection of the main menu, call for essential addresses in the World Wide Web, termination of the program, and detailed program information are available (Fig 3a). The main menu contains four options, among which 'species determination of freshwater gastropods' undoubtedly represents the core of the software. Additionally, information on the ecology of Central-European freshwater gastropods can be interrogated in order to obtain a deeper insight into the life and colonization strategies of single species. Another option of the main menu enables the user to navigate to a detailed literature list including numerous scientific studies on freshwater gastropod determination, biology, and ecology. The 'help' option opens a window, within which main steps for the correct description of diverse gastropod shells (Fig. 2) are summarized (Fig. 3b).

Concerning the determination of indigenous freshwater snails collected from lakes and rivers, the program follows respective recommendations of GLÖER & MEIER-BROOK (2003), who have introduced an efficient system of flow charts enabling a fast discovery.
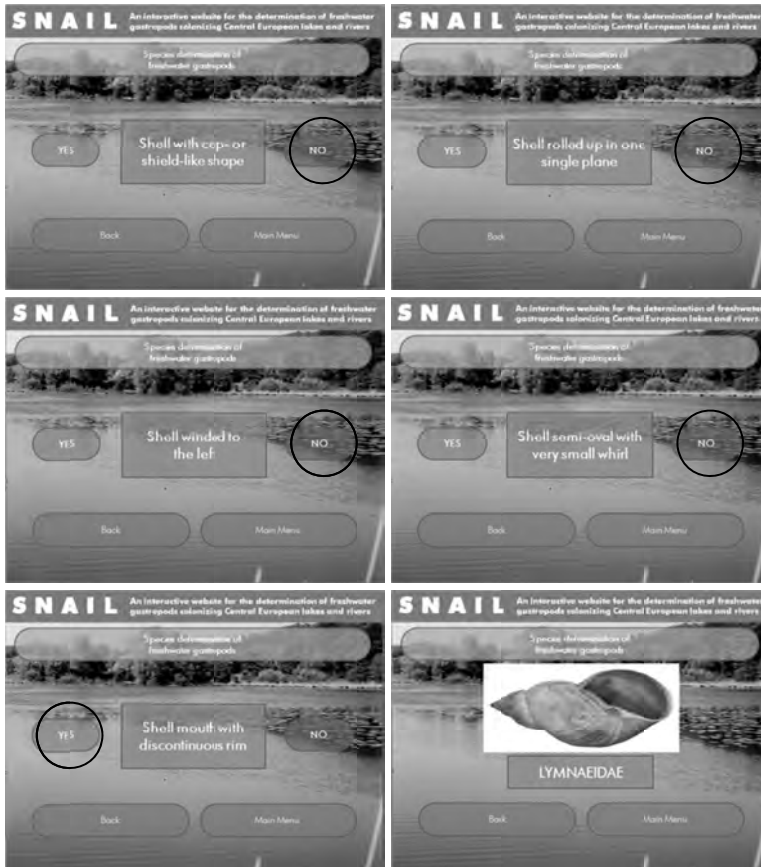
974

(a)

(b)

Fig. 3: The computer program SNAIL (version 1.0) with its entrance menu (a) as well as the main menu (b).

Results

Determination of the gastropod family − an example

In order to demonstrate the easy handling of the computer program, a short trial run resulting in the commitment to the family of the pond snails (Lymnaeidae) is presented.

Fig. 4: Key offered by the computer program SNAIL for determining the family of the Lymnaeidae.

As exhibited in Fig. 4, the user is asked, if the collected shell is distinguished by cap- or shield-like shape. Since this is not the case, the next statement deals with the mode, according to which the shell is rolled up. As the shell is not rolled up in a single plane, the program asks, if the shell is winded to the left (left-handed whorl). This question has to be again answered with 'no', so that the following statement deals with the general shape of the shell. A semi-oval geometry with very small whirl can be excluded in the present case, which gets the user to the question, if the shell mouth contains a disconti-nuous rim. This statement has to be answered with 'yes', finally providing the above mentioned gastropod family as result.

Determination of the gastropod species − an example

For a successful determination of the peaked pond snail *Lymnaea stagnalis*, only a few further steps have to be carried out in the program, which are summarized in Fig. 5. The first statement concerns the thickness of the shell wall that is not reduced in the given case. Neither is the shell of the collected gastropod transparent, nor is it spherically blown up. In the next window, the user is asked for the shape and size of the shell. Since the statement, according to which the shell has a long and peaked whirl and is greater than 25 mm, has to be affirmed, the user finally gets to the genus *Lymnaea*, which is represented by the single species *Lymnaea stagnalis* in Central Europe.

Fig. 5: Key offered by the computer program SNAIL for determining the species *Lymnaea stagnalis*.

Discussion

Advantages and drawbacks of gastropod determination software

As clearly demonstrated in this brief study, taxonomic documentation of freshwater gastropods can be effectively conducted on the computer in the meantime. By navigating through the single program windows containing the determinative information, a successful taxonomic address of collected snails can be attained within several minutes. This circumstance represents a great advantage with respect to printed determinative keys such as those of FALKNER (1990), TURNER et al. (1998), and GLÖER & MEIER-BROOK

(2003), if high numbers of gastropods have to be subjected to the determination proce-
dure. Scientific computer programs are often declared as freeware or shareware, which
should undergo rapid and extensive distribution within the scientific world. In order to
reach this goal, the software can be delivered with the help of the World Wide Web.

Another advantage of the introduced software consists in its excellent applicability for
pedagogical purposes. Therefore, the program can be called into action in science-
oriented school lessons (e.g., scientific laboratory), where disciples is set the task to
determine various molluscs living in indigenous aquatic habitats. By using the computer,
rapid determinations of provided species can be carried out. Besides its numerous
advantages, the software also disposes of one grave drawback, which concerns its appli-
cation in the field. In many cases, determination of freshwater gastropods and bivalves
should be handled on the spot, because this strategy avoids the taking and storage of
large samples. In this case, however, a printed determinative key can often render a
better service then a computer program stored on a notebook. Despite of this disad-
vantage, it has to be mentioned here that SNAIL represents a web program also running
on small and well manageable tablet PCs.

Availability of the computer program

The program SNAIL has been developed with a HTML editor and has been compiled as
website containing numerous web pages that are connected by respective links. The
advantage of this specific programming mode consists in the easy opening of the soft-
ware on any computer, because only a web browser such as MS Internet Explorer or
Mozilla Firefox is required for work. Furthermore, the software can be used as online
resource being simultaneously available for a high number of users. This last point pre-
destinates SNAIL to be applied at schools or universities.

All people being interested in an acquisition of the software can download the program
from the respective Research Gate website of the author.

Zusammenfassung

SNAIL − Ein interaktives Computerprogramm zur Bestimmung mitteleuropäischer Süßwasser-
gastropoden.

Die vorliegende Arbeit beschreibt ein Computerprogramm mit der Bezeichnung SNAIL (Version
1.0), welches die Artbestimmung von in mitteleuropäischen Seen und Flüssen lebenden Süßwasser-
gastropoden ermöglicht. Das Programm wurde mithilfe eines HTML-Editors entwickelt und bietet
neben einem bedienungsfreundlichen Menüsystem eine einfache Navigation durch die einzelnen
Fenster. Der umfangreiche Bestimmungsschlüssel wird durch zahlreiche Seiten ergänzt, die rele-
vante ökologische Daten zu den einzelnen Gastropodenfamilien enthalten. Ein Hilfefenster bietet
Unterstützung bei der Bestimmung der Gehäuse, während ein weiteres Fenster nützliche Links zu
mit dem Thema in Verbindung stehenden Internetseiten enthält. Zusätzlich können noch inter-
essante Literaturzitate aufgerufen werden, welche die Systematik und Ökologie der Weichtiere
behandeln. Die Handhabung des Programms wird anhand der Bestimmung der Schlammschnecke
Lymnaea stagnalis demonstriert.

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