Computer-based Online Identification Programme for Forest Relevant Insects

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Abstract: Um die Ausbildung der Studenten bei der Bestimmung von Forstinsekten und E-Learning auf universitärem Niveau zu unterstützen, wurde ein Online-Bestimmungsschlüssel entwickelt. Der dichotome Bestimmungsschlüssel ermöglicht Studenten und später auch anderen Interessenten, Insekten am Computer in einer didaktisch unterstützenden Form zu bestimmen. Neben einem Einstieg über das adulte Insekt wird der Schlüssel später auch andere Einstiegsmöglichkeiten bieten, z.B. über den Waldtyp, die Baumart und das Schadbild. Im Rahmen eines Bestimmungskurses können mit Nummern codierte Exemplare an die Studenten ausgeteilt werden. Dies erlaubt es, den Bestimmungsweg zu verfolgen und präzise Rückmeldungen über eventuelle Fehlentscheidungen zu geben. Nach einer erfolgreichen Bestimmung sind PDF-Dokumente mit weiteren Informationen über die betreffende Art (Lebenszyklus, Bedeutung und Gefahr für die Forstwirtschaft, Bekämpfungsmaßnahmen, etc.) verfügbar.

Der Fokus lag bisher auf den Curculionidae (Rüssel- und Borkenkäfer), einer Familie, die die häufigsten Forstschädlinge in Mitteleuropa beinhaltet.

Key Words: Online-Bestimmung, Forstinsekten, dichotomer Bestimmungsschlüssel, E-Learning

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Introduction

A survey of the systematics of insects as well as insect identification training is integral to the scientific training of many universities. The Department of Forest Zoology and Forest Conservation of the Büsgen-Institute of the Georg-August-University of Göttingen is making an effort to establish the students' knowledge of species during the first two semesters of the bachelor studies for Forest Sciences and Forest Ecology, by offering weekly seminars and lectures for an overview in this field. Generally, students at this level tend to have limited previous knowledge of insect species and forms (Berck & Klee 1992). The large number of students present and the heterogeneity of the study groups make optimal support of the students during practical courses very difficult.

Bearing in mind this experience, the Department of Forest Zoology and Forest Conservation has decided to establish an online learning plan within the eLearning framework of the Faculty of Forest Science and Forest Ecology of the University of Göttingen. The notion eLearning comprises all kinds of learning using digital media for the presentation and distribution of study material and / or for supporting communication (Kerres 2001). The eLearning framework was founded within the ELAN project of Lower Saxony aiming at assisting universities in transforming existing structures and establishing new ones that use multimedia in teaching, studies and advanced training. It is within this framework that the Department of Forest Zoology and Forest Conservation in cooperation with the Department of Ecoinformatics, Biometrics and Forest Growth have created the project "Online Identification of Forest Insects". An internet-based identification key for forest insects has been developed to be used in teaching on the one hand, and to be available online to students on the other hand. The project, partly financed by tuition fees, represents the main item of a new didactic concept using the online system as a supplement for identification training in forest zoology.

In helping the students working on their own, the system can carry out many of the routine tasks of the tutor – such as answering questions, assessing identification results or analysing faults. The basic idea is to keep everyone busy studying and to enable students to work on their own within the heterogeneous study groups. In addition to that, the students can use the key to deepen their knowledge of the subject. This is where self-determined ways of acting promise high-quality learning results (Schaal & Randler 2004).

Structure of identification key and supplements

The online identification key is based on the eTree® study platform by DIS Informationssysteme GmbH (Osnabrück, Germany). Its main feature is a dichotomic decision tree offering a choice between two distinctive characteristics in each step of the identification. The way of identification includes descriptions, drawings and photos of morphological characteristics relevant to the identification process.

At first, the structure of the question trees has been developed and the texts for decisive points have been written as well as the final pages with regard to certain systematic levels (sub-families, genus, species). In addition to that, there is a glossary for learning scientific terms, which is directly accessible from the texts. In addition, PDF-documents with supplementary information on life cycle, distribution area, economical importance, preventive measures etc. are available on the species level.

Detailed drawings are presented for those identification steps related to specific morphological characteristics, such as commissures or hair patterns on the claviform antennae. These drawings are available at the ramifications of the decision tree and can be reached by pop-up help windows if required. Important decisive characteristics mentioned in the text are linked with coloured markings in the drawings which can be activated (fig. 1).

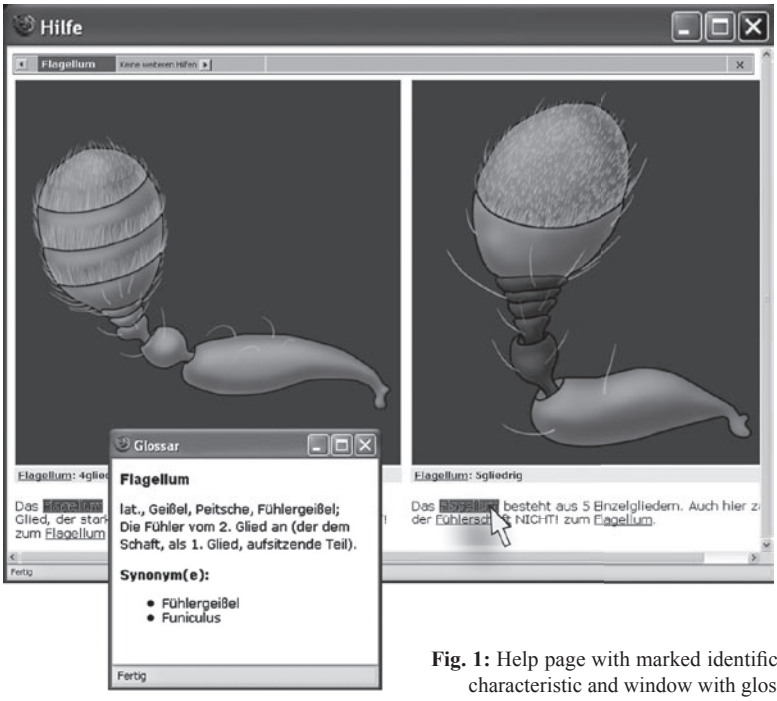

Fig. 1: Help page with marked identification characteristic and window with glossary.

In addition to that, the identification key also includes macro-photos of the respective species. Owing to the curculionidae's various body sizes (ca. 1 to 10 mm) and body colour, it was necessary to establish a comprehensive method for taking such macro-photos. In order to guarantee highest faithful reproduction of colour and also a suitable preparation, only fresh insects were used. A digital reflex camera (Canon 40D) with different lenses (Canon EF 100mm 1:2.8, Sigma DC 17-70mm 1:2.8-4.5) was used. For shots of high

magnification, the wide-angle lens was mounted in inverse position. In full-size shots, the given depth of field was not sufficient to present the whole vertical length of the insect's body in one single shot (Piper 2007). Therefore, several shots of the same detail were taken while adjusting the focus. The software Combine ZM® and Helicon Focus® were used to create one completely focused image from several partially focused images by combining the respective focused areas. The picture thus created may show – depending on the combination method used - some artifacts such as hairs not really existing on the body or so-called halos (Agarwala & al. 2004) which can be corrected using Adobe® Photoshop® CS3. The photos are presented on the final pages of the key. Different views (dorsal, lateral, cranial, caudal) of the respective insects are shown in the pop-up media window (fig. 2).

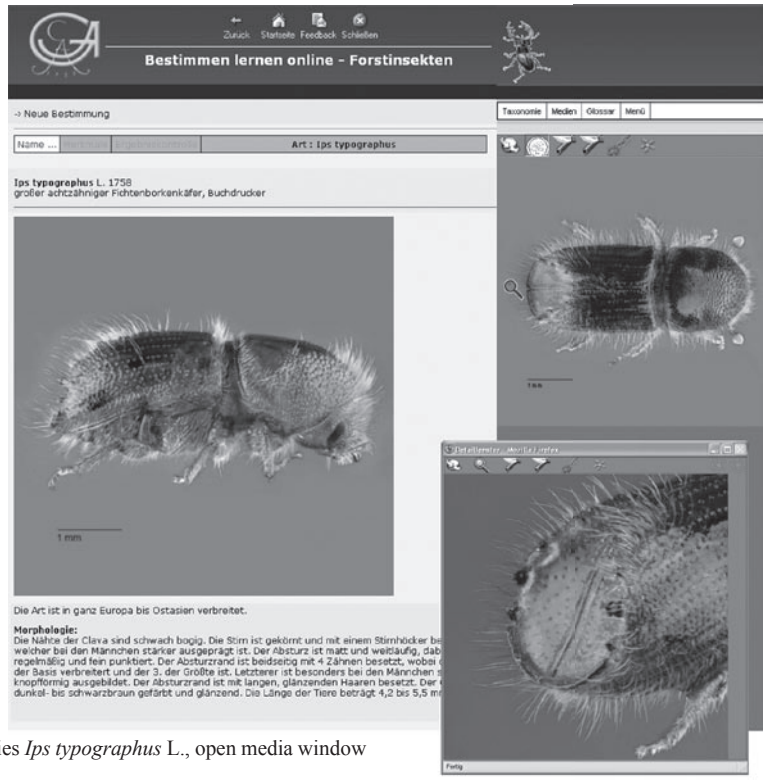

Fig. 2: Final page for the species *Ips typographus* L., open media window showing caudal view.

Using the identification key

So far, different specimens of the Curculionidae family including Platypodinae and Scolytinae sub-families (platypodid beetles and bark beetles) have been included in the identification key. Further specimens of Curculionidae (snout beetles) and of the Cerambycidae family (longhorn beetles) are to follow. In the future, the identification key shall comprise every important Central European forest insect.

Whereas by now only an identification key for imagines is available, further ways of determination based on host tree species or forest type and typical pattern of damage will be possible. This will invite different target groups – apart from students – to use the publicly available identification system for their practical work. The identification key has already been presented to a group of students for critical assessment and their feedback has been integrated. Such formative evaluation attending the procedure is considered a major chance for the development of high-quality educational schemes (Gediga & Hamborg 2002; Stahl & Bromme 2002; Stahl & al. 2005). Proposals for improvements made by users during or after the evaluation will certainly continue to be integrated in the system.

Only a standard internet browser is required to get access to the system but no special software (Draeger & Lanwert 2009). This enables interested people, who do not have the latest computer technology, to use the online key at home, too. Accompanying texts at different levels as well as links between the drawings and the glossary will help during the identification work.

The system offers two different ways of working. On the one hand, students can – either during the course or at home - independently identify a specimen without knowing the result they will get and use their own material in order to increase their knowledge. On the other hand, it is also possible to work with coded material (e.g. when preparing for the exam). The students will then get specimens with a number code according to which the system can check if the identification was performed correctly. In case of misidentification it indicates at which step the error has occurred. By analysing the user's work in this way, intermediate results as well as the taxon achieved can be rated true or false. If a student reaches the third question after a wrong decision, the system will warn and lead back. The already passed systematic levels will be shown in the course of identification (fig. 3).

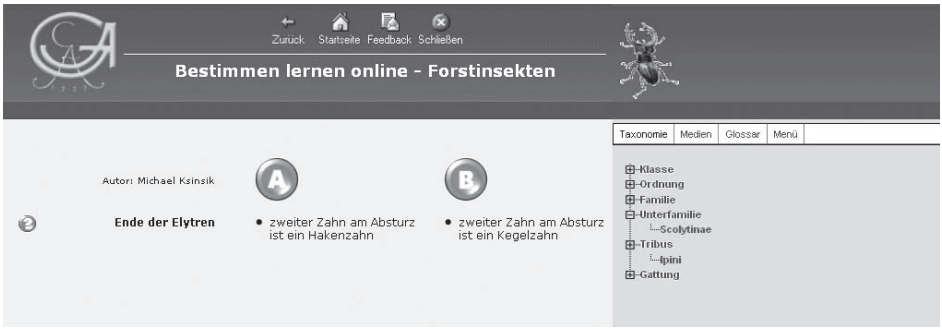

Fig. 3: Typical view of the user interface with a point of dichotomic decision and already passed systematic levels.

The students can view the continuous decision path and the first wrong decision will be marked. They will then be led back to this point, and can continue the identification. This direct individual feedback enables the user to memorize important distinctive details and characteristics. The feedback will also enable the users to assess their own learning success. Advanced users can also start directly at already known levels (e.g. family or genus) of the identification key without having to go through the entire systematics.

The possibility of eLearning offers a double advantage for students who are the main target group of the online identification key. On the one hand, it is possible to employ the photos from the key as auxiliary learning material in a course, e.g. decisive identification-relevant details of the insect's body can be shown on a screen to all the students. On the other hand, students are enabled to proceed to the identification of insects following their individual speed of learning (during the course as well as at home) and to take the precise feedback on faults into consideration. The internet availability of the key will also help to reduce the stress in overcrowded entomology courses and will give students the opportunity to repeat the identification process as often as required and thus acquiring the necessary routine. As a result, they will become well-experienced and have good chances to pass their exams. Numerous photos (of details) and drawings as well as auxiliary learning features (e.g. coloured markings, glossary, PDF-documents) and the links between them are meant to incite the students to independent explorative learning (see Strzebkowski 1997). Considering all these facts, one may well expect faster and longer lasting results as regards the study objectives "Using an identification key" and "Knowledge of species".

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