

THE FRENCH INFORMATION SYSTEM ON SAPROXYLIC BEETLE ECOLOGY (FRISBEE): AN ECOLOGICAL AND TAXONOMICAL DATABASE TO HELP WITH THE ASSESSMENT OF FOREST CONSERVATION STATUS

C. BOUGET¹, H. BRUSTEL² & P. ZAGATTI³

RÉSUMÉ. — *La base de données sur l'écologie des coléoptères saproxyliques (FRISBEE): un outil taxinomique et écologiques pour l'évaluation de l'état de conservation des forêts.* — La base de données sur l'écologie des Coléoptères saproxyliques français (French Information system on Saproxylic BEetle Ecology, FRISBEE) a pour objectif la compilation organisée de l'information écologique disponible pour toutes les espèces de Coléoptères associées au bois mort ou dépourissant, ou aux micro-habitats connexes. Cette base de données relationnelles est composée de 4 tables: (i) une table bibliographique, (ii) une table taxinomique, dotée d'un référentiel taxinomique des espèces avec leur valeur patrimoniale, (iii) une table écologique, incluant 11 descripteurs du bois ou traits écologiques caractérisant l'association des insectes aux attributs ligneux, (iv) et une table photographique. La base FRISBEE constitue un outil pragmatique pour l'évaluation de l'état de conservation des forêts ou pour l'analyse fonctionnelle des assemblages d'espèces.

Mots-Clés: Autécologie, statut de conservation, gestion forestière.

SUMMARY. — The French Information system on Saproxylic BEetle Ecology (FRISBEE) is aimed at organizing species-specific ecological information for all wood-associated beetle species in France. Four tables are linked in a relational database structure: (i) the reference table, (ii) the taxonomical table, containing information with standardized nomenclature and species patrimonial value, (iii) the ecological table, including 11 wood parameters or ecological traits that categorize the association of a species to different wood attributes, (iv) and the photographic table. The FRISBEE database is meant to serve as a pragmatic tool for assessing the conservation status of forests and for carrying out functional analyses of saproxylic beetle assemblages.

Keywords: Autecology, conservation status, forest management

CONTEXT

As soon as 1988, the Council of Europe encouraged European governments to use the saproxylic organisms in the evaluation of forest conservation status: "The Committee of Ministers, under the terms of Article 15.b of the Statute of the Council of Europe, [...] recommends that the governments of member states: [...] consider the desirability of making a survey of

¹ Institute for engineering in agriculture and environment (Cemagref), Research Unit «Forest ecosystems», Domaine des Barres. F-45290 Nogent-sur-Vernisson. E-mail: christophe.bouget@cemagref.fr

² ESA Purpan, 75 Voie du TOEC. F-31076 Toulouse cedex 3. E-mail: herve.brustel@esa-purpan.fr

³ Institut Français de la Biodiversité, 57 rue Cuvier, CP 41. F-75231 Paris cedex 05. E-mail: zagatti@versailles.inra.fr

saproxylic organisms when assessing the quality of forests for nature conservation purposes, particularly where the intention is to re-establish natural forest conditions within a protected area” (Recommendations R(88)10 and 11 on the protection of saproxylic organisms and their biotopes). Nevertheless, about twenty years later, only a few tools are available to satisfy this objective.

Since saproxylic biodiversity is very high in European forests, it is a challenge to monitor dead-wood associated organisms. About 25% of forest species are saproxylic organisms in Scandinavia (Stokland *et al.*, 2004), and 20% of the forest fauna is related to dead wood in Great-Britain (Elton, 1966 *in* Dajoz, 1998). Just after the fungi (30% of the saproxylic organisms), beetles are dominant in saproxylic assemblages (20% of the saproxylic organisms; Stokland & Meyke, 2008). Furthermore, 20% of national beetle species are saproxylic in Germany (Köhler, 2000) and Finland (Berg *et al.*, 1994). Among national forest beetles, saproxylic beetles represent 40% (Finland, Martikainen, 2003) to 56% of species (Germany, Köhler, 2000). This high biodiversity is threatened, since 20% (Finland, Berg *et al.* 1994) to 35% (Germany, Köhler, 2000) of saproxylic beetles are currently red-listed. At least 2% of the national fauna was driven to extinction, from 1800 in Finland (Martikainen, 2003) or from 2900BC in Great-Britain (Buckland & Dinnin, 1993).

Information systems focusing on the species-rich group of saproxylic beetles has been developed in several European countries (Scandinavia: Dahlberg & Stokland, 2004; Great-Britain: Alexander, 2002; Germany: Köhler, 2000, Schmidl & Bussler, 2004, Müller *et al.*, 2005).

In France, the saproxylic beetle fauna is only partly covered by these databases. The first French project was a list of 300 species written by Brustel (2004) as a pragmatic conservation tool. This pioneer initiative now suffers from a poor representativeness (i) in a taxonomical point of view (only 15% of the species and 40% of the families are represented), and (ii) in an ecological perspective (only mid-size, large and remarkable species were included).

STRUCTURE

The French Information system on Saproxylic Beetle Ecology (FRISBEE) has the ambitious aim to organize species-specific ecological information for all wood-inhabiting beetle species in France. The current project aims at building a national and homogeneous information system on ecology, but not on geographical distribution. The FRISBEE database does not include other insect groups (e.g. Diptera, Hymenoptera, Hemiptera and Lepidoptera), nor other invertebrate groups (e.g. mites and pseudoscorpions).

Three steps have been planned and are still in progress:

1 - to make a complete taxonomical table of saproxylic beetle French fauna, based on a corrected update of the Fauna Europaea (ca 2500 species, 71 families including Staphylinidae, Buprestidae, Anobiidae, Cerambycidae, Curculionidae (Scolytinae), Tenebrionidae, etc.);

2 - to compile the available autecological data in predefined variables for each species (larval trophic regime, larval micro-habitat, relation to flowers, tree species preference, etc.);

3 - to attribute a patrimonial value to each species (in agreement with the approach of Alexander, 1988 and Brustel, 2004).

Like in other databases dealing with flora (LEDA (Knevel *et al.*, 2003), Theophrastus (Weiher *et al.*, 1999), BioFlor (Kuhn *et al.*, 2004)) or insects (hoverflies, i.e. Diptera Syrphidae, Speight *et al.*, 2005), the data is organized as records in several tables being linked in a relational database structure. Each record has a reference to the information source.

Figure 1 shows the FRISBEE tables with their fields and the connections between them.

Four main tables were defined:

— the reference table, compiling the different sources of information (books, journal articles, reports, conference papers, electronic sources, theses, etc.);

— the taxonomical table, containing information with standardized nomenclature, national and international status, and patrimonial value;

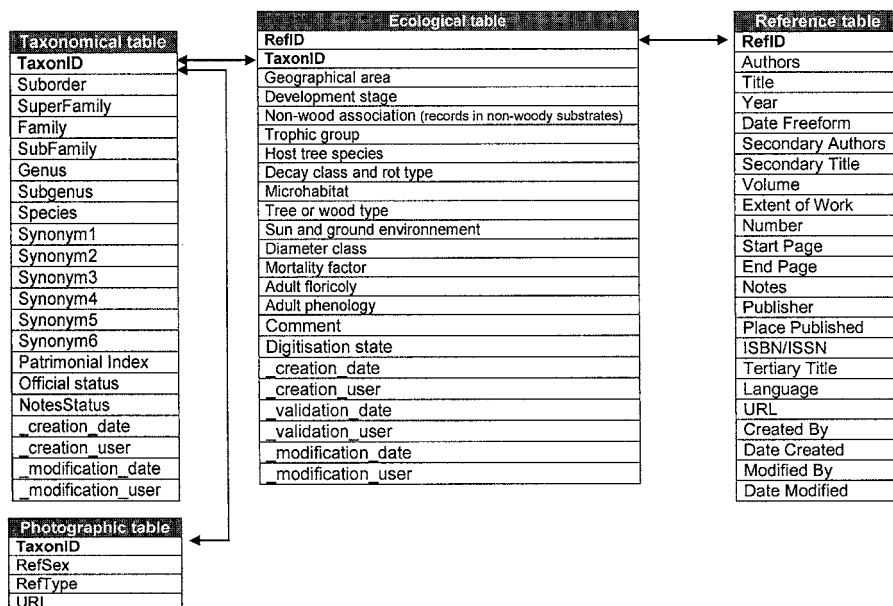


Figure 1. — Structure diagram of the relational database FRISBEE. Tables, fields and connections between them.

— the ecological table, including 11 wood parameters or ecological traits that categorize the association of a species to different wood attributes. In order to exchange information with the Nordic database, the Nordic ecological fields were retained in the FRISBEE database. Nonetheless, 5 fields were adapted to the entomological FRISBEE context: non-wood association (records in non-woody substrates), trophic group, microhabitat, tree or wood type, mortality factor. Moreover, 2 fields were added: adult floricolity and adult phenology.

— the photographic table, i.e. a picture library portraying adults, larvae or traces of beetles.

The process of digitizing data, under the framework of some useful guidelines, was divided into steps, from the compilation of primary bibliographic information in a table of raw data to the coding of synthetic tables by expert filters.

As the saproxylic database is developed in cooperation between several people, it will be available online to facilitate the multi-site digitizing tasks. The online version is currently programmed by data processing specialists at the French Forest National Inventory (IFN). Data will be managed using MySQL, and the FRISBEE application developed in PHP5.

AIMS

The FRISBEE database mainly aims at (i) assessing and comparing the conservation status of stands, forests or reserves, by cumulating the species patrimonial indices of saproxylic beetle assemblages sampled in standardised conditions, and (ii) carrying out functional analyses of the relationship between local dead wood profiles and ecological groups defined on the basis of autecological variables.

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REFERENCES

- ALEXANDER, K.N.A. (1988). — The development of an index of ecological continuity for deadwood associated beetles. *Antenna*, 12: 69-71.
- ALEXANDER, K.N.A. (2002). — *The invertebrates of living and decaying timber in Britain and Ireland - a provisional annotated checklist*. English Nature Research Reports, 467.
- BERG, A., EHNSTROM, B., GUSTAFSSON, L., HALLINGBACK, T., JONSELL, M. & WESLIEN, J. (1994). — Threatened plant, animal, and fungus species in Swedish forests: distribution and habitat associations. *Cons. Biol.*, 8: 718-731.
- BRUSTEL, H., (2004). — Biological value of French forests assessed with saproxylic beetles: a way to conserve this natural heritage. *Proceedings of the 3rd European Symposium and Workshop on the Conservation of Saproxylic Beetles*. Riga, Latvia, July 7th-11th 2004.
- BUCKLAND, P. & DINNIN, M. (1993). — Holocene woodlands, the fossil insect evidence. Pp 6-20 in: K. Kirby, & C. Drake (eds). *Dead wood matters: the ecology and conservation of saproxylic invertebrates in Britain*. English Nature, Peterborough (UK).
- DAHLBERG, A. & STOKLAND, J. (2004). — *Vedlevande arters krav pa substrat - sammanställning och analys av 3600 arter*. Skogsstyrelsen, Report N°7.
- DAJOZ, R. (2000). — *Insects and forests: The role and diversity of insects in the forest environment*. Lavoisier, Paris.
- KNEVEL, I.C., BEKKER, R.M., BAKKER, J.P. & KLEYER, M. (2003). — Life-history traits of the northwest European flora: The LEDA database. *J. Veget. Sci.*, 14: 611-614.
- KÖHLER, F. (2000). — *Totholz Käfer in Naturwaldzellen des noerdlichen Rheinlandes. Vergleichende Studies zur Totholz Käferfauna Deutschlands und deutschen Naturwaldforschung*. Landesamt für Agrarordnung NordRhein-Westfalen.
- KUHN, I., DURKA, W. & KLOTZ, S. (2004). — BiolFlor - a new plant-trait database as a tool for plant invasion ecology. *Divers. Distrib.*, 10: 363-365.
- MARTIKAINEN, P. (2003). — Saproxylic beetles in boreal forests: temporal variability and representativeness of samples in beetle inventories. Pp 83-86 in: F. Mason, G. Nardi & M. Tisato (eds). *Proceedings of the International Symposium "Dead wood, a key to biodiversity" Mantova, Italy, May 29th-31st 2003, Sherwood 95*.
- MÜLLER, J., BÜSSLER, H., BENSE, U., BRUSTEL, H., FLECHTNER, G., FOWLES, A., KAHLER, M., MÖLLER, G., MÜHLE, H., SCHMIDL, J. & ZABRANSKY, P. (2005). — Urwald relict species - Saproxylic beetles indicating structural qualities and habitat tradition. *Waldökologie Online*, 2: 106-113.
- SCHMIDL, J. & BUSSLER, H. (2004). — Ecological guilds of xylobiotic beetles in Germany. Use in landscape ecological surveys - a methodological standard. *Naturschutz und Landschaftsplanung*, 36: 202-218.
- SPEIGHT, M.C.D., CASTELLA, E., SARTHOU, J.P. & MONTEIL, C. (2005). — *Syrph the Net, the database of European Syrphidae*. Syrph the Net Publications, Dublin.
- STOKLAND, J. & MEYKE, E. (2008). — The Nordic saproxylic database - an emerging overview of the biological diversity in dead wood. *Rev. Ecol. (Terre Vie)* in press.
- STOKLAND, J., TOMTER, S. & SÖDERBERG, U. (2004). — *Development of dead wood indicators for biodiversity monitoring: experiences from Scandinavia*. Pp 207-226 in: M. Marchetti (ed.). *Monitoring and indicators of forest biodiversity in Europe - From ideas to operationality*. EFi workshop, November 12th-15th 2003, Firenze, Italy, Vol. 51.
- WEIHER, E., VAN DER WERF, A., THOMPSON, K., RODERICK, M., GARNIER, E. & ERIKSSON, O. (1999). — Challenging Theophrastus: a common core list of plant traits for functional ecology. *J. Veget. Sci.*, 10: 609-620.