

## FORUM

# Bycatches of ecological field studies: bothersome or valuable?

Sascha Buchholz<sup>1</sup>, Martin Kreuels<sup>2</sup>, Andreas Kronshage<sup>3</sup>, Heinrich Terlutter<sup>4</sup> and Oliver-D. Finch<sup>5\*</sup>

<sup>1</sup>TU Berlin, Department of Biodiversity Dynamics, Rothenburgstr. 12, 12165 Berlin, Germany; <sup>2</sup>AraDet, Alexander-Hammer Weg 9, Münster, Germany; <sup>3</sup>LWL-Museum of Natural History, Außenstelle Heiliges Meer, Bergstr. 1, Recke, Germany; <sup>4</sup>LWL-Museum of Natural History, Sentruper Street 285, Münster, Germany and <sup>5</sup>University of Oldenburg, Faculty V, Biology and Environmental Sciences, Animal Biodiversity and Evolutionary Biology, D-26111 Oldenburg, Germany

## Summary

1. Ecological field studies dealing with invertebrates are regularly applied, often using various special kinds of traps within a relatively intensive trapping program. During such programs, large amounts of bycatch – animal material not needed for the original scientific aim of the study – are collected.
2. We discuss general aspects about the handling of such bycatches. Given that the potential utility of bycatches from trapping programs can be immense, we strongly advocate a more thorough handling of the bycatch material than is currently typically practised.
3. Ways for an efficient transfer of bycatches between taxonomic experts have to be established. Problems concerning labelling as well as concerning costs and space for storage have to be solved to facilitate adequate management of the collected material.

**Key-words:** collecting methods, faunistic records, invertebrate biodiversity, museum collections, species richness, voucher specimen

## Introduction

Ecological field studies involving invertebrates have a long tradition and are widely applied today to assess habitat quality in ecological planning or for other scientific purposes (e.g. for biodiversity or population censuses within various monitoring programs). Such field studies typically include a relatively intensive trapping program. Traps widely used for scientific or applied studies in field ecology include pitfall traps, flight interception traps (like Malaise and window traps), automatic light traps, stem electors and emergence traps (e.g. Sutherland 1996; Basset *et al.* 1997; New 1998; Southwood & Henderson 2000). A standard procedure during such studies on invertebrates is to sample specimens for later determination in the lab as well as for the deposition of voucher specimens. Voucher specimens in particular are extremely valuable for controlling the quality of determinations, for taxonomy, and for other scientific purposes (Meesters 1990; Huber 1998; Winston 2007). In contrast to methods of direct searching and netting,

trapping programs typically do not collect only specimens of the taxon in focus or voucher specimens. In fact, the majority of the material collected in traps during many studies is bycatch – individuals of taxa that neither the researcher nor the monitoring program nor the institute that organizes the project is primarily interested in.

In general, the problem of bycatch generates frequent controversies among field ecologists. Are they bothersome or rather valuable? If valuable, how should they be handled, labelled, and how and where should they be stored? More practically, how should the required, usually unpaid excess work be managed? Would it not be better to focus on writing the reports or papers that concern the actual project directly rather than handling old, worthless dead animals? These and similar questions represent applied ecology in practice.

As an example, there are no general guidelines concerning the deposition of voucher specimens (i.e. the deposition of determined specimens of a research project in a museum collection) or of bycatch in Germany, not even within officially funded research projects (GfBS 2006). However, these bycatches can often be extremely worthwhile – both for present and for potential future research. For instance, they can be of

\*Correspondence author. E-mail: [oliver.d.finch@uni-oldenburg.de](mailto:oliver.d.finch@uni-oldenburg.de)  
Correspondence site: <http://www.respond2articles.com/MEE>

exceptional interest for researchers working in another general field of ecology or on populations or the taxonomy of other taxa than the 'trapper' and his or her colleagues. Today no one knows what will be of interest for future generations of researchers in ecology and taxonomy. For example, no one could have foreseen 20 years ago how important voucher specimens would be today for molecular analyses (e.g. Watts *et al.* 2007) and more detailed and complete ecological collections from former times would be extremely helpful to determine effects of climate change on species assemblages and populations, among other potential questions, more accurately (e.g. Danks, Wiggins, & Rosenberg 1987; Yen 1993; Babin-Fenske, Anand, & Alarie 2008). Last but not least, although invertebrates have long fallen under the radar of the scope of Animal Ethics (New 1999), it remains that these animals are killed in the traps, certainly in good faith, and that everyone collecting animals in the field has an ethical responsibility to handle the collected material with care (e.g. Putman 1995; New 1999). Thus, it is also of ethical interest to utilize the bycatches as fully as possible. In this context, it has also to be emphasized that the effective use of bycatches would minimize the unnecessary impact over the populations and habitats when different teams repeatedly sample the same site in search of different taxa.

In the following, we would like to describe our experiences concerning bycatches. Above all, it is our hope that this contribution will promote and encourage critical thinking regarding the animal material casually collected in field traps.

### Where and when are bycatches collected?

The investigation of a site usually focuses on a specific research question (e.g. establishing patterns of activity, distribution, population size or community structure). In practice, most field studies have a scientific or applied background, with the specific aims usually being restricted to certain taxa, i.e. focal groups or indicator groups. Answering the research questions requires that qualitative or quantitative data be collected in a statistically adequate way, in turn requiring a large amount of animals. Therefore, most studies install various special kinds of traps in the field. The application of such successful and established methods enables us to obtain field data over longer sampling periods in a cost- and time-efficient manner (Dahl 1907; Barber 1931; Pedigo 1994). Trapping generally results in high densities of individuals and species of active arthropods. However, as virtually no trapping technique is 100% specific for the arthropod taxa in focus, many other organisms are also sampled by trapping: the bycatch.

### Transfer and storage of bycatches

When bycatches do attract attention of the scientific community, their examination regularly produces important results: rare and threatened species, new distribution records, or first records of non-native or alien species in an area (e.g. Hannig & Erfmann 2002; Finch & van der Kooij 2005; Kreuels 2006). Although not of direct interest to the primary user, the bycatch

might be of potential utility to a secondary user of the trapping results because of their different aims:

- gaining faunistic and ecological data for a certain taxonomic group (e.g. the first research is (carabid) beetles, the secondary study investigates spiders (e.g. Kretschmer & Schauermann 1991; Finch 2001);
- gaining distribution data for local, regional or broader scaled distribution range maps that may be used in faunal catalogues and macroecological studies (van Helsdingen 1999; Buchar & Růžicka 2002; Finch, Blick, & Schuldt 2008), many of which are freely available over the internet [e.g. Fauna Europaea (<http://www.faunaeur.org/>), record maps for arachnids in Germany ([http://www.spiderling.de/arages/index\\_eng.htm](http://www.spiderling.de/arages/index_eng.htm))];
- gaining data for species inventories and their subsequent analysis for lists of threatened species (Red data books, e.g. Binot *et al.* 1998); and
- gaining material for taxonomic studies (likewise in bycatches from the tropics and from temperate zones; e.g. the *Pardosa lugubris* group of spiders, which until 1990 were regarded as one species and then divided into four species with different ecological requirements, Töpfer-Hofmann & von Helversen 1990; Töpfer-Hofmann, Cordes, & von Helversen 2000).

Thus, one specialist's bycatch is another person's target or 'treasure trove'. There are several advantages for the secondary user that result from his or her working with the supplied bycatch. Notably, he or she saves time and money that would otherwise be required for field work. For instance, it is no longer necessary to wait one vegetation period or even longer to have the total catch necessary for a study. However, one important disadvantage of using bycatches lies in the fact that the secondary user of the catch has no influence on the trapping design or other details of the original study. In general, if the primary collector accepts the archiving of the bycatch of a study, he or she has to confront several additional tasks.

(1) The bycatch has to be labelled and conserved thoroughly to supply secondary users with the location, time and other pertinent additional information of the sample. We want to emphasize here that labelling for other users needs to be greatly more detailed than labelling for oneself. The omission of details such as year, location or the name of the collector has to be strictly avoided. Additionally, a log has to be kept about taxonomic groups that have already been removed, indicating whether or not and by whom they have been determined, or whether they have simply been sorted into separate containers.

(2) Any additional costs for storage vessels and conservation fluid.

(3) Space for long-term storage of the samples is required. In the case of storage in alcohol (or analogous preservation fluids), attention has to be paid to potential fire safety concerns and evaporation of the material.

(4) Any additional handling time of the collections (arranging loans, continuing the log book, among others).

Many of these tasks are onerous and time-consuming, with some (e.g. at least the final point) usually only being feasible in

cooperation with a professional institution (typically a natural history museum). In the best case scenario, storage space for the bycatches is available, with the museum subsequently being able to offer the material to further experts for the determination of the samples. Thus, it is important to gather detailed information about the bycatches, about the taxa already determined, and a list of all publications related to the material, to avoid duplication of work. This usually implies the use of a detailed log book. Importantly, when such detailed information is available, even older samples may be stocked for and of potential utility to the varying needs of future taxonomical and ecological research.

### Announcement of bycatches

Large amounts of bycatches are present in many regions. They are collected during research projects of universities and other institutions or during assessments for environmental planning (e.g. Kremen *et al.* 1993). To make the existence of such bycatches known to the broader community of experts, a published supra-regional database is important. Such a database should be supervised by an official institution (e.g. a natural history museum) to ensure a long-term availability and regular updates. The following information, taken from the best practice of entomological labelling (e.g. Abraham 1991), should minimally be included in this database:

- Detailed information concerning the investigation area, including coordinates and topographical names.
- Time and duration of the field investigation.
- Sampling design in the field.
- Name and institution of the collector.
- Collecting method(s).
- Trapping and conservation fluids.
- Taxa that have already been determined along with the name(s) of the expert(s) involved.
- Location of material already determined.
- Material of the investigation that has already been published, and a list of publications that originates from the material.
- Aim of the primary investigation.

### Two examples of networks of bycatches

Before describing the two examples, two important clarifications are in order. First, the examples have nothing to do with forums to trade invertebrates. Second, we also wish to clarify that we unconditionally do not support any purely aesthetic passion for collecting insects and other arthropods. Only collections with a sufficient scientific background, originating from scientific research and applied studies, should be included. Generally, all national and international wildlife laws, including guidelines for the protection of species (e.g. CITES) and of nature conservation, must have been respected during the collection. An approval of the collection by the competent authorities is another prerequisite.

The first example is the Australian National Insect Collection (ANIC, <http://www.csiro.au/places/ANIC.html>), which

has a web-based spreadsheet available advertising the 'bulk samples' for specialist use. These samples come, for example, from Berlesates, Winkler, Malaise and Flight Intercept Trap samples.

Another example that is better known to us (and meets the criteria in the first paragraph of this section) is a recent initiative in the German province of North Rhine-Westphalia that has already obtained first listings of bycatches from field biology stations, nature conservation authorities and universities working in the province. Several requests for material (e.g. for Bachelor theses) have already been made and answered. An internet-based database is currently in preparation, fulfilling the above mentioned criteria of necessary information, with the additional following points that should be included:

- a description of general labelling guidelines,
- a list of experts for the different taxa,
- a list of institutions with collections of taxa,
- information about species protection and nature conservation laws regarding the collection of animals in the field, and
- links to further initiatives.

It is intended to establish this network initially for North Rhine-Westphalia as the foundation for a later a nationwide database for Germany.

### Conclusions

(1) We urge the establishment of online databases that include lists of bycatches from scientific studies. These databases can be established at a regional, national or even broader scale to promote the exchange between collectors and researchers. The required information can easily be gathered from finished, ongoing and planned projects. A listing of unprocessed as well as of finished taxa should be included. A potential highly useful feature of such databases would be to incorporate push technology to send information that a bycatch of a taxon exists from a certain locality to a specific researcher or research station (see e.g. <http://mantis.cs.umb.edu/wiki/index.php/FilteredPush>). Such schemes can work on broad scales, from nation- to worldwide, and should aim to make registration of bycatch simple and not discouraging. They should also be easily modifiable.

(2) Relevant research projects should include funding for labelling and storage of bycatches and voucher specimens (GfBS 2006). Project reports should include statements such as where the material has been deposited and what kind of material is available for subsequent investigations. Bycatches from the tropics may benefit from this procedure in particular because research projects in these areas are often funded by national or international foundations.

(3) Archives for the deposition of bycatches should be created. Currently, many research institutions (e.g. universities) are unable to store the collected material because of a lack of space and necessary manpower. Therefore, natural history museums need more funding for staff and storage rooms (e.g.

possibly in form of off-premises storage) to be able to manage bycatches of research projects for the scientific community. Ideally, such 'ByCatch-Centers' may themselves also pursue funding for the adequate isolation, labelling and long-term storage of bycatch material. Potential sources of funding include local counties, or national or European organizations.

## Acknowledgements

We thank Heinz-Otto Rehage, Dr. Michael Kuhlmann, Dr. Johannes Lückmann, Prof. Dr. Reiner Feldmann, and the reviewers for their contributions to an earlier version of the manuscript. Dr. Robert Baumgartner and Prof. Dr. Olaf R. P. Bininda-Emonds kindly improved our English.

## References

- Abraham, R. (1991) *Fang und Präparation wirbelloser Tiere*. Fischer, Stuttgart.
- Babin-Fenske, J., Anand, M. & Alarie, Y. (2008) Rapid morphological change in stream beetle museum specimens correlates with climate change. *Ecological Entomology*, **33**, 646–651.
- Barber, H.S. (1931) Traps for cave-inhabiting insects. *Journal of the Elisha Mitchell Scientific Society*, **46**, 259–266.
- Basset, Y., Springate, N.D., Aberlenc, H.P. & Delvare, G. (1997) A review of methods for sampling arthropods in tree canopies. *Canopy Arthropods* (eds N.E. Stork, J. Adis & R.K. Didham), pp. 27–51. Chapman & Hall, London.
- Binot, M., Bless, R., Boye, P., Gruttke, H. & Pretscher, P. (1998) Rote Liste gefährdeter Tiere Deutschlands. *Schriftenreihe für Landschaftspflege und Naturschutz*, **55**, 1–434.
- Buchar, J. & Růžička, V. (2002) *Catalogue of Spiders of the Czech Republic*. Peres Publishers, Praha, 349 pp.
- Dahl, F. (1907) Die mechanische Methode im Sammeln von Tieren. *Zoologischer Anzeiger*, **31**, 917–919.
- Danks, H.V., Wiggins, G.B. & Rosenberg, D.M. (1987) Ecological collections and long-term monitoring. *Bulletin of the Entomological Society of Canada*, **19**, 16–18.
- Finch, O.-D. (2001) Webspinnen (Araneae) aus zwei Naturwäldern des Staatlichen Forstamtes Sellhorn (Lüneburger Heide). *NNA-Berichte*, **14**, 106–118.
- Finch, O.-D., Blick, T. & Schuldt, A. (2008) Macroecological patterns of spider species richness across Europe. *Biodiversity and Conservation*, **17**, 2849–2868.
- Finch, O.-D. & van der Kooij, J. (2005) The discovery of the Masked Shrew *Sorex caecutiens* in south Norway provides a further suggestion for the post-glacial colonisation of Scandinavia. *Mammalian Biology*, **70**, 307–311.
- GfBS (Gesellschaft für biologische Systematik) (2006) Verbindliche Hinterlegung von Belegmaterial aus biologischen Forschungsprojekten in öffentlichen wissenschaftlichen Sammlungen. URL [http://www.gfbs-home.de/index.php?option=com\\_content&view=article&id=119&Itemid=6](http://www.gfbs-home.de/index.php?option=com_content&view=article&id=119&Itemid=6) (accessed 15 April 2010).
- Hannig, K. & Erfmann, M. (2002) Großschmetterlingsbeifänge (Macrolepidoptera) einer Fensterfallenuntersuchung in der Lippeaue und den Rieselfeldern bei Waltrop (Kreis Recklinghausen, NRW). *Mitteilungen der Arbeitsgemeinschaft Westfälischer Entomologen*, **18**, 47–56.
- van Helsdingen, P. (1999) Catalogus van de Nederlandse Spinnen (Araneae). *Nederlandse Faunistische Medelingen*, **10**, 1–189.
- Huber, J.T. (1998) The importance of voucher specimens, with practical guidelines for preserving specimens of the major invertebrate phyla for identification. *Journal of Natural History*, **32**, 367–385.
- Kremen, C., Colwell, R.K., Erwin, T.L., Murphy, D.D., Noss, R.F. & Sanjayan, M.A. (1993) Terrestrial arthropod assemblages: their use in conservation planning. *Conservation Biology*, **7**, 796–808.
- Kretschmer, K. & Schauerermann, J. (1991) Zur Arthropodengemeinschaft zweier Naturwälder im Forstamt Sellhorn. *NNA-Berichte*, **4**, 150–156.
- Kreuels, M. (2006) Die Webspinnen (Arachnida: Araneae) aus Beifängen des NSG Teverener Heide (NRW, Kreis Heinsberg). *Acta Biologica Benrodis*, **13**, 185–193.
- Meesters, J. (1990) The importance of retaining voucher specimens. *Natural History Collections: Their Management and Value* (ed E.M. Herholdt), pp. 123–127. Transvaal Museum Special Publication 1, Pretoria.
- New, T.R. (1998) *Invertebrate Surveys for Conservation*. OUP, Oxford.
- New, T.R. (1999) By-catch, ethics and pitfall traps. *Journal of Insect Conservation*, **3**, 1–3.
- Pedigo, L.P. (1994) Introduction to sampling arthropod populations. *Handbook of Sampling Methods for Arthropods in Agriculture* (eds L.P. Pedigo & G.D. Buntin), pp. 1–11. CRC Press, New York.
- Putman, R.J. (1995) Ethical considerations and animal welfare in ecological field studies. *Biodiversity and Conservation*, **4**, 903–915.
- Southwood, T.R.E. & Henderson, P.A. (2000) *Ecological Methods*. Blackwell Science, Oxford.
- Sutherland, W.J. (1996) *Ecological Census Techniques*. CUP, Cambridge, UK.
- Töpfer-Hofmann, G., Cordes, D. & von Helversen, O. (2000) Cryptic species and behavioural isolation in the *Pardosa lugubris* group (Araneae, Lycosidae), with description of two new species. *Bulletin of the British Arachnological Society*, **11**, 257–274.
- Töpfer-Hofmann, G. & von Helversen, O. (1990) Four species of the *Pardosa lugubris*-group in Central Europe (Araneae, Lycosidae) - A preliminary report. *Bulletin Society of European Arachnology*, **1**, 349–352.
- Watts, P.C., Thompson, D.J., Allen, K.A. & Kemp, S.J. (2007) How useful is DNA extracted from the legs of archived insects for microsatellite-based population genetic analyses? *Journal of Insect Conservation*, **11**, 195–198.
- Winston, J.E. (2007) Archives of a small planet: The significance of museum collections and museum-based research in invertebrate taxonomy. *Zootaxa*, **18**, 47–54.
- Yen, A.L. (1993) Some practical issues in the assessment of invertebrate biodiversity. *Rapid Biodiversity Assessment* (ed A.J. Beattie), pp. 21–25. Macquarie University, Sydney.

Received 15 April 2010; accepted 3 June 2010  
Handling Editor: Robert P Freckleton