Introduction

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Images have always been of fundamental importance in taxonomy and for the documentation of natural history specimens. In recent years, however, digital photography and other imaging techniques are rapidly transforming the way in which we take and portray images in these fields. The contributions in this publication describe some of the methods and technologies currently in use for imaging biological specimens – particularly types, which are those specimens of special importance in acting as name bearers. A variety of taxa are targeted so as to illustrate some of the many problems and solutions that are emerging from the digital imaging of type specimens. We decided that this publication was best described as a "manual", because it is composed of chapters written by practitioners of various techniques and experiences. To some extent this renders the volume somewhat idiosyncratic and less well structured and planned – indeed, it developed from two workshops, a genre the very essence of which is flexibility. We hope, however, that readers will not only tolerate the approach taken, but rather that they might value it, firm in the recognition that the contributions flow from colleagues having „hands-on" experience of equipment, a knowledge of the „tricks of the trade", and an understanding of how to handle the digital results produced.

The idea for producing such a manual originated from work undertaken for a specific activity under the "European Network for Biodiversity Information (ENBI)", a thematic network project funded by the European Commission under its Fifth Framework Programme (see SCOBLE, "The Place of the Manual in the European Network of

Biodiversity Information", in this volume). The main goal of this particular component of the ENBI work programme on "Co-operation of pan European databases on biological collections and specimens" was to develop and implement technical standards or rules of best practise for type-specimen databases, particularly with regard to digital imaging. As originally planned, the standards were to be implemented via demonstrator databases for type-specimens from three exemplar taxa, butterflies, fish, and flowering plants, and the results were also to be made available in a final report (access to these demonstrator databases is available online at the BioCASE portal, http://www.biocase.org/; see also chapters by BERENDSOHN et al., HÄUSER et al., and HURST & SIEBERT in this volume).

But to encourage wider interest across Europe, two workshops were held, one in March 2004 in Stuttgart, Germany, and one in January 2005 in Chania, Crete. These events attracted considerable interest with participation extending well beyond the institutional partners directly involved in the ENBI project, and, furthermore and encouragingly, from outside Europe. The enthusiasm and interest generated at the workshops led us to expand the original work plan beyond the production of a formal report on the demonstrator databases, so as to capitalize on the multitude of experiences made available – particularly from the presentations made and the resulting discussions. The idea for a more comprehensive manual quickly took shape, with the intention of including the experiences gained from work on as many different taxa and approaches as were available. A quick survey of the equipment, procedures and standards applied by specimen imaging activities in different institutions and projects was conducted, for which a questionnaire was developed and distributed. The results of this survey have also been included in this volume under "case studies".

Some background on biosystematic research and taxonomic procedures may help the reader to appreciate better the tremendous importance and scientific value of biological type specimens, and more generally to understand why making information available from specimens in biological collections is not carried out just for academic purposes. It is not always appreciated that our basic know-

Fig. 1. Participants of the ENBI workshop, Stuttgart, March 2004. Photo: F. HAAS.

ledge of biodiversity is founded on information we have gleaned from biological specimens. Much of our understanding of natural organisms (their appearance, anatomy, occurrence in time and space, and much of their basic biology including preferred habitats, nutrition, and life cycles), is either directly or ultimately based on the specimens preserved in scientific collections and the information associated with them, which typically is recorded on labels or written notes attached directly to the specimens.

The information contained in and connected to what amounts to an estimated 3 billion biological specimens preserved in the world's scientific collections thus represent an unsurpassed treasury of information on the living world (e.g. SUAREZ & TSUTSUI 2004). Efforts to make this information more widely or even universally available have been under way for some time, and the rise of the internet and the storage and data-exchange capacities of modern information technology will greatly facilitate this huge task - a task, moreover, that the Global Biodiversity Information Facility (GBIF) has made one of its priorities. Having such a vast reservoir of specimen data readily accessible will contribute greatly to bridge what remains a considerable gap in knowledge and a significant bottleneck in successfully facing and eventually overcoming the global biodiversity crisis (HÄUSER 2004).

According to the international rules for the scientific naming of organisms (GREUTER et al. 1999, International Commission for

Zoological Nomenclature 1999), one of the fundamental principles of the system of scientific nomenclature for organisms is the "type concept", which requires that to be validly published and form part of accepted nomenclature, every scientific name must be connected to and based on some biological material or specimen to be preserved in a collection. Ideally a single specimen, the so-called holotype, should serve as the name bearer. This type specimen thus becomes the material basis for any scientific name whether for species, subspecies or higher categories. As a result, identities of taxa can be tested and verified. Such type specimens, therefore, constitute the ultimate scientific reference for any name, and constitute a lasting nomenclatural standard for taxonomy.

Although the emphasis of this manual lies with type specimens, many of the techniques and standards presented and discussed are obviously applicable to other biological specimens and materials. Our emphasis in this manual on type specimens, however, is explained by the special role they play in taxonomy and the great importance assigned to them by taxonomists. Their importance is underlined by the overall priority assigned to them when digitising specimen information including such proposals as the “e-type” initiative (e.g. BERENDSOHN & OEHLSCHLÄGER 2004, see also chapter on E-Types by SPEERS, in this volume). It is for this reason that taxonomists press for the highest possible standards in image quality and it means that they will, within reason, expend the time necessary to achieve top quality when documenting type specimens. Time and resources available, however, are unlikely to permit such standards to be extended to the vast number of non-type specimens, but they will still be useful as general guidelines.

With the entire field of information technology, particularly the area of digital photography and imaging, still undergoing rapid development, some of the technical information and equipment presented in this volume will become outdated quickly. Yet the general issues and challenges addressed in individual chapters, such as colour representation and management, effects of lighting, and techniques for handling specimens, will almost certainly persist. We hope therefore that much of the material presented in this volume will

remain useful for some time to come. But whatever its lifespan, we commend this volume to any reader with an interest in the field. And the editors and contributing authors encourage and welcome comments and additions, thus furthering the spirit of the workshops from which this manual evolved. To facilitate such iteration, and to promote the flow of information, the contents of this publication are also available in digital form from the publishers and they appear in full on the ENBI website (www.enbi.info). Efforts will be made to maintain and update this site to enrich further its contents in the future.

There is no doubt whatever that the digital age has reached and is transforming taxonomy. This manual addresses what are essentially practicalities. But we hope that the vast number of digital images of natural history specimens being created, whether of types or others, will contribute part of the infrastructure for what looks like a movement in taxonomy towards a modernised, web-based taxonomy (GODFRAY 2002; SCOBLE 2005).

Acknowledgements

Without the considerable funding for establishing the European Network for Biodiversity Information (ENBI) by the European Commission neither this volume nor much of the work it reports would have been possible. We thank the Commission for its support. The editors and the ENBI management acknowledge with gratitude also the support received from the Global Biodiversity Information Facility (GBIF), particularly towards participation of GBIF staff in the two workshops. We are grateful to all those who participated in these workshops and who helped to make them lively and productive events. We thank CHRIS JOHNSON and MELPO SKOULA and their colleagues for hosting the second workshop at the Mediterranean Agronomic Institute, Chania, Crete: both the venue and organisation were appreciated by all. ELIZABETH WATSON prepared the questionnaire for the case studies. VANESSA PIKE, the Natural History Museum, London, and MONIKA PFEFFER, Staatliches Museum für Naturkunde, Stuttgart, helped keep track of the financing of the preparation of this Manual, and we are grateful to them for their

efforts. We thank our institutions, the Staatliches Museum für Naturkunde, Stuttgart, and the Natural History Museum, London, and all those staff involved in ENBI matters and in the preparation of the workshops.

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