THE INVERTEBRATE COLLECTION OF THE AUSTRALIAN QUARANTINE AND INSPECTION SERVICE (AQIS), NEW SOUTH WALES

G. Hangay[1] and R. Adam Broadley[2]

[1] 29 Warili Road, Frenchs Forest NSW 2086, Australia
Email: gyuri@tpg.com.au
[2] Australian Quarantine & Inspection Service (AQIS)
Entomology, PO Box 657, Mascot NSW 1460, Australia
Email: adam.broadley@aqis.gov.au

Summary

The AQIS NSW invertebrate collection contains specimens from four phyla (Platyhelminthes, Annelida, Mollusca and Arthropoda). Mollusca (52 families, 86 genera, 110 species) and Arthropoda (204 families, 571 genera, 1126 species) form the largest part of the collection, represented by approximately 14000 dry specimens, 6000 specimens preserved in ethanol and 3000 slide preparations. The history of the collection and the associated curatorial work from 1971 until present is described and a list of known determiners is provided.

Keywords: quarantine, AQIS, collection, history

INTRODUCTION

The NSW Australian Quarantine and Inspection Service (AQIS) invertebrate collection is relatively small compared to those managed by other institutions. It is, however, a unique and important collection. It contains a diverse assemblage of insects and other invertebrates, which were intercepted from incoming vessels and aircraft as well as from imported goods and dunnage. Many are exotic species that may not be present in any other collection in Australia. Undoubtedly the collection is valuable and should be considered a part of the nation's cultural heritage. To record its history and provide a description of it for future reference is equally important.

The collection is located in the AQIS Entomology Laboratory at 1 Crewe Place, Rosebery in Sydney. Its main function is to serve as a reference collection to assist the identification of intercepted invertebrates and it also provides a valuable resource for further research. Most of the specimens are quarantine interceptions; however, small parts of the collection consist of donations made by the public, together with material obtained from overseas sources. Some indigenous species are included as comparative reference material. The collection is also utilised for both training of AQIS officers and for public relations projects.

Four phyla are represented: Platyhelminthes, Annelida, Mollusca and Arthropoda. There are only a very few specimens of Platyhelminthes and Annelida, while 52 families, comprising 86 genera and 110 species of molluscs are housed in the collection. The majority of the arthropods are represented in 18 orders, comprising 204 families, 571 genera and 1126 species of pinned insects in the dry collection. Small and soft-bodied arthropods (e.g. Acari, Thysanoptera and Diaspididae) are preserved as slide preparations. There are approximately 3000 slides in the collection. The remaining arthropods in the collection belong to the orders Araneae, Scorpiones and Pseudoscorpiones and these are mainly alcohol preserved specimens in the wet collection. This section of the collection also contains insect specimens from 71 families, divided into 117 genera and 183 species. Most of these, with the exception of the Isoptera (5 families, 20 genera, 60 species) and the Formicidae (Hymenoptera) (25 genera, 36 species), are larval and/or pupal forms.
Presently the collection consists of approximately 14000 pinned or pointed dry specimens housed in 100 metal drawers in standard 10 drawer entomological metal cabinets. There are 840 lots, comprising approximately 6000 specimens stored in 30 mL screw top glass vials of 700 g L^{-1} ethanol. The mollusc collection contains dry shells in unit boxes and/or glass vials as well as whole animals preserved in ethanol. In addition to the scientific collection there are some demonstration or teaching specimens of molluscs, arachnids and insects that are either pinned or preserved in 70% ethanol.

HISTORY

The earliest written records show that the formation of a reference collection for quarantine in New South Wales began in 1971 (for a list of interceptions prior to 1965 see Chadwick and Nikitin (1969)). The first specimen to be registered was a bamboo borer *Dinoderus minutus* (Fabricius) (Coleoptera:

Bostrichidae) on August 24, 1971. At that time, the collection was housed in the NSW Department of Agriculture - Export and Import Branch at 110 Day Street, Sydney. It remained there until 1988 when the office moved to the Remington Centre at 169-183 Liverpool Street, Sydney. In 1990 the collection was moved again, to 2 Hayes Road, Rosebery. On September 20, 1995 the Commonwealth Department of Primary Industry and Energy (DPIE) resumed the Department's function and thus the Export and Import Branch of the Department of Agriculture of NSW was incorporated into the regional office of DPIE (later Agriculture Fisheries and Forestry (AFFA) and now Department of Agriculture, Fisheries and Forestry (DAFF)). AQIS was, and still is, a working group of DAFF. In September 2003, AQIS NSW offices including the Entomology Laboratory and the invertebrate collection were relocated from 2 Hayes Road, Rosebery to a new building at 1 Crewe Place, Rosebery.

It is difficult to determine the rate at which the collection grew during the earlier years. Several volumes of hand-written ledgers, and more recently a computer database, indicate the number of interceptions, but the actual number of specimens incorporated into the collection was not recorded. On the other hand, quite a number of specimens that were not quarantine interceptions were also added to the collection. Many of these originated from other collections in Australia and overseas or were collected by staff and members of the public. In a number of cases the name of the collectors are shown on the specimen labels but many of them were unknown entomologists and their identity through the passage of time has become somewhat obscured.

The oldest specimens in the collection are two auger beetles *Xylion cylindricus* (Macleay) (Bostrichidae) collected by H. Dreis at Fairfield NSW, on February 14, 1903, that were determined by K.M. Moore in 1956. Another pair of the same species originated from Sydney and were collected on March 23, 1923 (the collector's name was not recorded, however these may be the specimens mentioned by Walter W. Froggatt (1927, p.100)). Notable specimens include two specimens of the bostrichid *Xylodeleis obsipa* Germar that were collected by Froggatt at Morisset NSW, on November 17, 1924. One of the more interesting components of the collection is a number of insects obtained mostly by R. Paton from both Norfolk and Christmas Islands, as well as some of the other islands around Australia, Papua New Guinea and Vanuatu, from the period 1976 to 1986.

DETERMINERS

Due to the diversity of the collection, a relatively large number of entomologists worked on it. Most of them are or were specialists of certain groups, while others have had general knowledge of broader sections. It is very difficult, if not impossible to make up a complete list of all those people who determined specimens in the collection. Their institutional affiliations would be equally difficult to list, partially because their circumstances have or might have changed and because of the lack of recorded information. However, by searching through the ledgers, database and the data labels pinned under the specimens, the workers listed in Table 1 were identified as determiners.

In earlier years the principal workers in the collection were usually those who were in charge of the Entomology Laboratory. Based on recorded information in the hand-written ledgers, these were A.A. Catley (1971-1977), K.L. Lindsay (1977-1978) and B.J. Read (1978-1989). For much of the time between 1989 and 1993 Graham Brown replaced Brian Read as Quarantine Entomologist at the Liverpool Street, and then the Hayes Road locations. In 1993, James Walker joined Entomology. James initially worked under the supervision of Graham Brown and Brian Read until 1995, when he became the Senior Entomologist. His keen interest in insects helped to further develop the collection. Many newly acquired specimens were determined, labelled and prepared by James and his colleagues, Ross Rickard (from 1998) and Luke Halling (from 2001). Diane Cooper (1998-2001) was employed to prepare slides of small organisms not suited for pinning. In 1996 Graham Goodyer began work on the collection as a contractor and he reviewed the bulk of the intercepted specimens. He curated much of the collection and this involved re-sorting specimens, writing uniform, hand-written name labels and he also caught up with a backlog of unprocessed specimens. Roger de Keyzer was contracted as a consultant from 2000, to determine incoming specimens, especially those belonging to the Cerambycidae (Coleoptera). James Walker transferred to the AQIS Cairns office in 2001 and Ross Rickard took over the management of the AQIS NSW Entomology Laboratory as Senior Entomologist. Adam Broadley joined AQIS NSW Entomology in 2002 as a Quarantine Entomologist.

From time to time it was (and still is) necessary to send specimens to taxonomists working for other institutions for assistance with identifications. Some of these institutions include NSW Department of

Table 1. Determiners known to have assisted AQIS NSW Entomology with the identification of invertebrates.

Bain, J.	Fletcher, M.J.	Kim, S.P.	Pullen, K.R.
Baker, G.L.	Froggatt, W.W.	King, J.	Qin, T.K.
Beard, J.J.	Gellatley, J.G.	Knihinicki, D.K.	Raven, R.J.
Beattie, G.A.C.	Gibson, G.A.P.	Lawrence, J.F.	Read, B.J.
Bellis, G.A.	Gill, B.D.	Levot, G.W.	Rees, D.P.
Britton, E.B.	Gillespie, P.S.	Lindsay, K.L.	Rickard, R.A.
Broadley, R.A.	Goodyer, G.J.	Loudon, B.J.	Riley, J.G.
Brown, G.R.	Gordon, R.	Madge, R.B.	Russell, R.C.
Brown, H.H.	Gray, M.R.	May, A.W.S.	Russell, S.K.
Calder, A.A.	Greening, H.G.	Maynard, G.V.	Schedl, K.E.
Cardale, J.C.	Grose, M.	McAlpine, D.K.	Schicha, E.
Carver, M.	Gross, G.F.	McDonald, F.J.D.	Schnetz, A.
Catley, A.	Guidicipietro, M.	McEvey, S.F.	Shattuck, S.O.
Chadwick, C.E.	Gullan, P.J.	McGuire, D.J.	Shea, M.
Cheesman, J.	Halliday, R.B.	McKinnon, D.	Smithers, C.N.
Clift, A.D.	Halling, L.A.	Mekhamer, M.	Stibick, J.N.L.
Colless, D.H.	Halstead, D.G.H.	Merkl, O.	Sweet, M.
Colman, P.H.	Hancock, D.L.	Misko, S.	Szitó, A.
Cooper, D.H.	Hangay, G.	Moore, K.M.	Taylor, R.W.
Cox, M.L.	Hardle, D.	Mound, L.A.	Walker, J.A.
Cranston, P.S.	Harvey, C.A.	Naumann, I.D.	Walter, D.E.
Crowe, B.	Henshaw, D.J.	Oberprieler, R.	Weir, T.A.
Doggett, S.L.	Horak, M.	O'Halloran, L.	Welbourn, W.C.
Donaldson, J.F.	Horwood, M.A.	Papp, J.	Westcott, A.E.
Drew, R.A.I.	Houston, K.J.	Paton, R.	Zhang, Z.Q.
Eldridge, R.H.	Humphreys, J.	Podlussány, A.	Zimmerman, E.C.
Fan, Q.H.	Kent, D.S.	Ponder, W.F.	
Fenner, T.L.	Keyzer, R.G. de	Postle, A.C.	

Primary Industries (Orange Agricultural Institute), CSIRO and the Australian Museum. Ross Rickard, Luke Halling and Adam Broadley assisted with the upgrade of the new Entomology Laboratory at Crewe Place and with the assistance of the contractors, the collection is continuing to improve and expand.

RECORDS

The oldest records can be found in the nine hand-written ledgers, beginning August 24, 1971 and ending August 21, 1985. These volumes contain recorded data including the accession number, date, commodity, country of origin, name of collector, name of vessel or mode of arrival to Australia, together with the identification of each specimen(s), and the name of the determiner of 15844 interceptions. This number does not indicate the

number of specimens preserved in the collection because not all interceptions were kept. Current data labels for specimens that were retained in the collection now mark these ledger numbers with a ## prefix.

A computer database, Pest and Disease Information Database (PDI), was first developed for the former Commonwealth Department of Health in the early to mid 1970s. When DPIE (now DAFF) assumed the quarantine function from the Department of Health they inherited the PDI program. At that time it was run by AQIS as a mainframe application until 1993 when it was redeveloped into the Sybase® platform as a server application. It has undergone a number of modifications since then, the most recent being a move to the SQL Server platform in June 2003 (J. Caling pers. comm.). The first specimen to be entered into the database for NSW was *Plodia interpunctella* (Hübner) which was identified by B.J.Read (N000001) on July 1, 1986. In addition to the "N" number, another number, called the accession number, was used to denote individual taxa. If a specimen was added to the collection, this number was marked with a # prefix on the data label. PDI was constructed for nationwide use and between January 1, 1986 and June 30, 2003, 174969 identifications were performed nationally involving 4518 taxa (J. Caling pers. comm.). After June 30, 2003 AQIS ceased using PDI as a working database. However PDI remains accessible to AQIS for retrieval of historic data and is used to generate reports.

PDI was succeeded by a new AQIS database entitled Quarantine Incidents. It was created for national use in 2002 and became active on July 1, 2002. Data recorded in it was dumped into PDI until June 30, 2003 after which Quarantine Incidents replaced PDI. To mark the beginning of the new system and distinguish entries from the previously used PDI numbers, entry numbers in the Quarantine Incidents database for AQIS NSW started at N100000 and accession numbers were given an "NA" suffix. In early 2003, an AQIS collection database was constructed under the name of Quarantine Invertebrate Collections Database (QICD). This database is collection specific, and will eventually contain the collection and identification data for all specimens in AQIS entomology collections located in Melbourne, Sydney and Brisbane (Sparks 2003). Its function fills a gap as donations, material from other collections and locally collected specimens were not entered into either PDI or Quarantine Incidents. QICD uses a separate accession number, which bears no resemblance to the interception number. In the AQIS NSW collection it starts with 1 NC, the letters denoting NSW Collection. The first specimen, a dampwood borer beetle, *Hadrobregmus australiensis* Pic (Anobiidae) was registered in QICD on March 20, 2003.

RECENT WORK

In 2001, one of the authors (G. Hangay) was contracted to assist with the complete restoration of the collection. At that time the great majority of the specimens' data labels had only an interception number, indicating records in the ledgers or in the PDI database. These were changed to computer generated, uniform labels printed on 160 g m^{-2} archive quality card, showing interception and accession numbers, country of origin, date of interception and collection, commodity which the specimen was associated with and scientific determination. Original labels showing all or most of the above-mentioned information were retained and pinned under the specimen. Those labels with historical significance (the very fragile labels associated with the oldest specimens) were re-mounted on card and also pinned under the insects.

A number of determinations were revised and new name labels were added. Authors' names and dates of publications were investigated and checked against available references and information from the Internet as well as consultations with specialists. Damaged specimens, if considered important, were restored, and occasionally re-mounted. Corroded, old pins were replaced with good quality stainless steel pins. Only a very small number of badly damaged duplicates were discarded.

Data of the Isoptera collection and most of the specimens collected by R. Paton from Norfolk and other Pacific islands were investigated and their data re-established from a hand-written notebook by an anonymous author (Paton?).

Between May 2001 and July 2004 approximately 4500 new specimens were prepared and added to the collection. Most of these were pinned or pointed insects, many of them representing new taxa for the collection. In addition, 20 life-cycle preparations were incorporated into the Diptera, Hymenoptera, Orthoptera and Lepidoptera collections. In the same period, some striking examples of exotic pest species were also acquired through donations. These, together with the above mentioned life-cycle preparations have increased the collection's capacity

to demonstrate bio-diversity and to assist the training of AQIS staff.

Determination of the newly acquired specimens was carried out mostly by G.J. Goodyer, R. de Keyzer and permanent staff, R.A. Rickard, L.A. Halling and R.A. Broadley. G. Hangay determined the Scarabaeoidea (Coleoptera), life-cycle specimens and donated material. Some Pentatomidae (Hemiptera) specimens were determined by F.J.D. McDonald; Dermestidae (Coleoptera) by A. Szitó, Curculionidae (Coleoptera) by E.C. Zimmerman and Isoptera by R. Eldridge. A number of exotic Braconidae (Hymenoptera), Tenebrionidae and Curculionidae (Coleoptera) specimens were determined by O. Merkl, J. Papp and A. Podlussány of the Hungarian Natural History Museum, Budapest. Tephritidae (Diptera) specimens were sent to R.A.I. Drew for determination. Mollusca were determined by Australian Museum staff and by P. Colman. R.A. Broadley has begun transferring all collection data into QICD. During this procedure all numbers and recorded information will be checked and if necessary, corrected once again.

ACKNOWLEDGMENTS

The information regarding the history of the collection was obtained from written records (ledgers, notebooks and data labels on the specimens) and through verbal communication with persons who worked with the collection in its earlier days or had some personal knowledge of its origins. We are grateful to all, especially to Mr Ross Rickard, Dr Graham Brown, Mr Brian J. Read, Mr John Caling and Mr James Walker who gave valuable advice and provided information that assisted in our work. We are also grateful for advice and assistance regarding taxonomic queries, namely to Dr. E.G. Matthews, Dr. O. Merkl, A/Prof. F.J.D. McDonald, (the late) Dr. E.C. Zimmerman and Mr. A. Podlussany.

REFERENCES

Chadwick, C.E. and Nikitin, M.I. (1969). Some insects and other invertebrates intercepted in quarantine in New South Wales. Part 1. Coleoptera. *The Journal of the Entomological Society of Australia (N.S.W.)* **5**: 36-59.

Froggatt, W.W. (1927). Forest Insects and Timber Borers. Alfred James Kent, Government Printer, Sydney. 107pp.

Sparks, K. (2003). Quarantine Invertebrate Collections Database (QICD) User's Guide. AQIS Victoria 18 pp.

This page left blank intentionally