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Mollusca Types in Great Britain: founding a union database

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Abstract

Type specimens are essential to the study of malacology and are distributed across a wide range of museums in the UK. This initiative, funded by the John Ellerman Foundation, is the beginning of an integrated access and learning project bringing together curators from across the museum sector. Malacological curators from Amgueddfa Cymru - National Museum Wales (AC-NMW) and The Natural History Museum, London (NHM) worked with staff at seven partner museums in six UK cities. Together they developed a database and online resource connecting the Mollusca collections of National and other museums for the first time. At the time of publication, data on over 1800 type lots are available on the 'Mollusca Types in Great Britain' website. Since the launch in March 2018, some 1,189 users have accessed the site from over 60 countries. The database and website continue to be developed and new entries can be made at any time. The regional museum partners were given training focused on building confidence in recognising, researching, and interpreting the molluscan type specimens in their collections. The broader aims of this project were to strengthen and develop curatorial skills in specialist areas that could be transferable to other historically important natural history collections.

Keywords: Type specimens, Mollusca, database, collections, digitisation, holotype, syntype, malacology, conchology, handwriting, taxonomy

Introduction

Molluscs (e.g. snails, slugs, clams, and octopuses and their relatives) are an enormous group of animals, with around 80,000 known species in terrestrial and aquatic environments worldwide (Rosenberg, 2014). Eminently collectible, molluscs have been gathered and used by people since prehistory and their

influence reaches many areas of human life (Dance, 1986; Coan and Kabat, 2018). Many are of social, economic, or medical importance as sources of food, jewellery, dye, calcium, and even cloth or musical instruments, or as pests or vectors of disease (Tucker Abbott, 1989; Wilson, 2007; Thomas, 2007). The study of molluscs is a specialist endeavour heavily reliant on collections, and is known as malacology or



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conchology. Shells form the nucleus of many great natural history collections, with older collections in the UK particularly rich in types (Dance, 1986).

Nomenclatural type specimens, 'types', in natural history collections are the original specimens used to describe species. They are objects of permanent and global value, the fundamental basis of scientific naming and biodiversity inventories, and hence vital to environmental research (ICZN, 1999). Types are still necessary and sought out by researchers, but many curators today are insufficiently specialised, or lack resources, to attend to their research and curation (Kemp, 2015; Deucher, 2017). Such types risk being 'lost' to the international scientific community, which is unaware of their location. This is exacerbated by the fact that the UK is remarkably rich in museums that hold type specimens, a situation not seen in many other parts of the world. In our own experience, researchers from overseas often assume that types are found only in centralised collections in a state's capital city, and may overlook the smaller regional collections. Due to the historical reach of the British Empire and the UK's global position in trade and industry, many UK museums hold type specimens not just of national but also of international importance. In order to improve our understanding of the natural world, information on type specimens is desperately needed by the global scientific community in order to (re-)define what a species actually is. Taxonomy and systematics is, however, not the only beneficiary of such research. When researched, understood, and documented, types can become the stars in stories of historic, global exploration (e.g., Fraussen and Terryn, 2007; Breure, Audibert and Ablett, 2018) and discovery by local pioneering naturalists (Emberton, 1907; Norman, 1907). They offer continuity between the fervour of museums' founding years and contemporary scientific research.

The curatorial teams in AC-NMW and NHM were uniquely placed to undertake an initiative to digitally unite these scientifically valuable specimens for global access and highlight the contribution of dispersed regional museums' collections to worldwide science. The mollusc collections in these two institutions are the two largest in the UK, containing some of the most important collections worldwide, and are currently the only UK museums to have dedicated Mollusca curatorial staff. Together, we have specialist expertise in most groups of molluscs and access to huge comparative collections and libraries. In 2016, our curatorial team received a grant from the John Ellerman Regional Museums and

Galleries Fund. Entitled 'Great British Mollusca Types', the aim of the project was to assist certain museums in England, Scotland and Wales to better recognise their Mollusca types so that they may be safeguarded and more widely used, and in turn for these natural history collections to be more widely accessible and celebrated. The key outputs of the project included the database, the dissemination of results, and enhanced skills and knowledge of the participating staff at each museum, as well as the stronger relationships forged between the institutions. Setting the scope of the project, in terms of the museums included, and its future expandability were given much thought.

There was no existing catalogue of Mollusca types for all British or UK museums, though types at Manchester were listed by McGhie (2008), at Edinburgh by Smaldon, Heppell and Watt (1974), and are sometimes covered in part by other works (e.g. McMillan, 1985 for Liverpool). Both AC-NMW and the NHM have their own institutional specimen databases (see Wood and Turner, 2012; Scott and Smith, 2014 respectively) and some specimen records are available online through other museums' databases. AC-NMW had previously verified, databased and imaged all their Mollusca holotypes and lectotypes. Due to the large size of the Mollusca type collection in the NHM (c. 60,000 specimens) only a subset of these specimen lots have been databased (19,183 as of 27th November 2018 - mainly from direct register transcription efforts) and only a very small fraction of these have been critically verified. Due to the conditions of the funding source, the fact that both lead institutions have permanent dedicated molluscan curatorial staff and the large amount of material involved, it was felt that the type holdings of both museums would not be included in any initial project stage. The focus was instead on verifying and uniting material from smaller UK museums.

It is not the only online initiative to focus on types in this way; others include GB3D Type Fossils Online (Howe and McCormick, 2013) and the JSTOR Global Plants Database (JSTOR, 2018). Such projects are indicative of the demand to draw type material together and how this can be well-served in practice by partnership projects that specialise in particular taxa or kinds of collections. MolluscaBase (MolluscaBase, 2018) is a well-known and well-used database of Molluscan taxonomic names, which aims to 'provide an authoritative, permanently updated account of all molluscan species'. Whilst such databases are invaluable to researchers MolluscaBase

currently does not provide data on where the type specimens of these taxonomic names reside. The ideal information tool probably draws both names and specimens together.

Methods

The partners

We selected partner museums each known to have many mollusc types in varying stages of curation and research, but currently lacking a specialist malacology curator. Few of these types were traceable online or in print, and fewer still had been photographed. None were databased in a way that allowed all collections to be searched at once, or for the holding institutions

and their contributors to be seen in context. As partners, we approached curatorial staff from seven museums across six cities (Figure 1). These were as follows: Kelvingrove Art Gallery & Museum, Glasgow (Richard Sutcliffe); The Hunterian Museum, Glasgow (Maggie Reilly); The Great North Museum: Hancock, Newcastle-upon-Tyne (Dan Gordon); The Manchester Museum (Rachel Petts); Leeds City Museum (Rebecca Machin and Clare Brown); World Museum, Liverpool (Tony Hunter); Royal Albert Memorial Museum, Exeter (Holly Morgenroth).

Mention may be made of the National Museums Northern Ireland, Belfast. Dance (1986) does not indicate what is present, though Ross (1984) suggests



Figure 1. Map showing distribution of project partners. © AC-NMW/NHM

that type, figured and cited material may be present in older collections. This is true of other UK museums which were not included in the first phase of this project, where institutions with large numbers of types were the focus. Inclusion of Mollusca types from this or other collections in Northern Ireland would give a broader reach to the current project and would make the adjective 'Great British' inappropriate. We would welcome such data and can alter the name of the website in the future if required.

Training

We began with baseline evaluation, by asking each partner museum to complete a questionnaire on their mollusc collections and their awareness, skills, and confidence in dealing with them. The recognition and research of types requires specialist literature and knowledge. We understood there would be a need to build capacity and community amongst the participants, who each had different levels of skills in this area and whose collections each face different challenges. Therefore, in June 2016, staff from our seven partner museums took part in a two-day training workshop at AC-NMW covering the scope of the project, and providing a chance to introduce each of the project partners to each other (Figure 2). This was a uniquely specialised workshop, requiring all eight of our project team to be involved in creating and delivering different sessions, including on the

history of shell collecting and biographical data on key collectors and dealers. We covered malacological terms such as the different parts of the shell for the major molluscan groups and ran a technical session on imaging shells including the essential views to capture for each of the major groups. There was a section on type theory, with practical exercises on recognising types in collections using worked examples. Here we also introduced valuable research resources such as fundamental literature and websites. We also covered various aspects of collection management such as documentation, storage, and conservation. We were keen that project partners would be able to develop stories and educational materials from their specimens, and interpret the scientific, social, and local history behind them, so we also included aspects of outreach such as text writing, delivered by specialists from the Learning Department at AC-NMW. Each of the attendees testified to enhanced skills in recognising types, improved knowledge of their collections and collectors, and an increased awareness of each other's holdings.

Collections visits

Each participating museum was assigned two people, one from each of the AC-NMW and NHM project teams, who arranged collections visits of several days' duration to locate known and potential types.



Figure 2. Mollusca Types Training Workshop AC-NMW, June 2016. © AC-NMW/NHM

Top row L-R: J. Gallichan, A. Salvador, A. Holmes, J. Turner, H. Wood, J. Ablett, B. Rowson
Bottom row L-R: R. Machin, H. Morgenroth, T. Hunter, R. Petts, R. Sutcliffe, D. Gordon

Efficiently locating types in large collections needed both a subject and a contextual practical knowledge, so joint working with the participants was vital. Curators are the gatekeepers to their own collections and each of them held vital knowledge that helped locate potential type specimens within their collections. The visits were valuable for many reasons, including making new contacts, learning how different collections are organised and used, and highlighting specific conservation issues. The specimens were then loaned to AC-NMW or NHM for specialist photography, databasing, further taxonomic research and literature work by the team, and, as necessary, minor curation and conservation. Since the curators from AC-NMW and NHM are experienced in taxonomic research and type verification, and due to the time restraints of the project partners, it was felt that it was a better use of time and funds for these staff to lead on this aspect. It is hoped that with training and further collaboration staff at the partner institutions will feel empowered to begin future type examinations.

Evaluating Type Material

Researching and interpreting type specimens is a skill that requires training, practise and a good understanding of the International Code of Zoological Nomenclature. As previously noted, the reducing number of specialist curators, and the widening responsibilities of curators in general, has meant that many natural history curators no longer have the skills, time or resources to undertake a critical evaluation of their types. Evaluating the type status of historical material is often difficult because the available evidence may be poor or missing. Our approach has been to maintain rigorous standards, but to combine this, where appropriate, with a measure of pragmatism based on knowledge of collections, institutions and individuals. Much of this knowledge can only come from an in-depth understanding of a museum's history and associated people. Whilst in-depth instructions on how to recognise and check type material are outside the scope of this paper, we endeavour to outline the criteria used by the team in this project. Below is a list of the steps involved when evaluating type material:

- Locate original species description in the literature
- Compare collection locality, collector, and date information on label with specimen
- Compare figure, and measurements (if available) with specimen(s)

- Critically evaluate specimen data based on knowledge of institution, author, collectors, etc.
- Deduce type statuses from description – i.e. holotype, syntype, paratype etc.
- Check if original description is valid (or not, e.g. nomen nudum)
- Note reasoning for type designation if applicable and assign who verified type status.

The process of verifying type material is not an exact science and therefore, as more information is discovered and our understanding of the movement of collections and the interactions between malacologists become better known, the interpretation of material may change. Therefore where type status is in doubt we have labelled type material as 'possible' types. Where we feel that non-type material is important and could have future interest to those studying taxonomy and nomenclature, we have added these as 'non-type material'. Additional material, labelled as type, has been added subsequent to the launch of the project in March 2018. If not examined directly by the AC-NMW or NHM staff or other member of the project team, these have been annotated in the data set as 'unverified'. These are therefore visible to the community as a whole and can be investigated in the future.

Digitisation

The main digitisation element of the project was divided into three distinct processes:

1. Acquisition and aggregation of specimen data
2. Digital imaging of specimens and associated material
3. Development of a public-facing website to enable access to the images and data

The initial stage was to acquire collection datasets of Mollusca types held within each of the seven partner museums (i.e. not AC-NWM or NHM) and aggregate the data into a single purpose-built project database, developed following a Darwin Core schema. In most cases, datasets were exported from the partner museum's collections management system (CMS) in the form of Microsoft Excel spreadsheets. As would be expected when working across multiple institutions using a range of CMSs, the collection data was not consistent in regards to field terminology, naming protocols, and data formats, and therefore required a certain degree of 'cleaning' (e.g.

concatenation or splitting data, reformatting of data, etc.) prior to being mapped and aggregated into the database. The collated data was then further refined within the database as part of the taxonomic research and literature work of the team members.

The second stage consisted of specimen photography. In order to achieve consistency across the project, it was important to standardise the imaging process as much as possible. In the early stages of the project, protocols regarding specimen digitisation were discussed and agreed upon by the project team'. These included:

- Required views of specimens (Figure 3)
- Labels and documentation
- Lighting and backgrounds
- Image elements (scale bars, copyright information) and post-processing
- File formats and image resolution

These protocols allowed for flexibility where additional views and details were required to be captured, whilst still maintaining a reasonable level of consistency across the digitisation process.

All specimen labels and documentation were digitised, as was any documentation associated with the specimen lot. This also included relevant labelling or writing on the specimen storage containers. The mounting of some very historic material and the condition of some fluid-preserved material was such that it limited the ability to image some specimens to the desired level.

A Unique Identification Number (UID) corresponding to an image database record was assigned to each image and added as a printed label to each specimen lot. Specimen metadata, such as catalogue/accession number and type nomenclature, was stored in a separate image database and was used to link the image records back to the type specimen in the project database. Image file names were derived from the UIDs, and multiple versions of each image were retained as a data security measure. These consisted of a full resolution unprocessed RAW file (Adobe DNG) or Tiff; a full resolution Tiff processed and compressed (LZW + ZIP compression with layers); and Jpeg versions resampled to 1024px along the longest dimension and optimised for website use. Images and data are maintained and secured as part of the AC-NMW digital preservation protocols. Partner

museums received duplicate copies of all images and data associated with their collections.

The final stage of the digitisation process was the development of a public-facing website to allow universal access to type specimen data and associated images, with each specimen clearly linked back to its holding institution. The model for this was similar to AC-NMW's own mollusc type website (Wood and Turner, 2012) but designed with current browsing standards and responsivity in mind. The website was developed using standard web programming languages (PHP, Javascript, HTML5) with queries to database records via the *Filemaker*® API for PHP. The website aims to comply with all Priority 1 requirements and Priority 2 of the W3C Web Content Accessibility Guidelines 2.1 (WCAG2.1) (W3C, 2018), otherwise known as Level AA compliance.

To ensure longevity of the website, maintenance costs were written into the funding application and have been set aside for such needs in the future.

Evaluation and Outreach

The project concluded with a two-day debrief workshop at the NHM, providing a forum to reunite participants and to share our results and experiences. On the second day, this was opened up to potential future partners at a joint meeting in the morning; it concluded with a presentation in the afternoon, as part of the NHM's regular Collections Seminar Series, to the partners and other interested parties.

Throughout the project we endeavoured to ensure that news from the project was widely disseminated before its conclusion through poster presentations at a range of conferences, including the Natural Sciences Collections Association (Cambridge, 2017), the Museums Association Conference (Manchester, 2017), the Molluscan Forum (London, 2017), a Regional Meeting of the Conchological Society of Great Britain & Ireland (Cambridge, 2017), Porcupine Marine Natural History Society Conference (Edinburgh, 2018), an iDigBio session at Bristol Museum and Art Gallery (2018) and the British Museum 'Museums and Digital Memory' National Programmes Conference (London 2018). In May 2018, the website was given a positive review in the Museums Association's *Museums Journal* (Knott, 2018). We also used various social media platforms to promote the project while it progressed.

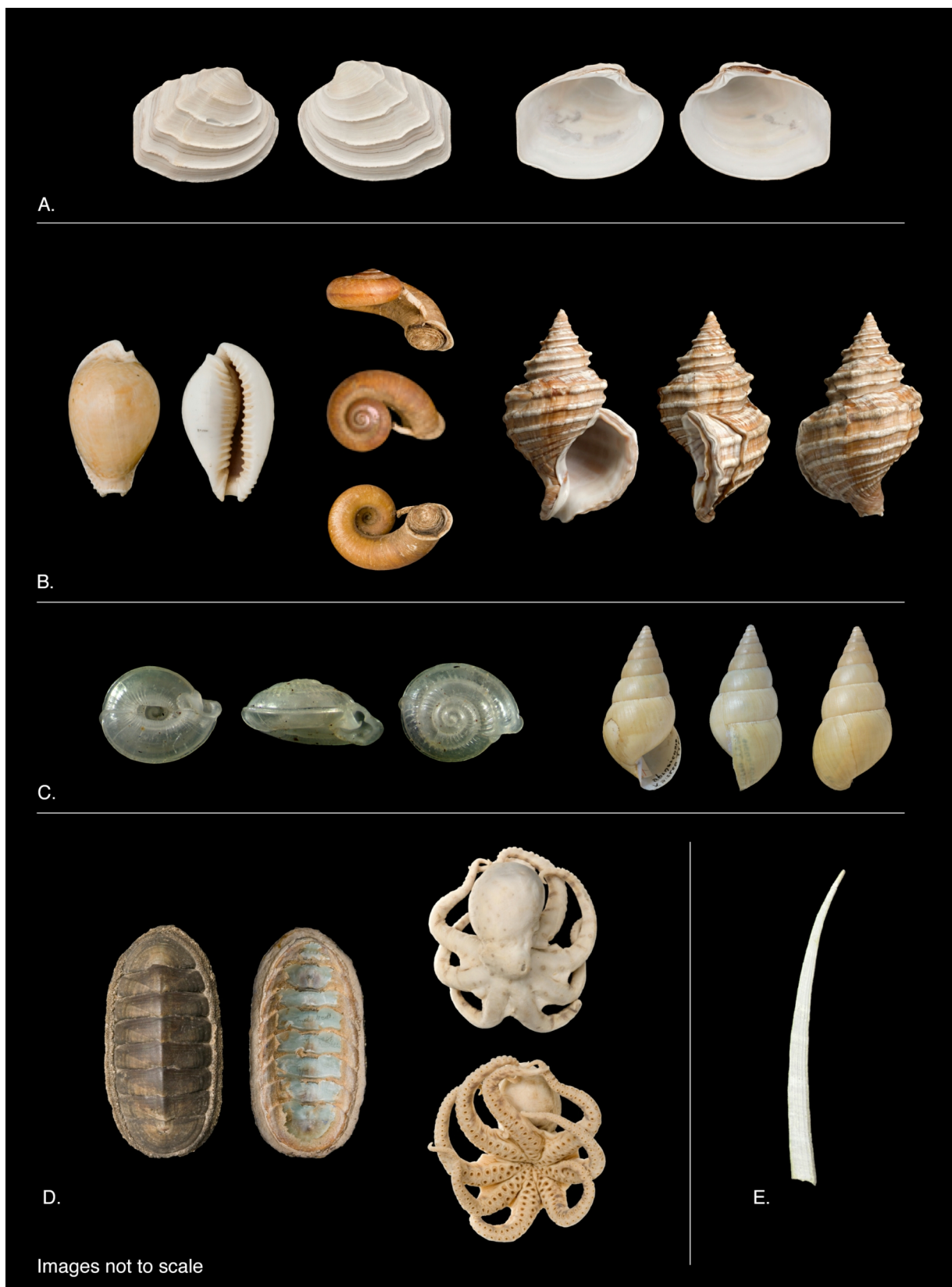


Figure 3. Views required for each type specimen. A. Bivalves – internal and external views of all shells. If the specimen is whole (i.e. not separate valves) then external views only; B. Marine Gastropods –dorsal/rear and ventral/apertural (apical, lateral or umbilical optional depending on species); C. Terrestrial Gastropods, High-Spired: apertural and rear (lateral optional), Low-spired: apertural, apical and umbilical (lateral optional); D. Polyplacophora, Cephalopoda: dorsal and ventral; E. Scaphopoda: lateral.

Results

Type specimens in collections

By the end of the project (May 2018) we had curated and conserved over 700 type and non-type lots from the seven partner museums' collections. All specimens were repackaged and relabelled, a particular success being the conservation of over 20 fluid-preserved sea slug type lots at Great North Museum: Hancock, which were in a vulnerable state (Figure 4). As hoped, we discovered previously unknown type material in most collections, making remarkable progress at Exeter Museum, where nearly 30 extra type lots were located in the Col. George Montagu and Miss J. E. Linter collections. The findings from this research have been published in a series of papers (Oliver, Morgenroth and Salvador, 2017; Oliver and Morgenroth, 2018). At least one previously 'lost' type of J. C. Melvill, untraced in the 1980s (Trew, 1987), was rediscovered unexpectedly at Liverpool, rather than Cardiff or Manchester where most of his material is known to be housed.

All material dealt with is now clearly labelled with its type status, image numbers, and relevant data, and is safely housed in each collection. High-resolution copies of the specimen(s), label photographs, and an export of the catalogue dataset have been distributed to each partner. A further outcome was that the research supported and allowed an application to Arts Council England for Designated status for the Montagu collection at Exeter.

The database and website

To provide universal access to the type specimens from the partner museums, the specialist photographs and specimen data have been made available in a single online database <https://gbmolluscatypes.ac.uk>, with each specimen clearly linked back to its holding institution (Figure 5). Each partner museum has remote access to their collection records on the database with the ability to change existing records and to add new ones as they acquire, or locate, new type material. All the



Figure 4. Fluid-preserved specimens of sea slug type lot (*Doridopsis clavulata* Alder & Hancock, 1864, NEWHM: 2002.H2557) © Great North Museum: Hancock, Newcastle, with images from original description inset (Alder & Hancock. 1864. pl.XXXI; figs.10, 11, 12).

participating staff are included as authors in the website citation (Rowson et al., 2018).

Our focus on mollusc types led to them becoming better-documented internally at each museum, as well as externally visible through the website. All partners reported an increased level of visibility of their type material online. By the end of April 2018, 547 types were catalogued on the website, nearly all of which were photographed in detail. All lots are fully researched and their type status confirmed (or amended), with clear links to the original publications. In the four months after the launch, the site had over 1,189 unique users, over 326 of these (27%) being from the UK, and the others from over 60 other countries (data from Google Analytics, 5 December 2018). We and the partners have dealt with several detailed enquiries from researchers (e.g. from the UK, France, Argentina, and the Netherlands) about the material featured. Many of the partner curators have indicated their desire to continue work on particular mollusc collections in their care (e.g. Lincolne (Manchester), Hunter (Glasgow)).

Throughout 2018, further records were added to the website, including primary types from AC-NMW (approx. 430 verified records); over 300 secondary types from Manchester (based on the list by McGhie,

2008), and over 500 records from Liverpool, from an unpublished list created by Ian Wallace (the source of these records being made clear on the website). The Liverpool dataset includes a number of specimens lost due to bombing in the 1939-1945 war. We have also included data on important collectors and collections held in the Booth Museum of Natural History, Brighton; the Cole Museum of Zoology, Reading; and the Warrington Museum & Art Gallery. Further records are in preparation.

The website also includes important information on handwriting, the location of collectors and collections worldwide, along with a list of other useful resources. We hope to expand upon these areas via future grants and projects, as we feel they are invaluable aids to curators and collections managers as well as visiting researchers and the public who wish to research molluscan collections.

Problems encountered

Most aspects of the project went well. We encountered few problems, most of which were minor. We had some issues transferring funds between museums in advance of the workshops to cover the travel and subsistence of the partner curators. We were not expecting the difficulty such

Tropidophora balfouri Godwin-Austen, 1881 Syntype(s)

Godwin-Austen, H.H. 1881. On the Land Shells of the Island of Socotra collected by Prof. Bayley Balfour. Part 1. Cyclostomaceae. *Proceedings of the Zoological Society of London*, pp.251-258 [256; pl.28; figs.4] [Original Description]

Current name: *Tropidophora balfouri* Godwin-Austen, 1881 [source: Original citation]

Classification: Gastropoda : Littorinimorpha : Littorinoidea : Pomatiidae

Type Status: Syntype(s) [Verified - Jon Ablett]

Collection: The Hunterian Museum, Glasgow

Catalogue No.: GLAHM.140280

No. specimens: 2 (dry shell)

Type Locality: on limestone ridge to the S.W. of Gollonsir village' [Yemen]

Collecting details: Prof. Bayley Balfour.

Notes ^

Donated: Prof. Balfour, 1881

References v

Specimen Data v

Tags

- Asia
- balfouri
- Gastropoda
- GLAHM.140280
- Godwin-Austen
- Godwin-Austen, 1881
- Gollonsir village
- Littorinimorpha
- Littorinoidea
- Pomatiidae
- Prof. Bayley Balfour
- Socotra
- Syntype(s)

Figure 5. Screenshot of the published website: Mollusca Types in Great Britain © AC-NMW/NHM

transfers could cause, given the small amounts involved and that both the purpose and the source of the funds was clear.

We and the partner curators were asked for valuations and proof of insurance by two partner institutions at the point of issuing a loan agreement. This was slightly problematic since the assumed monetary (as opposed to scientific) value of type specimens is well below that required to qualify for the Government Indemnity scheme available to AC-NMW and NHM, and indeed so low that it is difficult to obtain commercial cover. After consultation with the AC-NMW staff Collections Management Group, we obtained a suitable policy from a broker to cover all loans for the project to a total of £10,000. Notional replacement cost valuations were undertaken by the partner curators and condition checks by a conservator were arranged for incoming material. The insurance requirement was most unexpected, being an issue that has scarcely arisen in our many years' experience of lending and borrowing type and scientifically valuable material from museums around the world (nor was it raised by participants during the

application development or at the June 2016 workshop). It may be seen as a practice typical for museums whose loan traffic consists mainly of art and artefacts with much higher commercial values, and that lack special procedures for taxonomic specimens.

One aspect that was discussed repeatedly was the question of scope, and of titles for both the website and the project that would accurately reflect this. It was clear from the outset that the technical scope of the database content (e.g. regarding type status, verification and imaging standards) would need to be somewhat flexible even when following the Code consistently. We also necessarily had to restrict ourselves to the UK museums taking part in the project, notwithstanding the availability of type data from the NHM collection through its Data Portal (Scott and Smith, 2014). The title adopted for the website was 'Mollusca Types in Great Britain', to avoid any potential confusion about the geographic source of taxa that might stem from the project title 'Great British Mollusca Types'.

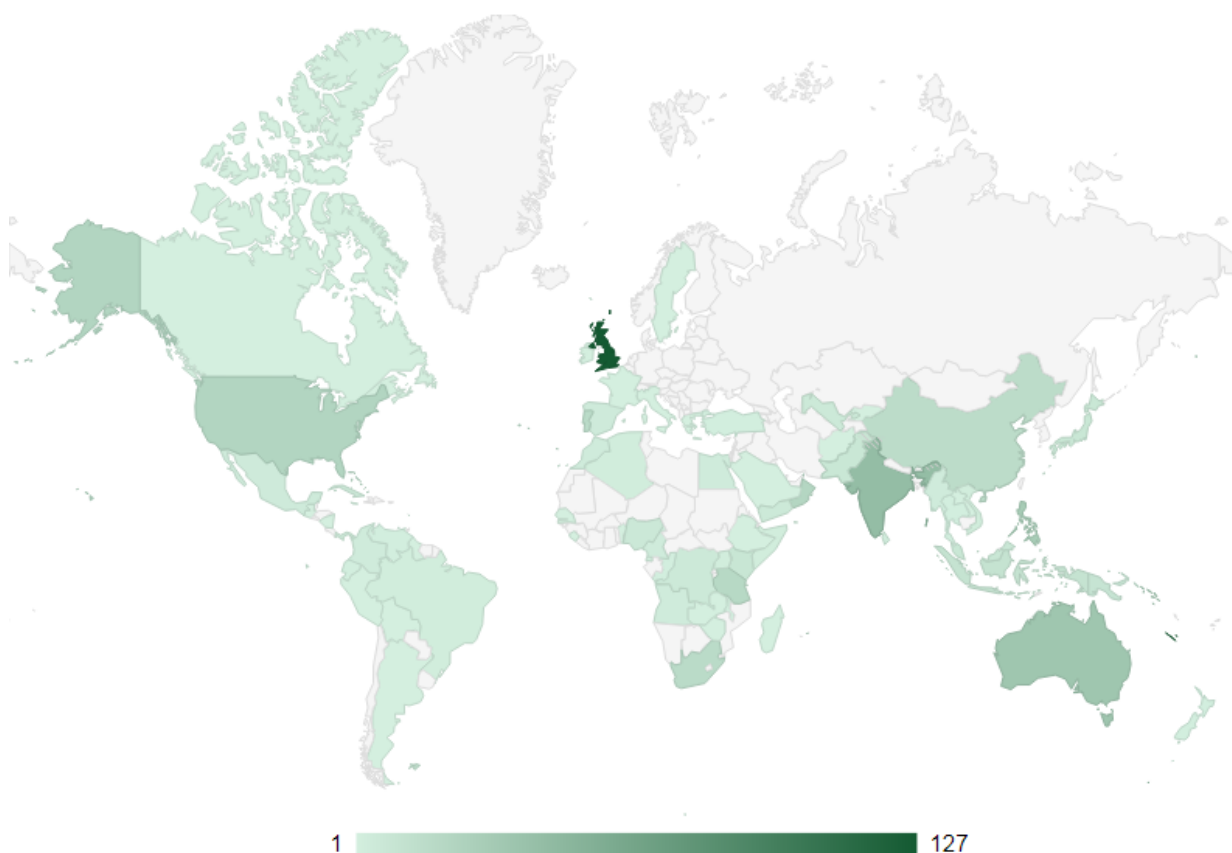


Figure 6. Countries/territories from which types came. © Google Analytics.

An analysis of collections

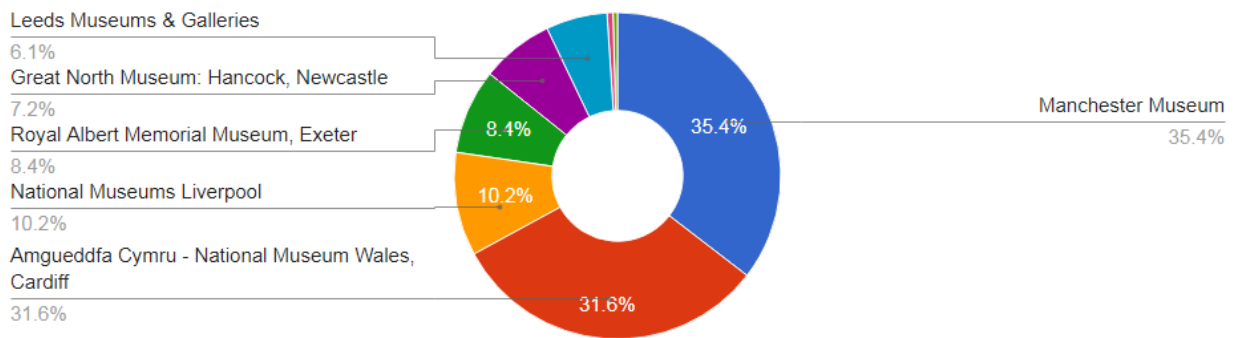
With an estimated 60,000 type specimens, the Natural History Museum, London has by far the largest concentration of Mollusca types, but most larger cities, ports, and towns have public museums incorporating natural history collections. Often, these collections were part of the nucleus around which the museum was built or developed, particularly in the 19th century (Alberti, 2002). Thanks to previous workers, we knew when embarking upon this project where most of the larger Mollusca type holdings were, but we did encounter some surprises. We also discovered that bringing a list of types together for the first time allowed us to analyse different aspects of the collections such as differences in the geographic and temporal acquisition of collections, along with any regional differences.

Molluscs from all major seas worldwide are represented, as are non-marine taxa from countries

worldwide (Figure 6). Europe (mainly Britain), Africa, and Australasia are relatively better-covered than Asia or the Americas. Most of the major taxonomic groups are represented, with a preponderance of Neogastropoda (including cones, murexes, whelks and olives) and the stylommatophoran land-snails. These are popular groups in any global shell collection - the difference being that in this case, each species was brand new to both the collector and his or her contemporaries.

Notably, even some of the larger collections are dominated by the types of one or a few authors. Charts of the proportion of types in each museum and the proportions described by the most prolific authors are remarkably similar (Figure 7). This may reflect the non-random nature of deposition, where donors/sellers, and the curators/buyers, helped ensure each UK museum developed a good collection. However, this was seldom straightforward,

Breakdown by Museum



Most prolific Authors

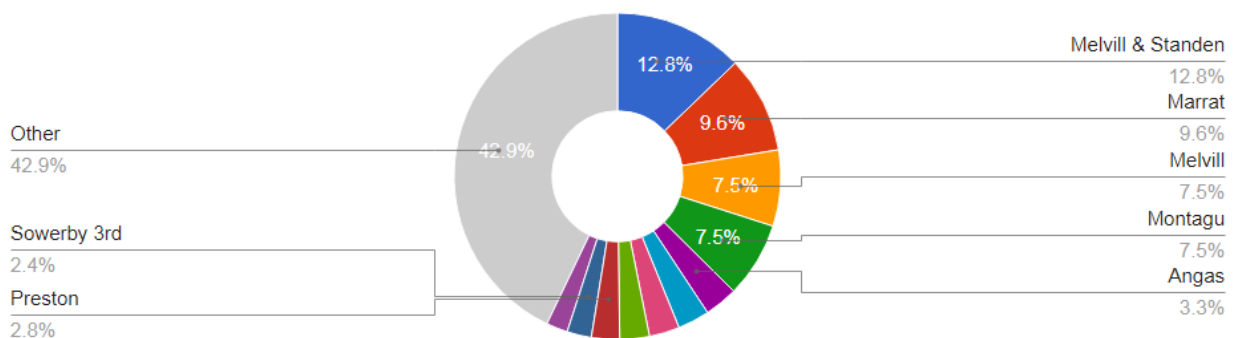


Figure 7. Proportions of the types in each museum, and those described by the most prolific authors. © AC-NMW/NHM

and collections such as Hanley’s at Leeds (Coan and Kabat, 2012), and Montagu’s at Exeter (Oliver, Morgenroth and Salvador, 2017), had already been partially dispersed. Other authors were museum employees, such as Marrat at Liverpool, and Standen at Manchester (McGhie, 2008; Bowden and Simkiss, 2003); while Alder and Hancock were naturalists whose ties to their local museum at Newcastle were forged over decades (Emberton, 1907; Norman, 1907). The types of J. C. Melvill, an establishment figure who was both wealthy and generous, came to rest in at least three UK museums (Trew, 1987; McGhie, 2008). Such diverse circumstances add to the story of the UK’s museums and emphasises the fact that no two of the country’s natural history collections are alike.

Most of the types were collected and named, perhaps unsurprisingly, in the late Victorian era (Figure 8), in the middle of what Dance (1986) termed the “abundant years” of conchology. Exotica imported from across the British Empire dominate, although new taxa in and around Britain were still being recognised. The chart also shows how few molluscs discovered in the last 100 years are represented by types at the museums dealt with here.

The majority of the scientific names that these types represent remain in use today, which is by no means always the case. Our estimate of the degree of synonymy, using MolluscaBase (2018), MUSSELp (Graf and Cummings, 2018) and other relevant sources for current nomenclature, suggests that on average 70%

of each author’s names are still accepted, although of course most have moved genus. The high synonymy rate for Montagu, pioneer as he was, might relate to most species in the British fauna being geographically widespread, and thus already described by other Europeans. The still higher rate for F. P. Marrat might reflect his being one of few British workers to flirt with the notorious methods of J. R. Bourguignat’s ‘Nouvelle Ecole’ (Melvill, 1905; Dance, 1970). Yet his types at Liverpool remain in demand by specialists. The low synonymy rate of other authors may in some cases be attributable to a lack of recent revisions. It is only thanks to the care that the collectors, and succeeding generations of curators, took of these collections that such material will be available for study in the future.

Conclusion

At the time of writing (December 2018) the data set included 1898 records from all seven partner museums and AC-NMW, with the majority including images of both specimens and labels. This is the first time such a multi-institutional type data set has existed for Mollusca, and it is hoped that scientists, the regional, UK and wider public will benefit from much improved access to type specimens. Digitisation is one of the most efficient ways to help meet the expectation of continually-widening access to museum collections (Beaman and Cellinese, 2012). Type specimens held in regional museums have the potential to spark the imagination and pride of their constituents. Any natural history specimen has social

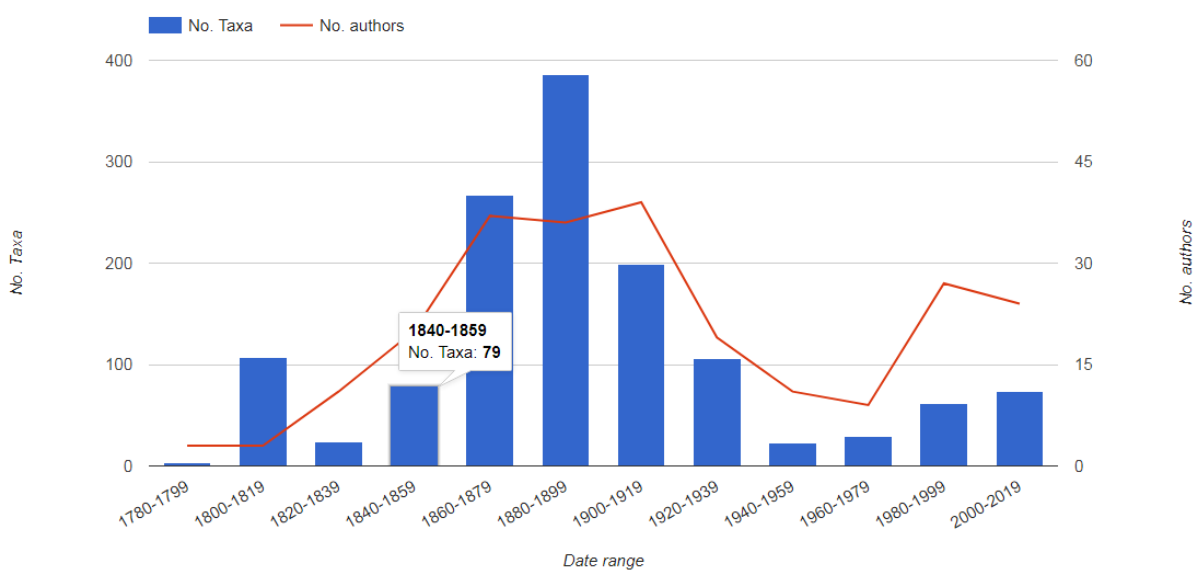


Figure 8. Number of taxa described, and number of authors, for each period. © AC-NMW/NHM

history, cultural, and aesthetic dimensions as well as the scientific one. Users may be interested in any one of these, or several, and any might inspire or attract newcomers of all ages. Making links between objects can help enrich local and national culture and may encourage participation and debate. The high-quality images and other products of research will be suitable for use in many contexts, and for years to come, including exhibitions, social media, events, merchandise, and publications.

This was a time-limited project of two years, yet we believe it will leave a strong legacy. Data has been recorded permanently on a universally accessible resource, with potential for future expansion as other UK museums contribute their Mollusca types to the database, and as new types are acquired. The existence of this resource could attract further type donations, which can be added by the contributing museums (including AC-NMW or NHM). The curatorial skills that this project helped strengthen will hopefully be developed at regional museums, and these skills are transferable to their other historically important natural history collections. Relationships

between all our museums have been strengthened and enhanced, to the benefit of all participants and their wider audiences.

The project and its outputs were well-received at our organisations, as an example of how partnerships with regional museums help connect and support curators and collections around the UK. Our respective staff and those of the partner museums have benefited from and enjoyed working more closely with one another, and value has been added to their collections.

The team of over 15 staff spent around 200 days working together on the collections. This contributed to better mutual understanding of each collection, its history and linkages across regions, and better contacts between curators and their networks. Logistical relationships (e.g. with administrative staff and registrars) and collections awareness were also improved and testimonials were highly encouraging (Figure 9). The team also assisted with evaluation of a schools service mollusc collection in Leeds, shared literary references for a project in Glasgow, identified



Figure 9. Selected quotes from project partner staff and website users. © AC-NMW/NHM

slugs for visitors at Liverpool, and discussed future partnership research with Manchester and Glasgow. We hope that if any perceived barriers between regional and national museums did exist, then we have made headway in removing them. It is hoped that these positive working relationships will extend outside the Mollusca collections to other areas. What we will take away from this project is the new relationships we have made. It proves that by sharing skills, we are stronger in the long run and the outlook for retaining these skills for the future is much improved.

As we look to the future of the database, we hope to build on and expand the datasets in several ways. By including a number of new partner museums, we could increase (and nearly complete) our coverage of the UK's Mollusca types outside NHM. We are currently in the process of applying for funding to add a further 11 institutions, and we plan to extend coverage to Northern Ireland and to the Republic of Ireland (thus becoming 'Mollusca Types in Britain & Ireland'). In order to create a true Union Database for the UK, it is hoped that the Mollusca types held in the NHM would also be added. At the present, an internal pilot study is being planned to understand the resources, impacts and challenges of such a large-scale digitisation project. We also plan to enrich the social and historical functionality of the website by developing a 'Biography' tab allowing users to search collectors, handwriting, and archive materials linked to type material spread across institutions. And finally, we hope to extend the database's reach by developing two-way links between each record and the global data aggregators for Mollusca and indeed, all taxa (MolluscaBase, 2018; GBIF, 2018).

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References

- Alberti, S.J.M.M., 2002. Placing nature: natural history collections and their owners in nineteenth-century provincial England. *British Society for the History of Science*, 35(3), pp.291-311.
- Alder, J. and Hancock, A., 1864. Notice of a collection of Nudibranchiate Mollusca made in India by Walter Elliot, Esq., with descriptions of several new genera and species. *Transactions of the Zoological Society of London*, 5(3-4), pp.113-147.
- Beaman, R.S. and Cellinese, N., 2012. Mass digitization of scientific collections: New opportunities to transform the use of biological specimens and underwrite biodiversity science. *Zookeys*, 209, pp.7-17.
- Bowden, A.J. and Simkiss, W., 2003. Henry Hugh Higgins and Frederick Price Marrat: the reluctant palaeobotanists and the Ravenhead collection. *Proceedings of the Geologists' Association*, 114, pp.327-338.
- Breure, A.S.H., Audibert, C., and Ablett, J., 2018. *Pierre Marie Arthur Morelet (1809-1892) and his contributions to malacology*. Leiden: Netherlands Malacological Society.
- Coan, E.V. and Kabat, A.R., 2012. The malacological works and taxa of Sylvanus Hanley (1819-1899). *Malacologia*, 55(2), pp.285-359.
- Coan, E.V. and Kabat, A.R., 2018. *2,400 Years of Malacology (15th ed.)*. [online] Available at: <http://www.malacological.org/2004_malacology.html> [Accessed 27 July 2018].

- Dance, S.P., 1970. "Le fanatisme du nobis": a study of J.-R. Bourguignat and the "Nouvelle Ecole". *Journal of Conchology*, 27, pp.65-86.
- Dance, S.P., 1986. *A history of shell collecting*. Leiden: E.J. Brill.
- Deucher, S.D., 2017. What does a 21st-century curator need? *Museums Journal*, 117/11, p.14.
- Emberton, D., 1907. Life of Albany Hancock. In: Hancock, A. *The British Tunicata. An unfinished monograph. Volume 2*. London: Ray Society. pp.xvii-xxviii.
- Fraussen, K. and Terryn, Y., 2007. The family Buccinidae: Genus Neptunea. In: Poppe, G.T. and Gros, K. (eds.), 2007. *A Conchological Iconography*. Hackenheim: Conch Books.
- GBIF: The Global Biodiversity Information Facility (2018). *What is GBIF?* [online] Available at: <<https://www.gbif.org/what-is-gbif>> [Accessed 17 July 2018].
- Graf, D.L. and Cummings, K.S., 2018. *The Freshwater Mussels (Unionoidea) of the World (and other less consequential bivalves), updated 9 August 2018*. [online] Available at: <<http://www.mussel-project.net/>> [Accessed 18 August 2018].
- Howe, M. and McCormick, T., 2013. *GB3D type fossils online*. [online] Available at: <www.3d-fossils.ac.uk <http://www.3d-fossils.ac.uk/home.html>> [Accessed 13 August 2018].
- ICZN, 1999. *International Code of Zoological Nomenclature. Fourth edition*. London: The International Trust for Zoological Nomenclature. [online] Available at: <<http://www.iczn.org/>> [Accessed 18 August 2018].
- JSTOR, 2018. *Global Plants database*. [online] Available at: <<https://plants.jstor.org/>>. [Accessed 18 August 2018].
- Kemp, C., 2015. Museums: The endangered dead. *Nature*, 518, pp.292-294.
- Knott, J., 2018. Mollusca types in Great Britain. *Museums Journal*, 118(5), p.59.
- McGhie, H.A., 2008. Catalogue of type specimens of molluscs in the collection of The Manchester Museum, The University of Manchester, UK. *ZooKeys*, 4, pp.1-46.
- McMillan, N.F., 1985. Frederick Price Marrat, 'Conchologist etc'. *Merseyside County Museums Occasional Papers*, 3, pp.1-34.
- Melville, J.C., 1905. Frederick Price Marrat. *Journal of Conchology*, 11, pp.225-227.
- MolluscaBase, 2018. *MolluscaBase*. [online] Available at: <<http://www.molluscabase.org>> [Accessed 17 July 2018].
- Norman, A.M., 1907. Life of Joshua Alder. In: Hancock, A. *The British Tunicata. An unfinished monograph. Volume 2*. London: Ray Society. pp.xvii-xxviii.
- Oliver, P.G., Morgenroth, H., and Salvador, A., 2017. Type specimens of Mollusca described by Col. George Montagu in the Royal Albert Memorial Museum & Art Gallery, Exeter and The Natural History Museum, London. *Zoosystematics and Evolution*, 93(2), pp.363-412.
- Oliver, P.G. and Morgenroth, H., 2018. Additional type and other notable specimens of Mollusca from the Montagu Collection in the Royal Albert Memorial Museum & Art Gallery, Exeter. *Zoosystematics and Evolution*, 94(2), pp.281-303.
- Rosenberg, G., 2014. A New Critical Estimate of Named Species-Level Diversity of the Recent Mollusca. *American Malacological Bulletin*, 32(2), pp.308-322.
- Ross, H.G.C., 1984. Catalogue of the land and freshwater Mollusca of the British Isles in the Ulster Museum. Ulster Museum. Belfast: Ulster Museum.
- Rowson, B., Ablett, J., Gallichan, J., Holmes, A.M., Oliver, P.G., Salvador, A., Turner, J.A., Wood, H., Brown, C., Gordon, D., Hunter, T., Machin, R., Morgenroth, H., Reilly, M., Petts, R., and Sutcliffe, R., 2018. *Mollusca Types in Great Britain*. [online] Available at: <<https://gbmolluscatypes.ac.uk>> [Accessed 17 July 2018].
- Scott, B. and Smith, V., 2014. *Natural History Museum Data Portal*. [online] Available at: <data.nhm.ac.uk> [Accessed 27 November 2018].
- Smaldon, G., Heppell, D., and Watt, K.R., 1976. Type specimens of invertebrates (excluding Insects) held at the Royal Scottish Museum, Edinburgh. *Royal Scottish Museum Information Series, Natural History* 4. 118 pp.
- Thomas, I. 2007. *The Shell: A World of Decoration and Ornament*. London: Thames & Hudson.
- Trew, A., 1987. *James Cosmo Melville's New Molluscan Names*. Cardiff: National Museum of Wales, Cardiff.
- Tucker Abbott, R., 1989. *Shells*. New York: Portland House.

- W3C, 2018. *Web Content Accessibility Guidelines (WCAG) 2.1. W3C Recommendation 05 June 2018*. [online] Available at: <<https://www.w3.org/TR/2018/REC-WCAG21-20180605/>> [Accessed 13 August 2018].
- Wilson, M.J., 2007. Terrestrial mollusc pests. In: Lacey, L.A. and Kaya, H.K. (eds). *Field Manual of Techniques in Invertebrate Pathology*. Dordrecht: Springer. XXXIV + 910 pp.
- Wood, H. and Turner, J.A., 2012. *Mollusca Types Catalogue*. Amgueddfa Cymru - National Museum Wales. [online] Available at: <<http://naturalhistory.museumwales.ac.uk/molluscatypes>> [Accessed 17 July 2018].