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PULSE

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News from the Linnean Society of London – A living forum for biology

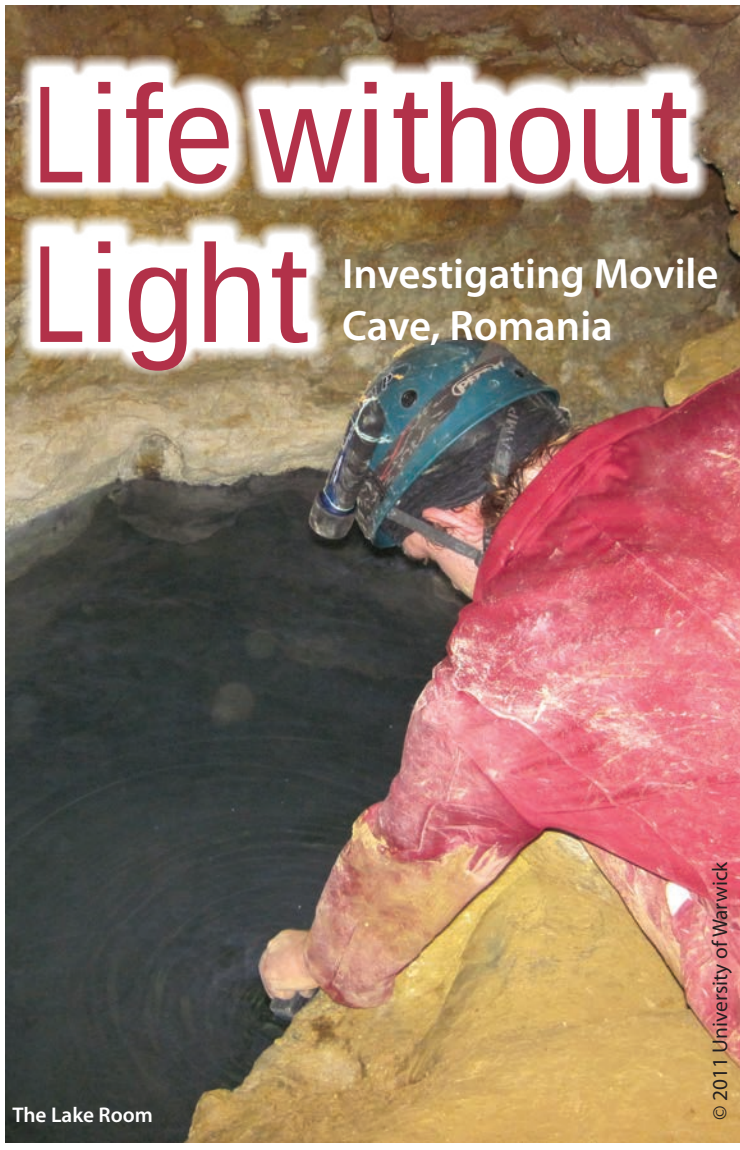
Life without Light

Investigating Movile Cave, Romania

One of the privileges of my career has been being able to work in Movile Cave, Romania. I have thus far led two UK expeditions into the Cave and was the first UK scientist to explore it since its discovery in 1986. Movile Cave is truly unique in that it is the only known environment on Earth that is completely sealed from the outside world, with no natural entrance, and yet is full of life, with over 40 insects and annelids identified thus far, over 30 of which are endemic to the Cave.

Peştera Movile translates as "the cave of the mounds", referring to the Cave's location beneath a 500m-wide ring of small hills just west of the city of Mangalia in southern Romania. The hills surround a depression known as *obanul mare*, "the great sinkhole[1]". It is thought that a large network of karsts was present in the limestone under *obanul mare* but that a collapse-event over 5 million years ago sealed off part of the network, leaving Movile Cave isolated from the rest of the world.

In 1986, the story goes that Nicolae Ceaușescu himself saw *obanul mare* from a helicopter and, knowing of the geothermal activity of the land and sea around Mangalia, suggested it to be a suitable location to build a geothermal power plant on the large, flat area in the middle of the *obanul*. Speculating holes were dug, by hand, at various points around the ring of small hills, one of which struck scientific gold. About 30m below the surface, engineers hit a tunnel and contacted speleologist Cristian Lascu (now Chief Editor of *National Geographic*, Romania) to examine the tunnel. Lascu found no natural entrance to the tunnel, yet chambers were inhabited by cave-adapted organisms. In tandem with biologist Serban Serbu, they demonstrated using carbon-13 ratios that all organisms present in the Cave derived their carbon not from the CO_2 found externally, but ultimately from carbonate derived from limestone. What's more, this carbon had not been "fixed" into sugars, etc., by plants (as in photosynthesis) but by floating "mats" of bacteria that had taken up the carbon into sugars, etc., through *chemosynthesis*—a process in which inorganic ions such as S^{2-}, Fe^{2+} and Mn^{2+} are oxidised into SO_4^{2-}, Fe^{3+} and Mn^{4+}, respectively, allowing microbes to synthesise ATP at the expense of these reactions rather than at the expense of sunlight. Though chemosynthetic or *lithotrophic* ("stone-eating") organisms are found in most environments, such as soils or rivers, they represent only a small fraction of the *primary productivity*—the rate at which CO_2 is converted into larger molecules—as in these environments, photosynthesis is the dominant process. In Movile, however, 100% of the primary productivity is lithotrophic since daylight does not enter the Cave. A number of experiments—including measuring isotopes from the recent Chernobyl disaster—showed that the Cave was completely sealed and had been for over 5.5 million years. Owing to the scientific value of the Cave, it was promptly sealed, the power station cancelled and research commenced.



The Lake Room

Beyond the 30m entrance shaft (sealed by three trapdoors, the bottom of which is gas-tight, to keep the Cave sealed), a series of dry galleries of limestone coated in ochre clay must be navigated in order to reach the main chamber, known as the Lake Room, in which the lower, submerged levels begin. A thick layer of hydrophobic clay above the galleries means that rainwater does not penetrate into the Cave, and thus there are no speleothems present.

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1 *Sensu stricto*, "obanul" has no translation into English and derives from "oban", a word that refers to sinkholes that usually have water in the bottom. *Obanul mare* does not have water in the bottom.

The Linnean Society of London

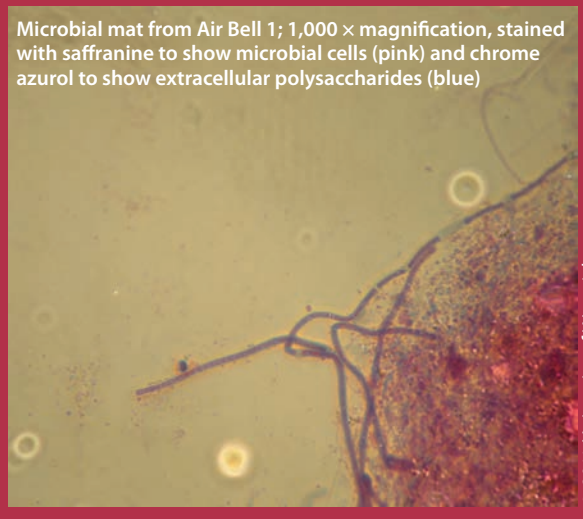
Continued from p.1

The Lake Room walls are covered in gypsum crystals caused by the action of hydrogen sulphide gas and lithotrophic bacteria converting calcium carbonate into calcium sulphate. The submerged levels comprise about 50m of tunnels, along which four "air bells" exist, in which cave gases become trapped in domed areas of rock above the surface of the water. It is in these chambers that life abounds!


Dr Rich Boden FLS

The Cave is fed by geothermal waters from kilometres below the surface and with geothermal gases. The "air" in the Lake Room contains about 10% oxygen, 3% carbon dioxide, 0.2% hydrogen and 1% methane, all originating from kilometres below the surface. This is around 50% of the normal oxygen concentration of air and 1,000% of the normal carbon dioxide concentration, so working in the Cave is exhausting! After about five hours, early signs of hypercapnia start to show.

The microorganisms of the Cave form "mats" floating on the surface of the water that look like floating tissue paper or cobwebs. These mats contain billions of microbial cells stuck together as a huge network and carbon dioxide and methane are both taken up by the mats at the expense of hydrogen sulphide, iron and manganese, which form oxides that colour the mats orange and black. The mats are then eaten by nematodes and mites such as *Niphargus* spp. and *Asellus aquaticus infernus*. Larger organisms then eat these, and so on up to the top predators, which include cave-adapted strains of *Cryptops anomalans* and a number of spiders, many of which form webs to catch springtails and mites, since nothing in the Cave appears to fly. Cave adaptations include a lack of pigment, lack of eyes and elongated legs and antennae to better sense things in the dark. *Nepa anophthalma* is a white water scorpion completely lacking in eyes. The first cave-adapted leech (*Haemopis caeca*) was also discovered in Movile Cave.


Microbial mat from Air Bell 1; 1,000 × magnification, stained with saffranine to show microbial cells (pink) and chrome azurol to show extracellular polysaccharides (blue)

Whilst we are beginning to understand the mysteries of Movile, we have really only scratched the surface of this world-within-a-world and the other as-yet-undiscovered worlds beneath our feet!

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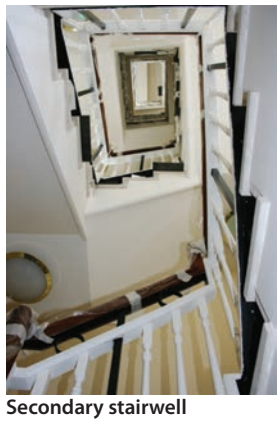
The Linnean Society Lift!

After a difficult but exciting eight months the Society now has a lift. The final touches to the programme of works are still to be completed, but we are almost there.

The entrance to the lift is located in a new alcove on the right as you enter the building. In the basement the ladies and gents toilets have switched locations and lockers are now available for visitors to securely store their belongings. There is also a new disabled toilet in the basement and the lift now provides level access to the basement, Library and Council Room. We are very pleased to finally be able to provide level access for our disabled visitors.


Lift entrance in Foyer


Secondary stairwell

There were a few problems along the way, namely the discovery of a huge Victorian girder, which would have blocked access to our new secondary stairwell. A modern girder had to be fitted to support the wall before removing the old one, which delayed work by about 5 weeks. The secondary stairwell, already christened the"green stairs", follows the lift, accessing levels up to the Tower Room.

The reception carpet has been removed, revealing the original stone floor. We hope to have the floor and stairs cleaned and restored over the coming weeks. Fellows and visitors are invited to join us for the Open House event on 21 September; we may even be able to better last year's visitor numbers of 725. We hope to see you then!

Room Hire

The Linnean Society of London offers a prestigious central London venue for meetings, conferences and lectures, with facilities for meetings for up to six people, board meetings for up to 40 or lectures for audiences of 100. Our central London location is both convenient and atmospheric, with rooms available at surprisingly competitive rates.

Our rooms will be open again from September—with newly renovated areas and highly improved access throughout the building via our lift, our elegant rooms are a great respite from the London bustle. If you or any associates are interested in learning more about room hire in this historic building, please get in touch with Tom Helps (tom@linnean.org) who will be happy to help you.

Field Trip 2013

It doesn't always rain in North Wales!

This year Professor John Good OBE and his colleague Dr Tony Ramsay, Honorary Senior Lecturer in Geology at Cardiff University, put together an extremely varied programme for the 27 eager participants, which included many new Fellows. Our first day was spent on the sunny Island of Anglesey, where we visited three areas, starting with Parys Mountain, the site of a late 18th-century copper mine, where Dr David Jenkins (past chairman and founder member of Amlwch Industrial Heritage Trust) provided fascinating insights into the industrial archaeology—this extraordinary landscape is gradually being colonised by plants and lichens, as explained to us by Professor Alan J.M. Baker (a botanist/ecologist specialising in phytoremediation) and Dr William Purvis (a lichenologist, Associate at the Natural History Museum, London). We then drove to South Stack in search of some rare plants, including the spotted rock rose *Tuberaria guttata* and fleawort *Tephroseris integrifolia* subsp. *maritima;* though these eluded us we saw the amazing bird colonies (guillemots and razorbills in spectacular numbers) on the cliffs, while the RSPB reserve lookout streamed live video footage of young choughs in a nest deep in the cliff face. It was then on to Newborough Warren to hear from Craig Shuttleworth about the success of the red squirrel conservation programme and the many challenges faced (including how squirrels cross the Menai Bridge). A visit to a dune re-stabilisation project with Graham Williams (Countryside Council for Wales, Newborough Warden) was followed by Llanddwyn Island, where Tony showed us the pillow larva and 'mélange' on the beach.

LEFT: Parys Mountain; TOP: Mélange on Llanddwyn Island; BOTTOM: Darwin's erratic boulders

After a rest and a fortifying dinner we were ready for day two—starting with a wind-scorched walk on Great Orme, a massive dolomite peninsula and home to the beautiful silver-studded blue and grayling butterflies. The trip ended with a rather wet walk up to the semicircular valley of Cwm Idwal, bounded by the cliffs of Twll Du (Devil's Kitchen), and the Llyn Ogwen lake, where Dr Barbara Jones (Upland Ecologist with CCW) explained about efforts to minimise grazing by livestock to allow the alpine plants and scrubby heath to expand, so returning the landscape to its 'original' state. Dr Brian Rosen gave an interesting account of Charles Darwin's visits to the area and we saw the erratic boulders which Darwin had observed when investigating glaciations. All-in-all, the trip was much enjoyed by all participants!

Images © Elizabeth Rollinson

Alfred Russel Wallace Centenary Event

On 7 June a joint meeting to celebrate the life and work of Alfred Russel Wallace took place between the Linnean Society of London and the Society for the History of Natural History (SHNH), and was hosted by the Bournemouth University Festival of Learning. Organised by Samantha Murphy and Gina Douglas respectively, the day was led by a line-up of five brilliant lectures, including Caroline Catchpole's well-received talk which incorporated stories and quotes from the Wallace Correspondence Project at the Natural History Museum, London (NHM) and brought to life a very 'human' Wallace. Jim Costa spoke about his research into speciation using Wallace's 'Species Notebook' 1855-59, tracking Wallace's thought processes and identifying those who would have influenced his work (like Charles Lyell). And our own Janet Ashdown revealed insights into her work conserving Wallace's notebooks, and the routes that lead a conservator to 'conserve' or 'preserve'.

Tribute at Wallace's grave

Images © BNSS, © Samantha Murphy

Later, director Geinor Styles and theatre company Theatr na nÓg told Wallace's story via a theatrical performance which drew many questions from the audience about Wallace's early life in Neath (from where the theatre company originates). An evening reception at the Bournemouth Natural Science Society (BNSS) proved to be a veritable treasure trove for many guests and capped off a fascinating first day.

Reception at the BNSS

The following morning the group were taken on a nature walk guided by President of the BNSS, Mark Spencer, spotting grass snakes, damselflies, drosera and roe deer. A toast was then given at Wallace's graveside in Broadstone, Dorset (of which the Linnean Society are caretakers), where the group ended their time with the great man.

Future Wallace Events

- 21–22 October: Alfred Russel Wallace and his legacy (Two–day meeting @ The Royal Society) **royalsociety.org/events/2013/wallace-legacy**
- 22 October: Alfred Russel Wallace—the compleat naturalist (Evening lecture by Dr Sandra Knapp @ The Linnean Society) **www.linnean.org/compleatnaturalist**
- 23 October: Alfred Russel Wallace and his Legacy —Wallace100 conference (Day event @ the Natural History Museum, London) **www.nhm.ac.uk/visit-us/whats-on/events**

Registration is essential for all of these events

Cultural Recovery

HOW JAPANESE MUSEUMS WERE AFFECTED BY THE TSUNAMI DISASTER

Rikuzentakata City Museum (RCM); Images © Masayuki Oishi, © deformer, 2013 (Shutterstock)

On March 11, 2011 Japan was badly shaken by a mega-earthquake measuring M 9.0 off the Pacific coast of Tōhoku, north eastern Japan. The fault slip between the oceanic and continental plates triggered a huge tsunami, which devastated cities along the coastline in the Iwate, Miyagi and Fukushima prefectures.

Many museums located on the Sanriku coast (Pacific coast of Kitakami Mountains) were severely hit by the tsunami. In Rikuzentakata City, which is the most damaged area in Iwate Prefecture, the tsunami engulfed the Rikuzentakata City Museum (RCM) and the Sea and Shell Museum (SSM) as they were hit by waves more than 15m in height.

A few weeks after the full scale of the disaster emerged, the Agency of Cultural Affairs (ACA) launched "A Rescue Project to Save Cultural and Other Properties" in partnership with many institutions. In Iwate Prefecture, the Iwate Prefectural Museum in Morioka City (IPMM) staff and volunteers started a project to save museum materials in Rikuzentakata in early April, under the authorisation of the Board of Education.

The RCM was founded more than 50 years ago, and houses more than 150,000 materials in the fields of archaeology, history, folklore, biology and geology. The SSM was established in 1994, having a seashell collection of about 110,000.

Baird's beaked whale from the Sea and Shell Museum (SSM)

Sadly, seven staff members, from both the RCM and SSM, were lost to the tsunami.

Mr Masaru Kumagai of the SSM, who survived the disaster and was the only remaining curator in Rikuzentakata City, had been busy in a municipal position assisting displaced citizens immediately after the tsunami. It was at the end of March 2011, a few weeks after the catastrophe, that he was ordered to save the museum materials by the municipal authorities. Although the top priority was, of course, the rebuilding of people's lives and reconstruction projects for the regions, Masaru began work on the rescue of cultural assets with a sense of mission and passion, saying:

> *It is not a true reconstruction without cultural assets. They are the accumulation of nature, history, culture and memories in this region and they give identity to Rikuzentakata.*

The rescue operation by the municipal staff of Rikuzentakata, the IPMM and other museums began slowly, due to a large amount of rubble in the RCM building. It swiftly moved forward with the collaboration of the Japanese Ministry of Defense in late April. Large amounts of museum materials (such as cultural assets and natural history specimens) were moved from the RCM and SSM to a recently closed elementary school (currently used as the makeshift RCM) in the mountain area of Rikuzentakata City.

In addition to physical damage, the museum materials had been contaminated by the seawater and the colloidal sediments brought by the tsunami, and became mouldy and rusted. Enormous amounts of historical documents from the 18th to 19th centuries were transported to the IPMM and conservation on these materials was started with a trial and error process. Tens of thousands of herbarium and insect specimens were sent to natural history museums in many parts of Japan, which offered to save the decimated specimens. As for geological specimens and folklore objects, curators from many parts of Japan came to the makeshift museum to clean and repair them. Restoration is currently ongoing and it will require several years before everything we want to achieve is accomplished.


Damaged insect specimens at the RCM

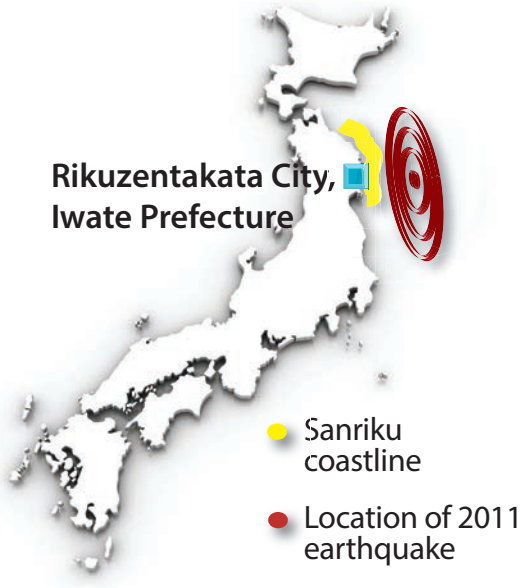
Throughout the rescue and conservation of the natural history collection, a new appreciation began to build for Mr Genzo Toba (1872–1946)—a naturalist from the Rikuzentakata region—and his work studying the local ecology. Genzo's herbarium significantly traces the history of the region's environment in the early 20th century. It also became clear that Toba was an early contributor to the study of Japanese geology, owing to a set of Permian fossil specimens and a record in a 1918 school diary that were found near the defunct elementary school. Modern geology shows that the Southern Kitakami Terrane, including the Rikuzentakata area, was located in lower latitudes in the Paleozoic Era (541–252.2 million years ago), then the plate pushed slowly northwards. With this in mind, the natural history collection of the RCM is significant for ecological study, not only from a regional point of view but also from a global perspective.

However, since the title of the rescue project organised by the ACA was "A Rescue Project to Save Cultural and Other Properties", it gave the initial impression that natural history specimens were not covered by the project. The official position of the ACA is that "Other Properties" include natural history specimens. Biologists and geologists were mindful of the fact that the ACA does not deal with natural history specimens in its usual remit, and most natural history specimens have no regal protection in Japan. Those natural history specimens that are covered by the Japanese Law for the Protection of Cultural Properties are few in number and have been designated a type of 'natural monument' status. As a result, some scientists have started to assess the need for developing a category encompassing "important natural history properties".

What is the necessity for the rescue of the Rikuzentakata natural history collections? These collections not only serve as historical and ecological records of the region, but they outline progress in academic research. Consequently, a more concrete structure to natural history collection rescue is something we hope to give evidence for, and work on, in the future.

What do we interpret through natural history collections? As already shown, through examination of the geological specimens recovered from the RCM, we notice many Permian brachiopods and Carboniferous corals; these organisms tell us that this region had moved northwards from lower latitudes over a long time.

Even though the alignment of plates in the Quaternary period, the last period of the Cenozoic Era (66.0 million years ago–present), is different from those in the Paleozoic, the oceanic plate still subducts itself under the continental plate at a rate of 8cm a year in the Japan Trench. As circumstances have remained relatively constant since the Quaternary period, the plate movement will keep breeding earthquakes and tsunamis. Catastrophic events such as the 2011 earthquake are common occurrences in the Earth's history.



Natural history collections are often the entry point through which people engage with the Earth, its history and the natural world; by extension, this engagement can also dictate an attitude to disaster prevention. Yet it is somewhat disquieting to note that natural history education in Japan is perhaps not addressing this—for example, it can only benefit the future to teach plate tectonics and related phenomena in all elementary educational programmes in Japan.

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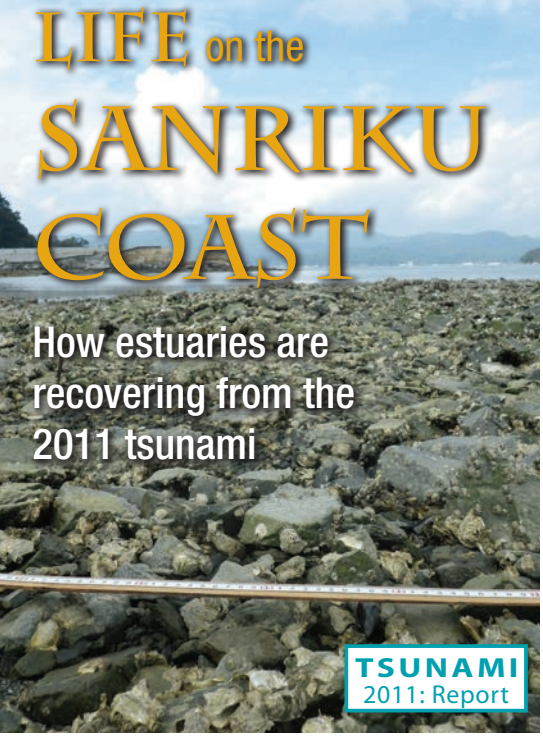
LIFE on the SANRIKU COAST

How estuaries are recovering from the 2011 tsunami



Images © Masatoshi Matsumasa

Estuarine environments sustain the most productive ecosystems; these habitats harbour a variety of unique animals and plants. The environments along the coastline of the 'Sanriku' region in northern Japan were severely damaged by the Tōhoku earthquake and associated tsunami in 2011, as the Sanriku coastline consists of many groups of rias—low, partially-submerged river valley structures that branch out, tree-like, into open sea. Due to this, Sanriku is prone to wave amplification during tsunamis, and life in the estuaries is vulnerable.

A lot of animals and plants had been swept away by the huge waves and/or been buried under mud and sand. Particularly, adult bivalves such as *Mya (Arenomya) arenaria oonogai* and *Laternula (Exolaternula) marilina* (which have difficulty submerging themselves into sand and mud once they've been removed from the sediment), died of exposure (Fig. 1 – *a* and *b*).

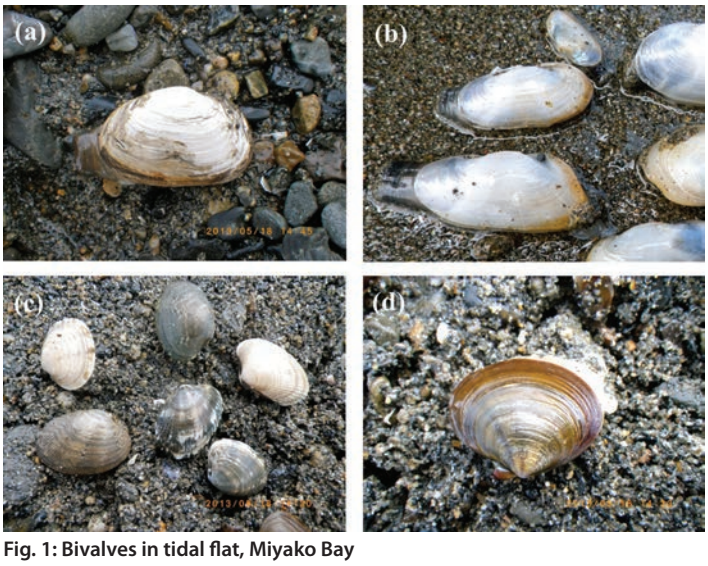


Fig. 1: Bivalves in tidal flat, Miyako Bay

The other bivalves such as the Japanese carpet shell (*Ruditapes philippinarum*) and purple olive clam (*Nuttallia japonica*) may have suffocated under the thick piles of allochthonous sediments (Fig. 1 – *c* and *d*). Almost all of the reed marshes of *Phragmites australis* had also swept away with the associated animals and plants. In addition, the subsidence had made sessile intertidal animals such as the striped barnacle *Amphibalanus amphitrite* and the Pacific oyster *Crassostrea gigas* (Fig. 2 – *a* and *b*) move 0.5-1.0 m downwards, so that the newly bare intertidal hard substrates were conspicuous. Consequently, the normally productive intertidal areas in estuaries had been changed into lifeless worlds.

Fig. 2: Striped barnacles (a) and Pacific oysters (b) found in a newly created tidal area, Otomo-ura

Fortunately, populations of estuarine species are recovering much more quickly than expected. In particular, some highly mobile epifauna (*e.g.* the brachyuran crab *Hemigrapsus penicillatus* and the caridean shrimp *Palaemon serrifer*) had been observed on tidal flats in Miyako Bay and Yamada Bay of Iwate prefecture, three months after the tsunami disaster. This may be as a result of re-colonisation by the adult individuals emerging from places of refuge, since observed individual sizes were more than one year old. Adult mud shrimps, *Upogebia major* and *U. yokoyai*, had also been observed in relative abundance in summer 2011 (approximately five months after the tsunami), probably because they could have escaped the devastation by hiding in their deep burrows (Fig. 3). The recovery of mobile species such as infaunal mussels and clams, and sessile animals such as barnacles and oysters (that have larval stages in their lifecycles), may be dependent on the larval supplies. The movement of larvae from undamaged to damaged areas might be very important, as well as autochthonous reproductions within the damaged area. Settlements of barnacles, a mussel *Mytilus galloprovincialis* and the Pacific oyster on hard substrates had been observed during early summer to autumn in 2011 around their breeding seasons. The recoveries of other bivalves, *M. (Arenomya) arenaria oonogai, L. (Exolaternula) marilina, R. philippinarum* and *N. japonica* were witnessed during the summer of 2012.

Fig. 3: A mud shrimp, *Upogebia major*, captured at Miyako Bay

A gastropod, the marine mud snail *Batillaria cumingi* (=*attramentaria*), does not have any larval stage in its lifecycle and the juveniles hatch with the same morphology as the adults (Fig. 4). We had expected that this reproductive strategy, versus those with a larval stage, would be a disadvantage in a major disturbance, particularly one that drastically altered the coastline's topography and brought with it contagious diseases. Contrary to our expectations, the recovery of this gastropod species has been remarkable, evident just one year after the tsunami. This may be related to the fact that the gastropod has succeeded in expanding its distribution to North America as an exotic species. Clarifying the effects of huge disturbances on the relationships between native versus exotic species is an interesting problem for researchers in biology and ecology.

Fig. 4: Gastropod *Batillaria cumingi*, Miyako Bay—this species does not have any larval stages

The tsunami created some new intertidal areas along the coastline of the Tōhoku region. 'Otomo-ura' of Hirota Bay is one such area in Iwate prefecture. The tidal flat of the Otomo-ura had been reclaimed for farmland only 50 years prior, but has 'returned to the sea' after the tsunami. Colonisations of a variety of animals and plants are succeeding, and a rich ecosystem is developing. Monitoring the changes in structure and function of the ecosystem is invaluable for the wise use of various 'ecosystem services', such as food production and the recreational benefits of these newly created tidal areas. Nature has tested, and continues to test, our wisdom in response to unforeseen events on the evolutionary scale.

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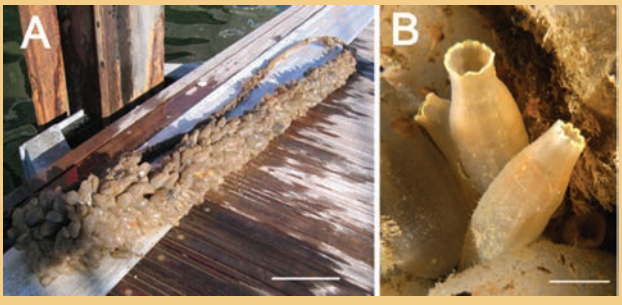
Read more about how the tsunami affected local plant life in our December issue

Article based in part on research supported by the Mitsui & Co., Ltd. Environment Fund (to Prof MM).

The Role of Developmental Buffering in the Ecology and Evolution of the Chordates

Report from the Anne Sleep Award Winner 2011

Studies of cellular and developmental biology have generally been undertaken in rather stable laboratory conditions, but life in nature is subject to an ever changing environment. There is an increasing awareness amongst both the scientific community and the general public of the impact of environmental change and its concomitant effects on organisms. Predicting the impact of such change on organismal adaptation is a central issue that needs to be addressed in the 21st century. For example, susceptibility to thermal stress (thermal tolerance) is a key determinant of species invasiveness, but the molecular basis of organismal thermal tolerance is still largely unknown, and hence prediction of the impact of temperature change is difficult.



a) Sea squirts cover a rope in Plymouth, b) *Ciona intestinalis*

To address this question, I have been studying the sea squirt *Ciona intestinalis* species complex. *Ciona intestinalis* is an invasive marine chordate that is of economic interest because it is a fouling pest that causes financial loss in the shellfish industry. *C. intestinalis* was initially described by Linnaeus in the 18th century using specimens from Naples. It has been extensively studied in various fields of biology, such as ecology, reproductive biology, developmental biology and genomics. However, recent comparative genomics studies have revealed that there are at least two distinctive species (type A and type B) in this species complex. Surprisingly, these types show distinct patterns of global distribution: type A are found in the Pacific Ocean and Mediterranean Sea, whereas type B is limited to the Northern Atlantic; only around the English Channel are both types found together. I hypothesised that type B has adapted better to colder temperatures than type A, explaining the difference in their ecological habitats.

Dr Atsuko Sato

I started working on this question in Plymouth, where these two species are found together, as a Ray Lankester Investigator at the UK's Marine Biological Association, followed by an AXA Research Fellowship at the University of Oxford. During this period, I found that types A and B reacted extremely differently to thermal stress and that the reaction is maternally inherited. I also conducted genome sequencing of type B and as well as a comparison of gene expression (transcriptome analysis) under thermal stress between types A and B using microarray analysis and next generation sequencing at the Okinawa Institute of Science and Technology. This project was thereby developed by both British and Japanese scientists—the Anne Sleep Award funding provides an excellent opportunity to further develop such collaborations.

The funding allowed me to test predictions by transcriptome analysis on the molecular basis of thermal tolerance in multiple replicates using different individuals of *C. intestinalis* around Plymouth. As a result, I found that widely used ecological markers, such as heat shock proteins, do not predict maternal inheritance of thermal tolerance. Instead, we found that endoplasmic reticulum (ER) chaperones, which have been almost neglected in the study of thermal tolerance, do predict maternal inheritance of thermal tolerance. The result opens up a new paradigm of studying ER in the context of thermal tolerance and adaptation to different thermal environments. My next aim is to determine if these results can be generalised to other species, and to understand just how significant this variation might be to ecology and evolution.

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Images courtesy Atsuko Sato

Book Review: The Secret Museum by Molly Oldfield

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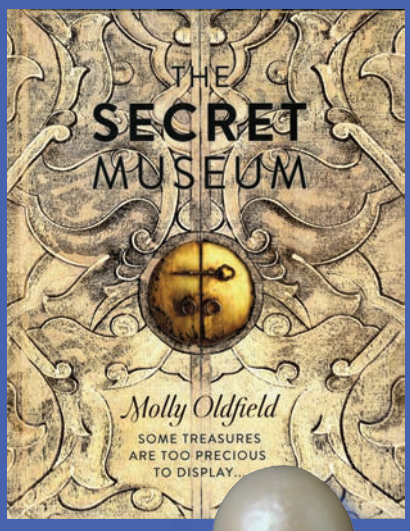
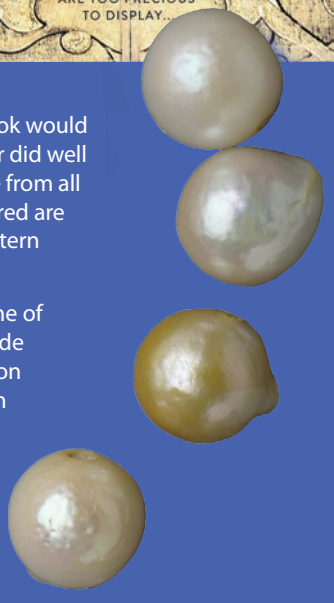


Museums and galleries often house the majority of their collections in storage. In *The Secret Museum*, Molly Oldfield successfully highlights some of the reasons why many of the world's most interesting and precious cultural objects rarely see the light of day.

Selecting 60 objects, Oldfield uses facts and stories to describe her chosen objects and the institutions in which they are stored. The objects cover a large range of periods and cultures and are emotive; finding an appropriate overall tone for this book would have proven difficult but the author did well to find one. While the objects come from all over the world, the museums featured are mainly in the United Kingdom, Western Europe, North America and Brazil.



The Linnaean pearls are listed as one of these 'hidden' objects. Others include The Canadian Museum of Civilization in Ottawa, which holds 'Song 21', an early 20th-century recording of an Inuit song before contact with white culture, highlighting the need to preserve artefacts from a culture that has been irrevocably changed. Also included is Blaschka's glass jellyfish in Harvard University's Museum of Comparative Anatomy—a delicate structure which shows that wonderfully accurate artistic objects can rival, and on occasion even be better than, specimens in jars.

This book is enjoyable, but perhaps the author could have stopped at 50 objects—some felt like after-thoughts. At times anecdotes went slightly off-topic and some extra editing is certainly needed. Additionally, the image captions proved to be distracting, as they were just repeated from the text.

However, the book does touch on the importance of digitisation so these collections can be shared with the world on a virtual level at the very least. Overall, the book manages to deliver the important message that while museums, libraries and galleries have a duty to share their collections with the world, they are also responsible for their protection and preservation, even if that means hiding certain objects away.

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Digitisation Project Officer

Lifelong Learning

Are you looking for places that offer instruction in identifying and classifying organisms? Perhaps you are interested in attaining a specific qualification, or just want to take the family or grandchildren out to a one-day, educational event. You may even be looking for an easy-to-find, central place to send others with queries about studying taxonomy.

The Linnean Society has launched a new page in the Education section of our website, listing identification, taxonomy and systematics course providers in the UK.

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Visit www.linnean.org/lifelonglearning and peruse the providers included. Courses range from those that can lead to a professional qualification to others which are purely for pleasure and interest, including special courses particularly suitable for children and families.

Forthcoming Events 2013

18 Sept **Day Meeting** **11.30–17.00**	The Role of Museums and Collections in Biological Recording *Taxonomy and Systematics Committee Plenary Meeting* **Registration required:** www.linnean.org/events
19 Sept **Evening Meeting** **18.00–19.00**	Crowdsourcing Genomic Analyses of Ash Dieback—Power to the People Speaker: *Prof Sophien Kamoun, The Sainsbury Laboratory* www.linnean.org/ashdieback
17 Oct **Day Meeting** **10.00–17.00**	Fungi: Keystones of Evolution and Earth Processes *British Lichen Society, British Mycological Society and the Linnean Society of London Joint Event* **Registration required:** www.linnean.org/fungi2013
17 Oct **Evening Meeting** **18.00–19.00**	Truffles, Trees and Animals: Life in the Black Box Speaker: *Prof Jim Trappe* (This evening meeting follows a day meeting and is likely to be busy) www.linnean.org/truffles
22 Oct **Evening Meeting** **18.00–19.00**	Alfred Russel Wallace—the Compleat Naturalist Speaker: *Dr Sandra Knapp* **Registration essential:** www.linnean.org/compleatnaturalist
13 Nov **Evening Meeting** **18.00–19.00**	The British Conservation Model: Unambitious, Irrational and Afraid of Nature? A debate between conservationists and rewilders *Systematics Association and the Linnean Society of London Joint Event* **Registration required:** www.linnean.org/bcmdebate

Please check our website for details of other events not listed here
www.linnean.org or email events@linnean.org

All articles welcome! Please submit your articles in electronic format to the Editor at pulseeditor@linnean.org
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