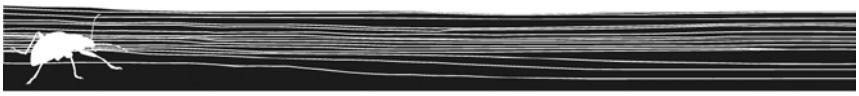
15th September 2016 edition

Quaternary Entomology Dispatch



Editorial

Dear colleagues,

It is with great pleasure that I present the latest edition of QED.

In this edition, our colleagues Allan Ashworth and Phil Buckland provide you with news from their labs in the USA and Sweden, including details about their latest database updates and projects. Over the next few pages, you will be able to learn about fascinating Quaternary Entomology research projects that are currently underway in New Zealand and the British Isles, an interesting exhibition in Japan and the upcoming PAGES-OSM meeting in Spain, in which you may like to participate.

This newsletter could not exist without your participation, so I would like to thank all those of you who sent me their contributions!

To help enliven discussions and expand our community, I encourage you to invite your colleagues and students in Quaternary Entomology that are not yet subscribed to our mailing list to do so. Please also feel free to share QED with them.

Happy reading! :)

Véronique Forbes (email: veroforbes@gmail.com)

Contents

15th September 2016 edition

Quaternary Entomology Dispatch

News from our colleagues

News from the Quaternary Entomology Lab, North Dakota State University, Fargo, USA

From **Allan Ashworth** (email: allan.ashworth@ndsu.edu)

I retired two years ago but the University has provided me a lab and I'm continuing to work on several projects, most of them related to Quaternary studies. Life is not dull, especially since I was elected as president of INQUA last year. Twenty years ago, I became seriously diverted from Quaternary insect studies to work on Miocene fossil assemblages in Antarctica. During the course of six expeditions, we found fossil assemblages containing insects, freshwater molluscs and plants in the McMurdo Dry Valleys and also on the Beardmore Glacier. The stratigraphic settings of the fossil beds, interbedded with glacial deposits, are very similar to those in the Quaternary. Several papers have appeared describing various aspects of the geology and paleoecology. Coming soon, there will be a paper coauthored with Terry Erwin of the Smithsonian Institution in ZooKeys describing the first carabid beetle from Antarctica. The beetle is a trechine with affinities to *Trechisibius* of South America that is being named to honour George Ball's 90th birthday. George has been a long-term supporter of fossil beetle studies and has made major contributions to carabid research through his own efforts and through the training of graduate and postdoctoral students in the Department of Entomology at the University of Alberta, Edmonton.

Several years ago, I teamed up with Eric Grimm, Russ Graham, Steve Jackson and Jack Williams and we initiated an online database subsequently named the **Neotoma Paleoecology Database** <Neotomadb.org> . Records for various fossil groups e.g. insects, pollen, vertebrates, packrat middens, ostracods, diatoms, testate amoebae, etc. are being made available online. The timeframe is Pliocene to modern but that will soon be expanded to include the Miocene. The focus has been on North America but some of the groups e.g. pollen do include data from other parts of the world. My role with the database is as the steward for the fossil insect data.

Work is progressing and currently there are data for 128 sites available (see map on page 3). Metadata for the sites includes site location, literature references, age and stratigraphy. Some of the information is visible through a Data Explorer and other, such as details about chronology, can be downloaded as spreadsheet files. The species lists have been updated to show current taxonomy but older names are preserved in synonomies. Spelling errors, large numbers of them in the literature, have been corrected. One of the real improvements over original data is that all ages are shown as calibrated years BP in addition to their original format. Also, age models are being provided where sufficient data is available. Construction of age models has enabled ages to be assigned to specific samples – that wasn't possible in the initial studies.

The URL for the database is http://www.neotomadb.org. Once in the database, click on the Explorer Map icon and a Google Maps screen will open up. In the Search Box select Advanced Search and from the dropdown menu select insect and then activate search. The fossil insect sites for which data is available will show up on the map.

To access site and fossil data double-click on a location marker and a box will appear containing site information. To see what fossils are available, double-click on the site name next to the small black icon with an I. The taxa described for the site are listed alphabetically and the age of the sample is shown. Other tabs provide information about the site, the chronology and references. The taxa data can be downloaded or emailed as a .csv file by clicking on small icons in the upper right of the screen.

Current research on the database is progressing on numerous fronts. One effort is to improve the display of taxa data. Currently only alphabetical lists are available. Soon it should be possible to convert them to a systematic list which is easier for most of us to use. The Taxon search tool is being improved. Currently, the tool works well for species e.g. *Diacheila polita*. If you want to find out all records of *Diacheila* it is a bit more

klutzy. In the advanced search select insect from the dropdown menu. Do not write *Diacheila* in the Taxa box but doubleclick on the icon with two cog wheels. This will bring up another search box. Select insects in data set type then type in *Diacheila*. This will bring up multiple records and select each and hit the Go button. This should display as Multiple Taxa Selected in the search box and hit the Search button and all records of *Diacheila* should be displayed on the map. There are currently limitations to the searchability of the database that will be improved in the future. For example, an investigator might want all records for a particular family. At this time that is not possible to see in the Explorer but we are working to make that possible in the next few months.

During the next few years, I anticipate that fossil insect data from Australia, Europe, New Zealand, Japan, Russia and South America will be available through Neotomadb. Phil Buckland is a working member of the expanded Neotoma research group and our intent is that European fossil beetle data currently available in **BugsCEP** http://www.bugscep.com will be able to be searched through the Neotoma Explorer and vice versa. We will also be working on uploading modern species distributions to Neotomadb. They will then be able to be linked to modeled global climate web services already available online and MCR-type analyses will be able to be conducted using algorithms already available in ArcGIS.

As the community most likely to be using the database, I have some requests of you. First, would you check to see if the sites that you have worked on and published are online. If you find sites that are not online would you please email me and I will make sure that those sites are uploaded. If you have unpublished data and would like to see it online please email it to me. Second, I would like to think that you would be able to input your own data very soon. This is complicated at the moment because the only way to input data into Neotomadb is by using Tilia software. This is time-consuming and requires learning how to input the data. The strength of the approach is that the data checking within Tilia is excellent and the data that ends up online is in the most up-to-date form that it can be. A web services form is under development and soon it should be possible for data to be inputted from around the world.

If you are interested in working with any of the aspects of the database from providing comments, to inputting data, to writing programs to use the data, to developing teaching modules, please email me.

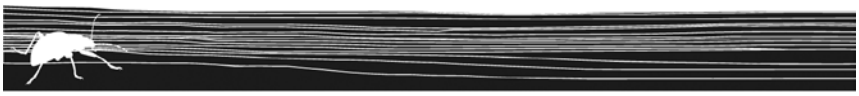
As an example of a simple lab exercise using fossil beetle, mammals and plants for use by high school junior or seniors or by introductory students in ecology or earth science labs please check out: http://serc.carleton.edu/neotoma/activities/121242.html.

News from Umeå, Sweden

From **Phil Buckland** (email: philip.buckland@umu.se)**:**

I am currently working mainly on various database stuff, including:

a. Keeping BugsCEP running despite Microsoft's continued attempts to disable it! For those who have problems, I've found it is best to call me over Skype so that I can talk you through the various tricks to convince Windows that BugsCEP is safe to run.



I've also added (at long last) a climate envelope explorer for sites (see http://bugscep.com/downloads.html). This is experimental and comes with no instructions, so please email me if you have trouble with it.

b. Porting the data from BugsCEP over to SEAD so that it is available online through http://qsead.sead.se

c. A couple of international projects linking the data in SEAD (and thereby BugsCEP) to other databases (palaeoecology, archaeology, historical data, literature studies etc). This includes the newly funded DataArc project (previously http://www.cybernabo.org/) being run from NSIDC in Boulder, Colorado.

We've managed to get a large 5-year grant from the University for the running of our Environmental Archaeology Lab for the next 5 years. This should allow us to support more palaeoentomology, so if any of you are interested in working more closely with us, or just spending some time in lovely Umeå - let me know! :)

I'm also in the process of writing up numerous bits of work using the data in BugsCEP, which should be ready later this term.

Ongoing research projects

Using the pre-settlement insect ecology to test the integrity of a restored ecosystem in the central North Island, New Zealand

By **Maureen Marra** (University of Waikato, email: mmarra@waikato.ac.nz), C. Watts (Landcare Research) & D. Thornborrow (Landcare Research)

This project is a comparison between restored ecosystems and the pre-human ecosystem in New Zealand. It is important because New Zealand's biodiversity was severely compromised (e.g. around 50% of bird species became extinct) with the arrival of people and the introduced mammals, especially rodents that accompanied human settlement. Therefore, managing biodiversity has a high priority focus as part of one of New Zealand's National Science Challenges. The New Zealand Department of Conservation, which is the Government agency charged with conserving biological heritage, monitors biodiversity through **ecological integrity** - a concept that is assessed through;

a) Indigenous dominance – the level of indigenous influence on the composition, structure, biomass, trophic and competitive interactions, mutualisms and nutrient cycling in a community;

b) Species occupancy – the extent to which any species capable of living in a particular ecosystem is actually present at a relevant spatial scale; and

c) Representation – the distribution of indigenous biota across a gradient of abiotic variables (Lee et al., 2005).

However, it raises an important and timely question: *How can ecological integrity be assessed when the only ecological evidence we have to go is compromised by several hundreds of years of human disturbance and mammal predation impacts?*

In addition, it is not known if conservation areas are robust enough to withstand further pressures, such as adjusting to a warmer climate. The main problem in assessments of restoration outcomes, biodiversity or ecological integrity is that because ecological data, at best, extend back just a few decades, the baseline data are records of disrupted, threatened and/or declining ecologies. Although these data provide the basis for improving or worsening conditions, a question remains about the ability of human impacted ecosystems to survive over time under different climatic conditions.

To address this question, our research compares a pre-human fossil ecosystem with a restored ecosystem, for which there are 10 years of monitoring data. We use an ecosystem functions-based model to make the comparison between the fossil ecosystem and the restored modern ecosystem. For the comparison we also include variables such as extant/extinct, size, habitat, dispersal capability and host specificity.

Both the restored and fossil sites are located in central North Island; both are around 500 m.a.s.l. and are podocarp (southern Conifer) forest environment although there is a difference in the dominant forest tree species. The fossil site is a well-known buried forest at Pureora which was buried as a result of the massive Taupo eruption that occurred AD 232+/- 10 (Hogg et al, 2012). The plant paleoecology was first investigated in the 1980's when the area was cleared and drained for farming and forestry. Fossil insects were extracted and identified by Green (1987) at the time but were never published. In our study we extended the study to include two additional sites; one within the Pureora Forest and the other c. 10 km east of Pureora – which we combine with the Green (1987) data. Thus we have a total of c. 350 fossil taxa that we will use to make the comparison with the restored ecosystem for which there are c. 250 taxa. The fossil assemblage was dominated by forest species. One of the notable fossils was the giant weevil *Anagotus* (Fig. 1). It is now extinct in lowland New Zealand, probably a result of introduced mammal predators (Green 1987; Watt 1982). This species survived the Taupo eruption because it is known from more recent fossils from central North Island, dated around 1,680 +/- 50 years BP (Worthy, 1984). According to Green (1987), the fossil *Anagotus* from Pureora appears to be closely related to a species of *Anagotus* that is confined to the Poor Knights Islands where it inhabits the bases *Cyperus* sedges (Worthy, 1984).

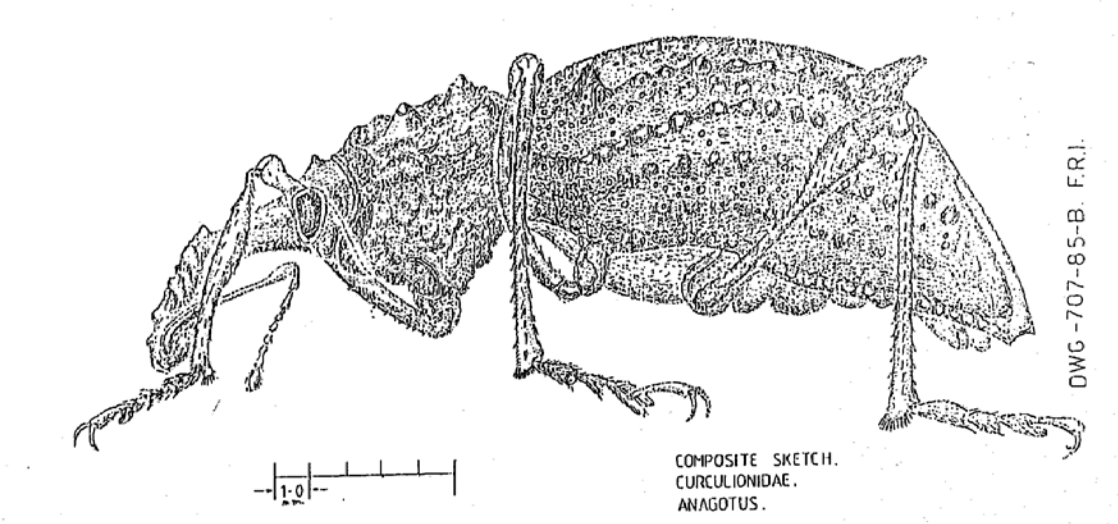
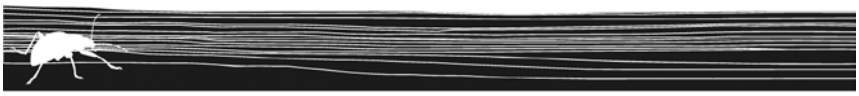


Figure 1. *Anagotus* sp. 1 (Curculionidae: Aterpinae) found at Pureora Buried Forest. Image copied from Green (1987).



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Kuschel, G. (1982) Apionidae and Curculionidae (Coleoptera) from the Poor Knights Islands, New Zealand. *Journal of the Royal Society of New Zealand* 13 (3): 273-282.

Watt, J. (1982) Terrestrial arthropods of the Poor Knights Islands, New Zealand. *Journal of the Royal Society of New Zealand* 12: 283-320.

Worthy, T.H. (1984) The Faunal and floral remains from F1, a cave near Waitomo. *Journal of the Royal society of New Zealand* 14 (4): 367-377.

CELTIC CONNECTIONS AND CRANNOGS: Exploring the connections between our ancestors

By **Kim Davies** (Plymouth University, email: kimberley.davies@plymouth.ac.uk) and **Nicki Whitehouse (**Plymouth University)

The AHRC funded project: 'Celtic Connections and Crannogs' is a new cross-disciplinary research project and includes a large palaeoentomological component. This component is being led by Dr Nicki Whitehouse (CO-I) at Plymouth University with Dr Kim Davies as PDRA. The work is in collaboration with researchers at the University of Southampton (Professor Tony Brown, Professor Pete Langdon and Dr Maarten van Hardenbroek), Newcastle (Dr Andrew Henderson and Dr Helen Mackay) and Queens Belfast (Dr Finbar McCormick and Dr Emily Murray)

Crannogs are island dwellings that were typically located in lakes and mires and have a distribution centred around the Northern Irish Sea, having mostly a 'Celtic' distribution across the north of Ireland and Scotland. There are around 1500 known sites in Ireland and 400 in Scotland (but only one in Wales and none in England). Many were constructed during the Iron Age, ca. 2500 years ago and used up until the Medieval Period, but some examples are even earlier. We still know relatively little concerning their role in society – were they long-lived or restricted to a short period of use, permanent (year-round) settlements, seasonally occupied or 'boltholes'? Were they functional (storage, craft manufacture) and/or ritual sites or did they have a defensive/protective function for the elite? The recovery of several high status Christian artefacts has also raised questions around the role of crannogs in the spread of Christianity through the Celtic world in a region in almost (but not total) isolation from Roman Britain.

To answer these questions and explore the cultural significance of these Celtic communities, we need to understand the chronology, longevity, intensity of use, form, function, material culture and environmental context of these sites. This project aims to derive this information from the crannogs themselves through archaeological excavation but also, where excavation isn't possible, by tracing the signal of the crannogs in the surrounding lake sediments through palaeoenvironmental proxies. These include more traditional proxies

such as pollen, diatom, Coleoptera and chironomids, which can highlight the local and regional environmental conditions prior to disturbance, across the period of crannog construction, and during its use and abandonment. More novel proxies, including lipid biomarkers of faecal matter, will be employed to highlight intensity of habitation and usage, whilst aDNA metabarcoding will highlight the domesticated animal and plant species being exploited.

Sediment cores have been retrieved from alongside crannogs and the centre of lakes at a series of sites across Northern Ireland and SW Scotland. Analyses have focused on two sites so far; Lough Yoan (county Fermanagh, Ireland, Fig. 1) and Black Loch of Myrton (SW Scotland, Fig. 2).

Figure 1. The remains of the crannog at Lough Yoan (Photo: H. Mackay)

Figure 2. The excavation at Black Loch of Myrton (Photo: G. Cavers)

At Plymouth University, the team is focused on the palaeoentomological proxies that have been collected from both excavation and within lake sediments. This includes Coleoptera, Diptera and ectoparasite remains, which have been collected on-site at the Black loch of Myrton; these are providing insights into crannog function (human/animal waste and activities, living conditions). Large numbers of flies and ectoparasites within Iron Age house structures indicate the presence of domesticated animals within buildings or in close proximity of buildings, whilst Coleoptera suggest less than clean living conditions on-site.

Additionally, chironomids have been analysed from the lake sediments located close to the crannogs in Lough Yoan. Increases in taxa such as *Chironomus spp.*, *Glyptotendipes pallens*-type and *Polypedilum spp.* over the period of crannog use highlight an increase in nutrients to the lake system. This may have led to a more eutrophic/productive lake system as suggested by macrophyte-associated taxa such as *Dicrotendipes* spp., *Endochironomus* spp. and *Phaenopsectra spp.*

Further entomological work will continue on the excavation material from the Black loch of Myrton to add to the picture of conditions within this important wetland site with additional chironomid and Coleoptera work to be completed on the sediment cores from the remaining sites.

Announcements

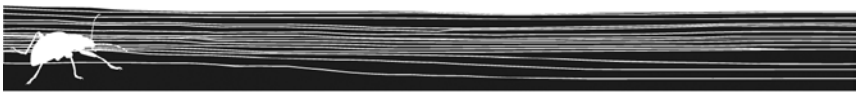
Special Exhibition 'Ice Age' - Climatic History and Fossil Records in Japan

The 47th Special Exhibition at the Osaka Museum of Natural History, "Ice Age", is open to visitors until 16th October 2016. **Shigehiko Shiyake** (Osaka Museum of Natural History, email: shiyake@mus-nh.city.osaka.jp) participated in the creation of this exhibition by introducing fossil insects and extant relics on the alpine zone.

The guide book is available on this website: http://omnh-shop.ocnk.net/product/1576

Fossil pronotum of *Elaphrus lapponicus* dating from the Last Glacial Period. The species appears to have become locally extinct as it is not found in present-day Japan.

Coccinella hasegawai, an alpine species of Coccinellidae from Japan.



PAGES Past Global Changes - 5th Open Science Meeting in Zaragoza, Spain, 9th-13th May 2017

Below are a few sessions that may be of interest for Quaternary Entomologists. The abstract submission deadline for OSM is **20 December 2016**. Details of the meeting can be found here: http://www.pages-osm.org. For more information, please contact **Nicki Whitehouse** at nicola.whitehouse@plymouth.ac.uk

19. Do species move, adapt or die? Exploring past biodiversity, ecological change and community dynamics in the fossil record

*Co-conveners: Nicki Whitehouse (*nicola.whitehouse@plymouth.ac.uk*), Helen Roe (*h.roe@qub.qc.uk*), Donatella Magri (*donatella.magri@uniroma1.it*), Althea Davies (*ald7@st-andrews.ac.uk*) and M. Jane Bunting (*m.j.bunting@hull.ac.uk*)*

The remains of many species are well-preserved in Quaternary palaeoecological deposits and offer the opportunity to explore the formation, development and dynamics of biological communities over long temporal periods and address a range of key ecological and conservation questions. These include issues such as how species and communities differ in their responses to changing environmental conditions and whether these differ over time-scales. Do species primarily move, adapt or die? Are responses essentially the same over time or is there evidence for adaptation or niche evolution? What can the fossil record tell us about the vulnerability of particular communities and species – are some more vulnerable to extinction or declining populations compared with others?

For some groups, taxonomic issues also present significant challenges to understanding long-term community changes, although for others, new approaches to taxonomy, analytical advances (e.g. aDNA analysis) and novel modelling methods offer the potential to enhance and indeed revolutionize ecological interpretations and our understanding of species responses to future climate change. We solicit papers that address these themes, dealing with all types of biological proxy records from paleoecological and paleolimnological contexts, using standard paleoecological methods, species distribution models, novel modeling methods, aDNA approaches and phylogeography. We particularly encourage papers that seek to explore species and community spatio-temporal dynamics and interactions, spread, extinction and niche evolution, over the different time-scales that apply to Quaternary studies.

29. Palaeoecological perspectives on the role of animals in community dynamics and trophic interactions

*Co-conveners: Althea Davies (*ald7@st-andrews.ac.uk*), Nicki Whitehouse (*nicola.whitehouse@plymouth.ac.uk*) and M. Jane Bunting (*m.j.bunting@hull.ac.uk*)*

Ecosystems are complex, multi-layered and highly interconnected. Changes at higher trophic levels have cascading effects on community composition, vegetation structure and ecosystem function, which put them centre-stage in ecological and societal debates on rewilding and ecosystem services. Research on the mechanisms and ecological consequences of changes at higher trophic levels, particularly changes in animal populations, is dominated by shorter-term ecological data, which may overlook slow or cumulative impacts of trophic shifts on ecosystem variability and function. Conversely, most long-term efforts via paleoecology focus on lower trophic levels, especially on autotrophs (plants, via pollen and diatoms). Higher trophic levels

often enter the picture at a relatively late stage as explanatory mechanisms for disturbances, through comparison with cultural and faunal data from archaeological sites and cave systems, or via insect records used to understand past climate. The growing literature on the consequences of megafaunal extinctions and shifting baselines in marine systems shows the potential for a more integrated approach to the study of trophic systems over longer timescales, and provides an opportunity for paleoecology to enrich interdisciplinary and applied debates on the significance of animals in ecosystem function.

In this session, we propose to bring together a diverse range of scientists studying the paleoecological expression of short and long term ecosystem shifts and interactions between trophic levels, with the aims of:

- showcasing the wide range of methodologies for reconstructing the presence and abundance of vertebrates in the past, especially those from higher trophic levels, and linking these records with more familiar vegetation distribution and climate reconstruction studies;

- developing a stronger evidence-base on the role of animals in community dynamics, ecosystem function and trophic interactions over long timescales, to better inform critical scientific, political and public debates on issues such as rewilding; and

- stimulating discussion of future research directions and collaborations on trophic interactions over long timescales.

We invite speakers working on this theme from single and multi-proxy paleoecological perspectives, using fossil, experimental and modelling approaches, to submit abstracts.

Recent publications

Böcher, J., Kristensen, N.P., Pape, T. & Vilhelmsen, L. (eds.) (2015) *The Greenland Entomofauna, An Identification Manual of Insects, Spiders and Their Allies.* Fauna Entomologica Scandinavica Vol. 44. Brill Leiden/Boston. 881 pp.

Breitling, R. & Buckland, P. I. (2015). Epigean spiders at Abisko Scientific Research Station in Swedish Lapland (Arachnida: Araneae). *Arachnology* 16 (8): 287-293.

Buckland, P.C., Buckland, P.I. & Panagiotakopulu, E. (2016). Caught in a trap: Landscape and climate implications of the insect fauna from a Roman well in Sherwood Forest. *Archaeological and Anthropological Sciences*.

(PRESENTATION ABSTRACT) Buckland, P.I. & Lemdahl, G. (2015). Explaining Late Quaternary beetle extinctions in the UK using palaeoenvironmental databases for quantitative environmental reconstruction. Paper presented at The XIX INQUA Congress: Quaternary Perspectives on Climate Change, Natural Hazards and Civilization, Nagoya, Japan, 26 Jul - 2 Aug, 2015.

Forbes, V., Dugmore, A.J & Ólafsson, E. (2016) The life and death of barn beetles: faunas from manure and stored hay inside farm buildings in northern Iceland. *Ecological Entomology* 41: 480-499

Huchet, J.-B. (2013) Des insectes dans la tombe 40 – archéoentomologie d'une urne funéraire. In: W.V. Andringa, H. Duday, S. Lepetz, et al. : *Mourir à Pompéi – Fouille d'un quartier funéraire de la nécropole romaine*

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Huchet, J.-B. (2013). L'archéo-entomologie : les insectes nécrophages associés aux soldats de Carspach. In: B. Schnitzler & M. Landolt : *A l'est du nouveau ! Archéologie de la Grande Guerre en Alsace et en Lorraine,* pp. 109-110. Musée de Strasbourg, collection Archéologie.

Huchet, J.-B. (2014) L'archéoentomologie funéraire. (chap. 15). In D. Charabidze & M. Gosselin (eds): *Insectes, cadavres et scènes de crime, Principes et applications de l'entomologie médico-légale*, pp. 201-224. Editions De Boeck, Louvain-la-Neuve, 280 pp.

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Muschitiello, F., Pausata, F.S.R., Watson, J.E., Smittenberg, R.H., Abubakr, A.M.S., Brooks, S.J., Whitehouse, N.J., Karlatou-Charalampopoulou, A. & Wohlfarth, B. (2015) Fennoscandian freshwater control on Greenland hydroclimate shifts at the onset of the Younger Dryas. *Nature Communications* 6. DOI:10.1038/ncomms9939.

Otranto, D., Huchet, J.-B., Giannelli, A., Callou, C., Dantas-Torres, F. (2014) The enigma of the dog mummy from Ancient Egypt and the origin of '*Rhipicephalus sanguineus*'. *Parasites and Vectors* 7 (2): 1-6.

Pradat, B. & Huchet, J.-B. (2016). Découverte exceptionnelle d'un stockage de moutarde (Brassica nigra) à Poitiers « les Cordeliers » (Vienne) (with the collaboration of A.-M. Jouquand & A. Wittmann). *Aquitania* 31: 337-360.

Strawhacker, C., Buckland, P.I., Palsson, G., Fridrikkson, A., Lethbridge, E., Brin, A., . . . Dawson, T. (2015). Building Cyberinfrastructure from the Ground Up for the North Atlantic Biocultural Organization: Introducing the cyberNABO Project. In: G. Guidi, R. Scopigno, J.C. Torres, H. Graf *et al.* (eds.), *Proceedings of the 2015 Digital Heritage International Congress: Paper presented at 2015 Digital Heritage International Congress, 28 September – 2 October, Granada, Spain,* pp. 457-460. IEEE Press 2.

Vickers, K. & Buckland, P.I. (2015) Predicting island beetle faunas by their climate ranges: the tabula rasa/refugia theory in the North Atlantic. *Journal of Biogeography* 42 (11): 2031-2048.

Wohlfarth, B., Muschitiello, F., Greenwood, S., Andersson, A., Kylander, M., Smittenberg, R., Steinthorsdottir, M., Watson, J. & Whitehouse, N. (2016, in press) Hässeldala – a key site for Last Termination climate events in northern Europe. *Boreas.*

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Quaternary Entomology Dispatch

About the Quaternary Entomology mailing list

Back in 2011, myself and Scott Elias set up a mailing list to facilitate communication amongst researchers in Quaternary Entomology. The list allows subscribers, including experienced workers in the field but also students, to exchange news and ideas and to query their colleagues about any questions, problems or requests they may have. Our mailing list is hosted by Jiscmail, a national academic service based in the UK.

The mailing list is used to distribute new editions of the Quaternary Entomology Dispatch. **The next edition of QED is scheduled for March 2017,** and a call for contribution will be sent to the mailing list during the previous month.

To subscribe to the mailing list, please visit:
https://www.jiscmail.ac.uk/cgi-bin/webadmin?A0=QUATERNARYENTOMOLOGY