Poster ID: **128**
(Foyer: sessions 4 & 5; Thursday pm)

CENOMANIAN LARGER BENTHIC FORAMINIFERA AND THEIR BIOSTRATIGRAPHIC UTILITY

Mike Simmons[1], Mike Bidgood[2], Lorenzo Consorti[3] & Felix Schlagintweit[4]

1 - Halliburton, 97 Milton Park, Abingdon, OX14 4RW, UK mike.simmons@halliburton.com and The Natural History Museum, Cromwell Road, South Kensington, London, SW7 5BD, UK 2 - GSS Geoscience Ltd., Oldmeldrum, Aberdeenshire, AB51 0GA, UK mike@gssgeoscience.co.uk 3 - Istituto di Scienze Marine (CNR-ISMAR), Area Science Park, Q2 Building, Basovizza, Trieste, Italy lorenzo.consorti.es@gmail.com; lorenzo.consorti@cnr.it 4 - Lerchenauerstr. 167, 80935 Munich, Germany felix.schlagintweit@gmx.de

SUMMARY

Despite forming a distinctive, diverse and often abundant element of the preserved fossil assemblages of mid-Cretaceous Neotethyan and central American carbonate platforms, there is no generally accepted and well-defined bioevent/biozonation scheme for larger benthic foraminifera (LBF), which limits their utility as biostratigraphic tools. To achieve this requires, in turn, a review of the identity of the taxa involved and a critical review of published reports of their stratigraphic ranges.

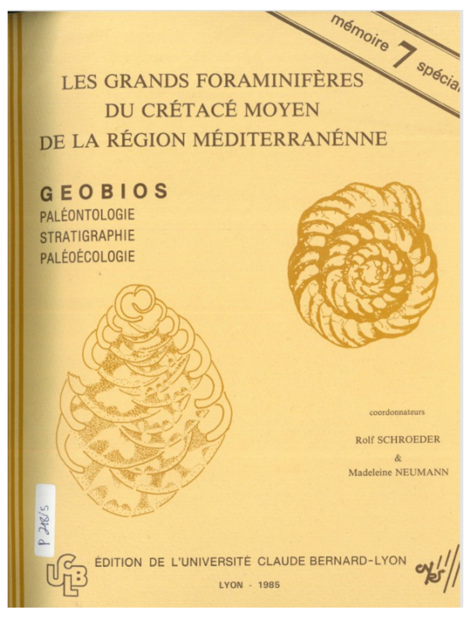
We have reviewed, and are reviewing, the published occurrences of over 150 taxa to establish their stratigraphic ranges. Once misidentifications are discounted, it is apparent that the inceptions and extinctions of some taxa (e.g., the alveolinids) provides a useful basis for recognising Cenomanian substages and occasionally events at higher resolution. Endemic forms and facies control on stratigraphic distribution means that the choice and timing of some key bioevents differs between regions within the Neotethyan – central American realm.

Intriguingly, some taxa are truly long-ranging and survive the end-Cenomanian extinction event, sometimes reappearing after an apparent absence of several million years. The reasons for this remain unknown but may include survival in refugia or homeomorphy of forms well-adapted to specific environmental niches. In summary, we present a draft biozonation for Cenomanian LBF, calibrated where possible to other fossil groups and the carbon isotope chronostratigraphic proxy, thereby increasing the biostratigraphic utility of this important fossil group.

RATIONALE

Forty years ago, in collaboration with many international experts, Rolf Schroeder (Frankfurt) and Madeleine Neumann (Paris) co-ordinated a Herculean effort to document and collate the records and distribution (in time and space) of what we call “larger benthic foraminifera” (LBF) from the mid Cretaceous period. They identified 56 taxa (species) from the Albian, Cenomanian and Turonian stages. Their work focussed in and around the Mediterranean region, from where the vast majority of their source material came. Despite this monumental work, Schroeder & Neumann (1985) did not use their range data to construct a *biozonation scheme* based on LBF. Quite correctly, they suggested that the high level of facies dependence displayed by many LBF would not easily translate into chronostratigraphically-calibrated biozones, correlatable over large distances. Additionally many sections where LBF are common, lack deeper-water fossils that afford better long-distance correlation and, more importantly, age-calibration.

Moreover, they also recognised that, for many LBF subgroups (e.g. at genus & family level) there was still insufficient knowledge of the precise taxonomic *identity* of the species therein. In other words, how can index fossils be recognised correctly if we cannot agree on how they *should* be recognised? (continued right)...



The milestone 1985 publication by Schroeder & Neumann which collated known occurrence data of mid-Cretaceous LBF and provided useful identity information on many of the taxa then known. Several taxonomic groups were not included because not enough was known about them - particularly their identity criteria.

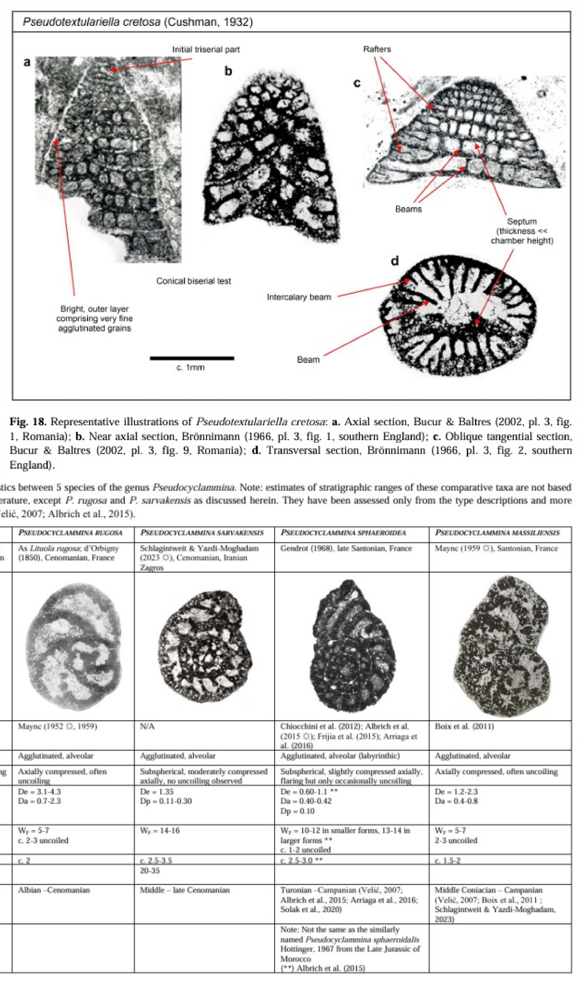
WORKFLOW

Literature search identifying, obtaining and cataloguing new (and old) sources

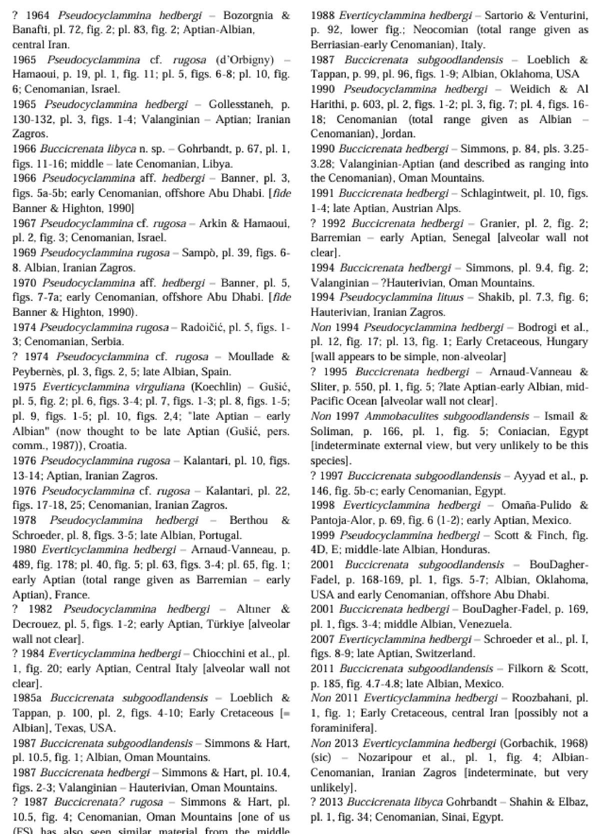
Assessment and grading of identity.
Is the specimen the species it is supposed to be?
If not, what *should* it labelled as?

Assessment and grading of age-calibration.
Is the age attributed to the specimen/locality reasonable?
Is the age corroborated by other fossil groups?
Is there independent calibration such as isotope data?

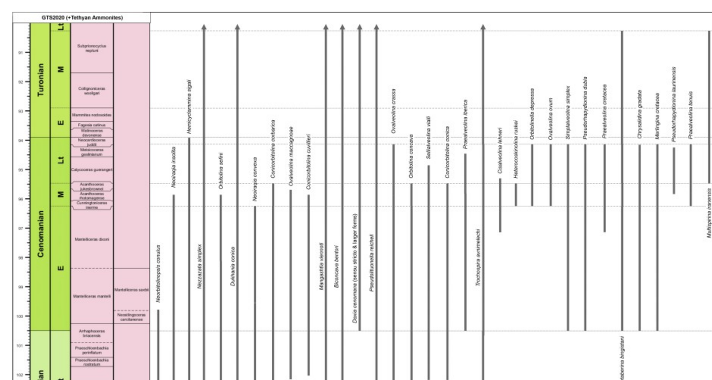
ESTABLISH CONCISE IDENTITY CRITERIA



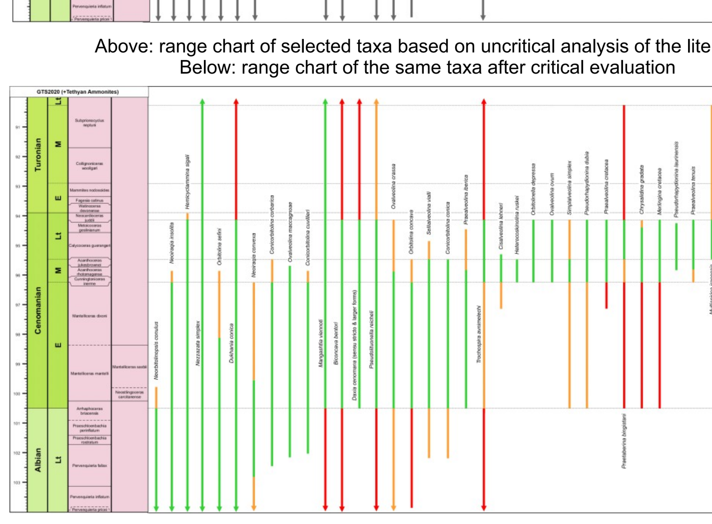
BUILD SYNONYMY/CHRESONYMY LISTS

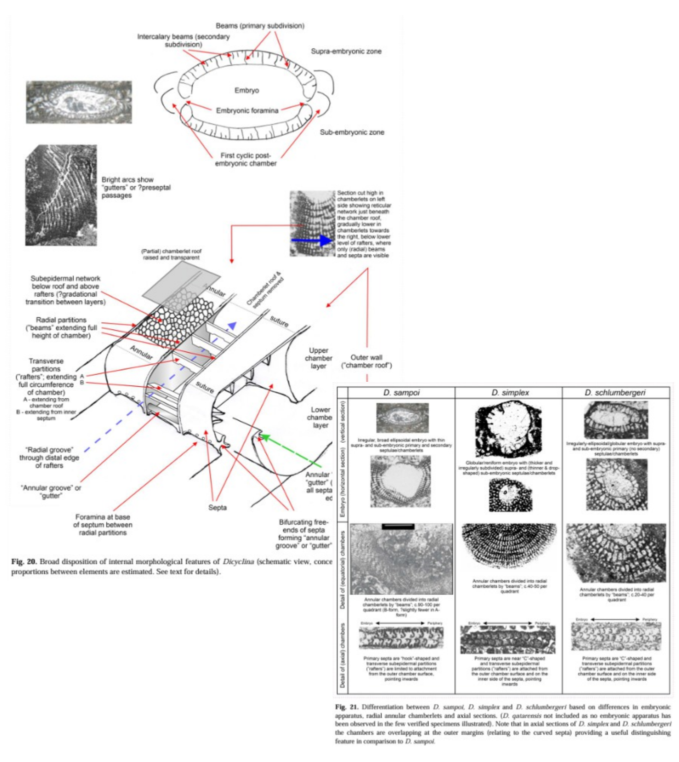


EVALUATE DISTRIBUTION DATA BASED ON ASSESSED CONFIDENCE



Above: range chart of selected taxa based on uncritical analysis of the literature
Below: range chart of the same taxa after critical evaluation

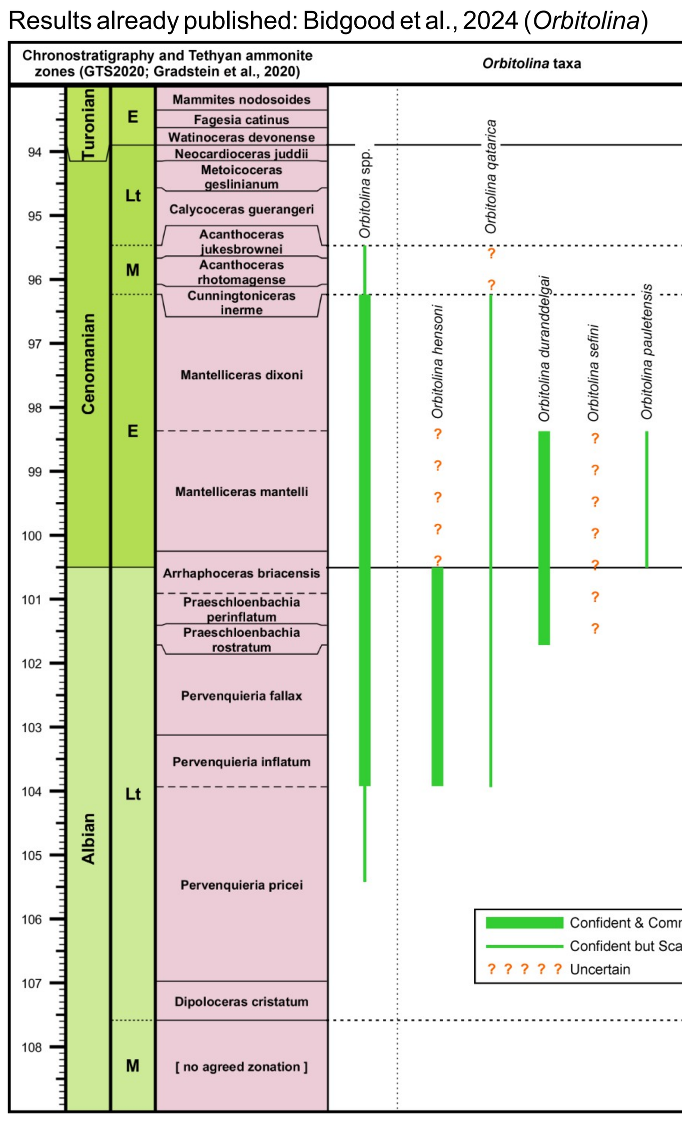




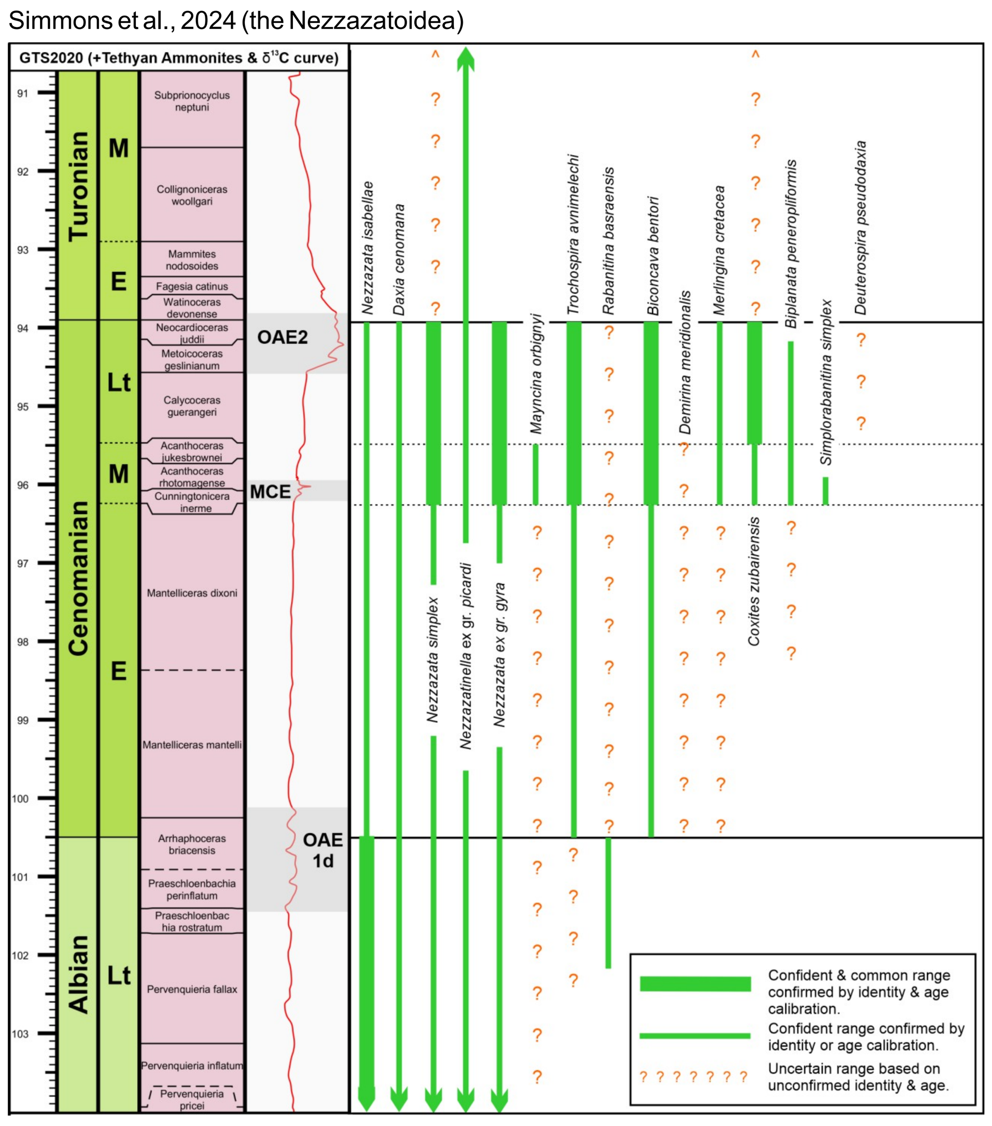
Guide to the identification of key features in *Dicyclina* (a genus not treated by Schroeder & Neumann, 1985), by Simmons et al. (2025).

PRODUCTION OF CALIBRATED RANGE CHARTS AND ASSESSMENTS OF CONFIDENCE

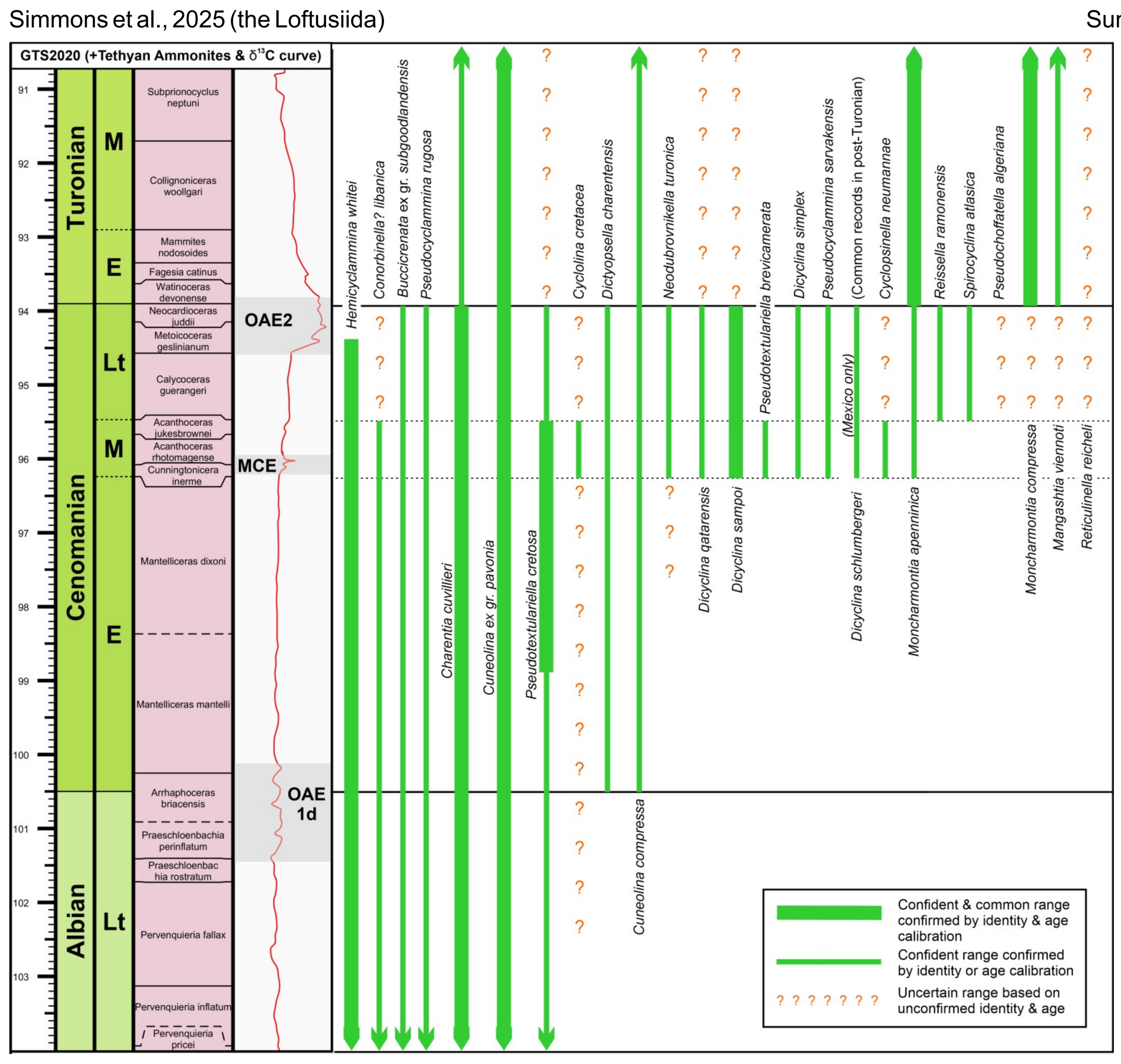
Results already published: Bidgood et al., 2024 (*Orbitolina*)



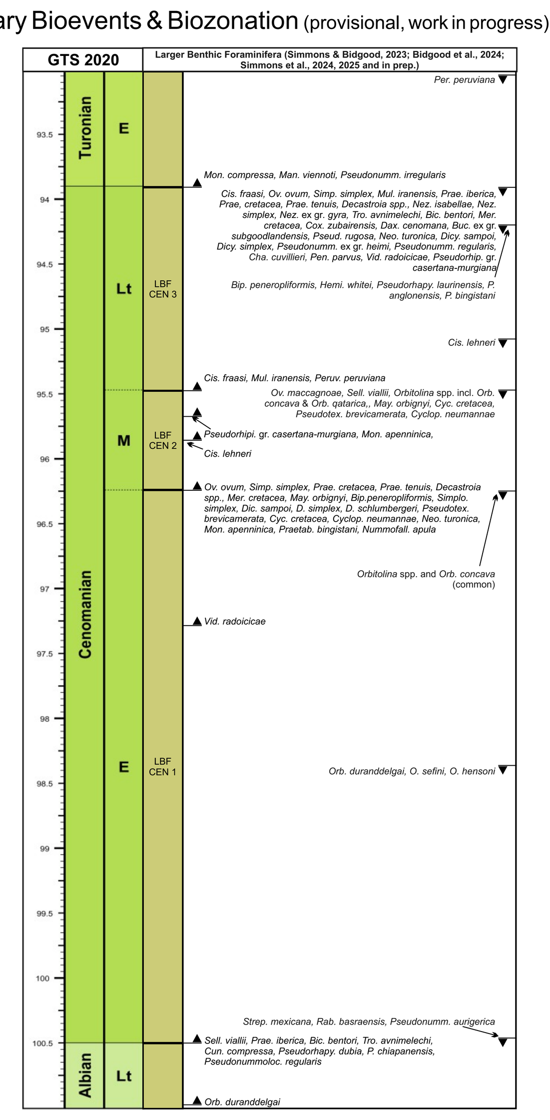
Simmons et al., 2024 (the Nezzazatoidea)



Simmons et al., 2025 (the Loftusiida)



Summary Bioevents & Biozonation (provisional, work in progress)



RATIONALE (...ctd.)

In the four decades since Schroeder & Neumann’s work, the amount of additional, available literature has more than trebled and records have extended virtually across the globe to include the Americo-Caribbean region, the broader Middle East region, East Africa, the Subcontinent and the Far East. Many new species have been described, both from these “new” areas and from in and around the “classic” Mediterranean. This big increase in data (1,000+ references) has, however, come with a price. Many records of LBF from rock sections in many places are based on poorly identified specimens and/or poorly age-calibrated section intervals. In an early canvass of new data, we estimated as many as a half of all data points in the recent literature were based on material whose identity (if specimens were actually illustrated at all) was questionable at best. In parallel, we also found that many age labels attributed to sections and their LBF specimens, were uncorroborated by actual independent evidence, or was the result of circular reasoning. Such “loose” treatment of identity and age-calibration results in LBF ranges which can be considerably extended from the species’ true range. Such information dilutes the effectiveness of any fossil as a biostratigraphic indicator and has repercussions for other studies based on the same, erroneous data, such as paleoenvironmental reconstructions and evolutionary history.

Our work has involved a thorough review of the literature in a workflow (left) which will eventually result in the treatment of six major Cenomanian LBF subgroups which, in total, amount to more than 150 species. The results for two subgroups have already been published, building on general work by Simmons & Bidgood (2023); on the Nezzazatoidea (Simmons et al., 2024) and the Loftusiida (Simmons et al., 2025) and a third, smaller paper has concentrated on the genus *Orbitolina* sensu stricto (Bidgood et al., 2024). Current work is focussed on the Alveolinoid Superfamily and the Orbitolinid Suborder (to be published hopefully later this year) with work on the final groups - the Soritoid Superfamily and ‘Miscellaneous’ Taxa - to begin later this year. A seventh part will produce a synthesis of the work into a biozonation scheme for Cenomanian LBF, with further discussions on paleobiogeography of the whole group and observations on evolution and extinction patters and mechanisms.

Anecdotally, informal experiments with publically-available literature and AI/LLM to try and establish consistent identity and confident biostratigraphy for individual species has provided answers which are too ‘vague’ to be of any real value other than just a relatively simple approximate ‘guide’ and certainly not at the level of detail required to establish accurate biostratigraphic interpretations. This is partly due to inconsistencies/errors in the published data, and deficiencies in the AI/LLM programs themselves. Our approach has been distinctly ‘old school’ - relying on assessments by subject-matter experts (SMEs) based on knowledge and experience.

ACKNOWLEDGEMENTS

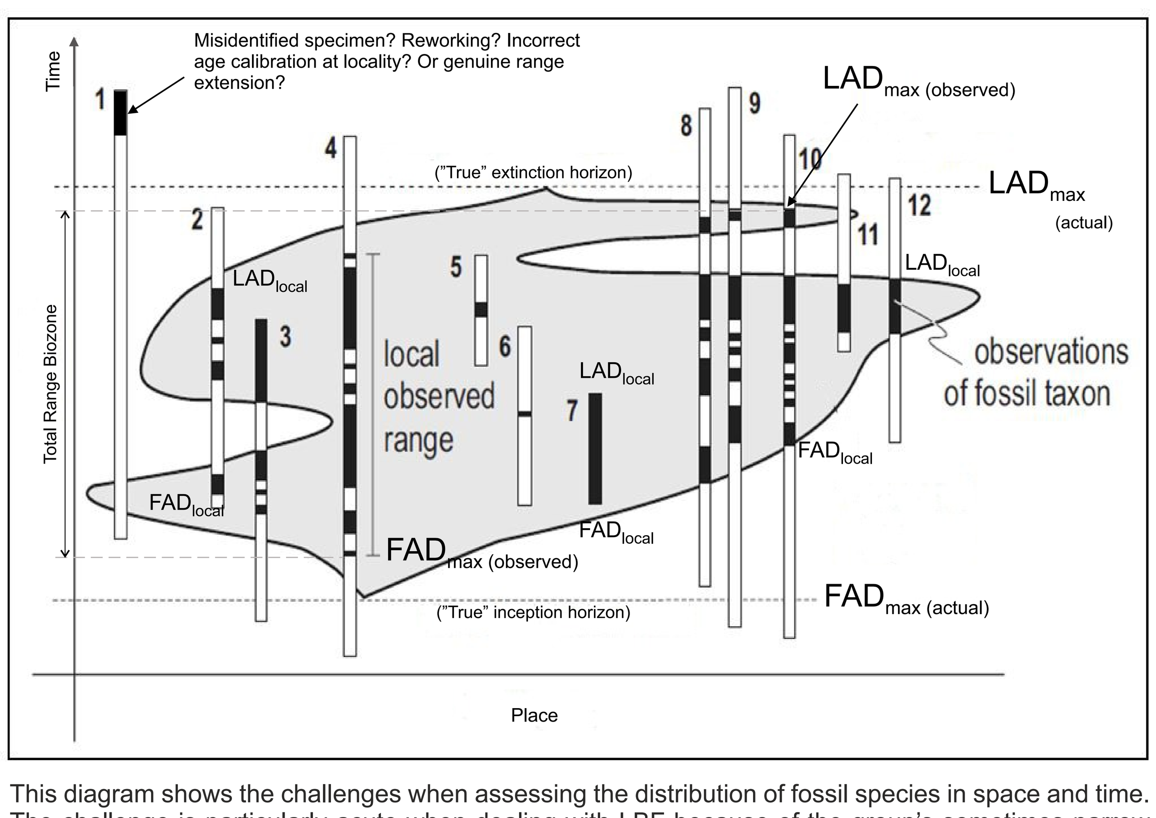
We are very grateful to our friend and colleague **Prof. Johannes Pignatti** (University of Rome: “La Sapienza”) whose - in addition to his own multi-facetted academic talents - remarkable reference collection and ability to locate the most obscure articles from obscure journals is second to none and has rescued us on numerous occasions when we “...*just have to check that reference from the Mining Journal of Northern Armenia 1904... who’s got a copy*?". We are grateful to the editors (**George Pleş** & **Iuliana Lazar**) and their team at *Acta Palaeontologica Romaniae* who have published our output, and to the various reviewers therein who have added much value to our work.

REFERENCES

References used in our study are far too numerous to list here. Nearly 1,200 references have been used (so far) herein to evaluate the range and distribution of Cenomanian LBF (see bibliographies in, for example, Bidgood et al., 2024 and Simmons et al., 2024, 2025).

- Bidgood, M.D., Schlagintweit, F., & Simmons, M.D. 2024. The genus *Orbitolina* d'Orbigny, 1850 (Larger Benthic Foraminifera) and its constituent species: notes on identity and stratigraphic ranges. Acta Palaeontologica Romaniae, 20 (2), 33-59.
- Gale, A.S., Mutterlose, J., Batenburg, S., Gradstein, F.M., Agterberg, F.P., Ogg, J.G. & Petrizzo, M.R. 2020. The Cretaceous Period. In: Gradstein, F.M., Ogg, J.G., Schmitz, M.D. & Ogg, G.M. (eds). Geologic Time Scale 2020. Elsevier, 1023-1086.
- Schroeder, R. & Neumann, M. (co-ordinators), 1985. Les grands Foraminifères du Crétacé moyen de la région Méditerranéenne. Géobios, Mémoire Spécial, 7: 1-161.
- Simmons, M.D. & Bidgood, M.D., 2023. “Larger” Benthic Foraminifera of the Cenomanian. A Review of the Identity and the Stratigraphic and Palaeogeographic Distribution of Non-Fusiform Planispiral (or Near-Planispiral) Forms. Acta Palaeontologica Romaniae, 19 (2), 39-169.
- Simmons, M.D., Bidgood, M.D., Consorti, L. & Schlagintweit, F., 2024. Review of the identity and biostratigraphy of Cenomanian "Larger" Benthic Foraminifera: Part 1 - the Nezzazatoidea. Acta Palaeontologica Romaniae, 21 (1): 5-57.
- Simmons, M.D., Bidgood, M.D., Consorti, L. & Schlagintweit, F., 2025. Review of the identity and biostratigraphy of Cenomanian "Larger" Benthic Foraminifera: Part 2 - the Loftusiida. Acta Palaeontologica Romaniae, 21 (1): 103-192.

Scan here to go to our Cenomanian Projects website where papers written by us on Cenomanian LBF can be downloaded.



This diagram shows the challenges when assessing the distribution of fossil species in space and time. The challenge is particularly acute when dealing with LBF because of the group’s sometimes narrow restriction to a discrete environmental biofacies. Cross-calibration provided by other fossil types which are facies-independent (e.g., planktonic forams, nannofossils, ammonites) is difficult as the two groups are seldom found together in the same rocks. (Diagram after Pearson (1998) and Sadler (2010) with modifications).