BIOL381

Evolutionary Palaeontology

S2 Day 2014

Dept of Biological Sciences

Contents

General Information

Unit convenor and teaching staff
Unit Convenor
John Alroy
john.alroy@mq.edu.au
Contact via john.alroy@mq.edu.au

Other Staff
Katherine McClellan
katherine.mcclellan@mq.edu.au
Contact via katherine.mcclellan@mq.edu.au

Credit points
3

Prerequisites
39cp including (BIOL261 or BIOL262)

Corequisites

Co-badged status
Biol904

Unit description
This unit investigates the evolution, classification, and techniques of preparation of stratigraphically important fossil invertebrate groups, particularly brachiopods, cnidarians, echinoderms, molluscs and trilobites; particular attention is given to functional morphology and evolutionary phylogeny. The unit integrates fieldwork, practical work, lecture material, and the reading of pivotal palaeontological papers so that students gain an in-depth appreciation of the types of problems that palaeontologists are currently coming to grips with. This unit is largely a hands-on unit where students learn how to identify invertebrate fossils using a range of traditional and modern taxonomic methods. The skills learned in this unit are equally applicable to biological materials. The unit has a compulsory weekend field excursion where students collect fossil material that forms the basis of ongoing practical work throughout the semester.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

Utilise fossils combined with analytical skills to solve evolutionary problems

Outline, define and discuss the origins, radiation, biodiversity trends and evolutionary relationships of key animal groups in the fossil record.

Understand the importance of adaptive radiations and mass extinctions to animal evolution

Describe the form, function, morphology and phylogeny of the selected taxa in the fossil record

Conduct and interpret cladistic analyses

Work with basic numerical methods that involve palaeoecology, biostratigraphy, and extinction rates.

Use proper scientific techniques to collect fossil material in the field

Formulate, write and format primary manuscripts based on readings of the primary palaeontological literature.

General Assessment Information

3.2 Practical work (30%)

Practical work constitutes a large proportion of the unit and each weekly prac session is intended to lead on directly from the lecture. All prac sessions will generally be 3 hours in duration. The prac sessions will held in E5A 220 on *Mondays from 12.00 - 3.00 pm* each week. Students are expected to attend the prac session *every single week*.

Assessment of the Lab sessions will be based on completion of an online quiz available after the end of each Lab session. If you do not attend the lectures you will likely not perform well on the quizzes.

The weekly pracs will alternate between hands-on surveys of fossils and more paper- and computer-based exercises that introduce the core methods of analytical palaeobiology. All students of palaeontology should have a basic understanding of these concepts and techniques. You will be provided with the skills to not only conduct your own analyses but to also critically assess those in the literature.

Week 1 will involve surveying disparate marine invertebrate fossils in order to understand the timing and origins of multicellular animals during the Ediacaran, the development of animal body plans, and the dramatic radiation of phyla during the Cambrian Explosion. We will explore many aspects of this milestone evolutionary event, including the stem

group vs crown group concept and the idea of “skeletospace”.

Week 2 will be the first to discuss methods used to quantify patterns in the fossil record. Specifically, the lecture and prac will detail a key method of producing time scales based on occurrences of fossils within stratigraphic sections.

Week 3 will introduce the form and functional morphology of the group that dominated the ocean floor during the Palaeozoic: the brachiopods. The accompanying lecture will describe large-scale patterns of diversification in the marine fossil record and explain how these patterns are interpreted in an analytical framework.

Data similar to those used in the biostratigraphy prac will be used in week 4 to compute extinction rates using several simple equations. The lecture will also be on this topic.

Week 5 will involve reconstructing water depth (palaeobathymetry) by studying ostracod fossils. The accompanying lecture will introduce microfossils, plants, and insects.

There will be no classes during week 8 because the Monday falls on Labour Day.

Weeks 6, 7, and 9 will be devoted to studying cladistics, the primary means of elucidating evolutionary relationships amongst fossil organisms. Cladistics works by grouping organisms together based on the number of derived characters they share (i.e., synapomorphies). It has the advantage of allowing numerous characters to be analysed simultaneously and objectively. The lectures during these three weeks will introduce vertebrates in general and dinosaurs and mammals in particular.

Week 10 will focus on using the morphology of fossil horse teeth to infer precipitation and will complement the accompanying lecture on Cenozoic mammals.

Week 11 marks the shift in the unit toward palaeocology. In the first prac you will use quantitative analyses of community data to infer water depth in a different way. The lecture will discuss general concepts in this area.

Week 12 will explore key methods used by palaeoecologists to reconstruct climates and environments in ways that go beyond geochemistry, including leaf morphology, pollen counts, and annual growth rings of trees and corals. The lecture this week will concern

human evolution and Quaternary extinctions, both of which have been discussed very often in relation to paleoclimate.

The unit will wrap up in week 13 with a prac involving the exciting new area of conservation palaeobiology. Palaeontologists are increasingly concerned with using the more recent part of the fossil record to quantify human impacts that are not well documented by historical records. The prac will involve synthesizing multiple environmental proxies to tackle the question of what has caused recent change in a major estuarine system.

3.3 Discussion Topic (15%)

The Discussion Topic will provide each student with the opportunity to read and evaluate recent published scientific papers. Your task will be to carefully read the papers and provide a written comment/evaluation on them. You will have to discuss their strengths and weaknesses in a relatively short and succinct manner. Most journals only allow a maximum of 800 words for a technical comment or written opinion piece - so you need to marshall your arguments carefully and clearly. This task will allow you to become familiar with the way scientists communicate their ideas in published papers.

Policies that apply to the Major Assignment regarding attribution and use of your own words also apply to this one (see below).

See the separate link on the Discussion Topic for details of the papers you need to read.

3.4 Major Assignment (25%)

Each student enrolled in BIOL381 will be expected to submit *one* major assignment from three possible topics. Information on Assignment Topics is listed separately on iLearn.

Assignment format

The Major assignment for BIOL381 will provide you with the opportunity to synthesize current and sometimes controversial research concerning evolutionary palaeobiology. For this assignment you are required to formulate your own ideas and conclusions regarding the strengths and weaknesses of the data presented in a series of published papers.

So that you adequately understand the topic it is *essential* that you delve into the primary literature in the library and read widely about the topic. It is *not sufficient* to only refer to Web material. You will need to rigorously assess and evaluate the data and evidence presented in each of the relevant primary sources and frame your answer based on not only on the literature but on your own synthesis of the available data. *Do not* fall into the trap of simply summarising the conclusions of the author(s) of each paper. I want *your* evaluation of the topic.

The assignments also must be written *in your own words*. You must not copy material from any source without attribution. Any copied words, no matter how few, must be placed in quotation marks. If you copy anything without attribution *or* without using quotation marks *you will not receive credit* for the relevant part of the assignment. If you have copied without attribution then depending on the severity of the case you may be reported to the Faculty Student Administration Manager, in accord with the Academic Honesty Procedure (see the Policies and Procedures section).

Please also put a high priority on writing in a concise, well-organised manner. If you are not feeling very confident in your ability to do so you may want to purchase the short, simple volume by W. Strunk and E.B. White, *The Elements of Style*, Macmillan (normally available in the Co-op bookshop).

Important points to note regarding the format and structure of the Major Assignment:

- Word limit is 2500 words ± 10%. Include an accurate word count on the front of the assignment.
- Assignments must be word processed using 12 pt font and double spaced – *hand written assignments will not be accepted*.
- The assignments *must* include additional supporting figures, graphs and/or tables.
- Given that the Major Assignment is worth 25% of your assessment, I expect it to be of a very high standard. The assignment should be written in the succinct, tight style of a scientific paper following the format of a mainstream science journal such as *Paleobiology* (see http://www.paleosoc.org/content/AuthorContribInstr.html).
- Make sure all primary information sources used are cited in the text in the appropriate manner. A full reference list in alphabetical order should be included at the end of the assignment. Only sources cited in the main text of the assignment should be listed in the reference list. Make sure you read and follow the formatting guidelines for authors given

by a major journal such as *Paleobiology*.

- Regardless of the details, you *must* use the Harvard Referencing Style when writing your assignments. This means use of footnotes or numbered reference citation (Oxford referencing style) should be completely avoided.

The Library Web page (http://www.library.mq.edu.au/) has a number of very useful databases for searching out relevant primary sources. Use databases such as Web of Knowledge or Scopus or publisher websites such as BioOne, JSTOR, ScienceDirect, Springer Link or Wiley Online Library when searching for information. You should access at least a couple of them to build up a good list of primary scientific papers relevant to your topic.

Note: Primary source = a paper published in a peer reviewed international scientific journal that presents raw scientific data collected in the field or the lab, interpretation of results and conclusions. Primary sources are written by the scientists who undertake the original investigation and experimentation.

Secondary source = a review or compilation of the research work performed by other workers (usually primary sources). Examples of secondary sources include Wikipedia, textbooks, popular science magazines (e.g. New Scientist), newspapers, and most other websites (though there are exceptions such as the online journal Palaeontologica Electronica). While these sources can be useful in some respects, they often present the conclusions only and not the raw data or evidence the conclusions are based on. The reader therefore has no way of checking the data to see if alternate conclusions can be reached. Secondary sources also often publish material that can be out of date or simply misinterpreted.

Assignment marking criteria

Marks for the Major Assignment will be allotted for the following:

The research of your topic (scientific content) or how well you have evaluated the evidence to support your answer written in your own words. - **50%**

The relevance, effectiveness and referencing of figures, graphs and/or tables that *must* be included in your assignment to support your views. - **10%.**

The logical organization, clarity of expression and quality of the information you present in your assignment including the use of side- or sub-headings; style / grammar / spelling will also be assessed. - **20%**

The full list of references you have consulted in researching your topic and *cited in the text* (see

Harvard Referencing Style Guide). - **20%**

Important note: anything not in your own words does not demonstrate researching the topic; evaluating the evidence; writing logically, clearly, and grammatically; or finding references on your own. Therefore, if you copy extensively *you may receive little or no credit* in any or all of these areas.

3.5 Final Examination (30%)

The Final Examination will cover important concepts introduced in lectures and further developed during the practical activities. More information will be provided later in the semester.

Assessment Tasks

Name	Weighting	Due
Practical Work	30%	varies
Discussion Topic	15%	Week 4 Prac 25 August
Major Assignment	25%	Week 10 Prac, 20 Oct
Final Exam	30%	Exam Period

Practical Work

Due: **varies**
Weighting: **30%**

Weekly online quiz on practical work

On successful completion you will be able to:

- Utilise fossils combined with analytical skills to solve evolutionary problems
- Outline, define and discuss the origins, radiation, biodiversity trends and evolutionary relationships of key animal groups in the fossil record.
- Understand the importance of adaptive radiations and mass extinctions to animal evolution
- Describe the form, function, morphology and phylogeny of the selected taxa in the fossil record
- Conduct and interpret cladistic analyses
- Use proper scientific techniques to collect fossil material in the field

Discussion Topic

Due: **Week 4 Prac 25 August**
Weighting: **15%**

800 word comment on a current controversy in the primary palaeontological literature

On successful completion you will be able to:

- Utilise fossils combined with analytical skills to solve evolutionary problems
- Outline, define and discuss the origins, radiation, biodiversity trends and evolutionary relationships of key animal groups in the fossil record.
- Conduct and interpret cladistic analyses
- Formulate, write and format primary manuscripts based on readings of the primary palaeontological literature.

Major Assignment

Due: **Week 10 Prac, 20 Oct**
Weighting: **25%**

2500 word assignment on current research. There will be 3 topics to choose from.

On successful completion you will be able to:

- Understand the importance of adaptive radiations and mass extinctions to animal evolution
- Describe the form, function, morphology and phylogeny of the selected taxa in the fossil record
- Conduct and interpret cladistic analyses
- Work with basic numerical methods that involve palaeoecology, biostratigraphy, and extinction rates.
- Formulate, write and format primary manuscripts based on readings of the primary palaeontological literature.

Final Exam

Due: **Exam Period**
Weighting: **30%**

The Final Exam will be based on lecture material and practical work

On successful completion you will be able to:

- Utilise fossils combined with analytical skills to solve evolutionary problems
- Outline, define and discuss the origins, radiation, biodiversity trends and evolutionary relationships of key animal groups in the fossil record.
- Understand the importance of adaptive radiations and mass extinctions to animal evolution
- Describe the form, function, morphology and phylogeny of the selected taxa in the fossil record
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- Work with basic numerical methods that involve palaeoecology, biostratigraphy, and extinction rates.
- Formulate, write and format primary manuscripts based on readings of the primary palaeontological literature.

Delivery and Resources

Workload. Since BIOL381 is a 3 cp unit, you are expected to spend ~9 hours per week (including face-to-face teaching time) working on this unit for the duration of the semester. Please note that Macquarie University defines a semester as being 15 weeks in duration – 12 weeks of face-to-face teaching, plus the two week mid-semester break and the Labour Day holiday.

Lectures. There will be two hour lecture to be held in E7B 164 every Monday at 9 am. These will be recorded live and posted on Echo360 (access via the BIOL381 iLearn site). The weekly quizzes will include material from the lectures. Because there is only a one-hour gap between the lectures and pracs, this means that *if you do not attend the lectures you may receive poor grades on the quizzes*.

Weekly practical laboratory sessions: Each student *must* attend 3 hour prac session on Monday each week. Sessions will be held in E5A 220 and will run from 12 – 3.00pm.

See the Unit Schedule for the topics to be covered each week. It is in your best interests to attend the lectures each week. It has been my observation that *students who regularly attend lectures tend to perform better* than those students who attend lectures infrequently.

Occupational health and safety. Due to OH&S regulations, all students *must* wear fully enclosed footwear (i.e. no thongs) at all times during practical laboratory sessions in E5A 220. Students without proper footwear will be unable to enter the lab. Food and drink may not be consumed in the lab at any time either.

NOTE: PRACTICAL LABORATORY SESSIONS BEGIN IN WEEK 1!

6. THE RALPH FAULKNER PRIZE

For the person enrolled in a science degree who is judged the best student in BIOL381 there is a prize made possible by the generosity of the late Mr Ralph Faulkner, one of Macquarie's first intake of students in 1967. As an external student, Ralph completed all the palaeontology units on offer. His good cheer and wonderful sense of humour made him a very popular participant in class and especially on field trips. Sadly, Ralph passed away in 2001, a victim of cancer. Because he appreciated what Macquarie had done for him and he was especially interested in palaeontology, Ralph undertook to provide the Invertebrate Palaeontology Prize. He did this for many years, but when he knew his death with imminent, he organised to leave funds to Macquarie so the award would continue after his death. Ralph was, for many years, part of the Science Staff of Kiama High School.

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Unit Schedule

4. UNIT DELIVERY AND ATTENDANCE REQUIREMENTS

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*Workload.*Since BIOL381 is a 3 cp unit, you are expected to spend ~9 hours per week (including face-to-face teaching time) working on this unit for the duration of the semester. Please note that Macquarie University defines a semester as being 15 weeks in duration – 13 weeks of face-to-face teaching, plus the two week mid-semester break.

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Lectures. There will be 1 x 1 hour Lecture to be held in E6A133 every Wednesday at 10 am. These will be recorded live and posted on Echo360 (access via the BIOL381 iLearn site).

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Weekly practical laboratory sessions: Each student **MUST** attend 1 x 3 hour Lab session on Wednesday each week. Lab sessions will be held in E5A220 and will run from 11.00am – 2.00pm OR 3.00 pm – 6.00 pm.

See the Unit Schedule for the topics to be covered each week. It is in your best interests to attend the lectures each week. It has been my observation that students who regularly attend lectures tend to perform better than those students who attend lectures infrequently.

*Occupational health and safety.*Due to OH&S regulations, all students **MUST** wear fully enclosed footwear (i.e. no thongs) at all times during practical laboratory sessions in E5A220. Students without proper footwear will be unable to enter the lab. Food and drink may not be consumed in the lab at any time either.

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NOTE: PRACTICAL LABORATORY SESSIONS BEGIN IN WEEK 1!

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Field excursion. A **voluntary** weekend field excursion to examine fossiliferous Silurian and Devonian successions in the Yass region, southern NSW will be held on 23-24st March.

Note: The Unit Handbook indicates the Excursion was originally scheduled for 30-31 March, but this coincided with the Easter long weekend and accommodation was not available. We have thus decided to move the excursion one week earlier than advertised in the Handbook. More details about Excursion costs, itinerary and planning will be provided at a later date.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit http://informatics.mq.edu.au/help/.

When using the University's IT, you must adhere to the Acceptable Use Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcome

- Use proper scientific techniques to collect fossil material in the field

Assessment tasks

- Discussion Topic
- Major Assignment

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcomes

- Conduct and interpret cladistic analyses
- Work with basic numerical methods that involve palaeoecology, biostratigraphy, and extinction rates.

Assessment tasks

- Discussion Topic
- Major Assignment

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Outline, define and discuss the origins, radiation, biodiversity trends and evolutionary relationships of key animal groups in the fossil record.
- Understand the importance of adaptive radiations and mass extinctions to animal evolution
- Describe the form, function, morphology and phylogeny of the selected taxa in the fossil record
- Conduct and interpret cladistic analyses
- Work with basic numerical methods that involve palaeoecology, biostratigraphy, and extinction rates.
- Formulate, write and format primary manuscripts based on readings of the primary palaeontological literature.

Assessment tasks

- Practical Work
- Discussion Topic
- Major Assignment
- Final Exam

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Outline, define and discuss the origins, radiation, biodiversity trends and evolutionary relationships of key animal groups in the fossil record.
- Understand the importance of adaptive radiations and mass extinctions to animal evolution
- Describe the form, function, morphology and phylogeny of the selected taxa in the fossil record
- Conduct and interpret cladistic analyses
- Work with basic numerical methods that involve palaeoecology, biostratigraphy, and extinction rates.

Assessment tasks

- Practical Work
- Discussion Topic
- Major Assignment
- Final Exam

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Outline, define and discuss the origins, radiation, biodiversity trends and evolutionary relationships of key animal groups in the fossil record.
- Describe the form, function, morphology and phylogeny of the selected taxa in the fossil record
- Conduct and interpret cladistic analyses
- Work with basic numerical methods that involve palaeoecology, biostratigraphy, and extinction rates.
- Use proper scientific techniques to collect fossil material in the field

Assessment tasks

- Practical Work

- Discussion Topic
- Major Assignment
- Final Exam

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcome

- Work with basic numerical methods that involve palaeoecology, biostratigraphy, and extinction rates.

Assessment tasks

- Practical Work
- Discussion Topic
- Major Assignment

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcomes

- Describe the form, function, morphology and phylogeny of the selected taxa in the fossil record
- Use proper scientific techniques to collect fossil material in the field
- Formulate, write and format primary manuscripts based on readings of the primary palaeontological literature.

Assessment tasks

- Discussion Topic
- Major Assignment
- Final Exam