

# Global Change Biology – BIOL 427

## CURRENT ISSUES AND APPROACHES IN GLOBAL CHANGE RESEARCH

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### Preamble | *Whakamahuki*

The conditions necessary for life on Earth are provided by a suite of interacting physical, chemical and biological global scale cycles and energy fluxes. This is now often referred to as the Earth System. In recent decades it has been realised that biological processes play a much stronger role than thought previously.

This course will address selected major issues concerning the role of biological processes in the Earth System and the impact on these of human activities (global change). Discussion will include carbon and nutrient cycling in terrestrial and marine ecosystems, the impacts of past and future climate change on biota, the significance of biodiversity loss on ecosystem processes and strategies to mitigate climate change.

It is recommended that you have passed one or more of the following courses: BIOL374/385 Marine Ecosystems, BIOL377 Global Change and Biosecurity, BIOL378 Population Ecology and Conservation. However, if you do not have any of these but are strongly interested in the topic then you should be able to cope with the course content following some background reading which we can supply.

In order to cover the issues raised above we will be discussing the functioning of organisms (and groups of organisms) at a range of scales (global, regional, ecological, whole organism, physiological and biochemical levels). The following set of 6 tutorial topics provide an overview of issues which we hope are both interesting and intellectually challenging. Remember, in a course like this it is impossible to cover all the possible issues in this very broad topic!!

## Intended Learning Outcomes (*Hua Akoranga*) and Associated Assessment (*Aromatawai*)

*As a student in this course, I will develop the ability to:*

- Acquire an in-depth appreciation of important concepts in global change biology and be able to apply these to current problems (*assessment task: final exam*).

**Related Graduate Attributes and Kaupapa:** Critically competent in the core academic discipline, Globally aware.

- Evaluate the importance of the processes that control the response of terrestrial ecosystems to global change drivers at a variety of scales ranging from individuals to ecosystems and landscapes (*assessment task: final exam*).

**Related Graduate Attributes and Kaupapa:** Critically competent in the core academic discipline, Employable, innovative and enterprising, Globally aware.

- Apply an understanding of scientific practice and of global change biology and ecology to the generation of new testable hypotheses (*assessment task: proposal assignment*).

**Related Graduate Attributes and Kaupapa:** Critically competent in the core academic discipline, Globally aware.

- Display a high level of critical thinking including critique and synthesis of research, development of hypotheses, research objectives and methodologies, and integration of theory and applications (*assessment tasks: proposal assignment & final exam*).

**Related Graduate Attributes and Kaupapa:** Critically competent in the core academic discipline, Employable, innovative and enterprising.

- Synthesise primary scientific literature to provide necessary background and context for understanding and interpreting experimental data (*assessment task: research proposal*).

**Related Graduate Attributes and Kaupapa:** Critically competent in the core academic discipline, Employable, innovative and enterprising, Globally aware.

- Reflect on how one’s actions result in ecosystem change, and relate this to the social and economic trade-offs that underpin environmental decision-making (*assessment task: final exam*).

**Related Graduate Attributes and Kaupapa:** Critically competent in the core academic discipline, Biculturally Competent and Confident (kaupapa 1,3,5,6), Employable, innovative and enterprising, Globally aware.

- Develop a high level of communication skills appropriate for a number of audiences (*assessment task: oral presentation, research proposal development*)

**Related Graduate Attributes and Kaupapa:** Employable, innovative and enterprising.

### Transferable Skills / Pūkenga Ngaio

*As a student in this course, I will develop the following skills:*

- Writing a grant application. This will be important for any career in research or in an NGO, where you will need to write convincing applications for increasingly-limited funding. *We will have a short tutorial to provide instruction on the elements of successful proposals and develop your abilities to identify these elements.*
- Synthesising information. In everyday life and in many job situations you will be required to read information from different sources, construct your own understanding and shape your own viewpoint. *In tutorials we will discuss recent research papers in a group environment and this will develop your abilities to identify the essential elements of research outputs - you will then use in proposal writing and the exam.*
- Written and verbal communication. Clear written communication is essential for most professional careers, and communicating verbal to a range of audiences is also critical in any area of endeavour. *We will provide instruction on the elements of successful communication and help you develop these elements during tutorial sessions.*

## Āhuatanga Tāura | Graduate Profile

Critically competent	Employable, innovative and enterprising	Biculturally competent and confident (BiCC)	Engaged with the community	Globally aware
Yes	Yes	Yes	-	Yes

### Tutorials | Akoranga (2 hr sessions)

The course consists of an orientation meeting in week 1, six weekly 2-hour sessions and a summary session in week 8. The final test will be in the June exam period.

\* *Course orientation meeting*  
(Matthew Turnbull)

Structure, timing of sessions, assessment – a general check-in and meet-and-greet the class before we start the class proper (1 hr max).

1 *What is global change and why should we care?*  
(Matthew Turnbull)

At the beginning of this series it is important for us to consider the nature global change – what do we mean by this term? What are the major links between biological systems and the earth system. What do researchers in global change biology do?

We will discuss the major global change drivers, the important biological responses, and approaches to understanding where we are heading. We will discuss the major sources of greenhouse gases and provide a brief overview of the consequences of anthropogenic emissions. We will also consider the impacts of climate change on biota. What is the evidence for impacts to date and what is the physiological basis for responses?

**2**      *Human modification of global nutrient cycles*  
(Matthew Turnbull)

Nutrients such as nitrogen (N) and phosphorus (P) are critical for life. However, as with many things, too much of something good can have dire consequences. On a global scale, humans have doubled N inputs and quadrupled P inputs relative to pre-industrial levels. In this module, we will discuss major nutrient cycles, human modifications of those cycles, and consequences for the distributions, abundances, interactions, and biodiversity of organisms at local and global scales.

**3**      *Global change impacts on marine fisheries: what do we know and what do we surmise?*  
(David Schiel)

A changing climate is interacting with numerous other stressors to alter the character, diversity and functioning of the marine environment worldwide. An important consequence of this is changes to marine food webs and fisheries. These changes are driven by over-exploitation, alteration to top-down controls, and changes mediated by bottom-up controls through climate forcing. In this seminar, we will examine this topic and some underpinning mechanisms.

**4**      *Marine production – global change impacts*  
(David Schiel)

Phytoplankton are of critical importance as they are at the base of most marine food webs and are able to affect climate due to their key function in the Biological Carbon Pump. We will start with a general discussion of the roles of phytoplankton in the marine carbon cycle and the effects of environmental change. We will then focus on research that has investigated the effects of warming of surface waters. Has this increased or decreased productivity? How will change in productivity feedback on climate?

**5**      *Impacts of aquatic invasive species; are invasive species drivers or passengers of change?*  
(Mads Thomsen)

Thousands of non-native aquatic species have spread around the globe mediated by human transport systems. Many of these species become invasive in their new regions, breaking down past biogeographical provinces and outcompeting and eating native species. Still, it is often debated how much the invasive species are the underlying 'drivers of ecosystem changes' or merely 'passengers of change' in already stressed ecosystems. Questions we will address include: How do aquatic invasive species alter local communities and ecosystems? Are aquatic invaders typically drivers or passengers of change and how can we tell the difference? Do additional co-occurring human stressors, such as eutrophication, warming, and habitat destruction, generally reduce or increase impact from aquatic invaders?

**6**      *Links between biology and the earth system – net primary production and the role of vegetation and soils in providing ecosystem services*  
(David Whitehead – Landcare Research & Matthew Turnbull)

As we begin to appreciate the extent of human impacts it is important we consider environmental technologies that may be useful in future management – these must be based on a sound understanding of environmental science and ecosystem processes. This will enable us to manage our ecosystems to optimise for a range of services in a changing climate and inform policy makers who are responsible for regulating land management practices and reporting on our environmental performance.

\*      *Course summary*  
(Matthew Turnbull)

A brief session to summarise what we have done and to discuss issues with your research proposal.

\*      *Proposal talks*  
(Matthew Turnbull)

A brief session to present the verbal version of your research proposal.

## Time and Venue

Always check this on the Course Information System (or timetable <http://www.canterbury.ac.nz/theuni/timetable/>) prior to attending class. We have the initial 1-hr briefing in week 1. The six 2-hr tutorial sessions are then weekly from weeks 2-7. The second briefing session on in week 8 will be a wrap-up of the course and discussion on progress of the assignment. The final meeting in week 10 is scheduled for proposal presentations.

## Reference Material

Each topic will have a set of references that are relevant to the planned discussion. Because many of you will be starting “cold” on the topic, by necessity your reading may include a number of “review”-type articles to give a broad overview. Some of these may seem quite long but they have been chosen to provide you with an effective introduction to the topic. These will be supplemented with a small number of shorter papers based on experimental work - these are the basic unit in the scientific literature and are included to provide “case-studies” specific to the topic. In listing the reference material, where possible some attempt has been made to provide a logical reading order.

In some cases additional reference material may be listed. The purpose of this is to provide further material for those interested in a particular topic, and they may also be of use in collecting information for your written work. I recognise that during the course of this year you will have a lot of reading to do. For this reason, your performance in this course will be assessed on the basis of your understanding of the listed reading material, not the additional material.

The following general texts are available in the Central Library and could be useful for providing some general context and explanations of topics discussed in more detail in the seminars.

Steffen W et al. 2004. *Global change and the Earth System*.

Chapin, F.S. et al. 2011. *Principles of Terrestrial Ecosystem Ecology*, 2<sup>nd</sup> edition. Available as an e-book through library.

## Tutorial sessions

Tutorials will take the general form of discussions on the topic and reading outlined in the handout. The format will vary between different teachers. In some session members of the class will be nominated to present a summary of one of the papers set for that session. The idea of this summary is that it gives a critical overview of the reasons for the work, the way the work was done, and the major findings/conclusions of the work. This selection will be made at the previous tutorial session so that the people are aware of their responsibilities well in advance. The input of the presenters is an important part of the tutorial process and the tutorial is most likely to succeed if the people presenting display:

- Evidence of having read the reference material!
- Evidence of preparation for the session (summarise the paper according to the guidelines below)
- Willingness to facilitate discussion in the session (e.g. questions to be asked, lines of discussion)

In order to aid the presenter it is expected that each member of the group will have read all discussion papers (not just the one they are giving a presentation on) and noted questions or discussion points to be incorporated in the discussion following the summary. **Please be prepared to be asked to contribute a question/comment at each session.**

## Summaries

Getting up in front of people and making a verbal presentation does not come easily or naturally to anybody - it is something you learn. This year is all about learning new skills. The idea behind this activity of the tutorials is for you to get some experience of preparing and presenting brief summaries of published material. I expect that each presentation will last 15-20 minutes, in addition to time for questions, interjections (?), and discussion. You might like to consider some of the following suggestions in order to help you prepare your tutorial summaries:

- Be systematic - remember, all the information is in front of you. Every good story should have a beginning, a middle, and an end - so it is for good papers (reviews or experimental reports).
- Always try to use the format - WHY, HOW and WHAT. Why they did the work, how they did it and what they found/conclude from it. This is less easy for review-type articles, where the first and last sections are the most important.
- Use a small number of visual aids in Powerpoint to summarise what you are trying to present. A computer will be available in each session to load up your presentation.

## Discussion

Regardless of the format of the session, as participants in these tutorial sessions you are free to comment or ask questions of the presenter and/or the group at large. Clearly we would prefer the line of discussion to follow the theme

of the day, and these themes should be broad enough to satisfy most tastes (within limits!). If discussion gets bogged down in areas that seem to be getting nowhere then we will suggest alternative directions. Remember that the ability to question is one of the foundations of a life in science - don't be afraid to question why a piece of work was done, how it was done, how it was written up or the conclusions that were drawn from it.

Please remember that the tutorial environment has the potential to be very effective in the exchange of ideas and if they work well everybody should get something out of them. **Whether or not they work in practice is largely up to the participants (you).** It is expected that everybody will participate in discussions and that my input as facilitator will be kept to a minimum.

## Assessment | *Aromatawai*

### Written research funding proposal (30%)

Within a small team, write a research proposal (following the format set for applications to the Marsden Fund – available on Learn) for funding to support a modest research project (maximum \$100,000 per year) to pursue a topic relating to some aspect of global change biology of interest to you. **NOTE: this proposal must not be on the same topic you are proposing for your formal research proposal in BIOL412.**

The purpose of the Marsden Fund is to support pure, interest-based research, so you may like to think of pursuing a question of broad and fundamental importance in global change biology. Depending on your interests you may also wish to direct your proposal to research carried out in natural ecosystems or that concentrating on managed ecosystems (e.g., forestry, agriculture). To this end we will widen the scope of the applications eligible for Marsden funding to include more overtly “applied” research. Any decision to confine the scope of the research must be well reasoned in the body of the application. It is important that you come and see Matthew *at least* once to discuss your thoughts on possible topics.

We will briefly discuss the things that might be expected in a research proposal in tutorial 3 and a separate short meeting in May/June. We will also discuss possible interesting avenues of research you might follow. In arguing your case for funding part of your rationale should have an historical (“what work has been done”), a contemporary (“what is happening now”) and a critical (“what has been missed out and what should we do in the future”) flavour. One important criterion I will use in assessing your work is evidence that you have attempted to access as much of the published literature as is possible.

- Length – see format and page limit for Marsden Fund applications
- Style - you should follow the format required by the Marsden Fund. We will make modifications to sections where appropriate - more on this in the final wrap-up session.
- Be sure to cite in the text all references listed in the reference list (and list all references cited in the text!)
- **Due date – to be advised, but suggest Friday May 24.**

### Verbal presentation of research proposal (10%)

In the week before final submission (week 10), your team will give a verbal presentation (approximately 12 minutes plus 3 minutes discussion time) outlining the research proposal you have prepared above. The criteria on which your presentation will be assessed will be the extent to which it:

- Outlines the background to the topic.
- Clearly describes the work proposed, including hypotheses and methods to be used.
- Makes a clear case why the research should be funded.

### Contribution to class discussions (10%)

During the course of our sessions together we will be assessing your willingness and ability to contribute to class discussions. This includes both your own presentations AND your contribution to discussion/questions on other assigned readings.

### Examination (50%)

Choice of 3 essay-type questions out of 4. This will be a 48-hr take-home exam that will be submitted on-line. **Dates to be confirmed.**

In framing the exam questions, we will be drawing upon themes from any (or all) of the tutorial topics. In some cases, we may combine overlapping themes - the extent to which themes may overlap should become clearer as the tutorials progress. Some questions may require you to comment on data taken from papers that you may or may not have seen before.

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## RULES, REGULATIONS, AND WHAT TO DO WHEN THINGS GO WRONG

[updated March 2023]

**If in doubt:** ASK! The course coordinator is happy to answer questions. All staff involved in the course are available for advice on specific issues.

### **What do I do if I have to miss a test/exam or if my performance was impaired?**

In Biological Sciences, we require a satisfactory level of achievement in both the theoretical aspects of the discipline and in practical activities. **This means you must attend all class activities (labs, tutorials, fieldtrips)** and submit all items of assessment unless you have a very good reason not to (e.g. medical reasons) and if this has been approved by your course coordinator.

If you feel that **illness, injury, bereavement, or other extenuating circumstances beyond your control** prevented you from completing a **test/exam** worth 10% or more of the total course assessment, or if these circumstances affected your performance in such assessments, you should apply for Special Consideration. Applications for Special Consideration should be submitted via the Special Consideration website <http://www.canterbury.ac.nz/study/special-consideration/> *within five working days* of the assessment or its due date. You should also notify the course coordinator. If you apply for Special Consideration because of medical reasons, you should visit a doctor within a reasonable timeframe (application form available on the website above or from the Student Health Centre).

The Special Consideration provisions are intended to assist students who have covered the work of a course but have been prevented by illness or other critical circumstances from demonstrating their mastery of the material or skills at the time of a test/exam – **they do not excuse you from doing the test/exam** within a reasonable time agreed with the course coordinator.

### **What do I do if I have to miss a quiz or assignment or if I need an extension?**

You cannot apply for Special Consideration if you miss an assessment that is not a test/exam, such as a quiz, lab report, essay, literature review or other assignment, or if the test/exam is worth less than 10% or more of the total course assessment. If this happens or if you need an extension because of **illness, injury, bereavement, or other extenuating circumstances beyond your control**, please contact the course coordinator and arrange an alternate activity and/or submission date. You should also do this if you have to miss a laboratory, tutorial or field trip.

### **What are other valid reasons to miss an assessment or mandatory course activity?**

The Special Considerations policy (<https://www.canterbury.ac.nz/about/governance/ucpolicy/student/special-consideration-procedures-and-guidelines/>) outlines only a few kinds of activities that UC considers valid reasons for missing an assessment or mandatory course activity other than those outlined above. These include **involvement in international or national representative sport or cultural groups**. Holiday trips, birthday parties, weddings, work-related commitments etc. are not given special status in this University policy. Please contact your course coordinator to ask for an alternate activity and/or submission date if you are eligible.

### **Special Consideration for late discontinuation of a course**

Students prevented by **extenuating circumstances** from completing the course after the final date for withdrawing, may apply for Special Consideration for late discontinuation of the course. Applications must be submitted via <http://www.canterbury.ac.nz/study/special-consideration/> no later than five working days after the examination period has finished.

### **Academic Integrity**

It is the responsibility of each student to be familiar with the definitions, policies and procedures concerning academic misconduct/dishonest behaviour. Instances of academic misconduct will be dealt with in a serious and appropriate manner. Students should refer to: <https://www.canterbury.ac.nz/about/ako/academic-quality/academic-integrity/>

### **Plagiarism**

It is essential that you are aware that plagiarism is considered a very serious offence by the academic community, the University and the School of Biological Sciences. Plagiarism is defined as taking content from another work or author and presenting it, without attribution, as if it is your own work. Content here includes text (sentences or major parts of sentences), display items (graphs and tables), and overall structure (the detailed sequence of ideas). Plagiarism includes:

- re-use of previous assignments (even if each individual sentence has been rephrased to say the same thing in different words, if the overall structure is re-used).
- copying of another student's work (with or without their consent).
- the unreferenced use of published material or material from the internet, e.g. cutting and pasting of paragraphs or pages into an essay.
- the generation of text using artificial intelligence technology without disclosure and when it is not intended to be part of an assignment.

For most pieces of in-term assessment you will be given information concerning the use of direct and indirect quotes from previously published work. If you have any doubt about the appropriate use of published material, please speak with an academic staff member. If you are unsure what plagiarism is, seek advice.

It is a School policy that courses will likely that you submit work electronically for subsequent analysis of originality using *Turnitin*. Students agree that by taking courses in BIOL, assessments may be submitted to Turnitin.com for textual similarity review. All submitted papers will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. Use of the Turnitin.com service is subject to the Terms and Conditions of Use as posted on the Turnitin.com site.

### **Where do I hand in assignments and then collect them once marked?**

All assignments should be submitted as directed by the course coordinator. Typically, this will be electronically via Learn for on-line grading and for analysis in *Turnitin*. If a hard copy is requested, assignments should be placed in the designated collection boxes in the foyer of the 2nd floor of the School of Biological Sciences (Julius von Haast building, at the top of the stairs). All assignments must be accompanied by a cover sheet signed by you stating that the submitted work is not plagiarised. Cover sheets are available on top of the collection boxes, or you can download one from the Biology website (<http://www.canterbury.ac.nz/media/documents/science-documents/assignment-coversheet.pdf>).

Marked assignments will be returned through Learn or, if in hard copy, can be collected from the School of Biological Sciences reception, unless directed otherwise by the course coordinator. Teaching staff will endeavour to return work as soon as possible, and should contact you if there are likely to be any delays that will prevent return within the maximum 4-week timeframe.

### **What if I can't get it finished in time?**

Reports and assignments should be handed in on time. Extensions may be granted if you have a valid reason (see above). **If you require an extension, you should request one from the course coordinator** (or the lecturer responsible for marking the work), with as much notice as possible. Please do this BEFORE the deadline for the assignment. **If you have been given an extension and you have been asked to submit a hard-copy of your work, you should hand the work DIRECTLY to the course coordinator** (do not put it in the drop box as it may not be cleared after the due date).

If an extension has not been granted:

- work handed in within 1 hour of the deadline: penalty of up to 5 percentage points of the mark for the assignment (e.g., a mark of 75% might be reduced to 70%).
- work handed in 1 – 24 hours after the deadline: penalty of 10 percentage points of the mark for the assignment (e.g., a mark of 75% is reduced to 65%).
- work handed in 1 – 7 days after the deadline: penalty of 15 percentage points of the mark for the assignment (e.g., a mark of 75% is reduced to 60%).
- work handed in more than 7 days after the deadline will not be marked or earn credit.

### **What if I have written more than the word or page limit?**

If there is a word limit on an assignment, it is usually there to stop you doing too much work and to encourage you to write succinctly. You can be up to 10% over without too much worry, but if the length increases beyond that your mark may suffer due to failure to follow the requirements. If you find yourself way over the word limit talk to the lecturer concerned about how to get your assignment to an acceptable length. Unless specifically advised that there is flexibility, you must adhere to the word limit indicated.

### **What if I fail part of the course?**

In Biological Sciences, we require a satisfactory level of achievement in both the theoretical aspects of the discipline and in practical activities. This means you must attend all class activities and submit all items of assessment unless you have a very good reason not to (e.g. medical reasons). **A student must attain an average score of at least 40% for in-course assessments (e.g. assignments, reports, quizzes) and an average score of at least 40% in the exam and/or tests, AND score at least 50% overall for the course, to be awarded a passing grade. See the course outlines for clarification of the assessment items included in each category and ask the coordinator if you are still unsure.**

### **What's the best way to give feedback?**

We welcome constructive feedback at all times – help us to make this a valuable course for you. We endeavour to remain approachable at all times. If you would rather give feedback anonymously, please use the online course survey or talk to lab demonstrators, or your class rep (who will all report back to the staff-student liaison committee that includes a representative from each of the undergraduate classes). Class representatives will be selected from each class at the start of course.

### **What's the best way to complain?**

If you feel you have not been fairly treated during this course, please raise the issue with the lecturer or course coordinator in the first instance. Other avenues include your class rep., who can raise issues anonymously, or the UCSA education coordinator.

## **Grading**

A+	90% or above
A	85 – 90
A-	80 – 84
B+	75 – 79
B	70 – 74

B-	65 – 69
C+	60 – 64
C	55 – 59
C-	50 – 54

A restricted pass (R) **may** be awarded to those who are close to a pass (i.e. an overall score of 48-49.9%) AND who have achieved at least a 40% overall score in both in-course assessment and tests/exams. If an R grade is awarded you gain credit for the course but **cannot continue into papers that require this course as a pre-requisite**. NB. The R grade is only available at 100 and 200 level - it cannot be awarded for third year papers.

Failing grades: D 40-49            E 0–39