Island Educational Module

The Alexander Archipelago: A forest for thought

Created by Galen Rask

This module can be used as an in-class assignment for advanced high-school age or early college students. It is designed to span 4 one hour periods, with discussion each day to ensure students have read and understood the assigned readings. Discussions should be led by peers but may be led by a teaching assistant or teacher. For peer led discussions, separate the students into groups of four and assign each group member a section of the paper (Introduction, materials and methods, results and discussion). Do not tell them which section they will have ahead of time to promote careful reading of the entire paper. Before assigning the paper, ask students to think critically about the paper. What are its strengths? What are its weaknesses? Are their conclusions reasonable? Discussions should last ~30 minutes or more, depending on the amount time lectures last.

- Purpose: To introduce fundamental concepts about island geography, history, ecology and evolution, through primary literature while aiding in understanding the structure and content of scientific papers (primary literature) in comparison to textbooks (secondary literature).
- Key concepts:
    - Development of scientific concepts through time
    - Island refugia
    - Glacial history (last glacial maximum)
    - Role of extinction vs. colonization in patterns of island biodiversity
    - Endemic species
- Skills:
    - Learn to absorb information from scientific papers
    - Learn how species populate islands differently
    - Learn how glacial history affects contemporary diversity
- Materials provided:
    - How to read a scientific paper
    - Scientific papers:
        - David R. Klein. 1965. Postglacial Distribution Patterns of Mammals in the Southern Coastal Region of Alaska, Arctic, Volume 18, No. 1, March 1965, Pages 7-20.
        - Joseph A. Cook, Natalie G. Dawson, Stephen O. MacDonald. 2006. Conservation of highly fragmented systems: The north temperate Alexander Archipelago, Biological Conservation, Volume 133, Issue 1, Pages 1-15, ISSN 0006-3207, 10.1016/j.biocon.2006.05.026.
        - J.A. Cook, A.L. Bidlack, C.J. Conroy, J.R. Demboski, M.A. Fleming, A.M. Runck, K.D. Stone, S.O. MacDonald. 2001. A phylogeographic perspective on endemism in the Alexander Archipelago of Southeast Alaska, Biological Conservation, Volume 97, Issue 2, Pages 215-227, ISSN 0006-3207, 10.1016/S0006-3207(00)00114-2.

Reference Materials for Background

- Swarth, H. S. (1911) Birds and Mammals of the 1909 Alexander Alaska Expedition. University of California Publications in Zoology 7:9-172. [a descriptive paper on the region provides historical background.] http://archive.org/stream/cu31924001585482#page/n7/mode/2up
- MacDonald, S. O. and J. A. Cook. 2007. The Mammals and Amphibians of Southeast Alaska. Museum of Southwestern Biology, Special Publication 8, 191pp. [a comprehensive view of the mammals of the region]

- Maps of Alexander Archipelago
  - Blank map to label on day 4

- Discussion questions

- Assignments
  - Day 1: Explain what students will be doing over the next few days and what the goal of this module is. Ask them if they know the difference between islands and archipelagos. See if students can hypothesize how an archipelago is different than a group of islands. Introduce the idea of oceanic and continental islands. Have a discussion about what the students already know about islands, the different types, the different geographic locations, and how organisms came to inhabit them.
  - Assign
    - Textbooks differ in their content, but the textbook reading assigned should be about islands, biogeography or conservation. Being on topic is important, but the style of textbook writing is the focus of this assignment so that students can see how it contrasts to scientific writing.
    - How to read a scientific paper
    - Using the techniques from "How to read a scientific paper", read Klein's 1965 Postglacial Distribution Patterns of Mammals in the Southern Coastal Region of Alaska
  - Day 2: Begin class with a short discussion (does not need to be peer led) of what the traits of textbook writing are and what they learned from the paper "How to read a scientific paper", and have them come up with additional tools. Follow this discussion, discuss the Klein paper. Incorporate the following into the discussion:
    - How does reading a scientific paper differ from a textbook?
      - What did they find most difficult?
      - What made it easier to read?
  - Assign
    - The Klein paper again. Ask the students to read carefully and determine if they gained a better understanding of the paper when reading it after a discussion.
  - Day 3: Begin by introducing the following concepts:
  - The students now know what an archipelago is and how it differs from an island

- Use concrete examples of interisland exchange of species and the evidence proposed for these ideas in the Alexander Archipelago
    - i.e. How bears travel between islands, briefly mention that ice sheets used to allow species to travel between islands
- Explain that Cook is a mammalogist so these papers are centered around mammals, who have limited ability to travel between islands. What about other groups of species like plants?
- Have a follow-up discussion from Day 1, and discuss how their understanding and knowledge base of island systems has developed.
- Assign the following:
    - Read Cook *et al* 2001 using skills from how to read a scientific paper
    - Write a one-page summary of this paper answering these questions:
        - What are some traits of the Alexander Archipelago that make it of interest to the authors?
        - What is an endemic species? On what type (size, distance from mainland, etc.) of island are they most likely to occur?
        - Which species do the authors hypothesize to be endemic? What genetic trends support these hypotheses? (I'm think about removing this one and adding the next one)
        - Write a short summary of how they assessed genetic divergence in each species.

- Day 4: Explanation of Alexander Archipelago history and diversity.
    - Discussion this day will be focused around Last Glacial Maximums (LGM) and how glacial cycles affect diversity
    - Description of ice layers that (for example) used to cover most of Northern North America.
    - Discussion of Cook *et al.*2001.
        - How would these glacial advances change the genetic diversity of these species? (This is a very hard question, but I would like them to think about it. The answer is given in Cook *et al.*2006, but I would be interested in them thinking critically about it beforehand)
    - Assign the following:
        - Read- Cook *et al.*2006, using skills from How to read a scientific paper
        - Write a two page summary of Cook *et al.*answering these questions:
            - Choose 10 islands in the Alexander Archipelago. For each island. Make a table that includes the following information:
                - Would colonization or relaxation be the main driver of species diversity?
                - What traits of that island support that method of diversifying?
                - How does a species colonizing from the mainland differ from a species emigrating from an island refugium? Think of both genetic diversity and spacing across islands.

        - If an island is a refugium, how does the species diversity on that island change? Use your knowledge from Cook *et al.*2001 to answer this question.
        - Based on this article, what do you think endemic means?
- Day 5: Readdress, as a class, how does reading a scientific paper differ from a textbook now that they have read multiple scientific papers. The remainder of class will be utilized to summarize Cook *et al.*2006 and a culmination in map activity.
    - Quick discussion of Cook *et al.*2006 paper. Very briefly discuss how this paper is different from Cook *et al*. 2001 both in the way it was conducted and in the subject matter.
    - In small (5-6) person groups create a map labeling where the most diverse islands may be and which islands would have the most endemic species using the following guidelines:
        - In the two papers that we have read, the authors made quite clear that large, close islands are more likely to support mainland species. As you go farther out, less of these species will have emigrated off the close islands to the outer islands.
            - A general trend in island biogeography, not unique to the AA is that oceanic islands systems, and sometimes continental ones, like the Alexander, though island refugia (creating a new "mainland" source population) blurs this signal.
                - Discussion of why colonization from different sources in the Alexander Archipelago causes it to behave differently
        - Be able to provide at least 3 reasons for the locations that are marked as possible refugia (some possible answers could be the lack of glacial cover at LGM, the increased continental shelf exposure, or the unique genetic signatures presented in the papers).
            - For the bigger picture: What scientific fields could contribute to the questions raised in these papers? (acceptable answers may include Anthropology, geology, oceanography, climatology, etc)
            - What technologies could be used to push these issues further?
            - What is the connection between the marine and terrestrial biomes? If climate warms, what would we expect to see on these islands? (acceptable answers may include rising sea levels, change in type of environment, etc)
            - How would species respond? (migrate, adapt, go extinct)

If you want to expand this, and have it focus on for or against these arguments, you can give them an empty map of the AA and have them color the islands based on species diversity from table 2 in Cook *et al.*2006, shading from Red (most diverse) to Blue (least diverse), then, find another table for another archipelago that seems to follow the trend more closely, and do the same. Then, have some questions that ask what color trends do they see, do they follow island biogeography theory, why or why not, etc. But, that is just adding more reading to the mix. Perhaps it'd be good to read a paper on a "classic" island to compare to AA.

How to read a scientific paper

Reading a scientific paper is not like reading a novel, nor is it like reading a textbook. Reading a scientific paper from beginning does not provide you with the fullest understanding of the experiment conducted and the conclusions. It does not break down the information as a textbook does, instead you should read it in a way that you can easily break down the information for yourself.

First read the abstract. Don't get bogged down with trying to understand the whole experiment from the abstract, but understand why they are doing this experiment and what they are trying to prove.

Next look through the paper, examine the figures and read the figure captions. Attempt to summarize their conclusions to yourself.

Read the introduction. The first paragraphs will likely be background information which is important to set the theme of the paper. Skim through this once, read the experiment summary then read back through the background information more carefully.

Skip the materials and methods section and the results section for now.

Read the Conclusion. Attempt to understand what conclusions they were making and why they might have the significance that the authors believe they do.

Now return to the materials and methods section followed by the results section. Knowing the results that they expected to get (from the introduction) and the way they interpreted the results they received (from the conclusion) should allow you to have a fuller understanding of the experimental set up and why they were collecting the data that they did.

Think about the paper as a whole. Why did the authors conduct this research? Was the outcome as they expected? Is this the final act in a series of research projects or the beginning?

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