The Polar Bear of the Salt Marsh? Case Study by Beth Lawrence and Christopher Field

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Carthage College, Kenosha, WI

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Course: BIO 1120 (Organisms, Population, and Systems) for Bio Majors

Class size is 24.

We taught this case study (CS) in two successive sessions of ~75-85 minutes each, as part of daily activities in a studio format course that meets 3x weekly for 2 hr 20 min.

We used this CS during the first third of the semester, after covering concepts on evolution, speciation, and phylogenetic relationships. Students are also engaged in lab activities which focus on developing experimental designs with *Manduca sexta* larvae during this time.

**DAY 1**

*Homework completed before class includes reading the Deutsch et al., 2008 paper on the Impacts of Climate Warming on Terrestrial Ectotherms Across Latitudes. It also consists of typing up responses to focus questions related to this assigned reading.*

1. Begin with the original case study implementation slides 1-10.
	1. Part 1 – What’s Going On? (10 minutes) (Slides 1-5)
	2. Part 2 – Rising Sea Levels (20-25 minutes) (Questions on CS handout)
	3. Part 3 – Vegetation (10 minutes) (Slides 6 & 7)
	4. Part 4 – The Future (10 minutes) (Slides 8 & 9)
	5. Part 5 – How to Respond? (2 minutes) (Slide 10)
		1. Only introduce the question on slide 10, but wait to go through the rest of this section until day 2.
		2. Assign students to one of the five “sea-level response strategies”
		3. Have each student research the pros and cons of their assigned strategy
		4. Inform each student that they will have to defend their response strategy, even if they don’t agree with it.
	6. Deutsch focus questions – Present as a Think-Pair-Share model (25-30 minutes) (Slides 11-20)
		1. These are the pre-class assignment questions so each student should have come to class with their own thoughts distilled in their assignment responses.
		2. Ask each student to take their assignment responses and compare their responses to the students around them (I suggest groups no larger than 4)
		3. Assign each group a question from the assignment that they are responsible for presenting (if time allows) and discuss any misconceptions about these topics.
			1. NOTE: Defining latitudinal zones is necessary here.
			2. NOTE: Explaining why Polar regions, not Tropical regions, experience the greatest magnitude of temperature variation is needed here.
		4. As a large group, go through each of the Deutsch focus questions
		5. On slide 18, provide students with the handout “Assessing species extinction risks” and tell them that they need to find a local species that fits the criteria listed on that slide.
			1. This information should be entered into a google sheet file that is shared with the class so there isn’t overlap in species selected
			2. All information should be entered before the beginning of the next class period

NOTE: Slides with the Deutsch focus questions and answers are included as part of our adaptation plan.

**DAY 2**

*Homework completed before class includes completing the handout “Assessing species extinction risks” and calculating their species’ thermal safety margin and warming tolerances.*

1. Begin with original case study implementation slides 10-17.
	1. Part 5 - How to Respond? (20-30 minutes) (Slides 10-17 on original PowerPoint or slides 1-8 of our adaptation file ‘Saltmarsh Sparrow Day 2’)
	2. Present this as a T-P-S.
		1. These are the pre-class assignment questions so each student should have come to class with their own thoughts distilled in their assignment response.
		2. Ask each student to take their assignment responses and compare their responses to the students who were assigned to the same ‘sea-level response strategy’
		3. Ask each group to prepare a collective argument for and against their strategy
	3. Have each group come to the front of the room and present their pros and cons to their response strategy
	4. After all groups have presented, give the groups a few more minutes to weigh the pros and cons of all strategies.
		1. After a couple of minutes of final discussion, have each student vote for their preferred option
			1. NOTE: Make sure they know that they can vote for any option and they should choose the option that they think is the best solution to the problem. This should also weight factors such as likelihood of implementation, cost, and environmental impact.
			2. Tally the class votes and discuss why they chose a particular option.
2. Project the spreadsheet of species that the students calculated TSM and WT’s for.
	1. Have students compare and contrast the TSM’s and WT’s in their small groups (Project slide 9)
	2. Ask the students to decide which species they would rank as their top 3 species to spend conservation funds on and tell them they need to defend their answers.
	3. Have each group share their top 3 species choices and write out the responses on the board
	4. After everyone has shared their responses, ask each group to look over the data and selections again and make any final changes to their list.
	5. Gather those changes, and then discuss which species would be the best candidates for conservation funds. NOTE: This decision should be based on likelihood of survival in a warming climate, how charismatic the organism is (i.e. will the general public see the value in conserving that species?), and the scientific value of the organism (i.e. is it a keystone species that would mean the conservation money would really be protecting more than one species?)
3. Return to the discussion on the Deutsch et al. paper (Project slide 10)
	1. Share the raw data set provided by Deutsch et al. and tell the students that the goal is to summarize the data by mean warming tolerances and range of warming tolerances per Order of insects.
		1. A Summary Table of this goal is on slide 10
		2. Examples of insects from each Order are on slide 10
	2. Project the excel data and as a class, show the students how to sort and analyze data in Excel or other data analysis software of your choice
	3. Have students enter Excel functions as part of their data summary
	4. Project slide 10 again as an example of what the students should get as their final calculations
	5. When everyone has completed their Excel exercise, discuss what the data means