

## **SESYNC Case Study: Tell Them We Don't Want to Leave... The Marshallese and Sea-Level Rise**

**Title:** Tell them we don't want to leave... The Marshall Islands and the Rising Sea

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### **Summary:**

This case study focuses on the peoples of the Marshall Islands, a collection of islands and atolls in the Pacific Ocean. The Marshallese are faced with increasing population pressures, a struggling economy, droughts and rising sea levels as well as repercussions from the atomic testing by the US military. This case study exposes students to the ways in which social-environmental systems operate and connect across different scales. Using a combination of a directed case study and a decision case, students review documents, environmental and social data, along with qualitative data. Students synthesize the data to begin to understand sea-level rise and current and potential impacts on the Marshallese. In the decision case portion of the study, students work together in small groups to identify a suite of possible actions to be taken by groups in the US and/or in the Marshall Islands for adaptation to climate change impacts.

### **What course(s) might this case be appropriate for?**

Introductory environmental or sustainability sciences course or non-majors science or sociology course; with adaptations, the case could be appropriate for upper level undergraduates in environmental sociology, environmental sciences, multidisciplinary policy or governance courses.

### **What level is this case appropriate for?**

This case is designed for lower level undergraduates in an introductory course or AP class in high school; with adaptations, the case would be appropriate for upper level undergraduates.

### **SES Learning Goals- which SES goals are addressed in this case:**

**SES Goal 1.** Ability to describe a socio-environmental system, including the environmental and social components and their interactions.

*Learning objective:* Students will produce a concept map representing the social-environmental system of sea-level rise and the Marshallese people.

*Related activity:* Students will create a concept map at the beginning of the case study and refine it as they gain more information and insights.

**SES Goal 3.** Ability to find, analyze and synthesize existing data.

*Learning objectives:*

- Students will be able to identify the location of the Marshall Islands and Arkansas on a map

- Students will be able to identify three sources of variability of sea level rise and describe two pieces of scientific evidence of climate change as they pertain to sea level rise
- Students will be able to compare and contrast the issues facing the Marshall Islands communities with those facing a receiving community (Springdale) based on basic demographic information
- Students will be able to use the basic population formula (change = births + deaths + net migration)
- Students will identify differences and congruencies in time and geographic scales for environmental and social data

*Related activity:* Lower level undergraduates, introductory students will be provided data for analysis and synthesis through handouts and web resources. Students will be introduced to qualitative as well as quantitative data. Modification for upper-level undergraduates would have students define what information is needed and then locate appropriate data. Students will synthesize data, combining sea-level rise projections and demographic data to estimate possible population impacts. Adaptation for upper-level undergraduates could include more sophisticated mapping and spatial analysis, developing actual models, writing policy recommendations for the Republic of the Marshall Islands and/or for the US government, or developing mitigation projects for remaining on the Islands.

**SES Goal 4.** Ability to consider the importance of scale and context in addressing socio-environmental problems. Understand the ecological and social processes often vary across differing contexts, including space, time and conditions (e.g. economic or political).

*Related activity:* In the homework assignments and classroom activities, students will be introduced to concepts of long-range impacts of the nuclear testing on the environment and people's health, the relatively slow speed of sea-level rise and the episodic nature of storm surges and king tides, and thus learn about phenomena at differing time and geographical scales. Students will construct timeline of events to demonstrate temporal scales. Students will also examine the interplay across multiple scales of the social-environmental system (for example, the local flooding of Majuro as a result of global sea-level rise increases global migration to Arkansas resulting in pressure on local educational system resources).

**Note:** Assessment activities are boxed; estimated time for sections found in red

### **Introduction/Blocks of Analysis**

This case study is designed to introduce students to the concept of linked social and environmental systems and provide exposure to selected basic skills. The case study assumes little prior experience; for students with more skills or background, the case study can be easily modified to be more challenging. This case was selected because it provides a social-environmental system in which the links between the systems are reasonably straightforward and the consequences of the interactions increasingly urgent. The impacts of sea level rise in the Marshall Islands are often categorized as a “slow” disaster even though the Marshallese themselves report experiencing consequences right now. The case study places students on the leading edge of the climate change mitigation and adaptation discussion. Sea-level rise, driven by global climate change, is causing land erosion, saltwater intrusion, and flooding in the

Marshall Islands. Additionally, the Marshall Islands have been experiencing a drought. These events have combined to result in declines in agricultural production and threats to freshwater resources. As a result, people are moving from the outer atolls and islands to Majuro and Ebeye, the largest of the atolls. These two very densely populated atolls already have high unemployment and poverty rates. From Majuro and Ebeye, some Marshallese are moving to the US, often ending up in Springdale, Arkansas.

The Marshall Islands are over 1,200 islets in 29 atolls scattered across  $\frac{3}{4}$  million square miles. The average height above sea level is 2 meters (7 feet). The highest elevation, found on Likiep Atoll, is 6 meters. The atolls are coral rims that partially or completely surround a lagoon. Often the atolls also are fringed by coral reefs which serve as the atolls' defense against ocean surge. The water over these reefs, however, is often only a few feet and sometimes only a few inches. Climate change and sea-level rise research began in the Marshall Islands in the early 1990s as these atolls were expected to be amongst the first places where such changes would be detected (<http://www.rmiembassyus.org/Environment.htm>).

In addition to sea-level rise, the Marshall Islands have another environmental problem. During World War II, the US captured the Marshall Islands from the Japanese and when the war ended, the US served as the administration of the islands as a trust territory for the United Nations. The US military conducted nuclear testing on several of the islands, notably Bikini Atoll (still uninhabitable) and exposed the people of Rongelap and other atolls to radioactive fallout. Marshallese exposed to this fallout have experienced high rates of thyroid tumors (benign and malignant) and birth defects. In 1986, the Islands gained independence, signing the Compact of Free Association with the US and receiving a monetary reparation payment of \$150 million in reparations for the atomic testing impacts. The US military continues to maintain a large base on Kwajelain atoll; the base and its operations play a major role in the local economy.

The two largest atolls, Majuro and Ebeye, have rapidly rising populations of about 40,000 (out of approximately 55,000 total in the Marshall Islands) and outstrip the natural resources of the atolls. These urbanized populations are dependent on imported foods and goods. Poverty, unemployment, adult obesity, non-communicable diseases, teenage pregnancy, suicide, alcoholism, and tobacco use are all high. Migration to Springdale, AR, started in the mid-1980s and as a result, the largest population of Marshallese outside the islands is now found in Springdale. Although Marshallese now migrate primarily to find employment, better health care, and better educational opportunities, the environment of the islands is becoming a more important factor as it is not clear if the Marshallese people will be able to continue to inhabit their traditional lands. As the students synthesize socio-economic, topographical, sea-level and legal data, they will have an opportunity to experience the importance of multidisciplinary in studying social-environmental systems.

## References

### For use in class or assigned to students

1. "Tell them" poem by Kathy Jetnil-Kijiner: <http://jkijiner.wordpress.com/2011/04/13/tell-them/>
2. Concept Mapper: <http://cmap.ihmc.us/>
3. Climate Change and Sea-level Rise:

- a. [http://www.smithsonianmag.com/videos/category/3play\\_1/climate-change-101-with-bill-nye-the-science/?no-ist](http://www.smithsonianmag.com/videos/category/3play_1/climate-change-101-with-bill-nye-the-science/?no-ist)
- b. <http://www.epa.gov/climatechange/science/overview.html>
- c. <http://ocean.nationalgeographic.com/ocean/critical-issues-sea-level-rise/>
- d. <http://www.climate.org/topics/sea-level/>

Maps:

4. [http://www.lib.utexas.edu/maps/australia/oceania\\_ref\\_2012.pdf](http://www.lib.utexas.edu/maps/australia/oceania_ref_2012.pdf)
5. [http://commons.wikimedia.org/wiki/File:MH\\_map\\_A.png](http://commons.wikimedia.org/wiki/File:MH_map_A.png).
6. King Tide: <https://www.youtube.com/watch?v=B4abshci7rY>
7. Marshallese in Springdale, video: <https://www.youtube.com/watch?v=iiLhduZDr9Y>
8. Marshallese in Springdale, article: <http://www.nytimes.com/2012/07/05/us/for-marshall-islanders-hopes-and-troubles-in-arkansas.html>
9. Nuclear testing and rights:  
<http://ajph.aphapublications.org/doi/pdfplus/10.2105/AJPH.91.9.1371>
10. Kathy Jetnil-Kijiner at the UN:  
<http://thinkprogress.org/climate/2014/09/23/3570736/kathy-jetnil-kijiner-marshall-islands-un-speech/>

Demographic data:

11. RMI 2011 Census Report: <http://www.spc.int/prism/country/mh/stats/Publications/pub-new.htm>
12. RMI Migration data: <http://www.un.org/en/development/index.shtml/desa/index.html>
13. Springdale census data:
  - a. <http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml>
  - b. <https://www.census.gov/construction/chars/completed.html>
  - c. <http://www.census.gov/popest/data/counties/asrh/2013/index.html>

## Additional background material

Marshall Islands:

<http://www.rmiembassyus.org/>

<http://www.spc.int/prism/country/mh/stats/Publications/pub-new.htm> (has a variety of reports on the RMI, including censuses)

CIA (Central Intelligence Agency) 2014. World Factbook: Marshall Island Economy Overview. Found at <https://www.cia.gov/library/publications/the-world-factbook/geos/rm.html0>

Basic demography:

[www.uaex.edu/business-communities/Understanding%20Community%20Demographics.pdf](http://www.uaex.edu/business-communities/Understanding%20Community%20Demographics.pdf)

Climate change primers:

<http://ncse.com/climate/climate-change-101>

<http://www2.ucar.edu/news/backgrounders/understanding-climate-change-global-warming>

<http://www.fs.usda.gov/ccrc/climate-basics/climate-primer>

Concept mapping:

<http://cmap.ihmc.us/publications/ResearchPapers/TheoryCmaps/TheoryUnderlyingConceptMaps.htm> or [https://www.youtube.com/watch?v=H4Rcj\\_JYTeo](https://www.youtube.com/watch?v=H4Rcj_JYTeo).

## **Classroom Management**

*Class 1 (50-minute class)*

Introduce topic with a brief description of the Marshall Islands – map, satellite pictures (5 minutes)

Play “Tell Them” video by Kathy Jetnil-Kijiner [<http://jkijiner.wordpress.com/2011/04/13/tell-them/> and/or provide handout of poem]. Follow with short discussion of students’ reactions. Be sure to elicit understanding that Jetnil-Kijiner wants to “tell them” about the impacts (not just the threat) of sea-level rise on her personally and on her nation. Explain to students that the activities in this case study are to help us learn about some of what Jetnil-Kijiner would like to tell us. (15 minutes including playing video)

Demonstrate a simple system and draw on board with students. A concept map is a method for diagramming concepts and their relationships. See supplemental file for a few examples or see <http://cmap.ihmc.us/publications/ResearchPapers/TheoryCmaps/TheoryUnderlyingConceptMaps.htm> or [https://www.youtube.com/watch?v=H4Rcj\\_JYTeo](https://www.youtube.com/watch?v=H4Rcj_JYTeo). Working in pairs, have students then individually create a concept map for the Marshall Islands social-environmental system as completely as they can. Have students turn in concept maps (30 minutes)

**Give Homework 1 assignment** (found in separate file): complete reading on climate change and sea-level rise (items 3 a-d above) and answer questions after completion of reading assignment.

*Class 2 (50-minute class)*

Hand out global maps (items 4 and 5 above) and have students mark areas around the globe which are threatened by sea-level rise. Have students locate the Marshall Islands and note whether or not they previously identified the Marshall Islands as being at risk. Have students identify Arkansas and roughly estimate the distance between the Marshall Islands and Arkansas. Quickly review/summarize information from homework assignment: variations of sea-level and the contributions of melting ice caps, thermal expansion, wind and tidal patterns. (15 minutes)

Show video of storm surges and high tides, item 6 above. (5 minutes)

Display pictures of Majuro and Marshallese in Springdale (found in supplemental PowerPoint file). Give students population data handout (Table 1 in Appendix). Work through example of population change formula with class, perhaps using local statistics (easily found at <http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml>).

Have students work in pairs and using Table 1, **complete Homework 2 (found in separate file)**; this homework contains questions to be answered from the demographic data. Assign for take-home if additional time needed.

Have the students work in pairs to identify three problems facing the Republic of the Marshall Islands government and three problems facing the Springdale, Arkansas government based on *both* demography and the environment. Have students construct lists of words (nouns or verbs) they have used in describing the three problems. Then as a whole class, use Wordle (<http://www.wordle.net/create>) to create a word cloud from the students' word lists. Discuss with students the dominant themes. (30 minutes)

Have students turn in their problems and word lists for an assessment.

If time in class, show video of Marshallese in Springdale (item 7 above). Otherwise, assign for viewing outside class or have students read article about Marshallese in Springdale (item 8 above).

For homework assignment, have students read material on nuclear testing and fallout in the Marshall Islands, item 9 above. Assign video/reading about Marshallese in Springdale, item 7 or 8 above, if not done in class.

*Class 3 (50-minute class)*

In pairs, have students revisit their concept maps. Working together, they should modify the concept map with the additional information from previous classes. (10 minutes)

Play video on Nuclear Remembrance Day and the atomic testing in the MI ([http://www.youtube.com/watch?v=e\\_2AgIsLva0](http://www.youtube.com/watch?v=e_2AgIsLva0); stop at credits).

Have students write 5-minute reflection paper on the video, including ways in which this historical experience influences current day concerns of Marshallese (10 minutes). Use this paper as an assessment. After collecting reflection papers, have students share their thoughts and reactions in class.

Using all the information provided to this point, lead class discussion on how the differing time scales play a factor in looking at the situation in the Marshall Islands: for example, atomic testing took place in the 50s and 60s; what's the time frame for human impacts? For environmental impacts? What's the time frame for sea-level rise? For climate change? What about human time scales? How do these time scales compare and overlap? Look for general understanding and comparison – is this a long time or a short time? Does it happen in one lifetime or over generations? How does it relate to human planning horizons and response times (individuals, families, governments, political cycles, etc)? (10 minutes)

For an assessment, have students fill in time line from 1900 to 2100 with decades marked in between (see sample in supplemental file). Allow students time to sketch in events unprompted. Then have them add any of these they did not include originally. Provide the event but not the time horizon. After collecting students' timelines, work through quickly on board at least the items below and solicit any students may have included that are not in this list (10 minutes).

World War II (1939-45)

Atomic testing in RMI (1946-62)

Kathy Jetnil-Kijiner's life so far (1988-2015)

Their life so far

Climate change (start with 1900 and all the way to 2100 to indicate rise in CO<sub>2</sub> with industrialization)

Sea-level rise (also begins in 1900 but students could also indicate since 1990s as that's when modern instrumentation began; continues to 2100)

Rapid rise in Marshallese emigration to Springdale, AR (as well as other parts of US) – mid to late 1980s to today

RMI as nation (any or all of these):

RMI officially a nation (1979 forward)

Compact of Free Association (1986 forward)

RMI no longer trustee and joins UN as fully independent, sovereign nation (1990 forward)

Health impacts of atomic fallout from testing on RMI residents (1946 forward and continuing into future; could be the impacts end with deaths of those exposed except for DNA damage passed on to children)

Environmental impacts of atomic fallout from testing on RMI islands (1946 forward and continuing into future)

In small groups, have students examine their concept maps and identify the points in the system they believe most amenable to producing effective change for the Marshallese. Have the students note the criteria used to make these determinations. Then have students brainstorm ideas for possible actions to be taken based on these decisions. Goal is to generate as many ideas as possible in 2 minutes. When finished, groups should take another 2 minutes to select the “best” and the “most

creative” ideas. Have groups report to the whole their criteria, decision points and two selected ideas  
(20 minutes)

Have students turn in their list of ideas as an assessment.



*Class 4 (50-minute class)*

In pairs, have students name the justice issues involved for Marshallese but also for people in Springdale; collect all different justice issues on board (5 minutes)

Work with class on identifying the individuals, groups, organizations, governments that may “hold the power” to address specific elements of justice issues. Compare this discussion’s outcomes with the previous session’s ideas and decision points. Goals of discussion are: 1) to identify the agency of individuals as well as organizations and institutions; 2) to connect justice issues across the various scales already covered (time, geography, local-global); 3) to elicit the social and physical locations of different knowledge; 4) identify connections missing from concept maps. This discussion/lecture is intended to highlight social-environmental synthesis (30 minutes for discussion).

In-class assignment: have students finalize individual concept maps and submit (15 minutes)

**Homework assignment:** submit short essay (1-2 pages) entitled “What I would say to Kathy Jetnil-Kijiner if I had the opportunity.” Essay should be personal reflection which utilizes data and insights from the case study and provides specific ideas, suggestions or recommendations to Jetnil-Kijiner for the Marshallese or specific ideas, suggestions, or recommendations for the US or both.

## Assessments

Assessments are provided throughout case study, grading rubrics for reflection paper and essay below. Some assessments are intended for grading, others are participatory only.

1. Create and refine concept map (graded)
2. Complete Homework 1 (graded)
3. Complete Homework 2 (graded)
4. Contribute to wordle through identified issues and word lists (participatory)
5. Write 5-minute reflection paper on the video about Nuclear Remembrance Day and the atomic testing in Marshall Islands (graded)
6. Completed timeline (graded or participatory)
7. List of potential ideas for interventions (participatory)
8. Write short essay (1-2 pages) entitled “What I would say to Kathy Jetnil-Kijiner if I had the opportunity” (graded)

See attached table for more details.

### *Grading rubrics for writing assignments*

#### Reflection paper:

Paper should reflect ways in which historical experiences influence current day concerns of Marshallese. Any of the ideas below (or similar connections) should be demonstrated. Empathy for the Marshallese is appropriate, but point of assessment is to determine if student can “connect the dots” and see the synthesis of the social and environmental data provided so far in terms of human responses and outcomes.

1. loss of environmental resources driving migration, short- and long-term health problems as a result of nuclear testing
2. conflicted relationship between US and Marshallese
3. loss of cultural identity as a result of loss of traditional activities and access to traditional lands
4. economic drivers of migration (health care, education, employment)
5. impacts of globalized economy and security activities of US military (presence of US military base both provides jobs and skews local economy)
6. efforts to make Marshallese voice heard and demonstrate/utilize agency (power)

#### Essay

Essay is intended to demonstrate what student has learned throughout the case study. Students should employ concepts and information provided to construct educated, not merely emotional, response. Objective for student is to demonstrate synthesis of the social and environmental data and concepts in application to a real-world problem.

Essay should include at least 2 specific ideas or recommendations and provide justification based on information from the case study.

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<b>Goal</b>	<b>Detail of goal</b>	<b>Learning Objective</b>	<b>Activity</b>	<b>Assessment</b>
Goal 1: Ability to describe a socio-environmental system, including the environmental and social components and their interactions.	Identify the environmental and social components of the system and their interactions	Students will be able to create a concept map that links the social and environmental components of the social-environmental system in the Marshall Islands	Concept map developed throughout case study	Turn in pre and final concept maps
	Identify feedbacks and explain the dynamics of an S-E system			Reflective 5-minute essay; final essay
Goal 4: Ability to consider the importance of scale and context in addressing socio-environmental problems.	Understand that ecological and social processes often vary across differing contexts, including space, time and conditions (e.g. economic or political)	Students will sketch timeline of events and impacts Students will create a list of possible actions or responses of the Marshall Islands people, incorporating the issues of time, space and conditions generated in previous activities.	Students will sketch timeline. Groups will create lists	Students will turn in timelines; class will review together. Groups report to class as a whole; groups will turn in lists; create wordle
	Understand that ecological and social processes interact	Students will be able to compare and contrast the issues facing the Marshall Islands communities with those facing a receiving community (Springdale)	Groups will create compare and contrast tables	Groups report to class as a whole

	across different scales			
Goal 3: Ability to find, analyze and synthesize existing data.	Identify data sources and appropriate tools, evaluate quality of data, and manage data	Students will be able to identify the location of the Marshall Islands and Arkansas	Students will use maps and identify locations	Formative assessment in class ascertaining that students have successfully identified information
	Understand the different kinds of data and research methods used by relevant disciplines in the natural and social sciences	Students will be able to identify three sources of variability of sea level rise and describe two pieces of scientific evidence of climate change as they pertain to sea level rise		Homework assignment with questions to answer
		Students will be able to manipulate the basic population formula		Homework assignment with questions to answer
		Students will combine demographic data and map data to perform a simple correlation analysis		Formative assessment in class ascertaining that students have successfully identified information