Ways of Knowing

The Integration of Indigenous Knowledge and Scientific Knowledge for Natural Resource Management

Teacher's Notes

Amity Doolittle, PhD
Yale School of Forestry & Environmental Studies

This work was supported by the National Socio-Environmental Synthesis Center (SESYNC) under funding received from the National Science Foundation DBI-1052875

TABLE of CONTENTS

Summary

This case study explores the nature of indigenous knowledge (IK) and scientific knowledge (SK) in terms of natural resource management. The goal of the case study is to encourage students to think critically about the nature of different ways of knowing the natural world and different types of evidence or data; to consider how to integrate IK and SK for natural resource management; to explore how knowledge integration would benefit natural resource management, indigenous peoples and the scientific community; and finally to consider some of the obstacles to knowledge integration. Students will analyze data sets from both IK and SK; read a peer reviewed, scientific article that provides a comprehensive and practical illustration of knowledge integration for natural resource management; and reflect on the pros and cons of future knowledge integration for natural resource management from the perspective of both scientists and indigenous peoples.

The case is designed in three sections, with each section getting more complex in terms of learning goals, moving from acquiring basic knowledge, to understanding how to apply basic knowledge to real world circumstances, to being able to summarize and evaluate knowledge systems, to being able to analyze, synthesize and finally debate the pros and cons of different knowledge systems, in reference to natural resource management.

- **In Section 1: "Ways of Knowing"** students will learn to differentiate between IK and SK in terms of various epistemological characteristics associated with knowledge production.

- **In Section 2: "Types of data"** students will learn to compare, contrast, summarize and evaluate the differences between the worldviews of indigenous peoples and scientists.

- **In Section 3: "Data Integration"** students will learn how to evaluate various ways that IK and SK can be integrated. They will debate the pros and cons of knowledge integration and develop arguments supporting the integration or exclusion of different knowledge systems for natural resources management.

This case study would be appropriate for the following types of courses: Natural Resource Management, Environmental Anthropology, Human Geography, Conservation Biology, Political Ecology, Environmental Justice,

This case study is designed for upper lever undergraduates and graduate students in environmental studies, human geography, environmental anthropology or similar fields.

Socio-Ecological Synthesis Learning Goals

This case addresses the following Socio-Ecological Synthesis Learning Goals:

SES Goal 1: Analyze and synthesize existing data, ideas (e.g. frameworks or models), and methods.

SES Goal 2: Co-develop research questions and conceptual models in inter- or trans-disciplinary teams.

SES Goal 3: Consider the importance of scale and context in addressing socio-environmental problems.

Learning Objectives

Section 1: Ways of Knowing

Learning objectives: Students will learn to differentiate between IK and SK in terms of various epistemological characteristics associated with knowledge production. They will be able to answer the following questions:

- How is knowledge acquired?
- What types of information can be considered as evidence?
- What are the sources of information and knowledge?
- How can we differentiate the difference between truth and falsehood and assess the validity in different knowledge systems?

Additionally students will learn to summarize the similarities and differences in data from IK and SK in their own words and demonstrate a full understanding of the concepts. Students will learn how to analyze and discuss different perspectives on IK and SK, and will learn to work collaboratively to build censuses around the strongest definitions.

Section 2: Types of data

Learning Objectives: Students will learn to summarize and evaluate the difference types of data from the two different worldviews—scientific knowledge and indigenous knowledge. Further, they will be required to defend and justify their opinions about the value or validity of different types of data. Finally, through the close examination of several data sets students will learn to extrapolate the different types of research methods needed to collect the various data sets.

Section 3: Data Integration

Learning Objectives: Students will learn how to evaluate various ways that IK and SK can be integrated in a research project. They will debate the pros and cons of knowledge integration in terms of effective natural resource management from the perspective of scientists and indigenous peoples. Finally students will be able to synthesize and reflect on what they have learned through the final evaluation where they are presented with a specific scenario and asked to write a paper in support of either the integration or the exclusion of different knowledge systems

Background

NOTE: This background material is divided into two sections: "Introduction" and "Widening the Lens". The "Introduction", should be presented to students the day before you begin the in-class activities of the case study. This material is covered in a PowerPoint presentation (see Supplemental Materials, **Ways of Knowing: Introduction.ppt**). The PowerPoint specifically does not provide in-depth definitions of IK and SK, developing those definitions will be part of the students' assignments. **TIME:** The PowerPoint will take ~10-15 minutes and should be made available for students to refer to later.

NOTE: The material below under "Widening the Lens" will be presented verbally by the teacher in Section 3: Data Integration, prior to Activity 3c (see page 19 of the Teacher's notes).

INTRODUCTION: This case study was prompted by a news article titled "Biodiversity Panel Gives Indigenous Knowledge a Core Role". Reading past the headline we learn that the Intergovernmental Platform on Biodiversity & Ecosystem Services was established in April 2012 with the mission to "assess the state of the world's biodiversity and ecosystems, and help policymakers make well-informed decisions" (Kennedy 2014). This decision was seen by the international community as unique in its explicit endorsement of "different scientific disciplines (natural, social, engineering sciences), as well as diverse (western science, indigenous, local and practitioners' knowledge" (Diaz 2015). Many international conservation organizations regarded this decision as an innovative endeavor—something that had never been tried before.

In many ways this announcement is welcome and timely. Indigenous communities around the world have long called for recognition of their traditional knowledge. A better understanding indigenous knowledge system is particularly important when considering appropriate adaptations to environmental changes related to climate change.

However, not all scientists have responded enthusiastically; some are skeptical about the value of traditional knowledge. Traditionally scientific research focuses on determining the true nature of reality through systematic observation, measurement, and experimentation. Scientists' primary goal is to produce falsifiable and generalizable data. Indigenous

knowledge is considered to be the quintessential opposite: social and natural systems are seen in a holistic manner, and knowledge inherently place based, drawn from experience and non-generalizable. The rules of science regarding evidence, quantification, replication and generalization do not carry the same value in indigenous knowledge systems (Berkes and Berkes 2009).

Additionally many social scientists and indigenous peoples themselves worry that the central assumption in any attempts to integrate different knowledge systems—that local knowledge can conform to scientific knowledge—is flawed. Traditional knowledge and science are sufficiently distinct to make these knowledge systems incommensurable (Bohensky and Maru 2011). Thus, the result of any project aimed at knowledge integration will only result in diminishing the value of both indigenous knowledge and scientific knowledge (Jackson et al. 2014).

Nevertheless the interest in integrating indigenous knowledge with scientific knowledge is growing. Bohensky and Maru (2011) present three arguments for the integration of indigenous and scientific knowledge systems. 1) The integration of indigenous knowledge and scientific knowledge is essential for maintaining global cultural diversity and the biological diversity with which it is intricately connected; 2) Local or traditional knowledge contribute invaluable knowledge for science and natural resource management, filling gaps in understanding that science cannot; 3) Recognition of traditional knowledge in natural resource management has importance beyond scientific merit; it is tantamount to social justice, sovereignty, autonomy, and identity of indigenous people.

Climate change makes integration of IK and SK even more relevant. Many of the arguments for knowledge integration revolve around the concept of resilience—the ability of a social-ecological system to withstand disturbance and remain flexible in response to changing environmental and social contexts. It follows that the "management of complexity and uncertainty in social ecological-systems can benefit when diverse types of knowledge are combined; co-management arrangements that allow knowledge to be integrated through collaboration can build social as well as ecological resilience" (Bohensky and Maru 2011: 2).

WIDENING THE LENS: Many of the existing research projects that integrate indigenous and scientific knowledge focus on investigating discrete data points on topics like: the absence and presence of certain species or observations on changing ecosystems, and weather patterns. But indigenous knowledge is much more than that. It encompasses a whole worldview about how to interact with world, in a sustainable manner and with the future generations in mind. In indigenous knowledge systems humans are seen as guardians of the earth. Conversely, scientific knowledge is based in a culture that is imbued with the philosophy that economic growth is the paramount goal. In market-based economies natural resources are as seen as the necessary energy to fuel economic growth. At the root of these different worldviews are variations in how people perceive the so-called nature-culture divide, or the nature of humankind's relationship to the natural world. This generalization does not mean that all scientists are economic-driven capitalists, nor does it mean that all natives are 'noble savages' living in harmony with the world. But it does highlight the fact that worldviews in which both scientific and indigenous knowledge are embedded are vastly different. Most importantly, for indigenous people, their environmental knowledge extends to every aspect of their social world, while scientists knowledge tends to be fragmented by disciplines that look at various elements of nature and various elements of society in relative isolations (think of biology, sociology, botany, anthropology).

Broadening our understanding of indigenous knowledge, beyond descriptive observations, to include stories and explanations of indigenous ethics, belief and values that guide their understanding of the environment raises many questions about the larger project to integrate scientific and indigenous knowledge systems. These questions, about how to achieve knowledge integration and the ultimate value of knowledge integration, are not immediately answerable and warrant further and deeper exploration.

References

1. Alaska Native Science Commission's definition of indigenous knowledge http://www.nativescience.org/html/traditional_knowledge.html. Accessed 7/17/2014.
2. Alexander, Clarence, et al. 2011. "Linking Indigenous and Scientific Knowledge of Climate Change". BioScience 61(6): 477-484.
3. Barnhardt, Ray and Angayuqaq Oscar Kawagley.2005. "Indigenous Knowledge Systems and Alaska Native Ways of Knowing". *Anthropology & Education Quarterly* 36 (1): 8-23.
4. Berkes Fikret and Mina Kislalioglu Berkes. 2009." Ecological complexity, fuzzy logic, and holism in indigenous knowledge". Futures 41 (2009) 6–12
5. Bohensky, E. L., and Y. Maru. 2011. Indigenous knowledge, science, and resilience: what have we learned from a decade of international literature on "integration"? *Ecology and Society* **16**(4): 6.
6. Boillat, Sébastien and Fikret Berkes. 2013. "Perception and Interpretation of Climate Change among Quechua Farmers of Bolivia: Indigenous Knowledge as a Resource for Adaptive Capacity". Ecology and Society 18(4): 21.
7. Chaudhary, Pashupati and Kamaljit S. Bawa. 2011. "Local perceptions of climate change validated by scientific evidence in the Himalayas". Biological Letters. 7 (5): 767-770
8. Díaz, Sandra, et al. 2015. "The IPBES Conceptual Framework — connecting nature and people", *Current Opinion in Environmental Sustainability*. Vol. 14: 1-16.
9. Gupta, Anil. 2007. "How local knowledge can boost scientific studies." SciDevNet. http://www.scidev.net/global/bioprospecting/opinion/how-local-knowledge-can-boost-scientific-studies.html. Accessed 7/17/2014.
10. International Network of Mountain Indigenous Peoples. 2014. "The Bhutan Declaration on Climate Change and Mountain Indigenous Peoples". http://www.andes.org.pe/note-the-bhutan-declaration-on-climate-change-and-mountain-indigenous-peoples. Accessed 7/17/2014
11. Jackson, Sue E., Michael M. Douglas, Mark J. Kennard, Brad J. Pusey, Jabal Huddleston, Bill Harney, Lenny Liddy, Mona Liddy, Robert Liddy, Lizzy Sullivan, Brenda Huddleston, Melissa Banderson, Andrew McMah and Quentin Allsop. 2014. " 'We Like to Listen to Stories about Fish':

Integrating Indigenous Ecological and Scientific Knowledge to Inform Environmental Flow Assessments". Ecology and Society 19(1): 43.
12. Kennedy, Nick. 2104. Biodiversity panel gives indigenous knowledge core role." SciDevNet . http://www.scidev.net/global/indigenous/news/biodiversity-panel-gives-indigenous-knowledge-core-role.html?stay=full. Accessed 7/17/2014.
13. Kulkarni, Ashwini , Savita Patwardhan K. Krishna Kumar, Karamuri Ashok, and Raghavan Krishnan. 2013 "Projected Climate Change in the Hindu Kush–Himalayan Region By Using the High-resolution Regional Climate Model PRECIS". Mountain Research and Development, 33(2):142-151.
14. International Network of Mountain Indigenous Peoples. 2014. **The** Bhutan Declaration on Climate Change and Mountain Indigenous Peoples**.** Mountain Communities Workshop on Climate Change and Biocultural Heritage. May 26-June 1, 2014._http://pubs.iied.org/pdfs/G03798.pdf. Accessed 2/25/2105.
15. Nakweya, Gilbert. 2014. "Project mixes local, expert know- how to predict weather" SciDevNet. http://www.scidev.net/global/climate-change/news/project-expert-predict-weather.html. Accessed 7/17/2014.
16. Raman, Usha. 2011. "Local knowledge 'can corroborate climate data'" SciDevNet. http://www.scidev.net/global/biodiversity/news/local-knowledge-can-corroborate-climate-data--1.html .Accessed 7/17/2014.
17. Ridely, Matt . 2014."Five Free Market Truths". *Competitive Enterprise Institute* 27(3): 1-3. http://cei.org/sites/default/files/CEI%20Planet%20Summer%202014.pdf. Access 2/22/2014
18. Wikipedia's definition of *Scientific Method;* http://en.wikipedia.org/wiki/Scientific_method. Accessed 7/17/2014

Section 1: Ways of Knowing

Lecture and Handouts to be provided the day before Section 1: Ways of Knowing

NOTE: The day before you begin the classroom activities and discussions this case study, provide the students with a short introductory PowerPoint to orient them to the work ahead. The PowerPoint specifically does not provide in-depth definitions of IK and SK, developing those definitions will be part of the students' assignments. See file:

- **Ways of Knowing_Introduction.ppt** (Supplemental Materials, separate file). Students should have access to this PowerPoint throughout the case study.

NOTE: After the introductory PowerPoint and prior to first in-class session, provide students with the following handouts for homework:

- **Assignment 1: Ways of Knowing, Definitions** (see separate file "Student Handouts")
- **Assignment 1: Ways of Knowing, Table** (separate file "Student Handouts")

HOMEWORK Assignment 1: For homework the students should read the handout with the definitions of science knowledge (SK) and indigenous knowledge (IK). The handouts also include two links to two videos for students to watch at home. These are:

- "Vandana Shiva on Mechanists vs Scientific Knowledge" https://vimeo.com/103764529
- "Science and the Scientific Method" https://vimeo.com/33295400

A second handout is a blank table for the students to complete comparing and contrasting IK and SK. Students should complete this table before class meeting and bring it to the discussion.

IN CLASS Activity 1a: In class students will meet in groups of 3-5 students to their compare tables they completed as homework. Through discussion they will produce a new, single table that encompasses the best of everyone's table. Make sure each group selects a rapporteur who takes notes of the conversation and person to report back to class.

TIME: Small group discussion ~20 minutes
NOTE: For this activity it would be useful for students to have large flip charts to record their answers and bring up to the front for the class discussion in Activity 1b.

IN CLASS Activity 1b: Each group reports back to class as a whole. As a class, develop a single master chart drawing on all students' ideas and make this available as a resource for students.

TIME: Reporting back and class discussion ~15-20 minutes
NOTE: Plan ahead how to use the blackboard to capture the summary of the class discussion. Take a picture of the black board when you are finished in order to create a summary document for the students to have a reference for future sections.
NOTE: see **Activity 1: Ways of Knowing**, **Answer Key** (page 11 of Teacher's Notes) for a comprehensive overview of the differences between IK and SK. Use the answer key to fill in any gaps in the student responses

IN CLASS: Formative Assessment 1: At the end of this activity ask each student write one paragraph comparing and contrasting indigenous knowledge and scientific knowledge, providing a brief example of each.

TIME: **Formative Assessment 1:** ~10 minutes
NOTE: Collect these and respond to them collectively in next session to ensure that the class has a solid grasp of the concepts. Eg. If you notice any common patterns that demonstrate confusion make sure to clarify those issues in the next session. Begin the second session reviewing student answers, correcting any misconceptions, and asking students for questions.

NOTE: All of Section 1 should take no more than 45-60 minutes. If you are planning section 1 and 2 in a single seminar, this would be a good time for to stretch and take a short break.

Activity 1: Ways of Knowing, Answer Key

Key questions	Indigenous knowledge	Scientific knowledge
How is the relationship between nature and culture perceived?	holistic	reductionist; disciplinary specific; controlled experiments
What are the predicative abilities at different scale (local versus)	Place-dependent	generalizable at larger scales; predictive
What types of data and explanations are generated?	qualitative; context dependent; place-based	quantitative, experimental
How is knowledge acquired?	listening; experience	academic training; testing
How is knowledge communicated and managed?	oral traditional, song, experience	peer review journal
Key Principles, concepts or descriptors	fuzzy logic	precision
	expansive, inclusive	parsimonious
	moral, spiritual, subjective	objective, rational, non-normative
		hypothesis driven
		falsifiable
		replicable
		dependent, independent variables

Section 2: Types of Data

Activity 2a: In class, in teams of 3-5 students, read over and discuss the different data sets on climate change in the student handouts. For each data set answer the questions in the handout.

NOTE: Hand out in class for small group discussion (see Students' Handouts, separate file)

- **Activity 2: Types of Data Questions**
- **Activity 2: Types of Data, Data Set 1**
- **Activity 2: Types of Data, Data Set 2**
- **Activity 2: Types of Data, Data Set 3**

NOTE: Make sure each group selects a rapporteur who takes notes of the conversation and person to report back to class.
NOTE: Make sure these are different groups that the previous sessions.

Instructor's verbal introduction for Activity 2a:

For this activity you will be provided with various different data sets. When you receive the handouts take a few moments to orient yourself to each data set. In the footer of each data set is the citation of the original article from which the material is extracted. Read over all the questions before you begin your discussion. This discussion should build on your understanding of the principles introduced in Activity 1 by applying those concepts to the data that has been generated using indigenous and scientific knowledge.

TIME: Small group discussion ~25-30 minutes
NOTE: For this activity it would be useful for students to have large flip charts to record their answers and bring up to the front for the class discussion in Activity 2b.

IN CLASS Activity 2b: Each group reports back to class as a whole. As a class develops a single master chart drawing on all students' ideas and make this available as a resource for students.

TIME: Reporting back and class discussion ~20-25 minutes
NOTE: Plan ahead how to use the blackboard to capture the summary of the class discussion. Take a picture of the black board when you are finish in order to create a summary document for the student for the students to have as a reference guide.

IN CLASS: Formative Assessment 2: At the end of this activity ask each student a short reflection piece based on these questions

1. Why should we care about indigenous knowledge when the scientific community is able to provide the data we need? (Do not feel constrained here. If you wish to defend a position against the integration of indigenous and scientific knowledge go ahead. Just make a good argument.)
2. What difference can indigenous knowledge make to natural resource management plans?

TIME: **Formative Assessment 2:** ~15 minutes
NOTE: Collect these and respond to them collectively in next session to ensure that the class has a solid grasp of the concepts. Eg. If you notice any common patterns that demonstrate confusion make sure to clarify those issues in the next session. Begin the second session reviewing student answers, correcting any misconceptions, and asking students for questions.

Activity 2: Types of Data, Answer Key

Data Set 1	
Describe the format in which the data is presented.	Phrases taken from discussion and interviews
What types of data are presented?	Wide ranging observations and experiences of the natural world
What are the units of analysis?	Various
How is the relationship between people and the environment portrayed?	People and their use of natural resources is central
What methods would be needed to collect this data?	Interview, focus group discussions
What is the scale that the data was collected out (individual, household, community, region)?	Regional, short-term
Other comments/observations	Note the differences from explanations like "It was very difficult to touch the water with bare hands in winter" compared to "temperatures are persistently rising"

Data Set 2, Box 1		
	Left column	**Right Column**
Describe the format in which the data is presented.	Narrative from head of council	Mean monthly averages over 60 year period average soil temperature; freezing depth of permafrost
What types of data are presented?	Experiences of temperature change and food availability	Mean monthly averages over 60 year period average soil temperature; freezing depth of permafrost –BUT specifics numbers are absent
What are the units of analysis?	Individual narrator, community experience	Unknown
How is the relationship between people and the environment portrayed?	Personal experiences are connected to natural resource base	No human data or presence
What methods would be needed to collect this data?	Interviews	Thermometer, measure stick, soil cores
What is the scale that the data was collected out (individual, household, community, region)?	Community, short term	Monthly over 6 decades, medium term

Data Set 2, Box 3		
	Left column	**Right Column**
Describe the format in which the data is presented.	Narrative from individual, tribesmen	Report from NASA Earth Observatory
What types of data are presented?	Experience with ice and whales from fisher people	Rates of melting ice
What are the units of analysis?	Yearly experiences, long-term historical	Kilometers
How is the relationship between people and the environment portrayed?	People are concerned to the environment and availability of resources	No human data or presence
What methods would be needed to collect this data?	Interviews	Satellite imagery or remote sensing
What is the scale that the data was collected out (individual, household, community, region)?	Community, regional	Regional, short term

Data Set 3		
	Figure 1	**Figure 2**
Describe the format in which the data is presented.	Data are [resented in graphs, averages over time	Models of geographic region
What types of data are presented?	Data include rainfall and temperature averages over different geographic scales	Models of predicted percentage change in precipitation and temperature
What are the units of analysis?	Monthly averages, standard deviation above and below the average	Percentage change in precipitation and temperature
How is the relationship between people and the environment portrayed?	No human data or presence	No human data or presence
What methods would be needed to collect this data?	Thermometer, rain gauge	In addition to Thermometer, rain gauge, modeling software
What is the scale that the data was collected out (individual, household, community, region)?	Regional averages over past 50 years, medium term	Draws on previous data to predict temperature and rain changes over the next century, long-term

Summarizing the differences

Once these data sets have been carefully look at, a broader discussion is in order to reinforce some of the key differences found in these data sets and discussion in Section 1: Ways of Knowing. The key differences include:

- How is the relationship between the nature culture divide portrayed in theses different data sets
    - The divide is strongly present in the scientific data which never include reference to people
    - In the indigenous narratives the changes in natural resources were always made in reference to humans.
- What observations can be made about different temporal and spatial scales?
    - Temporal scale in IK tend to tends to have a deep roots (20,000 years) and often extends out to future generations
    - Temporal scale in SK is more discreet: monthly and yearly. However, some data sets extend back many decades and one modeled changes a century into the future
    - Spatial scale in IK is generally very local—the community and regional level
    - Spatial scale in SK was particularly large in the Report from NASA Earth Observatory, which relied on remote sensing. For further discussion see http://earthobservatory.nasa.gov/IOTD/view.php?id=6797&eocn=image&eoci=related_image
- How do the units of analysis vary?
    - SK is really very discrete, eg. percentage change over time, centigrade, variations from means, etc.
    - IK tends to have more fluid units of analysis

Section 3: Data Integration

NOTE: Before reviewing the assignment and beginning Activity 3, review the students' answers to the **Formative Assessments 1 and 2**, correcting any misconceptions, and asking students for questions. Allow time to answer questions.
TIME: ~5-10 minutes

IN CLASS Activity 3a: Divide into groups of 3-5 students and discuss the article "*We Like to Listen to Stories about Fish*". Make sure to have a rapporteur to take good notes of the discussion.

TIME: ~ 15-20 minutes.
NOTE: Questions to lead the discussion are found in Student Handouts, **Activity 3a: Data Integration, Questions**
NOTE: Make sure each group selects a rapporteur who takes notes of the conversation and person to report back to class.
NOTE: Make sure these are different groups that the previous sessions.
NOTE: It would be useful for students to have large flip charts to record their answers and bring up to the front for the class discussion in Activity 3b.

IN CLASS Activity 3b: Each group reports back to the class about their discussion.

TIME: ~ 15-20 minutes.
NOTE: Plan ahead how to use the blackboard to capture the summary of the class discussion. Take a picture of the black board when you are finish in order to create a summary document for the students.
NOTE: See Activity 3a: Data Integration, Answer Key (page 21 in Teacher's Notes) for a comprehensive overview of the questions asked in Use the answer key to fill in any gaps in the student responses

NOTE: If you are doing section 3a, b and c in a single seminar, this would be a good time for a stretch and short break.

Framing Activity 3c, Instructor's verbal introduction: Widening the Lens
Many of the existing research projects that integrate indigenous and scientific knowledge focus on investigating discrete data points on topics like: the absence and presence of certain species or observations (eg. the article we read "We Like Stories About Fish"), on changing ecosystems, and weather pattern (such as the data sets on climate change in Section 2). But indigenous knowledge is much more than that. It encompasses a whole worldview about how to interact with human and natural world, in a sustainable manner and with the future generations in mind. Humans are seen as guardians of the earth. Conversely, scientific knowledge is based in a culture that is imbued with the philosophy that economic growth is the paramount goal. In market-based economies natural resources are as seen as the necessary energy to fuel economic growth. At the root of these different worldviews are variations in how people perceive the so-called nature-culture divide, or the nature of humankind's relationship to the natural world. This generalization does not mean that all scientists are economic-driven capitalists, nor does it mean that all natives are 'noble savages' living in harmony with the world. But it does highlight the fact that worldviews in which scientific and indigenous knowledge are embedded are vastly different. Most importantly, for indigenous people, their environmental knowledge extends into every aspect of their social world, while scientific knowledge tends to be fragmented by disciplines that look at various elements of nature and various elements of society in relative isolations (eg. biology, sociology, botany, anthropology).

Broadening our understanding of indigenous knowledge, beyond descriptive observations, to include stories and explanations of indigenous ethics, belief and values that guide their understanding of the environment raises many questions about the larger project to integrate scientific and indigenous knowledge systems. These questions, about how to achieve knowledge integration and the ultimate value of knowledge integration, are not immediately answerable and warrant further and deeper exploration.

With this mind, what the following video which examines the relationship between indigenous knowledge and wider issues of indigenous peoples' struggle for self-determination, wider recognition of their stewardship of the natural world, and the impact and oppression they have experienced as a result of development.

VIDEO: https://vimeo.com/108466803
TIME: ~ 15 minutes
Prior to the next activity review the video "The enabling power of participatory 3D mapping among the Saramaccan People of Suriname"

IN CLASS: Activity 3c: Widening the lens. Divide into groups of 3-5 students and read over the handouts and discuss questions.

- **Activity 3c: Data Integration, The Bhutan Declaration** (see Student Handouts, separate file)
- **Activity 3c: Data Integration, Questions** (see Student Handouts, separate file)

TIME: Give the students ~5-10 minutes to read the handouts before beginning the small group discussions. Allow ~10-15 minutes for small group discussion. Leave ~10-15 minutes for a class wrap up and answering questions.
NOTE: Instead of small groups reporting back, use the remaining time in the session (after small group discussions) to open up the class as a whole to discuss the issues raised in this exercise.

WRAP-UP Discussion (~10-15 minutes): this discussion could be quite wide ranging touching on several issues including ethics, worldviews, community, conservation, natural resource management, economic growth and development, sustainability, and so on

Final evaluation (homework): write a 3-5 page paper responding to the scenario in **Final Paper Prompt** (in Student Handouts). Students will need several days to complete this at home.

Activity 3a: Data Integration Questions, Answer

Look at the list of authors and their associations. What does this tell us about the project?	• **Government, natural resource management**
	  o Centre of Excellence in Natural Resource Management, University of Western Australia
	  o NT Fisheries Research, Northern Territory Department of Resource
	• **University, ecology**
	  o Australian Rivers Institute Griffith University
	  o NERP (Northern Environmental Research Program) Research Hub, Charles Darwin University
	• **Research center, ecology**
	  o TRaCK: Tropical Rivers and Coastal Knowledge: research center, ecology
	• **Aborigine**
	  o Wagiman Traditional Owner: Aborigine
	  o Wardaman Association: Aboriginal Group
	• **NOTE**: Absence of any anthropologist or social scientist

How would you characterize the partnership between indigenous people and scientific researches in this research project?	• The partnership seems to be driven largely from the perspective and needs of the scientists • Although aborigines did express "Concern about the rapidly attenuating local knowledge base has motivated these groups to partner with scientists and undertake activities to conserve their knowledge." (p. 3)
What mechanisms were used to form the partnership? In your opinion, is anything missing in how the partnership was formed?	• "The project secured the consent and involvement of the three indigenous language groups, i.e., Wagiman, Wardaman, and Jawoyn, from the middle and upper sections of the Daly River during preliminary meetings in 2005. Indigenous groups were invited to join as study partners in recognition of their twin roles as custodians with local knowledge of their customary estates and as statutory landowners." (p 3) • "terms of the research partnership were negotiated under research agreements that established protocols for research and communication activities, promoted the sharing of benefits, and ensured protection of indigenous intellectual property. Approval for our research was granted by the human ethics committee at Charles Darwin University." (p. 3) • **NOTE on what might be missing**: It is unclear whether there was a clear determination about the ownership of intellectual property rights over indigenous knowledge at the outset of the project. Without this firm agreement, later concerns about the theft of knowledge can be an issue. o **EG: "Bioprospecting** is the process of discovery and commercialization of new products based on biological resources. Despite being intuitively helpful, bioprospecting has only recently begun to incorporate indigenous knowledge in focusing screening efforts for bioactive compounds. Bioprospecting also includes biopiracy: the exploitative appropriation of indigenous forms of knowledge by commercial actors. As well as the search for previously unknown compounds in organisms that have never been used in traditional medicine before" (Wikipedia).

How did the scientists and indigenous people collaborate to integrate their knowledge systems?	• The research appears to have primarily extracted of indigenous peoples knowledge as the aborigines led scientists through their territory, collaboratively trapping fish and describing them. • One occasion when the scientist contributed the indigenous peoples' knowledge was: "the case of the freshwater sole… This species is small and exceedingly cryptic and was not known to Wagiman participants prior to the electrofishing fieldwork when it was located buried in the sandy river bed. " (p. 6) • " project funded indigenous participation at scientific conferences on at least three occasions. A poster of the fish found within the customary estates of the Wagiman language group was produced with corresponding language names "'a lasting benefit of the project'" (p. 10)
What were the major benefits of the integration for indigenous people?	• "Traditional owners appreciated the project's holistic approach to identifying important cultural values and to community development" (p. 10) • "for many old people these research trips were the first time they had a chance to see country for a long time" (p 10) • "storytelling provided an opportunity to pass knowledge on to younger generations, and audiovisual recordings were made for conservation purposes" (p. 10) • "participation of young people instilled pride and recognition in future leaders – it strengthened their spiritual ties to country, their community and identity" (p. 10) • " project funded indigenous participation at scientific conferences on at least three occasions. A poster of the fish found within the customary estates of the Wagiman language group was produced with corresponding language names "'a lasting benefit of the project'" • "Elders reported feeling 'very proud to show their achievements to the wider community and through presentations at conferences" (p. 10) • built the capacity of a number of indigenous people to contribute to water planning and conservation management decisions. (p 10) • **NOTE:** but we do not hear what the aborigines feel about how much they are able to contribute to water planning and conservation management decision\
What were the major benefits of the integration for scientists?	• Confined existing knowledge • "Project results influenced the conceptual models developed by scientists to understand the flow ecology as well as the structure of risk assessment tools designed to understand the vulnerability of particular fish to low-flow scenarios." (p 11)

What were the limitations of the integration?	**From the scientists' perspective**: • "The negotiation and execution of one of the research agreements required more time than any of us consider is reasonable" (p. 10) • "the project experienced a small number of minor difficulties characteristic of remote indigenous Australia." (p. 10) • "difficulties that arose when attempting to confirm fish names [which] could have been avoided had the project team included a linguist" (p. 10) **From the aborigine side**: We have no knowledge • **NOTE**: As we will see in Activity 3c the project largely failed to capture stories and explanations of indigenous ethics, belief and values that guide their understanding of the environment. The little recognition of aborigine worldviews was present in the introductory quote that seem quite weak and did nothing to capture the complexity of aboriginal dreamtime stories o "Brad (scientist): Bill, why are the white tail (strawman or black mask) in the same family?; Bill (indigenous elder): Well they got a relation there, cousins, auntie and uncles; Brad: From the dreamtime?; Bill: Yeah, from the dreamtime; they're all family." (p.1) o one mention of this shortcoming; "In this case, the ontologies that are expressed frequently in local "myths" would be worthy of further examination. A number of creation stories were recounted during the project, and these included explanations of the origins of fish traits such as the shiny scales of barramundi, poisonous spines in catfish, and the distribution patterns of turtle species across the freshwater–saltwater interface. These characteristics were determined by the behavior of ancestral creator beings during a time when humans and nonhumans were beings of the same ontological kind: fish and other animals danced, walked, fought with each other, and carried out ceremonies and rituals." (p. 9)
What is science better equipped to show?	• High level of taxonomic certainty • The ability to collect from multiple sites across river system
What is indigenous knowledge better equipped to show from the scientists' perspective?	• "Indigenous respondents frequently identified the role of predation as an important influence on the ecology of fish in the Daly River. Movement by fishes throughout the year was also heavily emphasized in conversations, and floods were seen as important in stimulating migration upstream into tributaries or into floodplain wetlands. Changes in fish condition at different times the year were also stressed." (p. 6) • IEK also provided additional information on the distribution and habitat use of several rare species, including freshwater stingray and freshwater sawfish, as well as habitat use for common species like the sleepy cod and Hyrtl's catfish (p. 6)

All Assessments

IN CLASS Formative Assessment 1: Spend 10 minutes writing one paragraph that,

1. Compares and contrasts indigenous knowledge and scientific knowledge
2. Provide a brief example of each.

IN CLASS Formative Assessment 2: Spend 15-20 minutes writing a short reflection based on these questions,

1. Why should we care about indigenous knowledge when the scientific community is able to provide the data we need? (Do not feel constrained here. If you wish to defend a position against the integration of indigenous and scientific knowledge go ahead. Just make a good argument.
2. What difference can indigenous knowledge make to natural resource management plans?

HOMEWORK Final evaluation: *Write a 3-5 page paper responding to this scenario below. The assignment is a combination of a reflective opinion piece and an analytical essay. You need to decide your own personal opinion on the differences between scientific and indigenous knowledge, their use in natural resource management plans and the value of integrating different knowledge systems. No position is incorrect as long as you marshal sufficient evidence and logic to justify your position.*

Scenario

You are the lead scientist whose research project is to develop a management plan for a proposed national park high up in the Himalayan Mountains. This area is a globally recognized hotspot of importance, particularly for rare medicinal and aromatic roots and herbs.

At slightly lower elevations there are several communities of local farmers and herders. Their main livelihoods depend on a complex system of agriculture and animal husbandry. They rely on the herbs and roots as their own only source of traditional medicines and as an important food source during lean times. These lean times are becoming more frequent with climate changes. Currently there are growing pressures on the region from outside traders who are beginning to collect roots and herbs at an unsustainable rate for international markets. While the local people have managed these natural resources sustainably for centuries, the areas is not well known to western scientists.

The head of your department thinks you should develop a team of scientists, including biologists, botanists, ecologists, mammalogist, ornithogists, hydrologists, soil scientists, and geologists to complete and rapid environmental inventory based on the guidelines by the Chicago Field Museum. According to the Chicago Field Museum, "During Rapid biological inventories, scientific teams focus primarily on groups of organisms that indicate habitat type and condition and that can be surveys quickly and accurately…to identify the important biological communities in the site…and determine whether these communities are of outstanding quality and significance" (http://fm2.fmnh.org/rbi/what.asp)

This approach, she argues, will provide valuable high quality scientific data in a short time period; it will be the most efficient and effective way to collect the scientific data needed to build a sound management plan. There is no time to waste and quick results will likely attract further funding for more in depth studies.

Your roommate is an anthropologist and is concerned that the government will relocate all the local community members in an effort to preserve the biodiversity in the region. Based on the innumerable times this has happened elsewhere he knows that the indigenous ecological knowledge will be forever lost when they are relocated. He argues this knowledge could be valuable for the management plans and he urges you to consider a different approach that would include research into the local ecological knowledge. In this scenario your research team would need an anthropologist to live with community for an extended period (maybe more than a year) to collect their traditional ecological knowledge.

When you talk to your department head about an alternative approach that would include collecting indigenous knowledge she scoffs at you saying: "Indigenous knowledge is nothing more that folk wisdom and voodoo science and will have no application to your project. Such stories and myths have no place in the world of scientific environmental management".

You are not entirely persuaded by her dismissal of this idea. You understand the importance of local knowledge systems and different worldviews. And you greatly admire how indigenous people have managed their lands so

successfully for generations. So you plan to do a preliminary scouting trip to assess the feasibility of both proposed approaches.

You meet with the leader of the local community and tell her of the two different approaches being proposed. She raises many concerns about both approaches, but you are surprised that she is most concerned about the ideas of having anthropologists collecting their indigenous knowledge. She is insulted by the thought that an outsider could collect all the knowledge that has been produced by generations of the collective wisdom of their elders in such a sort period of time. And she is worried that their local understanding of the medicinal properties of the herbs and roots will be stolen. She has heard rumors of thins happening. In particular she has heard stories that European researchers got rich taking the indigenous peoples' knowledge of the Neem tree in India.

Clearly you are in a tough place, but must choose a research plan. Write a proposal for research that argues for one of three approaches suggested below. Your argument must address both the pros and cons of integrating IK and SK and argue why you chose a particular research approach.

1. You will conduct a standard ecological rapid assessment with a team of experts in order to produce valid scientific data for use in a management plan. Perhaps there will be future funding for an indigenous knowledge component.
2. You will work with the local leader to come to an agreement that allows you to live in their community for 12-18 months and learn everything you can about their ecological knowledge, including the wider issues of their medicinal use of herbs and roots, their ethics and worldview.
3. You will design some hybrid of the two.

Imagine you have the all resources in the world to design whatever project you want. In your answer consider what you have learned in each of the activities we have done in the following sections:

1. What types of data can be collected using IK and SK?
2. What are the key differences between IK and SK and how can they contribute to management plans?
3. How valid will your results be at varying scales and with varying data sources?
4. What are the ethical issues involved?