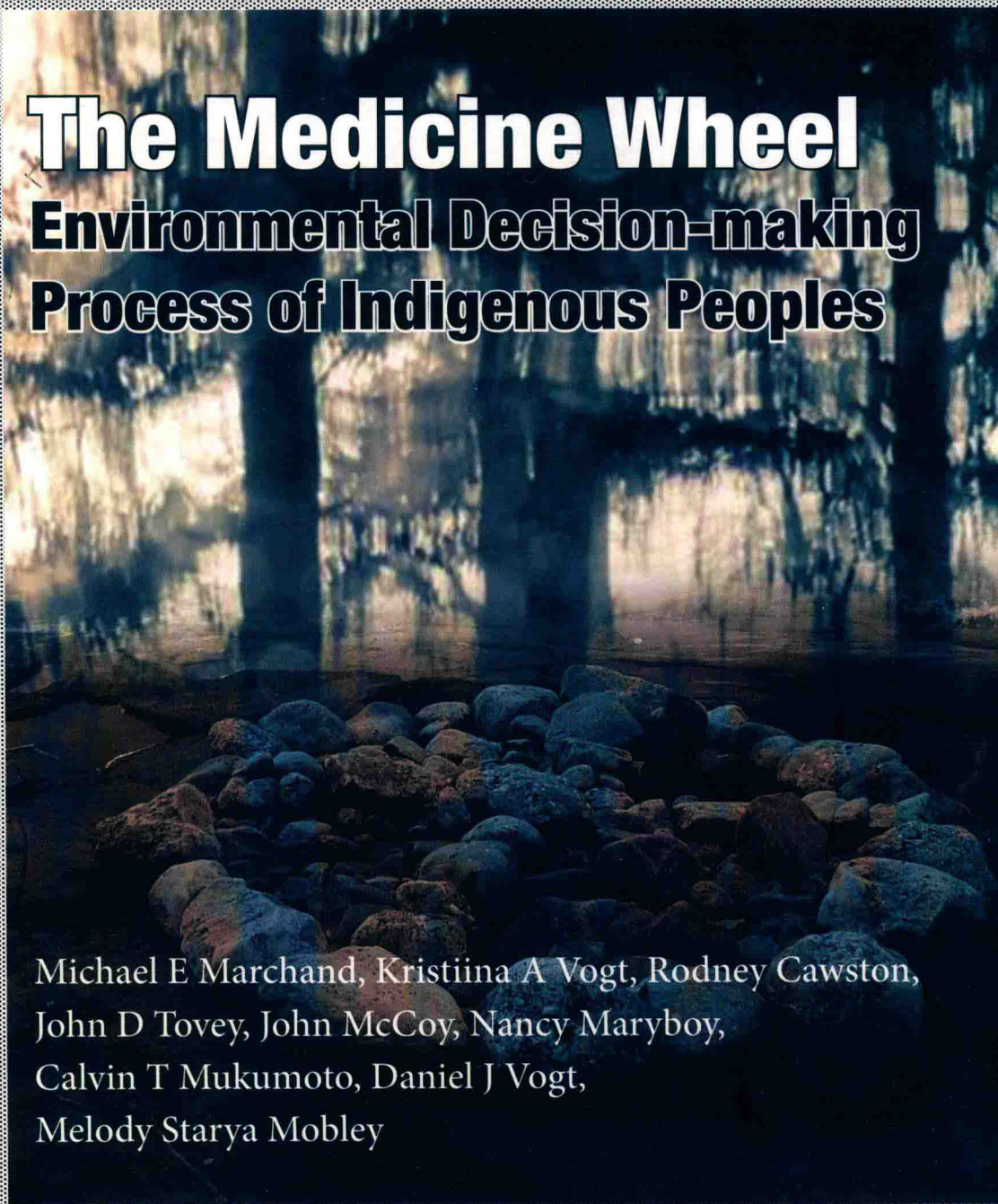
Ecosystem Science and Applications

The Medicine Wheel

Environmental Decision-making Process of Indigenous Peoples



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Acronyms

AAAS	American Association for the Advancement of Science
AAC	Annual Allowable Cuts
ABA	Arctic Biodiversity Assessment
ABC	American Broadcasting Company
ACT	American College Testing
AHDR	All Hazards Disaster Response
AIS	American Indian Studies at University of Washington
AML	Aboriginal Media Lab
ANC	Alaska Native Corporations
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act
AP	Associated Press
apps	short for *application* especially for small wireless computing devices such as a smartphone
ATNI	Affiliated Tribes of the Northwest Indians
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BMW	Bayerische Motoren Werke (in German), or Bavarian Motor Works (in English)
BS	Bull Stuff (in polite form), slang for meaning a mistake, bad idea, wrong, inappropriate
CAT	Caterpillar
CBS	Columbia Broadcast System
CCH	Commerce Clearing House
CCVI	Climate Change Vulnerability Index
CDFI	Community Development Financial Institution
CEA	Council of Economic Advisers
CEO	Chief Executive Officer
CFR	Code of Federal Regulations
D.C.	District of Columbia, typically Washington, D.C. in the U.S.
D.Q.	Deganawidah-Quetzalcoatl University in California, U.S.
DAPL	Dakota Access Pipeline
DNA	deoxyribonucleic acid

DNR	Department of Natural Resources
DOI	U.S. Department of the Interior
DOJ	U.S. Department of Justice
DV	Daniel Vogt
E4	Enlisted rank 4 (sergeant)
EEO	equal employment opportunity
EPA	Environmental Protection Agency
ESP	extra sensory perception
EVCC	Everett Community College
FAQ	frequently asked questions
FDPIR	Food Distribution Program on Indian Reservations
FES	Yale's School of "Forestry and Environmental Studies"
FIT	fire, investment, and transformation
FMP	Forest Management Plan
FORTRAN	Formula Translation, programming language for computing
GAO	Government Accountability Office
GED	General Educational Development
GHGs	Greenhouse Gases, gas in the atmosphere that absorbs and emits radiant energy within the thermal infrared range
GMP	Game Management Plan
GRE	Graduate Record Examination
GSE	Graduate School of Education (Harvard University)
IBM	International Business Machines, American multinational technology company
ICDP	Integrated Conservation and Development Project
IFMAT	Indian Forest Management Assessment Team
IGERT	Integrative Graduate Education and Research Traineeship program in the U.S. National Science Foundation for PhDs
IK	Indigenous Knowledge
IPCC	Intergovernmental Panel on Climate Change
IQ	Intelligence Quotient
IRA	Indian Reorganization Act
IRENA	International Renewable Energy Agency
IRS	Internal Revenue Service
ITARA	Indian Trust Asset Reform Act
ITC	Intertribal Timber Council
ITEDSA	Indian Tribal Energy Development and Self-Determination Act
ITO	Indian Tribal Organizations
JD	John David Tovey III
JLARC	Joint Legislative Audit and Review Committee
LLC	Limited Liability Company
MBA	Master of Business Administration

MEMA	Meaningful Engagement of Indigenous Peoples and Communities in Marine Activities
MIT	Massachusetts Institute of Technology
MM	Melody Mobley
MPA	Master of Public Administration
NAGPRA	Native American Graves Protection and Repatriation Act
NASA	National Aeronautics and Space Administration
NBC	National Broadcasting Company
NCAI	National Congress of American Indians
NEPA	National Environmental Policy Act
NGOs	Non-Governmental Organizations
NIFRMA	National Indian Forest Resource Management Act
NMTC	New Markets Tax Credits
NORC	National Opinion Research Center
NPS	National Park Service
NPT PBS	Nashville Public Television Public Broadcasting Service
NRC	National Research Council
NSF IGERT	National Science Foundation's Integrative Graduate Education and Research Traineeship program
NWIFC	Northwest Indian Fisheries Commission
NYT	New York Times
ODOT	Oregon Department of Transportation
OSB	oriented strand board
PAHs	polycyclic aromatic hydrocarbons
PBDEs	polybrominated diphenyl ethers
PBS	Public Broadcasting Service
PCBs	polychlorinated biphenyls
PEIS	programmatic environmental impact statement
PhC	Candidate of Philosophy
PhD	Doctor of Philosophy
PNW	Pacific Northwest (in the U.S.)
POW WOWS	a social gathering held by many different native American communities to meet and dance, sing, socialize, and honor their cultures
PTSD	Post-Traumatic Stress Disorder
QFC	Quality Food Centers, supermarket chain
RCW	Revised Code of Washington
REI	Recreational Equipment, Inc
RFP	Request for Proposal
S&L	Savings and Loan
SAMBR	State of the Arctic Marine Biodiversity Report
SCADA	Supervisory Control and Data Acquisition system

SISU	Finnish term meaning tenacity of purpose, grit, bravery, resilience and hardiness
SNAP	Supplemental Nutrition Assistance Program
SNBH	Są'áh Naagháí Bik'eh Hózhóó, Navajo belief system that guides harmonious living
STEAM	a science, technology, engineering, arts and mathematics in science education
STEM	science, technology, engineering, and mathematics in science education
STREAM	a science, technology, writing, engineering, arts, and mathematics in science education
SWOT	strengths, weaknesses, opportunities and threats
TED	Tribal Economic Development
TFPA	Tribal Forest Protection Act
TIMOs	timber investment management organizations
TMI	Thornton Media, Inc.
TV	television
U.S.	United States
U.S.C. (USC)	U.S. Code
U.W.	University of Washington, Seattle, Washington, USA
UNDRIP	United Nations Declaration on the Right of Indigenous Peoples
UNISYS	an American global information technology company based in Pennsylvania, USA.
UNIVAC	Universal Automatic Computer, first commercial computer produced in the U.S.
USDA	United States Department of Agriculture
USFS	United States Forest Service
VA	Veteran Affairs
VIP	very important person
WA	Washington, a state in the U.S.
WDFW	Washington (State) Department of Fish and Wildlife
WSDOT	Washington State Department of Transportation
WWF	World Wildlife Fund
WWII	World War II

Preface

Photo Source: Cal Mukumoto

We live in an age where persistent environmental problems are decreasing the health of our lands, water, species and air compared to the impacts of natural processes [1]. The gigantean environmental problems we face today only emerged within the last century. They are a result of technology allowed industrializing societies to utilize fossil carbon compounds for energy production that transformed our lands by altering our carbon and nutrient cycles [2]. These changes also build our synthetic lifestyles of today. **The enormous capacity of humans to impact our environment has even led many geologists to declare we have been ushered into the "Anthropocene Era" where the activities of humans swamp natural cycles and processes.**

These world-wide problems will not be solved by only searching for solutions in academic institutions of higher education. Educational institutions forming knowledge to solve problems in isolation from the rest of society and other disciplinary fields have not worked since the same environmental problems continue to persist for centuries. Today there is a call for science to become part of popular media so the decision-makers are sufficiently knowledgeable in the sciences to understand the problems they need to solve. We think this is important but also that there is a need to engage youth from K-12 grades to learn how to form knowledge and think critically on complex environmental and societal problems. They are our future decision-makers!

Further the most common framework and scientific methods used to form knowledge needs to be completely restructured and envisioned. Current tools are not solving the problems emerging in today's environment, and certainly won't solve tomorrow's problems. Generally, economics is the tool used to resolve environmental and societal problems because decision-makers decontextualize and compartmentalize environmental problems. Economics is a common tool to explore trade-offs since it simplifies the problem-solving process into discrete numbers than can be compared and scored for "value". But this approach is not working for the environment because it misses the holistic, intrinsic, and qualitative aspects of ecological systems that are just not capable of being quantified or assigned a dollar value. There has to be a better way to make decisions that do not increase the risks of impacts on social and environmental health.

Two reasons for writing this book can be summarized as: (1) Scientists, citizens and amateur scientists are unfamiliar with the Indigenous ways of forming holistic knowledge despite its importance for addressing tricky and complex environmental problems. Indigenous knowledge forming processes and communication approaches are an essential tool for non-Tribal communities to learn. It will allow decision-makers to resolve environmental problems in a shorter period of time, so problems do not fester and be left for future generations to figure out; and (2) Tribes are natural-resource dependent communities and are at the forefront of facing the impacts of climate change. They and their ancestors lived resiliently in the natural environment and sustainably managed their resources for thousands of years, often with comparable human populations as present day. They passed this knowledge down through the generations and the entire community was involved in the decision process. Tribes do not compartmentalize their society into those people who form knowledge of nature and the environment, and those who make decisions. In contrast, Western societies mostly educate scientists to form knowledge on nature and non-scientists, especially economists, make the policy decisions. Another important issue is that knowledge in the Western world is not holistic. It is fragmented and decontextualized from the emerging problem and compartmentalized by disciplinary fields. Such an approach is not designed to identify emerging resource problems

in contrast to Tribal ways of forming knowledge.

REASON ONE: The Tribal ways of forming holistic and balanced knowledge needs to become the tool used to resolve environmental problems. The Western world process for forming science knowledge are not designed to address complex and interdisciplinary-based environmental problems. Western-trained scientists do research complex environmental problems but typically use a disciplinary lens incapable of mechanistically linking people and nature. The Western world use of the scientific method narrows the scope of the problem and assumes causality based on the current context. Thus, a researcher decontextualizes the problem from its holistic environmental context or the ecosystem within which it is embedded. These approaches result in each environmental problem persisting for decades since an environmental manager identifies the wrong causal factor(s) to monitor for detecting emerging problems. Also, it is impossible to link a specific management intervention as the reason for the successful resolution of an environmental problem.

The Western science approach is not holistic to the temporal and spatial scale of the problem. It develops general principles or paradigms to focus the research problem. These are general principles that are applied everywhere, and not localized to where the problem is occurring. Today, it is common to use technology and a diversity of models to develop knowledge. These tools are not sensitive to the diversity of processes that occur across the landscape through space and time. **Amateur naturalists**, who focus on long-term observations of nature at the local scale, are frequently the first to warn of an emerging environmental problem. Stager wrote a New York Times article entitled "The Silence of the Bugs" how amateur naturalists made the alarming discovery that "*76 percent decline in the total seasonal biomass of flying insects netted at 63 locations in Germany over the last three decades*" [4]. University scientists did not make this discovery because their tools are not sensitive to identifying local changes occurring in the environment and they are not observing nature over long time scales.

Further, when "early warnings" indicators of a negative environment change are not local place-based knowledge, a researcher may conclude there is no emerging environmental catastrophe even though an undetected problem has already emerged. Once the existence of the problem is recognized at a later time, a tipping point may already have been passed where it may be difficult or impossible to mitigate the impacts of the problem. Conniff comments on the use of "total area protected" as an indication of future conservation success and noted this indicator is delusional [5]. As he writes:

> *"Designating protected areas is relatively easy (and with publicity bonus points for politicians), but hardly anyone seems to be bothering with the hard work of actually protecting them. Roughly a third of national*

> *parks, reserves, refuges and the like now face intensive and increasing human pressure. So many protected areas now face development that there's an acronym for it — Paddd, for protected area downgrading, downsizing and degazettement — and a website for keeping up on the bad news."*
>
> *"Politicians, like the rest of us, are suckers for numeric targets.... These targets seem simple, objective, easily comparable from one place to the next, and inexpensive to measure.* ***Pretending to protect species based purely on the number of acres protected is like managing human health care based on the number of hospital beds*** **"irrespective of the presence of trained medical staff"** ***or*** **"whether patients live or die."**

There has to be a better way to protect our environments than creating monitoring tools unable to provide an early warning that a problem is emerging. This is where the Native Peoples' practices should be used to identify and detect environmental problems before they explode.

REASON TWO: Tribes are natural-resource dependent communities already impacted by climate change. They have a history and knowledge developed over several thousand years of living on resources collected from the land and waters. Tribal People continue to practice resilient decision-making and form nature knowledge that is holistic despite their need to adapt and survive from a smaller land area after European colonization. Indigenous forms of knowledge is local-based but also embedded in a regional context since tribes historically managed large areas of land. Lands managed by Tribes were resilient and natural, which is why the early colonialists thought the lands they conquered were "wilderness" areas. They practice a nature-based ethical decision-making process that does not compartmentalize knowledge by professions or practice top-down decision-making. It is not human-egocentric but nature-focused and holistic. Therefore, Tribal approaches to forming nature knowledge are fundamentally different from those used by Western societies. If the goal is to manage environments to be resilient and retain the characteristics of "wilderness" areas, we need to understand the practices of Native People.

In the Western world, scientists and decision-makers rarely make decisions as a community or tribe. Scientists are the reservoirs of disciplinary-based knowledge while decision-makers mostly have little science knowledge. This situation appears to politicize environmental decisions and evidence-based knowledge is not part of the decision-making toolkit. Scientists should not be faulted for all the problems emerging in our environment and which may persist for decades. It's the politicians or policy-makers, with little science education, who make the decisions and determine whether to fund activities that result in environmental problems. No one suggests that scientists alone or decision-makers should make

environmental decisions. Each contributes knowledge that is only part of the information needed to plan and make decisions. **Also, the community needs to be involved in the decision process on complex environmental problems. People with holistic knowledge of an issue, and those with no vested interest in the final outcome, need to be "at the table" when decisions are made. Environmental and social justice is only possible when environmental problems are de-politicized and not human centric.** If this does not happen, it will be difficult to build consensus on complex environmental issues.

There is urgency for Western societies to accelerate the rate at which environmental planning becomes holistic and decision-makers use evidence-based knowledge in their decision process. Amateur naturalists do play a very important role in observing and forming knowledge of nature but the community of people capable of forming science knowledge needs to expand beyond to the general public. More lay people need to become scientifically competent, but not by following the traditional "scientist" education track. Science knowledge needs to be part of decision-making, but this is not going to happen if more citizens and future decision-makers need to go to college. We need to focus on youth learning and practicing holistic approaches to environmental management. This needs to start when youth first attend kindergarten and continue into their high school years. Unfortunately, today our youth formally learn about nature and the environment when they matriculate into institutions of higher education. However we suggest that this could be too late. In contrast to that, Tribal youth, for example, learn holistic environmental knowledge throughout their life from their grandparents and the stories they hear throughout their life. We think that non-Tribal youth need to learn nature stories when they are young. They need to learn to tell or digitize stories just like Native people. Youth — our future leaders — can use technology to build applications that transcribes knowledge given as stories into a digital or multi-media format. Thus, youth can create innovative communication tools for complex resource and environmental problems that are challenging for less technologically-skilled adults.

To fully grasp why the general public needs to learn Indigenous knowledge-forming processes to solve complex environmental problems, you need to understand the differences between Western science and Indigenous knowledge. The goal of this book is to provide a context for the attributes of the Western science and Indigenous knowledge frameworks so the reader can build their own holistic and ethical decision framework to provide environmental leadership. Our take-home message is that Indigenous knowledge should be an equal partner with Western Science in environmental assessments under today's climate-changing umbrella. We contend that the Western science knowledge framework is incomplete without this localized intergenerational knowledge introduced by Indigenous people. What is different about our book is that we do not just describe the

problems inherent to each knowledge framework but offer new insights for how to connect culture to a science knowledge-forming framework. We also want the reader to think about who they listen to when getting their facts about their knowledge of science and culture, e.g., stories of knowledge passed down through multiple generations via Tribal elders or scientific experts. Today, our science communicators and cultural facts move along parallel tracks that seldom seem to cross.

This story also has to explore how culture gives "tenacity of purpose and guts" to Indigenous people. This character is what sustained the continuity of Tribal members, practices and preservation of their Traditional knowledge and their cultures, despite the numerous road-block they have experienced over the past several hundred years. They continue to be challenged by Western-trained local, state and federal-level agency scientists who do not know how to include culture in their decision-making. These battles continue despite the many published success stories reporting how Indigenous Peoples' practices are increasing conservation efficacy and land health. Some might question why we should listen to Indigenous people since they are "legally recognized as holding only 10 percent" [6] of the global terrestrial land area today. We say that despite Indigenous people having lost their lands to European colonialists, that they care about these lands and have fought and continue to fight many battles to restore nature's health.

This book presents our roadmap of how two knowledge streams bound by different cultural/art/spiritual landscapes may provide a pathway by which decision-makers can use scientists as filters or a lens to interpret large datasets. We offer a second pathway for environmental managers to become "Essential Leaders" capable of making culturally-based decisions for complex environmental problems. However both approaches should be simultaneously considered to effectively address environmental issues, especially with today's climate change impacts are occurring in highly altered environments. A strength of the Indigenous knowledge framework is culture and localized intergenerational knowledge that drives the knowledge-forming process. This process allows Indigenous knowledge practitioners to address "scarcity of knowledge". The obvious strengths of the Western science approach are its tools and methods for assessing scarcity of land and resources under a climate-change scenario, albeit at the "airplane science" scale. In contrast, a weakness in the Western science framework is the lack of functional drivers that link peoples' decisions and land-use activities to ecological systems. Therefore, both knowledge-forming processes can contribute to building a holistic approach to more effectively define and manage emerging environmental problems. A holistic approach would shift problem identification from a reactive assessment of what has already played out to a proactive approach that has a greater potential to diminish the intensity of a problem before it erupts. Today we react to an emerging environmental prob-