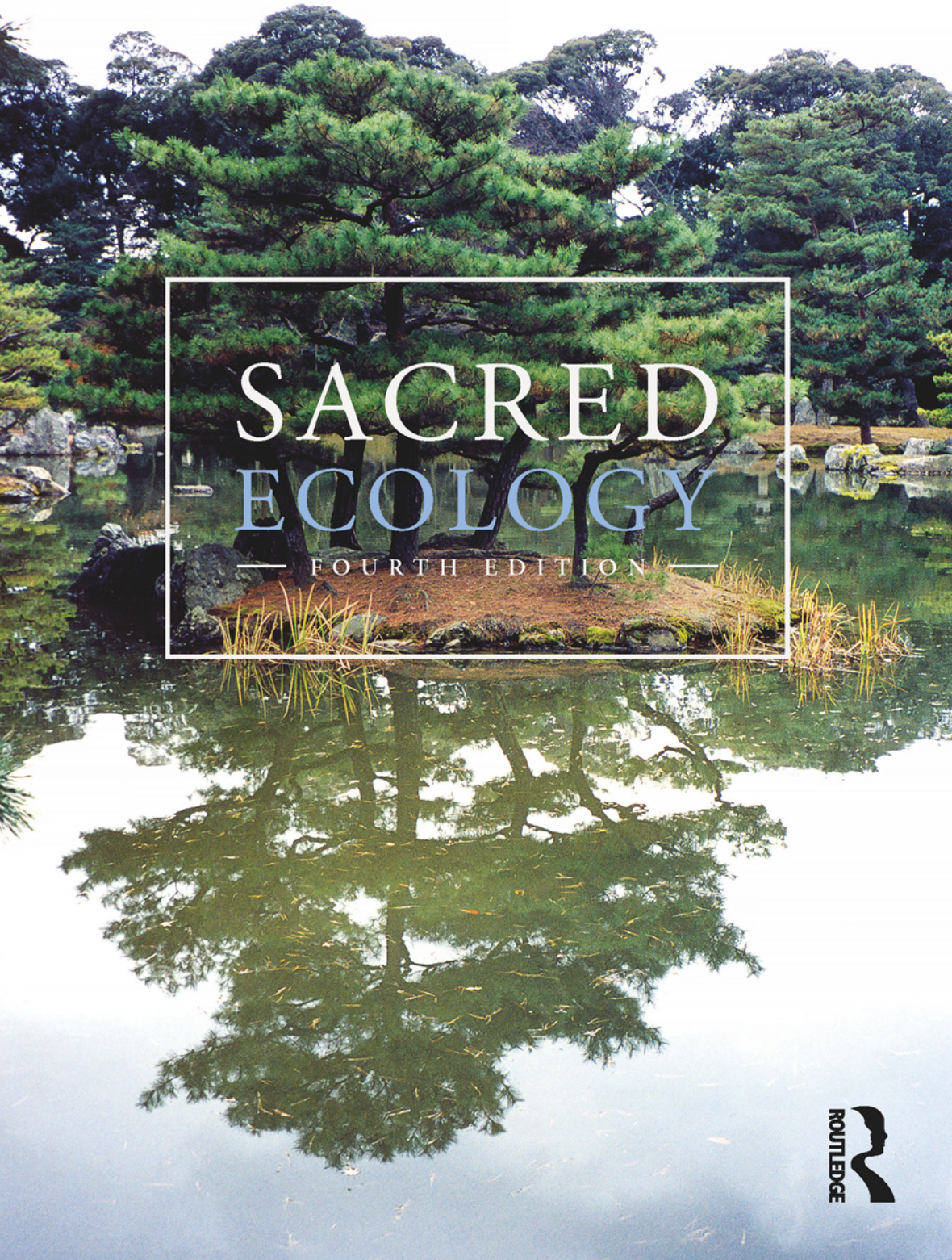
FIKRET BERKES



SACRED ECOLOGY

FOURTH EDITION

ROUTLEDGE

Sacred Ecology
Fourth Edition

Sacred Ecology examines bodies of knowledge held by indigenous and other rural peoples around the world, and asks how we can learn from this knowledge and ways of knowing. Berkes explores the importance of local and indigenous knowledge as a complement to scientific ecology, and its cultural and political significance for indigenous groups themselves. With updates of relevant links for further learning and over 180 new references, the fourth edition gives increased voice to indigenous authors, and reflects the remarkable increase in published local observations of climate change.

Fikret Berkes is Distinguished Professor Emeritus and former Tier 1 Canada Research Chair in Community-based Research Management at the Natural Resources Institute, University of Manitoba, Canada. His studies on community-based resource management have led to explorations of local and indigenous knowledge. He has authored some 250 scholarly publications and ten books, including *Linking Social and Ecological Systems* (Cambridge University Press, 1998), *Navigating Social-Ecological Systems* (Cambridge University Press, 2003) and *Coasts for People* (Routledge, 2015).

Sacred Ecology has become the book to go to for understanding the deep cultural relationship between traditional people (especially North American Indian people) and their environments. I have successfully used the book in undergraduate and graduate classes. Students learn easily from the many useful cases. Simply outstanding.

Richard W. Stoffle, *School of Anthropology, University of Arizona*

Berkes' interdisciplinary approach to understanding traditional ecological knowledge is unique, rigorous, and applicable. Without romanticizing or patronizing local and Indigenous societies, *Sacred Ecology* honors diverse voices and delivers insightful responses to emerging environmental concerns.

Paul Faulstich, *Professor of Environmental Analysis, Pitzer College*

Each new edition of this book deepens and broadens insights into traditional ecological knowledge, including how such knowledges are crucial to our continued survival as a species. The wisdoms of indigenous ways of knowing have an able and sensitive collaborator in Fikret Berkes. This book provides the central text in my undergraduate Anthropology and Environment course. It never fails to engage students, open new ways of thinking, and inspire all of us to the difficult, important work of re-thinking our human place in relation to the other-than-human persons with whom we have the fortune and responsibility of co-existing.

David Syring, *Associate Professor of Anthropology, University of Minnesota, Duluth and Co-Editor-in-Chief of* Anthropology and Humanism

In this age of the urgency of climate change, the fourth edition of Berkes' book is more than timely. Teaching courses in environmental anthropology, I have come to value *Sacred Ecology* as a text that helps students grapple with the complexities and importance of TEK. His inclusion in this edition of more indigenous voices is particularly valuable, especially in light of the struggles of Native peoples around the world (the resistance against the Dakota Access Pipeline being a critical case in point). I appreciate the ways in which Berkes integrates scientific and traditional ecological knowledge, effectively demonstrating the ways in which these forms of knowledge complement each other and validating the need for interdisciplinary research to deal with climate change and environmental problems.

Sue Darlington, *Professor of Anthropology and Asian Studies, Hampshire College*

For years I have used *Sacred Ecology* as a primary text for my course in Indigenous Knowledge and Sustainable Development, and the book, especially the exhaustive sections on Cree worldview and ecological practices, has been universally appreciated by graduate and undergraduate students. Berkes' critical purpose of delineating an environmental, science-compatible understanding of indigenous knowledge remains the same, however, the fourth edition of *Sacred Ecology* brings crucial improvements and updates to this important text, especially in accurately reflecting the depth of research on traditional ecological knowledge that has been undertaken by indigenous scholars. I will gratefully continue to use *Sacred Ecology*, Fourth Edition, as a key text.

Claudia J. Ford, *Lecturer, Rhode Island School of Design*

Sacred Ecology

Fourth Edition

Fikret Berkes

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Preface to the First Edition

When I started to write this book, I had to remind myself of the oft-repeated conventional wisdom that the amount of knowledge in the world has been doubling every decade in recent times. Aside from the questions of just who measured the amount of knowledge and how, the obviously rapid pace of the growth of information all around us is sobering to anyone interested in traditional ecological knowledge. Has ancient knowledge perhaps become irrelevant, or has it simply been swamped by modern knowledge and reduced merely to a footnote? Just what can the study of traditional knowledge contribute to the contemporary world? This volume tries to answer these questions somewhat along the lines of the quotation attributed to the British philosopher Bertrand Russell: "One of the troubles of our age is that habits of thought cannot change as quickly as techniques, with the result that as skill increases, wisdom fades."

The interest in indigenous systems is not merely academic. The lessons of traditional knowledge, especially of the ecological kind, have practical significance for the rest of the world. There is a growing line of thought, as this volume documents, that we are moving in the new millennium toward different ways of seeing, perceiving, and doing, with a broader knowledge base than that allowed by modernist Western science. For many of us, the science of ecology has a historic role to play in this process. As Theodore Roszak observed in his 1972 book, *Where the Wasteland Ends*, "ecology already hovers on the threshold of heresy." Some three decades ago, ecology held a great deal of promise to step across this threshold, and "in so doing,

revolutionize the sciences as a whole. . . . The question remains open: which will ecology be, the last of the old sciences or the first of the new?" (Roszak 1972: 404).

It may be an exaggeration to say that the science of ecology as a whole has such a momentous choice to make. No doubt much of ecology will continue as conventional science, and at least for the foreseeable future, such ecology will have a role to play in the advancement of knowledge. The fact of the matter is, an overwhelmingly large part of ecology tries to adhere to the tenets of conventional science. It tends to be quantitative, reductionistic, and not at all sacred or spiritual, seemingly bent on dashing Roszak's hopes, as Evernden (1993) later noted. But for me the more interesting kinds of ecology are the unconventional ones—if not quite "heretical," certainly at the edge of scientific respectability! Thomas Kuhn's (1970) *The Structure of Scientific Revolutions* argues that new scientific paradigms arise at the peripheries of mainstream science. New ways of looking at phenomena come about as the conventional paradigm proves less and less capable of explaining observations. A case in point is the replacement of Newton's mechanistic model of the universe by Einstein's relativity principle. Does traditional ecological knowledge represent some such paradigm change (in a small way) in the field of ecology? Only time will tell.

Before entering the world of traditional ecological knowledge, let me explain how I came to develop an interest in it. I first became involved in the human ecology of an indigenous group, the Cree Indians, in 1971, but I did not start my field studies in James Bay in subarctic Canada until 1974. At the time, I had just finished my Ph.D. work as a marine scientist and applied ecologist, and I had spent much of my graduate student years practicing being a "good scientist," always skeptical and always questioning the evidence. I also believed that all phenomena could be studied by the use of the scientific method. This latter belief was shaken somewhat in 1972 when I first started to teach at McGill University in Montreal. The course was about environmental studies and social change, taught by a team led by John Southin and Wade Chambers, themselves unconventional thinkers. I was exposed to a great many new ideas, and for the first time, to philosophy of science. Now this was a new field for me; science students (and scientists) almost never read philosophy of science! One book, perhaps the earliest one that forced me to take a broader view of knowledge, was R. G. H. Siu's *The Tao of Science* (1957).

By 1974, I was in James Bay fishing with the Cree. I had turned down an excellent opportunity to do a postdoctoral fellowship with a leading marine ecologist, to work instead with my anthropologist colleague, Harvey Feit, a move considered quite suicidal professionally by many of my scientist friends. My early studies of human ecology, fisheries, and environmental assessment in James Bay actually went very well. I had a little innovative twist in my study plan. Instead of setting my own nets and sampling my own fish as scientists normally do, I was

accompanying Cree fishers to go to *their own* fishing areas and collecting the usual biological data from their catch, as well as collecting data on the Cree fishery itself. The reason for the unusual study design was only in part deliberate as a study of *human* ecology; in part it was dictated by the limitations of my budget.

I was comfortable with the collection of "objective" and quantitative data, and the Cree fishers and their families were quite content that I was not the kind of researcher who was always asking questions. We did a lot of fishing; the fishery was not a commercial one but subsistence, carried out only for household and community needs. One year I calculated that with my puny research grant, I had outfished (outsampled) the government research team, which had a quarter-million-dollar budget to conduct fisheries assessment in the same waters. But it was really the Cree who were doing the fishing. I was only the guest and inept helper, as they effortlessly set nets and pulled in the fish, zipping up and down the most complicated coastline you could ever imagine, where the configuration changed at each phase of the tide. I was beginning to develop a healthy respect for their knowledge and capabilities.

Twice I thought I would wrap up the James Bay project, once in 1978 and again in 1982, but somehow I ended up going back. I was finding that the more research I did in James Bay, the more interesting research questions presented themselves. Many were questions I had not asked at the start of my research, such as, "With no government regulation, how come the Cree did not overfish, and how come the resources did not suffer from the tragedy of the commons?" The answer was that the Cree had community-based resource management, and the analysis of common property resources became my main line of research (e.g. Berkes 1989a). There were other questions as well, some of which I did not get to until quite recently. Traditional knowledge is one of them. I had made considerable progress in describing and analyzing traditional, community-based resource management of the Cree. But this analysis had been based on *my* academic interpretation of the system, what some anthropologists would call the *etic* view. (Chapter 7 gives a detailed account of that work.) I had not given much thought to the *emic* view or how the Cree themselves saw their systems, nor did I think the unique Cree worldview of nature, as documented by an earlier generation of anthropologists, was particularly relevant in James Bay of the 1980s. I was soon proven wrong.

It started with a comment by one of my Cree associates. He said: "Now that you have been doing work here (on and off) for ten years, you must have learned something of our hunting and fishing. How about doing something useful for the community, writing down for us some of our rules and practices to help educate the younger generation?" We had an unwritten agreement about the conditions of my research in the community: I would come back and be accountable (they did

not approve of researchers who disappeared with the data after a year or two), and I would help put the information to the use of the community as needed. Now my associate was taking me up on it. A promise is a promise, although I should admit, I initially regarded the task as free consultancy, or worse, as a secretarial/editorial job, but in any case the request was consistent with the Cree practice of reciprocity and therefore impossible to refuse without losing face.

My fears about the drudgery of the job were quickly dispelled when I started meeting with the self-selected task force organized by my associate, George Lameboy, and by the head of the Chisasibi Cree Trappers Association, Robbie Matthew. It was a group of brilliant, humorous, and wise people. I found myself as the invited scribe in a latter-day "Black Elk Speaks" (Brown 1953), with an internal check and consensus mechanism thrown in, because I had not one elder but a whole group with me! We proceeded Cree-style, slowly and deliberately, with many digressions and much good humor. They set the agenda; I made the notes, and edited and brought them to the next meeting. Then they went over each line, translated back to Cree for the benefit of the members who did not speak English, and they made sure, as only meticulous hunters can, that I eventually got everything right. This process continued though five meetings in 1984, and at the end of the year I presented the group with the final report. It was later turned by the Cree into a small book, *Cree Trappers Speak* (Bearskin *et al.* 1989). Chapter 5 of the present volume borrows heavily from the report, and Chapter 6 gives a flavor of the Cree-style discourse that led to it.

The slow pace of the proceedings meant that I could keep up with the notes and did not have to use a tape recorder, which many of the older Cree dislike as a symbol of white man's technology. It also meant that I had time to absorb the discussion and seek clarification every now and then. Here was a group of elders and experts, speaking without the prompting of a meddlesome researcher, about their views of life, spirituality, rituals in the bush, uncomfortable relations with missionaries (Berkes 1986b), the cycling of animal populations, the proper ways to hunt caribou and geese, and on and on. In my ten years, I had never asked questions about these things, and some of these matters I did not think they would talk about at all.

Out of the discussion emerged a worldview different from the mainstream Euro-Canadian one, a worldview in which nature pulsated with life, compelling in its spiritual ecology. In one of the stories Cree elders told, a famous and influential missionary of the James Bay coast of the 1930s was quoted as repeatedly telling the Cree, "there are no spirits in the bush." The Cree elder sighed and added, "No matter how much he repeated that, we all knew that the land was sacred and full of spirits." Here we were, in 1984, on the sacred land where the animals determined the success of the hunt. Violate rules of respect and reciprocity, you came back from the hunt empty-handed. Many of the Cree believed that; some of the

younger hunters were skeptical but not willing to take a chance either (although many others violated the rules nevertheless).

Somewhat to my surprise, I found myself comfortable with the Cree view of nature, even though, by virtue of my Western education and scientific training, I was heavily inclined to resist it. My generation had grown up with the marvels of the space age and the glorification of science and technology. Later, the environmental movement of the 1960s and the 1970s had provided a devastating critique of the misapplications of science and technology, but we were short on prescriptions, especially of the nonscientific kind. The standard view of ecosystems on which I had been brought up was rather machine-like. The influential ecologist, Eugene Odum (1971), for example, characterized ecological cycles as giant wheels powered by the energy of the sun. In this mechanical ecology, there was little room for the discussion of ecological ethics and even less of the sacred.

There were other views of ecology, but they were not a part of the discussion among ecologists. As Paul Shepard once observed, although ecology is a science, its greater and overriding wisdom is universal. That wisdom can be approached mathematically, experimentally, or it can be danced or told as myth. It is in Australian aboriginal people's "dreamtime" and in Gary Snyder's poetry. I discovered Aldo Leopold's (1949) "land ethics" only in the 1970s. Among the exceptions to conventional ecology was the work of Ian McHarg. He was writing about nature and environment, not as an ecologist but as a landscape architect and planner, inspiring dissatisfied ecologists such as myself to widen our radius of intellectual search. The chapter "On Values" in his *Design with Nature* (1969) talked about Iroquois bear rituals preceding a hunt. The hunter talks to the bear and assures the bear that the killing is motivated by need; at the same time, the ritual reminds him of his ethical obligations. McHarg observed, "Now if you would wish to develop an attitude to prey that would ensure stability in a hunting society, then such views are the guarantee." The science of ecology did not discuss such views, but Siu, Leopold, McHarg, and later Bateson (1972) mentally prepared me to be receptive to a traditional ecology that did.

A large number of people (academics, resource managers, and practitioners) contributed to the development of this volume by sharing their ideas and insights and by sending material. I am grateful to them all. They include Arun Agrawal, Upali and Mala Amarasinghe, Mac Chapin, Johan Colding, Iain Davidson-Hunt, Jocelyn Davies, Roy Dudgeon, Nick Flanders, Carl Folke, Milton Freeman, Madhav Gadgil, Anne Gunn, Chris Hannibal Paci, Jeff Hutchings, Bob Johannes, Stephen Kellert, Gary Kofinas, Allice Legat, Robin Mahon, Henrik Moller, Barbara Neis, Garry Peterson, Dick Preston, Kent Redford, Yves Renard, Mere Roberts, Allan Smith, Frank Tough, Ron Trosper, Nancy Turner, Marty Weinstein, and Elspeth Young. I would like to pay a special tribute to Mike Warren (Iowa

State University) who passed on prematurely in 1997; his enthusiasm and generous friendship will be sorely missed.

A large number of people shared their traditional and local knowledge with me, in Quebec, Ontario, Manitoba, Northwest Territories, British Columbia, Newfoundland, and Labrador (all in Canada), the Caribbean area, Turkey, India, Bangladesh, and Sri Lanka. I cannot possibly name them all and do justice, but I am nevertheless much indebted to them. In regard to the three chapters on the James Bay Cree, the key people who influenced me include George and James Bobbish, William and Margaret Cromarty, George Lameboy, Robbie Matthew, John Turner, and their families.

For chapter reviews I am thankful to Frank Tough, Yves Renard, Allan Smith, Kent Redford, and my wife, Dr. Mina Kislalioglu Berkes. My son, Jem Berkes, assisted a great deal with the technical production. Prabir Mitra drew the figures. The assistance of the Taylor & Francis team, especially that of Alison Howson, Catherine Kovacs, and Elizabeth Cohen was greatly appreciated.

Preface to the Second Edition

When *Sacred Ecology* first came out in 1999, I received a number of invitations to speak. One was from the Anishinabek/Ontario Fisheries Resource Centre in North Bay, Ontario. The Centre is an independent body that provides a forum for information sharing and participation in fisheries management in the Anishinabek area on the Canadian side of the upper Great Lakes. They were proposing to organize a meeting for me with the Ojibwa resource managers of the area. Red flag: Ojibwa are famously guarded and sensitive over issues of traditional knowledge. The celebrated artist Norval Morrisseau, founder of the woodland school or medicine painting, had been censured heavily by his own people two decades earlier for painting Ojibwa legends. What would they do to me—a non-native—for daring to write and talk about traditional knowledge?

I showed up in North Bay with a great deal of trepidation. It was a cool winter day on the icy shores of Lake Nipissing off Georgian Bay/Lake Huron. There were 35 or so Ojibwa tribal resource managers at the meeting, most of them in their thirties and Western educated. They were all quite familiar with the contents of the book and had copies of it in hand. They did not attack me at all. In fact, they were so appreciative and so receptive. The one thing they wanted to discuss, over and above all else was, how does one talk to elders? How does one learn from them? Now almost a decade later, I think they meant, how do you access elders' ways of knowing. That is, as Katja Neves-Graça would put it, "knowledge, the process" was what they were interested in; not "knowledge, the thing known."

This second edition of *Sacred Ecology* has a greater emphasis on knowledge as process. There are two new chapters and one of them (Chapter 8) is about

climate change, based on an Inuit-initiated project that started just after the first edition came out, a project that has had considerable policy impact since the release of its video in 2000. The chapter shows how the Inuit people made sense of climate change. Indigenous people do not of course have prior or "traditional" knowledge of climate change. What they have is sensitivity to critical signals from the environment that something out of the normal is happening.

The other new chapter (Chapter 9) is about how indigenous knowledge deals with the complexity of the world around us. The chapter mainly uses examples of environmental change in the North to build a theory of how indigenous ways of knowing can help observe and monitor complex systems. Along with new material in Chapter 10 about the evolution of knowledge, and in Chapter 11 about how traditional knowledge gets modified in response to local economic needs and global opportunities, I think we have a stronger, better rounded book, both in theory and in practice. All the chapters have been modified in major ways and updated with recent references.

The second edition of *Sacred Ecology*, as with the first edition, contains a great deal of material with which I am familiar first-hand. It is based on the work undertaken by colleagues and graduate students affiliated with the University of Manitoba's Centre for Community-based Resource Management that started in 2002 when I received the Canada Research Chair in Community-based Resource Management. I thank the Canada Research Chairs program (www.chairs.gc.ca) for allowing me to concentrate on research and graduate education. Also important for the contents of the book, I have had the benefit of a network of other colleagues and partner groups, including many indigenous groups and other rural communities.

In putting together the revised book, I relied on a large number of people. In addition to continuing collaboration with many colleagues and former students listed in the original preface, I thank the following for their help and insights: Derek Armitage, Grazia Borrini-Feyerabend, Nancy Doubleday, Emdad Haque, Eugene Hunn, Igor Krupnik, Frank Lake, Louis Lebel, Micheline Manseau, Charles Menzies, Katja Neves-Graça, Douglas Nakashima, Theresa Nichols, Per Olsson, Jules Pretty, P. S. Ramakrishnan, Marie Roué, Colin Scott, Kaleekal Thomson, and David Turnbull.

It gives me pleasure to thank a growing number of our graduate students whose research has contributed to the field. Many of them have produced works that are cited in this volume: Tikaram Adhikari, Eleanor Bonny, Damian Fernandes, Colin Gallagher, Sandra Grant, Carlos Idrobo, Anne Kendrick, Serge LaRochelle, Kenton Lobe, Maria M'Lot, Alejandra Orozco Quintero, Brenda Parlee, Claude Peloquin, Dyanna Riedlinger Jolly, and Cristiana Seixas. Carlos also assisted with the redrawing of figures. I thank our secretary, Jacqueline

Rittberg, for technical assistance, Routledge editors, Siân Findlay, Stephen Rutter and David McBride, their staff, and Susan Leaper and the Florence Production team for making the book possible.

I wish to pay special tribute to two pioneers of indigenous knowledge/traditional ecological knowledge who passed away recently, Bob Johannes and Darrell Posey. Bob's *Words of the Lagoon* (1981) was a major inspiration for my own traditional fisheries knowledge work. For its detail of documentation, I don't think it has been surpassed. Darrell Posey did his signature work with the Kayapo of Brazil. He used to say, yes, he is an American, but a Brazilian too, and really a citizen of the world. In my mind, he embodied the paradoxical nature of indigenous knowledge: it is intensely local, but at the same time, it is universal.

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Preface to the Third Edition

This edition of *Sacred Ecology* has been updated with about 150 new references and that is only a fraction of the literature that has emerged since 2008. As David Turnbull observed in the 2009 special issue of *Futures*, the future of indigenous knowledge lies in the creation of a knowledge space, and the explosion of the literature in recent years indicates that this seems to be happening. Major contributions in the area of biodiversity conservation, with various volumes cited here, and the creation of "modern" indigenous knowledge in such areas as local environmental monitoring indicate the continuing relevance of local and traditional knowledge.

This new edition further develops the point that traditional knowledge as process, rather than as content, is what we should be examining. Also important is the issue of a knowledge dialogue. Scholars have wasted in my view too much time and effort on a science vs. traditional knowledge debate; we should reframe it instead as a science *and* traditional knowledge dialogue and partnership. The issue of a power differential between science and traditional knowledge will never be completely resolved. But in recent years, as documented in *Sacred Ecology*, we have made great progress in the co-production of knowledge for problem-solving in critical issues such as climate change. Here we are not referring to somehow synthesizing science and traditional knowledge, but rather the generation of new knowledge through the synergy of combining what is already known to science and to local and traditional knowledge.

The major change in this third edition is the addition of web links in a section at the end of the book. This electronic supplement provides links to web pages to

enrich the material in the book, extra case studies, and web-based open-access publications. Through these links, readers and instructors who use this book for teaching can access additional material and can follow up many of the topics and themes in the book. I have taken some care to include sites with practical applications of local and traditional knowledge, and have added teaching tips and study questions organized by chapter.

I am fortunate to have many supportive colleagues. In addition to those mentioned in the earlier editions, I am grateful to a number of scholars: Alpina Begossi, Sébastien Boillat, David Bray, Josh Cinner, Inger Marie Gaup Eira, Michael Ferguson, Bruce Forbes, Natalia Hanazaki, Eugene Hunn, Erjen Khamaganova, Gita Laidler, Mimi Lam, Raul Lejano, Gabriela Lichtenstein, Flora Lu, Ole Henrik Magga, Andrei F. Marin, Svein Mathiesen, Leticia Merino, Gonazlo Oviedo, Helen Ross, Jan Salick, Sylvie Shaw, and Renato Silvano.

My students are my best teachers. For their work and for sharing their insights, I thank Catie Burlando, Nathan Deutsch, Arthur Hoole, John-Erik Kocho-Schellenberg, Andres Marin, Andrew Miller, Eva Patton, Ryan Pengelly, Julia Premauer, Lance Robinson, Shailesh Shukla, Kate Turner, and Melanie Zurba, in addition to those mentioned in earlier editions.

I have augmented the illustrations in this new edition with photographs; I am grateful to Upali Amarasinghe, Yilmaz Ari, Catie Burlando, Carl Folke, Frank Lake, and James Robson for permitting me to use their photos. I thank Ron Jones for his expert work in researching websites, and Nancy Turner and Robin Kimmerer for additional suggestions. It was a pleasure working with Routledge editors Stephen Rutter, Leah Babb-Rosenfeld, and Gail Newton, and the Routledge production team.

Preface to the Fourth Edition

Traditional ecological knowledge continues to fascinate people. The setting: a large lecture hall at the National Chengchi University, Taipei. I am about to give a talk when I discover that the lecture hall is full of mostly undergraduates. A mild panic attack: would I be able to hold their attention? Would they leave early in twos and threes? But throughout our fieldtrip on indigenous lands in the mountains of Taiwan, the graduate students had been working on a translation of my PowerPoint slides. The lecture goes up on double screens: one in English and the other in Mandarin. The undergraduates are sitting at the edge of their seats, totally captivated by this field that they had never encountered in their regular courses.

The major changes in this edition of *Sacred Ecology* are in Chapters 2, 8, 9, 11, and 12. In particular, Chapter 2 has new content that gives increased voice to indigenous authors, as traditional ecological knowledge and indigenous knowledge (TEK/IK) literature has been enriched with a number of recent volumes from indigenous scholars. While most chapters of the volume are somewhat longer, reflecting the availability of new material, the last three chapters are in fact shorter because I have reorganized and tightened them. All chapters have been updated with new references, some 188 of them. The Web Links section has also been revised and updated.

Chapter 8 on climate change has been expanded more than the others, for a good reason. A comparison of the number of TEK/IK-related references in two reviews, 2012 and 2016, gives a measure of the remarkable increase in published local observations of climate change. Nakashima *et al.* (2012) showed 305 references; Savo *et al.* (2016) had 1,017. Although the two compilations are not strictly

comparable, these numbers suggest more than a three-fold increase over only four years. It also explains why the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, Working Group II) shows an expanded coverage of TEK/IK-related references as compared to the Fourth Assessment Report. Nevertheless, Ford *et al.* (2016) consider the most recent IPCC coverage as still too general, with little critical engagement with TEK/IK systems and contextual complexities.

The elaboration of TEK/IK has been qualitative as well as quantitative. In the area of climate change, it is now established that TEK/IK is a source of adaptive capacity, a major factor in helping people and communities to deal with change. In resource management, ancient "clam gardens" of the Pacific Northwest are receiving attention from scientists who are wondering how in the world science did not notice these indigenous aquaculture systems for such a long time. A number of TEK/IK-related concepts are finding their appropriate terminology. The *multiple evidence base approach* of Maria Tengö and colleagues (2014) now provides a label for the process of connecting diverse knowledge systems to generate new insights and innovations through complementarities. Nature has intrinsic values and instrumental values. But the insights of Kai Chan and colleagues (2016) help uncover yet another set of values, *relational values*, as nature has personalized, place-based, and kinship-oriented values for indigenous peoples and others.

As always, I am grateful for the support of many colleagues and research students. In addition to those mentioned in the earlier editions of this book, I am pleased to acknowledge the following colleagues whose insights and contributions are reflected in this volume: Richard Atleo, Daniel Babai, Gregory Cajete, Kai Chan, Tony Charles, Maria Fernández-Giménez, James Ford, Michael Gavin, Ro Hill, Richard Howitt, Jay Johnson, Andrew Kliskey, Dana Lepofsky, Yih-Ren Lin, Renee Pualani Louis, Joe McCarter, Aroha Mead, Zsolt Molnár, Victoria Reyes-García, Chantelle Richmond, Jennifer Rubis, Janet Stephenson, Ruifei Tang, Maria Tengö, Anna Varga, and Susan Walsh. For their contributions, I thank my students and recent graduates: Ashoka Deepananda, Jack Frey, Eranga Galappaththi, Durdana Islam, Connor Jandreau, Marta Leite, Yolanda Lopez-Maldonado, Jean Polfus, Kaitlyn Rathwell, Mariana Rodriguez, Aibek Samakov, and Olivia Sylvester.

This edition of *Sacred Ecology* is dedicated to the memory of Marty Weinstein, my graduate school colleague from McGill and thoughtful observer of indigenous fishery systems.

CHAPTER 1

Context of Traditional Ecological Knowledge

> Most of us have lost that sense of unity of biosphere and humanity which would bind and reassure us all with an affirmation of beauty. Most of us do not today believe that whatever the ups and downs of detail within our limited experience, the larger whole is primarily beautiful.
>
> Gregory Bateson, *Mind and Nature*

> Ecological awareness will arise only when we combine our rational knowledge with an intuition for the nonlinear nature of our environment. Such intuitive wisdom is characteristic of traditional, nonliterate cultures, especially of American Indian cultures, in which life was organized around a highly refined awareness of the environment.
>
> Fritjof Capra, *The Turning Point*

We live in a world densely populated by humans in close communication with one another over the surface of the earth. More and more, the world looks like a single society, a "global village." But in fact, human society consists of a great many groups, as different from one another as the city dwellers of New York, rice farmers of India, and aboriginal hunters of northern Canada. People of our global village differ not only in their daily occupations and material wealth, but also in the ways in which they view the world around them. This multitude of perceptions is directly related to cultural diversity around the world, a diversity that is rapidly

shrinking. Surrounded by the built landscape, it has become difficult for many people to relate to the environment. This alienation from nature has contributed to the environmental problems of the contemporary world. But at the same time, it has triggered a search for new ways of relating to nature.

The science of ecology, or at least one school of ecology that takes a broader holistic view, provides a new vision of the earth as a system of interconnected relationships. Emerging out of the discourse of ecology is a view of human society as part of a web of life within the ecosystem. Researchers are discovering, in the words of Berry (1988), "a universe that is dynamically alive: a whole system, fluid and interconnected. . . . Science is discovering a new version of the 'enchanted' world that was part of the natural mind for most of human history." This view is a radical departure from the static, mechanical, disembodied view of the world formulated by Descartes, Newton, and other thinkers of the Age of Enlightenment which has dominated our thinking.

The land ethics of Aldo Leopold (1949), deep ecology (Naess 1989), Gaia (Lovelock 1979), a sense of place, bioregionalism, topophilia or love of land (Tuan 1974), and biophilia or love of living things (Kellert and Wilson 1993; Kellert 1997) are some of the ways in which people concerned with environmental ethics have searched for the personal and spiritual element of ecology that has been missing in scientific ecology (Shaw and Francis 2008; Sponsel 2012). Yet others have explored Eastern religions and Native American worldviews for insights (Callicott 1994; Bruun and Kalland 1995; Grim 2001; Taylor 2009; Turner 2014). These efforts are very much a part of the broader context of the interest in traditional ecological knowledge, since it represents experience acquired over thousands of years of direct human contact with the environment.

The term *traditional ecological knowledge* came into widespread use only in the 1980s, but the practice of traditional ecological knowledge is as old as ancient hunter-gatherer cultures. Although this book is about traditional *ecological* knowledge and deals with environment and resources, the study of other types of traditional knowledge is valued in a number of fields. In fact, in comparison to some of these fields, the study of indigenous knowledge in ecology is relatively recent.

The earliest systematic studies of traditional ecological knowledge were carried out by anthropologists. As part of this endeavor, ecological knowledge was studied by ethnoecology, an approach that focuses on the conceptions of ecological relationships held by a people or a culture (Toledo 1992, 2001; Nazarea 1999; Hunn 2008; Johnson and Hunn 2010). Ethnoecology is a subset of ethnoscience (folk science), defined by Hardesty (1977: 291) as "the study of systems of knowledge developed by a given culture to classify the objects, activities, and events of its universe." As the definition indicates, much of the early research in

ethnoscience was concerned with folk taxonomies. Pioneering work by Conklin (1957) documented, for example, that traditional peoples such as the Hanunoo of the Philippines often possessed exceptionally detailed knowledge of local plants and animals and their natural history, recognizing in one case some 1,600 plant species.

Various kinds of indigenous environmental knowledge have come to be accepted and used by scientific experts in a number of areas. For example, there has been growing recognition of the capabilities of traditional agriculturalists (Warren *et al.* 1995; Anderson 2005), pharmacologists (Schultes 1989), water engineers (Groenfelt 1991; Tiki *et al.* 2011; Yuan *et al.* 2014), and architects (Fathy 1986). Increased appreciation of ethnoscience, ancient and contemporary, paved the way for the acceptability of the validity of traditional knowledge in a variety of fields. In the area of ecology, various works showed that indigenous groups and other traditional peoples in diverse geographical areas, from the Arctic to the Amazon, had their own understandings of ecological relationships and systems of managing resources. The feasibility of applying traditional ecological knowledge to contemporary resource management problems in various parts of the world was gradually recognized in the international arena, as reflected in the following quotation from *Our Common Future*, the report of the World Commission on Environment and Development:

> Tribal and indigenous peoples' . . . lifestyles can offer modern societies many lessons in the management of resources in complex forest, mountain and dryland ecosystems.
>
> (WCED 1987: 12)

> These communities are the repositories of vast accumulations of traditional knowledge and experience that link humanity with its ancient origins. Their disappearance is a loss for the larger society, which could learn a great deal from their traditional skills in sustainably managing very complex ecological systems.
>
> (WCED 1987: 114–15)

Defining Traditional Ecological Knowledge

There is no universally accepted definition of traditional ecological knowledge. The term is, by necessity, ambiguous since the terms *traditional* and *ecological knowledge* are themselves ambiguous. In the dictionary sense, *traditional* usually refers to cultural continuity transmitted in the form of social attitudes, beliefs, principles, and conventions of behavior and practice derived from historical

experience. It is cumulative and open to change (Nakashima 1998; Ellen *et al.* 2000). Hunn (1993a: 13) explains: "New ideas and techniques may be incorporated into a given tradition, but only if they fit into the complex fabric of existing traditional practices and understandings. Thus traditions are enduring adaptations to specific places. . . . Traditions are the products of generations of intelligent reflection tested in the rigorous laboratory of survival. That they have endured is proof to their power."

For some, *tradition* and *change* are contradictory concepts, and it is difficult to define just how much and what kind of change would affect the labeling of a practice as "traditional." Worse, as Lewis (1993a) points out, the traditional "may be dismissed or denigrated because the custodians of such knowledge are no longer considered 'traditional' by outsiders, particularly those in positions of power and authority." This is one of the reasons why some scholars avoid using the term *traditional* and instead favor the term *indigenous*, thus avoiding the debate over tradition, as Warren explains:

> In 1980, David Brokensha, Oswald Werner and I were struggling to find a term that could replace "traditional" in the designation "traditional knowledge." In our view, "traditional" denoted the 19th-century attitudes of simple, savage and static. We wanted a term that represented the dynamic contributions of any community to problem-solving, based on their own perceptions and conceptions, and the ways that they identified, categorized and classified phenomena important to them. At the same time Robert Chambers and his group at Sussex were struggling with the same issue. Independent of each other, we both came up with the term "indigenous."
>
> (Warren 1995: 13)

For many others *traditional* does not mean an inflexible adherence to the past; it simply means time-tested and wise. In particular, for many groups of indigenous people the word *tradition* carries many positive meanings. For example, when the Inuit participants in a 1995 conference were asked to describe traditional knowledge, there was consensus on the following meanings: practical common sense; teachings and experience passed through generations; knowing the country; being rooted in spiritual health; a way of life; an authority system of rules for resource use; respect; obligation to share; wisdom in using knowledge; using heart and head together (Emery 1997: 3).

Notable among these descriptors is traditional ecological knowledge as a way of life (Witt and Hookimaw-Witt 2003) and an abundance of references to ways of knowing (Simpson 2001). Ways of knowing and ways of doing things mark traditional knowledge as process—as opposed to knowledge as content.

Indigenous scholars Battiste and Henderson (2000: 46) write: "what is traditional about traditional ecological knowledge is not its antiquity, but the way it is acquired and used." When the young Anishinaabe resource managers of the Great Lakes area were reacting to the first edition of *Sacred Ecology* (see Preface to the Second Edition), the word *traditional* was not a concern and neither was the content of the book. What they were really interested in discussing was how to interact with and learn from elders, the processes by which this traditional knowledge is acquired and transmitted.

The term *ecological knowledge* poses definitional problems of its own. If ecology is defined narrowly as a branch of biology concerned with interrelationships in the biophysical environment, in the domain of Western science, then *traditional ecological knowledge* is an oxymoron. If, on the other hand, *ecological knowledge* is defined broadly to refer to the knowledge, however acquired, of relationships of living beings with one another and with their environment, then the term becomes tenable. It is what Lévi-Strauss (1962) has called the *science du concret*, the native knowledge of the natural milieu firmly rooted in the reality of an accumulation of concrete, personal experiences, as opposed to book-learning. It is guided by "spirituality, ethical relationships, mutualism, reciprocity, respect, restraint, a focus on harmony, and acknowledgement of interdependence" (Johnson *et al.* 2016: 5; Cajete 2000).

In this context, *ecological knowledge* is not the term of preference for many traditional or indigenous peoples themselves. For Australian indigenous people, knowledge comes from *country*; knowledge is a situated process tied to a specific place (Weir 2009; Lauer and Aswani 2009; Muir *et al.* 2010). In the Canadian North, aboriginal peoples often refer to their "knowledge of the land" rather than to ecological knowledge. *Land* to them, however, is more than the physical landscape; it includes the living environment. For example, the Dogrib Dene (Athapascan) term *ndè* is usually translated as "land." But its meaning (like *country* in Australia) is closer to "ecosystem," except that *ndè* is based on the idea that everything in the environment has life and spirit (Legat *et al.* 1995). Interestingly, in the history of the science of ecology, *land* was also often used as a synonym for *ecosystem*, as in the "land ethic" of Leopold (1949).

In this book, *ecological knowledge* is used in this sense of knowledge of the land. It is a fairly broad consideration of ecology, but not broad enough to encompass all aspects of knowledge. Indigenous knowledge cannot be reduced simply to its ecological aspects (McGregor 2004), but a book has to have a focus and the ecological aspects of traditional knowledge are the focus of this book. As such, the broader topic of spiritual ecology is also outside of our scope. Religion and ecology, personal and emotional ecology, popular movements, and the wider range of thoughts and actions of historic and contemporary pioneers of spiritual

ecology have been expertly dealt with elsewhere (Taylor 2005, 2009; Jenkins 2010; Sponsel 2012; Vaughan-Lee 2016).

To arrive at a definition of *traditional ecological knowledge*, it is necessary to sift through the various meanings and elements of the concept through the development of the fields of ethnoscience and human ecology (see Chapter 3). The study of traditional ecological knowledge begins with the study of species identifications and classification (ethnobiology) and proceeds to considerations of peoples' understandings of ecological processes and their relationships with the environment (ethnoecology and human ecology). Implied in the concept is a component of local and empirical *knowledge* of species and other environmental phenomena. There is also a component of *practice* in the way people carry out their agriculture, hunting and fishing, and other livelihood activities. Further, there is a component of *belief* concerning peoples' perceptions of their ethical relationships within ecosystems. Closely related is the worldview which frames how people interpret their observations of the broader environment.

Boxes 1.1 and 1.2 illustrate the idea that purely ecological aspects of tradition cannot be divorced from the social and spiritual. Stories and legends are part of

Box 1.1 The Tradition of Coyote Stories

"Traditions include ideas of religion, patterns of artistic expression, and familial relationships, for example, in addition to knowledge of economically valuable resources. However, close examination will reveal that it is not possible to divorce the ecological aspects of a tradition from the religious, the aesthetic, or the social. For example, among native American people of the Columbia Plateau of northwestern North America, moral precepts are inculcated by means of a body of 'Coyote stories,' " explains Hunn. An elder from the Columbia Plateau tribes may know more than sixty such stories, each one constituting a full evening's performance. "To appreciate the meaning these stories convey requires an intimate knowledge of the local natural environment, local animals and plants being the main characters and local places the stage on which they act out the human drama. Children learn the moral precepts that will guide them in their social and ecological relationships by listening to their elders tell these stories. Thus religion, art and ecology are one. Traditions are thus ecological in the sense that they represent a complex and integrated system of practices and beliefs."

Source: Hunn 1993a: 14.

Box 1.2 A Cree Legend of Flood and Origin of the Earth

According to archaeological evidence, the Cree have been living in the James Bay area for thousands of years. According to native beliefs and legends, the Cree have lived on this land "from the beginning," since time immemorial. They lived through major floods that destroyed the rest of the earth.

After the flood, according to the legend, the Cree trickster-hero, Wesakachak, found himself floating helplessly along with otter, beaver, and muskrat. The Creator gave Wesakachak the power, not to create, but to remake the world if only Wesakachak could bring up some earth from underneath the flood waters. Wesakachak turned to his companions for help. First, he called on the otter to dive down and bring up a piece of the earth. But the otter failed. Wesakachak then asked the beaver to do the same, but the beaver was also unsuccessful. Finally, Wesakachak, in desperation, turned to the muskrat. Small as he was, the muskrat had a strong heart and he tried very hard. Twice he dove and twice he failed. On the third attempt, he dove so deep that he almost drowned. But when he came up, against his breast in his forepaws, he held a piece of the old earth . . .

Source: Traditional. There are many versions of this popular legend. I collected this version from Moose Factory, Ontario. In some Mushkego (West Main) Cree legends, Wesakachak is the first human or the creator of all things. He is a teacher but also a fool who finally puts a barrier between all the earth's creatures so that they can no longer talk to one another. The older Chisasibi Cree hunters still refer to the ancient "time when humans and animals talked to one another."

culture and indigenous knowledge because they signify meaning. Such meaning and values are rooted in the land and closely related to a "sense of place." Writing about the tribal area of Shimshal in northern Pakistan, Butz (1996: 52) notes that indigenous "ecological knowledge and activities [are] symbolically and instrumentally embedded in the places and life worlds out of which they developed and which they help constitute." Writing about another tribal group, the Penan of Sarawak, eastern Malaysia, Brosius (2001: 148) adds, "The landscape is more than simply a reservoir of detailed ecological knowledge. . . . It is also a repository for the memory of past events, and thus a vast mnemonic representation of social relationships and of society."

Putting together the most salient attributes of traditional ecological knowledge, one may arrive at a working definition of traditional ecological knowledge

as *a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment*. This definition, evolving from our earlier work (Berkes 1993; Gadgil *et al.* 1993; Berkes, Folke, and Gadgil 1995a), is the operational definition used in this volume. Traditional ecological knowledge is a way of knowing; it is dynamic, building on experience and adapting to changes. It is an attribute of societies with historical continuity in resource use on a particular land. By and large, these are non-industrial or less technologically oriented societies, many of them indigenous or tribal, but not exclusively so. Some non-indigenous groups, such as inshore cod fishers of Newfoundland (Neis 1992, 2005; Murray *et al.* 2008), some ranchers of northwest Colorado (Knapp and Fernandez-Gimenez 2008, 2009), and users of Swiss Alpine commons (Netting 1981) no doubt also hold traditional ecological knowledge, in the sense of multi-generational, culturally transmitted knowledge and ways of doing things.

Traditional ecological knowledge as used here refers to ways of knowing (knowing, the process), as well as to information (knowledge as the thing known). The distinction between the two is important for analytical reasons and for understanding traditional ecological knowledge properly (Box 1.3). The type of empirical knowledge familiar to biologists and ecologists and readily accepted cross-culturally (e.g. species names, life cycles, habitats) could be more aptly described as information (Spak 2005).

The various concerns with the term *traditional ecological knowledge* have sent scholars to look for other terms. For example, some in the Canadian Arctic prefer to use the term *Inuit Qaujimajatuqangit*, abbreviated as IQ (Arnakak 2002; Wenzel 2004). The term covers all aspects of Inuit values and way of life, and may be too broad to use in place of traditional ecological knowledge (Wenzel 2004). Pretty (2007) prefers the term *ecological literacy* that gets around several issues. Others use *experiential knowledge* (Fazey *et al.* 2006). *Local knowledge* is the term of choice of some scholars "because it is the least problematical" (Ruddle 1994a: 161). But Raffles (2002) questions if *local knowledge* adequately captures the fact that indigenous knowledge is relational or situated knowledge. There are other shortcomings: the term *local knowledge* conveys neither the *ecological* aspect of the concept, nor a sense of the temporal dimension and cumulative cultural transmission.

Likewise, the term *indigenous knowledge* has its own critics. First, it implies a kind of knowledge that is restricted to indigenous people. Second, it implies that there is a category of knowledge that can be clearly labeled as indigenous. Ellen and Harris (2000) point out that the epistemic origins of much knowledge are obscure, constraining the perceived divide between kinds of knowledge. Is

Box 1.3 Some Indigenous Descriptions of Traditional Ecological Knowledge

"Aboriginal people define TEK as much more than just a body of knowledge. While this is a part of it, TEK also encompasses such aspects as spiritual experience and relationships with the land. It is also noted that TEK is a 'way of life'; rather than being just the knowledge of how to live, it is the actual living of that life. One way of looking at the differences between Aboriginal and non-Aboriginal views of TEK is to state that Aboriginal views of TEK are 'verb-based'—that is, action-oriented. TEK is not limited, in the Aboriginal view, to a 'body of knowledge'. It is expressed as a 'way of life'; it is conceived as being something that you do."

Source: McGregor 2004: 78.

"Epistemological characteristics of Indigenous science include oral transmission; observation over generations; cyclical time orientation; specific cultural/literary style and symbolism; knowledge is context specific to a tribal culture and place; conservation of knowledge through time and generations."

Source: Johnson et al. 2016: 5, largely from Cajete 2000.

indigenous knowledge clearly separable from other kinds? Bjorkan and Qvenild (2010) argue that all knowledge, including indigenous knowledge, is situated and hybrid. Analyzing the knowledge of rubber production among Asian smallholders, Dove (2002) shows that their agroecological knowledge could hardly be less indigenous in nature. The rubber tree itself is not indigenous to the region (it came from the Amazon). The historical construction of rubber knowledge in Asia shows that it is a kind of hybrid knowledge that involved many partners. It developed iteratively through multiple steps and local innovations.

In this volume, *local knowledge* is used when referring to recent knowledge, as in the nontraditional knowledge of some Caribbean region peoples discussed in Chapter 10. The term *indigenous knowledge* is defined as the local knowledge held by indigenous peoples or local knowledge unique to a given culture or society, following Warren *et al.* (1995). It is used as the broader category within which *traditional ecological knowledge* fits. There is a good reason to proceed this way.

Much of the indigenous knowledge literature is not about *ecological* relationships but about many other fields of ethnoscience including agriculture (Warren

et al. 1995; Armitage 2003), ethnobotany (Schultes and Reis 1995; Cunningham 2001; Laird 2002), ethnozoology (Clement 1995; Sillitoe 2002; Anderson and Tzuc 2005), ethnopharmacology (Marles *et al.* 2000), irrigation systems (Mabry 1996; Xiang 2014), soil and water conservation (Reij *et al.* 1996; Tiki *et al.* 2011), soils or ethnopedology (Pawluk *et al.* 1992), ethnoveterinary medicine (Mathias-Mundy and McCorkle 1995; SRISTI 2011), human food and healing (Pieroni and Price 2006), weaving (M'Closkey 2002), basketry (Athayde *et al.* 2009), ethnoastronomy (Ceci 1978), ethnoclimatology (Orlove *et al.* 2000, 2002), ethnooceanography (Gasalla and Diegues 2011), and others.

There is even a literature on indigenous knowledge and classification of snow (Pruitt 1984; Magga 2006), freshwater ice (Basso 1972), and sea ice (Nelson 1969; Freeman 1984; Riewe 1991; Oozeva *et al.* 2004; Krupnik *et al.* 2010). Some of these areas of ethnoscience (e.g. soil and water conservation) are directly related to ecological knowledge, but others (e.g. ethnoastronomy) are less so. The terms *traditional ecological knowledge* and *indigenous knowledge* have often been used interchangeably. But in this volume, the use of *traditional ecological knowledge* is limited to more explicitly land-related knowledge and is considered a subset of the broader category of indigenous knowledge.

Traditional Ecological Knowledge as Science

There are both similarities and differences between traditional science and Western science. Bronowski considers the practice of science (including magic) as a fundamental characteristic of human societies: "to me the most interesting thing about man is that he is an animal who practices art and science and, in every known society, practices both together" (Bronowski 1978: 9). Both Western and indigenous science may be considered, along with art, the result of the same general intellectual process of creating order out of disorder.

More controversial is the question of the existence of curiosity-driven inquiry among traditional peoples. Opinions differ, but there is a great deal of evidence that traditional people do possess scientific curiosity, and that traditional knowledge does not merely encompass matters of immediate practical interest. In his classic study, *The Savage Mind*, Lévi-Strauss (1962) argues this point on the grounds that ancient societies could not have acquired such technological skills as those involved in the making of watertight pots without a curiosity-driven scientific attitude and a desire for knowledge for its own sake. As Lévi-Strauss (1962: 3) states it, "the universe is an object of thought at least as much as it is a means of satisfying needs."

Lévi-Strauss's work is groundbreaking in part because he avoids Western society's long-standing prejudice against non-Western cultures, especially those of

"primitive" societies. He prefers to call the latter " 'prior' rather than 'primitive' "; "it was no less scientific and its results no less genuine. They were secured ten thousand years earlier and still remain at the basis of our own civilization" (Lévi-Strauss 1962: 16). The worlds of the shaman and the scientist are two parallel modes of acquiring knowledge about the universe, "two distinct though equally positive sciences: one which flowered in the Neolithic period, whose theory of the sensible order provided the basis of the arts of civilization (agriculture, animal husbandry, pottery, weaving . . .)." However, the two kinds of sciences are fundamentally distinct in that "the physical world is approached from opposite ends in the two cases: one is supremely concrete, the other supremely abstract" (Lévi-Strauss 1962: 269).

Banuri and Apffel Marglin (1993) also consider traditional ecological knowledge to differ from Western scientific ecological knowledge in a number of substantive ways. They use a systems-of-knowledge analysis, of which the philosophical and anthropological background goes back to Weber and Nietzsche, to contrast indigenous and Western scientific knowledge. According to this analysis, indigenous knowledge systems are characterized by embeddedness of knowledge in the local cultural milieu; boundedness of local knowledge in space and time; the importance of community; lack of separation between nature and culture, and between subject and object; commitment or attachment to the local environment as a unique and irreplaceable place; and a noninstrumental approach to nature. These features contrast with Western scientific knowledge systems, which are characterized, respectively, by disembeddedness; universalism; individualism; nature:culture and subject:object dichotomy; mobility; and an instrumental attitude (nature as commodity) toward nature.

One important point of difference is that many systems of indigenous knowledge include spiritual or religious dimensions (beliefs) that do not make sense to science or fall outside the realm of science. For example, some Dene (Athapascan) peoples of the North American subarctic consider that not only plants and animals but also rivers, mountains, and glaciers are alive and have agency, the ability to individually express free will (Miller and Davidson-Hunt 2013). Working in the area of St. Elias Mountains, a glacier field that straddles Alaska, Yukon, and British Columbia, Cruikshank (2001, 2005) found that Tlingit and Tagish storytellers considered glaciers to be sentient and responsive, and attributed human-like characteristics to them. Stories told about periodic surges of glaciers (a geophysical fact) but also about glacier responses to human folly, such as cooking with grease on the glacier or making disrespectful remarks.

Animists everywhere in the world impute life and spirit to parts of the environment that Western science considers inert. For example, indigenous peoples in northern Canada and the Saami of northern Norway consider aurora borealis (northern lights), and Native Americans of the Midwest consider tornados to have

life-force. Are these concepts far-fetched? Not according to Ingold (2006) who points out that *life* should perhaps not be restricted to be an attribute of things (e.g. whether it contains DNA or not). Life can also be "immanent in the very process of that world's continual generation or coming-into-being" (Ingold 2006: 10). One can argue, as Ingold does, that extending the definition of life to consider the continuous birth of the world may serve the purpose of "recovering the sense of astonishment banished from official science" (Ingold 2006: 9). It can also help restore the "sacred" into ecology, to inject some life-force into the machine-like scientific conceptualizations of ecosystems that was once fashionable.

Traditional knowledge systems tend to have a large moral and ethical context; there is no separation between nature and culture. In many traditional cultures nature is imbued with sacredness, as in Paul Shepard (1973) and Gregory Bateson's (Bateson and Bateson 1987) sense of *sacred*. This is " 'sacred ecology' in the most expansive, rather than in the scientifically restrictive, sense of the word 'ecology' " (Knudtson and Suzuki 1992: 15). It is also the "sacred," as proposed in Gregory Bateson's *Angels Fear*, as a venue for addressing the complexity of human-environment relations from a non-reductionist perspective (Katja Neves-Graça, personal communication).

As told by Catherine Bateson, Gregory "had become aware gradually that the unity of nature . . . might only be comprehensible through the kind of metaphors familiar from religion . . . an integrative dimension of experience that he called the sacred" (Bateson and Bateson 1987: 2). He did not think "religion" captured what he had in mind; "he searched for an understanding of the related but more general term, 'the sacred', moving gingerly and cautiously into holy ground, 'where angels fear to tread' " (Bateson and Bateson 1987: 8). The present book continues this line of thinking, and explores sacred ecology as a way to approach the unity of humans and environment. Interest in the sacred also brings the argument closer to indigenous thinking:

> Sacred relationship must be the foundation of any successful sustainability effort, with success achieved only when resource management practices and policies engage the spirit and are aligned with equitable and respectful interactions among human and non-human. By sacred, we refer to those sentiments, actions, and commitments that emerge from spirit-based relationships that are founded on love, respect, care, intimate familiarity, and reciprocal exchange.
>
> (Keali'ikanaka'oleohaililani and Giardina 2016)

It is clear that some of these distinctions between traditional science and Western science are fundamentally important, and the attitudes behind the two

kinds of knowledge are also distinctively different. However, the separation between the two kinds of knowledge is not absolute or clear. As seen earlier in the case of rubber agroecology in Asia (Dove 2002) the two kinds of knowledge are nearly impossible to sort out. The distinction is often "a difference of degree (quantitative) rather than of type (qualitative)," as Giarelli (1996) puts it. Various authors have offered many other (and sometimes simplistic) distinctions, including the alleged *inability* of traditional systems to use controlled experiments, to collect *synchronic* (simultaneously observed) data, and to use quantitative measures.

These alleged distinctions simply do not hold up to evidence. Counter-examples are available in fact to show that traditional knowledge experts are capable of carrying out controlled experiments (Chapter 7, the Cree fisher's experiment on species selectivity of gill nets). Some traditional management systems are based on *synchronic* data collected over large areas, rather than merely *diachronic* data, or a long time-series of local information. Examples include the Dene system of monitoring caribou movements over a broad front across the subarctic region of central Canada (Chapter 6) and regional observations of environmental change (Chapters 8 and 9).

As well, examples are available to show that quantitative thinking in some cases can be part of traditional systems of management. The case in point is Barnston's nineteenth-century estimate of goose populations, which must surely be one of the earliest published uses of traditional knowledge for resource management. Barnston (1861) was one of the first biologists/naturalists to attempt an estimate of wild goose populations in North America. Based on a field survey that indicated that the Cree Indians of James Bay killed some 74,000 geese per year, and an elders' rule of thumb that "for every goose killed, 20 must leave the Bay," Barnston came up with a total goose population figure of 1,200,000 for the region. This is an entirely plausible figure and well within modern population counts, which give a range of one to two million geese that use James Bay as a flyway, including two species, Canada goose (*Branta canadensis*) and the lesser snow goose (*Anser caerulescens*).

Differences: Philosophical or Political?

The relationship between Western science and traditional science is complex. Considering that there are a number of different traditions of Western science, and a range of indigenous knowledge systems, caution is necessary in generalizing about differences. Agrawal (1995a) argues that finding clear demarcations between indigenous and Western knowledge is futile, given the failure of philosophers of science to find satisfactory verification criteria to distinguish science from non-science. Further, Agrawal (1995b) points out that "it is difficult to