

Adaptive Management Framework for the Central and North Coast of British Columbia

Adaptive Management Guidebook

January 29, 2009

Final Report
Prepared for the Ecosystem Based Management Working Group
Dave Daust, Stephen Tyler, Karen Price
Contact: adaptive@telus.net
pricedau@telus.net



Disclaimer

This report was commissioned by the Ecosystem-Based Management Working Group (EBM WG) to provide information to support full implementation of EBM. The conclusions and recommendations in this report are exclusively the authors', and may not reflect the values and opinions of EBM WG members.

Table of Contents

1	How to Use this Guidebook.....	4
Part I. General introduction to adaptive management.....		6
2	Introduction to adaptive management	7
2.1	Context for adaptive management in the North and Central Coast	7
2.2	Adaptive management focuses on learning and management	7
2.3	Improved plans are a major benefit of adaptive management	9
2.4	Shared learning through collaboration is a major benefit of adaptive management	10
2.5	Is adaptive management the right solution?.....	10
3	Implementing adaptive management—the general case	12
3.1	The adaptive management cycle.....	12
3.1.1	Overview	12
3.1.2	Plan.....	13
3.1.3	Implement strategies	14
3.1.4	Monitor outcomes	15
3.1.5	Revise knowledge	15
3.2	How to do adaptive management.....	17
3.2.1	Decision tree.....	17
3.2.2	Question 1: Stakeholder workshops to set objectives	18
3.2.3	Question 2: Knowledge synthesis and assessment.....	19
3.2.4	Question 3: Expert/stakeholder workshops to craft strategies and/or re-draft objectives	21
3.2.5	Questions 4 and 5: Implementation monitoring	21
3.2.6	Question 6: Research and validation monitoring	22
3.2.7	Question 7: Effectiveness monitoring	22
3.3	Collaboration	23
3.4	Legal feasibility	24
3.5	Results of Adaptive Management and How to Use Them.....	24
3.5.1	Checklist for adaptive management steps	25
3.5.2	Recommended reading for section 3.....	26
Part II. Applying adaptive management to specific situations.....		29
4	Adaptive management plans for forestry practitioners.....	30
4.1	Participation in adaptive management planning	30
4.2	Steps for planning and conducting adaptive management studies.....	30
5	Adaptive management for community resource managers.....	32
6	Adaptive management in community economic development and human well being	37
7	Adaptive management for researchers working on the coast	44
8	Adaptive management for regional-scale managers.....	45

9 Literature cited..... 47
 Appendix I. Adaptive management of grizzly bears (a hypothetical example) 49
 Appendix II – Human well being monitoring and research tools 52
 Appendix III – Resource data collection standards..... 56
 Appendix IV – Template for adaptive management plan 59

List of Figures

Figure 1. The relationship between adaptive management, conventional management and basic research. 9
 Figure 2. A basic adaptive management cycle with planning steps elaborated. 13
 Figure 3. Simple decision tree for identifying high priority adaptive management tasks. Answer the questions for each objective related to a broad goal. 18
 Figure 4. Example portion of an overview diagram depicting relationships among goals, objectives and strategies 20
 Figure 5. Example graphical relationship between indicator and objective: probability of success at achieving water quantity (flow) objective is a function of forest clearance (Equivalent Clearcut Area). 20

List of Tables

Table 1. Checklist for determining if management context is appropriate for adaptive management. 11
 Table 2. Checklist for determining if organisation capacity is appropriate for adaptive management 11
 Table 5. Degree of participation in each adaptive management step..... 24
 Table 6. Checklist: questions answered “yes” lead to adaptive management success..... 25
 Table 7. Overview of Steps to implement adaptive management for community resource managers. 32
 Table 8. Steps to implement adaptive management for HWB managers..... 39
 Table 9. Steps for researchers wanting to participate in adaptive management. 44
 Table 10. Steps needed to implement regional-scale adaptive management 45

1 How to Use this Guidebook

This guidebook is intended for managers using adaptive management as one of the tools for implementing Ecosystem-Based Management on the Central and North Coast of British Columbia. It provides a practical overview of adaptive management and refers readers to useful and accessible reference sources for further information. The document is not intended to provide detailed methodological guidance for researchers in industry, government or universities. Neither will it provide instructions for the design of specific operational monitoring and research studies, because every management situation is different and studies will vary depending on the nature and scale of the questions, the availability of existing data, the availability of funding, and many other contextual factors.

This guidebook can be used by First Nations and non-First Nations managers. First Nations territories cover the Central and North Coast. First Nations people make up many of the communities. Managers applying adaptive management may represent First Nations governments or companies owned by First Nations. As part of the Joint Land and Resource Forum, First Nations governments resolve policy issues together with the province of British Columbia. When management affects First Nations rights and title, First Nations become part of the management team (subject to interest) and collaboration is required.

Adaptive management supports ecosystem-based management (“EBM”) by organizing and steadily improving the knowledge needed to make decisions in the face of uncertainty. Managers can use this guidebook to learn how to use adaptive management effectively.

This guidebook is divided into two parts. Part I introduces adaptive management and provides an overview of the adaptive management process. These sections may be skipped by readers already familiar with adaptive management. Part II is organized in short sections, each describing the application of adaptive management in a different situation:

Part I

Section 2: **Introduction to Adaptive Management**—relevant to all readers who are unfamiliar with the intent and potential benefits of adaptive management.

Section 3: **Implementing Adaptive Management: the General Case**—relevant to all managers considering an adaptive management approach, irrespective of management focus (i.e., social, economic or environmental) or the scale of management (i.e., from community project scale to regional management)

Part II

Section 4: **Adaptive Management for Forestry Practitioners**—relevant to operational planners who are required to develop “adaptive management plans” if they choose the flexibility provisions of the Ministerial Orders.

Section 5: **Adaptive Management for Community Resource Planners** – relevant to community-scale land and resource managers who are developing or implementing resource management plans (e.g. for marine resource management, tourism development, detailed Strategic Land Use plans, etc). This section explains how adaptive management can be integrated into implementation of community-level plans.

Section 6: **Adaptive Management for Planners of Community Economic Development and Human Well Being** – relevant to community planners who are developing or

implementing plans that directly affect local people. This section emphasizes the use of social science approaches to learning in relation to economic development and human well being elements of EBM.

Section 7: Adaptive Management for Researchers Working in the North and Central Coast – relevant to researchers working in the North and Central Coast. This section explains how different kinds of locally- or externally-initiated research activity may (or may not) be linked to adaptive management.

Section 8: Adaptive Management for Regional-Scale Managers – relevant to managers of resources and socioeconomic development at the regional scale (i.e., North and/or Central Coast). This section describes how monitoring and research priorities can be derived from agreed regional Land Use Objectives and strategies using a formalized Knowledge Summary, and how these priorities can be used by the proposed Adaptive Management Support Unit, by provincial agencies, and by external research organizations.

Appendix I. Adaptive management of grizzly bears (a hypothetical example).

Appendix II. Human well being monitoring and research tools

Appendix III: Resource data collection standards.

Appendix IV: Adaptive management plan template

Where appropriate, the sections include guidelines and checklists to help organize adaptive management efforts. In some cases, adaptive management activities can be implemented by local professional staff using their experience, knowledge and common sense together with these guidelines. However, in other cases, particularly when reliable data and careful analysis are crucial to drawing valid conclusions for important management decisions, it may be cost-effective to seek external technical advice at an early stage in the process.

After reviewing relevant sections of this guidebook, managers should consult with advisors, research contacts, planning agencies and/or local leaders in order to determine how best to apply adaptive management in their given context. Additional support for adaptive management may become available from a proposed Adaptive Management Support Unit.

Key contacts for further adaptive management information (add in your own):		
<u>AM Support Unit</u> _____	phone ()	email
_____:	phone ()	email
_____:	phone ()	email
_____:	phone ()	email
_____:	phone ()	email

Part I.

General introduction

to

adaptive management

2 Introduction to adaptive management

2.1 Context for adaptive management in the North and Central Coast

In 2006, the provincial and First Nation governments announced land-use decisions for the Central and North Coasts of British Columbia that included an initial suite of land management and socioeconomic objectives and a commitment to fully implement EBM by March 31, 2009 (Anon. 2006a and 2006b). Ecological and cultural objectives from these agreements are now reflected in ministerial orders specifying legally-enforceable land use objectives.

The definitions of ecosystem-based management and adaptive management found in Government-to-Government agreements and related documents provide important context for this guidebook:

Ecosystem-Based Management... means an adaptive, systematic approach to managing human activities, guided by the Coast Information Team EBM Handbook, that seeks to ensure the co-existence of healthy, fully functioning ecosystems and human communities (Anon 2006a and 2006b).

Full implementation of EBM [includes establishing]... a governance framework that provides an adaptive land use and resource management regime... [that includes]... Government-to-Government collaborative arrangements... and structures and processes for ongoing... stakeholder involvement...(Joint Land and Resource Forums. 2007)

"Adaptive Management" means a systematic approach to resource management that engages the Parties and stakeholders in structured, collaborative research and monitoring with the goal of improving land and resource management policies, objectives and practices over time...(Anon. 2006a and 2006b)

These definitions state 1) that participants in coastal resource planning processes have agreed to adaptive management as an integral part of EBM, 2) that adaptive management, in this context, is broad in scope because EBM is broad in scope, aiming to both maintain ecological integrity and promote human well being¹, and 3) that adaptive management is to be undertaken collaboratively.

2.2 Adaptive management focuses on learning and management

Natural ecological systems and human societies are inherently complex. Management of either—or both together—is difficult. Often, we do not know enough to be able to predict which strategies will best meet agreed planning objectives. Learning about outcomes of strategies can improve future management decisions by decreasing uncertainty. Adaptive management is simply a formal process for continually improving management policies and practices by learning from their outcomes (Taylor et al. 1997).

Changing management in response to a failed strategy is prudent, but is not the most efficient way to learn. Adaptive management can improve the opportunity to learn by encouraging structured thinking about an issue. Hence, it involves evaluating management options, predicting the outcomes of each option based on hypotheses about the relationship between an objective

¹ The broad scope of adaptive management does not necessarily imply that each project is broad in scope.

and a management strategy, and monitoring outcomes to assess whether the predictions held. This process helps managers identify knowledge gaps. Adaptive management also provides the structure to gather, synthesise and share new information about management consequences.

Adaptive management benefits from carefully designed studies. Without a carefully designed study, managers will not know whether the failure was due to the strategy or to some other cause (e.g., climate change, overfishing, changed economy; see Box 1). Adaptive management is similar to other kinds of structured learning processes used by professions and businesses in a variety of fields. It also shares many features with “structured decision making” processes that aim to develop strategies that reflect clearly articulated values and knowledge. In the field of natural resource management, adaptive management was first developed by Holling 1978, Walters 1986 and Lee 1993.

For example, you may have an objective to remain healthy. Your strategy is to wash your hands every time you return from town. The outcome is that you catch two colds over the winter. Does this outcome mean that you should change your strategy? You could have reduced your uncertainty in several ways: 1) with a control: if people who didn't wash their hands got four colds, you would probably feel that your strategy worked; 2) with replication: if you measure over several years, your average number of colds/winter might be lower—maybe the year in question was bad for colds due to some random factor; 3) with a before/after measurement: if you knew that you had five colds normally, then you would be more confident that your strategy had worked. These three elements—**controls, replicates and before/after measurements**—all help increase confidence in whether or not a strategy has worked.

Box 1. Elements of carefully designed studies.

Adaptive management crosses the traditional boundaries between research and management (Figure 1) and requires skills in both disciplines:

As a hybrid between scientific research and resource management, adaptive management blends methods of investigation and discovery with deliberate manipulations of managed systems(Nyberg J.B. 1998).

To be informative and efficient, adaptive management projects must be led by people who know what options for study designs and analyses are available, and the relative strengths and weaknesses of each (Nyberg J.B. 1998).

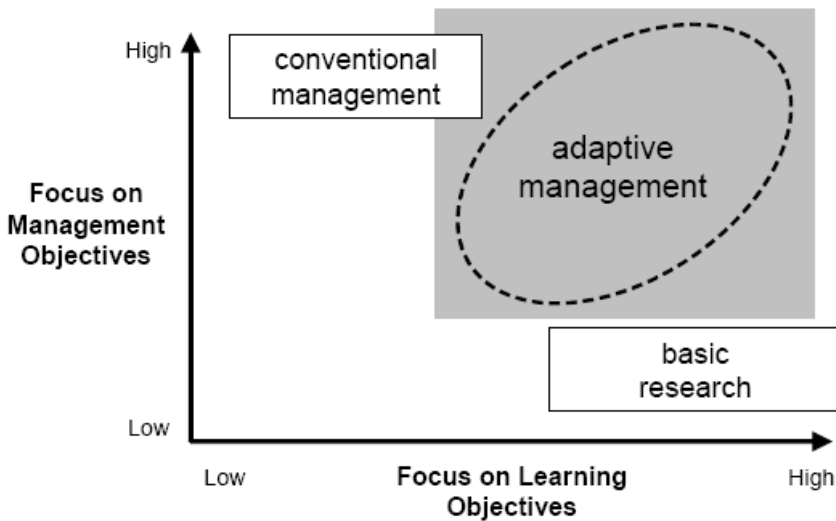


Figure 1. The relationship between adaptive management, conventional management and basic research (Marmorek et al. 2006).

Although it uses research and monitoring methods, adaptive management differs from these approaches in two important ways. First, it includes steps to focus research and monitoring on management issues. Second, it includes steps to engage managers. In order to focus on management issues, research “ideals” must often be compromised—a trade-off exists between conducting well-designed, but less-relevant studies and conducting less well-designed, but more-relevant studies. Adaptive management explicitly recognizes and considers this trade-off, whereas “standard” research tends to focus on well-designed studies only. Managers engage by defining problems and potential solutions, by contributing knowledge and by evaluating outcomes.

Two types of adaptive management have been traditionally recognised.

***Passive AM** is an approach whereby managers, when faced with uncertainty, implement the alternative they think is “best” (with respect to meeting management objectives), and then monitor to see if they were right, making adjustments if desired objectives are not met... **Active AM** is an experimental approach whereby managers, when faced with uncertainty, implement more than one alternative as concurrent experiments to see which will best meet management objectives.. (Walters 1986)*

Within these types, however, there is a wide range of research and monitoring options. Some questions can be dealt with relatively easily; others will require more complex studies.

2.3 Improved plans are a major benefit of adaptive management

In the process of implementing adaptive management, people have realised that improved planning can bring immediate benefits to management by clarifying purpose and by promoting logical, knowledge-based strategies.

Planning can range from an informal process, where managers rely on experience to develop ad-hoc management strategies, to a highly structured process that involves a range of participants, with different interests and expertise, and uses various analytical techniques. While the highly structured process is only appropriate in the most complex planning situations, many ad-hoc

planning processes can be improved by adding some basic structure. Developing a good plan need not be complicated. It simply requires taking the time to clearly document the answers to three questions:

- Where do you want to get to (objectives)?
- How do you plan to get there (strategies)?
- Why do you think the plan will work (supporting knowledge)?

2.4 Shared learning through collaboration is a major benefit of adaptive management

In adaptive management, collaboration among different interest groups (e.g. licensees, users, First Nations elders, technical experts) typically helps to develop management strategies, to identify key questions or uncertainties, to define useful indicators and monitoring methods, and then to interpret results of data collection.

Collaboration is an essential part of adaptive management when public resources are involved (Williams et al. 2007). In such cases, management should reflect societal values and typically requires some degree of consensus among stakeholders² for success. “Collaborative frameworks provide a basis for agreement, by fostering mutual learning, relationship building, and shared understanding. Collaborative structures are essentially negotiated agreements among stakeholders, which are sustained because stakeholders accept outcomes of a process they believe to be participatory and fair” (Williams et al. 2007, p. 14).

Even in cases that do not require stakeholder consensus, adaptive management cannot be effectively undertaken by individual professionals or experts acting on their own. An essential part of adaptive management is assembling existing knowledge in order to frame current (or alternative) understanding of cause and effect. Another essential element is interpreting results from monitoring or research and their management implications. No single person knows enough about the complex human or ecological systems being managed to effectively tackle these tasks alone, but at the same time it is not necessary to involve groups or individuals needlessly. Collaboration avoids “re-inventing the wheel”. It also helps to speed learning by sharing knowledge and experience and by applying different perspectives to complex problems. This collaborative learning is a major benefit of adaptive management, but it requires time, effort and skill to ensure effective communications and interaction. Practitioners should be aware of these requirements, plan accordingly, and seek support if needed.

2.5 Is adaptive management the right solution?

Adaptive management is not suitable for all conditions. It has been applied mostly to complex systems, functioning over long time frames. Before deciding to undertake adaptive management, managers must ask if adaptive management is worthwhile. Specifically, is the management context appropriate (

Table 1) and is the organisation willing and able to undertake adaptive management (Table 2)?

² the term “stakeholders” is used broadly here and refers to any person or group with an interest in management outcomes.

Table 1. Checklist for determining if management context is appropriate for adaptive management (“yes” answers mean appropriate; based on Williams et al. 2007).

Questions about management context	✓
If interested parties exist, can they be engaged? • Are interested parties willing to work collaboratively and commit the necessary time?	
Can a real management choice can be made? • Do different management alternatives produce substantially different outcomes? • Are the alternatives ecologically, economically, politically and legally feasible?	
Do specific, measurable management objectives exist or can they be developed? • Are objectives sufficiently measurable that poor performance relative to targets can be identified and corrected?	
Can management impacts, including uncertainty, be expressed as a set of testable models? • Is knowledge sufficient to at least predict the direction of the response? • Can major uncertainties be listed?	
Is the value of information for decision making high? • Will reducing uncertainty accelerate progress towards achieving objectives? • Does the improvement in management justify the research and monitoring costs?	
Can a monitoring system be established to reduce uncertainty? • Is the “signal to noise ratio” high enough to be detected within budget?	
Is there an opportunity to apply learning? • Can resource management decisions can be revisited? • Do management institutions have sufficient longevity to learn and to incorporate lessons into management (decades)? • Do ecological responses occur sufficiently quickly?	
Can adaptive management be conducted legally: • Are regulations sufficiently flexible to allow desired experiments? • Will research and monitoring activities contravene any regulations?	

Table 2. Checklist for determining if organisation capacity is appropriate for adaptive management (“yes” answers mean appropriate; based on Williams et al. 2007)

Questions about organisational capacity	✓
Is the organisation willing to adjust decisions to avoid undesirable social or ecological consequences?	
Is the organisation willing to work collaboratively with other interest groups?	
Is the organisation willing to commit to scientific rigour?	
Is the organisation willing to develop a more inclusive and robust, knowledge-based, decision-making process?	
Is the organisation willing to commit long-term funding and related support?	
Will executive leadership support the institutional culture and organizational arrangements necessary to promote learning, by encouraging experimentation and risk taking and by embracing lessons?	

Adaptive management may seem onerous to small organisations. Indeed, steps to involve stakeholders in planning, to develop rigorous conceptual models and to monitor outcomes can take significant resources. However, each step can be seen as an investment. Involving stakeholders early can save time later; if issues are not contentious, stakeholder involvement need not be onerous. Rigorous models can improve management even before monitoring begins.

Monitoring results can improve management efficiency and credibility. Adaptive management is an iterative process—the first iteration does not need to be perfect.

3 Implementing adaptive management—the general case

This section describes how to implement adaptive management. It first describes the adaptive management cycle, which consists of a series of steps, some of which are repeated regularly over time. It then shows a decision tree to help managers identify which steps in the cycle need attention and what specific task should be undertaken. Finally, it describes methods for undertaking tasks.

3.1 *The adaptive management cycle*

3.1.1 Overview

Adaptive management aims to **learn** about the effectiveness of management in order to **improve** future management. Adaptive management follows a cycle of repeated steps, where a complete iteration may take months or years (Figure 2). The cycle begins with planning—developing clear objectives and designing management strategies that are consistent with objectives and current knowledge³. Next, management strategies (and any experimental research projects) are implemented. Then the outcomes of management practices and experimental studies are monitored. Finally, management knowledge (and assumptions) are revised to reflect monitoring results (i.e., **learning occurs**). The cycle begins again with planning, but this time using revised knowledge (i.e., **management improves**). Ideally, a formal protocol should exist to ensure that revised knowledge is passed to the planning cycle and used to modify plans as warranted.

The degree of effort required in each step in the adaptive management cycle depends partly on historical management practices. Some existing management processes may have developed rigorous plans and/or may have begun monitoring while others may have basic plans with no monitoring. For example, regional land-use objectives have resulted from a significant planning effort and require little additional planning work, while plans for community-based projects will be more variable. If plans are not well-developed, improved planning will be a priority.

To keep Figure 2 simple, monitoring is represented as a single step, however, monitoring projects (experimental and non-experimental) also need to be planned. This planning identifies gaps in management knowledge and then designs studies that try to fill the gaps. Experiments need to be planned at the same time that management strategies are developed and need to be implemented along with regular management strategies.

A knowledge summary is a critical link in the adaptive management cycle—it bridges the gap between learning from monitoring and improving plans. It points out gaps in knowledge that require monitoring. It records monitoring results and integrates these new findings with previous understanding. It provides the basis for designing improving management strategies, and sometimes for revising objectives. A knowledge summary can range from documented management rationales to background reports and problem analyses, that describe current science, to complex computerised models.

³ Key terms related to the adaptive management cycle are defined at the end of this section (3.1)

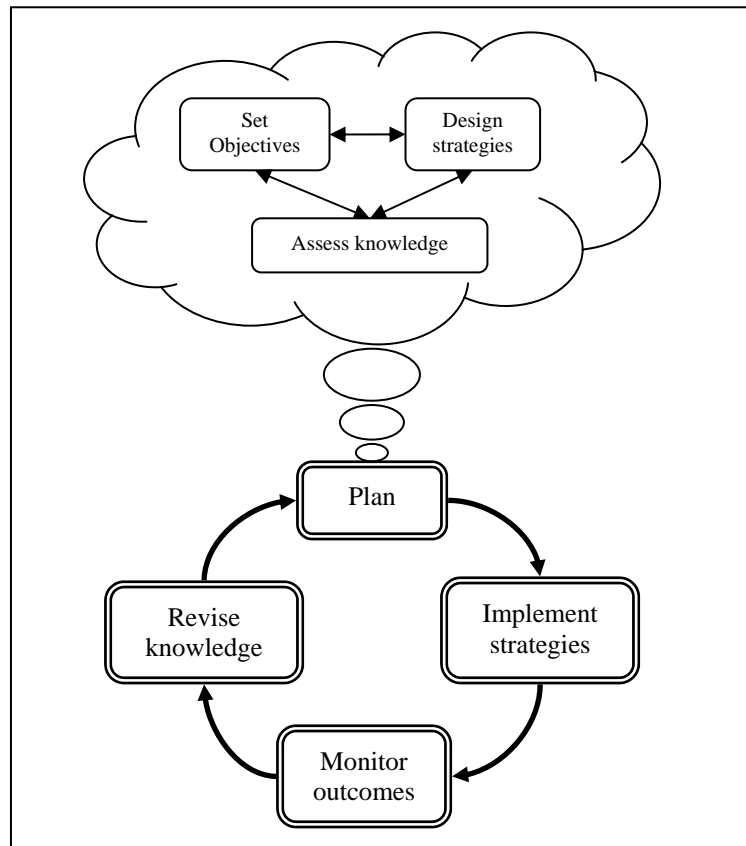


Figure 2. A basic adaptive management cycle with planning steps elaborated.

3.1.2 Plan

Good plans are necessary to achieve management objectives, particularly when multiple resource values are involved. They are also a prerequisite to learning from monitoring. If management objectives are not clear, then measured outcomes cannot be judged. If strategies are inappropriate (inconsistent with objectives and/or current management knowledge), then adaptive management studies are not necessary—management can be improved by using existing knowledge and consistent logic.

Good plans consist of clear objectives, a summary of relevant management knowledge, and clear strategies that are consistent with objectives and knowledge. The process of setting objectives, gathering and assessing knowledge and developing strategies is iterative. Knowledge identifies potential strategies (e.g., alternatives). Potential strategies define further knowledge requirements and point out incompatible objectives. Revised objectives alter knowledge requirements. Etc.

Set objectives

This step identifies clear, agreed-upon objectives (and broad goals) that are used to guide strategies and to evaluate success (Williams et al. 2007). An objective is a desired outcome; it can be applied to “processes” (e.g., harvest rate, peak stream flow) and “states” (e.g., amount of

old forest, population size). As the number of objectives increase, the complexity of the problem increases.

To facilitate decision-making, objectives should have a specific subject (e.g., peak stream flow), a clear direction (e.g., within the range of natural variability) and a specific timeframe for achievement. Generic statements such as “provide public access” are ambiguous: does public access include motorised and non-motorised (vague subject) and how much access should be “provided” (vague target)? Objectives should contain elements that can be readily measured (e.g., hiking trails). Current knowledge about natural and socio-economic systems should indicate the objective can be achieved.

Stakeholders play an important role in setting objectives. In the Central and North Coast, years of discussion have led to regional objectives, recorded in land-use agreements (Anon. 2006a and 2006b) and in the EBM Handbook (CIT 2004).

Gather and assess knowledge

In order to develop strategies to address objectives, managers must gather and assess knowledge relevant to the management problem. In adaptive management, knowledge is formally articulated. Explicit cause-effect “models”⁴ provide a basis not only for formulating management strategies, but also for identifying and learning about key management assumptions. Formally-documented knowledge is easier to share and to update.

Each participant in a planning process has his or her own ideas of how to develop strategies to achieve the objectives, based on their knowledge and values derived from past experience and education. Separating knowledge (e.g., cause-effect relationships) from values (e.g., objectives) is a crucial step in adaptive management, because it allows knowledge to be examined and improved. These are different kinds of discussions: values must be negotiated and common ground accepted, but knowledge requires evidence that is subject to critical review and debate. Adaptive management can help to address gaps and deficiencies in knowledge, but only after common values (goals and objectives) have been negotiated.

Design strategies

Strategies are the means of achieving objectives⁵. They are designed with guidance from the formal cause-effect models that predict outcomes. This step in the planning process usually involves “gaming”: repeated analyses to explore interactions among strategies and among outcomes relevant to different objectives. Clear strategies are specific and measurable, and can usually be articulated as a target level of an implementation indicator.

3.1.3 Implement strategies

Strategies are not always easily implemented. While specified strategies must be feasible, often more detailed plans, policies, training programs and quality controls must be developed to ensure proper implementation.

⁴ See definition of model on previous page.

⁵ Strategies can be expressed in the form of a desired result (e.g., leave 45m wide riparian buffers; deliver 1000 m³ this year)

Strategies often describe a desired end result (e.g., leave 70% old forest). Determining the acceptable level of action (e.g., how much old forest to harvest), requires knowing both the current level and target level of implementation.

3.1.4 Monitor outcomes

After strategies are implemented, monitoring and research document the level of implementation, assess outcomes relevant to the objectives and study uncertainties that limit predictive power.

The planning of monitoring and research activities should begin at the same time management plans are developed. Planning identifies research and monitoring priorities and decides what type of data are required, who will collect them and how. Research and monitoring priorities emerge from scrutiny of conceptual models contained in a knowledge summary. Research and monitoring plans should be prepared as strategies are being developed to allow design of experimental strategies. In adaptive management, research and monitoring can be used for four different purposes (based on Noss and Cooperrider 1994; the last two purposes distinguish adaptive management from planning and quality control):

- to determine resource status (inventory)
- to determine level of strategy implementation (implementation monitoring⁶)
- to detect consequences to values addressed by objectives (effectiveness monitoring)
- to reduce uncertainty related to management models (research and validation monitoring)

Baseline monitoring is sometimes distinguished from the types listed above. Baseline monitoring characterizes reference conditions (e.g., before management interventions or in an unmanaged area) as part of effectiveness or validation monitoring.

3.1.5 Revise knowledge

The results of studies can be used in various ways. Some study results are of direct interest to the research community and may be published in peer-reviewed journals. Other results allow managers and stakeholders to track and adjust implementation or to determine outcomes. Most importantly, study results can be used to improve cause-effect models (“learn”), leading to better management decisions in the future (“adjust”). Meshing new findings with existing knowledge, however, is not often straight forward.

Adjusting management strategies requires a commitment to respond to new information. Ideally, a clear process for adjusting management strategies should be defined before issues arise. The process should specify peer review needed for significant findings and any specific thresholds (e.g., 25% population decline) that trigger strategy revision. It should outline steps to take and participation in each step.

⁶ implementation monitoring data overlaps with inventory data, however the data are used for different purposes: inventory data supports strategy design; implementation data confirms that strategies have been appropriately implemented.

Definition of key adaptive management terms***Stakeholders***

Individuals and organizations (e.g., managers, scientists, private citizens, nongovernmental organizations) with a vested interest in a shared enterprise (Williams et al. 2007).

Vision statement

Describes overarching ends or the broadest objective (e.g., improve human well being): a vision statement should be agreed upon, general, visionary and brief (CMP 2007).

Goal

Used interchangeably with vision statement.

Objective

A broad statement describing a desired future state or condition of a value (e.g., maintain high value fish habitat) where a value is defined as a characteristic of interest (CSA 2002).

Strategy

A prescription of the “means” to be used to achieve the end. Strategies can be expressed as target levels (e.g., three) of an implementation indicator (e.g., snags/ha).

Indicator

A variable that measures or describes the state or condition of a value (CSA 2002). A “good” indicator should correlate strongly with the value, be sensitive to management and be readily measured.

Implementation indicator

A metric that responds directly to management intervention and that influences achievement of an objective.

Target

A specific statement describing a desired future state or condition of an indicator (CSA 2002).

Model

Models explicitly represent our ideas about how things work (including the key pieces and the driving forces). They can be expressed in words, diagrams, mathematical functions or computer code. Models help to clarify understanding and can be used to predict outcomes of management.

Knowledge summary

Refers to a collection of models with supporting references.

Research (general sense)

A systematic investigation undertaken in order to increase knowledge and understanding.

Monitoring

The process of collecting data that describes the characteristics or functioning of a system (e.g., ecosystem, social system). Often measurements are repeated over time (Arts and Nootboom 1999).

Implementation monitoring⁷

Collects data to determine whether designed strategies are being followed (e.g. does stand-level retention meet target levels?)

Effectiveness monitoring

Collects data to determine whether objectives are being met (e.g. are old-growth species maintained in the stands with target levels of retention)

Validation monitoring

Investigates the relationship between implemented strategies and objectives (e.g. are the old-growth species maintained in the stands because of stand-level or landscape-level retention)

Experimentation

The imposition of treatments on subjects or experimental units for the explicit purpose of learning about treatment effect by observing outcomes (Williams et al. 2007).

3.2 How to do adaptive management

3.2.1 Decision tree

A range of different planning and monitoring tasks support adaptive management. This section describes a decision tree (

Figure 3) that can be used to identify the most useful types of planning and monitoring projects to undertake—essentially a rough prioritisation procedure. The decision tree contains a series of questions to be answered for each broad management goal. The first three questions address the planning (objectives, knowledge, strategies); the remaining questions address monitoring. To answer each question, managers will benefit from engaging topic experts, particularly in relation to monitoring issues. Answers to questions lead to other questions or to specific tasks, described in more detail below the figure. Appendix I demonstrates use of the decision tree in a hypothetical example.

⁷ Definitions of different types of monitoring are based on Noss and Cooperrider 1994.

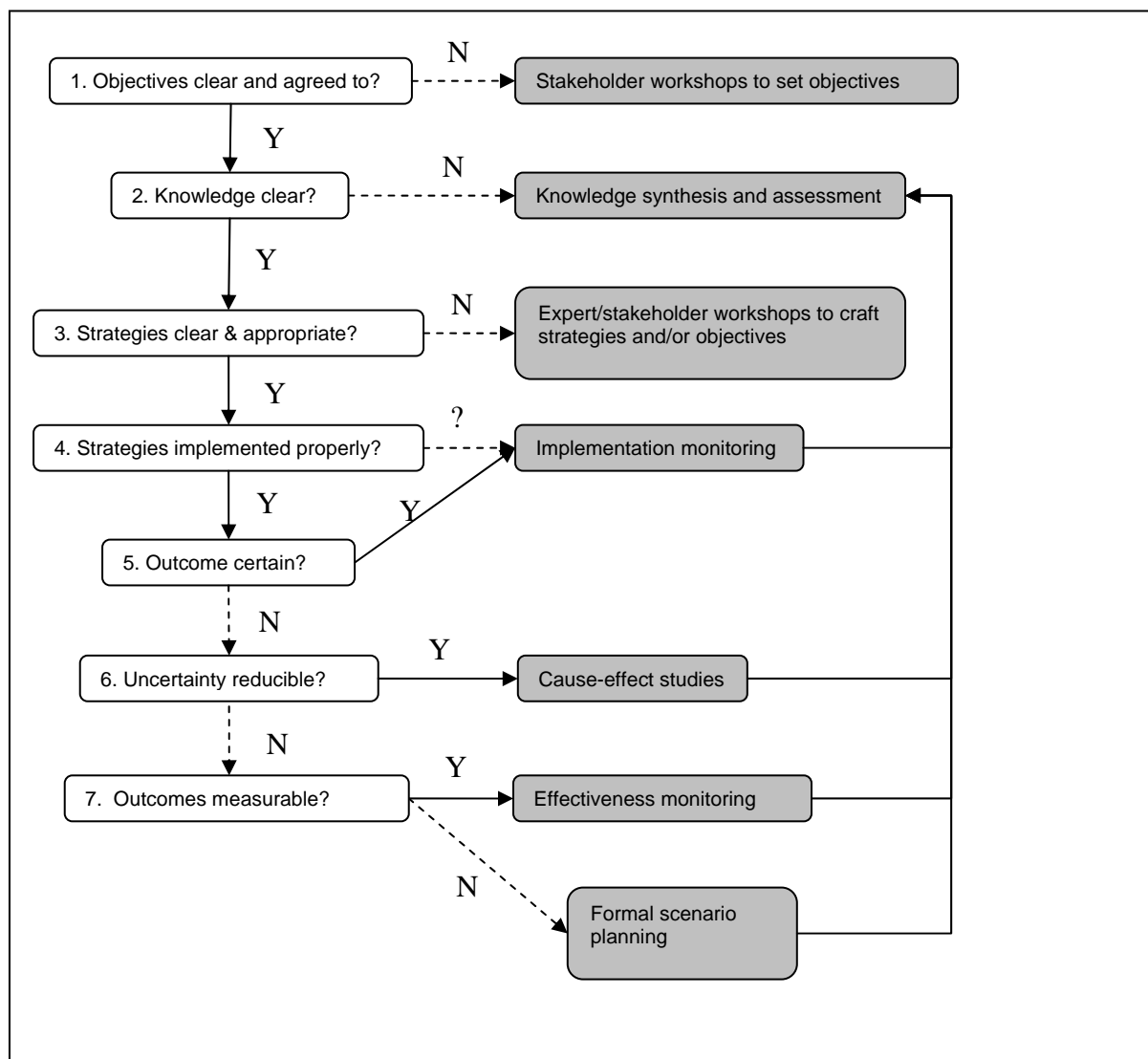


Figure 3. Simple decision tree for identifying high priority adaptive management tasks. Answer the questions for each objective related to a broad goal.

3.2.2 Question 1: Stakeholder⁸ workshops to set objectives

Structured workshops allow people with diverse interests and knowledge to share perspectives and learn about the system they are managing. Typically, participants (e.g., interested parties and managers) start by articulating a broad management vision. Participants then identify important “values” associated with the managed system (e.g., water quality, stream morphology, economic activity) and general connections among values. Finally they articulate objectives for the different values that are consistent with the overall vision (e.g., maintain water quality within range of natural variability). The level of facilitation required depends on the degree of conflict

⁸ The term stakeholder is used broadly and refers to anyone with an interest in the management subject (e.g., managers, community groups).

over resource use. Some management situations have few stakeholders and require less formal communication processes.

Objectives are based primarily on participants' values. Initial discussions to set objectives do not include much consideration of structured knowledge models or of tradeoffs among values. Hence, initial objectives can be ambitious and ambiguous (e.g., provide unlimited access), and incompatible with other objectives. Feedback from assessments of knowledge and attempts to develop strategies lead to clarification of objectives.

3.2.3 Question 2: Knowledge synthesis and assessment

This step synthesizes knowledge relating to the objectives from a range of sources (e.g. practitioner experience, expert advice, scientific literature, and traditional or local knowledge). The knowledge is most usefully expressed as conceptual models that predict the outcome of management strategies and describe uncertainties that limit predictive power. Conceptual models may be expressed using different levels of sophistication, from diagrams and logical textual arguments, to computer-based probability networks and simulations. See Burgman (2005) for a in depth description of how to use knowledge to support decision-making.

Synthesizing relevant knowledge from a variety of sources can be challenging and time-consuming. Theories may not be well studied; studies from elsewhere may be of questionable local relevance; expert opinion (including scientific, local and traditional knowledge) may vary. The time and effort devoted to gathering and synthesizing knowledge will depend on the resources available, the availability of knowledge and the importance of the management objective. Weak knowledge can be improved over time.

A relatively simple method of representing knowledge uses “overview” diagrams to depict relationships between goals, objectives and strategies (Figure 4) and uses graphical relationships to predict the effect of different strategy options on objective outcomes (Figure 5)⁹. Uncertainty, limiting the accuracy of predictions, is represented explicitly when possible and sources of uncertainty are described in text. Graphical relationships can be replaced with text when people are not comfortable with graphs, for example:

I believe that I have a high chance of maintaining water flows within their natural range when harvesting remains below 20% ECA; this chance of success decreases rapidly until 40% ECA, beyond which I think my chances are low. I am not very certain about my belief because different types of watersheds respond differently, etc.

⁹ This approach was used to summarise some of the regional-scale knowledge related to ecological integrity and human well being (examples only for well being). See Price et al. 2008.

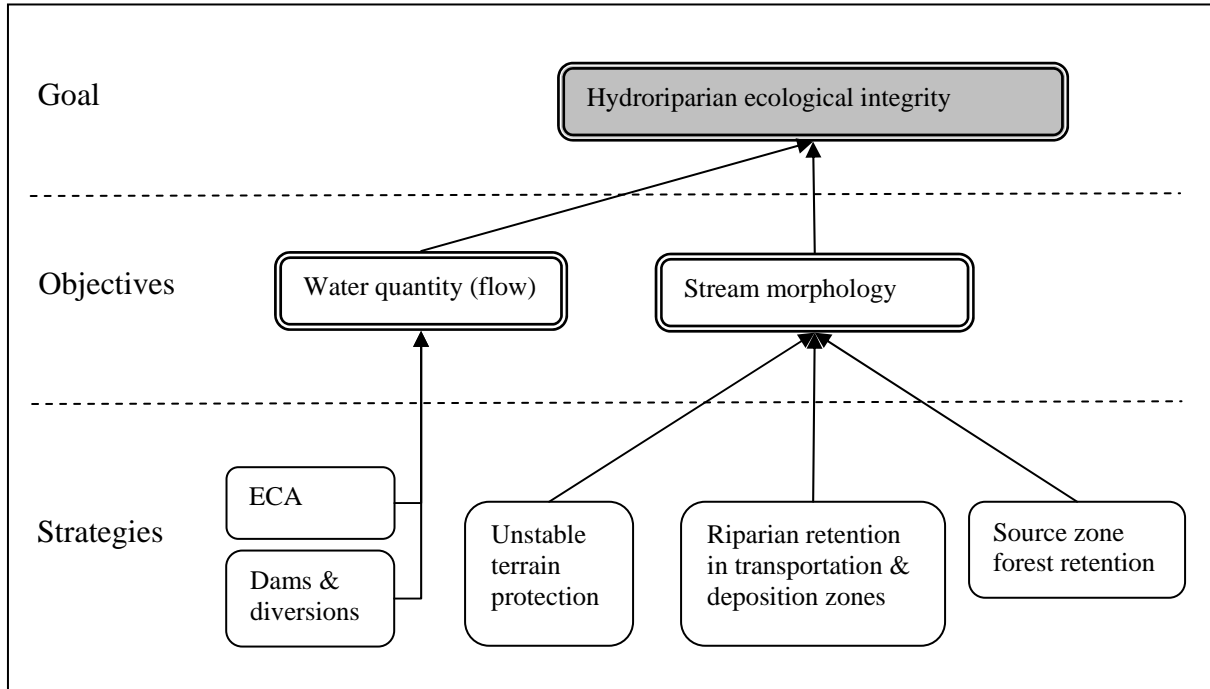


Figure 4. Example portion of an overview diagram depicting relationships among goals, objectives and strategies (based on Price et al. 2008)

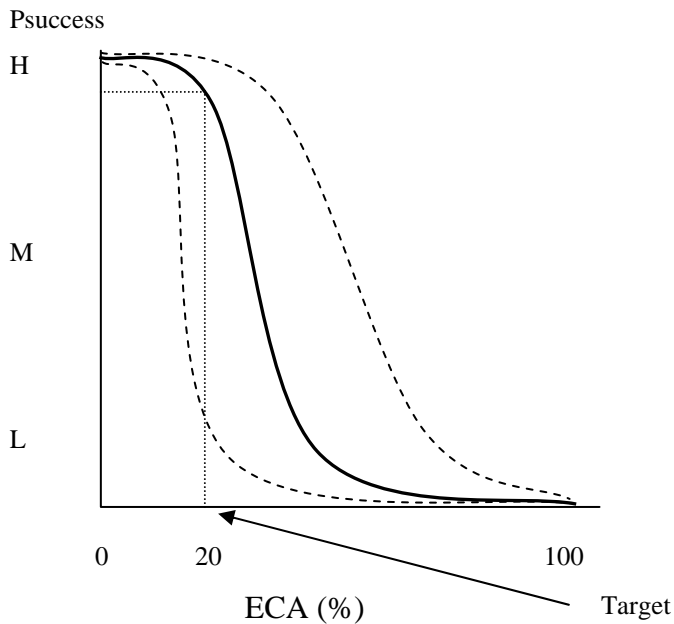


Figure 5. Example graphical relationship between indicator and objective: probability of success at achieving water quantity (flow) objective is a function of forest clearance (Equivalent Clearcut Area). Solid line shows best-estimate; dashed line shows uncertainty. A complete strategy specifies a target level of the ECA indicator (e.g., do not exceed 20% ECA). (based on Price et al. 2008)

Assessment of conceptual models has three main purposes:

- to identify interactions among strategies and objectives
- to examine alternative strategies and to identify strategies that are consistent with objectives
- to identify knowledge gaps and other data needs

Assessment occurs as the model is being developed and understanding of the managed system increases. In addition, formal techniques such as scenario analyses and sensitivity analyses can be applied to assess outcomes, interactions and uncertainty.

3.2.4 Question 3: Expert/stakeholder workshops to craft strategies and/or re-draft objectives

Structured workshops to develop strategies serve the dual purpose of helping stakeholders learn about the complexities of the managed system and helping topic experts frame the problem based on stakeholder objectives. Objectives should be reasonably well developed and knowledge at least partially synthesized before strategies are contemplated, because strategies rely on knowledge to achieve objectives. At this point, incompatible and ambiguous objectives will be revealed. The available synthesized knowledge can help to clarify them and to determine underlying uncertainties.

The degree of involvement of stakeholders in the process of developing strategies depends partly on the level of trust among stakeholders and between stakeholders and topic experts. The process should be transparent and open. The need for stakeholder involvement will likely be made clear by stakeholders. As is the case with setting objectives, some management situations have less stakeholder interest and require less formal communication processes.

3.2.5 Questions 4 and 5: Implementation monitoring

Implementation monitoring checks that strategies are implemented as planned. When re-measured periodically, implementation indicators can provide trends over time.

For ecological integrity, implementation monitoring typically measures some landscape feature that is directly affected by forest management (e.g., the amount of old forest or the width of a riparian buffer). Often, indicators can be calculated by manipulating existing inventory data (e.g., by overlaying digital maps to create desired polygons). Other potential sources of implementation data include the Forest and Range Evaluation Program¹⁰, company certification programs and the Forest Practices Board audits. In some cases new remotely-sensed or field data must be collected.

For human well being, implementation monitoring typically measures short-term management actions as inputs to activities designed to achieve objectives (e.g. number of staff hired or trained, or amount of profit shared). Operating entities, such as economic development corporations, usually have most of the information needed for monitoring economic sector strategies, but this may need to be collated across multiple entities to get a sectoral total. In other areas such as culture, recreation or health, quantitative indicators may not be collected at the relevant scale for community monitoring. If data exist at all, they will likely be scattered among agencies and inconsistent in format; collating data across a broad series of objectives and strategies may be a big task. In some cases qualitative indicators (such as the completion of

¹⁰ <http://www.for.gov.bc.ca/hfp/frep/>

culturally-modified-tree surveys; or the creation of an arm's-length business operation) may serve to measure the degree of implementation of a strategy. However, the data problem for implementation indicators diminishes at the community scale, where most of the interest in these objectives lies, because each community is likely to emphasize a small number of goals and objectives, so there will be less need to compare across a broad range of strategies. Establishing a consistent set of regional implementation indicator data for human well being would be challenging. If this is necessary, it should start from the priorities and indicators developed by communities themselves.

3.2.6 Question 6: Research and validation monitoring

Cause-effect research, also known as validation monitoring¹¹, aims to reduce uncertainty about the relationship between management strategies and objectives. In this way, it can increase the chance that management strategies (“cause”) will lead to desired outcomes (“effect”). Various types of studies can be used, including retrospective studies examining effects of past practice and experimental studies that test present-day management alternatives. Specific questions and scope will determine which approach is most appropriate. In general, active experimental approaches are expensive and long-term, but are able to clarify relationships with more certainty. Studies that aim to reduce uncertainty about cause-effect relationships do not necessarily need to focus on management interventions. Studies addressing more basic uncertainties about ecological, social and economic systems can be equally important (e.g., better models of wind behaviour, and consequent windthrow, and of stream temperature response to climate change may improve predictions about the effects of riparian management on fish stocks).

3.2.7 Question 7: Effectiveness monitoring

Effectiveness monitoring checks whether objectives are being met, but cannot usually attribute cause convincingly. For example, monitoring may show that fish stocks have declined in a logged watershed, but if no comparable unlogged benchmark watersheds have been studied, it is not possible to demonstrate that logging caused the decline.

Effectiveness monitoring can be short or long-term. Short-term effectiveness monitoring is useful where there is a short lag time between management intervention and response (e.g. deactivating a road in response to chronic sedimentation). Long-term monitoring is necessary to determine trends in objectives over time (e.g., are bear populations being “maintained”), and to gain a better understanding of long-term system dynamics (e.g., tree mortality rates in post-harvest stands).

Effectiveness monitoring varies in expense. For ecological integrity, effectiveness monitoring ranges from mechanized systems (e.g., climate stations and stream gauges) to fairly specialized and expensive field work (e.g., darting caribou from helicopters). Long-term monitoring requires a long-term commitment of resources. For human well being, effectiveness monitoring may gather and evaluate existing statistics on economic and health status or may collect new data. If survey or interview data are to be collected, researchers must pay particular attention to terminology, sampling protocols, communication and interpretation issues because the same

¹¹ Note that the definition of validation monitoring varies in the literature; here we mean any study that improves knowledge about the cause-effect relationship.

questions often have different meaning to different people. Even if surveys are needed monitoring of human well being objectives is often less costly than for ecological integrity.

Effectiveness monitoring is not always necessary. If the relationship between management strategies and objectives is well understood and highly predictable, then monitoring implementation of well-designed targets can provide enough confidence that objectives will be achieved.

3.3 Collaboration

Successful adaptive management is generally collaborative (Williams et al. 2007). The definition of adaptive management for the Central and North Coast specifies a collaborative approach. All steps, apart from the actual implementation of management and monitoring plans, benefit from collaboration. The specific approach to collaboration can be developed by participants. The degree of collaboration should reflect the management context. Some management situations are neither complex nor contentious and do not require significant involvement from stakeholders, topic experts or facilitators. This section provides some guidance to help with designing a collaborative approach.

Participants generally include stakeholders, managers, topic experts, researchers and process facilitators (some people may participate in more than one capacity). Each group likely will want to participate to different degrees in different phases of adaptive management (Table 3). First Nations are represented in different roles (e.g., local resource managers representing First Nations governments or companies, topic experts on cultural or fish resources, researchers examining riparian forest).

Stakeholders, in this context, include any parties interested in the consequences of management decisions that do not have direct responsibility for management (e.g., environmental groups, recreation groups, chambers of commerce, industry groups, and town councils). Stakeholders help articulate and confirm goals and objectives, monitor the development of conceptual models and review strategies and monitoring plans for consistency with objectives; they also review the management implications of research and monitoring and help to adjust plans.

Managers include people that are responsible for designing strategies and implementing management decisions (e.g., professional staff, experienced employees, business managers and owner-operators). Because First Nations are highly involved in resource management decisions affecting rights and title, they must be engaged with respect to these issues.

Topic experts hold knowledge related to some component of the managed system; they contribute knowledge, design monitoring plans, help interpret research findings and integrate findings with existing knowledge (e.g., First Nations elders, hydrologists, foresters, biologists, economists, social scientists and managers with extensive experience in particular subject areas).

Managers and topic experts monitor the setting of goals and objectives so that they are aware of underlying values and concerns; they contribute conceptual models and develop (and adjust) management strategies and monitoring plans; they may or may not be directly involved in research, but they help to interpret research for the purposes of management.

In collaboration with topic experts, researchers (employees, local consultants or university researchers) design and undertake specific research projects. Researchers must be aware of

knowledge gaps, and then design and oversee research projects to address these gaps. They must possess good communication skills and analytical ability.

Facilitators manage the process; they solicit background information, arrange, facilitate and record meetings, ensure objectives, knowledge, strategies and monitoring plans are clearly documented and ensure that adaptive management steps are completed in a timely manner. Facilitators may be managers or consultants with specialized skills.

Table 3. Degree of participation in each adaptive management step. X = mainly observing or addressing specific questions; XX = participating, but deferring to others with more expertise; XXX = fully participating.

Adaptive management step	Stakeholders	Managers	Topic Experts	Researchers	Facilitators
Set objectives	XXX	XX	X		XX
Synthesize and assess knowledge	X	XX	XXX	XX	XX
Design strategies	XX	XXX	XX		XX
Design research/ monitoring	X	XX	XX	XXX	XX
Implement strategies		XXX			
Monitor/research		X	X	XXX	
Adjust knowledge	X	XX	XXX	XX	
Adjust plans	XXX	XXX	X		XX

3.4 Legal feasibility

Legislation can limit adaptive management in two ways. It prevents experimental management treatments that exceed legal limits. It limits the range within which managers can adjust certain practices. These restrictions should be considered prior to implementing an adaptive management program. For example, the Central and North Coast Order (Anon. 2007a) limits the additional reduction in functional riparian forest for the purposes of adaptive management to 10%. This allowable reduction seems too low to support an adaptive management experiment, however, other options may exist: the order may be amended to implement adaptive management objectives (Anon. 2007a).

3.5 Results of Adaptive Management and How to Use Them

Completed planning and monitoring projects feed back information into the adaptive management process (Figure 2). Planning projects address missing objectives, strategies or targets and feed directly into the planning process in Figure 2.

Completed implementation monitoring projects feed back data on the current state to inform future monitoring decisions and to identify implementation problems (i.e., a quality control issue). Completed research projects update the cause-effect hypotheses and inform future monitoring priorities and selection of management strategies.

If managers have good knowledge of the systems they are managing, and if objectives are clear and achievable, then management strategies will successfully predict the outcomes of management actions. By following the processes outlined above, managers will be more

confident of this outcome. In this kind of situation, adaptive management suggests that monitoring implementation to ensure targets are achieved is all that is necessary.

3.5.1 Checklist for adaptive management steps

Answering yes to the following questions (Table 4) indicates that important aspects of each step in the adaptive management process have been completed. This checklist also includes prerequisites to adaptive management.

Table 4. Checklist: questions answered “yes” lead to adaptive management success (based on Williams et al. 2007).

Prerequisites to adaptive management
Collaboration
<ul style="list-style-type: none"> • Have all relevant management bodies (e.g., First Nations, Province of BC) and interested parties been identified? • Have managers and interested parties committed to participate over the long term, from setting objectives to reviewing monitoring results? • Can interested parties influence decisions? • Has a process been established to foster effective communication and participation? • Can the adaptive management process adapt to changes in participant views?
Legal feasibility
<ul style="list-style-type: none"> • Do managers, scientists and interested parties understand relevant laws and regulations? • Are laws and regulations sufficiently flexible to allow adaptive management, particularly experiments? • Has a process been developed to ensure compliance with laws and regulations?
Adaptive management steps
Set Objectives
<ul style="list-style-type: none"> • Do objectives have specific subjects and direction? • Have tradeoffs among objectives been considered? • Have participants agreed to objectives?
Gather and Assess Knowledge
<ul style="list-style-type: none"> • Is model scope sufficient to address objectives? • Are relevant environmental and socio-economic processes included? • Are relevant management options included? • Do models express management options as testable hypotheses? • Do models adequately represent current understanding? • Are models calibrated with available data (e.g., current resource status)?
Design management strategies
<ul style="list-style-type: none"> • Are the strategies specific and measurable—can they be expressed as an indicator and a target? • Do strategies reflect current knowledge? • Are strategies consistent with management objectives? • Have tradeoffs among strategies been considered? • Were interested parties consulted when strategies were developed?
Design research and monitoring
<ul style="list-style-type: none"> • What are the monitoring priorities, based on relevance of information and costs of data collection? • Has the desired accuracy of data been specified? • Have experimental studies been designed (where applicable)? • Will results be available in time to allow strategy adjustments? • Are managers, scientists and interested parties sufficiently committed to support an ongoing monitoring program?
Implement strategies

• Do estimates of the current level of implementation exist (necessary to determine amount of additional change allowed)?
• Do existing inventories describing resource status provide information necessary to support implementation?
• Have the specific tasks needed to implement the strategies been described?
• Has necessary training been provided?
• Is feedback from implementation monitoring used in a “quality-control process”
Conduct research/monitoring
• Are sampling and analysis needs understood?
• Is data collected in a timely manner?
• Is data collection consistent with established standard methodologies?
• Are data managed in a way that allows long-term storage and easy retrieval?
Learn and adjust
• Are results peer reviewed?
• Are results interpreted for management relevance?
• Are results integrated into the existing knowledge summary?
• Does a protocol exist to inform managers about potentially important results?

3.5.2 Recommended reading for section 3

If you want to read some of the “classic” adaptive management works, see

Holling, C.S. 1978. Adaptive Environmental Assessment and Management. John Wiley and Sons, New York, NY.

Walters, C.J. 1986. Adaptive management of renewable resources. New York: Macmillan. 374 p.

Lee, K., 1993. Compass and Gyroscope. Island Press, Washington DC.

For a description of how to apply adaptive management broadly across a resource management agency, see

Williams B. K., R. C. Szaro and C. D. Shapiro. 2007. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, D.C.

<http://www.doi.gov/initiatives/AdaptiveManagement/documents.html>

For a general discussion of adaptive management and how to apply it to forestry in BC, see

Taylor, B. L. Kremsater and R. Ellis. 1997. Adaptive management of forests in British Columbia. Ministry of Forests, British Columbia.

<http://www.for.gov.bc.ca/HFD/pubs/docs/Sil/Sil426.htm>

For an example of how a forest company applied adaptive management to biodiversity conservation (with good ecological rationale for indicators), see

Coast Forest Strategy. http://www.forestbiodiversityinbc.ca/forest_strategy/default.htm

Bunnell, F., G. Dunsworth, D. Huggard and L. Kremsater. 2003. Learning to sustain biological diversity on Weyerhaeuser’s Coastal Tenure. URL:

http://www.forestbiodiversityinbc.ca/forest_strategy/am/framework.htm

Bunnell, F.L., and Dunsworth, B.G. 2004. Making adaptive management for biodiversity work – the example of Weyerhaeuser in coastal British Columbia. For. Chron. 80: 37-43.

For a discussion of the top ten factors that enable adaptive management, see

Marmorek, D.R., D.C.E. Robinson, C. Murray and L. Greig. 2006. Enabling Adaptive Forest Management – Final Report. Prepared for the National Commission on Science for Sustainable Forestry by ESSA Technologies Ltd., Vancouver, B.C. 94 pp.
<http://www.essa.com/projects/descriptions/1432.htm>

For a sophisticated but readable discussion of how to make decisions that account for risk and uncertainty, see

Burgman, M. 2005. Risks and Decisions for Conservation and Environmental Management. Cambridge University Press, Cambridge.

For a description of how to develop conceptual models and how to apply adaptive management to conservation, see

Conservation Measures Partnership. 2007. Open standards for the practice of conservation, version 2.0. www.conservationmeasures.org

Conservation Action Planning network and tools:
<http://conserveonline.org/workspaces/cbdgateway/cap/index.html>

For a comparison of different methods of synthesizing community knowledge, see

Lynam, T., W. De Jong, D. Sheil, T. Kusumanto, and K. Evans. 2007. A review of tools for incorporating community knowledge, preferences, and values into decision making in natural resources management. Ecology and Society 12(1): 5. [online]
<http://www.ecologyandsociety.org/vol12/iss1/art5/>

Appendix II of this guidebook.

For a good discussion of different types of monitoring, see

Lee, D.C., 2004. Making monitoring work for managers.
www.fs.fed.us/psw/topics/fire_science/craft/craft/Resources/Lee_Bradshaw_monitoring.pdf

For an introduction to different research methods and a protocol for designing a study, see

Bergerud, W. 2002. Planning and implementing a research study. Research Branch, Ministry of Forests, Victoria, BC. 22 pages.
<http://www.for.gov.bc.ca/hre/forprod/researchprotocols.pdf>

For a comprehensive description of different research and monitoring methods (and a good description of decision analysis, see

Sit, V. and B. Taylor (editors). 1998. Statistical methods for adaptive management studies, Res. Br., BC Min. For., Res. Br., Victoria, BC, Land Manage. Handb. No. 42.:
<http://www.for.gov.bc.ca/hfd/pubs/docs/lmh/lmh42.htm>

For guidance on conducting studies in communities, see

Appendix II of this guidebook

For guidelines on developing inventory and monitoring protocols, see

Vesely, D., B. C. McComb, C. D. Vojta, L. H. Suring, J. Halaj, R. S. Holthausen, B. Zuckerberg, and P. M. Manley. 2006. Development of Protocols To Inventory or Monitor Wildlife, Fish, or Rare Plants. USDA Forest Service Gen. Tech. Report WO-72

http://www.fs.fed.us/rm/pubs_other/wo_gtr072.pdf

For standards for collecting ecological data, see

Appendix III of this guidebook

Resources Information Standards Committee. www.ilmb.gov.bc.ca/risc/

Forest Investment Account: Land Base Investment Program Home Page.

<http://www.for.gov.bc.ca/hcp/fia/landbase/>

For local monitoring support, see

Pacific Streamkeepers Federation. <http://www.pskf.ca/index.html>

Coastal Guardian Watchmen Network.

http://www.coastalguardianwatchmen.ca/training/steering_committee/

Part II.

Applying adaptive management

to

specific situations

4 Adaptive management plans for forestry practitioners

This section is for forest practitioners. It recommends an approach for developing “adaptive management plans” associated with management “flexibility” in ministerial orders (Anon. 2007a and 2007b). Adaptive management plans have not yet been tested in practice, thus following the recommendations below does not guarantee that an acceptable adaptive management plan will be produced.

Unlike other sections in Part II of this document, this one focuses entirely on the research/monitoring stage of adaptive management—a context set by the ministerial orders. First it describes who should participate in the planning process, and second it outlines the planning steps.

4.1 Participation in adaptive management planning

Legally, the responsibility for developing adaptive management plans currently rests with licensees, however adaptive management requires a team approach.

First Nations should be involved from the outset (prior to considering flexibility). Initial discussions should address First Nations interest in adaptive management issues and outline a process for future involvement. Topics for discussion may include how to share results, collaboration on topics of mutual interest and potential employment and training opportunities.

Researchers and forest practitioners (and First Nations where appropriate) should develop and undertake adaptive management plans collaboratively (workshops are useful to identify potential research topics and to share results). This does not mean that everyone does everything, rather that good communication is established so that everyone has an opportunity to review each step, make comments and track progress. In particular, adaptive management plans can be greatly improved by feedback from practitioners and from other researchers.

Several licensees (and perhaps other parties) may contribute resources to one large, complex study. In such cases, communication protocols become more important and efforts should be made to ensure consistency of results (e.g., use same forms and data collection protocols).

Periodic (at least annual) meetings should be arranged to ensure that research is still on track (e.g., field conditions may limit planned data collection or the researcher may have become side-tracked).

4.2 Steps for planning and conducting adaptive management studies

An adaptive management plan describes a management related problem, identifies specific questions related to the problem, outlines an approach for answering one or more of these questions¹² and describes a process for translating study results into management practice. Appendix IV provides a template for an adaptive management plan. The basic steps to develop the plan follow:

1. Practitioners initiate a discussion with First Nations regarding their participation; First Nations also participate in the steps below in the same manner as practitioners, subject to interest.

¹² A general description of different types of monitoring approaches is provided in Part I, Section 3.

2. Practitioners/First Nations and researchers identify management issues, usually in a workshop setting. Researchers and practitioners should review existing knowledge summaries prior to meeting.
3. Researchers and practitioners/First Nations prepare an adaptive management plan (Appendix IV).
4. Field research crews (mainly) conduct the adaptive management study.
 - a. Work collaboratively with forestry crews to implement any treatments;
 - b. Consider potential for forestry crews to collect data.
5. Researchers (mainly) analyse results and write report.
6. Practitioners/First Nations and researchers evaluate relevance of findings to management:
 - a. Consult with topic experts;
 - b. Integrate new knowledge with pre-existing knowledge (i.e., update conceptual models).
7. Practitioners/First Nations (mainly) adjust management:
 - a. Standard operating procedures and best management practices;
 - b. Policy recommendations.
8. Researchers and practitioners/First Nations prepare extension products for other practitioners:
 - a. Workshops (particularly field-based courses);
 - b. Extension notes.
9. Researchers (mainly) prepare extension products for the research community:
 - a. Conference presentations;
 - b. Journal articles.

5 Adaptive management for community resource managers

5.1 Overview

This section is intended for resource managers operating in and around communities, for example in the fields of tourism, forestry or aquaculture. Managers can come from companies seeking to use adaptive management to address business objectives. They can come from agencies, representing the interests of the community and/or the general public, seeking to use adaptive management to better manage for multiple objectives. Managers may or may not be representing First Nations.

Resource managers considering adaptive management should follow a sequence of steps to decide first if adaptive management is worthwhile and then, if appropriate, to implement adaptive management (Table 5). These steps will complete the first iteration of the adaptive management cycle. Below the table, more detailed information and relevant questions are provided to guide each step. Refer to Part I of this document for a broad discussion of the benefits of adaptive management and for a description of the adaptive management cycle.

Many of the adaptive management steps may seem onerous. Managers should remember that although collaboration is time consuming, it can reduce later conflict. Also, adaptive management is an iterative process—the first iteration does not need to be perfect. For example, the first iteration can develop knowledge for the more obvious challenges. Similarly, small research/monitoring budgets can still address important issues over the long term.

Table 5. Overview of Steps to implement adaptive management for community resource managers.

Scoping
1. Form a preliminary adaptive management team
2. Decide if adaptive management can help you
3. Decide on the scope of adaptive management
Setup
4. Form the full adaptive management team
5. Engage First Nations
6. Identify and engage interest groups
7. Involve the community
Planning
8. Take a hard look at management issues
9. Prepare a learning plan
10. Design studies for selected questions
11. Look for external funding
Project Implementation
12. Hire a research/monitoring crew
13. Supervise monitoring
Feedback
14. Interpret results
15. Communicate results
16. Adjust management, if appropriate

5.2 Steps to implement adaptive management for community resource managers

1. Form a preliminary adaptive management team

- Create a small team of people with different backgrounds, including good local knowledge and practical experience with operations. Tackle the next three steps.
- Identify and contact sources of adaptive management support (see How to Use this Guidebook).

2. Decide if adaptive management can help you

Do you have the management flexibility to change practices to reflect learning?

- What aspects of your operations are tightly restricted by regulations?

What are the potential benefits of adaptive management?

- information that can improve commercial operations (e.g., improved practices, employee satisfaction; community relations)
- information that can improve management of important public values (e.g., protecting fish)
- better management plans
- reduced conflict with interest groups
- increased local employment

What are the potential costs of adaptive management?

- increased time and effort devoted to planning and related documentation
- costs of monitoring and research
- increased communication and training costs to help people learn and to adjust historic management practices

Is adaptive management worth it (do the benefits exceed the costs)?

- Where uncertainty is high and amenable to study, adaptive management can help.
- New types of business ventures (e.g., aquaculture for different species) have bigger knowledge gaps and more to learn, thus benefits can exceed costs.
- Management of multiple public values is often complicated and can benefit from new, shared information.
- Highly contentious issues can affect markets and consume time, thus collaborative learning through adaptive management may be a cost effective way to avoid conflict.
- Don't commit to adaptive management unless you're prepared to spend time and money: identify resource limits at the outset to manage expectations of all parties and to build commitment of others.

3. Decide on the scope of adaptive management

- Do you have a specific problem to tackle, an issue that you are already aware of but don't know the best way to handle?
- Do you think you could improve practices, by systematically looking at each management strategy and trying to improve it?
- Do you want to create a culture of learning in your organization or just solve some specific problems?

4. Form the full adaptive management team

- Based on the type of management problems you have, you will need certain types of advice. Typically, you will need to involve someone who really understands your operation—on the ground—and someone who can help you plan studies to answer your questions. You may also want to bring in experts, when appropriate, to help clarify management problems and design studies (e.g., experts on sea lice management). Any adaptive management team should be led by somebody with good communications skills.

5. Engage First Nations

- First Nations organisations should already have completed this step, however, this is an opportunity to make sure appropriate people have been contacted in the leadership and in the communities.
- For non-First Nation managers, establish a relationship with First Nations as soon as possible in the management process. Relationships take time to build. Then engage First Nations in adaptive management. Discussion will be required to determine the scope of their involvement. Depending on the issue, their interests, and prior involvement, First Nations may wish to serve as knowledge sources, as joint decision-makers, as partners in new management strategies, as partners in learning, or merely as recipients of referrals / information.

6. Identify and engage interest groups (“stakeholders”)

- What political sensitivities exist about your operation? What kinds of evidence are required to respond to those? Who needs to be engaged to review, validate, or recognize that evidence in order to mitigate potential criticism?
- Are stakeholders willing to commit the time necessary to participate?
- Work with stakeholders to develop a mutually-agreeable approach to collaboration.

7. Involve the local community

- Let the community know what you are up to (i.e., trying to improve management) and ask for feedback.
- Respond to feedback.
- Work with community members to develop capacity and provide employment opportunities (e.g. monitoring).

8. Take a hard look at your current management¹³

- Do you have a clear idea about what you want to achieve?
- Do you have a plan that’s based on experience and current knowledge?
- Does the plan clearly describe expected outcomes of management practices?
- If you are tackling a specific problem, do you have the latest information?
- What questions do you need answered in order to improve management?

9. Prepare a learning plan

- List the questions that you need to answer first

¹³ See Part I, Section 3 for a decision tree that identifies the types of issues to address with adaptive management.

- where you have the most to learn (biggest knowledge gaps)
- where new information could make a big difference to management outcomes
- where bad outcomes are not reversible (e.g., loss of fish run)
- Look at approximate costs of studying high priority questions.
- Decide which questions to study based on benefits and costs (some questions will be too difficult or expensive to study or unlikely to yield clear answers).

10. Design studies for selected questions

- Get some advice from someone who has conducted similar research or monitoring.
- Decide if you need an experiment or if you can just sample existing conditions.
- Design the experiment or the sampling program (e.g., see Sit and Taylor 1998).

11. Look for external funding

- Contact local researchers to see if they think any of the projects might qualify for outside funding and to see if they wish to collaborate.
- Review funding opportunities and prepare a proposal if appropriate.

12. Hire a research/monitoring crew

- Think locally (e.g., Streamkeepers¹⁴, Guardian Watchmen¹⁵).
- You may or may not need an experienced team leader, or special skills.
- You may be able to use your own staff, if they are interested.
- You may have to hire summer students, or a part-time, year-around crew.

13. Supervise monitoring

- Keep tabs on progress; research and monitoring plans encounter problems just like any other project and benefit from the guidance of an experienced manager.
- Remind people to think about how their findings will change management.
- Results from one study can often be inconclusive and typically raise new questions related to the original problem. Getting enough information to solve the original problem can require a series of projects and take several years. But you typically learn useful, unexpected things along the way.

14. Interpret results

- How reliable are your study results (e.g., was it a rigorous peer reviewed study)?
- Do they contradict previous understanding?
- What are the management implications?
- Are the management implications big enough to warrant another study to confirm results?
- Seek expert advice when management implications are significant.

15. Communicate results

- Discuss results with your co-workers.
- Let the community know what you learned.

¹⁴ Pacific Streamkeepers Federation. <http://www.pskf.ca/index.html>

¹⁵ Coastal Guardian Watchmen Network. http://www.coastalguardianwatchmen.ca/training/steering_committee/

- Let stakeholders know.
- Let other companies and professionals know (e.g., attend a conference).

16. Adjust management, if appropriate

- Seek practical advice from co-workers on implementing new practices.
- Describe and test new procedures.
- Provide training.
- Monitor implementation.
- Recommend changes to broader policy

6 Adaptive management in community economic development and human well being

Communities on the Central and North Coast can use the tools and approaches of adaptive management in their planning and implementation of economic development or human well being (HWB) programs. Community managers and economic development officers already have initiated many activities, either independently or in collaboration with regional groups like Coastal First Nations¹⁶, to improve human well being in coastal communities. Forestry operations, shellfish aquaculture, marine resource planning, tourism, as well as cultural activities, education and health initiatives are all underway in various communities. Each of these efforts already benefits from the experience of similar activities elsewhere, and applies lessons from its own experience. Adaptive management provides new ways to improve management effectiveness through structured learning.

Managers working in human well being should first review the introductory sections of this guidebook (Sections 1 – 3). For economic activities mainly reliant on natural resources Section 5 will also be of interest. The steps in applying adaptive management for human well being are similar to those presented in Section 5, and are summarized in the table below as a rough guide.

There are some differences in the process of implementing adaptive management between HWB issues and land use issues. One is that, unlike trees or fish, people are capable of making a wide range of choices and then acting on the world around them to create change. Because the choices they make have an effect on the outcomes of HWB strategies, it is even more important to involve people in planning, decision-making, and learning. The experiences of understanding intentions, of being able to influence outcomes, and of recognizing new insights all contribute to personal commitment. Commitment can make a big difference to successful outcomes, whatever the strategies. Therefore, in HWB strategies, the people most closely involved and affected should play an important role in planning and in learning from implementation.

Effectiveness monitoring is important in HWB (see explanation in Section 3 above). This is because there are often only loose linkages between feasible strategies (e.g., training) and important objectives (e.g., increased employment), so the effects even of well-designed strategies can be hard to predict. Monitoring the outcomes of HWB strategies is therefore helpful to limit perverse or unintended consequences. But monitoring outcomes alone may not help to improve management strategies (see Box 2 below).

¹⁶ The Coastal First Nations Turning Point Initiative is an alliance of First Nations groups on the Central and North Coast and Haida Gwaii. See <http://coastalfirstnations.ca/>.

Box 2. What can we learn from effectiveness monitoring?

There are many external factors besides management strategies that have an impact on HWB objectives: for example the objective of forestry employment is not only a function of acquiring a forest license (as one management strategy) but also of timber supply, accessibility, market conditions, the match between required and available labour skills, and other factors beyond managers' control. Simply measuring forestry employment does not tell you how much of that result is due to one or more management strategies, and how much to outside factors. If forest jobs go up, the strategy will be claimed to be successful even if it had little to do with this result. If they decline, the strategy may be blamed when it may not be at fault. To learn how the management strategies are affecting an objective requires more study to better understand the relationships between them (validation monitoring). So in the forestry example, to understand the relationship between objective (e.g. employment) and strategy (e.g. community holding license) would require a study that accounted for these various other factors and their influence on the results. Measuring outcomes (such as employment) will tell you what is happening, but to improve management you need to know why it is happening.

Many economic initiatives on the Coast are directly linked to natural resource use. This means that they will have social, economic and environmental dimensions. Here it is important to keep ecological and human well being management conceptually separate. For example, managers will design guidelines to ensure ecotourism operations do not cause significant disturbance to wildlife. But communities also want to manage ecotourism operations to create local employment and income benefits. There are linkages between management efforts to generate employment and at the same time to protect wildlife. But these are different objectives that each require different management strategies or plans, different kinds of knowledge, and must be monitored using different indicators. It is important to keep these two sets of management issues distinct to clarify analysis. This also helps to assess ways that they may interact (e.g. if size of tourist parties is limited to 6 clients for environmental reasons, how does this affect the cost structure and employment for guiding trips?).

Learning about people's responses to management strategies must be constrained by ethical considerations. For example, it would be unethical to test strategies (even in an experimental context) that were expected to have negative consequences for individual health or well being. Collection of personal information also requires measures to ensure informed consent and confidentiality.¹⁷

Given the overall intent of human well being, adaptive management efforts in this domain should pay special attention to issues of building local capacity and employment through appropriate engagement of local leadership, operational level staff, students and research assistants. Practitioners should look for opportunities to engage community members at multiple levels in sharing information and in learning.

¹⁷ For more direction on ethics in socio-economic research, the reader can consult these summary guidelines from a recent European project intended to guide researchers at all levels:
<http://www.respectproject.org/ethics/guidelines.php>

Table 6. Steps to implement adaptive management for HWB managers.

Scoping
1. Explore the issues from different perspectives
2. Decide if adaptive management can help you
3. Decide on the scope of adaptive management
Setup
4. Develop an adaptive management team to undertake remaining steps
5. Identify and engage knowledge holders, learners and other stakeholders
6. Involve the community
Planning
7. Look at management issues carefully
8. Prepare a learning plan
9. Explore funding options
10. Design studies for selected questions*
Implementation
11. Implement studies
Feedback
12. Interpret results
13. Communicate results
14. Adjust management, if appropriate

**References for related social science and evaluation research methods and tools are summarized in Appendix II. Guidance and support for implementing any of the steps in this process, including additional reference materials, suggested contacts, and advice, may be available from the proposed regional Adaptive Management Support Unit.*

1. Explore the issues from different perspectives

- Assemble a small group of people with different backgrounds and knowledge of the issue to undertake initial steps. They could include managers, practitioners, and topic experts (e.g. First Nations elders). Seek their advice on the next two steps.

2. Decide if adaptive management would be helpful

- What scope exists to make management changes on the basis of what is learned? Some areas of service provision are tightly regulated. For example, even if you learn how better to introduce indigenous language and cultural education in secondary schools there may be limited opportunities to influence curriculum when content is fixed by provincial requirements.

- Many aspects of business and service operations do not need adaptive management. Standard practices for specific tasks that deliver predictable results do not need much attention (except to make sure they actually happen). Most management practices are of this type.
- Are you dealing with contentious issues? Many conflicts can be significantly reduced by clear evidence or shared learning through an adaptive management process.
- See also the guidelines in Section 2, Table 1 and 2. Does your situation meet most of these requirements?

Compare costs of adaptive management with potential benefits

- Costs include time and effort of planning and documentation, costs of research and data collection, and the costs of training and learning to adjust management practices.
- Benefits could include more effective achievement of key objectives (employment, income, health, cultural values)
- Don't commit to adaptive management unless you're prepared to spend time and money: identify resource limits at the outset to manage expectations of all parties and to build commitment of others.

3. Decide on the scope of adaptive management

- Do you have a particular problem to tackle, an issue that you are already aware of but don't know the best way to handle?
- Or are you trying to improve practices and create a culture of learning across the whole organisation, by systematically looking at each management strategy?

4. Develop an adaptive management team to undertake remaining steps

- Based on the approach you choose, you will need certain types of advice. Typically, you will need to involve someone who understands the operational aspects of the organization, process, service or issues you are working with. You will also need skills in research: how to design and plan studies to answer questions. Bring in experts as appropriate, to help clarify specific areas of knowledge (e.g., elders to assess strategies for identification or protection of cultural resources). For initial stages of defining and sorting out questions to coordinate different knowledge perspectives and then later to share results, it is essential that team leaders have good communications skills. These combined skills may be held by different members of the team, or one member may hold several of the relevant skills. Team members may be recruited locally, or outside the community. They may contribute a lot of time to the effort or only minimal guidance, depending on requirements.

5. Identify and engage knowledge holders, learners and other stakeholders

- Identify and consult the key persons / organizations who are expected to gain from learning: not only managers, but also those with other interests in the objective. This could include business partners, staff, community leaders or elders, current or potential clients, and financial backers. Are they interested to be involved in sharing lessons? Some of them will be on the adaptive management team, and may represent their interests that way.

6. Involve the community

- For human well being issues, it is often valuable for teams to seek input from actual or potential beneficiaries in order to understand the barriers that could constrain their participation in the planned activity. This knowledge provides input to structuring the problem and potential learning opportunities.
- Keep the community informed of planned studies, potential employment in data collection or surveys, and share results.
- Depending on the particular adaptive management project, look for ways to build the capacity and understanding of community members more widely on those issues that engage them. This could be through participation in early planning, engagement in sharing knowledge, and/or in considering results.

7. Look at management issues carefully

- Do you have a clear idea about what human well being objective you are trying to achieve? Would you be able to measure success?
- Are management strategies and actions based on experience and up-to-date knowledge?
- Does your plan clearly describe expected outcomes of management strategies (targets)?
- What questions do you need answered in order to improve management?
- Consider developing your own Knowledge Summary to structure existing knowledge about the relationship between strategies and the particular objective of interest, using the model of the HWB Knowledge Summary, and the guidelines in Section 3 above. This will help to identify the kinds of studies or monitoring that will be most valuable. Developing a Knowledge Summary is a good potential way to structure useful information from a wide range of sources: other managers, staff, users, elders, community leaders, outside experts, researchers.

8. Prepare a learning plan

- List the questions that you would like to answer first
 - where you have the most to learn (biggest knowledge gaps, greatest uncertainty)
 - where new information could make a big difference to management outcomes
 - where failed strategies are likely to cause serious or irreversible damage
- Seek general advice on how to get reliable answers to these questions from advisors or team members with research expertise. This step could lead to redefining the questions, and will probably be iterative.
- Look at approximate costs of studies.
- Decide which questions to study based on benefits and costs (some questions will be too difficult or expensive to study or unlikely to yield clear answers).

9. Design studies for selected questions

- Get advice from someone who has conducted similar research or monitoring (see Appendix II for potential sources of advice).
- Decide what kind of study is most appropriate for the work needed: a retrospective study; a descriptive study; a survey of existing conditions or missing data; a carefully structured evaluation; a comparative analysis of causal factors; or more complex research.

- Because there is limited data available at the appropriate scale to monitor community human well being strategies, implementation monitoring will probably become part of most strategies themselves in order to produce that information. The indicators that are available, or can be readily constructed, are mostly effectiveness indicators measuring objectives.
- Involve users and beneficiaries in research where they are important knowledge holders already and / or where learning may result in changes to their behaviour that contribute to the objective (e.g. cultural practices, resource management).
- Research or evaluation studies should be designed to involve local staff to the extent feasible, for capacity building and employment purposes.

10. Explore funding options

- Contact researchers to see if they think any of the projects might qualify for outside research funding.
- Have researcher prepare funding proposal if project qualifies and if researcher interested.
- Explore Coast Opportunity Funds (potential funding available to First Nations for feasibility or management improvements for economic development, and for conservation investments)
- It may be possible to have a graduate student work on the project at little or no cost, under supervision of a university professor. Consider ways to involve a community member or practitioner in collaborating with or advising the student.

11. Implement studies

- Will studies be let under contract? If so, terms should specify how local staff or assistants could be engaged, both to build their capacity in doing this work and to generate short-term employment.
- If your organization will undertake the studies itself, maintain contact with the advisors who helped you design the study (# 10 above).
- Post-secondary students from the community may be helpful in seasonal data collection with appropriate training.
- Keep tabs on progress: research and monitoring plans encounter problems just like any other project and benefit from the guidance of an experienced manager.
- Results from one study can often be inconclusive and typically raise new questions related to the original problem. Getting enough information to solve the original problem can require a series of projects and take several years. But you typically learn useful, unexpected things along the way.

12. Interpret results

- The multiple perspectives of a diverse team are especially important here, and may need to be supplemented by additional advisors.
- How accurate are your study results and what factors limit that accuracy?
- Were the results as expected? Much of the time, if our knowledge is good, they will be.
- What are the management implications? Are they big enough to warrant another study to confirm results?
- Seek expert advice when management implications are significant.

13. Communicate results

- Part of the communication task is already accomplished when multiple parties are engaged in reviewing the work and interpreting results (#12 above).
- Present results in a clear and simple way to colleagues and to interested parties inside and outside the community (see #5 and 6 above). Encourage discussion and questions.
- Share lessons with professional colleagues in other communities.
- Participate in regional conferences and meetings to present and discuss conclusions

14. Adjust management, if appropriate

- If there is broad consensus on management implications and practical solutions, implement them. If there is ambiguity about the interpretation of results or management implications, decide whether this can be resolved by further study.
- Describe and test new management procedures (pilot funding and effectiveness monitoring).
- Train staff
- Monitor implementation

7 Adaptive management for researchers working on the coast

Researchers working in and around coastal communities may come from academia, government, industry or consulting. The motivation for participating in adaptive management includes increasing the relevance of research findings and obtaining funding (that may be matched by other funding bodies). Researchers have several options for plugging into adaptive management processes. They can consider adaptive management near the end of their studies, as they write management recommendations. At this point they can consult the documented knowledge summaries to determine the context and relevance of their results and can discuss findings with adaptive management program staff. If results are relevant and researchers are willing to work with adaptive management staff (e.g., from the proposed Adaptive Management Support Unit) to help synthesize results with existing information, then knowledge increases. Alternatively, researchers can consider participating in adaptive management before undertaking their projects. They can probe knowledge summaries to find questions of interest and design their research to address these questions. Researchers can use knowledge summaries to demonstrate management relevance to funding agencies. They may also be able to obtain funding from community-based or regional adaptive management programs if the research topic is of sufficiently high priority; funding may be matched by other research funding bodies.

Table 7. Steps for researchers wanting to participate in adaptive management.

1. Contact regional- and community-scale adaptive management programs and ask for information about their programs (e.g., knowledge summaries and monitoring priorities) and ask if they fund research and monitoring. Note that adaptive management programs are not yet underway and may take time to become established.
2. Review any documents provided that describe knowledge gaps and research and monitoring priorities.
3. Decide if your current research addresses any gaps or priorities and if it is worthwhile adding your results to the adaptive management knowledge summaries.
4. If worthwhile, contact adaptive management program staff to discuss adding your research results.
5. Decide if your future research interests match identified knowledge gaps or monitoring priorities.
6. Consider developing a proposal to the adaptive management program or responding to requests for proposals, as appropriate.
7. Consider developing a proposal, in collaboration with an adaptive management program, to an external funding body.

8 Adaptive management for regional-scale managers

This section is relevant to managers and other parties that influence policy in the North and Central Coast. It provides an overview of the process of conducting regional-scale adaptive management (Table 8). This process has been specifically designed to address the multiple interacting objectives and the diversity of interested parties that characterize coastal land use plans.

At the regional scale, adaptive management will be implemented by adaptive management staff (e.g., from the proposed Adaptive Management Support Unit) who have knowledge related to ecological integrity, human well being and research / monitoring. The Joint Land and Resource Forum (or a future First Nations—Provincial Government decision-making body) will be the main audience for the information emerging from adaptive management studies. A strong link between the decision-making body and the adaptive management program is necessary for adaptive management to work successfully. Adaptive management program staff also provide important communication and coordination functions for community-based and forestry-based adaptive management projects.

Table 8. Steps needed to implement regional-scale adaptive management

1. Summarize management objectives and strategies from the land use plans that apply to the North and Central Coast ¹⁸ .
2. Develop a knowledge summary ¹⁹ that links management strategies/practices ²⁰ to specific objectives, that predicts the outcomes of management, and that records the main sources of management uncertainty. Sources of knowledge include scientific literature, traditional ecological knowledge, practitioner knowledge and expert advice.
3. Identify priorities for planning, research and monitoring by following a structured procedure ²¹ to identify information gaps and their relative importance, using the knowledge summary.
4. Hold a meeting to select research and monitoring projects to fund. Meeting participants should objectively determine the most appropriate studies considering identified priorities and other factors such as project costs, available budget and benefits to local communities.
5. Administer research projects.
6. Interpret the management relevance of results considering the reliability of the new information and of the pre-existing information.
7. Update the knowledge summary to reflect findings.

¹⁸ For a summary of objectives and strategies related to ecosystem-based management on the north and central coast, see Price and Daust. 2007

¹⁹ See partially complete knowledge summaries for ecological integrity and human well being (Price et al. 2008).

²⁰ Note that some land use objectives in ministerial orders prescribe specific practices.

²¹ See prioritization procedure in Daust et al. 2008.

- | |
|---|
| 8. Recommend policy changes, if warranted, to the Joint Land and Resource Forum. |
| 9. Prepare extension material and share findings with other audiences, particularly with forestry practitioners and First Nations managers. |

9 Literature cited

- Anon. 2006a. Land use planning agreement-in-principle (AIP) between Mamalilikulla-Qwe'Qwa'Sot'Em First Nation, 'Namgis First Nation, Tlowitsis First Nation, Da'naxda'xw Awaetlatla First Nation, Gwa'sala-'Nakwaxda'xw First Nation, We Wai Kai First Nation, We Wai Kum First Nation and, Kwiakah First Nation (collectively, the "KNT First Nations" or a "Party") and the Province of British Columbia.
- Anon. 2006b. Land and resource protocol agreement between Gitga'at First Nation, Haisla Nation, Heiltsuk Nation, Kitasoo/Xaixais First Nation, Metlakatla First Nation, Wuikinuxv First Nation, (collectively the "Coastal First Nations" or a "Party") and Her Majesty the Queen in Right of the Province of British Columbia.
- Anon. 2007a. Central and North Coast Order December 19 2007. Province of British Columbia. <http://ilmbwww.gov.bc.ca/slrp/lrmp/nanaimo/cencoast/plan/objectives/index.html>
- Anon. 2007b. South Central Coast Order. Province of British Columbia. <http://ilmbwww.gov.bc.ca/slrp/lrmp/nanaimo/cencoast/plan/objectives/index.html>
- Arts J. and S. Nooteboom. 1999. Environmental impact assessment monitoring and auditing In J Petts (editor), Handbook of Environmental Impact Assessment. Blackwell Science, Oxford. Volume 1, pages 229–251.
- Burgman, M. 2005. Risks and Decisions for Conservation and Environmental Management. Cambridge University Press, Cambridge.
- CIT (Coast Information Team). 2004. Scientific Basis for Ecosystem-Based Management. <http://www.citbc.org/ebmscie.html>.
- CIT (Coast Information Team). 2004. Ecosystem-based management planning handbook. <http://ilmbwww.gov.bc.ca/citbc/ebmplan.html>.
- CMP (Conservation Measures Partnership). 2007. Open standards for the practice of conservation, version 2.0. www.conservationmeasures.org
- CSA. 2002. CSA Standard Z809-02 Sustainable forest management: requirements and guidance. Canadian Standards Association, Mississauga, Ontario. www.csa.ca
- Daust, D., K. Price and S. Tyler. 2008. Guide to using the Adaptive Management Knowledge Summary and Project Prioritization Procedure for the Central and North Coast. Report to the EBM Working Group.
- Holling, C.S. 1978. Adaptive Environmental Assessment and Management. John Wiley and Sons, New York, NY.
- Joint Land and Resource Forums. 2007. Definition of “Full Implementation of Ecosystem Based Management (“EBM”) by March 31, 2009”. [http://www.ilmb.gov.bc.ca/slrp/lrmp/nanaimo/central_north_coast/docs/Full_Implementation_\(Final%20July%2010%202007\).pdf](http://www.ilmb.gov.bc.ca/slrp/lrmp/nanaimo/central_north_coast/docs/Full_Implementation_(Final%20July%2010%202007).pdf)
- Lee, K., 1993. Compass and Gyroscope. Island Press, Washington DC.

- Marmorek, D.R., D.C.E. Robinson, C. Murray and L. Greig. 2006. Enabling Adaptive Forest Management – Final Report. Prepared for the National Commission on Science for Sustainable Forestry by ESSA Technologies Ltd., Vancouver, B.C. 94 pp
- Noss, R.F., and Cooperrider, A. 1994. Saving Nature's Legacy: Protecting and Restoring Biodiversity. Island Press, Washington DC
- Nyberg J.B. 1998. Statistics and the practice of adaptive management. Pages 1-8 in: V. Sit. and B. Taylor (eds.). Statistical Methods for Adaptive Management Studies. Land Management Handbook No. 42, British Columbia Ministry of Forest Research, Victoria, BC.
- Price K. and Daust D. 2007. Land-use plan summary for the north and central coast regions of British Columbia. Report to the EBM Working Group.
- Price, K., S. Tyler, D. Daust and C. Soto. 2008. Knowledge Summary for the Central and North Coast: Information used for estimating probability of success and uncertainty for EBM strategies. Report to the EBMWG.
- Sit, V. and B. Taylor (editors). 1998. Statistical methods for adaptive management studies, Res. Br., BC Min. For., Res. Br., Victoria, BC, Land Manage. Handb. No. 42.:
<http://www.for.gov.bc.ca/hfd/pubs/docs/lmh/lmh42.htm>
- Taylor, B. L. Kremsater and R. Ellis. 1997. Adaptive management of forests in British Columbia. Ministry of Forests, British Columbia.
<http://www.for.gov.bc.ca/HFD/pubs/docs/Sil/Sil426.htm>
- Walters, C.J. 1986. Adaptive management of renewable resources. New York: Macmillan. 374 p.
- Williams B. K., R. C. Szaro and C. D. Shapiro. 2007. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, D.C.
<http://www.doi.gov/initiatives/AdaptiveManagement/documents.html>

Appendix I. Adaptive management of grizzly bears (a hypothetical example)

Use this example with reference to the Decision Tree in Figure 3, p. 20

Year 0

- Vision (goal) is to maintain ecological integrity.
- Objective is to maintain grizzly population at natural level.
- Sub-objectives are to minimize human-induced mortality, displacement and habituation and to maintain critical habitat.
- First management strategy is to protect all critical habitat.
- Second management strategy is to limit displacement of bears by avoiding logging activity during key feeding periods.
- Grizzly Bear Knowledge Summary (KS) contains cause-effect relationships (e.g., Figure A1-1), a conceptual model (Figure A1-2), and text description saying that human-induced mortality is the largest threat, followed by loss of habitat (availability) and then displacement from habitat, etc.

Year 1

- Local bear biologist comes in seeking funding to estimate bear population. Is the project worthwhile? No: **Decision tree** indicates that strategies must be in place prior to monitoring and concept map shows that critical strategies related to bear mortality are not in place. Thus based on existing knowledge, strategies are not currently designed to achieve the objective.
- KS indicates that accessible road density is the biggest controllable factor affecting bear mortality. Hunting is a big factor, but not within jurisdiction to control.
- Managers hold workshop to develop road management strategy.
- New management strategy sets maximum open²² road density to 0.2 km/km²
- **Decision tree** highlights that current level of implementation (i.e., open road density) is unknown.
- AM team undertakes a study to assess current road density (implementation monitoring).

Year 2.

- Last years study results show that open road density is 0.7 km/km²
- Managers propose actions to limit public access using gates.

Year 3.

- Public access restrictions (gates) are put in place to theoretically limit public road access to 0.2 km/m².
- **Decision tree** asks if the outcome is relatively certain and if uncertainty can be reduced.
- In the KS, text indicates that a major uncertainty about the outcome (i.e., bear mortality) relates to the effectiveness of access restrictions.
- AM team undertakes study to monitor effectiveness of gates (to reduce uncertainty in the relationship between open road density and bear mortality).

Year 4.

²² accessible to the general public

- Study results indicate that significant traffic goes around or through gates.
- Managers move some gates to better locations.
- Managers start a public awareness program to explain need for gating.
- Managers consider limiting roadside seeding (provides forage that attracts bears), but want to see if gating works first. KS indicates that roadside seeding is not a big factor if open road density is low.

Year 5.

- AM team monitors gate effectiveness and finds 95% of gates effectively block public traffic (study to improve cause-effect relationship).
- Decision tree asks if outcome is relatively certain; KS indicates yes.
- Managers consider this to be sufficient, but plan to check again on the effectiveness of gates in three years.

This example shows how AM can improve management by dealing with weak plans (missing strategy addressing open road density), by determining the current condition (implementation monitoring of open road density) and by reducing uncertainty (about the effectiveness of gating).

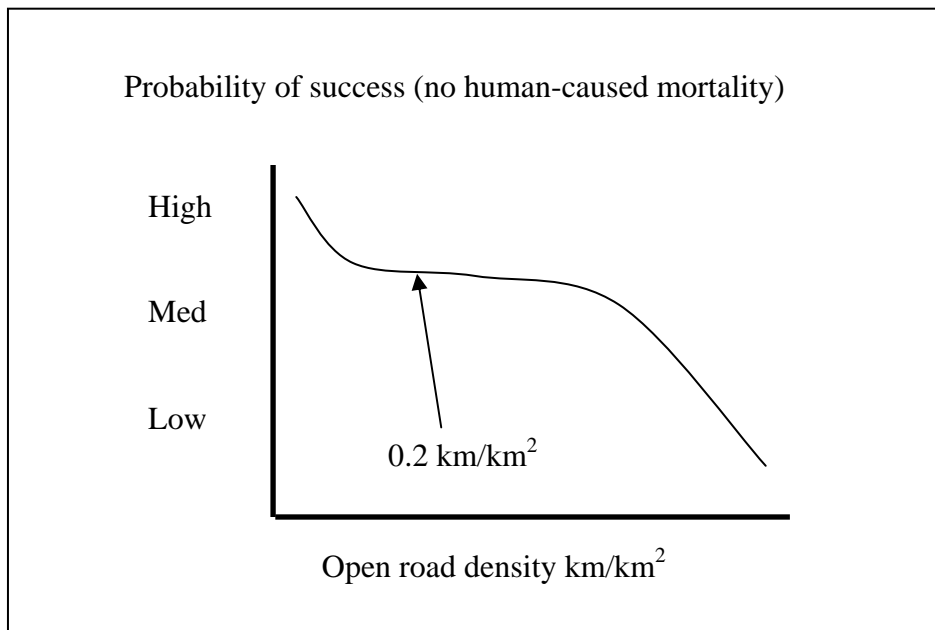
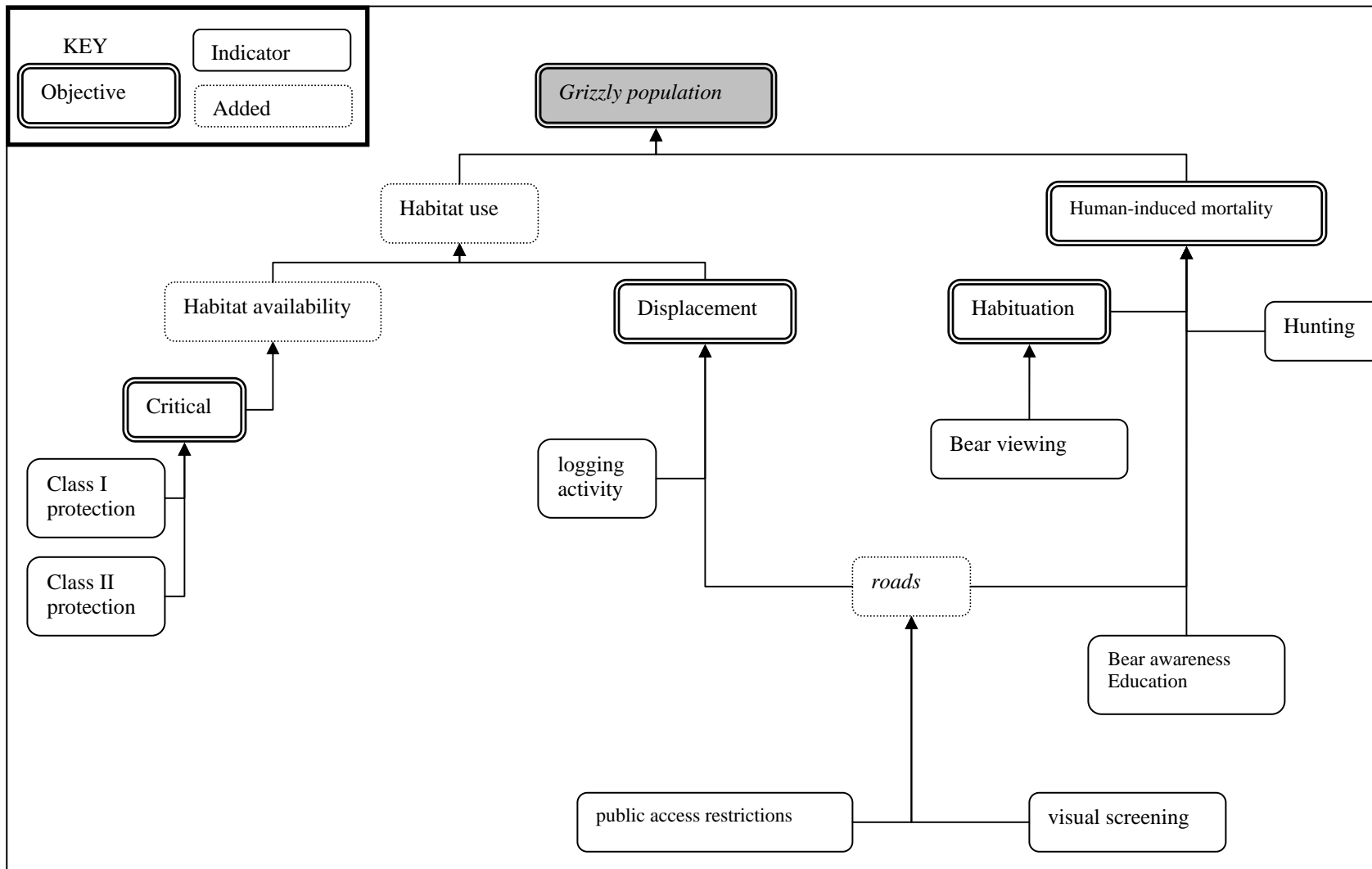


Figure A1-1. Hypothetical relationship showing probability of minimizing human-caused bear mortality versus open road density within watersheds.

Figure A1-2. Hypothetical conceptual model showing key factors affecting grizzly bears populations.



Appendix II – Human well being monitoring and research tools

There is a vast realm of social science and evaluation reference material relevant to the task of adaptive management for human well being and resource development. The selected references here provide introductions to various topics. They have been selected because they summarize good practice in a clear and direct style, or because they provide access to a broader range of useful reference material, and because they are easily accessible. These suggestions are starting points for managers and community leaders. They are not a comprehensive bibliography, nor are they sufficient technical background to undertake effective research and monitoring.

Evaluation: The field of project and program evaluation is closely linked to research on human well being initiatives. This field developed mainly to improve management and accountability for government social programs that expanded in the 1960's and 70's. The emphasis of most evaluation is still on accountability: i.e. demonstrating that objectives for social or economic programs have been accomplished, often in order to meet the requirements of funders. However, increasing effort has been devoted to what is often called *formative evaluation*, which is intended to provide lessons to managers in how to better implement their programs. This is closer to adaptive management. Both formative evaluation and adaptive management (in social and economic applications especially) are informed by work on organizational learning. A popular book covering theory, examples and practical guidelines by one of the leading practitioners is:

Senge, Peter M. 1990 (revised edition 2006). *The Fifth Discipline: the art and practice of the Learning Organization*. New York, Doubleday.

Evaluation guidebooks can provide useful direction on issues such as structuring questions, developing relevant and measurable indicators, organizing and undertaking research, and using results to improve management. All of these elements are relevant to adaptive management. The Kellogg Foundation, a major U.S. donor to community social and economic development initiatives, has developed a guidebook for its recipients. The guidebook introduces approaches to evaluation to make it:

1. Relevant, understandable, and useful to communities
2. Grounded in local circumstances
3. Flexible not rigid and prescriptive
4. Inclusive of those affected or their representatives in all stages
5. Integrated into the initiative or program, not an isolated, “stand-alone” monitoring process

While the handbook is intended for foundation grant recipients, its advice is widely applicable to any organization wanting to learn from its management of community development programs.

W.K. Kellogg Foundation Evaluation Handbook

<http://www.wkkf.org/Pubs/Tools/Evaluation/Pub770.pdf>

Another guidebook for planning and evaluation that was developed for practitioners working in international development is helpful because it focuses on using qualitative or behavioural indicators, rather than quantitative measures of change. This may be of interest to organizations considering human well being management strategies or objectives that are not easily represented by numbers.

Earl, S., F. Carden and T. Smutylo. 2001. Outcome Mapping: Building Learning and Reflection into Development Programs. Ottawa, International Development Research Centre.

Full text available on-line: http://www.idrc.ca/en/ev-9330-201-1-DO_TOPIC.html

First Nations research on land and resources: This guide documents best practices for traditional land use studies for First Nations in simple and clear language. It covers planning, organization, data collection, mapping, communicating research. It provides a good overview of how First Nations people can design and lead research for their own purposes. While it focuses on traditional land use issues, it has many helpful directions for organizing and managing research and conducting interviews that are widely applicable by First Nation communities.

Tobias, T. N. 2000. Chief Kerry's Moose: A guidebook to land use and occupancy mapping, research design and data collection. Ecotrust Canada and the Union of B.C. Indian Chiefs.

http://www.ecotrust.org/publications/Chief_Kerrys_Moose.pdf

More general guides on community engagement in ecosystem monitoring:

Yarnell, P. and D. Gayton. 2003. Community-Based Ecosystem Monitoring in British Columbia: a survey and recommendations for extension. FORREX.

<http://www.forrex.org/publications/forrexseries/fs13.pdf>

General guide to community based ecosystem monitoring:

<http://www.ccmn.ca/english/library/ccmn.pdf>

Social Research and Community Development: The Social Planning and Research Council of B.C. offers technical support, publications, and training courses through their website and network of community researchers. Examples of practical courses offered include: community-based research methods, community social planning, community indicators, and development planning. SPARC also offers low-cost workshops on community development to rural and northern B.C. communities.

<http://www.sparc.bc.ca/>

The B.C.-based Centre for Community Enterprise has developed tools for community research in support of economic development. They support capacity building, training and knowledge transfer. Their website includes an electronic library of almost 700 top references on community economic development in .pdf format.

<http://www.cedworks.com/index.html>

The following document is now out of print but has been loaded on the web by the American Indian Studies Center at UCLA because of its continuing relevance to research with indigenous communities:

Guyette, S. 1983. Community-Based Research: A Handbook for Native Americans. American Indian Manuals and Handbooks Series, No. 1

<http://www.books.aisc.ucla.edu/toc/na handbook.html>

Participatory Research:

This three-volume sourcebook provides easy access to field-tested Participatory Research and Development concepts and practices for practitioners, researchers, and academics. The sourcebook captures and examines PR&D experiences from over 30 countries, illustrating applications in sustainable crop and animal production, forest and watershed management, soil and water conservation, and postharvest and utilization. Each of the sections and cases is brief, but readers will want to select those portions of greatest interest and relevance.

Gonsalves, J. et. al. 2005. Participatory Research and Development for Sustainable Agriculture and Natural Resource Management: a sourcebook. Ottawa: IDRC. Full text available on-line: http://www.idrc.ca/en/ev-73443-201-1-DO_TOPIC.html

Morford, S. 2004. Moving along the community–researcher continuum towards participatory research in British Columbia. BC Journal of Ecosystems and Management 4(1):42–47. URL: www.forrex.org/jem/2004/vol4/no1/art6.pdf

Different perspectives on knowledge, learning and management: Different groups have quite different assumptions and understandings about even the most fundamental aspects of adaptive management (e.g. what is knowledge and how is it gained?). Indigenous knowledge is especially relevant to adaptive management because it is based on feedback and experience from practice, and so has a high degree of relevance and confidence among traditional resource users. But it is usually expressed and validated in different ways than scientific knowledge. Often it is difficult to compare or integrate the two kinds of knowledge because they use different cultural frameworks, validation mechanisms and are used in different ways. This guidebook provides helpful perspectives on respectful approaches to bridge knowledge divides.

Adler, Peter S. and Juliana Birkhoff. Building Trust (Twenty things you can do to help environmental stakeholder groups talk more effectively about science, culture, professional knowledge and community wisdom).

<http://www.policyconsensus.org/publications/reports/docs/BuildingTrust.pdf>

University-based Research groups in B.C.: Communities who are seeking advice or support on more complex or long-term research methods may wish to contact one or

more of these organizations, all of whom have experience working with coastal communities.

Simon Fraser University – Centre for Sustainable Community Development

The Centre was founded in 1989, and supports the sustainable development of communities through research, education and community mobilization. It provides training and advisory services throughout B.C, integrating economic, social and environmental objectives in community development.

<http://www.sfu.ca/cscd/>

University of Northern British Columbia – Community Development Institute

The institute emphasizes the importance of capacity-building, collaboration, learning, and complementarity between UNBC research centres. Research that is undertaken balances academic credibility with practical relevance. Beyond research, the Institute is involved in outreach activities and serves as a conduit to expand and enhance local educational opportunities related to community development.

<http://www.unbc.ca/cdi/>

University of British Columbia – Resilient Communities project and Coastal Communities Project. The Coastal Communities Project succeeded the Resilient Communities project. Both involved large research teams actively engaged with coastal communities and government agencies for several years to examine social factors related to well being in these communities.

<http://coastalcommunitiesproject.ca/>

<http://www2.arts.ubc.ca/rcp/index.php>

University of Victoria – Office of Community-based Research

The OCBR facilitates collaborative community-university research and partnerships to enhance the quality of life and the economic, environmental and social well being of communities. It works mainly on Vancouver Island but shares research and best practices.

<http://web.uvic.ca/ocbr/>

Appendix III – Resource data collection standards

Resources Information Standards Committee

According to their web page...

The Resources Information Standards Committee (RISC) is responsible for establishing standards for natural and cultural resources inventories, including collection, storage, analysis, interpretation and reporting of inventory data. A number of Government initiatives, including Forest Investment Account and Forest Practices Code, require participants in those initiatives to adhere to RISC standards. These initiatives have come to expect RISC to be the approving body for a range of standards beyond the initial focus of RISC.

At the time of this update, April 2004, some 214 documents have been produced comprising the range of inventory standards and procedures, field guides, field forms and background documents. For a complete listing of standards visit [RISC: Standards](#)

RISC Standards Categories

Aquatic Ecosystems

Atmosphere & Air Quality

Coastal Ecosystems

Culture (includes Recreation & Tourism)

Earth Sciences

Land Use

Terrestrial Ecosystems - Ecology

Terrestrial Ecosystems - Biodiversity

Terrestrial Ecosystems - Vegetation

Other

RISC: Background Document Categories

Aquatic Ecosystems

Atmosphere & Air Quality

Coastal Ecosystems

Culture (includes Recreation & Tourism)

Earth Sciences

Terrestrial Ecosystems - Ecology

Terrestrial Ecosystems - Bio Diversity

Terrestrial Ecosystems - Vegetation

Other

FIA: Land Base Investment Program Home Page

The Land Base Investment Program (LBIP) eligible activities and delivery standards are provided under the following components: (<http://www.for.gov.bc.ca/hcp/fia/landbase/>)

- [Strategic Resource Planning](#)
- [Stand Establishment & Treatment](#)
- [Infrastructure](#)
- [Restoration & Rehabilitation](#)
- [Information Gathering & Management](#)

Note that some links point to RISC documents

Information gathering and management component:

Activity Area Expectations	Standards for the following Eligible Activities
Resource Inventories	<ul style="list-style-type: none"> ▪ Archaeological Overview Assessments ▪ Karst ▪ Fish & Fish Habitat ▪ Recreation and Visual Resource ▪ Terrain Stability Mapping ▪ Wildlife Species Inventory ▪ Wildlife Habitat Inventory/Modelling ▪ Growth and Yield ▪ Inventory Monitoring ▪ Inventory Projection ▪ Airborne and Satellite Remote Sensing Data ▪ TRIM ▪ Predictive Ecosystem Mapping ▪ Terrestrial Ecosystem Mapping ▪ TEM/VRI Integrated Inventory ▪ Vegetation Resource Inventory for TSAs and TFLs ▪ Woodlot Inventory (VRI Phase I) ▪ Community Forest Inventory (VRI Phase I)

<p><u>Monitoring</u></p>	<ul style="list-style-type: none"> ▪ Water Quality/Quantity Monitoring ▪ Terrestrial biological and physical monitoring ▪ Aquatic biological and physical monitoring ▪ Carbon Sequestering
<p><u>Forest Dynamics & Decision Support</u></p>	<ul style="list-style-type: none"> ▪ Site Productivity Estimation (including SIBEC) ▪ Wildlife, Habitat and Ecosystem Modelling ▪ Timber Supply Analysis (for IFPAs and DFAM Scheduled Analysis) ▪ Operability

http://www.for.gov.bc.ca/hcp/fia/landbase/info_gathering_eligible_activities.htm

Appendix IV – Template for adaptive management plan

1. Project Title
2. Project leader
 - name and contact information.
3. Management problem
 - Provide an overview of the general management problem.
 - Present a referenced synopsis of current knowledge relevant to the problem, highlighting key management uncertainties.
 - List the research questions that need to be answered to reduce uncertainty.
 - Identify one or more questions that seem most relevant and tractable to be the focus of the study; note rationale for choice.
4. Research problem
 - Describe the specific question to be studied.
 - Present a referenced synopsis of current knowledge relevant to the specific research question.
 - Refer to any other studies that are underway.
5. Project objectives
 - Describe the objective of the study. Note whether the study will test hypotheses or simply describe resource condition.
6. Potential benefits to management
 - Discuss the likely reliability of the study results.
 - Describe how study results might influence management, including the potential magnitude of change.
 - Discuss limits of management response due to economic and other constraints, including management uncertainties.
 - Describe how results may influence standard operating procedures and best practices or lead to policy recommendations.
7. Target Audience
 - List which government agencies, First Nations and licensees will benefit most from results.
8. Geographic scope
 - Describe the location of the study and the region where results will be applicable.
9. Study Design and Methods
 - Demonstrate that the study design is capable of answering the question.
 - Describe the study design including treatments, controls, stratification, sample size, replication and response variables.
 - Describe the sampling protocol (reference existing protocols where applicable): Because studies can take several years, meta-data forms should be used to describe the design of each project, the sample locations and the data collection protocol. The contents of the field forms need to be described well enough to allow anyone to interpret data.

- Describe the analysis procedure (should match study design)
10. Evaluation of Management Implications
 - Describe how findings will be meshed with pre-existing knowledge.
 - List topic experts who will participate in this process
 11. Management Feedback
 - Describe the process for updating standard operating procedures or best practices.
 - Describe the process for making policy recommendations.
 12. Academic products (if applicable)
 - Describe the type of product and the target audience (e.g., internal research report, journal publication, conference presentation)
 13. Extension products (as applicable)
 - Describe the type of extension materials: extension notes, workshops, policy recommendations, web-based information.
 - Describe the target audience (e.g., other licensees, forest practitioners)
 14. Budget
 - Provide a detailed plan for the first year
 - Describe the in-kind and funding contributions of the various partners
 15. Multi-year Funding Commitments
 - Describe arrangements to support multi-year projects, specifying the commitments of various partners.
 16. Schedule
 - Describe the timing of any treatments
 - Describe the timing of data collection
 17. Project Team
 - List the core team members, their skills, roles and time commitments.
 - List contact information.
 18. Partners
 - List partners providing funds or in-kind contributions that are not part of the project team and their contact information.