12 Integration of Traditional and Western knowledge in forest landscape restoration

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Introduction

Given the diversity of environmental, historical, social, economic and cultural contexts in which forest landscapes (and their degradation) occur, restoration efforts require the effective engagement and mobilization of the social and human capital that exists within these socio-ecological systems. This involves the utilization of diverse knowledge systems (von der Porten and de Loë, 2014), which in some cases, includes a significant body of Traditional knowledge and expertise that was marginalized during colonial periods (Stewart, 2002). Importantly, these knowledge systems remain largely misunderstood and underappreciated by contemporary, Western-trained managers, planners, resource specialists, foresters, scientists and other professionals (Trosper *et al.*, 2012b). It can be argued, however, that there is a growing recognition of the importance of incorporating information from Traditional knowledge systems, alongside Western knowledge, into land management decision-making, especially where there is the goal of better aligning management with the varied and growing needs and place-based objectives of diverse stakeholders (Klooster, 2002; Charnley *et al.*, 2007; Uprety *et al.*, 2012; Chazdon *et al.*, 2017; Sterling *et al.*, 2017; Diaz *et al.*, 2018) and the historical ecological realities of forest landscapes.

It is our contention that well-integrated approaches to forest landscape restoration (FLR) will be most effective at mitigating the numerous, often persistent drivers of landscape degradation. Parties involved in formulating a restoration strategy need to reach a common understanding of 'what degradation means and is'. Conflicts can arise between indigenous/local communities and other stakeholders who see very differently the factors that have degraded and continue to degrade not only the landscape but also ecological processes and socio-cultural practices. Lack of consensus among all FLR parties on the applications of Traditional and local knowledge to managed resources can undermine top-down, often industrial/commercial focused, efforts to manage agricultural lands, rangelands, forests and other ecosystems that have valued resources and services.

By engaging broader approaches to FLR, including the integration of multiple knowledge systems, we suggest that local communities, agencies, public user groups, and downstream or adjacent ownerships will be better able to participate in or even lead the management process, to the benefit of both natural and human systems (Berkes, 2009; Gilmour, 2016; Sterling *et al.*, 2017). While desirable, shifting from a model of government agency-driven, top-down management to a model of shared governance can represent a significant challenge (Brown, 2005; Gilmour, 2016). As discussed in earlier chapters of this book, achieving the aims of FLR – defined here as returning ecological integrity and resilience to deforested or degraded landscapes while enhancing human wellbeing – requires recognition that landscapes are not simple biophysical spaces, but rather, complex socio-ecological systems that simultaneously shape and are shaped by people (Berkes, 2009; Gilmour, 2016). Further, landscape-scale, community-based and intergenerational stewardship of place has sustained residents within and beneficiaries outside of landscape boundaries for millennia (Berkes *et al.*, 2009). These realities are often dismissed in depictions of landscapes as once pristine ecological systems that have been degraded by contemporary user groups (Botkin, 2004).

In a highly integrated, relationship-driven framework for FLR, collaborative management creates a pathway for negotiating and reconciling the needs and objectives of diverse stakeholders (Brown, 2005; Berkes, 2007; Gilmour, 2016). In the case of community-based conservation, for example, Berkes (2007) notes that

> improving the integration of conservation and development requires rethinking conservation by using a complexity perspective and the ability to deal with multiple objectives, use of partnerships and deliberative processes, and learning from commons research to develop diagnostic tools. Perceived this way, community-based conservation has a role to play in a broad pluralistic approach to biodiversity protection: it is governance that starts from the ground up and involves networks and linkages across various levels of organization.

In this chapter, we will explore the process of integrating multiple knowledge systems in FLR, with a primary focus on experiences in North America (see also Trosper *et al.*, 2012a). We will first examine the values and worldviews underlying Western and Traditional knowledge systems, as well as specific efforts to integrate knowledge systems in restoration and management at landscape scales in a variety of ecological and socio-cultural contexts. We consider the challenges – and opportunities – involved with integrating Traditional and Western knowledge systems at various stages of the FLR planning and implementation process, and how these challenges have been met, through case studies in Canada and the US. Insights gained from these analyses are summarized in an FLR planning cycle model, which

seeks to accommodate Traditional knowledge to a greater extent than those previously considered (e.g. by Vallauri *et al.*, 2005).

Traditional peoples, stakeholders and FLR managers will learn of each other's interests, restoration goals and values associated with resources or specific habitats of the landscape. Different forms of knowledge reflect various ways of understanding ecological processes, socio-cultural stewardship practices and management systems. Different knowledge systems may also have strengths and weaknesses at different scales of social or ecological factors influencing the processes of FLR.

Utilizing Traditional knowledge in forest landscape restoration

Working together, FLR entities strive to understand each other's histories, potential bias, perspectives for applicable strategies, and position or role. In this section, we identify ways of recognizing historical legacies of landscapes and human communities, and consider the degradation of socio-ecological systems and approaches for respecting and reconciling worldviews and interests by examining model approaches. Each section addresses methods that integrate Traditional knowledge and indigenous stewardship practices with Western knowledge and management practices in FLR strategies.

Recognizing historical legacies, understanding degradation, and respecting cultural identity and diverse worldviews

An important starting point for collaborative management towards FLR objectives, specifically those involving indigenous communities, is an appreciation that (a) their Traditional knowledge belongs to their communities and (b) these communities continue to carefully maintain and thoughtfully articulate their ancestral connections to place. These connections to place are complex and rich despite centuries of colonial subjugation and contemporary efforts to disenfranchise indigenous peoples of their lands, resources and culture in most parts of the world (Parrotta and Trosper, 2012). It is important to recognize that, in many parts of the world, natural resources were a central focus of colonizing and/or modern state-driven forces, which brought with them approaches to resource exploitation and management that favoured centralized decision-making and methods that often conflicted (and continue to conflict) with the community-based decision-making and resource management strategies of indigenous communities.

The inherited colonial history of many North American landscapes, and other landscapes globally, left not only a biophysical legacy but also a perceptual legacy that (1) emphasizes centralized control of decision-making, planning, resource management, monitoring and communication

and (2) minimizes the role of indigenous communities, whose involvement is often restricted to serving in volunteer programmes and/or providing feedback on proposed activities through limited avenues of state government to tribal government consultation, and communication during narrow public comment periods. As a result, colonial histories continue to shape interactions among governmental land management agencies and communities (Williams, 1990), with forest industry and conservation enterprises often defining how FLR is conceived, implemented and assessed, and how the actual or expected economic and other benefits of FLR are allocated among 'stakeholders'.

Such important historical legacies need to be addressed at the outset when government agencies, or others with jurisdictional control over lands, seek meaningful involvement of local and, particularly, indigenous communities in FLR planning and management. As von der Porten and de Loë (2014) point out, indigenous communities perceive their role in collaborative environmental governance to be one of ancestrally defined, sovereign nations versus the 'stakeholder' roles assumed by those seeking knowledge from indigenous communities. Within this context, it may be difficult for Western-trained professionals to see traditional knowledge systems as pillars of cultural identity that support indigenous peoples' efforts to maintain (and in some cases, restore) their place as nations situated on (often illegally) occupied 'settled' landscapes. For those seeking Traditional knowledge to help inform FLR, historical legacies that continue to negatively impact indigenous communities are often seen as part of a dark but distant past that has at least partially been resolved, for example through negotiated treaty and legal processes (von der Porten and de Loë, 2014). Indigenous cultural lifeways and practices, as well as personal, familial and community wellbeing, all depend on intimate relationships with the natural world (see Table 3.1) (Donatuto *et al.*, 2014; Kealiikanakaoleohaililani and Giardina, 2016). The task of integrating Traditional knowledge systems into an FLR process, therefore, requires an openness to conversations that challenge assumptions about Western contemporary knowledge of history, governance, stewardship, and the cultural linkages between indigenous people and their ancestral lands (Davidson-Hunt and O'Flaherty, 2007).

Most socio-ecological landscapes continue to be impacted by colonial legacies (e.g. overlapping tenure and property rights, land use practices, fire suppression and exclusion, industrial forest management, top-down decision-making approaches and structures), and some lands requiring FLR underwent often violent removals of ancestral residents (e.g. indigenous peoples and local communities). For this reason, we argue that contemporary professionals leading efforts to integrate Traditional knowledge into FLR should acknowledge, examine, and seek to better understand colonial features and other historical legacies within current restoration approaches (cf. Hall and Fenelon, 2016). This process of understanding assumptions, preconceptions and biases is required to effectively build respectful, long-term relationships that lead to partnerships that eventually

can support integrated FLR planning and implementation. It should be noted that these recommendations are complementary to, and could be relied on to support, other models proposed for FLR planning (e.g. Dudley *et al.*, 2005; Vallauri *et al.*, 2005; Giardina *et al.*, 2007).

Other important questions relate to who the beneficiaries of FLR will be, and over what time scale benefits are to be expected (Boedhihartono and Sayer, 2012). FLR partners work to gain recognition of the contributing factors and aim to have a shared common understanding of the nature, manifestations and root causes of degradation to socio-ecological systems. Identification of current challenges, and direct and indirect threats and stressors to the recovery of landscapes, allows the partners to formulate solutions and take actions (i.e. restoration strategies) to alleviate or effectively address agents of degradation (O'Connor *et al.*, 2005).

Such dialogue is critically important at the outset of any FLR programme for a number of reasons. Because restoration is defined as bringing about recovery to a degraded landscape, value-laden terms such as 'degraded' – whose meaning also shifts over time – can be highly problematic, particularly when dealing with indigenous landscapes that have been dramatically altered. How a landscape geographer, an ecologist or an indigenous practitioner views 'degradation' will be defined by their particular biophysical or environmental value system, operational context, epistemological framework, and history with the landscape. Approaches to incorporating different knowledge systems into FLR, in part, have to question underlying assumptions about the role humans have as 'degraders' or active agents of ecosystem recovery across different landscapes. Regardless of which partnership model is involved in FLR, complicated and often difficult questions need to be addressed so that the partnership members develop both a common understanding of what degradation means and a shared understanding of the causes. Further, since degradation is not only ecological but inclusive of socio-cultural systems, there may be differences in perspective that need to be discussed regarding which parts of the coupled human and natural system are degraded, and whether an intact ecological system can be considered degraded because it does, or cannot for legal reasons (e.g. endangered species conservation), sustain the human members of the larger community (Andrade and Rhodes, 2012).

Few Western-trained ecologists appreciate the extent and depth to which indigenous peoples throughout the world have gone to manage and so transform landscapes prior to European colonization (Mann, 2002; Stewart, 2002; Bowman *et al.*, 2011). This led early ecologists and anthropologists to suggest that pre-colonial landscapes were relatively 'pristine', a conservation belief deeply embedded in Western knowledge systems (Nash, 2014) that is challenged in the Americas by overwhelming evidence about the de-population of these landscapes following European contact with indigenous peoples and subsequent changes to those landscapes (Cronon, 1996; Wallman *et al.*, 2018; see Box 12.1). As a result, the question of

Box 12.1 The role of indigenous fire management practices in shaping landscapes and their ecologies in North America

Mythology about historical wilderness areas free of human influence has long dominated conservation discussions, while the rich history of indigenous management across most of North America, and other areas globally, has been largely ignored (Nash, 2014). A poignant example of this divide that can separate knowledge systems is the tall grass prairies in the central plains of North America and oak savannahs in the western United States. These landscapes are commonly thought of as having been maintained primarily by natural fires (e.g. lightning), when in fact they were created and maintained though active indigenous burning (Stewart, 2002). If not for millennia of prescribed burning by Native Americans seeking to create rangelands for the American bison and other early seral dependent game species, a practice actively continued by homesteading ranchers to the present day, much of North America's tall grass prairie and savannah would revert to forest. These tall grass prairie and savannah systems have evolved to include a remarkable diversity of fire-adapted grass, forb and some tree species that in turn shape the ecosystem and characterize that landscape, but these systems are disappearing because natural fires (e.g. lightning ignitions) are too infrequent and rainfall too high to maintain fire-adapted species. This loss to forest recovery, ironically, is alarming to ecologists who view these systems as 'natural'. Are these systems degraded forests in need of restorative fire exclusion? Or rather, should their grassy, open condition be viewed positively as the result of millennia of interactions with human communities?

In the western United States, significant investments are being made to restore landscapes in order to reduce fire danger. Ironically, nearly all of the western United States had been intensely managed with fire by native peoples until conquest (a little over a century ago) replaced indigenous management of landscapes with practices that resulted in the removal of large, commercially valuable, fire-resistant trees, which have since been replaced by dense regrowth of small-diameter trees, introduction of grazing animals that reduced very fine fuels (i.e. grasses/forbs), and landscape-scale attempts to suppress any and all fires (Stewart, 2002). This combination of practices largely explains the severe mega-fire events plaguing western US states in recent years (Hessburg *et al.*, 2015).

Many non-indigenous managers and the public, who are less dependent on fire-induced resources in this region, view a more closed, densely 'forested' landscape as beneficial for conservation, recreation and scenic values. This contrasts with the views of local indigenous communities, who consider the same landscape as not adequately burned through a functional cultural fire regime promoting 'open' forests that could provide more water, foods, materials, medicines and ecosystem services, and sustain fire-dependent cultural practices and knowledge systems in a heterogeneous and resilient landscape (Berkes and Davidson-Hunt, 2006; Hessburg *et al.*, 2015; Lake *et al.*, 2017). Consequently, the restoration of more open fire-adapted forests and the reinstatement of tribal/indigenous burning are prevented in some areas of the landscape in order to protect the currently suitable transitional habitat

for endangered wildlife, a habitat condition resulting from industrial forestry operations and fire exclusion practices (Kimmerer and Lake, 2001; Long *et al.*, 2016). A philosophical difference thus arises for FLR planning and management: 'ecosystem services for humans, or humans services for ecosystems?'

which attributes of the landscape should be considered as an historical reference by restoration strategists and partners is complicated by such flawed conceptual models of landscape condition and change.

When entering into a process in which Traditional knowledge is sought for informing FLR, it is valuable to consider a culturally sensitive best practices framework (Grenier, 1998). How should one request access to Traditional knowledge? If shared, how can this knowledge be used without being appropriated in an exploitive way (i.e. free prior and informed consent (UNDRIP, 2007))? In the context of integration of Traditional knowledge into Canadian water resources management, von der Porten *et al.* (2015) make six recommendations for the practice of collaborative environmental governance that are broadly relevant to FLR efforts: (1) approach or involve indigenous peoples as self-determining nations rather than as one of many collaborative stakeholders or participants; (2) identify and engage with existing or intended environmental governance processes and assertions of self-determination by indigenous nations; (3) create opportunities for relationship-building between indigenous peoples and policy or governance practitioners; (4) choose venues and processes of decision-making that reflect Indigenous rather than Eurocentric venues and processes; (5) provide resources to Indigenous nations to improve capacity for collaboration or for policy reform decision-making; and (6) find ways to support indigenous nations in their own continued environmental decision-making and 'self-determination'.

It is possible, however, to engage Traditional knowledge on a deeper level, but this requires understanding of how the foundations of Western resource management differ from those supporting traditional (i.e. indigenous and local) resource management (Berkes *et al.*, 2000, as addressed earlier in Chapter 3). These distinctions are typically not understood or even recognized by government agency land managers (von der Porten and de Loë, 2014), in part because Western management and natural resources education rarely includes examination of the epistemological framework in which (cultural) management approaches are embedded, or the value systems and assumptions upon which they are built (Chase, 1986).

There is also a need for greater understanding of how natural resource management within coupled human and natural systems has been influenced, even driven, by historical shifts from local to centralized control over forests and their management in many landscapes (Smith, 2012;

Nash, 2014; Steen-Adams *et al.*, 2015, 2017). Legacies of management control are not trivial, as responses of forest composition, structure, function and dynamics to management can take centuries to manifest.

Utilizing effective and appropriate partnership models

Optimally, the socio-economic and biocultural context in which forest landscape restoration is to proceed defines the process for initiating discussions and planning specific projects or a comprehensive, multi-decade initiative. To this end, the chances of success will be greatly enhanced if participants, including formal management organizations with jurisdictional responsibility for identified resources and informal stewardship entities that have local, indigenous or other historical ties to a landscape, come together to dialogue as partners in the process.

Partnership models are highly diverse, but may be grouped into three broad categories: (1) the *government model*, where decisions are made completely within one or more government agencies having legal control over public lands and their management, and outside (e.g. local) opinions may or may not be sought depending on the specific situation and availability of options for public input; (2) the *collaborative model*, where decision-making power is shared across formally identified partners; and (3) the *community model*, where decision-making power resides with community members who own or have had formal or informal traditional and customary rights to the management of specific territories. These models differ in a number of important respects: (1) the extent to which different knowledge systems are – or could be – utilized in resource management; (2) distribution of authority for resource use and management; (3) distribution of expected benefits (i.e. ecosystem services) to broader society versus local communities; (4) economic capacity affected by governance stability and global to local market economies; and (5) jurisdictional control or tenure ownership of specific landscapes and resources (Table 12.1). Understanding which model is operative (or feasible) in a given landscape allows more effective integration of Traditional knowledge into the visioning, planning, overall decision-making and implementation processes.

Integration of knowledge systems under these partnership models can take several forms. Within the government model, Traditional knowledge may be treated as another source of supplemental or anecdotal information for management carried out entirely by a public agency. Where there is potential for and interest in utilizing the collaborative model to integrate Traditional knowledge into FLR, and where appropriate decision-making mechanisms are developed and agreed upon, the identified partners may need to engage in a process that enhances understanding among all concerned of the epistemological underpinning of different approaches to resource management. Partners learn of the socio-economic and biocultural context that has shaped historical landscape management as well as

Table 12.1 Partnership model types and scope of knowledge systems capacity for FLR

Model type	*Knowledge system application to FLR and resource management*	*Decision authority for resource use and management*	*Scope of expected landscape benefits (i.e. ecosystem services) to broader society versus local communities*	*Economic capacity affected by governance stability and global to local market economies*	*Rights to the management of specific geography: jurisdictional control or tenure ownership of resources*
Government	Western strongly favoured over local/Traditional	Centralized: government agency representatives often not living on the land	Broad, to address national-scale economic interest serving society, with some local resource interests	Higher to moderate, based on global to national capital market interest, e.g. carbon cap and trade revenue	Colonial-state controlled: national-scale policies/ authorities affect local community-scale rights
Collaborative	Both Western and local/Traditional, with the former often more prominent	Semi-centralized: mixed partner representatives, some living on land	Broad to regional, to support national economic interest and serving some local water, food and forest products interests	Moderate, based on national to regional market factors affecting resource and natural capital values	State/regional controlled: national scale with allowances for local stewardship and engagement
Community	Local/Traditional generally more prominent than Western	Decentralized: local/ traditional leadership living on land. Often hereditary or with elder councils	Regional to local, to support mostly local needs and serving some regional and fewer national resource interests	Lower to moderate, based on reduced dependency on national capital markets and greater reliance on local resources for security and livelihoods	Local/regional controlled: Usufruct and hereditary rights with traditional area or resource stewardship claims

the impacts of transitions from a historical indigenous community model of resource management to a government model. Through such a mutual learning process, participants can identify shared values and interests, establish a common language and perspective on land, resources, and management strategies, build the trust necessary for the integration of Traditional knowledge into FLR, and ideally, create a framework that guides a successful collaboration model approach into the future.

Defining partnership interests, values and resource needs

Forest landscape restoration programmes benefit from defining partners' interests, the values they attribute to the landscape, and their diverse resource needs. In this section, we identify components of socio-ecological processes in FLR that integrate Traditional knowledge and indigenous stewardship practices. We focus on how partner values influence FLR strategies, as well as conservation and restoration targets and goals with respect to specific sites, habitats and/or species. We also concentrate on the collaborative governance model (versus the government or community model) because most forest landscape governance today occurs under the government governance model, and here we seek transitions to more collaborative approaches where indigenous communities are recognized as full partners in shaping the design of ecological, cultural and economic landscapes.

Inclusive stakeholder involvement and participation in collectively identifying shared values and interests is vitally important for successful outcomes of FLR, as it acknowledges what each brings to the discussion and their history with the landscape (Brown, 2005). Reconciliation and efforts to (re)build trust through dialogue among partners are essential (von der Porten *et al.*, 2016). All partnership entities work together to identify knowledge, resources and capacities that each can contribute. They recognize their own and each other's political, economic and ecological strengths and weaknesses as potential opportunities and barriers to achieving FLR. Legal standing, tenure and governance structures of indigenous communities are factors that affect the viability of FLR approaches. Economic capacity includes partnership development for an efficient restoration programme and securing financial resources for programme planning to initiate the implementation of FLR treatments in strategic areas across the landscape. FLR goals emphasize how partners foster recovery of coupled human and natural systems over time for the production of ecosystem goods and services provided by habitats and various resources.

Analysis of past degradation (e.g. contributing factors), active pressures (identified as challenges, or threats and stressors operating at different scales) and potential influences on the landscape is needed. Political, socio-economic, cultural or ecological processes (actual or perceived) all need to be considered in the integration of Traditional and Western knowledge

systems for collaborative approaches to FLR to succeed. Given the various perspectives and interests that might be represented in a partnership, conducting a needs assessment and developing restoration targets may reveal some conflicts. Defining needs and targets so that they meet various partner values is important, and ideally, discussions during the initiation phase can lead to efficient and consensual definition of restoration goals. Stakeholders (or partners) can collaboratively define restoration and conservation targets (i.e. Open Standards for the Practice of Conservation) at various spatial scales, and constrain actions within various socio-political or jurisdictional boundaries (single ownerships, watershed partnerships, eco-regional or trans-national reserves), as scales and boundaries relate to shared values (Grantham *et al.*, 2010).

In the context of FLR planning and implementation involving local and indigenous communities and their knowledge, restoration may include re-establishment of former resource stewardship responsibility and associated practices. This includes 'eco-cultural revitalization' in the form of coupled socio-ecological restoration processes at various scales: landscapes, habitats and resources (Kimmerer, 2011; Martinez, 2014).

Indigenous perspectives of conservation emphasize managing for abundance so that a resource can sustain communities. For Western-trained conservationists, restoration may be strongly aligned with preservation of biodiversity, achieved through reconnecting forest patches, buffering protected areas or creating 'stepping stones' in the landscape. For an indigenous community steward, effective management may mean focusing on actions that promote the abundance and fitness of cultural keystone species, to be harvested, gathered or otherwise sustainably used by community members as part of an intergenerational practice of culture (Joseph and Mansourian, 2005; Sterling *et al.*, 2017). Restoring a cultural keystone species or habitat in a landscape is of high priority in order to create abundance of that resource and sustain people, their knowledge systems and cultural practices. This is illustrated in the case studies of eastern white pine restoration by the Kitcisakik Algonquin community of western Quebec (Box 12.2) and the restoration of traditional *manomin* (wild rice) management by the Wabaseemoong Independent Nations in Northwestern Ontario (Box 12.3).

The identification of protection (conservation) and management as passive or active restoration strategies, coupled with cross-scale indigenous stewardship practices, informs the FLR approach. Indigenous perspectives often consider utilization (i.e. stewardship) of resources (habitats or species) as a goal of restoration. Priority areas that require restoration reflect the shared landscape values and habitats or resources most critical to perpetuating socio-ecological processes to achieve conservation goals or targets (Uribe *et al.*, 2014). Strategies may identify which landscapes, jurisdictional units or functions (ecosystem services) are to be maintained, enhanced or restored, as well as focal or indicator species (i.e. cultural

Box 12.2 White pine restoration in cultural landscape, western Quebec, Canada

The Kitcisakik Algonquin community of western Quebec desires restoration and sustainable management of eastern white pine (*Pinus strobus* L.) on its ancestral landscape, where it was abundantly available in the past. A cultural keystone tree species in the forests of eastern North America, white pine provides numerous ecosystem goods and services to indigenous peoples and has long been an important component of traditional life within the Kitcisakik Algonquin community (Uprety *et al.*, 2013). The community suggested that mixed plantations should be used in a culturally adapted restoration strategy.

The community's interest in restoration was communicated to the Université du Québec en Abitibi-Témiscamingue through the Kitcisakik Forest Management Committee. The university designed the research together with the community. Before suggesting culturally adapted white pine restoration and management strategies, it was crucial to document why and how the species was important to the community and how it could be restored. The aboriginal community's bottom-up approach called for restoration of white pine, and the research was designed by the academic institution. Restoration and management strategies integrated both Traditional and Western knowledge.

Following these findings, an ecological study was carried out in collaboration with community members to find out whether the landscape was still suitable for the restoration of white pine. Based on analysis of ecological types and sampling, it was concluded that the landscape held potential for white pine restoration, addressing their needs (Uprety *et al.*, 2014). The study illustrated that different management strategies should be used near northern range limits, where effects of site conditions and disturbance agents are different than in the centre of a species' range. Five scenarios were suggested, taking into account community needs and ecological types (potential vegetation and abiotic conditions) (Uprety *et al.*, 2017). The strategies have been endorsed by Kitcisakik Forest Management Committee, and the committee is awaiting financial support to begin the restoration plan.

This case study illustrates how the concerns of aboriginal people can be addressed by integrating Traditional and Western knowledge (see also Steen-Adams *et al.*, 2011). The aim is not to restore white pine everywhere on the territory for industrial purposes, but rather, to maintain or increase the provision of white pine-associated ecosystem services to the Kitcisakik community. The responsibility for some of the restoration and management operations on family hunting grounds could be given to community members by agreement with the Crown once guidelines and training have been provided. Such community-based approaches have been shown to be efficient, to have increased legitimacy and to be more sustainable (Ribot *et al.*, 2006).

Indigenous peoples' participation, and the recognition and inclusion of their knowledge into restoration and management projects, can contribute to building a strong partnership for successful implementation that significantly improves the social acceptability, economic feasibility and ecological viability of restoration projects (Garibaldi and Turner, 2004; Higgs, 2005; Uprety *et al.*, 2012). Therefore, a shift from 'just another stakeholder' to 'shared

decision makers' (Stevenson and Webb, 2003) is possible. The approach presented here, where restoration and management scenarios take into account cultural needs and ecological constraints, could find wide application in diverse forest settings, as it could help meet the objectives of certification standards (e.g. Forest Stewardship Council (FSC)) with regard to the rights and needs of indigenous people (Uprety *et al.*, 2017).

Figure 12.1 White pine restoration in the Kitcisakik ancestral territory, western Quebec.

Notes
Top: (a) Undertaking ecological study in the landscape. (Photo: Y. Uprety.)
Bottom: (b) Young white pine forest in the cultural landscape. (Photo: Y. Uprety.)

Box 12.3 Biocultural design: harvesting Manomin (wild rice) with Wabaseemoong independent nations in northwestern Ontario, Canada

Restoration as a practice has suffered from the same challenge as ecology in general through the removal of humans as integral actors within our conceptualization of an ecological system (Davidson-Hunt and Berkes, 2003). From this perspective, restoration is often conceived as a return to the pre-settlement, or historical, condition of an ecosystem, repairing the harm done by human presence. In contrast, Wabaseemoong Independent Nations in northwestern Ontario, Canada, offer an Indigenous understanding of 'restoring' manomin (wild rice). This landscape is a mosaic of forests and lake-wetland systems in which wild rice was historically a dominant riparian/aquatic habitat. Many factors have contributed to the reduction of this culturally important species across its historical range (Pillsbury and McGuire, 2009).

Manomin (*Zizania palustris* L.), an aquatic grain, has been central to Anishinaabe economic, political, social and cultural life since time immemorial (Vennum, 1988; Davidson-Hunt *et al.*, 2005). An important source of food for Aboriginal communities, it also became a key staple during the fur trade era and a specialty product exported around the world up to the present time. It required both care for its sustained production and political negotiation among Anishinaabe communities, and other Aboriginal neighbours, for key lakes where it was harvested as well as emerging colonial governments. Harvest camps are recorded both in the ethnohistorical record and in Elders' memories as times when people, who lived dispersed during much of the year, came together and worked together to harvest rice, but also conducted other social affairs. Its centrality to Anishinaabe life was reflected in the name of the moon that occurs during its harvest, and its presence in ceremonies.

For Wabaseemoong people, such interwoven relations with manomin continued through the early post-war period of the twentieth century in spite of the fur trade and the establishment of the institutions of colonial governance in northwestern Ontario. However, increasing disruptions during the twentieth century eventually broke the weave of the manomin fabric of relations (Kuzivanova, 2016). These disruptions began in the early twentieth century with the establishment of reserves on which the Wabaseemoong were required to live to receive Treaty annuities and continued with the establishment of residential schools in the mid-century. The latter introduced children to new foods and language and separated them from their parents and land-based practices such as manomin harvesting. In the 1950s, two dams were established, one upstream and one downstream of the community. These dams disturbed the natural flow patterns of the rivers as well as flooding many wetlands and lakes attached to the rivers, destroying many manomin fields. The Wabaseemoong, along with other communities whose fields had likewise been impacted by other dams, began to harvest in eastern Manitoba, but this practice was halted by the establishment of a provincial park. Mercury contamination of the river systems led to long-term human

health impacts through consumption of fish and other aquatic foods. By 2013, with the cumulative degradation of the river ecosystems and cultures, only Elders who had themselves participated in the harvest of manomin retained the knowledge of how to harvest and process the rice. Most younger adults and children had only consumed manomin purchased from stores served at cultural events in the region.

Restoring manomin in Wabaseemoong was not just implementing a set of technical procedures for re-establishing a habitat or population of *Zizania palustris*, but the reweaving of a set of relations with manomin (Kuzivanova, 2016; Kuzivanova and Davidson-Hunt, 2017). This required, as a first step, locating manomin fields that were not affected by dam regulation or by waters impacted by mercury. The Traditional Land Use Area agreement, signed with the government of Ontario, provided Wabaseemoong people with the political framework needed to use manomin fields outside of their reserved lands.

Along with the re-establishment of access to the fields, it also required reintroducing younger people to the practices associated with the harvest and processing of manomin. This began with a rice harvest camp in 2014 through 2017, during which young people harvested manomin, learning-by-doing with Elders in the community, who shared their knowledge (stories, values and techniques) related to the harvest, processing and cooking of manomin.

Figure 12.2 Marvin McDonald, Resources Information Officer for the Wabaseemoong Traditional Land Use Area, showing manomin grain hand harvested on the Scott River.

Source: photo V. Kuzivanova.

This approach to restoring manomin expresses a relational perspective in which restoration recentres manomin within a set of appropriate political, economic, social and cultural relations and, more generally, the life of Wabaseemoong people. Elders recognize skilled restorationists as 'manomin ogimaa', or 'wild rice boss', which, from an Anishinaabe perspective, recognizes the duty a person takes on for the care of the political, economic, social and cultural practices associated with another being with whom people co-journey on their life's pathway. This approach ensures not only that manomin has the necessary conditions to persist within the landscape (restoration in the narrow sense) but also that manomin again becomes a nutritious food supporting the social fabric of the community, is recognized within ceremony and land-based values, and becomes part of the contemporary stories of Wabaseemoong people today and into the future. Restoring manomin, in this sense, is integral to decolonizing processes linked to broader socio-ecological movements of Aboriginal resurgence, reconciliation and recognition of Treaty (rights), and healing of people, the land and relationships of place (Corntassel and Bryce, 2012). While proceeding through the steps of a restoration initiative, this experience supports the approach central to Indigenous perspectives on what is part of a coupled socio-ecological restoration process.

keystone or conservation umbrella populations) in need of specific research/monitoring and management attention. This process can also identify which species, as socio-ecological system (SES) degraders (challenges/threats/stressors), might need to be controlled or eradicated, or those that are SES integrators to be retained, promoted or reintroduced. For example, conservation efforts may emphasize linking restoration and recovery of forests to provide connectivity between protected areas, whereas indigenous cultures may focus on the importance of sacred sites connecting areas that host higher levels of biophysical and ecological diversity with culturally based conservation tenets governing the limited harvest of rare or endemic species.

Defining strategies forming the restoration framework

Forest landscape restoration programmes may use assessment of current, past and applicable 'reference' landscape states or desired conditions for informing the selection of appropriate restoration actions. In this section, we discuss the desired targets for the condition of landscape that represent the outcomes of eco-cultural revitalization efforts, management actions and stewardship practices at applicable scales. Considerations for knowledge integration and protection measures for Traditional knowledge are also offered.

FLR strategies informed by Traditional knowledge and integrating indigenous stewardship can assist with longer-term and broader-scale recovery

of socio-ecological systems that support the production of ecosystem services, as well as economic and food security of indigenous and rural communities (cf. van Oosten, 2013; Parrotta *et al.*, 2015; Sterling *et al.*, 2017; Díaz *et al.*, 2018). For example, many indigenous communities (and arguably society at large) rely on forest ecosystems for provision of water and forest products. Economic development and sustainable forest management for communities are at the heart of many FLR discussions – and not just for indigenous communities.

What can be expected to be restored, and at what scale and over what anticipated time frame (years, decades or centuries), needs to be defined. Several FLR programmes have utilized results chains or modelling in the development of land use scenarios (Hawkins and Selman, 2002; Sisk *et al.*, 2006). Spatially explicit modelling and mapping of current versus desired future landscape conditions provides partners with the opportunity to evaluate potential trade-offs associated with various FLR strategies. In some cases, indigenous communities already have elaborate maps of where, when and how actions are done on the landscape. Depending on locality, it may be less a matter of developing new maps than of integrating existing maps (e.g. geographic information system (GIS) data layers), addressing values and resources of interest, with agreed-upon protocols for spatially explicit depiction (scale or specificity) across the landscape (see Lewis and Sheppard, 2006).

The development of possible restoration trajectories to achieve short-term and long-term goals (including models, time frames and maps), can assist managers and stakeholders (the public, indigenous communities) with the evaluation of different courses of action linked to conservation targets or the production of ecosystem services (Brown, 2005). Reconciliation of land use options to achieve targets based on shared values can assist with building trust in negotiating options and scenarios to accomplish FLR objectives. This process can inform the evaluation of the feasibility of specific goals while meeting shared needs or reconciling conflicting demands for particular ecosystem services (e.g. water and forest products) from the landscape. Several FLR partnerships (or collaboratives) have an identified set of goals, strategies and tactics for each zone (landscape jurisdictions, administrative types or ownerships) and contributing factors (challenges/stressors) in the landscape (Steen-Adams *et al.*, 2017). Such an approach can provide a framework for the prioritization of where, when and how FLR activities will take place on higher-value or higher-interest areas of the landscape (Uribe *et al.*, 2014).

For example, in the case of the Western Klamath Restoration Partnership in California (see Box 12.4), each component of the plan identifies required or anticipated resources, partner capacity, required knowledge/technical expertise, and time frame for allocated funds, and quantified targets are derived from the analysis. The plan includes statements of collaboratively developed commitments, with a vision statement owned by all

Box 12.4 The Western Klamath Restoration Partnership (WKRP), northern California, USA

WKRP is a collaborative land and fire management effort between tribal, federal and non-governmental stakeholders located in northwestern California. It is based on 20 years of collaborative work between diverse partners, ultimately forming the WKRP in 2013. After a century of fire exclusion and even-aged forest management, forests in the Western Klamath Mountains are in need of ecological restoration treatments to restore fire process and function. The WKRP seeks to build trust and a shared vision for restoring fire resilience at the landscape scale. The past century of governmental-enforced fire exclusion of natural and cultural burning has severely impacted water supplies, forest health, communities, cultural resources and threatened species. WKRP formulated shared values to guide principles of FLR. These values are: Fire-adapted communities; Restored fire regimes; Healthy river systems; Resilient biodiverse forests/plants and animals; Sustainable local economies; and Cultural and community vitality. Such values influence restoration strategies. WKRP development was facilitated by the Open Standards process and has brought diverse stakeholders together to accomplish work by identifying Zones of Agreement where all parties agree on upslope restoration needs. The geographical prioritization of treatments represents the overlap of multiple values and interests across the landscape. The implementation of various treatments demonstrates the partners' shared values.

WKRP created a plan for restoring fire resilience at the landscape scale, founded upon Traditional knowledge and practices, linking to concepts outlined in the United States Federal National Cohesive Wildland Fire Management Strategy (Resilient landscapes, Fire-adapted communities, Safe and effective wildfire response). These include focusing treatment around communities, transportation routes and specific geographic landscape features (e.g. strategic ridges) to manage fire to accomplish resource objectives.

This plan incorporates ecological, economic, social and cultural values spatially across a 486,000 ha landscape to determine where restoration treatments would yield the most beneficial results with the lowest impact. Restoring fire processes can create resilient landscapes, providing integral resources and services to ecosystems and communities. These include improved water quality and yield, healthy streams and aquatic populations, increased wildlife and plant diversity, eco-cultural revitalization and a sustainable supply of forest products. Local tribes and the general public depend on the landscape for a variety of social, economic and ecological factors. Treatments proposed by the WKRP aim to produce sustainable beneficial outcomes, creating forests and communities that are more resilient to stressors ranging from recent extreme wildfires and invasive species infestations to climate change and drought. With more than 90% of the nearly 0.5 million ha WKRP area in publicly owned federal national forest lands, there is an opportunity to collaboratively pursue significant large-scale ecological forest restoration. The landscape today tells a story of the traditional human/fire relationships of our past – and can guide future fire management strategies. The Karuk

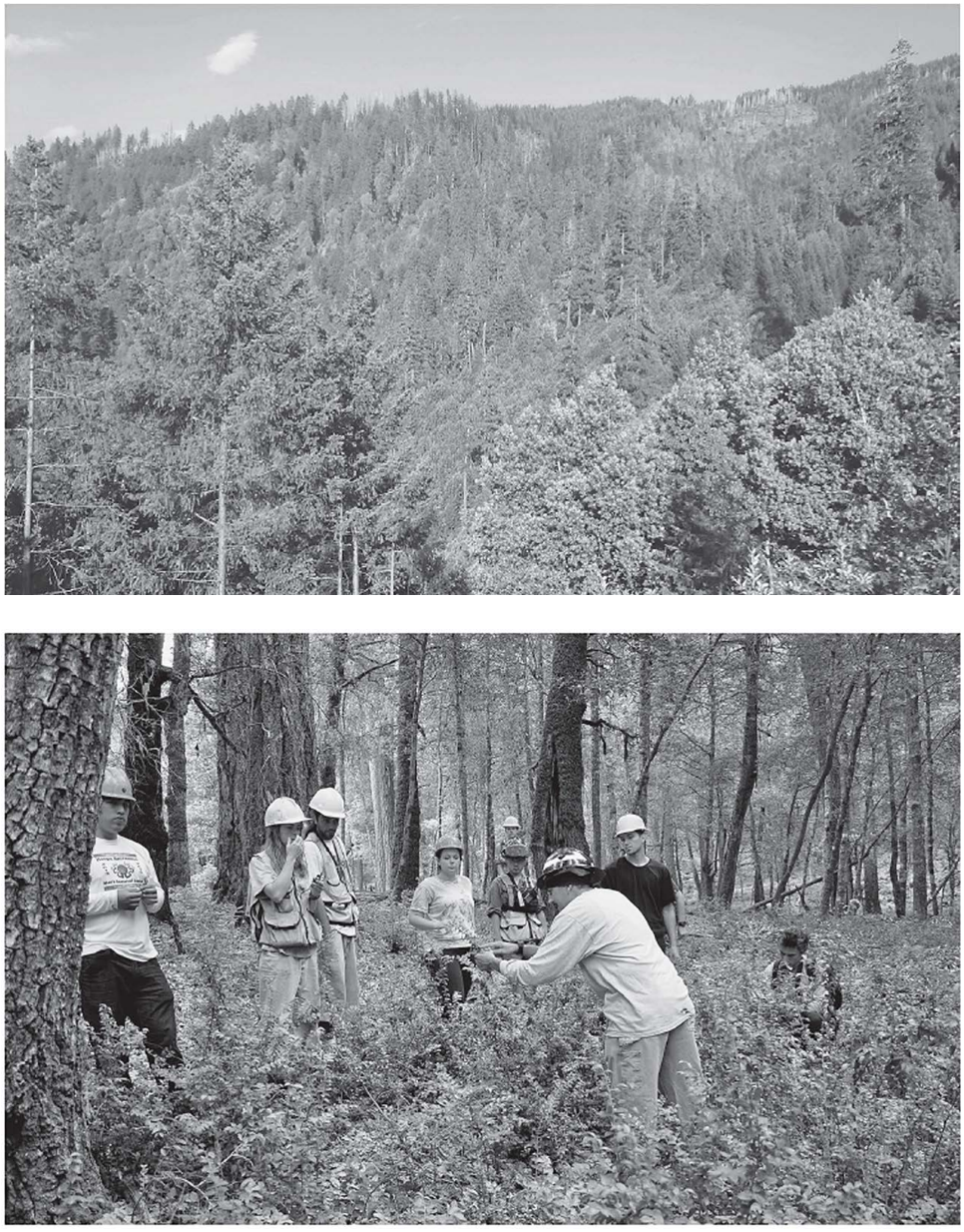

Figure 12.3 Restoring resilience and functional values through fire management practices based on Traditional knowledge.

Notes
Top: (a) At Upper Rogers Creek, which includes variable-age Douglas fir/tanoak 'mixed conifer-evergreen' forest (foreground and ridge), and plantations (middle of photo), 2017 wildfires resulted in significant damage to the natural forest canopies as well as plantation areas. (Photo: F. Lake, USDA Forest Service.)
Bottom: (b) Frank Lake showing tribal students and WKRP workers a partially restored research plot of tanoak acorn and evergreen huckleberry (*Notholithocarpus densiflorus* (Hook. & Arn.) Manos, Cannon & S.H. Oh and *Vaccinium ovatum* Pursh.). This traditional food resource patch is becoming more resilient and functional for a range of cultural ecosystem services. The next restoration treatment would be an autumn understory burn to reduce additional surface fuels, control acorn insect pests, promote regrowth of huckleberry bushes, and enhance other forage plants for wildlife. (Photo: E. Knapp, USDA Forest Service.)

Tribe has refined these strategies over thousands of years to maximize diversity, resiliency and resource production. The WKRP seeks to restore these traditional practices in a modern context, enhanced by Western science, in order to restore and maintain these critical ecosystem processes, including wildland fire, to achieve multiple resource objectives. This is depicted by evaluating the condition of valued resources within planned treatment units, an emphasis on indigenous focal species, and collaboratively developed prescriptions that support the achievement of shared values with project implementation.

participants that reflects a shared perspective on what the larger FLR process, outcomes and so on mean to each member of the planning team. Alignment of the FLR vision (shared values informing Zones of Agreement) among user groups/stakeholders is important. The plan would also include a knowledge and data sharing/ownership agreement on how Traditional knowledge is incorporated, which data is sensitive or confidential (e.g. sacred sites or endangered species), and how the various forms of information will be used and made publicly available.

It is important to note that many indigenous communities may not want to share or disclose specific knowledge, beliefs or cultural practices to the general public, given often legitimate fears that this information will be appropriated or used against them, further limiting their engagement with the landscapes being restored in their traditional territories. Building trust and formalizing methods to promote effective and respectful communication among FLR parties is essential. FLR collaboratives, therefore, need to consider institutional arrangements or agreements that protect sensitive or confidential information/data as well as an understanding for ownership of data collectively acquired through planning, implementation, research/monitoring or other interdisciplinary methods (Gamborg *et al.*, 2012).

Implementation: reviving traditional knowledge systems and practices

Forest landscape restoration programmes rely on effective planning, efficient prioritization and cohesive teams of managers trained to achieve the desired outcomes of a planning process. In this section, we identify components of effective implementation in FLR that integrates Traditional knowledge and indigenous stewardship practices. We focus on: (1) piloting successful restoration; (2) approaches to exporting or upscaling successes; and (3) implementation of restoration plans. These steps allow new partnerships (under the collaborative model) to build on smaller successes before taking on larger-scale efforts. Such a cautious approach may benefit from developing, and in some cases evolving from, smaller-scale pilot projects undertaken at specific sites identified as achievable (multiple factors

lining up to support success) or because specific conditions are favourable to the realization of restoration goals (intersection of ownerships, stabilization of critical habitat, or location of priority cultural sites). While scaling up from this smaller-scale pilot phase may be viewed as essential to achieving identified conservation targets and restoration goals, these early successes, even if small scale, may represent meaningful achievements, depending on context, and serve to strengthen partner relationships.

Because of the complex history of land tenure, jurisdictions, governance, and inclusivity (participation) of stakeholders, trust and confidence built during planning stages will be tested during project implementation, and so starting at smaller geographic scales may allow rapid corrections and adaptation to the evolution of partnership thinking in response to visualizing on-the-ground demonstrations (van Oosten, 2013). For indigenous communities, going back to traditionally (historically, before colonization or indigenous relocation) managed sites may be more efficient in some cases than developing new pilot sites. These localities, despite the complexity of their socio-political and ecological history, may be most effective for demonstrating the legacy of former traditional management systems and how this can inform current and future strategies across the landscape. An important part of implementation addresses relationship-building, not only among those involved but also between people and place (Kimmerer, 2011). The foundation of cooperation with pilot projects demonstrates capacity that may facilitate cooperative action at larger, more complex scales of the landscape. Implementation of larger-scale actions often requires more socio-political negotiations, policy and governance authority and support, recruitment and evaluation of contributing knowledge systems, funding and personnel capacity, with opportunities for sharing resources across jurisdictions (van Oosten, 2013). Lessons learned from initial pilot project results, both successes and failures, inform adaptive management in FLR implementation (Berkes *et al.*, 2000; O'Connor *et al.*, 2005).

Evaluation, corrective actions and adaptive management moving towards fully restored coupled human and natural systems

The emphasis in this section is on the role of Traditional knowledge approaches to monitoring, criteria and indicators, and evaluation of achieving sustainable management applicable to FLR programmes. In this section, we identify and focus on monitoring changes in resource condition and the production of desired ecosystem goods and services. We offer a conceptual model (Figure 12.4) linking ecological and socio-ecological processes across scales to evaluate their influences on FLR strategies.

Successful scaling up from pilot- to landscape-scale projects requires evaluation of various meaningful metrics or indicators that reflect the shared values (social, economic, ecological) of restoration partners and,

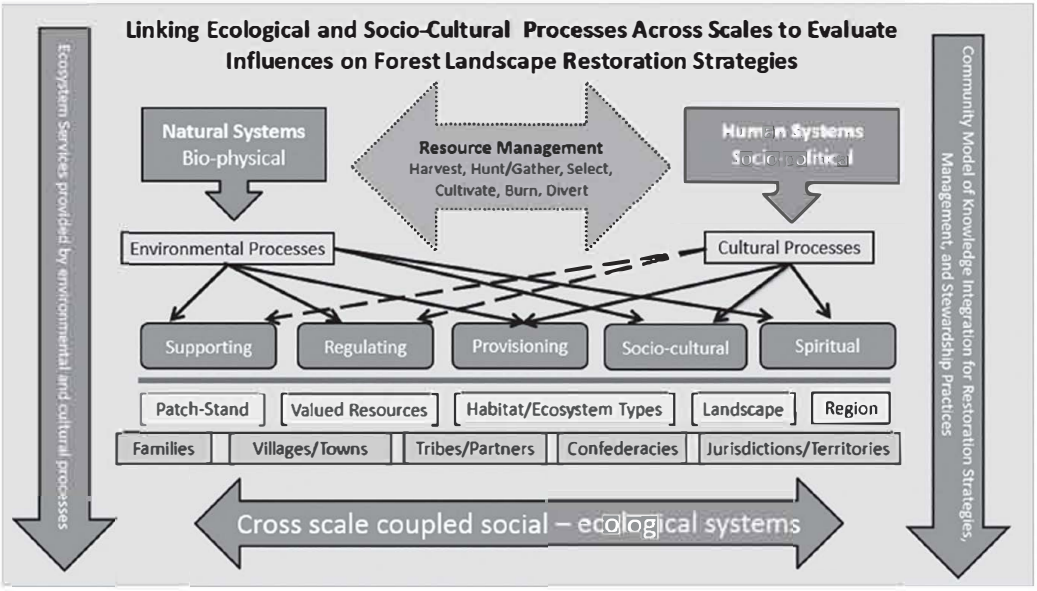

Figure 12.4 The Processes and Scale figure depicts a way to frame the interactions of Natural (bio-physical) and Human (socio-political) influences and associated processes for coupled socio-ecological systems. There are environmental and cultural influences on the production of ecosystem services. Some of these processes have greater and lesser degrees of influence and direct or indirect effects on ecosystem services, as indicated by the thickness of solid and dashed lines. The bottom boxes above the Cross scale arrows depict (left to right) local area (Patch-Stand/Families) to broader regional extent (Landscapes/Jurisdictions or Territories) of natural and human system interactions of resource management needed to support FLR strategies.

more broadly, of all stakeholders (i.e. landscape-scale ecosystem service/goods beneficiaries). The restoration trajectory reappraisal, as informed by Traditional and Western knowledge systems' criteria, should be evaluated according to previously agreed-upon qualitative and quantitative benchmarks or metrics reflecting advancement towards or achievement of broader values. At this stage, the role of Traditional knowledge can inform approaches to monitoring changes in resource condition based on socio-culturally meaningful criteria for evaluating indicators that represent shared values (Sterling *et al.*, 2017). By incorporating indigenous or local community measures of success or failure, partners can collaboratively develop a monitoring plan and incorporate research to objectively evaluate treatments. The incorporation of monitoring activities before, during and subsequent to restoration treatments/practices at multiple scales is critical to the implementation of corrective actions when and where needed, or may provide validation check points for the FLR process. Ultimately, while there are some influences on the restoration of forested landscapes that management actions can address and have the ability to influence, other

stressors or agents of change (e.g. climate) will have to be identified, considered and adapted to.

Effective restoration strategies anticipate the potential effects of climate change, considering resistance and resilience at different spatial scales (i.e. from stand to landscape). Recovering forests, whose attributes include composition, structure and functional characteristics, coupled with traditional knowledge systems and practices, may take decades to centuries. For example, cultural dependency on critical aspects of the resources only provided by older forests, which may have been degraded by large-scale extractive commercial forestry practices, may require special adaptive measures that incorporate climate mitigation and cultural resource considerations. In such cases, an appropriate objective (or monitoring criterion) may be to retain a proportion of the landscape in old forests, with indicators of this habitat condition involving size, age and condition of cultural keystone tree species. Another value or criterion may be to have a proportion of the landscape in an active, intensively managed agroforestry gradient for forests or agricultural lands. Various restoration treatments can, at different scales and locations, facilitate the advancement of ecological processes and socio-cultural practices that promote such desired conditions. Some of these approaches and desires may be mutually supportive, while others may conflict at a given scale or for particular habitats of the landscape. A successful FLR programme that evaluates outcomes of processes and actions at various stages can support the recoupling of human and natural systems through the promotion of Traditional and Western knowledge-based stewardship practices that enhance provision of ecosystem services from the landscape of interest.

Given a range of future uncertainties, partners will need to consider the production of desired ecosystem goods and services that support economic as well as cultural non-market forest products. The process of monitoring and evaluation of what was planned versus the actual outcomes of restoration treatments and strategies will require finding cohesion in the shared values, interests and management strategies of diverse user groups, local and indigenous, as well as the broader public and societies for landscapes (Lamb *et al.*, 2012; Sterling *et al.*, 2017). A successful FLR programme evaluates the attainment of processes and actions, at various stages, that support the recoupling of human and natural systems through promotion of Traditional and Western knowledge-based stewardship practices to enhance the provision of ecosystem services from the landscape of interest.

Conclusions

In this chapter, we explored the process of integrating multiple knowledge systems in FLR. FLR strategies that integrate Western and Traditional knowledge systems can improve our understanding of coupled social-ecological systems. A collective understanding of 'what degradation means

and is' is important. Well-integrated approaches to FLR can be effective at reducing or mitigating drivers of landscape degradation that affect both the socio-cultural and ecological communities. Sustainable harvesting and management practices emphasize the recovery of degraded forests, applicable cultural practices, and ecological processes to enhance the production of ecosystem goods and services. With such integration, local and indigenous community values associated with habitats and resources are balanced with the broader interests of external stakeholders/the public and society (Brown, 2005). The various steps of the FLR planning process discussed in this chapter provide a means to address the cultural, social and economic facets of sustainable management of landscapes and the integration of knowledge systems. There are important challenges but also opportunities associated with, and required for, knowledge system integration. We suggest that contemporary professionals leading efforts to integrate Traditional knowledge into FLR should acknowledge, examine and seek to better understand colonial and other historical legacies within current restoration approaches (Trosper *et al.*, 2012b).

Understanding which type of partnership model can be used, and which FLR strategies are feasible, in a given landscape allows more effective integration of Traditional knowledge into the visioning, planning, overall decision-making and implementation. A mutual learning process among participants can identify shared values and interests, and establish a common language and perspective on land, resources, and management strategies, building the trust necessary for successful outcomes. Scaling up from smaller-scale pilot projects may be essential to achieving identified conservation targets and restoration goals. Insights gained from the case studies presented and the approaches discussed in this chapter highlighted efforts to accommodate Traditional knowledge to a greater extent than previously considered. Various restoration treatments can, at different scales and locations, facilitate the advancement of ecological processes and socio-cultural practices that promote desired conditions to achieve FLR.

Success in collaborative management for FLR ultimately requires: (i) integrating management of the biophysical landscape with development needs of local residents; (ii) embracing the complexity and challenges associated with pluralistic decision-making and (iii) finding ways to legitimize and facilitate a transition from top-down decision-making to bottom-up collaborative approaches. Partnerships can utilize Traditional and Western knowledge for problem conceptualization, planning, strategy development, implementation, management, research/monitoring and adaptation, which collectively can result in long-term collaborative restoration of landscapes and their ongoing stewardship, ensuring that they contribute benefits to local and indigenous peoples and the wider societies within which they persist (Sterling *et al.*, 2017; Díaz *et al.*, 2018).

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