



From fragments to connections to restoration: A case history of emergent sociocultural services in the Clark Fork River and Lake Pend Oreille fishery

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Lake Pend Oreille and the Clark Fork River provide essential ecosystem services, including fisheries and hydroelectric power, to residents of Montana, Idaho, and Washington. Although conflicts exist, these services are maintained in concert by emergent sociocultural services created by a multi-institutional, transboundary collaboration. This has been enabled by an innovative Federal Energy Regulatory Commission license settlement agreement among a multitude of stakeholders. The consensus-based agreement promotes connections among people, projects, waterways, and fish populations. Collaborative management efforts allow stakeholders to address controversial issues, such as invasive fish suppression. We demonstrate how reciprocal cultural ecosystem services and services to ecosystems can enable ecosystem-scale restoration that addresses invasive species, habitat protection, and water quality management. Continued ecosystem management success relies on sustaining the relationship-building and shared knowledge services that have emerged over the past 25 years.

Keywords: collaboration, multi-institutional governance, mitigation, services to ecosystems

Introduction

Large river systems provide substantial benefits to society in the form of power, transportation, irrigation, and fisheries (Allan et al., 2015). Within those systems, fisheries are components of beneficial regulating, supporting, and provisioning ecosystem services (ES) (Millennium Ecosystem

Assessment, 2005; Dugan et al., 2010; Lynch et al., 2016a; Peterson et al., 2018). Fisheries also benefit society via cultural ecosystem services (CES)—belief and knowledge systems, traditions and heritage, sense of place, or spiritualism—and derived amenity services like fishing, boating, and tourism (Kurlansky, 1998; Villamagna et al., 2014; Carlson et al., 2020).

Within fisheries, cultural services are understood and acknowledged to be fundamental to conservation and management. As social artifacts, CES emerge, operate, and eventually embed within the bounds of human history, and are most directly experienced and intuitively appreciated when direct links to human wellbeing exist and are maintained (Daniel et al., 2012; Plieninger et al., 2013). With respect to fisheries, CES also emerge in management; we cannot remove ourselves and our social, political, and economic institutions from nature and the functioning of ES. Historically, technocratic systems of environmental management and decision-making have not been fully inclusive of the concept of culture—behaviors, values, norms, and institutions—and the production and use of traditional knowledge due to differences in validity criteria or the challenge of operationalizing culture within an existing management paradigm. Attention to CES can improve the cultural

sensitivity of process and participants, help to optimize management approaches, increase the relevance of management actions to participants, and highlight tangible benefits (Chan et al., 2012; Martín-Lopez et al., 2012; Fish et al. 2016).

The traditional view of ES as benefits derived from nature implicitly presumes a one-way flow of benefits from nature *to* humans. Yet, many ES, including CES, are purposely cultivated or modified by humans to enhance ecosystem quality or quantity. That represents a flow of benefits from humans *to* nature, which Comberti et al. (2015) term services to ecosystems (S2E). The S2E perspective views conservation and management as benefitting nature via protecting, enhancing, and restoring services, which creates feedback of reciprocal benefits to human wellbeing. Moreover, S2E categories mirror the protection, mitigation, and enhancement (PME) management efforts enacted by large river fisheries management (Schaich et al.,

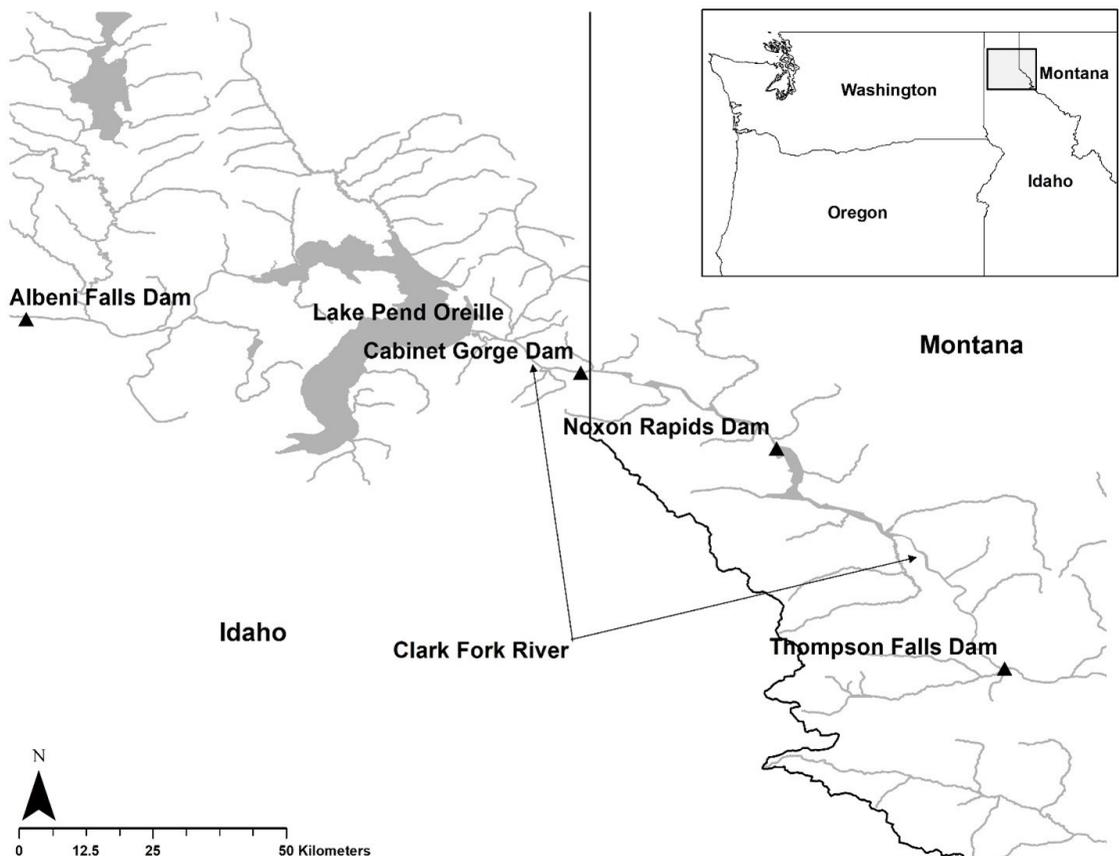


Figure 1. Map of the Lower Clark Fork River, Lake Pend Oreille, and Pend Oreille River drainages comprising the geographic scope of the Clark Fork Settlement Agreement.

2010; Chan et al., 2012; Thom et al., 2016).

From that perspective, we reflect on PME efforts in the Lake Pend Oreille-Clark Fork River (LPO-CFR, Figure 1) fisheries and suggest the CES and S2E concepts are boundary objects that aid large river fisheries management as they develop and maintain long-term collaborative management and planning partnerships (Schleyer et al., 2017). We use a case study approach (cf. Churchill et al., 2002) to describe the scope of PME efforts and fishery responses from ecological, economic, and sociocultural perspectives over the history of these efforts. We recount the initial conditions and tactics that prompted, improved, and now sustain management of fisheries. We illustrate how initial conflicts and eventual cooperation facilitated the emergence of several CSE and S2E: collaboration-consensus pathways, multi-institutional governance, transboundary culture, shared knowledge systems, and public involvement. Our use of CES and S2E to frame PME outcomes and the LPO-CFR's future demonstrates that the two-way flow of services and feedback of benefits between fisheries and people are useful schemas to conceptualize and enact long-term, multi-stakeholder collaborations.

Lake Pend Oreille-Clark Fork River system

The LPO-CFR consists of the largest lake in Idaho and the largest watershed (by volume) in Montana, respectively. Currently, three hydroelectric dams constructed in the mid-20th century operate on the LPO-CFR system in Idaho and Montana, downstream from Thompson Falls. Two dams—Cabinet Gorge (CG) and Noxon Rapids (NR)—are owned and operated by Avista. The third, Albeni Falls Dam, is operated by the U.S. Army Corps of Engineers in conjunction with the Bonneville Power Administration. Collectively, approximately 793 MW can be generated for regional power grids, which is enough to power about 631,000 homes in the Pacific Northwest for a year (NPCC 2021). In addition, the flow rates associated with these dams are influential throughout the Columbia River Basin.

Inherent to all hydroelectric projects, the dam complex substantially alters aquatic habitats and

reduces biological connectivity throughout a transboundary region that includes Montana, Idaho, and Washington. Migration corridors were blocked for migratory Bull Trout (*Salvelinus confluentus*) and Westslope Cutthroat Trout (*Oncorhynchus clarki lewisi*) while impoundments within free-flowing sections benefitted invasive species, e.g. Walleye (*Sander vitreus*) and Northern Pike (*Esox Lucius*) (Scarnecchia et al., 2014).

Dam operations influence the system's natural hydrograph, including hourly flow fluctuations to meet hydropower demands and seasonal regulation of the top 11.5 feet of LPO for flood control purposes. Dam operations are among a myriad of factors negatively influencing LPO fishery productivity. The LPO fishery once supported a kokanee (*O. nerka*) sport and commercial fishery of 1,000,000 fish/year annually and world-records for Rainbow Trout (*O. Mykiss*) and Bull Trout. Exponential growth of Lake Trout (*Salvelinus namaycush*) threatened the stability of the kokanee, Bull Trout, Cutthroat Trout, and Rainbow Trout populations, as predation became a primary limiting factor for kokanee (Corsi et al. 2019). More recently, illegally introduced Walleye and Northern Pike have expanded their range in the basin, further threatening native and sport fishes in the watershed.

Non-federal projects, including CG and NR, were regulated by the Federal Power Commission (now known as the Federal Energy Regulatory Commission, or FERC) under the Federal Power Act (U.S. Congress, 1940) and 50-year licenses were issued. By the mid-1990s, many licenses were nearing expiration and utilities were faced with relicensing their projects. The FPA calls for appropriate PME of fish and wildlife resources affected by licensed facilities, with FERC establishing license conditions. These license conditions are typically where PME for effects of a dam are specified. The traditional relicensing process consists of three stages: (1) a preliminary application that includes comments from resource agencies and tribes and proposed studies; (2) execution of studies, submission of results, and a draft application that includes comments from resource agencies and tribes; (3) submission of a final application.

The Clark Fork Settlement Agreement

Relicensing was contentious and frequently litigated as utilities and stakeholders fought over mitigation responsibilities. As a result, FERC developed the Alternative Licensing Process (ALP) which allowed a collaborative approach to empower stakeholders and develop relationships and produce an uncontested license that met needs of both utilities and stakeholders (Avanish, 2004). With CG and NR due for relicensing in the early 2000s, Avista announced they would use ALP, reasoning that their Clark Fork projects provided a realistic opportunity to work collaboratively to achieve license certainty.

With the intent to file a new license by 2000, Avista began work in 1995 with a broad spectrum of participants to create a Clark Fork Relicensing Team that collaboratively prepared an Environmental Assessment and worked toward developing PME measures that met the needs of all parties (Bruch et al., 2007). Participant groups included federal and state agencies, local governments, Native American tribes, and non-governmental organizations such as sportsman groups, conservation organizations, and property owners. Importantly, Avista provided logistical and financial support for participation allowing for a broader representation of participant interests than would be involved in the traditional process.

In 1999, the 27 participating parties agreed to terms of the Clark Fork Settlement Agreement (CFSA; Avista, 1999), to include term of license, project operation sideboards, and decision structures for allocation of funds. Three important issues were not resolvable prior to signing of the CFSA, but stakeholders reached consensus on processes identified to work through these issues (fish passage, minimum flows, and total dissolved gas below CG and NR spillways). That decision is indicative of the level of trust and commitment that was developed between parties. The CFSA provided certainty to both Avista and stakeholders, but was formed as a “Living License”, allowing consensus-based adaptive change to effectively use new information.

Long-term funding for fish and wildlife conservation, along with funding for recreation and

the protection of cultural resources and values, was provided in a PME package valued at approximately \$200 million (1999 dollars). Funds were established to be allocated annually. Importantly, for most identified fish and wildlife PMEs, unused annual funds “roll over” and can be used in subsequent years; funds may also be reallocated to other PME measures based on consensus agreement. Further, CFSA, which is non-federal, is readily matched with other funds received through outside grants, including federal funding.

The collaborative approach employed by Avista produced a settlement agreement that had broad acceptance and ownership amongst stakeholders. Avista was satisfied with the commitment for a 45-year license that preserved their operational approach, and PME measures that provided a high level of certainty in meeting their PME commitment. The conditions of trust led Avista, with support of the stakeholders, to roll licenses for both CG and NR into a single agreement, thus simplifying the regulatory environment. The Living License approach preserved the opportunity for stakeholders to collaborate, as needed, to adaptively modify license conditions based on new information. The CFSA and license was satisfying to stakeholders because it prescribed collaborative implementation and was funded at a level where PME work was meaningful. Further, and perhaps most importantly, once the CFSA was codified, Avista was no longer the ultimate manager of PME funds. The members of the CFSA are the managers of funds, putting Avista on equal footing with jurisdictional agencies with statutory authority who are also co-implementers of CFSA PMEs (State of Idaho, State of Montana, US Forest Service, US Fish and Wildlife Service).

Emergent services in the Lake Pend Oreille-Clark Fork River

As the history of the LPO-CFR and CFSA evince, management of large river systems and fisheries is complicated by the nature of transboundary resources, multiple jurisdictions empowered to manage resources, and subsequent inter- and intra-jurisdictional conflict (Carlson et al., 2020). Such complexity inherently positions stakeholders in sociocultural and political arenas

fraught with disagreements about the relative value of ES and appropriate PME policies. We maintain that the CFSA's improvement of extant services and establishment of new services stems from interactions and feedbacks between people, institutions, management, and ecosystems which evolve and shift in response to one another (Good et al., 2016a).

Reflection on the history of the CFSA initiated discussions of its maintenance, and how we could articulate—to the next generation of staff, stakeholders, practitioners, and managers (Good et al., 2016b)—sociocultural values with focus on relationship-building, trust, and institutional cooperation as integral to successful large river fisheries management. Recognizing the “hidden obvious”, we knew that individuals and institutions involved with the initial CFSA were shaped and influenced by the LPO-CFR's past conditions, and that these initiated several PME efforts. At the same time, we know past and current human actions and stakeholder relationships shaped and will continue to shape the system and its management.

While implicit, it is often a challenge to clearly articulate recognition that the system shaped our management and planning, and that we cultivate and enhance desired outputs (benefits/services) from the system (Thom et al., 2016). To focus on the CES and S2E benefits provided by or to nature that have derived from collaborative social-ecological management guided by the CFSA over the past 25-years, we use the term *emergent services*. We use CES and S2E to describe the loop of reciprocal and flow of mutually beneficial relationship between humans and nature (Comberti et al., 2015). Services to ecosystems are categorized as protecting (species/habitat protection, cultural proscriptions, formal regulation), restoring (invasive species removal, habitat/niche restoration, spawning/migration improvement) and supporting (local knowledge, belief systems). With regard to CES, we rely on the conventions of the Millennium Ecosystem Assessment (MA) and Common International Classification of Ecosystem Services (CICES) but also broader interpretations like the recognition or reestablishment of traditional rights policy (Berkes, 1996), the implementation of inclusive management (Coscieme et al., 2020), or the establishment of knowledge interchange (Lynch et al., 2016b).

Collaboration-consensus pathways, an overarching emergent CES and S2E institutionalized by the CFSA and perpetuated by its members, created the appropriate conditions for the emergence of four additional S2E integral to the functioning and now the continuation of the CFSA: (1) multi-institutional governance, (2) transboundary culture, (3) shared knowledge systems, and (4) public involvement. The aforementioned services may be considered meta-services; other benefits to and from ecosystems we discuss include the contribution and acquisition of local and scientific knowledge, trust-based decision-making, shared experiences and common learning, and ownership in processes and outcomes.

Multi-institutional governance

The CFSA formalizes multi-institutional governance as the agreement is cooperatively administered by all members (Avista, 1999). Projects, being the main activity of CFSA members, are an exemplar of this emergent S2E. A project proposal process begins with initial vetting by a team comprised of Idaho, Montana, Avista, and US Fish and Wildlife Service representatives, then by technical advisory committees comprised of a member from each CFSA signatory. Projects are then moved ahead to the Management Committee (MC), comprised of representatives of the signatories to the settlement who are authorized by their organizations to make decisions in the selection process.

The MC strives for consensus decision-making but provides a structure for decisions in the event consensus cannot occur. Five entities (Idaho, Montana, Avista, US Fish and Wildlife Service, and US Forest Service) with jurisdictional and statutory authorities retain the right to veto a decision. Because of the inclusive process used to bring projects forward for consensus vote, veto power is almost never used. Additionally, with five parties holding that power, any inappropriate use of veto has consequences.

The common path to consensus within the CFSA begins with stakeholders convening at a facilitated meeting. Meetings are designed to not only build relationships but work through a structured process that identifies how each stakeholder group views

themselves, as well as how they are viewed by others. A typical full-day agenda consists of opportunities to “break bread” (both figuratively and literally, as Avista provides meals) and facilitated conversations pertinent to functional working relationships. Erstwhile, opposition is transformed to support via discovering how stakeholders can take ownership for outcomes. The MC meets twice annually, with the spring meeting primarily focused on reviewing and approving proposals and funding for those, and the fall meeting primarily used to check in on implementation progress, receive new information, and to consider any changes that might be needed. Importantly, the MC meetings provide opportunities for stakeholders to re-connect in a social setting including meals and field tours, contributing to a shared sense of mission. The structure and processes of the MC establish a sense of ownership, to include non-jurisdictional collaborators (e.g. non-governmental organizations) that might otherwise be left out of PME packages. Through the outlined process, stakeholders have collaborated and come to agreement on implementation of \$98 million PME dollars (approximately 100 projects, annually, e.g. Avista, 2020). These agreements addressed the previously unresolved issues related to fish passage (see below), dissolved gas mitigation, and minimum flows. Stake holders have amended minimum flow requirement downstream of Cabinet Gorge Dam (FERC 2019) and developed approaches to monitoring and reducing total dissolved gas as well as mitigating for the potential fishery impacts of high total dissolved gas caused by spill at Noxon Rapids and Cabinet Gorge Dams (Avista, 2004; Avista, 2009)

Transboundary culture

The collaborative pathways and shared governance formalized by the CFSA create conditions for members to gain project ownership across jurisdictional and philosophical boundaries (Midway et al., 2016). Members see how projects on one side of a boundary positively impact objectives on another side of a boundary, whether biologically direct, biologically indirect, or politically. This facilitates project development that has been broad in scope. Since 1999, more than

36,000 ha encompassing about 359 km of stream habitat in Idaho and Montana have been protected through purchase and conservation easements. More than 50 stream habitat projects have been implemented on at least 20 tributaries in Idaho and Montana combined.

Perhaps the epitome of this transboundary culture is the restoration and improvement of connectivity for migratory species within the watershed. Since 2000, downstream passage has been restored with emigrating juvenile Bull Trout and post-spawn adult Bull Trout in tributaries of the lower CFR being captured, transported, and released downstream of CG, where they have free access to LPO. Since inception of this program, 3,850 juvenile and 78 post-spawn Bull Trout have been transported downstream of CG (see Oldenburg, 2018). In 2001, an annual upstream transport program began at CG, whereby adult Bull Trout maturing in LPO are captured near the base of CG and released upstream in Montana. In 2014, managers agreed to begin upstream transport of spawning Westslope Cutthroat Trout. Over the course of this program 681 Bull Trout and 184 Westslope Cutthroat Trout have been transported upstream of CG (see Bernal and Johnson, 2018; Bernal and Duffy, 2019). After several years of negotiation to reach consensus on a scientifically defensible design for a permanent fish passage facility, a fish trap is being constructed at CG in order to further enhance fish passage upstream to spawning habitat in Montana. Fish passage negotiations not only focused on trap design and operation, but also on means for preventing the movement of fish pathogens from Idaho into Montana. The fish passage facility trap is currently under construction and is anticipated to be operational by 2022.

Shared knowledge system

As the CFSA has matured and relationships among members have developed and evolved, shared knowledge has become a cornerstone of PME successes throughout the basin (Avista, 2019). Members have developed a sense of community and recognition of each other’s goals that translates into synergy and integrity at technical and policy levels. This leads to broader management perspectives,

creativity, and allows thinking at biologically relevant scales. Together, these and other aspects of a shared knowledge system offer the LPO-CFR supporting S2E.

Funds from the CFSA are primarily directed at PME, but sharing research from programs outside the CFSA has been critical to the success of CFSA PME. The best example has been creative implementation and integration of mitigation funds associated with Albeni Falls Dam. Research conducted in that program have broadened the scope of conservation efforts with the support of rigorous research, monitoring, and evaluation. These research programs have allowed for effective implementation of adaptive management cycles where management is both science-based and experimental in nature (Halbert 1993). Shared knowledge has had a positive impact on the Bonneville Power Administration (BPA) programs as well. The mitigation program through the BPA uses a less streamlined process, which also serves the entire US portion of the Columbia River basin. Successes with CFSA work have provided a steppingstone to bringing in BPA funding to expand programs, especially the suppression of invasive fishes in Lake Pend Oreille (see below, Rust et al. 2020, and <https://researchoutreach.org/articles/non-native-lake-trout-suppression-fisheries-restoration/>).

Public involvement

Over the course of the CFSA, its substantial resources and associated PME programs created significant conservation opportunity, and several programs are notable for their scope and aspiration. However, under the public trust doctrine, PME efforts are beholden to public preferences and priorities (Sax, 1970). Perhaps the most notable example of this has been the suppression of non-native predatory fishes which has occurred in LPO since 2006. Suppression was spurred by the increase of non-native Lake Trout and subsequent collapse of kokanee. In 2002, a citizen advisory committee was established to work with Idaho Department of Fish and Game (IDFG) to identify tools to reduce Lake Trout abundance. In 2003, IDFG adopted the committee recommendations for Lake Trout, including commercial harvest, removing bag limits, and allowing experimental trap-netting.

Due to negative perceptions of suppression and netting, an anti-suppression group, Citizens Against Netting Fish on Lake Pend Oreille, was formed by Lake Trout anglers. Founders of the group circulated a petition to stop the netting, and local officials and state legislators intervened, resulting in a halt to a planned second year of experimental netting in 2004.

Idaho Department of Fish and Game responded with two strategies. First the agency initiated annual State of the Lake Meetings, to disseminate monitoring information, provide a forum to scope public concerns, and answer questions. Second, in 2006, a new citizen group, the Lake Pend Oreille Fishery Recovery Task Force (Task Force) was formed. Some of the participants were specifically recommended, and all participants vetted, by legislators, thus giving the Task Force broader political backing. This proved important, as legislators now had ownership in the group and its outcomes.

As a commitment to participants that their efforts would be relevant, Task Force members were informed that IDFG would advocate for their recommendations, provided they were legal and biologically defensible. Early on, the Task Force reached agreement to incentivize anglers to harvest Lake Trout. Even anglers who petitioned against suppression of Lake Trout became participants. In mid-2006, third party expertise was brought in to provide additional credibility to the science and information used by the Task Force.

In 2007, the kokanee population reached an all-time low. That, along with the combined success of netting and incentivized angling at removing Lake Trout, invigorated commitment to rebuild the kokanee population. The Task Force agreed with ramping up netting effort. The Task Force continued to meet and became a prominent advocate for the management approach, providing leadership within the angling community. As one example, the Task Force put on fishing clinics to teach people how to be more effective anglers for lake trout.

Suppression appears to be achieving success with Lake Trout numbers declining and kokanee rebounding (Dux et al., 2019). Walleye (*Sander vitreus*) represent an emerging threat to the food web and fishery present in LPO and have recently been the subject of exploratory suppression as this species has the potential to undo the achievements

of the Lake Trout Suppression Program (Corsi et al., 2019). Suppression efforts on LPO have resulted in the removal of more than 229,000 Lake Trout and 2,900 Walleye (see Rust et al. 2020 for program details). The combined efforts of netting and angler harvest on Lake Trout have been successful, and in 2013 the kokanee fishery rebounded and was re-opened for the first time since 2000. Annual State of the Lake meetings continue for public involvement, as managers move to address new challenges to the fishery such as the recent growth of the Walleye population.

Conclusions

Fisheries and fisheries management receive and provide services to nature. This case study describes novel services deriving from cultural values and social interactions, the conditions and tactics that have led to a successful multi-institutional/trans-boundary collaboration, the scope of PME efforts and fishery responses, and what we believe is required of stakeholders to maintain these services into the future.

Ultimately, our experiences show the path to collaboration and consensus requires what Kemmis (1990) referred to as the “indispensable element of trust.” Moreover, we view the CFSA’s collaboration-consensus pathways as the means for “getting to yes”, but not perfection. While multi-stakeholder collaborations can increase actions that benefit fish and fisheries, the sociocultural elements that facilitate collaboration—communication, mutual purpose, trust, etc.—require connections among people and institutions (Pleasant et al., 2014; Gelcich et al., 2019). From those connections, requisite conditions are met and previously nonexistent pathways emerge which are required to sustain the resultant fisheries system.

The success of the collaborative in producing conservation outcomes is a CES that will require a continued commitment by participants to maintain its effectiveness. During the 20th anniversary of the CFSA, at the semi-annual meeting, a portion of the meeting was devoted to presentations and testimonials from first, second and third generation participants (Avista, 2019). This approach was to foster sustained value from the CFSA by promoting passing on of institutional knowledge, continued

opportunities to build and maintain relationships, continued commitment to negotiation in good faith, and continued opportunity for participants to own and share in successful outcomes.

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