

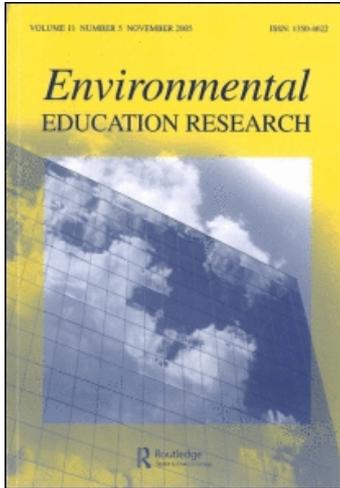
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Participatory action research and environmental learning: implications for resilient forests and communities

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How can a participatory approach to research promote environmental learning and enhance social–ecological systems resilience? Participatory action research (PAR) is an approach to research that its’ supporters claim can foster new knowledge, learning, and action to support positive social and environmental change through reorienting the standard process of knowledge production. PAR is posited as being particularly suitable for use with historically disadvantaged groups. As such it may be a useful tool for environmental learning which would enable a social–ecological system to better respond to change as theorized by resilience thinkers. In this paper, we examine a PAR project to determine how PAR fostered environmental learning and, in turn, how the learning influenced resilience. The project partnered an ecologist, federal and state forest managers, and harvesters of salal (*Gaultheria shallon*), a non-timber forest product gathered and sold for use in the floral industry in the forests of the Olympic Peninsula, Washington, USA. Based on interviews with each group of partners during and after the PAR project, we found that the PAR approach did indeed generate environmental learning, defined here as ecological literacy, civic literacy, values awareness, and self-efficacy, and contributed to resiliency through promoting greater diversity, memory, redundancy, and adaptive capacity. However, the political vulnerability of the salal harvesters, who were largely undocumented Latino workers, inhibited the extent to which adaptive measures could be taken to revise permitting procedures and additional collaborative research. We conclude that the PAR approach is a valuable tool for environmental learning but the extent to which learning can actually promote system change and greater resilience must also be understood within the underlying context, especially political realities.

Keywords: participatory research; participation; resilience; environmental learning; forest; local ecological knowledge

Introduction

What kind of environmental learning can enhance resilience at different (institutional) levels in society, and how would this enhance social–ecological system resilience? What are the implications of new alternative forms of environmental learning, such as community participation in natural resource management, for environmental education taking place in informal settings?

One approach to learning, which builds on community participation and has steadily influenced those who are interested in social–ecological systems and improving their

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sustainable management, is participatory research. Once an approach largely used in the health profession, participatory research is being employed more to learn about and to enhance sustainable practices in forestry, agriculture, wildlife management, and restoration, including more equitable access to and co-management of resources (Fortmann 2008; Wilmsen et al. 2008). Scholars describe participatory research as a collaborative, more democratic approach to learning and education built on communication, negotiation, observation, reflection and analysis between scientists and non-scientists sharing local knowledge and expertise (Gaventa 1988; Minkler and Wallerstein 2003; Reason and Bradbury 2006). This process facilitates the creation of what might be considered a learning community in which scientists and community members from different backgrounds and experiences work collectively to investigate a problem in a deliberate way (Lave and Wenger 1991). A specific type of participatory approach, participatory action research (PAR), can be defined as 'systematic inquiry involving the collaboration of those affected by the issue being studied for purposes of education and taking action or effecting change' (Green et al. 2003). Because the PAR approach pays explicit attention to power imbalances between scientists and non-scientists, it is suggested that PAR can potentially contribute to more resilient ecosystems and communities. This can occur through multiple-loop social learning in which a diversity of individuals examine their own assumptions and values on which management decisions are based (Keen, Brown, and Dyball 2005). Theoretically, this suggests new information is included from non-scientist groups, which fosters reflection and possibly new action among professional managers. However, while PAR continues to expand geographically and across disciplines, it is important to point out critiques that suggest the approach is biased, unreliable, and simplifies the complex nature of participation and empowerment (Cornwall and Jewkes 1995; Hayward, Simpson, and Wood 2004). Though scholars and practitioners acknowledge that some attempts at PAR are unsuccessful, its emphasis on co-learning and collaboration around environmental problems suggests great potential as an environmental learning approach (Reid et al. 2008).

A crucial question then is how does PAR facilitate environmental learning, and what are its implications for resilience at different (institutional) levels in society and the social-ecological system itself? Resilience scholars emphasize the '... need for learning that encourages reflection, promotes flexibility, and ultimately fosters adaptation' (Krasny, Lundholm, and Plummer 2010a). Given the emphasis participatory research processes place on joint problem-solving and reflection, it seems likely that PAR can contribute substantially to individual learning and institutional adaptation that support resilient social-ecological change (Finger and Verlaan 1995; Park, Brydon-Miller, and Hall 1993; Reason and Bradbury 2006). Furthermore, both resilience and PAR scholars see management of complex social and ecological systems as benefiting from a combination of scientific and traditional (or local) ecological knowledge, as well as addressing directly the underlying political context in which knowledge is generated and used (Berkes, Colding, and Folke 2003; Calheiros, Seidl, and Ferreira 2000; Nelson and Wright 1995; Rocheleau 1994). However, there are few published papers that discuss the implications of participatory research approaches for environmental education (Hacking, Barratt, and Scott 2007; Mordock and Krasny 2001; Robbotom and Sauvé 2003; Schusler and Krasny 2008), and none, to our knowledge, that directly address the question of how PAR facilitates environmental learning and resilience.

In this paper, we examine a PAR project initiated by a forest ecologist (the first author) who partnered with harvesters of salal (*Gaultheria shallon*), a non-timber forest product (NTFP) gathered for sale as a commercially valuable flora product,

as well as several public and private land managers in the Olympic Peninsula, Washington, USA. The increasing intensity of harvesting and selling salal has raised serious question about its regrowth and biological productivity as well as the appropriateness of existing permitting procedures. We use the Salal Sustainability Study (hereafter the Salal Study) as our empirical case for assessing the value of PAR on learning and resilience, as well as its further implications for environmental educators.

Environmental learning and resilience

Our analytical framework combines scholarship on learning from PAR (Fortmann 2008; Gaventa 1988; Nelson and Wright 1995; Wilmsen et al. 2008), environmental literacy and citizenship (Berkowitz, Ford, and Brewer 2005), social learning in environmental education and natural resource management (Keen, Brown, and Dyball 2005; Krasny and Lee 2002), and resilience thinking (Berkes 2009; Fazey et al. 2007; Folke 2006). These fields have begun to converge on participatory approaches to education that have emerged recently in the environmental education literature and include attention to youth participation in civic action, scientific processes, and their own educational processes (Hacking, Barratt, and Scott 2007; Reid et al. 2008; Robbotom and Sauvé 2003; Schusler and Krasny 2008). Simultaneously, environmental education scholars have recently called for greater emphasis on defining and researching environmental learning itself, including greater focus on context and process (Dillon 2003; Falk 2005; Rickinson 2006).

Environmental learning in the context of community participation involves multiple factors and occurs at multiple scales. As described by the editors of this collection, environmental learning is not only learning *about* the bio-physical environment but also *for* the environment, and thus includes critical thinking and action skills to solve environmental problems (Krasny, Lundholm, and Plummer 2010b). To address the call for more explicitly defining and researching environmental learning, we highlight four key areas (defined below) as the goals and outcomes of environmental education (Berkowitz, Ford, and Brewer 2005). Focusing on these four areas gives equal weight to the social, cultural, and ethical understanding and skills that individuals need, in addition to the scientific and ecological knowledge and skills, to build and maintain resilient communities and ecosystems. We use an adapted version of Berkowitz, Ford, and Brewer's (2005) interdisciplinary model of environmental literacy as our frame for analyzing individual learning outcomes of the participatory research process which, like the resilience framework, incorporates both social and ecological components, specifically:

- *Ecological literacy*: understanding the key ecological systems and processes, while also understanding the nature of ecological science and how science is conducted.
- *Civics literacy*: understanding the key social, economic, cultural and political systems, and applying critical thinking skills.
- *Values awareness*: awareness and clarification of one's own personal values with respect to the environment, awareness and appreciation of others' values, and ability to connect these values with knowledge in order to make decisions and act.
- *Self-efficacy*: having the capacity to learn and take action with respect to personal values and knowledge of the environment.

The question then is how can learning as defined above be facilitated and further linked to institutional changes that scale up to system-level resilience? At its core, the resilience approach is about systems responding to new learning, reflection, and action occurring at multiple, nested levels (Berkes, Colding, and Folke 2003; Gunderson and Holling 2002). A key mechanism suggested for implementing resilience thinking is taking an adaptive management approach, whereby professional natural resource managers seek greater cooperation or even adaptive co-management with affected user communities (Berkes 2009). Krasny and Tidball (2009) suggest that applying a resilience framework to environmental education enables examination of how individual environmental learning can be better linked to social and ecological health; and how might these better reinforce one another. Resilience scholars have focused on the capacity of systems to absorb shocks and still maintain function, but increasingly they are focusing on the dynamics of how systems are renewed, reorganized, and redeveloped, including modification of individual behaviors and systemic level behavioral, policy, and institutional responses, especially governance practices (Folke 2006). This dynamic and multi-scaled approach involves closer attention to what enables people to learn and to apply that learning to building more flexible institutions (e.g., Carlsson 2003; Colding, Elmquist, and Olsson 2003). As with participatory action researchers, resilience thinkers emphasize on learning-by-doing and take the view that resource management policies can be treated as 'experiments' from which managers can and should learn (Berkes, Colding, and Folke 2003, 9). Feedback, and especially feedback learning, is central mechanisms that make resilience an iterative, co-evolutionary process between management policy and the state of the resource, and what leads individuals, organizations, and systems to eventually reorganize, renew, and resolve problems (Berkes, Colding, and Folke 2003). Feedback learning occurs when reactions to a particular action actually promote changes in thinking or learning.

Learning to be resilient involves a variety of social and biological processes operating at different but mutually reinforcing scales (Folke 2006; Walker and Salt 2006). Key attributes of resilience which learning should address and reinforce include: *diversity* of both biological and cultural systems including learning to manage for diverse biological attributes and functions informed by diverse cultural practices and traditional knowledge; *memory* includes the mechanisms for how plants and other biota reproduce themselves over time (such as successional pathways), and how humans learn to remember through oral, pictorial and other forms of cultural transmission involving multiple forms of knowledge; *redundancy* involves complementary and repeated forms of flora and fauna as well as governance and institutions; *short feedback loops* are reactions to particular actions that facilitate the capacity to learn and innovate in a fairly short timeframe; *self-organization* refers to the emergence of larger scale patterns from independent smaller scale processes (Berkes, Colding, and Folke 2003; Folke 2006; Walker and Salt 2006). Additionally, how and under what conditions people are capable of building adaptive social institutions has been informed by decades of work on *social capital*, or networks of mutual exchange, cooperation and trust (Adger 2003; Plummer and FitzGibbon 2006).

A discussion of resilience in the context of environmental education is an opportunity to draw attention to the often-neglected importance of the political aspects of the system in which environmental education occurs. With some exceptions (e.g., Bowers 2004; Gruenewald 2004), few researchers in environmental education have addressed the ways power, politics, and social-economic context influence whether

and how environmental learning occurs and how learning among individuals and small groups does or does not translate upward into institutional and larger system reorganization. When there is an imbalance in power due to politics and differing socio-economic values and interests, as is the case for salal harvesters and land managers in Olympic Peninsula, Washington, this may impede efforts at institutional change and reorganization (Blaikie and Brookfield 1987; Neumann 2005; Paulson, Gezon, and Watts 2003). As an example, Nadasdy (2007) has pointed out how institutional change toward greater resilience has been blocked by underlying political processes. Therefore, we now apply a critical lens to the case of the Salal Study, applying the analytical framework of environmental learning and resilience to a PAR case in which the political aspects of the system are considered carefully.

Setting and background

Salal (*Gaultheria shallon*) is a NTFP used in the floral industry. It is harvested primarily by undocumented Latino forest workers between the ages of 20 and 40 who speak English as a second language (Ballard and Huntsinger 2006) (Figure 1). The shrub is native to western Washington, Oregon, and Northern California and sells by the pound (from \$0.45 to \$1.00/pound depending on the season). Harvesters sell to wholesalers who then ship salal all over the world. Harvesters gain access to the salal through permits or leases on public and private lands on which it grows throughout the region, including on national forests, state forests, and private industrial timber lands. Concern about the sustainability of the commercial harvest, combined with a lack of information about the ecological impacts of harvest, gave rise to the PAR project we examine here. It involved collaboration between Ballard and the Northwest Research and Harvester Association (NRHA), founded by and for harvesters in 2001. The research question that emerged collaboratively among the partners was, 'What are the impacts of differing harvest intensities on salal regrowth and commercial and biological productivity on the Olympic Peninsula, Washington, USA?' This question differed entirely from the initial research question that Ballard and land managers had developed alone; extensive dialogue with harvesters led to greater attention to varying harvest intensities, which differed greatly among harvesters depending on their security of land access.

The leaders of the NRHA organization formed the core research team and worked with Ballard in all stages of the research project; details of local harvester ecological knowledge, the ways harvesters participated in the research project, and research results have been described elsewhere (Ballard 2008; Ballard and Huntsinger 2006; Ballard, Trettevick, and Collins 2008; Collins et al. 2008). For the purposes of this analysis, we describe each research stage and the activities that reflect a PAR approach (Table 1). Approximately 35 harvesters took part in the Salal Study, 10 of whom participated during all three years, while others participated only in data collection or interpretation (Figure 2).

An important step in any PAR project is that of applying research findings to address the problem identified (Minkler and Wallerstein 2003). The ecological results showed that over the three-year study, heavy harvest stimulated growth rather than suppressed it. This was attributed to root reserves in the long-lived plant, such that repeated heavy harvest would eventually cause decreased growth and reproduction. Incorporating the key insights from harvesters about the influence of annual rainfall patterns and insect damage, these results led to management recommendations and a



Figure 1. A harvester participating in the Salal Study demonstrates how he picks salal (*Gaultheria shallon*) in the forests of the Olympic Peninsula, Washington. © Heidi Ballard.

report given to regional land managers. At the conclusion of the Salal Study in 2003, the NRHA and other harvester advocacy organizations began planning future inventory and monitoring projects with public lands agencies (the USDA Forest Service and Washington State Department of Natural Resources) and tribal governments on the Olympic Peninsula. This included harvesters and agency personnel working

Table 1. Stages of the research process and corresponding PAR activities during the Salal Study.

Stages of the research process	PAR activities during Salal Study
Establishing partnerships	Formation of collaboration between NRHA, ecologist Ballard, and staff of several public lands agencies in 2001.
Defining the research question	Harvesters, land managers, and Ballard define research question focusing on harvest impact through discussions and field work. Rather than testing the effects of harvesting different salal products (length of stems), the research question was re-designed so that the two different harvest intensities most often used were tested.
Study design	Harvesters, land management staff, and Ballard design research methods and site selection drawing extensively on the local ecological knowledge of the harvesters. Harvester-designed measurement variables address commercial quality, not just biological production, as was common in previous work (Bunnell 1990; He and Barclay 2000).
Data collection	Harvesters, USDA Forest Service technicians, and Ballard collect ecological data in teams. Data sheets were translated into Spanish. Harvesters were paid an hourly wage to compensate for time they could have been harvesting.
Apply experimental treatments	Harvesters and Ballard collaboratively design and apply experimental harvest treatments to mimic realistic harvest practices and patterns, one 'heavy' (100% of commercially saleable material removed) and one 'light' (33% of commercially saleable material removed) treatment. All biomass removed, both commercially usable and waste material, was weighed.
Analyze data and interpret results	Harvest yield results were analyzed during a workshop facilitated by Ballard and leaders of the NRHA, in which 35 harvesters participated in interpreting graphs of harvest yield results. Ballard taught members how to interpret graphs and draw conclusions from evidence. They discussed why some results differed from their hypotheses, why sites responded differently to the same harvest treatments, and how the results could be used for management recommendations.
Draw conclusions	Harvester leaders of NRHA and Ballard discussed conclusions based on the results. Harvesters suggested that because the Heavy harvest seemed to increase growth in the short-term, a rest-rotation system should be implemented by permitting agencies.
Disseminate findings	Ballard wrote dissertation and executive summary and distributed to NRHA, USDA Forest Service, and Washington State DNR.

collaboratively on a salal inventory and monitoring project and working together to modify salal permitting policies.

Research design

To examine the relationship among PAR, environmental learning, and resilience, we revisit a PAR project conducted by first author Ballard with harvesters of salal in public and private forests of the Olympic Peninsula, Washington, USA. In a discussion



Figure 2. Members of the NRHA gather for dinner and data analysis during the Salal Study. © Heidi Ballard.

of community resilience, it is important to acknowledge that scholars have called for greater attention to communities of mobile forest users such as those collecting NTFPs in addition to communities of residents commonly involved in logging, understanding their knowledge and experience is an important but until recently untapped resource for improving forest sustainability and management (Baker and Kusel 2003; Mclain and Jones 1997). We analyzed three sets of previously conducted interviews:

- (1) semi-structured interviews with 30 salal harvesters regarding their local ecological knowledge of salal ecology, harvest practices, and forest management;
- (2) semi-structured interviews with 10 land managers of the USDA Forest Service, Washington State Department of Natural Resources, and private industrial and non-industrial forest lands in the project area, Mason County, Washington; and
- (3) interviews with harvesters by an interviewer unaffiliated with the Salal Study to learn about harvesters' reflections on the process of participatory research, what they felt they learned, and what they thought Ballard had learned one year after the Salal Study was completed.

We also used additional sources of evidence: personal communications with several harvesters and a community worker in the region, and recent news articles regarding the social, political, and economic conditions of salal harvest that have emerged since the final interviews were conducted in 2004. Using these sources of evidence, we asked: (1) In what ways did this PAR project contribute to environmental learning (ecological literacy, civic literacy, values awareness, and self-efficacy) on the part of harvesters and agency personnel? (2) In what ways did learning lead to increased social–ecological resilience in the social–ecological system, specifically the

institutions, stakeholders, and ecosystems of the forests on the southwestern Olympic Peninsula, Washington?

Results and discussion

Environmental learning

Our analysis of harvester and land manager interviews suggest that environmental learning occurred for many individuals in both groups (Table 2). The two areas of environmental learning most impacted among harvester participants were ecological literacy and civics literacy. Many harvesters demonstrated increased understanding of how and why science is conducted and how quantifying forest conditions and impacts of salal harvesting may improve harvest efficiency and practices. For example, one harvester commented, ‘We enclosed the plots and then see in the next season which plots the plant would sprout more. We had to weigh all the bunches [of salal], everything you take off, even the leaves that are unusable had to be weighed. Then the next year, the same thing, to see how much material was produced from the same plot the next year. And that’s what she [Ballard] would do, record it, look at the results.’ Harvesters also expressed an increased understanding of the institutions involved in forest management, specifically in the ways scientific research can inform policy and management (i.e., civics literacy). One harvester commented, ‘Sometime somebody will go back to, maybe this experiment, maybe other experiments, and use it as a basis for maybe changing some laws ... Who knows? If the harvesters are out there having a part in it, if harvesters are a part of it, they can see where it’s coming from, and why it is.’

Learning also occurred on the part of the agency personnel who participated in the Salal Study (Table 2). Documenting learning among professionals is unusual in the most studies of the learning impacts of participatory approaches focus on non-professional participants only (Bonney et al. 2009; Brossard, Lewenstein, and Bonney 2005; Krasny and Bonney 2005). The two areas of environmental learning most influenced by the Salal Study among agency personnel were ecological literacy and Values Awareness (of their own values related to harvesters’ knowledge and participation in forest management). All participating agency personnel reported increased understanding of optimal forest conditions for commercial salal growth and impacts associated with of varying harvest intensities. Several forest technicians from the USDA Forest Service expressed surprise at and increased appreciation for harvesters’ ecological knowledge of the understory and of forest management practices in general, with one staff person remarking, ‘I didn’t realize they know so much about the woods. I guess it makes sense when they’re out here all day picking, but I didn’t realize they know so much about how we manage the timber, too.’

Resilience attributes in the salal harvester case

The environmental learning that occurred as a result of PAR in the Salal Study influenced several attributes that scholars suggest foster resilience. With respect to biological diversity, the research contributed to better understanding of impacts of different harvest methods on salal among both harvesters and land managers. This new knowledge contributed to revisions of local state and federal salal permitting policies. Attention to salal suggests a movement by USDA Forest Service personnel to

Table 2. Evidence of environmental learning by harvesters and land management agency personnel during the Salal Study.

Area of environmental learning	Salal harvester participants reported:	Land management agency personnel participants reported:
Ecological knowledge and scientific research skills	<ul style="list-style-type: none"> • Increased understanding of the scientific process and concepts such as data reliability, validity, and consistency • Increased understanding about the quantitative stand characteristics for commercial quality salal • Increased understanding about the quantitative impacts of different harvest intensities on salal • Increased field data collection skills, including making consistent observations, and use of measurement instruments (e.g., compass, clinometer, DBH tape, and measuring tape) • During results interpretation workshop, gained skills in reading and interpreting graphs, drawing conclusions from evidence, and explaining how the results compared to their own observations in the forest 	<ul style="list-style-type: none"> • Increased understanding about the quantitative impacts of different harvest intensities on salal • Increased understanding about the quantitative stand characteristics for commercial quality salal • Learned from harvesters the qualitative stand characteristics for good commercial quality salal, how salal is harvested, transported, stored, and sold
Civic literacy (social, political, economic knowledge, and skills)	<ul style="list-style-type: none"> • Increased understanding of key social and economic systems that govern their livelihoods, particularly the government and NGO organizations in the region • Increased awareness and value of membership in harvester organization, which increased from 20 to approximately 45 members over the project • Improved relationships between harvesters and forest managers, including formal and informal meetings 	<ul style="list-style-type: none"> • Improved relationships between harvesters and forest managers, including formal and informal meetings
Values awareness	<ul style="list-style-type: none"> • For some, increased concern for the health of the forest, and for the sustainability of the resource • For some, increased awareness and concern for how their harvesting practices affected the health of the forest, though made it very clear that the economic pressures to harvest heavily outweighed any concern for the environment 	<ul style="list-style-type: none"> • Increased awareness and appreciation of harvester ecological knowledge, livelihood skills, knowledge of forest management practices, and harvesters' role in their overall forest management

Table 2. (Continued).

Area of environmental learning	Salal harvester participants reported:	Land management agency personnel participants reported:
Self-efficacy	<ul style="list-style-type: none"> • For NIRHA leaders, increased confidence that the research results changed the way salal was managed, and knew it was partly due to their own efforts • Increased awareness of skills and abilities in ecological research, though for most this was not highly valued or seen as improving their livelihoods 	<ul style="list-style-type: none"> • No change evidenced

diversify management objectives beyond the historic focus on timber. Furthermore, because harvesters were involved in the design and analysis of the research as well as data collection, the effort drew from more diverse knowledge sources than had it been a conventional scientific research project. This was particularly important with regard to salal because no specific measurement or monitoring protocols were available from the literature. Thus, harvesters and Ballard designed appropriate protocols collaboratively.

Though the time-scale was quite short, efforts were begun to develop more enduring structures for documenting and sharing information about sustainable harvest methods which we suggest trend toward the memory attribute of resilience. Experienced harvesters (eight years or more) described longer term views of their harvesting impacts and more sustainable practices than inexperienced harvesters (Ballard and Huntsinger 2006). Knowledge transmission about harvest practices occurs when crews of harvesters pick together. Typically, these crews are entirely newly arrived immigrants, and so new harvesters learn from other relatively inexperienced harvesters and may result in inappropriate or destructive practices. In the Salal Study, the NRHA linked the inexperienced with experienced harvesters in an effort to promote more productive and sustainable harvesting practices. The NRHA's attention to sustainable harvesting practices and instructing new collectors potentially contributed to 'ecological memory' because it helped maintain salal populations and vigorous growth and reproduction.

Increased learning by harvesters and land managers about the impacts of different harvest methods may contribute to institutional redundancy through developing new and complementary salal monitoring procedures and governance institutions among both the NRHA and public agencies. For example, the NRHA gained exclusive access to harvest salal in several Washington State Forests in exchange for sharing their data on harvest yields and participating in the Salal Study. This was accomplished through a memorandum of understanding between NRHA and Washington Department of Natural Resources. This MOU represents an entirely new institutional arrangement that was complementary in function to other existing arrangements in the region. The existing arrangements include long-term leases with individual harvesters in some cases and large wholesale companies in others, as well as easily obtained, two-week long permits on public lands. The redundancy in institutions suggests that the function will likely continue should one or other of the institutional mechanisms fail.

Lastly, the Salal Study created relatively quick (or 'short') learning feedback loops for both the NRHA and regional land management agencies. The regional land management agencies gained new knowledge and appreciation for an approach to salal harvest and management that challenged their prior assumptions not only about forest ecology and management but also about the social-political system. Staff from the public agencies acknowledged that they initially felt harvesters were a liability rather than an asset. However, the PAR process resulted in land managers appreciating harvesters who were knowledgeable about and motivated to manage the understory sustainably, and the value of the NRHA as a mechanism by which harvesters can communicate with the agency regarding harvest location and volumes. Public-land managers came to see harvesters and their institutions as assets in their effort to manage forests for NTFPs. As an example of feedback learning, the favorable interactions prompted harvesters to collaborate on a salal inventory project that has the potential to improve resource assessment and permit allocation based on the actual availability of the resource. However, as we will explain below, the capacity to

build more adaptive institutions may be limited by underlying social and political conditions.

At the end of the Salal Study, it seemed that the mutual learning that had occurred among the participating individuals and organizations was successfully facilitating collaborative approaches that had the potential to improve salal growth, harvest, and management in Mason County, WA. Interviews with harvesters and community workers after the Salal Study found that USDA Forest Service District Rangers had begun to invite harvesters to provide input and attend meetings to discuss permitting policies. Several harvesters in the NRHA became interested in research on other NTFPs as well. They were particularly interested in learning more about effects of fertilizers on commercial production of salal, and how white pine blister rust could be treated using pruning methods for commercial use of the pine boughs. Both research topics were being pursued by harvesters in collaboration with Washington State University Extension scientists in the years following the Salal Study.

In 2007, however, the US Border Patrol began implementing checkpoints and raids on areas where harvesters gathered in order to detain and deport undocumented workers (James 2009). Simultaneously, Immigration and Customs Enforcement increased activity in the area as part of the Department of Homeland Security emphasis on illegal immigrants, as reported by health and safety workers in the area through emails and phone calls to the first author. As of 2009, harvesters were detained daily at checkpoints or buying stations. Getting to and from harvest areas became extremely risky. Harvesters reported that while they had been interested in collaborations with the USDA Forest Service before, these recent events completely eroded their trust in all government agencies. Hence, the proposed salal harvest research and monitoring project plans were indefinitely delayed.

The new salal inventory and monitoring program was not implemented due to the political vulnerability of undocumented harvesters, who were unwilling to draw attention to themselves in this volatile context. Despite the significant learning outcomes from the Salal Study, the educational process and its capacity to contribute to institutional reform were impeded by political realities. Consequently, despite a positive trajectory, more adaptive, flexible, complementary institutions surrounding salal harvest were not developed.

Conclusions

This case offers several lessons regarding ways that PAR can be used to promote environmental learning, especially among different groups of resource users and managers. First, PAR provides a constructive strategy (or useful means) for individual learning: (1) participants can learn environmental science content and specific scientific processes and skills by participating in scientific research; (2) participants can also acquire knowledge and skills about civic processes that govern their lives and livelihoods through applied collaborative research; and (3) participants and managers can clarify and even change their values as they incorporate new knowledge into their understanding of the social–ecological system. PAR in this case led to increased dialogue and negotiation among salal harvesters in the NRHA, an ecologist, and land management agency staff. The PAR process, which largely occurred within the forest while harvesting was being done, contributed to the formulation of research questions, the identification of appropriate research methods, data interpretation, and management recommendations that resulted. PAR created a platform for situated

learning in practice about both the ecology of salal and the social institutions surrounding it.

An important goal of PAR is that learning contributes to community empowerment through action based on that learning. A major variable in the ability of individual learning to influence institutional change, and potentially the re-organization of a social–ecological system toward greater resilience, was the political vulnerability of undocumented salal harvesters. The role of PAR in fostering learning and in identifying constraints to institutional change in the case of the Salal Study is not exceptional because PAR is often utilized with historically marginalized communities who by definition face intense political challenges. In the case examined here, the status of undocumented workers precluded further participation by them, and thus constrained efforts to apply their environmental learning to new monitoring and permitting procedures. At the time of this writing, salal harvester research and monitoring have ceased. Over time, the successes of this Salal Study might contribute to future forest management and systems resilience, given the improved understanding and knowledge gained by managers about salal harvesting. For individual harvesters, this increased understanding of the process and value of conventional science led to small salal management experiments by several harvesters, according to reports from NRHA leaders. However, collaboration on a larger scale with federal agencies is very unlikely due to lack of trust on the part of harvesters. This understanding could contribute to better diversifying NTFP-based livelihoods, and shifting forest management away from the historic focus on timber production, contributing to community empowerment and to the restoration of more multi-storied and diverse forest ecosystems.

Lastly, what are the implications of this study for resilience theorists interested in learning processes and how they may lead or not to institutional change and reorganization? We suggest that one approach is to continue to build insights into learning processes through PAR. In our case, PAR demonstrated the benefits of a more democratic approach to knowledge production, located outside formal classrooms, involving a more dialogue-centered and collaborative approach to research. In this way, the different concerns and practices of salal harvesters were communicated to managers, and managers were better able to appreciate the ecological knowledge of experienced harvesters to improve salal growth, reproduction, and management practices. In this light, the PAR approach contributes to more equitable relationships and functions as an intermediary between managers and resource users. An important lesson for environmental educators is to heed the call inherent in resilience thinking to pay close attention to the complexities and politics of social–ecological systems change. This entails examining conditions and implications of unequal resource access and vulnerability that characterize many of the communities who live with or collect natural resources, as well as the multiple factors that foster or impede institutional change in particular locales. Engaging the politics of learning (especially by those with the power to change institutions) may pose the biggest challenge yet for environmental education researchers and others concerned with building resilient social–ecological systems.

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