

◆ 論 文

Shifting paradigms in ecosystem based approach: An case of forest fire history in United States and the science policy interface of them

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Abstract

We review the paradigm shifts from an expert-led planning approach to a more adaptive and “open” process symbolized in the term “ecosystem approach” or “ecosystem-based approach”. This paradigm shift was caused in circumstances that expert-led planning did not perform efficiently and various environmental problems were difficult to solve without more open and adoptive approach. Yet, ecosystem approach has not been established. For example, issues including participation of stakeholders remain. Role and significance of science policy interface was overlooked in the era of expert-led planning. It is necessary to elaborate the appropriate interface that make effective participation of stakeholders be possible. In this paper, the shift is illustrated and analyzed with the example of historic perspective of the US forest fires. Implications for policy making are drawn from the case how participatory approach can be accommodated with the scientific rigor. This historical analysis reveals that the current forests with frequent forest fires and strong drought stress in the US were formed in the contexts of the forest reserves mainly from early 20th century and the environmentalism including prejudice on the pre-modern environmental managements. In recent years, synergies of the different types of knowledges including traditional and indigenous knowledges are explored. In this context, development of the methods for reflecting voices of various stakeholders with those knowledges to environmental managements, and the methods to elaborate trust among the stakeholders are urgent issues.

和訳要旨

生態系の管理は、専門家主導で策定された計画を実施するというアプローチから、「生態系アプローチ」という言葉に象徴されるような、より開かれプロセス重視へのアプロー

チへと変化してきた。このパラダイムシフトは、専門家主導のアプローチが効果的に機能せず、様々な環境問題を解決することが難しい状況において起きたものである。ただし、代替とされる生態系アプローチは発展途上である。例えば、ステークホルダーの参加方法を含む課題が残されている。科学・政策のインターフェイスの構築は、専門家主導の計画が主流であった時代にはその重要性が見過ごされており、ステークホルダーの参加を可能にする適切なインターフェイスの構築が必要とされている。本研究では、そのパラダイムシフトの考察を、米国の森林火災と森林管理を事例とする歴史的な分析を基に行った。その結果、科学と住民参加のバランスについての対話と政策的示唆が得られた。歴史的な分析により、前近代的な環境マネジメントの方法に対する偏見を含む森林保全策や環境思想が、頻発する森林火災や乾燥ストレスにさらされている現在の森林を形成したことが明らかになった。伝統知や地域知を含む多様な知の相乗的活用が求められている現在において、多様なステークホルダーの声を環境マネジメントに反映させる方法、ステークホルダー間の信頼感を醸成する方法等の開発が喫緊の課題である。

Keywords

Ecosystem approach; expert-led planning, equilibrium, participation, science policy interface

キーワード

生態系アプローチ、専門家主導の計画、均衡、参加、科学・政策インターフェイス

1. Background

In the past couple of decades, we have witnessed shifts from an expert-led planning approach to a more adaptive and “open” process symbolized in the term “ecosystem approach” or “ecosystem-based approach” (Franklin et al. 2000; Kohsaka & Inoue, 2005; Layzer, 2008; Mori et al. 2013). An expert-led planning approach in a top down manner has limitations in terms of managements of socio-ecological systems and stakeholder involvement. An ecosystem-based approach aims to manage complex whole ecosystems and interfaces of human society and nature. The shift to the latter approach has been required and implemented in the process of understanding the limitations of the former approach.

Simultaneously, such shifts caused changes in paradigms and general perceptions of what is regarded as rationale and scientific in addition to the practical management styles. The change of the perceptions affected concepts of academic research and

practices in the fields including forest research and managements. The experiences of forest fires based on historic materials are illustrated in this paper to highlight such shifts toward more adaptive management with the example from the United States. The historical process provides the challenges and potentials of the paradigm shifts and ecosystem-based approaches.

2. Ecosystem Based Approach

2.1 Overview of the shift to ecosystem-based approaches

During the last several decades, ecosystem-based approaches have become one of the dominant management paradigms to reconcile multiple needs for sustainability including commodity demands and biodiversity conservation. Now, many forms of ecosystem-based approaches exist across different regions and sectors (including difference perceptions surrounding the linkages between human society and nature; Mace 2014); one of the frontiers in the general context is rooted on the forestry sector in the US. The absence of consideration of integrated and complex ecosystems with long term consequences in the past forest managements of the US have lead to the current vulnerable forest ecosystems. In recent years, the “philosophy” of ecosystem management globally shared by the experts has now changed from previous assumptions about the ability to make precise predictions and maintain stable conditions (so-called, “balance of nature”) to more focus on adaptability and changeability in order to cope with the uncertainties and unpredictability that are inherent in ecosystems (the dominance of non-equilibrium paradigm) (White & Pickett 1985; Wu & Loucks 1995; Levin 1999; Phillips 2004; Mori 2011).

In the forest sciences, the ecosystem management concept developed as a result of scientific findings and debates, and growing realization of the need for conservation of forest biodiversity (Franklin, 1997; Lindenmayer & Franklin 2002). Since the early 1990s, the primary management goal for forest management in some parts of the world has shifted from providing a sustained yield of timber to conserving biodiversity, with an emphasis on endangered species (Thomas et al. 2006). To conserve threatened species, it is increasingly recognized that a broader regional perspective is important to maintaining the array of habitats and the complex ecological processes in the ecosystems that these species inhabit. Thus, the primary focus has shifted to an ecosystem-based approach that primarily seeks to conserve and restore ‘ecological integrity’ in forest landscapes. This is now one of the major approaches in modern resource management, which aims

to conserve biological diversity and preserve the major services that an ecosystem provides while meeting the social, economic, political and cultural needs of current and future generations (Grumbine, 1994; Christensen et al., 1996). The concept of ecosystem management (or ecosystem-based management) is increasingly becoming important as it can provide the foundation for human response to numerous environmental changes such as land degradation and climate change (Mori et al. 2013). In the face of uncertainty, ecosystem management approaches can help build the capacity for learning and adaptation by human societies (Layzer, 2008). As a result, societies will be better prepared to respond to unexpected events associated with global environmental change. This shift in approach challenges the conventional, expert-led, more rigid planning style.

2.2 An example for ecosystem-based perceptions

Among several frameworks based on the ecosystem approach, one that is notable is the emergence of nature-oriented forestry over the last several decades. For instance, retention forestry, which aims to preserve key structural elements of the forest stand during harvesting to ameliorate the negative impacts of typical post-logging structure that can persist over forest generations (Lindenmayer et al. 2012), is becoming increasingly important as an alternative to clearcutting (Gustafsson et al. 2012). This approach to harvest is largely different from clearcutting practices that may often ignore natural processes. In other words, even extensive natural disturbances such as stand-replacing fires leave biological legacies in stands, such as logs and stumps, and create spatially heterogeneous arrangements of post-disturbance patches in a landscape, which contrasts with the bare stands and simplified landscape structures resulting from traditional clearcutting (Franklin et al. 2000). In contrast to clearcutting that primarily aims to maximize and stabilize timber yields, retention forestry respects the natural variability that is an integral part in nature (Mori 2011). Recent meta-analyses have shown quantitatively that such ecological set-asides are effective for conserving local biodiversity in production forests (Fedrowitz et al. 2014; Mori & Kitagawa 2014). However, for this approach there is still large uncertainty about cost-effectiveness and potential economic benefits (Auld et al., 2008). Importantly, loss of revenue from the retention of potential harvestable trees is generally carried by the forest owners or contractors conducting the harvests and there are currently no government subsidies to defer the costs (Gustafsson et al. 2012). In spite of the costs of retention forestry, the fact that this silvicultural approach is becoming common in different regions exemplifies

a major shift from the conventional and traditional approach based on the myth of predictability to an approach that considers and respects system changeability.

The latter approach, when shared by stakeholders, also plays a critical role in the recent resilience-based ecosystem management (Layzer 2008; Chapin et al. 2009). In Chapin et al. (2009), Swanson and Chapin (2009) describe the importance of forestry practices aimed at emulating natural disturbance. More specifically, they stated that, in a manner similar to shifting attitudes about fire – from enemy to potential collaborator – forest managers have come to see structural elements retained such as standing dead woods and decaying woods as integral to ecosystem management rather than a threat to forests. Removing these elements during harvest could rather reduce ecological integrity and resilience, potentially making forests vulnerable to further environmental changes. As illustrated in such paradigm shifts, which natural resource management is aimed at acknowledging dynamics nature of ecological systems.

3. Changing paradigms with struggles and challenges

Struggles and challenges are involved in the changing paradigms. In the case of the U.S., the Forest Service efforts to manage today's overgrown, unnaturally dense forests undergo continuous challenges from individuals and groups determined to protect what they perceive as the many environmental benefits of trees and the forest ecosystem without harvest or vegetation removal. Management actions are often halted or slowed, and always made more costly.

3.1 Management struggles

The U.S. public began expressing dissatisfaction with timber-oriented management early in the twentieth century, seeking a forest managed for recreation, wildlife, and other uses. The 1960s and 70s changed Forest Service management to include more mechanisms for public input. As part of the National Environmental Policy Act (1970) and forest planning, the public can make suggestions and comment about forest management, and the agencies are required to listen and to consider them, but the agency is solely responsible for final decision-making and implementation. Public input is strictly on a "consultative" basis. There is little evidence that these approaches increased public confidence in the agencies or reduced conflict over forest management—in fact the opposite may be true in many cases, as is supported by the explosion in litigation in the following decades (Kaiser 2006; Broussard and Whitaker 2009; Henderson and

Krahl 1996).

Through the 1960s, the Forest Service did not have more than one or two court cases about an administrative decision at a single time; in the 80s there were one to two dozen at a time (Wondolleck 1988). Litigation had become such a crucial tool that in the 1980s the Wilderness Society created a two volume manual explaining how to appeal national forest plans (Wondolleck 1988). Between 1970 and 2001 there were a little less than 300 cases brought against the Forest Service with regard to its NEPA compliance (Broussard and Whitaker 2009). Suits against the Forest Service for any type of transgression generally increased every year from 1989 till the year 2000 with a high of 76 cases in 1998 (Keele et al 2006). NEPA itself has fed into this process, as the technical requirements of the law provide fertile ground for legal challenges.

3.2 Challenges in participatory approaches

The 1990s brought attempts at transformation for the Forest Service through many new social and ecological strategies to address this broad skepticism – conflict resolution, interest-based negotiation, alternative dispute resolution, community forestry, ecosystem management, adaptive management, and watershed councils (Leach 2006). Community forestry and other attempts at sharing decision-making have been constrained by an inability to fully share decision-making (Moote and McClaran 1997), a legacy of the institutional context of the agency. Clarifying the limits of shared decision-making has been critical to participatory processes (Fernandez-Gimenez et al. 2008). Participatory management efforts that follow the two way model of an agency working with stakeholders have not proven to be the full answer to stakeholder distrust. For example, one comprehensive study of collaborative projects found that “collaboration experience was negatively associated with trust, indicating that participants with past experience in many collaborative groups were less trusting of other participants than participants with little previous collaborative experience” (Wagner and Fernandez-Gimenez 2009). Fully developed co-management is not feasible because of the institutional legacy, and the agency finds itself relying on “good faith” efforts as a basis for moving forward in working with the public (Sulak et al. 2015).

To develop the forest management with ecosystem-based approaches and overcome the issues in the approaches and changing paradigms, Understanding the detailed process of paradigm shifts is useful, because the historical trajectories in the past affect

the current stakeholders' decision makings and trends of social conditions. In the next section, we provide the historical materials in the U.S. as case study.

4. Case study: The “scientific forestry approach” in the United States

4.1 Importation of European forestry models

In the United States (U.S.), a major shift in the conception of forests occurred about 1900, when importation of European forestry models set American forest management on a path markedly at odds with forests managed by the traditional residents of the North American continent. A scenario for forest management, constructed based on ecological and social norms from Europe, has had an enormous impact on the status of forest ecosystems and forest management in the western U.S.

Like the pre-Norman forests of England or the relict woodlands of the Spanish dehesa, U.S. forests were managed by the indigenous residents for diverse uses, by carefully controlling tree density to allow the development of understory vegetation and the many benefits that mixed vegetation, and understory cropping, provided. Human settlement in the western United States dates back more than 13,000 years. Considered a home and a garden by the original residents, a complex set of cultural norms and beliefs guided forest management prior to colonization. For example, in northwestern California the Yurok tribe (Huntsinger and McCaffrey 1995, Huntsinger and Diekmann 2010) managed dense coastal forests using deliberate burning to control tree cover and density, as the understory species were valuable sources of food and materials essential to life. Fire was used to preserve or increase the spatial and temporal extent of the grassland, oak woodland, and shrub communities which provided diverse foods and material resources. Fire could control tree density and distribution, clear underbrush, hunt and trap game, stimulate vegetation growth useful for carving and weaving, increase the harvest of acorns, hazelnuts, and other fruits, and protecting villages and houses from larger fires by clearing surrounding areas.

Using fire in these ways was common throughout California and in the west (Alagona et al. 2013). Planting, irrigation, and pruning also influenced plant communities. Lightning frequency records, oral histories, and tree ring data confirm that Native Californians in some areas shortened wildfire intervals from about once a century from lightning to a frequency of a decade or less (Keeley et al. 2004; Syphard et al. 2007). After the introduction of livestock European settlers used fire to manage range. Leiberg (1902 in Allen-Diaz et al. 1999) attributes the continued existence of “grassy glades” to burning

and grazing, and notes that when protected from grazing and fire, they rapidly become dense sapling stands.

4.2 The Forest Reserves

Observing forest conditions in 1895, soon-to-be President Theodore Roosevelt wrote, "It is almost needless to say that this country needs a thoroughly scientific and permanent system of forest management in the interests of the people of to-day, and, above all, in the interests of their children and grandchildren..." He says of local people that "their selfish clamor is allowed to stand in the way of a great measure intended to benefit the whole community (Bowers et al. 1895)." In 1891, Forest Reserves began to be set aside by the national government for government management in order to provide for the "protection and improvement of forests for the purpose of insuring a permanent supply of timber and the conditions favorable to a continuous waterflow" for people of the U.S. (Roth 1901). Most were established early in the 20th century. In 1905 Gifford Pinchot became the first Chief Forester of the new Forest Service, under the administration of President Roosevelt.

Pinchot learned forestry from Bernhard Fernow, who was trained in Prussia, where demand for trees was intense and land area was comparatively small. Professional forestry as implanted to the U.S. brought an end to the mixed-use forest and sanctified trees, in the interest of preventing a scenario of "timber famine" that has never come close to materializing in North America. The norms of scientific forestry were incorporated into Forest Service policy and practice. One of the major threats to trees that the Forest Service sought to control was fire. Fire was seen as a major evil, in contrast to its valuable place in indigenous life. Huge fires in the western U.S. in 1910 contributed to an anti-fire sentiment (Pyne 2008). In an 1895 article on how to manage Yosemite National Park, where native Californians had burned regularly for centuries, Pinchot wrote that "There is no doubt that forest fires encourage a spirit of lawlessness and a disregard for property rights." Bernhard Fernow explained that "the whole fire question in the United States is one of bad habits and loose morals. There is no other reason for these frequent and recurring conflagrations." (Bowers et al. 1895).

Ranchers accustomed using fire to clear the understory on Forest Service ranges were accused not only of damaging the forest, but of being unpatriotic. In 1918 the Shasta Trinity Forest Supervisor sent letters to local stockmen quoting President Wilson:

Preventable fire is more than a private misfortune. It is a public dereliction. At a time like this of emergency and manifest necessity for the conservation of national resources, it is more than ever a matter of deep and pressing consequences that every means should be taken to prevent this evil. (Morrow 1918; Forero 2002)

He goes on to say that it took the equivalent of 400 men working every day for four months to suppress human-caused fires, and these men were needed at the front. It was the duty of stockmen to prevent fire (Morrow 1918; Forero 2002; Huntsinger and Diekmann 2010).

The “professional norms” of the forestry profession have been identified as a lens through which foresters and forest scientists have interpreted forest conditions, forest purposes, and forest management practices (Fortmann and Fairfax 1989). Four salient characteristics of “scientific forestry” underlie professional forest management: dismissal of local knowledge and management and the belief that science is the only legitimate form of knowledge; emphasis on production of trees and wood products; assertion that solutions to complex forest problems are in technology and tree planting; and the need for centralized, comprehensive management resulting in a National Forest resource management budget that is largely dedicated to top down planning. Fortmann and Fairfax argue that the “inflexible technical professionalism” of American professional forestry, “arising out of a commitment to comprehensive, large-scale planning” is one of the “prominent reasons for the failure of international forestry projects, particularly in developing countries.”

These norms supported the Forest Service scenario of timber famine, used to communicate with the public and politicians. Under this scenario, as the U.S. population grew and increased its demand for wood, the nation would run out of timber. From this standpoint, protection of trees, without regard to the inherent dynamics of the ecosystem, including long dry summers, became paramount in the Western U.S. for forest professionals. This included suppressing and preventing all fire, including indigenous and rural burning. There was no attempt to distinguish the low intensity ground fires characteristic of frequent burning for understory vegetation control from catastrophic crown fires that burned even big trees. As early as 1890, the well-known explorer and ethnographer John Wesley Powell wrote:

... under conditions of civilization, the great forests of the arid lands are being

swept from the mountains and plateaus. Before the white man came the natives systematically burned over the forest lands with each recurrent year as one of the great hunting economies. By this process little destruction of timber was accomplished; but, protected by civilized men, forests are rapidly disappearing. The needles, cones, and brush, together with the leaves of grass and shrubs below, accumulate when not burned annually. New deposits are made from year to year, until the ground is covered with a thick mantle of inflammable material. Then a spark is dropped, a fire is accidentally or purposely kindled, and the flames have abundant food.

4.3 Environmentalism

The environmental movement, also getting underway in the early 20th Century under the leadership of such figures as John Muir, like professional forestry endorsed government control of forests and fetishized trees (Fairfax and Huntsinger 1999). Muir was an ardent supporter of centralized forest management. In an article written in 1897, Muir claimed:

All sorts of local laws and regulations have been tried and found wanting, and the costly lessons of our own experience, as well as that of every civilized nation, show conclusively that the fate of the remnant of our forests is in the hands of the federal government, and that if the remnant is to be saved at all, it must be saved quickly.

However, environmentalism seeks to protect forests not for their timber products, but for their contributions to scenery, recreation, wildlife, and spiritual life. Muir wrote extensively about the pristine beauty of the Sierra, terming it the range of light, because the wide spacing of the large, old trees meant you could see for long distances and considerable light reached the forest floor. He would never know that the "Range of Light" was a deliberate creation of people he largely ignored and once referred in the following way:

Occasionally a good countenance may be seen among the Mono Indians, but these, the first specimens I had seen, were mostly ugly, and some of them altogether hideous. The dirt on their faces was fairly stratified, and seemed so ancient and so undisturbed it might almost possess a geological significance.

The older faces were, moreover, strangely blurred and divided into sections by furrows that looked like the cleavage-joints of rocks, suggesting exposure on the mountains in a cast-away condition for ages. Somehow they seemed to have no right place in the landscape, and I was glad to see them fading out of sight down the pass.

4.4 Current situation

There is no need to belabor the tremendous wildfire problem in the United States. The national forests of the U.S. have four to five times the amount of trees per acre compared to when Lewis and Clark ventured west in 1804. Together with poor land use planning, the widespread suppression of indigenous, rural, and natural burning that began around the turn of the 20th century is credited with increasing the density of trees and drought stress to forests. Along with climate change, increased tree density has contributed to pest outbreaks devastating millions of ha of US forests, and to increasingly massive and intense wildfires. Suppression has also led to the invasion of montane grasslands and meadows by shrubs and trees, drying formerly moist habitats, as trees consume and transpire soil water (Raumann and Cabik 2008).

Compared to the average year in the 1970s, in decade up to 2012 there were seven times more fires with an extent greater than 4,000 ha each year (Climate Central 2012). Of the 20 largest forest fires in the history of California, 11 have occurred since 2000. In 2012, wildfires burned 3.4 million ha, costing 1.9 billion U.S. in suppression costs, while the Forest Service only harvested approximately 81,000 ha. This means that 44 times as many ha burned as were harvested. The Rim Fire, the third largest in CA history, burned about 24,000 ha in 2013. The fire was caused by a hunter's illegal fire that went out of control, going from 16 to 4,000 ha in 36 hours. Forest officials estimated "that almost 40% of the area inside the fire's boundary is nothing but charred land" - more than 414 square km out of the 1036 square km burned. They stated that this extent of destruction was "unprecedented" for historic Sierra Nevada fires. The King Fire burned more than 40,000 ha in 2014. It went 24 km in one day.

According to testimony by the U.S. Forest Service, 24-34 million ha of Forest Service Lands are at "high risk of wildfires." The cost of suppressing catastrophic wildfires has grown enormously in recent years. In fact, wildland fire management activities have risen from 13 percent of the Forest Service budget in 1991 to now over half the annual budget. Projections indicate this trend will only increase as a result of hazardous fuels

build-up. But on top of all this, crowded forests lack resilience to drought and climate change, and evidence is growing that we are facing high rates of tree mortality in the western US forests in coming years (Westerling et al. 2006). Thus a scenario developed in the early 20th Century has profoundly changed U.S. forest ecosystems.

5. Limits and challenges from US experience

It is clear that conventional expert-led planning methods are challenged by uncertainties and the need for sustainability. Yet, is participation a simple answer to such challenges? With larger numbers of participants, an approach may be more flexible but the goals may be lowered, and incompatibilities among goals may be more likely.

We have examined the experience in the US forestry with their changes in legal and management practices. It reveals that the current forests with frequent forest fires and strong drought stress in the US were formed in the contexts of the forest reserves mainly from early 20th century and the environmentalism including prejudice on the pre-modern environmental managements. The changes happened with the influence from the social demands and scientific findings with remaining challenges to integrate the multiple purposes of forest uses. In recent years, synergies of the different types of knowledges including traditional and indigenous knowledges are explored, as discussed in The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). In this context, development of the methods for reflecting voices of various stakeholders with those knowledges to environmental managements, and the methods to elaborate trust among the stakeholders are urgent issues.

Acknowledgement

This work was supported by the JSPS KAKENHI Grant Numbers JP26360062; JP15H01597; JP16KK0053; Environment Research and Technology Development Fund (S-15-2 (3) Predicting and Assessing Natural Capital and Ecosystem Services (PANCES)) of the Ministry of the Environment, Japan; Research Institute for Humanity and Nature; Heiwa Nakajima Foundation; Kurita Water and Environment Foundation.

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