

2007

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Recommended Citation

Brinkman, Todd J.; Kofinas, Gary P.; Chapin, F. Stuart III; and Person, David K.. "Influence of Hunter Adaptability on Resilience of Subsistence Hunting Systems." *Journal of Ecological Anthropology* 11, no. 1 (2007): 58-63.

Available at: <https://digitalcommons.usf.edu/jea/vol11/iss1/4>

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CRIB NOTES

Influence of Hunter Adaptability on Resilience of Subsistence Hunting Systems

TODD J. BRINKMAN, GARY P. KOFINAS, F. STUART CHAPIN III AND DAVID K. PERSON

Abstract

The capacity of hunters to shape the fundamental properties of their lifestyle at times when extrinsic factors change the availability of subsistence foods is critical to subsistence cultures. Recent changes in deer hunting on Prince of Wales Island, Alaska illustrate the social-ecological challenges to the resilience of a rural subsistence hunting system and raise the broader question of whether efficient hunting strategies necessarily enhance resilience. During the latter half of the 20th century, indigenous people of Alaska's Prince of Wales Island adapted to changing subsistence opportunities by capitalizing on increased availability of deer due to clearcut logging and the construction of roads. Consequently, deer became a more important source of protein. Four decades later, a decline in logging activity is likely to reduce deer availability due to successional changes in habitat. In the face of this social-ecological change, the resilience of the deer hunting component of subsistence traditions will depend on hunters' capacity to adapt to irreversible landscape changes by adopting different harvest strategies that may require more effort to maintain sufficient levels of subsistence harvest. For example, hunters may return to pre-road hunting methods or reduce their reliance on deer for meat and re-emphasize marine resources. These ecologically driven changes in social harvesting practices suggest that adaptability protecting the fundamental properties of a subsistence system from one disturbance may increase vulnerability to another. We show that increased efficiency of a subsistence system did not necessarily enhance resilience if system flexibility is reduced.

Introduction

In an environment where people have on-going access to wild plants and animals as a subsistence food source, cultural connections to the land often depend strongly on hunting and harvesting those foods (e.g., Wolfe and Walker 1987). However, rapidly changing social, ecological and economic factors often challenge people's capacity to maintain a subsistence hunting lifestyle. We describe a subsistence system in which people diversified their harvest and diet from mainly marine resources to a greater dependence on Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) in response to new and more efficient (return per unit effort) hunting opportunities. In the face of more recent ecological changes, these hunters may be forced to change their harvest strategy again. We examine

current and projected landscape changes—regrowth of forests following clearcut logging—and their likely effects on the availability of deer, upon which rural communities have come to depend nutritionally and culturally. Flexibility is critical to the resilience of a subsistence lifestyle and, therefore, to the resilience of cultural traditions and identity at times when extrinsic factors cause changes in the availability of subsistence foods. Further, our case study illustrates that movement of a subsistence system to a more efficient state does not necessarily enhance resilience. We describe how adoption of a more efficient hunting method increased the system's rigidity and its vulnerability to future disturbances, particularly those imposed by external forces beyond the control of local hunters. It

is our hypothesis that human adaptation to higher efficiency and potentially reduced resilience often occurs rapidly, whereas the building of resilience at the cost of more effort may be slow and result in a reassessment of social-ecological values. The main components that we address are applicable to many social and ecological circumstances.

Adaptability and Resilience

The ecological anthropology of traditional hunting cultures has long focused on questions of adaptation and changing human-environment relations (Bennett 1976:243-305; Moran 1982:4). Variables such as resource diversity, social organization, and worldview have been addressed to explain the structure and function of those systems. The 'adaptive system' has been framed by some with an exclusive focus of energy flows while others have highlighted institutional dimensions. In a modern context, issues of shifting ideology and economy have been explored as factors contributing to the transformation of subsistence-based hunting systems to mixed subsistence-cash economies (Kleinfeld et al. 1983; Usher 1976). Although those issues remain important, dramatic changes in land use raise other challenges for subsistence hunting and underscores the novel and complex social-ecological dynamics underlying sustainability of subsistence hunting.

Resilience theory (Berkes et al. 2003; Gunderson and Holling 2002) provides a useful framework for understanding the persistence of subsistence hunting and harvesting systems during times of rapid change. Social-ecological resilience is the capacity of a system to persist and maintain its fundamental properties despite shocks or strong perturbations. Adaptability is the capacity of actors in a system to influence resilience (Walker et al. 2004). Together, these properties potentially contribute to the sustainability and persistence of subsistence lifestyles. Robards and Alessa (2004) argue that the natural capital on which subsistence harvesters depend waxes and wanes through time and that adaptation to those conditions is central to the system's resilience. Adaptation may therefore at times require a shift from short-term increases in efficiency to foster long-term control over the fundamental properties of the system.

In our case study, the fundamental properties of the subsistence system are communities that place a high cultural value on the harvest and consumption of wild resources (marine and terrestrial), and sufficient availability (supply and access) of these resources. Resilience could be viewed as the vulnerability of the subsistence system to losing either of these properties. Whether resilience is enhanced or reduced therefore depends on hunter response to changes in wildlife availability, as well as on subsistence hunters' perceptions of 'sufficient' supply and access. We specifically focus on how hunter responses to changes in deer availability influenced the resilience of the entire subsistence system.

Subsistence Hunting System on Prince of Wales Island

For centuries, indigenous people of Southeast Alaska depended largely on marine resources that varied seasonally (Emmons 1991:102-127). Until the mid-1900s, Prince of Wales Island, in the southern portion of the region, was inhabited primarily by Tlingit and Haida people living in small fishing villages. Tlingit and Haida Indians share many social patterns, and their cultures are largely based on the abundant availability of salmon (*Oncorhynchus* sp.). Prior to the mid-1900s, these indigenous groups harvested deer opportunistically along shorelines in conjunction with their maritime activities (Ellanna and Sherrod 1987). Deer represent the only significant terrestrial source of meat on Prince of Wales Island for subsistence hunters currently and historically.

Industrial-scale harvesting of timber began in 1954, and by 1990 about 200,000 ha of forest had been clearcut logged. Clearcut logging created favorable deer habitat, particularly during years with mild winters, and an extensive network of roads (~4800 km) that facilitated easy and efficient harvesting of deer. Roads significantly increased risk of deer death from hunting (Farmer et al. 2006) and dramatically expanded the number of areas accessible to hunters.

Shortly after industrial logging commenced, island hunters began changing their harvesting practices from hunting out of boats along beaches

to driving along roads to hunt deer in open muskeg habitat and clearcuts. Road access to deer increased the stability of deer as a food resource because weather conditions (e.g., high seas) had less effect on vehicle access compared to boats, and deer were available during times of the year when marine resources were less abundant. Hunting of deer from roads required less time and effort than the early 1900s, causing most hunters to shift their subsistence focus from mainly marine resources to one that included a large proportion of deer (Ellanna and Sherrod 1987). Within one generation, accessing deer hunting areas from roads became the dominant hunting tradition, which has lasted for more than 40 years. Indeed, the minority of hunters have experience or an expectation of hunting in any other manner.

Logging activity from 1950 to 1990 corresponded to a dramatic increase in human population on the island, particularly of non-Native immigrant loggers who arrived already accustomed to living in rural areas and hunting deer via logging roads and new clearcuts. Ferry services connected the island to other parts of Alaska in 1974 further promoting population growth and hunting by off-island residents. However, competition among hunters was likely mitigated during that period because of the simultaneous expansion and increase in density of roads, and therefore, accessibility to more deer.

During this time of intensive logging, resilience of the system was enhanced by the opportunity to diversify subsistence harvest and diet. Those who previously practiced a marine subsistence lifestyle now had the opportunity to switch prey at times of the year when deer were more available than fish.

Resilience Challenged

Young clearcuts produce abundant forage for deer during snow-free months (Alaback 1982). Deer within young clearcuts are easily visible to hunters (Farmer et al. 2006). Local knowledge of island hunters indicated that clearcuts less than nine years post-logging yield abundant deer, but availability of deer begins to decline after that time. Hunters reported that it is virtually impossible to hunt in clearcuts older than 14 years. Twenty-five to 40 years after cutting, clearcuts transition into stem-exclusion

second-growth forest that shades out and virtually eliminates understory vegetation needed by deer for forage (Alaback 1982; Hanley 1993; Wallmo and Schoen 1980). Because clearcut logging often occurs adjacent to logging roads, densities of deer near roads will likely decline after clearcuts transition to second-growth forest (Person 2001).

Logging activity and road maintenance declined with the collapse of the Alaskan market for timber in the 1990s (Morse 2000). Post-logging forest succession and road closures caused preferred deer habitat for hunting and access to hunting areas to decline faster than they were replaced, resulting in increased hunting pressure in fewer areas, more hunter competition, and possibly fewer deer. According to timber market projections (Morse 2000), industrial logging is unlikely to rebound to levels that would support hunting strategies relying on extensive road access and new clearcuts. Further, current land management plans do not include second-growth harvesting that would augment deer populations and will reduce hunting opportunities by closing roads that are considered unsafe, environmentally detrimental, or expensive to maintain (United States Department of Agriculture 2006). In the early 1990s, subsistence hunters of Prince of Wales Island expressed concern that they were experiencing difficulty harvesting enough deer to meet their needs (Unit 2 Deer Planning Subcommittee 2005). The recent decrease in logging may be causing ecological changes that reduce harvest efficiency within a single generation of hunters. This trend is projected to continue for many decades.

Discussion

A successful subsistence harvesting tradition requires substantial adaptive capacity to cope with seasonal and annual fluctuations in resource availability. A diversified subsistence harvest that combines multiple resources and harvest strategies fosters long-term resilience of the system. Equally important is the presence of formal and informal institutions that respond flexibly to changing ecological and social conditions. In the context of deer hunting, resilience can be assessed by determining the alternatives that are potentially available, the institutional framework

that influences the feasibility of (and control over) these alternatives, and costs and benefits of adopting each alternative.

Local hunters lack control over natural (i.e., forest succession) and extrinsic (e.g., global timber market, political) forces driving landscape changes and influencing the availability of deer for harvest. The only way to temporarily maintain current success rates of hunters using vehicle-based hunting strategies is to increasingly restrict harvest opportunities of non-subsistence hunters (e.g., non-Alaskans and Alaskan hunters that reside in areas designated as urban, such as Ketchikan). This policy only delays the inevitable reduction in deer harvest all hunters using roads will experience owing to habitat changes. Harvest restrictions already implemented have created conflict among hunting groups. For instance, the current regulatory regime provides subsistence hunters of deer on Prince of Wales Island with more hunting opportunities than non-subsistence hunters. Despite the widespread perception by co-managers and agency regulators that competition with non-subsistence or non-local hunters was the most important factor, data collected through Geographic Information Systems analysis and interviews with island hunters suggested that landscape change was the primary cause of harvest difficulty, and perceptions of hunter competition was an indirect effect of these ecological changes.

Another potential strategy is to liberalize harvest of black bears (*Ursus americanus*) and wolves (*Canis lupus ligoni*) that prey on deer, as recommended by a public and interagency deer management workgroup focusing on Prince of Wales Island (Unit 2 Deer Planning Subcommittee 2005). This solution has many ecological and wildlife management consequences (Person 2001). For example, wolves on Prince of Wales Island were petitioned in 1994 to be listed as 'threatened' under the Endangered Species Act (United States Fish and Wildlife Service 1973) in part due to concern that roads would lead to over-harvesting of wolves (Biodiversity Legal Foundation 1993). Clearly, predator reduction to enhance deer hunting may invoke extrinsic pressures beyond the control of subsistence hunters on Prince of Wales.

Although the relationship between deer population change and clearcut logging is poorly documented, deer will likely remain moderately abundant despite succession of logged stands into stem-exclusion forest. Crude estimates on deer abundance suggest a stable population over the last two decades (Alaska Department of Fish and Game 2005), which is consistent with information collected through hunter interviews. Further, alpine meadows, muskegs and productive old-growth forests important to deer will remain undisturbed by logging activity under current forest management plans (United States Forest Service 1997). Many of those lands, however, will not be directly accessible by roads, and hunters must hike or boat to reach them. The small portions of these habitats that are accessible by road will have concentrated hunting activity unless hunters are willing to expend the greater effort to hike into productive areas or hunt along shorelines using boats.

The ease and efficiency of using roads to hunt deer from clearcuts was so alluring during the logging boom that former hunting traditions were largely abandoned within one generation. We suggest that the resilience of lifestyles based on subsistence deer hunting in conditions of irreversible landscape changes will depend on the capacity of hunters to adapt their harvest strategies and revise their hunting 'traditions.' Adaptations that require more effort with less return may occur slower than the hunter adaptation to a road-hunting strategy. This may cause hunters to reassess the cultural value of deer. Alternative strategies for maintaining existing harvest efficiency through regulations that exclude competing non-subsistence hunters will only delay the necessary transition to other hunting strategies and elevate conflict between hunters.

Roads and clearcuts may represent a cultural trap analogous to ecological traps (*sensu* Kokko and Sutherland 2001) in which the long-term sustainability of that strategy is questionable and cultural resilience is diminished despite short-term gains in efficiency. Ultimately, building resilience into subsistence hunting of deer by indigenous and non-indigenous people of Prince of Wales will require careful reflection on the value of deer harvesting as a way of

life and a concerted effort to modify and transform local traditions, perhaps to a less desirable strategy. This new strategy may be less efficient than during the period of intensive logging, but more efficient during the post-logging era and in the long term. Because of the continued abundance of marine resources, the fundamental properties of the subsistence system could potentially be maintained with reduced opportunities to harvest deer. Nonetheless, the level of effort to which hunters have become accustomed may have reduced system flexibility, resulting in a subsistence lifestyle more vulnerable to state-altering shocks or perturbations. The implications of this case study to resilience thinking underscores the need to consider carefully the dynamics of tradition, the rate at which societies move towards greater efficiency, and the challenges associated with transforming those behavioral patterns.

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