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Resource Defense

Eric Alden Smith and Benjamin Hanowell
University of Washington, Seattle, WA, USA

Synonyms

Resource control; Territoriality

Definitions

Resource defense consists of controlling or denying others' access to resources, including territoriality.

Introduction

Resource defense is a broad category covering all the means by which individuals or groups actively attempt to control or deny access of others to resources, using agonistic or display behavior. This entry focuses on defense of material resources located within spatially circumscribed territories by humans, particularly in non-state societies documented ethnographically and archaeologically.

The Logic of Economic Defensibility

Half a century ago, the biologist Jerram Brown published a short paper entitled "The Evolution of Diversity in Avian Territorial Systems" (Brown 1964). Brown's immediate goal was to explain why some bird species are strongly territorial, others are not, and some species in fact alternate between territorial and open-access regimes. Further variation exists in the immediate benefits of controlling a resource; for many species, it is local patches of food that are defended, while for others, nesting sites or roosts are the object. Brown pointed out that controlling the resources in a territory has benefits, but comes at a cost: time and energy (and potentially risk of injury) spent monitoring an area, advertising one's presence, and deterring intruders. His simple but profound argument was that natural selection would only favor defending territories if the benefits of doing so exceeded these costs – if the net benefits (measured in fitness or its correlates) were positive. This principle has since been labeled *economic defensibility*. Brown gave this principle empirical meaning by linking it to the spatiotemporal distribution of resources – specifically, their density and their predictability.

Dense resources are more defensible (are more likely to repay the costs of territorial defense) because the area the territory holder must defend to control access to a given resource is smaller, thus requiring less time and effort to monitor. Predictable resources are more defensible for

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two reasons: the area that must be defended to encompass them is easier to locate (spatial predictability) and the income from them is higher and more reliable (temporal predictability). Note that this argument does not entail environmental determinism, since the costs and benefits of both territory defense and resource acquisition also depend on the resource consumer's capabilities (e.g., birds can fly, can advertise territory residence with song, and so on); in the human case, consumer capabilities include technology and other culturally variable attributes.

Although dated in its particulars, Brown’s simple argument has greatly helped biologists explain the diversity of animal territorial systems, just as his title had promised. It harnessed the logic of natural selection (i.e., the trade-offs involved in gaining some benefit at some cost and their effects on fitness) to ecological variation. The economic defensibility model has proved remarkably durable and has been validated in hundreds of studies of spatial behavior in a wide variety of species (Davies and Houston 1984; Dubois and Giraldeau 2005). Dyson-Hudson and Smith (1978) published the first anthropological application of the model. That paper employed qualitative assessments of the economic defensibility model in various ethnographic and ethnohistoric contexts to draw three broad conclusions: (1) territorial behavior (exercise of spatial ownership claims, controlling access to resources) is facultative and varies strategically (demonstrating that people are at least as clever and flexible as birds); (2) this strategic behavior corresponds to variation in resource density and predictability across space and over time, as predicted by the economic defensibility model; and (3) within the same social system (even the same household), territorial strategies may be applied to some resources but not to others. The following section expands on these points, citing relevant ethnographic and archaeological data.

Variation in Human Resource Defense

The basic expectations derived from the economic defensibility model are summarized in Table 1 (after Dyson-Hudson and Smith 1978; see also Cashdan 1992). Note that these expectations and their predictors are stated in ordinal terms (e.g., low versus high density, intermediate defensibility); rigorous tests would require precise quantitative measures rarely found in the ethnographic and archaeological data (for a recent effort to estimate such values, plus a formalization of the economic defensibility model, see Baker (2003)). Nevertheless, the qualitative evidence is quite extensive.

Variation Across Space

The economic defensibility model predicts that, if density and predictability are high enough, territorial systems (property rights in land) will be favored. There are many cases in which steep gradients in resource density or predictability correlate with marked shifts in land use. For example, over a vast stretch of the Pacific coast of North America, dense and predictably located runs of salmon fostered permanent villages, territorial claims to salmon streams by corporate kin groups (Donald and Mitchell 1994), and chronic warfare (focused not only on control of resource sites but also on seizing property and slaves). Yet a short distance inland, across the coastal ranges in the Columbian Plateau and Subarctic regions, where resources were much lower in density and also generally less predictable, the indigenous societies had traditional land use patterns stressing communal access rights (the exceptions being favored salmon-fishing spots at falls and rapids, which were sometimes owned by kin groups).

Finer-scale variation in land use within ethnolinguistic areas is perhaps even more convincing. The Eskimoan (Yup’ik and Iñupiat) peoples of coastal Alaska had permanent (winter) villages and strongly defended discrete territorial boundaries (Andrews 1994; Burch 1980). Yet when some Iñupiat spread eastward across the Canadian arctic about one millennium ago, the much lower resource density encountered there led to greatly relaxed boundaries approaching open-access land use. Similar variation in territoriality and related aspects of land use are found in the ethnolinguistically homogenous Great Basin. Most of the Great Basin is very arid, resulting in

Resource Defense, Table 1 Resource density, predictability, defensibility, and resultant land use (Modified from Dyson-Hudson and Smith 1978)

	Resource density	Resource predictability	Economic defensibility	Predicted land use
A.	Low	Low	Low	High mobility, dispersed population
B.	Low	High	Intermediate	Home range system
C.	High	Low	Intermediate	Mobility, information sharing
D.	High	High	High	Geographically stable territoriality

low resource density and predictability. The indigenous Shoshone and Paiute were highly mobile and had few controls over land use. Yet in well-watered areas such as the Owens Valley, relatively dense and predictable resources were associated with decreased mobility and forms of land ownership that were clearly territorial (Steward 1938; Thomas 1981). Archaeological analyses of variation in territorial strategies too numerous to cite here detail similar patterns in varied locations worldwide.

Steep gradients in resource density and predictability can have profound implications for broad aspects of political economy. Many scholars have pointed out that stratified social systems have initially arisen in areas with such gradients, such as fertile floodplain valleys surrounded by arid regions and rainforests with patchily distributed potable water resources. The link to economic defensibility can be quite direct: where kin groups or other coalitions are able to control key resource patches, subordinates have few options, and stable levels of exploitation can increase (Boone 1992; Smith et al. 2010). Again, note that this is not environmental determinism: resource density and predictability are in part functions of social and technological variables (e.g., agricultural techniques, labor division, social stratification), and social agency (in seeking or resisting political and economic domination) is central to the process.

Variation Over Time

A theory of spatial behavior that did not allow rapid change over time would be falsified by the historical record. In fact, the economic defensibility principle leads one to expect such change whenever there are sufficient large shifts in resource density or predictability. These shifts can arise from exogenous factors, such as environmental change that alters these parameters for key resources; or it can be generated by endogenous shifts in resource utilization due to technological, demographic, economic, or political variables.

Examples of both exogenously and endogenously driven shifts in defensibility parameters are evident at various temporal scales. Ethnohistoric data on Algonquian peoples in the North American eastern subarctic document a shift from hunting focused on caribou to semi-sedentary settlement patterns focused on trapping of furbearers and foraging for moose and small game (Bishop 1986). The former pattern was characterized by high mobility, extreme flux in group composition, and open access to resources, the most adaptive configuration for harvesting caribou with indigenous technology, as these preys clump together and move rapidly and unpredictably across the landscape. In contrast, fish, hare, furbearers, and even moose are dispersed and relatively sedentary prey, most efficiently harvested by foragers in small family-based groups who can economically defend hunting territories and coterminous traplines. The shift from the caribou-hunting economy to the fish/hare/moose/trapping economy was a complex process driven by economic factors (particularly the fur trade) as well as technological (steel traps, guns, etc.) and environmental ones (e.g., caribou declines).

On intermediate time scales, the intensification of agriculture is generally associated with higher labor inputs and shortened fallow, which increase both resource density and predictability. Such intensification is also associated with increased formalization of property rights and wealth inheritance (Shenk et al. 2010), thereby institutionalizing resource defense across multiple generations. On an even broader time scale, it has been argued that the dramatic increase in environmental stability (and thus resource predictability) with the transition from Pleistocene to Holocene climates, coupled with suitable local ecological and social conditions, was necessary for agriculture to develop and spread over much of the globe in the last five to ten millennia (Richerson et al. 2001).

Differential Defense Across Resources

There are many cases in which actors (individuals, households, or larger groups) exhibit territorial behavior with some resources but not others. This can be fully consistent with the economic defensibility model: if resource X is dense and predictable enough to be economically defensible, but resource Y is not, the simplest expectation is territorial defense of X but not Y. An example is the pattern of land use and property rights found among many East African cattle herders, where garden plots and livestock are claimed as property by individuals or households, but grazing land is communally owned by the "tribe" (ethnic group). This is clearly expected from defensibility logic, as good grazing areas are dependent on patchy and highly unpredictable rainfall distribution, whereas gardens are dense and predictable resources due to direct management. Livestock are even denser and predictable to the extent that people control their movements (Dyson-Hudson and Smith 1978). Extension of this argument to pastoralists in other areas has found broad support for economic defensibility predictions (Casimir 1992).

Group-Level Territoriality and Collective Action Problems

The previous section explained how the spatiotemporal scale of a resource is critical to its defensibility. This logic applies to the demographic scale as well. Suppose a resource is indefensible at the individual level because monitoring and defense costs are too high relative to the benefits of resource control. The resource may become defensible if individuals cooperate in monitoring and defense, and the economy of scale lowers per capita cost sufficiently. For example, East African pastoralists generally do not defend grazing land against members of their own "tribe" (ethnolinguistic group) but violently defended it against encroachment by other tribes. Dyson-Hudson and Smith (1978) admit their model does not explicitly treat intergroup conflict of this scale, focusing analysis of territory defense on the household level. The question then is how to secure the cooperation necessary to defend agricultural plots at the household level and grazing land at the ethnic group level. More generally, how and under what circumstances do individuals solve the problem of cooperative resource defense?

A collective action problem (CAP) arises when members of a collective (e.g., a household, village, voluntary association, etc.) must pay costs to produce a collective good – a resource available to all members of the collective (Olson 1965). Some theorists define CAPs more stringently as any case in which increasing the number of cooperators in a group increases the average group payoff but any given member of the group is always better off defecting no matter the actions of other members (McElreath and Boyd 2007).The structure of the payoffs to collective action matters. For example, if group members benefit from cooperating whatever their social partners do, there is no CAP to solve (Clutton-Brock 2002). If group members can share the benefits or costs of cooperation and the benefit-to-cost ratio is high enough, a stable mixture of cooperators and defectors (or a stable mixed strategy employing both cooperation and defection) is expected to emerge (Doebeli et al. 2004; Maynard Smith 1982). Even if cooperation is mutually beneficial to all, complications may remain if group members must coordinate their cooperative investments (e.g., in organizing territorial monitoring). The linguistic capabilities of humans certainly facilitate complex coordination and communication of social norms (Smith 2010).

In sum, at least two types of CAPs may occur in territory defense: when it is impossible for a group member to defend the territory alone, and when the loss of territory is not costly enough to a single group member to deter a positive fraction of group members from shirking (Boone 1992). Even in fairly small groups, the mechanisms that potentially ensure cooperation in dyads such as direct reciprocity (Axelrod and Hamilton 1981; Trivers 1971) and kinship (Hamilton 1964) are insufficient (Boyd and Richerson 1988). If enforcement (punishment of free riders) is also costly to group members, a second-order collective action problem must be solved.

One class of solutions emphasizes private (individual) gains linked to collective action. Models of indirect reciprocity posit that individual reputations for cooperation become known through observation or gossip and then cooperators can avoid helping defectors even if they will not have the repeated interactions required for direct “tit-for-tat" reciprocity (Leimar and Hammerstein 2001; Panchanathan and Boyd 2003). Linking this to collective action requires that reputations be determined by contributions to collective action and then subsequent dyadic interactions allow cooperators to withhold aid from defectors (Panchanathan and Boyd 2004); for example, if B knows A avoids contributing to territory defense, B can then withhold aid from A when A is sick or hungry or wants to arrange a marriage for his son.

Alternatively, contributions to collective action can constitute a signal of individual qualities (such as health, fighting ability, social network size and quality, etc.) that are difficult to observe directly (Gintis et al. 2001), and observers can use the signal to make mutually beneficial “side deals” with above-average signalers by allying with or deferring to them in other contexts (Lyle and Smith 2014).

Another class of CAP solutions involves inter-demic group selection, which involves selection among partially isolated and competing groups in a population. Under this framework, selection occurs both within and among groups. Within-group evolution selects against altruism because altruism is by definition costly to a given group member (e.g., those who vigorously monitor and defend group boundaries may suffer increased mortality risk). Selection among groups favors altruistic participation in group resource defense (collective action) because this increases the average payoff, thus the rate at which the group proliferates at the expense of other groups. Because within group variation is usually much greater than variation among groups, selection must be weaker within groups than between them for group selection to work (Boyd and Richerson 2007). Inter-demic group selection may be more likely in cultural species like humans because cultural transmission occurs on one-to-many and many-to-one bases, which, coupled with conformist bias within groups (“When in Rome, do as the Romans”), will decrease variation within groups and increase variation between them (Henrich and Boyd 2001), paving the way for culturally transmitted group-beneficial traits to proliferate at the expense of individuals. There is some empirical support for group selection involving territorial defense. Soltis et al. (1995) found that cultural group selection among warring territorial groups in New Guinea could have favored group-beneficial traits through the extinction of groups by assimilation, though at a quite slow rate. Mathew and Boyd (2011) analyze ethnographic data on Turkana cattle raiding as reflecting the effects of cultural group selection.

To sum up this section, territoriality occurring in larger groups requires cooperation among the individuals and smaller social units that make up the group. The cooperation requirement introduces possible collective action problems (CAPs). Solutions to such CAPs might involve complex conditional strategies, interactions between genetic and cultural inheritance, selection occurring at multiple levels, or a combination of these. Regardless of mechanisms, as long as groups do find a way to cooperatively defend territories, the basic predictions of economic defensibility models apply.

Conclusions

This article summarizes the evolutionary ecological approach to resource defense known as the economic defensibility model and application of this model to explain variation in human territorial behavior that demonstrates its robust support in light of ethnographic and archaeological research. It highlights the importance of assessing model validity relative to the appropriate spatiotemporal as well as social and demographic scales. It addition, the economic defensibility principle of territoriality models can be applied to a broad range of resource types, including social networks (Chabot-Hanowell and Smith 2013).

Three main conclusions follow. First, ecological approaches to territoriality developed in biology and anthropology provide a flexible and robust framework for analyzing resource defense in a variety of species, including humans. Second, the net benefits of territorial resource defense are a function of variation in resource density and predictability, as specified in the economic defensibility model, as well as the specific capabilities of the competing individuals or groups. Finally, human territoriality involves a complex set of practices that vary within and across societies and thus requires nuanced understanding and application of evolutionary ecological models.

Cross-References

► Costs and Benefits of Territoriality
► Despotic Distribution
► Economic Defendability
► Resource Patchiness
► Shared Resource Defense

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