Institutional Analysis of Lobsterfishing, Mount Desert Island, Maine, USA

Part 1: Static Analysis

1 Collective action

The case of Lobsterfishing off the southern tip of Mount Desert Island, Maine, U.S.A. is part of the original Common-Pool Resource (CPR) database. The original CPR report, developed in the 1980s by Edella Schlager and Shui Yan Tang at Indiana University, may be found at https://seslibrary.asu.edu/seslibrary/case/2/cpr. The lobstergrounds of Mount Desert Island are located within Hancock county, Maine, some 250 miles northeast of Boston and 150 miles southwest of the U.S.--Canada border. The original case spans from 1969 to1974 and catalogues an action situation involving approximately 75 lobster fishermen; lobster is the stationary resource unit.

1.1 The Commons Dilemma

There is no commons dilemma at the time of the study. However, four aspects of the case indicate an incipient over-appropriation dilemma: 1) encroachment of the lobstergrounds by "outsiders"; 2) variability of the resource due to uncertain climatic conditions; 3) average trap density increases from 563 per square mile in 1969 to 850 square mile in 1974; 4) a lack of mechanisms for mitigating a prevailing incentive for lobstermen to fish as many traps as possible. Over the duration of the case, the available quantity of lobster declined from moderate abundance to moderate shortage (inferred).

1.2 Biophysical Context (IAD)

The Mount Desert Island resource is a lobsterground (renewable); lobster are the resource unit (stationary). Biophysical attributes of the resource system vary unpredictably. Both the spatial distribution of lobster in a single year and the flow of lobster inter-annually vary considerably. There is also variability in the quality of lobster caught in different micro-environmental zones. Variability in the quality of lobster does not affect management of the resource. Breeding lobster and lobster eggs are sensitive to water temperature. Cooler waters (predicted for Maine at the time of the original case) would resource trigger migration to warmer waters. When in storage (any time post-catch), the resource is very sensitive to overcrowding, which leads to cannibalism, and to changes in salinity, water temperature, and pollution.

Private, human-made hard infrastructure (technology), mediates the interaction between the resource and the resource users. These technologies include boats, lobster traps, bait, netting, radios (to communicate and exchange information about weather and rescue), hydraulic haulers, fathometers (to measure depth), and buoys. Private, human soft infrastructure also mediates resource and resource-user interactions. Human soft-infrastructures include working knowledge of the best fishing grounds and the attributes of the fishing community. A variety of hard public infrastructures also impact the resource. These infrastructures include wharves, roads (for transport of lobster to markets), radio spectrum, maps and charts of resource distribution, and physical historical records of hauls.

Resource appropriation is heavily mediated by a variety of public and private infrastructures. The resource itself is sensitive to climatic conditions. Spatial and inter-annual variability of the resource make it difficult for lobstermen to know if resource over-appropriation occurs.

1.3 Attributes of the Community (IAD)

The Mount Desert Island community consists of two harbors, nine villages, and approximately 75 resource users: lobster fishermen. Fishing of the lobstergrounds dates back to the late 1700s or early 1800s. The group of appropriators featured in the case are fairly homogenous. Fisherman are prohibited from owning the fishing territory, but are granted leave to fish by the regional government (public infrastructure provider). A high level of trust among community members existed at the beginning and end of the study period (inferred).

Fishermen rely on a combination of soft human infrastructure (knowledge and experience), hard human-made infrastructure (fathometers, radios), and trial and error to locate the lobstergrounds season-to-season. Such soft human infrastructure is generally a form of knowledge about family (informally, clan) grounds. This knowledge is traditionally passed down to only one son per family. Men may marry into wealth or come into a berth (a fishing license and informal territory) from non-traditional means, but these forms of entry often come with social stigma. Social stigma may lead to trap cutting, an illegal but common strategy lobster fishermen use to enforce informal territorial boundaries.

A lobsterman's main private human-made hard infrastructure is his boat. Fishermen may optimize boat technology optimizes for haul, speed, balance with haul, speed with haul, etc. There is a norm among fishermen that boat's and equipment be kept clean. Cleanliness indicates a fisherman's pride and reputation as honest; reputation helps manage social stigma and maintain high levels of trust within the community (inferred).

A lobsterman's main human soft infrastructure is his fishing strategy. A lobsterman will generally adopt one of two of strategies: "slow and canny," with winter months an "off season" spent tending equipment and pursuing other jobs or hobbies, or "rapid and uniform," "hard," with activity occurring nearly year-round, straining the lobsterman and his equipment. The tradeoff between the two strategies is cost. The hard strategy may yield more, but also costs more and entails greater physical hazard. The real goal of the lobsterman's strategy is to maximize profit. Were a "hard" strategy to dominate the community, one result could be over-appropriation of the resource, contributing to a potential commons dilemma.

Monitors within the community record resource extraction by lobstermen, enforce rules against trap cutting (thereby settling informal territorial disputes through formal court systems), and enforce conservation laws (via fines) protecting the resource. Monitors are selected from the local community by an un-specified, general purpose government (inferred to be the State of Maine). Monitors are are paid, but are not reported to have an additional vested interests in the community or the resource. Beyond monitors and the informal human soft infrastructures noted above (clan grounds, reputation, social stigma, trap-cutting), no forms of collective action ensure the provision of the resource.

1.4 Rules in Use (IAD)

Position rules:

- Lobster fisherman.
- Warden (enforces scope rules, established in 1883 to with conservation laws).

Boundary rules: Lobster fisherman: must be a citizen of the U.S., resident of Maine, living with property in the Mount Desert Island community; must hold a license to access the resource.
- Warden: unspecified.

Choice rules: Lobster fisherman may set traps to catch lobster; pass fishing license to a family member; pass a fishing license outside of the family, with approval of a group of local appropriators (see aggregation rules); sell lobster; "car" lobster (store a catch to time the market).
- Wardens may enforce informal territory disputes; must enforce conservation laws.

Scope rules: Lobster fisherman may not catch egg-bearing, female lobster or "purchase, sale [*sic*], expose, give away, transport, ship, have in possession" lobster less than or more than a specified length (Grossinger, p. 237-242; source unclear on lengths; Maine State Department of Sea and Shore Fisheries authored the 'conservation laws'). Fisherman may notch the tail of lobster caught but not complying with conservation laws.
- Lobster fisherman may not fish on sundays from June 1 to August 31.
- Lobster fisherman may not cut the trap/buoy/line of other fishermen (Grossinger, p. 165) or steal from the trap of another fisherman (p. 219).
- Lobster fisherman may not sell lobster on the northern side of the island.

Information rules: Lobster withdrawals recorded by unspecified officials; fishermen share information about catch, lobster location, and tensions on shore and via radio; buoys are painted a fisherman's chosen colors to signal informal territory; price per pound of lobster affects fishing strategy. Trap-setting relies on implicit knowledge of the fishing grounds (best shoals, weather, etc.; hearsay or suspicion about successful grounds (use of landmarks, overhearing radio conversations); continuous experimentation (use of a fathometer to explore shoal topography).

Pay-off: If catch is secured in accordance with rules-in-use, sale of fish at local and external markets is allowed. If rules are not followed, light fines, severe "community shunning," "incarceration," and "physical violence" may result.

Aggregation: A group of local appropriators is required to approve a fisherman's request to pass his licensee outside of his immediate family.

1.5 Summary

Lobsterfishing at Mount Desert Island has operated continuously without a common-pool resource dilemma for some 174 years (from 1800 to 1974, the end of the original case). Success of the community seems to be a function of resource abundance, informal attributes of the community (social stigma associated with greed, dishonor; trap cutting enforcement), and conservation laws to safeguard the integrity of the resource. However, increasing pressure from outside resource users, greater catch volumes, absence of formal collective action strategies, and sensitivity of lobster to climatic variability suggest that the Mount Desert Island lobsterground is vulnerable to over-appropriation.

Part II. Dynamic Analysis - Robustness

This update to the Mount Desert Island Lobsterfishery case was made in 2013 by Michael Bernstein at Arizona State University. The update extrapolates from research on changes in the greater Gulf of Maine (GOM) lobsterfishery. In-text parenthesis indicate corresponding links in the system representation on the SES library.

2 Updated commons dilemma

The original case review inferred that a variety of factors were contributing to incipient over-appropriation and under-provision issues. Based on the case update in 2013, this inference was incorrect. Favorable biophysical conditions have contributed to greater resource productivity, offsetting any effects from increased appropriation or new modes of provision. Lobster landings in the Gulf of Maine are at record levels, with no indication of resource depletion (MFC, 2009).

2.1 Shocks, Capacities, and Vulnerabilities…

… to and of the Resource (link 7 to R)

Warming of GOM waters have affected lobster migration patterns and lifecycle (MFC, 2009; Mills et al., 2013). Changes to the equipment and technology (private, hard human-made infrastructure) employed by U.S. lobster fishermen have contributed to steadily increasing catch sizes (MFC, 2009) (link 1). While increased warming of northwest atlantic waters has increased the productivity of lobstergrounds, warming effects may cause lobster to reproduce and mature at different times (Mills et al., 2013). If lobsterfishing efforts are not adjusted to reflect these changing biophysical conditions, homogenization of the timing of reproduction, growth, and molting of lobster, may make the resource vulnerable to over appropriation (Mills et al., 2013).

…to and of Public Infrastructure (link 7 to PI)

Changes to federal law (soft public infrastructure) have divided the Atlantic Seaboard into seven formal Lobster Conservation Management Areas (LCMAs), subsuming the informal territories of lobster fisherman (Brewer 2012a) (link 4). Mount Desert Island is now within zone B of the Gulf of Maine LCMA (MFC, 2009). Changes to state law (soft public infrastructure) have created new co-management arrangements between local resource users and Atlantic State governments (MFC, 2009).[1] New co-management arrangements include harsher sanctions for trap cutting, increased monitoring authority of state marine patrol officers, zone-based trap limits (entrained fragility), limits to license distribution, and new anonymous balloting measures at the collective-choice level (entrained fragility) (MFC, 2009; Brewer, 2012a,b) (link 5). Federal public infrastructure providers 'enforce' state co-management arrangements by withholding federal funds in cases of non-compliance (Brewer 2012a) (link 3).

…to and of Pubic Infrastructure Providers

Major advances in scientific understanding (soft human infrastructure) of the lobster lifecycle in general and under changing biophysical conditions (e.g., water temperature effects on maturation, molting, etc.) have improved the ability of PIPs to monitor the 'health' of the resource system, guard against over-appropriation (MFC, 2009), and calculate optimal catch effort to maximize profitability of resource extraction (link 5). As one example of the application

[1] "Co-management" refers to the, "gradient in the levels of autonomy and authority granted" to resource users and state government (Brewer, 2012b).

of this new soft public infrastructure, bioeconomic modeling research suggests that profitability of the fishery could be increased by reducing effort and catch (Holland, 2011a).

…to and of Resource Users

Trap limits have had the unintended effect of increasing overall number of traps fished in zones (limits created incentives for those fishing fewer traps to fish more traps (Brewer 2012a)). Harsher sanctions against trap-cutting have hamstrung local efforts to enforce informal territories (Brewer, 2012b). Anonymous balloting measures that control changes to operational rules have reduced the effectiveness of social censure on enforcing norms (Brewer, 2012b) and restricted availability of new licenses (Brewer, 2012a). Outside sale of existing licenses (some for up to $500,000), new licenses are available only to experienced (three years) individuals under 18 (MFC, 2009; Brewer 2012a). Dependance in Maine on the service industry for employment has led to a loss of knowledge and experience (private, soft human infrastructure), making it still more difficult for new individuals to become lobster fishermen (Brewer, 2012a) (link 6).

Changes to public infrastructure and resource users in Mount Desert Island (inferred from GOM) have degraded the norms and strategies used by lobstermen for local-level management, monitoring, and enforcement (Brewer, 2012a). Without social censure, license holders use anonymous ballots to restrict entry to the lobstergournds, increasing the profitability of owning a license and concentrating this economic benefits for license owners (Brewer, 2012a,b).

	Clear boundaries & memberships	congruent rules	collective-choice arenas	monitoring	graduated sanctions	conflict-resolution mechanisms	recognized rights to organize	Institutional performance
Original 1974	yes, informally	yes, informally	yes, informal	yes, formal & informal	yes, formal & informal	yes, informally	yes, local, informally	robust, not resilient
Updated 2013	yes, formally; no informally	yes, formally	yes, formal; anonymous	yes, formal only	yes, formal only	yes, formal only	yes, formal co-mgmnt.	robust, not resilient

Table 1: Evaluation of original and updated Mount Desert Case against the IAD design principles (Ostrom, 1990)

2.2 Robustness Summary

In the late 1800s, the lobstergrounds were threatened by over-appropriation until the establishment of conservation laws in the 1880. Before 1976, lobster fishery management at Mount Desert relied on formal conservation laws and local informal institutions (e.g., de facto enforcement of informal territories with trap cutting and social censure) to manage the lobster resource. Concern over foreign incursion into U.S. fisheries prompted federal intervention in fisheries management across the North Atlantic coast (Allain Barnett, personal communication). After 1976, a series of federal and state interventions "up-scaled" and formalized resource boundaries and imposed new rules affecting provision, appropriation, and enforcement.

A 1997 amendment to the Fisheries Conservation and Management Act (FCMA) has a stated goal of "a healthy American Lobster resource and management regime, which provides for sustained harvest, maintains appropriate opportunities for participation, and provides for cooperative development of conservation measures by all stakeholders" (MFC, 2009). When evaluated against the stated criteria of the FCMA, the Gulf of Maine fisheries management

regime performs moderately well: catch levels are increasing, the resource is 'healthy', and there are local actors (although a concentrated minority) involved in the management regime.

However, an entirely different picture emerges when broader criteria (Ostrom, 2011) are applied.

	Economic Efficiency	Fiscal Equivalence	Redistributional Equity	Accountability	Conformance to Values of Local Actors	Sustainability
Original 1974	provides for local community and market	moderate	high	high at local level; limited state or federal involvement	high	moderate
Updated 2013	high-value, sub-optimal profitability	low	low	none at local level (anonymous ballot); low, local to state; moderate, state to federal	low	moderate

Table 2: Application of IAD Evaluative Criteria (Ostrom, 2011)

Intervention by federal and state government may have assured the robustness of the North Atlantic Fisheries against foreign incursion, enhanced economic efficiency, and maintained sustainability. As of 2013, local capacity to enforce traditional norms and strategies has been hamstrung, indicating that government interventions may have achieved FCMA objectives at the cost of fiscal equivalence, redistributional equity, accountability, and conformance to local values. Although these sacrifices do not indicate the presence of a commons dilemma, they reduce diversity and redundancy within the resource user community (fewer and more influential license holders, fewer individuals with capacity to fish; license holders increasingly dependent on single resource (Brewer 2012b)), suggesting a trade-off of specific robustness for general resilience.

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Additional references

Holland, D. S. (2011a). Optimal intra-annual exploitation of the Maine lobster fishery. *Land Economics*, 87(4), 699-711.

Holland, D. S. (2011b). Planning for changing productivity and catchability in the Maine lobster fishery. *Fisheries Research*, 110(1), 47-58.

Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge University Press: United Kingdom. 298pp.

Ostrom, E. (2011). Background on the institutional analysis and development framework. *Policy Studies Journal*, 39(1), 7-27.