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Title: Institutional resilience in marine resource governance

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Abstract:
The marine environment is a complex area for commons management requiring multi-level governance to ensure that large numbers of (often conflicting) users can sustain their resource use, and the quality of ecosystems, over the long term. Multi-level governance, however, brings its own problems in term of institutional conflict and inertia, which prove problematic for dynamic ecological, political and socio-economic systems. Although Ostrom (2007) has demonstrated the importance of the need for local input into 'evolutionary' rule making, governance of marine resources has increasingly moved away from local communities of resource users to regional, national, and even international institutions. Inshore and deep-sea fisheries around the UK, for example, are under threat from highly centralised policies that manage and control fishing, marine conservation, seabed mineral extraction, and energy generation. Despite the overlapping and complex institutional arrangements to manage fisheries regional management approaches (such as the North Sea Cod Recovery Plan) are not achieving their stated goals; stocks of many species remain low, and numbers of fishermen are declining with negative impacts on local communities and associated supporting service industries. Recent and potential legislative change at UK and EU level suggests there are opportunities for exploring community-based institutional arrangements that may enhance the resilience of a range of institutional structures governing fisheries and a wider range of marine resources. Resilience in a complex marine environment requires capacity for adaptation within the interaction between ecological and socio-economic systems, to enable continued ecological functioning, value creation in the face of change, and effective management. The paper explores the effectiveness of multi-layered governance on marine resource management. In particular, it examines the institutional arrangements influencing the interplay between ecological, political, and socio-economic systems in relation to the marine environment, and their capacity for adaption and resilience.

Key words: institutional change, commons, adaptation, resilience, inshore fisheries, upland commons

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Introduction

A significant literature has grown up around the concepts of institutional change, resilience and adaptation in relation to commons management. In particular there has been concern about the failure of institutional arrangements on commons in the face of exogenous change, which have been identified in all parts of the globe.

This paper takes as a starting point Birkes' (2006) need to look "…beyond the community-based resource paradigm, towards commons governance in complex systems", particularly in marine resource management where, "…the importance of institutions that straddle levels and provide incentives for sustainability is increasingly recognized…". Birkes suggests commons management should be understood as 'the management of complex adaptive systems', and presents three 'scale challenges':

- Failure to recognize important scale and level interactions
- Mis-matches between levels and scales in human-environment interactions
- Failure to recognize heterogeneity in the way scales are perceived and valued by different actors (or, ignorance, mis-match and plurality).

Birkes also suggests the principle of subsidiarity is the most suitable approach for dealing with cross-scale issues – in other words decisions should be taken as closely as possible to those affected, while Ostrom's design principles, as modified by Cox et al. (2010), asks whether design principles developed at community level are applicable at larger scales. Both views are suggesting that scale will influence the identification of solutions to commons resource governance problems.

The paper explores the complex nature of resource management with multiple interacting variables and the need for cross-level and cross boundary relationships occurring both within and between ecological and socio-economic systems; with the realisation it may never be possible to identify the key variable(s) or relationship(s) that ensure the sustainable management of the socio-ecological system. Rather than examine the huge range of multiple variables and drivers influencing social, economic, political and ecological relationships, the paper asks: 'what are the factors that give rise to resilience in a system?'. Figure 1 below illustrates the direction of influence in some of the relationships of a fisheries focused socio-ecological system. It highlights the wide range of factors potentially affecting management of the fisheries resource, and that is before one even begins to explore cultural, political, market forces and institutional relationships.

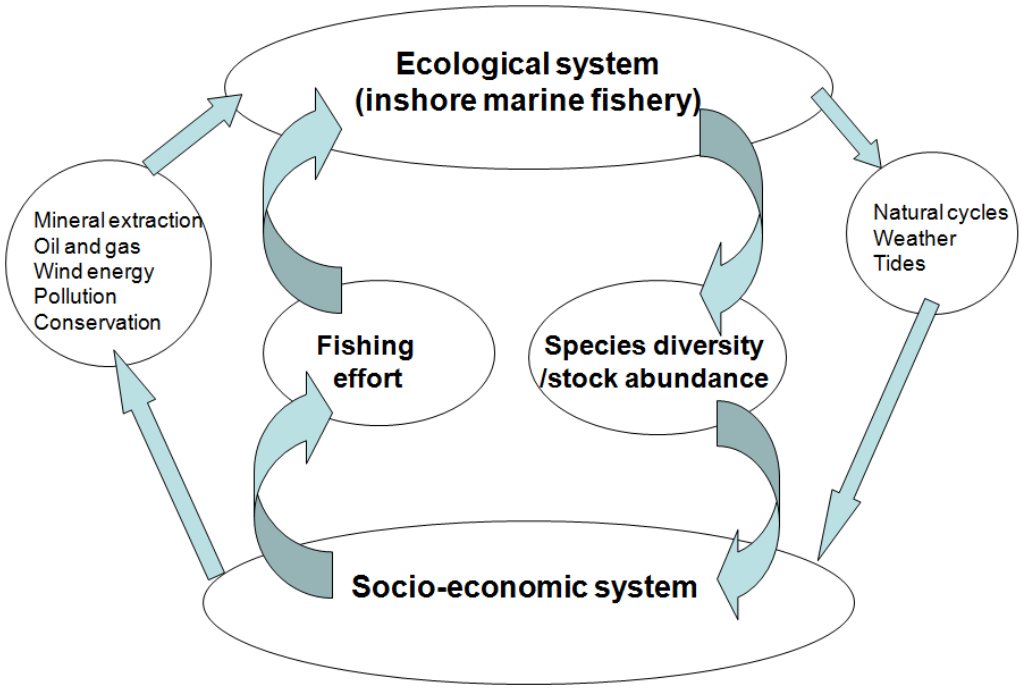

Figure 1: Factors influencing a marine resource system

The focus on 'change' suggests that ecological and socio-ecological systems must have the capacity to adapt to impacts and influences that impinge on the system. Adaptability is viewed as a key ingredient of resilience – adaptability of the ecosystem and of the socio-cultural system with which it is related. Adaptability assumes that change is inherent as systems are in dynamic equilibrium and never static (although they may have the appearance of static systems in the short run). Ecological perturbations occur constantly in relation to population dynamics, predator-prey relationships, food availability, and other environmental and climatic drivers. Adaptability of institutional structures are less well understood, as are the processes of institutional change, which also alter continuously, though at different rates and in response to market drivers, political goals, cultural values as well as ecological factors. A key to understanding the process is the time period over which change is examined – institutional change always involves a time lag as a result of institutional inertia, lack of information, and pressures to maintain the status quo.

Exploring the concept of resilience

Resilience is often put forward as the key requirement for system integrity in the face of disturbance, shock, or stress. Identification of those factors that make a system more or less resilient can sometimes be seen as the 'holy grail' of socio-ecological management. As a result a large literature has appeared around the concept, which has spread from its original ecological application to other disciplines, and in the process the term has become more ambiguous, and acts

more as a means of enabling interdisciplinary work through shared but imprecise meanings. (Brand and Jax, 2007)

The concept has been disaggregated into differences between ecological, social, and institutional resilience (Fabricius et al, 2007; Adger, 2003), with some recognition of the importance of the linkages between them. Thus, ecological resilience can be thought of as relating to the capacity for an eco-system to withstand change, or restore itself following some external shock; social resilience might be thought of in terms of stability of organisational components in the face of change; and institutional resilience can be related to the stability of social relationships such as trust and accountability between actors in a system. In broad terms resilience of both social and ecological systems relates not only to the capacity for each to adapt to change, but also on the linkages between them. If an ecosystem cannot adapt to changing environmental conditions being imposed (climate change for example), it will not matter how effectively the social system alters in response to the change, the whole socio-ecological system is likely to collapse. Alternatively, if a socio-economic system changes, creating greater pressure on a particular aspect of an ecological system, (overfishing of a species, for example) the result may be the elimination of that species completely, wider ecological effects, and consequent impacts on the communities dependent on utilisation of that species as a resource. The identified features of resilience include: 'the ability to absorb or buffer disturbances while maintaining core attributes' (Pradhan, 2006); and 'the ability…to cope, persist and adapt to hardship, crisis or changes…while increasing ability to meet future challenges' Tucker (2008) A 'resilient' ecosystem may be able to survive relatively intact even under long periods of poor management and failure of the social system, and 'resilient' institutions may be able to adapt to a reduction in a particular species, for example, through greater regulation and control of harvesting.

Gunderson and Holling (2002) discuss resilience in general terms as 'the magnitude of disturbance that can be absorbed before a system flips from one state to another' and suggest that resilience in an ecosystem (with respect to variation in environmental conditions) depends on the existence of species capable of supporting key ecological functions as conditions vary (one benefit from substitute or 'redundant' species in an ecosystem may be to provide stability). Factors that contribute to resilience in a socio-economic system are less clear but will depend on the continued operation of key institutional arrangements operating within and across scales, the size of the unit of analysis and the time period over which factors operate. Institutional arrangements that may appear to damage the ecosystem in the short term, for example timber harvesting operations in a forest ecosystem, may be adequate when viewed ecosystem resilience is viewed over the long term (Carlsson, 2000). On the other hand, intimate knowledge of the resource, often cited as a key aspect of effective long-term management, does not always result in resilience and can blind resource users to wider changes affecting society and economy, especially those socially or institutionally isolated.

Resilience does not always mean the best forms of commons management survive. There are examples (e.g. certain areas of common land in England) where creation of 'negative' social capacity has resulted in control of the commons resource by a small elite, who keep out other entitled rights holders through some form of intimidation, and situations where the institutional arrangements that perpetuate management systems are at odds with the changing agricultural conditions and ecological goals. The institutional arrangements are 'resilient' but exclusive, in terms of benefit sharing. Resilience may also result in degradation of the resource through continuation of poor or inappropriate management practices. Overgrazing, for example, was the result on some upland commons when headage payments made livestock farming more attractive. Organizations and institutions that currently exist to manage a commons resource may be resilient to change, but may not necessarily provide optimum benefits to society. (North, 1994). The concept of a 'rigidity trap' or, 'static engineered resilience rather than 'dynamic, ecological resilience', has been put forward (Atwell et al., 2009) to explain how ecosystems with high external inputs might appear to function at optimum levels but lose ability to respond to 'adaptive cycles of growth, collapse, reorganisation and exploitation'. Factors operating at different scales in the socio-ecological system can also combine to create a static configuration that resists change.

Research in community management in India suggests multi-layered decision making and accountability structures are often more effective, as the capacity to make small adjustments makes institutions resilient to internal disturbances; while alliances and networks that cross several different boundaries are needed to deal with external disturbances. But in order to understand resilience one also needs to explore the question of: resilience for what purpose and for whom? (Pradhan, 2006)

Resilience in a commons management system relates to the capacity of the interactions between ecological and socio-economic systems both to create value and maintain the systems in the face of external pressures or changes. Resilience in a commons thus requires adaptability in the interaction between an ecological system and a socio-economic system to enable *both* continued ecological functioning *and* value creation in the face of economic, social, political and/or environmental change. A natural system managed as a common property resource is a particular form of socio-ecological system, where the aim is the long-term optimization of social, economic and ecological values across a defined community. Thinking of resilience in terms of the interplay between ecological and socio-economic systems focuses attention on factors that influence or control that interaction and its capacity to adapt, providing the possibility of identifying key variables making the interaction more, or less, resilient. Key characteristics of resilience for a commons resource may include:

Ecological

- Capacity to cope with external stress
- Capacity to replenish/restore without significant loss of function

Socio-economic

- Ability to continue to support vibrant communities in the face of external disturbance and stress
- Capacity for rules, ways of doing, and conventions to evolve
- Capacity for trust relationships to endure in the face of external or internal disturbances
- Capacity for 'value creation'

Institutional

- Capacity to change without losing ability to effectively manage the resource of interest
- Capacity for 'transparency and accountability' to remove ambiguity and distrust
- Networks and a diversity of actors

Resilience in the North Sea fishery

The EU Common Fisheries Policy established in 1983 (and currently under review) set up a management system based on total allowable catch and allocation of national quotas. In the UK the quota is allocated to producer organisations, although the inshore fisheries also have their own quota allocation. Creation of individual quotas has resulted in concentration of quota into a smaller number of hands as the smaller and less economically efficient owners have sold out to larger operators. In addition minimum size requirements and problems of targeting single species in a mixed fishery has led to problems of illegal landings and discard (throwing away under-sized, poorer quality, or over-quota fish). One estimate of discards suggests up to 1 million tonnes fish are discarded every year in the North Sea alone (accounting for one third of the total catch). (Scacht and Bongert, 2008). It has been suggested that the quota system is a form of crisis management rather than a long-term sustainable approach (Symes, 2005).

The EU situation is interesting as an example of an attempt to create a 'common pool' resource at a regional level but with limited local scale input. The North Sea fishery can be viewed as an ecosystem impacted by environmental changes, with a large number of stakeholders including fishermen (commercial and recreational), food processors, national and EU policymakers, scientists, energy interests, conservationists, and mineral extraction companies, that has also suffered for a long time from institutional failures resulting in significant social and economic impacts on fishing communities. It is a socio-ecological system under pressure and experiencing deep changes over a period of decades, which has transformed an open access fishery to a semi-privatized system based on quotas, where entry into the system is expensive and limited. The ecological system is complex with high level of uncertainty over the condition of the resource at any one time resulting in management of a mixed fishery through controlling the catch of each species separately. (Simmonds and Jardim, 2012)

The CFP claims to be focused on recovery and management of sustainable stocks of fish, yet fishing effort has become more concentrated in the hands of large commercial operators with limited or no links to specific coastal communities. It has been argued that small scale, inshore fishermen operate in a more sustainable manner, and deliver a higher quality product, yet are being squeezed out of the industry. They are more flexible in where and when they fish, are linked to specific coastal communities, and deeply concerned over the management of stocks. Local knowledge, built up from years of experience, is still important for inshore fishermen, providing information on where and how to fish for a variety of species at different times of the year.

Exploring alternative management options

As part of the preparations for improving the resource management under the revised Common Fisheries Policy a small scale survey was carried out for the EU Commission Scientific, Technical and Economic Committee for Fisheries (STECF) to examine fishermen reactions to four alternative management regimes:

Management Approach 1:
- Continue the current management plan (landing Total Allowable Catch controls (TACs), effort controls)
- Simplified derogations for fleets that demonstrate reductions in the Cod catch through adoption of avoidance or technical measures

Management approach 2:
- Mixed fishery catch quotas reduced to match across species
- In-year increases if Cod catches are kept below specific limits

Management Approach 3:
- Individual vessel/business catch quotas set at single species level
- Vessel must tie up once any single quota is exhausted

Management Approach 4:
- Effort based real-time incentives
- Each vessel allocated ‘fishing credits’

Each approach was explained more fully in the questionnaire using a sketch of a fishing boat and short summaries highlighting key aspects of the proposed management regime. Each management approach was described using the minimum of information to explain the main aspects of the approach. The same set of questions was asked about each management approach in turn to obtain respondent views on whether the approach would be more difficult, no different, or easier than the current situation for the following activities:

- Managing my fishing effort
- Controlling costs
- Managing my Cod quota

- Managing my quota for other species
- Reducing discards of Cod
- Reducing discards of other species
- Using my knowledge and judgement about when and where to fish
- Fish safely
- Adapting my effort to the weather and other environmental conditions

Respondents were also asked to indicate potential financial impacts, i.e. changes in annual income, profit, input costs (fuel, supplies, new gear, repairs), and number and type of crew employed, and provide an indication of how difficult they felt it would be to enforce the approach.

Results

An on-line questionnaire was developed (due to resource constraints) to explore views of fishermen to the four different management options. Nineteen useable responses were received. All respondents operated in the North Sea, 4 in the West of Scotland, 2 in Eastern Channel, and 4 in other areas. A total of 12 respondents were targeting Cod, and other key species include Haddock, Saithe, Whiting, and Monkfish.

Option 3 (Individual vessel/business catch quotas set at single species level; vessel must tie up once any single quota is exhausted) was viewed as the least favourable approach. More than half of respondents indicated that under this option the following activities would be more difficult:

- Managing my fishing effort
- Managing my Cod quota
- Managing my quota for other species
- Reducing discards of Cod
- Reducing discards of other species

In addition more than half of respondents indicated the approach would have a negative impact on annual income and profit. Five respondents indicated that managing effort, cod quota and cod discards would be easier, and four indicated a positive impact on annual income from fishing activities. When asked for specific opinions on the approach the focus of respondents was on the impact of the quota issue on their activities and problems identified included:

> *"I cannot take all my quota"*
>
> *"It will not work because the small quota on Whiting would stop you fishing within weeks"*
>
> *"Unworkable – impossible to stop fishing when one species is caught"*

"Lack of Cod quota and the cost of renting quota"

"Most would be forced to sell up or go bankrupt"

"Lack of quota for certain species - Hake and Coley"

"Unworkable - impossible to stop fishing when one species caught"

"Cannot stop fishing when one species is caught"

Respondents also indicated that the perceived abundance of Cod caused problems in terms of meeting or exceeding their quotas.

"It's impossible to fish and avoid Cod due to their abundance"

"There has always been a dominant species, - trying to regulate the fishery on one species will always result in abuse and discards of the dominant species"

When asked about benefits of the approach, respondents also focused on the quota issue:

"Vessels with high quota will be able to fish as they should those that have no quota will have to stop fishing sooner"

"Reducing discards and getting extra quota in long term will reduce leasing costs"

"Vessels that have quota will be able to fish as they should be, those that have no quota and most of the discards will have to stop fishing sooner"

The views provided by the respondents suggests that those who had adequate quota would be better off under this management approach, but those with low quota (i.e. small-scale fishermen) would suffer, because as soon as their quota for a species was used up they would have to tie up. The nature of the on-line questionnaire suggests that some of the respondents picked up on this particular aspect of the proposed approach and it strongly influenced their opinion.

Other management options received mixed responses. Option 2 (Mixed fishery catch quotas reduced to match across species; in-year increases if Cod catches are kept below specific limits) was also seen as problematic having a negative impact on controlling costs, controlling quota, and discarding. The key problem was the reduction in quotas to match the mix of species in the fishery, and the potential for increasing species quota being dependent on reducing the Cod catch. In a mixed

fishery where Cod is perceived (by fishermen) to be increasing in abundance the potential for reducing Cod catches was viewed as extremely difficult, and thus creating a situation where catch across all species would be reduced. Management approach 4 received fewer responses, partly due to the nature of the approach, which was completely new to most respondents, and required a more in-depth explanation.

Activity	Harder	No different/easier
Fishing effort	> Half say 3 and 4 is harder	25% say all Options are easier
Controlling costs	Options 2 and 3 appear more negative	Option 4 has fewer negative responses
Controlling quota	For Cod 2 & 3 appears more negative	Option 1 appears easiest for other species
Reducing discards	For Cod and other species Options 2&3 appear more negative	For Cod and other species Option 1 no different
Using my knowledge	Options 2 & 3 more negative	
Fishing safely		Majority saying no difference under all Options
Adapting effort to controls	Option 3 has most negative responses	Majority saying no difference under all Options

Table 1: Fishermen perceptions of management option impact

Techniques for enforcing management regimes

A key aspect of any management regime is enforcement of the rules as this will determine the extent to which it will meet its objectives. Controlling a fully disclosed fishery (FDF) system in combination with any of the options for regulating discarding practises requires monitoring of the fishing activity at sea where the discarding takes place. There are four enforcement tools that allow for that; on board observers, patrol vessels, aircraft and CCTV-systems (sensors, GPS, cameras). Other enforcement tools such as landings- and administrative controls can be used to identify irregularities in the length and catch composition that indicates that discarding has been taken place. CCTV-systems can provide coverage of the entire fishing activities for a fraction of the cost of other enforcement tools at sea making it highly attractive from an enforcement perspective, with the additional benefit of providing highly useful information on fishing activity through GPS data.

The responses suggest a high level of support for particular implementation techniques. There appears to be general support for activities such as banking and

borrowing from one year to the next, and surprisingly, for CCTV. Examples of responses include:

> *"CCTV is very good on reducing Cod discards and making the skipper think where to fish and with what size nets"*
>
> *"Reducing discards and getting extra quota in the long term will reduce leasing costs. I'm in favour of expanding CCTV to certain boats/species"*
>
> *"Banking and borrowing is a good idea, with a 15% limit, allows for mistakes and unexpected catch"*

In terms of ease of enforcement the majority of respondents felt that Option 1 (closest to the current situation) would be easiest to enforce; and Option 2 the most difficult. Respondents were equally divided over the ease with which Options 3 and 4 could be implemented with half thinking they would be easier and half thinking they would be more difficult.

Management option	Very easy	Easy	Difficult	Very difficult
Option 1	1	8	3	1
Option 2	0	4	6	3
Option 3	4	2	2	4
Option 4	3	3	4	2

Table 2: Management Options: ease of enforcement

Enforcement regimes within mixed fisheries management using quotas are not straightforward. In order to achieve a good level of compliance the initial allocation of quotas is important, in fisheries with a large overcapacity the initial allocation is difficult, particularly the allocation of quota to 'choke' species to achieve relative stability. This suggests the need for a borrowing system (e.g. buying, renting, or borrowing from a future year/using savings from aprevious year) that can bridge compliance periods to allow for possibilities that cover an unexpected catch and provide flexibility but it adds to the control burden for authorities. Table 3 below

summarises some of the key issues surrounding use of enforcement tools indicating the central role of on-board CCTV.

Evaluation crtieria	Management Measure				
	CQM /FDF-discard ban	**CQM /FDF-with no discard ban**	**Individual catch quota**	**Gear**	**Area and area closures**
Controllability	**High**	**Low**	**High**	**Low**	**High**
Cost effectiveness	**High**	**Low**	**High**	**Low**	**Medium**
Compliance	**Medium**	**Low**	**Medium**	**Medium**	**High**
Enforcement measures	**CCTV**	**CCTV**	**CCTV**	**Checks at sea, and on-shore**	**Checks at sea VMS**
Infringement type	**Discarding**	**Mis-reporting**	**Over-fishing**	**Technical**	**Illegal fishing practice**
Incentives	**Higher quotas Access to closed areas Exemptions from landing obligations Etc.**	**Higher quotas Access to closed areas Exemptions from landing obligations**	**None**	**Additional Quotas for certain gear.**	**None**

Table 3: Evaluation of controls

Summary of the fishermen survey

The views of fishermen are based on a very small sample, and the management options presented range from the known and familiar (Option 1) to the unfamiliar (Option 4), which would undoubtedly influence perceptions. Option 4 (real time incentives), which is the least familiar is the most difficult to interpret with no clear set of views emerging. This might be due to lack of familiarity with the ideas presented. Option 3 is the least preferred and appears to have the highest perceived negative financial impacts.

A major focus of respondents throughout all management approaches was on quota and a perception of relative Cod abundance. Respondents with enough quota suggest that Options 2 and 3 would be less damaging than those with limited quota, who see option 3 in particular as restricting their fishing opportunities. The main negative impacts for Options 2, and 3 apply to the following activities:

- Managing my fishing effort
- Controlling costs
- Managing my Cod quota
- Managing my quota for other species

- Reducing discards of Cod

Activities least impacted by the proposed measures relate to:

- Using my knowledge and judgement about when and where to fish
- Fish safely
- Adapting my effort to the weather and other environmental conditions

There is support for implementation actions such as CCTV and banking/borrowing from one year to the next.

Discussion

Evidence of action to make the system more resilient include the following:

- Fishermen switching from mixed activities to focusing on unregulated species (e.g. Brown Crab)
- short-term investments, e.g. in crabbing and shrimping
- EU focus on banning of discards and landing the whole catch

At the local level the focus is on economic survival. There are few or no new entrants due to entry costs (difficulties of obtaining quota) and minimal economic return. Current fishermen continue to operate because of lifestyle. The current pressures are not short term, they are long-term based on overfishing (resulting from improvements in technology and excess fishing capacity), along with continual reductions in quota and restrictions on catch and days at sea to avoid further damage to declining fish stocks.

Making a common resource such as a mixed fishery more resilient depends not just on the capacity for adaptation but also on understanding institutional weaknesses in relation to goals of commons management. If the institutional weaknesses are understood energy can be focused on the forms of change that will be most effective. The small-scale survey of fishermen provided almost the only social science based input into the Scientific, Technical and Economic Committee for Fisheries (STECF) research on a range of alternative management options. It demonstrated two important facts: first, that fishermen are not averse to strict enforcement regimes (such as CCTV); and second, that the role of quotas is of overriding significance for fishermen both financially and operationally. Quotas are generally recognised as a blunt instrument in managing a mixed fishery where more selective controls are needed, along with flexibility to allow for unexpected catches of untargeted species. To date, effort controls (days at sea) and quotas have not succeeded in either reducing the negative impacts of fishing on the ecosystem, or in making fishing a more financially stable activity capable of benefitting local communities. Until a more flexible set of management controls are adopted the North Sea fishery, as a socio-ecological system, will lack resilience, and the consequences will remain unpredictable for both socio-economic and ecological communities involved.

References

Adger, W. N., Hughes, T.P., Folke C.,Carpenter, S.R., and J. Rockstrom (2005) Social-ecological resilience to coastal disasters. *Science* 309:1036-1039.

Adger, W. N. (2000) Social and ecological resilience: are they related? *Progress in Human Geography* 24(3):347-364.

Agrawal, A. (2003) Sustainable governance of common-pool resources: context, methods, and politics. *Annual Review of Anthropology*, **32**, 243-62

Atwell, R. Schulte, L., and L. Westphal (2009) Linking resilience theory and diffusion of innovations theory to understand the potential for perennials in the US Corn Belt. *Ecology and Society* **14**(1)30 online.

Birkes, F. (2006) From community-based resource management to complex systems: the scale issue and marine commons. *Ecology and society* 11(1):45 [online].

Brand, F. S. and K. Jax (2007) Focusing the meaning(s) of resilience: resilience as a descriptive concept and a boundary object. Ecology and Society 12(1):23 (online)

Brown, K. (2006) New challenges for old commons: the role of historical common land in contemporary rural space. *Scottish Geographical Journal* **122**(2) 109-129.

Carlsson, L. (2000) Management, resilience and strategy of the commons. http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/368/carlssonl032100.pdf?sequence=1

Fabricius, C., Folke, C., Cundill, G., and L. Schultz (2008) Powerless Spectators, Coping Actors, and Adaptive Co-managers: A Synthesis of the Role of Communities in Ecosystem Management. *Ecology and Society* **12**(1) 29 (online).

Folke, C. (2006) Resilience: the emergence of a perspective for social-ecological system analyses. *Global Environmental Change* 6(4):1018-1024.

Gunderson, Lance H., and C. S. Holling (2002) *Panarchy: Understanding Transformations in Human and Natural Systems*. Island Press.

North, D. C. (1994) Institutional Change: A Framework of Analysis. http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/4102/9412001.pdf?sequence=1

Ostrom, E. (1990) *Governing the Commons: The Evolution of Institutions for Collective Action.* New York: Cambridge University Press.

Ostrom, E. (2007), 'A diagnostic approach for going beyond panaceas', *Proceedings of the National Academy of Sciences*, 104 (39), 15181–15187.

Perrings, C. (2006) Resilience and sustainable development. *Environment and Development Economics* 11:417-427.

Pradhan, S.K. (2006) Building resilience in local institutions for natural resources management. 11th Biennial Conference of the International Association for the Study of Commons, Bali, Indonesia, 19-23 June, 2006. http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/2071/Pradhan_Sisir_Kanta.pdf?sequence=1

Schiller, C. and S. Kuhnle (2008) The erosion of the institutional pillars of the German Sozialstaat. *The Korean Journal of Policy Studies*, **23**(1) 73-103.

Simmonds, J. and Ernesto Jardim (Eds) (2012) *Scoping for Impact Assessments for Multi-Annual plans for Baltic Multi-species and Cod in the Kattegat, North Sea, West of Scotland and Irish Sea*. (STECF EWG 15-11). European Commission, Joint Research Centre.

Ternström, I. (2004) Disturbances and Resilience in Common-Pool Resource Management Systems. http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/1761/Ternstrom_Disturbances_040525_Paper326.pdf?sequence=1

Tucker, C. (2008) Coffee Production and Communal Forests in Honduras: Adaptation and Resilience in a Context of Change. http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/1555/Tucker_228601.pdf?sequence=1