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Short Communication

Can fisheries management be quantified?

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ABSTRACT

Policy efforts to reduce fisheries impact have often created micro-management. Detailed regulations are restricting the fishing industry, and are also acknowledged to limit the progress towards sustainable management. Industry representatives, political bodies and scientists have therefore argued for more simplicity and transparency. Here, fisheries management is quantified in terms of trends in regulations for different Swedish fisheries in the Baltic Sea during the period 1995–2009. The results suggest that many fisheries are suffering from increased micro-management, but interestingly some fisheries showing a different trend.

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1. Introduction

Despite increasing efforts to adjust fishing effort to the available fish resources on a global, regional or at local levels [1–3], the status of the world fish stocks is deteriorating [4]. This negative trend during the past 10–30 years is not due to lack of management, in contrast, it is evident in sea areas with developed fisheries management systems (e.g., Baltic Sea, California Current, Celtic-Biscay Shelf, North Sea, Newfoundland-Labrador Shelf, and Southeast US Continental Shelf) [5] and fished by countries with high scores on the FAO Code of Conduct for responsible fisheries [6]. The iconic example, the cod collapse of the coast of Newfoundland in 1992 illustrates the complex role of fisheries management in relation to exploitation patterns; this stock sustained an open access fishery for centuries but collapsed within 15 years after introduction of the Canadian EEZ, where optimistic stock assessments and an expansive national fishing fleet played a key role in the resulting overexploitation [7,8].

At the same time, the fishing industries in many countries are suffering from decline in employment and low profitability [9,10]; Fig. 1. This has stimulated a wide discussion on reforming fisheries policies towards less top-down control (also called command-and-control management [11]). As alternatives, co-management [12] including Individual Transferable Quotas (ITQs) [13], have been proposed as tools towards giving the fishing communities and the

fishing industry a more pronounced role in implementing resource use policies. In Europe, the fishing sector has, since the 2002 Common Fishery Policy (CFP) reform, officially been advising the European Commission through the Regional Advisory Councils (RACs), which is indeed a development towards increased responsibility. But an added responsibility by the industry also requires increased flexibility through simplified regulations. The Green Paper for the reformed European CFP published in April 2009 suggested that the failure of the CFP, which has aimed for an economically viable fishing industry that minimises impacts on marine ecosystems, was partly due to the increase in centralised bureaucracy, i.e., increasing micro-management [14]. One policy option is thus to reduce centralised micro-management and devote more responsibility to the industry, i.e., reversing the burden of proof in fisheries management [15].

In this paper, regulations are quantified over time, and the degree to what degree micro-management is influencing different types of fisheries is explored using data for empirically defined Swedish fishing strategies.

2. Material and methods

The Swedish Baltic Sea fishery spans small-scale, coastal passive gear fisheries to large-scale industrial trawl fisheries [9]. Fishing operations were categorised on the basis of fishermen's logbook data into fishing tactics, representing typical trip-based catch and effort characteristics. Fishing strategies were defined as combinations of tactics pursued by individual fishers over one year, and could for example be trawling for small pelagics for

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industrial use, complemented with seasonal herring fishing for human consumption. In total 18 fishing strategies were defined; more details of the analysis are provided in [16,17].

An analysis in four steps was performed in order to define and measure the degree of micro-management:

1. All national regulations during the study period (1995–2009, $n=34\text{--}57$ annually) were indexed in terms of which species, gears and vessel types they covered.

2. All regulations affecting each fishing strategy were summarised per year.
3. The changes in regulations between years were quantified (based on Table 1). An introduction or specification of a regulation was given a score of -1 whereas the removal or relaxation was given a score $+1$.
4. Changes in “regulation scores”, i.e., degree of micro-management, were summarised for each fishing strategy over the study period.

This method yielded a relative measure of micro-management over time, where increasing negative values suggested more micro-management in a particular fishing strategy. The year 1995, when Sweden joined the European Union and thus became subordinate the CFP, was chosen as a reference year with a reference management score 0 for all fishing strategies.

3. Results and discussion

The quantitative method presented here demonstrates an integrated measure of management and regulations over time. Even though this study is focused on regulations on the national level (Sweden), these regulations are implementations of the fisheries management at the EU level. This implies that this simple method and these results can be considered for a large part of fisheries management within EU.

The general trend observed was an increased number and level of detail of regulations, i.e., an increase in micro-management over time. Among the 18 fishing strategies considered, 16 were more micro-managed in 2009 than in 1995 (Fig. 2a). This applies, e.g., for the small-scale cod fishing with long-lines (Fig. 2b). During the study period, this fishing strategy, along with several other fishing strategies targeting groundfish species, have faced a wide array of new types of regulations such as specified landing harbours, licensing, effort restrictions, and prohibition against combining target species and/or fishing areas. Departing from the general picture, the three fishing strategies targeting small pelagics (herring, *Clupea harengus* and sprat, *Sprattus sprattus*) are on approximately same level of micro-management in 2009 as in 1995 (scores in 2009: 1, 0 and -1). This is exemplified by the large-scale small pelagics trawl fishing strategy (Fig. 2c).

All changes in regulations were treated equally, but we acknowledge that regulations may differ in their absolute effect on the fishery. Qualitative information (e.g., from interviews with fishermen) may help weighting different regulatory changes



Fig. 1. Micro-management becomes inefficient when fishers find creative ways of circumventing detailed regulations. The owner of this Swedish vessel has cut the stem to lower the vessel's overall length, in order to avoid the otherwise mandatory reporting requirements. Photo: Eva-Britt Larsson.

Table 1
Template for categorisation and scoring of management regulations.

	More strict	Less strict
Effort		
Spatial	Closed area	Not closed area
Temporal	Closed season/period	Not closed season/period
Total effort	Limit on number of gears or fishing days	No specified limit of number of gears or fishing days
Harbours	Special landing harbours	No special harbour regulations
Spatial flexibility	Not allowed to combine fishing areas	Allowed to combine fishing areas
Catch		
Individual catch allowances	Short-term catch allowance	Longer-term catch allowance
Individual quotas	Individual non-transferable quota	ITQ
Pooling allowances from several vessels	Not allowed	Allowed
Minimum size limits	Higher size limit	Lower size limit
Target species flexibility	Not allowed to combine catch species	Allowed to combine catch species
Licensing		
Special permits	Required	Not required
Market-based		
Subsidies	No price additions	Price additions

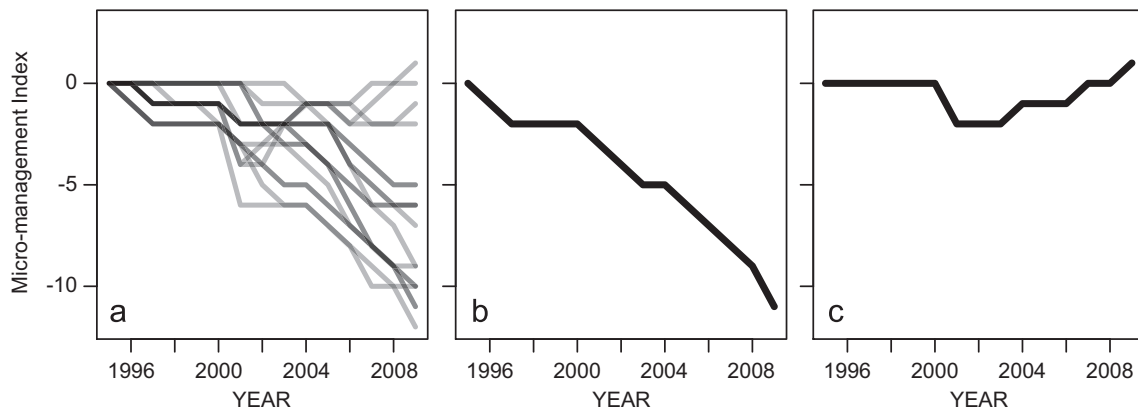


Fig. 2. Change in management per fishing strategy in the Swedish Baltic Sea fishery. (a) All 18 fishing strategies. Note that the general trend is an increase in micro-management, i.e., more detailed regulations. Dark colours in the graphs indicate overlap in the data between several strategies. Two examples with contrasting trends are provided: (b) a small-scale fishing strategy targeting cod with long-lines; (c) a large-scale fishing strategy targeting mainly mixed sprat and herring with pelagic trawls for industrial use, with complementary human-consumption herring trawling. List of all strategies included in Fig. 2a LS refer to large-scale (vessels > 10 m) and SS refer to small-scale (vessels < 10 m): LS Herring trawl; LS Mixed trawl herring and sprat, mid-size vessels; LS Cod gillnet; LS Cod trawl; LS Flounder; LS Cod line; LS Salmon driftnets; LS Turbot; LS Mixed trawl herring and sprat, large vessels; SS Eel; SS Cod gillnet; SS Herring gillnet; SS Freshwater species net (Pikeperch etc.); SS Flounder; SS Freshwater species net (Perch etc.); SS Cod line; SS Turbot; SS Salmon.

according to their effect on different fishing strategies. However, the aim here was only to analyse the general trends over time and not the detailed changes within particular fishing strategies.

The two fisheries exemplified in Fig. 2b and c tell two different stories. The trend towards more detailed and strict regulations in the groundfish fisheries can explain an increasing need for restrictive management actions due to stock declines and persistent overcapacity, which has forced management to enforce strict regulations. The trend is supported by qualitative evidence from other European groundfish fisheries e.g., [18], which suggests generality of our findings. In contrast, the observed management “relaxation” in the pelagic segment could partly be explained by that herring and sprat stocks in the Baltic during this period were in better condition than the cod stocks. Also, and importantly, the industry targeting those species in the Baltic initiated through intense lobbying during the 2000s, a change towards individual quotas and later ITQs (implemented in 2009), leading to a substantial reduction of this fleet segment ([19] (J Hjelm, personal comment)). This has possibly led to a lower need for detailed management.

Simplified management is requested by the fishing industry, and the same view has been developed within management bodies in Europe. ITQs [13] and other examples of co-management, can be a way forward for sustainable fisheries. Departing from the micro-management paradigm requires that management bodies embrace the know-how of fisheries and devote actual responsibilities to the industry. Policy-makers will have a crucial role in stipulating the targets and goals of the policy.

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