LIFE CYCLE THINKING AS A TOOL TO INFORM FISHERIES MANAGEMENT

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ABSTRACT

The fishing phase generally dominates the total environmental impact and resource use attributed to the seafood product. Great differences are however seen between similar products. These differences are the result of fisheries having different management in terms of e.g. gears and effort. The integrated perspective Life Cycle thinking brings could therefore prove to be important to inform fishing policy for an overall better resource use in seafood production. Based on examples of Swedish fisheries, resource management in fisheries supported by life cycle thinking is discussed. It is concluded that more integrated approaches is vital for the future development of the sector.

INTRODUCTION

In seafood production, the fishing phase generally dominates the total life cycle resource use and environmental impact attributed to the product (Ziegler, 2006). The differences between similar seafood products can be substantial, with e.g. gears, effort and quotas being important components explaining observed differences (Driscoll & Tyedmers, 2010). These measures are all taken by the authorities managing the fisheries, which unfortunately lack a system perspective. Therefore, actions taken have the potential to affect the resource use and environmental impacts in a broader perspective than is currently included in the decisional framework, such as increases in energy demand or seafloor area affected (Hornborg et al., 2012). This paper discusses where Swedish fisheries are now and future options of more integrated approaches to management.

MATERIALS AND METHODS

Results from prior studies of Swedish fisheries were combined and analyzed: species selective trawling for Norway lobster *Nephrops norvegicus* (Hornborg et al., 2012), discard assessments of Swedish demersal trawling by novel LCA methods (Hornborg et al. *in press*) and fuel efficiency in Swedish demersal trawling (Ziegler and Hornborg, *in review*). Data covered the year 2009.

Official landings from the Swedish Agency for Marine and Water Management (www.havochvatten.se) were also studied in terms of composition of threatened fish species (i.e. a status as Vulnerable (VU), Endangered (EN) or Critically Endangered (CR) according to the Swedish IUCN Red List; Gärdenfors et al., 2010).

RESULTS

Demersal trawling for crustaceans (northern prawn *Pandalus borealis* and Norway lobster) was in general more energy demanding per landing than mixed fish trawling in 2009, in particular when selective devices were used (figure 1). The selective fishery for *Nephrops* had the highest energy requirement per landing.

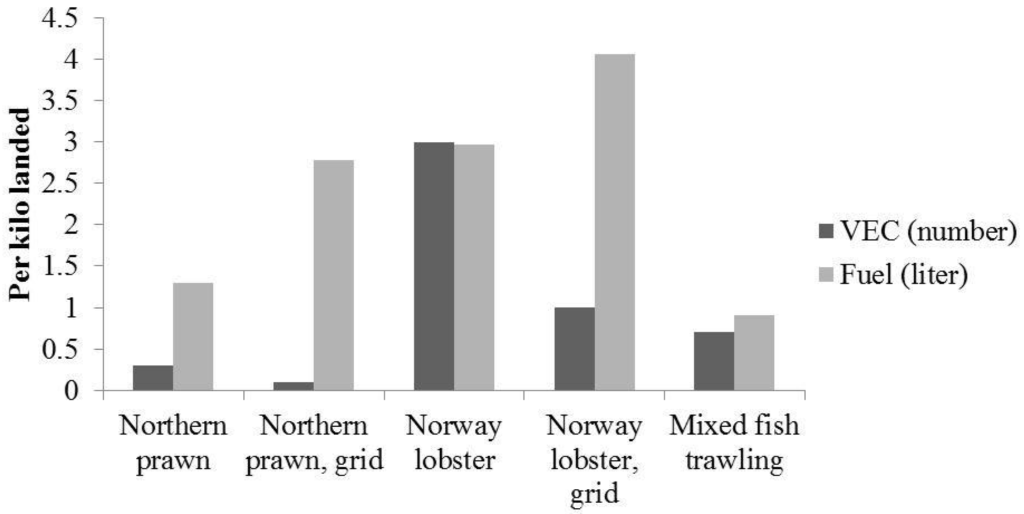

Figure 1. Discard of threatened fish species and fuel consumption per kilo landing in demersal fisheries on the west coast of Sweden in 2009 (fuel estimate for Norway lobster without grid is from 2007).

Five of the twenty most landed fish species in Swedish fisheries have a regional IUCN Red List status as threatened: Atlantic cod, haddock, whiting, pollack and ling (Table 1). Except for cod, which is targeted in the Baltic sea, these fish species are all caught in mixed fisheries. In terms of discard impact on threatened fish species (predominantly haddock, whiting and cod), demersal trawling for Norway lobster posed the greatest pressure; this was mitigated by using selective device (figure 1). In addition, selective trawling for *Nephrops* has been shown to affect a larger area of seafloor per kilo landing (Hornborg et al., 2012).

Table 1. Swedish landings of fish that are threatened according to the Swedish Red List.

Common name	Scientific name	Swedish Red List Category (2010)	Landings (tonnes)			
			2013	**2012**	**2011**	**2010**
Atlantic cod	*Gadus morhua*	EN	4596	14278	14436	13052
Haddock	*Melanogrammus aeglefinus*	EN	117	352	343	242
Whiting	*Merlangius merlangus*	VU	41	85	108	89
Pollack	*Pollachius pollachius*	CR	27	80	64	68
Ling	*Molva molva*	EN	12	37	36	39
Other with a regional threat category (CR, EN, VU)			3	261	375	458
Percentage of total landings			**5**	**9**	**8**	**6**

DISCUSSION AND CONCLUSIONS

Selective trawling protects threatened fish species but comes with trade-offs from a system perspective; the mixed demersal trawl fishery is more energy efficient per landing than selective demersal trawl fisheries. As fishing overcapacity has severely depleted many of the demersal fish species, mixed demersal trawling cannot be sustained at present. The managers of fisheries have been trying to reduce fishing mortality and implement rebuilding efforts of depleted fish species. However, fisheries for Norway lobster and northern prawn are too economically valuable to be restricted; selective demersal trawling for crustaceans is thus enabled despite high energy demand. This could however only be sustained in a short perspective. In the longer run, the prospects for energy intensive fishing methods are less certain. As there have been additional discussions on the risks with selective fisheries from an ecosystem point of view (Garcia et al. 2012), this could altogether indicate that it may be time to take a system perspective on the whole fishing sector. Given the present state, what is the overall optimum “fleet foraging strategy” in the defined area to ensure long-term sustainable seafood production from an overall resource management point of view?

One alternative way forward for is to enforce even stronger effort restrictions and only allow highly catch effective trawls that are obliged to land the whole catch. Fishing for *Nephrops* would then have to be based on creeling to a greater extent, which is more energy efficient and with less discard than demersal trawling (Ziegler and Valentinsson, 2008). Marine protein production from the area would then have to origin from other sources, such as mariculture of e.g. mussels. From adding a system perspective, and including product processing chain, increased utilization of otherwise discarded or wasted by-products would also generate more protein. Managing the area with a system perspective may prove to lower overall fuel demand, minimize seafloor interactions, increase utilization of available production and ease pressure on threatened fish species. Instead, the reform of the Common Fisheries Policy in the European Union during 2013 discusses details, such as if and how to implement a discard ban. As a result, increased use of selective demersal trawls in crustacean fisheries is seen. However, this picking bits and pieces out of the ecosystem in a highly energy demanding manner is the result of management lacking an integrated system perspective. Also, effective management has been shown to require increased transparency in order to not be influenced by harmful subsidies (Mora et al., 2009). Life cycle approaches could provide both an integrated and transparent decision support for the management of fisheries.

Data availability and available assessment methods have however been shown to be a major constraint for seafood LCAs. This also applies for managers of fisheries; there is a lack of data to determine biological reference points required for proper stock assessments of many of the fished stocks. Whiting, pollack and ling are all considered to be data deficient stocks. Still, these species are among the twenty most landed species by volume in Sweden. They have however been assessed by the Swedish Red List and are considered to be threatened (VU, EN, CR). This form of assessment has been shown to be fairly consistent with other metrics of vulnerability and has been proposed as a novel method in LCA (Hornborg et al., *in press*). Discard of threatened fish species varies between fishing practices, still discard estimates are only included in stock assessments of Atlantic cod, haddock and whiting; this is not the case for pollack nor ling. For an improved overall resource management, there is an emerging need to utilize other metrics and tools to evaluate current management regime. The added value of a life cycle approach, which utilizes a range of assessment methods, would be to create a framework that visualizes a broad range of aspects regarding the use and misuse of our common resources (both biotic and abiotic) on a product basis.

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