Marine Policy 60 (2015) 280–286

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol

Adaptation in a time of stress: A social-ecological perspective on changing fishing strategies in the Canadian snow crab fishery

Grant D. Murray [a,*], Danny Ings [b]

[a] Institute for Coastal Research, Vancouver Island University, 900 5th Street, Nanaimo, BC, Canada, V9R 5S5
[b] Department of Fisheries and Oceans, St. John's, Newfoundland, Canada

ARTICLE INFO

Article history:
Received 15 April 2015
Received in revised form
10 July 2015
Accepted 10 July 2015

Keywords:
Social-ecological systems
Crab
Fisheries
Fishing behavior
Newfoundland and Labrador

ABSTRACT

Recent scholarship has focused attention on the dynamics and management of marine social ecological systems and on the need for developing a deeper understanding of the fishing strategies of fish harvesters. This includes an understanding of how a broad range of factors influence the strategies of those at the 'center' of marine social-ecological interactions. This paper reports on the findings of a survey of snow crab (*Chionoecetes opilio*) fishers in Southeastern Labrador conducted at a time (2005) of significant stress in the fishery. Results highlight that snow crab fishers are embedded in a social-ecological system and that shifts in fishing strategies in times of stress are a product of adapting to a dynamic, interactive set of factors that have social, economic, ecological and management aspects. Important differences between fleet sectors (larger and smaller vessels) as well as processes of learning are also described. The article concludes with a discussion of the implications for management and the utility of a holistic social-ecological perspective.

1. Introduction

Recent scholarship has focused attention on the dynamics and management of marine social ecological systems [15,17] and on the need for developing a deeper understanding of how a broad range of social and ecological factors shape fishing strategies to better complement information on the nature and behavior of fish and fish assemblages [19,3,9]. Yet this remains an understudied area. Indeed, Ray Hilborn [10] suggested 30 years ago that the collapse of many fisheries can be explained by a lack of understanding of fishers' behavior, rather than a lack of understanding of fish stocks and behavior – a suggestion that more current research has repeated (see also [19,3,9]).

Understanding the factors that shape fishing behavior such as fishing location and gear selection has obvious implications in terms of understanding and managing the impacts of fishing on fish stocks and other environmental aspects. Work in this area has focused attention on the decision-making dynamics of fishers, with an emphasis on how fishers develop adaptive fishing strategies in response to a variety of social-ecological factors, including regulatory controls, changes in resource abundance, environmental conditions, safety, previous experiences, home life and other social considerations, input costs (e.g. fuel); and market or regulatory constraints [14,15,2,19,20,22,4].

This article focuses on descriptions of fishing strategies of snow crab (*Chionoecetes opilio*) harvesters in NAFO Division 2J, a large management area that extends off the coast of Southeastern Labrador, in the Canadian Province of Newfoundland and Labrador. Specifically, this article addresses some gaps in understanding of the dynamic social-ecological factors that influence where and how 2J fishers chose to pursue crab prior to the 2005 season 200. That point in time was an interesting year to talk to harvesters about strategies because it occurred when crab landings were in decline, effort was increasing, the licensing regime had been shifting, and fuel and other input costs were rising. Indeed, in the 2005 fishery, both the TAC and landings dropped to all-time lows, and effort dropped by 53% ([12]; see Fig. 1). Conducting interviews at this time provides some insights into how and why (in response to what factors) fishers adapt their behaviors in a time of stress. Understanding these factors becomes increasingly important in the context of rapidly changing social-ecological systems where system changes can create, heighten, diminish or even eliminate the effects of certain factors on fishing behaviors.

As well, this research has direct management implications in that one form of 'fisheries-dependent' data that is used in the management of the fishery is developed from the mandatory logbooks that record the trap placements (effort) of crab harvesters [6,1]. Information from the logbooks has been assumed to provide an interpretable reflection of the location and relative abundance of crab – a key consideration in terms of management response. Studies that qualify that interpretation, such as this one,

* Corresponding author.

http://dx.doi.org/10.1016/j.marpol.2015.07.014
0308-597X/

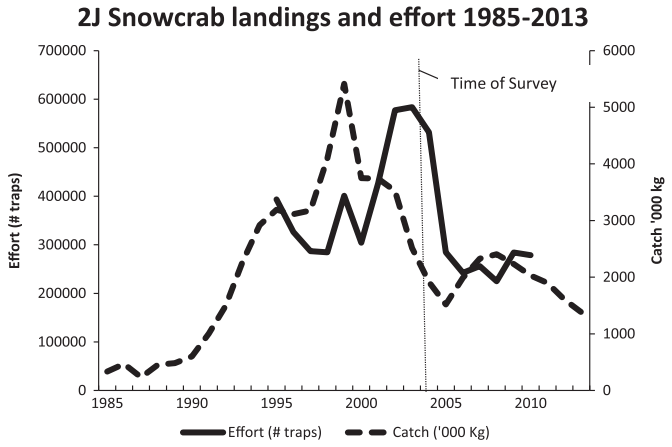

Fig. 1. Landings and effort of snowcrab in NAFO Division 2J: 1985–2013. Landings Data from NAFO Database 21a. Includes Newfoundland vessels only. Effort data extracted from [12].

remain relevant in a fishery that has the same basic structure in 2015 as it did in 2005: it is still pursued through the same basic technology, fleet distinctions remain the same, and overall the number of fishers remains similar [6,13][1] On the other hand, since the time of the survey, both TACs and landings recovered somewhat through 2008, then declined again (since 2009 landings have not met TACs)., while effort dipped to its lowest point in 2006 then increased through 2011 (though not to anywhere near pre-2005 levels) before declining again between 2011 and 2014 [7].

1.1. Background on 2J crab fishery

Snowcrab (alternately called queen crab; *C. opilio*) is widely distributed along Canada's coast as well as other parts of the world. It is usually found on sandy or muddy (what Newfoundland fishers call 'puggy') bottoms, usually in deep water. Only adult males are targeted in the fishery, with a minimum mesh size on traps (135 mm) and a minimum acceptable carapace width of 95 mm. Several characteristics of snowcrab biology are worthy of mention here, as they help to interpret the results presented below. The first is the fact that crabs moult, leading to the presence of 'soft-shell' crab which are not marketable and are very susceptible to mortality if not handled properly. Soft-shell crab are avoided by harvesters and areas with high soft-shell occurrence are sometimes closed by the Canadian Department of Fisheries and Oceans (DFO). Secondly, snowcrab productivity is uneven over both space and time [8].

The crab fishery is pursued using conical, baited traps and is pursued almost exclusively by the 'under 65' (vessels less than 65 feet in length) fleet [8]. Traps are attached to retrieval lines and marker buoys that are strung together in 'fleets' or 'strings'. In 2005, the fishery usually lasted just 8–10 weeks in the late spring (opening in late April or early May and closing by June or July). There is pressure to concentrate fishing effort early in the season because of the need for income, to fish when catch rates are high, to avoid soft-shell crab and soft-shell crab closures (management measures), and the desire for high-quality catches [18].

The Canadian snowcrab fishery began in the mid 1960s [6,8] in Atlantic Canada (which includes Newfoundland and Labrador as well as several other Provinces) and was developed following an opportunity created by a decline in supply internationally and government decisions to develop the fishery [8]. The Atlantic crab fishery as a whole grew rapidly between 1997 and 2004, with the overall value increasing from $200 to $600 million. This was attributed to an increase in abundance, market strengthening, and changes in the exchange rates. By 2004, snowcrab ranked as the second most important fishery in the Atlantic, behind only lobster [18].

However, the crab fishery was limited to areas south of NAFO Division 2J until the mid 1980 s, shortly after declines in the fishery in other areas farther to the south in Newfoundland [6]. Kennedy [11] describes the beginnings of the 2J fishery, and how initial fishing operations featured Labrador permit holders leasing Newfoundland boats. By 1990, 4 of these permit holders had obtained vessels of their own and had their permits converted to licenses. By 1990 the DFO had created a second category of snow crab fisher in 2 J by adding 'supplementary' permits to Labrador fishers that held groundfish licenses and a registered vessel over 35 feet [11]. This supplementary fleet originally pursued a chaotic derby fishery, but came under quota management by 1998 and the supplementary permits were converted to licenses. The 'supplementary fleet' is often referred to as the 'part-time' fleet. A third major component of the fishery was added in the mid 1990s with the addition, initially as temporary permits, of the 'under-35' fleet (referring to vessel length restrictions). Under pressure from fishers displaced from the collapse of the cod stocks, the numbers of these permits grew rapidly, and were eventually converted to licenses [11,18]. By 2005, there were 4 full time licenses, 31 supplementary licenses, and 67 'inshore licenses' [18] 'Inshore' licenses are referred to here as '<35'.

One of the important things to note about the fishery in 2005 was the distinct differences between fleet sectors, which were divided in terms of both vessel length and the quota allocated to them. Some of these differences are described in more detail below, but it is worth noting here that, according to the FRCC, different sectors pursue fishing somewhat differently. Smaller vessels (<35') fishing closer to shore, for example, often return to port daily, resulting in longer 'soak times' (time that baited pots are in the water) for pots that are left overnight. Larger vessels (between 35 and 65 feet) fishing offshore often fish for up to 4–5 days, depending on the equipment available on board to keep the catch alive. The cost and earning structures for the sectors are also quite different. For example, In 2005 the full time licenses were allocated 106,831 kg per license, supplemental/part-time were allocated 42,393 kg/license, and the <35' was allocated 4,789 kg/license, and average landings per license were estimated at $278, 451/license for the full-time sector, $123,179/license for the supplemental/part-time sector, and $13,148 for the <35' sector (Pinfold, 2005: 35). A different costs and earnings report from the Department of Fisheries and Oceans [5] shows that despite much higher costs in the full-time and supplemental fleet sectors net income from crabbing was much higher in the full and part-time categories. The 2004 report [5] covers a wide range of costs that are differ between the fleets; prominent among them include labour (larger crews in larger vessels) and fuel (longer trips in larger vessels with bigger engines).

In many ways, the 2J crab fishery at the start of the 2005 fishing season was a picture of a fishery in decline and a great deal of distress. The fishery was facing challenges that include resource sustainability, market structure and variability, competition from elsewhere (Alaskan and Russian snowcrab fisheries), exchange rates, and harvesting costs [18]. The 2005 stock assessment report noted a decline of the resource in some divisions, and noted specifically that commercial catch per unit effort (CPUE) had declined by 77% between 1998 and 2004 in 2J over the previous six years [6]. As shown in Fig. 1, landings declined by 65% between 1999 and 2004 (due to reductions in TAC). On the other hand, effort increased by 42% [6]. The exploitable biomass index dropped

[1] Minor changes include the adoption of biodegradable twine technology, continuing trends towards earlier and shorter seasons as fishers try to avoid soft shell crab, and a shrinkage in spatial coverage [13].