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Research article

On international fisheries agreements, entry deterrence, and ecological uncertainty

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ABSTRACT

A prerequisite for an international fisheries agreement (IFA) to be stable is that parties expect the benefits from joining the agreement to exceed the benefits from free riding on the agreement, and parties only comply with the agreement as long as this is true. The agreement, therefore, implicitly builds on an expectation of the ecological condition of the natural resource. Game theoretical models often assume that all parties have the same (often perfect) information about the resource and that the exploitation is an equilibrium use of the stock. As stated by experts in natural science, the fish ecology still has many open questions, for example how to predict population dynamics, migration patterns, food availability, etc. In some cases, parties disagree about the state, abundance, and migration of a stock, which can reduce the possibilities of reaching an agreement for exploitation of the stock. This paper develops a model and applies it to the North-East Atlantic mackerel fishery, in order to analyze an IFA under different ecological scenarios, and also combines the model with the economic theory of entry deterrence. The model is used empirically to determine whether the parties with original access to the resource have an advantage when forming an agreement with a new party in having the ability to fish the stock down to a smaller size and thereby prevent another party from entering into the fishery. With a basis in entry deterrence, combined with lack of information, the paper illustrates the obstacles that have made an agreement for the North-East Atlantic mackerel so difficult to achieve.

1. Introduction

In the literature on shared fishery resources the debate about the use of common resources dates back to Warming (1911), who, in his original contribution, debated the problem of what was later called open access. More widely known is the manuscript by Gordon (1954) dealing with same type of problem. If the rights to use the commons are too widely distributed, it often results in the *tragedy of the commons*. In fishery the problem of the tragedy of the commons can be described by two levels of conflicts: i) The nations trying to secure the fishery resources for their fishermen and ii) the fishermen competing for the resources the nation has secured or fishermen competing for resources not allocated to any nation. For the level ii) a lot of progress has been made with respect to understand how the tragedy of the commons may be solved when a society have gained exclusive rights for a resource, for example through community developed institutions (Ostrom, 1990) or through making the right to part of the fishery individual (Warming, 1931), for example as individual transferable quotas as addressed among others by Leal (1996). In this paper we solely address conflict level i): how nations may or may not agree on sharing an international fish resource.

A recent example from 2014 involves a general fishing moratorium on fish in the central Arctic Ocean (US Department of State, 2016), which, due to the melting ice, will become accessible. The agreement was made among the five nations surrounding this ocean. This endeavor of nations to secure resources at sea began after the Second World War, when several states attempted – unilaterally – to secure fishery resources by extending their territorial limits at sea outside the 3 nautical mile zone (later 12 nautical mile zone). The present legal status of the seas is set by the UN convention from 1982, which establishes a 200 nautical mile

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exclusive economic zone (EEZ) at sea, and by the UN Fish Stocks Agreement from 1995, which facilitates agreements among parties with an interest in management of straddling stocks. Many attempts have been made in the literature to reduce the conflicts over shared resources starting with the seminal paper by Munro (1979, 2007) (for a latter review on the literature of exploitation of shared resources, see Pintassilgo et al., 2015).

The consequences of climate changes for fish stocks have received increasing attention over the past decade. One of the main issues of climate change and its effect on stocks is the change in migration patterns. The seminal contribution by Hannesson (2007) deals with the effect of climate change on altered migration patterns from a game theoretical perspective. Hannesson found that when stocks transit from being exclusive in one country's EEZ to also straddle into another country's EEZ, there is a risk of overexploitation, and a slow rate of reaction to the changes will increase that risk. Liu and Heino (2013) confirm these results and present a model with two regimes: One with proactive management, where decision makers consider distributional shifts of stocks in the management decisions, and another with reactive management defined by Liu and Heino (2013) as the manager ignoring future distributional shifts (knowingly or unknowingly), Hannesson (2013) presents a stock-dependent migration pattern with two scenarios; 1) with a shift, where one player can exclude the other by keeping the stock low, 2) with a shift where the players have no influence on the migration pattern. He presents a model with two agents. As the model disregards prices and stock-dependent unit costs of fishing, the maximization problem can be based solely on harvest. He demonstrates, that if fish stocks are exploited non-cooperatively by the players, it can result in, that the stock is driven to extinction.

A change in migration pattern can empirically and theoretically lead to a new member problem (Kaitala and Munro, 1997; Pintassilgo and Duarte, 2000). Some real world examples of the new member problem are the case of the bluefin tuna in the Mediterranean Sea, where new distant-waters fishing nations turn up at regular intervals, and the case of the North-East Atlantic mackerel, which Iceland has had an economic interest in exploiting in recent years. With regard to the North-East Atlantic mackerel fishery, there was a successful agreement about the sharing of the stock for several years. Around 2007, however, the stock became available in significant abundance in Icelandic waters. Here the new member problem arose with Iceland as the entrant as a consequence of a change in the migration pattern of the stock. The North-East Atlantic mackerel fishery is the case of this paper.

One prerequisite for an international fisheries agreement to be stable is that the parties expect the benefits from joining the agreement to exceed the benefits from free riding on the agreement, and the parties only comply with the agreement as long as this is true. The agreement, therefore, builds on each party's expected payoff from the exploitation of the resource (Kronbak and Lindroos, 2007). Typically, the game theoretical models assume that all parties have the same, often perfect, information about the ecological conditions of the resource (e.g., Hannesson, 2007, 2012, 2013; Liu and Heino, 2013) and that the exploitation is in equilibrium with the use of the stock. However, the ICES (International Council for the Exploration of the Sea) reports that the fish ecology still has many open questions, for example how to explain and predict the population dynamics, migration patterns, food availability, etc. Parties can therefore easily be in disagreement about the state, the abundance, and the migration of a stock. The ecological settings partially define the framework conditions for the negotiations and, hence, the disagreement about these conditions can increase the level of complications for reaching an agreement.

In this paper we combine the new member problem created by a change in the migration pattern of the stock with an uncertainty for the reason behind this change. We deviate from the standard assumption of perfect information by allowing the parties to have different perceptions of the ecology of a fish stock (see, for example, Banks, 2011). The model demonstrates, by its empirical application to the North-East Atlantic mackerel (*Scomber scombrus*), that this change in the perception of the ecological conditions of the stock can make an international agreement more difficult to implement and sustain. Throughout the paper the terminology 'perception of stock size' is used. This covers the understanding of the ecological condition of the resource by a nation, which can be based on the country's belief or strategic decision.

2. The case of the North-East Atlantic mackerel

The North-East Atlantic (NEA) mackerel is an economically important species in the pelagic fishery of many coastal states in northern Europe. It has been harvested commercially for decades. The EU and Norway have shared this stock since the 1970s. Russian vessels have harvested the stock in Faroese waters since the 1980s. In 2000, the coastal states of the EU, Norway, and the Faroe Islands implemented an agreement on the sharing of the harvest in the NEA mackerel fishery. The agreement was made through the North East Atlantic Fisheries Commission (NEAFC), and, as a member state of the NEAFC, Russia received a share (4.5%) in the international area. The Faroe Islands were allocated 4.6% of the total quota, while the EU and Norway shared the remainder of the quota, with a 62.3% share for the EU and a 28.6% share for Norway (numbers based on the NEAFC (2006) agreement). This agreement was stable and was re-negotiated with the same percentages for a couple of years. However, in 2007, the migration pattern of the mackerel stock changed. Without precedent, the stock entered the Icelandic EEZ. The Icelanders began fishing mackerel in significant quantities starting in 2008 (Ellefsen, 2013). The Icelanders were invited to the negotiations over the 2010 fishery quotas. However, the parties did not reach an agreement, and the Faroe Islands, as they were no longer satisfied with their share of the total stock, left the existing agreement, while the EU and Norway entered a bilateral agreement. After four years of meetings, a three-party five year agreement between the EU, Norway, and the Faroe Islands was signed in March 2014, with a 12.6% share to the Faroe Islands, a 49.3% share to the EU, and a 22.5% share to Norway (numbers based on NEAFC (2014) agreement). Due to disagreements on how to share the harvest of the mackerel stock, Iceland and Russia were not signatories to in the agreement, but these parties, together with Greenland, were allocated a 15.6% share in the agreement. The existing harvest of the stock by the original coastal states, in combination with the fishing activity of Iceland, and later Greenland, implies that every year since 2008 the mackerel harvest has been well above the level recommended by the ICES biologists (ICES, 2012), as illustrated in Fig. 1. However, due to uncertainties about the ecological conditions, the biologists have recently abandoned their former biological model (ICES, 2013), resulting in the total allowable catches (TAC) for 2014 having been raised substantially. The TAC was raised by 87% from 542,000 tons in 2013 to 1,011,000 tons in 2014 as seen in Fig. 1. This sudden major increase in the biomass raises the question whether the biological information for the preceding years has been accurate or whether the biomass has been underestimated in preceding years (ICES, 2014). Fig. 1 also shows the fishery of the different nations involved in the fishery. From the figure we see that since the original agreement from 2000 EU and Norway have been major parties in the mackerel fishery. Since 2007 Iceland has been active, as well as Greenland from 2013. The Faroes and Russia have also increased their share of