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RTI may offer a solution to the choke-species problem under the landings obligation

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Summary

The 'Real-Time Incentive (RTI)' fisheries-management instrument replaces catch/landings quotas and days-at-sea limitations with a single 'quota' of fishing-impact credits ('RTIs'), for the integrated regulation of fishing mortality rates of multiple species and impacts on the ecosystem. Fishers can fish where and when they want and spend their allocated RTIs according to spatiotemporally varying tariffs. Managers set the tariffs based on agreed target mortality rates of multiple species, using knowledge of the spatiotemporally varying catchabilities of the various species caught/impacted in a mixed fishery. Through conceptual simulations we explore algorithms for combining historical and real-time CPUE data of the different species. Results demonstrate: In a traditional landings-quota scenario the fishers continue fishing until all quotas are exhausted and overexploit two of the three species by 100% and 33% respectively. In a catch-quota scenario (or equivalent effort-regime) where fishers have to stop fishing as soon as the first quota is exhausted, two of the three species are underexploited by 50% and 33% respectively. In an RTI-scenario, the choke species is overexploited by only 4% and the other two species underexploited by only 12% and 6% respectively. Our explorations demonstrate the potential of the RTI-system to address some problems of the landings obligation.

Introduction

The RTI management approach (Kraak *et al.* 2012, 2014) is designed to replace a multitude of quotas and other regulations (e.g. closed areas, technical measures) with one type of measure only, namely the RTI-tariffs and the individual allocation of RTI-credits. The system does not prescribe and forbid, but gives the fishers the freedom to fish where and when they want (barring closed areas) while choosing how to spend their RTIs, thus internalising the costs of fishing (costs to the commercial stocks and the ecosystem) into the individual fishing business. Particularly, the system could help address the "choke-species problem". With landings quota (conventional "TACs") fishers discard overquota catches of one species while fishing up their quotas for other species. Effort restrictions are sometimes used to limit effort to that needed to exhaust the most stringent quota. Also catch quota combined with a discard ban would restrict the fishing activity to that needed to fish up the most stringent quota. In both cases (catch quotas and effort limitations) the species whose quota is most stringent "chokes" the fishery leading to underexploitation of the other species. In case of a catch quota system, it is possible for fishers to fine-tune their targeting in time and space, and so balance their catches with their quotas (Branch and Hilborn 2008); but this requires that the fishers keep track of their usage of multiple quotas. With RTI, fishers have to keep track of only one currency. Because RTI has only been designed in blue-print, it has to be carefully examined whether, in principle, it works as envisaged.

Please check out my YouTube movie where I explain the study to you in 11 minutes.

Methods

We use an individual-based simulation model (Kraak *et al.* 2014), which is a parsimonious choice to explore the operational challenges to the RTI system as it allows us to study how system level properties emerge from the behaviour of individuals and how the system subsequently affects individual behaviour. We include variability among individuals, local interactions, and adaptation of individual behaviour relative to the changing environment. The model is abstract, based on fictive species, fictive fishers, and a fictive distribution area. The area consists of 100 cells, and time is divided up in 'years', consisting of 50 'weeks', which each consist of 6 'days'. We modelled 3 species with independent spatial distributions, and 100 fishers, distributed over 3 métiers, with each métier targeting one of the three species. We simulate that the tariffs are updated in weekly time-steps based on spatial real-time e-log information from the fishers, and there is a Harvest Control Rule adapting on an annual time scale: if the target Harvest Rate is overshot or undershot by more than 10%, the tariff thresholds are adapted. The algorithm we explore for combining the 3 species' CPUEs of the previous week for the setting of tariffs is as follows: For each species, if the week's CPUE in a cell falls in a higher or lower class than the week before, the species-specific tariff will be set one level higher or lower respectively; the highest of these 3 species-specific tariffs will be the tariff set for that cell for next week. The CPUE classes are initially as follows: <0.1, 0.1-0.5, 0.5-1, 1-2, 2-5, and >5 times the average for that week, but these boundaries between classes are modified by multipliers that make the tariffs more or less stringent. These multipliers are adapted annually based on the Harvest Control Rule. In our simulations, species A is the choke species, species B needs twice as much ***average effort*** to achieve the target Harvest Rate, and species C 1.5 times as much as the choke species A.

Results and Discussion

The outcomes of various scenarios demonstrate that RTI may work as envisaged when the resources have mutually independent, predictable spatial distributions (predictable because they are either autocorrelated in time or have seasonality). We ran simulations with traditional management, and found that under effort management the fleet would have only 70 days at sea, resulting in being spot on with regards to the target Harvest Rate of species A (the choke species) but in underexploitation of 50% and 33% with regards to target Harvest Rates of species B and C respectively. Under traditional landings quotas the fishers would use 140 days and fish up all quotas, leading to 100% overexploitation of species A and 33% of species C, while being spot on for species B. In contrast, with RTI, fishers can continue fishing during up to 130 days at sea if they target species B. In total there is only 4% of overexploitation of species A, and only 12% and 6% respectively of underexploitation of species B and C. So, in essence, the RTI management instrument is superior to effort management and landings quota, because it is able to use spatial heterogeneity and fine-tune the fishing opportunities so that each target can be approached much closer. It is superior to catch quota because it provides the fishers with only one 'quota' to stay within rather than multiple ones. This study is part of a series of explorations to examine how RTI may work in principle. Data-conditioned simulations are needed to evaluate the consequences in case studies. Please check out my YouTube movie where I explain the study to you in 11 minutes.

Reference

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