PROPERTY RIGHTS TO TRANSBOUNDARY FISHERY RESOURCES AND CONSEQUENCES FOR FISHERIES MANAGEMENT

Trond Bjørndal and Marko Lindroos

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Work in progress

Research question:

A very large proportion of world capture fishery production comes from fish stocks that are shared between two or more countries. While fish stocks that fully reside in the waters of one fishing state will be under the sole ownership and thus management of that nation, the issue of ownership and thereby management becomes more challenging for transboundary stocks. In this article we will address the issue of ownership of shared stocks and consequences for management.

BACKGROUND

The legal framework.

Within the EEZ, the coastal state has “exclusive rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living ----“ (UN 1982, Article 56 (1.a)).

When it comes to transboundary fish stocks, we have:

(a) Shared stocks crossing the EEZ boundary into the EEZs of one or more coastal states;

(b) Straddling fish stocks – stocks crossing the EEZ boundary into the adjacent high seas.

(c) Highly migratory stocks as defined in a special annex to the Convention.

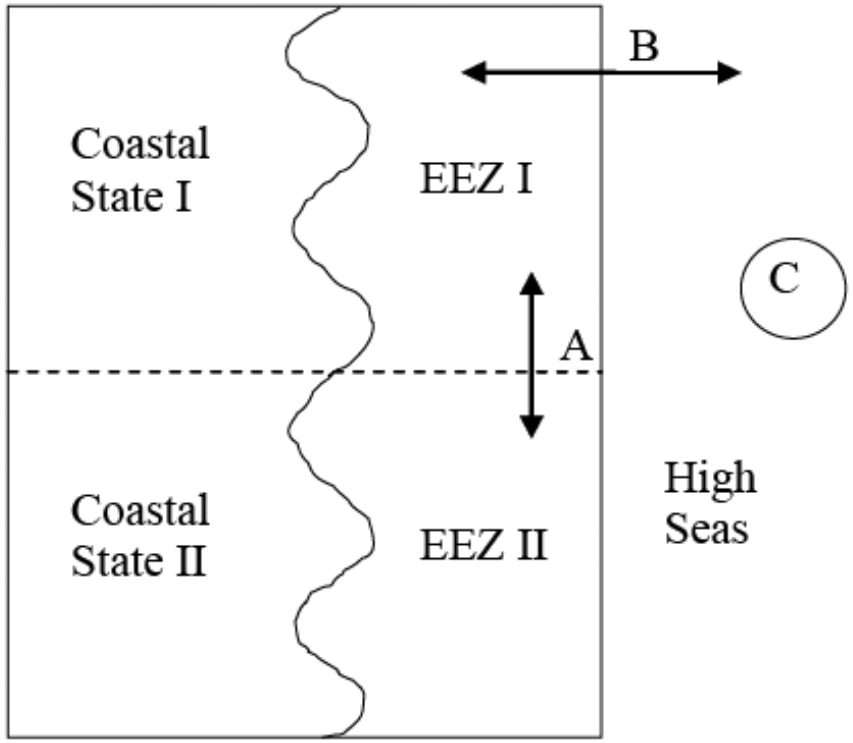


Figure. Shared stocks. A = shared stock. B = straddling stocks. C = discrete high seas fish stocks.
Source: Bjørndal & Munro (2012).

According to the 1995 United Nations Fish Stocks Agreement (UNFSA; UN; 1995), straddling fish stocks and highly migratory fish stocks are to be managed by Regional Fisheries Management Organisations (RFMOs), consisting of coastal states and relevant Distant Water Fishing States (DWFSs) with a “real” interest in the fishery.

Thus, exxclusive fish stocks existing in the EEZ of only one coastal state are under the management of the relevant state (UN, 1982). When it comes to shared, straddling and highly migratory fish stocks, however, the matter of property rights becomes much more complicated.

Principles for quota sharing

- *Zonal attachment* is a concept that has been suggested as a way to overcome disputes on how to share the TACs set for fish stocks. “Zonal attachment” = the share of the stock residing within a particular country’s EEZ, weighted by the time it spends in the zone over a year, if necessary.

- Although this principle might appear easy to apply, this is not necessarily the case. Shepherd and Horwood (2019) point out zonal attachment ignores several complicating factors. Fish migrate all the time, and there may be shifts in their distributions in response to climate change and other environmental factors. The reality is that one does not know where the fish are with any accuracy most of the time and there is no obvious basis for deciding how to assess and combine whatever information is available.

Qualifications to zonal attachment:

-Where are the fish most easily fishable?

-Where do the fish gain most weight?

-Location of spawning grounds

-Closeness to landing ports

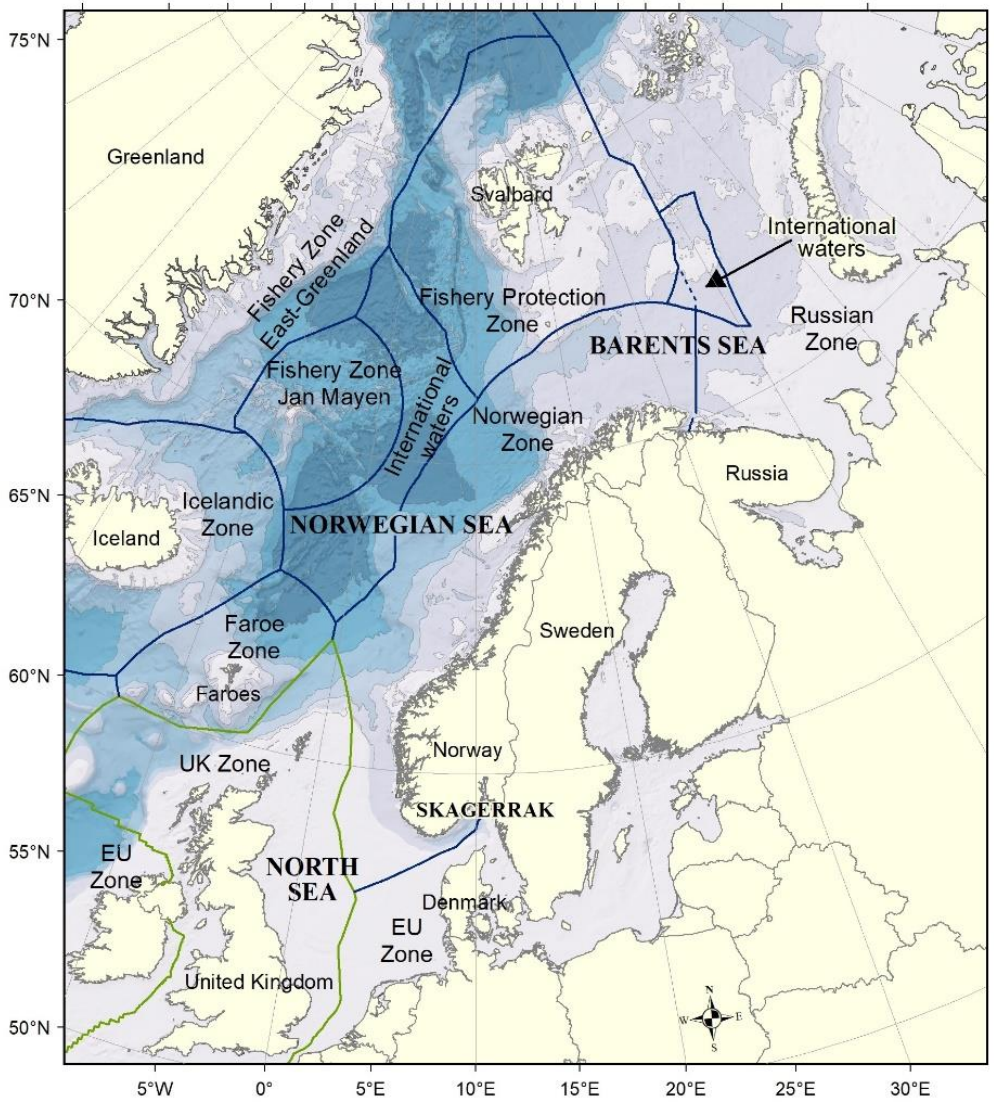
All these variables impact cost of harvesting and/or the price.

It is also important to bear in mind that zonal attachment is based on quantities. If benefits are shared in terms of revenues or net revenues, the outcome may be different from that of quantities (Bjørndal & Lindroos, 2004).

Environmental changes have had important impacts on fisheries all over the world. This impact is expected to become even greater in the future (Barange, 2018).

Unforeseen changes in fish stock migrations between national EEZs make the issue of arriving at and maintaining cooperative agreements on TAC and the distribution of these among interested nations difficult. With the division of catch quotas based on zonal attachment, it is not surprising that changes in fish migrations lead to a breakdown of existing agreements. This is an example in which a cooperative agreement may not be time-consistent.

The pelagic fisheries in the Norwegian Sea



The pelagic fisheries

The Norwegian Sea is home to three large pelagic fisheries for mackerel, Norwegian spring spawning – Atlanto Scandian herring and blue whiting.

In 2019, the total catch of these three species was 3,113,000 tonnes with a total value estimated at EUR 2.011 billion.

- The parties agree on annual TACs based on advice from ICES
- Each party sets national quotas; sum of unilateral quotas often > TAC
- Nevertheless, the three stocks are sustainably harvested (ICES)
- Cooperative agreements invariably break down because of changes in or disagreement about zonal attachment
- A working group reported on zonal attachment in February 2022, as a basis for new negotiations about quota sharing

Post-Brexit:

Fishery	Coastal states	Distant water fishing states
Mackerel	Norway, the EU, the UK, the Faroe Islands, Iceland and Greenland	Russia
Norwegian spring spawning – Atlanto Scandian herring	Norway, the UK, the Faroe Islands, Russia and Iceland	The EU, Greenland
Blue whiting	Norway, the UK, the Faroe Islands, and Iceland	Russia, Greenland

The mackerel fishery

- Mackerel is by far the most important of the three fisheries, in particular for the UK
- Important changes in the migratory pattern over time
- Post-Brexit, Norwegian and Faroese fishermen have not had access to fishing mackerel in the UK EEZ

Year	Cooperation	Notes
1999-2009	Tripartite coastal agreement Norway, the EU and the Faroe Islands.	
2008-2009	Tripartite agreement Norway, the EU and the Faroe Islands; Iceland singleton.	Iceland entered the fishery in 2008.
2010-13	Norway-EU agreement; Iceland and the Faroe Islands singletons.	As a consequence of Faroese demands for higher quota shares in 2010, the tripartite agreement broke down. Iceland demanded quotas as a costal state. Norway-EU agreement included access. In 2013, mackerel migrated to the Greenland EEZ for the first time.
2014-20	Renewed tripartite agreement Norway, the EU and the Faroe Islands; Iceland singleton.	Greenland has had no bilateral agreements regarding mackerel with any other country.
2021-	Agreement on TAC, unilateral quota setting by all countries	The UK enters as a coastal state.

BREXIT AND UK-EU FISHERIES COOPERATION

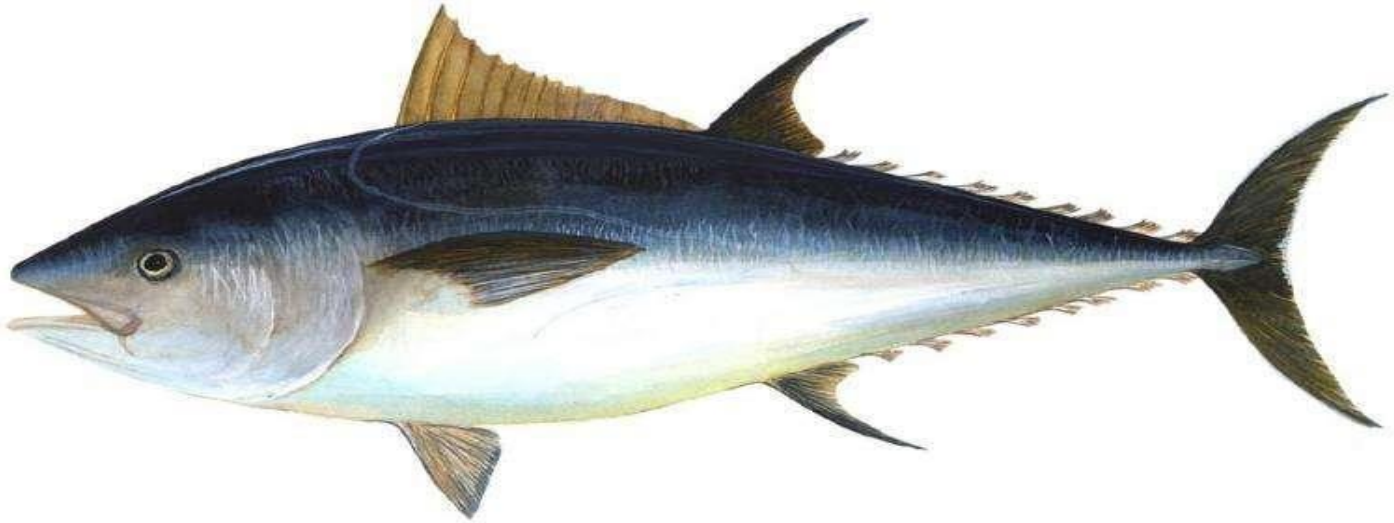
- In the Brexit negotiations, the UK demanded larger quota shares for many fish stocks based on zonal attachment. Moreover, the UK demanded no linkage between fisheries and trade.
- The 1980 Agreement, that manages fisheries in the North Sea, has essentially been maintained, however, it is now an EU-UK-Norway agreement. As before, TACs for jointly managed stocks are set annually; the quota shares of Norway on the one hand and the EU-UK on the other hand remain unchanged.
- As a consequence of the 2020 Trade and Cooperation Agreement (TCA), there have been adjustments in the quota shares of the UK and the EU. The UK has increased quota shares for cod (5.1 percentage points), saithe (2.7 percentage points) and herring (2.34 percentage points). On the other hand, there are reduced quota shares for haddock (2.2 percentage points), whiting (3.5 percentage points) with corresponding increases in EU quota shares.
- UK quota shares for most of these species will increase up to 2026 at the expense of corresponding reductions in EU shares (UK and EU 2020, ANNEX FISH.2).
- An important part of the 1980 Agreement was that, each party, within its EEZ, should grant access to fishing vessels of the other party to fish. While this part of the agreement has been maintained by the UK and the EU as well as Norway and the EU, currently Norway and the Faroe Islands have reduced access to the UK zone.

Other matters:

- The UK cannot unilaterally change the fisheries agreement without consequences in other areas (trade, transportation etc).
- The value to the UK of increased quota shares is still unknown.
- Did we witness a «fisheries» game between the UK and the EU?

The Northeast Atlantic and Mediterranean Bluefin Tuna Fishery: Back from the brink?

The Northern Atlantic and Mediterranean Bluefin tuna (*Thunnus Thynnus*) is a large oceanic pelagic fish and is also the largest of the tunas. Tuna is classified as a highly migratory fish stock.



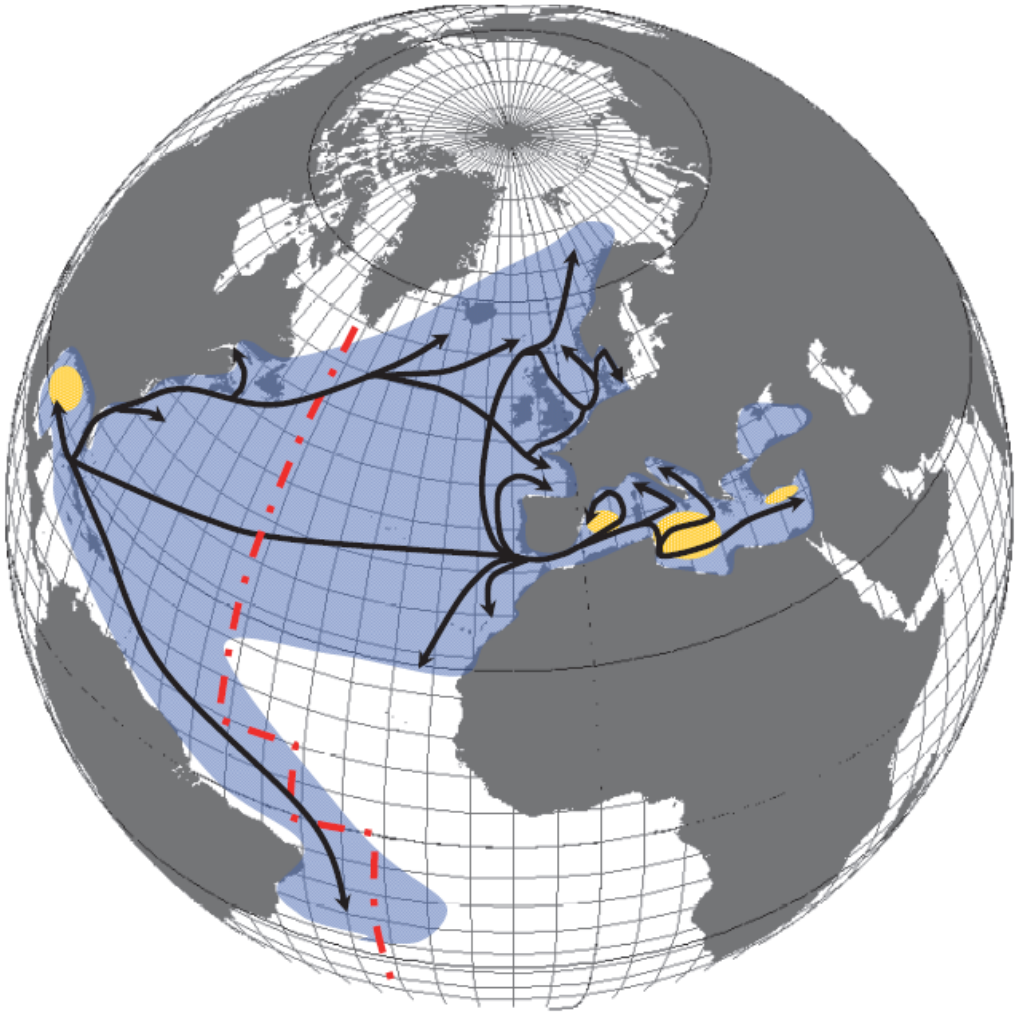


Figure 8.2. Map of the spatial distribution of Atlantic bluefin tuna (blue), main migration routes (black arrows) and main spawning grounds (yellow areas). The vertical dashed line depicts the stock delimitation between the two current ICCAT management units.

The management of the Northern Atlantic Bluefin tuna is the responsibility of the International Commission for the Conservation of Atlantic Tunas (ICCAT), an RFMO, which has 52 contracting parties and five “co-operators”.

Historically, more than 50 countries have participated in the fishery for East Atlantic bluefin tuna; currently (2018), 22 participate, including DWFSs employing long line.

At the end of the 1990s and in the early 2000s, the situation was very grave.

ICCAT (2006) itself indicated there might be a possible collapse of the stock “in the near future” unless adequate management measures were implemented.

A new management plan was introduced in 2007

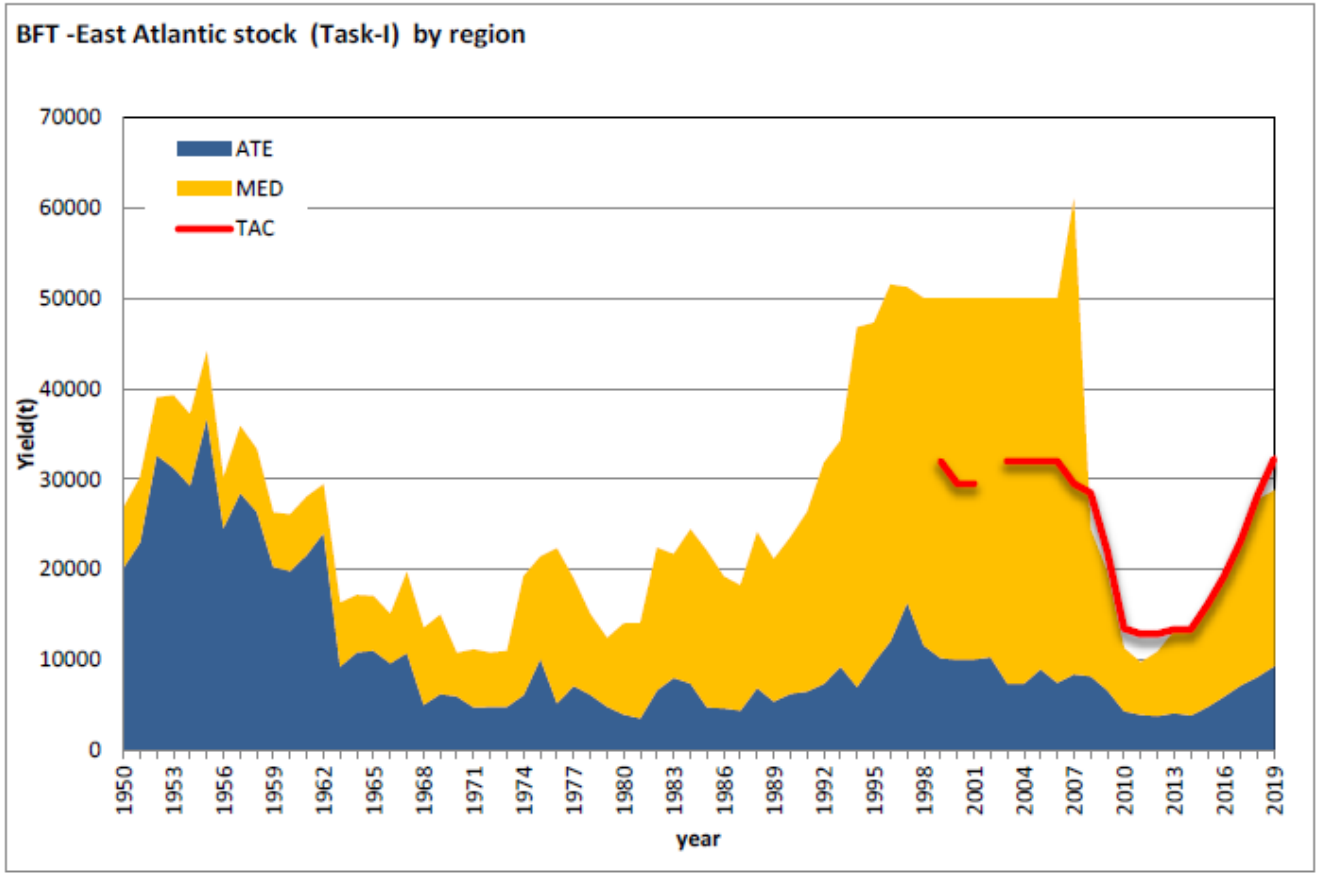
with the goal of achieving Bmsy with greater than 60% probability by 2022. TACs were drastically reduced and, importantly, official catches have ever since been in line with TACs.

Recovery plan measures:

1) Each fishing gear is regulated.
2) CPCs shall take the necessary measures to prohibit catching of small tunas.
3) Each CPC shall adjust its fishing capacity to ensure that it is commensurate with its allocated quota.
4) Vessel record.
5) A vessel monitoring system with stereo video cameras.
6) An observer programme was introduced.
7) Transhipment of bluefin tuna at sea is prohibited.
8) Catch documentation: Each tuna harvested is issued with a “certificate” that will accompany it until the point of final consumption or trade. Tunas without “certificate” cannot be traded in Japan and the EU.

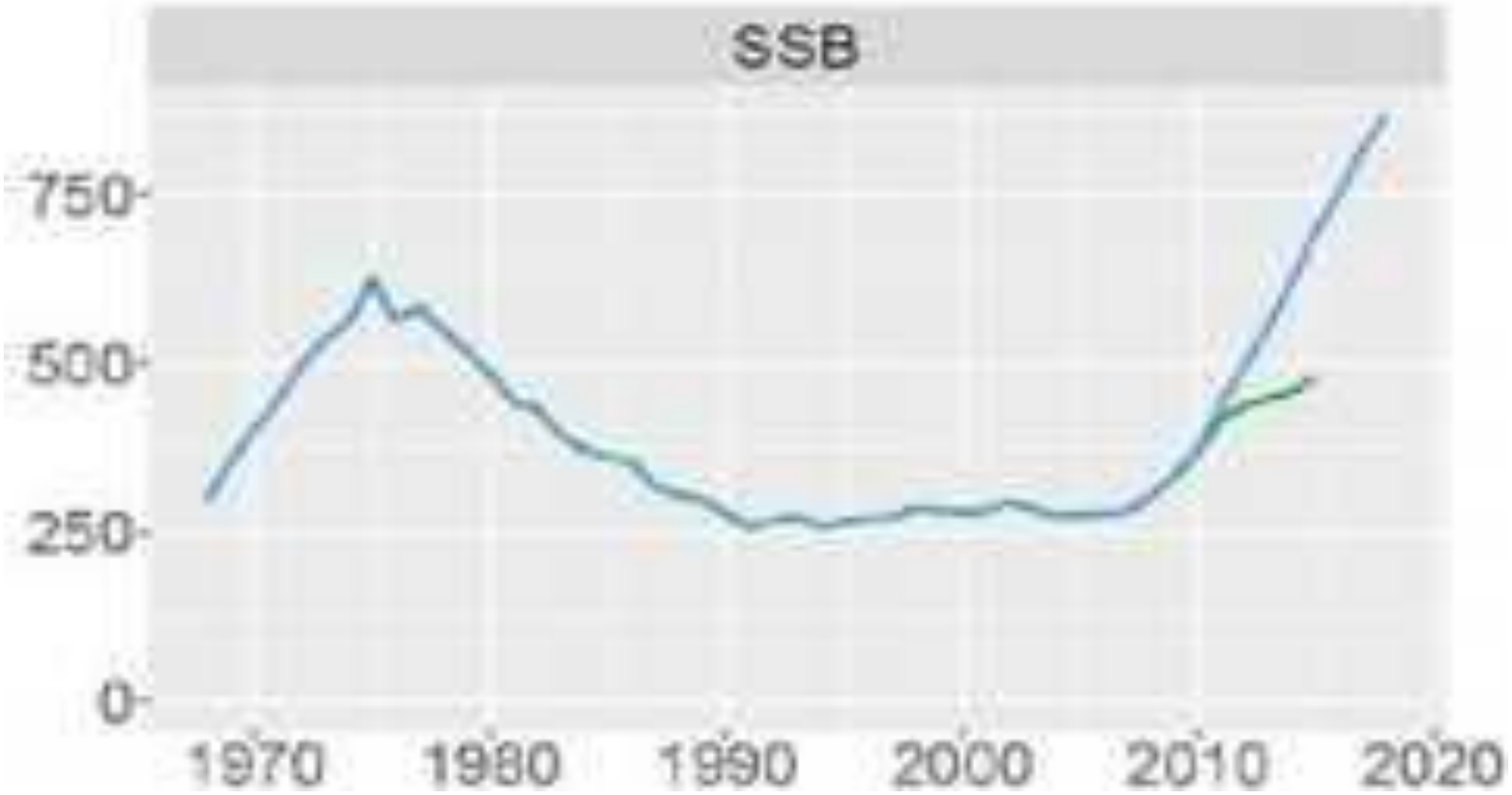
One indication of success:

The North Atlantic bluefin tuna fishery collapsed in the early 1960s and was absent from this area for more than 50 years.



Blufin tuna catches, Atlantic and Mediterranean, 1950-2018.
TAC 1995-2018. Tonnes.

Bluefin SSB 1968-2018



Policy challenge

One challenge to be encountered in the restoration of the stock arises from the fact that over 50 states participated in the fishery, when the resource was healthy, while currently 20-30 are active. Should the stock continue to improve and, as a consequence, the distribution area be extended, there will be a strong incentive for more states to join the fishery.

Question: Will the current cooperative management prevail?

- Effective communication among players
- Individual rationality constraint
- Collective rationality constraint
- Time resilience

Complication: the number of players matters. Once the number of players exceeds two, we run into the possibility of sub-coalitions. While we may have full cooperation, we may also have partial cooperation.

In addition, there is the problem of free riding: If free riding is rampant, condition number two, the “individual rationality” constraint, will not be satisfied. The difficulty in suppressing free riding increases exponentially with the number of players.

IUU fishing historically took on very large proportions. It is believed that the amount of IUU fishing has been severely reduced.

Another issue is the new member problem, which may lead to strain or even the breakdown of a cooperative agreement. Usually this is considered in a context where “new” DWFS may commence fishing on the high seas, however, for bluefin tuna this issue is relevant also for some coastal states. The resilience of the cooperative agreement will also depend on how new members are given quotas.

Incentives for IUU fishing:

- The high price of bluefin tuna and associated good profitability

- High seas fishing is difficult to monitor.

- Transhipment at sea is illegal but is also difficult to monitor.

So: What will the future bring for bluefin tuna?

Modelling issues

- Study of existing international property rights systems
- What elements are needed for stable sharing rules among countries
- Existing literature
- Future research needed

Sharing rules

- Theory, Shapley value, nucleolus etc are based on cooperative game theory: How to share benefits from cooperation.
- Endogenous sharing rules, eg in partition function games, also consider the externalities for countries not in the agreement. Positive externalities are a problem as they enhance free-riding opportunities.
- Three stages needed,
  (i) setting the sharing/allocation rule,
  (ii) formation of agreements,
  (iii) fishers play the game
- Note that (i) could also be replaced by countries setting management schemes/instruments such as taxes or enforcement policies

Comparing sharing rules

- Theoretically optimal ones, like the Almost Ideal Sharing Scheme which maximises the number of countries in the agreement and performs bioeconomically best
- Actual ones that are a result of political processes, lobbying, history etc like the principle of relative stability
- Simple ones like Equal sharing rule

Literature

- S. Kulmala, P. Levontin, M. Lindroos & P. Pintassilgo [2013]. Atlantic salmon fishery in the Baltic Sea - A case of trivial cooperation? *Strategic Behavior and the Environment* 3, 121-147.

For Baltic Salmon, relative stability principle results in only the trivial coalition being stable, hence relative stability causes instability.

- E. Nieminen, L.G. Kronbak and M. Lindroos [2016]. International Agreements of the Multispecies Baltic Sea Fisheries. *Environmental and Resource Economics*.

Multispecies management stabilises cooperation.

Future work 1

- Set up a model where we concentrate on stage (i)
- Non-cooperative behaviour on choosing the allocation / management scheme. Countries optimise with respect to their preferred allocation rule, result is a non-cooperative equilibrium in the first stage
- Bargaining on allocation / management scheme
- Application to a case study

Model 1, initial ideas

- Assume a 3-player symmetric game Pintassilgo and Lindroos 2008
- It is then known that the game is not stable (when checking for internal and external stability of the coalition formation game)
- Consider now the 1st stage of the game and set a sharing rule such that one of the players receives 0% of the catch
- Result is a stable game of the remaining 2 players
- Next study other sharing rules that may be stabilising given a positive share of the benefits for all players

- P. Pintassilgo and Marko Lindroos [2008]: Coalition Formation in High Seas Fisheries: A Partition Function Approach, *International Game Theory Review* 10, 303-317.

Preliminary results 1.1

- Consider a standard 3-player symmetric partition function game (Pintassilgo & Lindroos)
- It is then known that the game is not stable (when checking for internal and external stability of the coalition formation game)
- Consider now the 1st stage of the game and set a sharing rule such that one of the players receives 0% of the catch
- Result is a stable game of the remaining 2 players

- Next study other sharing rules that may be stabilising given a positive share of the benefits for all players
- Question: How large a share can be given to the 3rd player and still have stability of the international fisheries agreement?

Preliminary results 1.2

- Example: p=1, c=1, K=100, R=1, q=0.1
- Grand coalition payoff 20,25
- Two-player game payoffs 9,9,9 – total 27 hence not stable grand coalition
- However, giving one of the players 0% share creates stability as 20,25 – 18 = 2,25
-
- Maximum share the third player can be allocated is then 2,25/20,25 = 11,1%
- Case of four players: Payoffs 9,9,9,9, then you would be able to give a max 5,55% share to the outsiders

Remaining questions 1

- Question: How does this critical allocation percentage depend on the other parameters in the game ? That is, price, cost, catchability, biological parameters

- Note this could describe eg Brexit where one player is not anymore guaranteed a right to fish in the area and the remaining players need to consider whether to grant access to the third player.

- For asymmetric case see also: P. Pintassilgo, M. Finus, Marko Lindroos and G. Munro [2010]. Stability and Success of Regional Fisheries Management Organizations. Environmental and Resource Economics 46, 377-402.

- Then you would have more scope for cooperation and more scope for maintaining outsiders in the EEZ too (see the indexes)

Future work 2

- Build a two-period coalition formation game
- Study various allocation rules
- See which ones would perform best in time, or with stochastic shocks in the future (2nd period)

Model 2, initial ideas

- Consider an n-player asymmetric game Pintassilgo at al. 2010
- Depending on the parameters of the game number of countries in the agreement varies
- Now assume in the first period the game is stable
- Assume further a change in the cost structure or other parameters of the game after the first period
- If the change is significant the stability of the game may break down
- Note that this may also go to other direction in another game starting without an existing agreement
- Objective to study how coalition structures evolve in time

- P. Pintassilgo, M. Finus, Marko Lindroos and G. Munro [2010]. Stability and Success of Regional Fisheries Management Organizations. *Environmental and Resource Economics* 46, 377-402.