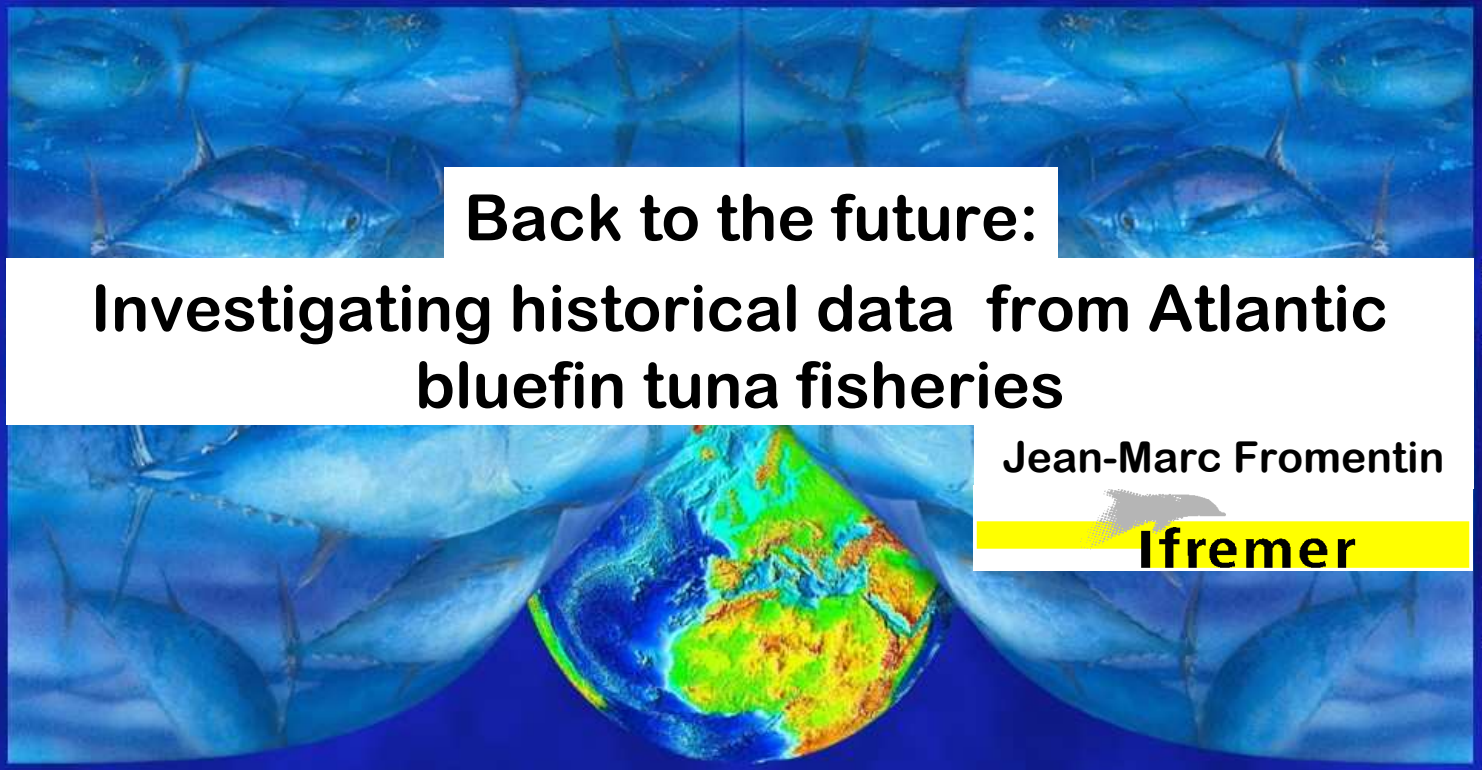
WORLD SYMPOSIUM FOR THE STUDY INTO THE STOCK FLUCTUATION OF NORTHERN BLUEFIN TUNAS (THUNNUS THYNNUS AND THUNNUS ORIENTALIS), INCLUDING THE HISTORIC PERIODS.

SANTANDER

22-24 APRIL 2008

SPAIN



Back to the future:

Investigating historical data from Atlantic bluefin tuna fisheries

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Ifremer

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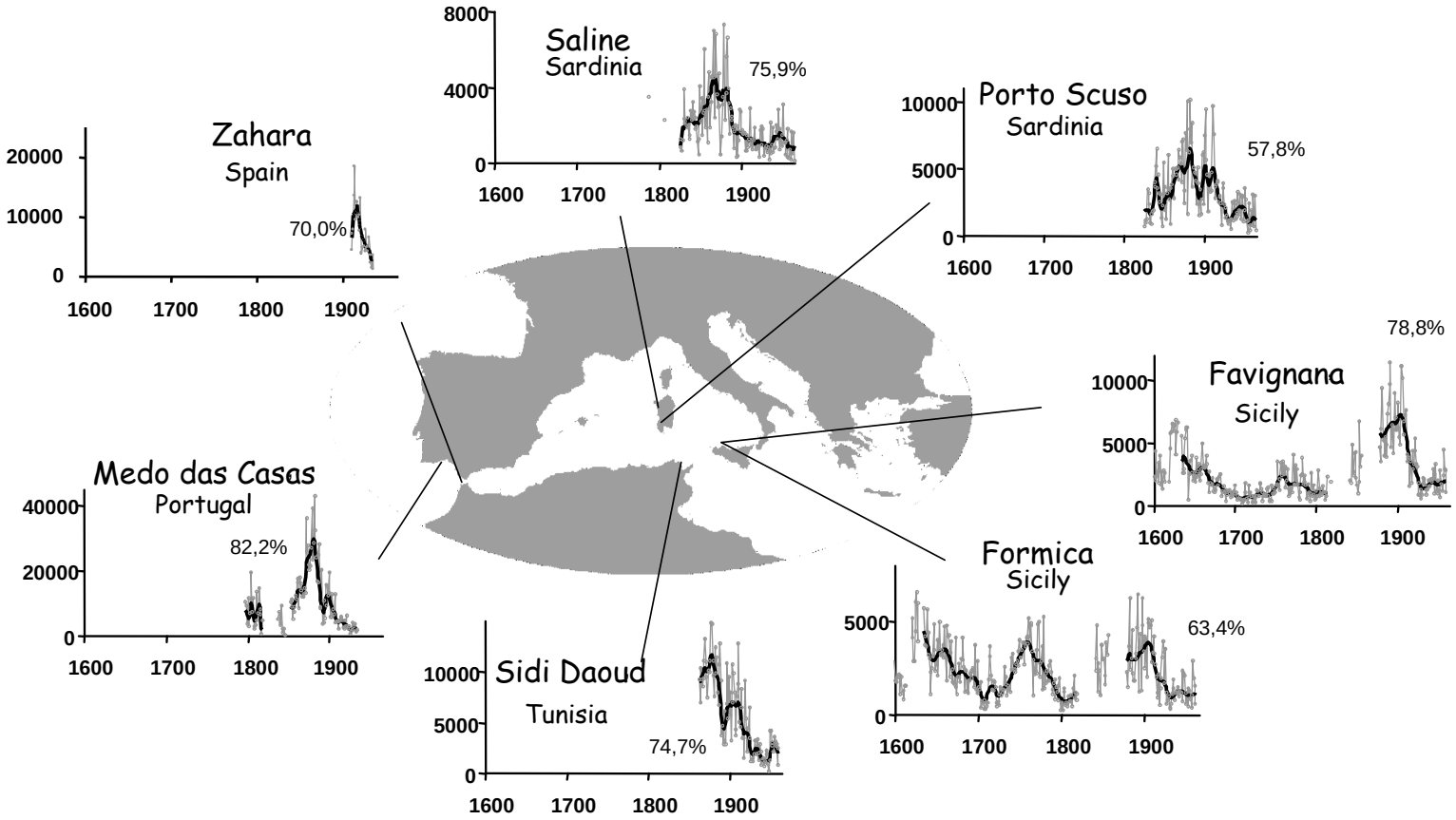
General context

Exploitation since the first millennium before Christ

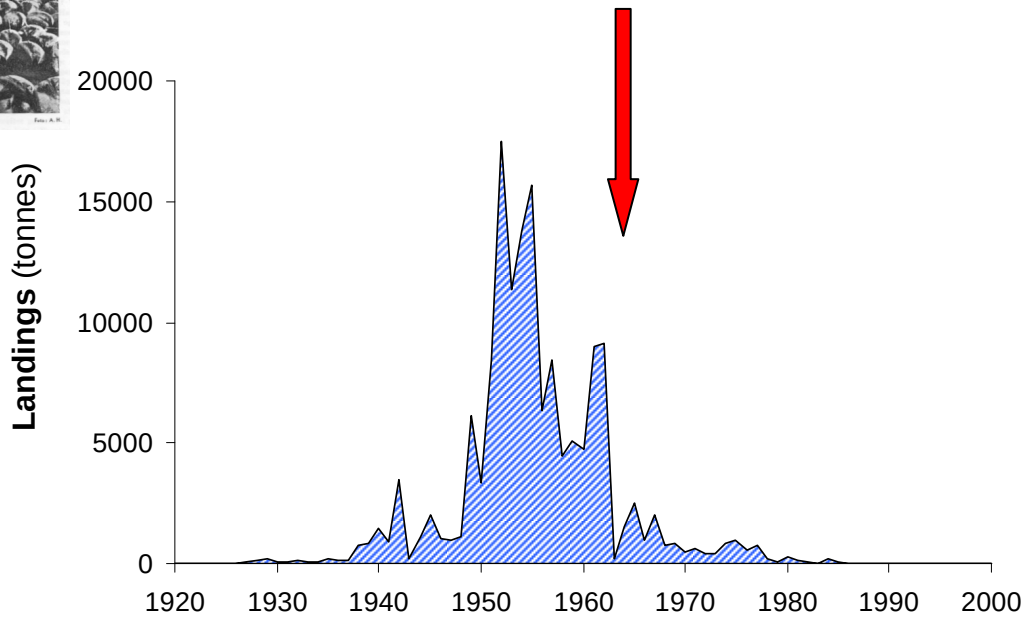
Bluefin tuna catch did not remain stable but displayed conspicuous long-term fluctuations, possibly in relation to changes in temperature *(Ravier and Fromentin 2001; 2004)*



The Nordic fisheries case

However, the leading Nordic fisheries were the most spectacular example of Atlantic bluefin tuna fisheries collapse *(Tiews 1978)*

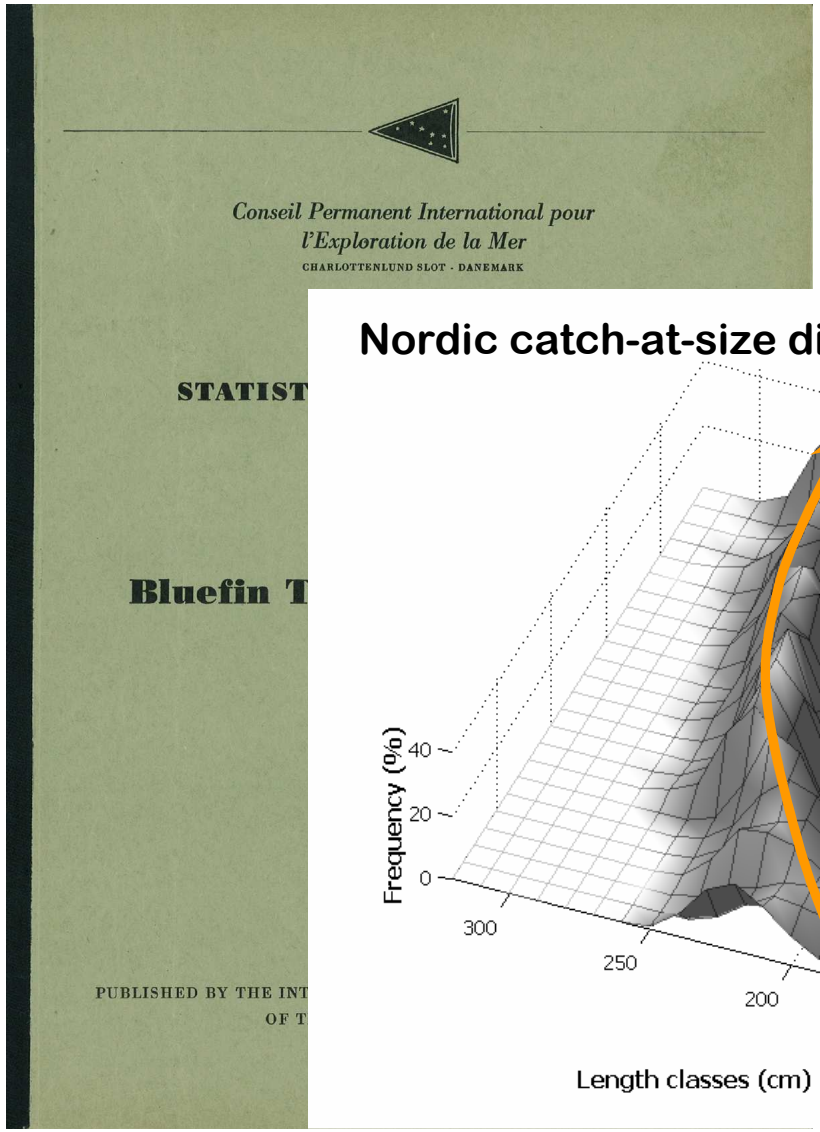
These fisheries suddenly collapsed in 1963 without any warning



What's happen to BFT in the North Sea and Norwegian Sea?

- Changes in migration patterns
- Restriction of the spatial distribution
- Recruitment failure/overfishing
- Eradication of a sub-population

The Nordic fisheries case



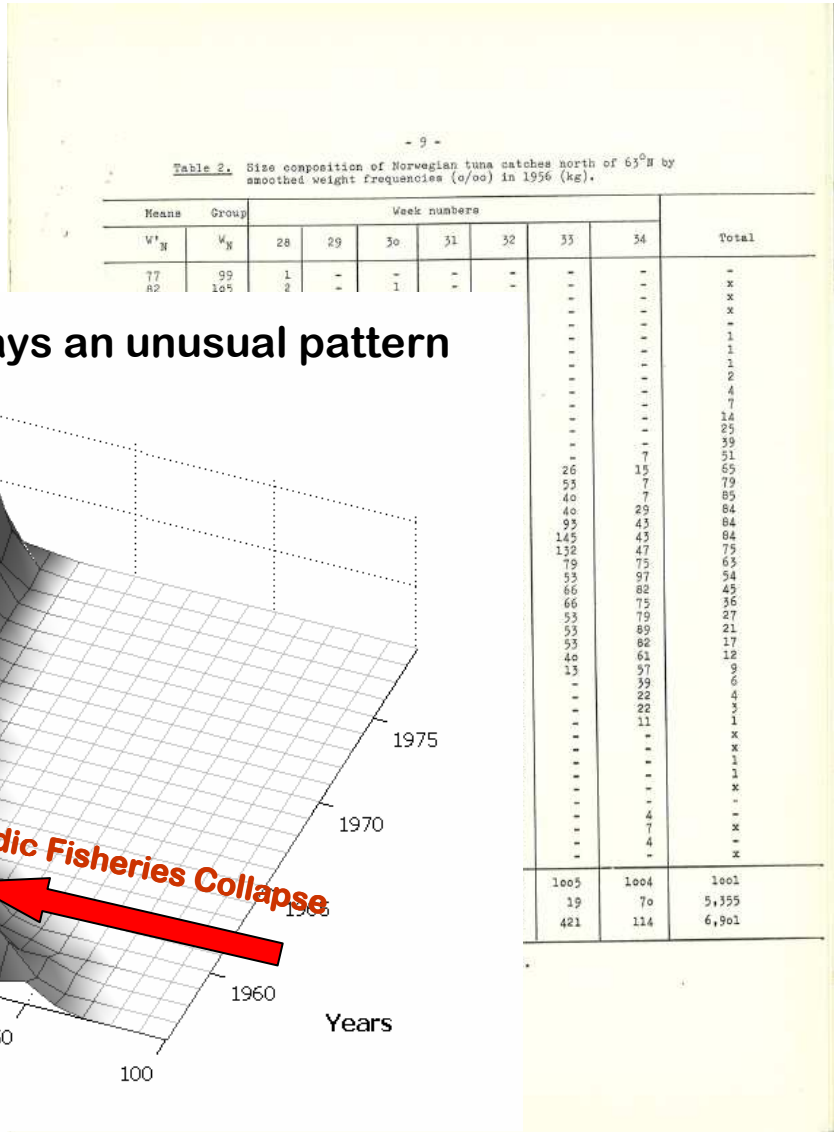


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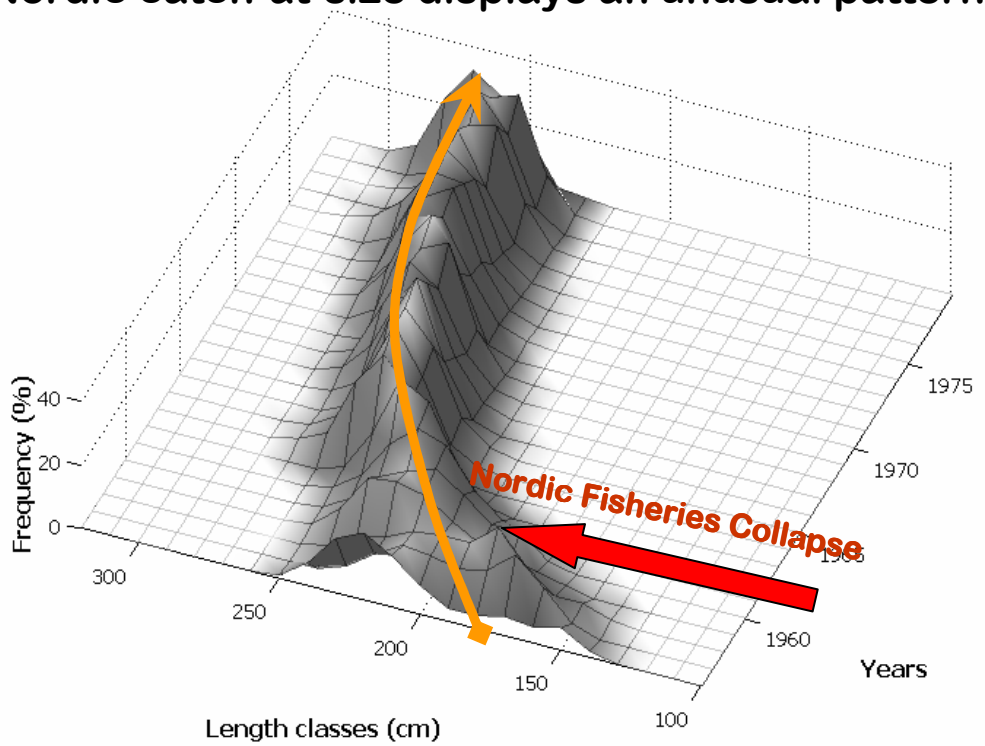
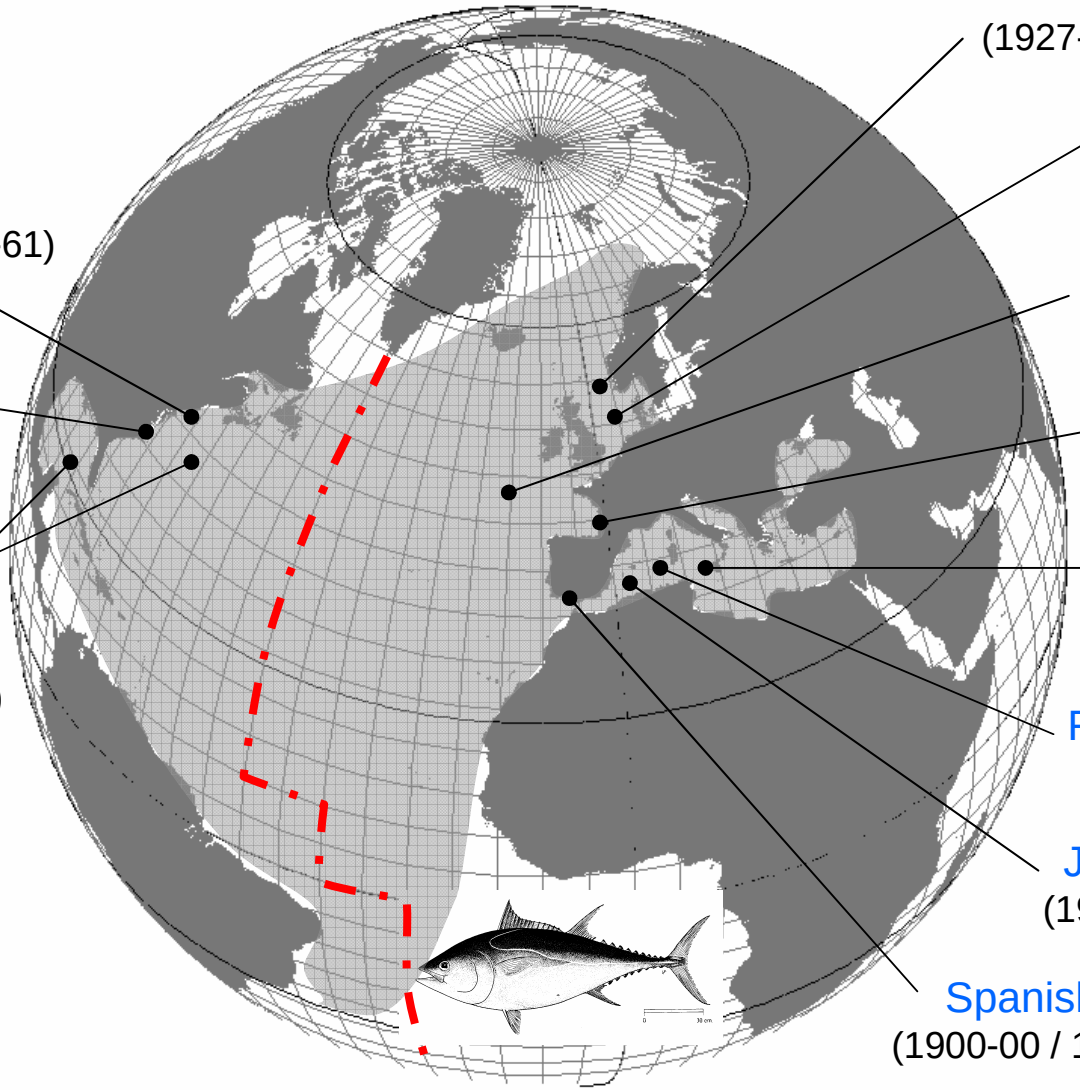
Table 2. Size composition of Norwegian tuna catches north of 63°N by smoothed weight frequencies (o/oo) in 1956 (kg).

Means		Group	Week numbers							
W'_N	W_N		28	29	30	31	32	33	34	Total
77	99		1	-	-	-	-	-	-	-
82	105		2	-	1	-	-	-	-	x
								-	-	x
								-	-	x
								-	-	x
								-	-	-
								-	-	1
								-	-	1
								-	-	1
								-	-	2
								-	-	4
								-	-	7
								-	-	14
								-	-	25
								-	-	39
								-	7	51
								26	15	65
								53	7	79
								40	7	85
								40	29	84
								93	43	84
								145	43	84
								132	47	75
								79	75	63
								53	97	54
								66	82	45
								66	75	36
								53	79	27
								53	89	21
								53	82	17
								40	61	12
								13	57	9
								-	39	6
								-	22	4
								-	22	3
								-	11	1
								-	-	x
								-	-	x
								-	-	1
								-	-	1
								-	-	x
								-	-	-
								-	4	-
								-	7	x
								-	4	-
								-	-	x
								1oo5	1oo4	1oo1
								19	7o	5,355
								421	114	6,9o1

Nordic catch-at-size displays an unusual pattern



Retrospective Analysis



Norwegian PS
(1927-79; 1956-79)

German PS
(1947-62; 1951-62)

Jap. LL (E. Atl.)
(1957-00; 1974-00)

Spanish BB
(1940-00 / 1966-00)

Italian TP
(1900-00 / 1956-79)

French & Italian PS
(1950-00; 1971-00)

Jap. LL (Med.)
(1963-00; 1974-00)

Spanish TP
(1900-00 / 1956-00)

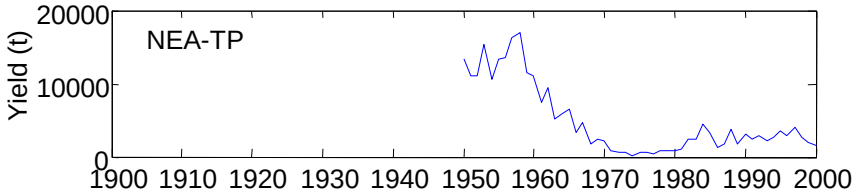
US TP
(1930-73; 1955-61)

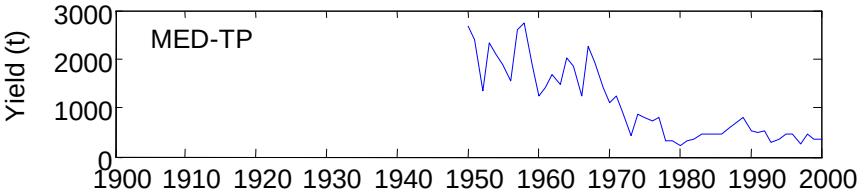
US PS
(1958-00; 1963-00)

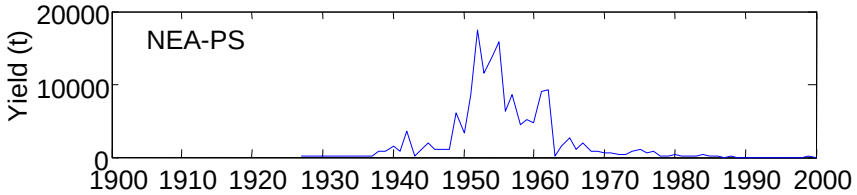
Jap. LL (W. Atl.)
(1957-00; 1971-00)

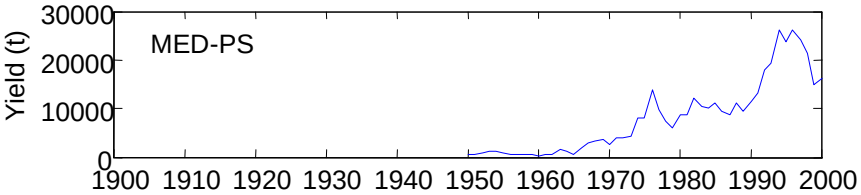
BB: Bait Boat
LL: Long Line
PS: Purse Seine
TP: Trap

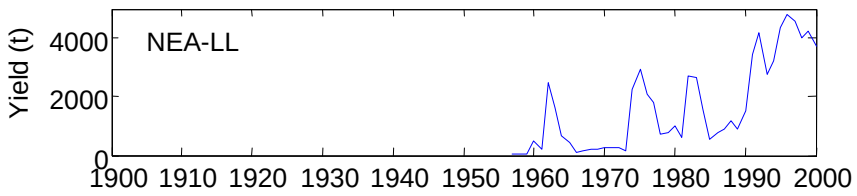
Retrospective Analysis: yeild

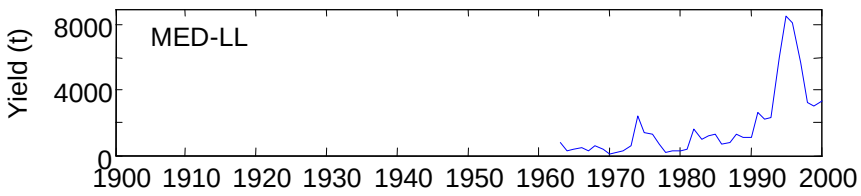


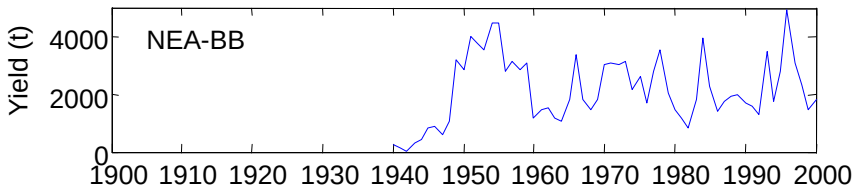


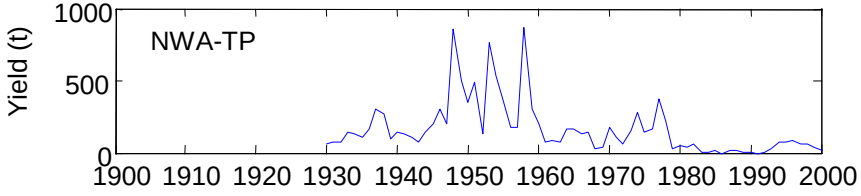


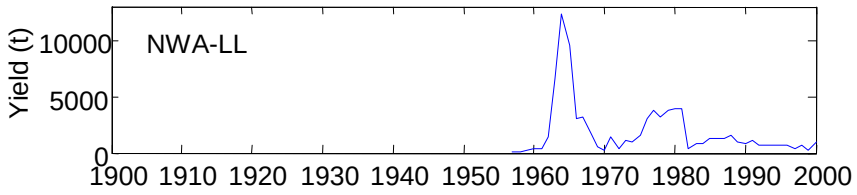


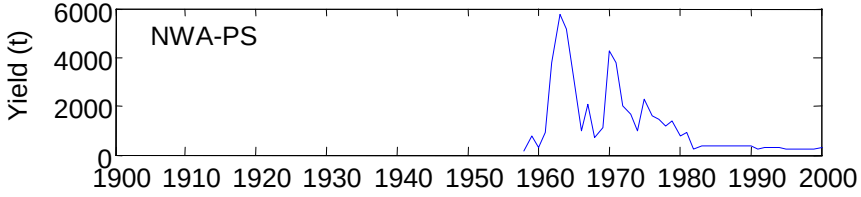




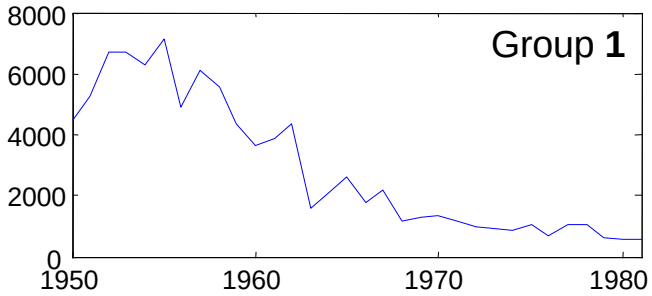


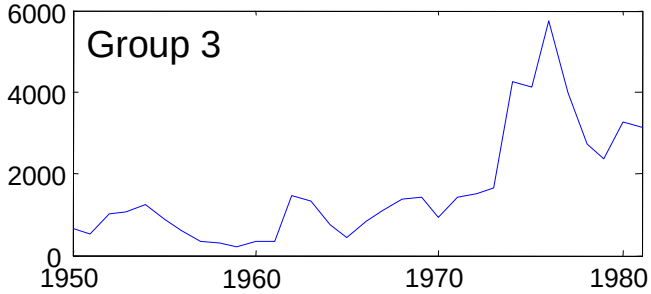


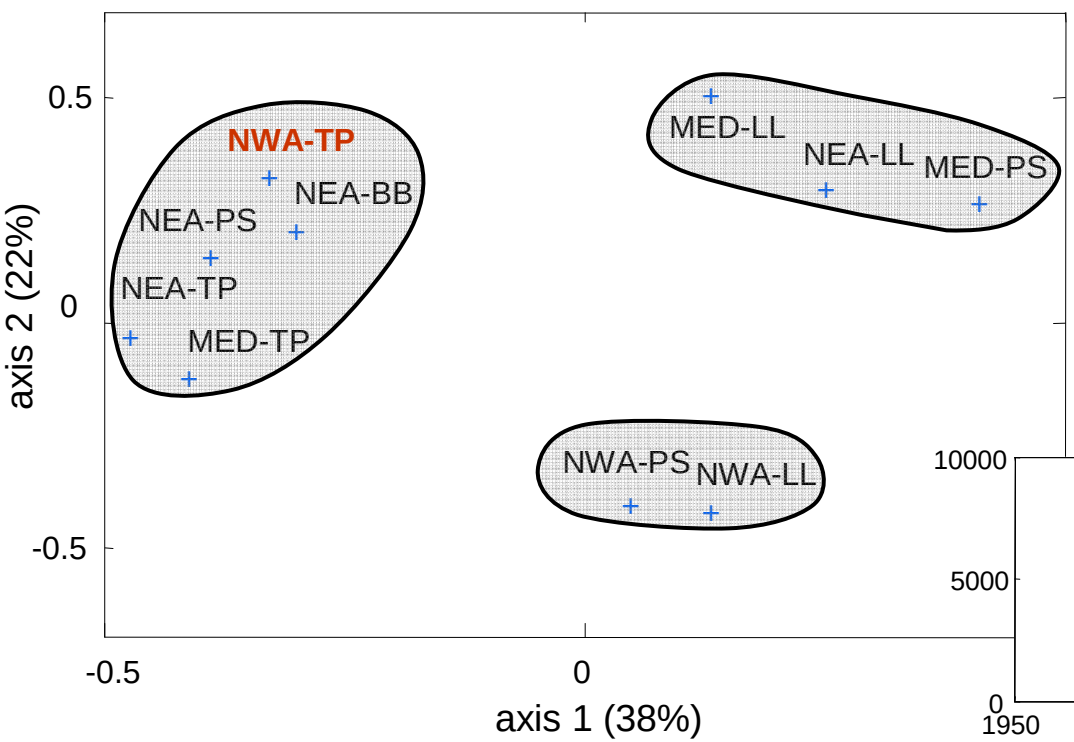


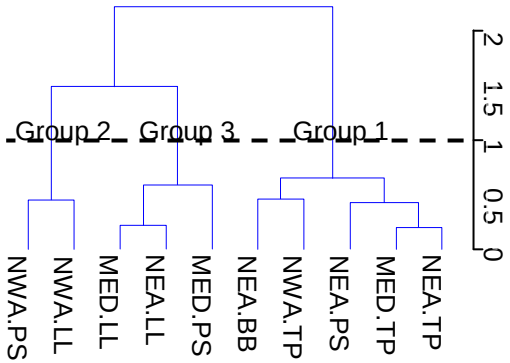


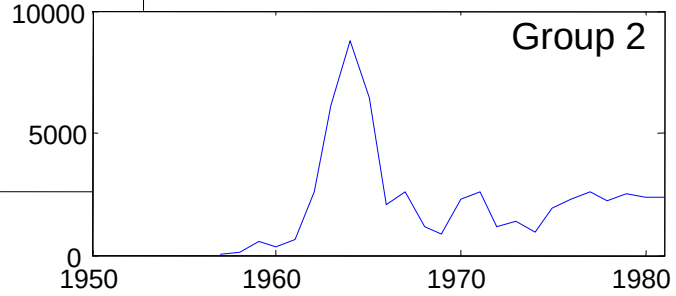
Retrospective Analysis: yeild





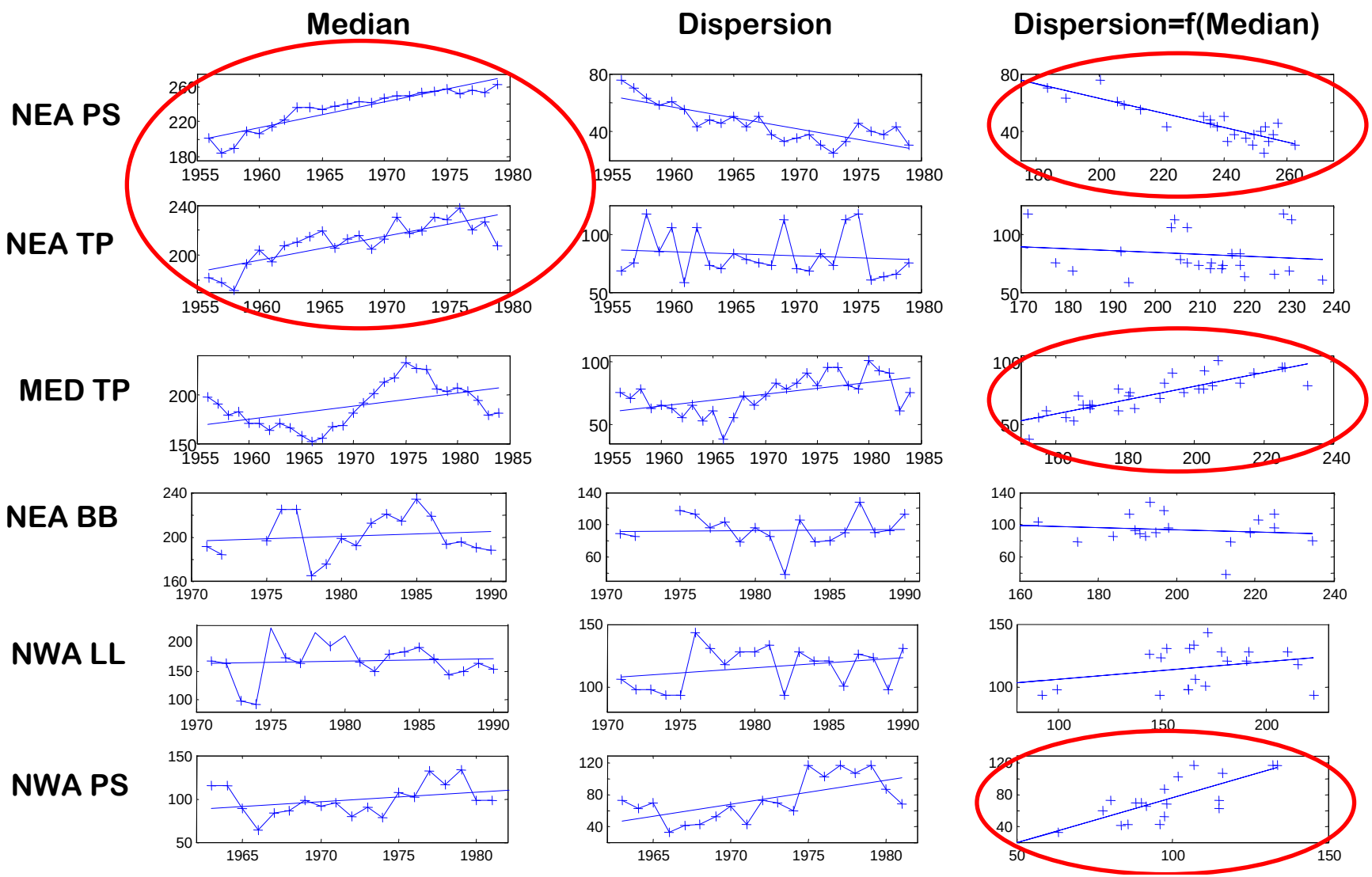






through time…

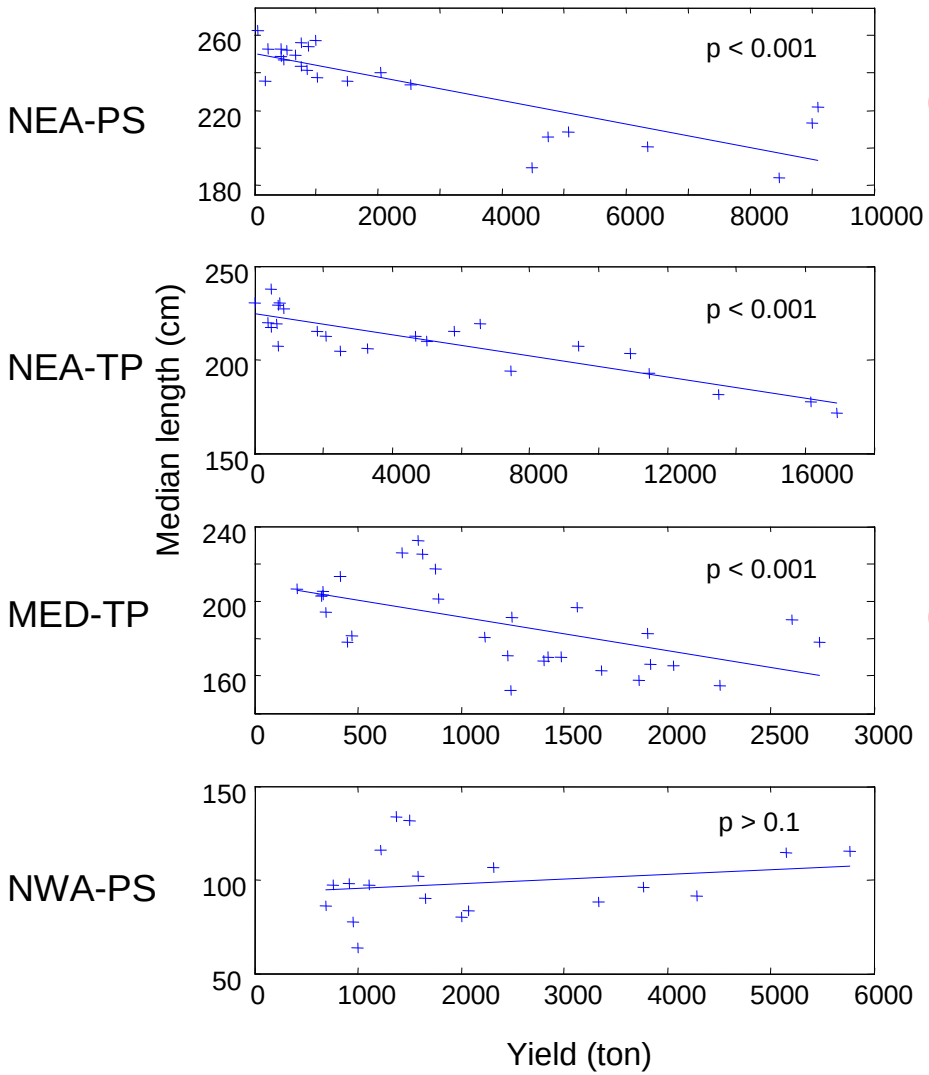
Retrospective Analysis: Size

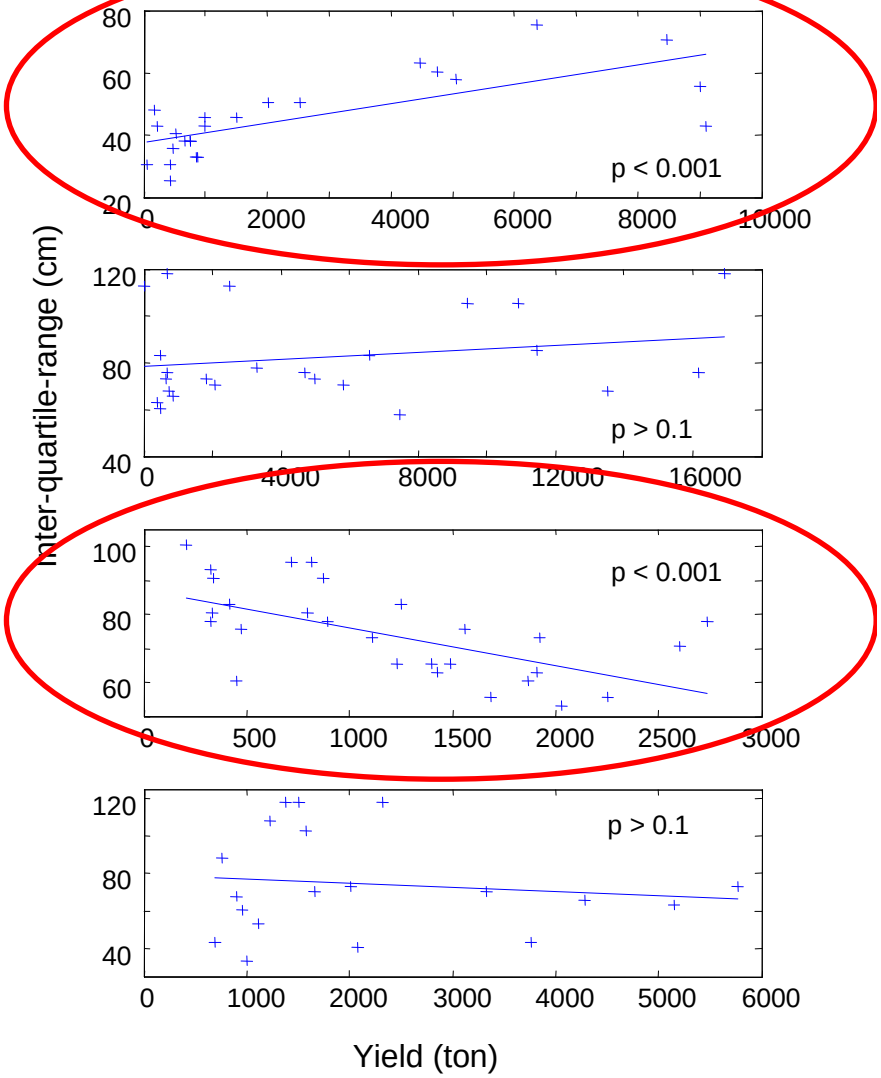


Retrospective Analysis: Size

Yield *vs* Median size

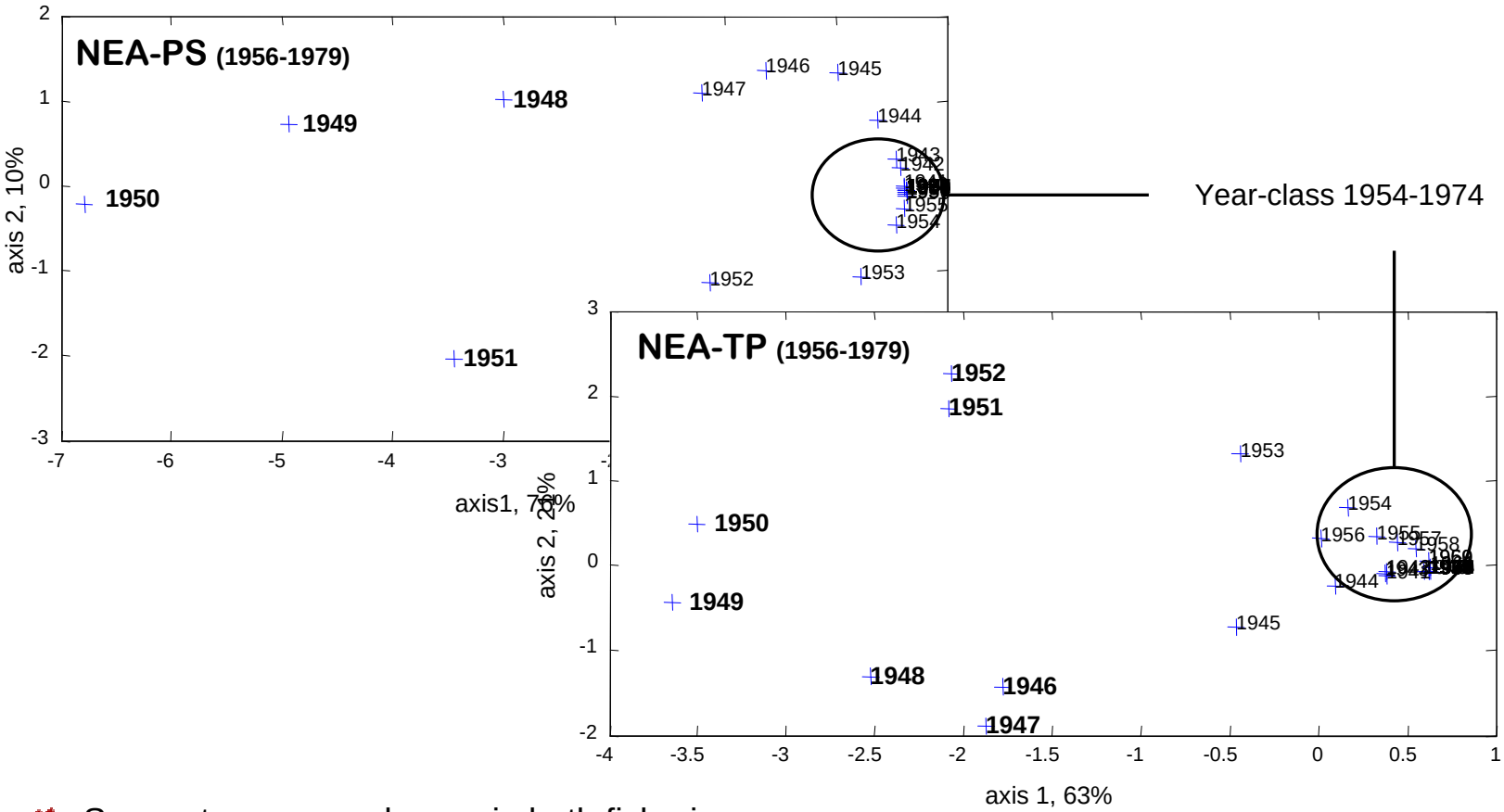
Yield *vs* Dispersion size





PCA…

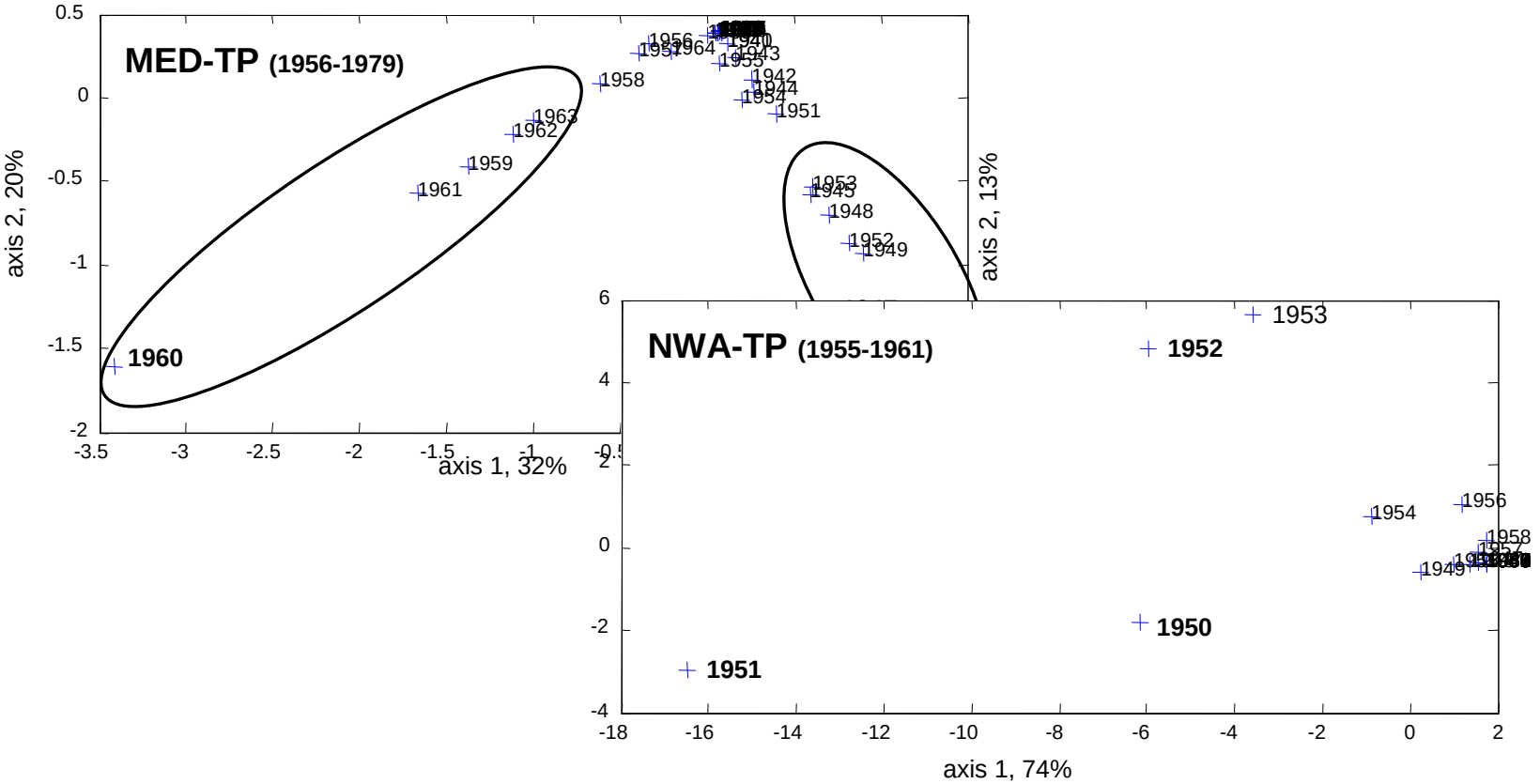
Retrospective Analysis: Cohort



- Same strong year-classes in both fisheries
- Include several continuous strong year-classes (here 1945 to 1952)
- There is no sudden stop, but a kind of “ebb and flow”

PCA…

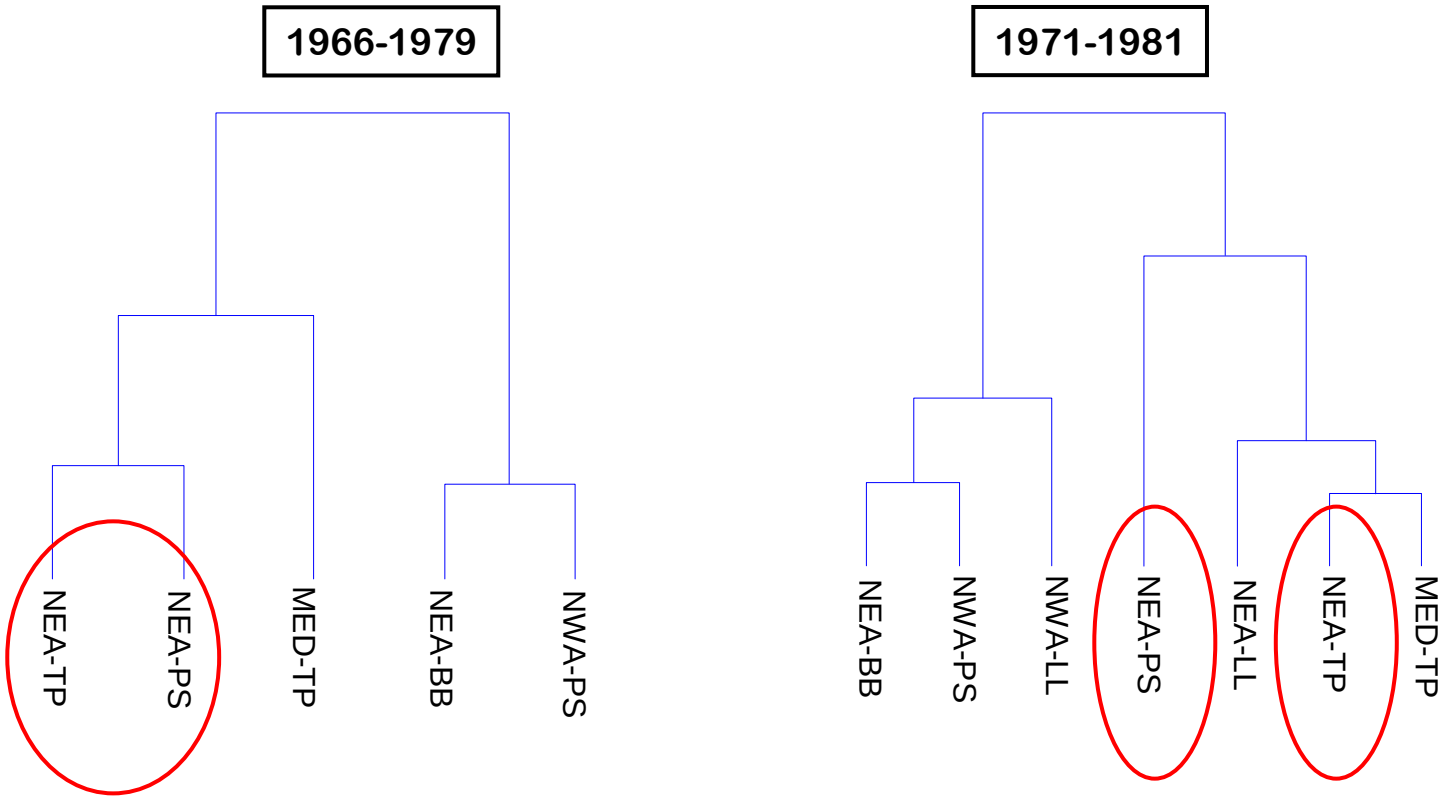
Retrospective Analysis: Cohort



- Other fisheries display different patterns, but also some similarities
- Also include several continuous key year-classes

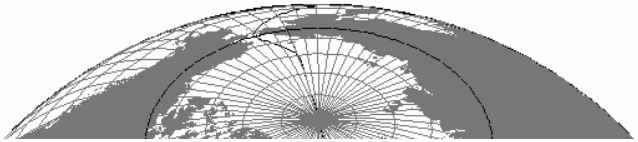
clustering…

Retrospective Analysis: Cohort

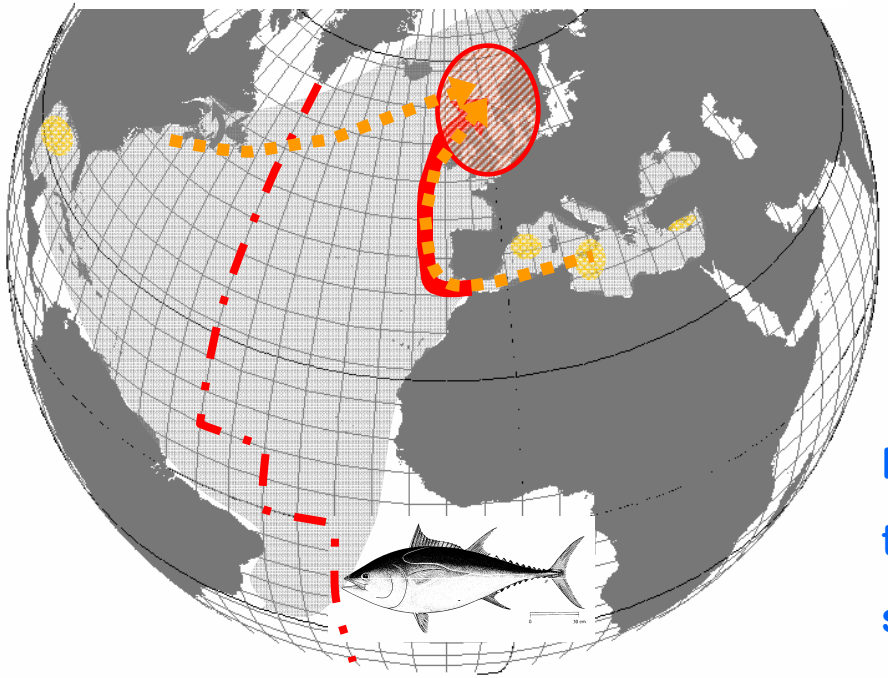


The strong link between Norway PS and Spain trap vanished during the 1970s

Discussion – Part 1



Key feeding ground in the Northeast Atlantic



- Strong connection between Gibraltar and the Northeast Atlantic fisheries during the 1950s and 1960s
- Possible connections between the Mediterranean Sea / Northwest Atlantic and the Northeast Atlantic

Main migration routes of Atlantic bluefin tuna were from the Mediterranean spawning grounds and from the West Atlantic coasts to the North Sea

In agreement with conventional tagging experiments from the 1950s and 1960s

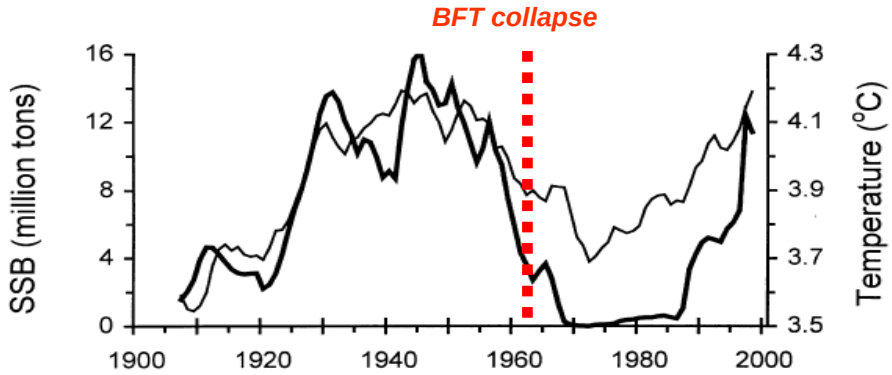
(Aloncle et al. 1974; Tiews 1978; Mather et al. 1995)

Discussion – Part 1

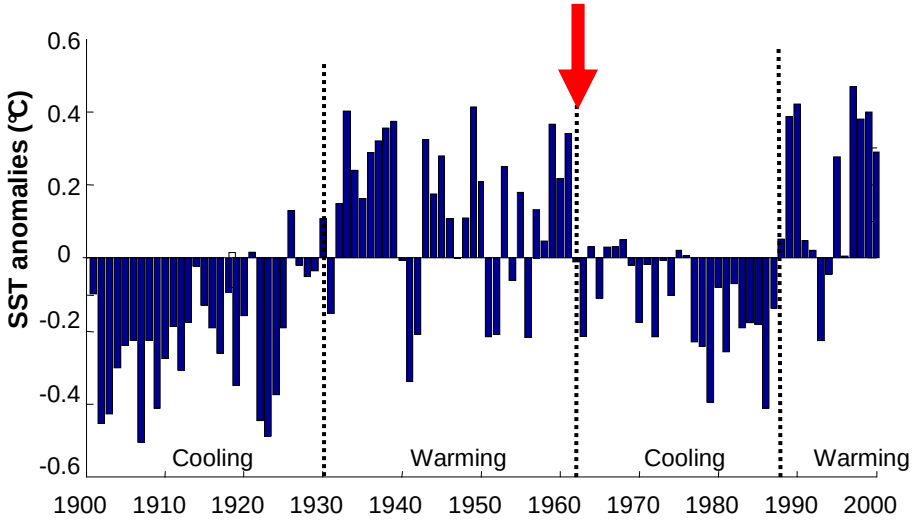
The Nordic bluefin tuna fisheries collapse might be due to the failure of the major Northeast Atlantic herring stocks

- Bluefin tuna primarily fed on juveniles herring (up to 400,000 tons/year, *Tiews 1978*)
- A significant cooling rapidly took place in the Northeast Atlantic in the early 1960s
- Atlantic herring stocks displayed large temporal and spatial variations being related to climate changes *(Hjort 1914; 1926; Alheit & Hagen 1997; Corten 2001…)*

Norwegian spring-spawning herring *(Torensen & Ostved 2000)*



SST anomalies from the Northeast Atlantic



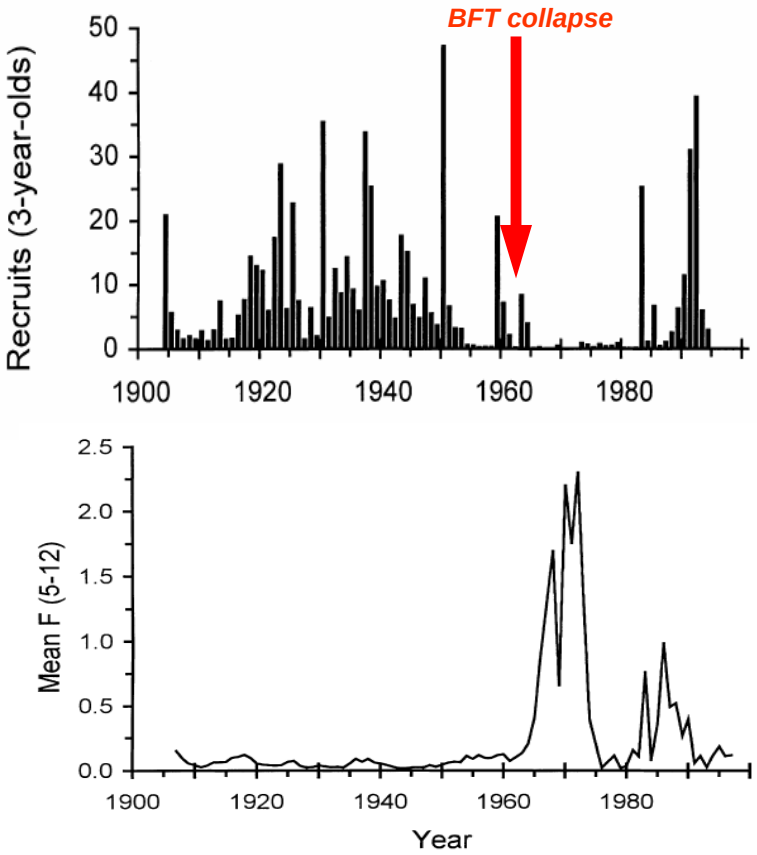
Discussion – Part 1

The Nordic bluefin tuna fisheries collapse might be due to the failure of the major Northeast Atlantic herring stocks

- The rapid cooling of the Northeast Atlantic could have affected herring recruitment that has indeed dropped since the mid-1950s and more obviously after 1962, so that this area could not support the voracious appetite of bluefin tuna

- The persistence of a high fishing capacity on herring has induced a huge increase in the fishing mortality and the crash of these populations *(another example of synergistic effects of climate and overfishing)*

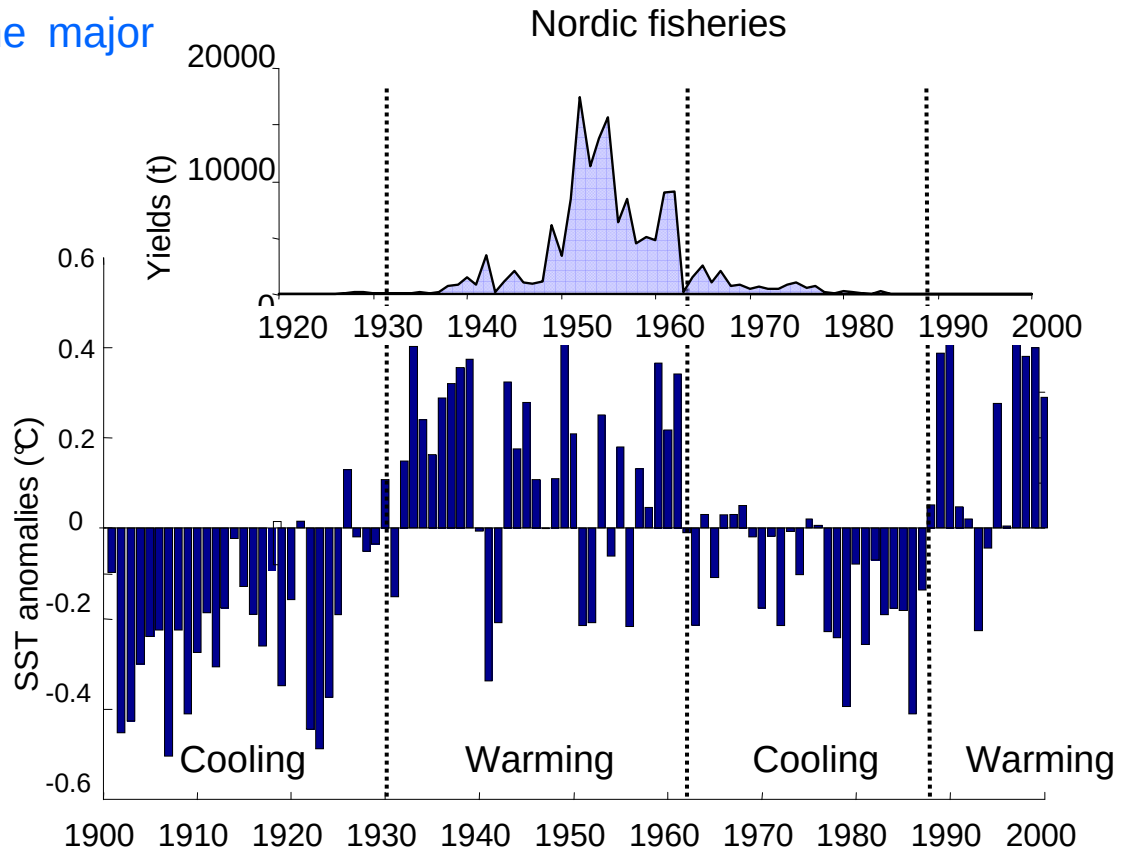
Norwegian spring-spawning herring *(Torensen & Ostved 2000)*



Conclusions – Part 1

The Nordic bluefin tuna fisheries collapse might be due to the failure of the major Northeast Atlantic herring stocks

BUT the close match between the cooling and the Nordic fisheries collapse may indicate that changes in temperature might have also affected BFT behaviour



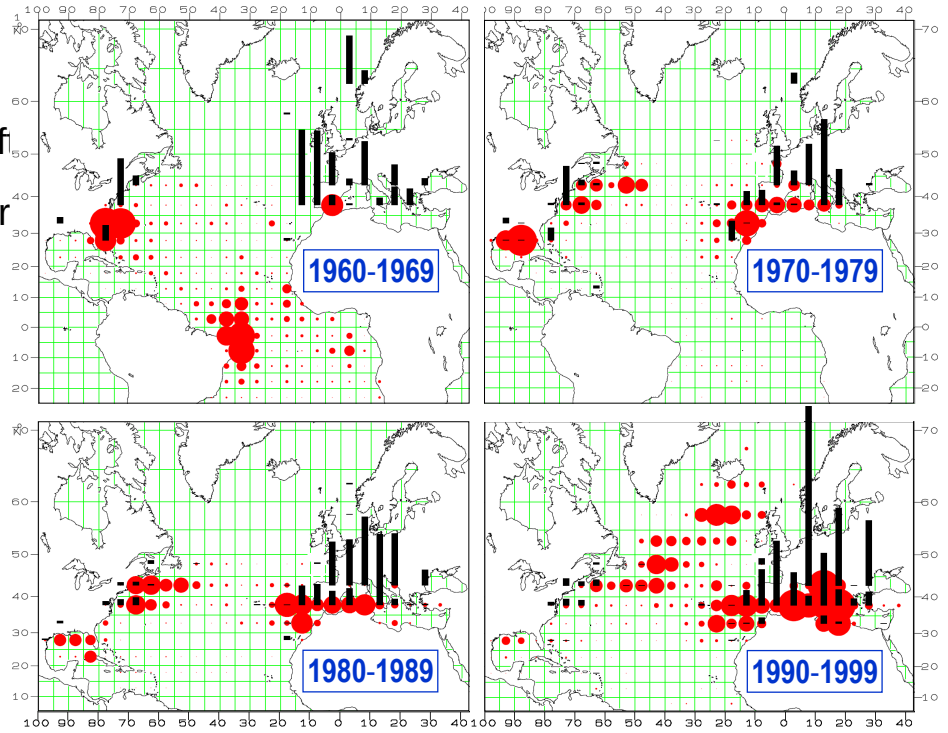
Discussion – Part 1

The Nordic fisheries collapse fisheries might result from changes in BFT migration patterns in relation to the collapse of the herring stocks and the cooling of the Northeast Atlantic during the early 1960s

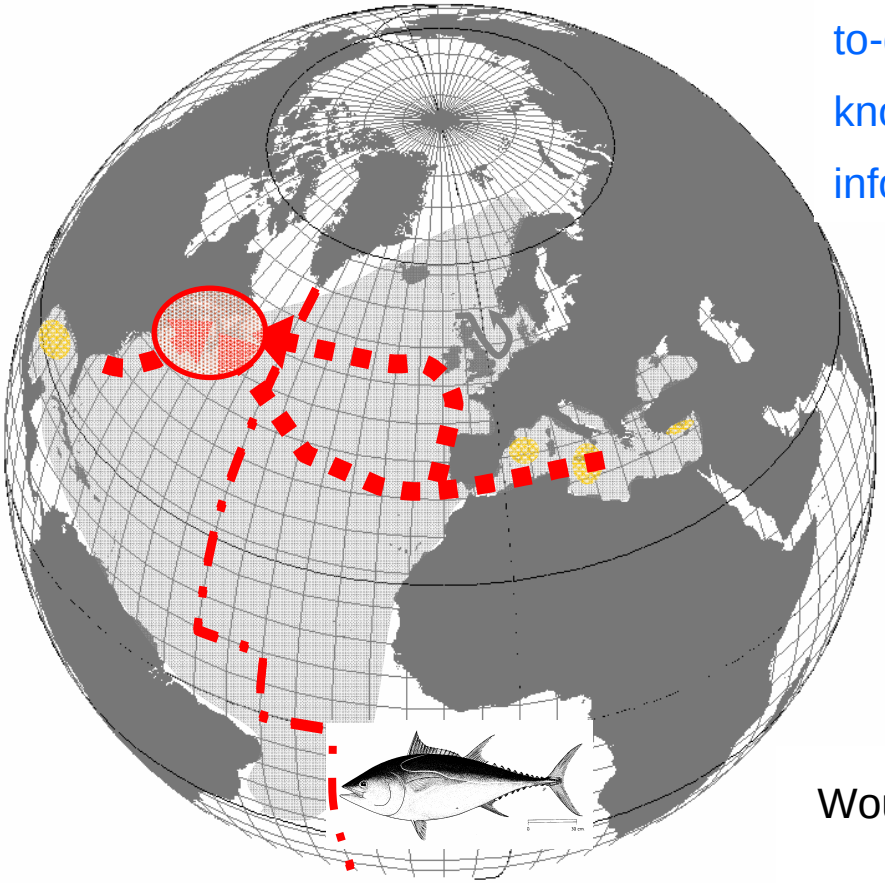
Why the strong connection between the Nordic fisheries and the Spanish traps did not vanish before the mid-1970s???

- No changes in BFT condition before and af
- No indication of recruitment failure in the Fr

BFT could have stayed in the Northwest Atlantic, as the high catches offshore of Brazil and along the US Northeast coasts during the 1960s could advocate for it



Discussion – Part 1



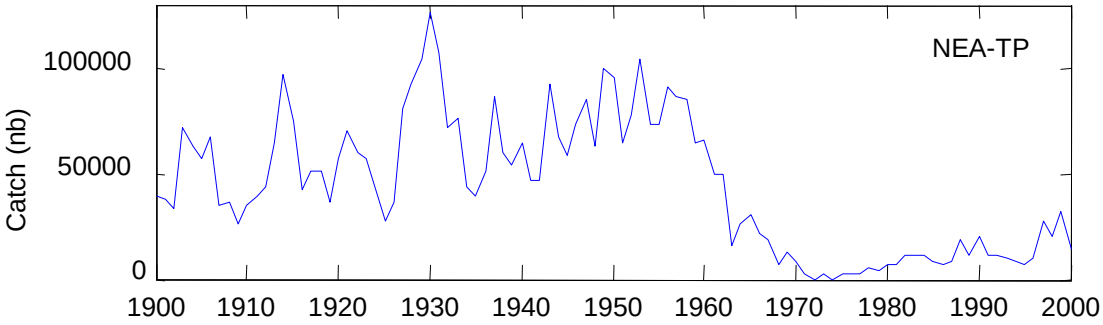
Changes in migration patterns from decade-to-decade is consistent with past & current knowledge as well as past & present tagging information (conventional and electronic)

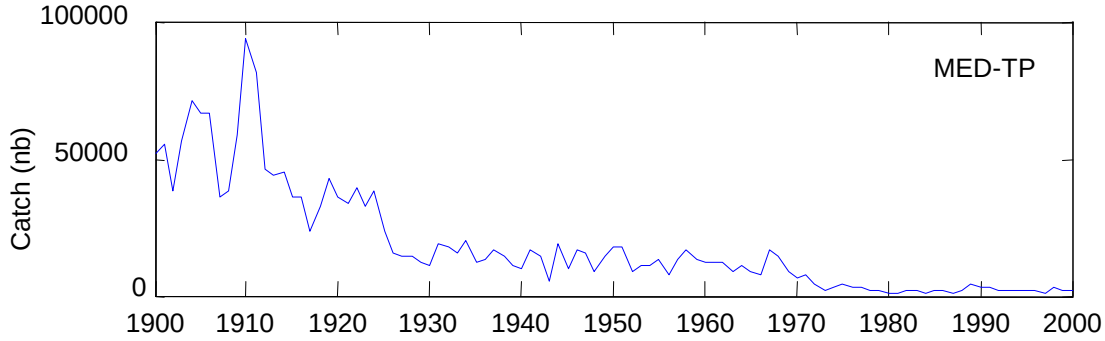
Would there be a nowadays a new key feeding ground in the Northwest Atlantic??

Discussion – Part 2

- Strong differences in yields, size and year-classes between the Northeast Atlantic and Mediterranean traps

- Differences in catches all over the 20th century



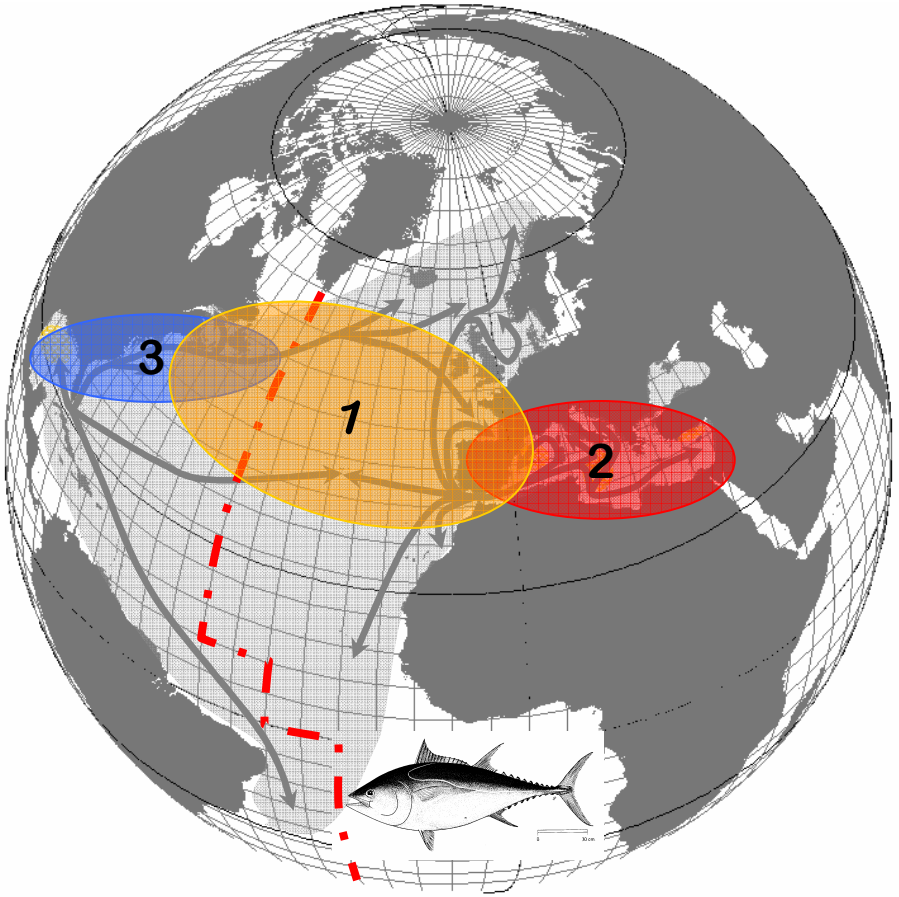


This can hardly be explained by changes in migration solely and underlying processes of collapse/decline of these two fisheries are likely to be different

Discussion – Part 2

Atlantic BFT could be constituted by **3 sub-populations**: (1) a highly migratory one over all the North Atlantic and Mediterranean, (2) a resident one in the Mediterranean and (3) a resident one in the West Atlantic

During the 1950-1960s, sub-population (1) would have been dominant and could have spatially mixed with the 2 others

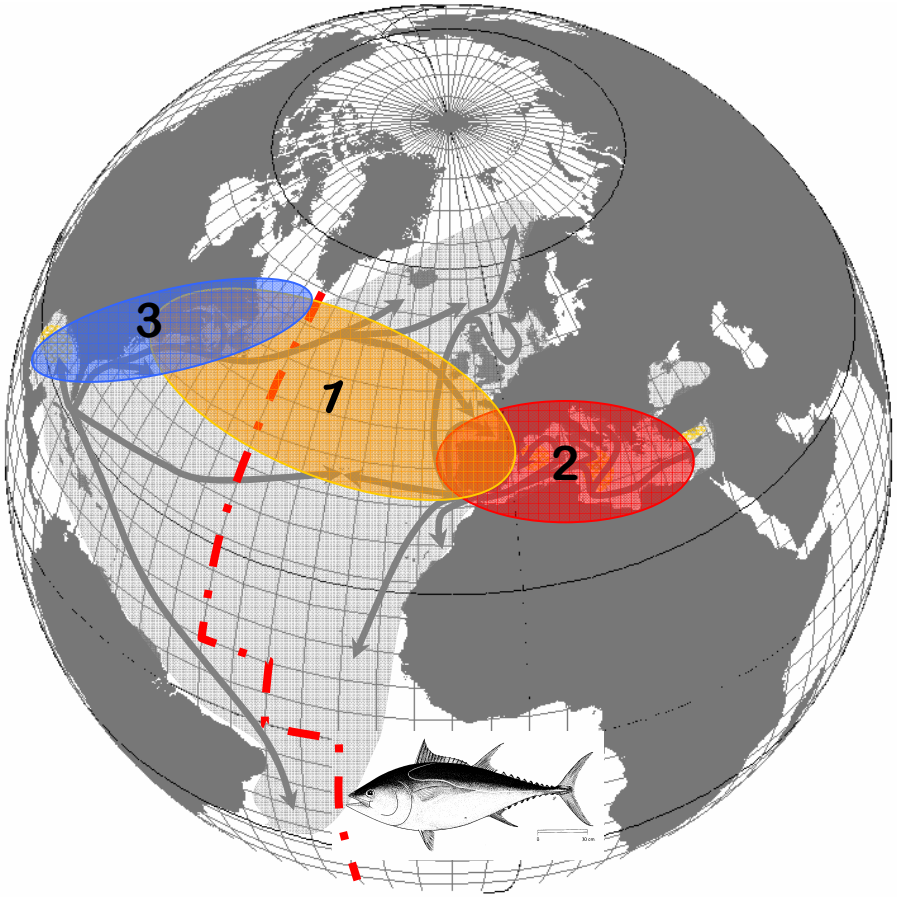


Discussion – Part 2

The declining catch in the North Atlantic and the increasing catch in the Mediterranean since the early 1980s may be interpreted as a change in sub-population size in response to environmental modifications and possibly overexploitation

Since the 1980s, the sub-population (2) would be dominant while sub-populations (1) and (3) would have strongly declined

Overexploitation in the Western Mediterranean Sea would prevent the rebuilding of sub-population(1) and could explain why bluefin tuna did not come back massively in the Northeast Atlantic since the 1990s



Conclusion

- Bluefin tuna migration patterns have probably changed through time (in relation to abiotic and trophic factors)
- Fisheries are also dynamics in both time AND space (mostly increasing/expanding)
- Bluefin tuna population structure that remains largely unknown is probably more complex than currently thought
- Abiotic factors (e.g. SST) that affect fish population dynamics and structure are also varying through time and space

The history of BFT fisheries is likely to reflect interactions between these biological, trophic, environmental and fishing processes

Thanks for your attention

Bluefin tuna fisheries have a tremendous history, but what about their future???