



Possible mechanisms and explanations for the drastic decline and disappearance of Atlantic bluefin tuna in the Norwegian fisheries since the early 1960s: What went wrong and what can we do?

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### Atlantic bluefin tuna fishing in Norway





### Norwegian catches of Atlantic bluefin tuna





## **Number of purse seiners**





### **Migration patterns of BFT**





#### Individual BFT weighed in Norway





#### Length-weight relationship



Length (cm)



#### Atlantic bluefin tuna weight at age



#### **Migration pattern of Atlantic bluefin tuna in 1928**





#### Length- and weight dependent migration pattern



			1958							
Average weight	Age	Year class	Troms	Nord	Trøn	Møre	Sogn	Hdl	Roga	Lindes
7	1	1957								
13	2	1956								
22	3	1955								
34	4	1954		X						
49	5	1953								
67	6	1952				X	X	x	X	x
88	7	1951		-		(x)	(x)	(x)	(x)	(x)
111	8	1950					X	x		X
137	9	1949	P				Х	x	X	x
165	10	1948			X	X	X	x	X	x
192	11	1947	x	X	X	X		x		
220	12	1946		X		X	X	x		
250	13	1945		X		X	X	x		
280	14	1944	x	X	X					
310	15	1943	X	X	X					
338	16	1942								



#### Weekly development of bluefin tuna catches





### **Scientific aims**

- Perform a Virtual Population Analyses (VPA) on the Norwegian historical Atlantic bluefin tuna data.
- Major focus on the strong 1950 and 1952 yearclasses.
- Compare and combine Norwegian data with contineous data on Atlantic bluefin tuna from the long time series excisting from the traps.
- Estimate population sizes of Atlantic bluefin tuna from 1950 onwards.
- Implement all information into the ICCAT database



### Mechanisms and processes involved

- Overfishing
- Recruitment and year class strength
- Distribution and migration patterns
- Learning processes and information transfer between tuna year classes
- Prey abundance and feeding opportunities
- Physical driving forces
  - decadal climate variability
  - temperature fluctuations in the Northeast Atlantic





### **Recruitment overfishing**

- The Norwegian fishery deminished in the beginning of the 1960's, due to lack of new year-classes and recruit spawners migrating to Norwegian waters.
- Comprehensive and detailed data from the Norwegian tuna fishery, indicate that the Atlantic bluefin tuna stock became significantly reduced in the 1960's partly due to a recruitment overfishing of 0-5 years old bluefin tuna.
- General overfishing of adult tuna also contributed
- Substantial changes of migration routes and distribution patterns could also have taken place

![](_page_15_Picture_5.jpeg)

## Learning and cognition in Atlantic bluefin tuna

- Research in recent decades has begun redress the misconception that animal cognition is absent in fish species
- Fishes exhibit a rich array of sophisticated behaviour with impressive learning capabilities: (foraging skills, predator recognition, social organisation and learning)
- Comparable with those of mammals and other terrestrial animals

Useful reading: Kieffer and Colgan 1992, Brown et al. 2006 (Book on Fish Cognition and Behavior).

Transfer of knowledge and information on established long-distance migration routes between year-classes

- Young immature tuna learn annual migration patterns from older mature individuals.
- Smaller mature tuna follow larger and more experienced tuna on their feeding migration, and thereby learn where to migrate.
- Tuna establish robust traditions in migration patterns over long periods and exhibit homing behaviour to a large extent

![](_page_17_Picture_4.jpeg)

#### Feeding migration to Norwegian waters: Why swim all the way to the north?

![](_page_18_Picture_1.jpeg)

![](_page_18_Picture_2.jpeg)

## Migrate north and gain plenty of weight

- Large individual tuna gained > 50 kg in weight during their annual feeding period (3-4 months) off Norway
- Main prey species included Norwegian springspawning herring, North Sea herring, Atlantic mackerel and sandeel
- Schooling prey species of great importance, linked to BFT tuna hunting behaviour
- Predictable long-term resources along the Norwegian coast during summer and autumn

# Norwegian spring-spawning herring

![](_page_20_Figure_1.jpeg)

![](_page_20_Figure_2.jpeg)

![](_page_20_Figure_3.jpeg)

![](_page_20_Picture_4.jpeg)

# **North Sea herring**

![](_page_21_Figure_1.jpeg)

![](_page_21_Figure_2.jpeg)

![](_page_21_Picture_3.jpeg)

![](_page_21_Picture_4.jpeg)

#### **Northeast Atlantic mackerel**

![](_page_22_Figure_1.jpeg)

![](_page_22_Figure_2.jpeg)

![](_page_22_Figure_3.jpeg)

![](_page_22_Picture_4.jpeg)

### Sandeel

![](_page_23_Figure_1.jpeg)

Fangst av tobis

![](_page_23_Figure_3.jpeg)

![](_page_23_Figure_4.jpeg)

![](_page_23_Picture_5.jpeg)

# Lack of prey is not the reason

- The reduction of bluefin tuna in Norwegian waters was much larger than the reduction of the major pelagic prey populations for tuna during the same periods
- Reduced prey availability cannot explain the disappearance of tuna in Norwegian waters.
- Today there is about 20 million tons of pelagic fish in the Norwegian Sea and along the coast of Norway in summer and autumn.
- Why is not tuna feeding up north in presently one of the most productive marine ecosystems on this planet?

#### Physical driving forces: large-scale patterns

![](_page_25_Figure_1.jpeg)

![](_page_25_Picture_2.jpeg)

#### Physical driving forces: large-scale and long-term patterns

![](_page_26_Figure_1.jpeg)

![](_page_26_Picture_2.jpeg)

#### Small-scale and short-term signals: Temperature time series in southwestern Norway

![](_page_27_Figure_1.jpeg)

![](_page_27_Picture_2.jpeg)

### The climate is generally not to blame

- Long-lived Atlantic bluefin tuna probably react more pronounced to large-scale and long-term changes in climate than small-scale and short-term fluctuations in temperature.
- Bluefin tuna should respond to accumulated and consistant changes (cold or warm periods) in the environment, and less to more unpredictable and "noisy" environment over shorter periods.
- Possible recruitment failures producing weak year-class strength during may also have taken place in the 1960's, due to more unfavourable environmental conditions with low temperature regime.
- Climate change cannot explain why bluefin tuna has not been present in recent decades in Norwegian waters.
- Warm ocean climate and plenty of food should now be highly favourable for the bluefin tuna off Norway.

### What should be done

- Protect spawning Atlantic bluefin tuna in the most important spawning areas and periods in the Mediterranean Sea
- Increase minimum landing size to protect vulnerable juveniles prior to maturity and spawning.
- Drastically reduce transfer of bluefin tuna to large pens for fattening, especially the oldest and largest individuals to protect those with the highest production potential, spawning success and experience within the population
- Combat IUU fishing by dramatically increase the control regime and provide effective national enforcement systems

![](_page_29_Picture_5.jpeg)

What have to be done The three most vital actions to be taken:

Ban fishing on Atlantic bluefin tuna!
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This should be done until we know better the real status of this extremely important fish species. Precautionary approach!
The major reason for this crucial step will be to effectively rebuild the threatend tuna stock and achieve a future long-term sustainable and valuable fishery
Please keep in mind the Norwegian collapse of our key pelagic species in the Northeast Atlantic
Still possible to turn a failure to success!