

ICES WGSPEC REPORT 2013

SCICOM STEERING GROUP ON ECOSYSTEM FUNCTIONS (SSGEF)

ICES CM 2013/SSGEF:04

REF.SSGEF, SCICOM

Report of the Working Group on Small Pelagic Fish, their Ecosystems and Climate Impact (WGSPEC)

25 February-1 March 2013

Fuengirola, Spain



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Recommended format for purposes of citation:

ICES. 2013. Report of the Working Group on Small Pelagic Fishes, their Ecosystems and Climate Impact (WGSPEC) , 25 February-1 March 2013, Fuengirola, Spain. ICES CM 2013/SSGEF:04.11 pp. <https://doi.org/10.17895/ices.pub.8839>

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Executive summary

The Working Group on Small Pelagic Fishes, their Ecosystems and Climate Impact (WGSPEC) had its 3rd meeting at the Centro Oceanográfico de Málaga (in Fuengirola, Spain) of the Instituto Español de Oceanografía (IEO). It was attended by six scientists from four countries.

At the WGSPEC meeting in 2012, a plan was developed to write a manuscript on the climate impact on the regime shift around the mid-1990s in ecosystems of NE Atlantic, incl. Mediterranean and NW African upwelling, with a focus on AMO/AMV (Atlantic Multidecadal Oscillation/Atlantic Multidecadal Variability) and North Atlantic gyres. The intersessional period was used to further develop this manuscript. These efforts were continued during the 2013 meeting with a focus on atmospheric and oceanographic processes and their impact on ecosystems. The result was a manuscript titled “Atlantic Multi-decadal Oscillation (AMO) modulates dynamics of small pelagic fish and ecosystem regime shifts in the eastern North and Central Atlantic” by Jürgen Alheit, Priscilla Licandro, Steve Coombs, Alberto Garcia, Ana Giráldez, Maria Teresa Garcia Santamaría, Aril Slotte, Athanassios C. Tsikliras. The manuscript was refined by correspondence after the meeting and submitted for publication in August 2013 to the Journal of Marine Systems.

1 Administrative details

Working Group name

Working Group on Small Pelagic Fishes, their Ecosystems and Climate Impact (WGSPEC)

Year of Appointment

2010

Reporting year within current cycle (1, 2 or 3)

Year 1

Chair(s)

Jürgen Alheit

Priscilla Licandro

Meeting venue

Centro Oceanográfico de Málaga (in Fuengirola, Spain) of the Instituto Español de Oceanografía (IEO)

Meeting dates

25 February – 1 March 2013

2 Terms of Reference a)-d)

- a) Specific analysis of climate impact of regime shift around the mid-1990s on ecosystems of NE Atlantic, incl. Mediterranean and NW African upwelling, with a focus on AMO/AMV and North Atlantic gyres
 - Understand respective physical mechanisms
 - Study reactions of plankton and small pelagic fish
 - Compare with similar events in 1st half of 20th century
- b) Study mechanisms that link variability of small pelagic fish populations in different ocean basins with large-scale climatic forcing
- c) Global comparison of climate variability impact on small pelagics
- d) Specific analysis of climate variability impact on non-clupeid small pelagics (such as mackerel)

3 Summary of Work Plan

Year 1	Specific analysis of climate impact and respective physical and biological processes around the mid-1990s
Year 2	Specific analysis of climate variability impact on non-clupeid small pelagics
Year 3	Summing up of results of WGSPEC

4 List of Outcomes and Achievements of the WG in this delivery period

Production of manuscript on “Atlantic Multi-decadal Oscillation (AMO) modulates dynamics of small pelagic fish and ecosystem regime shifts in the eastern North and Central Atlantic” by Jürgen Alheit, Priscilla Licandro, Steve Coombs, Alberto Garcia, Ana Giráldez, Maria Teresa Garcia Santamaría, Aril Slotte, Athanassios C. Tsikliras (which was submitted in August 2013 to the Journal of Marine Systems)

5 Progress report on ToRs and workplan

Around the mid-1990s, a number of significant changes was observed in the atmosphere and the N Atlantic ocean: contraction of Subpolar Gyre, strong weakening of NAO, strong increase in AMO index, changes in currents and salinity, decreased deep convection off Labrador, etc. Around the same time, significant changes have been observed in plankton and fish populations. In addition to those described in Hátún et al. (2009) in the region between English Channel and Barents Sea, changes in distribution and abundance have been observed in populations of small pelagic fish (sardine, anchovy, herring, sardinella, sprat) from NW Africa up to Nordic Seas, incl. Mediterranean and Baltic Sea. Also, zooplankton in North Sea exhibited changes at that time. Similar changes have been reported for the positive period of the AMO in the first half of the 20th century (1925-1965), particularly for fish and benthos in the northern N Atlantic (Drinkwater 2006). Consequently, the meeting aimed at extending the studies of Drinkwater (2006) and Hátún et al. (2009) in space (southern European waters, Mediterranean, North Sea) and time (1900 up to now).

Hátún, H., Payne, M. R., Beaugrand, G., Reid, P. C., Sandø, A. B., Drange, H., Hansen, B., Jacobsen, J. A., Bloch, D., 2009. Large bio-geographical shifts in the northeastern Atlantic ocean: From the Subpolar Gyre, via plankton, to blue whiting and pilot whales. *Prog. Oceanogr.* 80, 149-162.

Drinkwater, K. F., 2006. The regime shift of the 1920s and 1930s in the North Atlantic. *Prog. Oceanogr.* 68, 134-151.

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Abstract

Dynamics of abundance and migrations of populations of small pelagic clupeoid fish such as anchovy (*Engraulis encrasicolus*), sardine (*Sardina pilchardus*), sardinella (*Sardinella aurita*), sprat (*Sprattus sprattus*) and herring (*Clupea harengus*) in the eastern North and Central Atlantic between Senegal and Norway vary in synchrony with the warm and cool phases of the Atlantic Multi-decadal Oscillation (AMO). This is shown by compiling retrospective data on fish catches and anecdotal observations which in some cases date back to the mid-19th century. The AMO is defined as the detrended mean of North Atlantic (0 – 60°N) sea surface temperature anomalies. However, it is not primarily the temperature which drives the dynamics of the small pelagic fish populations. Instead, the AMO seems to be a proxy for complex processes in the coupled atmosphere-ocean system of the North Atlantic which is manifested in large-scale changes in strength and direction of the current system moving around North Atlantic water masses, very likely with involvement of the North Atlantic Oscillation (NAO), the Atlantic Meridional Overturning Circulation (AMOC), the Medi-

terranean Overflow Water (MOW) and the Subpolar Gyre (SPG). The contractions and expansions of the SPG play apparently a key role. This was particularly obvious in the mid-1990s, when the SPG abruptly contracted with the result that warm subtropical water masses moved to the north and east. Small pelagic fish populations in the eastern North and Central Atlantic, including those in the Mediterranean responded fast by changing abundances and migrating northwards. It seems that the complex ocean-atmosphere changes in the mid-1990s, which are described in the text in detail, caused a regime shift in the ecosystems of the eastern North and Central Atlantic, and the small pelagic clupeoid fish populations are the sentinels of this shift.

Key words: Atlantic Multi-decadal Oscillation, clupeoid fish, climate variability, North Atlantic Subpolar Gyre, eastern North and Central Atlantic

Highlights

- Abundance fluctuations of fish populations correspond to alternating AMO phases
- Regime shifts in eastern North Atlantic ecosystems are associated with AMO dynamics
- AMO affects Mediterranean fish populations
- European clupeoid populations exhibit synchronous multi-decadal changes in abundance
- Contraction of Subpolar Gyre assumed to trigger synchronicity in fish populations

6 Revisions to the work plan and justification

No need for revision

7 Elections

Jürgen Alheit was elected for another 3-year period as co-chair for WGSPEC.

8 Next meetings

Pedro Vélez offered to host the 2014 meeting of WGSPEC at the Centro Oceanográfico de Canarias in Santa Cruz de Tenerife, Spain, from 10-14 of March 2014.

Annex 1: List of participants

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