



Scaring effects in fish by offshore seismic explorations

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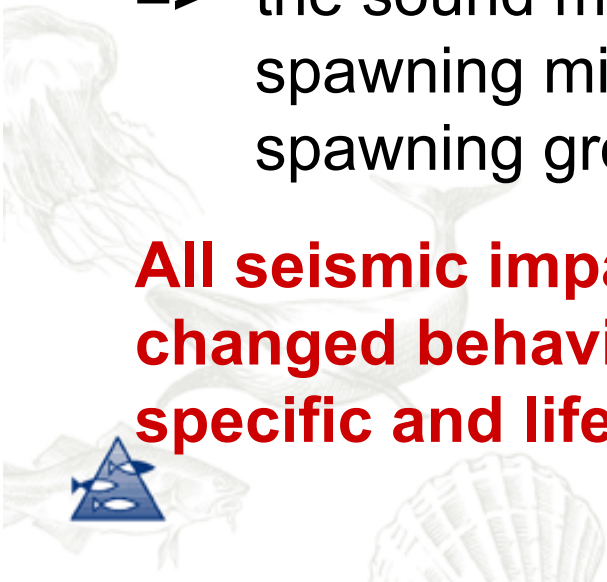
- Dalen, J. and Raknes, A. 1985. Scaring effects in fish from 3D seismic explorations. (In Norwegian). Institute of Marine Research, report no FO 8504, Bergen. 22 p.
- Dalen, J. and Knutsen, G.M. 1987. Scaring effects in fish and harmful effects on eggs, larvae and fry by offshore seismic explorations. In Merklinger: Proc. Symp. "Progress in underwater acoustics", 1987: 93-99. Halifax 1986.



Seismic investigations - impacts on fish and fisheries

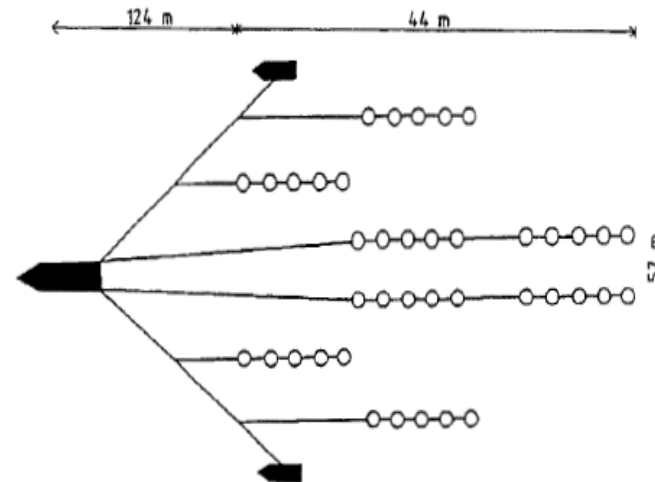
- => the energy from the seismic sources may be lethal or cause injuries to eggs, larvae and fry.
- => the sound from the seismic sources may scare fish on and away from the fishing grounds and / or reduce their activity with consequences to fishing activities.
- => the sound may scare fish and thereby disturb the spawning migration and the spawning processes on the spawning grounds.

All seismic impacts on fish and such stimuli leading to changed behaviour must be understood in a species specific and life state specific, and seasonal context!



PILOT STUDY ON WORLD BASIS NORTH SEA 1984

Objective 1: Study the fish distribution and abundance prior to, during, and after seismic shooting. Support the acoustic mapping and biological understanding by bottom trawling.

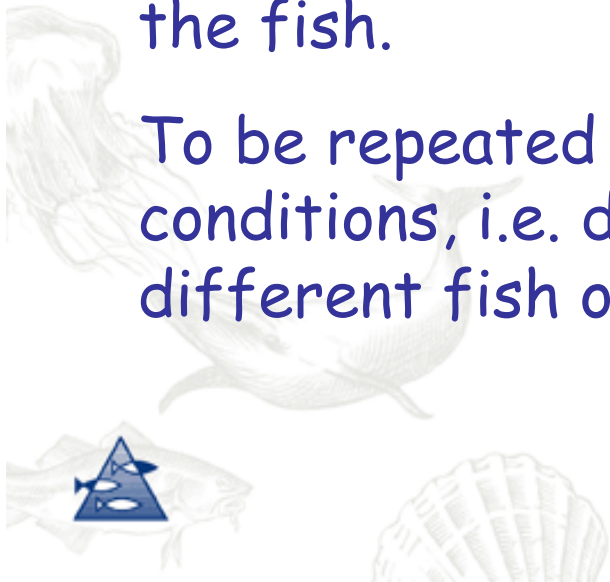


Seismic vessel, Geco's "Malene Østervold", with a super wide airgun array (one streamer)

Objective 2: Based on the seismic sailing program search for actual situations for sonar and echosounder observation where the observation vessel lays still at a certain distance from the course line of the seismic vessel.

While the seismic vessel approaches, passes and goes away, observe possible behaviour changes of the fish.

To be repeated several times at different conditions, i.e. day/night, different light conditions, different fish occurrences.



Seismic operational scheme

Seismic equipment:

1 seismic array,

8 sub-arrays,

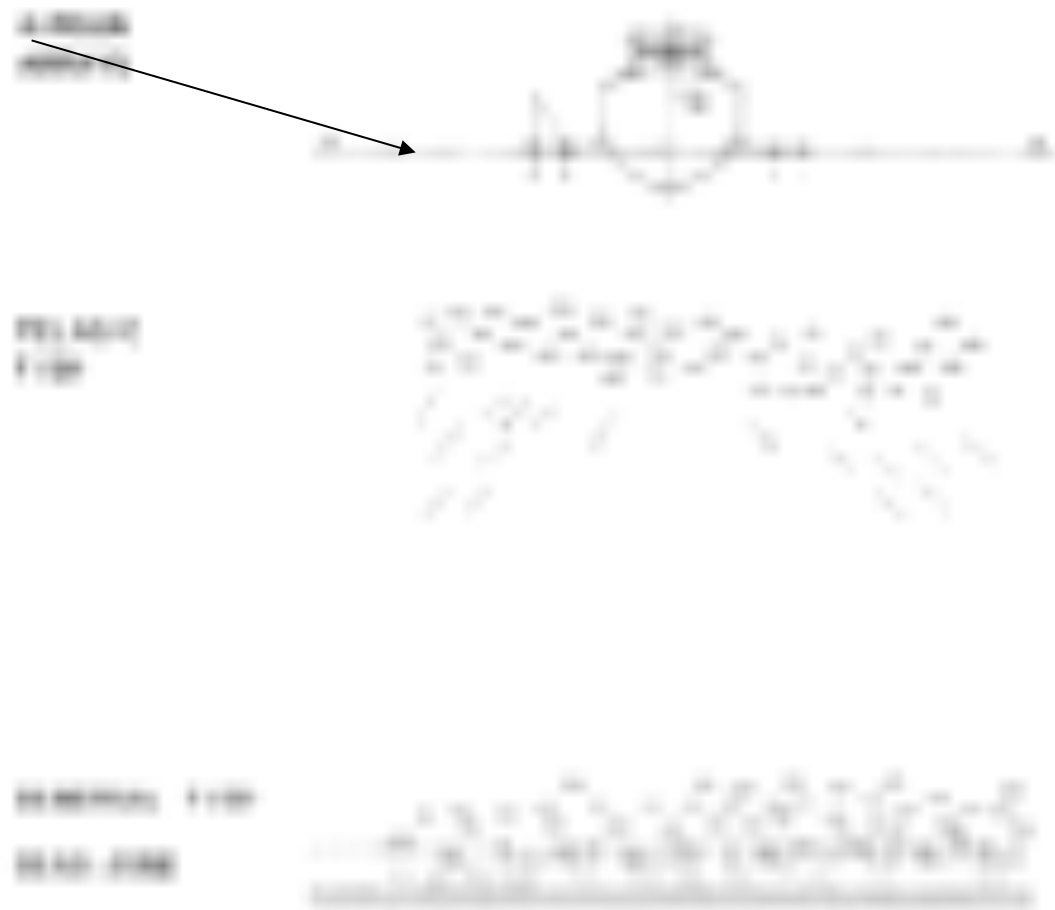
40 airguns,

$V = 77.9$ liter (4752 cu.in.),

$t_{int} = 10$ s / $r_{int} = 25$ m

$SL_N = 250$ dB// $1\mu\text{Pa}$

@ 1 m



Sketch of a seismic vessel and distribution of fish



Other characteristics

Total observation area: 35 x 18 nautical miles (65 x 33 km)

Seismic operation area: 6 x 9 nautical miles (11 x 17 km)

Performed task 1: Prior to the seismic exploration the fish populations in the seismic area and adjacent areas were acoustically mapped by echo sounder/echo integrator and sonars providing information of fish distributions in an "undisturbed" manner. 12 trawl hauls were made to identify the fish by species and size.



Other characteristics

Performed task 2: The observation vessel observed the acoustic abundance and fish distribution along every new seismic line prior to shooting. Immediately after shooting each line, the observation vessel made a new sweep along the line to observe any changes in acoustic abundance and fish distribution.

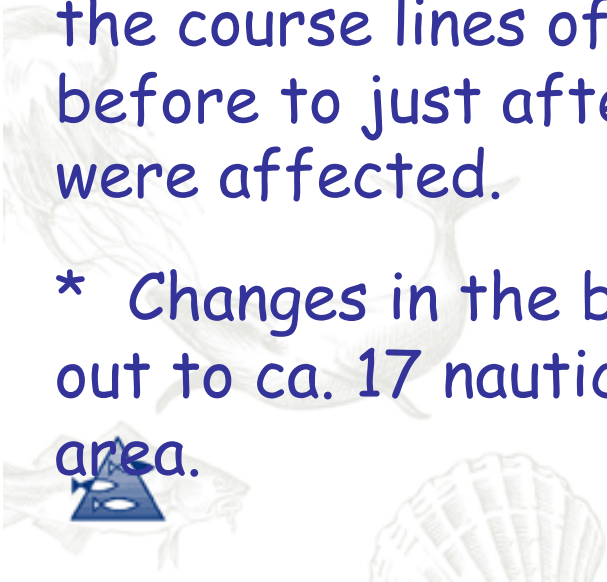
Performed task 3: The acoustic fish mapping was repeated during the last 18 hours of the survey providing information of fish migrations/movements in the seismic area and adjacent areas.

Planned task 4 (objective 2) could not be performed due to low noise requirements from the seismic vessel during data acquisition.

Results

Main outcome

- * The horizontal and vertical distributions of both pelagic fish and ground fish as observed by hydroacoustic methods and trawling within the total area surrounding the seismic operations area of 6 x 9 nautical miles were consistently changed after 6 days of airgun operations compared to the distributions prior to the operations.
- * Changes of the behaviour patterns of the fish along the course lines of the seismic vessel from immediately before to just after airgun shooting proved that the fish were affected.
- * Changes in the blue whiting distribution were observed out to ca. 17 nautical miles from the centre of the seismic area.



Results

- => **Blue whiting:** The echo abundance in the seismic area as observed by hydroacoustic methods was reduced by 54 % after 6 days of airgun operations compared to that prior to the operations.
- => **Ground fish** (mainly saithe, cod, haddock, whiting and great silversmelt): The echo abundance was likewise reduced by 36 %.
- => **Small pelagics:** Some reduction, 13 %, in the echo abundance after 6 days of airgun shooting, although no systematic changes. The overall echo abundance of this group was rather low during the whole survey.

=> additional studies were recommended!





Thank you for your attention!