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MFV Altaire

Survey 0321H

Report

7th June – 22nd June 2021

Ports

Loading: Ullapool, 7th June 2021
Unloading: Ullapool, 22nd June 2021

Personnel

Finlay Burns SIC
Hannah Holah (Co-SIC)
Alex Edridge
Eleanor MacLeod

Out-turn days per project: 16, SU02N0

Fishing/Sampling Gear: Gulf VII plankton sampler

Objectives

1. To map and define the spawning activity of mackerel *(Scomber scombrus)*, spanning the area of the Northern North Sea and further North up and along the Norwegian Sea from 60° N to 70° N.

2. Undertake opportunistic trawling for adult mackerel to collect biological information on individuals within the survey area and also to collect fecundity samples in order to progress ongoing research being undertaken within the region.

Introduction

WGMEGS, the ICES working group tasked with coordinating the triennial Mackerel and Horse mackerel egg surveys (MEGS) has since 2007 been observing and reporting on the offshore westwards and northwards expansion of mackerel spawning. During this period it had been noted that although the proportion of spawning taking place in these northern and western areas had indeed been small *(in comparison to the total annual egg production)* it had nevertheless been increasing with every subsequent survey. The results from the recent triennial MEGS surveys in 2016 and 2019 provided clear evidence that this was no longer the case, demonstrating a significant and unprecedented shift with emphasis moving away from the traditional spawning hotspot areas of Biscay and the Celtic Sea and instead over a large swathe of ocean often well away from the continental shelf. During the last 2 triennial surveys some of the highest spawning densities were observed to the west and Northwest of Scotland and also importantly very close to survey's northern and north-western survey boundary.

During the last NEA mackerel benchmark in 2017 a commitment was made by WGMEGS to undertake exploratory icthyoplankton surveys within these remote boundary regions and where the MEGS surveys have hitherto struggled to define a boundary. During 2017 and 2018 exploratory surveys undertaken by Ireland and Scotland successfully mapped and delineated a mackerel spawning boundary within the offshore areas of Hatton Bank/South Iceland Basin and the Scotland-Faroe-Iceland Ridge. This survey aims to conclude this exploratory survey objective by undertaking a similar survey to those completed previously but with the focus this time being up and along the Norwegian Sea area and once again during the month of June when mackerel spawning is expected to be at its peak within these Northern areas.

An additional objective included completion of several icthyoplankton transects undertaken within the Northern North Sea area and will form part of the North Sea MEGS survey which is also being undertaken at the same time. These stations (south of 62N) will feed directly into the North Sea Mackerel Egg Survey (NSMEGS) and will form part of the NSMEGS 2021 dataset. In contrast to the previous exploratory surveys in 2017 and 2018, trawling was scheduled during this survey with midwater trawl deployments being planned within both the North Sea and Norwegian Sea areas. Information on adult mackerel was required for both batch fecundity and spawning fraction estimation for the NSMEGS (trawl stations south of 62N) with those undertaken further North contributing to ongoing research led by the Institute of Marine Research in Bergen (IMR).

Narrative

Altaire departed from Peterhead at around mid-afternoon on the 7th June in near perfect weather conditions and headed North towards the survey starting point on the East side of Muckle Flugga, Shetland. After completion of the flowmeter calibrations Altaire headed East to commence surveying on the 60.75N transect a little after midday on the 8th June. Whilst still awaiting final clearance for permission to survey within the Norwegian EEZ, Altaire was able to complete an additional partial transect at 59.75N during the 9th June, however the clearance permit was issued shortly after allowing Altaire to continue eastwards on to the 60.75N transect towards the Norwegian coast before turning North and then west on the 61.75N transect towards Tampen. This concluded the NSMEGS component and from here on in the station spacing increased to 1 degree of longitude with double alternate transect spacing employed on the Northwards outbound survey plan. Following this plan and with weather conditions being generally calm albeit overcast Altaire was able to make excellent progress completing transects at 63.45N, 65.45N, 67.45N before completion of a the final outbound transect at 68.15N on the 16th June. During the inbound track Altaire proceeded south interlacing to complete the transects 'missed' during the outbound route North. As regards the geographic extent of the transect to the west, the intention was to survey at least as far west as the 1000m isobath, which was achieved and in several cases transects were extended even further west and out over 2000m (figure 1). After completion of a survey track of almost 2900 nm Altaire finally returned back to Peterhead in the early hours of the 22nd June with demobilisation taking place the same day.

Temperature

Surface temperatures encountered during the survey (*taken at 5m depth for North Sea MEGS surveys*) ranged from 9 degrees Celsius in the northernmost latitudes surveyed to almost 14 degrees further south and within the North Sea area over towards the Norwegian Coast. A period of relatively settled weather experienced prior to as well as during the survey period almost certainly contributed to the stratification observed throughout the survey with temperature profiles recording an average drop in temperature of approximately 3 degrees Celsius when comparing surface temperatures with those recorded at 50m depth. Figures 2 – 4 provide heat plots for 5, 20 and 50m temperatures recorded in Celsius during the survey.

Survey methodology

The samples were collected and analysed in accordance with the WGMEGS sampling at sea manual *(http://doi.org/10.17895/ices.pub.5140).* Double oblique deployments were conducted at every sampled station and these were taken to within 10m of the bottom or to a maximum depth of 200m, whichever was shallower. Scotland utilises a Gulf VII plankton sampler which is towed at a speed of 4 knots and uses a 250 µm plankton net. Valeport replica electronic flowmeters and a RBR Duo CTD attached to the sampler, provided volume sampled as well as recording depth, temperature and salinity during each deployment. Real-time sampler depth was monitored using a ScanMar depth sensor, also attached to the sampler. Whilst completing transects for the NSMEGS component (*south of 62N*) half degree longitude station spacing was retained thereby ensuring consistency between NSMEGS participants. During the exploratory plankton survey component (*North of 62N*) the nominal station spacing was increased to one degree of longitude. This is consistent with the previous exploratory surveys undertaken and maximises the geographical area that can be surveyed. Survey protocols for sample treatment as well as data work up for all stations are as per the WGMEGS at sea protocols for surveying in the North Sea. On retrieval the plankton net was washed down in seawater with the plankton being fixed in 4% buffered formalin. All samples were analysed within 36 hours of being fixed with all eggs being extracted and retained for analysis. All mackerel and ling eggs were subsequently identified, counted and their development stage determined. Abundance of pearlside *(M. muelleri) and boarfish (Capros aper)* were also recorded.

Results

Egg Abundance

87 Gulf deployments were made in total with 9 flowmeter calibration runs and a further 78 plankton deployments. These yielded 5123 mackerel eggs of all stages, of which 1671 were recently spawned stage 1 eggs. Mackerel eggs were recorded from every deployment with stage 1 eggs being recorded on all but 2 of the stations completed. The numbers of mackerel eggs extracted from the Gulf VII samples were standardised and the stage 1 data presented as numbers /m^2/day (see figure 5). Egg counts across the entire surveyed area were low to moderate with the highest egg counts generally being encountered within the southern half (south of 66N) of the survey area and reducing gradually as the survey proceeded Northwards until counts were entirely down to single figures on transects West of Lofoten and with even the surface temperatures cooled to levels approaching the perceived lower temperature threshold for spawning in mackerel.

Trawling

The vessel's own midwater trawl was deployed 5 times (figure 6) during the survey, and was successful in catching mackerel on two of those occasions. All trawl deployments were towed for approximately 1 hour. An attempt was made to collect adult fish for fecundity analysis as part of the NSMEGS, however the night-time deployment at Tampen was

unsuccessful. Further North it became clear that within the well stratified water column with relatively warm surface layer that Altaire's unfloated net would struggle to get close enough to the surface to be effective and unsurprisingly the trawls undertaken close to the Norwegian Coast at 63.75N and again at 66.75N were unsuccessful. Even with the trawl headline at 25 – 30m from the surface which was the shallowest that net could operate the sub 7.5 Celcius temperature recorded on the trawl headline sensor at these locations appeared to be too cold for mackerel. As an alternative method 3 sessions with rod and line were also tried at the surface but also with no success. The last two trawl deployments were undertaken on the inbound track and towards the western edge of transects at 64.75N 4E (AE03/04) and also 62.75N 1.25E (AE03/05) respectively and where stratification was less defined resulting in the layer of warm water extending deeper and importantly within reach of the midwater trawl. Trawl AE03/04 yielded 19 mackerel whereas AE03/05 was successful in catching approximately 180kgs mackerel of which 104 randomly selected fish were sampled (*approx. 37kgs*). Length, sex, maturity (*Walsh scale*) and age (*otoliths removed for ageing back in the lab*) were determined for each of the 123 mackerel sampled. In addition 60 ovary samples were collected for colleagues in IMR Bergen in order to progress current ongoing collaborative research being undertaken into spawning fish within the Northern region.
The adults sampled ranged from between 28 and 41cm in length with the majority within the length range 32 – 35cm. This translated into an age profile that spanned from ages 2 - 15 but where over 80% of those sampled were between ages 2 – 5 with age 4 being the most prevalent year class. Unsurprisingly, of the 123 mackerel sampled almost 60% were found to be maturity stage 5 (*partially spent*) while almost 20% were stage 6 (*spent*). Perhaps more surprisingly, almost 15% were stage 4 (*spawning*) (see figs. 7-9).

Conclusions/Discussion

The exploratory egg survey successfully completed the transects allocated to it within the North Sea area south of 62N with 29 stations being successfully incorporated into the NSMEGS dataset. As regards the exploratory objective this has also been completed successfully with Altaire delivering a comprehensive snapshot of mackerel spawning within the area of the Norwegian Sea and during the period when as has already been stated mackerel spawning activity would expect to be at its peak. Despite completing the most northerly transect at 68.25N the survey was unable to find a hard spawning boundary albeit the numbers of freshly spawned eggs being encountered within these very high latitudes were extremely low. This contrasts markedly with the previous exploratory surveys undertaken further West around Hatton Bank and North to Iceland during 2017 and 2018 and that were able to reaffirm the existence of a cold water barrier stretching from the East coast of Iceland across to the Faroe/Shetland and demonstrating very little if any mackerel spawning taking place in June at latitudes North of the Faroe Islands. The situation up and along the Norwegian Sea is very different with the influence of the warm Norwegian Current keeping sea surface temperature, even high above the Arctic Circle well within a range that is tolerable for spawning mackerel. Nevertheless, the spawning levels observed in the sampled stations North of 62 degrees were overall very low and for now there would appear to be no immediate requirement for WGMEGS to significantly extend the survey coverage in this region much beyond what was undertaken in 2019.

The data collected as well as the conclusions drawn from the results of this survey will prove to be extremely useful and will inform the planning process for the forthcoming triennial MEGS survey in 2022. The results were reported to the Working Group On Widely Distributed Species (WGWIDE) in August 2021 and will also be presented to WGMEGS together with the NSMEGS results in 2022. The egg abundance data collated during the exploratory survey has already been uploaded to the ICES egg and larval database.

Sightings of interesting marine fauna were few with the highlight being 2 Orca *(Orcinus orca)* that were sighted just after midday on the 11th June chasing what were assumed to be mackerel on the surface just after completion of plankton station 34. A Minke whale *(Balaenoptera acutorostrata)* was also observed breaching on two occasions just after completion of plankton station 72 during late morning on the 18th June.

A massive thank you to all of the crew on the MFV Altaire for all the help, advice and assistance provided throughout the survey and which ultimately ensured the overall success of the survey.

Finlay Burns 27/09/2021

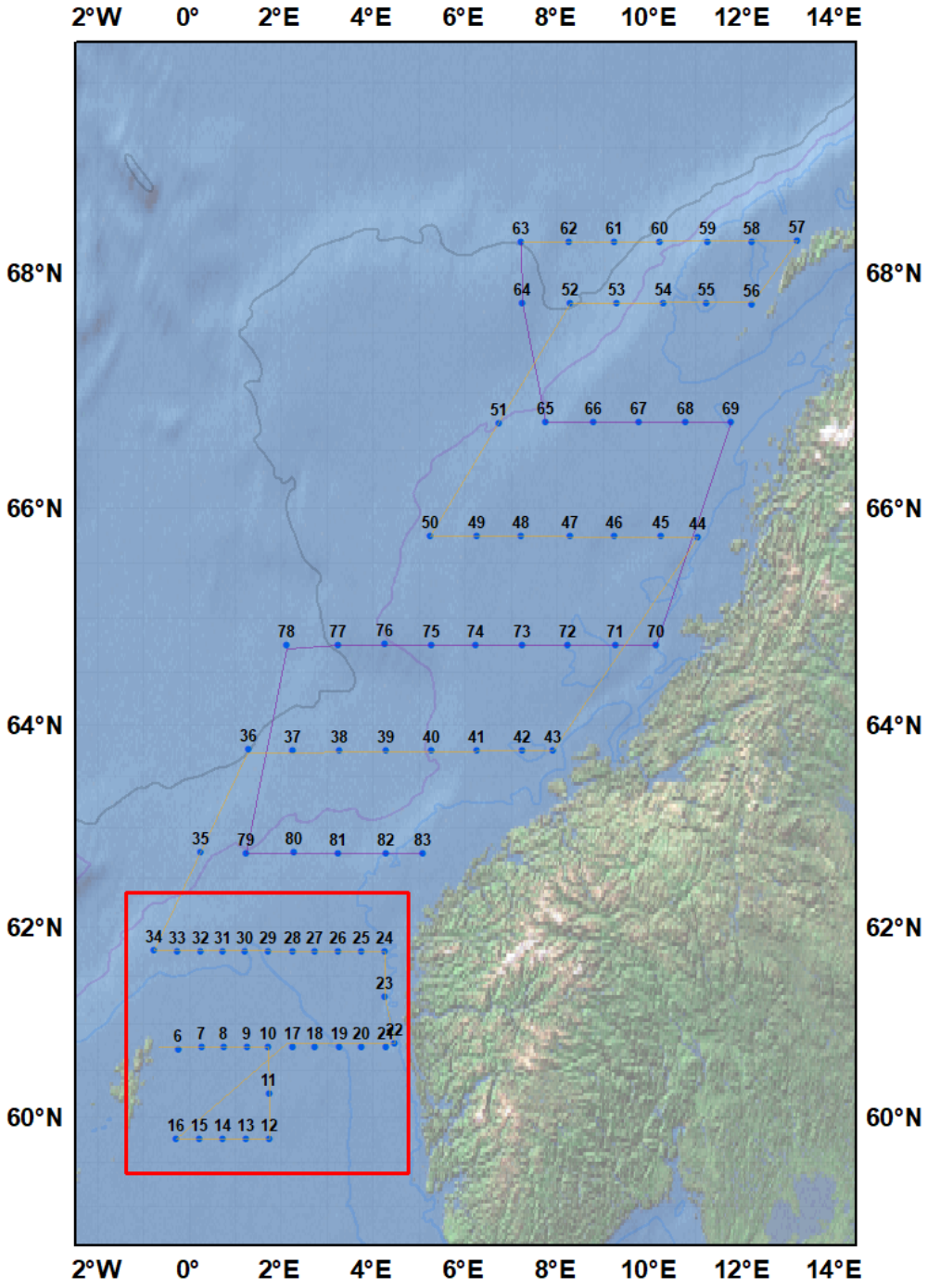
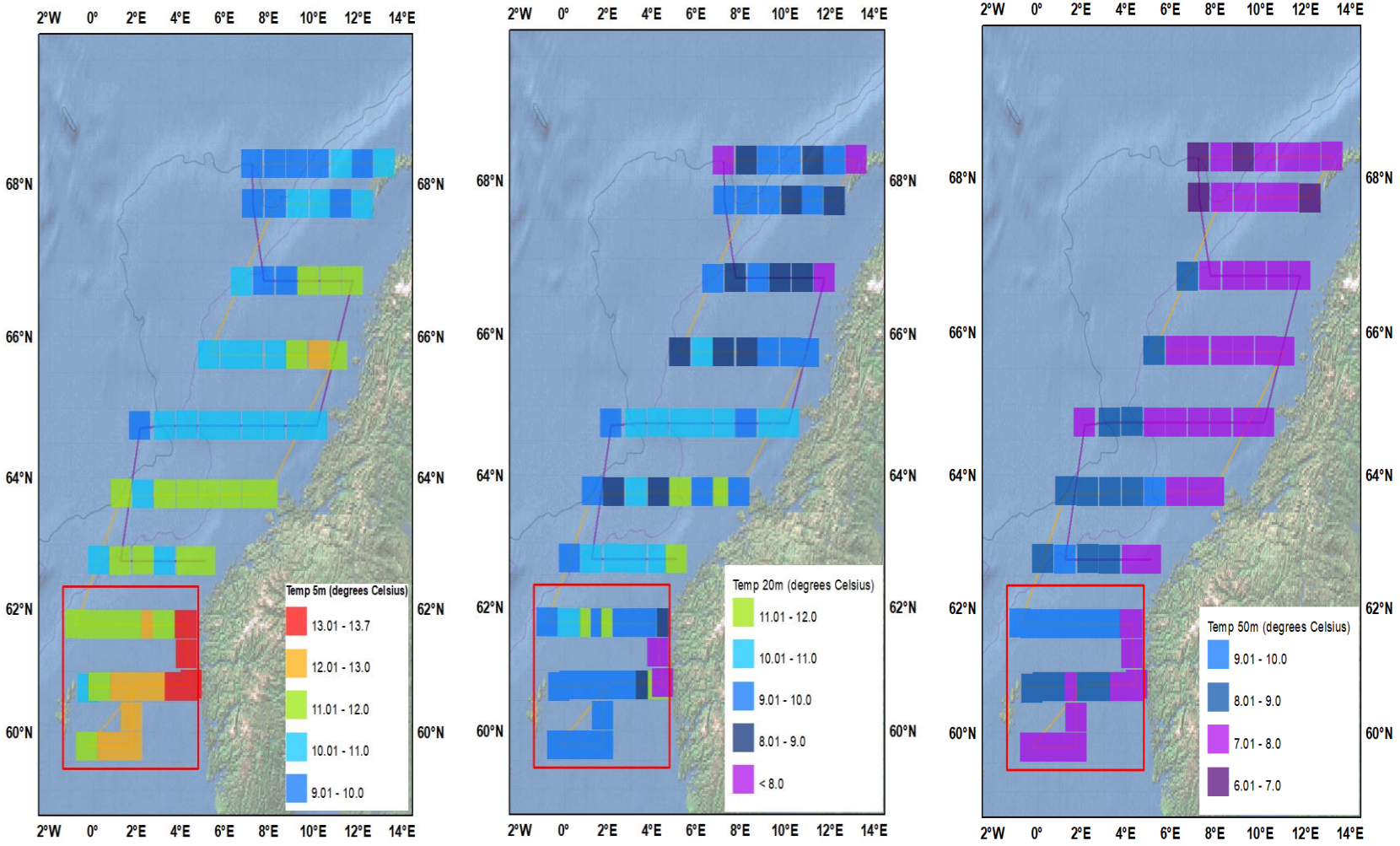


Figure 1: Survey track and stations for 0321H egg survey. Outbound track – orange and inbound track – purple. Red outline denotes 29 icthyoplankton stations undertaken south of 62N and contributing to NSMEGS. Isobaths at 200, 1000 and 2000m are also included for reference.



Figures 2 - 4: Survey 0321H temperatures recorded during Gulf VII deployments at 5m, 20m and 50m.

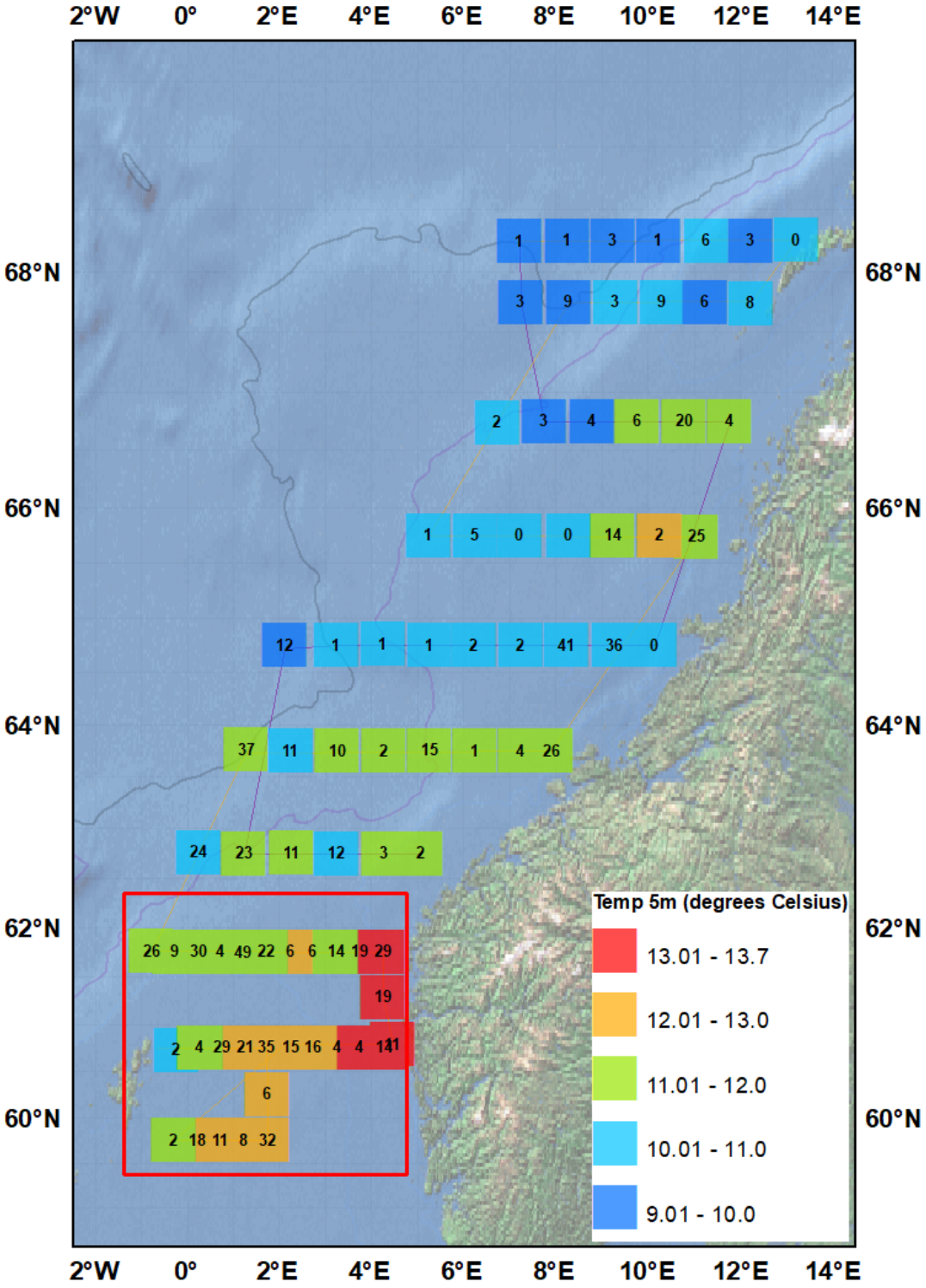


Figure 5: Mackerel stage 1 egg counts/m^2/day survey 0321H, for all stations sampled. The coloured squares represent the surface temperature in degrees Celsius at 5m depth during the icthyoplankton deployments.

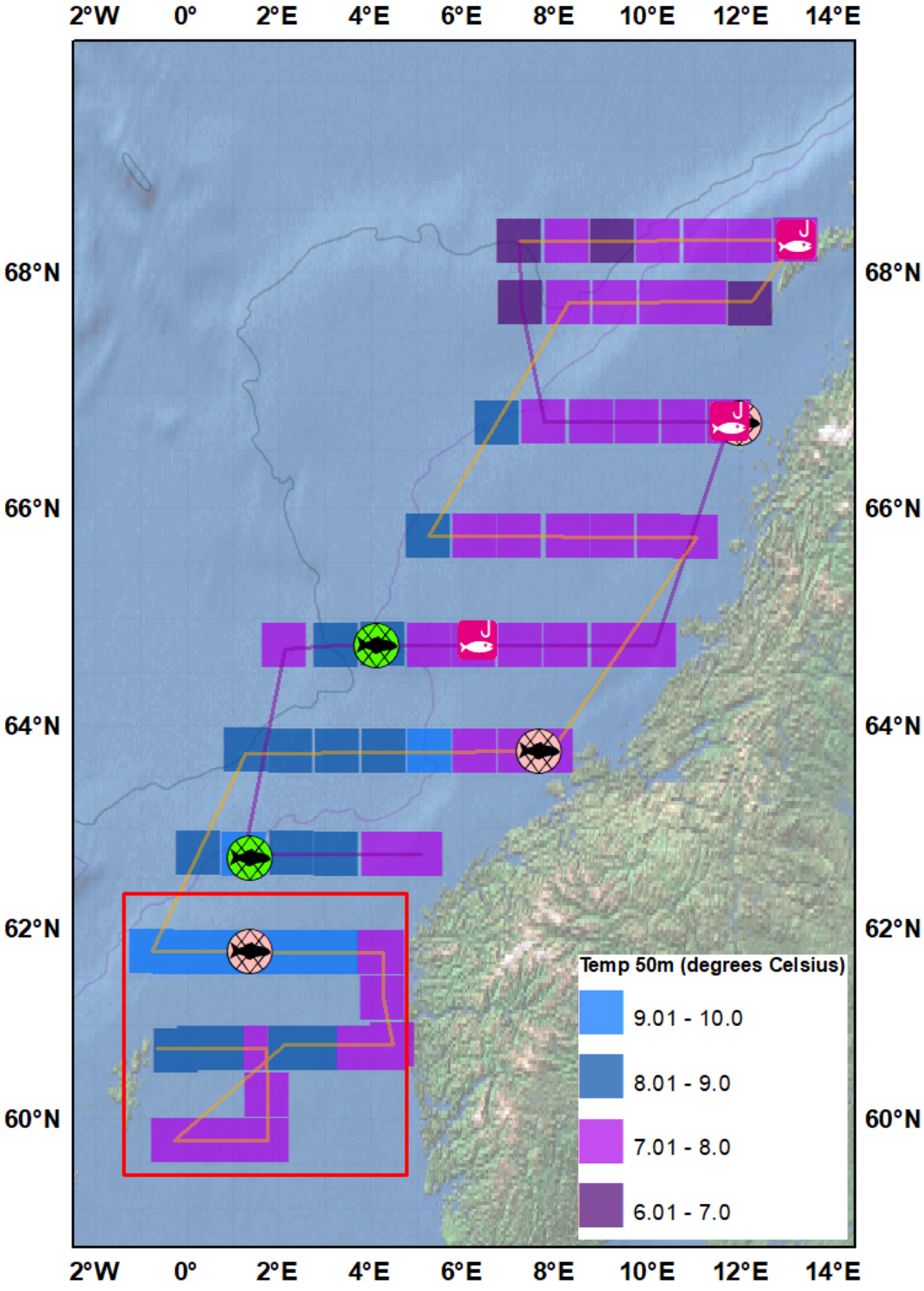
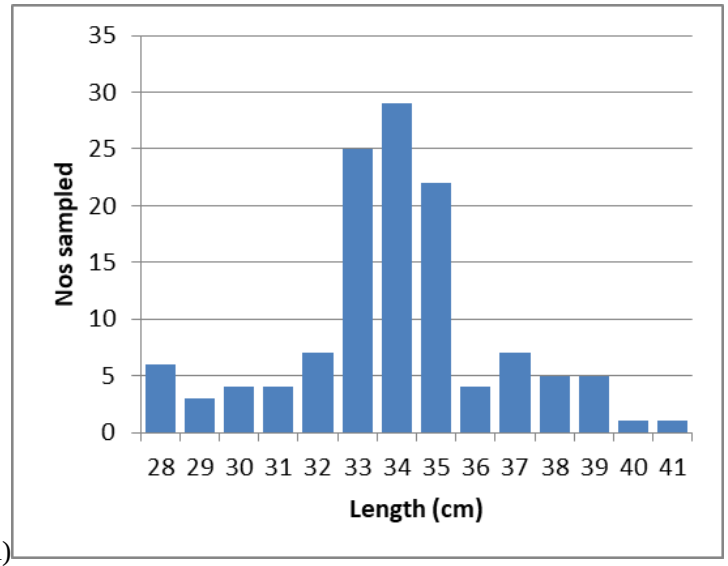


Figure 6: 0321H Trawl deployment. Red fish icons denote unsuccessful deployments, green fish icons denote deployments where mackerel were caught. Rod and line deployment locations (unsuccessful) are also presented. Temp profile at 50m is also underlain for reference.

1)



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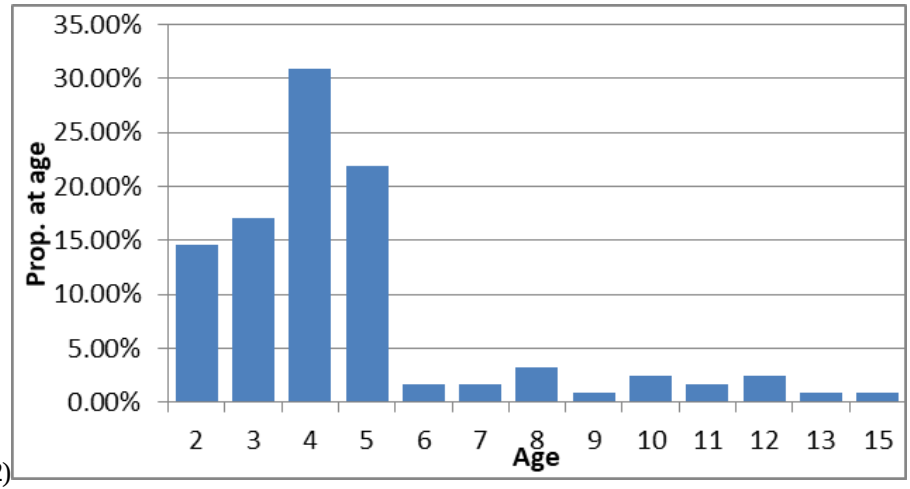

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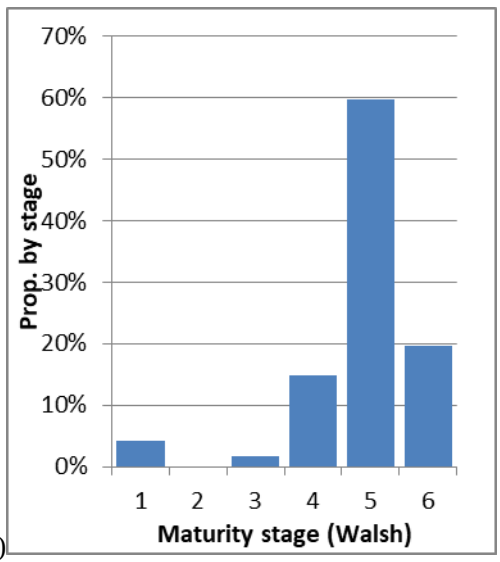

Figures 9 -11: Histograms presenting summarised biological parameters of adult mackerel sampled during survey 0321H. From the top - 1) length(cms), 2) age profile by proportion of total sampled and 3) maturity profile also as a proportion of total sampled. Combined total of 123 mackerel sampled from trawl deployments AE03/04 and AE03/05.