Age-0 fish in Upernavik and Uummannaq regions in August-September 2020

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English Summary

An ichthyoplankton survey was conducted onboard R/V *Sanna* between 19 August and 8 September 2020 in the Upernavik and Uummannaq regions in coastal West Greenland. The objective of the present report is to document the abundance and diversity of larval and juvenile fish in the region in the late summer of 2020. The age-0 fish collected belong to seven species, predominantly capelin (*Mallotus villosus*). No polar cod (*Boreogadus saida*) were collected during the survey, suggesting the extremely warm sea surface temperatures observed in the study area in 2020 resulted in massive mortality among the eggs and larvae, leading to a complete recruitment failure.

Greenlandic Summary – Kalaallisut Naalisarneqarnera

R/V Sanna ilaaffigalugu Upernaviup Uummannallu eqqaanni sinerissap qanittuani planton-inik aalisagaaranngortussanik misissuisoqarpoq ulluni 19. august – 8. september 2020-imi. Nalunaarusiornerullu uuma siunertaraa takussutissamik uppernarsaaserniassallugu 2020-imi aasap naajartornerani qanoq aalisagassanngortussanik qullugiaaqqanik aalisagaagaaqqanillu sumiiffinni taakkunani peqartigisimanersoq. Aalisagaagaaqqat suli ukioqanngitsut assigiinngitsut arfineq-marluupput, amerlanerpaajullutilli ammassaat (*Mallotus villosus*). Eqalukkanik (*Boreogadus saida*) katersat ilaqanngillat tamatumunngalu patsisaatinneqarpoq 2020-imi taamaasinerani immap qaava kissartorujussuusimammat suaaqqat qullugiaaqqallu eqaluganngortussat toqorarujussuarsimanerat, taamaalilluni pisarineqartussanngortussaagaluit piffissami tassanngaaneersuusut annaaneqarsimallutik.

Danish Summary - Dansk Oversigt

Ombord på R/V Sanna blev der mellem d. 19. august og d. 8. september 2020 udført en undersøgelse af fiskeplankton i de kystnære områder i Upernavik- og Uummannaq-regionerne i Vestgrønland. Formålet med denne rapport er at dokumentere, hvilke fiskearter der i sensommeren 2020 forekom som larver- og ungfisk, og hvor mange der var af dem, i regionen. De indsamlede fisk, der er mindre end et år gamle, tilhører syv arter, men er overvejende lodde (*Mallotus villosus*). Der blev ikke fundet polartorsk (*Boreogadus saida*). Det tyder på, at de ekstremt høje temperaturer, der blev målt i overfladevandet, medførte massiv død af æg og larver, så der ikke er kommet nye polartorsk ind i bestanden i 2020.

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1. Introduction

Coastal waters of West Greenland are rapidly warming, affecting fish population dynamics. Many marine fish species have pelagic larvae characterized by a narrow range of thermal tolerance, and are therefore highly sensitive to increases in sea surface temperatures. A recent study suggested partial recruitment failures of polar cod (*Boreogadus saida*) in the regions of Uummannaq and Disko Bay in warm years, following thermal stress and massive mortality among the eggs and larvae (Bouchard et al. 2020). In 2018-2019, a predominance of capelin (*Mallotus villosus*) was observed in Upernavik whereas the ichthyoplankton of Uummannaq was dominated by polar cod (Bouchard et al. 2020). The main objective of the present report is to document the late summer ichthyoplankton assemblages in Upernavik and Uummannaq regions in 2020. The objective of testing the glacial meltwater summer refuge hypothesis exposed in Bouchard et al. (2020) could not be tested as no polar cod larvae were found.

2. Materials and Methods

2.1. Field sampling

Ichthyoplankton samples were collected between 19 August and 8 September 2020 onboard R/V *Sanna* during fisheries surveys of the Greenland Institute of Natural Resources. Agathe Charbogne, master student at Aix-Marseille University, was responsible of the larval fish sampling as part of an internship at the Greenland Institute of Natural Resources supervised by Caroline Bouchard.

A Bongo sampler consisting in two 0.6 m-diameter frames equipped with one 335 µm mesh net, one 500 µm mesh net, and one additional 50 µm mesh net with a 10 cm mouth opening, was deployed at 7 stations in the Upernavik region and 12 stations in Uummannaq region (Figure 1). The Bongo was equipped with two flowmeters to record to volume of water filtered during each deployment, for each mesh size except the 50 µm mesh net. The Bongo was fitted with an acoustic sensor relaying depth in-time during deployment, and all deployments were made to 100 m. For a maximum of 25 larvae per species per station, fish were measured for fresh standard length (SL) and body depth at the anus (BD) onboard, identified to the lowest taxonomical level possible, and preserved in 96% ethanol. Taxonomical identification was later verified by Caroline Bouchard. Zooplankton samples from the three nets (50-, 335- and 500 µm mesh) were preserved in a 4% buffered formaldehyde seawater solution. A CTD was deployed at each station, but the data are not presented here.

2.2. Data analysis

The densities of age-0 fish were calculated for each taxon by dividing the number of individuals collected in a net by the volume of water filtered during the deployment (data obtained from the flowmeter), and averaged between the two nets for each station.

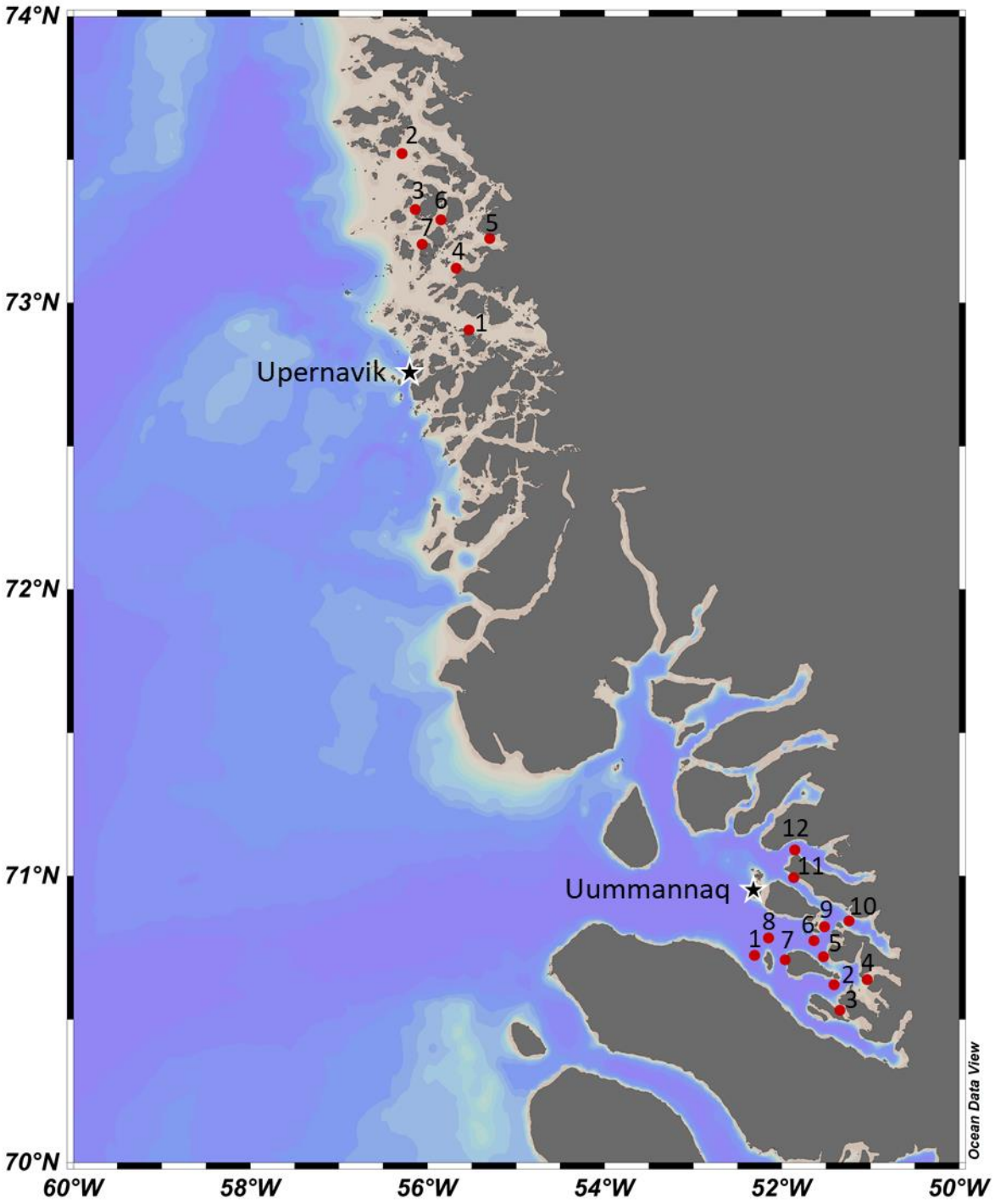

Figure 1. Map of the study area with station location. Upernavik region: stations UPV1-7, Uummannaq region: stations UMK1-12. Stars: towns.

3. Results

In total, 109 age-0 fish were collected and identified to species or to the highest taxonomical level possible, for a total of 7 taxa (Table 1). The ichthyoplankton was composed of 71% capelin (*Mallotus villosus*), 15% American plaice (*Hippoglossoides platessoides*), 5% redfish (*Sebastes* sp.) and 1% Atlantic cod (*Gadus morhua*), at the larval stage (mean SL < 11.6 mm), as well as Cottidae and Stichaeidae at the juvenile stage (mean SL > 23.5 mm). All American plaice were caught in Upernavik whereas all capelin and redfish were caught in Uummannaq (Figure 1, Table 2).

The ichthyoplankton of the Upernavik region was dominated by American plaice, with a maximum density of 12.5 ind. 1000 m^{-3} at station UPV7 (Table 2). In the Uummannaq region, capelin dominated the assemblages with a maximum density of 39.5 ind. 1000 m^{-3} at station UMK10 (Table 1).

The length frequency distribution of larval capelin was unimodal and centered around the mean value (Figure 2). The four larvae collected at stations UMK3-5 in the southern part of the sampling grid, were on average longer (13.6 mm) than the larvae collected at stations UMK10-11 (11.5 mm).

Table 1. Summary of ichthyoplankton caught in the regions of Upernavik and Uummannaq in West Greenland in August-September 2020. SL: standard length. SD: standard deviation.

Taxon	Common name	Number caught	SL (mean ± SD, in mm)
Cottidae			
Myoxocephalus scorpius	shorthorn sculpin	2	37 ± 11
Triglops nybelini	bigeye sculpin	1	30
Gadidae			
Gadus morhua	Atlantic cod	1	9.1
Osmeridae			
Mallotus villosus	capelin	77	11.6 ± 2.7
Pleuronectidae			
Hippoglossoides platessoides	American plaice	16	8.2 ± 2.3
Scorpaenidae			
Sebastes sp.	redfish	5	5.9 ± 3.7
Stichaeidae			
Stichaeus punctatus	Arctic shanny	7	23.4 ± 8.0

Table 2. Densities of age-0 fish in Upernavik (UPV) and Uummannaq (UMK) regions

Station	Density (ind. 1000 m^{-3})						
	M. scorpius	*T. nybelini*	*G. morhua*	*M. villosus*	*H. platessoides*	*Sebastes sp.*	*S. punctatus*
UPV1	0	0	0	0	2.1	0	0
UPV2	1.6	0	0	0	0	0	0
UPV3	0	0	3.1	0	4.8	0	0
UPV4	0	0	0	0	8.1	0	5.4
UPV5	0	0	0	0	0	0	1.7
UPV6	0	0	0	0	1.4	0	1.4
UPV7	0	0	0	0	12.5	0	0
UMK1	0	0	0	0	0	0	1.1
UMK2	0	0.8	0	0	0	0	0
UMK3	0	0	0	1.9	0	0	0
UMK4	0	0	0	4.1	0	2.1	0
UMK5	0	0	0	1.3	0	1.0	0
UMK6	0	0	0	0	0	1.6	0
UMK7	0	0	0	0	0	0	0
UMK8	0	0	0	0	0	0	0
UMK9	0	0	0	0	0	0	0
UMK10	0	0	0	39.5	0	0.8	0
UMK11	1.0	0	0	23.8	0	1.0	1.0
UMK12	0	0	0	0	0	0	0

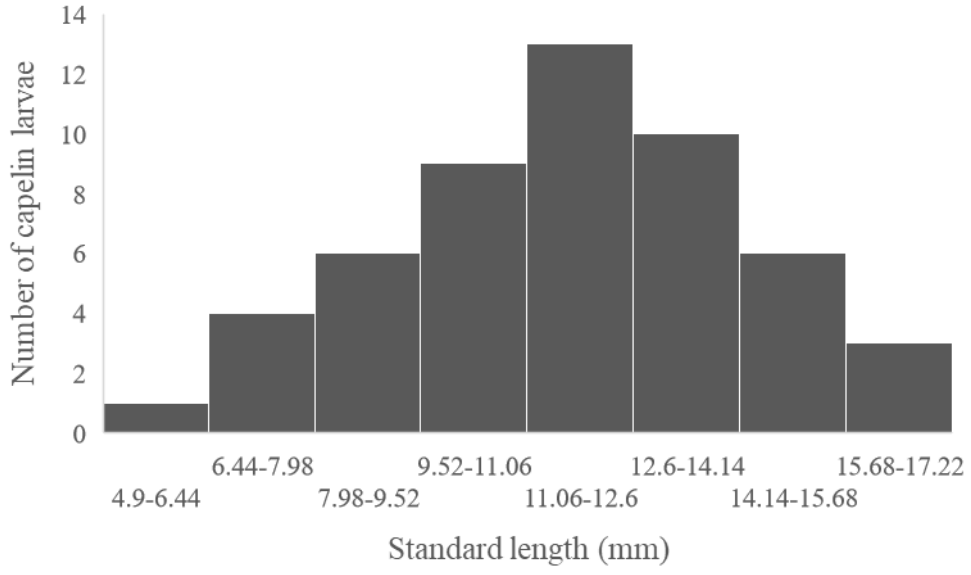

Figure 2. Length frequency distribution of larval capelin in Uummannaq region. n=52.

4. Discussion

No polar cod were collected in 2020, a striking difference from age-0 fish assemblages collected in Upernavik and Uummannaq in 2018-2019 (Bouchard et al. 2020). Sea surface temperatures were extremely high in the Arctic Ocean in the summer of 2020, especially in the study area (NOAA 2021). It seems likely that summer SST in Upernavik and Uummannaq in 2020 exceeded the upper thermal limit of embryonic and larval polar cod (3°C and 5°C, respectively), resulting in massive mortality and recruitment failure. Contrarily to the partial recruitment failures of Uummannaq and Disko Bay in 2018-2019, in 2020 the recruitment failures appeared to be total, as no survivor of the larval cohort were found in August-September.

The absence of capelin in Upernavik in 2020 contrasted with their high abundance in the region in 2019, but may be explained by the difference in sampling locations. Indeed, in 2019, capelin were caught at two stations in the mid- and inner sections of a fjord south of Upernavik, while in 2020, the sampling grid was entirely north of Upernavik, an area that also yielded no capelin larvae in 2019 (Bouchard et al. 2020). Capelin were found in the Uummannaq region in 2018 and 2019, mostly in the inner sections of fjords (Bouchard et al. 2020), in contrast with 2020 when they occurred more commonly across the area. The higher abundance of smaller larvae collected in the northern part of the sampling grid, and the few larger ones collected in the southern part, suggest a hatching location in the northern part and a subsequent southward drift.

American plaice larvae were abundant in Upernavik both times ichthyoplankton was surveyed in the region, in 2019 and 2020 (Bouchard et al. 2020), suggesting a potential hatching site for the species. Redfish larvae were found in the study area in 2020 but not in 2018-2019. Although not in high abundance, their small size suggests newly extruded larvae (e.g. Sevigny et al. 2000).

5. References

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