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State of the reproductive system of blue whiting from the North-East Atlantic in the spring/ summer period of 1979

by

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Abstract

When studying the state of blue whiting gonads in the Norwegian Sea during the spring/summer period it was found that mainly pre-spawning blue whiting of "local stock" were feeding there from April to mid-May, immature and also "non-breeding" fishes formed part of the population. From the second half of May spawned-out blue whiting migrated from western areas northward over the southern Norwegian Sea. Gonads of migrating fishes were at maturity stage VI-II. By August gonads of the bulk of fishes were at maturity stage II-III and there was no great difference between blue whiting of some populations.

Résumé

Les recherches sur l'état des glandes génitales du poutassou de la mer de Norvège au printemps et en été ont démontré qu'à partir d'avril jusqu'à la mi-mai c'est le poutassou franc "du cheptel local" qui s'engraisse en mer; une partie de la population est composée des poissons non-maturés et des poissons "stériles". A partir de la mi-mai le poutassou guai se déplace de l'ouest vers le nord en passant

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par les régions sud de la mer. Les glandes génitales du poisson migrateur atteignent le stade IY-II de maturité. Vers le mois d'août la plupart des poissons ont les gonades en stade II-III de maturité, les populations différentes du poutassou ne présentant pas de dissemblance considérable.

Introduction

Studying the development of blue whiting gonads in the spring/summer period will permit to specify the terms and area of spawning of the species, to determine the migration routes to feeding grounds after spawning and also to clear up why mature specimens do not spawn sometimes.

Materials and methods

Ovaries and testes of blue whiting from the southern (63°00' - 64°00'N), central (65°00' - 66°00'N) and northern (68°00' - 70°00'N) areas of the Norwegian Sea were the object of our investigations. Data were collected from April to August 1979. About 200 samples were fixed in Bouin's fluid. Treatment of data was carried out in the PINRO Laboratory of Physiology. Microscopic preparations were stained with iron hematoxylin.

Discussion

Small catches of mature blue whiting 29 to 35 cm long with gonads at maturity stages II, II-III and III were taken during the first trawlings in the area of Mona Threshold. The rest of time during the first decade of April works were carried out in areas of the central Norwegian Sea (65°00' - 66°00'N). Mainly adult blue whiting 29 to 36 cm long with gonads at maturity stages II, II-III, III and occasionally at stage III-IV (no more than 1%) were also caught there. Ovaries at stage III were light pink and roundish eggs were hardly seen through the transparent membrane of gonads. Older ovocytes were in the phase of initial accumulation of yolk. Older generation of eggs in ovaries at stage II-III was in the phase of vacuolization and in ovaries at stage II (VI-II) in the phase of one-layered follicle. Maturity coefficient of females at stage III was within 1-1.5%. It was possible that those specimens would participate in spawning but not earlier than July/ August. Fishes with gonads at maturity stage II-III and especially at stage II would not be likely to participate in spawning.

Areas of the southern Norwegian Sea (63°00' - 64°00'N) were investigated from the second decade of April. Immature blue whiting 19 to 28 cm long with gonads at maturity stages I and II were found in those areas together with mature specimens at stages II-

III, III and IVA. Ovaries at stage VIA weighed 9-12 g and had coloration from orange to brown. Eggs of different size 0.3-0.5 mm in diameter were seen through the transparent membrane. Older ovocytes were in the phase of intensive accumulation of yolk. Maturity coefficient of fishes did not exceed 4-5% (the highest maturity coefficient of pre-spawning blue whiting was 18-19%). As the gonads matured those specimens would probably migrate to spawning grounds (areas of the Faeroe Islands or Halten and Frøya Banks along the Norwegian coast) since we failed to find fishes with more mature gonads.

May. Works were carried out in the central Norwegian Sea (65°00' - 67°00'N) along the Norwegian Current. In the first half of May gonads of adult specimens were at maturity stages II-III, III, IVA and sporadically at stage VI. Ovaries of spawned - out females looked like elongated half-empty sacs of dirty brown colour. Developing eggs were not seen with the naked eye through the thickened membrane of gonads. In the cross section the cavity was well seen in which a minute quantity of remained eggs might be found. Maturity coefficient of those fishes was about 1%.

According to visual evaluation there occurred specimens whose ovaries were at maturity stage VI-IV. Ovaries were in the form of half-empty sacs through the transparent membrane of which roundish light yellow eggs 0.5-0.6 mm in diameter were seen. In the cross section of gonads there was seen the cavity. Blue whiting females with gonads of that kind had already participated in spawning, the portion or perhaps two ovulated eggs were spawned out. The microscopic examination showed that next portion of maturing eggs was subjected to resorption and, consequently, ovaries of those specimens might be at maturity stage VI-II. Maturity coefficient of

those fishes did not exceed, as a rule, 1-2%. The mass approach of post-spawning blue whiting was observed in late May. Migrating fishes 29 to 38 cm long were characterized by a low coefficient of fatness (3.2-5.8%) in contrast to blue whiting caught there earlier (4.5-10%). Gonads of both males and females were at maturity stage VI-II. Ovaries were yellowish-brown. Whitish eggs remained after spawning (often hardened, 0.5-0.7 mm in diameter) lying freely in glandular cavities were seen sporadically through the thickened membrane. The mass resorption of "joining stages" and remained follicles were observed in microscopic sections. Eggs in the phase of formation of the RNA peripheral ring represented the older generation of developing ovocytes.

Testes at stage VI-II were of dirty yellow to light pink colour. Gonaducts were transparent, glandular festoons lost their strength and form and were contracted. Spawning occurred, perhaps, in areas of the Porcupine and Rockall Banks in February/March. In May/June post-spawning blue whiting migrated to the north of the Norwegian Sea between the Faeroe and Shetland Islands. The first migration route lied in the north-western direction, northward of the Faeroe Islands to the East Iceland, along the East-Icelandic Current; the second - more eastward, in the northern direction, along the Norwegian Current.

In spring and early summer 1979 water temperature eastward and northward of Iceland (according to the results of investigations carried out by the R/V "Akhill") was below the norm, i.e. hydrological conditions were very unfavourable and for that reason, perhaps, spawned-out blue whiting migrated in one direction - along the Norwegian Current.

June. During June investigations were carried out in the central Norwegian Sea. Blue whiting which had already spawned out evidently in February/March accounted for 90% of fishes caught. Postspawning replacement of gonads (maturity stage VI-II) was observed in the majority of specimens. In late June there appeared specimens with gonads at maturity stage II-III. Ovaries of those fishes were of light yellow to light pink colour. The membrane was transparent but developing eggs were not seen through it. The internal cavity disappeared. Weak signs of the previous spawning, atretic bodies and more rarely remained follicles were seen in microscopic sections of those gonads. The older generation of developing sexual cells was in the phase of one-layered follicle.

During June blue whiting gonads of "local" population were at maturity stages VI and VI-II and in late June they were mainly at stage VI-II. Immature blue whiting 21 to 28 cm long were also found. Gonads of those fishes were at stages I and II.

July. Northern areas of the Norwegian Sea (68°00' - 70°00'N) were investigated. During July the number of mature fishes with gonads at stage II-III increased and percentage of fishes with gonads at stage VI-II decreased respectively. Marked differences between some populations of blue whiting both in the state of gonads and in fatness and fullness of fishes were not observed. Immature fishes 20 to 27 cm long accounted for about 30% of catches. Gonads of specimens 20 to 24 cm long were at maturity stage I and those of fishes 24 to 27 cm long - at stage II.

August. Works were carried out only in the first half of August. Areas of Mona Threshold (72°00' - 73°00'N) were investigated. Immature blue whiting 20 to 27 cm long accounted for about 25%. Gonads of most adult fishes were at maturity stage II-III, sometimes

according to visual evaluation they were at stage II, gonads of the rest of fishes were at stage VI-II and specimens at stage VI were found sporadically.

At that period it was difficult to single out specimens among mature fishes which had not participated in spawning.

The Norwegian Sea was the feeding range of some blue whiting stocks with various terms and areas of spawning. From April to August blue whiting of "local" stock or stocks were caught in different areas of the Norwegian Sea. Gonads of mature specimens were at different maturity stages: II-III, III, IVA, VI and in late July at stage VI-II. In 1979 spawning lasted from late April to July, i.e. over three months. The Halten and Fröya Banks, Faeroe Islands and others were probably the spawning grounds.

Mature fishes which had already spawned out evidently in February/March began to appear in the Norwegian Sea from mid-May. It was "western" stock of blue whiting characterized by the increased abundance. Gonads of those fishes were at maturity stage VI-II. During June and July signs of the previous spawning disappeared and stage VI-II changed into stage II-III. Mature specimens whose gonads were at maturity stage II in the spring/summer period and which in all probability had not participated in spawning should be also mentioned.

Those fishes were mainly caught in northern areas of the Norwegian Sea. That group of fishes was evidently recruited with specimens of "western" stock since those blue whiting appeared in the feeding areas in the exhausted state. Some specimens which had not succeeded in restoring their energy balance stayed probably for the winter recruiting the population of "non-breeding" fishes.

Table 1

Occurrence of mature blue whiting in the Norwegian Sea (%)

Maturity stages	April		MAY			June			July		August		
	II	III	I	II	III	I	II	III	I	II	II	I	II
	"local" stock												
II-III	2,4	3,8	3,8	5,6	I,I	0,6	0,3	0,2	0,2	0,I			
II	3,2	4,0	3,I	2,4	I,6	0,8	0,4	0,4	0,2				
IV	2,I	I,6	I,0	I,5	0,5	0,3	0,5	0,5					
VI						0,4	0,3						
	"western" stock												
VI-II			I5,0	68,0	77,0	75,0	77,0	54,0	20,0	20,0	30,0	26,0	
II-III							2,0	33,0	40,0	70,0	33,0	42,0	