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VARIATIONS IN PHYSICAL PROPERTIES OF PELAGIC EGGS IN DIFFERENT POPULATIONS - GENETIC ASPECTS

By

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INTRODUCTION

The size and specific gravity of pelagic eggs vary throughout the distribution area of a teleost species. In areas of high salinity the specific gravity of the eggs are higher than in brackish areas, and their size are usually smaller. This adaptation was thought to be of osmotic nature. Experiments were carried out to measure the effect of different salinities on the size and specific gravity of developing eggs (Jacobsen & Johansen 1908, Franz 1910, Kändler & Tan 1965). Most of these results, however, showed that the fertilized eggs are very little affected by the salinity.

On the other hand, Strodtman (1918) explained the different physical properties of pelagic eggs as a function of the osmotic state in the ovary: teleosts living in water of low salinity having a somewhat lower osmolarity in the ovary fluid. The dynamics of this mechanism was demonstrated by Solemdal (1967, in press) by transferring Norwegian flounders with running eggs from high to low salinity. During 2-3 weeks the egg size increased and the specific gravity decreased significantly. Transferring Norwegian flounders to water of low salinity 4-5 months before spawning had the same effect on egg size and buoyancy as the short-term experiments.

However, eggs from low salinity adapted Norwegian flounders never reach the large size and low specific gravity of Baltic flounder eggs. This fact indicates that the observed differences between eggs from Norwegian and Baltic flounder populations are caused by other factors than the immediate osmotic adaptation. The possibility of a long-term selection process in favour of thinshelled eggs for marine teleosts migrating into brackish areas has been put forward (Solemdal in press). The eggshell (chorion) has the greatest specific gravity of the egg components. Therefore, a

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variation in thickness of the chorion would alter the specific gravity of the whole egg. No material has been available to test this hypothesis so far.

The present paper gives the results of a comparative study of eggs from Baltic and Norwegian flatfish populations. Also, flatfish from two Baltic populations were transported to Bergen and kept in water of high salinity until spawning. Data on these eggs are given.

MATERIAL AND METHODS

Running flatfish, flounder (Platichtys flesus) and plaice (Pleuronectes platessa), were caught on a cruise with R/V "Alkor" from Kiel in April 1969 and during a visit to Tvärminne Zoological Station, Finland in May 1969. The eggs were artificially fertilized and measured at the 2 - cell stage. All determinations were made on live material. The methods for determining the diameter and neutral buoyancy are given elsewhere (Solemdal in press, 1970).

Flatfish were transported by air from Tvärminne to Bergen. Material from Arkona Deep was taken by boat to Oslo and by air from Oslo to Bergen. Transported Baltic flatfish were kept together with Norwegian flatfish in an outdoor tank at the Institute of Marine Research, Bergen, and fed with herring and Calanaus sp.

The dry-weights of the eggs was determined by heating to 105°C until constant weight. The weight of dried chorions was determined by squeezing the eggs, washing them thoroughly with distilled water and heating to 105°C to constant weight.

The greater part of the flatfish in the tank died during the autumn 1969, due to a heavy Vibrio infection.

RESULTS AND DISCUSSION

Data on eggs from flounder (Platichtys flesus) and plaice (Pleuronectes platessa) are given in Table 1. The neutral buoyancy for both species is almost identical within the same area. In spite of this, the egg size of the two species shows a difference. The Baltic populations of flounder have the largest eggs, while the Norwegian plaice have larger eggs than plaice from the Baltic, as also found by Mielck & Künne (1932).

The eggs of the transported Baltic flatfish all show a neutral buoyancy very close to the Baltic populations (Table 1), though a change from 16 to 20-21 °/oo salinity was found for the transported Arkona flatfish. The flounder from Tvärminne transported to Bergen, has egg size and neutral buoyancy identical to the Tvärminne population.

In Table 2, different weight data of eggs are given for the Norwegian flatfish populations and the transported Baltic flatfish. Both species transported from Baltic have low total dry-weight, irrespective of the diameter differences between the two species. This indicates a great difference in chorion between the different populations. This difference is clearly shown on the dry-weight of the chorion of plaice (Table 2). Compensating for the diameter difference between the two groups chorion from Norwegian plaice is about 3.7 times heavier than chorion from transported Arkona plaice.

An electronmicroscopical investigation of the chorion (Lønning & Solemdal, in preparation) shows that this weight-difference of chorion from different populations is due to varied thickness of the chorion.

SUMMARY

1. The present results indicate that the specific gravity of pelagic fish eggs to a great extent is determined by the thickness of the chorion.

2. The thickness of the chorion seems to be genetically controlled, as no change occured when flatfish transferred from the Baltic to Bergen developed running eggs in the new salinity environment.

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Table 1. Egg diameter and neutral buoyancy, flounder (Platichtys flesus) and plaice (Pleuronectes platessa). Fish from different population and transported from Baltic to Bergen 1 year before spawning.

Species	Locality	Salinity °/oo	No. of fish	Egg diameter, mean, mm	No. of eggs measured	Neutral buoyancy, °/oo salinity
Platichtys flesus	Bergen	35	14	0.884	1546	31.8
	Arkona	17-18	14	1.185	1470	16.2
	Tvärminne	5-7	7	1.010	715	20.3
	Transported from Arkona to Bergen	35	1	1.033	64	20.7
	Transported from Tvärminne to Bergen	35	1	0.992	91	20.1
Pleuronectes platessa	Bergen	35	8	1.851	827	31.9
	Arkona	17-18	1	1.733	71	16.8
	Transported from Arkona to Bergen	35	1	1.685	141	20.2
	Transported from Arkona to Bergen	35	1	1.486	84	21.3

Table 2. Diameter, neutral buoyancy, cod weight, total dry weight, weight of dried chorion and dried chorion as % of total dry weight. Eggs, flounder (Platichtys flesus) and plaice (Pleuronectes platessa) from Bergen and fish transported from the Baltic Sea 1 year before spawning.

Species	Locality	Egg diam. mean, mm	Neutral buoyancy, °/oo salinity	Wet weight, mg/egg	Total dry weight, %	Dried chorion, mg/chorion	Dried chorion as % of tot. dry weight
Pleuronectes platessa	Bergen	1.855	30.8	3.933	7.03	0.088	33.0
	Transported from Arkona to Bergen	1.561	20.5	2.000	4.31	0.017	19.3
Platichtys flesus	Bergen	0.855	30.4	0.3667	7.77	-	-
	Transported from Arkona to Bergen	1.015	20.6	0.5899	4.95	-	-
	Transported from Tvärminne to Bergen	1.014	19.4	0.5667	4.50	-	-