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The development of turbot-eggs, *Scophthalmus maximus* L., from the Baltic Sea under different temperature and salinity conditions+)

by

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Abstract

Eggs of the turbot, *Scophthalmus maximus* L., from the Western Baltic Sea were incubated under 12 different temperature-salinity conditions ranging from 12.5° to 17°C and from 15 °/oo to 30 °/oo S. The best viable hatch with a rate of 51.7 % occurred at the combination of 15°C and 20 °/oo S. No viable larvae hatched in 30 °/oo S.

Introduction

Although the turbot is one of the most recommended fish in todays mariculture research, only little attention was given to the embryonic development under different environmental parameters. The knowledge about adaptation and tolerance of marine fish eggs is most important, particularly in brackish waters with their wide T/S range. High mortality rates of the larvae and, perhaps, of the later life stages as well might be decreased by a better handling of the embryonic stages.

In order to find the optimal T/S combination for the incubation

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of the eggs of the turbot from the Western Baltic Sea 25 T/S combinations ranging from 6 - 20°C and from 5 - 20 °/oo S were examined in 1979 (KUHLMANN & QUANTZ, 1980). As only the ambient salinity conditions were considered, the effect of higher salinities still remained uncertain. These investigations were carried out this year to fill the lack.

Material and methods

The eggs of one female turbot (42 cm TL) caught off Langeland in the Belt Sea were stripped and fertilized with the sperm of one male (51 cm TL) in 16 °/oo S seawater at 15°C. Two hours after fertilization the living eggs were transferred into 1 000 ml jars at densities of 100 to 200 eggs per liter and constantly held under 12 different T/S combinations of 12,5°, 15°, and 17°C and 15 °/oo, 20 °/oo, 25 °/oo and 30°/oo S, respectively (Table I). Two replicates were run for each combination and the results were averaged.

The salt water was prepared by mixing fresh water with synthetic sea salt (New Tropic Marine) to achieve constant salinities throughout the trials.
The size of the eggs used was 0.97 ±0.02 mm. The fertilization rate was 83.5 %.
Dead eggs were removed daily and counted. The viable hatch was determined as number of larvae of normal appearence emerging from the egg-shells referring to the initial number of eggs.

Results

The data on embryonic survival of the different temperature and salinity trials are given in Table I. Less than 50 % mortality occurred when eggs were incubated at 12.5° and 15°C in 20 °/oo salinity and at 17°C in 15 °/oo and 20 °/oo S. 30 °/oo S caused more than 90 % mortality at all temperatures.

The percentage of hatched and viable larvae incubated under the experimental T/S combinations are shown in Fig. 1. The highest rate of viable larvae was 51.7 % and resulted from incubation in a T/S combination of 15°C and 20 ‰ S. In 30 ‰ S no hatch of viable larvae was observed.

The turbot eggs became buoyant in 27 ‰ salinity.

Discussion

The embryonic development of fish under different temperature and salinity conditions can be seen under economical as well as under ecological aspects. The knowledge of the optimal conditions for maximum egg survival helps to produce healthy larvae as a basis for further cultivation work. It also will somewhat explain the adaptation of the turbot to brackish water environments.

In comparison to a T/S-experiment done in 1979 (KUHLMANN & QUANTZ, 1980) this year the best viable hatch was found at a T/S combination of 15°C and 20 ‰ S instead of 17°C and 15 ‰ S (54.1 % and 51.7 % viable hatch, respectively). Fig. 3 shows that there is a small plateau-like optimum of approximately 50 % viable hatch ranging from 15 to 17°C and 15 to 20 ‰ S. When the salinity becomes higher than 20 ‰ S hatching success decreases rapidly.

The results indicate that the embryonic development of the turbot of the Baltic Sea is obviously adapted to spawning in coastal brackish water during early summer. In the Western Baltic, spawning activity has its peak in June and July. At that time, temperatures and salinities on the spawning grounds are similar to those found to be optimal for incubation. According to this adaptation and also according to a higher fertility of the Baltic turbot compared to the North Sea stock, as described by KÄNDLER & PIRWITZ (1957), the turbot of the Baltic Sea seems to be characterized as a brackish water subspecies.

Surprisingly, viable hatch only occurred in salinities where the eggs are not buoyant. According the catches of ripe females in the area at salinities below 20 ‰ it is suggested that spawning under such environmental conditions actually takes place. This also explains why there are almost no records of turbot eggs from plankton samples from the Western Baltic (KÄNDLER, 1949).

Differences in the conditions for optimal egg development were also shown for cod, plaice and flounder of the Baltic compared to fishes from the North Sea by v. WESTERNHAGEN (1970). But for these species optimal salinities for incubation were always found to be high enough for the eggs to stay buoyant, though the salinity optima for the different eggs were found to be very different. This shows that fish species living in the Western Baltic may be adapted quite differently to the governing salinity conditions.

Other marine species which spawn in coastal or estuarine areas show wide ranges of tolerance in egg development with respect to salinity and temperature levels during incubation (FONDS et al. 1974, HOLLIDAY & BLAXTER 1960). ALDERDICE & VELSEN (1971) found for Clupea pallasi that high percentage of viable hatch occurs on a ridge running from combinations of low salinity and low temperature to those of higher salinities and higher temperatures. For the development of turbot eggs, to a certain extent, high hatch success resultseither from conditions of low salinities and high temperatures or high salinities and low temperatures.

Temperatures and salinity are only two of various factors that can cause disturbances in early development (ROSENTHAL & ALDERDICE 1976). Nevertheless the prevention of sublethal and lethal conditions of salinity and temperature is the basis to obtain healthy larvae in cultivation.

Tab. I: Incubation of turbot eggs at 12 T/S combinations. (Total hatch = % of normal and abnormal larvae referring to total number of eggs. Viable hatch = % of normal larvae referring to the number of eggs)

Conditions Temp. °C	Sal. ‰ S	Total number of eggs sample I	Total number of eggs sample II	Egg-mortality (%) sample I	Egg-mortality (%) sample II	Egg-mortality (%) MEAN	Total hatch (%) sample I	Total hatch (%) sample II	Total hatch (%) MEAN	Viable hatch (%) sample I	Viable hatch (%) sample II	Viable hatch (%) MEAN
12.5	15	127	113	72.4	69.0	70.7	27.6	31.0	29.3	12.7	15.9	14.3
12.5	20	79	96	51.9	34.4	43.2	48.1	65.6	56.9	30.4	30.2	30.3
12.5	25	89	95	87.6	88.4	88.0	12.4	11.6	12.0	0.0	2.1	1.1
12.5	30	195	191	93.8	95.8	94.8	6.2	4.2	5.2	0.0	0.0	0.0
15.0	15	124	132	60.5	61.4	61.0	39.5	38.6	39.0	24.2	18.9	21.6
15.0	20	124	148	40.3	31.7	36.0	59.7	68.3	64.0	50.0	53.4	51.7
15.0	25	160	98	87.5	86.7	87.1	12.5	13.3	12.9	3.7	4.1	3.9
15.0	30	214	112	98.6	98.2	98.4	1.4	1.8	1.6	0.0	0.0	0.0
17.0	15	153	141	34.6	58.2	46.4	65.4	41.8	53.6	34.6	19.1	26.9
17.0	20	109	114	14.7	42.9	28.2	85.3	57.1	71.2	64.2	30.8	47.5
17.0	25	85	72	67.0	65.3	66.2	33.0	34.7	33.8	1.2	1.4	1.3
17.0	30	134	82	97.8	96.3	97.1	2.2	3.7	2.9	0.0	0.0	0.0

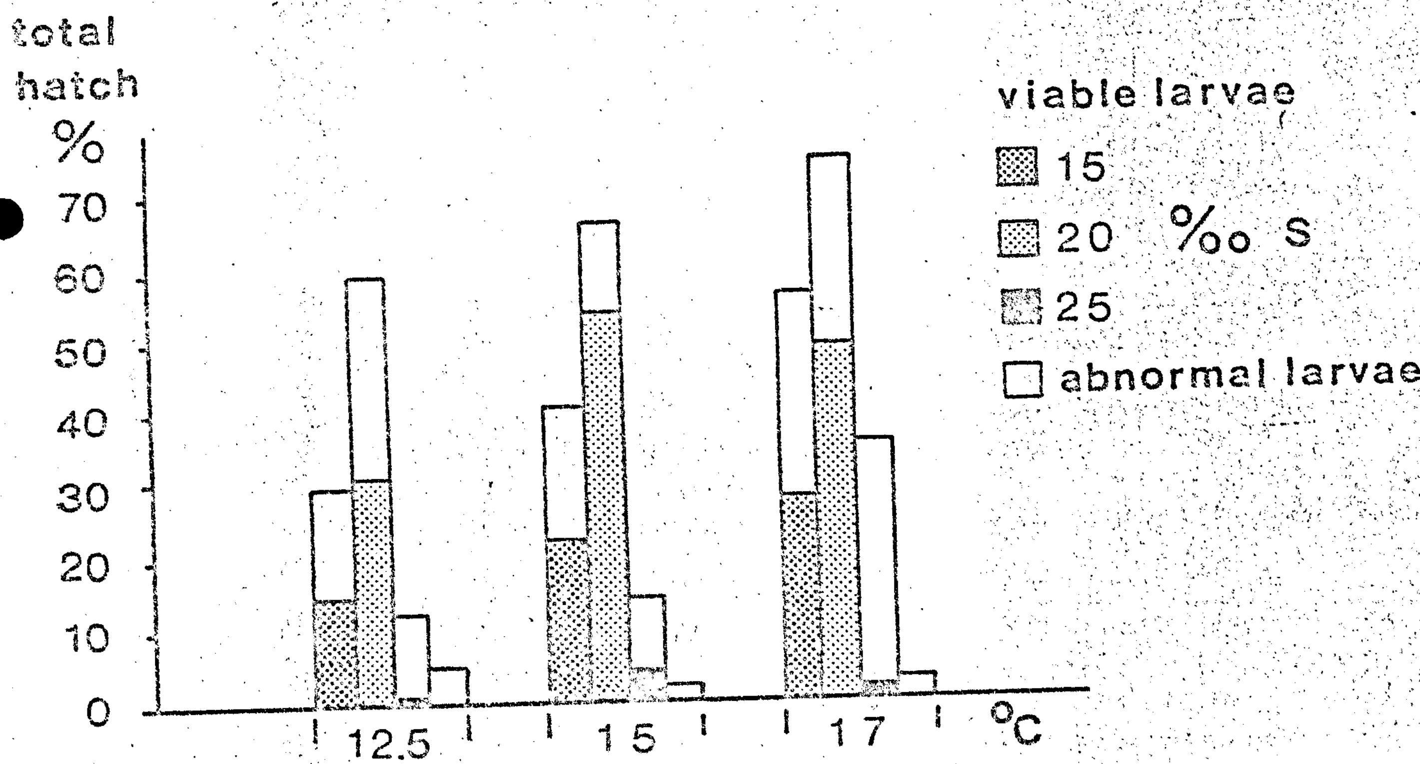

Fig. 1: Total and viable hatch of turbot eggs, incubated under different T/S combinations

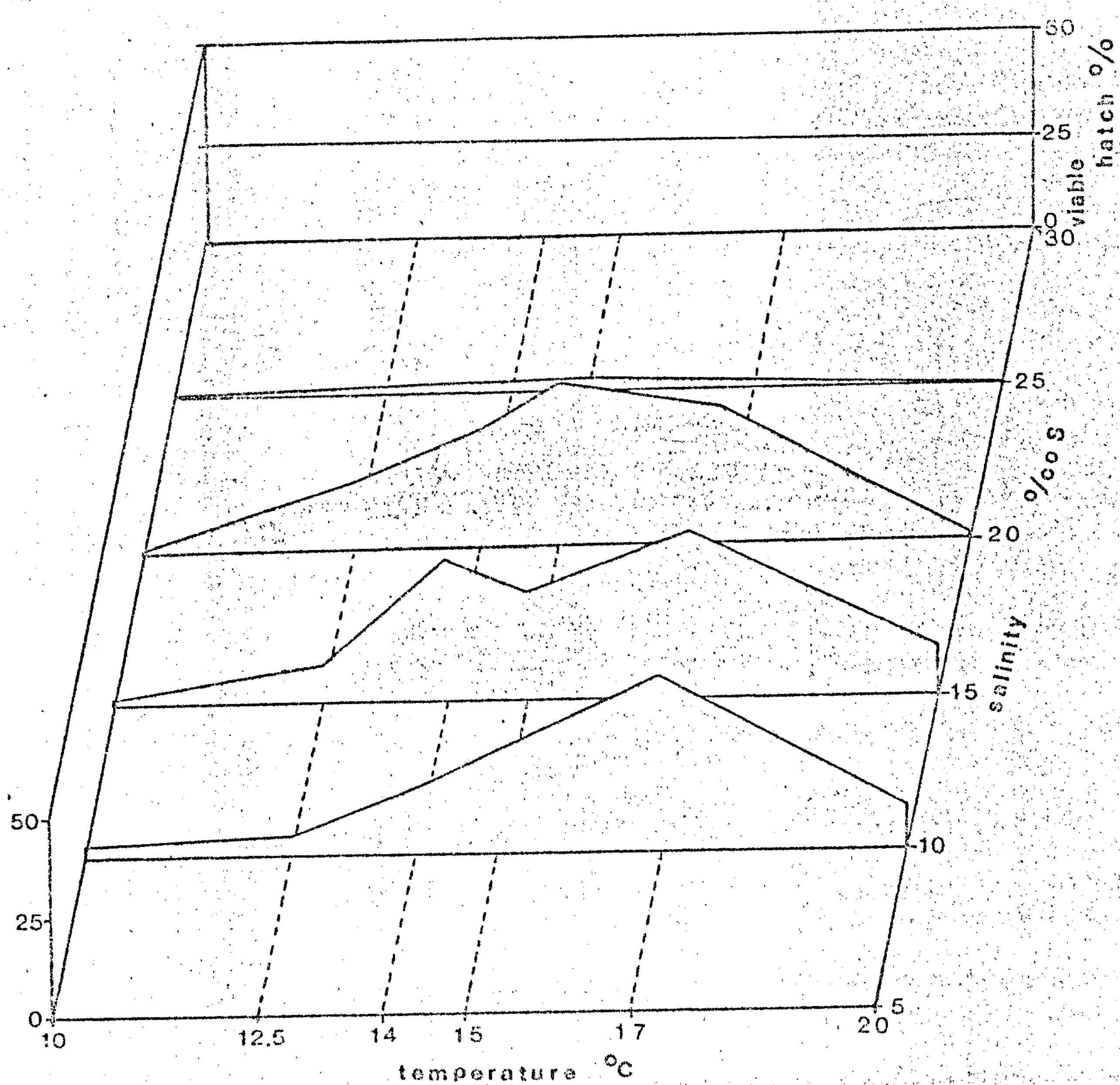

Fig. 2: Effects of temperature and salinity during incubation on the rate of viably hatched larvae of the turbot. Averaged data of 1979 (KUHLMANN & QUANTZ,1980) and 1980.

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