Observations on Viability of Eggs from Small Fish of a Local Herring Stock

H. Rosenthal and A. S. Hourston

Department of Fisheries and Oceans
Fisheries Research Branch
Pacific Biological Station
Nanaimo, British Columbia V9R 5K6

June 1982

Canadian Technical Report of Fisheries and Aquatic Sciences No. 1090

Government of Canada Fisheries and Oceans
Gouvernement du Canada Pêches et Océans

Canadian Technical Report of Fisheries and Aquatic Sciences

These reports contain scientific and technical information that represents an important contribution to existing knowledge but which for some reason may not be appropriate for primary scientific (i.e. *Journal*) publication. Technical Reports are directed primarily towards a worldwide audience and have an international distribution. No restriction is placed on subject matter and the series reflects the broad interests and policies of the Department of Fisheries and Oceans, namely, fisheries management, technology and development, ocean sciences, and aquatic environments relevant to Canada.

Technical Reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report will be abstracted in *Aquatic Sciences and Fisheries Abstracts* and will be indexed annually in the Department's index to scientific and technical publications.

Numbers 1-456 in this series were issued as Technical Reports of the Fisheries Research Board of Canada. Numbers 457-714 were issued as Department of the Environment, Fisheries and Marine Service, Research and Development Directorate Technical Reports. Numbers 715-924 were issued as Department of Fisheries and the Environment, Fisheries and Marine Service Technical Reports. The current series name was changed with report number 925.

Details on the availability of Technical Reports in hard copy may be obtained from the issuing establishment indicated on the front cover.

Rapport technique canadien des sciences halieutiques et aquatiques

Ces rapports contiennent des renseignements scientifiques et techniques qui constituent une contribution importante aux connaissances actuelles mais qui, pour une raison ou pour une autre, ne semblent pas appropriés pour la publication dans un journal scientifique. Il n'y a aucune restriction quant au sujet, de fait, la série reflète la vaste gamme des intérêts et des politiques du Ministère des Pêches et des Océans, notamment gestion des pêches, techniques et développement, sciences océaniques et environnements aquatiques, au Canada.

Les Rapports techniques peuvent être considérés comme des publications complètes. Le titre exact paraîtra au haut du résumé de chaque rapport, qui sera publié dans la revue *Aquatic Sciences and Fisheries Abstracts* et qui figurera dans l'index annuel des publications scientifiques et techniques du Ministère.

Les numéros 1-456 de cette série ont été publiés à titre de Rapports techniques de l'Office des recherches sur les pêcheries du Canada. Les numéros 457-714, à titre de Rapports techniques de la Direction générale de la recherche et du développement, Service des pêches et de la mer, ministère de l'Environnement. Les numéros 715-924 ont été publiés à titre de Rapports techniques du Service des pêches et de la mer, Ministère des Pêches et de l'Environnement. Le nom de la série a été modifié à partir du numéro 925.

La page couverture porte le nom de l'établissement auteur où l'on peut se procurer les rapports sous couverture cartonnée.

Canadian Technical Report of Fisheries

and Aquatic Sciences No. 1090

June 1982

OBSERVATIONS ON VIABILITY OF EGGS FROM SMALL FISH OF A LOCAL HERRING STOCK*

by

H. Rosenthal[1] and A. S. Hourston

Department of Fisheries and Oceans

Fisheries Research Branch

Pacific Biological Station

Nanaimo, British Columbia

[1]Address Biologische Anstalt Helgoland

2 Hamburg 50, Notkestrasse

Federal Republic of Germany

*Prepared under the auspices of the German-Canadian

Scientific and Technical Cooperation Agreement (Contribution No. 23)

Cat. No. Fs 97-6/1090 ISSN 0706-7457

ABSTRACT

Rosenthal, H., and A. S. Hourston. 1982. Observation on viability of eggs from small fish of a local herring stock. Can. Tech. Rep. Fish. Aquat. Sci. 1090: iv + 7 p.

A sample of 30 female herring from a roe-on-kelp operation which was experiencing difficulties in getting the fish to spawn was examined to test the quality of the fish. The age composition and fish length and weight at age were typical of a local stock from this area. Eggs tested from these fish showed an unusually low and highly variable fertilization rate which was attributed to handling during the pre-test period. Hatching rates were also highly variable, but within the range encountered in similar experiments. No apparent relationship was observed between fertilization rate and hatching rate. The average dry weight for an egg and the condition factor for a larva varied directly with the size of parental fish and was within the range reported for other stocks of Pacific and Altantic herring.

Key words: Clupea harengus pallasi, eggs, viability, local stocks.

KURZFASSUNG

Rosenthal, H., and A. S. Hourston. 1982. Observations on viability of eggs from small fish of a local herring stock. Can. Tech. Rep. Fish. Aquat. Sci. 1090: iv + 7 p.

Eine Probe von 30 reifen weiblichen Heringen wurde im Labor auf die Lebensfähigkeit der Eier geprüft. Die Fische stammten aus einer Gehegeanlage im Jervis-Inlet, in der durch naturliches Ablaichen an eingehängten Gro algen die Eier gewonnen werden sollten, diesmal jedoch Schweirigkeiten auftraten. Die Alterszusammensetzung und die Längen- Gewichtsrelation waren typisch fur einen lokalen Bestand aus diesem Gebiet. Die von diesen Fischen getesteten Eier wiesen eine ungewöhnlich geringe und sehr variabel Befruchtungsrate auf, die auf die Handhabung der Fische vor dem Versuch züruckgefuhrt wurde. Die Schlupfraten waren ebenfalls sehr variabel, jedoch innerhalb der Variationsbreite, die in ähnlichen Experimenten beobachtet wurde. Es wurde keine offensichtliche Beziehung zwischen der Befruchtungsrate und der Schlupfrate gefunden. Das durchschnittliche Trockengewicht eines Eies und der Konditions- faktor für die Larve variierte direkt mit der Größe des Muttertieres. Die Werte lagen innerhalb der für andere lokale Bestände des Pazifischen Herings beobachteten Grenzen.

RESUME

Rosenthal, H., and A. S. Hourston. 1982. Observation on viability of eggs from small fish of a local herring stock. Can. Tech. Rep. Fish. Aquat. Sci. 1090: iv + 7 p.

On a examiné un échantillon de 30 harengs femelles prélevés lors d'une opération de récolte d'oeufs sur varech, où la fraie des poissons a connu des difficultés, afin de déterminer la qualité du poisson. La répartition des âges de même que la longueur et le poids par âge des poissons étaient caractéristiques d'une population locale provenant de cette région. Le taux de fertilisation des oeufs c'est révélé anormalement faible et très variable, ce qui a été attribué à la manutention au cours de la période précédant l'analyse. Les taux d'éclosion ont été très variables, mais se situaient dans l'échelle de valeurs enregistrées lors d'expériences similaires. On n'a remarqué aucune relation apparente entre le taux de fertilisation et le taux d'éclosion. Le poids sec moyen des oeufs et le facteur condition des larves étaient directement proportionnels à la taille des parents et se situaient dans l'échelle des valeurs constatées, pour d'autres populations de hareng du Pacifique et de l'Atlantique.

Mots-clés: *Clupea harengus pallasi*, oeufs, viabilité, populations locales.

INTRODUCTION

During the 1976 herring season, a herring roe-on-kelp operation in Jervis Inlet on the lower mainland of British Columbia experienced some difficulty in getting captured herring to spawn on kelp fronds hung within the holding pond. In order to test the quality of the fish, a sample was removed from the pond and transported by air in a plastic bag to the Pacific Biological Station in Nanaimo. The elapsed time from removal of the fish from the pond to examination at the station was 3 h. On preliminary examination, neither the fish themselves nor the gonads showed any signs of disease or other abnormal conditions. Tests conducted on the viability of the eggs supported the results of the preliminary observations. It was therefore concluded that the failure of these fish to spawn in the pond was not caused by immaturity or unviable gametes.

It was apparent from the location of capture and the relatively small size of many of the mature fish that these herring came mainly from a local stock rather than the major migratory stocks which spawn on this part of the coast. These specimens provided an opportunity to assess the viability of eggs from such fish.

METHODS

Immediately after the arrival of the fish at the Pacific Biological Station, egg samples were taken from 30 females, distributed on glass plates, stored in sea water at 10°C and 20‰ salinity and fertilized about 10 min later when all the samples had been prepared. The eggs were then incubated in an aerated 40 L tank at the same temperature and salinity in which 50% of the water was exchanged every other day.

The total length, notochord length, fish weight and gonad weight (adjusted for eggs removed for fertilization) was recorded for each of these 30 females and scales were taken for age determinations. A second set of egg samples was removed from each fish for dry weight determinations. Three sub-samples of 10 eggs each were removed from each fish and mounted on silicated glass slides which were dried at a temperature of 60°C for 12 h and then stored in a dessicator. Each subsample was weighed on a Cahn balance several weeks later and the dry weight for 10 eggs from each fish was estimated as the mean for the 3 subsamples of eggs.

Fertilization rates for the incubated eggs were determined 24 h after fertilization. Egg volume (v) was estimated 4 days after fertilization by measuring the smallest (d_1) and largest (d_2) diameters of 25 eggs from each of the 30 fish using the formula of Alderdice et al. (1979):

$$v = 4/3 \ \pi \ [(1/2\ d_1)2 \times (1/2\ d_2)].$$

Finally, the number of hatched larvae from each fish was counted at the end of the incubation period and dry weights determined as for the eggs in order to calculate the condition factor [mg dry wt x 10^3 (length in mm)^3] for the larvae hatched from each of the 30 fish.

RESULTS

The 30 females sampled (Table 1) were smaller and younger than average for this region of the coast but typical of some of the local stocks in this area (Hourston 1981). Gonad weights ranged between 15 and 33% of fish weight (Table 1), which is well within the range observed for Pacific herring from this region (Hourston et al. 1981a). With one exception, dry weights of the eggs ranged between 0.210 and 0.327 mg, which is close to the range of 0.223 to 0.345 mg representing the mean minus 1 standard deviation for 7 day old eggs and the mean plus 1 standard deviation for 1 day old eggs reported by Hay et al. (MS) for a single specimen from a migratory stock. Hay's values, in turn, are virtually identical to those reported by Blaxter and Hempel (1963) for Atlantic herring from the North Sea.

Fertilization rates (Table 2) were highly variable (48-83%) and well below the nearly 100% level observed in natural spawnings (Hourston and Rosenthal 1981) and in several previous laboratory experiments using freshly killed fish (e.g. Hourston et al. 1981b). Moreover, we have previously obtained over 90% fertilization of eggs taken from dead fish stored for 7 to 9 h at 5°C using the same techniques and equipment. Conditions in the holding pond may have led to the retention of gametes beyond the normal spawning stage, thus reducing the potential for fertilization. Otherwise, the lack of refrigeration during transport to Nanaimo (gonad temperature was 11.5°C on arrival) and the extra handling of the sample were the only known factors which could have so adversely affected fertilization success.

Hatching rates (% hatch of fertilized eggs) were even more variable (7-91%) but approximated the most extreme ranges observed in previous experiments using freshly killed fish (Hourston and Rosenthal 1981).

There was no apparent relationship, direct or inverse, between the fertilization rate and the hatching rate for individual fish. Consequently the percent hatch from all eggs varied (5-71%) to an extent which was intermediate between that for the two rates.

The dry weight of an egg showed a tendency to increase with fish length and fish weight, especially when the data were grouped (Table 3). There was, however, considerable variability in this relationship for individual fish, as was reported by Farran (1938) for fresh herring. This relationship is also demonstrated by the condition factor values.

Egg volume bore no apparent relationship to any of the other variables; it appeared to vary more or less randomly.

DISCUSSION

The 30 females used in this study appear to have been representatives of a local stock of smaller than average British Columbia herring. They were unusual only in the relatively low and highly variable rate of fertilization they exhibited; this probably reflected the way the fish were handled rather than the condition of the fish before death.

Because of the relatively small size of these fish, the dry weight of their eggs was lower than that obtained in other such studies on British Columbia herring, both for the sample as a whole and for the individual age classes. Otherwise, these fish appear to have been similar to other herring, both Pacific and Atlantic, in the characteristics examined during this study.

ACKNOWLEDGEMENTS

Dry weight determinations were carried out by Ms. Susan Kerr. Drs. Dan Ware and Doug Hay reviewed the manuscript and provided constructive comments.

REFERENCES

Alderdice, D. R., H. Rosenthal, and F. P. J. Velsen. 1979. Influence of salinity and cadmium on capsule strength in Pacific herring eggs. Helgolander Wiss. Meeresunters. 32: 149-162.

Blaxter, J. H. S., and G. Hempel. 1963. The influence of egg size on herring larvae (Clupea harengus L.). J. Cons. Int. Explor. Mer 28, 211-240.

Farran, G. P. 1938. On the size and number of the ova of Irish herrings. J. Cons. Int. Explor. Mer 13, 91-100.

Hay, D. E., G. Kingston, and C. Moore. MS. Weight loss and change of condition factor during fixation of Pacific herring eggs and larvae: 28 p.

Hourston, A. S. 1981. Summary tables for annual assessments of the status of British Columbia herring stocks in the 1970's. Can. Data. Rep. Fish. Aquat. Sci. 250: 381 p.

Hourston, A. S., V. Haist, and R. D. Humphreys. 1981a. Fecundity data for British Columbia herring sampled in 1974 and 1978. Can. Data. Rep. Fish. Aquat. Sci. 253: 176 p.

Hourston, A. S., and H. Rosenthal. 1981. Data summaries for viable hatch from Pacific herring eggs deposited at different intensities on a variety of substrates. Can. Data. Rep. Fish. Aquat. Sci. 267: 56 p.

Hourston, A. S., H. Rosenthal, and H. von Westernhagen. 1981b. Condition at hatching of Pacific herring larvae from natural and artificial spawn of different intensities on a variety of substrates. Can. Tech. Rep. Fish. Aquat. Sci. 1045: 25 p.

Table 1. Fish and egg data by specimen.

Fish No	Age	Fork length (mm)	Stan. length (mm)	Fish weight (g)	Gonad weight (g)	Gonad wt / Fish wt	Dry weight of egg (mg)	Egg volume (mm3)
24	3	144	134	30.0	6.3	.210	.2733	.1925
25	2	147	137	30.5	4.9	.161	.2155	.1956
29	3	149	140	30.5	6.8	.223	.2161	.1655
22	2	150	141	29.5	6.3	.214	.2203	.1682
30	2	160	150	36.0	7.4	.206	.3175	.2638
26	3	161	151	37.5	10.9	.291	.2157	.1752
27	2	164	152	37.0	8.2	.222	.2901	.2178
23	3	161	152	43.0	9.3	.216	.2517	.2312
28	–	165	155	37.5	5.8	.155	.2214	.1929
5	3	168	158	54.5	13.9	.255	.3014	.2511
10	3	174	164	57.0	14.9	.261	.2899	.2474
17	4	176	166	57.0	14.4	.253	.2690	.2014
6	3	176	166	62.5	20.9	.334	.2685	.2113
2	2	176	168	53.0	10.4	.196	.1879	.1942
4	3	176	169	63.5	16.8	.265	.2924	.1872
16	4	181	170	64.0	16.4	.256	.2423	.2327
18	3	180	170	64.5	16.5	.256	.2642	.1781
13	3	181	170	65.5	20.4	.312	.3117	.2504
8	4	181	171	63.0	17.5	.278	.2848	.2089
9	3	181	171	67.5	19.3	.286	.3264	.2666
1	–	183	173	63.0	14.4	.229	.2101	.2015
7	7	187	178	72.0	16.5	.229	.2466	.2059
19	8	192	180	68.0	12.3	.181	.3270	.2503
12	4	190	180	71.0	18.9	.266	.2594	.1959
20	3	192	180	83.0	21.8	.263	.3232	.2575
15	4	194	183	79.5	20.9	.263	.2471	.1998
21	6	194	184	76.5	17.3	.226	.3085	.2042
14	4	212	199	114.0	37.9	.333	.3267	.2563
3	4	213	201	116.0	35.9	.310	.3009	.2245
11	3	212	201	107.0	30.3	.283	.2775	.1937

Table 2. Fertilization and hatching data by specimen.

Fish no.	Stan. length	No. of eggs: Total	No. of eggs: Fertilized	No. of eggs: Hatched	% Fert.	% Hatch of: Total	% Hatch of: Fert.	Condition factor for larvae: (Noto. len.)	Condition factor for larvae: (Total len.)
24	134	277	217	197	78.3	71.1	90.8	1.2468	1.0047
25	137	325	245	82	75.4	25.2	33.5	1.1861	0.9602
29	140	239	158	23	66.1	9.6	14.6	1.1115	0.9220
22	141	270	134	101	49.6	37.4	75.4	1.0524	0.8741
30	150	345	253	39	73.3	11.3	15.4	1.0667	0.8789
26	151	312	249	149	79.8	47.8	59.8	1.0892	0.8986
27	152	139	61	26	43.9	18.7	42.6	1.0536	0.8388
23	152	225	84	39	37.3	17.3	46.0	1.2244	1.0304
28	155	210	87	14	41.4	6.7	16.1	1.0070	0.8348
5	158	357	211	91	59.1	25.5	43.1	1.3813	1.1494
10	164	358	254	119	70.9	32.2	46.8	1.2922	1.0820
17	166	320	142	55	44.4	17.2	38.7	1.2461	1.0455
6	166	326	193	50	59.2	15.3	25.9	1.3663	1.1464
2	168	351	285	106	81.2	30.2	37.2	1.1178	0.9722
4	169	225	116	40	51.6	17.8	34.5	1.3156	1.1648
16	170	346	196	103	56.6	29.8	52.6	1.3027	1.0793
18	170	441	336	163	76.2	37.0	48.5	1.3128	1.1060
13	170	363	294	48	81.0	13.2	16.3	1.3332	1.1046
8	171	397	217	131	55.7	33.0	60.4	1.2599	1.0624
9	171	246	204	126	82.9	51.2	61.8	1.3499	1.1383
1	173	373	193	100	51.7	26.8	51.8	1.2168	1.0280
7	178	316	234	61	74.0	19.3	26.1	1.2767	1.1163
19	180	250	179	142	71.6	56.8	79.3	1.1660	0.9607
12	180	331	248	135	74.9	40.8	54.4	1.2174	1.0351
20	180	275	182	51	65.4	18.6	28.0	1.4232	1.1727
15	183	386	279	63	72.3	16.3	22.6	1.2972	1.0888
21	184	274	212	93	77.4	33.9	43.9	1.2280	1.0477
14	199	348	246	16	70.7	4.6	6.5	1.4466	1.1965
3	201	360	287	56	79.7	15.6	19.5	1.4285	1.2004
11	201	262	125	67	47.7	25.6	53.6	1.3176	1.1230

Table 3. Relation between standard length, weight, egg dry weight and egg volume (grouped data). Mean and range are shown for each size group.

Size group (mm)	n	Standard length (mm)	Weight (g)	Egg dry weight (mg/10 eggs)	Egg volume (mm^3)
130-145	4	138.0 (134-141)	30.13	2.313	.1805
150-159	6	153.0 (150-158)	40.92	2.663	.2220
160-169	5	166.6 (164-169)	50.60	1.615	.2083
170-179	7	171.9 (170-178)	65.6	2.694	.2206
180-189	5	181.4 (180-184)	75.6	2.930	.2215
190-201	3	200.3 (199-201)	112.3	3.037	.2248