1950 International Commission for the Northwest Atlantic Fisheries 1970

RESTRICTED

Serial No.2432
(B.g.7)

ICNAF Res.Doc.70/83

ANNUAL MEETING - JUNE 1970

THE NUMBER OF HADDOCK SPAWNING ON GEORGES BANK AS ESTIMATED FROM EGG SURVEYS

by

J.A. Posgay and R.R. Marak

BCF Biological Laboratory, Woods Hole, Mass.

During the spring of 1968 we conducted a series of seven cruises to Georges Bank in an attempt to establish an egg production curve for haddock, Melanogrammus aeglefinus. The area selected for sampling (Figure 1) had been defined as the major, up to 80 percent, haddock spawning ground in Subarea 5 by Hardy Recorder surveys some years ago and more recent samplings of the commercial landings for spent and spawning fish. On each cruise 50 stations were occupied using a stratified random sampling design with 16 stations in Stratum 1, 12 stations in Stratum 2, 12 stations in Stratum 3, and 10 stations in Stratum 4.

Each station consisted of a BT cast to the bottom and a 15-minute, 5-step oblique haul from 50 meters depth to the surface at 3.5 knots (108 m/minute). The sampler was our smaller bongo (diameter 21 cm) with nets of #505 NITEX and a four-foot, V-FIN depressor. Since early stage haddock eggs cannot be reliably separated from those of cod, Gadus morhua, the cod-haddock eggs were immediately picked out of the catch of the starboard net and put in hatching jars. After these eggs hatched into identifiable larvae they were preserved and used to calculate a cod/haddock egg ratio. The catch of the port net was preserved.

Ashore, all of the cod-haddock eggs were picked from the catch of the port net and sorted into six developmental stages (Marak and Colton, 1961). The cod/haddock ratio from the hatched eggs was then applied to estimate the number of haddock eggs at each stage. Table 1 shows the arithmetic mean catch per cubic meter for Stage I and Stages I-VI by cruise and by stratum.

From Table 1 it is apparent that almost all the eggs were spawned between 3 April and 9 May in Strata 2 and 3. The few Stage I eggs that were found in Strata 1 and 4 may have been transported there from the shallower strata by the strong tidal currents which occur in the area. A plot of the stations and catches on the most successful cruise, that of 18 April, (Figure 2) shows that all but four of those hauls that took any Stage I eggs were inside the 50-fathom (91m) isobath. The concentration of the higher catches in the southwestern part of the sampling area suggests that there may have been some haddock spawning to the south and the west. If so, the Stage I eggs from these fish would not appear in our collections and our estimate of spawning stock size would be low.

ESTIMATE USING CATCHES OF STAGE I EGGS

Our estimate of the total number of eggs present in the sampling area at the time of each cruise was calculated by multiplying the area of each stratum by the sampling depth (50m) and then by the arithmetic mean catch per cubic meter and summing the four strata.

According to Walford (1938) it takes about seven days for a haddock egg to develop through Stage I at 3.0°C but only four days at 6.0°C. We used his graph of incubation period against temperature to convert the number of eggs present during any one cruise into an estimate of the mean number of eggs produced per day during the time immediately preceding the cruise. To illustrate: the estimate for the number of eggs present during the fourth cruise, 18 April, is 112.0 X 10^9 (Table 2). These eggs had developed in an average water temperature of 4.3°C and so required an incubation period of 5.5 days. Dividing number of eggs by number of days gives 20.4 X 10^9 as the average number of eggs produced per day during the five or six days preceding 18 April. The spawning date was then taken as 15 April, three days before the collection. The data and results for each cruise are shown in Table 2.

In order to calculate the total number of eggs produced during the entire spawning season we plotted the average number of eggs produced per day against the spawning date (Figure 3). Assuming a smooth curve with a single peak we fitted a curve to the points by eye and integrated the area under the curve. This gives an estimate of 575 X 10^9 eggs.

To estimate the number of female haddock that would be required to produce this many eggs we used the age 3+ length composition of the April landings from Subarea 5 and the fecundity data of Earll (1880). Very few of the age two fish are mature, but almost all of the age three spawn. This gave us 428 X 10^3 as the average number of eggs produced per female during the 1968 spawning season. Dividing total number of eggs produced by average number per female gives 1.3 X 10^6 as the number of spawning females.

Samples of haddock collected at the ports showed an approximately equal sex ratio so our estimate of the total number of fish spawning in the sampled area is 2.6 X 10^6.

ESTIMATE USING ALL STAGES OF EGGS

The effects of dispersion and mortality should act to reduce the number of later stage eggs in the water directly over the spawning ground. We have no data which would allow us to compensate for these factors. Walford (1938) also gives a graph of incubation period as a function of temperature through all egg stages to hatching. Using the same methods described above for the Stage I eggs, we calculated an estimate of spawning stock size from the catches of all stages of eggs (Table 3, Figure 4). This gives us 5.0 X 10^6 as the size of the spawning stock.

COMPARISON WITH OTHER METHODS

The Report of the Interim Meeting of the Assessment Subcommittee (Comm. Doc. 70/3) states that there were about 46 X 10^6 age 3+ haddock available in all of Subarea 5 in 1968. In the same document there is another estimate, calculated from the catches on research vessel surveys that there were about 16 X 10^6 mature haddock on Georges Bank in the spring of 1968. Removals of age 3+ haddock from all of Subarea 5 are estimated as 27 X 10^6 by fishing and about 4 X 10^6 by natural deaths. Our estimates from the egg surveys are both obviously too low.

Literature Cited

Earll, R.E. 1880. A report on the history and present conditions of the shore cod fisheries of Cape Ann, Massachusetts together with notes on the natural history and artificial propogation of the species. Report of the U.S. Fish Commission for 1878.

Marak, Robert R. and John B. Colton, Jr. 1961. Distribution of fish eggs and larvae, temperature, and salinity in the Georges Bank - Gulf of Maine area, 1953. SSR-FISH. NO. 398.

Walford, Lionel A. 1938. Effects of currents on distribution and survival of the eggs and larvae of the haddock (Mellanogrammus aeglefinus) on Georges Bank. Bulletin of the Bureau of Fisheries Volume 49.

Table 1. Mean numbers of Stage I and Stages I-VI haddock eggs taken per cubic meter filtered by stratum and cruise.

Stratum	1		2		3		4	
Stage	I	I-VI	I	I-VI	I	I-VI	I	I-VI
Date								
1 March	.000	.000	.000	.000	.000	.002	.000	.000
20 March	.000	.000	.000	.008	.007	.241	.000	.015
3 April	.000	.000	.034	.134	.181	.984	.004	.013
18 April	.000	.008	.343	1.144	.701	3.230	.058	.258
9 May	.019	.581	.071	.829	.172	1.952	.000	.091
24 May	.004	.138	.040	.614	.000	.363	.000	.167
5 June	.019	.056	.047	.386	.004	.108	.000	.047

43

Table 2. The estimated number of Stage I eggs in the sampling area, the average temperature for incubation, the incubation period (1.P.) at that temperature, the mean number of eggs spawned per day during the period (E/D) and the mean date of the spawning (S.D.) for each cruise.

Date	No. of Eggs $X10^9$	Temp. °C	I.P. Days	E.D. $X10^9$	S.D.
1 March	0.0	2.8	7.2	-	-
20 March	1.4	2.8	7.2	0.2	16 March
3 April	22.4	3.5	6.2	3.6	31 March
18 April	112.0	4.3	5.5	20.4	15 April
9 May	27.7	5.1	4.7	5.9	7 May
24 May	4.7	6.0	4.0	1.2	22 May
5 June	7.9	7.1	3.2	2.5	3 June

Table 3. The estimated number of all stages of haddock eggs in the sampling area, the average temperature during incubation, the incubation period (1.P.) at that temperature, the mean number of eggs spawned per day during the period (E/D), and the mean date of the spawning for each cruise.

Date	No. of Eggs $X10^9$	Temp. °C	I.P. Days	E/D $X10^9$	S.D.
1 March	0.2	2.8	24	0.0	-
20 March	26.8	2.8	24	1.1	8 March
3 April	116.1	3.2	23	5.0	22 March
18 April	471.5	4.0	21	22.5	8 April
9 May	375.9	4.9	19	19.8	30 April
24 May	133.1	5.6	18	7.4	15 May
5 June	62.5	6.4	16	3.9	28 May

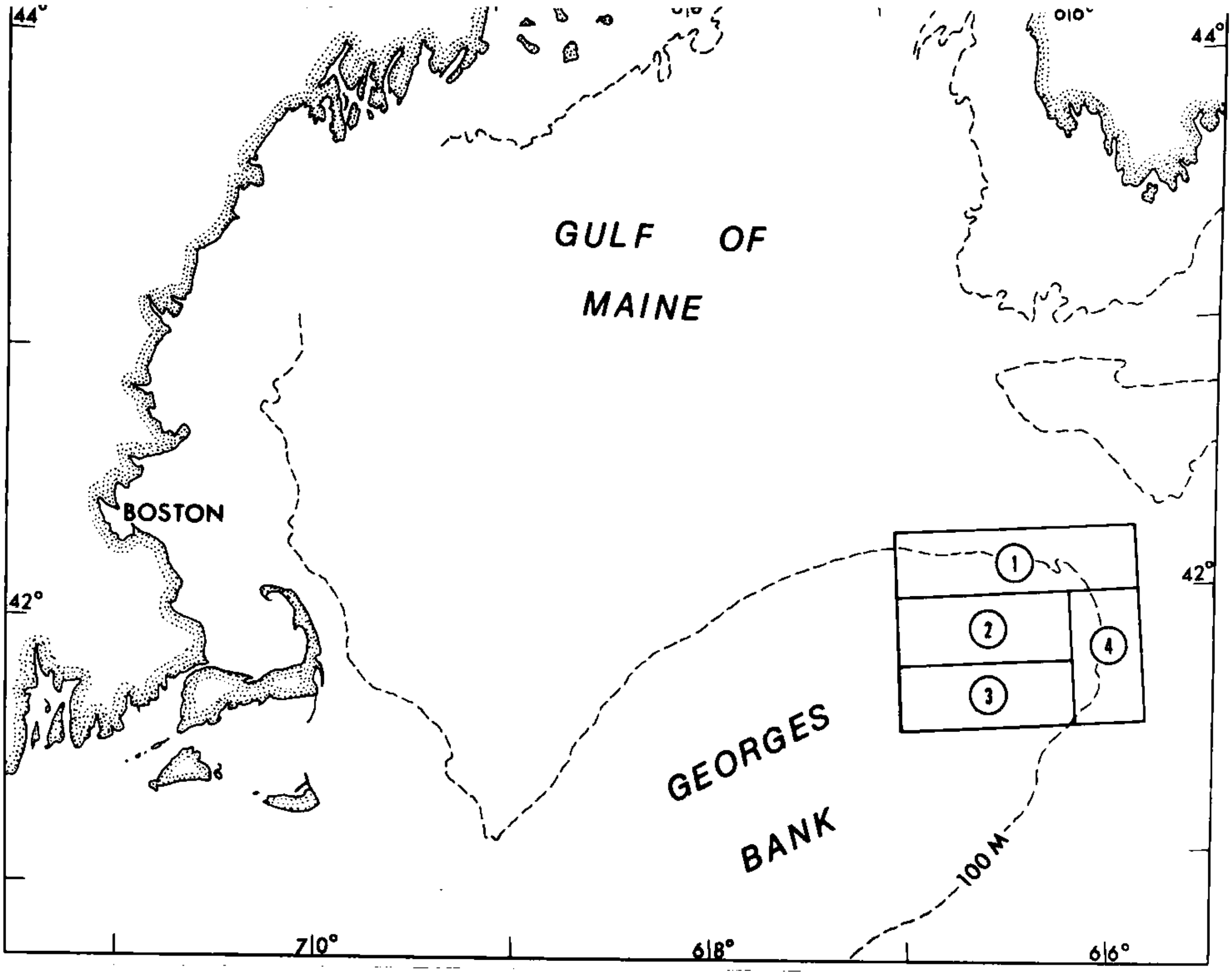

Figure 1. The location of the sampling area in Subarea 5 showing the four strata.

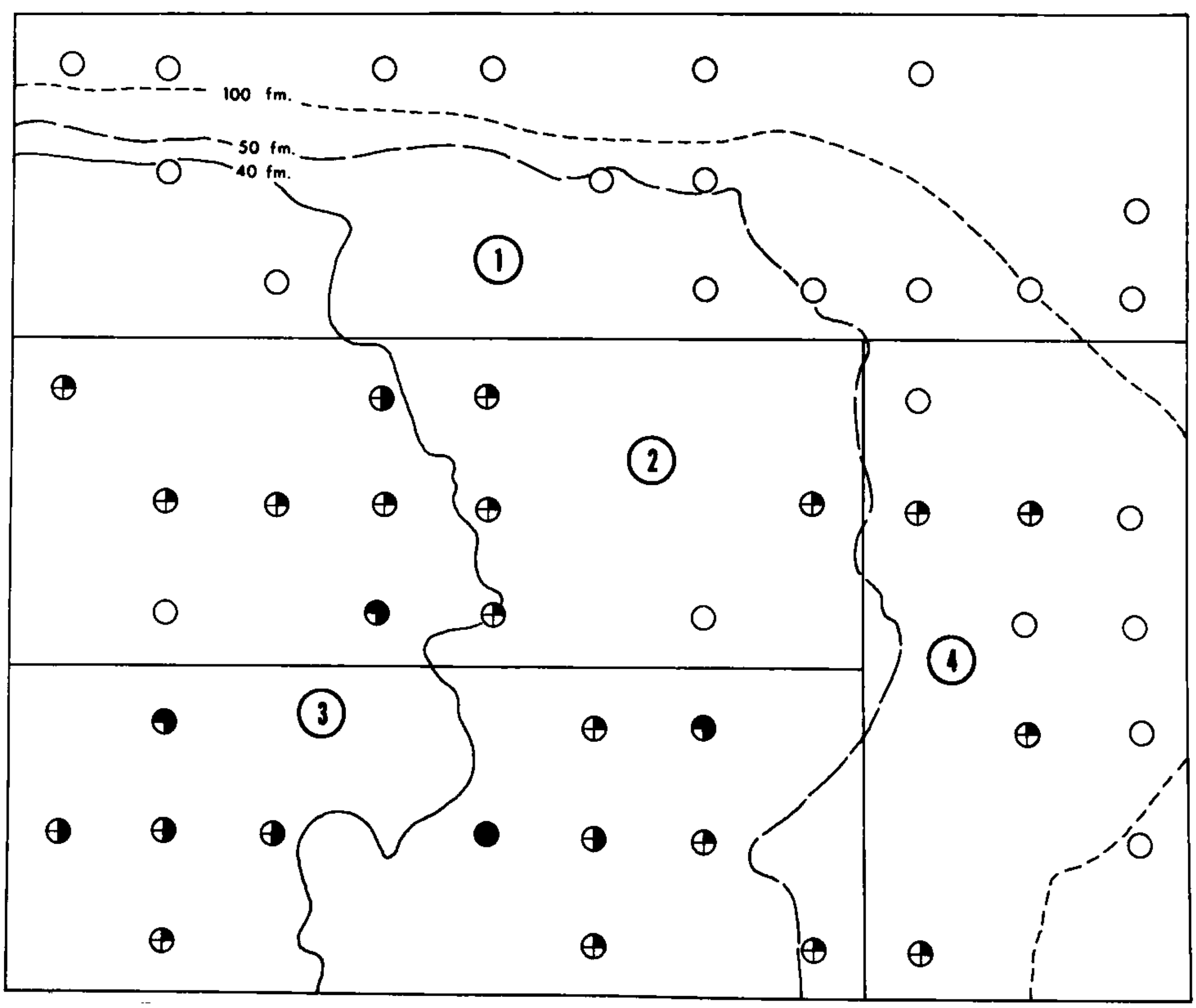

Figure 2. Station pattern and results of the fourth cruise, 18 April. The symbols show the number of Stage I haddock eggs taken per cubic meter filtered. ○ = none, ⊕ = .001-.050, ◑ = .051-.100, ◕ = .101-.150, ● = .151-.200.

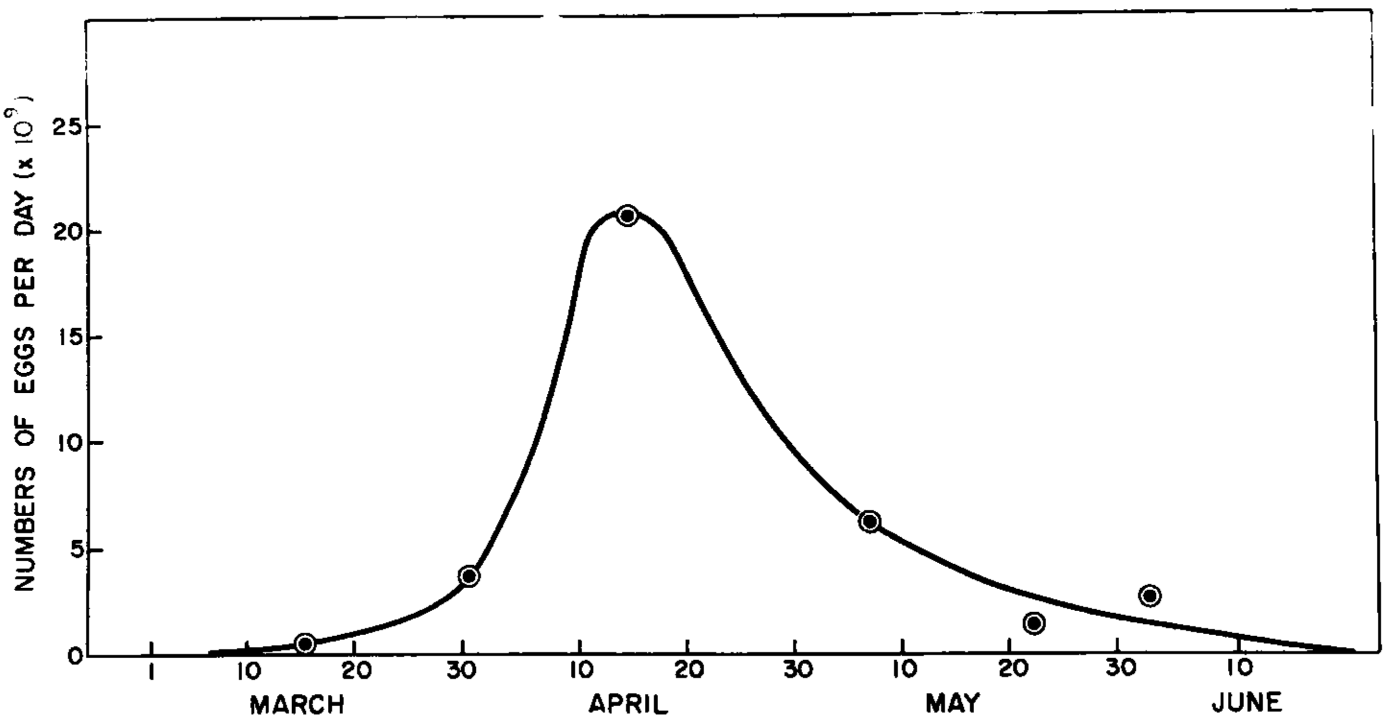

Figure 3. Egg production curve for the sampled area using catches of Stage I eggs only.

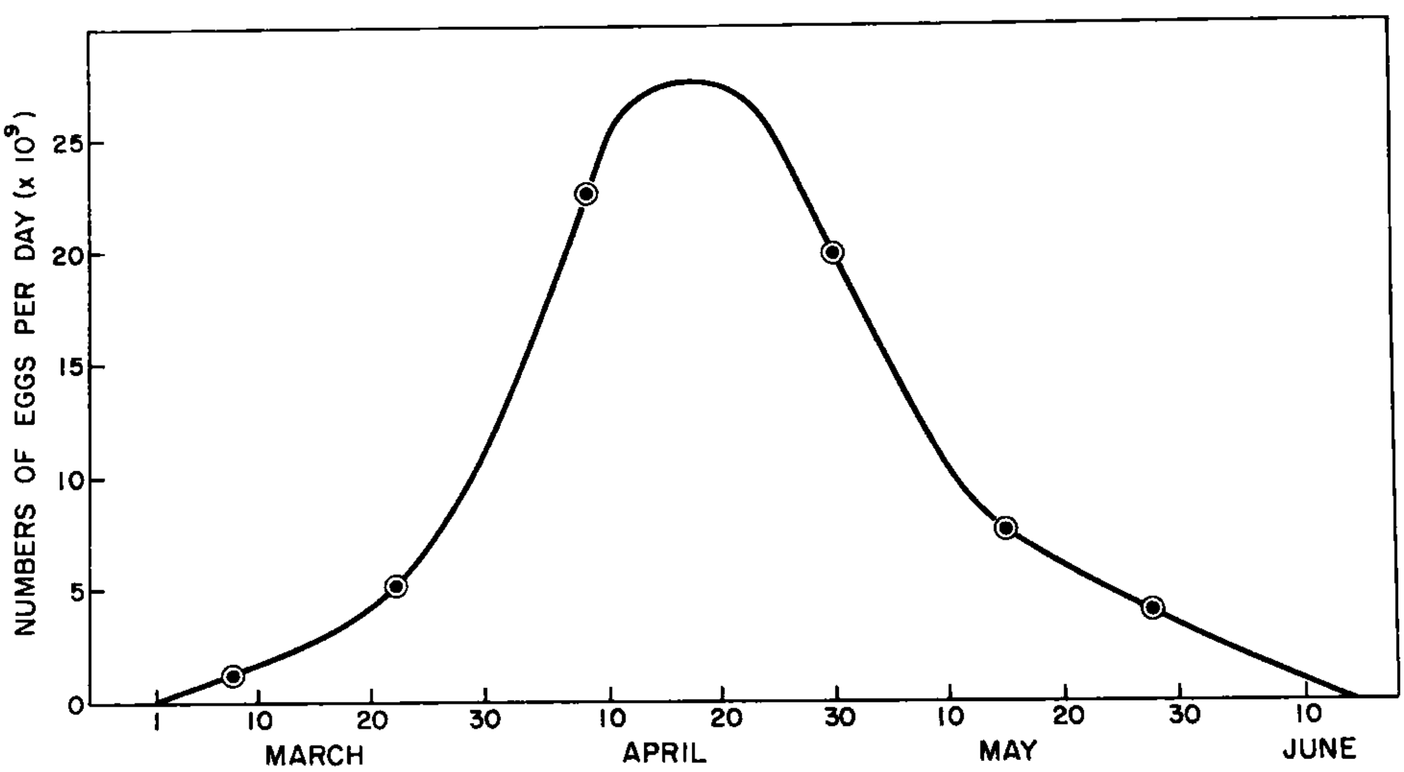

Figure 4. Apparent egg production curve as a function of date. Data from all stages.