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Multiple Fertilizations and Extrusions in Female Homarus americanus

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Abstract

It is well known that molting rate decreases with increasing size, so that very large lobsters may only molt once in several years. Since mating usually occurs immediately following molt, it has been assumed that the relatively greater fecundity of a large female is more than offset by the infrequency of spawning.

We have now recorded thirteen multiple extrusions in the laboratory from females ranging in carapace length from 118 to 195 mm. From this, we can say that multiple extrusion (two or more spawnings without an intervening molt) is common in large females, occuring in 40-50% of stock held in our facilities, and multiple fertilization (two or more fertilized broods from a single mating) also occurs. These observations indicate that "jumbo" lobsters should not be dismissed as non-productive members of the population until their true reproductive value can be determined.

Résumé

Que la fréquence des mues diminue à mesure que le homard croît est un phénomène bien connu. Comme résultat, chez les très gros homards, la mue ne se produit qu'à intervalles de plusieurs années. L'accouplement ayant lieu ordinairement peu après la mue, on a supposé que la fécondité relativement grande des grosses femelles était plus que neutralisée par la rareté des mues.

Nous avons à ce jour noté treize extrusions multiples en laboratoire chez des femelles de 118 à 195 mm de longueur. On peut donc dire que l'extrusion multiple (deux pontes ou davantage sans qu'il y ait mue entre-temps) est commune chez les grosses femelles: elle se produit chez 40 à 50% du stock maintenu dans nos installations. Il y a également fécondation multiple (deux portées ou plus fécondées à la suite d'un accouplement unique). D'après ces observations, on ne devrait pas considérer les gros homards comme membres non productifs de la population, sans une évaluation préalable de leur potentiel reproducteur.

Herrick (1895, 1909) concluded that the majority of lobsters spawn biennially, but this has not generally been accepted, particularly for large lobsters. We have known for some time that a 2-yr molt-reproductive cycle is the rule for lobsters up to approximately 120 mm CL (Aiken and Waddy 1976, 1980a, 1980b; Waddy and Aiken 1979), and have felt that the 2-yr ovarian cycle continues throughout the life of the lobster.

Molting rate decreases with increasing size, and very large lobsters may only molt once in several years. Since mating usually occurs immediately after the molt, it has been assumed that the relatively greater fecundity of a large female is more than offset by the infrequency of spawning. In other words, the relative contribution of jumbo females has generally been considered to be insignificant.

We questioned the validity of this assumption several years ago when a large Bay of Fundy berried female, brought into the laboratory for brood stock, hatched its eggs and then extruded a second fertile brood without an intervening molt. Since that time we have demonstrated there is no correlation between successful mating and the egg-laying cycle (Waddy and Aiken 1979) and have verified earlier reports that the seminal receptacle still contains large numbers of sperm after extrusion and fertilization, and appears indistinguishable from pre-ovigerous mated females. Obviously, female Homarus have the potential for fertilizing more than one brood from a single mating and are capable of making use of this potential.

Multiple extrusions are accepted in true crabs (Broekhuysen 1941; Nye 1977; Wear 1970), and the literature contains references to the phenomenon in Homarus. The fact that only part of the stored spermatozoa are utilized by female Homarus at oviposition has been noted several times previously (Bumpus 1891; Krouse 1973; Templeman 1936), and multiple extrusion has also been observed before (Knight 1916; Scott 1903). To date we have recorded 13 multiple extrusions in the laboratory (Table 1). The smallest of these was 118 mm CL and the largest was 195 mm CL. Seven of these successfully fertilized and carried their eggs until hatch. The six that did not retain their eggs had no evidence of a sperm plug following extrusion, but it is not known whether egg loss was due to lack of fertilization or some other cause.

Four of the seven that successfully fertilized a second brood had been held in isolation, so the multiple fertilizations were definitely from a single insemination. The other three females extruded under communal conditions, so it is possible that the second brood was fertilized from an intermolt mating. Mating normally occurs after ecdysis, but intermolt mating does occasionally occur (Dunham and Skinner-Jacobs 1978; Aiken and Waddy 1980 a,b). The reasons for its occurrence are not known, but the one incident we observed involved an uninseminated female with a maturing ovary. It may be that intermolt mating is stimulated at some critical point in the cycle of an uninseminated female, and serves as a mechanism to prevent extrusion (and therefore loss) of unfertilized eggs. If this is the case, the four multiple extruders that lost their eggs may have done so because they were not inseminated and did not have access to a male for intermolt mating that would have ensured their fertility.

Table 1. Record of multiple extrusions and fertilizations in laboratory-held females.

Stock	CL	Holding conditions	Last molt	Last extrusion	Extrusion date	Eggs fertilized
PB[1]	122	Individual	wild	1976	Aug. 77	Yes
PB	118	Individual	wild	1976	Sept. 77	Yes
PB	165	Individual	wild	1977	July 79	No adhesion*
PB	195	Individual	wild	1977	July 79	No adhesion*
P[2]	120	Communal	1977	1978	Aug. 79	Yes
GM[3]	131	Communal	wild	1977	Aug. 79	Yes
GM	125	Communal	wild	1977	Aug. 79	No
GM	132	Individual	wild	1977	July 79	?+
GM	146	Individual	wild	1978	July 80	Yes
GM	173	Individual	wild	1978	July 80	Yes
PB	152	Individual	wild	1978	Aug. 80	No
GM	139	Communal	wild	1978	Aug. 80	Yes
GM	141	Communal	wild	1978	Aug. 80	No

*No sperm plug present following extrusion.

+Lobster sacrificed 4 hours post-extrusion. No sperm plug present in annulus nor any sperm in area of sperm plug, oviduct, or "sternal gland."

[1]Passamaquoddy Bay, Bay of Fundy.

[2]Pictou, N.S.

[3]Grand Manan.

At this point we can say that multiple extrusion (two or more spawnings without an intervening molt) is common in large females, occurring in 40-50% of stock held in our facilities, and multiple fertilization (two or more fertilized broods from a single mating) also occurs. There is also the possibility that intermolt mating occurs routinely in cases where a mature, uninseminated female is approaching oviposition. Even without the potential of intermolt mating, it is possible to project at least 20 yr of biennial spawning for females, since the capability for multiple fertilization means 4 or 5 yr can elapse between molts without exceeding two extrusions for each postmolt mating.

These observations indicate that "jumbo" lobsters should not be dismissed as non-productive members of the population. Their much greater absolute fecundity combined with their potential for sustained egg and larval production indicates their relative fecundity - and therefore their true reproductive value to the population - should be determined.

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