



## Maine Department of Marine Resources Ovary Staging

### Citations:

**Original methods and staging criteria:** Aiken, D. E., and Waddy, S. L. 1982. Cement gland development, ovary maturation, and reproductive cycles in the American lobsters *Homarus americanus*. *Journal of Crustacean Biology*, 2: 315–327.

Waddy, S. L., and Aiken, D. E. 2005. Impact of invalid biological assumptions and misapplication of maturity criteria on size-at-maturity estimates for American lobster. *Transactions of the American Fisheries Society*, 134: 1075–1090.

See page 6 for additional references and recent uses of these methods

Table 1 from Waddy and Aiken (2005) “Morphological criterial for categories of ovary development in the American lobster (adapted from Aiken and Waddy 1980a, 1982)”

Immature ovary	Developing ovary	Mature ovary	Spent/resorbing ovary
Stage 1: Ovary white Oocytes <0.5 mm Ovary factor <100	Stage 2: Ovary yellow, orange, beige, or pale green Oocytes <0.8 mm Ovary factor <100  Stage 3: Ovary light to medium green Oocytes <1.0 mm Ovary factor <200  Stage 4a (autumn): Ovary medium to dark green Oocytes 0.1–1.6 mm Ovary factor <200	Stage 4b (spring): Ovary medium to dark green Oocytes 0.8–1.6 mm Ovary factor 200–325  Stage 5: Ovary dark green Oocytes 1.0–1.6 mm Ovary factor >325  Stage 6: Ovary dark green Oocytes 1.4–1.6 mm Ovary factor >400  Stage 6a: Postovulation (oocytes free in ovary)	Stage 7: Ovary large, flaccid, white or yellow; may have residual green oocytes.

$$\text{Ovary factor} = 10 \times \text{ovary wet weight (mg)} / [\text{carapace length (cm)}]^3$$

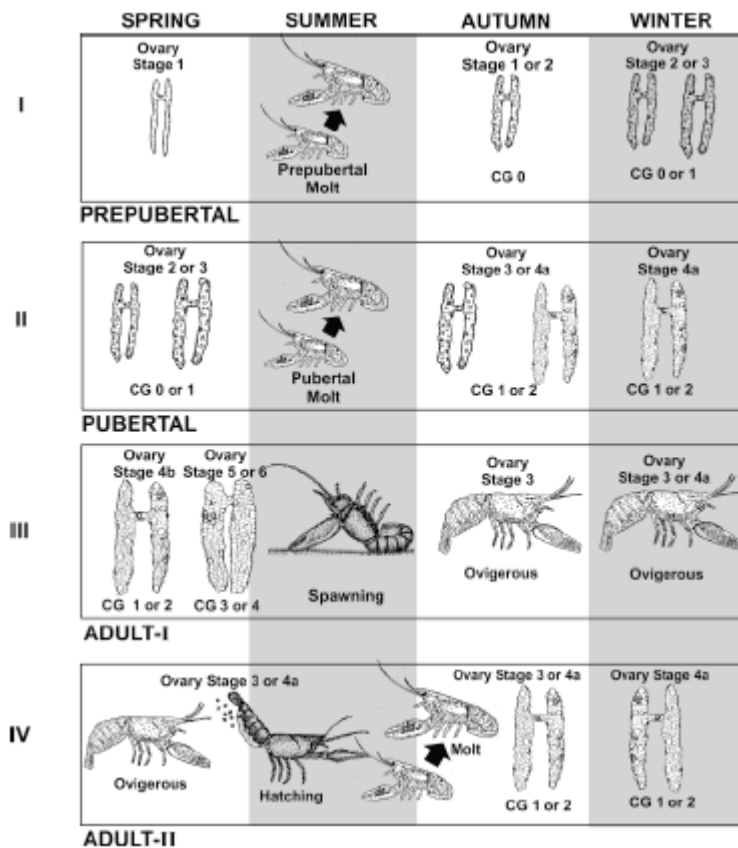


Figure 1 from Waddy and Aiken (2005) “Reproductive cycle of a typical female American lobster over a 4-year period spanning the prepubertal, (panel I), pubertal (panel II), adult-I (panel III), and adult-II years (panel IV).”



## Ovary Staging

### Suggested supplies:

- Dissecting microscope with overhead lighting
- Camera mounted on microscope
- Microscope slides or glass dish
- Chilled and filtered seawater (FSW)
- Dissection scissors
- Kim wipes or similar wipes for microscope slides
- Forceps
- Scale

### Ovary collection and prep:

- 1) Hold the lobster in one hand so the carapace is facing up.
- 2) Using scissors, cut the carapace from tail to head along the vertical line in the carapace. Keep the scissors pointed upward along the top of the shell to avoid bursting the ovaries and the stomach (Fig. 1A).
- 3) Cut the shell horizontally behind the eyes (from middle line to behind the claws) and remove the shell on either side. Now cut into the tail.
- 4) Once the entire ovary is visible (Fig. 1B), use scissors to remove all the membranes holding the ovary in place. Record the color of the ovary, carefully remove it from the body, and weigh it on the scale.
- 5) Cut a small segment out of the ovary (take from center) and put into a glass dish with FSW for examination under a microscope and other measurements.

Figure 1. Carapace removal with ovary partially (A) and fully visible (B).

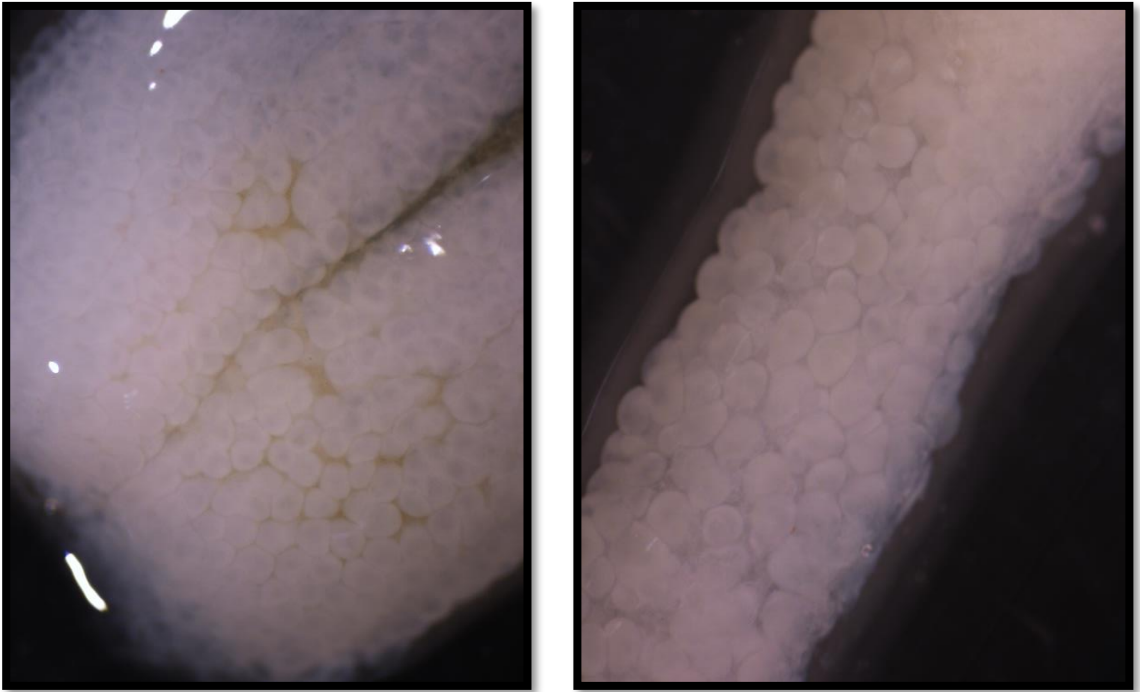




## Ovary Staging

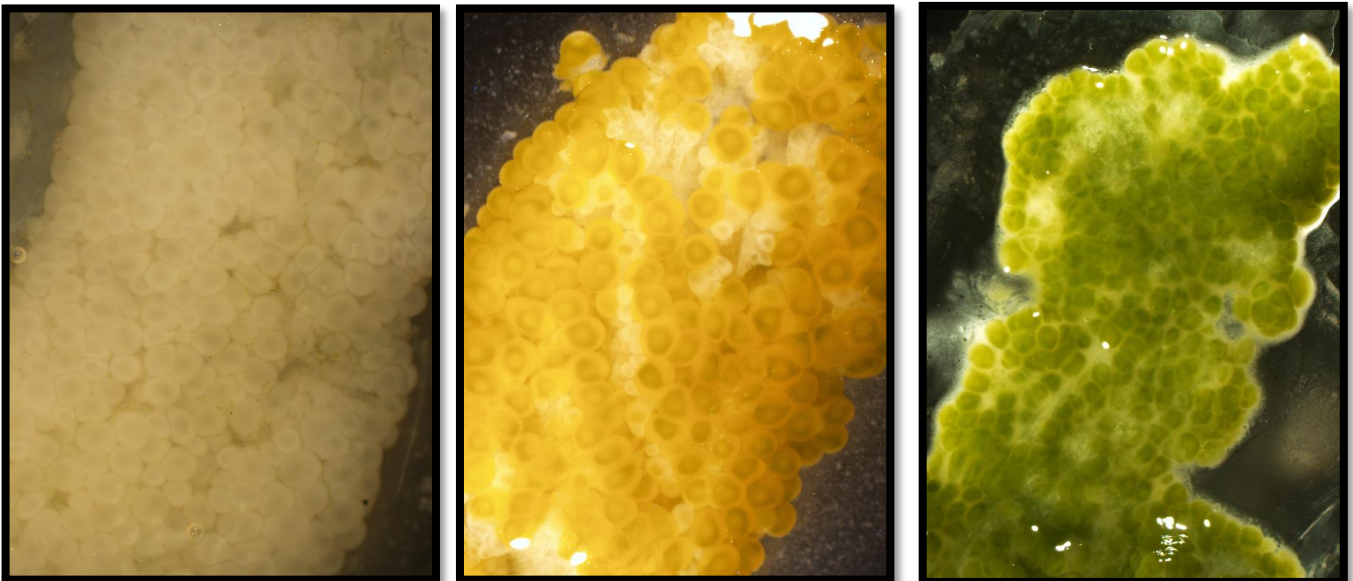
\*All images taken at 0.8-3x  
Image credits: MEDMR

### Stage 1 (Immature):



- Ovary is a bright to dull white in color
- Ovary appears stringy and it is difficult to distinguish individual oocytes
- Oocytes <0.5 mm and ovary factor <100

### Stage 2 (Developing)



- Ovary and individual oocytes can range in color during this stage from off-white to yellow/orange or a very light green
- Ovary is slightly thicker in appearance compared to stage 1
- Oocytes <0.8 mm, ovary factor <100

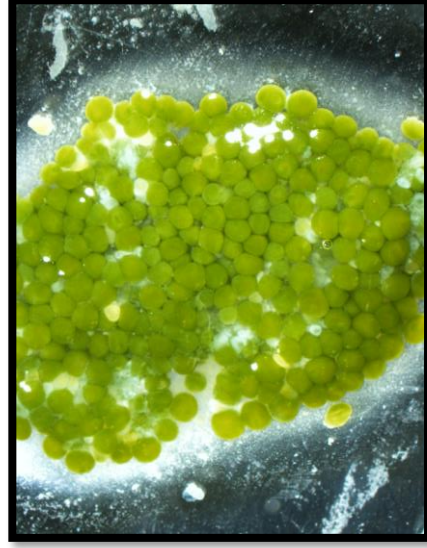


## Ovary Staging

\* All images taken at 0.6-1.5x

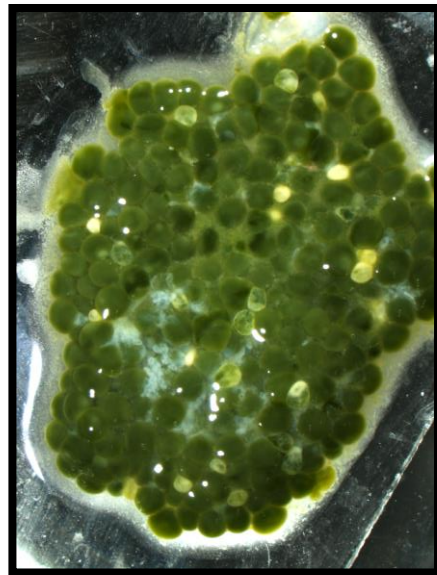
Image credits: MEDMR

### Stage 3 (Developing):



- Ovary is a light to medium green, consistent coloration
- Individual oocytes become more visible to the naked eye and look robust under the microscope
- Oocytes <math>< 1.0\text{ mm}</math>, ovary factor <math>< 200</math>

### Stage 4b (Mature):



- Use this criteria for maturity if females are collected in the spring, use the criteria for 4a (see references) if collected in the fall
- Individual oocytes well defined and easily visible to the naked eye
- Ovary is a medium to dark green color
- Bright yellow “flecks” may be present during this and subsequent stages, indicating oocytes that were not extruded or resorbed. This should be considered as a previous ovary maturity indicator.
- Oocytes 0.8-1.6 mm, ovary factor 200-325

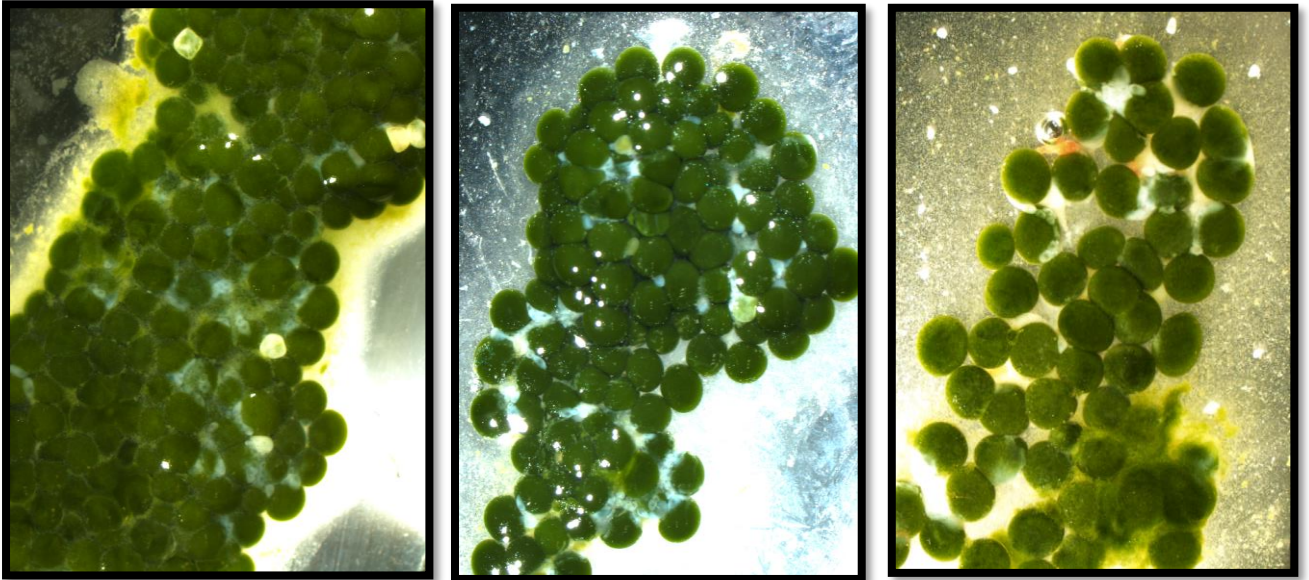


## Ovary Staging

\* All images taken at 0.80-1x

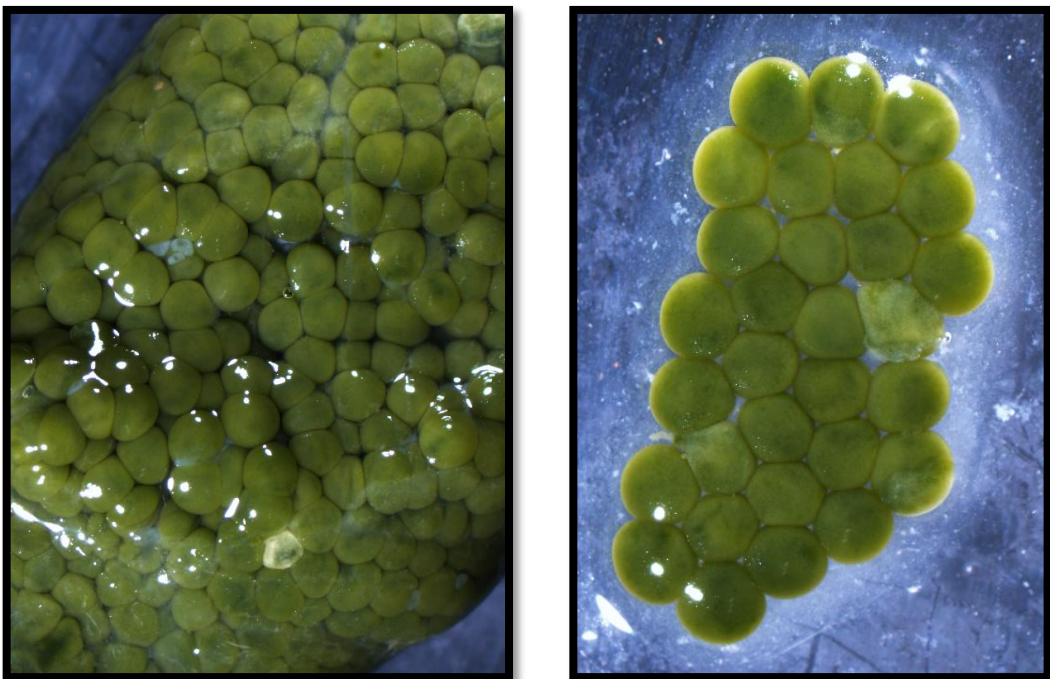
Image credits: MEDMR

### Stage 5 (Mature):



- Ovary is dark green and fills the body cavity and most of the tail
- "Flecks" may be present
- Oocytes 1.0-1.6 mm, ovary factor >325

### Stage 6 (Mature):



- Ovary very dark green, almost black
- Oocytes appear full and have a distinctly round shape
- Oocytes may appear loose in the ovary
- Oocytes 1.4-1.6 mm, ovary factor >400



## Ovary Staging

Image credits: MEDMR

### Selected references using these methods

- Comeau, M., & Savoie, F. (2002). Maturity and reproductive cycle of the female American lobster, *Homarus americanus*, in the southern Gulf of St. Lawrence, Canada. *Journal of Crustacean Biology*, 22(4), 762-774.
- Ellertson, A. A., Waller, J. D., Pugh, T. L., & Bethoney, N. D. (2022). Differences in the size at maturity of female American lobsters (*Homarus americanus*) from offshore Southern New England and eastern Georges Bank, USA. *Fisheries Research*, 250, 106276.
- Little, S.A. and W.H. Watson III. 2003. A comparison of the size at maturity of female American lobsters between an estuarine population and a nearby coastal population. *J. Shellfish Res.* 22: 857-864.
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 \* **See this paper for methods to remove oocytes without sacrificing the female**
- Johnson, K.J., J.S. Goldstein, and W.H. Watson III. 2011. Two methods for determining the fertility status in early-stage American lobster, *Homarus americanus*, eggs. *Journal of Crustacean Biology*, 31(4): 693-700.
- Pugh, T., J.S. Goldstein, K. Lavalli, M. Clancy, and W.H. Watson III. 2013. At-sea determination of female American lobster (*Homarus americanus*) mating activity: Patterns vs. expectations. *Fisheries Research*. 147: 327-337.
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- Waller, J. D., Reardon, K. M., Caron, S. E., Jenner, B. P., Summers, E. L., & Wilson, C. J. (2021). A comparison of the size at maturity of female American lobsters (*Homarus americanus*) over three decades and across coastal areas of the Gulf of Maine using ovarian staging. *ICES Journal of Marine Science*, 78(4), 1267-1277.
- Watson, W.H. III, J.S. Goldstein, E.M. Morrissey, H.A. Cole and T.L. Pugh. 2017. Evidence of mating by sexually immature female American lobsters *Homarus americanus* (H. Milne Edwards, 1837) (Decapoda: Nephropidae). 2017. *J. Crustacean Biol.* 37(1): 2-6. doi:10.1093/jcbiol/ruw010.