

Berried Lobster Seasonality Surveys

May 2023 – May 2025



Nadine Hanlon and Dr James Stewart
Devon and Severn Inshore Fisheries and Conservation Authority

Research Report March 2026

Contents

Executive Summary	3
1. Introduction	4
1.1 Background	4
1.2 Objectives.....	5
2. Methodology	6
2.1 Survey method	6
2.2 Data analysis.....	8
3. Results.....	8
4. Discussion	16
5. Conclusions	18
References	19
Appendix 1.....	21

Version Control History			
Officer	Date	Comment	Version
N. Hanlon	10/03/2026	Draft report	0.1
J. Stewart	16/03/2026	Review by J Stewart	0.2
N. Hanlon	18/03/2026	NH amendments following JS review	0.3
J. Stewart	24/03/2026	Added statistical analysis of egg bearing and shedding periods. Report finalised for SMT review.	0.4
S. Clark	25/03/2026	Report reviewed, amendments made and finalised for publication	1.0

Acknowledgements

Devon and Severn IFCA is grateful to the fishing vessel owners, masters and deckhands who welcomed and supported officers on board for this project.

Cover image: Lobster (*Homarus gammarus*) sample caught in Devon and Severn IFCA's District.

Executive Summary

Egg-bearing (berried) lobsters cannot be landed under current National Legislation. However, some fishers have been known to illegally remove eggs from lobsters before landing, which breaches fisheries legislation and affects stock sustainability. To improve understanding of the lobster lifecycle and provide information for enforcement options, Officers set out to establish when egg-bearing and natural shedding of eggs occurs, and what factors might affect this.

Officers undertook surveys on board commercial fishing vessels to sample catches between May 2023 and May 2025. On sampling days, all lobsters caught were measured and females were inspected for egg bearing and signs of recent shedding. Statistical modelling was used to estimate the probability that a non-berried female, at any time of year, had *recently* shed its eggs naturally. Lobster size and capture depth were tested to see whether these factors influenced the timing or probability of shedding.

Spawning (new egg attachment) begins around August, with early-stage eggs also found through autumn. Peak egg-bearing, in the Devon lobster fisheries studied, occurs from February to May, with the highest proportion of berried females seen in these months.

Natural egg shedding happens mainly between May and August, with the highest probability of observing a recently shed lobster in mid-June, and no shedding observed between October and April.

In winter, the probability that a non-berried female has shed naturally is effectively 0%, meaning any females showing signs of recent egg bearing (due to condition of pleopods and occasional eggs) are almost certain not to have naturally shed.

Based on the samples measured here, lobster size and depth influence the overall probability of a lobster being mature and therefore shedding, but do not affect the time of year at which shedding naturally occurs.

There is now a strong evidence base for assessing whether signs of recent egg shedding are likely to be natural. Natural shedding does not occur in autumn, winter, or early spring, so egg remnants on pleopods during these months should be treated with particular scrutiny.

The predictable seasonal pattern shown here aligns with scientific studies elsewhere in the UK, providing confidence in the results.

1. Introduction

1.1 Background

The European Lobster, *Homarus gammarus*, is geographically distributed around all UK coasts, and is fished commercially and recreationally throughout the Devon and Severn Inshore Fisheries and Conservation Authority (D&S IFCA) District.

Female European lobsters typically have a two-year reproductive cycle, with spawning typically occurring in late summer to early autumn after a moulting has occurred. However, some studies have reported a small number of *H. gammarus* to spawn in consecutive years without moulting (Agnalt et al. 2007; Latrouite et al., 1981). After spawning, eggs are carried on the pleopods (swimming limbs on the underside of the body) and go through 4 distinctive embryo development phases as per Appendix 1 (Coleman et al., 2019) and hatching the following summer (Free 1994; Agnalt et al., 2007; Prodöhl et al., 2006).

Egg-bearing, or “berried”, lobsters are protected through UK legislation for a number of reasons: to protect brood stock, provide a buffer against overfishing, and to allow females to grow older and larger, as larger individuals can produce more, larger eggs (Tully et al., 2001; Moland et al., 2010).

The prohibition on landing of egg-bearing (“berried”) lobster came into force in the UK on 1st October 2017 through the Lobsters and Crawfish (Prohibition of Fishing and Landing) (Amendment) (England) Order 2017. The legislation makes it illegal for British registered fishing vessels to fish for berried lobsters, or land them in English ports, regardless of where they are caught.

Fishers may voluntarily mark berried lobsters with a ‘V’ notch in the tail before returning the lobster to the sea, allowing sexually mature breeding females to be identified after the eggs have been shed and affords protection allowing them to breed before the v-notched grows out during moulting. The Lobsters and Crawfish (Prohibition of Fishing and Landing) Order 2000 prohibits the landing and retention of any lobster with a ‘V’ notched tail. V-notching thereby helps to preserve the stock of breeding female lobsters. However, as the V-notching itself is a purely voluntary measure, un-notched sexually mature female lobsters may be landed when they are not bearing eggs. Under D&S IFCA’s Potting Permit Byelaw Conditions (condition 1.2), it is prohibited to remove from a fishery any berried, V-notched or mutilated lobster (whereby one or more flaps from the tail fan has been deliberately mutilated to hide or obliterate a V-notch).

In some instances, certain fishers have sought to increase their income on a given day by “scrubbing” the eggs from berried lobsters (using mechanical or chemical means) so that they can attempt to land the lobsters without being prosecuted. This practice is not only illegal, but carries a risk to the lobster stock, affects the wellbeing of animals recently recognised as sentient (under the Animal Welfare (Sentience) Act 2022) and also reduces the fishers’ potential future income.

Eastern Sea Fisheries Joint Committee reported in 2008 that the value of one berried female lobster, at the minimum conservation reference size (MCRS) at the time of 87mm, will be worth approximately £10 to a fisherman if scrubbed and landed. At this size they estimate a female would carry approximately 5,000 eggs, of which 0.005% (25 individuals) would recruit into the fishery. Therefore, scrubbing of one female may result in a potential recruitment loss of 25 lobsters: an approximate net loss of £240. Today’s equivalent value for a minimum sized

(90mm) female lobster is £7.50 during summer months, up to £16 over winter, which puts the potential recruitment loss value today at £187.50 to £400, depending on the time of year.

A lobster that has naturally hatched larvae will display remnants of the egg attachment on its pleopods for 2-4 weeks, appearing stringy and straw coloured, and will often have small clusters of un-hatched eggs present (J Karlsruon & R Sisson, 1973). The process of scrubbing removes eggs & egg cases, and tears cementum stalks so that no egg casings remain.

Visual clues to recent scrubbing may be present on lobsters, such as presence of sporadic eggs on the lobster, and damage to the pleopods. However, the technique for testing of scrubbed lobsters involves removing and staining a pleopod from the lobster abdomen, followed by microscopic examination, to identify presence of remaining 'cement'. At particular times of year, the presence of this 'cement' and/or a small number of eggs on a lobster may indicate either that the lobster has recently shed its eggs, or that the eggs have been artificially removed. Identifying the time of year at which each of these explanations applies may help to target appropriate enforcement action.

1.2 Objectives

The objective of this project is to ascertain, within the D&S IFCA's District:

- the months of the year during which lobsters carry eggs;
- the stages of development of these eggs;
- the shedding period;
- the months where there is no egg bearing by lobsters.

This will provide an evidence base to help inform the use of enforcement tools that may be used to identify if a berried lobster has been scrubbed of its eggs.

2. Methodology

2.1 Survey method

D&S IFCA carried out surveys between May 2023 and May 2025 aboard commercial fishing vessels in the District. The surveys were initially undertaken during the egg-shedding months of May to October, however this was extended to include February to March in 2025 to increase confidence in the timing of egg maturation and shedding, and to collect more information on egg bearing in winter. Although additional surveys were planned for other months, poor winter weather and resource constraints meant that this could not be achieved.

All live lobsters caught were sexed and measured. Carapace length (CL), carapace width (CW), and abdominal width (AW), were measured with callipers to the nearest millimetre. The egg stage of all berried lobsters was assessed (Table 1, Figure 1), and lobsters that had 'recently shed' their eggs were identified based on the presence of a small number of remaining eggs, and/or the presence of the sticky substance secreted by the cement glands, used to secure eggs to the setae on the pleopods.

Any damage to the lobster, including tail mutilation, 'V' notches, and damaged or missing claws, were also recorded. All lobsters prohibited from being removed from a fishery in accordance with D&S IFCA Potting Permit Byelaw and Conditions, for example under-sized, mutilated, notched or berried lobsters, were returned to the sea immediately after measurements were taken.

Additional data were collected for every string of pots hauled, including the start and end coordinates of the string, the gear type used, number of pots in the string, average depth of the string, soak time, and bait used.

Table 1. Egg staging guide for *H. gammarus* (Coleman et al., 2019) (Adapted)

Egg Stage	Egg description
1	Black in colour
2	Two tone black/purple, Black yolk ½ of egg
3	Orange/red in colour, Black yolk ½ of egg
4	Dark red/brown/green in colour, Black yolk 1/8 of egg, developed larvae present
5	Eggs sparse or missing, pleopods appear covered in mucous

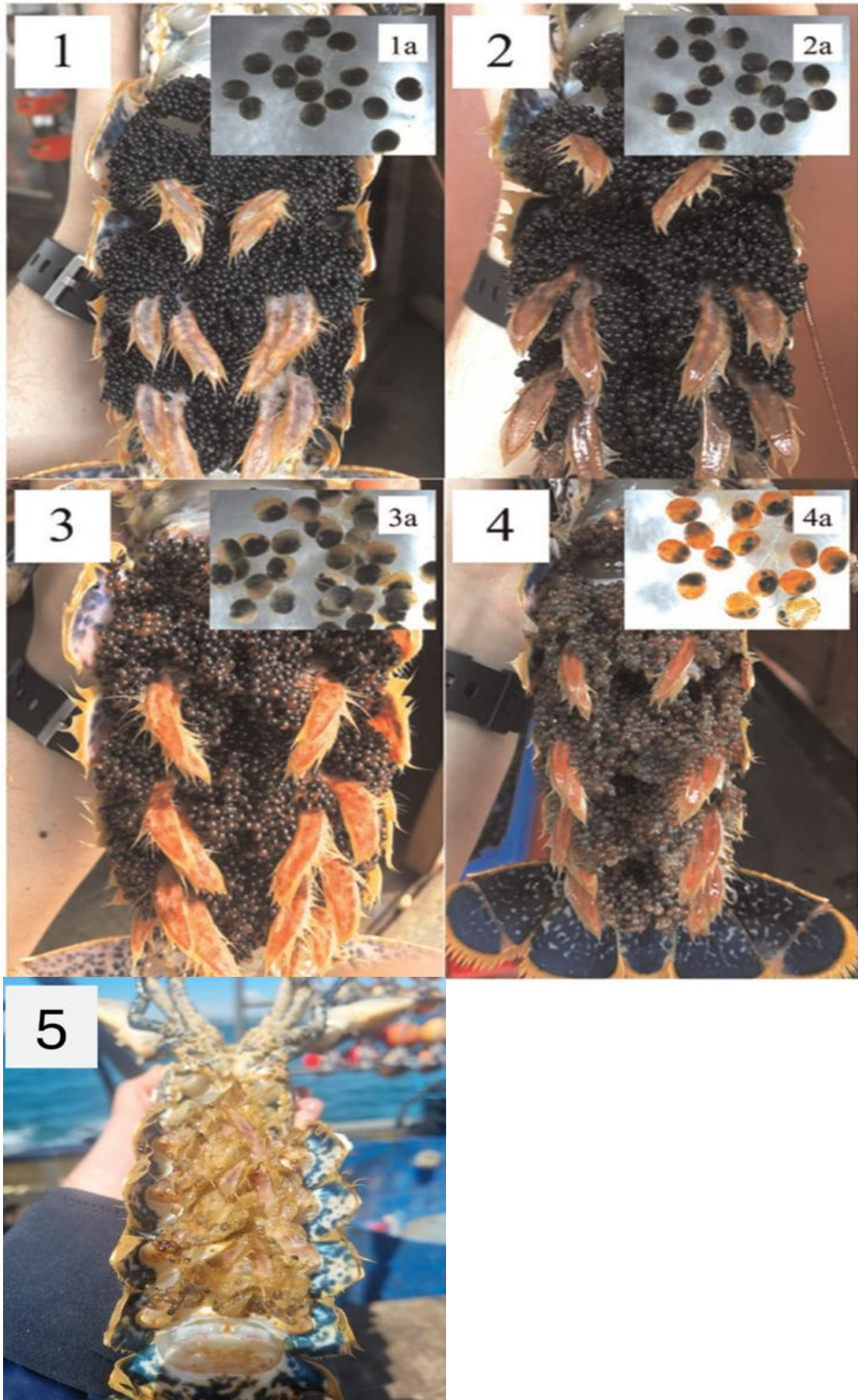


Figure 1. Visual egg staging guide for *H. gammarus* (Coleman et al., 2019) (Adapted)

2.2 Data analysis

Summary statistics were calculated and plotted for each calendar month including the egg stage of berried lobsters.

ANOVA was used to investigate any relationship between lobster size (carapace length and abdomen width) and fishing depth with the timing of berried lobsters releasing eggs.

Data modelling – overview

Logistic regression models were used to understand the factors that determine the probability and timing of natural egg shedding. This essentially answers the question “if I observe a female lobster with no eggs present on its abdomen, what is the probability that it has naturally shed its eggs?”. Details of how this was achieved are included below.

Data modelling – detail

Logistic regression (Generalised Linear Model with binomial error structure and logit link function) was used to predict the probability and timing of shedding. Specifically, lobsters observed without eggs were classified as recently shed (1) or non-berried (0). Those that were classed as recently shed were classed as such due to evidence of recent egg-bearing: a mucous-like layer on pleopods and/or presence of occasionally stage 4 eggs on their underside. Non-berried females had no evidence of recent egg bearing. This binary (1/0) response variable was then modelled via logistic regression, and several potential predictors were tested: day of year, depth, individual ratios between abdomen width and carapace length (a potential predictor of maturity). Vessel identity (anonymised) was tested in all models to control for between-vessel differences but did not improve model fit or materially influence other parameter estimates, so was excluded in favour of model simplicity. Candidate model sets were constructed by considering all plausible predictor combinations and interactions; model parameters were estimated using maximum-likelihood, and AIC-based model selection was used to determine model ‘parsimony’: models were retained in a final candidate set if they had a $\Delta AIC \leq 6$ of the model with lowest AIC and there was no simpler model with a lower AIC. Model diagnostics were checked based on simulated residuals using the R package ‘DHARMA’ (Hartig, 2024). Collinearity between predictor variables was checked using variance inflation factors using the R package ‘car’ (Fox and Weisberg, 2019).

Day of year is typically presented as a linear measure, increasing from 1 to 365. However, for seasonal phenomena like breeding cycles it is important to represent day of year as a ‘circular’ variable, recognising that day 365 in the first year is followed by day 1 in the second year, so that days 365 and 1 may be more similar to each other than might otherwise be expected. To allow day of year to be treated as a ‘circular’ predictor variable, it was modelled using a ‘harmonic regression’ approach, which is a time-series analysis method that uses Fourier series (sine and cosine pairs) to model complex seasonal patterns.

R v2026.01.0 or later (Posit team, 2026) was used for all data analyses.

3. Results

Over the two-year survey period, 35 surveys were undertaken from five participating fishing vessels (Table 2). However, 32 (91%) of all surveys were carried out from just two of these vessels, both operating out of Salcombe. The remaining three surveys were undertaken from vessels based out of Exmouth, Axmouth and Clovelly (Figures 2 and 3). The two Salcombe fishing vessels were used more frequently due to their fishing effort being more focussed on

lobster ground (meaning more lobsters would be available to sample, making the most of Officer time onboard), the suitability of the vessel for an on-board officer to carry out the survey, and the willingness of the vessel master to participate in the study and assist D&S IFCA with the data collection. With only one survey occurring on the North Devon coast, the data collected are most appropriately applied to the south of D&S IFCA's District.

Table 2. Summary of surveys per location

Base Port	2023 surveys	2024 surveys	2025 surveys	Total surveys	
Salcombe	14	13	5	32	91%
Exmouth	1	0	0	1	3%
Axmouth	1	0	0	1	3%
Clovelly	1	0	0	1	3%
Total	17	13	5	35	



Figure 2. Location of pot strings hauled by year (2023 – 2025) in D&S IFCA's District

* www.copyright.ukho.gov.uk

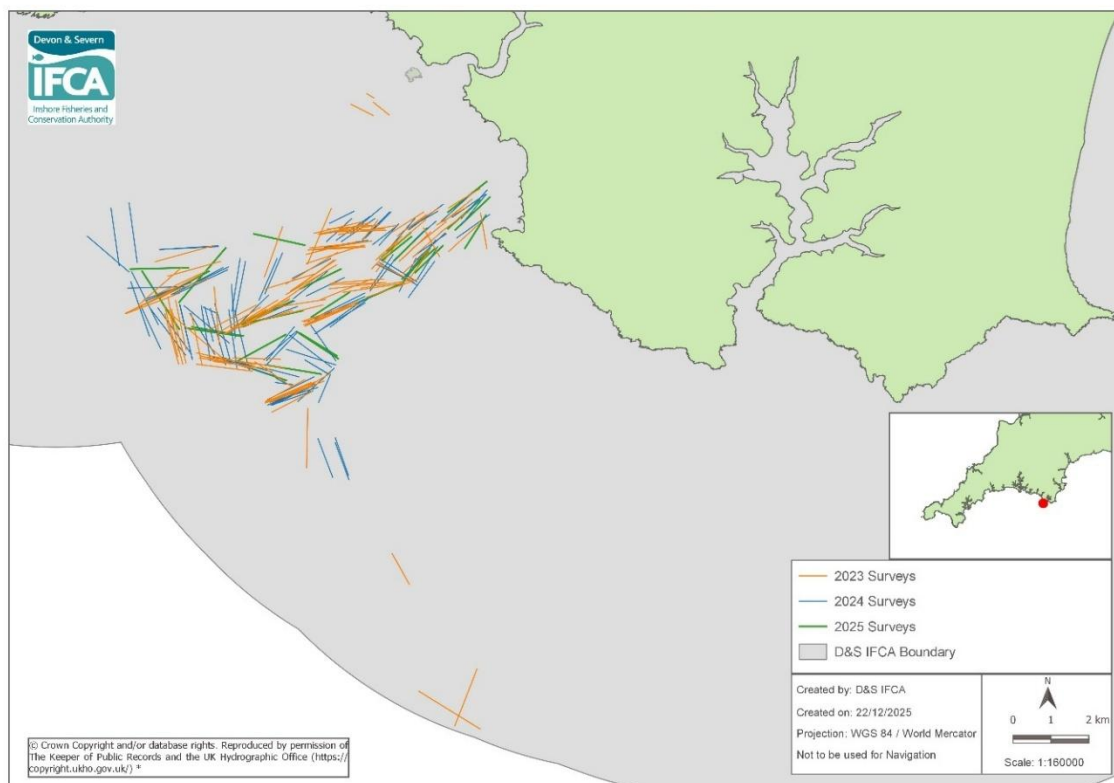


Figure 3. Location of strings hauled by year (2023 – 2025): Salcombe based vessels
 * www.copyright.ukho.gov.uk

A total of 3,918 lobsters were caught and measured. Of these, 2,376 (60.6%) were female, of which 406 (17.1%) were berried and 76 (3.2%) were identified as having recently shed eggs (Table 3, Figure 4; Figure A1, Appendix 1).

Table 3. Summary of lobsters captured from May 2023 to May 2025

Year	Month	Number of Surveys	Total Lobsters	Male	Female	Number and % of Berried Females	
2023	May	2	86	23	63	20	32%
	June	6	946	407	539	78	14%
	July	4	366	148	218	16	7%
	August	3	419	148	271	16	6%
	September	2	170	64	106	12	11%
2024	May	1	89	42	47	15	32%
	June	2	366	172	194	34	18%
	July	4	377	146	231	7	3%
	August	3	205	67	138	7	5%
	September	1	177	66	111	23	21%
	October	2	392	137	255	80	31%
2025	Feb	1	128	35	93	62	67%
	April	1	56	28	28	10	36%
	May	3	138	56	82	26	32%

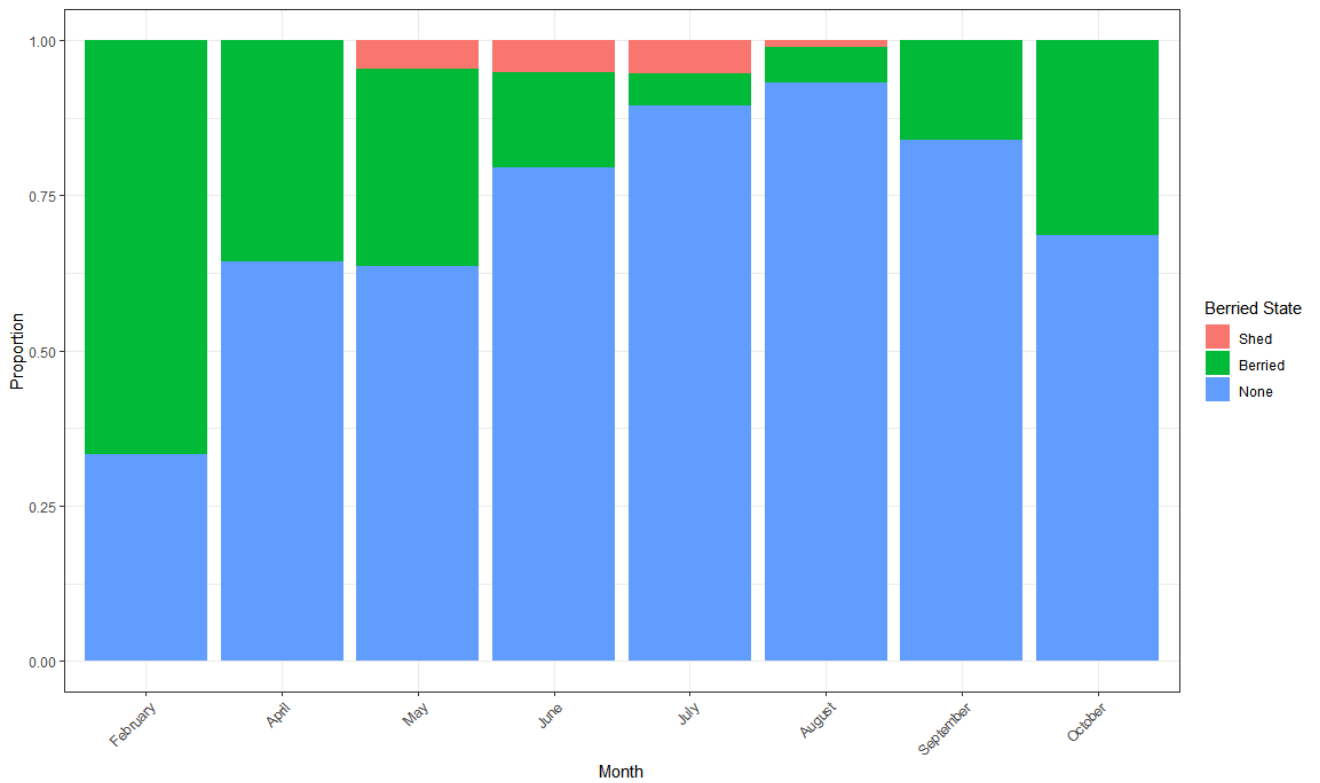


Figure 4. Proportion of berried, non-berried (none) and recently shed female lobsters by month

The highest proportion of berried lobsters caught were during the months of February, April and May, with the lowest proportions of berried lobsters caught during the months of July and August (Figure 4; Figure A1, Appendix 1).

No lobsters were identified as having recently shed their eggs in September (2023 and 2024) or October (2024). The earliest month ‘shed’ lobsters were seen was in May, with the greatest proportion of shed lobsters caught during the months of June and July, and no recently shed lobsters between the months of September and April.

The highest proportion of lobsters carrying stage 1 eggs was in the months of August, September and October for both 2023 and 2024 (Table 4, Figure 5; Figure A2, Appendix 1).

Table 4. Summary of berried and shed lobsters from May 2023 to May 2025. Percentages shown relate only to stages 1-4.

Year	Month	Berried Stage 1		Berried Stage 2		Berried Stage 3		Berried Stage 4		Shed Stage 5
		Count	%	Count	%	Count	%	Count	%	
2023	May	9	45%	3	15%	0	0%	8	40%	3
	June	16	21%	18	23%	16	21%	28	36%	24
	July	6	38%	1	6%	6	38%	3	19%	8
	August	10	63%	2	13%	1	6%	3	19%	1
	September	8	67%	3	25%	0	0%	1	8%	0
2024	May	6	40%	0	0%	9	60%	0	0%	2
	June	8	24%	17	50%	3	9%	6	18%	12
	July	1	14%	1	14%	4	57%	1	14%	16
	August	4	57%	3	43%	0	0%	0	0%	4
	September	23	100%	0	0%	0	0%	0	0%	0
	October	80	100%	0	0%	0	0%	0	0%	0
2025	Feb	28	45%	24	39%	7	11%	3	5%	0
	April	1	10%	0	0%	7	70%	2	20%	0
	May	1	4%	14	54%	5	19%	6	23%	4

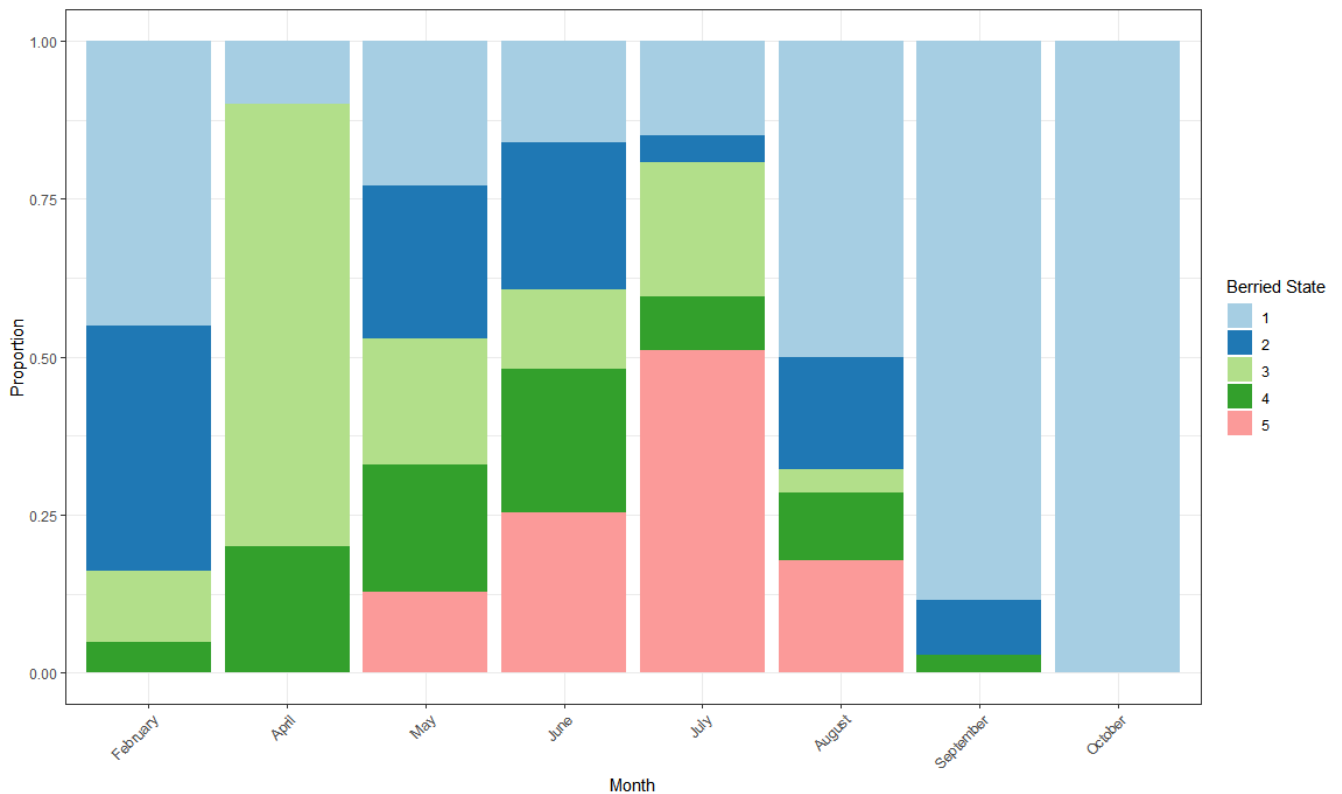


Figure 5. Egg stage of berried lobsters by month. Stage 5 represents lobsters that have recently shed their eggs.

The probability of seeing a naturally shed lobster was highest in mid-June (Figure 6). In mid-June, the model estimates that there is a probability of approximately 7% that a lobster observed without an egg mass has recently shed. By contrast, over late autumn, winter and early spring, the probability of such a lobster having naturally shed recently is approximately 0%.

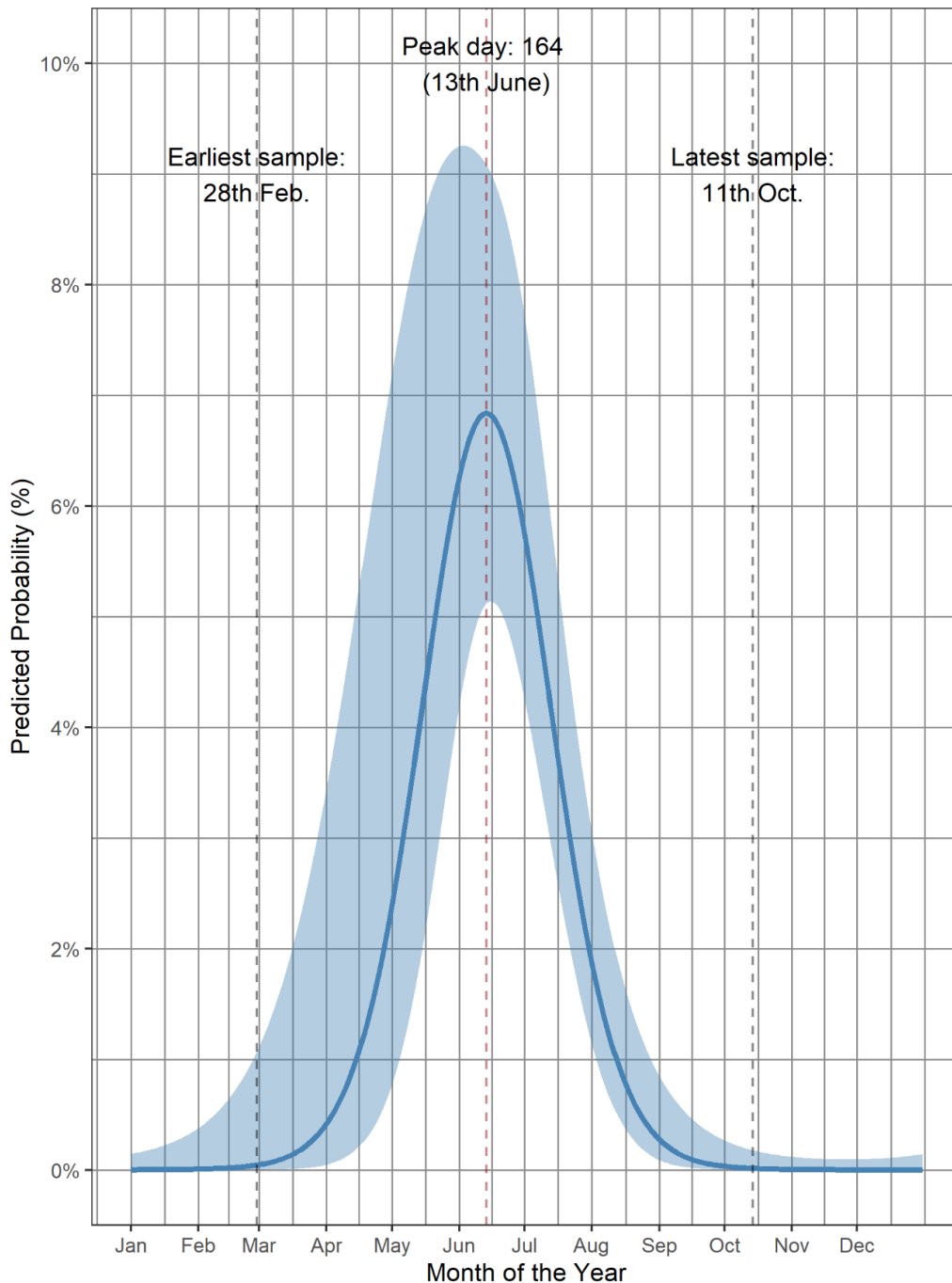


Figure 6. Seasonal probability distribution: Probability of a non-berried female lobster having recently shed its eggs. Showing predicted probability and 95% confidence intervals from a logistic regression model. Based on all survey data May - Sept. 2023, May - Oct. 2024 and Feb. - May 2025. Peak of shedding activity predicted around 13th June.

There was no significant effect of lobster carapace length ($p > 0.153$; Figure 6), abdomen width ($p > 0.277$), or depth ($p > 0.453$) on the timing of observed shedding (Figure 7).

This was supported by the testing of logistic regression models for the probability of egg shedding, which found no significant evidence for an interaction between day of year and either depth or lobster size. When testing additional variables for their influence on the probability and timing of shedding, both depth and lobster size (abdomen width:carapace length ratio) were variables included in the best-fitting logistic regression model. It was found that they influence the overall probability of shedding being observed, but not the timing of the peak in shedding activity (Figure 9 and Figure A3, Appendix 1). In other words, timing of shedding did not vary based on lobster size (abdomen width:carapace length ratio), although females with larger abdomens relative to their length were overall more likely to have recently shed, reflecting their higher probability of being mature (Figure 9 and Figure A3, Appendix 1).

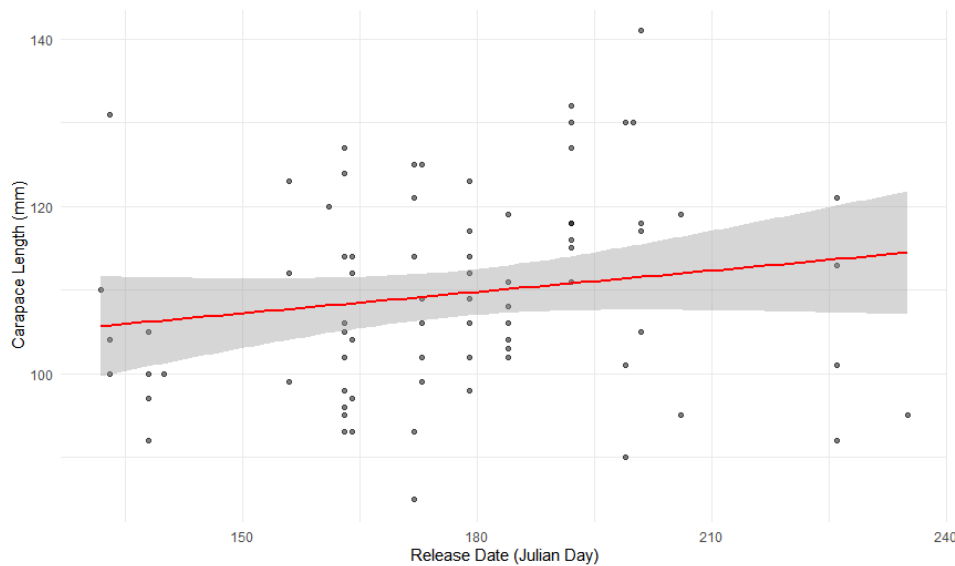


Figure 7. No significant relationship between lobster carapace length and timing of shedding being observed.

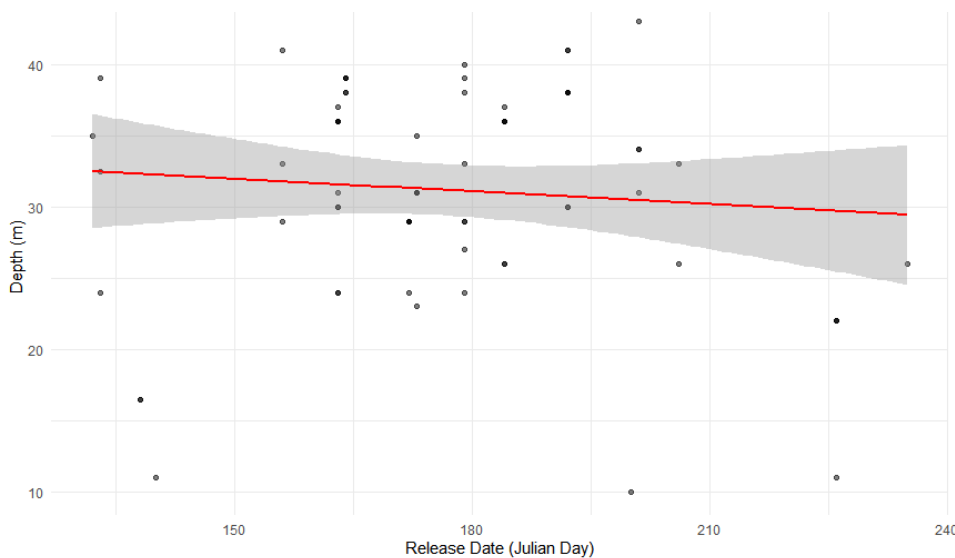


Figure 8. No significant relationship between capture depth and timing of shedding being observed.

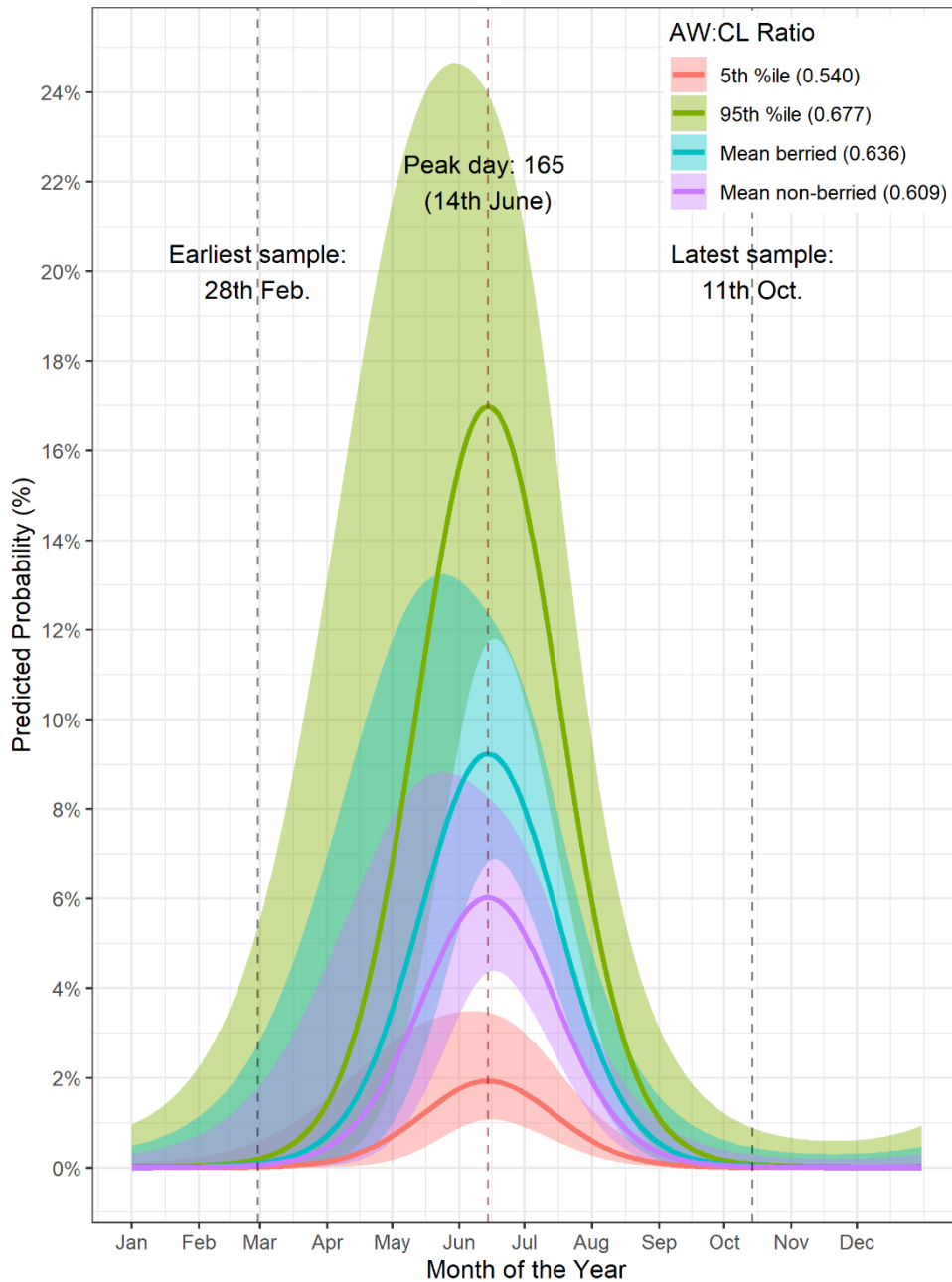


Figure 9. Seasonal probability distribution: Probability of a non-berried female lobster having recently shed its eggs based on day of year and lobster size (AW:CL ratio = abdomen width:carapace length ratio). Showing predicted probability and 95% confidence intervals from a logistic regression model. Based on all survey data May - Sept. 2023, May - Oct. 2024 and Feb. - May 2025 which had depth, abdomen width and carapace length data recorded. Peak of shedding activity predicted around 14th June. Timing of shedding did not vary based on lobster size (abdomen width:carapace length ratio), though females with larger abdomens relative to their length were more likely to have recently shed overall, reflecting their increased probability of being mature. Model used to calculate the predictions shown here also included an effect of capture depth (shown in Figure A3, Appendix 1). Predictions here are based on an assumption of capture at the median capture depth (29m).

4. Discussion

It is widely reported that the European lobster (*Homarus gammarus*) lay its eggs in late summer and begin hatching the following year in late spring or early summer (Free, 1994; Agnalt *et al.*, 2007; Prodöhl *et al.*, 2006).

The results from this survey identify that within the D&S IFCA's District, main lobster spawning starts around the month of August with eggs then being carried for between 9 to 12 months, being released between the following May and August. The highest proportions of berried lobsters were caught in the months of February to May, with the smallest proportion of berried females caught between July and August.

This correlates with Free's (1994) results which calculated an egg incubation period between 7 to 9 months in Selsey, West Sussex (September or October through to May or early July), 9 to 12 months in Bridlington, Yorkshire (October to July), and 9 months in Dale, Pembrokeshire (September to May or June).

The probability of seeing a naturally shed lobster was highest in mid-June (Figure 6). In mid-June, statistical modelling based on D&S IFCA's survey data estimates that there is a probability of approximately 7% that a lobster observed without an egg mass has recently shed. By contrast, over late autumn, winter and early spring, the probability of such a lobster having naturally shed recently is approximately 0%.

Interpretation of the probability of recent shedding in summer, as presented in Figure 6, is relatively complex: although the overall probability of recent shedding in mid-June is approximately 7%, the interpretation would differ depending on the state of the individual lobster. For example, a lobster observed with mucous-like substance and occasional eggs on its body in mid-June is highly likely to have recently been bearing eggs (greater than 7% probability) and has either recently shed or has had its egg mass removed. The latter may be considered more likely if the remaining eggs on the carapace are in an early developmental stage (so are unlikely to have been naturally shed under normal conditions) or there is other evidence of artificial removal. Further evidence of the lobster being scrubbed may include the presence of cement on the pleopods, the condition of the pleopods and abdomen, and the presence and embryonic stage of any remaining eggs.

By contrast, interpretation of Figure 6 in winter is relatively more straightforward: a lobster observed with mucous-like substance and/or occasional eggs on its body in winter is highly likely to have recently been bearing eggs, and there is an approximately 0% probability that the eggs were naturally shed. The confidence intervals on Figure 6 demonstrate that such a lobster is almost certain to have had less than 0.25% probability of naturally shedding in mid-October to mid-January, rising to a theoretical maximum of 1% probability of naturally shedding at the start of March.

In a fecundity study that measured the eye index of lobsters off the coast in North Wales, Hepper and Gough (1978) observed that embryonic development occurred rapidly during autumn and spring, and slowly in the winter months, which correlates with the results from this survey. Early-stage berried lobsters (egg stages 1 and 2) were observed at their lowest levels between April and June, however stage 1 berried lobsters were identified in every month throughout the survey period. The proportion of late-stage berried lobsters (stages 3 and 4) increased between February and June, indicating that the speed of embryonic development may increase as temperatures or daylight increases, or a combination.

A single berried lobster was observed at egg stage 4 on 14th September 2023, suggesting that shedding may continue for a longer period than the rest of the results indicate. All other samples from September and October in 2023 and 2024 were in the early stages of being berried. In February 2025 approximately 80% of berried lobsters caught were in the early berried stages (1 and 2), indicating that they had remained in this embryonic stage throughout winter. By April 2025 only 10% (approx.) of the lobsters caught were in the early berried stage, with the majority being in berried state 3 or 4, showing rapid egg development between February and April. However, in 2023, 2024 and 2025 the early stage berried lobsters began to increase again from May highlighting the start of the spawning season.

The earliest date that a shedding lobster was caught during the survey period was 12th May, with the latest date being 23rd August. As previously mentioned, it is likely shedding may continue into September based on the evidence of a late-stage berried lobster in mid-September 2023. However, no shed lobsters were recorded during the months of September or October, and no shed lobsters were recorded prior to May. The proportion of berried lobsters with eggs in each of the four developmental stages does not always clearly show a consistent pattern of advancing development from month to month; this may be due to variation in sampled areas between months and a reflection of the sample sizes being relatively small compared to that of the overall population of lobsters in the area. However, the narrow confidence intervals on Figure 6 provides high confidence of a lack of natural shedding over late autumn through to early spring, and the overall pattern of egg bearing periods matches that shown in previous studies of the European lobster as discussed above.

Hepper & Gough (1978) reported a linear relationship between the carapace length and fecundity (number of eggs), and the carapace length can be seen as an indicator of size at sexual maturity for female lobsters. Ovigerous (egg-bearing) females were recorded below the MCRS during the survey, from 85mm upwards. Therefore, carapace length alone cannot be used as an indication of sexual maturity in female lobsters for the purpose of identifying scrubbed lobsters in the D&S IFCA's District, as it can be assumed that any female lobster landed above MCRS has the potential to be sexually mature and carrying eggs., although the study did not record abdomen width measurements.

Simpson (1961) used the abdomen width to carapace length (AW:CL) ratio to indicate functional maturity of the European lobster, and this ratio has also been used in combination with other criteria as an index of physiological maturity in further studies (Free, 1994; Tully *et al.*, 2001; Lizárraga-Cubedo *et al.*, 2003).

The data collected here indicate that the timing of natural shedding does not appear to vary based on depth of lobster capture or based on lobster size (AW:CL ratio) (Figure 9 and Figure A3, Appendix 1). Instead, these factors appear to influence the overall probability of shedding: the probability of shedding was higher for lobsters with larger abdomens and for those caught at greater depths, which may simply reflect the higher probability of maturity in these lobsters. However, this study was not set up to calculate the length of the egg-bearing period of individual lobsters; therefore, whilst depth and lobster size did not appear to influence timing of shedding, they may have independent influences on the timing of spawning and the length of the egg-bearing period. Interpreting this effect is further complicated by the ability of lobsters to move between deeper and shallower areas, so it is difficult to interpret the influence of depth at a single point in a lobster's lifecycle.

Local sea temperature and geographical longitude are both important factors influencing the reproductive cycle and the egg incubation period, with lobsters maturing at smaller sizes where the temperature range is greatest (Free, 1994; Tully *et al.*, 2001; Ellis *et al.*, 2015). Ellis *et al.* (2015) demonstrated a positive correlation between fecundity of *H. gammarus* with the

annual range in sea surface temperature and easterly longitude. Free (1994) demonstrated that the incubation period decreased as average sea temperature increased at different longitudinal levels around the UK coast and suggests this may allow females in warmer seas to spawn more frequently than the reported 2-year reproductive cycle of mature females, of up to twice in a three-year period. Geographical variation and temperature variation may influence the timings of activity in relation to embryonic development and egg release. This potentially could suggest that differences may exist between the North and South Devon lobster fisheries. However, whilst this study has not quantified differences in water temperature or egg bearing/shedding in the different areas studied, these areas are relatively close in latitude and are likely to have similar water temperatures. Whilst 97% of the data collected in this survey was from the coastal waters of South Devon, the results are consistent with observations from previous lobster surveys conducted around Lundy Island and along the North Devon coast. Therefore, the conclusions of this research are applicable to the lobster fisheries within the whole of the D&S IFCA's District

5. Conclusions

This study has shown that egg-shedding primarily occurs between May and August, peaking in mid-June. The probability of natural shedding reduces to approximately zero over winter months. Seasonal context is therefore essential in determining whether a lobster has been illegally scrubbed.

A lobster showing mucous-like substance on the pleopods or traces of egg attachment in winter is almost certainly not a naturally shed individual. It is likely to have had its eggs removed artificially, or to have experienced significant physiological stress causing egg shedding. Based on all survey observations, normal fishing operations are not expected to cause sufficient stress to result in egg shedding.

Overall, between May–August

✔ Natural shedding occurs, peaking in mid-June. Signs of recent shedding may be genuine.

In late April and late August:

⚠ Some natural shedding may be observed. In these transitional periods, interpretation of whether natural shedding has occurred should consider egg stage and pleopod condition.

Between October and early April

✘ Natural shedding is not expected to occur. Egg remnants or cement strongly suggest recent egg-bearing and there is high confidence for enforcement decisions on this basis.

References

[The Lobsters and Crawfish \(Prohibition of Fishing and Landing\) \(Amendment\) \(England\) Order 2017](#)

- Agnalt, A.L., Kristiansen, T.S. and Jørstad, K.E., 2007. Growth, reproductive cycle, and movement of berried European lobsters (*Homarus gammarus*) in a local stock off southwestern Norway. *ICES Journal of Marine Science*, 64(2), pp.288-297.
- Coleman, M.T., Porter, J.S. and Bell, M.C., 2019. Investigating fecundity and egg loss using a non-invasive method during brooding in European lobster (*Homarus gammarus*). *ICES Journal of Marine Science*, 76(6), pp.1871-1881.
- Ellis, C.D., Knott, H., Daniels, C.L., Witt, M.J. and Hodgson, D.J., 2015. Geographic and environmental drivers of fecundity in the European lobster (*Homarus gammarus*). *ICES Journal of Marine Science*, 72(suppl_1), pp.i91-i100.
- Free, E.K., 1994. *Reproductive processes in the European lobster, Homarus gammarus* (Doctoral dissertation, University of Southampton).
- Hartig, F., 2024. DHARMA: Residual Diagnostics for Hierarchical (Multi-Level / Mixed) Regression Models. R package version 0.4.7, <https://CRAN.R-project.org/package=DHARMA>.
- Hepper, B. T., and Gough, C. J. 1978. Fecundity and rate of embryonic development of the lobster, *Homarus gammarus*(L.), off the coast of North Wales. *Journal du Conseil International pour l'Exploration de la Mer*, 38: 54–57.
- Karlsson, J. and Sisson, R., 1973. A technique for detection of brushed lobsters by staining of cement on swimmerets. *Transactions of the American Fisheries Society*, 102(4), pp.847-848.
- Latrouite, D., Leglise, M. and Raguenes, G., 1981, January. Données sur la reproduction et la taille de première maturité du homard *Homarus gammarus* d'Iroise et du golfe de Gascogne. In *CIEM 1981: Comité des Mollusques et Crustacés*.
- Lizarraga-Cubedo, H.A., Tuck, I., Bailey, N., Pierce, G.J. and Kinnear, J.A.M., 2003. Comparisons of size at maturity and fecundity of two Scottish populations of the European lobster, *Homarus gammarus*. *Fisheries Research*, 65(1-3), pp.137-152.
- Moland, E., Olsen, E., and Stenseth, N. 2010. Maternal influences on offspring size variation and viability in wild European lobster (*Homarus gammarus*). *Marine Ecology Progress Series*. 400. 165-173. 10.3354/meps08397.
- Posit team (2026). RStudio: Integrated Development Environment for R. Posit Software, PBC, Boston, MA.
- Prodöhl, P.A., Jørstad, K.E., Triantafyllidis, A., Katsares, V. and Triantaphyllidis, C., 2006. European lobster-*Homarus gammarus*. *Genetic Impact of Aquaculture Activities on Native Populations. Final Scientific Report*, pp.91-98.
- Tully, O., Roantree, V. and Robinson, M. 2001. Maturity, fecundity and reproductive potential of the European lobster (*Homarus gammarus*) in Ireland, *Journal of the Marine Biological Association of the United Kingdom*, 81(1), pp. 61–68. doi:10.1017/S002531540100340X.

Simpson, A.C., 1961. A contribution to 'the bionomics of the lobster (*Homarus vulgus* Edw.) on the coast of North Wales. *Fish. Invest. Lond. Ser.* 2(23), p.7.

ESFJC, 2008. Synopsis of work conducted to develop a test to identify lobsters (*Homarus gammarus*) that have had their eggs scrubbed illegally, Eastern Sea Fisheries Joint Committee, 2008

Appendix 1

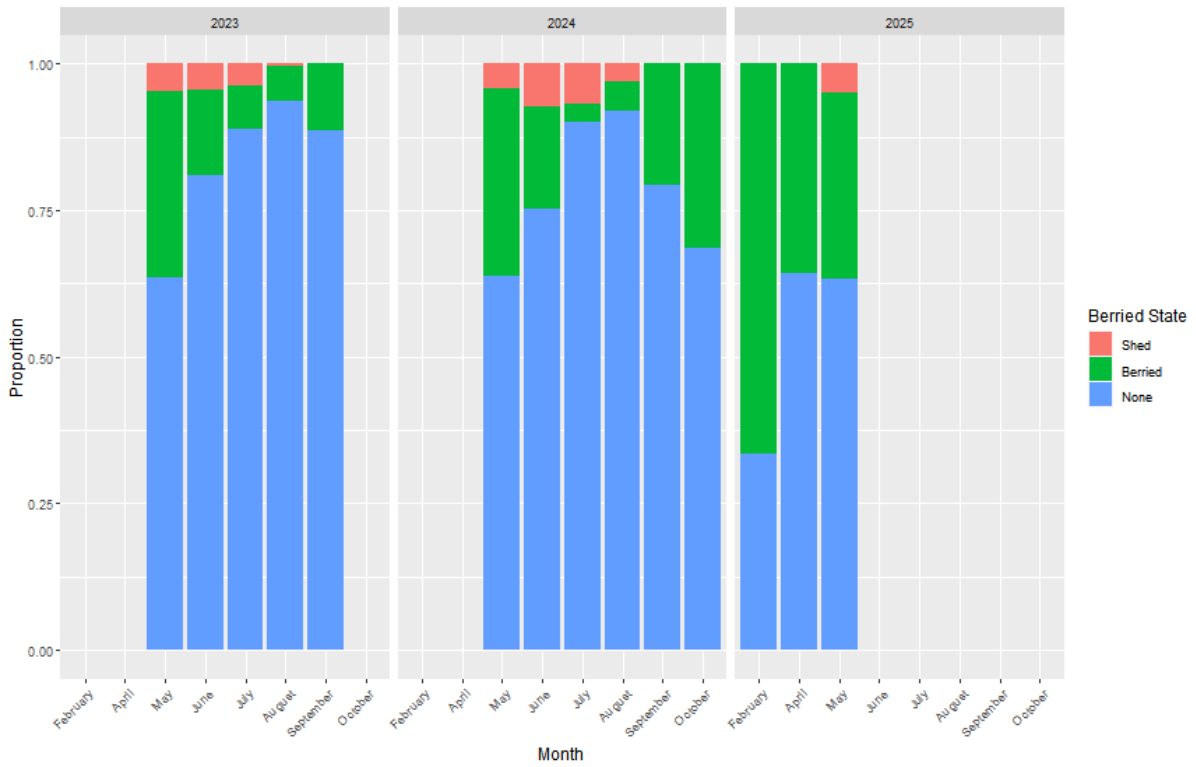


Figure A1. Proportion of all non-berried, berried and recently shed lobsters by month and year

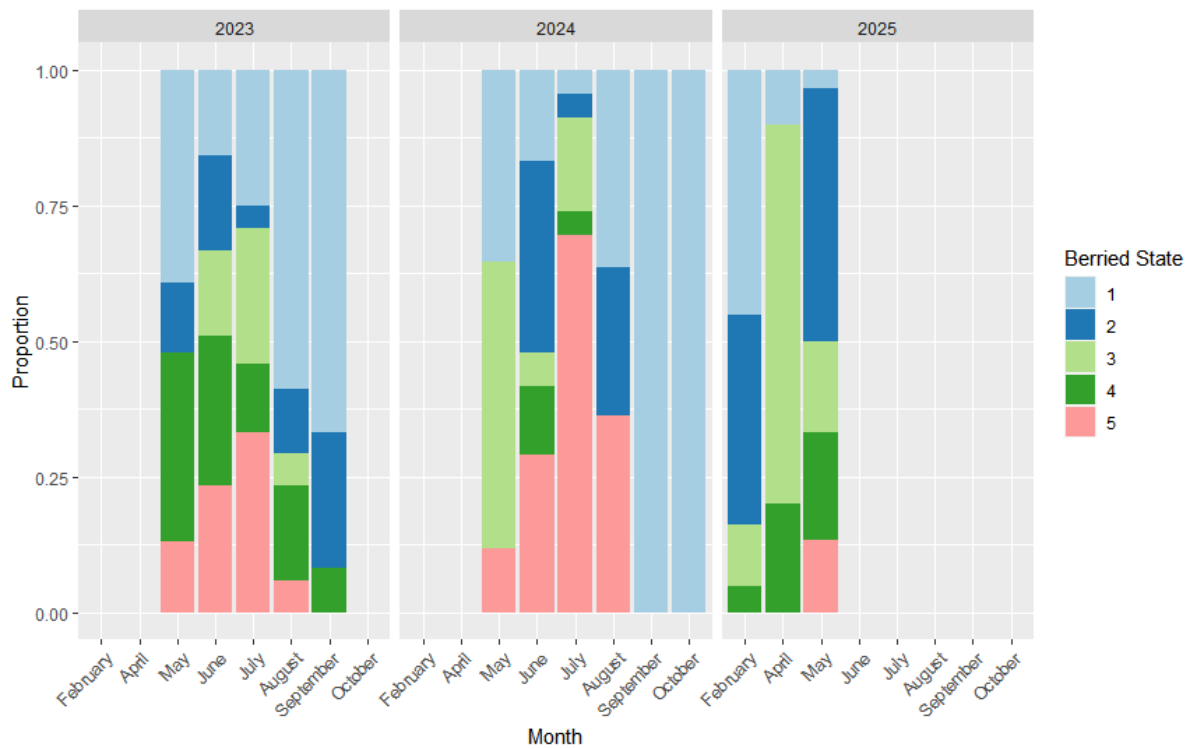


Figure A2. Proportion of berried lobsters by berried state over the survey period, by month and year

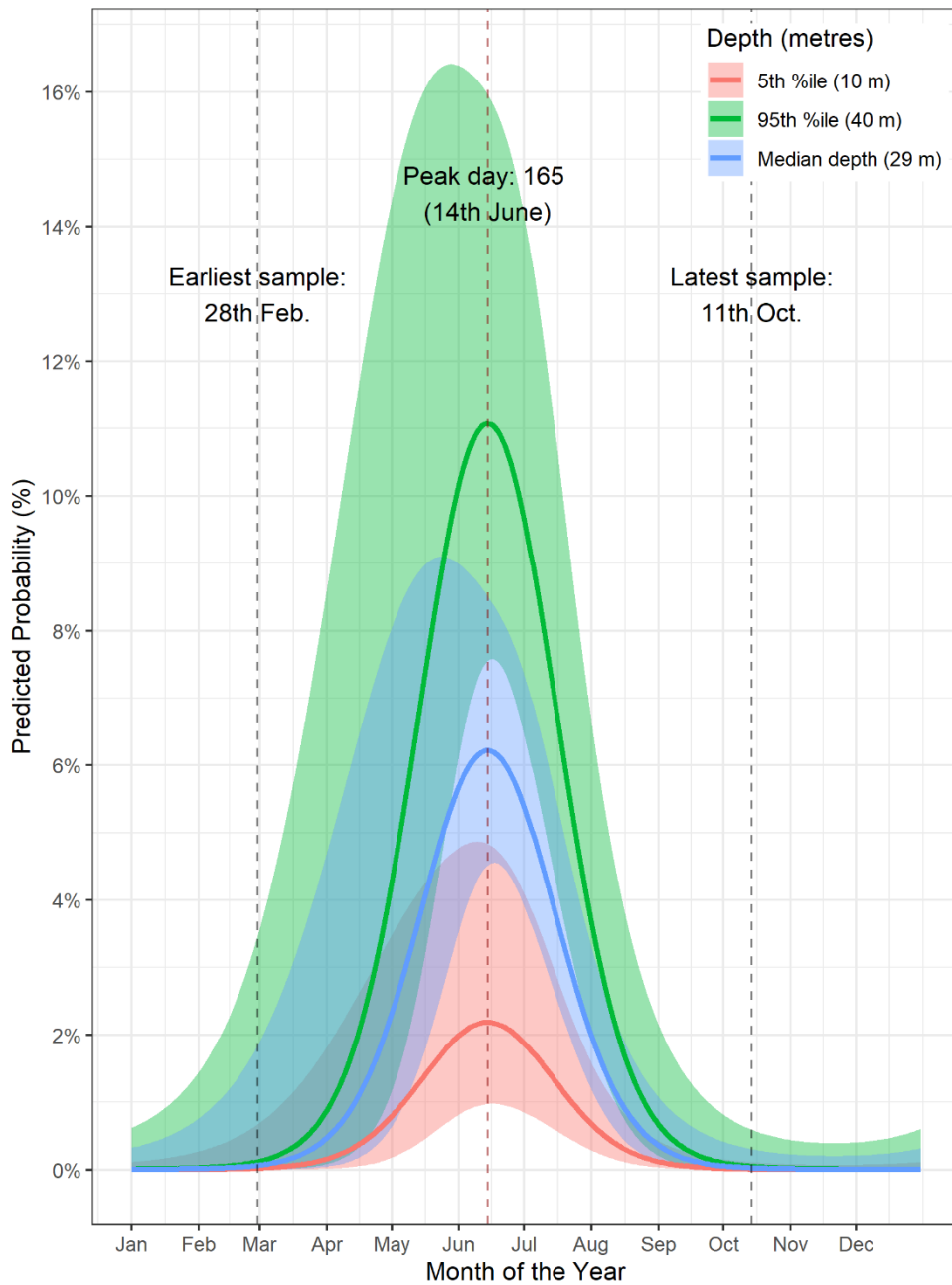


Figure A3: Seasonal probability distribution: Probability of a non-berried female lobster having recently shed its eggs based on day of year and depth of capture (showing a prediction line for a shallow, deep and median capture depth). Showing predicted probability and 95% confidence intervals from a logistic regression model. Based on all survey data May - Sept. 2023, May - Oct. 2024 and Feb. - May 2025 which had depth, abdomen width and carapace length data recorded. Peak of shedding activity predicted around 14th June. Timing of shedding did not vary based on depth, though females caught at greater depths were overall more likely to have recently shed, reflecting their increased probability of being mature. Model used to calculate the predictions shown here also included an effect of lobster size (abdomen width:carapace length ratio) (shown in Figure 7). Predictions here are based on an assumption of capture at the median abdomen width:carapace length ratio.