

Identifying the Breeding Season of the Whelk
Buccinum undatum within the Devon & Severn
IFCA's District
Supplementary Report



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1	Katherine Stephenson	Sarah Clark September 2019	Inserted whelk landing and value figures for 2018, and for Brixham and Devon 2016-2018

1. Executive Summary

Following Devon and Severn Inshore Fisheries and Conservation Authority's (D&S IFCA) original study, "Determination of the Size of Maturity of the Whelk *Buccinum undatum* within the Devon & Severn IFCA's District" (Stephenson, 2015), a need to collect more data on the seasonality of breeding for whelks in the D&S IFCA's District was identified.

Samples of whelk were collected from both Exmouth and Ilfracombe in December 2017 and January 2018. Analysis was carried out to calculate gonad size indices (gonad weight standardised to digestive whorl weight) for each sample. These were combined with the data from the previous study and used to identify the months when peak breeding activity occurs.

At both sample sites mating and spawning take place during the winter. In Exmouth the peak breeding activity occurs during November and December, whilst in Ilfracombe it appears to start slightly earlier, in October/November. A closed season, covering these key months, could be considered as a viable management option to protect breeding whelks and enhance recruitment.

*This is a supplementary report and should be read in conjunction with "Determination of the Size of Maturity of the Whelk *Buccinum undatum* within the Devon & Severn IFCA District" (Stephenson, 2015) for the overall account of this project.*

2. Introduction

The UK whelk (*Buccinum undatum*) fishery has shown a rapid increase over the past decade. Whelk landings, in terms of both tonnage and value, approximately doubled between 2002 and 2012, and have continued to increase over the last few years. This increase in effort has raised concerns over the sustainability of the fishery, for which the stocks have never been formally assessed (MMO, 2012).

In 2013 D&S IFCA carried out a 12-month study to determine the Size of Maturity (SOM) and the seasonality of spawning of the whelk within the D&S IFCA's District. Monthly samples were collected from both Ilfracombe, to represent the north coast, and Exmouth, to represent the south coast. The study found that for the Exmouth fishery female whelks reached sexual maturity at 69.3mm shell height, and males 70.9mm. The SOM was greater for Ilfracombe, with 76.6mm for females and 76.4mm for males. This implied that the EU Minimum Conservation Reference Size (MCRS) of 45mm was doing little to protect the spawning stocks and, therefore, the sustainability of the population (Stephenson, 2015). This led to the introduction of new management by D&S IFCA. In November 2018, D&S IFCA raised the MCRS of whelk within its District to 55mm, with another 10mm increase to 65mm planned for November 2020.

Stephenson (2015) found that in Exmouth both spawning in females and copulation in males appears to take place in the winter months, between December and February. In Exmouth females' gonad sizes increased towards December with a fall in size in January / February suggesting eggs are maturing until December, copulation follows and then spawning takes place thereafter. Males show a similar pattern. However, no samples could be collected in January due to bad weather, so it was not possible to identify exactly when copulation / spawning occurs (Figure 1, a & b). The gonad indices of whelks landed onto Ilfracombe were less clear, although it appeared that copulation takes place throughout November to January, when the male gonad indices show a decline. The females appeared to spawn in November. But this was followed by an increase in the gonad indices for December, and as there was no sample for January the extent of the spawning time could not be identified (Figure 2, a & b). Before any management to protect spawning and breeding whelks can be considered, the seasonality of spawning needs to be clearly identified. Therefore, the data gaps for January in the gonad indices need to be filled. This supplementary study aims to fill those gaps, by analysing further samples collected in December 2017, to strengthen the December data, as well as samples collected in to January 2018.

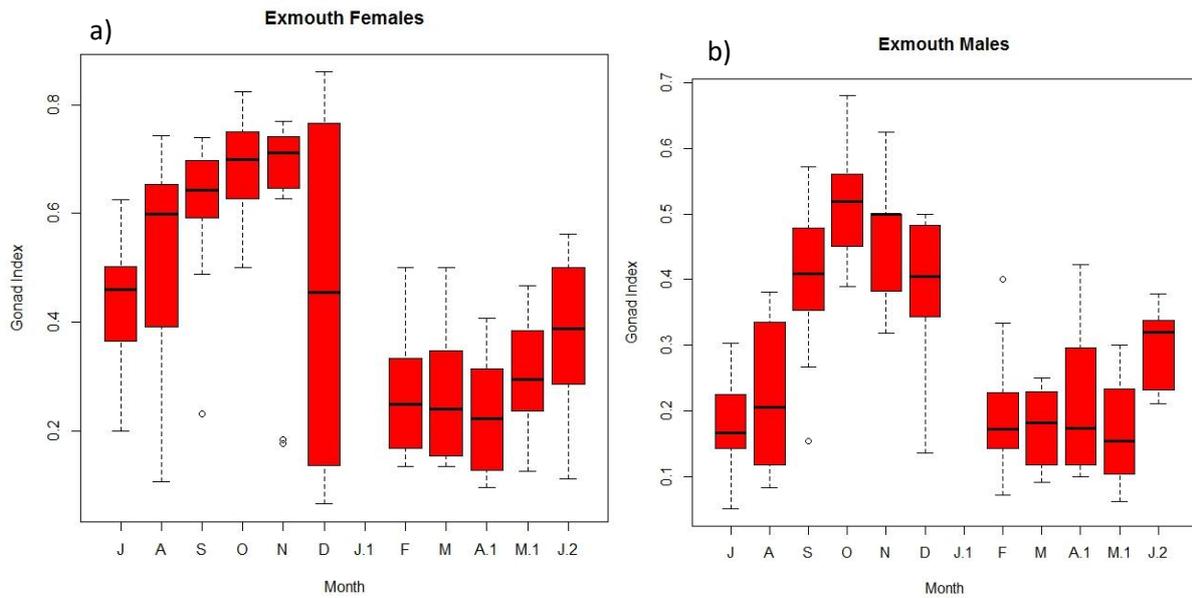


Figure 1 Distribution of gonad index for each sample month from Exmouth (except January, due to poor fishing weather), starting in July, for a) females and b) males.

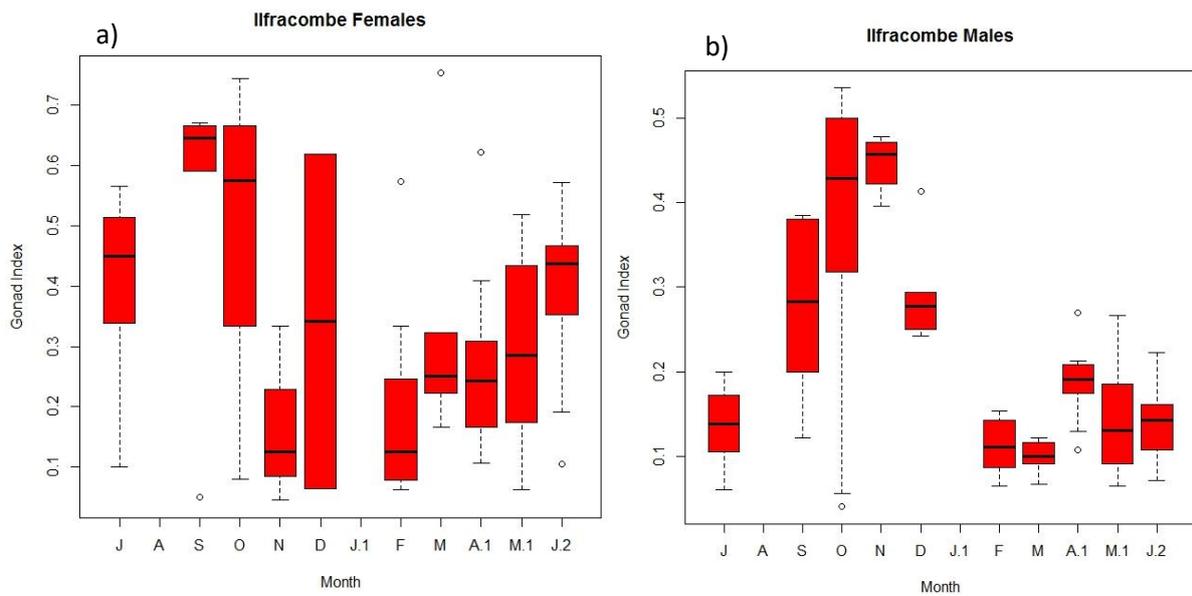


Figure 2 Distribution of gonad index for each sample month from Ilfracombe (except August when the fisher did not fish and January due to poor fishing weather), starting in July, for a) females and b) males.

3. Objectives

Primary aim:

- 1) To identify the spawning season of whelks in the D&S IFCA's District
 - a) Acquire adequate size and sex stratified samples from Ilfracombe and Exmouth.
 - b) Process whelk samples and compile maturity data and biometrics into a database.
 - c) Analyse data to identify when spawning occurs for both males and females.

4. Methodology

Samples were collected in December 2017 and January 2018 from both Ilfracombe and Exmouth.

The methodology for analysis of maturity status is the same as that described in “Determination of the Size of Maturity of the Whelk *Buccinum undatum* within the Devon & Severn IFCA District” (Stephenson, 2015). Using the biometric data collected from the mature whelks only, gonad size indices (gonad weight standardised to digestive whorl weight) were calculated and combined with the data from the previous study, before being plotted for each month. Separate plots were created for each sex and each site. These plots show how the gonad size increases as it matures and when the size declines after copulation/spawning.

5. Results

The indices of gonad size (gonad weight standardised to digestive whorl weight) from this study and Stephenson (2015) were combined and plotted by month, for each sex at both sites (Figures 3 - 6). These plots show how the gonad size increases as it matures and when the size declines after copulation/ spawning.

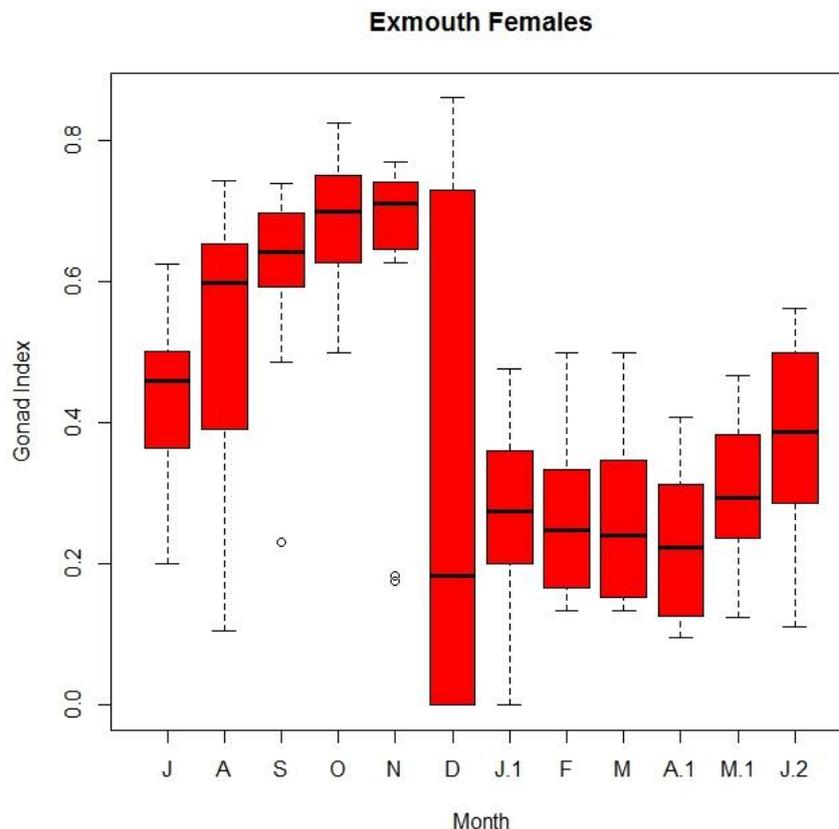


Figure 3 Box and whisker plot showing distribution of gonad index for each sample month, starting from July, for female whelks in Exmouth.

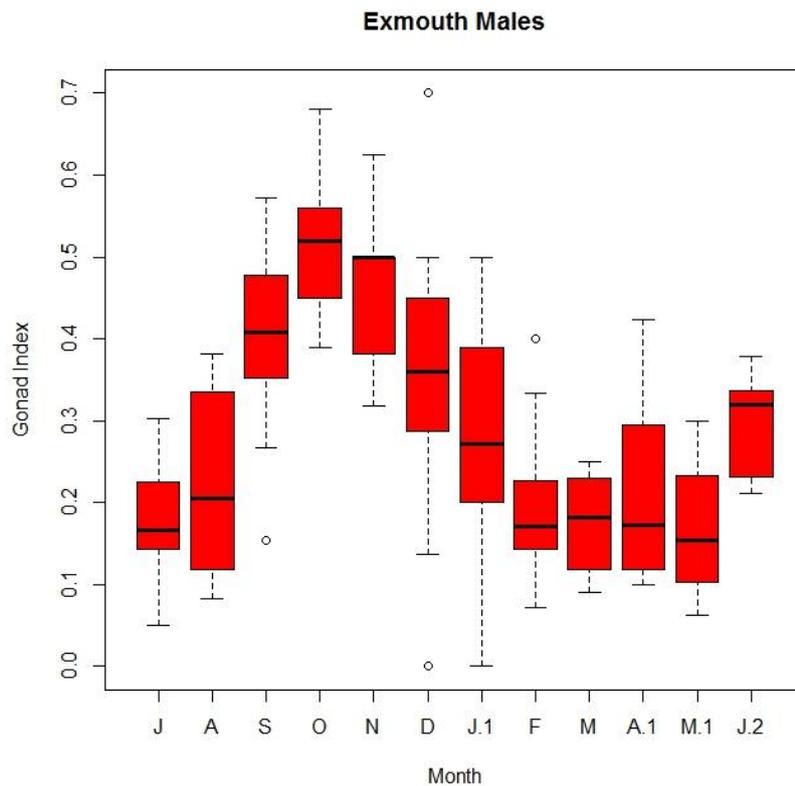


Figure 4 Box and whisker plot showing distribution of gonad index for each sample month, starting from July, for male whelks in Exmouth.

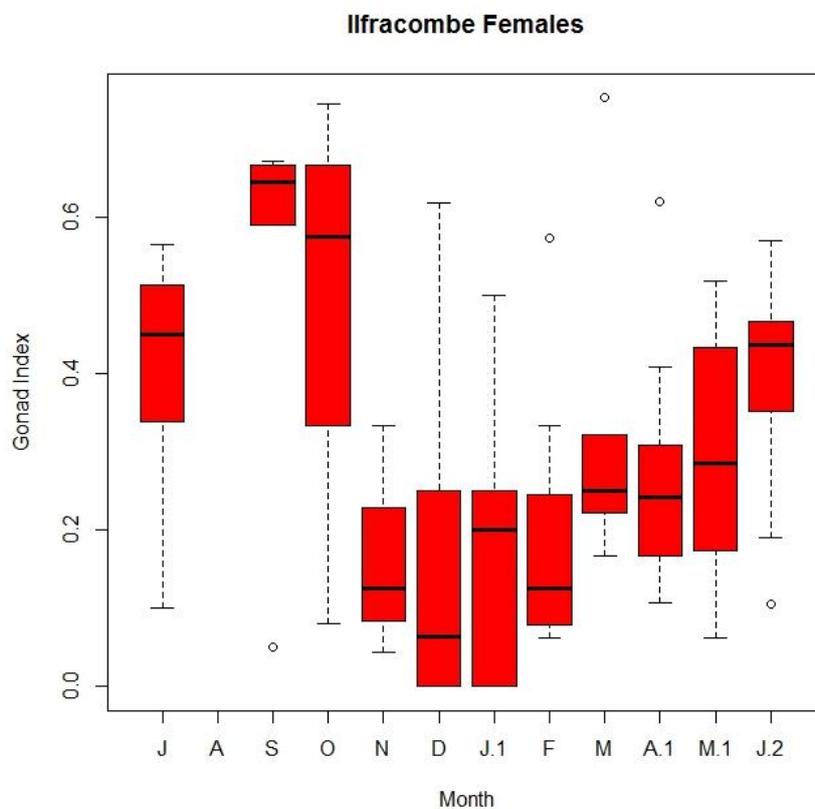


Figure 5 Box and whisker plot showing distribution of gonad index for each sample month, starting from July, for female whelks in Ilfracombe. (No sample was collected in August as the fisherman did not fish that month)

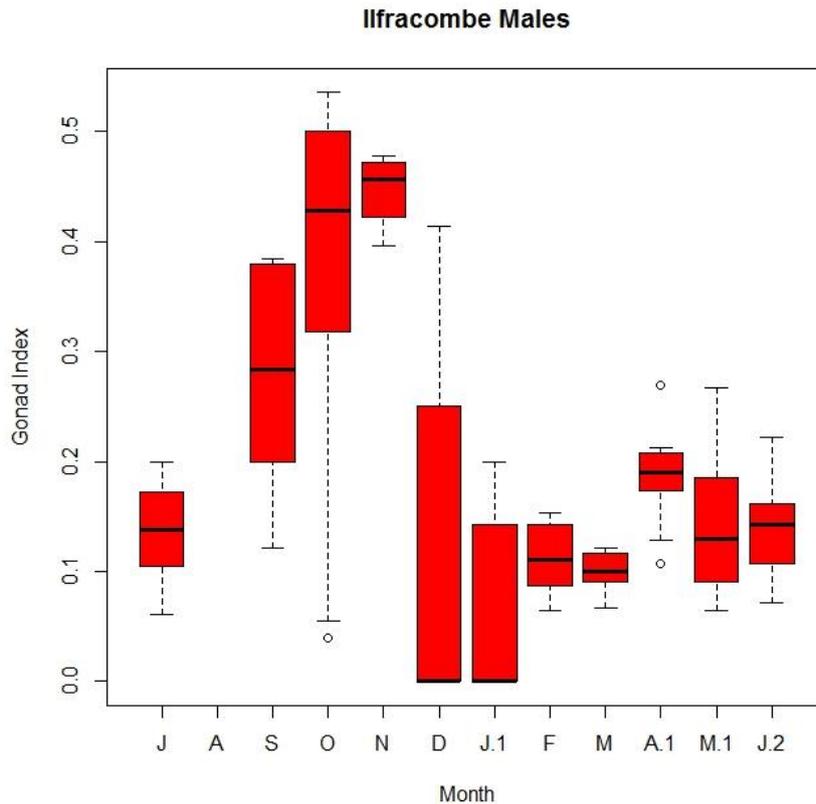


Figure 6 Box and whisker plot showing distribution of gonad index for each sample month, starting from July, for male whelks in Ilfracombe. (No sample was collected in August as the fisherman did not fish that month)

6. Discussion

The gonad index graphs show how the average gonad sizes of mature whelks change throughout the year. For the Exmouth females the gonad indices steadily increase from July to November, followed by a steep drop between November and December, before slowly starting to rise again. This indicates that the eggs are maturing until November, copulation takes place and then peak spawning activity taking place in December. The Exmouth males' gonad indices increase from July to October before steadily declining to the lowest value in February, then increasing again. This suggests that copulation is likely to begin in October/November and continues throughout December and declines in January.

For female whelks landed in Ilfracombe the gonad indices show a sharp decline between October and November, staying low until February, before starting to increase again. This indicates that spawning takes place between October and November. Ilfracombe males' gonad indices show a large increase from September to October and a slight increase in the median value between October and November (although the upper quartile show a decline). A sharp decline is seen in December, then starting to increase again in February. This pattern suggests that copulation starts in September/October and continues through November and declines throughout December. Females are able to store spermatozoa from the males to ensure the best conditions for spawning so there is often a slight difference in copulation and spawning times.

The findings of this study are in line with the general observed pattern of copulation/spawning: copulation, where the males pass sperm onto the females to fertilize their eggs, usually takes place between three weeks and two months before the females spawn and release the eggs (Kideys et al., 1993). Therefore, the gonad indices would be expected to show the male gonads maturing, and increasing in size, before those of the females. Then there should be a sudden decline in male gonad size after copulation, shortly followed by a decline in female gonad size, when spawning takes place. After copulation and spawning the gonads of both sexes will start to increase in size as they start to mature again.

The results from Ilfracombe are slightly less clear than those for Exmouth. This may be due to not having as many mature whelks within the samples. Another source of variation could arise from the fact that is often difficult to tell the difference between an immature whelk and a “spent” whelk, i.e. one that has recently copulated/spawned. Therefore, some whelks that are in fact mature may be wrongly classed as immature. Both of these sources of variation could potentially be reduced by having a larger sample size.

7. Conclusions & Management Implications

From the results of this study it can be deduced that at both sites mating and spawning take place during the winter. In Exmouth the peak breeding activity occurs during November and December, whilst in Ilfracombe it may start slightly earlier, in October/November.

A study of the Japanese whelk fishery identified mating as likely to occur around March, and egg-laying taking place between May and September. This led to a recommendation to set fishing periods to exclude times of copulation and egg-laying, which would enhance recruitment (Ilano et al., 2003).

A closed season to protect breeding whelks in the D&S IFCA's District, and enhance recruitment, might be considered as a viable management option. Any such closed season should cover at least November and December, to cover the peaks in breeding activity on both coasts of the District. However, a closed season running from October to January, the entire duration of breeding activity, might be the most effective.

However it is important to consider information about the fishery and its seasonality. Annex 1 shows the values and landings of the whelk fishery in the D&S IFCA's District. Figure 7 shows both the tonnage and value of whelk landings in Ilfracombe and Figure 8 Exmouth for 2016, 2017 and 2018. It is clear that in Ilfracombe the whelk fishery is very valuable over the winter months, and in 2017 the highest landings were in January. Therefore, a closure at this time of year may have a strong negative economic impact on the fishery. Exmouth seems to be less reliant on the whelk fishery over the winter months, especially during November and December. However, it is worth noting that these are not the only ports in D&S IFCA's District where whelk are landed, and each port may be affected differently by a seasonal closure. For example, Brixham has higher whelk landings than Exmouth or Ilfracombe and in 2016 the peak in landings was over the winter, whilst in 2017 the peak landings were during the summer. The landings and values for 2016-2018 for Brixham and all Devon ports are shown in Annex 1 Figures 9 and 10. It should be noted that the y axis scale (landings and value) are different in these graphs compared to Figures 7 and 8, due to the higher landings and values recorded. Some vessels landing into Brixham and hence other Devon ports may

be fishing for whelks outside the D&S IFCA's District, but the landings and their value are shown to be significant, particularly for the first eight months of the year. Therefore the social and economic impacts of further management of the whelk fishery, particular with reference to a closed season, will need to be considered alongside the need to protect the stock and allow for the sustainability of the fishery.

8. Acknowledgement

This survey has been made possible only with the help and co-operation of the whelk fishers involved. Thanks to the skippers and their crews for the collection of the whelk samples.

9. References

Ilano, A.S., Fujinaga, K., Nakao, S. (2003) Reproductive cycle and size at sexual maturity of the commercial whelk *Buccinum isaotakii* in Funaka Bay, Hokkaido, Japan. *Journal of the Marine Biological Association of the UK*. 83, 1287-1294.

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MMO (2012) Evaluating the distribution, trends and value of inshore and offshore fisheries in England (MMO 1011)

Stephenson (2015) Determination of the Size of Maturity of the Whelk *Buccinum undatum* within the Devon & Severn IFCA District. IFCA research report KS012015.

Annex 1 Whelk Landings and Values

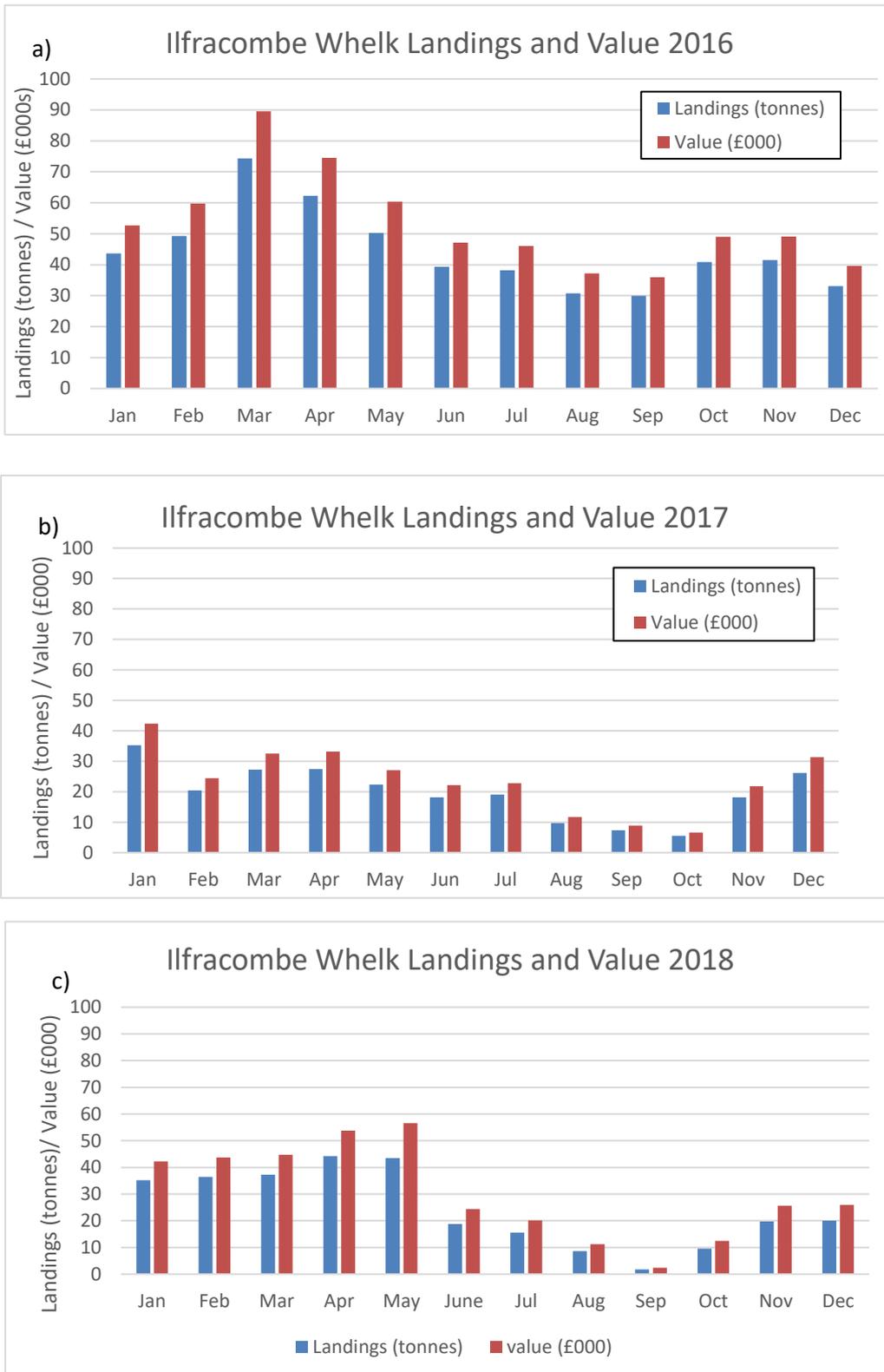


Figure 7 Value and tonnage of whelk landings in a) Ilfracombe 2016, b) Ilfracombe 2017, c) Ilfracombe 2018

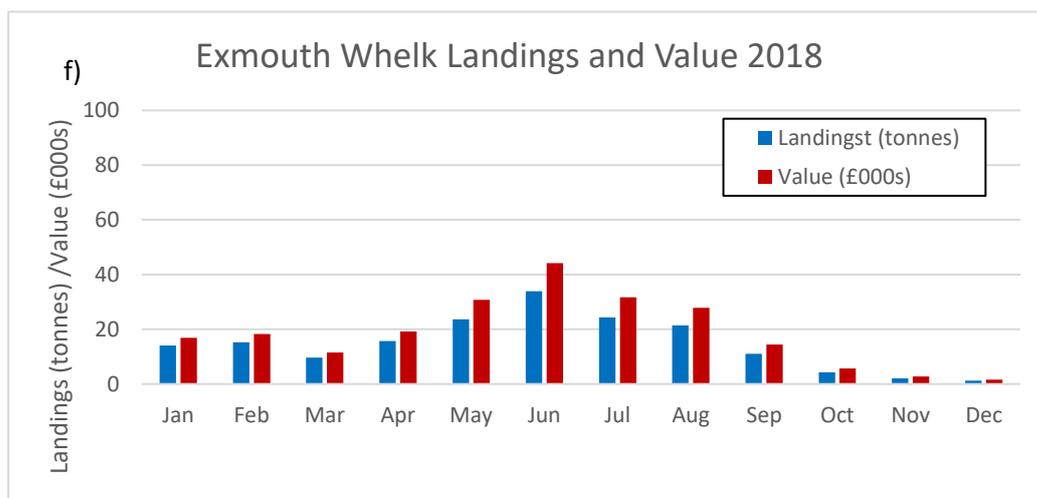
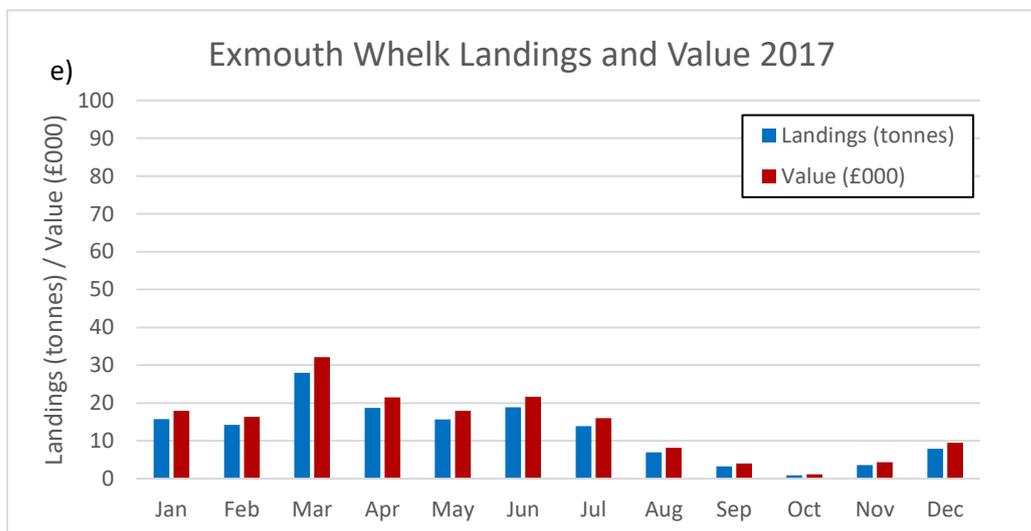
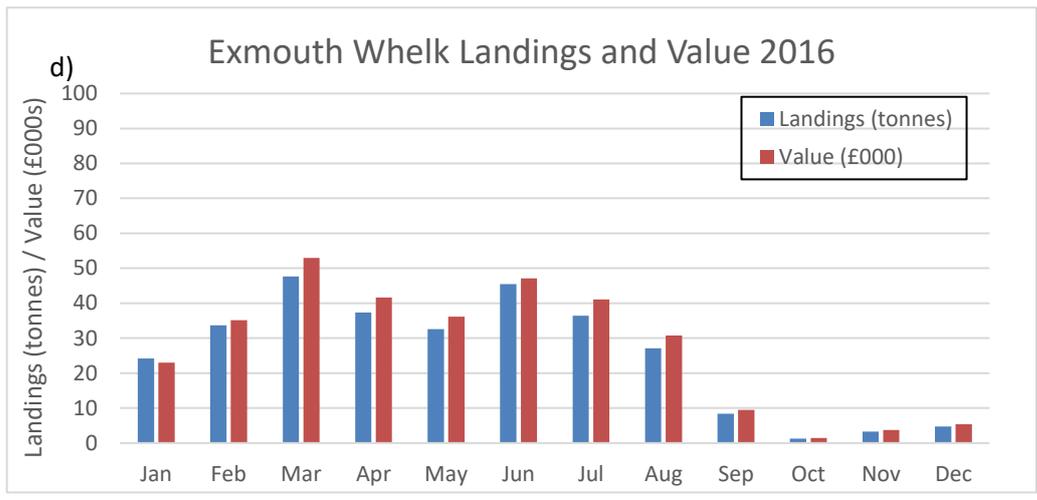


Figure 8 Value and tonnage of whelk landings in d) Exmouth 2016, e) Exmouth 2017, f) Exmouth 2018

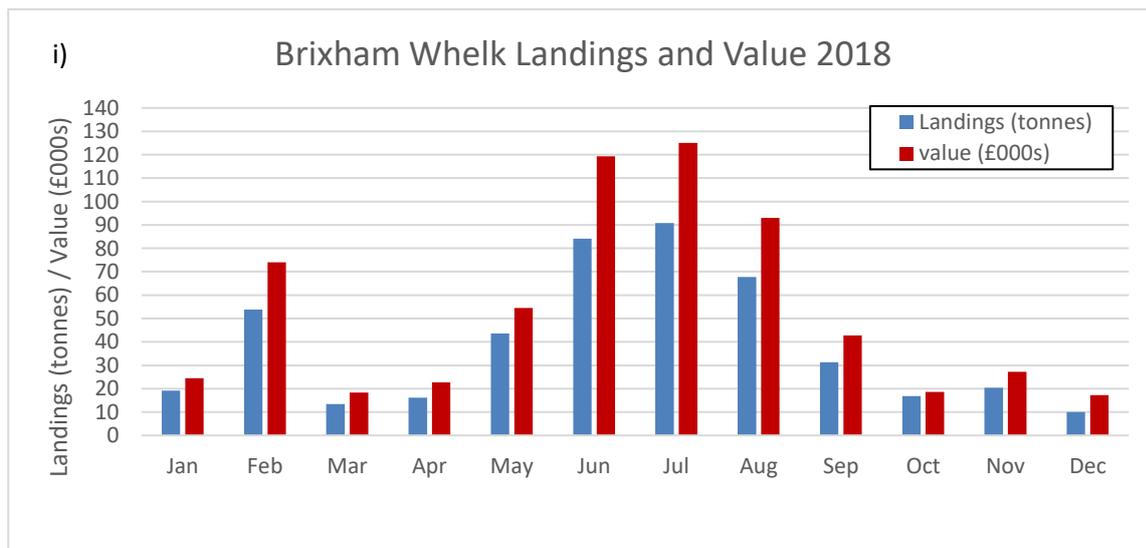
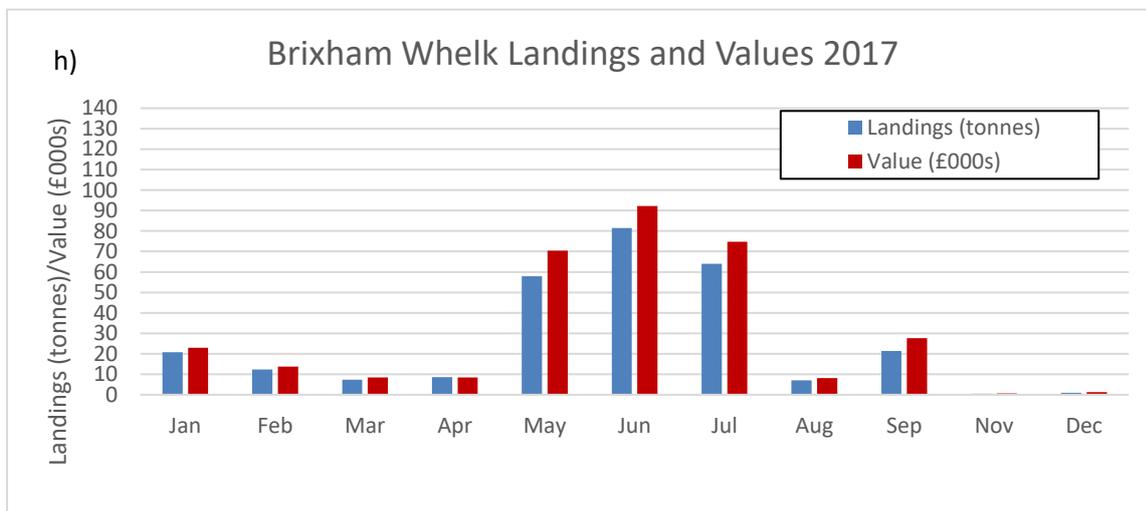
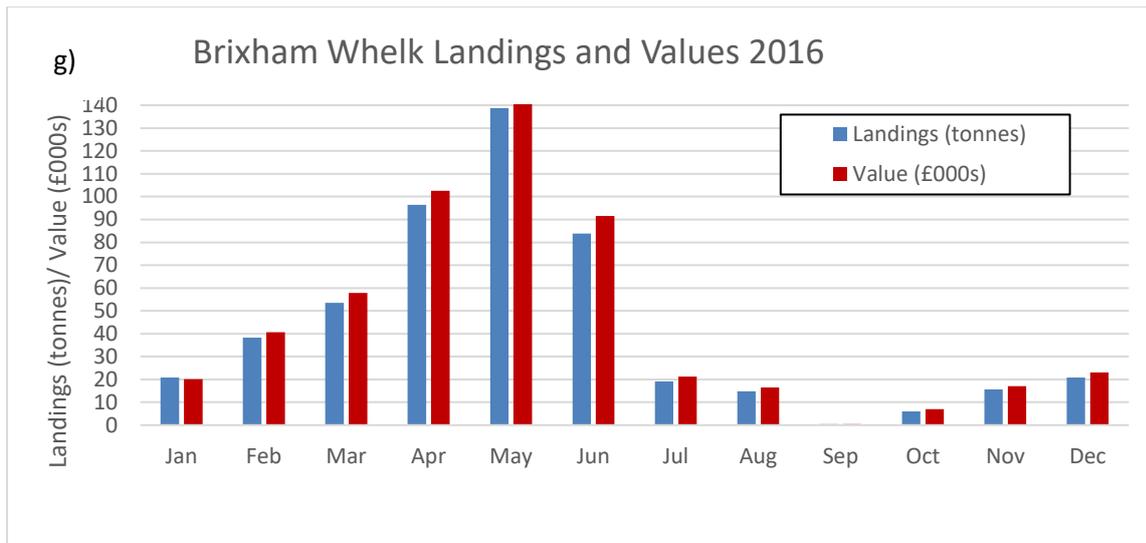


Figure 9 Value and tonnage of whelk landings in g) Brixham 2016, h) Brixham 2017, i) Brixham 2018

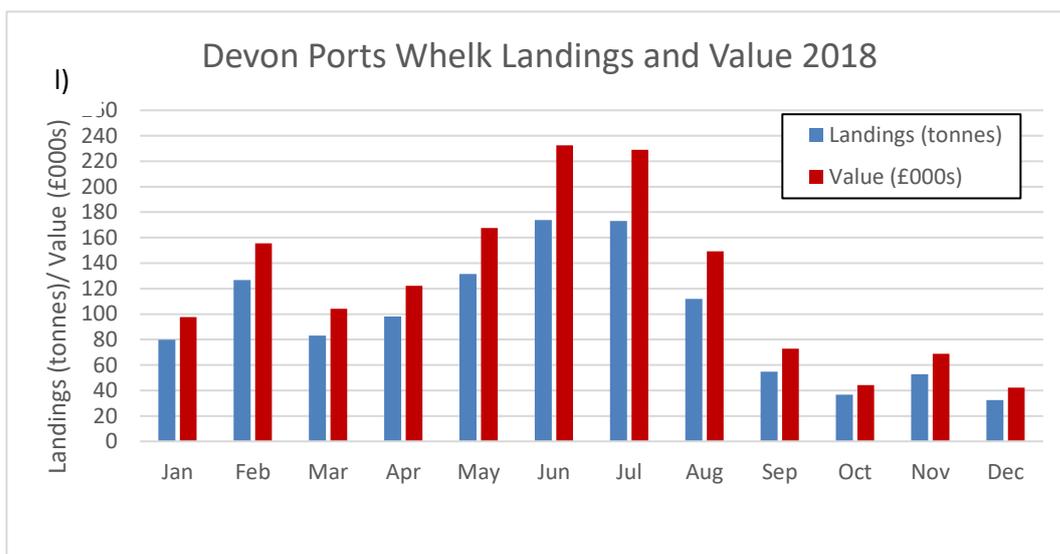
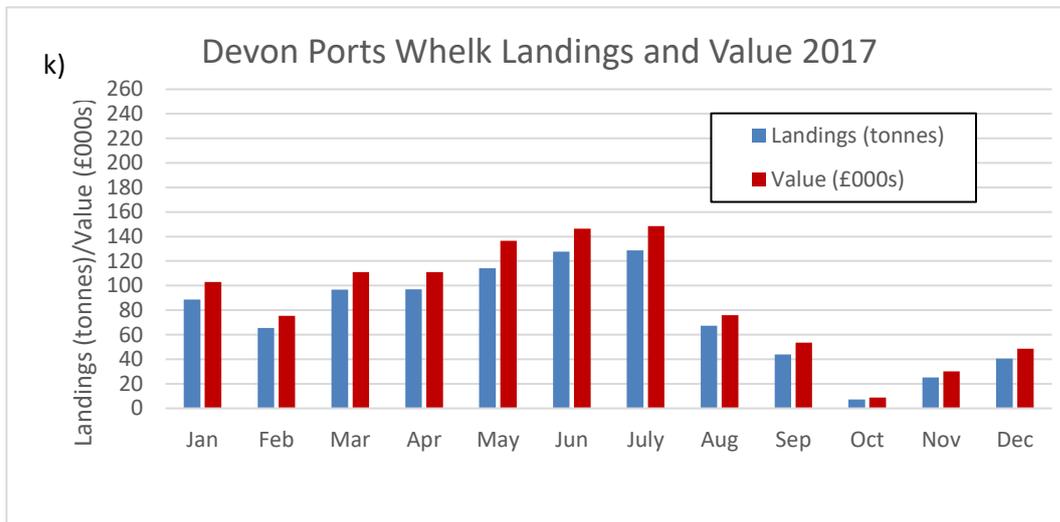
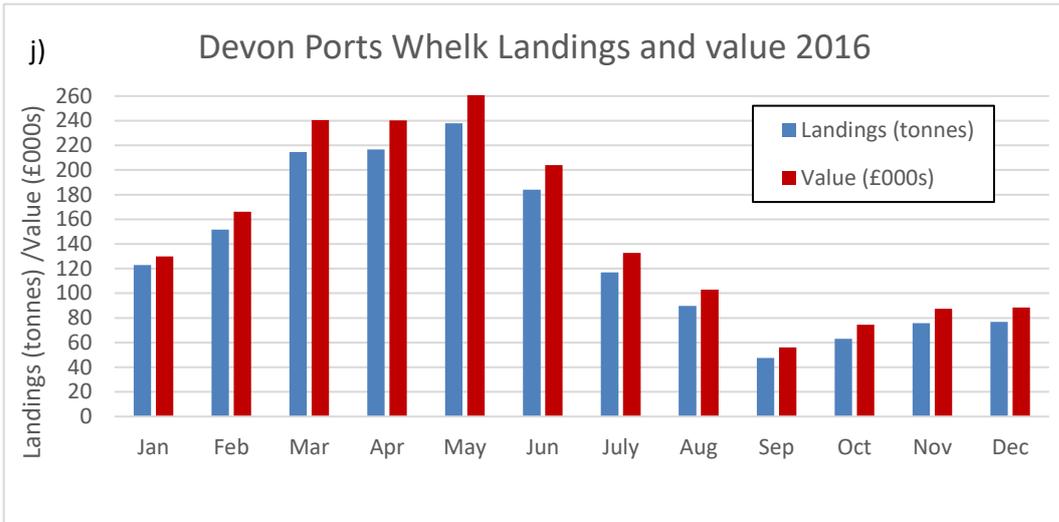


Figure 10 Value and tonnage of whelk landings in j) Devon 2016, k) Devon 2017, l) Devon 2018