NAFC Marine Centre

Lobster Stock Conservation - V-Notching

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Introduction

Lobsters have been fished in Shetland for many years, with the fishery at its peak in the late 1950's and early 1960's (Figure 1). At that time there was a scarcity of whitefish and new lobster grounds were discovered around Foula. The levels of landings seen during this time were not maintained however, and catches have been in decline since then (Figure 1).

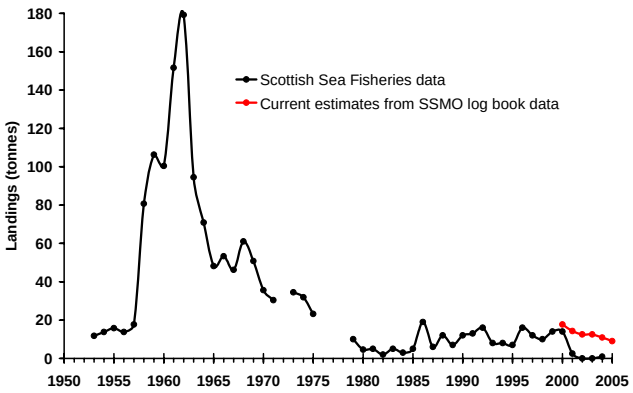

Figure 1: Trends in lobster landings in Shetland; as SSMO landings are reported in numbers the estimates from logbook data are based on a mean weight of 0.8kg per lobster.

Lobster v-notching has been carried out in many countries as a method of stock conservation. The aim of v-notching programmes is to remove breeding females from the fishery, thereby increasing the potential fecundity of the population, with associated benefits to recruitment. Tully (2001) states that for small scale fisheries with high exploitation levels substantial increases in the reproductive potential of the population can be achieved through v-notching programmes.

The reproductive potential of v-notched lobsters is defined as the maximum number of eggs carried by the v-notched females. The frequency of spawning and the number of eggs a female lays varies with her size and the moulting cycle, so these factors are taken into consideration in egg estimates. Only a small proportion of the eggs produced will recruit as adults to the fished population, and so estimates of egg production are termed reproductive *potential*.

Scotland

Scottish legislation for v-notching was introduced in November 1999 under the Sea Fish (Conservation) Act 1967, Statutory Instrument: The Lobsters and Crawfish (Prohibition of fishing and Landing) (Scotland) Order 1999 (Scottish Statutory Instrument No.88), and the first conservation scheme began in June 2000 in the Western Isles where funding secured a substantial v-notching programme.

Figure 2: V-notching a lobster tail fan.

Shetland

A lobster conservation programme was set up in 2001 in Shetland, with funding from the Shetland Islands Council and the Shetland Fishermen's Association. Following this in 2005/06, funding from Shetland Shellfish Management Organisation (SSMO), the NAFC Marine Centre, and Shetland Enterprise has enabled a second v-notching scheme to run. Growth studies have indicated that the 10 mm v-notch may take 4 years to disappear, and so the timing of this new programme was significant.

Lobster Stock Conservation – V-Notching

Whilst lobster landings continue to decrease, it is hoped that v-notching will play some role in conserving the stocks. Benefits of v-notching can only be expected to be evident some 4-5 years or even 6-7 years later, as it may take this long for offspring to develop and grow to a size that is seen in the creel fishery.

Methods

Female lobsters were v-notched on the first uropod to the right of the telson (Figure 2). A stainless steel notching device, normally used for livestock marking was used. The process of v-notching does not unduly harm the lobsters; however, the telson at the centre of the lobsters' tail should be avoided when v-notching, as this contains the gut ending and can cause damage to the digestive tract of the lobster.

The reproductive potential of the v-notched females can be calculated in terms of annual egg production. For this work the methodology of Tully (2001) was used to calculate the annual egg production using data on lobster length, spawning frequency (Aiken & Waddy, 1982), the percentage of mature females in each size class, and the number of individuals v-notched in the programme.

In the absence of maturity data for Shetland lobsters, the proportion of mature females was estimated by pooling the data on berried females from 2001 and 2005/06 and calculating the proportion of berried females within each size class. This data was then used along with the spawning frequency to estimate the proportion of mature individuals.

Results

In 2001, from July till November 32 fishermen participated in the scheme and a total of 1200 female lobsters were v-notched. These lobsters ranged in size from 85mm to 166mm, with a mean length of 111.9mm, (Figure 3). The range of weights recorded was from 0.388 to 2.541kg and the mean weight of lobsters that were v-notched in this scheme was 0.956kg, the size weight relationship can be seen in Figure 5. Just under half of these lobsters (44.9%) were berried at the time of v-notching.

A total of 13 fishermen participated in the 2005/06 programme, from October till January, and through v-notching broodstock from a juvenile reseeding programme in the late summer and autumn; a total 365 lobsters were v-notched. These lobsters were in the range 82 to 163mm carapace length with an average length of 111.4mm (Figure 4), and from 0.455 to 2.599kg in weight. The total weight of lobsters was 344.75kg, giving an average weight of 0.945kg per female lobster, with 43.6% berried. Of the lobsters sampled individual length weight data was available for 360 females (Figure 6).

It can be seen from the length frequency of individuals measured (Figures 3 & 4) that distribution of non-berried females was skewed to the smaller sizes while the distribution of berried individuals followed a more normal distribution. This was particularly the case in 2001, where the sample sizes were greater.

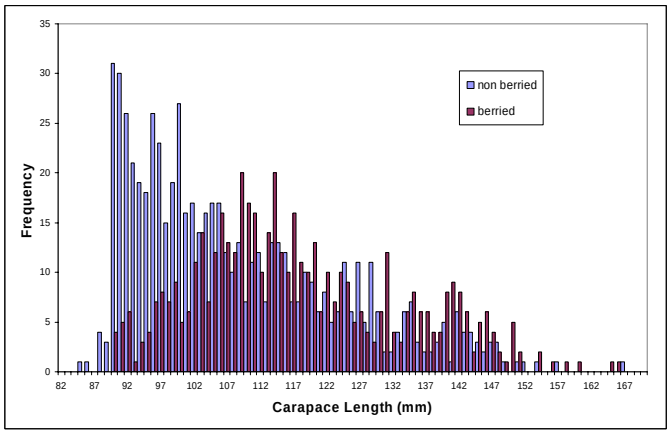

Figure 3: Length frequency of berried and non berried lobsters v-notched during the 2001 programme.

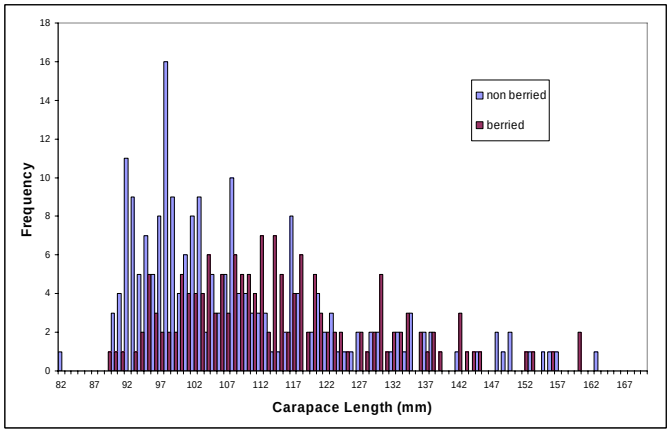

Figure 4: Length frequency of berried and non-berried lobsters v-notched during the 2005/06 programme.

There was a strong relationship between length and weight in both years (Figures 5 & 6). It can be seen that that there is a good fit with the R^2 values close to 1 in both years. Where greater scattering of points occurs below the trend line this is influenced by lobsters with missing appendages. A missing claw will result in a lower than expected weight with respect to length.

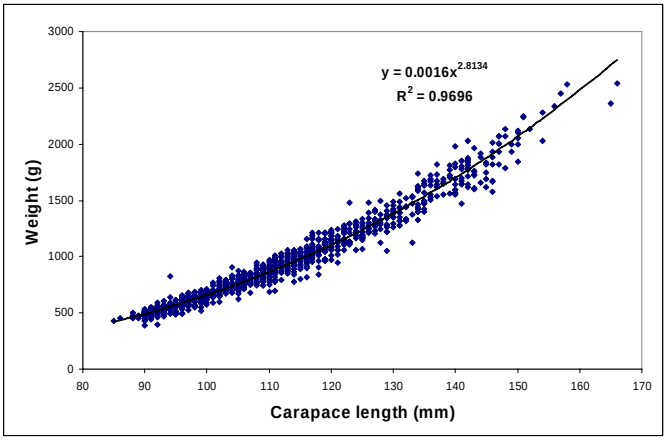

Figure 5: Length-weight relationship from female v-notched lobsters in 2001.

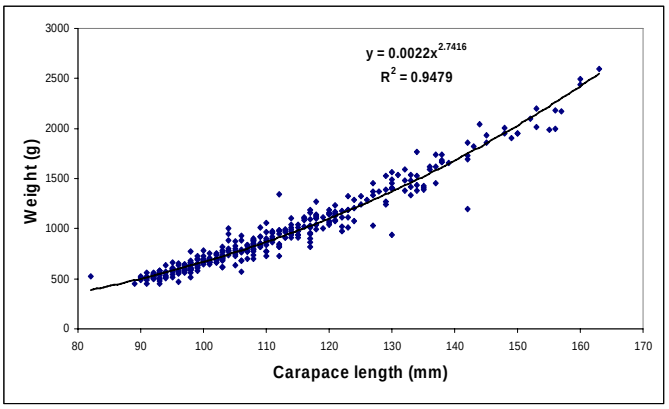

Figure 6: Length-weight relationship from female v-notched lobsters in 2005/06.

Information from SSMO logbook data since the 2001 v-notching programme shows that a relatively low proportion of v-notched lobsters have been re-caught (Figure 7) ranging from 3 to 7% of the total 1200 that were v-notched. There has been an overall decline in the numbers of v-notched lobsters reported from a high of over 7% in 2002.

It can also be seen that there is an apparent reduction in the numbers of juvenile lobsters caught in creels in the period since the first female lobsters were v-notched. Over 5000 were recorded in 2001, however, this has fallen to less than 2000 in 2005.

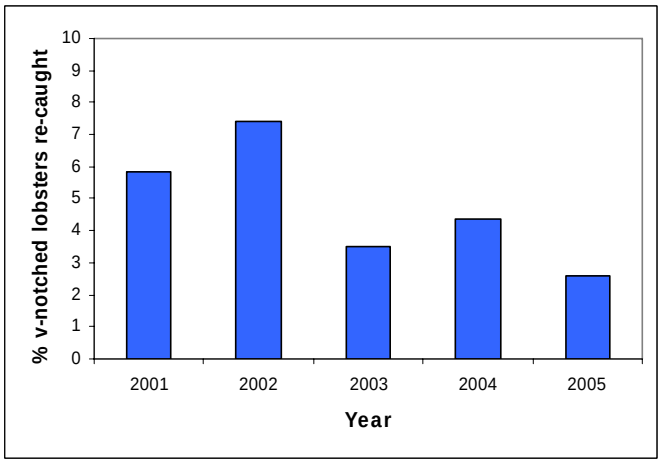

Figure 7: The percentage of v-notched lobsters re-caught each year, from SSMO log book data.

A calculation of the fecundity of females indicated that the total fecundity of the lobsters v-notched during the 2001 programme would be in the region of 9,206,615 eggs per year. The estimated total fecundity for those lobsters v-notched in the 2005/06 scheme was 2,788,884 eggs per year.

Discussion

A total of 1565 lobsters were v-notched in two separate programmes in 2001 and 2005/06. The lower numbers v-notched during the 2005/06 season could be attributed to the programme being carried out around Christmas when the fishermen obtain the highest prices for their catch, and it is therefore possible that more lobsters were landed than submitted to the scheme due to market forces and elevated seasonal prices.

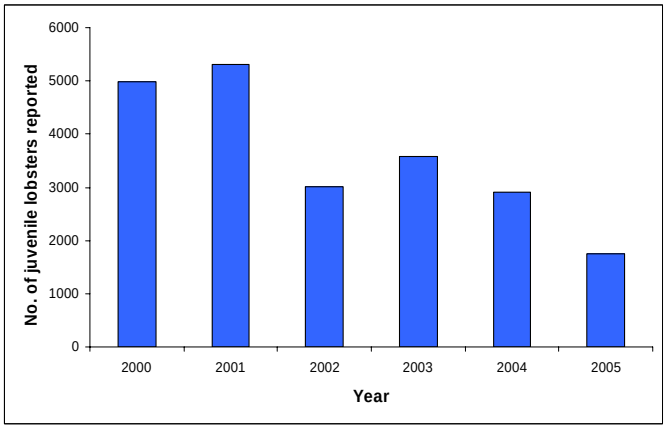

Figure 8: The numbers of juvenile lobsters being caught each year and recorded in SSMO logbooks.

The size distribution and length frequencies of berried and non-berried lobsters were similar between years (Figures 3 & 4). There were differences in length frequencies of berried and non-berried females, with more non-berried females recorded in the smaller carapace lengths.

Berried females were recorded throughout the size range; however, the skewed-ness of the non-berried females could suggest that a lower proportion of smaller females are reproductively active. This fits with the model of spawning frequency used for Irish populations by Tully (2001) from data collected for populations of the American lobster (Aiken & Waddy, 1982), where spawning is generally biennial but for lobsters >120mm spawning would occur in 3 out of every 5 years. Thereby a greater proportion of larger females would be carrying eggs.

The length weight relationships displayed in each programme were very similar (Figures 5 & 6). They are characteristic of the growth of crustaceans, and in both cases the data show a good fit with R^2 values close to 1.

The low percentage of re-caught v-notched lobsters (Figure 7) is most likely due to the relatively small proportion of the population which was v-notched during the 2001 programme. It is also probable that a percentage of lobsters were re-caught and not reported through the logbook system. It may also be the case that in 2004 and 2005 the v-notch marks are becoming more difficult to determine following several moults.

The perception of local fishermen has been that there were increasing numbers of juveniles in recent years; however, the SSMO log book data does not back this up (Figure 8). This could be due to under reporting of caught juveniles in the logbooks. In addition to this, there are many factors which could affect the numbers of juveniles appearing in creels, some of which include prey availability, changes in climate, and the presence of predators. V-notching of lobsters has been shown to be successful as a conservation method in other fisheries

and so there is every reason to believe that this will also be the case in Shetland.

There are difficulties associated with determining the success of v-notching programmes. Although local increases in the reproductive potential of the population can be assessed through estimations of egg production, the link between reproductive potential and recruitment is more difficult to determine. From estimates of total annual egg production, and assuming that the v-notch is present for 4 years, the females marked in 2001 could potentially produce around 36,826,460 eggs, before the v-notch was lost. The females v-notched in 2005/06 could be expected to produce around 11,155,536 eggs. These estimates do not take into account any growth or mortality resulting in changes in the reproductive potential over time. Only a small proportion of these eggs will result in individuals that will be recruited to the fishery, however, the benefits in terms of egg production are clear. It is hoped that future logbook data will show the translation of this egg production into increased numbers of juveniles being recorded.

Alternative Stock Conservation Methods

It has been shown for some fished lobster populations that a multidimensional approach to lobster stock management can provide a more robust approach to lobster conservation). Such an approach is being applied in Shetland, through an increased minimum landing size and lobster restocking programmes, in addition to the work described in this note.

Future conservation programmes for the European lobster around Shetland which may be worth investigating are: the inclusion of large males in v-notching programmes and the introduction of a local maximum landing size for lobsters. Both of which could provide benefits in terms of the reproductive success of the population by protecting the most reproductively active and fecund individuals from the fishery. It has been shown that larger females produce larger eggs and larvae, which settle out onto the seabed at a larger size, potentially increasing their chances of survival. Should these larger females be allowed to remain in the breeding population, there may be a greater success in increasing recruitment. Only the largest and most dominant males mate with females. These large males are therefore very important to the reproductive output of the population. They are more capable of producing enough sperm to allow a large female to fertilize her brood of eggs and there are likely to be genetic benefits if only the largest and most successful individuals are reproducing.

The potential impact of a maximum landing size (M_{ax}LS) on the catches of lobsters is shown in Table 1. It can be seen that a M_{ax}LS of 140mm would result in around a 6% reduction in the annual lobster landings, while M_{ax}LS of 145mm and 150mm would result in catch decreases of around 4% and 2% respectively. The removal of these individuals would have a lesser percentage impact in terms of the value of landings, as individuals in these size ranges are less valuable than smaller "select" lobsters. It can be seen that the introduction of a M_{ax}LS of 145mm would result in increases in egg production similar to those gained in the 2005/06 v-notching programme. This does not take into account the benefits of retaining the largest males within the population, as their contribution to potential fecundity is much more difficult to assess.

Table 1: The potential reduction in catches for different minimum landing sizes – based on landings and length frequency data from 2005. Data on the egg production of females removed from the fishery by each M_{ax}LS are also shown.

Maximum landing size	140mm	145mm	150mm
Reduction in catch - Females	5.83%	3.68%	1.54%
Potential egg production	4,631,118	3,129,540	1,454,712
Reduction in catch - Males	6.44%	4.30%	2.51%
Overall reduction in catch	6.21%	3.94%	1.98%

The potential for increased effort on legal sized lobsters through the introduction of a M_{ax}LS has been noted, however, given the small percentage reduction in overall catch and the potential benefits in terms of egg production (Table 1) it is not considered that this would be a major issue in the Shetland fishery. Any changes in effort through the introduction of a M_{ax}LS would be recorded in the annual stock assessments and could be evaluated in terms of the overall stocks.

Acknowledgements

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References

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Tully, O. (2001). Impact of v-notch technical conservation measure on reproductive potential in a lobster (*Homarus gammarus* L.) fishery in Ireland. *Mar. Freshwater Res.* 52: 1551 – 1557.

A full copy of this report is available from the NAFC Marine Centre Library.

â€¢ Appropriation: live traders harvested larger lobsters, resource stocks further depleted by taking of small lobsters (for consumption and trade) â€¢ Markets: Live transport expanded market, canners were crowded out, catch totals reduced but prices remained high, lucrative trade in small lobsters â€¢ Complex Regulation: Some seasonal restrictions, live traders lobbied for rules against taking small lobsters, but most ignored these regulations, leadership of State Commissioner.Â Informal territorial system FCMA and complex regulations Pro-conservation norms. Appropriation and use National markets Formal regulations Informal rules and norms.Â The Evolution of the Maine Lobster V-Notch Practice: Cooperation in a Prisonerâ€™s Dilemma Game. Ecology and Society 16(1). V-Notch Conservation Program. by Capt. Warren "Ted" E. Colburn.Â notched lobsters for every one legal, harvestable lobster. An important indicator that the program is suc-ceeding is that many of the notched lobsters (40-45%) are producing eggs, as observed when recaptured females are returned to the sea. A. Captain Warren "Ted" E. Colburn, PE, is chairman of the Ocean Technology Foundation based at the UConn Avery Point campus in Groton, Connecticut. Ted has been actively involved in implementing the lobster v-notch. portion of these eggs will become. conservation program in Rhode. legal-sized lobsters in about five. Island since its inception. Indigenous lobster traps hauled from Nova Scotia waters over weekend days after Sipekne'katik First Nation launch their own self-regulated fishery. Non-Indigenous fisherman are calling for federal government intervention. Alexa MacLean reports.Â Those numbers show that sustainability of the lobster stocks are not threatened, she added. â€œThere are a thousand commercial fishing boats fishing 350 traps everyday, more or less, between November and May,â€ she said. The lobster fishery of the Sipekneâ€™katik First Nation, with seven licenses to fish from 350 traps, â€œis about the equivalent then, of one of those commercial boats.â€