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**LOBSTER (*HOMARUS GAMMARUS*) CATCHES IN SOUTHWESTERN NORWAY,
INCLUDING THE FIRST RECAPTURES OF PREVIOUSLY RELEASED JUVENILES**

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ABSTRACT

Since 1990, 20-30 000 tagged lobster juveniles have been released each year at Kvitsøy, south west Norway, by the Institute of Marine Research. In 1992 the first 19, legally sized lobsters, of these releases were caught. All were males. Tag analysis showed that they originated from a batch hatched in the summer of 1988 and released in the spring of 1990. Of the 241 undersized lobsters tested in the tag detector in 1992, 95 carried a tag, and 37 more had a pair of cutter chela - as all the lobsters released in 1990 - indicating that more than 50% of the undersized lobsters in the catch were of hatchery origin. Before returned to sea all undersized lobsters were given individual external codes for later recognition.

The lobster fishery at Kvitsøy has been monitored since 1991. Of the 1071 lobsters registered by local fishermen at Kvitsøy in 1991, 926 were legally sized (over 220 mm TL). In 1992 the minimum legal size was increased from 220 mm to 240 mm TL. In the spring 1992, 539 lobsters were registered, 486 of which were legally sized. In 1991, nearly 35% of the legally sized lobsters were classified as cultured juveniles originating from releases in 1985-86. In the spring 1992 about 25% were classified as released lobsters, while only 19% were characterised as released lobsters in the autumn 1992. Sex distribution was approximately equal in the autumn catches, and slightly female biased in the spring.

Introduction

Since 1990, large scale releases of tagged lobster juveniles have been executed yearly at Kvitsøy by the Institute of Marine Research as part of a governmental programme for development of sea ranching (van der Meer et al. 1990). As in the rest of Norway, a sharp decline in the lobster catches has been registered since the 1950's also in the release area (Tveite 1991). In 1985-86, untagged lobster juveniles were released by a commercial company, and later recognized by morphological traits (Tveite 1990). The recaptures were not registered systematically and did not need for the evaluation of the economic outcome of these releases. Since autumn 1991, the Institute of Marine Research in cooperation with local fishermen at Kvitsøy, started systematical registration of the lobster catches. Since 1992, a tag detector is placed at the local lobster landing post for routine checking of all lobsters delivered to the site.

This report contains the first recapture results, from both the ordinary fishery, and a scientific fishery on undersized, tagged lobsters. It also discusses central issues that must be solved before sea ranching of lobster can be recommended for development as a trade.

Materials and methods

Catch and temperature measurements

The owner of the local lobster landing post on Kvitsøy (Figure 1), Kjell Meling, has kept a record of the weight of all delivered, legally sized lobsters. He also measures the temperature at 1 m. depth outside the landing post, twice a week year-round.

The local fishermen started to keep a diary for the daily catch from the season opening of 1. October 1991. The diary contains the date of catch; place (with map location); number of lobsterpots; number of undersized lobsters; number of legally sized lobsters; sex; and indication of wild or hatchery origin based on morphological traits. In the spring 1992 (1. April to 31. June), some fishermen also measured carapace length (CL) and total length (TL) of all the lobsters caught on random days. The relationship between CL and TL is comparable to Bossy et al. (1992).

Tag research

All the lobsters released since 1990, have been tagged with an internal, magnetized microtag (Wickins, Beard & Jones 1986; van der Meer 1990). A tag detector was installed at the landing site in spring 1992. Six fishermen cooperated in an experimental fishery for undersized lobsters for tag control and population estimate research in the autumn 1992. The lobsters were caught in ordinary lobsterpots and kept in floating boxes or submerged in the fishing boat until the control days of 6., 19., 29. October, 5. November and 1. December. Coloured elastic bands on the chelae were used to distinguish lobsters caught on different locations. The legally sized lobsters were kept by the fishermen in the same way and delivered on the same dates.

All legally sized lobsters smaller than 120 mm CL were tested in the tag detector. Lobsters giving positive tag response were collected, measured, weighed and frozen for later analysis. Later on they were X-rayed to determine the tag position. When the tag was located, it was taken out and decoded.

At the landing post, the undersized lobsters were checked for tags, sexed, measured for carapace and telson length (CL., TL.), carapace width (CW) and tail width (TW)). All undersized lobsters were marked externally by branding an individual code on the tail

(Abrahamson 1965) before release back to the site of capture. At release magnetic tagged and untagged lobsters were mixed. Legal size has been raised from 220 mm TL (appr. 80 mm CL) in 1991 to 240 mm TL (appr. 83 mm CL) in 1992.

Results

Catch data

The diaries showed a large variation in individual fishing activity, from 217 to 1087 pothauls per fisherman per year. Of a total of 5680 pothauls, 827 were registered in 1991 and 1992, respectively. The catch data are presented in Table 1.

The total catch per unit effort (CPUE) was lower in 1992 than in 1991. In 1991 the individual catch per pot varied from 0.08 to 0.26 lobster. In 1992 the variation was between 0.08 to 0.4 lobster per pot. The sex ratio in autumn catches was 48.7% males and 51.3% females, and 49.6% males and 50.4% females in 1991 and 1992 respectively. In the spring the sex ratio was slightly female biased, with 56.5% being females. The proportion of lobsters classified as "released" was decreasing, from about 35% in 1991 to 25% in spring 1992 and only 19% in the autumn 1992. The size distribution of the legally sized lobsters, is shown in Figure 2. Lobsters between 90 and 100 mm CL dominated. Only 15.4% of the legally sized lobster were between 70 and 90

Figure 2. Size distribution of 208 legally sized lobsters, spring 1992.

Table 1. Lobster catches at Kvitsøy 1991-1992.

Year	Numbers undersized, tagged	Numbers undersized, untagged, 2 cutters	Numbers undersized, untagged 1 crusher	Numbers tagged, legal size	Legal size, total catch	Catch per pot average
1991	-	-	145	-	1071	0.16
1992	95	39	182	19	1500	0.11

Legally sized lobsters

In autumn 1992, 578 kg live lobsters were delivered to the local lobster landing post for sale. This was less than in 1991 (672 kg) and 1990 (629 kg), but within the normal variation known at this landing post. In addition, 172 kg and 866 kg were delivered in the spring/summer 1991 and 1992, respectively, as a result of an extraordinary fishery for lobster broodstock. In 1992, the first 19 tagged, legally sized lobsters appeared in the fishery. They ranged between 83 mm and 91 mm CL and were all males. The total weight (6.6 kg) of these lobsters was 1.1% of the total amount of landed lobsters. In addition, two larger lobsters, CL >100 mm, also gave positive response in the tag detector.

Undersized lobsters

During autumn 1992, a total of 241 undersized (42 - 83mm CL) lobsters (T) were registered at the landing post (Figure 3).

Tags were detected in 95 (39.4%) of these (M=CuCuM+CuCrM). Another 39 lobsters without tags (CuCuM-) had the characteristic double cutter chelae, often seen in reared

lobsters. These were probably released lobsters with tag failure. Among the M-lobsters, 31% had developed a crusher chela (CuCrM). If a similar amount of lobsters with tag failure also develop crusher chelae (CuCrM-), then the CuCu-lobsters made up only 70% of the released lobsters with tag failure. The estimated amount of released lobsters in the catches will then be $(M+CuCuM+CuCrM-)*100/T = (95+39+17)*100/241 = 62.6\%$.

Tag analysis

The X-ray check revealed that the 19 lobsters between 240 and 250 mm TL carried microtags in the right base of the fifth pereopod. The two lobsters >100 mm CL had metal fragments in the gut. When decoded, all the tags originated from the spring release in 1990.

Growth

The mean size of the most fast growing lobsters had increased from about 21 mm to 89 mm CL from the time of release in April 1990 to recapture in October 1992 (Figure 4). The mean size at recapture was 73 mm CL.

Temperature

Since 1990, the sea temperature has been relatively warm for long periods (Figure 5). Both summer and winter temperature has increased markedly, compared to 1986-87.

Discussion

Fishery results

The commercial catch was lower in 1992 than the year before, in spite of very good weather conditions during the fishery. This is natural because of the increased minimum legal size, which will temporarily reduce the number of animals available for sale. The extraordinary spring fishery in 1991 and 1992, to get broodstock for the sea ranching programme might also have a negative impact on the subsequent fishery season. The smaller minimum legal size (75-80 mm CL in 1991) is reflected also in the unproportionally low number of lobsters less than 90 mm CL caught in 1992. Still, the increased legal size cannot alone explain why 90 mm CL lobsters dominated the fishery. Most lobsters less than 90 mm CL were probably hatched between 1985 and 1987. These years were relatively cold and unfavourable for hatching and larval survival (Wahlé & Steneck 1991), and can be the cause for a weaker cohort. About 31 000 one year old lobster juveniles were in 1985 and 1986 released by a private enterprise, Timar, (Tveite & Grimsen 1990). The sudden increase in one year old lobsters these years, might have been unfavourable for the settlement of stage IV wild lobsters in the same regions. In shore crabs *Carcinus maenas*, older juveniles exterminate newly settled juveniles (Klein Breteler 1975). Still, the Kvitsøy catches in 1992 are better than the mean catches for Rogaland county on the whole (Tveite 1991).

The lobsters released in 1985-86, originated from british caught broodstock (Uglem, pers.comm.). These juveniles were not given the opportunity to develop a crusher chela, and many also showed a lighter colour morph than the Norwegian stock (Tveite & Grimsen 1990). The local fishermen claim that they easily recognize the released lobsters from the local ones by these morphological traits. In 1989, more than 50% of the lobsters caught, were characterized as "released" by the fishermen (Tveit & Grimsen 1989). The trends in our material from 1991 and 1992 shows a steady decrease in the catches of "released" lobsters, probably due to harvesting of the cohort. No "released" lobsters has ever been reported from adjacent areas outside Kvitsøy.

The sex distribution was fairly equal in the catches, but will be followed continuously to see if there are seasonal differences between the sexes.

We have started to work on methods to estimate the lobster population at Kvitsøy, both to be able to monitor the development of the whole population over time, and to be able to evaluate mortality of the released lobsters. We know that the release method means much for immediate survival (van der Meeren 1991). Habitat quality and hiding behaviour is also important for survival (Hudon 1987; Wahle 1992; Wahle & Steneck 1992). Research is made to evaluate if mortality is connected to time of the release, place of release, density of the released juveniles and repeated releases on the same sites.

At minimum legal size, a lobster weighs approximately 0.3 kg. Mean weight of legally sized lobsters is registered to 0.7 kg (Grimsen, pers.comm.). Between 150 kg and 1,000 kg lobsters are delivered to the landing post each year (Meling, pers.comm.). An unknown amount is fished for private consumption and unregistered, illegal sale. A conservative estimate is that 1,000-2,000 kg of lobsters are fished in the area each year. In experimental studies, up to 40 % of American lobsters have been shown to avoid pots (Karnofsky & Price 1989). A mark/recapture experiment in a natural population indicated that intensive fishing could take nearly 50 % of the local recruiting population within one year (Dannevig 1936). Still, with the decreased fishing activity the last 20 years, we should expect that a lower frequency of the population is fished each year. Still, if 20% got caught in 1992, the lobster population constitute of less than 10 tons. That means the whole populations might be no more than 10,000-20,000 lobsters with a mean weight of 0.7 kg. The population must be regarded as vulnerable and easily overfished.

Tag research

Based on known growth rates, no recaptures of legally sized, tagged lobsters were expected before 1993 (Bannister et al. 1990, Tveite 1990; van der Meeren et al. 1991). Nevertheless, 19 males, all of the cohort hatched in 1988, were found. The exceptionally warm winters and fairly warm summers might explain this rapid growth.

Among the undersized lobsters, an unexpectedly high proportion of released lobsters was found. Several explanations can be plausible:

- * The natural recruitment to these cohorts has been very weak.
- * The released lobsters are more prone to be caught.
- * The released lobsters repress the wild lobsters.

As discussed earlier, there might have been a recruitment failure to these cohorts in 1985-87. If so, the release has been important as enhancement and stabilizer to the population.

However, if one or both of the two latter explanations are found to be true, serious considerations must be made. For sea ranching purposes, a pot prone lobster is a plus. Still, this would mean that the released and wild lobsters differ in behaviour. If so, the behavioural differences should be tested to be sure that the released lobsters are not less viable than the wild ones.

Research will be started in 1993 to find out if released lobsters repress the wild lobsters. In the same region, the development of comparable populations without released lobsters will be surveyed.

During the next five years the Institute of Marine Research expects to gain enough knowledge about population dynamics and the effects of lobster releases, to be able to evaluate whether sea ranching of lobster juveniles can become a profitable activity and a tool for sound fishery management.

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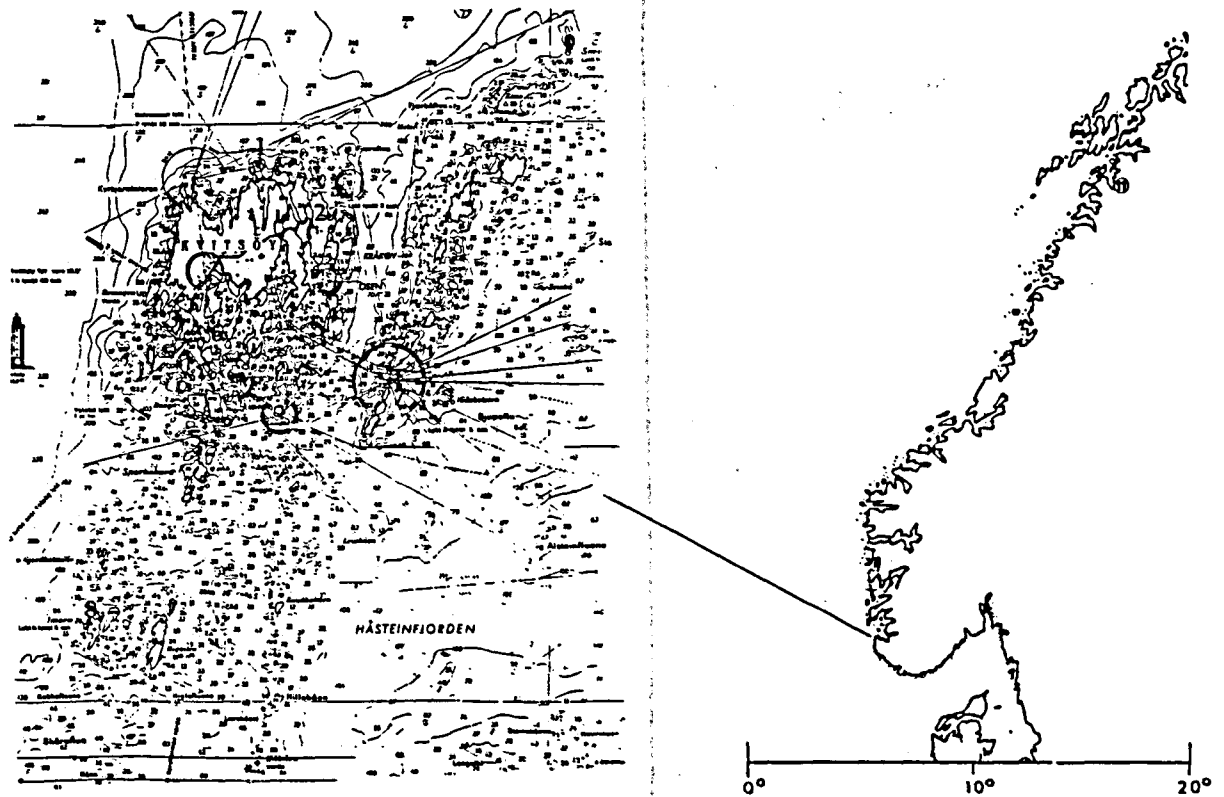


Figure 1. Map showing the location of the release area, Kvitsøy.

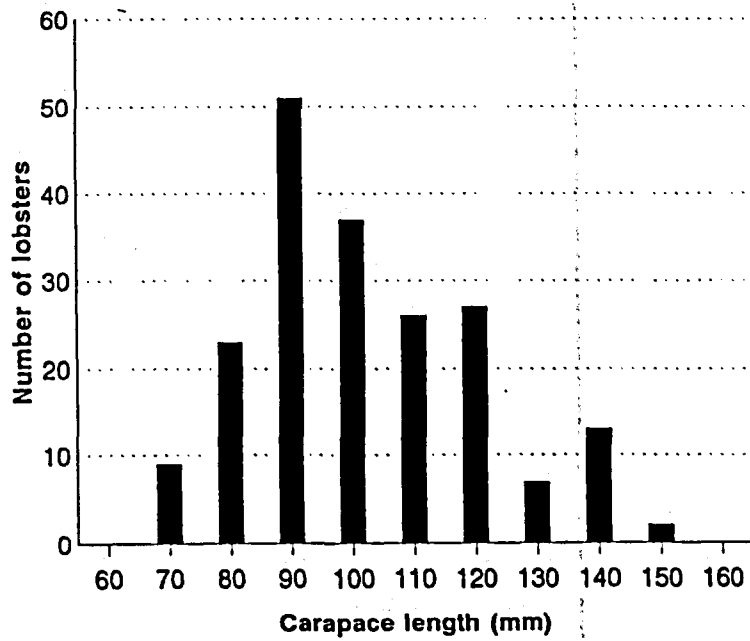


Figure 2. Size distribution of 208 legally sized lobsters, spring 1992.

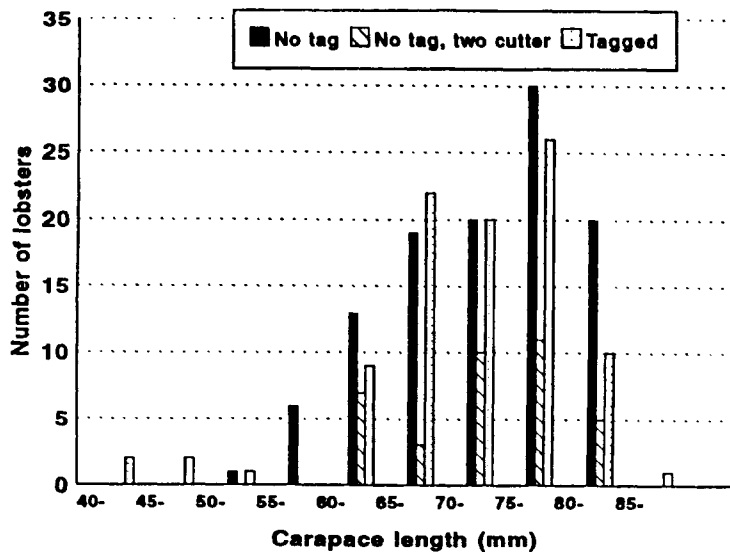


Figure 3. Size distribution of undersized lobsters, 1992.

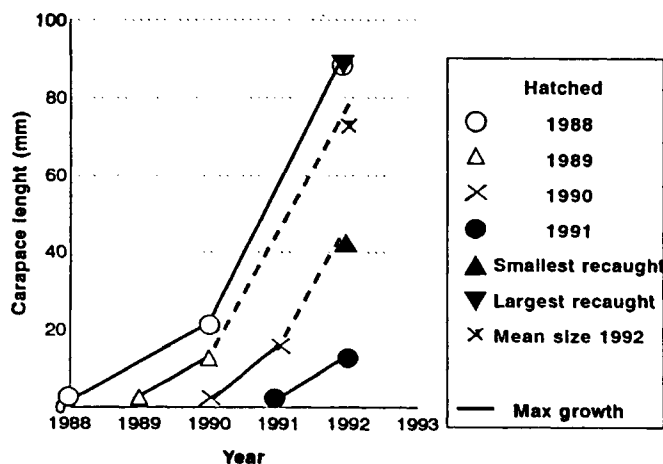


Figure 4. Mean size (CL) at hatching, release and recapture of the lobsters for each year. CL of the largest and smallest lobster in 1992 is also noted.

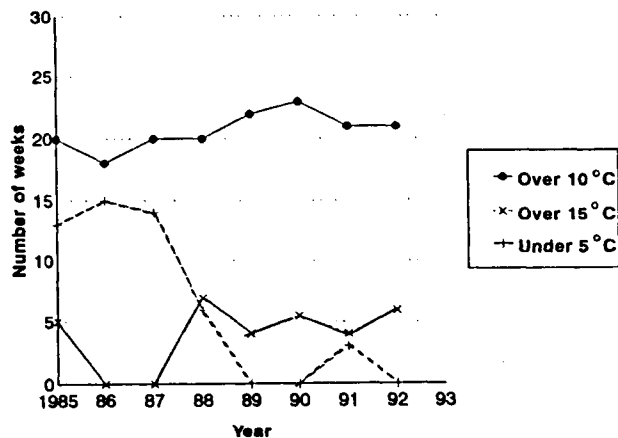


Figure 5. Sea temperature at one m depth at Ydtsebø Harbour (after K. Meling)