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On the Use of Plastic Tags for Tagging Brown Shrimps (Crangon vulgaris Fabr.)

by

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Tagging experiments on crustacea face the added difficulty that the animal moults from time to time so that tags externally attached to the skeleton are lost latest after the first moult. In larger crustacea this difficulty has been overcome by using tags attached to the gills (Penaeid shrimps) or so-called suture tags (crabs), which are inserted into the muscle through a suture of the skeleton, at which the exuvium breaks during the moulting process. In other large crustacea, such as lobsters or cray fish, holes - being visible over several moults - have been punched into the telson.

All these methods cannot be applied, when tagging Crangon, because of its small size. The only method used so far to tag the brown shrimp in the field, was by the dying technique with the methylviolett "gentiana violett B" of Fa. Merck (Münzing, 1960, 1962, Meyer-Waarden and Tiews, 1962). By this method great numbers of shrimps can easily be tagged, but only anonymously and unfortunately only over short periods extending at the latest until the next cast. The doubt that the animals would be blinded through the dying procedure and, therefore, would not behave naturally, could not be confirmed in recent experiments conducted by the Institut für Küsten- und Binnenfischerei. It was found that dyed shrimps show the same phototactic behaviour as undyed shrimps. They bury in the sand at daylight and swim restlessly during the dark, as demonstrated in aquaria experiments.

In searching for a method to tag Crangon individually and over longer periods extending over several moults, Tiews (1953) wrapped a thin silver wire, having a diameter of 0.22 mm only, around the animal between the carapace and the first abdominal segment, keeping all swimmerets free, and he was able to keep shrimps tagged over several, up to 3 successive casts. Shrimps tagged by this method were observed to behave normally, i.e., to bury in the sand, to follow the common light-dark rhythm, even to copulate, to deposit eggs between their swimmerets and to hatch larvae. Many of the shrimps can moult despite of the wire ring, as the cast breaks dorsally between the carapace and the first abdominal segment and as its ventral connection tissues are so tender that they break rather easily during the powerful moulting movements of the shrimp. The stripping of the silver ring is being prevented in both directions by the carapace and the first pair of swimmerets, which cover the ring.

There is no certainty as to how many moults an animal can be kept tagged, since shrimps kept in captivity always show a rather high mortality rate at the time of moulting. Tiews (1954) had even difficulties in keeping untagged shrimps over more than two moults alive, when he studied the morphological changes of the shrimp from moult to moult. These difficulties were even existing, although he kept the shrimps single in separate tanks so that one of the main factors, causing high mortality rates in shrimps kept in aquaria, i.e., the cannibalism among freshly moulted animals, had been eliminated. He came to the conclusion that tagged shrimps kept in captivity show a similar life span as untagged shrimps. However, he doubts that tagged shrimps can pass more than 3 to 4 moults. The majority may pass even less than two moults.

After the dying method applied by Münzing (1960, 1962), which was also applied by the Institut für Küsten- und Binnenfischerei in a field experiment in November 1962 (not yet published), had proved to be of a rather limited value for the known reasons, it became desirable to conduct a large-scale field experiment with the silver ring method at the said institute in order to clarify whether shrimps can be kept tagged over the winter period, and it was intended to obtain a better understanding of their winter migrations. Tagging was purposely done during November and December at rather low temperatures (3-7°C) in order to take advantage of the low moulting frequency to be expected at low temperatures. According to Tiews (1954), the moulting frequency depends on the age of the animal and also on the water temperature. At water temperatures of about 10°C the time interval between two moults amounts to 40

days in adult shrimps, while it amounts to about 25 days only when temperatures are around 15°C, and to more than 8o days when the temperature is as low as 5°C.

The diameter of the silver wire used for these field experiments was 0.18 mm and in order to make the tag better visible small coloured discs (6 mm in diameter) were dorsally attached to the silver ring. These discs were simply punched out of plastic covers as commonly used for keeping documents by means of an ordinary bureau perforator. In order to keep the weight of these discs as low as possible, they were divided into halves. Colours used were faint yellow, faint blue, white and red. In one experiment a combination of white and red discs was tried.

Special care was taken to inform the fishermen about the conduct of the experiments, and special experiments were designed to estimate the chance of finding recaptured shrimps. The results of these experiments were as follows: - while it can be said that many of the fishermen did their best to watch their catches carefully at least during the weeks of tagging and at the localities of tagging, the chance to obtain records by peelers seems to be rather low, since in some of the experiments none of the shrimps, which were tagged and smuggled into the peeling good, were reported back. Yet, there are few records of recaptured shrimps also from peelers. The reason for the low probability that peelers discover recaptured shrimps, although one would be rather inclined to expect a contrary result, may be that peelers peel shrimps practically blind because of their great routine. So the recovery of recaptured shrimps is mainly restricted to fishermen, who may find them, when sorting the catch or when cleaning and washing the catch before cooking or when cleaning the catch a second time from small fish etc. after cooking. Many fishermen, who practice fishing during night - in some fishing villages even the majority -, will find it very difficult, if not impossible, to discover tagged shrimps. So the chances of getting recaptured shrimps reported back are not very great, and this the more the better the catches are. An example may demonstrate this. Supposing the catches per one-net haul amount to 1 basket of shrimps only, this would mean that roughly 2o - 1oo,ooo shrimps, depending on the size composition of the catch, had to be checked. However, good catches are much greater, even more than 1o times, which means that 2oo,ooo - 1,ooo,ooo shrimps are on the deck at once, after dragging the nets for roughly one hour only. After one day's fishing, catches amounting to 6 mill. shrimps may be loaded on one of the small fishing vessels, when returning to the port. These figures indicate that, at times of the main fishing season, chances for detecting tagged shrimps aboard have to be considered as very few.

In general the chances to get returns of tagged shrimps are even 2oo - 1,ooo times smaller than they are in tagging experiments on fish, since, for instance, the average catch per haul of German high-sea cutters amounts to some 1,ooo flatfish or cod or other round fish only. The probability to find a tagged fish is even greater than these figures reveal, in as much as every single fish is taken by hand when being gutted.

In view of the few chances of getting reports of recaptured shrimps, only shrimps having the size of edible shrimps were tagged. In total, 26,236 animals could be tagged (Table 1).

Table 1. Time and location of release of shrimps tagged by the silver wire method

Date	Location	Colour of tag	Number of shrimps tagged
31.X.-13.XI.,62	Norddeich harbour	blue and yellow	1o,ooo
15.XI.-22.XI.,62	Neuharlingersiel harbour	red	1o,ooo
11.XII.-2o.XII.,62	Cuxhaven harbour	white	5,32o
2o.XII., 62	Light vessel "Elbe 1"	white/red combined	916
		Total	26,236

These shrimps were nearly all released in the harbours of the respective tagging localities Norddeich, Neuharlingersiel and Cuxhaven, but 916 were released near to the light vessel "Elbe 1", which is about 16 miles offshore.

They were tagged all by bare hands without using any special tools. Before tagging operation the silver wire had been preformed, as shown in Figure 1. Making use of the skill of the women shrimp peelers employed in the fishing villages, it was possible, for instance, to tag 10,000 shrimps with a staff of 6 shrimp peelers within four days in Neuharlingersiel. On the average, one woman was able to tag per hour 50 - 60 animals. The most skillful women even succeeded in tagging 90 animals per hour. The tagged specimens recovered very quickly from the tagging procedure, when being placed back into sea water, which was kept in special containers. They were not released into the sea until they had fully recovered. There was no immediate tagging mortality.

So far, 84 tags were returned. 65 returns were red-coloured tags from the Neuharlingersiel experiments, 13 returns were faint yellow and faint blue tags from the Norddeich experiments and 5 returns, i.e., 3 red-white tags (combination tags) and 2 white tags were from the Cuxhaven series. While all returns from the Neuharlingersiel and the Norddeich experiments were obtained within a period of less than one month after tagging, which means during the period immediately following the tagging and extending until the time when the fishing season was terminated for 1962, the 5 recaptures from the Cuxhaven experiments were made 3-5 months later after the new fishing season 1963 had started. At the time when the tagging program was launched in Cuxhaven, the 1962-fishing season was over. 2 of these recaptured shrimps were approximately 5 months in freedom after tagging, 1 for 4 months and 2 for a little more than 3 months.

A critical analysis of these data reveal several important facts, which should be put into account, if further experiments should be carried out.

1. Three of the "long-termed" recoveries were combined tags (red-white). They belong to a batch of tagged shrimps, which was the smallest, if compared with the others. Only 916 shrimps were tagged in this way. Although there was no fishery of shrimps for nearly 3 months, the recapture rate for this batch was nearly half as high as that from the Neuharlingersiel experiment, in which all recaptures were made within a period of 3 weeks only after tagging, and was thus astonishingly high, i.e., higher than in the other batches. The reason for this relatively high recapture rate may be explained by the circumstance that combined tags are better visible than the simple ones, but may stand also in certain relationship to the fact that those animals were released offshore and not in the harbour. It might be that many shrimps released at the harbour of Cuxhaven were caught by the unusual severe winter, which immediately followed the tagging experiment and had died.

2. Although 20 fishing vessels from Neuharlingersiel were fishing during the Neuharlingersiel experiments, only 9 recorded returns. On an average each of these fishing boats reported 6.2 returns, between 2 and 11. This shows clearly that only half of the fleet was able or willing to co-operate with us. When estimating the total recapture rates, the estimate should be based on the recapture rate per boat as calculated from those boats successfully co-operating. In other words, the recapture rate for the Neuharlingersiel experiments is likely at least double as high as can be concluded from the actual returns. The recapture rate can thus be estimated to be 1.2% for this experiment.

3. Although it can be expected - according to what has been said under 2 - that at least 60 tagged shrimps could not be detected aboard the fishing boats, only 6 = 10% of these were found by the peelers. Such a low percentage is in agreement with the findings of the experiments made to estimate the chance of getting returns from the peelers.

The result of this tagging experiment as to the migration habits of the brown shrimp, which shall be published in detail in the near future, can be summarized as follows: -

All recaptures were made close to the locality of release within a radius not exceeding about 15 nautical miles. In the case of the Norddeich experiment the general trend of migration was directed to the west. Most of the recaptures had migrated to the open offshore waters. A similar offshore migration can be concluded from the Neuharlingersiel experiment and this is in accordance with the general migration theory. The results obtained from the 5 "long-termed" recaptures are certainly of special interest. Also they were recaught all in an area within 15 nautical miles from the places of release. Two of these 5 shrimps, which were released in the harbour of Cuxhaven, did also migrate in western direction and had

reached the Weser estuary. The three shrimps, tagged by red-white tags and released near the light vessel "Elbe 1", had clearly migrated during the spring in a southern direction, i.e., into the more inshore waters of the Weser estuary. Also this is in agreement with the general migration theory of brown shrimps. All these 5 shrimps had left the fishing grounds of the Cuxhaven fishermen in the meantime and had migrated to the more western fishing grounds of their neighbour fishermen. It surprises, however, that no larger migrations had been conducted over a period of 5 months.

This seems to indicate that the shrimp stocks are at least during the winter months rather stationary and do not perform long winter migrations but do rather hibernate offshore though not too far from the usual fishing grounds.

Since these returns are from a batch which had been released practically at the beginning of the winter it might be that the results obtained are more characteristic for a group of shrimps, about which the fisherman says that it hibernates in the coastal waters more or less on the fishing grounds. These tagging results thus prove that there is in fact a group of such hibernating shrimps which does not perform wide migrations.

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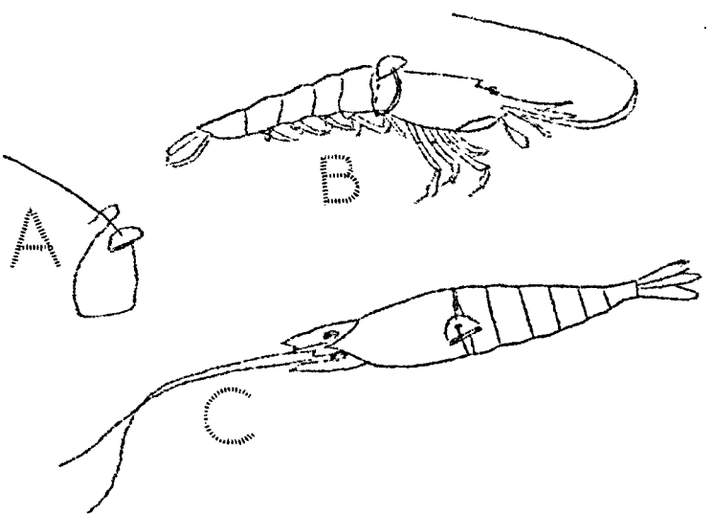

Figure 1. A = preformed tag B = lateral view and C = dorsal view of shrimp showing the attachment