

# Potential for use of coded wire tags for fishery investigations of common shrimp, *Crangon crangon*

Application Note APC07

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## Contents

1. BACKGROUND .....	1
1.1 Introduction.....	1
1.2 Earlier investigations using cwt on shrimps and other decapods. ....	2
2. Overall aims of the project.....	2
2.1 Some information on shrimp populations and fisheries .....	2
2.2 Some questions that might be answered .....	3
3. General approach .....	4
3.1 Marking.....	4
3.2 Tag recovery. ....	4
4. Tagging methodology .....	5
5. Experimental design.....	5
6. Suggested way ahead .....	6
7. References.....	7

## 1. BACKGROUND

### 1.1 Introduction

1.1.1 During the ICES annual science meeting in Alborg, Denmark, in September 1995, NMT presented a trade stand and demonstrated their range of fish and shellfish tagging techniques. Dr Thomas Neudecker (Institut für Seefischerei, Hamburg), who is chairman of the ICES Crangon Working Group, expressed an interest in the potential for coded wire tags (cwt) to be used for large-scale stock assessments of common shrimp.

1.1.2 Key features of the system which make it potentially ideal for this task are:

- tags are very small (1.0 mm x 0.25 mm) and cause no damage to small animals
- tags have a high coding capacity for batch marking;
- high retention rates through moults have been achieved with decapod crustaceans;
- high tagging rates are achievable;
- automatic catch scanning systems are available, allowing tags to be automatically detected in commercial landings at processing plants.

1.1.3 After initial discussion with Dr Neudecker I agreed to construct a draft proposal for an investigation involving cwt. This document is the result.

## 1.2 *Earlier investigations using cwt on shrimps and other decapods.*

- 1.2.1 Prentice and Rensel (1977) examined cwt retention in juvenile spot prawns (*Pandalus platyceros*) in captivity. They ranged in initial size from 15.0 to 22.5 mm carapace length, and the tags were inserted into the thoracic sinus. The animals moulted at least twice during the six-month experiment. There were no significant differences in survival, growth and behaviour of tagged and control groups. Average tag retention over six months was 95%. These authors also reported successful trials using tags injected into the abdominal musculature, but concluded that locating the tags in a potentially edible portion was best avoided.
- 1.2.2 A current project is underway in Japan with small (average 40 mm length) shrimps (*Penaeus japonicus*). The tags are placed in the abdominal musculature, and tagging rates of 231 to 1203 per hour were achieved by different operators using Mk IV injectors. Highest retention rates were achieved by an operator working at 800 per hour. A total of over 280,000 shrimps was marked in thirteen days in July-August 1995. After 7 days in captivity the shrimps were released near the mouth of Matsum City Bay. Samples from the release site in the first five weeks of sampling contained 49.3%, 37.7%, 40.0%, 54.0% and 47.8% tagged individuals. Two samples from nearby areas contained 12.5% and 21.4% tagged individuals.
- 1.2.3 Although we are not aware of any other investigations involving Caridea, some experiences with other decapoda are of interest. Coded wire tags have been used with Lobsters (*Homarus gammarus*) reared to 12-15 mm carapace length for release in an enhancement project (Anon, undated). Over 90,000 individuals were marked in the base of the 5th walking leg, a non-edible area. A total of 1468 tags were recovered from commercial landings, 3 to 9 years after release. Uglem and Grimsen (1995) report using cwt in lobsters as small as 8 mm carapace length.
- 1.2.4 Bailey and Dufour (1987) used cwt on snow crabs (*Chionoecetes opilio*) in a field investigation. The tags were placed into the dactylus of a walking leg, a different leg being used for different size classes. No flesh is extracted from this area for human consumption. Nearly 5000 crabs were tagged, and 83 tags were recovered from landings of 109534 individuals that were monitored.

## 2. Overall aims of the project

### 2.1 *Some information on shrimp populations and fisheries*

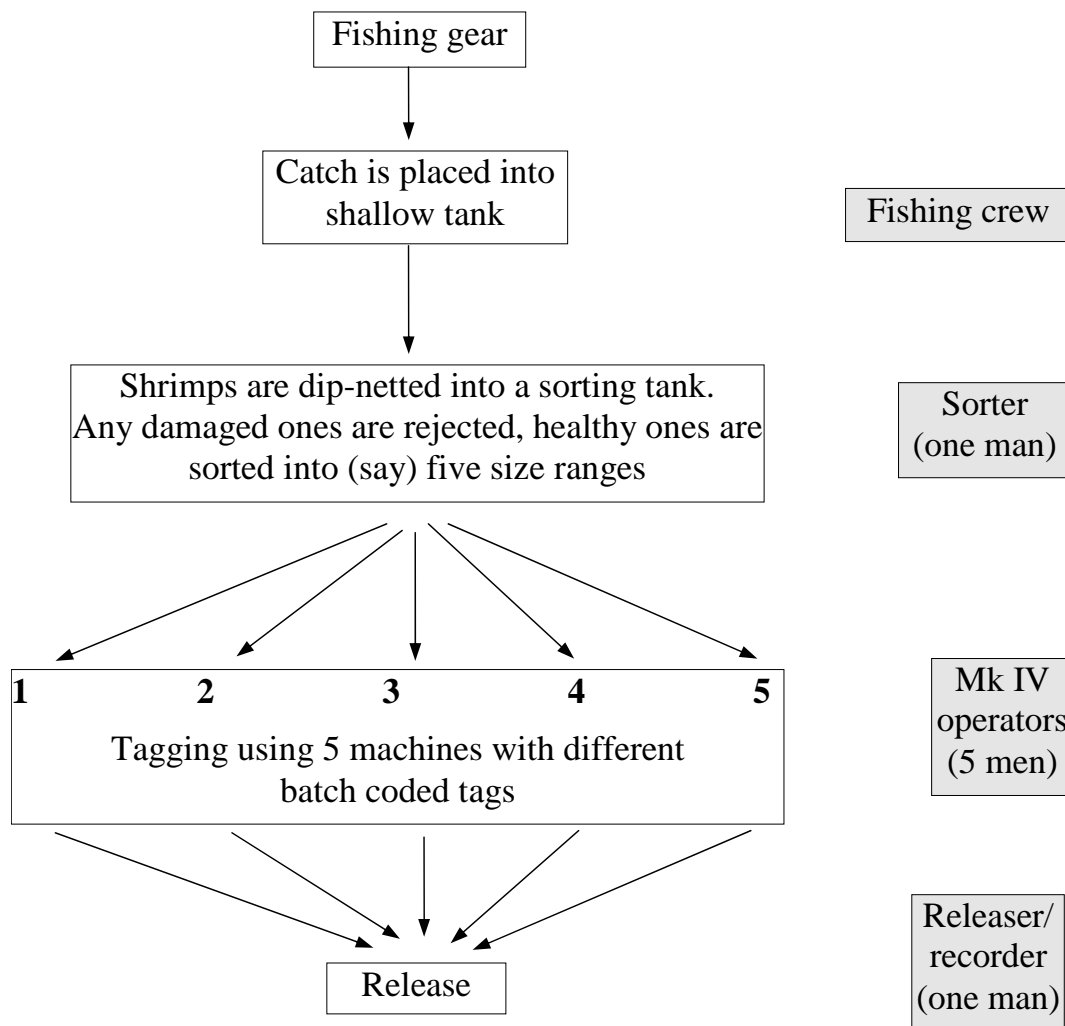
- 2.1.1 The stock of interest resides in the Southern North Sea and German Bight. Recorded landings are of the order of 20,000 tonnes per year. The smallest individuals in the catch are about 40 mm, most are 55-60 mm, and the largest are about 90 mm. Most individuals in the catch are 1 to 3 years of age. Most of the landings are made at about fifteen major ports (Husum, Büsem, Fridrichskoog, Cuxhavn, Fedderwardsiel, Accumersiel, Greetsiel and Norddeich in Germany, and Den Oever, Harlingen, Lauwersoog, Termunten and Vlissingen in the Netherlands). The catch is generally cooked on the fishing boat and landed at a processing plant. Much of the catch processing is automatic, involving conveyor belts and shelling machines.

## 2.2 Some questions that might be answered

2.2.1 Groups of shrimps could be batch-marked according to date and place of release, and size band.

Detection, recovery and decoding of tags could then allow assessment of:

- total population size by size and age class
- fishing mortality (catch as proportion of estimated extant stock)
- natural mortality (decline in recovery of tags)
- growth rates
- dispersion and migration
- stock and sub-stock separation



2.2.2 It is stressed that successful achievement of statistically-robust measures of all the above would be a major project, but is eminently feasible. The general approach that might be taken and the logistics of tagging and tag recovery are discussed below.

### 3. General approach

#### 3.1 Marking

- 3.1.1 Shrimps would be captured, tagged and released from research vessels or chartered commercial vessels at sea. In order to optimise resource use it would be necessary to have several Mk IV tagging machines operating, each perhaps marking a particular size range of animals; sorting and measuring facilities would thus also be required. The shrimps would be released as near as possible and as soon as possible after capture. For some inshore sites it may be preferable to bring the captured shrimps ashore to sort and mark, returning them to the capture area for release with minimal delay.
- 3.1.2 A suggested team is illustrated below. Assuming benign weather conditions such a team of seven (in addition to the fishing crew) could tag 100,000 shrimps per week, with five eight-hour days. If a larger vessel were available, a greater number of tagging machines and shifts of taggers would allow a considerably higher rate of tagging.
- 3.1.3 The tags used would be batch-marked to indicate the date, location and size range of shrimps. Standard tags are normally supplied in spools of 10,000, each of which bears an identical code. Each spool of tags bears a different code.
- 3.1.4 Mk IV tag injectors operate on 24 v d.c. and are designed and manufactured for safe and reliable use in wet environments, including salt water.
- 3.1.5 After tagging the shrimps would be passed through a quality control device. This detects the tag and sorts tagged and untagged individuals, and feeds-back the tag count to the computer in the injector. The tagged shrimps are then released, perhaps using a release pipe running to the sea bed to minimise predation losses.

#### 3.2 Tag recovery.

- 3.2.1 The optimal arrangement for recovery of tags would be for a tunnel detector to be located at each large processing plant to monitor all landings. This would ideally be sited on a conveyer belt at the entry to the plant, so that the boat landing the catch could be identified for each tag recovery; the fishing ground could then be determined. A deflector gate (mechanical or water jet) would divert a quantity of shrimp into a box when a tag was detected, so that the tagged individual could be sorted and recovered. The tagged animal could then be examined and appropriate data recorded (e.g. length, sex, egg-bearing etc.) and the tag recovered for decoding.
- 3.2.2 Tunnel detectors are available with the following dimensions:

<b>Model</b>	<b>Dimensions of aperture</b>	<b>Length</b>
T4	Under development	
R8000	10.2 x 20.0 cm	106.0 cm
R9500	12.1 x 24.1 cm	149.2 cm

The optimal velocity through the tunnel for tag detection is 1.5 - 4 metres per second, but the value can be factory-set outside this range. We do not have any figures for the rate at which shrimp could be monitored, but it is likely to be of the order of tonnes per hour.

3.2.3 A simpler alternative would involve gravity feeding the shrimps through the detector, but this may be more difficult to incorporate into existing processing systems or may require that a smaller proportion of the catch is scanned.

3.2.4 Assuming that the tag is not in an edible portion of the shrimp and that it is rejected with the waste, the discarded offal could be scanned if this were more acceptable to the plant operator. This is likely to lead to loss of data regarding the source of the recapture and on the size of the shrimp, though some information might be obtained from the dimensions of the discarded shell.

#### **4. Tagging methodology**

4.1.1 There is little doubt that tagging in the abdominal musculature would be effective, with little tag loss through many moults. However, it is assumed that a site in a part of the animal that is not used for human consumption is to be preferred. NMT believes that no harm will accrue from ingestion by humans of coded wire tags, but any concerns are removed by avoiding placing tags in edible portions. We have therefore undertaken some preliminary trials specifically for this proposal.

4.1.2 Trials were undertaken at the Fawley Aquatic Research Laboratories Ltd, using shrimps collected from the intake wells at Hinkley Point Power Station. Initially just a few individuals were tagged in one of two sites:

- the top segment of the first abdominal leg
- the muscle block of the uropod

After one month all animals retained their tags. A larger scale trial was therefore performed, using the same locations, involving over 100 animals held in individual containers. Monitoring is continuing.

4.1.3 The uropod site is currently preferred. It is easier to hold the animal in the appropriate position, and higher tagging rates are achievable. Smaller individuals can be tagged (down to 35 mm at least). We have checked that this area is not removed with the edible portion when hand-peeling, but it would be prudent to ensure that this was also the case for mechanical peeling. A tagging rate of about 360 per hour was achieved for a batch of 50 animals, and there is no doubt that 500 an hour or more could be maintained with practice and well-planned facilities.

#### **5. Experimental design**

5.1.1 Although the population size, natural mortality and fishing mortality are among the parameters that the project would be designed to establish, it is necessary to hypothesise certain aspects of shrimp population dynamics in order to design the project in statistical terms.

4.1.2 The annual landings from the stock are about 20,000 tonnes. If the mean size is 55 mm, this approximate to a mean weight of 1.16 g (Tiews, 1970). This indicates that the landings comprise about  $1.724 \times 10^{10}$  individuals. If the exploitation rate is assumed to be 1% per annum on shrimps of fishable size, the total stock of such animals at any time is of the order of  $1.7 \times 10^{12}$  individuals.

5.1.3 If one million individuals were marked, then immediately afterwards they would represent one in  $1.7 \times 10^6$  of the population, and there would be about one tagged animal per two tonnes. The total annual catch

would contain about 10,000 tagged animals, and to recover a total of 1000 tags we would need to scan about 10% of landings. A return of 1000 tags would allow very good estimates to be made of the contribution of marked animals to the stock in different areas, and thus of the overall population and the pattern of dispersion. Numbers of tagged animals would of course fall quite quickly as a result of fishing and natural mortality, and distribution throughout the catch would of course not be even, but these numbers give a basis for initial experimental design.

5.1.4 Such numbers may seem large, and indeed they are when compared to what is achievable using conventional marking methods. However, they are not exceptional by coded wire tag standards. About 50 million tags per year are put into juvenile Pacific salmon, and large-scale catch scanning programmes lead to the recovery of tens of thousands of tags. As early as 1979, Childerhose and Trim wrote:

“In 1974 more than 25,000 (coded wire) tags of Canadian and US origin were recovered in British Columbia. More information about ocean distribution, and the numbers of fish farm hatcheries in specific fisheries, was gathered in 12 months than had been gathered in the previous 12 years. By the end of 1975 almost 15,000,000 coded-wire-tagged chinook and coho were released in the Pacific Northwest”.

## **6. Suggested way ahead**

6.1.1 Dr Neudecker to comment upon this document, and to correct any misconceptions regarding the aims, the fisheries or the population biology of shrimps.

6.1.2 Dr Neudecker to provide information regarding possible research establishments where feasibility and pilot scale studies could be undertaken, and to suggest how they might be approached. (As soon as possible).

6.1.3 NMT to explore ways of incorporating automatic detection and tag recovery in the landing/processing system based.

6.1.4 NMT to provide cost estimates for a range of options (early 1996).

6.1.5 If interested research establishments are found and funding looks likely, Dr Solomon to visit Germany to discuss the project, to help set up tagging trials, and to visit shrimp processing works.

6.1.6 Full feasibility/pilot scale programme to be commissioned in Germany to explore

- tagging techniques and tag retention
- tag recovery

This programme would require one MK IV injector and 4 quality control device (to be purchased, rented or borrowed - there are several units in Germany). It would also require a tunnel detector or a tube detector (there are no longer made but a large part of the feasibility study could be undertaken using an existing piece of equipment). This could be undertaken during 1996.

6.1.7 Dependent upon the outcome of (6.1.6), a full programme for 1997.

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