International Commission for the Northwest Atlantic Fisheries

Serial No. 5337

ICNAF Res. Doc. 79/II/12

SPECIAL MEETING OF STACRES - FEBRUARY 1979

Tagging Trials on Captive Squid (*Illex illecebrosus*)

by

R. K. O'Dor, R. D. Durward, R. W. M. Hirtle
Biology Department, Dalhousie University
Halifax, Nova Scotia, Canada

and

T. Amaratunga
Fisheries and Oceans Canada, Fisheries and Marine Service
Resource Branch, Halifax, Nova Scotia, Canada

Introduction

Tagging has been used extensively in mapping the migratory patterns of Todarodes pacificus in Japanese waters since 1927 (Soeda, 1950), but has seen little use for cephalopods elsewhere. This in part reflects lower interest in squid outside Japan but may also be related to recognition that with the use of techniques which involve handling of individual squid, the return rates have been low. Hamabe and Shimizu's (1966) experiments from 1950 to 1960 show returns of 500 squid out of 17,282 tagged, an average rate of 2.9%. This is an acceptable rate (and higher than most other squid studies), but over 98% of these returns were within the first five days and only four of the returns occurred after more than 10 days. Despite such difficulties, long and complex migrations have been traced in considerable detail by careful selection of time and site of release (eg., Hamabe and Shimizu, 1966).

There is now sufficient interest in Illex illecebrosus to justify similar studies to trace the spawning migrations and to examine the relationship between various stocks. Although a few small-scale tagging experiemnts on inshore populations have been tried, future studies should include the offshore populations and need to be carefully designed

because of fishing techniques used and the international character of the fishery may both contribute to low return rates. Tags used should be easily observable and do minimal damage to the squid. It would also aid in interpreting the results of field studies if effects of tagging on the survival and behaviour of the tagged individuals were known. The results of Murata et al (1971) indicate that in the sea recoveries of squid tagged with modern anchor-type tags are significantly greater than those of the traditional clip-type tags (0.7% returns versus 0.08% in their experiments). We have compared the effects on both survival and behaviour of several types of tags located in different positions on captive squid held for periods of up to 2 months.

Materials and Methods

Experiments were carried out on squid drawn from a school of approximately 300 brought into the 15m diameter pool of the Aquatron Laboratory from a trap net on July 18, 1978 using transportation and maintenance techniques previously described (O'Dor et al, 1977). In an initial survey five different types of tags were tried, some in several different locations as indicated in Fig. 1. All were attached without anaesthesia to simulate field conditions, and some selection was made to avoid animals in obviously poor condition. It was only necessary to test each tag-location combination on 2 or 3 animals since we were able to make continuous observations of each animal's condition during daily feeding. Lost tags were recovered when vacuuming the pool every 2 or 3 days so that the approximate date of loss was known even if the animals were no longer identifiable. Dead animals were collected daily and the condition of tags or tagging site noted.

A second, quantitative experiment was conducted with one of the best tag-location combinations, 3cm anchor tags projecting up from near the mid-line at the front of the mantle (No. 5, fig. 1). A total of 25 animals were selected

and tagged. Skin lesions are the principal cause of death in squid that have been handled; these usually result from contact with rough or dry surfaces. Animals which had rubbed against the knotted nets of the trap showed hairline scratches visible against the dark background of the expanded chromatophores and were rejected as survival was unlikely (Bright light usually causes chromatophore expansion and helps observation).

To avoid damage during experiments squid were handled only with shallow dipnets made of 3 mm mesh knotless netting and with wet hands; all contacted surfaces were wet with seawater. Tagging was done on a tray covered with a smooth polyethyene bag using a Swiftachment gun (Dennison Manufacturing Co., Drummondville, P.Q.) and could be completed in a few seconds. Squid usually spent about 30 seconds out of the water, but the animals were also weighed during this time. The tray was lowered into the water so that the animals could swim away.

Results

The results of the survey are summarized in Fig. 1. Only animals tagged with anchor tags survived for more than one week. Average survival of tags and animals with anchor tags in the tail was 10.5 days and in the dorsal mantle 18.5. Four general classes of problems were identified and Fig. 1 rates in the various tags in terms of these problems.

1) Skin lesions. Squid have very delicate skin and any contact with foreign objects seems to cause lesions which usually fail to heal and often spread. Large lesioned areas lead to death within a few days. The reason for these dramatic effects are not clear, but is probably related to either infection or ion balance (O'Dor, 1979). The most disasterous tags were the thin, flexible plastic strip tags (No. 8, Fig. 1) which initially looked quite promising; but, in fact, flapped in the current as the squid swam and "whipped" large areas of skin.

2) Muscle lesions. Squid have no bones or hard parts in which to anchor a tag, but their muscle is very firm and holds tags fairly well; however, tags which project into the current around the animal wobble, and wear away the muscle. These lesions don't spread and seem to do less damage than skin lesions, but tags may fall out as the holes enlarge.

3) Imbalance. Tags can cause difficulties without any obvious damage to the squid. The relatively heavy tags (No. 1 and 2, Fig. 1) cause the squid to "list" simply because they affect balance. When such tags are placed on a fin the animals tend to swim in circles. Tags with discs or "flags" attached create a drag which also causes erratic swimming, particularly if placed off center. Flag tags (No. 4, Fig. 1) were pulled down over the head by the squid and held between the arms apparently to reduce drag. In this position they rubbed against the skin of the head. Even a small tag has some effect on the streamlining of a squid and slows it down making it a less effective competitor. Squid that move irregularly or behave unusually are also frequently attacked and driven from the school, an additional hazard for tagged squid.

4) Permanence. Decay, corrosion, etc. of tags are unlikely to be problems even in the field since the life expectancy of the squid is at most several months. The only difficulty encountered was tags falling off the squid.

The survival of the 25 squid with anchor tags is compared to survival of untagged squid in the pool in Fig. 2. As the solid line shows even the survival rate of untagged squid was not high. The survivorship curve appears to have three components. About 45% of the squid died between days 5 and 10. These are typical deaths from net damage in the trap and from handling; skin lesions take several days to become apparent and death follows a few days later. Normally the death rate stabilizes at a level similar to that seen from day 35 to 60 after this, but continued handling for other experiments

(O'Dor et al, 1979) probably increased the rate from day 10 to 35. The squares in Fig. 2 show the survival of 10 squid which died with their tags on. The death rate in this group during the early period is lower than that of untagged squid, probably as a result of the selection of undamaged animals, but the rate is about six times higher during the second period. In all but one of these animals the wound at the tagging site remained open and in most there was considerable wear which enlarged the hole. In the animal which survived for 56 days (and died after spawning) the wound was completely healed and there was no evidence of ill effects on skin or muscle. The triangles in Fig. 2 shows tag retention for all 25 animals. 60% of the squid lost their tags and this line records the time the tag was found, usually 1 or 2 days after it was lost. In most instances the squid survived after losing their tags; some scarred squid survived for many weeks.

Discussion and Conclusions

None of the tagging techniques tested suggested long term survival of tagged squid; however significant improvements in technique are possible and reasonable returns over periods of several weeks can be expected. Clip tags attached to the mantle lip in location 1 have a minimal affect on swimming and behaviour, but cause skin lesions which usually lead to death within a week or two; this seems to be unrelated to tag composition since aluminum, plated steel and plastic all cause similar damage. Plastic strips and flag tags (including the anchored flags used by the Japanese) flap and cause erratic behaviour as well as skin damage. The spaghetti tubing-anchor tag can be positioned to do minimal skin damage (over 60% of the squid survived into the third week), and when short lengths of tubing are placed in location 1 the effects on swimming and behaviour are also small. The principal difficulty with this position was that the tubing slid down through the hole and fell out. A bulge or "T" on the tubing

end might prevent this without too much increase in drag. A position on the ventral mid-line where gravity would tend to hold the tag in place should also be tested (Fig. 1, location 5).

Consideration must also be given to the condition of the squid to be tagged and to handling during the tagging. The results show that carefully selected squid, even when tagged, survived longer than squid that were poorly "handled". Our records also show that large squid have a better chance of survival than small. The principle problem in handling appears to be skin damage which can be recognized; squid with skin damage should not be tagged. Our squid were brailed from a trap-net with fine mesh nets, but some still showed damage from bumping the coarse net. We have also attempted to keep squid obtained from bottom trawls, but these always have extensive skin damage and survive only a few days; they seem a poor prospect for tagging. The Japanese generally tag squid taken by lining. We have had limited experience with this technique, but have noted that squid taken on hooked jigs fail to show normal arm posture and have poorer survival than brailed squid. Hookless jiggers may avoid this problem. Whatever the technique, the time from capture to release should be minimised, particularly the time out of water. Squid have a limited capacity for anaerobic respiration (Hochachka et al, 1975) and suffer irreversible damage when respiration is stopped for as little as 2 to 3 minutes (O'Dor, 1979).

In our only field trial, brailing from a trap net and using gun insertion of anchor tags, three of us (one brailer, one tagger, one releaser) were able to tag 2 to 4 squid per minute and animals rarely spent more than 15 seconds out of water. This seems an acceptable method of operation for tagging inshore stocks, and with a suitable tag return system should yield considerable information even with no further

modification of tags. Tagging of offshore stocks will be more difficult. Lining with hookless jigs may be satisfactory, but a system similar to that used inshore may also be possible using a light attractant-purse seine techinque for the initial capture.

References

Hamabe, M and Shimizu, T. (1966). Ecological studies on the common squid, Todarodes pacificus Steenstrup, mainly in the southwestern water of the Sea of Japan. Bull. Jap. Sea Reg. Fish. Res. Lab. 16, 13-55 (Fish, Res. Bd. Can. Transl. Ser. No. 812).

Hochachka, P.W., Moon, T.W., Mustafa, T. and Storey, K.B. (1975). Metabolic sources of power for mantle muscle of a fast swimming squid. Comp. Biochem. Physiol. 52B, 151-158.

Murata, M., Onoda, Y., Tashiro, M., Yamagishi, Y. (1971). Ecological studies on the squid, Todarodes pacificus Steenstrup, in the northern waters of the Sea of Japan in 1970. Bull. Hokkaido Reg. Fish. Res. Lab. 37, 10-31. (Japanese with English summary)

O'Dor, R.K. (1979). Laboratory experiments with Illex illecebrosus In: Balch, N., T. Amaratunga and R.K. O'Dor (Eds.) Proceedings of the Workshop on the squid, Illex illecebrosus, May, 1978; Fish. Mar. Serv. Tech. Rept. No. 833. pp. 000-000.

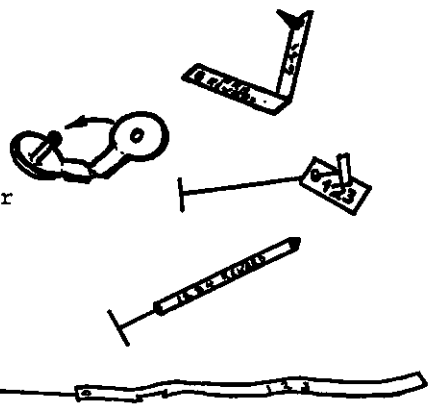
O'Dor, R.K., Durward, R.D., and Balch, N. 1977. Maintenance and maturation of squid (Illex illecebrosus) in a 15 meter circular pool. Biol. Bull. 153, 322-335.

O'Dor, R.K. Durward, R.D., Vessey, E.and Amaratunga (1979). Feeding and growth rates in captive squid (Illex illecebrosus) and the influence of food availability on growth in the natural populations. ICNAF Res. Doc.

Soeda, J. (1950). Migration of the "Surume" squid, Ommastrephes sloani pacificus (Steenstrup), in the costal waters of Japan. Sci. Pap. Hokkaido Exp. Fish. Inst. 4, 1-30 (Fish. Res. Bd. Can. Transl. Ser. No. 533).

Figure 1. Serverity of problems associated with various types of tags. See text for a discussion of problems.

Tag	Location**	Problems*			
		1) Skin Lesions	2) Muscle Lesions	3) Behaviour	4) Permanence
1) Metal clips	1	++	++	-	-
2) Metal clips	3	++	+++	+	+
3) Plastic clip	4	++	+	+++	-
4) Tape flag-anchor	1	++	+	+++	-
5) Tubing-anchor	1	-	+	+	+++
6) Tubing-anchor	2(up)	+	+	+	++
7) Tubing-anchor	2(down)	++	+++	+	-
8) Plastic strip	2(up)	+++	+	-	-



*- no problem; + little; ++ moderate; +++ major.

**Locations indicated in drawing below.

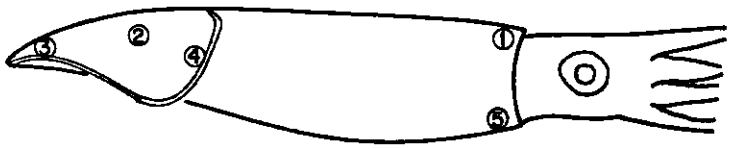


Figure 2: Survival of untagged squid in the pool compared to the survival of squid tagged with spaghetti tubing-anchor tags and to the length of time tags were retained by the squid. With these tags tag loss was a more serious problem than mortality - see text.