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〈Note〉

The Effective Location of Visible Implant Tags for Short-Term Marking in Nile Tilapia (*Oreochromis niloticus:* Cichlidae)

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Identification of individual fish is essential for fisheries research on growth, migration, mortality, stock identification, and gear selectivity to trace the fate of a particular fish population (Konstantinov, 1978), although short-term retention may suffice for some experimental laboratory studies. To identify fish in fishery management or research tagging experiment should basically be considered the effect of tag on fish survival, behavior, growth, recognition, and cost of marking technique (McFarlane et al., 1990; Zerrenner et al., 1997). External tags ordinarily allow individual identification and visual information from live fish. However, tag loss and unknown or deleterious biological effects are disadvantages (Bergman et al., 1992). Ideal tag should provide positive identification throughout the life cycle, unlimited number of combinations, rapid application, readability without demaging fish, and low cost. In addition, the tag must not influence behavioral or physiological characteristics of fish (Kincaid and Calkins, 1992).

The visible implant (VI) tag designed to later identify individual specimens is an alphanumerically labeled strip of bio-compatible plastic (Haw et al., 1990). The VI tag is designed to be implanted internally under transparent tissue, such as the post-orbital adipose tissue, so the unique identification code could be read externally through the tissue throughout the life of animal (Bergman et al., 1992). Many fish species have transparent tissue suitable for tagging including opercula, mandible, top of head, body, and fins (Bergman et al., 1992). However, sites to retain tags varies among species. Tagging sites in other body locations may also be used successfully. The purpose of this study is to assess efficacy for the site beneath branchiostegal ray inside operculum in Nile tilapia *Oreochromis niloticus* as a potential target of VI tagging.

Fish used in this experiment were healthy Nile tilapia with mean total length of 19.1 ± 1.5 cm, ranging 17.2 cm to 22.4 cm and mean body weight of 95.7 ± 22.6 g, ranging 62.9 g to 147.4 g. The application of VI tags to treatment fish and handling of control fish occurred on 23 January 1998. All fish were anaesthetized in 30 ppm lidocaine-hydrochloride/$NaHCO_3$ (Kim et al., 1998). Fish were sedated until they were completely immobile, individually removed from the anesthetic solution, rinsed in fresh water, and placed on a flat surface for tagging. VI tags (2.5×1.0×0.1 mm, Northwest Marine Technology, Inc.) with an alphanumeric code on a black

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background were applied with a VI tag injector (Northwest Marine Technology, Inc.) similar to the methods of Haw et al. (1990), Kincaid and Calkins (1992) and Zerrenner et al. (1997). VI tags were placed beneath branchiostegal rays inside left operculum (Fig. 1). Control fish were handled the same as the treatment fish, except that no marks were applied.

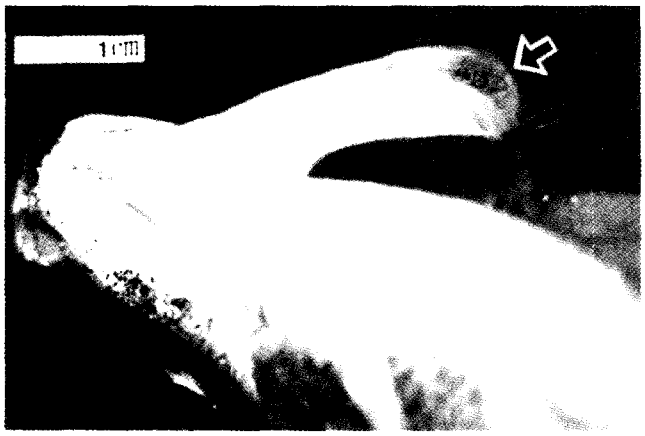

Fig. 1. **Visible implant (VI) tag beneath branchiostegical ray inside the operculum of Nile tilapia *Oreochromis niloticus*. An arrow indicates visible implant tag that is readable.**

A flow-through water system was employed throughout the study, and fifty fish marked with VI tags and fifty control fish were placed in each of two 8.6 m^3 (2.8 m diameter) indoor rearing tanks. Ground water was supplied to the tanks, and water temperature was maintained at 26±0.5℃. The fish were fed daily to satiation on dry commercial food (Agribrand Furina Korea Co., Korea) throughout the study. For 75 days after tagging, retention and readability of marks were determined at every 15 day intervals (a total of six times) and any mortalities were recorded in each tank. Tag retention rates were calculated according to the method of Zerrenner et al. (1997), where mark retention data recorded from dead fish were used to calculate percent retention up to the date that they died, but were not used in the calculation afterwards. All experiments were performed in duplicate.

After tagging cumulative survival rate, retention and readability of VI tags in Nile tilapia are given in Table 1. Although no mortalities occurred in control fish throughout the study period, survival of

Table 1. Cumulative survival rate, retention and readability of visible implant tags in Nile tilapia from 0 to 75 days after tagging[1]

Variable	Days after tagging					
	0	15	30	45	60	75
Number of survivors	50	48	46	45	45	45
Survival rate (%)	100	96	92	90	90	90
Number of tags retained	50	48	46	45	30	5
Tag retention (%)[2]	100	96	92	90	60	10
Number of readable tags	50	48	47	41	26	1
Tag readability (%)[3]	100	100	100	91	87	20

[1]Means of duplicate samples.
[2]Tag retention (%) is based on the original number of tagged fish (N=50).
[3]Percentage of readable tags among remaining tagged fish at each inventory.

tagged fish decreased to 90% after 75 days. No tag loss occurred at the time of tagging, but tag retention rate decreased with time after tagging; cumulative tag retention after 15 days was 96%, 92% for 30 days, 90% for 45 days, 60% for 60 days and 10% for 75 days. All tags were readable through 30 days after they were implanted (Fig. 1). However, the percentage of readable tags decreased to 91% after 45 days, 87% after 60 days and 20% after 75 days. This study demonstrated that during experimental period of the 45 days the site beneath the branchiostegal ray inside the operculum of Nile tilapia was suitable for VI tagging. Various sites on the head, e.g., mandible in walleye *Stizostdion vitreum* (Larscheid, 1995) and elsewhere on heads (Buckley et al., 1994), appear to be particularly useful. Dorsal, anal, and adipose fins also provide potential targets for tagging (Oven and Blankenship, 1993; Tipping and Heinricher, 1993).

Previous attempts by Northwest Marine Technology to tag the Nile tilapia have been unsuccessful (NMT, 1998). This study showed Nile tilapia implanted with VI tags beneath branchiostege of the operculumn provide satisfactory short-term results. Application of the visible implant tags for short-term to Nile tilapia in suitable tissue of this study are advantagous of VI Alpha tags: high retention in suitable tissue/species, though with the necessity to sacrifice the fish tags detected visually and readable in live specimens and minimal impact on survival, and conquest the limitation of VI Alpha tags; unsuitable for very small fish and species with suitable tissue and tag visibility may become occluded

by pigmentation (NMT, 1998). Considering the results of use in elastomer tags with generally retained at greater rates than 90% (Willis and Babcock, 1998), application of elastomer tags to the same site used in this study in Nile tilapia needs to explore.

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