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Preliminary Study on the Effect of Anchor Tags on Japanese Eel, *Anguilla japonica*

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A field culture experiment on adult Japanese eel (*Anguilla japonica*) was carried out to investigate the efficiency of anchor tags and their effect on growth and survival of eel. It was conducted in a sea water pond from December 1987 to September 1988.

Forty one eel were divided into three groups: (A) tagged, with hormone treatment; (B) tagged, without hormone treatment; and (C) control.

Filamentous algae were found to grow on the tags one month after the commencement of experiment when the marks on the tags were still clearly seen. Five months latter, the marks on the tags became hardly recognizable. It is thought that the marks on the tags will last for at least six months since the covering of filamentous algae are less possible under a strictly controlled environment (or treated in open sea).

It was found from this experiment that the tags were shed due to infections, inflammations and ulcerations of the fish. However, the tags will not be easily shed when they were properly embedded deeply into the eel skin under adequate environmental conditions.

Taggings had an obvious effect on the eel, particularly the retardation of growth. Inflammations and ulcerations caused by tagging are not the main cause for the death of eel.

Key words: Japanese eel, Tagging

關鍵詞：白鰻、標籤。

INTRODUCTION

The subtropical weather of Taiwan is very suitable for the aquaculture of eel. To meet the increasing demand of marketing, the farming areas have been expanded incessantly, to result in an yearly increasing demand of elver for aquaculture to about 250,000,000. However, the yearly catch of elver from the coast of Taiwan is always under 50,000,000. Therefore, a considerable number of elver must be imported from abroad to meet the need of aquaculture (Tzeng, 1986).

To increase the production of elver, two ways have been done by either artificial propagation or releasing mature eel to increase the natural production. In order to gain this goal, the studies on migration route, growth and other biological characteristics of the eel has been conducted by the Taiwan Fisheries Research Institute with artificially induced maturation and with releasing mature eel since 1976. Tagged mature eel have been released since 1987 (Tabeta *et al.*,

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1987; Tzeng, 1985a; 1985b). Some tagged eel were kept in captivity to investigate the possibility of tag loss, recognition of the marks on tags and the tagging effect on growth and mortality. The present paper was processed and included these preliminary results of the experiment.

MATERIALS AND METHODS

Materials

Mature eel: A total of 1,481 individuals of 2-3 years old pond eel (Table 1) were acclimated in a concrete pond of 14 m×14 m×1.4 m in size with 24-26‰ sea water for about two weeks.

Tagging gun: The tagging gun (BANO'K 203 standard type) and anchor tag (US pin, 45 mm) marked with T.F.R.I. (Taiwan Fisheries Research Institute) and serial number in Indian ink (Shiyatihata stamp ink, Shiyatihata industry company) were used.

Methods

Induced maturation: A total of 162 individuals of large-sized female eel with round pectoral fin, and high condition factor, were stocked in 4 concrete ponds (6 m×3.3 m×1 m). A dosage of synthetic hormone (500 IU of compound vitamin in 0.5 cc of saline solution, and one pituitary gland of common carp) was then injected intramuscularly on back once a week. This had been done six times for the stocking period. Similarly, 50 male eel of smaller size were injected but three times during the same period.

Tagging: Before tagged, the eel were transquilized with 2°C ice water for weakening activities. All experimental fish were measured in length (BL, in cm) and weight (BW, in g) prior to be tagged. Subsequently, a tag was shot on the back near the dorsal fin base.

Experimental design: Eel were divided into three groups (Table 2): (A) 10

Table 1. Number of eel for various treatment in 1987

Treatment / Tagging / Experiment	Hormone treatment		Without hormone treatment		Subtotal
	Tagged	Untagged	Tagged	Untagged	
Released to sea	52	100	296	992	1440 (97%)
Kept in pond	10	0	21	10	41 (3%)
Subtotal	162 (11%)		1319 (89%)		1481

Table 2. Sample size, type of treatment, body length and body weight range of three groups of eel in the experiment

Group	A	B	C
Sample size	10	21	10
Hormone treatment	+	—	—
Body length (cm)	68.0~86.5	60.7~66.0	66.6~83.4
Body weight (g)	420~1060	320~1050	400~1100
Tagging	Tagged	Tagged	Untagged

tagged individuals, with hormone treatment, (B) 21 tagged individuals, without hormone treatment, and (C) 10 individuals for control. All these eels were kept in concrete ponds (6 m×3.3 m×1 m) with 26-31‰ sea water and fed once a day from December 1987 to September 1988.

Observations and measurements of eels: Body length and body weight of the eel were measured on the 16th of each month. Tags and healthy condition of the wound area on eel skin were inspected carefully.

RESULTS AND DISCUSSION

Change of body size

The monthly fluctuation of the mean body length and body weight was shown in Fig. 1 and Fig. 2, respectively. The mean body length and body weight of the tagged eel decreased more significant in the hormone-treated eel than the untreated eel. As for the control group, the mean body length and body weight remained in a steady manner during the first few months of experiment, increased in the later part of the experiment.

The decreasing mean body length (Fig. 1) in all groups at the final period of experiment is caused by the removal of large-sized dead eel. The change of length is not a good parameter for evaluating fish condition in this species. However, mean body weight might be wisely used for comparisons instead (Fig. 2). Body weight of group B maintained steadily even throughout the experimental period while that of group A decreased drastically in the later period than that of control group.

The stress from the induced maturation and the mechanical harm due to tagging are major responsible for the retardation of growth. Similar results were evidenced for the European eel, *Anguilla anguilla* (Berg, 1985).

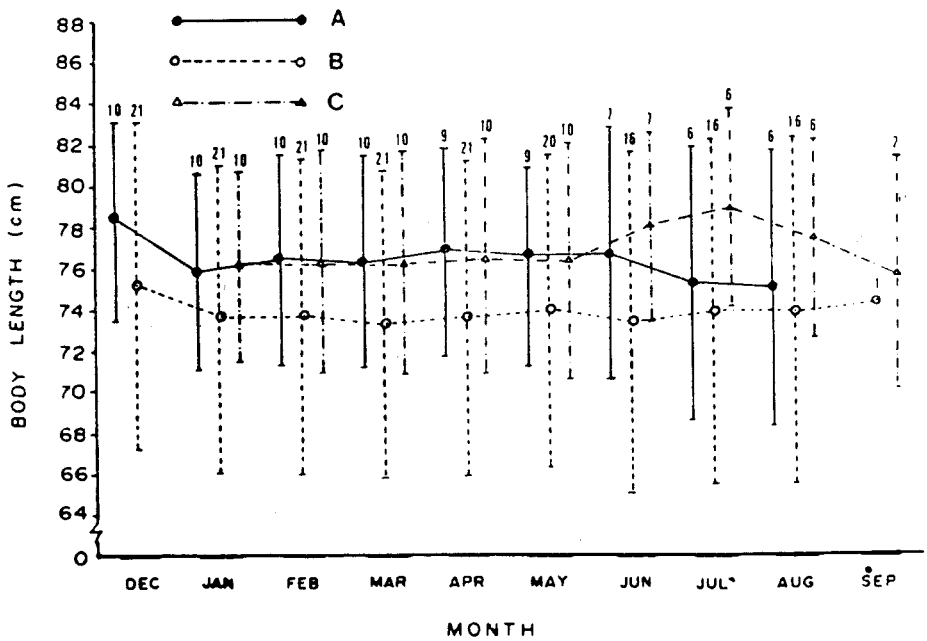

Fig. 1. Monthly change of mean body length (±S.D.) among three groups (A, B, C). Numerals on the figure indicate the number of specimens.

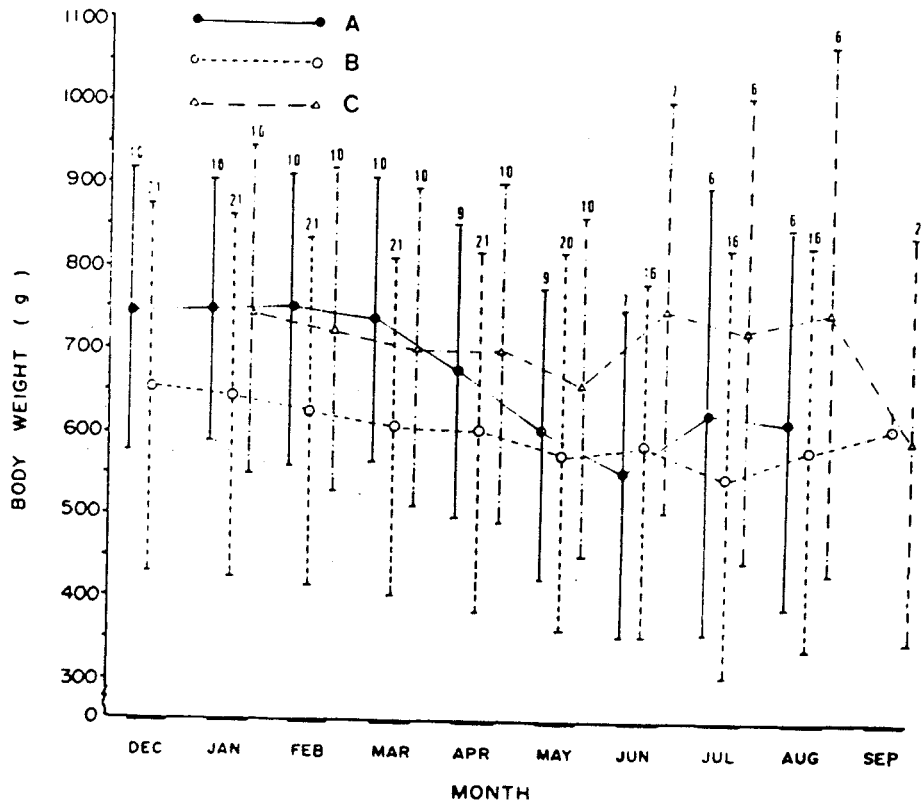

Fig. 2. Monthly change of mean body weight. (±S. D.) Numerals of the figure indicate the number of specimens.

Shedding of tag, and mortality of eel

In group A, growing filamentous algae were found on the tags one month after the experiment conducted. However, the characters on the tags were still recognizable. The filamentous algae grew continuously along with the duration of the experiment, but the characters on the tags sustained for up to four months from the beginning of the experiment. The marks on the tags became less recognizable five months after the experiment commenced. The eel in Fig. 3, indicated no symptom of inflammation within the first month (January 1988) of experiment. Two eel were inflammed two months later, but soon be recovery in the next month. All fish came back to health by the third month. By the 4th month, two eel were inflammed, one was dead with the tag remaining in normal condition. By the fifth month, one eel was found to have ulceration around the wound area without losing tag. After six months of experiment, two eel escaped from the ponds while the remaining seven eel were in healthy condition. By the 7th month, one more eel died, five with ulcer on the wound area and only one in normal condition. The tag in the normal eel was shed but the wound on fish skin was healed. After eight months of experiment, tags of the two ulcerated eel were shed off with the wounds healed, while tags on other two ulcerated eel and one healthy eel were still in position. All these eel were dead at the end of this experiment in the immediate coming month.

In group B, the growing pattern of the filamentous algae on the tags were the same as those in group A. After two stages of experiment in January 1988, all 21 eel were in good condition. By the second month of experiment, 14 eel were inflammed, among them two were ulcerated, with tags remaining in

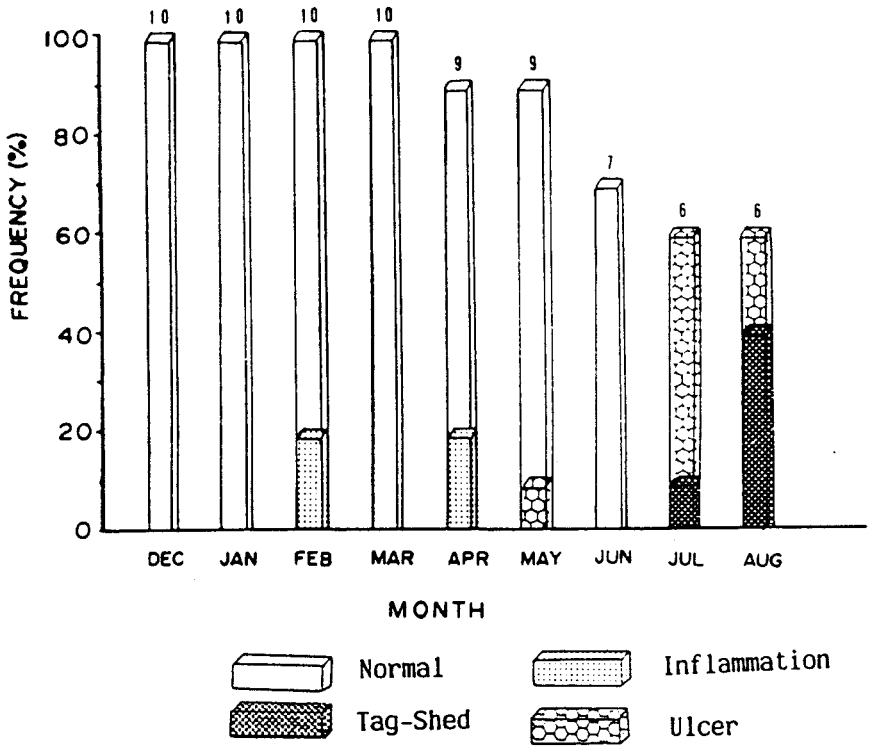

Fig. 3. Survival rate of tagged eel with hormonal treatment.

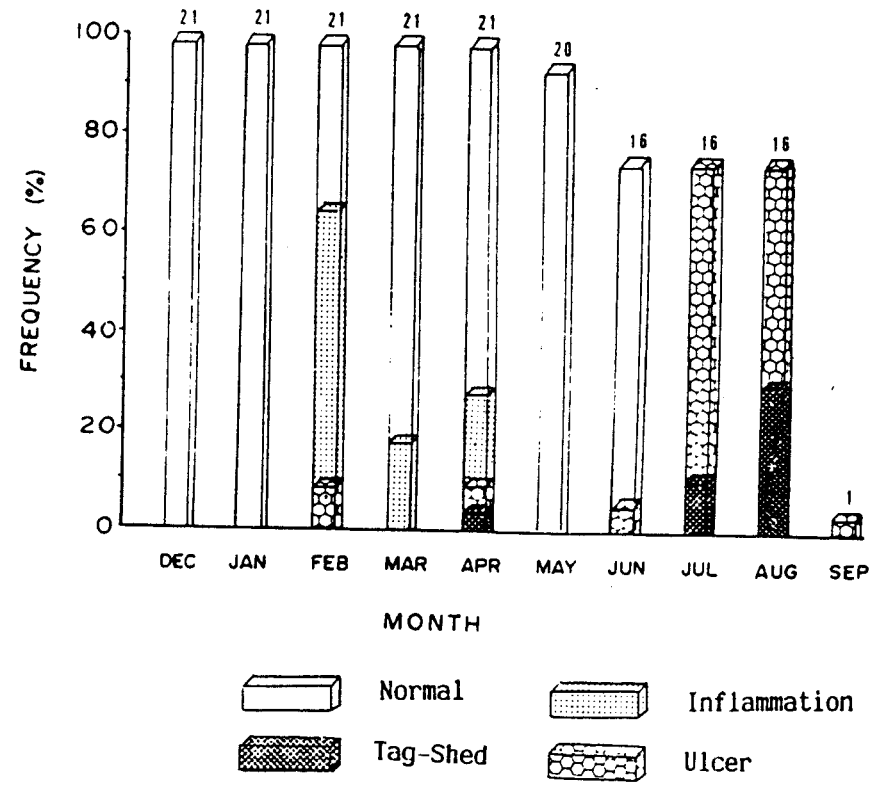

Fig. 4. Survival rate of tagged eel without hormonal treatment.

position. By the third month, only three were inflammed. By the 4th month, four eel were inflammed, one of them was ulcerated with its tag shed off. By the fifth month, the ulcerated one was dead, while the others were in good health. The marks on the tags became obscure due to heavy growth of algae and the effect of sea water. The circulated open sea water could prevent this phenomena. By the sixth month, 4 out of 20 eel escaped from the ponds, the remainders included 15 healthy eel and 1 ulcerated eel. By the seventh month, all 16 eel were ulcerated, and the tags of two eel were shed off. By the eighth month, ulceration of the eel did not improve. Further three tags were shed off, with healed wounds on the skin. At the end of this experiment (the 9th month), only one was alive (Fig. 4).

Higher incidence of losing tags in the later period of experiment is probably linked with higher rates of infection and inflammation on the fish. Good environmental condition could improve the situation.

In control group C (Fig. 5), all 10 eel remained steadily in good health during the first 5 months of experiments, deaths increased from June (the sixth month) until the end of experiment in September when two eel were still alive. The death of eel in group C were not in connection with disease.

Apart from the effect of physiological stress, the small culture pond with high rearing density of eel are another cause for inflammation and ulceration of fish skin, as well as the death of fish, due to high infection rate of bacteria or other pathogenic microorganisms, especially during the warm summer. Higher water temperature in August and September caused high mass mortality of the eel, regardless whether the eel were tagged or not. The enclosed rearing system is more favourable for the growth of pathogenic microorganisms.

Of many kinds of tagging methods (Nielsen, 1987; Shiota and Tsukamoto, 1987), anchor tagging is the most effective but harmful method to eel. However, the advantage of this method could be considered because of its easy handling and fast identification while recaptured (Rawstron, 1973). Nevertheless, other tagging methods will be studied furtherly.

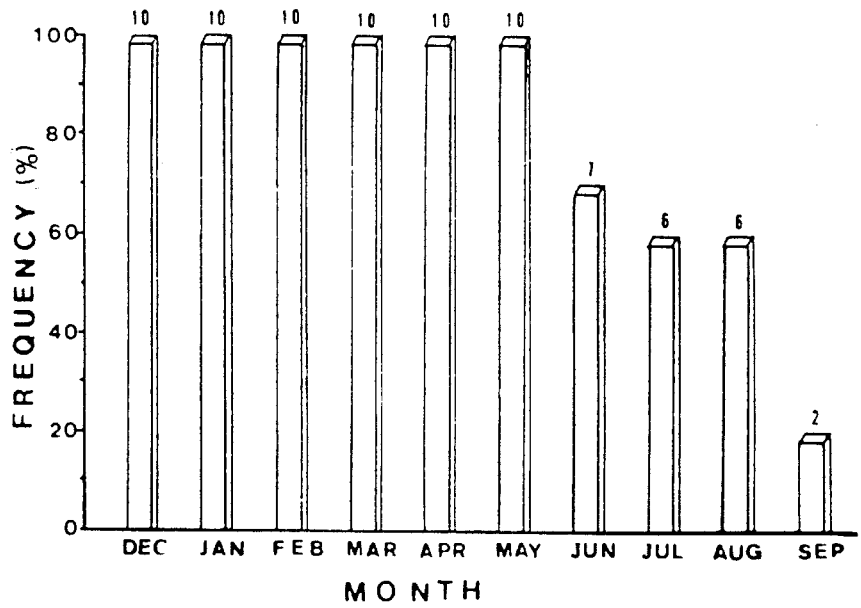

Fig. 5. Survival rate of control group.

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固定型標籤對白鰻 (*Anguilla japonica*) 影響之初步探討

郭慶老・余廷基・吳全橙・陳榮華

爲瞭解 Anchor Tag 標識法之效果及其對白鰻，*Anguilla japonica*，之影響，利用經海水馴化之種鰻 41 尾，於 1987 年 12 月至 1988 年 9 月分成 A (有標識且催熟)、B (有標識無催熟)、C (對照組) 三組，進行標識及體長、體重等項觀測。

標識後第一個月卽有絲藻附著，但號碼清晰可辨，第五個月起開始模糊。若管理良好或在大海中，絲藻附著不嚴重，則字跡應可維持半年以上。由於標識的發炎、潰爛，而引起標識籤的脫落；但如果打標識時確實植入鰻體，且環境適當，不使標識部位發炎、潰爛，標識籤應是不容易脫落的。

標識籤若脫落，由於鰻魚之復原能力强，若有再捕，很難由標識的痕跡確認是經過標識之鰻魚。

標識對種鰻的成長有明顯之影響，但標識部位的發炎、潰爛並不是導致種鰻死亡的主要原因。