Japanese Journal of Ichthyology
Vol. 32, No. 3 1985

魚類学雑誌
32巻3号 1985年

Individual Identification by Spine and Ray Clipping for Freshwater Sculpins

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(Received March 27, 1985)

Various methods have been developed for marking fish in studies on population estimates, individual growth rate, migration pathway, homing rate and so on. For studies on the life history and characteristics of individual fish, however, there have been few methods of individual marking which give the fish a permanent mark. Laird and Scott (1978) have listed and discussed conventional methods of marking and tagging. Unfortunately, these were not applicable to population estimates, and studies on individual growth rate and movement of the river sculpin *Cottus hangiongensis*, due to the small size of fish and the probable effect on behavior and growth of fish. Recently, Rinne (1976) and Welch and Mills (1981) reported improved methods of individual marking by coded fin-spine clipping in the spiny-rayed fish *Tilapia* and fin-ray scarring in three salmonids and white sucker.

In the present study, a new method of individual marking, modified from the coded method of clipping fin-spines, is described and demonstrated with emphasis on its suitability as a permanent mark when used in long-term mark and recapture population studies for the river sculpin *C. hangiongensis*.

Materials and methods

Studies on population estimate, growth, and movement of individual river sculpin, *C. hangiongensis*, were conducted in the Daitobetsu River, near Hakodate, Hokkaido, during the period from October, 1983 to December, 1984. Individuals larger than 50 mm in body length, which were captured with dip nets and selected from total catches, were anesthetized a few at a time with approximately 0.0001% ethyl p-aminobenzoate solution before marking. They were marked by removing combinations of 1st dorsal fin spines and 2nd dorsal fin rays. The Daitobetsu River population of *C. hangiongensis* studied has 8–10 spines and 19–22 rays in the 1st and 2nd dorsal fins respectively (Goto, 1974, 1977). The 1st 8 dorsal spines were coded as from I to VIII toward the posterior and the 1st 18 dorsal rays were coded as from 1 to 18 in the same way. Each spine or ray was removed from individuals by incising the inter-spine or inter-ray tissue with a small surgical scissor. Clipping spines and rays at the extreme proximal end was one of the most important techniques in preventing the regeneration of them after marking. It was also important to leave the 1st two rays and at least two rays between the two rays clipped, in order to reduce the probability of error in reading the coded marks on individuals when recaptured.

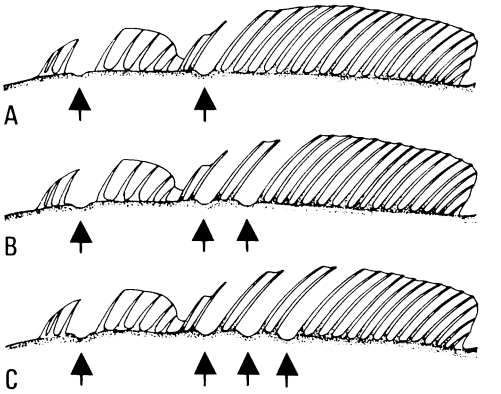

Fig. 1. Dorsal fins of *Cottus hangiongensis* indicating coded spine and ray clipping used to identify individuals. Arrows indicate positions of spine or ray removed. A, a fish designated as IV: 3; B, a fish designated as IV: 3, 6; C, a fish designated as IV: 3, 6, 9.

For example, an individual had its 4th spine and 3rd ray removed and was designated as IV: 3 (Fig. 1A). Similarly, the individual designated as IV: 3, 6 had its 4th spine and 3rd and 6th rays removed (Fig. 1B) and the individual designated as IV: 3, 6, 9 had its 4th spine and 3rd, 6th and 9th rays removed (Fig. 1C). In this way, sculpins captured were marked methodically with various dorsal-spine and -ray combinations. After marking, an antibiotic (Chlomy-p ointment, Sankyo Co., Ltd.) was applied to the wounds of all spine- and ray-clipped individuals, and then the individuals were released at the various sampling sites. At the end of the study, the number of

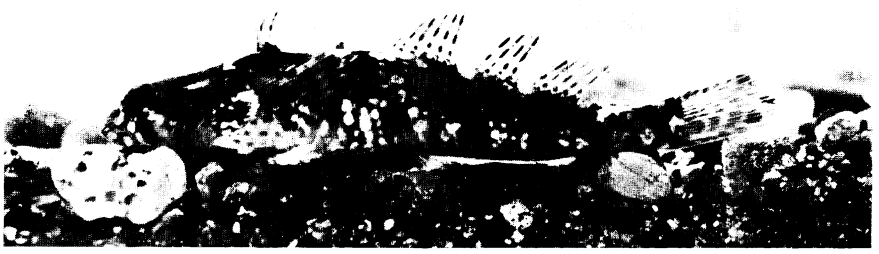

Fig. 2. A female fish which was designated as IV-: 7, 12, 18, and recaptured at about 7 months after marking. The body length was 62.2 mm at time of recapture.

individuals marked amounted to an approximate total of 2,500.

Results

Recapture of marked sculpins was attempted at intervals of various months more than one month after marking. Whenever they were recaptured, the coded marks on individuals were so distinct that individual sculpins could be distinguished. For example, a small female of 62.2 mm in body length, designated as IV-: 7, 12, 18, of which spines from 4th to 9th and 7th, 12th and 18th rays were clipped on December 3, 1983, was recaptured on July 11, 1984 (Fig. 2). In this case, the marking was clearly readable as IV-: 7, 12, 18, despite the fact that 7 months had passed since marking. In general, 3 months or more after marking, the rays on both sides of the clipped ray were inclined to adhere to each other fused by fin membrane. Although fused together, the marks were readable without error in most cases. Fifteen individuals were recaptured and identified 12 months or more after marking, and 14 months was the longest duration for marks recorded at the end of this study (Table 1).

An example of a mark-recapture summary of *C. hangiongensis* studied during the non-breeding season from October, 1983 to March, 1984 in a section of the Daitobetsu River is shown in Table 2. A total of 245 individuals was marked during the period. The proportion of recaptures in catches varied from 16.0% to 28.8%, with an average of 23.8%. Fifty-seven individuals (23.3%) were recaptured at least once. Six individuals (2.4%) were recaptured more than once.

Table 1. Fish recaptured and identified by marks 12 months or more after marking.

Designation of fish marked*	Sex	Date of marking	BL at marking (mm)	Date of recapture	BL at recapture (mm)
IV-: 5	Male	8 Oct. 1983	95.4	18 Dec. 1984	96.8
IV-: 5, 12	Female	8 Oct. 1983	84.5	20 Oct. 1984	84.9
IV-: 7, 14	Male	8 Oct. 1983	136.2	24 Dec. 1984	136.7
IV-: 9, 17	Male	5 Nov. 1983	96.4	17 Nov. 1984	98.9
IV-: 3, 9, 12	Female	5 Nov. 1983	80.7	17 Nov. 1984	84.2
V-: 10, 15	Male	12 Nov. 1983	95.6	19 Nov. 1984	102.6
V-: 4, 9, 18	Female	12 Nov. 1983	92.6	19 Nov. 1984	93.7
V-: 4, 10, 17	Female	12 Nov. 1983	96.0	19 Dec. 1984	96.4
V-: 4, 11, 15	Female	12 Nov. 1983	86.8	19 Dec. 1984	90.8
V-: 6, 11, 14	Female	7 Dec. 1983	94.5	21 Dec. 1984	97.2
VI-: 3, 12	Female	15 Oct. 1983	81.0	21 Dec. 1984	82.9
VI-: 6, 12	Female	15 Oct. 1983	96.7	21 Dec. 1984	100.7
VI-: 8, 12	Female	14 Nov. 1983	87.0	20 Nov. 1984	91.2
VII-: 3	Male	26 Oct. 1983	73.6	11 Dec. 1984	107.5
VII-: 4, 11	Male	26 Oct. 1983	100.1	18 Dec. 1984	104.3

* Bars at the right side of Roman numerals indicate that all spines behind the numerals were also removed.

Table 2. Summary of a mark-recapture study of *Cottus hangiongensis* during the non-breeding season in a section of the Daitobetsu River.

	11 Oct.	12 Nov.	7 Dec.	10 Mar.	Sum	$\bar{x}$
No. of fish caught	75	119	111	45	350	87.5
No. of unmarked fish	75	100	79	33	287	71.8
No. of recaptures	—	19	32	12	63	21.0
No. of first time recaptures	—	19	27	11	57	19.0
No. of fish marked	75	95	75	—	245	81.7
Proportion of recaptures in catch	—	0.160	0.288	0.267		0.238
Proportion of marked population caught	—	0.253	0.188	0.049		0.163
Cumulative proportion of marked population caught	—	0.253	0.271	0.233		

Discussion

Welch and Mills (1981) listed 11 criteria for the ideal fish marks after Arnold (1966). The most important criteria listed were that the marks should remain unaltered for the lifetime of the fish; should not be a health hazard to the fish; should not have an effect on behavior, growth and vulnerability to predation; and should be inexpensive and readily available. Also, another important criterion, though not listed, should be that the mark is usable for identification of as many individual fish as possible.

As far as the hitherto mentioned individual marking methods by fin or fin spine removal or scarring of fin ray are concerned, it has been pointed out that those methods have several disadvantages. In rainbow trout, for example, fin removal can have moderate to severe effects upon probability of survival (Nicola and Cordone, 1973). In the spiny-rayed fish *Tilapia,* spine removal is subject to spine regeneration on fish less than about 15 cm in length (Rinne, 1976). Individual marking by scarring soft fin ray, which was used on lake trout and Arctic char, has the disadvantage of a relatively high error rate when reading marks (Welch and Mills, 1981).

The advantages of the present individual marking method are that it is cheaply and easily done and permanent if spines and rays are removed at the extreme proximal end. In the river sculpin *C. hangiongensis,* it is possible to mark up to 4,200 individuals simply by increasing the combinations of dorsal-spine and -ray clipping by multiplying 327 individuals by 13 cases. The former number indicates the number of individuals marked by combinations of clipping less than 3 rays in the 2nd dorsal fin and the latter shows the number of combinations by clipping less than 2 spines on the 1st dorsal fin. The method is also unlikely to have any lasting effect on behavior and health of the sculpin. The main disadvantage of this method is that it is technically very difficult to remove the spines or rays from sculpin smaller than 50 mm in body length. For relatively large individuals, however, this method may be applicable to studies on population estimates, individual growth rate, life history, and characteristics of an individual sculpin, because of relatively high recapture rates as shown in Table 2. Further, it may be usable on other spinyrayed fishes such as gobiid fishes.

Acknowledgments

I wish to thank Drs. Keikichi Hamada and Fumio Yamazaki, Faculty of Fisheries, Hokkaido University, for their valuable advice. Thanks are also offered to my coworkers at Hokkaido University, Messrs. Tatsuyoshi Hirata, Kazuya Usui, Shinya Ogasawara and Teruaki Inarimori for their kind cooperation. This work was partly supported by Grant-in-Aid for Scientific Research (No. 57340035) and Special Project Research on Biological Aspects of Optimal Strategy and Social Structure (No. 58121004) from the Japanese Minis-

try of Education, Science and Culture.

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淡水カジカ類の背鰭棘及び軟条の除去による個体識別

後藤　晃

淡水カジカ類の一種カンキョウカジカの第1背鰭棘と第2背鰭軟条にそれぞれコード番号を符した後，それらを組み合わせて除去することによって個体識別する方法を考案し，またそれを自然河川個体群に適用することによって有効性を検討した．その結果，本マーキング法は体長 50 mm 以上の個体に容易に用いることが出来，魚の運動能力にほとんど影響を与えることがなく，組み合わせによっては数千個体の識別が可能であり，かつ，永久マークとなるので極めて有効なマーキングの方法であると判断された．

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