Short Paper

First record of *Anguilla japonica* Glass Eel Collected in the Kuroshio Current

Yoshitaka Sakakura,*¹ Youichi Tsukamoto,*² Katsumi Tsukamoto,*¹
and Munuo Okiyama*¹

*¹Ocean Research Institute, The University of Tokyo, Nakano,
Tokyo 164, Japan

*²National Research Institute of Fisheries Science, Kanazawa,
Yokohama, Kanagawa 236, Japan

(Received July 14, 1995)

Key words: *Anguilla japonica*, glass eel, Kuroshio Current, metamorphosis, otolith, early life history, inshore migration

A greater understanding of the early life history of the Japanese eel *Anguilla japonica* has been gained as a result of the capture of small leptocephali and the discovery of a possible spawning area in the mid Philippine Sea.^{1,2)} However, information about the process of inshore migration of a billion glass eels that recruit annually to the coastal waters of Japan is still scarce. A total of 9 glass eels have been collected offshore on the west side of the Kuroshio Current^{3–7)} (Fig. 1). We collected a glass eel of *Anguilla japonica* in the flow axis of the Kuroshio Current during a cruise of R/V Tansei-Mar (KT-94-2) of the Ocean Research Institute, The University of Tokyo. This is the first record of glass eel caught within the Kuroshio Current.

The specimen was collected during an oblique tow of 10-foot IKMT (1.0 mm mesh size; deepest towed depth, 207 m) made offshore of Cape Ashizuri (31°54.8'N, 132°24.4'E) at 17:43–18:45 on February 7, 1994 (Fig. 1). Surface water temperature was 20.6°C, and the collection location was determined to be in the main flow axis of the Kuroshio Current based on reports of the hydrographic department, Marine Safety Agency of Japan.⁸⁾ The specimen was immediately frozen at –85°C, and after 3 months it was fixed for 1 hour in 5% buffered formalin to allow morphological observation before being transferred to 70% ethyl alcohol for preservation.

Measurements in mm were: Total length 56.9 (57.1 before fixation), standard length 55.6, head length 5.0, snout length 1.3, upper jaw length 1.8, eye diameter 0.5, predorsal length 31.5, preanal length 34.1, body depth just before eye 1.8, at pectoral 2.0, at anus (maximum) 2.5. Total myomeres were 117, predorsal 27, preanal 37, dorsal fin rays 249, anal fin rays 202, caudal 1+2+2+2+1=10. Teeth were absent, and the head was relatively short, 8.9% of TL. The lower jaw was protruding slightly in front of the tip of the upper jaw. Punctate melanophores were present on the lateral side of the posterior end of the tail. Based on the limited distribution of genus *Anguilla* around Japan (only *A. japonica* and *A. marmorata*) and these characteristics of body form, pigmentation and especially myomere counts, the present specimen was easily identified as *Anguilla japonica*.⁹⁾ This specimen (TL, 57.1 mm) was smaller than the largest and oldest leptocephalus

(TL, 58.2 mm) ever reported,¹⁰⁾ and was in the middle of the size range of offshore glass eels, which range from 53.0 to 61.2 mm.^{3–7)}

The sagittal otolith was extracted and the age was determined by counting otolith increments using the methods of Tsukamoto.¹¹⁾ The specimen was collected 97 days after hatching and the estimated birthdate was 3 November, 1993, which was in the late spawning season.¹²⁾ The sagittal diameter was 295 µm, with a 12 µm diameter dark opaque core. There were 28 wide incremental zones outside the increment of age 51 days and 18 narrow increments outside the wide incremental zone. This suggests that the present specimen was collected 18 days after metamorphosis, because the wide incremental zone is thought to correspond to the period of metamorphosis.^{12,13)}

All four previously collected metamorphosing leptocephali were from the east of Taiwan, i.e. waters east of the origin of the Kuroshio Current^{10,14–16)} (Fig. 1). Total lengths and ages of glass eels caught along the Japanese coast were about 55 mm and 120 days respectively.¹⁷⁾

Fig. 1. Sites of *Anguilla japonica* glass eels collected offshore.

Asterisk shows the collection site of the present specimen. Open circles indicate previous collection sites of glass eels^{3–7)} and solid squares, of metamorphosing leptocephali.^{10,14–16)} Shaded line indicates the flow axis of the Kuroshio Current at the present collection.⁸⁾

These facts and our present otolith examination suggest the possibility that metamorphosis of *Anguilla japonica* may begin near the origin of the Kuroshio Current, and end during the passive transport in the Kuroshio Current. If this is the case, the timing of metamorphosis of *Anguilla japonica* seems different from that of the European eel *Anguilla anguilla*, in which metamorphosis is suggested to begin after detrainment from the current.¹⁸⁾ Despite being only one individual, this record provides important ecological information on the timing of metamorphosis and the process of inshore migration of this species. One reason postmetamorphic glass eels have never been collected in the flow axis of the Kuroshio Current may be the development of stronger swimming and net avoidance ability after metamorphosis.¹⁹⁾

The authors are grateful to the crew of R/V Tansei-Maru of the Ocean Research Institute, The University of Tokyo for their assistance. We thank Dr. Michael J. Miller for critically reading the manuscript. Y. Sakakura was partly supported by the Fellowships of the Japan Society for the Promotion of Science for Japanese Junior Scientists.

References

- 1) K. Tsukamoto: *Nature*, **356**, 789–791 (1992).
- 2) S. Kimura, K. Tsukamoto, and T. Sugimoto: *Marine Biology*, **119**, 185–190 (1994).
- 3) O. Tabeta and T. Takai: *J. Shimonoseki Univ. Fish.*, **22**, 1–5 (1973).
- 4) Y. Shojima: *Zool. Mag.*, **76**, 167–171 (1967).
- 5) Y. Shojima: *Nippon Suisan Gakkaishi*, **32**, 41–44 (1966).
- 6) Y. Shojima: *Suisan Gijyutsu to Keiei*, **36**, 18–28 (1990) (in Japanese).
- 7) O. Tabeta: *Kaiyo to Seibutsu (Aquabiology)*, **3**, 412–417 (1981) (in Japanese).
- 8) Marine Safety Agency of Japan: *Reports of the hydrographic department, Marine Safety Agency of Japan*, 1994.
- 9) W. Ege: *Danna Report*, **16**, 1–127 (1939).
- 10) Y. Tsukamoto, A. Umezawa, K. Tsukamoto, and M. Okiyama: *Nippon Suisan Gakkaishi*, **58**, 2209 (1992).
- 11) K. Tsukamoto: *Nippon Suisan Gakkaishi*, **55**, 1017–1021 (1989).
- 12) K. Tsukamoto: *J. Fish Biol.*, **36**, 659–671 (1990).
- 13) O. Tabeta, K. Tanaka, J. Yamada, and W.-N. Tzeng: *Nippon Suisan Gakkaishi*, **53**, 1727–1734 (1987).
- 14) O. Tabeta and T. Takai: *Nippon Suisan Gakkaishi*, **41**, 137–145 (1975).
- 15) O. Tabeta and T. Takai: *Japan. J. Ichthyol.*, **22**, 100–103 (1975).
- 16) S. Tanaka: *Nippon Suisan Gakkaishi*, **41**, 129–136 (1975).
- 17) A. Umezawa: Ph.D thesis, The University of Tokyo, Tokyo, 1991, p. 173 (in Japanese).
- 18) F. Tesch: in “The Eel, Biology and Management of Anguillid Eels” (ed. by F. Tesch), Chapman and Hall, New York, 1977, pp. 133–240.
- 19) K. Tsukamoto and A. Umezawa: *La mer*, **28**, 188–198 (1990).