

## Distribution of Leptocephali and Other Fish Larvae around the Tanegashima Island, with Special Reference to the Coastal Migration of *Anguilla japonica*

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Received October 30, 1992

**Abstract** A total of 242 non-anguillid leptocephali was collected in the coastal water (20-60 m deep) around the Tanegashima Island, especially in the southern and western coasts. The dominant was *Gnathophis nystromi nystromi* (54.5%). The species was caught in any depth and at any time in the coastal water. Many oceanic larvae and juveniles of non-Anguilliformes fishes were also captured. Hydrographic characteristics including temperature and salinity of the coastal water showed that the water was extremely homogeneous horizontally and vertically, and was very similar with the Kuroshio water in quality. All the data obtained in the present study imply that the Kuroshio Current flows directly into the coastal water of the island and transports many oceanic larvae and juveniles of fish species there. Routes of the coastal migration of *Anguilla japonica* could not be clarified.

**Key-words:** *Anguilla japonica*, coastal migration, fish larvae, Kuroshio Current, leptocephali, Tanegashima Island.

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### INTRODUCTION

A whole life history of the Japanese eel *Anguilla japonica* has remained a mystery even after the spawning area of the Atlantic eels *A. anguilla* and *A. rostrata* had been outlined by SCHMIDT (1922, 1925). Quite recently the spawning area of the Japanese eel has been estimated to be in the North Equatorial Current from 14° to 16°N and 134° to 143°E on the south side of a salinity front by collections of significant numbers of the smallest leptocephali in that area (TSUKAMOTO 1992).

However, both recruitment strategies of the Japanese eel from the spawning area to the Kuroshio Current and from the Kuroshio to coastal waters are still unknown (TSUKAMOTO 1990). The periods are missing links left to be clarified in the life history of the Japanese eel. The present study was planed (1) to know the ichthyofauna surrounding the migrating

routes of *A. japonica*, (2) to clarify the routes, and finally (3) to determined the recruitment mechanisms of the glass eels to coastal waters. In this paper we report preliminarily the collection records of leptocephali and other fish larvae during two cruises conducted in 1991 around the Tanegashima Island.

## MATERIALS AND METHODS

Samplings were carried out during TS-91-10 cruise of T.V. Toyoshio Maru of Hiroshima University between November 7 and 15, and during KT-91-16 cruise of R.V. Tansei Maru of Ocean Research Institute, University of Tokyo between December 6 and 18. Three main collecting lines were placed at right angles to coastal lines of the east, south and west coasts of the Tanegashima Island and some supplemental collecting lines were also used (Fig. 1). Fish was

collected by several consecutive oblique tows between bottom and surface and step tows with 6 ft. and 10 ft. Issacs-Kidd Midwater Trawl (IKMT, mesh aperture 1.0 mm), and horizontal surface and bottom tows with a larva net (mesh aperture 0.33 mm, mouth opening 1.33 m<sup>2</sup>), an ORI net (mesh aperture 1.0 mm, mouth opening 2.00 m<sup>2</sup>) and a 1.45 m sleigh net (mesh aperture 0.33 mm) for 15-20 min by day and night (Tables 1 and 2). Wire length of the oblique tows, step tows and bottom tows were 40-190 m. Step tows were conducted in the three depths (surface, middle and bottom; each 10 min). Six dredges (0.5 m span-ORI type, mesh aperture 4.0 mm) were also carried out in the place of 30-130 m deep (Table 2). Water temperature and salinity were measured with STD or CTD at every 1 m from the surface to the bottom at each station.

At night on November 12th and December 11th, collection of *Anguilla* glass eels approaching the river mouth was carried out with a hand-net along the Nagahama

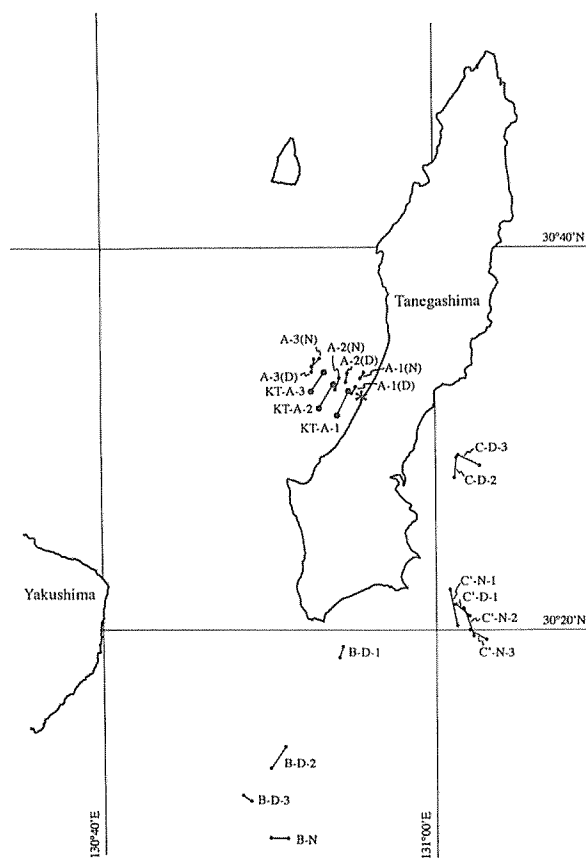


Fig. 1 Sampling stations in the present study. St-As and St-KT-As were located at the mouth of the Ihara River (asterisks). St-Bs and St-Cs were located in the southern and the eastern coasts of the Tanegashima Island, respectively. Sampling areas in the eastern coast were shifted south on account of stormy weather and the stations were named St-C's. St-KT-As were surveyed in KT-91-16 and other stations were used in TS-91-10.

Table 1. Collection data of Anguilliformes leptocephali in TS-91-10.

Date	Station	Location		Depth (m)	Time		Net-type	Towing method	Wire out (m)	Number of Leptocephali
		Latitude	Longitude		In	Out				
9 Nov 1991	B-D-3	30°11'04	130°48'80	112	13 : 37	13 : 59	IKMT	Oblique	220	1
		30°11'30	130°48'11	114-107	14 : 02	14 : 17	Larva	Surface	—	0
	B-D-2	30°12'74	130°49'70	65-57	14 : 32	14 : 54	IKMT	Oblique	120	3
		30°12'85	130°49'81	65-59	14 : 36	14 : 51	Larva	Surface	—	0
	B-D-1	30°19'13	130°54'25	41-35	15 : 45	15 : 58	IKMT	Oblique	80	0
		30°19'13	130°54'25	41-35	15 : 47	16 : 02	Larva	Surface	—	26
B-N	30°09'46	130°50'46	99-75	19 : 43	20 : 08	IKMT	Oblique	190	3	
	30°07'62	130°49'55	99-75	20 : 13	20 : 28	Larva	Surface	—	0	
10 Nov 1991	C-D-3	30°28'55	131°02'64	108-80	09 : 30	09 : 52	IKMT	Oblique	220	0
		30°28'62	131°02'48	108-80	09 : 33	09 : 48	Larva	Surface	—	0
	C-D-2	30°29'02	131°01'81	92-85	10 : 07	10 : 16	Sleigh	Bottom	200	0
		30°29'29	131°01'13	69-62	11 : 08	11 : 18	Sleigh	Bottom	200	0
	C'-D-1	30°29'16	131°01'44	71-56	11 : 29	11 : 42	IKMT	Oblique	120	0
		30°29'20	131°01'26	62	11 : 32	11 : 47	Larva	Surface	—	0
	C'-N-3	30°21'39	131°01'21	75-35	13 : 21	13 : 37	IKMT	Oblique	130	0
		30°21'34	131°01'28	75-35	13 : 23	13 : 38	Larva	Surface	—	0
	C'-N-2	30°21'66	131°00'85	40	13 : 53	14 : 03	Sleigh	Bottom	120	0
		30°19'47	131°02'93	102-85	17 : 45	18 : 03	IKMT	Oblique	180	0
	C'-N-1	30°19'73	131°02'86	102-85	17 : 46	18 : 01	Larva	Surface	—	0
		30°19'65	131°02'24	88-61	18 : 33	18 : 50	IKMT	Oblique	150	0
13 Nov 1991	A-3(D)	30°21'41	131°01'61	61	18 : 54	19 : 09	Larva	Surface	—	0
		30°22'08	131°00'71	59-40	19 : 25	19 : 35	IKMT	Oblique	100	0
	A-3(N)	30°21'98	131°00'72	59-40	19 : 26	19 : 42	Larva	Surface	—	0
		30°34'20	130°52'78	54	14 : 03	14 : 19	IKMT	Oblique	120	1
	A-3(N)a	30°34'14	130°52'76	54	14 : 05	14 : 20	Larva	Surface	—	0
		30°34'18	130°53'26	45	15 : 03	15 : 23	Sleigh	Bottom	200	0
	A-3(N)b	30°33'69	130°52'52	53-51	18 : 48	19 : 00	IKMT	Oblique	100	0
		30°33'92	130°52'72	53-47	18 : 54	19 : 10	Larva	Surface	—	0
	A-3(N)c	30°33'99	130°53'16	47-46	19 : 15	19 : 36	Sleigh	Bottom	150	0
		30°32'37	130°54'96	24-18	20 : 25	20 : 45	Larva	Surface	—	0
	A-3(N)d	30°33'46	130°54'85	29-28	20 : 52	21 : 12	Larva	Surface	—	0
		30°32'53	130°53'57	38-33	21 : 21	21 : 41	Larva	Surface	—	0
A-3(N)e	30°33'51	130°53'48	48-44	21 : 48	22 : 08	Larva	Surface	—	3	
	30°32'55	130°52'11	54-50	22 : 16	22 : 36	Larva	Surface	—	1	
A-3(N)f	30°33'57	130°52'28	53-51	22 : 43	23 : 03	Larva	Surface	—	2	
	30°32'41	130°54'90	20-19	09 : 42	09 : 47	IKMT	Oblique	40	0	
14 Nov 1991	A-1(D)	30°32'59	130°55'00	24-19	09 : 45	10 : 00	Larva	Surface	—	1
		30°32'79	130°55'23	21-19	10 : 09	10 : 26	Sleigh	Bottom	70	0
	A-2(D)	30°32'47	130°55'11	23	10 : 35	10 : 55	Sleigh	Bottom	70	0
		30°32'77	130°54'22	32-30	12 : 12	12 : 30	Sleigh	Bottom	90	0
	A-1(D)	30°32'34	130°54'04	30	12 : 38	12 : 54	Sleigh	Bottom	90	0
		30°32'96	130°54'44	28	13 : 02	13 : 12	IKMT	Oblique	60	0
	A-2(D)	30°33'22	130°54'52	28	13 : 07	13 : 22	Larva	Surface	—	1
		30°32'08	130°54'69	19	14 : 30	14 : 35	Larva	Oblique	40	0
	A-3(D)	30°32'86	130°54'26	31	14 : 45	14 : 51	Larva	Oblique	60	0
		30°33'77	130°52'49	54	15 : 04	15 : 14	Larva	Oblique	100	2
	A-2(N)	30°33'05	130°54'18	33	17 : 45	18 : 00	Larva	Surface	—	2
		30°32'59	130°53'82	33-32	18 : 05	18 : 14	IKMT	Oblique	60	1
A-1(N)	30°33'25	130°54'33	31	18 : 21	18 : 41	Sleigh	Bottom	100	0	
	30°33'41	130°55'55	18	18 : 53	19 : 00	IKMT	Oblique	40	0	
A-1(N)a	30°33'31	130°55'47	20-18	18 : 56	19 : 10	Larva	Surface	—	3	
	30°32'62	130°54'94	21-18	19 : 14	19 : 34	Sleigh	Bottom	70	0	
A-1(N)b	30°31'87	130°54'52	19	20 : 30	20 : 50	Larva	Surface	—	1	
	30°32'93	130°54'73	27	20 : 54	21 : 14	Larva	Surface	—	2	
A-1(N)c	30°32'41	130°53'54	38	21 : 21	21 : 49	Larva	Surface	—	4	
	30°33'57	130°53'50	47	21 : 47	22 : 07	Larva	Surface	—	1	
A-1(N)d	30°32'78	130°52'28	52	22 : 12	22 : 32	Larva	Surface	—	0	
	30°33'85	130°52'51	55	22 : 38	22 : 58	Larva	Surface	—	0	

Table 2. Collection data of Anguilliformes leptocephali in KT-91-16.

Date	Station	Location		Depth (m)	Time		Net-type	Towing method	Wire out (m)	Number of Leptocephali	
		Latitude	Longitude		In	Out					
10 Dec 1991	KT-A-3(D)	30°32' 35	130°52' 65	48-43	13 : 07	13 : 43	IKMT	Step	88	11	
		30°32' 59	130°52' 83	48-46	13 : 13	13 : 33	ORI	Surface	—	0	
	KT-A-2(D)	30°33' 60	130°53' 31	46	13 : 50	14 : 07	Dredge	Bottom	87	0	
		30°32' 81	130°53' 96	38-33	14 : 26	15 : 01	IKMT	Step	36	6	
		30°32' 56	130°53' 82	37-32	14 : 30	14 : 50	ORI	Surface	—	0	
	KT-A-1(D)	30°31' 54	130°53' 01	38	15 : 06	15 : 17	Dredge	Bottom	78	0	
		30°31' 33	130°54' 16	20-18	15 : 36	16 : 12	IKMT	Step	38	0	
		30°31' 48	130°54' 27	20-19	15 : 39	15 : 59	ORI	Surface	—	0	
	KT-A-3(N)	30°32' 30	130°54' 88	17	16 : 18	16 : 25	Dredge	Bottom	30	0	
		30°33' 26	130°53' 15	51-45	18 : 15	18 : 51	IKMT	Step	88	52	
		30°33' 10	130°53' 09	46	18 : 19	18 : 29	ORI	Surface	—	0	
	KT-A-2(N)	30°32' 00	130°52' 51	51	18 : 59	19 : 07	Dredge	Bottom	132	0	
		30°31' 82	130°53' 34	35-31	19 : 23	19 : 57	IKMT	Step	83	14	
		30°32' 00	130°53' 51	33-32	19 : 25	19 : 45	ORI	Surface	—	0	
	KT-A-1(N)	30°33' 03	130°54' 18	31	20 : 03	20 : 09	Dredge	Bottom	85	0	
		30°32' 61	130°55' 09	20-18	20 : 24	20 : 57	IKMT	Step	38	19	
		30°32' 49	130°54' 96	20	20 : 27	20 : 47	ORI	Surface	—	3	
	11 Dec 1991	KT-A-3(D)	30°31' 22	130°54' 11	21	21 : 00	21 : 07	Dredge	Bottom	—	0
30°33' 46			130°53' 17	52-45	09 : 25	10 : 01	IKMT	Step	88	7	
KT-A-2(D)		30°32' 14	130°52' 65	52-45	10 : 04	10 : 24	ORI	Surface	—	0	
		30°31' 53	130°53' 17	34-30	10 : 42	11 : 16	IKMT	Step	83	9	
		30°31' 71	130°54' 42	30-26	11 : 20	11 : 41	ORI	Surface	—	2	
KT-A-1(D)		30°32' 66	130°54' 86	34-20	11 : 52	12 : 22	IKMT	Step	38	3	
		30°32' 67	130°53' 60	50-37	12 : 30	12 : 50	ORI	Surface	—	3	
14 Dec 1991		KT-A-3(N)	30°33' 29	130°53' 21	45-42	21 : 48	22 : 22	IKMT	Step	88	13
			30°32' 99	130°53' 07	44	21 : 55	22 : 15	ORI	Surface	—	3
		KT-A-2(N)	30°31' 90	130°53' 32	32	22 : 35	23 : 09	IKMT	Step	63	9
			30°31' 97	130°53' 38	32	22 : 37	22 : 57	ORI	Surface	—	0
		KT-A-1(N)	30°32' 55	130°54' 97	19-18	23 : 21	23 : 55	IKMT	Step	38	7
			30°32' 48	130°54' 91	18	23 : 23	23 : 43	ORI	Surface	—	2
15 Dec 1991		KT-A-3(D)	30°33' 23	130°53' 05	46-44	08 : 45	09 : 18	IKMT	Step	88	7
			30°32' 99	130°52' 98	45-44	08 : 47	09 : 07	ORI	Surface	—	0
		KT-A-2(D)	30°31' 87	130°53' 91	35-32	09 : 31	10 : 04	IKMT	Step	63	2
			30°31' 98	130°53' 35	35-32	09 : 33	09 : 53	ORI	Surface	—	0
		KT-A-1(D)	30°32' 57	130°54' 19	21-19	10 : 26	11 : 00	IKMT	Step	38	3
	30°32' 50		130°55' 00	21-20	10 : 28	10 : 48	ORI	Surface	—	0	
	KT-A-(D)a	30°30' 50	130°54' 00	18-17	13 : 02	13 : 23	ORI	Near Bottom	30	0	
		b	30°30' 90	130°54' 30	18-15	13 : 21	13 : 40	ORI	Near Bottom	55	0
		c	30°31' 90	130°55' 00	16-15	13 : 47	14 : 02	ORI	Near Bottom	65	0
		d	30°32' 60	130°55' 30	17-16	14 : 10	14 : 28	ORI	Near Bottom	60	0
	KT-A-(N)a	30°31' 70	130°55' 34	11	17 : 01	17 : 25	ORI	Near Bottom	60	0	
		b	30°31' 98	130°55' 54	10	17 : 29	17 : 53	ORI	Near Bottom	60	0
c		30°30' 67	130°54' 67	10	18 : 23	18 : 45	ORI	Near Bottom	60	0	
d		30°31' 84	130°55' 43	10-9	18 : 51	19 : 13	ORI	Near Bottom	60	0	
e		30°31' 91	130°54' 61	27-24	19 : 41	20 : 06	ORI	Near Bottom	90	1	
f		30°32' 51	130°52' 78	49-46	20 : 33	20 : 55	ORI	Near Bottom	150	7	

Beach besides the mouth of the Ihara River (facing to the collecting line A) (asterisk in Fig. 1).

Leptocephali and fish larvae were preserved in 10% neutralized formalin. Identification of leptocephali and fish larvae was from OKIYAMA (1988).

## RESULTS AND DISCUSSION

A total of 242 Anguilliformes leptocephali were collected by step and oblique tows of IKMT during day- and night-time, and by horizontal surface and bottom tows of the larva

net and the ORI net during night time at the stations around the Tanegashima Island (Tables 1-4). However, no anguillid leptocephali and glass-eels were found among them. The depth of each station was ranged 10-114 m. All the leptocephali were belonged to the order Anguilliformes including Congridae, Dysommataidae, Muraenidae, Nettastomatidae and Ophichthidae (Tables 3 and 4). Congridae consisted of *Gnathophis nystromi nystromi* (132 specimens), *Ariosoma*-sps. including sp.5, sp.7 and others (45 specimens) and Congrinae-sps. including Congrinae sp.1 and others (7 specimens) (Tables 3 and 4). Dysommataidae specimens were identified to be *D. anguillare*. Nettastomatidae were *S. lateromaculatus* and *S. stylurus*. Others were identified to spp. levels.

*G. n. nystromi* is a dominant species among the leptocephali collected in the present study, and occupies 41% and 56% of the total catches in TS-91-10 and KT-91-16, respectively. The species was collected at most stations in the western and southern coasts of the island of 20-60 m deep by surface tows and oblique or step tows during both day- and night-time. Many *G. n. nystromi* had been collected in the open sea and the Kuroshio Current (TABETA and MOCHIOKA 1988, UEMATSU et al. 1990). Upon these observations, we

Table 3. List of Anguilliformes leptocephali collected in TS-91-10.

Date	Station	Gear	<i>Dysomma anguillare</i>	<i>Ariosoma</i> sp.7	<i>Ariosoma</i> spp.	<i>Gnathophis nystromi nystromi</i>	Congrinae sp.1	<i>Myrophinae</i> sp.1	Total	
9 Nov 1991	B-D-3	IKMT			1				1	
	B-D-2	IKMT			2		1		3	
	B-D-1	Larva		5	16	5			26	
	B-N	IKMT	1	2					3	
13 Nov 1991	A-3(D)	IKMT			1				1	
	A-3(N)d	Larva				3			3	
	A-3(N)e	Larva				1			1	
	A-3(N)f	Larva	1			1			2	
14 Nov 1991	A-2(D)	Larva				1			1	
	A-1(D)	Larva						1	1	
	A-3(D)	Larva		1		1			2	
	A-2(N)	Larva				2			2	
		IKMT		1					1	
	A-1(N)	Larva				3			3	
	A-1(N)a	Larva				1			1	
	A-1(N)b	Larva				2			2	
	A-1(N)c	Larva				4			4	
	A-1(N)d	Larva				1			1	
	Total			2	9	21	24	1	1	58

Table 4. List of Anguilliformes leptocephali collected in KT-91-16.

Date	Station	Gear	<i>Muraenidae</i> spp.	<i>Dysommma anguillare</i>	<i>Ariosoma</i> sp.5	<i>Ariosoma</i> sp.7	<i>Ariosoma</i> spp.	<i>Gnathophis nystromi nystromi</i>	<i>Congrinae</i> sp.1	<i>Congrinae</i> spp.	<i>Saurenchelys lateromaculatus</i>	<i>Saurenchelys stylurus</i>	<i>Nettenchelys gephyra</i>	<i>Ophichthinae</i> spp.	Total
10 Dec 1991	KT-A-3(D)	IKMT		1				10							11
	KT-A-2(D)	IKMT	1	1				1				3			6
	KT-A-3(N)	IKMT		10				34			1	5	1	1	52
	KT-A-2(N)	IKMT		3		1	1	9							14
	KT-A-1(N)	IKMT		1				14		1		1		2	19
		ORI						2				1			3
11 Dec 1991	KT-A-3(D)	IKMT		3				4							7
	KT-A-2(D)	IKMT	3		1	1		2	1			1			9
		ORI						2							2
	KT-A-1(D)	IKMT	3												3
		ORI	2					1							3
14 Dec 1991	KT-A-3(N)	IKMT			2	1		7		3				1	14
		ORI		1				2							3
	KT-A-2(N)	IKMT		1		2		3				3			9
	KT-A-1(N)	IKMT				2		4		1					7
		ORI		1				1							2
15 Dec 1991	KT-A-3(D)	IKMT		2		1		4							7
	KT-A-2(D)	IKMT					2								2
	KT-A-1(D)	IKMT	1					1			1				3
	KT-A-(N)e	ORI(Bottom)						1							1
	KT-A-(N)f	ORI(Bottom)					1	6							7
Total			10	24	3	8	4	108	1	5	2	14	1	4	184

speculate that the leptocephali were transported by the Kuroshio Current from the open sea to sea shore around the Tanegashima Island. The results that many oceanic larvae and juveniles of *Bathylagus ochotensis*, *Gonorynchus abbreviatus* and *Myctophiae* spp. were caught in coastal area also support this view (Tables 5-10). Glass eels or leptocephali of the *Anguilla japonica* should also approach the Tanegashima Island along the Kuroshio Current like other fish larvae and juveniles. Most leptocephali usually distribute in the surface layer shallower than 100 m in the ocean (CASTONGUAY and MCCLEAVE 1987). Water temperature in the stations measures ranged between 22.7-24.3°C in TS-91-10 and between 20.2-22.1°C in KT-91-16, and vertical differences were usually smaller than 0.3 degrees in every station shallower than 100 m. Salinity in the survey area was constant vertically and horizontally and ranged between 34.5-34.7‰ in TS-91-10 and between 34.6-34.9‰ in KT-91-16. The distribution of the leptocephali, and the horizontally and vertically constant

Table 5. A list of non-Anguilliform fish larvae collected by the IKMT net in TS-91-10.

Family	9 Nov 1991			10 Nov 1991					13 Nov 1991			14 Nov 1991			Total		
	B-D-3	B-D-2	B-D-1	B-N-2	C-D-3	C-D-2	C-D-1	C-N-3	C-N-2	C-N-1	A-3(D)	A-3(N)	A-1(D)	A-2(D)		A-2(N)	A-1(N)
Gonostomatidae		2		4	1			2									9
Melanostomiidae				1													1
Synodontidae				3													3
Notosudidae		2		3													5
Myctophidae	1	2		4					1	1		1		1	1		12
Labridae		1				1					1					1	4
Acanthuridae				1													1
Scorpaenidae	1			1								1				1	4
Bothidae		2		1				1				1				1	6
Tetradontidae														1			1
Total	2	9	0	18	1	1	0	3	1	1	1	3	0	2	1	3	46

temperature and salinity in the survey area may imply that the surface water of the Kuroshio containing leptocephali might be thrust into shallower coastal area as approaching the island, since the temperature and salinity of the Kuroshio Current between 0-100 m depth were similar values as those observed during the two cruise (temperature and salinity in October, 1988\*, and temperature in November and December, 1991\*\*).

More than 600 *Anguilla* glass eels were collected at the Nagahama Beach by four persons between 19:30 and 20:30 on November 12. Seven lightly pigmented glass eels were also collected from bottom sand in the Ihara River at a point about 100 m up the river mouth on 11th December. Although we failed in collection of *Anguilla* glass eels on board in spite of our desperate collecting efforts, recruiting glass eels had been approached the beach keeping away from our fishing gears. New collecting devices alternative to the bottom dredge and the bottom larva net must be needed.

**Acknowledgement** We thank T. SHIMA, K. HIRAHARA, A. NAKAJIMA, A. WANISHI, M. YAMADA, S. ABE, Y. KONDO, C. MUROMOTO, H. TOMODA, T. YASUOKA, students of Faculty of Applied Biological Science, Hiroshima University, and N. MIZUNO of Fisheries Laboratory, the University of Tokyo for their assistance in the cruises. Thanks are also due to the Captain Y. FUKUURA and the crew of R. V. Toyoshio Maru, and the Captain K. UENO and the crew of R. V. Tansei Maru for their kind support at sea.

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\*\* Bi-weekly published reports from the Hydrographic Department, Maritime Safety Agency of Japan, Tokyo.

Table 6. A list of non-Anguilliform fish larvae collected by a larva net in TS-91-10.

Date	9 Nov 1991				10 Nov 1991					13 Nov 1991						
	B-D-3	B-D-2	B-D-1	B-N-2	C-D-3	C-D-2	C-D-1	C-N-3	C-N-2	C-N-1	A-3(D)	A-3(N)	A-3(N)	A-3(N)	a	b
Clupeidae															1	
Engraulidae			2													
Gonostomatidae																
Gonorynchidae	327	65	28	4							9	4	5	9		
Synodontidae		1	34	2	2											
Notosudidae																
Myctophidae			4		2											
Hemiramphidae		1	1													
Exocoetidae	1		4					2				2	1	1		
Macrorhamphosidae																
Sygnathidae																1
Mugilidae	2						2		1		1	1	4	1		
Percichthyidae			1		4	3	2	3								
Apononidae																1
Labracoglossidae																
Caranigidae							1									
Coryphaemidae																
Lethrinidae																
Chaetodontidae																
Pomacentridae										1						
Labridae										1		4				1
Scaridae									14	2	1	11	1	25		
Gobiidae												1				
Uranoscopidae													1	1		
Blenniidae																
Scorpaenidae																1
Platycephalidae																
Bothidae			1													
Monacanthidae																1
Tetradontidae																
Unidentified			1		4						2		1			
Total	330	67	76	6	12	3	5	5	15	4	13	23	15	41		

Table 7. A list of non-Anguilliform fish larvae collected by a sleigh net in TS-91-10.

Date	10 Nov 1991			13 Nov 1991		14 Nov 1991						Total
	C-D-3	C-D-2	C-D-1	A-3(D)	A-3(N)	A-1(D)	A-1(D)	A-2(D)	A-2(D)	A-2(N)	A-1(N)	
Gonostomatidae					2							2
Synodontidae						1						1
Myctophidae				1	4							5
Mugilidae	1											1
Apononidae					1							1
Labridae					5					1		6
Gobiidae										2		2
Mugiloididae	1	2		11	7			1	1	2		25
Scorpaenidae										1		1
Platycephalidae				4								4
Bothidae	2											2
Total	4	2	0	16	19	1	0	0	1	5	2	50



14 Nov 1991																	
A-3(N)	A-3(N)	A-3(N)	A-3(N)	A-1(D)	A-2(D)	A-1(D)	A-2(D)	A-3(D)	A-2(N)	A-1(N)	A-1(N)	A-1(N)	A-1(N)	A-1(N)	A-1(N)	A-1(N)	Total
c	d	e	f			obli.	obli.	obli.			a	b	c	d	e	f	
1																	2
	1	1				2			1					1			8
																3	3
5	6	10	3	6					4	9	6	2	4	11	4	12	533
		1							5		1	1		1		1	49
									1								1
	1			2	1			2	8					1			21
				1													3
		1		3								1	1	1			18
									1								1
									1				2			2	6
				1					1	1	2	1	1				19
									1	3							17
1		1	1						1		1						6
	1																1
		1							2		1						5
													1				1
									1			1					1
	1				1												1
		10	3														3
16	1	70	11	1					27	1		2	5	4	1	2	61
									7	13	16	49	52	23	7	16	336
													1				1
										1				1			3
										1					2		2
										1			2				4
		1			1					1							4
1	1	2			1										1		7
									1								1
	1	1	2							8	5	1		1			27
24	13	99	20	14	6	0	0	2	62	38	32	58	69	44	15	36	1147

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Table 8. A list of non-Anguilliform fish larvae collected by the IKMT net in KT-91-16.

Family	10 Dec 1991			11 Dec 1991					14 Dec 1991			15 Dec 1991			Total	
	KT-A-3(D)	A-2(D)	A-1(D)	A-3(N)	A-2(N)	A-1(N)	A-3(D)	A-2(D)	A-1(D)	A-3(N)	A-2(N)	A-1(N)	A-3(D)	A-2(D)		A-1(D)
Clupeidae				2		3	1						5			11
Engraulidae	31	43	37	122	101	40	29		17	152	137	116	22	22	6	875
Bathylagidae	2	2	6	8	5	18	1		2	74	64	12	5	6		205
Gonostomatidae	10	101	43	122	125	64	69	6	37	107	39	17	83	18	1	842
Cauliodontidae											1	1	1		1	4
Stomiidae				12					6	1	1					20
Astronesthidae	1												1			2
Synodontidae				3	3		2			10	4	1				23
Scopelarchidae		1			2		1									4
Notosudidae	4	9	2	31	9	29	6	1		2	1	3	2		1	100
Myctophidae	53	105	41	122	174	95	95	36	27	155	46	51	39	11	18	1,068
Paralepididae		10	1	6	3		1			5	1	1		2		30
Scomberesocidae												1				1
Macrorhamphosidae	2						2		2	4	1	3			1	15
Bregmacerotidae	10	7	2	5	1		5	4	2	8	3	2	1		1	51
Carapodidae		1											1			2
Mugilidae					1											1
Serranidae		2	1				1									4
Kuhliidae							1						1			2
Priacanthidae									2							2
Labracoglossidae	4					3	1				1					9
Scombroptidae												1	3			4
Carangidae								2					1	2	1	6
Sparidae		2														2
Pomacentridae				2			1									3
Labridae			2	4	2	2	1			4	1					16
Scaridae	1	2		2			2				1	1	1			2
Champsodontidae	4			2	1											7
Gempylidae	4	2	3	2	2		1		2	3	3		1	3	1	27
Trichiuridae		1													1	2
Centrolophidae		2														2
Gobiidae	5			9	8	2	6		1		6	2	1			40
Mugiloididae				1	4						1					6
Scorpaenidae	2			2							2	5				11
Triglidae								1								1
Bothidae		1	1	2		1	3			4		3				15
Soleidae															1	1
Tetraodontidae										1		1				2
unidentified		5		1	5		2	2		3	5	3	2			28
Total	133	296	139	460	446	257	233	50	96	535	319	233	160	64	33	3,454

Table 9. A list of non-Anguilliform fish larvae collected by the ORI net (horizontal, surface) in KT-91-16.

Family	10 Dec 1991					11 Dec 1991					14 Dec 1991			15 Dec 1991			Total
	KT-A-3(D)	A-2(D)	A-1(D)	A-3(N)	A-2(N)	A-1(N)	A-3(D)	A-2(D)	A-1(D)	A-3(N)	A-2(N)	A-1(N)	A-3(D)	A-2(D)	A-1(D)		
Clupeidae												1				1	
Engraulididae			3	12	7	66	1	1	11	6	41	1			1	150	
Bathylagidae			1		2	3			2	3						11	
Gonostomatidae	7	2	1	8	2	68	1	13	5	16	14	6	1		2	146	
Astronesthidae													1			1	
Synodontidae								1						1		2	
Notosudidae				1	1	3										5	
Myctophidae <sup>b</sup>	17	7	20	6	3	20	7	4	3	3	7	2		2		101	
Paralepididae								1								1	
Scomberesocidae	2			1		1				2		3				9	
Exocoetidae											1	1				2	
Macrorhamphosidae	1	1					10	2					4			18	
Bregmacerotidae					1	5		2							2	10	
Ophiidiidae		1						1								2	
Mugilidae						1		1				1				3	
Labracoglossidae									2			1				3	
Scombroptidae													1			1	
Carangidae						1		1		1	4					7	
Girellidae						1							1	2		4	
Sparidae												1				1	
Pomacentridae							1	2	2		1					6	
Labridae				1												1	
Scaridae				3		3										6	
Champsodontidae												1				1	
Gempylidae		1														1	
Trichiuridae	1					1		1			1	1				5	
Centrolophidae												1				1	
Gobiidae						2			1							3	
Scopaenidae						1										1	
Bothidae			1					1					1			3	
unidentified				1		1						1				3	
Total	28	12	26	33	16	177	2	41	18	34	30	70	11	4	7	509	

Tabel 10. A list of non-Anguilliform fish larvae collected by the ORI net (horizontal, bottom) in KT-91-16.

Family	15 Dec 1991										Total
	KT-A-(D)a	A-(D)b	A-(D)c	A-(D)d	A-(N)a	A-(N)b	A-(N)c	A-(N)d	A-(N)e	A-(N)f	
Engraulididae	2	12	4	10	4		24	7	11	67	141
Bathylagidae		6	5	5	1		2		8	4	31
Gonostomatidae		5	2	5			2		12	27	53
Myctophidae		3	1	2			2		3	51	62
Paralepididae		3									3
Macrorhamphosidae										2	2
Bregmacerotidae									1	1	2
Symphysanodontidae		1									1
Carangidae		3									3
Leiognathidae							2				2
Labridae			1						1		2
Gempylidae		1		1						1	3
Gobiidae								2			2
Scopaenidae				1							1
Callionymidae										1	1
Bothidae										2	2
unidentified										3	3
Total	2	34	13	24	5	0	32	9	36	159	314

種子島周辺に出現したレプトケファルス幼生とその他の仔稚魚  
——特に黒潮とニホンウナギの接岸回遊との関連について——

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種子島沿岸での，1991年11月（広島大学豊潮丸）および12月（東京大学淡青丸）の採集により，計242尾のウナギ目レプトケファルス幼生と計5520尾の他目の仔稚魚が採集された。ニホンウナギの幼生は採集されなかった。採集されたレプトケファルス幼生の54.5%をギンアナゴ *Gnathopis nystromi nystromi* が占めた。ギンアナゴ幼生は種子島の西岸および南岸の水深 100-10 m の測点で，水深や昼夜を問わず採集された。ギンアナゴ幼生，および他目の仔稚魚の中で優先したネズミギス *Gonorynchus abbreviatus*・ソコイワシ *Bathylagus ochotensis*・ハダカイワシ科 *Myctophidae* spp. は，いずれも通常は沖合い水域に出現する魚種である。当該海域の水温・塩分濃度は表層から底層まで極めて均一であり，しかも同じ時期の黒潮の水温・塩分濃度とよく一致した。以上より，種子島の西岸と南岸には黒潮水が直接流れ込むことが明らかとなった。沖合い性の仔稚魚は黒潮によって運ばれ，種子島沿岸に達するものと推察される。同時に行なわれた，種子島西海岸長浜なぎさにおける採集では多数のニホンウナギのシラスが採集された。

キーワード：黒潮，接岸回遊，種子島，仔稚魚，ニホンウナギ，レプトケファルス幼生