DISTRIBUTION AND MIGRATION OF TWO SPECIES OF *STENELLA* IN THE PACIFIC COAST OF JAPAN

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ABSTRACT

Distribution and migration of *Stenella coeruleoalba* and *Stenella attenuata* in the Pacific coast of Japan were studied basing on the fishing data and the sighting data, and the relationship between them and the marine environment was discussed. *S. coeruleoalba* and *S. attenuata* are distributed in the pelagic and coastal waters influenced by the warm Kuroshio current. *S. attenuata* is distributed in slightly warmer waters than *S. coeruleoalba* is. Their range of distribution seems to extend up to 46°N in summer season and retreats to 33°N in winter. The concentration of these species in the northern boundary of the Kuroshio current is suggested.

INTRODUCTION

At least three species of *Stenella* are known from Japanese coastal waters. They are the spinner dolphin *S.* cf. *longirostris* (Mizue *et al.*, 1964), the spotted dolphin (Mizue *et al.*, 1962, Nishiwaki *et al.*, 1965) and the blue white dolphin (Okada, 1936, Ogawa, 1936). The first is rare and only known from the southern part of Japan, and the color pattern of these are very similiar to *S.* cf. *longirostris* described by Perrin (1972) from Hawaiian waters. The other two species are fairly common and have been the object of the commercial hunting at several places on the Pacific coast of Japan. These two species are caught at Taiji (33° 36′ N, 135° 56′ E) on the coast of Kii Peninsula, at Arari (34° 48′ N, 138° 46′ E) on the west coast of Izu Peninsula, and at Kawana (34° 57′ N, 139° 08′ E) and Futo (34° 52′ N, 139° 06′ E) on the east coast of Izu Peninsula. The fishermen at Taiji hunt the dolphin with hand harpoon, or with hand harpoon and shot gun off the coast of Kii Peninsula, but they have introduced the driving method since 1973. The people at Arari had captured the various species of dolphins in Suruga Bay with driving method, but the operation has almost ceased since 1962. The two villages on the east coast of Izu Peninsula operate the dolphin hunting with driving method in Sagami Bay and the waters around Oshima Island (Tobayama, 1969, Kasuya, 1972). Details of dolphin fishing is described by Ohsumi (1972).

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Tobayama (1969) analyzed the catch statistics of the two fishermen's cooperative unions at Kawana and Futo, and suggested the influence of the marine topography in the formation of the fishing ground. Howeven, Kasuya (1972) suggested another factor the inflow of warm water into Sagami Bay. Ohsumi (1972) analyzed the official statistics of dolphin fishing prepared by the Ministry of Agriculture and Forestry, and showed an estimated migration route of blue white dolphin.

This study intends to analyze the distribution and migration of *Stenella coeruleoalba* and of *Stenella attenuata*. This analysis is based on the catch records of the fishermen's cooperative unions and sighting records of these species collected by us or reported by various authors.

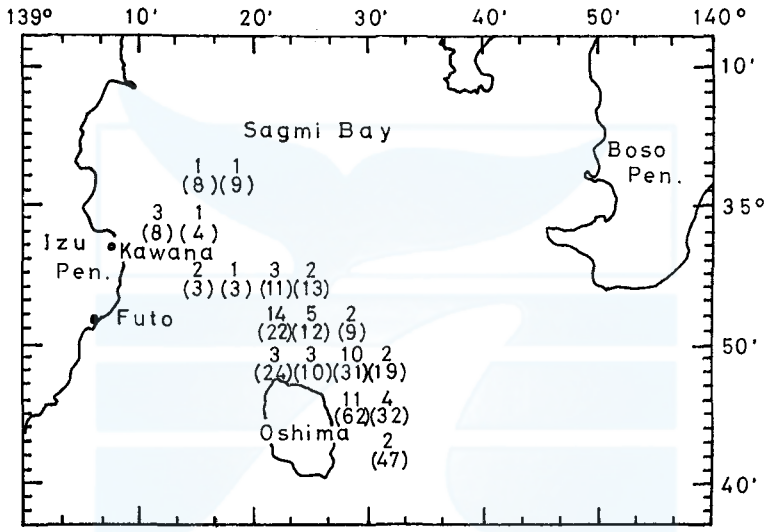

Fig. 1. The number of schools of *Stenella* spp. sighted by the scouting boats in 3.3′ (6.1 km) squares during 8 seasons from 1964–'65 to 1973–'74. Numerals in parenthesis indicate the number of schools per 10^7 nautical miles of scouting. (For Sagmi Bay read Sagami Bay)

MATERIALS

The statistics were collected by Miyazaki from four fishermen's cooperative unions.

The data collected at Taiji covers ten years from 1963 to 1972. Some of the statistics were provided by Dr. Kajihara. The distinction of the two species of *Stenella* is made only in recent three years. In this district " Mairuka " and " Haukasu " indicate *S. coeruleoalba* and *S. attenuata* respectively. All of that catch were made with hand harpoon, or hand harpoon and shot gun.

The data collected at Arari covers the catch of fourteen seasons from 1950 to 1970, but there are only sporadic catches after 1962. *S. coeruleoalba* and *S. attenuata* are recorded by the name " Mairuka " and " Hasunaga or Arari-iruka " respectively.

The various informations on the dolphin fishing in Sagami Bay were col-

lected from the fishermen's cooperative unions at Kawana and Futo. They comprise the number of dolphins and schools, position of sighting, and the hours and the number of scouting boats engaged. The number of dolphins is known for the twenty seasons from 1949–'50 season to 1973–'74 season. But the statistics are fragmental before the 1961–'62 season, and do not give the total number of dolphins of the genus *Stenella* caught in Sagami Bay. The two species of *Stenella* are recorded separately since 1969–'70 season. The main fishing area in Sagami Bay is shown in Fig. 1. The total scouting hours of the four high speed, 20 knot at maximum, scouting boats were available for eight seasons from 1964–'65 to 1973–'74 season. This was used as the indicator of the fishing effort. These scouting boats leave the harbor, if the weather is good, at 5 o'clock in the morning. And if they find a suitable school, they drive it into the harbor with the help of other slower boats. They usually find the school before the noon, but they sometimes continue the scouting until 3 o'clock in the afternoon. The fishing season in Sagami Bay starts in the autumn season (October) and ends in the winter of the next year (January).

The sighting records of *Stenella coeruleoalba* and *Stenella attenuata* were obtained by Kasuya and Miyazaki through five cruises of the research vessel the Tanseimaru. They are used together with the many sighting records and sporadic catches of these species reported by various authors (Tables 1, 2).

Oceanographical data obtained through two cruises of the Tanseimaru in 1971 and 1972, and that reported by Japanese Meteorological Agency, Japanese Maritime Safety Agency, Tokyo Metropolitan Fisheries Experiment Station, and Shizuoka Prefectural Fisheries Experiment Station were used in analyzing the relation between the distribution of the dolphins and the environment.

ANALYSIS OF THE STATISTICS

Annual fluctuation of catch

Fig. 2 shows the annual fluctuation of the catch of *Stenella* spp. in each fishing area.

Though the statistics are imperfect before 1961–'62 season, it is suggested that the number of the dolphins caught in Sagami Bay shows rapid increase after that season. This seems to be related with the introduction of the high speed scouting boats. After this year the amount of the catch increases to record the maximum catch of 15,649 dolphins in 1965–'66 season. As the two fishermen's unions started the cooperative operation in 1967–'68 season to control the market price, the number of dolphins caught decreased to about one third of the maximum catch. But the change of the mode of operation cannot explain all the annual fluctuation of the catch. Because the number of dolphins caught per one scouting hour shows the fluctuation parallel with that of total number of catch (Fig. 3). It is suggested that the annual fluctuation of the catch will indicate that of the abundance of the dolphins migrating into the fishing ground. Fig. 4 shows the relation between the annual catch of *Stenella* spp. in Sagami Bay and the distance from Oshima Island to

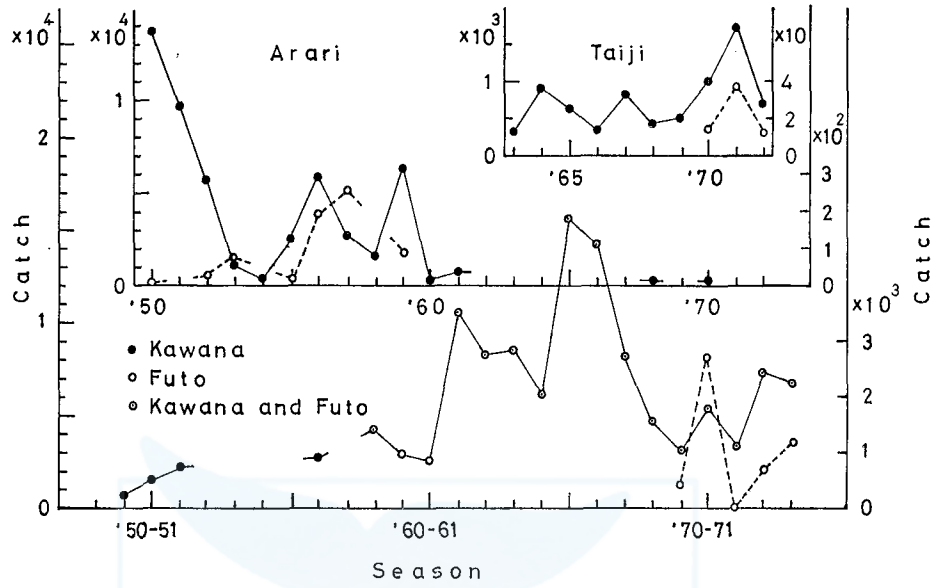

Fig. 2. The number of catch of *Stenella coeruleoalba* (left scale) and of *Stenella attenuata* (right scale) at each fishing ground. Solid line indicate *S. coeruleoalba*, and broken line *S. attenuata*.

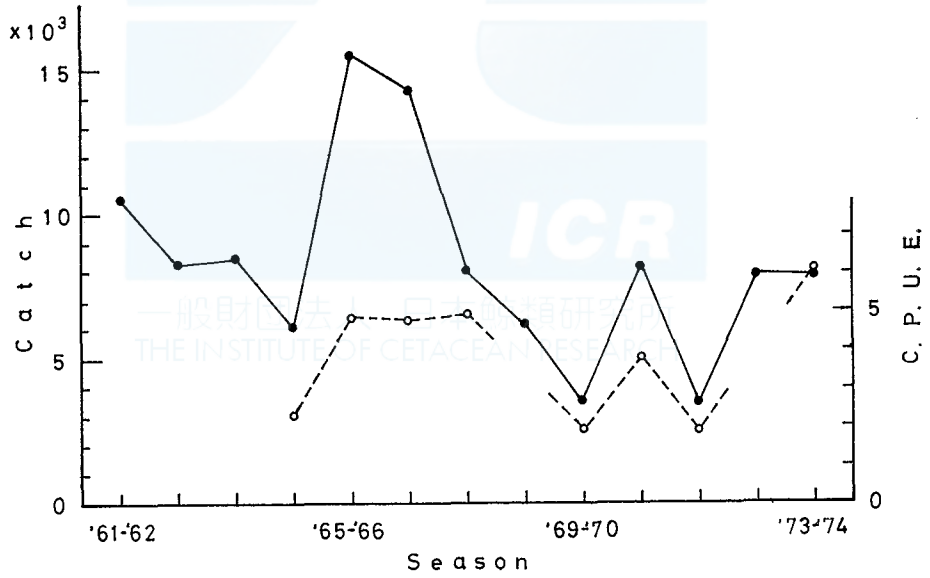

Fig. 3. The number of catch and the catch per one scouting hour (C. P. U. E.) of *Stenella* spp. in Sagami Bay. Closed circle and solid line indicate the catch, and open circle and broken line catch per one scouting hour.

the nearest border of the Kuroshio current from October to December (Japanese Maritime Safety Agency, 1961–'71). As the surface water temperature is highly variable by the effect of the meteorology or of the tide, the position of the 15°C isothermal at the depth of 200 m was used as the indicator of the position of the Kuroshio current. It is clear in Fig. 4 that the catch of *Stenella* spp. in Sagami Bay has the negative correlation with the distance of the Kuroshio current from the main fishing area. This means that in the years when the Kuroshio current situates close to Sagami Bay, there migrates many dolphins of the genus *Stenella*. The catch or catch per unit effort changes affected by the abundance of the migrating dolphins. Though the two species of *Stenella* are recorded separately in the statistics only in the seasons from 1969–'70 to 1973–'74 season, as the catch of *S. attenuata* comprises 4,956 individuals or 16.1 % of the total catch of *Stenella* spp. in Sagami Bay in these season, it is reasonable to expect the catch of *S. attenuata* even in the preceding years.

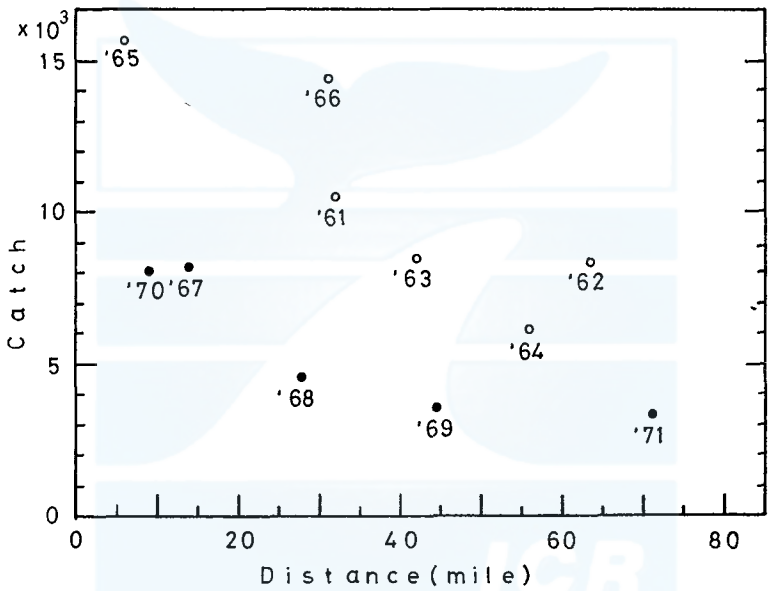

Fig. 4. Relationship between the number of catch of *Stenella* spp. in Sagami Bay, and the distance (nautical mile, 1.85 km) from Oshima Island to the 15°C isothermal line at the depth of 200 m. Closed circle indicates cooperative operation and open circle competitional operation. The numerals indicate the starting year of the season.

The catch of *Stenella* spp. in Suruga Bay was high until the early 1950's (see Arari in Fig. 2). But they had almost finished the operation since 1962. This age coincides with the time when the catch in Sagami Bay increased rapidly. The other shorter cycle of annual fluctuation of the catch is expected to be affected by the oceanographical conditions as in the case of Sagami Bay. Though Nishiwaki *et al.* (1965) reported the information from the fishermen's telling that the catch of *S. attenuata* in 1959 or in 1964 was the first case for them to catch this species. It is

difficult to trust their telling at the following two aspects. At first, after that year the capture of several schools of *S. attenuata* within short period were reported from the village (Nishiwaki *et al.*, 1965), and secondly the catch of *S. coeruleoalba* and *S. attenuata* in the village seems to have been recorded by the different vernacular names mentioned before.

The catch statistics off Kii Peninsula shown in Fig. 2 do not include the catch by driving method as it was started in 1973. The general trend of the catch of *Stenella* is gradually increasing in recent years. The statistics of two kinds of *Stenella* were recorded separately only in the recent three seasons. As the result of the difference of the price between two species in this local district, the fishermen prefer *S. coeruleoalba*. So, the catch of *S. attenuata* in the recent three years was only 63 animals or 1.8 % of the total number of the catch of the two species. This ratio is lower than that of the catch in Sagami Bay.

Seasonal fluctuation of catch

In Sagami Bay the fishing season starts in late September, and ended in the former years in January or in early February but in recent years it ends in late December (Figs. 5 and 6). Fig. 6 shows the difference of the fishing season of the

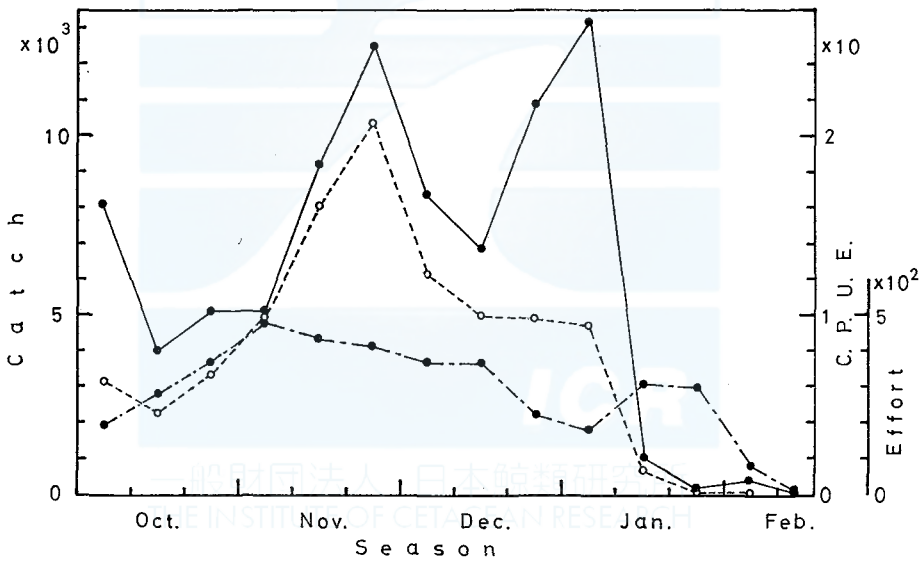

Fig. 5. The seasonal changes of the catch of *Stenella* spp., of the catch per one scouting hour (C.P.U.E.), and of the scouting hours (effort) in Sagami Bay. 8 seasons from 1964–'65 to 1973–'74 season are combined. Closed circle and solid line indicate C.P.U.E., closed circle and chain line the total amount of effort, and open circle and broken line the catch.

two species. Though the season of *S. attenuata* seems to start almost at the same season with that of *S. coeruleoalba*, the peak of the catch comes in early November and the season ends by late November. On the other hand the peak of the catch of

S. coeruleoalba is in late November about one month later than that of *S. attenuata*. The decrease of the catch of *S. coeruleoalba* in late October and early November will be the effect of the catch of *S. attenuata*.

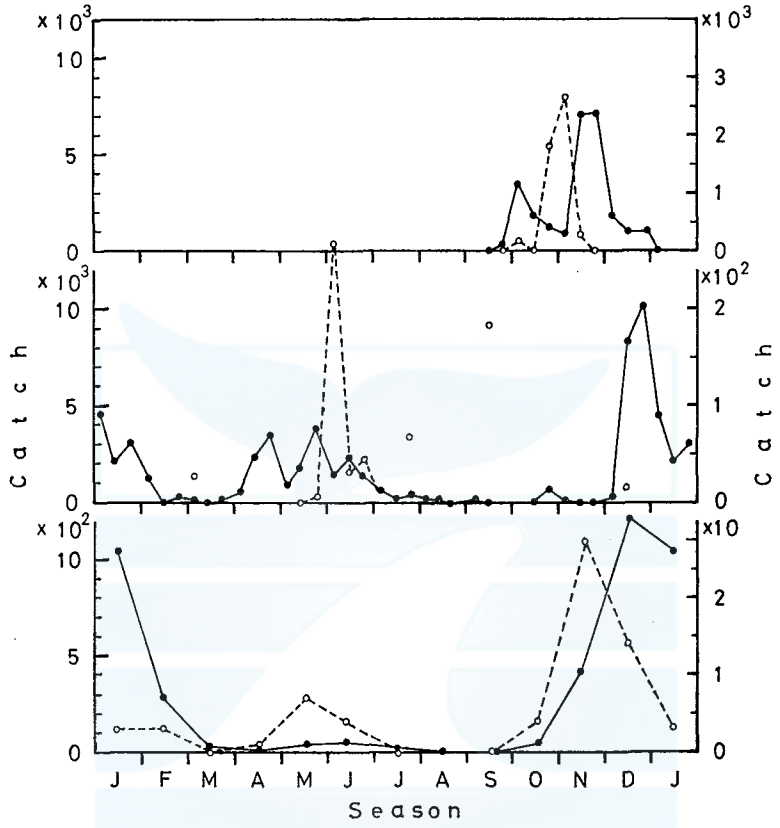

Fig. 6. The seasonal fluctuations of the catch of *Stenella coeruleoalba* and *Stenella attenuata* at each fishing ground. Closed circle, solid line and left scale indicate *S. coeruleoalba*, and open circle, broken line and right scale *S. attenuata*. Top: Sagami Bay, Middle: Suruga Bay, Bottom: Off Kii Peninsula.

The seasonal fluctuation of the catch per scouting one hour in Sagami Bay is shown in Fig. 5. The fluctuation shows three peaks, the first in early October, second in late November, and the third in late December or in early January. At the beginning of the season, they often start the catch after obtaining the information of sighting by other fishing vessels. And in the late December and early January the scouting effort decreases, because the fishermen spend the time for the new year festival or for its preparation. These two factors affect the catch per one scouting hour and keep it high. Accordingly, the first and the last peaks are supposed not to reflect the real abundance of the dolphins. The real peak of the migration of *S. coeruleoalba* in Sagami Bay is considered to be in the late November, and that

of *S. attenuata* is in late October.

In Suruga Bay the catch of *Stenella* spp. was made in any season of the year, but the peaks of *S. coeruleoalba* caught are in the seasons from April to July and from December to January. The former peak is not observed in Sagami Bay, and the latter is about one month later than the corresponding peak in Sagami Bay. The spring peak of *S. attenuata* in Suruga Bay seems to arrive later than that of *S. coeruleoalba*.

Fig. 6 shows the seasonal fluctuation of catch of two species of *Stenella* off Kii Penisula. Though the catch of *Stenella* spp. in this area is made in any season of the year, the peak of *S. coeruleoalba* are in the seasons from April to July and from October to March. The former will correspond to that of Suruga Bay, and the latter to the winter fishing seasons in other grounds. The winter peak of *S. coeruleoalba* arrives slightly later in the southern area than the northern. Similar feature is observed also in *S. attenuata*. The catch representing the spring peak of *S. attenuata* is too small to discuss the difference of the season. The fishermen say that the fishing ground in March becomes too far from the coast to operate the dolphin fishing. This will be one of the reason of the smaller catch in spring season.

GEOGRAPHICAL DISTRIBUTION

All the available records of sighting or of sporadic catch of *S. coeruleoalba* and *S. attenuata* in the Pacific coast of Japan are plotted in Fig. 7. The origin of these records are shown in Tables 1 and 2. The 17°C isothermal line shows the surface water

TABLE 1. LIST OF RECORDS OF SPORADIC CATCH OF *STENELLA* SPP. IN THE WESTERN NORTH PACIFIC.

No.	Date			Position	Author	Comments
S. coeruleoalba						
1	—	IX	'34	Off Choshi (35°44′N, 140°52′E)	Ogawa, 1936	Purchased at the market
2		—		Off Onahama (36°53′N, 140°52′E)	Okada, 1936	Purchased at the market
3	21	I	'35	Shimizu fish market (35°00′N, 130°30′E)	Okada, 1936	Possibly caught on Izu coast
4	27	II	—	Off Choshi	Okada, 1936	Purchased at the market
5	4	II	'35	Shimizu fish market	Okada, 1936	Possibly caught on Izu coast
6	26	I	'64	Kokufu (34°20′N, 136°52′E)	Higashikawa *et al.*, 1966	Stranded
S. attenuata						
7	12	VIII	'35	Nagasaki fish market (32°40′N, 129°50′E)	Ogawa, 1936	Purchased at the market
8	20	X	'61	Arikawa (33°00′N, 129°06′E)	Mizue *et al.*, 1962	Driven in
9	—	VIII	—	Onahama	Kasuya, 1972	—

temperature in the warmest and coldest months of 1970. This figure shows that the distribution of these species is not restricted in the coastal waters, but extends into the offshore waters. The northernmost records in the summer season are be-

tween 44°N and 46°N. This range approximately coincides to the 17°C isothermal line in the summer season. Though the northern range of the two species in winter season is not clearly indicated, it is suggested that they are distributed south of 17°C isothermal line.

TABLE. 2. LIST OF SIGHTING RECORDS OF *STENELLA* SPP. IN THE WESTERN NORTH PACIFIC.

No.	Date	Position	Time	Surface temperature (°C)	School size	Author
S. coeruleoalba						
1	11 VIII '51	Nemuro Bay	—	—	150	Sleptsov, 1961
2	31 VIII '51	Ekacherina Bay	—	—	50	"
3	9 IX '51	Laperyza Bay	—	—	20–30	"
4	8 VIII '54	38°18′N, 148°50′E	—	—	2,000	"
5	18 VIII '54	39°04′N, 153°30′E	—	—	400	"
6	13 IX '54	41°28′N, 153°03′E	—	—	150–200	"
7	15 IX '54	44°34′N, 149°51′E	—	—	—	"
8	22 IX '70	34°31′N, 139°35′E	13 : 45	22.7	10	Present data
9	22 XI '70	34°35′N, 139°38′E	14 : 20	22.7	1,000	"
10	21 XI '71	34°48′N, 141°07′E	11 : 10	20.6	60–70	"
11	21 XI '71	34°52′N, 141°05′E	10 : 36	—	—	"
12	19 I '72	29°36′N, 140°38′E	08 : 05	19.8	50	Masaki, 1972
13	19 I '72	29°32′N, 140°42′E	09 : 26	19.8	30	"
14	19 I '72	29°07′N, 141°11′E	12 : 18	21.4	100	"
15	21 I '72	26°39′N, 142°28′E	07 : 55	21.7	10	"
16	5 II '72	20°17′N, 152°12′E	11 : 46	25.5	30	"
17	24 X '72	34°52′N, 141°05′E	15 : 34	20.5	200	Present data
18	8 X '73	34°48′N, 139°54′E	10 : 00	24.7	50	"
19	8 X '73	34°44′N, 139°47′E	11 : 25	25.4	500–1,000	"
20	11 X '73	35°02′N, 139°18′E	08 : 00	23.1	20–30	"
21	10 II '74	32°05′N, 132°12′E	07 : 00	—	50–60	"
22	10 II '74	32°52′N, 133°08′E	12 : 00	—	100	"
23	10 II '74	31°28′N, 134°09′E	16 : 40	—	20	"
S. attenuata						
24	10 XII '67	26°40′N, 124°50′E	—	—	—	"
25	22 I '72	25°55′N, 143°38′E	06 : 40	22.2	50	Masaki, 1972
26	22 I '72	25°32′N, 142°00′E	09 : 41	21.9	50	"
27	22 I '72	25°22′N, 142°43′E	11 : 22	21.4	50	"
28	7 II '72	23°30′N, 151°42′E	12 : 23	24.3	20–30	"
29	7 II '72	23°35′N, 151°35′E	16 : 10	24.5	20–30	"
30	8 II '72	24°05′N, 149°09′E	16 : 00	24.8	20–30	"
31	23 V '73	31°28′N, 134°36′E	06 : 40	19.0	30	Present data
32	23 V '73	32°03′N, 135°01′E	11 : 00	19.0	—	"
33	24 V '73	33°19′N, 137°52′E	05 : 05	16.8	5	"

The similar feature is also observed in the water temperature at the positions of sighting collected by us or reported by various authors (Table 2). The 32 records of water temperature at the sighting position of *S. coeruleoalba* and the 9 records at the sighting position of *S. attenuata* are in the range between 16.8°C and 26.0°C.

These informations suggest that the two kinds of the dolphins are distributed, in the western North Pacific, in the waters influenced by the Kuroshio current. Fig. 8 shows the oceanographical structure and the positions of sighting of *S. coeruleoalba*. The schools of this species seems to be concentrated near the area where the warm water intrudes into the colder water at the periphery of the Kuroshio current. Similar oceanographical structure is observed at the southeast entrance of Sagami Bay in the winter season (Kasuya, 1972; Miyazaki *et al.*, 1973), and at the southeast

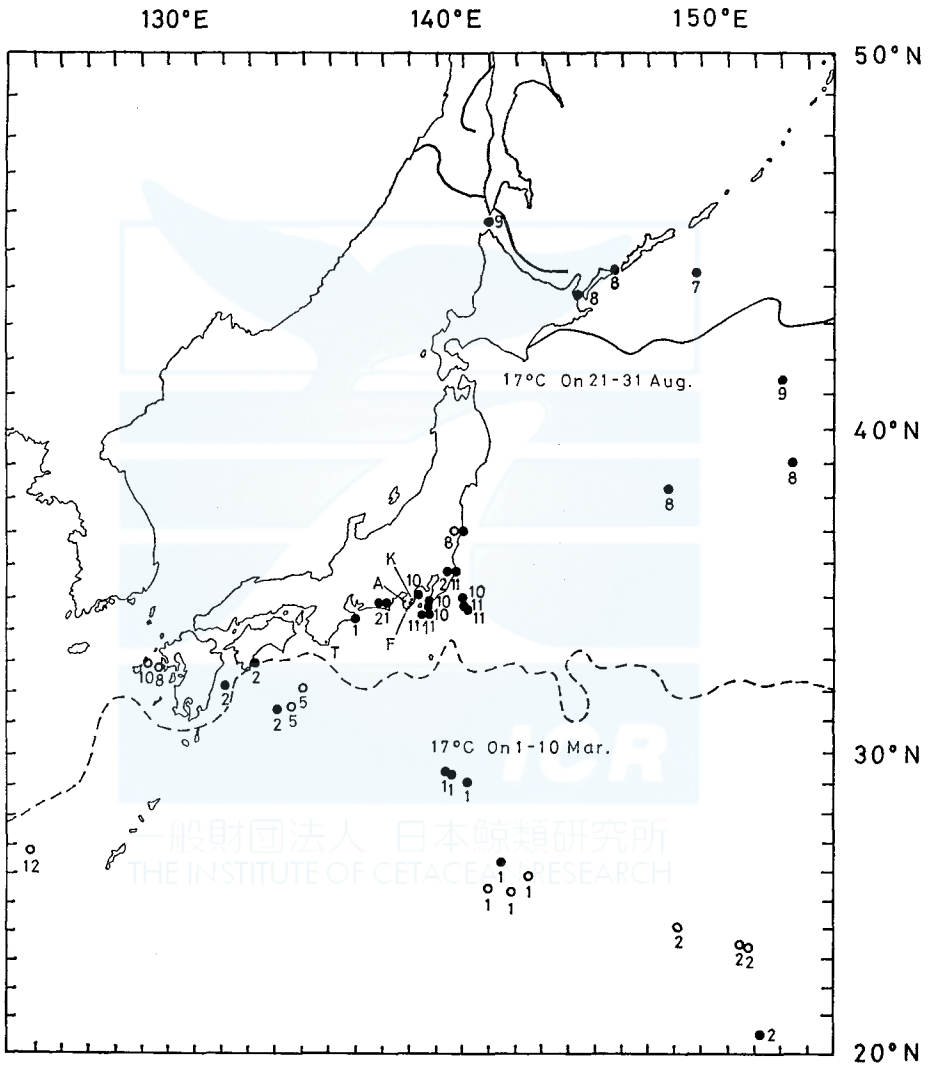

Fig. 7. Map showing the geographical distribution of *Stenella coeruleoalba* and *Stenella attenuata*. The numerals by the symbol indicate the month of sighting or collecting. A; Arari, F; Futo, K; Kawana, T; Taiji. The 17°C isothermal lines are for 1970 (Japanese Meteorological Agency).

area of Suruga Bay in winter and spring dolphin fishing season (Fig. 9). These places coincide with the important fishing ground of the dolphins. Though the species was not identified, there is observed in October and December a peak of landing of dolphins at the Choshi fish market (35°44′ N, 140°52′ E). This peak will

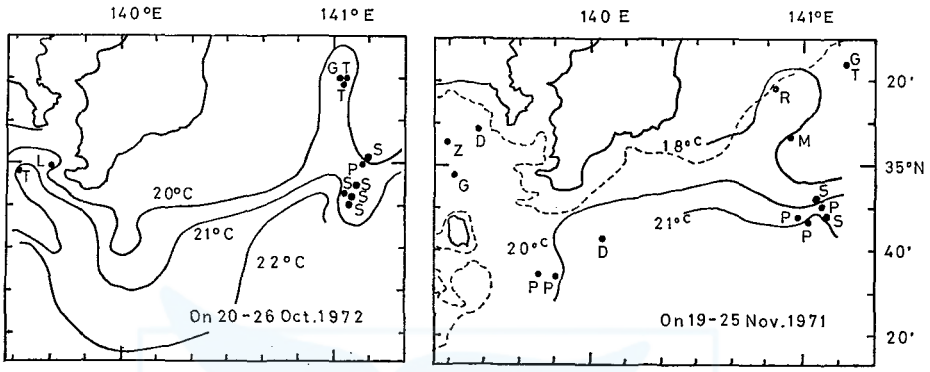

Fig. 8. The oceanographical condition and the sighting position of the dolphin obtained through 2 cruises of the Tanseimaru. S; *Stenella coeruleoalba*, L; *Lagenorhynchus*, T; *Tursiops*, D; Delphinidae, P; sperm whale, G; *Globicephala*, R; *Grampus*, M; minke whale, Z; Zyphiidae. Solid line indicate surface water isothermal line, and broken line the 200 m depth.

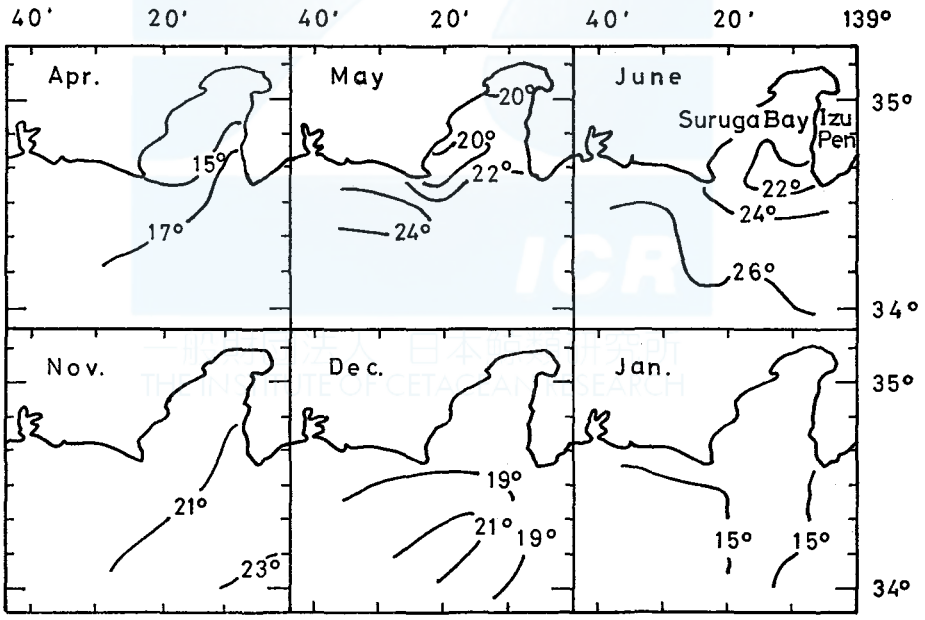

Fig. 9. The oceanographical condition in Suruga Bay in 1967. Solid line indicates surface water temperature. (Shizuoka Fisheries Experiment Station, 1967).

probably represent the catch of *Stenella* spp. in the waters off Choshi, where the similar intrusion of warm water is observed (Fig. 8). It is interesting to note that there occurs no intrusion of warm warter in the spring at the southeast entrance of Sagami Bay, and that this area has no spring dolphin fishing season.

DISCUSSION

Hubbs *et al.*, (1973) summarized all known records of *S. coeruleoalba* in the North Pacific, and showed that this species is distributed continuously from the west coast of North America to the central tropical Pacific. The sighting records reported by Masaki (1972) now suggest that the continuity of the distribution can be extended to the Japanese coastal waters. But this does not necessarily mean that *S. coeruleoalba* in the both sides of the North Pacific belongs to one population. It will be more reasonable to expect several separate populations in the North Pacific.

Stenella spp. and probably other tropical or subtropical dolphins seem to concentrate at the area where the warm water at the periphery of the Kuroshio current intrudes into the colder water as suggested by Kasuya (1972) and shown on large cetaceans by Uda (1954). This assumption can explain the mechanism concerning the formation of the several fishing grounds and fishing season. We don't deny all the possibility where the concentration of dolphins occurs on the steep slope along the continental shelf (Tobayama 1969). But this hypothesis can not explain the presence of the fishing ground near Choshi, because the sea floor off Choshi is flat and shallow.

The winter peaks for *S. coeruleoalba* and *S. attenuata* are observed in the earlier season in Sagami Bay at the north, and off Kii Peninsula at the south they delay for about one month. The time lag between Sagami Bay and Suruga Bay in closer distance is larger than that between Suruga Bay and Kii Peninsula in larger distance. This suggests that the time lag is related to the speed of the seasonal change of the oceanographical conditions or the seasonal movement of the area where the northern boundary of the Kuroshio current crosses the coastal waters. The spring peak observed in the catch at Taiji (Kii Peninsula) and Arari (Suruga Bay) will correspond to the northbound movement of the northern boundary of the Kuroshio current and that of dolphins induced by it. These features of the seasonal migration of the dolphins are close to that suggested by Ohsumi (1972). But it must be noted that the migration of these dolphins seems to be the shift of the area of the higher density of dolphins resulting in the expansion or retreat of the range of the distribution. Compared with the peaks of *S. coeruleoalba*, the winter peak of *S. attenuata* arrives earlier and the spring peak later. This indicates that *S. attenuata* lives in the warmer waters and possibly in the lower latitudes than *S. coeruleoalba* does.

As the catch of the two species of the dolphins are strongly affected by the annual fluctuation of the Kuroshio current, it was impossible to analyze the fluctuation of the population based on the fishing statistics covering only a short period.

ACKNOWLEDGEMENTS

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APPENDIX I. THE NUMBER OF CATCH OF *STENELLA COERULEOALBA* AND *STENELLA ATTENUATA* (IN PARENTHESES) IN ARARI.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1950	60		10	4,794	3,293	1,231 (1)	47					4,236	13,671 (1)
1951	2,194	125	93	1,321	1,990	826	646					2,469	9,664
1952	245		(25)			1,321	11					4,050	5,627 (25)
1953			88	19	759 (6)	62	153 (65)						1,081 (71)
1954	53					245							298
1955						69						2,483 (15)	2,552 (15)
1956	1,390			69		611	48		(188)			3,634	5,752 (188)
1957	261			102	274	68 (257)	275					1,771	2,751 (257)
1958	1,274			79	151				63				1,567
1959	4,117	1,440			76	671 (83)							6,304 (83)
1960								67					67
1961	151									613	11		775
1968			90										90
1970					41								41
Total	9,745	1,565	281 (25)	6,384	6,584 (6)	5,104 (341)	1,180 (65)	67	63 (188)	613	11	18,643 (15)	50,240 (640)

APPENDIX II. THE NUMBER OF CATCH OF *STENELLA COERULEOALBA* AND *STENELLA ATTENUATA* (IN PARENTHESES) IN TAIJI.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1963	16	30	34	18	46	4					63	120	331
1964	252	247	162	25	11	1		1	2	9	93	131	934
1965	207	138	29	17		14	3	4	1	30	78	121	642
1966	129	177	15	12	5						7	77	422
1967	336	206	29	29		1				16	97	105	819
1968	175	112	4	42	33					1	6	27	400
1969	77	3		3	90	12				3	74	237	499
1970	331	81		3	7	8	4			5 (1)	114 (8)	444 (5)	997 (14)
1971	423 (1)	178	11	(1)	5 (4)	8				35 (3)	327 (19)	730 (19)	1,717 (37)
1972	288 (2)	28 (3)	2	1	30 (3)	39 (4)				5	68	239	700 (12)
Total	2,234 (3)	1,200 (3)	286	150 (11)	227 (7)	87 (4)	7	5	3	104 (4)	927 (27)	2,231 (14)	7,461 (63)

APPENDIX III. THE NUMBER OF CATCH OF *STENELLA COERULEOALBA*

	Sep.			Oct.			Nov.		
	E	M	L	E	M	L	E	M	L
1949–'50		408							
1950–'51									
1951–'52									
1952–'53									
1953–'54									
1954–'55									
1955–'56									
1056–'57						1,035	374	71	
1957–'58									
1958–'59						862			279
1959–'60						717	275	510	310
1960–'61				470	364	237	283		210
1961–'62							268	162	1,903
1962–'63					99	158	183	952	1,187
1963–'64					820	453	686	160	389
1964–'65					50	351	116	173	1,445
1965–'66				29	101	248	1,634	1,229	2,768
1966–'67					1,324	191	404	251	1,203
1967–'68								162	2,325
1968–'69					169	510	11	1,643	1,345
1969–'70						401	145 (435)	1,840	355
1970–'71			131	1,310 (159)	293	603 (881)	0 (1,657)	314	2,197
1971–'72				517			25	776	
1972–'73				503	1,117	102 (213)	631 (189)	815 (260)	4,067
1973–'74				1,140	512	143 (786)	116 (376)	3,277	488
Total		408	131	3,969 (159)	4,849	6,011 (1,880)	5,151 (2,657)	12,335 (260)	20,471

*: The total catch at Futo and Kawana, but only the catch at Futo is given by month.

AND *STENELLA ATTENUATA* (IN PARENTHESES) IN KAWANA AND FUTO.

Dec.			Jan.			Feb.			Total
E	M	L	E	M	L	E	M	L	
327									735
1,515									1,515
		2,235							2,235
1,127	148								2,755
		973	1,805	100	129				4,148
		452			612				2,876
168	146	160	378	47	106				2,569
605	6,257	68	870	420	36				10,589
3,248	1,401	0	738	229	74				8,269
1,477	637	2,846	892	119	56				8,535
467	1,084	1,675	107	533	33	69			6,103
135	843	1,967	62	109	24				15,649*
3,253	1,500	50							14,351*
504	542	131	4,534						8,198
948									4,626
389									3,130 (435)
459									5,307 (2,697)
	903	1,094							3,315 (0)
									7,235 (662)
975	148								6,799 (1,162)
15,597	13,609	11,651	9,386	1,557	1,070	69			118,939 (4,956)