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Relationship between the Distribution of Water Masses and that of Demersal Fishes in the East China Sea in Spring

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The relationship between the distribution of demersal fishes and that of the water masses was examined by using the catches data and hydrographic data in the Yellow Sea and the East China Sea on May 13~19, 1996 and May 10~17, 1997. During the study period, the dominant fish species were *Cleisthenes pinetorum herzinsteini, Lophiomus setigerus and Pseudosciaena polyactis.* These three low temperature water species accounted for 21~24% of the total catches. The percentage of the low temperature water species was high in the Yellow Sea and the coastal area on the continental shelf of the East China Sea but was low in the vincinity of Kyushu during the study period. In the East China Sea, the isotherm of 15℃ at 50 m, mid layer depth, was located more southeast in 1996 than in 1997. The bottom water temperature was about 2℃ lower in 1996 than in 1997. The direction of the detided current on the continental shelf of the East China Sea was southward in 1996 and northward in 1997. Yellow Sea Bottom Cold Water (YSBCW) strongly expanded to south in 1996 when the northward current was weak. But, Tsushima Warm Current (TSWC) strongly intruded into the continental shelf of the East China Sea in 1997. As YSBCW expanded strongly to south in 1996, the percentage of the low temperature water species relative to the total catches was high. But, TSWC strongly intruded and the percentage of low temperature water fishes was low in 1997.

Key words: Tsushima Warm Current (TSWC), Yellow Sea Bottom Cold Water (YSBCW), low temperature water species

Introduction

The water masses influencing the oceanic condition in the East China Sea are Tsushima Warm Current (TSWC), Yellow Sea Warm Current (YSWC), Yellow Sea Bottom Cold Water (YSBCW), China Coastal Water (CCW) and Kuroshio Surface Water (KSW). The YSBCW is one of the most outstanding and important components in the shallow water hydrographic condition of the East China Sea (Guan, 1985). Cho (1982) noted that the water temperature greatly influenced the catches of the yellow croaker and the kangdal-li by studying the relationship between the catches of these two fish species and the YSBCW. TSWC plays also an important role to the variability of the water masses in the East China Sea because TSWC, one branch of Kuroshio, carries the waters of Kuroshio type with the shape of narrow (less than 1000 km in width) and shallow (above 300 m) band into the East China Sea (Moriyasu, 1972). YSWC is not discussed in the present study because it as a mean current has not yet been obviously detected. Because the East China Sea is shallow, the currents greatly influence the distribution of water mass (Seung, 1992). It is supposed that the variations of the currents influence the ocean environments and biological resource in the East China Sea. Sagami Bay located in the southern area of Japan is a good example showing that the change of current influences the fishing grounds. The change of the circulation in the bay by Kuroshio influenced intensively the catches of warm water fish species living mainly in the upper layer (Iwada, et al., 1987). According to Nitani (1972), the fishing grounds of purse-seiner were formed at the southern area of Cheju Island,

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about 33N, nearby the front area formed between the YSBCW and TSWC in December, 1959. But, the fishing grounds of purse-seiner were formed at the southern area of 30N in 1960 because the YSBCW expanded to south and the front area moved. The fluctuation of the YSBCW and TSWC influencing the oceanic condition in the East China Sea is an important index in studying the fisheries environments of the East China Sea. Therefore, we studied on how the fluctuation of TSWC and YSBCW influences the catches and the species composition in the East China Sea.

Material and Method

The catches data were collected by trawling (towing time : 1hour, towing speed: average 3.3 knot) while ocean surveys were carried out in the Yellow Sea and the East China Sea. The number of stations for the catches was eleven in 1996 and nine in 1997 (Fig. 1). Hydrographic surveys were carried out twice during the periods of May 13 to 19, 1996 and of May 10 to 16, 1997 by Nagasaki-Maru, the research vessel of Nagasaki University. Water temperature, salinity and dissolved oxygen were observed by CTD (Neil Brown, Mark III) at each station (Fig. 2). The currents were observed by the Japan Meteorological Agency (JMA) along the observation line A (31 55′ N line) at depths (0, 30, 50, 100 m) in 1996 and by Nagasaki-Maru along the observation line B (31 55′ N line) at depths (6, 30, 60, 80 m) in 1997. Total catches were used to investigate the distribution of the catches in 1996 and 1997 in the East China Sea. The species composition of the total catches was divided into low temperature water species and warm water species. In this study, the low temperature water species are defined as the fish species whose optimum temperature of catch is lower than 15 ℃ (National Fisheries Development Agency, 1998). The catches distributions of the low temperature water species were compared with the horizontal distribution of bottom temperature. The vertical distribution of temperature was also examined for the stations of line A and line B during the study period. Because the tidal currents were very strong in the East China Sea, tidal compositions had to be removed to know the real aspect of current from ADCP data. We used the phases and amplitudes of five constituents (M2, S2, K1, N2 and O1) of tides

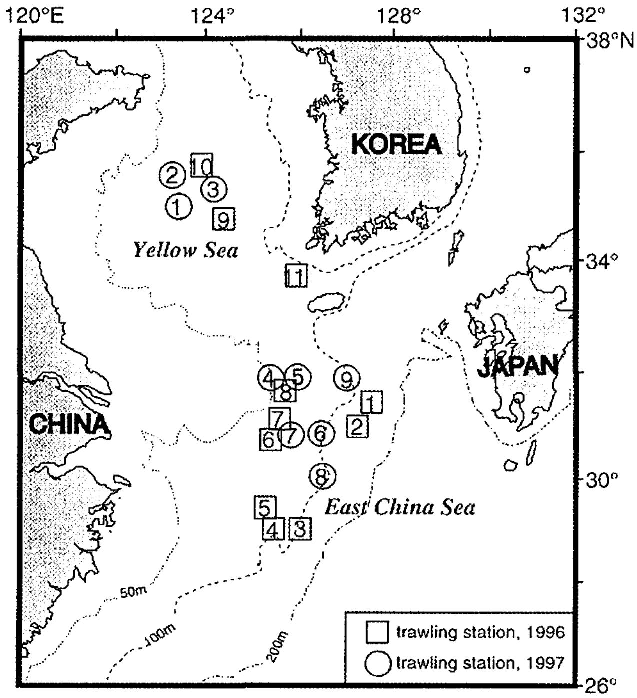

Fig. 1. Trawling stations in May 1996 and 1997.

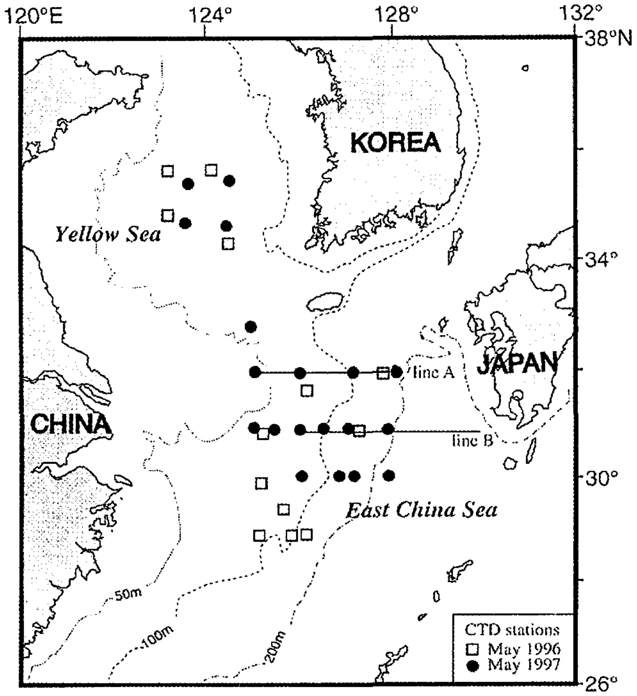

Fig. 2. Station map for CTD observations in May 1996 and 1997.

Table 1. Species composition of fishes collected in the East China Sea in May 1996

SPECIES	R	Total N	%	Accu.%	R	Total W	%	Accu.%
Todarodes pacificus (오징어)	1	133	10.30	10.3	2	14.50	11.47	11.47
Trichiurus lepturus (갈치)	2	95	7.36	17.66	2	8.864	6.75	18.22
Pampus argenteus (병어)	3	93	7.20	24.86	5	6,169	4.86	23.08
Cleisthenes pinetorum herzinsteini (용가자미)	4	90	6.97	31.83	10	5,028	3.96	27.05
Photololigo edulis (꼴뚜기류)	5	84	6.51	38.34	11	5,017	3.95	31.00
Trachurus japonicus (전갱이)	7	79	6.12	44.46	40	6,249	4.93	35.93
Lepidotrigla microptera (달강어)	6	79	6.12	50.58	14	3,239	2.55	38.48
Harpadon nehereus (물천구)	8	78	6.04	56.62	15	2,359	1.86	40.34
Pseudosciaena polyactis (참조기)	9	76	5.89	62.51	13	3,338	2.63	42.97
Argyrosomus argentatus (보구치)	10	62	4.80	67.31	6	6,086	4.80	47.77
Pleuronichthys cornutua (도다리)	11	50	3.87	71.18	9	5,057	3.99	51.76
Engraulis japonicus (멸치)	12	39	3.02	74.20	26	905	0.71	52.47
Scomber japonicus (고등어)	13	37	2.87	77.07	12	4,345	3.43	55.89
Lophiomus setigerus (아귀)	14	34	2.63	79.70	1	22,504	17.74	73.63
Erisphex pottii (풀미역치)	15	30	2.32	82.03	32	465	0.37	74.00
Hoplobrotula armata (붉은메기)	16	28	2.17	84.20	8	5,409	4.26	78.26
Sepia (Platy sepia) esculenta (참갑오징어)	18	25	1.94	86.13	18	1,513	1.19	79.46
Dentex tumifrons (황돔)	18	22	1.70	87.84	17	1,735	1.37	80.82
Pseudorhombus arsius (별넙치류)	19	18	1.39	89.23	20	1,360	1.07	81.90
Thamnaconus tessellatus (별쥐치)	20	14	1.08	90.32	30	656	0.52	82.41
Branchiostegus japonicus (옥돔)	21	12	0.93	91.25	19	1,502.5	1.18	83.60
Kaiwarinus equula (갈전갱이)	22	9	0.70	91.94	22	1,260	0.99	84.59
Liparis tanakai (꼼치)	22	9	0.70	92.64	31	644	0.51	85.10
Nipponololigo japonica (꼴뚜기)	22	9	0.70	93.34	35	409	0.32	85.42
Lepidotrigla guentheri (꼬마달재)	22	9	0.70	94.03	38	345	0.27	85.69
Coelorinchus mutispinulosus (줄비늘치)	23	8	0.63	94.65	36	362	0.29	785.9
Zeus faber (달고기)	24	7	0.54	95.20	28	768	0.61	86.58
Priacanthus macracanthus (홍치)	25	6	0.46	95.66	27	847	0.67	87.25
Lophius litulon (황아귀)	26	5	0.39	96.05	7	6,040	4.76	92.01
Nibea albiflora (수조기)	26	5	0.39	96.43	24	1,046	0.82	92.84
Zebrias fasciatus (노랑각시서대)	26	5	0.39	96.82	25	978	0.77	93.61
Gnathagnus elongatus (푸렁통구멍)	26	5	0.39	97.21	33	435	0.34	93.95
Raja acutispina (홍어류)	27	4	0.31	97.52	21	1,306	1.03	94.98
Minous monodactylus (말락솔치류)	27	4	0.31	97.83	43	170	0.13	95.11
Thamnaconus modestus (말쥐치)	28	3	0.23	98.06	39	322	0.25	95.37
Cynoglossus joyneri (참서대)	28	3	0.23	98.29	40	315	0.25	95.62
Pseudorhombus cinnamoneus (별넙치)	28	3	0.23	98.53	44	128	0.10	95.72
Setipinna taty (반지)	28	3	0.23	98.76	45	110	0.09	95.80
Muraenesox cinereus (갯장어)	29	2	0.15	98.91	16	1,860	1.47	97.27
Scombermorus niphonius (삼치)	29	2	0.15	99.07	23	1,185	0.93	98.20
Narke japonica (전기가오리)	29	2	0.15	99.22	29	740	0.58	98.79
Halieutaea stellata (빨강부치)	29	2	0.15	99.38	46	90	0.07	98.86
Protonibea diacanthus (수조기류)	30	1	0.08	99.46	34	425	0.34	99.19
Anago anago (괴붕장어)	30	1	0.08	99.53	37	355	0.28	99.47
Sebastiscus marmoratus (쏨뱅이)	30	1	0.08	100	41	296	0.23	99.71
Chelidonichthys spinosus (성대)	30	1	0.08	99.69	42	240	0.19	99.90
Saurida wanieso (매퉁이류)	30	1	0.08	99.77	47	60	0.05	99.94
Collichthys lucidus (황강달이)	30	1	0.08	99.84	48	44	0.03	99.98
Johnius belengerii (민태류)	30	1	0.08	99.92	49	20	0.02	99.99
Lepidotrigla japonica (가시달강어)	30	1	0.08	100.00	50	10	0.01	100
Total		1,291	100			126,861	100	

R=Rank, N=Number of individuals, Accu.%=accumulative percentage, W=wet weight

Table 2. Species composition of fishes collected in the East China Sea in May 1997

SPECIES	R	Total N	%	Accu.%	R	Total W	%	Accu.%
Pseudosciaena polyactis (참조기)	1	151	13.08	13.08	8	4,836	4.04	4.04
Todarodes pacificus (오징어)	2	138	11.96	25.04	2	11,985	10.01	14.04
Photololigo edulis (꼴뚜기류)	3	96	8.32	33.36	6	5,245	4.38	18.42
Cleisthenes pinetorum herzinsteini (용가자미)	4	90	7.80	41.16	4	7.556	6.31	24.73
Harpadon nehereus (물천구)	5	60	5.20	46.36	14	2,810	2.35	27.07
Trachurus japonicus (전갱이)	6	59	5.11	51.47	7	5,201	4.34	31.42
Pampus echinogaster (덕대)	7	47	4.07	55.54	5	7,390	6.17	37.59
Trichiurus lepturus (갈치)	8	44	3.81	59.35	3	8.939	7.46	45.05
Liparis tanakai (꼼치)	9	40	3.47	62.82	16	2,467	2.06	47.11
Argyrosomus argentatus (보구치)	10	38	3.29	66.11	11	3,590	3.00	50.10
Dentex tumifrons (황돔)	11	34	2.95	69.06	9	4,150	3.46	53.57
Engraulis japonicus (멸치)	12	33	2.86	71.92	34	700	0.58	54.15
Pleuronichthys cornutua (도다리)	13	30	2.60	74.52	15	2,635	2.20	56.35
Thamnaconus tessellatus (별쥐치)	15	29	2.51	77.03	13	2,890	2.41	58.77
Lepidotrigla microptera (달강어)	14	29	2.51	79.54	24	1,175	0.98	59.75
Collichthys lucidus (황강달이)	16	22	1.91	81.45	29	1,045	0.87	60.62
Kaiwarinus equula (갈전갱이)	17	21	1.82	83.27	17	2.449	2.04	62.66
Lophiomus setigerus (아귀)	18	15	1.30	84.57	1	13,140	10.97	73.63
Zoarces gilli (등가시치)	19	14	1.21	85.78	20	1,658	1.38	75.02
Doederleinia berycoides (눈볼대)	20	9	0.78	86.56	30	982	0.82	75.84
Zeus faber (달고기)	21	8	0.69	87.26	43	260	0.22	76.05
Eopsetta grigorjewi (물가자미)	21	8	0.69	87.95	45	222	0.19	76.24
Oratosquilla oratoria (갯가재)	21	8	0.69	88.64	46	220	0.18	76.42
Lepidotrigla guentheri (꼬마달재)	21	8	0.69	89.34	47	185	0.15	76.58
Raja acutispina (홍어류)	22	7	0.61	89.94	10	4,120	3.44	80.02
Pampus argenteus (병어)	22	7	0.61	90.55	23	1,246	1.04	81.06
Oligopus robustus (양메기류)	22	7	0.61	91.16	26	1,139	0.95	82.01
Thamnaconus modestus (말쥐치)	22	7	0.61	91.76	28	1,080	0.90	82.91
Pseudorhombus pentopthalmus (점넙치)	22	7	0.61	92.37	40	350	0.29	83.20
Scomber japonicus (고등어)	23	6	0.52	92.89	18	2,350	1.96	85.16
Branchiostegus japonicus (옥돔)	23	6	0.52	93.41	21	1,535	1.28	86.44
Pleuronchthys sp. (도다리류)	23	6	0.52	93.93	31	910	0.76	87.20
Conger myriaster (붕장어)	24	5	0.43	94.36	19	1,670	1.39	88.60
Saurida undosquamis (매퉁이)	24	5	0.43	94.80	22	1,528	1.28	89.87
Cynoglossus hilgendorfi (개서대)	24	5	0.43	95.23	33	720	0.60	90.47
Helicolenus hilgendorfi (홍감펭)	24	5	0.43	95.66	39	415	0.35	90.82
Coelorinchus mutispinulosus (줄비늘치)	24	5	0.43	96.10	49	150	0.13	90.95
Heterodontus japonicus (괭이상어)	25	4	0.35	96.44	25	1,160	0.97	91.91
Psenopsis anomala (샛돔)	25	4	0.35	96.79	32	906	0.76	92.67
Sebastiscus marmoratus (쏨뱅이)	25	4	0.35	97.14	38	445	0.37	93.04
Sepia (Platy sepia) esculenta (참갑오징어)	25	4	0.35	97.48	51	110	0.09	93.13
Priacanthus macracanthus (홍치)	26	3	0.26	97.74	36	540	0.45	93.59
Sebastes schlegeli (조피볼락)	27	2	0.17	97.92	12	3,400	2.84	96.42
Miichthys miiuy (민어)	27	2	0.17	98.09	27	1,100	0.92	97.34
Protonibea diacanthus (수조기류)	27	2	0.17	98.26	37	480	0.40	97.74
Narke japonica (전기가오리)	27	2	0.17	98.44	42	320	0.27	98.01
Hoplobrotula armata (붉은메기)	27	2	0.17	98.61	48	160	0.13	98.14
Niphon spinosus (다금바리)	27	2	0.17	98.78	50	122	0.10	98.25
Lateolabrax japonicus (농어)	28	1	0.09	98.87	35	600	0.50	98.75
Ilisha elongata (준치)	28	1	0.09	98.96	40	350	0.29	99.04
Nibea albiflora (수조기)	28	1	0.09	99.04	40	350	0.29	99.33
Sphyraena pinguis (꼬치고기)	28	1	0.09	99.13	41	338	0.28	99.61
Chelidonichthys spinosus (성대)	28	1	0.09	99.22	44	250	0.21	99.82

Table 2. Continued

SPECIES	R	Total N	%	Accu.%	R	Total W	%	Accu.%
Aulopus japonicus (히메치)	28	1	0.09	99.30	52	40	0.03	99.85
Minous monodactylus (말락쏠치류)	28	1	0.09	99.39	52	40	0.03	99.89
Pseudorhombus cinnamoneus (별넙치)	28	1	0.09	99.48	53	30	0.03	99.91
Sepiella japonica (쇠오징어)	28	1	0.09	99.56	53	30	0.03	99.94
Zenopsis nebulosa (민달고기)	28	1	0.09	99.65	54	24	0.02	99.96
Johnius belengerii (민태류)	28	1	0.09	99.74	55	15	0.01	99.97
Lophius litulon (황아귀)	28	1	0.09	99.82	55	15	0.01	99.98
Triacanthodes anomalus (분홍쥐치)	28	1	0.09	99.91	55	15	0.01	99.9957
Apogon lineatus (열동가리돔)	28	1	0.09	99.995	56	5	0.00	99.9999
Total		1,154	100			119,788	100	

R=Rank, N=Number of individuals, Accu.%=accumulative percentage, W=wet weigh

which Choi (1993) had calculated with observation data to remove tidal components during the study period in the East China Sea. The direction and velocity of detided components were calculated by eliminating the U-, V-components of tides from the U-, V-components of the ADCP data.

Results and Discussion

1. The change and distribution of catches

(1) The species composition of fishes and the catches change of low temperature water species.

In the catches survey in May, 1996 and 1997, Pointhead flounder (*Cleisthenes pinetorum herzinsteini*), black goosefish (*Lophiomus setigerus*) and yellow croaker (*Pseudosciaena polyactis*), were the dominant species. These three low temperature water species accounted for 21~24% of the total catches (Table 1 and 2). The percentage of low temperature water species catches relative to the total catches at each station accounted for 60% in the Yellow Sea (St. 9, 11) and 44~55% in the East China Sea (St. 6, 7, 8) in May, 1996. The catches percentage of the low temperature water species in the East China Sea was lower than that in the Yellow Sea. In 1997, the percentage of low temperature water species catches accounted for over 75% in the Yellow Sea (St. 1, 2) and 33~49% in the East China Sea (St. 5, 6, 7). The percentage of low temperature water species catches in the East China Sea was higher than in the Yellow Sea in May, 1997. The average percentage of low temperature water species catches was lower in 1996 (38.75 %) than in 1997 (40.36%) but, that of the low temperature water species catches excluding the Yellow Sea was higher in 1996 (32.12%) than in 1997 (29.59%) (Table 3).

The catches of low temperature water species were greater in the Yellow Sea than in the East China Sea, because there were more stations where the catches of low temperature water species accounted for more than 50% of the total catches in 1996 when compared to 1997. When the distribution of the total catches were compared with the horizontal distribution of the bottom temperature, the stations showing large catches were distributed around the isothermal line of 15℃. The total catches were smaller in the coastal area on the continental shelf of the East China Sea than in the surroundings of Kyushu but, the percentage of low temperature water species catches was the other way (Fig. 3).

Table 3. The percentage of the low temperature water species catches relative to the total catches at each station

Station No.	1996 (%)	1997 (%)
1	28.43	96.66
2	37.30	74.93
3	2.65	3.38
4	21.44	27.44
5	17.55	48.47
6	49.96	34.97
7	55.32	32.62
8	44.33	4.43
9	85.50	15.10
10	22.81	
11	60.72	
Ave	38.75	40.36
Ave*	32.12	29.59

Ave=Average of the percentage in all stations
Ave*=Average of the percentage in the East China Sea

(2) The relationship between the low tempe-rature water species and the bottom temperature

The correlation coefficient between the catches of the low temperature water species and the bottom temperature was 0.553 in 1996 and 0.399 in 1997. The bottom temperature was inversely proportional to the catches percentage of low temperature water species (Fig. 4). It corresponded to the result that the catches percentage of the low temperature water species was high when the bottom temperature was

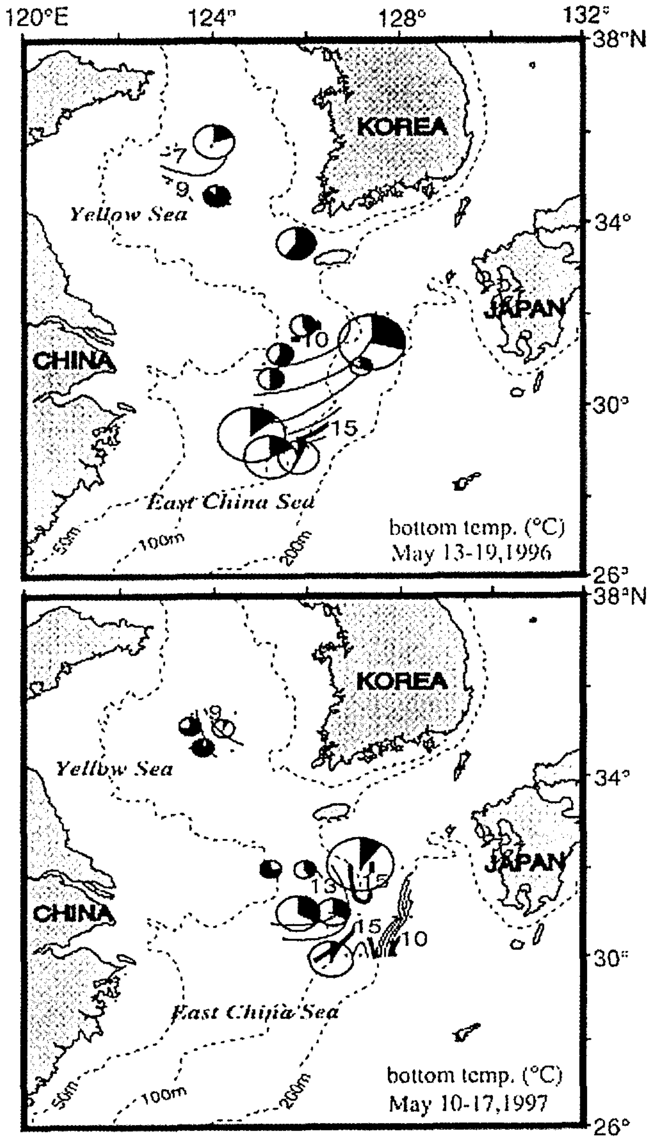

Fig. 3. The percentage of low temperature water species catches relative to the total catches at each station in May 1996 (upper) and 1997 (lower).
percentage of cold water species catches (black portion) and total catches (circle):
0-5 5-10 10-15 15-20
(0%) (25%) (50%)
20-25 25-30(unit:1000g)
(75%) (100%)

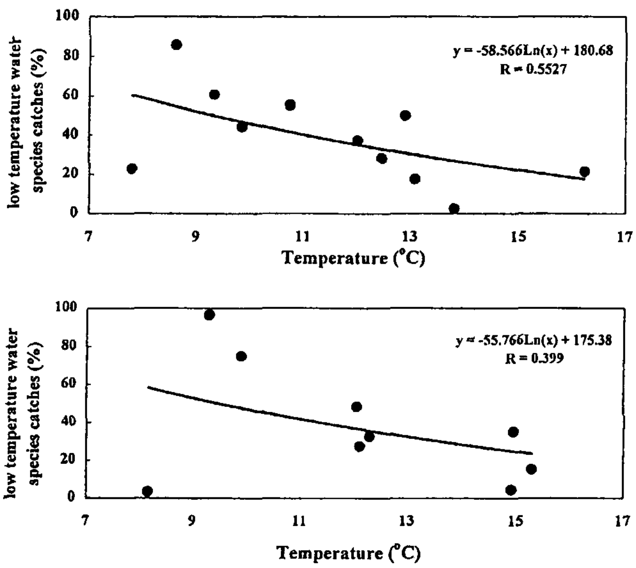

Fig. 4. Correlation between near bottom temperature and the percentage of low temperature water species relative to tatal catches in 1996 (upper) and 1997 (lower).

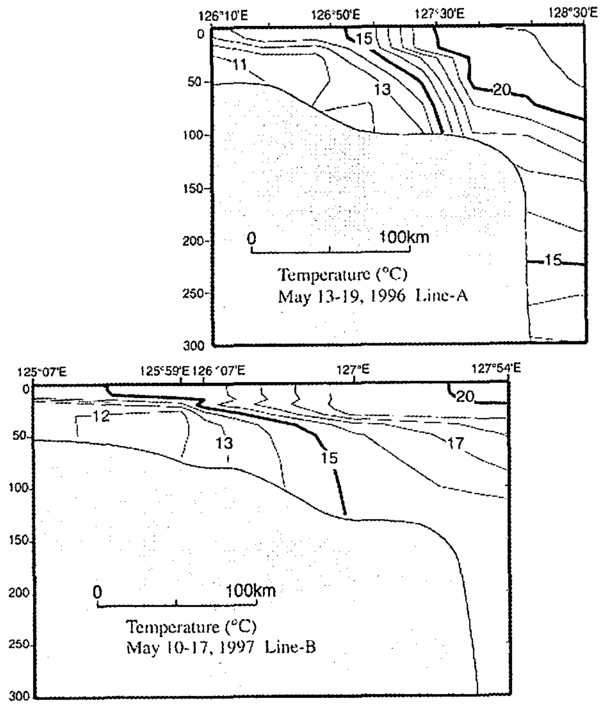

Fig. 5. Sectional distributions of temperature in the East China Sea.

lower than usual and this relationship was more distinctive in 1996 than in 1997. The result was that the percentage of the low temperature water species catches to the total catches of each station was higher in 1996 than 1997.

2. The change of the oceanic condition

(1) The change of the water masses

At line B in 1997, the distinct thermocline was formed. In 1996, the distinct thermocline was not formed but the low temperature water below 11 ℃ was distributed at line A (Fig. 5). Cho (1981) said the isothermal line of 15 ℃ was regarded as the index temperature of the front area. In 1997 when the isotherm of 15 ℃ moved further northwestward, high temperature waters were also dominant over the continental shelf of the East China Sea (Fig. 6). It was supposed that the high temperature water over 20 ℃ appeared in May, 1997 because the TSWC intruded intensively to north. In Fig. 7, the distribution of the water temperature of mid layer was shown using the temperature data at 50 meter-depth because the thermocline was formed at the depth of 20 to 40 meters. Yang et al. (1982) reported the isotherm of 15 ℃ expanded to 126 5′ E in January and to 128 E in April as the YSBCW expanded. The isothermal line of 15 ℃ in our study expanded to about 128 E like the result of Yang, et al in May, 1996 by the expansion of the YSBCW. But, The TSWC intruded intensively into the surface and mid layer of the eastern area of the East China Sea in 1997 and the isotherm of 15 ℃ expanded more to northwest. The temperature difference between sea surface and near bottom

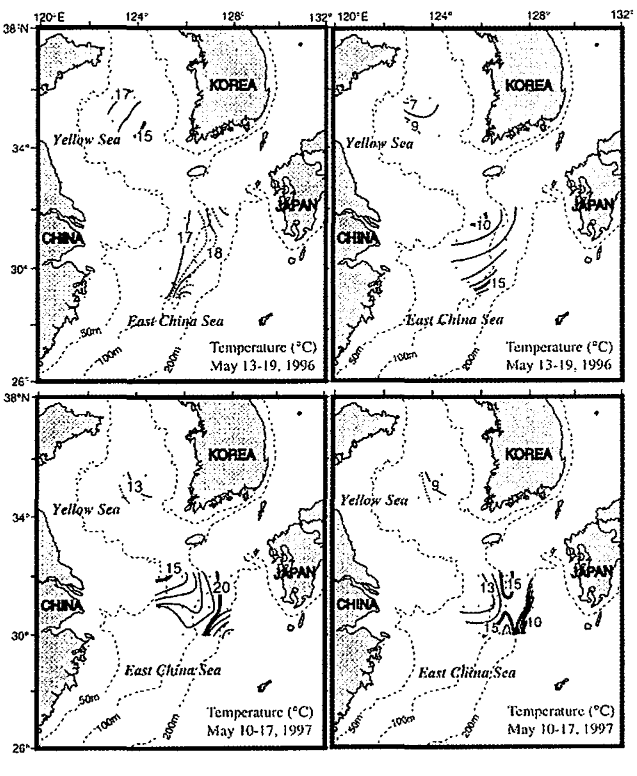

Fig. 6. Horizontal distributions of temperature at the sea surface (left) and the near bottom (right) in May 1996 (upper) and May 1997 (lower).

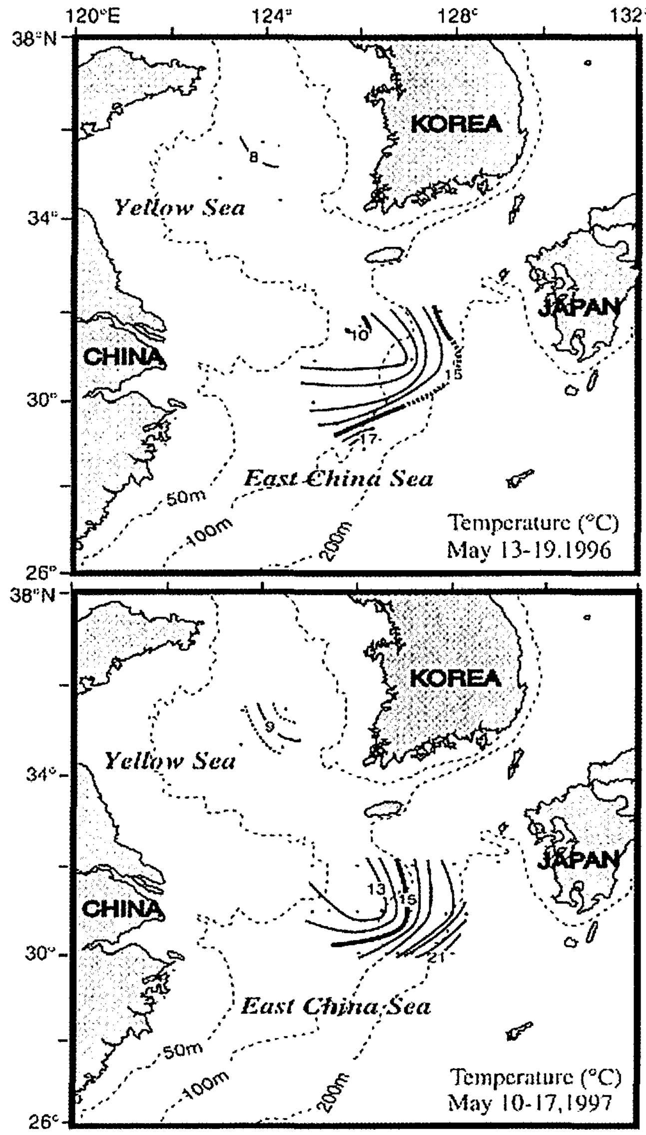

Fig. 7. Horizontal distributions of temperature at 50 m depth in May 1996 and May 1997.

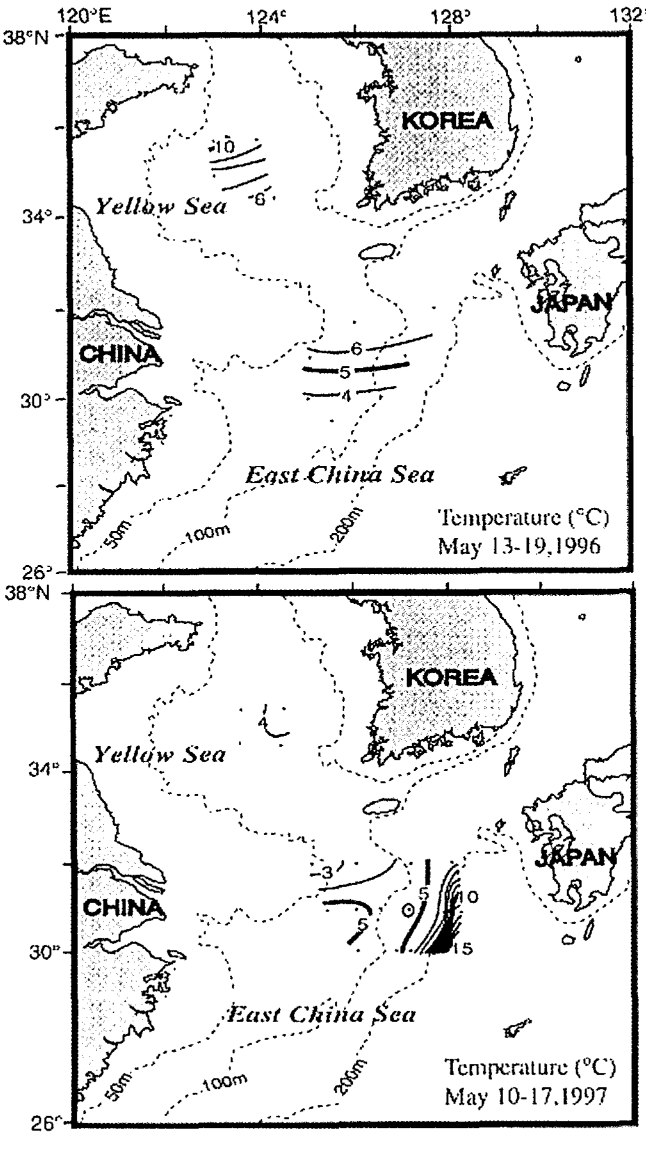

Fig. 8. Horizontal distributions of temperature difference between sea surface and near bottom in May 1996 and 1997.

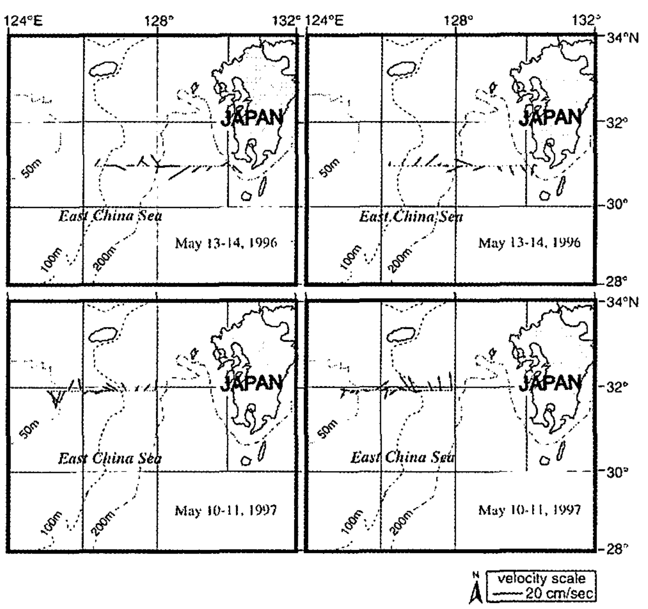

Fig. 9. Stick vector plots of the observed (left) and detided velocities (right) in May 1996 (upper) and May 1997 (lower).

was larger at the continental shelf of the East China Sea in 1996 than in 1997. Furthermore the temperature at the near bottom was lower in 1996 than in 1997. The result was that the existence of cold water masses was distinct at the near bottom in 1996 (Fig. 8). In Fig. 6, the distribution of the water temperature at the near bottom was about 3 ℃ lower than the sea surface, which was distinctive in 1996. The distribution of water temperature at the near bottom during the study period was compared to the distribution of the mean water temperature at the depth of one hundred meters of May in East China Sea (Lee, 1992). In 1996, the water temperature at the near bottom was lower than the mean water temperature but, not in 1997. The distribution type of the water temperature differed slightly to the mean distribution of the temperature above-mentioned but, there was no difference in the range of the water temperature. It was thought that the distribution of the water temperature at the near bottom was lower in 1996 than 1997 by the influence of the expansion of the YSBCW.

(2) The change of the currents

TSWC goes north to the Tsushima Strait through the East China Sea at the surface layer and mid layer (Lim and Fujimoto, 1972). It is also known that TSWC plays an important role to the variation of the currents in the East China Sea. Choi (1993) calculated the harmonic constants of the east and north constituents at the stations of the current observation using the whole data observed by the Euler method (Aanderaa current meter, etc.) and the Lagrange method (floater input) on the continental shelf of the East China Sea. The harmonic constants calculated by Choi were used to remove the tidal component from the current data observed by ADCP. The directions and velocities of currents were plotted above the observation line. The dominant direction of the currents in the East China Sea was wholly northwestward in 1996 and

1997 (Fig. 9). But, the regional pattern of the currents that influenced the distribution of the water masses showed a southward current in 1996 and a northward current in 1997. The isotherm of 15℃ expanded strongly to the southeast in 1996 because the southward current was dominant at the east of 128 E. The isotherm expanded weakly to the southeast because the northward current was dominant in 1997. The result is that high temperature water over 20℃ appeared at the surface layer and mid layer only in 1997.

Conclusion

Based on the distribution of the currents, the intrusion of the warm water was dominant regionally and the high temperature waters intruded more intensively in 1997 than in 1996. The horizontal distribution of the water temperature at 50 m depth showed a higher temperature distribution in 1997 than in 1996. YSBCW strongly expanded toward south in 1996 when the northward current was weak. But, TSWC strongly intruded into the continental shelf of the East China Sea in 1997. As YSBCW expanded strongly to south in 1996, the percentage of the low temperature water species relative to the total catches was high. But, TSWC strongly intruded and the percentage of low temperature water fishes was low in 1997. In the present study, the fluctuation between the YSBCW and TSWC influenced the formation of fishing grounds and the change of fish species composition in the East China Sea. It is prior to understand the flow pattern of the currents for studying the fisheries environments in the East China Sea. But, the origin of TSWC or the flow pattern of YSWC is yet hard to define obviously in the East China Sea (Lie et al., 1994; Isobe, 1998; Isobe, 1999). Further field investigations and biological and dynamical and numerical studies are needed for understanding fisheries environment and managing fishery resources in the East China Sea.

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