

**Salmon Stock Assessment in the North Pacific Ocean, 2001**

**by**

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## ABSTRACT

We summarize results of researches on salmon stock assessment conducted by Japan in summer of 2001. Five Japanese salmon research vessels (*Oshoro maru*, *Hokusei maru*, *Kaiyo maru*, *Kaiun maru* and *Wakatake maru*) conducted oceanographic observations, 71 gillnet (3,493 tans), 34 longline (900 hachi), 2 hook-and-line, and 2 trawl net fishing operations in the western, the central, the eastern North Pacific, and the Bering Sea from June to August. Mean sea surface temperature, abundance and body size of Pacific salmon in 2001 are compared to those from 1992 to 2000. Mean sea surface temperature at salmon research stations in 2001 was lower in the Bering Sea and the eastern North Pacific and higher in the western and central North Pacific than the mean of 1992-2000. A total of 17,672 salmonids, including 8,677 pink (49.1%), 5,381 chum (30.5%), 2,177 sockeye (12.3%), 1,115 coho (6.3%), and 112 chinook salmon (0.6%), and 210 steelhead trout (1.2%), was caught in summer of 2001. CPUEs of chum and sockeye salmon in 2001 were in high levels in 1992-2001. CPUE of pink salmon in 2001 was in a low level in the Bering Sea but in a high level in the western North Pacific among odd years of 1993-2001. No common trend in annual changes of mean fork lengths of salmonids was observed.

## INTRODUCTION

According to the 2001 Work Plan of the North Pacific Anadromous Fish Commission (NPAFC), the Committee on Scientific Research and Statistics (CSRS) should review results of salmon stock assessment research and the condition of salmon stocks (NPAFC 2000). This report summarizes the oceanographic conditions, abundance, and body size of salmon in the North Pacific Ocean and Bering Sea in 2001 from the salmon research conducted by Japan in the North Pacific Ocean from June to August 2001. In this report, we compared results in 2001 with those in the previous nine years from 1992 to 2000.

## MATERIALS AND METHODS

Five Japanese salmon research vessels (*Oshoro maru*, *Hokusei maru*, *Kaiyo maru*, *Kaiun maru*, and *Wakatake maru*) conducted 71 gillnet (3,493 tans), 34 longline (900 hachi), 2 trawl net and 2 hook-and-line fishing operations in the North Pacific Ocean and Bering Sea from June to August 2001 (Table1, Fig. 1). We divided the research area to 4 regions: the western North Pacific (38-51° N, 150-170° E), the central North Pacific

(38-52° N, 170° E-170° W), the Bering Sea (52-59° N, 170° E-170° W), and the eastern North Pacific (38-56° N, 170-140°W). To examine abundance of salmon, mean numbers of fish caught by 30 tans of non-selective research gillnets (CPUEs) were calculated (Takagi 1975). For body size of salmon, mean fork length (MFL) of fish caught by non-selective research gillnets was calculated.

## RESULTS AND DISCUSSION

### Sea Surface Temperature

Mean sea surface temperature at gillnet stations of Japanese salmon researches was 12.3°C in the western North Pacific, 12.5°C in the central North Pacific, 5.99°C in the Bering Sea, and 8.39°C in the eastern North Pacific in the summer of 2001 (Table 1). That was lower than the mean of 1992-2000 in the Bering Sea and the eastern North Pacific. In the western and central North Pacific, mean sea surface temperature in 2001 was higher than mean in 1992-2000. Ocean condition of the whole North Pacific in 2001 was described by Azumaya and Fukuwaka (2001).

### Salmonid and Non-Salmonid Catches

A total of 17,672 salmonids was caught using drift gillnet, longline, trawl net, and hook-and-line, including 8,677 pink (49.1%), 5,381 chum (30.5%), 2,177 sockeye (12.3%), 1,115 coho (6.3%), and 112 chinook salmon (0.6%), and 210 steelhead trout (1.2%) in 2001 (Table 2). No Dolly Varden was caught. Dominant non-salmonid catches included 3,605 Pacific saury (*Cololabis saira*) and 2,396 Atka mackerel (*Pleurogrammus monopterygius*), 950 Pacific pomfret (*Brama japonica*), and 890 neon flying squid (*Ommastrephes bartrami*).

### Salmon Abundance

CPUEs of chum and sockeye salmon in 2001 were in high levels in 1992-2001 in the North Pacific Ocean.

CPUE of sockeye salmon in the summer of 2001 was higher than in the last year, and was in the highest level in 1992-2001 (Fig. 2). Sockeye salmon are mainly distributed in the Bering Sea and the eastern North Pacific in summer. In 2001, CPUE of sockeye salmon in the Bering Sea ( $60.8 \pm \text{SD } 64.9$ ) was 138% of the mean in 1992-2001 ( $43.9 \pm \text{SD } 38.9$ ). Sockeye CPUE in the eastern North Pacific ( $77.9 \pm \text{SD } 86.3$ ) was 190% of the mean in 1992-2001 ( $40.9 \pm \text{SD } 39.4$ ).

CPUE of chum salmon in 2001 was in a high level in odd-years of 1993-2001 in the Bering Sea (Fig. 3). Chum salmon are mainly distributed in the Bering Sea in summer. In this region, chum CPUE is lower in odd years than in even years. CPUE of chum salmon in the Bering Sea ( $136 \pm \text{SD } 71.2$ ) was higher than the mean in odd-years of 1993-2001 ( $104 \pm \text{SD } 62.0$ ).

CPUE of pink salmon in 2001 was in a low level in the Bering Sea but in a high level in the western North Pacific among odd years of 1993-2001 (Fig. 4). Pink salmon are mainly distributed in the Bering Sea and the western North Pacific. In the Bering Sea, CPUEs in odd years are higher than in even years. CPUE in this region of 2001 ( $165 \pm \text{SD } 59.7$ ) was lower than odd-year mean in 1993-2001. In the western North Pacific,

CPUEs in odd years are lower than in even years. In this region, pink salmon CPUE in 2001 ( $128 \pm \text{SD } 132$ ) was the highest in odd-years of 1993-2001.

Coho salmon are distributed in the western, central, and eastern North Pacific. Coho salmon CPUEs in the central and eastern North Pacific of 2001 was in the similar level in 1992-2000, but it in the western North Pacific was lowest in 2001 during 1992-2001 (Fig. 5). Chinook salmon are distributed in the Bering Sea and their CPUE in 2001 was in a low level in 1992-2001 (Fig. 6). Steelhead trout are mainly distributed in the eastern North Pacific and their CPUE in 2001 was highest in 1992-2001 (Fig. 7).

### **Fish Size**

MFL of sockeye salmon in summer of 2001 was the smallest in 1992-2001 in the eastern North Pacific and the Bering Sea (Fig. 8). MFL of chum salmon in summer of 2001 was in the similar level in 1992-2000 in the central, eastern North Pacific and the Bering Sea, but that was the largest in the western North Pacific (Fig. 9). In these species, it was not possible to compare MFL by age groups, because age determination has not yet been finished.

MFL of pink salmon in summer of 2001 in the Bering Sea was relatively larger than in 1992-2000 (Fig. 10). In the North Pacific, MFL of pink salmon in 2001 was in the similar level in 1992-2000. MFL of coho salmon in summer of 2001 was relatively larger than in 1992-2000 in the North Pacific (Fig. 11).

No clear change in MFL was observed for chinook salmon and steelhead trout due to small number of samples (Fig. 12 and Fig. 13).

## **ACKNOWLEDGMENTS**

We thank captains, officers and crew of all Japanese salmon research vessels for their careful collection of data and samples.

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Table 1. Mean sea surface temperature (°C), standard deviation, and number of observations (in parentheses) of gillnet stations of Japanese salmon researches by regions in the North Pacific Ocean in the summer of 1992-2001.

Year	Western North Pacific	Central North Pacific	Bering Sea	Eastern North Pacific	Whole research area
1992	8.98 ± 4.13 (38)	10.6 ± 3.46 (38)	6.61 ± 0.53 (11)	9.56 ± 0.68 (9)	9.38 ± 3.61 (96)
1993	11.0 ± 3.50 (27)	11.0 ± 2.94 (32)	7.50 ± 0.56 (11)	9.36 ± 1.30 (8)	10.8 ± 3.22 (78)
1994	12.9 ± 4.99 (29)	12.3 ± 4.72 (32)	7.08 ± 0.59 (11)	10.4 ± 1.10 (10)	11.5 ± 4.62 (82)
1995	11.6 ± 4.14 (30)	11.6 ± 2.81 (32)	7.80 ± 0.70 (11)	9.78 ± 1.62 (7)	10.9 ± 3.42 (80)
1996	9.98 ± 2.71 (25)	12.4 ± 3.18 (33)	7.87 ± 0.56 (9)	9.62 ± 0.99 (9)	10.7 ± 3.08 (76)
1997	9.22 ± 1.79 (20)	11.6 ± 3.55 (31)	8.41 ± 0.64 (10)	12.2 ± 0.43 (9)	10.5 ± 2.93 (70)
1998	10.8 ± 4.39 (23)	11.2 ± 3.84 (22)	7.51 ± 1.14 (11)	9.98 ± 1.11 (12)	10.2 ± 3.65 (68)
1999	9.61 ± 3.63 (18)	10.7 ± 4.22 (19)	6.75 ± 0.60 (11)	9.72 ± 2.82 (13)	9.47 ± 3.61 (61)
2000	12.6 ± 7.14 (21)	8.49 ± 2.78 (22)	7.69 ± 1.25 (25)	9.89 ± 1.74 (26)	9.39 ± 4.40 (96)
92-00	10.7 ± 4.48 (231)	11.5 ± 3.66 (249)	7.48 ± 0.91 (96)	10.1 ± 1.74 (91)	10.5 ± 3.77 (667)
2001	12.3 ± 4.83 (17)	12.5 ± 4.11 (34)	5.99 ± 0.69 (13)	8.39 ± 1.11 (9)	10.8 ± 4.49 (73)

Table 2. Numbers of salmonids and other organisms caught by the Japanese salmon research vessels in summer of 2001.

Region	Research Vessel	Gillnet or other gear	Date	Oper ation	Tan/ hachi eye	Sock	Chum Pink	Coho nook head	Steel g squid	Flyin g squid	Other pomfret	Pacific saury	Pacific Lancet fish	Sharks	Atka mack erel	Walleye pollock	Other water fishes	Shear water s	Other birds	Mamm als				
																					Jun 6-Aug 1	17	735	0
Central North Pacific	<i>Wakatake maru</i>	Research	Jun 16-24	8	240	16	206	131	132	2	10	8	57	18	51	1	0	0	7	5	2			
		Commercial	Jun 16-24	8	136	6	116	39	178	7	16	3	0	8	0	0	2	7	0	1	0	0		
		Small-mesh	Jun 16-24	8	16	0	0	0	0	0	0	0	1	0	994	0	0	0	1	1	0	0		
<i>Kaiyo maru</i>	Trawl	Longline	Jun 15-27	12	360	29	98	28	57	0	4	0	1	4	0	0	0	0	0	2	0	0		
			Research	Jul 2-28	26	780	202	249	96	204	12	15	249	1002	523	405	1	106	0	0	144	0	0	
			Commercial	Jun 2-28	26	492	107	143	79	256	22	26	123	10	300	0	0	82	0	0	15	0	0	
Total		Small-mesh	Jun 2-28	26	28	0	0	0	1	0	0	0	15	2	1040	0	1	0	0	0	0	0		
			Jun 15-Jul 28	46	2052	360	812	373	828	43	71	383	1086	855	2490	4	195	0	0	168	8	2	0	
			Total	118	2104	720	1624	746	1651	86	142	383	1192	860	2490	8	196	0	0	172	8	2	0	
Beijing Sea	<i>Wakatake maru</i>	Research	Jul 2-14	13	390	790	1774	2144	1	33	0	0	18	0	0	0	0	6	1	0	17	2		
		Commercial	Jul 2-14	13	247	109	1455	2815	0	12	0	0	1	0	0	0	0	0	1	0	25	5	0	
		Longline	Jun 28-Jul 13	16	480	12	640	180	0	4	0	0	0	0	0	0	0	0	0	0	10	7	0	
Total		Longline	Jun 28-Jul 14	29	1117	911	3869	5139	1	49	0	0	19	0	0	0	0	6	2	0	52	14	0	
			Jun 20-Jul 8	9	255	644	313	285	98	7	61	0	30	0	0	0	0	3	0	0	1	0	1	2
			Jun 20-Jul 8	9	132	251	127	274	118	9	75	0	0	0	0	0	0	0	0	0	0	0	3	1
Eastern North Pacific	<i>Oshoro maru</i>	Commercial	Jun 20-Jul 3	9	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Small-mesh	Jun 20-Jul 3	9	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Longline	Jul 1-8	6	60	8	10	11	19	2	2	0	0	0	0	0	0	0	0	0	0	0		
Total		Hook & line	Jul 3-4	2	3	0	0	2	7	1	0	0	0	0	0	0	0	0	0	0	0	0		
			Jun 20-Jul 8	17	489	906	450	572	242	19	138	0	30	0	0	0	0	3	0	0	1	0	4	
			Jun 6-Aug 1	109	4393	2177	5381	8677	1115	112	210	890	1992	950	3605	7	263	2396	2	466	60	23	4	
Total			Jun 6-Aug 1	109	4393	2177	5381	8677	1115	112	210	890	1992	950	3605	7	263	2396	2	466	60	23	4	
			Jun 6-Aug 1	109	4393	2177	5381	8677	1115	112	210	890	1992	950	3605	7	263	2396	2	466	60	23	4	

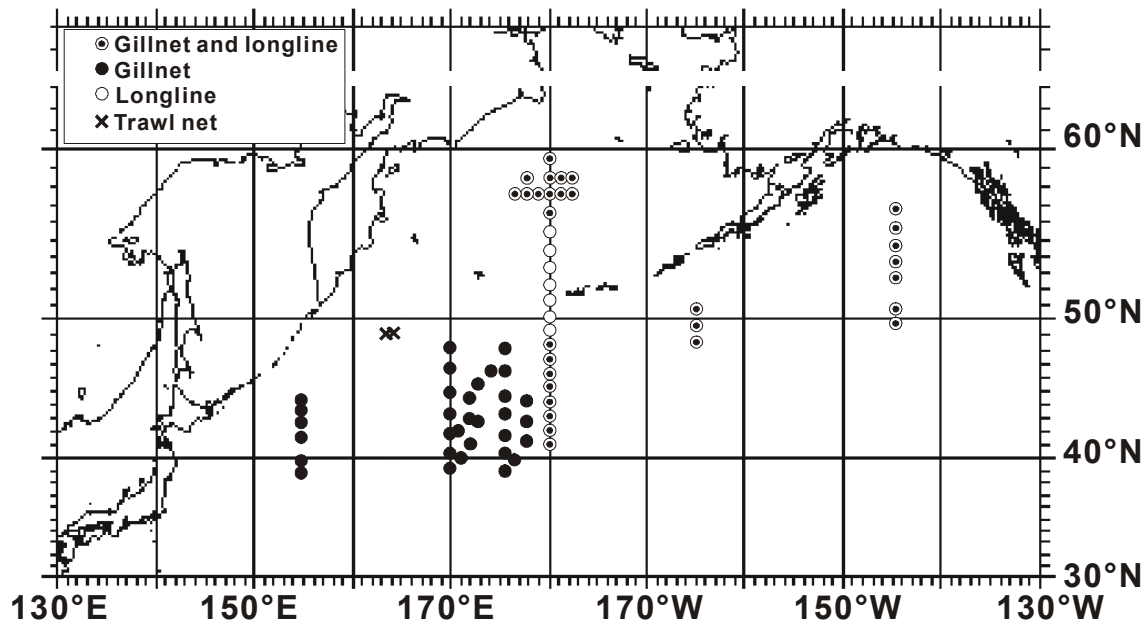


Fig. 1. Sampling locations for Japanese salmon research vessels in the North Pacific Ocean in summer of 2001.

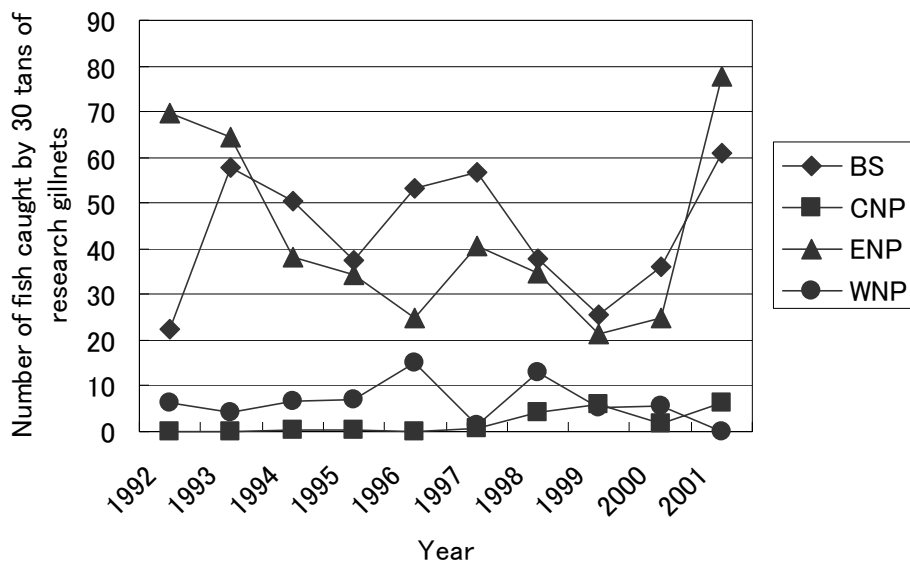


Fig. 2. Number of sockeye salmon caught by 30 tans of research gillnets in summer of 1992-2001 in the North Pacific Ocean.

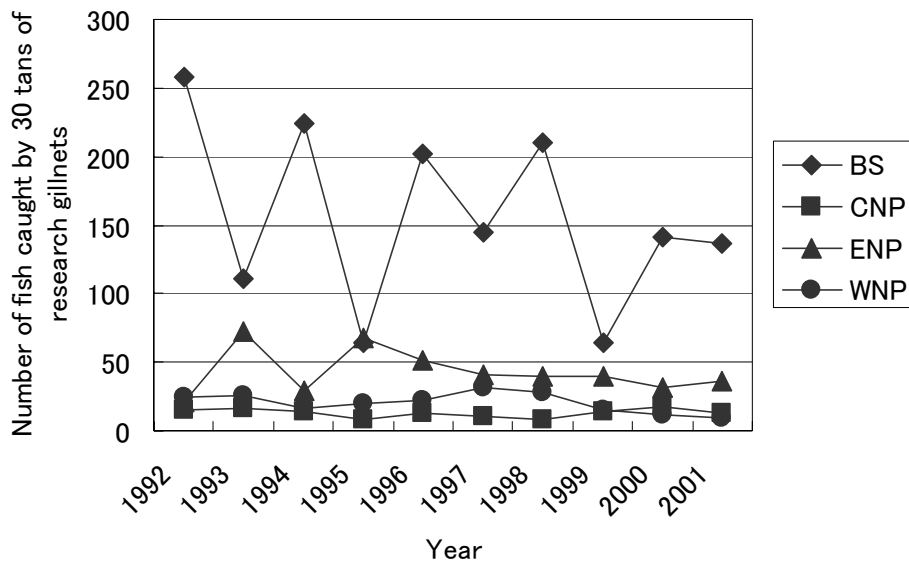


Fig. 3. Number of chum salmon caught by 30 tans of research gillnets in summer of 1992-2001 in the North Pacific Ocean.

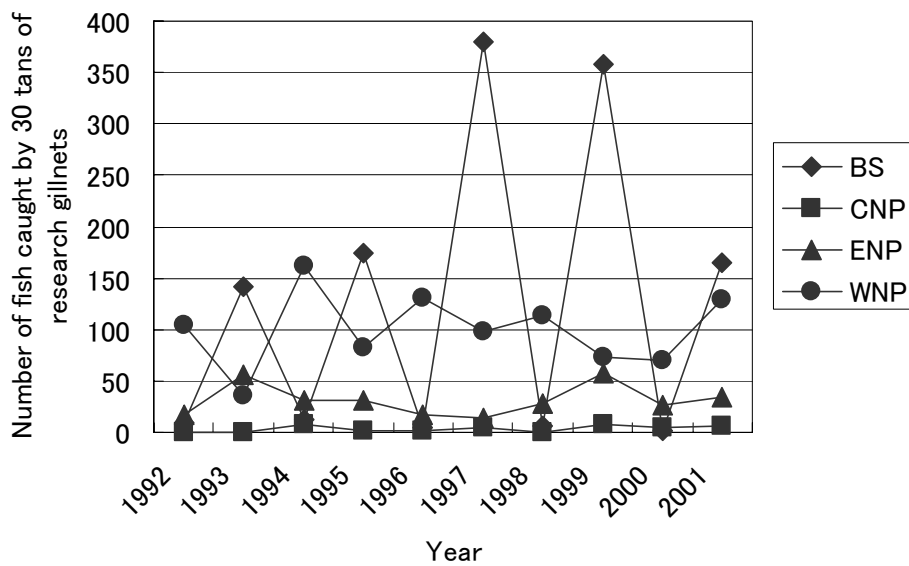


Fig. 4. Number of pink salmon caught by 30 tans of research gillnets in summer of 1992-2001 in the North Pacific Ocean.



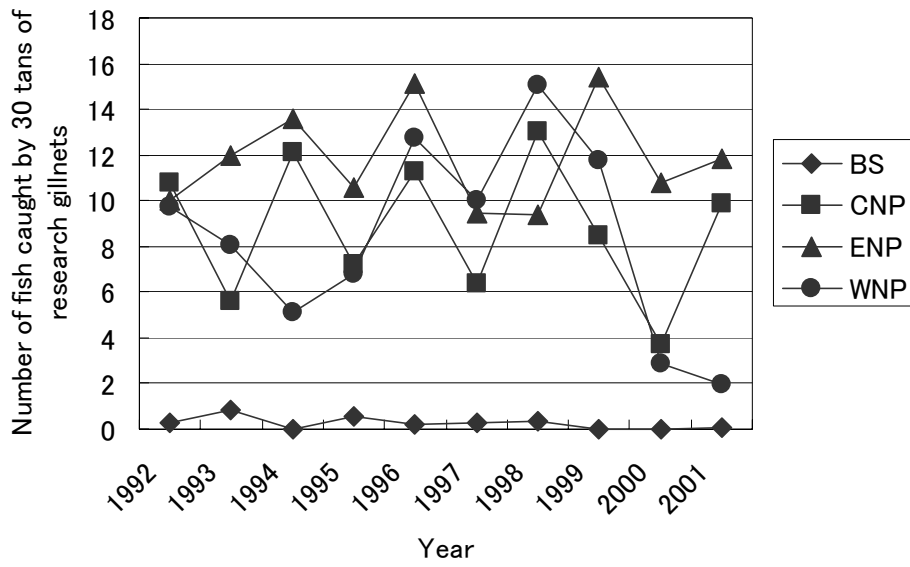


Fig. 5. Number of coho salmon caught by 30 tans of research gillnets in summer of 1992-2001 in the North Pacific Ocean.

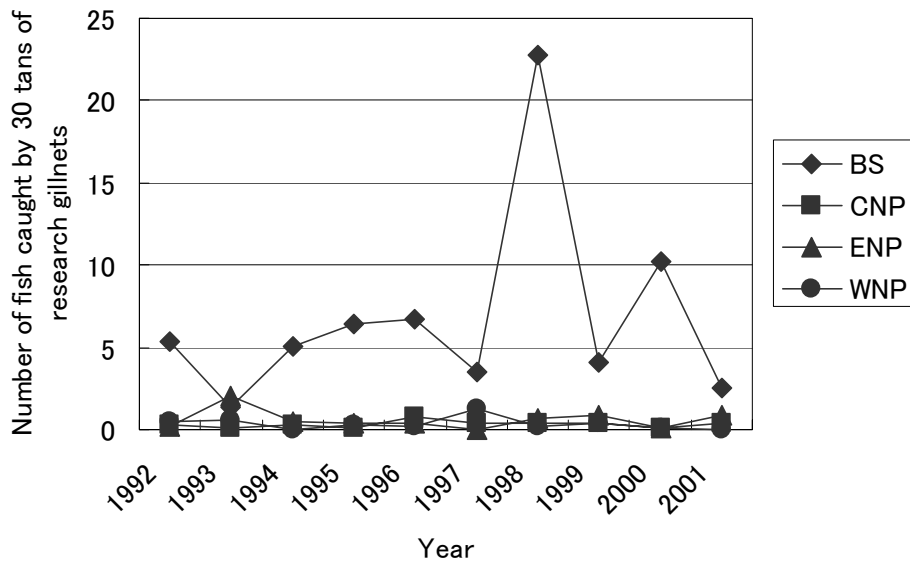


Fig. 6. Number of chinook salmon caught by 30 tans of research gillnets in summer of 1992-2001 in the North Pacific Ocean.

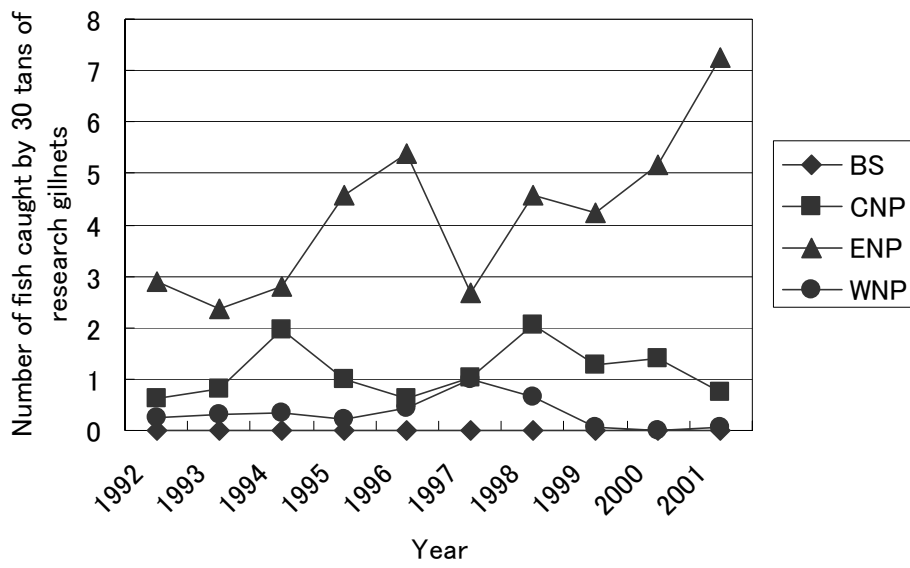


Fig. 7. Number of steelhead trout caught by 30 tans of research gillnets in summer of 1992-2001 in the North Pacific Ocean.

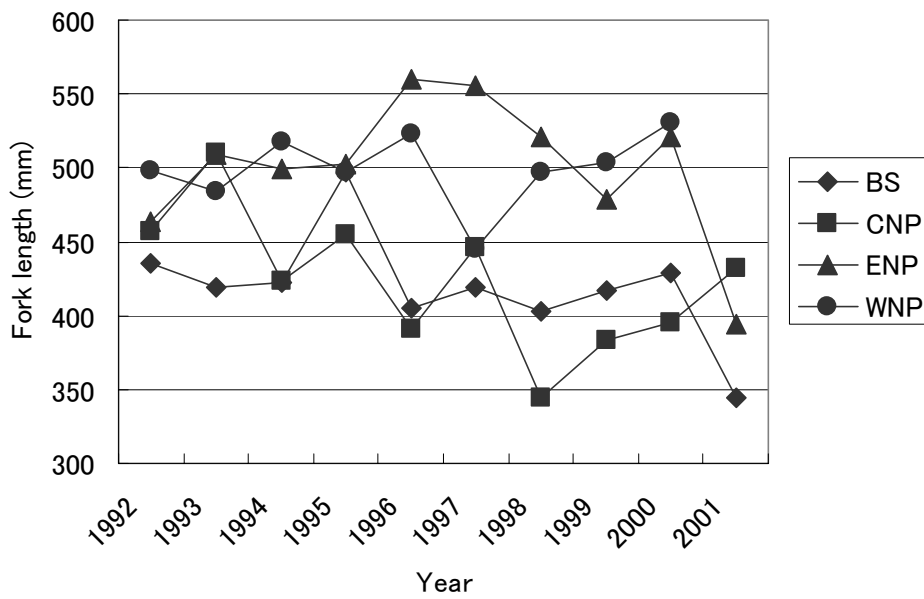


Fig. 8. Mean fork length of sockeye salmon caught by research gillnets in summer of 1992-2001 in the North Pacific Ocean.

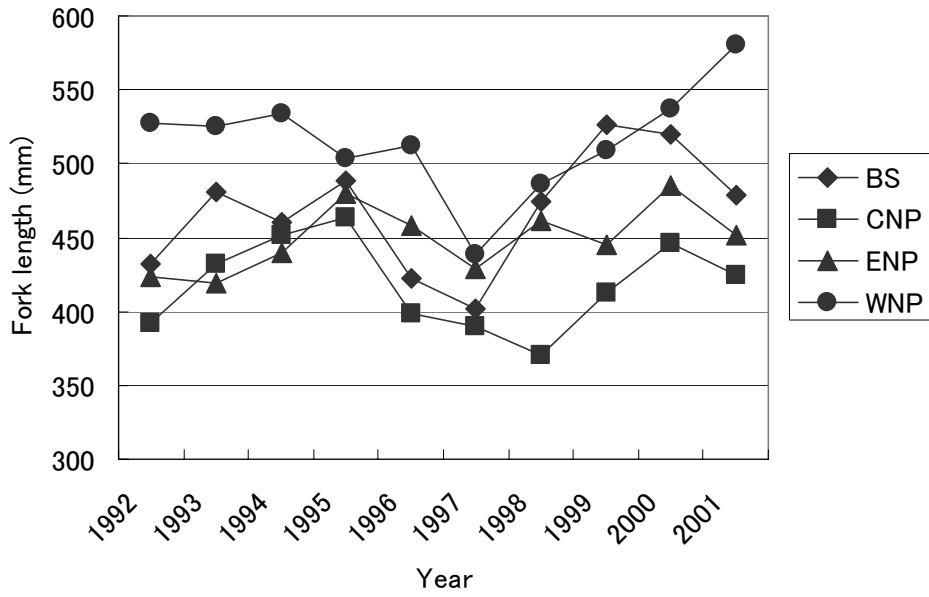


Fig. 9. Mean fork length of chum salmon caught by research gillnets in summer of 1992-2001 in the North Pacific Ocean.

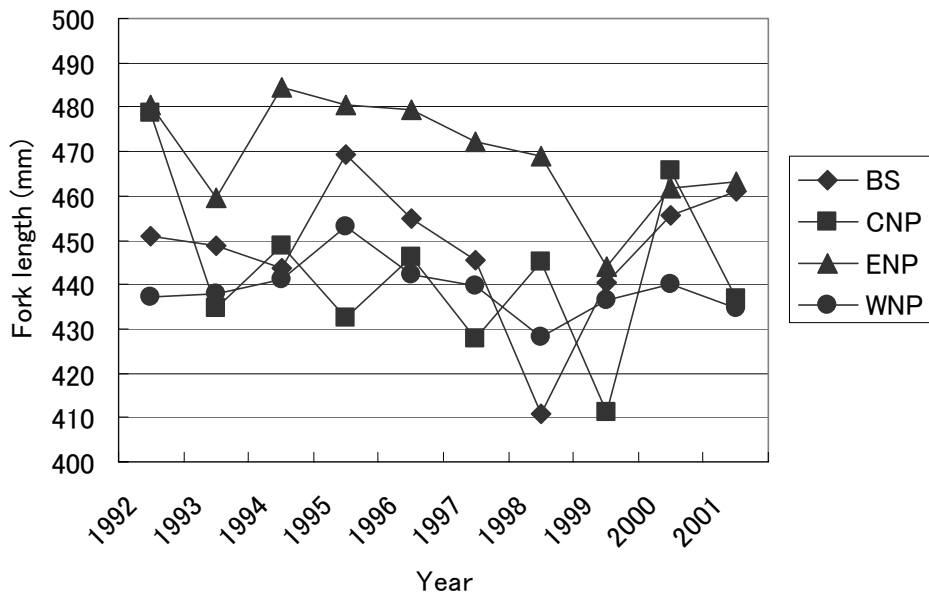


Fig. 10. Mean fork length of pink salmon caught by research gillnets in summer of 1992-2001 in the North Pacific Ocean.

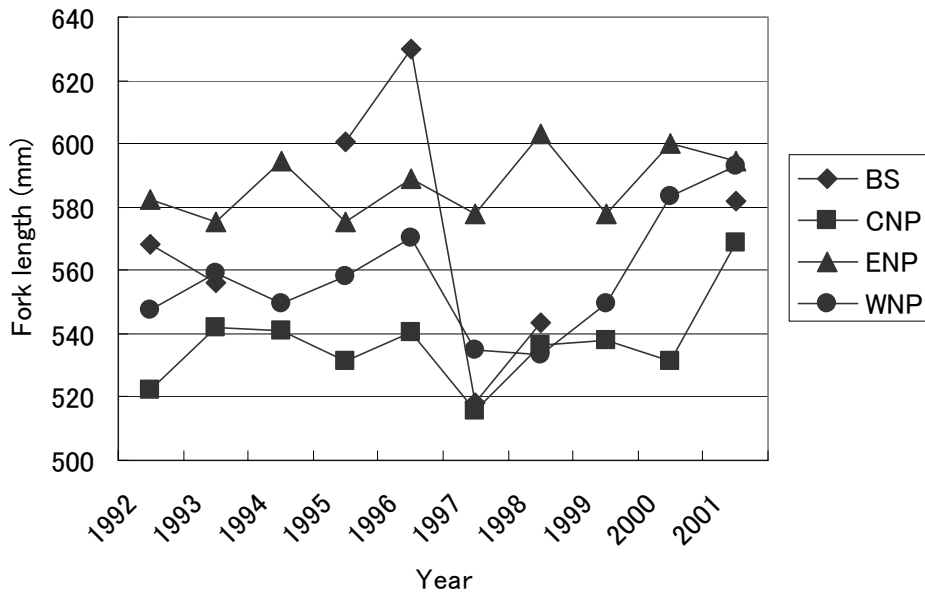


Fig. 11. Mean fork length of coho salmon caught by research gillnets in summer of 1992-2001 in the North Pacific Ocean.

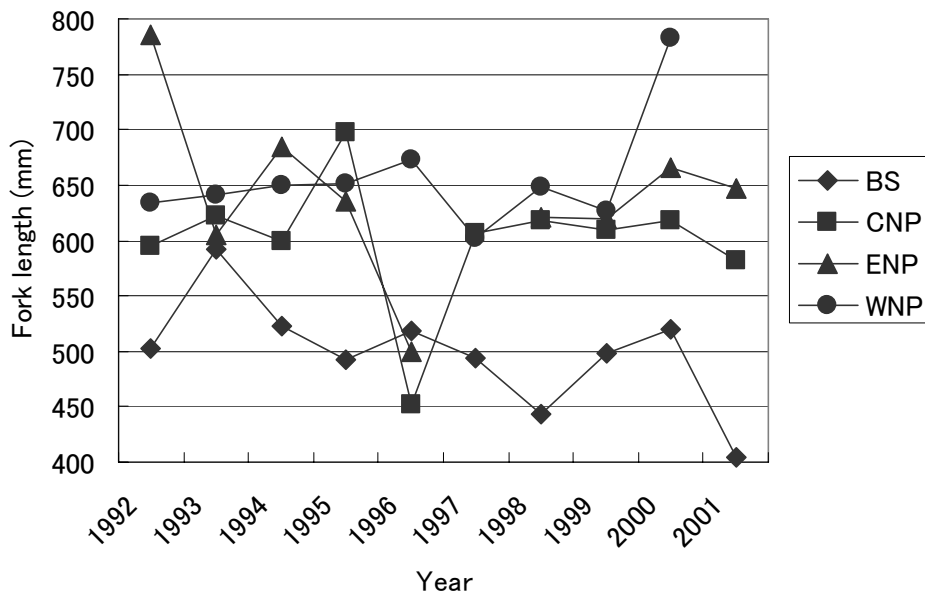


Fig. 12. Mean fork length of chinook salmon caught by research gillnets in summer of 1992-2001 in the North Pacific Ocean.

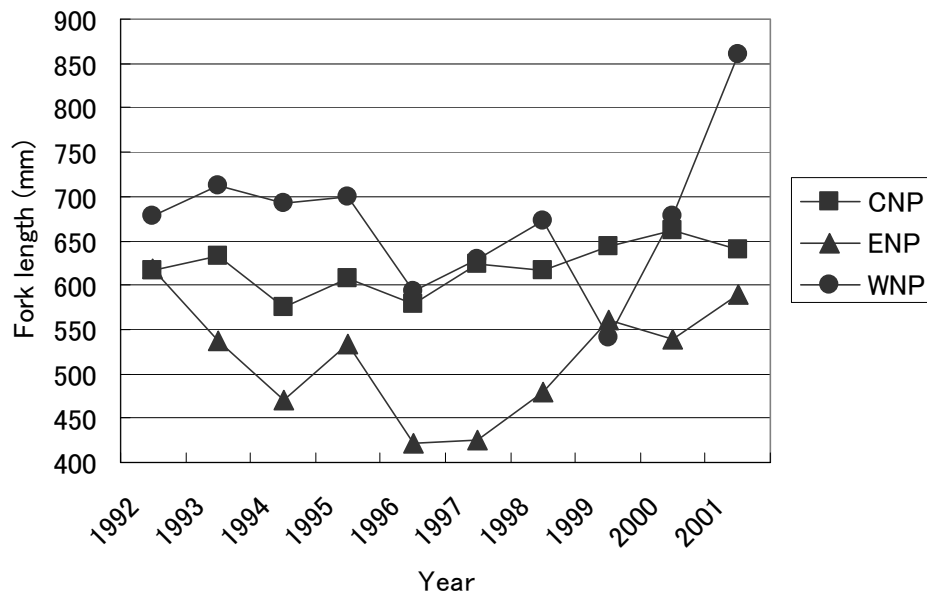


Fig. 13. Mean fork length of steelhead trout caught by research gillnets in summer of 1992-2001 in the North Pacific Ocean.