NPAFC
Doc. 624
Rev.

Zooplankton Biomass along a Transect at 180ºE in the Subarctic Pacific Ocean: Results in 1999-2001

by

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Submitted to the

NORTH PACIFIC ANADROMOUS FISH COMMISSION

by

JAPAN

October 2002

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER:
Morita, S. H., and O. Yamamura. 2002. Zooplankton Biomass along a Transect at 180ºE in the Subarctic Pacific Ocean: Results in 1999-2001 (NPAFC Doc. 624). Hokkaido National Fisheries Research Institute, Fisheries Research Agency, 116 Katsurakoi, Kushiro 085-0802, Japan. 11 p.

Zooplankton Biomass along a Transect at 180ºE in the Subarctic Pacific Ocean Results in 1999-2001

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ABSTRACT

Data on the biomass and composition of zooplankton collected with a Norpac net and an ORI net by the *Wakatake maru* along a transect of 180ºE, between 39º-58.5ºN. Zooplanktons were sampled after sunset at 21stations. We obtained whole wet weight and each classified wet weight at different latitudes and domains. The total biomass collected by the Norpac net was less abundant in the Transition Domain than other domains, but not significant. In the all domains, copepods were most abundant group. The total biomass collected by the ORI net was most abundant in the Bering Sea, copepods were most abundant group in all domains.

INTRODUCTION

The production of zooplankton is influenced by ocean environment and climate change (Kaiho et al., 1996; Beamish and Bouillon 1993; Planque and Taylor 1998), and zooplankton biomass affect Pacific salmon (*Oncorhynchus* spp.) production (Beamish and Bouillon 1993; Beamish 1993). Zooplankton in the Pacific Ocean is important prey for Pacific salmon (Ito 1964), therefore Zooplankton biomass could be important factor regulating the growth, survival and production of Pacific salmon. This report provides the biomass and composition of zooplankton collected in June to July during 1999-2001 at transect of 180ºE, between 39º-58.5ºN.

MATERIALS AND METHODS

The samples of zooplankton were collected after sunset at 21 stations along a transect of 180ºE, between 39º-58.5ºN, using a remodeled Norpac net (0.45 m diameter opening, 1.95 mm length, 0.335 mm mesh size) and an ORI net from June to July in 1999-2001 (Mori 1992, Motoda 1994). The Norpac net was towed vertically from 150 m in depth to surface with a speed of 1m per second, and the ORI net was towed just bellow the sea surface with a speed of 2 knot. The samples were fixed in 10% buffered formalin.

Zooplankton sorted to the following categories at the laboratory: euphausiids, copepods, amphipods, pteropods, appendicul-arians, chaetognaths, ostracods, jellyfishes, salps, fishes, squids, and others (polychaets, decapods, eggs etc.). We obtained each classified wet weight

and whole wet weight. Large (> 2cm) jelly fishes and salps were not included for data analysis.

We determine the location of the Transition Zone (station 1-2), the Transition Domain (station 3-7), the Subarctic Domain (station 8-14) and the Bering sea (station 15-21) based on temperature and salinity (Favorite et al., 1976), and examined relationships between latitude, domain and biomass of zooplankton.

RESULTS

The total biomass was significantly abundant in ORI net (ANOVA, $p < 0.05$), especially in the Subarctic Domain and the Transition Domain. The biomass of chaetognaths, coepods and euphausiids were more abundant in ORI net than Norpac net in almost domains (Fig. 1).

The each classified weight of zooplankton collected by the Norpac net differed between the domains (ANOVA, $p < 0.05$), but total biomass did not differ significantly between the domains (ANOVA, $p > 0.05$). In all domains, copepods were the most abundant group, followed by jellyfishes. The biomass of chaetognaths, euphausiids, jellyfishes, and squids were most abundant in the Bering Sea, salps was more abundant in the Transition Zone and the Transition Domain, but the biomass of copepods was not different from latitude and domain (Fig. 2, Table 1-3).

The each classified weight of zooplankton collected by the ORI net differed between species and domains (ANOVA, $p < 0.05$). The same as results of Norpac net, copepods were the most abundant group in all domains. The total biomass of amphipods and copepods were more abundant in the Subarctic Domain and the Transition Zone. The biomass of pteropods, and chaetognaths were less abundant in the Transition Domain, on the other hand, euphausiids were less abundant in the Bering Sea (Fig. 3, Table 4, 5).

ACKNOWLEDGMENTS

We thank Captain, the officers and crew of research vessel *Wakatake-maru* for their assistance during the cruises. We are grateful to many people for their help with data analysis.

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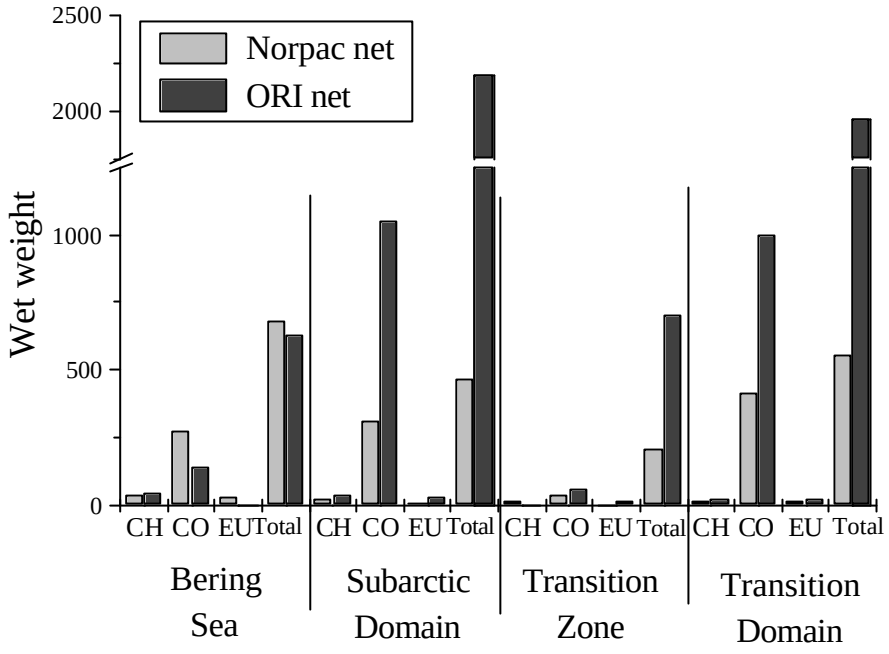

Fig. 1. The total wet weight and each classified weight (CH: chaetognaths, CO: copepods, EU: euphausiids) of zooplankton collected by the Norpac net and ORI net. Light grey and dark grey indicates Norpac net and ORI net respectively.

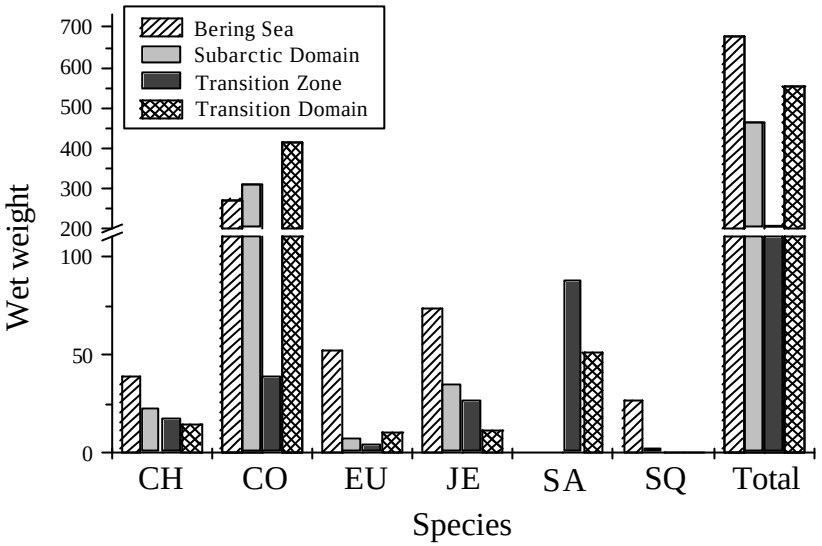

Fig. 2. The total wet weight and each classified weight (CH: chaetognaths, CO: copepods, EU: euphausiids, JE: jellyfishes, SA: salps, SQ: squids) of zooplankton collected by the Norpac net. Slash marc, Light grey, dark grey and closs mark indicate the Bering Sea, the Subarctic Domain, the Transition Domain and the Transition Zone respectively.

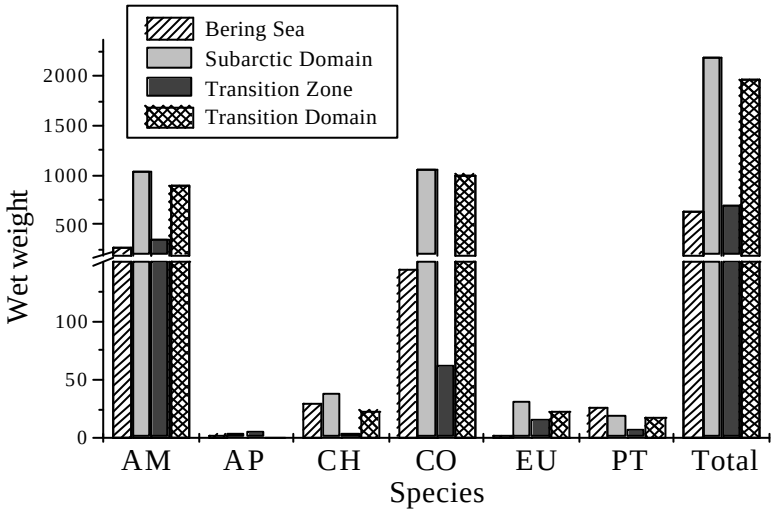

Fig. 3. The total wet weight and each classified weight (AM: amphipods, AP: appendicularians, CH: chaetognaths, CO: copepods, EU: euphausiids, PT: pteropods) of zooplankton collected by the Norpac net. Slash marc, Light grey, dark grey and closs mark indicate the Bering Sea, the Subarctic Domain, the Transition Domain and the Transition Zone respectively.

Table 1. Zoo plankton biomass (mg/ m^3) along a north-to-south transect at 180°E longitude from 39°N to 58°30' N latitude in the western North Pacific Ocean from mid June to early July in 1999. The samples were collected with a remodelled Norpac net after sunset.

Station			Location		Wet weight (mg / m^3)												
No.	Date	Time	Lat. (N)	Long. (E)	EU	CO	AM	PT	AP	CH	OS	JE	SA	FI	SQ	OT	Total
1	June 15	21:16	39°00'	180°00'	1	13	1	0	+	7	1	3	297	0	0	4	327
2	June 16	21:31	40°04'	179°55'	6	66	1	7	0	28	1	37	1	7	3	14	171
3	June 17	21:29	40°59'	179°58'	13	323	0	7	0	10	+	11	1	1	0	21	387
4	June 18	21:17	42°03'	179°58'	6	488	+	1	0	28	8	15	0	+	0	10	556
5	June 19	21:21	42°58'	179°58'	39	745	+	1	0	35	0	3	0	0	0	55	878
6	June 21	21:32	43°58'	179°54'	11	600	2	2	0	3	5	4	0	0	0	13	640
7	June 22	21:27	45°02'	179°56'	9	443	0	2	1	29	0	9	0	0	7	10	510
8	June 24	21:38	45°58'	179°59'	1	589	37	4	0	74	3	11	0	0	0	20	739
9	June 25	21:35	47°04'	179°57'	2	201	+	3	0	2	5	2	0	7	0	7	229
10	June 26	21:35	47°26'	179°57'	+	261	0	1	0	6	2	10	0	0	0	8	288
11	June 27	21:44	48°31'	179°59'	8	118	4	3	+	15	4	24	0	2	18	16	212
12	June 28	21:50	49°31'	179°59'	4	172	1	2	0	9	3	4	0	+	0	4	199
13	June 29	21:47	50°31'	180°00'	1	47	1	1	+	2	1	23	0	0	0	10	86
14	June 30	22:11	51°30'	179°58'	12	479	+	1	51	26	3	186	0	0	0	816	1574
15	July 01	22:29	52°29'	180°00'	6	196	4	122	1	52	3	65	0	0	0	350	799
16	July 02	22:19	53°31'	179°58'	0	162	1	4	37	50	4	181	0	11	0	576	1026
17	July 03	22:36	54°32'	179°59'	135	352	18	+	0	59	4	115	0	0	25	21	729
18	July 04	22:45	55°32'	179°59'	211	1573	38	+	3	78	9	112	0	0	267	41	2332
19	July 05	22:52	56°34'	179°53'	+	97	1	2	5	11	2	3	0	0	0	24	145
20	July 06	22:41	57°31'	180°00'	1	147	5	11	10	55	3	28	0	0	0	121	381
21	July 07	22:50	58°35'	179°50'	3	369	17	5	348	1	0	46	0	0	0	34	823

EU: euphausiids, CO: copepods, AM: amphipods, PT: pteropods, AP: appendicularians, CH: chaetognaths, OS: ostracods, JE: jellyfishes (medusae, ctenophores)
SA: salps, FI: fishes, SQ: squids, OT: others
+: value of under 1

Table 2. Zoo plankton biomass (mg/ m³) along a north-to-south transect at 180°00' longitude from 39°00'N to 58°30' N latitude in the western North Pacific Ocean from mid-June to early July in 2000. The samples were collected with a remodelled Norpac net after sunset.

Station			Location		Wet weight (mg / m³)												
No.	Date	Time	Lat. (N)	Long. (W)	EU	CO	AM	PT	AP	CH	OS	JE	SA	FI	SQ	OT	Total
1	June 12	21:19	39°00'	180°00'	6	37	1	53	7	4	1	36	15	0	1	16	177
2	June 13	21:06	40°00'	180°00'	3	41	+	0	19	3	2	31	39	1	0	16	155
3	June 14	21:13	40°57'	180°00'	4	134	3	5	12	7	1	27	30	+	1	47	271
4	June 15	21:14	42°00'	179°59'	+	119	+	+	0	3	3	7	+	0	0	25	157
5	June 16	21:13	43°00'	179°57'	3	365	+	+	0	26	+	10	0	0	0	6	410
6	June 17	21:26	44°01'	179°58'	1	696	12	1	+	38	3	17	42	0	0	8	818
7	June 18	21:31	44°58'	180°00'	16	188	2	1	0	7	1	16	572	0	0	321	1124
8	June 19	21:33	46°00'	180°00'	13	185	2	3	0	12	6	7	0	0	0	4	232
9	June 20	21:29	47°00'	179°57'	19	794	1	2	1	62	10	94	0	+	0	6	989
10	June 22	21:27	47°28'	179°57'	5	393	0	0	0	98	5	1	0	0	15	4	521
11	June 23	21:43	48°30'	180°00'	1	258	5	1	1	33	5	53	0	0	0	15	372
12	June 24	21:42	49°30'	180°00'	3	548	2	4	0	45	11	11	0	0	0	10	634
13	June 25	22:12	50°30'	180°00'	13	216	5	2	0	54	5	24	0	22	0	7	348
14	June 26	22:25	51°30'	180°00'	10	486	8	0	2	43	2	37	0	1	0	8	597
15	June 27		52°30'	180°00'	15	119	15	0	2	4	1	0	0	2	0	363	521
16	June 28	22:57	53°30'	180°00'	144	214	2	6	1	30	6	13	0	2	0	4	422
17	June 29	22:38	54°30'	180°00'	9	173	1	1	0	13	4	114	0	0	0	21	336
18	June 30	23:05	55°30'	179°56'	0	41	2	8	+	32	2	136	0	0	0	3	224
19	July 01	22:55	56°30'	179°59'	0	178	1	2	1	13	3	12	0	0	+	21	231
20	July 02	23:04	57°30'	179°54'	0	126	2	0	0	35	1	10	0	0	0	4	178
21	July 03	23:02	58°37'	179°53'	1	446	2	1	0	40	1	1	0	0	0	5	497

EU: euphausiids, CO: copepods, AM: amphipods, PT: pteropods, AP: appendicularians, CH: chaetognaths, OS: ostracods, JE: jellyfishes (medusae, ctenophores)
SA: salps, FI: fishes, SQ: squids, OT: others
+: value of under 1

Table 3. Zoo plankton biomass (mg/ m³) along a north-to-south transect at 180°00' longitude from 39°00'N to 58°30' N latitude in the western North Pacific Ocean from mid-June to early July in 2001. The samples were collected with a remodelled Norpac net after sunset.

Station			Location		Wet weight (mg / m³)												
No.	Date	Time	Lat. (N)	Long. (W)	EU	CO	AM	PT	AP	CH	OS	JE	SA	FI	SQ	OT	Total
3	June 15	21:55	41°01'	179°58'	25	310	3	+	19	15	12	6	10	0	1	189	590
4	June 16	21:09	41°55'	179°56'	29	185	1	1	1	9	2	2	8	0	0	28	266
5	June 17	21:27	43°00'	179°57'	14	571	3	2	1	4	7	2	0	0	0	9	613
6	June 18	21:42	44°03'	179°54'	1	519	2	+	0	5	3	2	+	+	+	7	539
7	June 19	21:24	44°59'	179°57'	2	532	7	1	+	6	6	+	0	0	0	11	565
8	June 20	21:27	45°59'	179°59'	19	149	2	6	3	25	8	7	0	0	0	14	233
10	June 23	21:46	47°30'	179°54'	27	172	10	3	11	45	8	17	0	0	0	4	297
11	June 24	22:04	48°29'	179°59'	16	78	3	4	51	0	1	0	0	0	0	9	162
12	June 25	21:48	49°29'	179°58'	2	121	4	17	29	4	0	1	0	0	0	29	207
13	June 26	22:56	50°30'	179°57'	+	313	9	4	2	11	2	3	0	0	27	3	374
14	June 27	21:55	51°31'	179°54'	33	680	150	13	2	83	7	0	0	2	0	47	1017
15	June 28	21:08	52°30'	179°58'	9	459	13	3	16	58	5	0	0	0	0	16	579
16	June 29	22:38	53°30'	179°58'	73	77	11	+	+	34	+	5	0	0	0	23	223
17	June 30	22:39	54°28'	179°58'	2	247	5	+	+	45	5	25	0	4	20	27	380
18	July 01	22:40	55°31'	179°54'	+	185	1	+	+	25	1	69	0	0	25	607	913
19	July 02	22:43	56°31'	179°55'	0	244	2	1	+	68	1	49	0	0	0	2524	2889
20	July 03	23:03	57°28'	179°57'	19	204	1	34	6	9	5	15	0	0	6	65	364
21	July 04	22:56	58°32'	179°56'	2	169	2	16	7	7	1	1	0	0	0	54	259

EU: euphausiids, CO: copepods, AM: amphipods, PT: pteropods, AP: appendicularians, CH: chaetognaths, OS: ostracods, JE: jellyfishes (medusae, ctenophores)
SA: salps, FI: fishes, SQ: squids, OT: others
+: value of under 1

Table 4. Zoo plankton biomass (mg/ m³) along a north-to-south transect at 180?00' longitude from 39?00'N to 58?30' N latitude in the western N
Ocean from mid-June to early July in 2000. The samples were collected with a ORI net after sunset.

Station			Location		Wet weight (mg / m³)							
No.	Date	Time	Lat. (N)	Long. (W)	EU	CO	AM	PT	AP	CH	OT	Total
1	June 12	21:19	39?00'	180?00'	32	104	270	+	3	2	144	555
2	June 13	21:06	40?00'	180?00'	1	21	431	7	8	6	375	849
3	June 14	21:13	40?57'	180?00'	87	847	928	+	+	5	42	1909
4	June 15	21:14	42?00'	179?59'	5	705	781	+	+	18	39	1548
5	June 16	21:13	43?00'	179?57'	+	3314	3356	+	0	42	0	6712
6	June 17	21:26	44?01'	179?58'	4	1499	1526	+	3	21	1	3054
7	June 18	21:31	44?58'	180?00'	3	2171	2275	0	+	101	0	4550
8	June 19	21:33	46?00'	180?00'	1	2794	2840	2	0	41	0	5678
9	June 20	21:29	47?00'	179?57'	36	1870	2037	0	0	70	76	4089
10	June 22	21:27	47?28'	179?57'	1	779	843	+	0	60	+	1683
11	June 23	21:43	48?30'	180?00'	+	1187	1289	2	+	53	4	2535
12	June 24	21:42	49?30'	180?00'	63	1196	1290	+	3	80	2	2634
13	June 25	22:12	50?30'	180?00'	193	5122	5237	0	0	61	44	10657
14	June 26	22:25	51?30'	180?00'	2	101	283	0	0	14	57	457
15	June 27		52?30'	180?00'	+	219	252	+	2	19	9	501
16	June 28	22:57	53?30'	180?00'	1	567	713	+	+	78	36	1395
17	June 29	22:38	54?30'	180?00'	+	4	564	4	+	137	395	1104
18	June 30	23:05	55?30'	179?56'	+	56	741	+	2	126	502	1427
19	July 01	22:55	56?30'	179?59'	+	19	392	2	+	49	175	637
20	July 02	23:04	57?30'	179?54'	0	110	414	2	0	99	29	654
21	July 03	23:02	58?37'	179?53'	0	76	322	5	0	34	45	482

EU: euphausiids, CO: copepods, AM: amphipods, PT: pteropods, AP: appendicularians, CH: chaetognaths, OT: others
+: value of under 1

Table 5. Zoo plankton biomass (mg/ m³) along a north-to-south transect at 180°00' longitude from 39°00'N to 58°30' N latitude in the western Ocean from mid-June to early July in 2001. The samples were collected with a ORI net after sunset.

Station			Location			Wet weight (mg / m³)						
No.	Date	Time	Lat. (N)	Long. (E, W)	EU	CO	AM	PT	AP	CH	OT	Total
3	June 15	21:55	41°01'	179°58' E	29	309	13	1	1	8	93	454
4	June 16	21:09	41°55'	179°56' W	3	352	1	+	0	+	7	363
5	June 17	21:27	43°00'	179°57' W	46	286	16	66	+	0	15	429
6	June 18	21:42	44°03'	179°54' W	+	246	3	2	+	6	7	264
7	June 19	21:24	44°59'	179°57' W	1	269	1	+	0	9	6	286
8	June 20	21:27	45°59'	179°59' E	+	662	13	2	0	5	36	718
9	June 22	21:23	46°58'	179°56' W	4	461	27	4	2	78	139	715
10	June 23	21:46	47°30'	179°54' W	2	154	35	58	8	23	40	320
11	June 24	22:04	48°29'	179°59' E	1	35	41	24	31	7	39	178
12	June 25	21:48	49°29'	179°58' W	+	14	30	30	0	17	26	117
13	June 26	22:56	50°30'	179°57' E	+	91	170	103	0	3	22	389
14	June 27	21:55	51°31'	179°54' W	5	234	244	1	0	7	36	527
15	June 28	21:08	52°30'	179°58' W	1	326	101	0	11	3	22	464
16	June 29	22:38	53°30'	179°58' E	10	164	80	1	+	10	59	324
17	June 30	22:39	54°28'	179°58' E	+	202	9	+	+	36	98	345
18	July 01	22:40	55°31'	179°54' W	+	9	22	51	1	73	503	659
19	July 02	22:43	56°31'	179°55' W	+	15	45	82	2	3	142	289
20	July 03	23:03	57°28'	179°57' W	2	225	28	16	+	17	29	317
21	July 04	22:56	58°32'	179°56' W	1	19	33	95	+	1	81	230

EU: euphausiids, CO: copepods, AM: amphipods, PT: pteropods, AP: appendicularians, CH: chaetognaths, OT: others
+: value of under 1