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Northern Shrimp (*Pandalus borealis*) on Flemish Cap in July 1996

by

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A stratified random bottom-trawl surveys on Flemish Cap was carried out in July 1996 following the same method used since 1988. Results of shrimp population (*Pandalus borealis*) are presented in this paper and compared with those previously observed.

#### Material and methods

The survey was conducted following the same procedures as in previous years (Vázquez, 1996). Samples of approximately one kilogram shrimp were taken in each tow this specie was present. Samples were frozen for posterior analysis. Males and females was separated according to the endopod of the first pleopod (Rasmussen, 1953). Individuals in the changing sex phase were included with males. Females were further separated as immatures (first time spawners) and matures (spawned previously) based on the condition of the sternal spines (McCrary, 1971). Oblique caparace length (CL): the distance from the base of the eye to the posterior dorsal edge of the caparace (Shumway et al, 1985) were measured to the lower 0.5 mm. 3828 individuals were weighed to the nearest 0.1 g to calculate the length-weight relationship.

#### Results

Total biomass estimated by swept area method and average catch per mile from 1988 to 1996 are presented in Table 1. Biomass increased from 5413 tons in 1995 to 6543 tons in 1996. Length frequencies and percentages by sex from 1996 survey are shown in Table 2. Samples from this year indicated an increase in the frequency of males (54.0% in 1996 and 34.5% in 1995). Females were the 46% of individuals splited as: 17.6% immatures, 26.7% matures and 1.6% ovigerous. Percentage of mature females was 41.6% in last year (Sainza, 1995), what indicated a pronounced decrease in mature group. Ovigerous females were much more prevalent than in the previous year. As the spawning period in Flemish Cap begins between the end of July and the beginning of August (Mena, 1991), small days fluctuation in the survey date may have caused this frequency change. Males presented a CL between 12 and 26.5 mm. Females presented a CL between 18 and 33 mm. The 23 mm length modal group is mainly made by individuals which had become females in 1995. Upper length females modal groups tended to be overlapped and indistinct (Savard et al, 1994).

Length frequencies by strata in 1996 (Table 3) indicate that the presence of shrimp is scarce in depths lower than 140 fathoms (252 m) or higher than 301 fathoms (554 m). The shrimp mainly occupy those strata between 141 and 300 fathoms. In strata of depths lower than 140 fathoms (252 m) the minimum length CL measured was 12 mm, in those between 141 and 200 fathoms (252 - 360 m) was 12.5 mm, in those between 201 and 300 fathoms (360 - 545 m) was 16 mm, finally, depths between 301 and 400 fathoms

(545 - 725 m) minimum length CL was 19 mm. According to this data, the minimum shrimp size increases with depth.

Total biomass estimated by strata in 1996 survey (Table 4) shows a distribution pattern similar to that observed in previous surveys, although with an increase in stratas 3, 6, 13 and 18, were in previous surveys the estimation was very low. The increase of biomass from 1995 to 1996 was mainly due to an increase of abundance of modal group 19 - 22 mm CL (named F in Figure 1). This group had a modal length of 17 mm CL in 1995 and dominated the commercial catch, but could have been underestimated in that survey due to a low efficiency of the 35 mm mesh-size of the cod-end used. The modal group of 14 mm CL (named G in Figure 1) represent the annual recruitment. The modal class with largest shrimp sizes which constitutes the bulk of fisheable stock has 28 mm CL in 1994, 26.5 mm in 1995 and 25 mm in 1996, but its abundance decreased not only due to the natural mortality but also presumable as a consequence of the shrimp fishing in this zone.

When the length-weight relationship from previous years were compared (Table 5) it was observed that shrimp weight increases for all length-classes greater than 25 mm CL since 1993 to 1996 and decreases for smaller sizes.

Catch distribution in kg/tow are presented in Figure 2.

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Table 1.- Total biomass estimated by swept area method and average catch per mile

Year	Biomass (t)	Average catch per mile (Kg)
1988	2164	1.54 ± 0.28
1989	1923	1.37 ± 0.24
1990	2139	1.53 ± 0.21
1991	8211	5.83 ± 0.71
1992	16531	11.75 ± 1.86
1993	9256	6.57 ± 1.04
1994	3337	2.37 ± 0.35
1995	5413	3.85 ± 0.44
1996	6502	4.62 ± 0.34

Table 2.- Length frequencies and percentages by sex

Length (mm)	Males	Immature Females	Mature Females	Ovigerous Females
12.0	47			
12.5	152			
13.0	290			
13.5	617			
14.0	731			
14.5	652			
15.0	471			
15.5	447			
16.0	401			
16.5	335			
17.0	448			
17.5	272			
18.0	599	2		
18.5	1176	10		
19.0	2284	15		
19.5	5004	157		
20.0	6041	271		
20.5	7435	368	7	
21.0	6435	865	83	
21.5	6021	1251	119	
22.0	2736	993	267	
22.5	1767	1174	397	
23.0	565	1096	830	9
23.5	398	1087	559	65
24.0	469	1315	1243	108
24.5	265	1884	1241	353
25.0	272	2121	2008	318
25.5	189	1290	2115	122
26.0	54	729	2191	196
26.5	53	639	2023	77
27.0		437	2069	17
27.5		202	1262	44
28.0		105	1544	13
28.5		36	1155	10
29.0		27	1069	12
29.5		39	830	28
30.0			813	
30.5		12	695	3
31.0			216	28
31.5			144	
32.0			71	
32.5			91	
33.0			6	
	54,0%	17,6%	26,7%	1,6%
frequency x 10 <sup>4</sup>				

Table 3.- Length frequencies by strata

Length	STRATA															Total
	3	5	6	7	8	9	10	11	12	13	14	15	16	18	19	
12.0			47													47
12.5			142				10									152
13.0			236				28	25								290
13.5	14	4	425	47			25	102								617
14.0	14	7	520		12		36	142								731
14.5	36	2	331		24		94	165								652
15.0	22	11	142		12	10	138	138								471
15.5	50	9		110	12	10	146	110								447
16.0	50	13		63	24	40	79	103				29				401
16.5	14	12	47	47	50	10	67	78		10						335
17.0	22	7		95	69	10	82	112				29	23			448
17.5	7	4	47		26	20	71	46				29	23			272
18.0	22	9		126	41	30	123	165		10		28	46			601
18.5	7	9		205	32	89	211	292	28	105	126	82				1186
19.0	7	13		614	118	190	407	469	55	63	115	179	46		24	2299
19.5	36	1	141	1447	328	357	831	769	158	104	572	369	23	13	12	5161
20.0	36	11	94	1544	396	263	819	788	369	356	723	767	91	7	49	6312
20.5	14	10	94	1700	617	321	810	833	442	565	1339	896	46	26	95	7810
21.0	58	11	283	1213	713	287	509	665	870	597	829	1012	137	33	168	7383
21.5	71	21	236	1038	613	271	404	553	1191	1122	911	524	159	23	252	7391
22.0	123	16	142	566	398	118	203	414	606	713	210	259	160	16	53	3996
22.5	100	10	47	299	294	40	279	423	517	579	325	101	228	7	88	3338
23.0	223	7	47	503	248	46	181	356	325	177	56	160	114	7	51	2500
23.5	35	8		298	163	42	300	454	112	178	88	315	68	13	35	2109
24.0	72	11		378	187	102	440	599	326	126	226	493	46	14	118	3135
24.5	43	7		314	122	156	562	542	359	169	815	455	46	36	117	3743
25.0	101	8		409	324	200	541	550	861	136	345	906	182	30	127	4719
25.5	14	1		283	227	89	375	262	767	116	400	750	273	19	138	3716
26.0	21	2	47	189	213	212	419	263	758	83	234	547	46	13	123	3170
26.5				31	120	134	290	245	861	210	267	539		16	81	2792
27.0	14	1		79	161	211	222	201	475	73	265	591	46	10	174	2523
27.5	7				100	104	168	101	359	126	142	277		19	102	1508
28.0	14			31	63	183	134	135	257		202	426	23	13	182	1662
28.5					17	81	133	123	246	53	188	196		13	150	1201
29.0				47		47	167	26	243		182	135			260	1108
29.5						36	116	97	194	116	86	79	23	3	149	897
30.0				31	17	24	103	26	35	53	182	179		7	157	813
30.5	7				23	17	67	39	111	53	129	102	23	6	133	710
31.0					11	24	6	24	28		31	12	23		86	244
31.5					17	12	11				6	13	46		39	144
32.0					6	12	6					12			36	71
32.5						12			28			13	23	3	12	91
33.0											6					6

frequency x 10<sup>4</sup>

Table 4.- Total biomass estimated by strata (tons)

Stratum	Depth (fathoms)	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	70-80	0	0	0	0	0	0	0	0	0
2	81-100	0	0	0	0	0	0	0	162	0
3	101-140	0	0	0	5	0	1	0	2	86
4	101-140	0	0	0	0	0	0	0	0	0
5	101-140	0	0	0	4	8	0	0	6	12
6	101-140	0	0	2	19	3	3	0	11	94
7	141-200	18	20	212	713	2134	1404	93	299	684
8	141-200	9	51	46	158	1130	545	3	183	412
9	141-200	57	47	24	150	88	109	0	506	324
10	141-200	115	44	188	1499	2278	972	658	873	707
11	141-200	89	0	105	733	2714	794	358	452	699
12	201-300	786	582	313	1733	3329	1786	599	778	910
13	201-300	64	58	42	63	28	120	0	28	416
14	201-300	255	218	407	814	1640	1161	556	632	706
15	201-300	404	328	558	1485	2522	2029	916	1021	922
16	301-400	308	234	239	171	303	133	44	47	148
17	301-400	2	10	0	0	0	0	0	0	0
18	301-400	0	0	0	0	0	0	0	1	30
19	301-400	56	331	4	663	354	163	111	412	351
Total:		2164	1923	2139	8211	16531	9256	3337	5413	6502

Table 5.- Length and weight of shrimp in the years 1993-1996

Length (mm)	Mean weight (g)			
	1993	1994	1995	1996
10.0	0.8	0.7	0.6	0.6
12.5	1.4	1.3	1.2	1.1
15.0	2.4	2.2	2.1	2
17.5	3.6	3.4	3.3	3.2
20.0	5.2	5	4.9	4.8
22.5	7.3	7.1	7	6.9
25.0	9.7	9.6	9.5	9.5
27.5	12.7	12.6	12.6	12.7
30.0	16.1	16.2	16.3	16.6
32.5	20.1	20.4	20.7	21.2
35.0	24.8	25.3	25.8	26.6

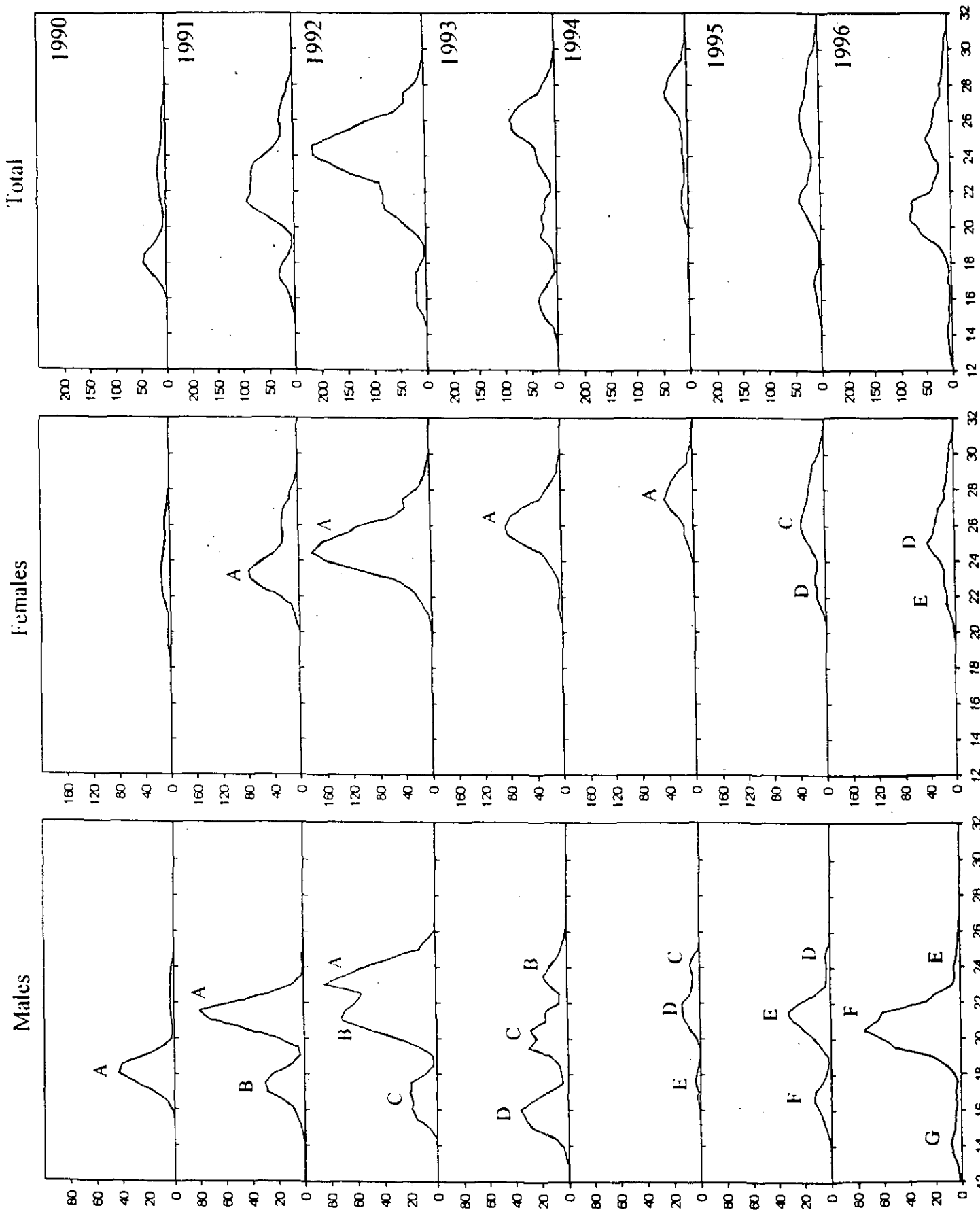


Figure 1.- Shrimp length distribution on Flemish Cap, 1990-1996  
Y-Axis = Frequency ( $10^4$ ) X-Axis = Length (mm)

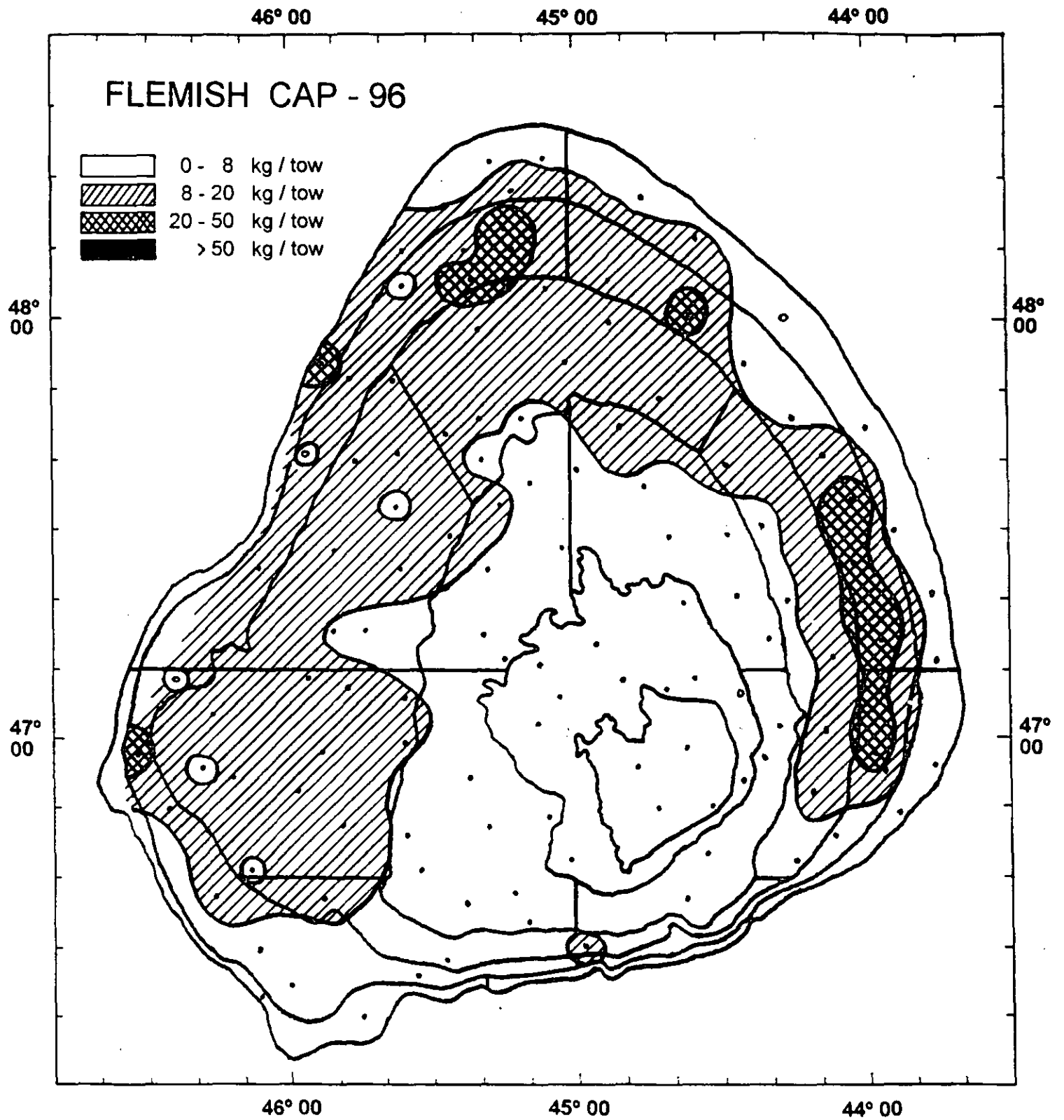


Figure 2.- Shrimp (*Pandalus borealis*) Catch Distribution in July 1996 on Flemish Cap