CHAPTER 3 RESULTS OF THE ACOUSTIC AND TRAWL SURVEY

3.1 DISCUSSION OF METHODS

In the trawl survey programme all catches were sampled for composition in weight and numbers by species. The bottom trawl has a headline of 31 m (float line), a footrope of 47 m, estimated headline height of 5 m and a distance between the wings during towing of about 18 m. All trawl hauls were monitored by SCANMAR trawl sensors (bottom contact, headline height and distance between the doors). This technology allows to determine with improved accurracy and the actual time the trawl is on the bottom. For conversion of catch rates to fish densities the area between the wings is assumed to be the effective fishing area i.e. the retention factor q is equal to 1. With the new vessel, a new trawl gear was introduced with smaller bobbins. This gear gives better bottom contact and higher catch rates for bottom dwelling species as monk and sole. For the hake species the new gear is assumed to have no difference in performance. The trawl doors, net, warp and wire dimensions are as with the former vessel (see Annex IV). The length of a haul, recorded as distance trawled, was measured by Doppler log on the bottom.

The problem of mid-water occurrence of hake and its effect on the swept area assessments has been discussed in earlier cruise reports. As in previous investigations off-bottom hake in mid-waters constituted only a minor problem in the south and in the central area. In the north it made up at average an 8% addition to the demersal biomass in the day hauls and in a more limited number of night hauls the average correction was 35% (Table 1). These corrections are much lower than those applied for the same area in survey 1/94 and are believed to be more representative (Table 1). However, it still seems probable that the relatively high rate of mid-water occurrences observed in the north have caused a negative bias and that the stock biomass for this area may be underestimated.

Table 1 Hakes. Frequency of observations of hake in mid-water during trawling. No. of trawl stations with swept area densities and no. of stations with observations of hake above 5 m from bottom with acoustic density estimate (tonnes/nm²).

	DAY	NIGHT
ORANGE RIVER - ST. FRANCIS BAY		
Trawl		
No. stations	60	16
Mean density	43.9	9.5
Acoustic obs.		
No. stations	11	3
Mean density	7.2	2.3
Average acou. corr.	3%	5%
ST. FRANCIS BAY - AMBROSE BAY		
Trawl		
No. stations	52	15
Mean density	20.7	9.4
Acoustic obs.		
No. stations	10	2
Mean density	2.7	2.9
Average acou. corr.	3%	4%
AMBROSE BAY - CUNENE RIVER		
Trawl		
No. stations	47	11
Mean density	26.2	16.5
Acoustic obs.		
No. stations	10	6
Mean density	9.4	10.7
Average acou. corr.	8%	35%

3.2 SOUTHERN REGION, ORANGE RIVER TO ST. FRANCIS BAY

The complete record of the fishing stations is shown in Annex III. Table 2 shows the catch rates of the main commercial species standardized to kg/hour for the shelf and the slope separately. Compared with the January-February survey the mean catch rates for the hakes are about 30% higher on the shelf and 40% higher on the slope. The mean monk catch rates have decreased by over 80% on the shelf and almost 40% on the slope, but they are still well above the rates obtained in previous years. The catch rate of kingklip increased by about 75% on the slope. The catch rates of the soles have not increased and are low as compared with the other commercial species.

Table 2. Southern Region. Catch rates in kg/hour by main groups by swept area bottom trawl for the shelf and the slope.

SHELF 50-259m

ST.NO.	DEP.	Hakes	Monk	Kingklip	Soles	Squid	Other
153	96	77.3		9.1	4.8		33.2
154	147	1291.0	8.0			17.8	1329.5
155	175	107.3				17.3	28.2
156	174	103.0	1.9	115.1		2.4	70.2
165	215	160.0				1.7	720.2
166	167	223.2	1.4			9.1	193.2
167	159	77.8	4.3	4.7		0.5	83.8
168	152	1123.0		5.9		28.8	343.1
169	172	1005.3	5.2			17.7	345.2
170	177	225.8	12.1			4.6	84.6
171	181	474.5	11.2	3.0		66.0	613.5
175	162	32.5					88.0
184	160	189.7			6.4	1.0	30.0
185	123	15.1				0.1	3.2
186	144	46.8					0.6
187	210	311.4					4.8
197	259	134.9					37.4
213	255	474.9	18.8			0.2	8.0
214	186	165.0					101.0
215	200	512.6					38.8
216	255	6689.0					4.7
223	182	2186.0					47.9
224	224	880.5			1.7	0.8	194.5
232	249	632.1	15.5		2.5	14.2	487.8
233	187	257.0					174.0
MEAN		695.8	3.1	5.5	0.6	7.3	202.6

SHELF 260-700m

ST.NO.	DEP.	Hakes	Monk	Kingklip	Soles	Squid	Other
157	382	432.4	33.3	14.6		18.4	158.2
158	468	1919.4		41.6			15.4
159	592	316.4				0.3	102.4
160	400	2051.9	9.2	123.8		7.9	103.3
161	320	692.8	45.7	31.4			620.4
163	443	2045.6		29.0		7.6	64.8
164	552	506.6				0.4	86.9
172	599	181.0				6.5	62.3
173	552	35.6					60.0
174	451	1407.2		30.9		20.4	103.1
176	437	524.6		13.6		11.6	54.8
177	550	219.5				19.6	34.6
178	378	973.7				19.8	62.1
179	540	536.4				4.1	67.0
180	588	69.2					268.1
181	475	90.5				1.7	119.9
182	380	2998.3		6.2			51.9
183	262	2297.7		5.5		1.1	317.1
188	288	1627.3	7.8			32.6	123.9
189	343	1961.7				10.1	199.0
190	426	1437.0	4.7	21.3		20.6	139.0
191	501	34.9				3.1	21.5
192	596	160.8		7.4		1.1	138.2
193	546	388.0				0.9	78.5
194	448	203.6		2.2		0.1	17.5
195	393	3962.9	21.8	25.1			272.6
196	330	4892.8	73.9	7.3			271.7
199	260	490.0					1.5
200	300	2306.6	18.8	651.6	6.7		29.1
201	348	609.4	22.3	124.8			63.3
202	376	3182.0	10.0	8.1		10.4	310.0
203	403	4030.5		19.9		7.2	324.5
204	419	2049.7				11.3	105.3
205	463	59.7				0.6	40.2
206	552	211.2					262.0
207	607	1192.8					4877.0
208	417	5790.4	49.1	14.8		6.0	393.7
209	396	1460.8	26.4	35.8		5.6	408.0
210	376	5081.1	118.0	21.9			244.7
211	332	6803.2	30.2	2.9			345.6
212	292	6374.6	85.0	1.5	7.1		61.6
217	280	1961.6	109.3		18.1		70.6
218	335	1581.4	111.3			0.2	209.7
219	410	67.1	91.3	22.0			200.0
221	599	452.1	11.0			22.6	126.7
222	465	2086.5		8.6		24.0	47.3
225	310	2645.7	58.0			12.5	291.6
226	341	1889.4	13.7				44.5
227	454	218.5	2.9	4.1		0.9	115.8
228	552	501.6	32.9			60.1	324.9
229	401	310.8	85.2	2.2		23.7	400.0
230	500	321.7	20.3			59.9	341.5
231	600	632.7				23.6	459.0
MEAN		1590.2	20.6	24.1	0.6	8.6	258.7

The depth distribution of the two hake species based on the catch rates converted to densities are shown in Table 3. Except for the Cape hake in shallow waters and deep water hake in 250-350 m, all densities are higher than in the previous survey for both species.

Table 3 Southern Region. Depth distribution of the two hake spacies. Mean densities in tonnes/nm^2 and mean catch rates kg/hour.

	100-250m	250-350m	350-450m	450-550m	550-650m
Cape hake					
Density	5.8	58.9	5.8	0.1	
Catch rate	175	1770	175	3	
Deep w. hake					
Density	0.3	8.6	60.5	22.2	12.2
Catch rate	10	260	1810	670	370
No. of hauls	21	17	17	17	11

The distribution of the two hake species based on plots of densities by fishing stations is shown in Figures 6 and 7. These include the acoustic estimates of fish present above the 5 m bottom channel during trawling as discussed above. The distribution pattern of the two species is similar to that found in the previous surveys with relatively high densities of Cape hake extending from 25°S to about 28°S.

Biomass estimates based on a post-stratification of the densities as shown in Figure 6 and 7, give 240 000 tonnes for the Cape and 215 000 tonnes for the deep water hake (Table 4). The estimates are 20 and 35% higher than in survey 1/94 for Cape and deep water hake respectively and for both species the highest in the time series. The 95% confidence limits give a range of ±14% on the estimate of the Cape hake and ±22% of the deep water hake.

Table 4 Southern Region. Estimates of total biomass by surveys, 1 000 tonnes.

Year/Survey	Cape hake	Deep water hake
90/1	130	22
90/3	130	25
91/1	113	31
91/2	80	82
92/1	200	145
92/2	160	125
93/1	210	150
93/2	180	115
94/1	200	160
94/2	240	215

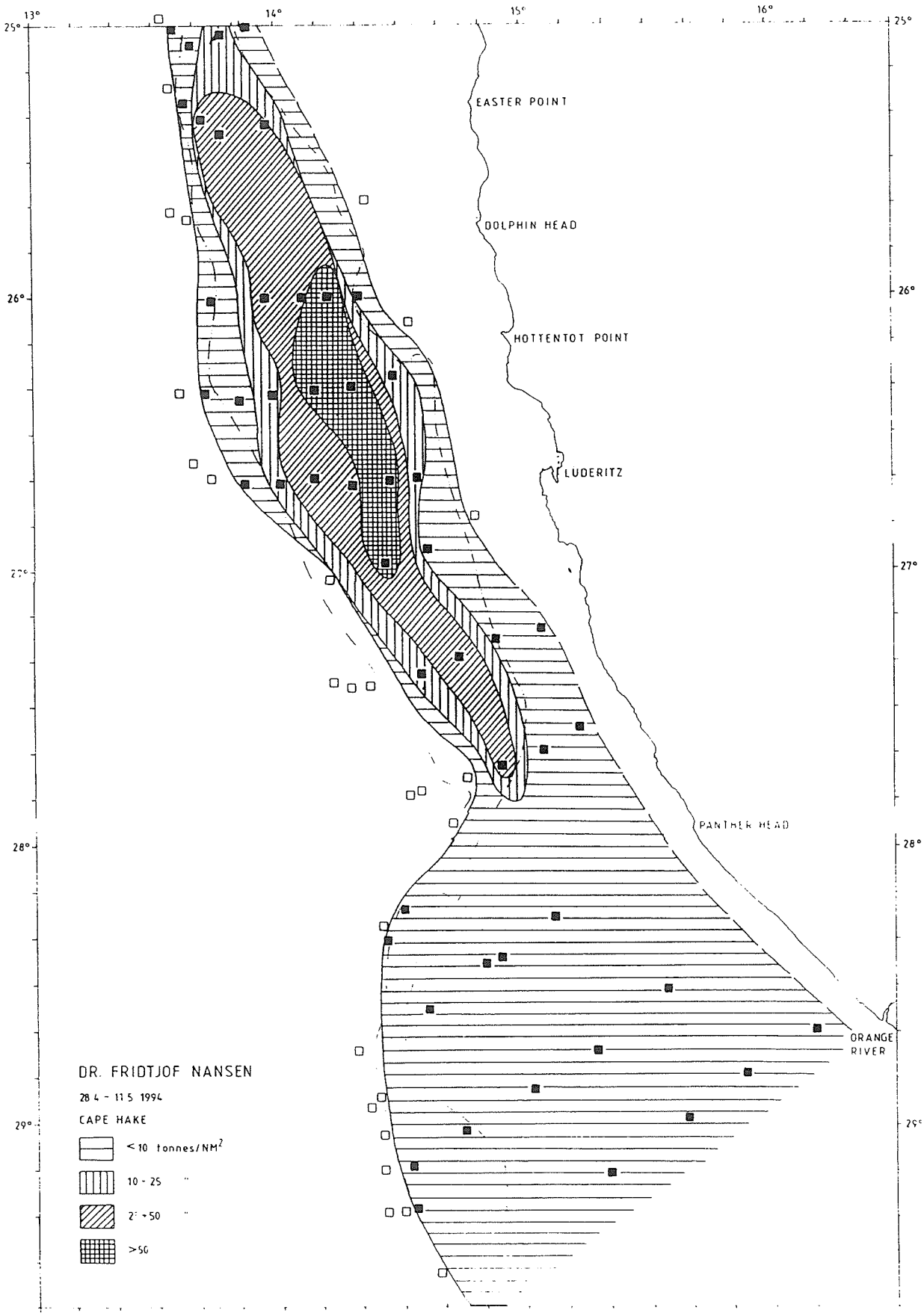

Figure 6 Orange River to Francis Bay. Distribution of Cape hake. Empty squares indicate stations where Cape hake was not caught.

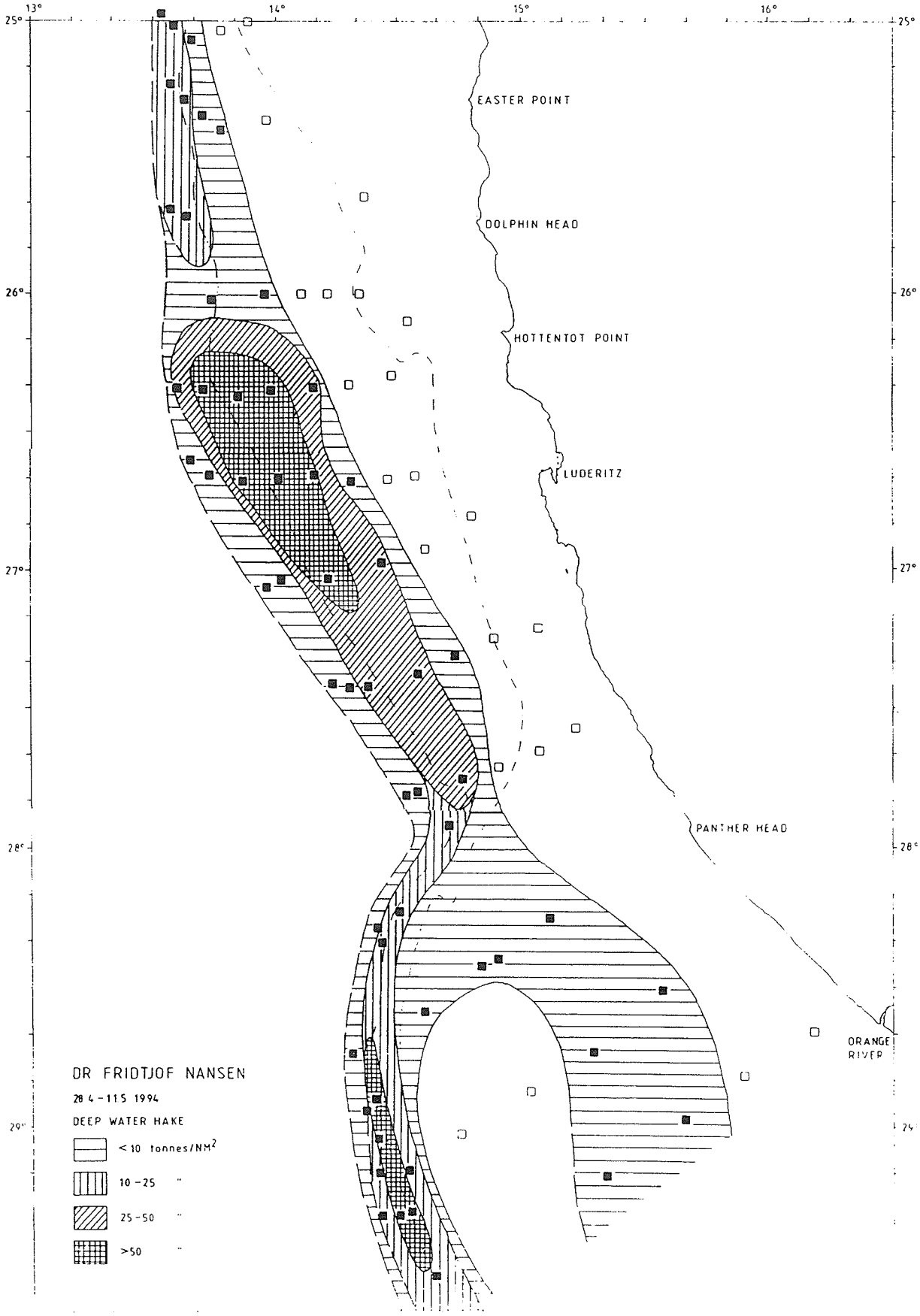

Figure 7 Orange River to St. Francis Bay. Distribution of deep water hake. Empty squares indicate stations where deep water hake was not caught.

The size compositions of the Cape hake from pooled samples weighted by catch rates are shown for each region by depth ranges in Annex I. There is as usual an increase of size with depth. A length frequency analysis, to identify the cohorts in the stock, was performed in the same way as during the three previous surveys . The results are shown in Table 5.

Table 5 Southern Region. Cape hake. Estimated age-cohorts from optimized length distributions.

Year class	Mean length	Sigma	Fraction of all fish	Population million N	Biomass 1 000 t
1993	22.0	1.50	0.11	85	5
1992	27.0	2.35	0.30	232	30
1991	32.5	3.30	0.42	237	75
1990	42.0	3.70	0.11	95	50
older			0.07	45	80

The dominating cohorts are the 1992 and 1991 yearclasses which is estimated to 72% of the total number of fish. The fishable part of the Cape hake in the region constitutes 140 mill. fish with a biomass of 130 000 tonnes. Since the previous survey the fishable biomass has increased with 20 mill. fish and about 24 thousand tonnes.

The size composition of the deep water hake is shown in Annex I. Results from a length frequency analysis on the deep water hake is shown in Table 6. The non-fishable part of the stock in the region is estimated to about 390 mill. fish with a biomass of 51 thousand tonnes, and about 270 mill. fish with a biomass of 164 thousand tonnes constitutes the fishable biomass.

Table 6 Southern Region. Deep water hake. Estimated age-cohorts from optimized length distributions.

Year class	Mean length	Sigma	Fraction of all fish	Population million N	Biomass 1 000 t
1993	23.5	2.0	0.26	168	14
1992	28.4	2.5	0.28	189	29
1991	38.0	3.0	0.25	178	66
older			0.21	125	106

3.3 CENTRAL REGION, ST. FRANCIS BAY TO AMBROSE BAY

Table 7 shows the catch composition for the shelf and the slope by main groups. The mean catch rates for hakes on the shelf are only about 50% of those obtained in the January survey this year, while the catch rates in the slope are almost the double. Also for monk the catch rates in the more shallow depth range have decreased considerably, while the rates in the deeper waters are at the same level as in January.

Table 7 Central Region. Catch rates by main groups in swept area bottom trawl hauls, kg/hour.

SHELF 100-259m

ST.NO.	DEP.	Hakes	Monk	Kingklip	Soles	Squid	Other
234	163	508.60					38.60
235	227	1383.76					156.02
244	235	3372.12					
245	147	182.70					0.40
246	143	158.40					
247	219	1422.40			1.34	2.56	316.94
248	252	1748.02	4.30			14.80	97.04
257	245	425.64	23.88				4520.40
258	218	884.30	10.82			65.80	3712.40
259	193	1957.44	6.16				1924.52
260	179	544.74	0.70				293.50
261	153	10.20					0.40
262	153	175.20					1.60
263	190	74.40					1.92
272	229	271.02	0.52				2.10
273	145	90.36					6.00
274	139	6.12					
275	160	145.38					6.12
281	224	141.04	0.18		5.14		3.60
282	157	242.40					3.72
283	130						
284	152	52.14					0.78
285	183						
297	212	274.00					1268.00
298	141	259.60					164.78
MEAN		573.20	1.86		0.26	3.33	500.75

SLOPE 260-700m

ST.NO.	DEP.	Hakes	Monk	Kingklip	Soles	Squid	Other
236	365	554.56	146.98			34.44	176.84
237	414	348.80	27.48	4.20		26.40	337.34
238	614	615.18	2.92			95.70	576.18
239	693	206.20				61.40	562.60
240	371	1160.40	12.58	2.30		36.80	272.24
241	340	1524.40	19.52	10.70		22.32	126.90
243	272	2534.72				19.60	1159.24
249	268	3028.92	2.88			34.00	550.20
250	275	1201.86	23.70				691.54
251	291	1128.06	12.32				1558.14
252	599	398.20	4.38			52.20	422.64
253	652	172.44	1.80				400.00
254	459	156.40	2.82			14.40	918.70
255	324	771.62	6.28			56.64	333.76
256	274	91.90	3.98			7.00	332.00
264	270	2043.74	5.48		4.60		436.42
265	353	974.80	55.60	3.30		184.80	2271.36
266	422	449.30	19.94			65.28	317.06
267	654	153.90	3.46				415.80
268	597	155.42	4.04				400.00
269	447	226.40	14.98			19.36	483.12
270	319	707.62	25.56				241.92
271	325	569.06	53.56			12.00	105.44
277	461	82.42	17.96	2.68			615.90
278	399	361.72	31.98	4.00		44.60	265.34
279	263	214.56					2.28
280	260	927.21	1.89				544.05
286	278	2500.16					541.84
287	329	1308.50	214.00	0.20	31.40		710.24
288	335	1379.40	22.68	0.62	9.52	23.40	1350.56
289	402	811.50	154.22	10.20		57.12	2089.64
290	497	385.10	243.00			2.04	822.58
291	495	365.50	66.20				853.60
292	541	174.20	44.06				577.24
293	463	251.60	86.42				614.08
294	405	648.94	148.50		0.68		608.70
295	333	528.64	1.08		2.40	2.46	92.46
296	284	168.60					7.80
357	400	263.64	36.58	25.94		2.80	355.00
358	604	160.90				12.30	676.14
359	500	523.30	5.10			20.40	651.90
360	361	193.92	31.02				120.00
361	310	469.10	44.90	0.56	3.22	7.56	144.52
MEAN		718.44	37.21	1.50	1.21	21.28	575.19

The density index by depth ranges of the two hake species is shown in Table 8. For the Cape hake the density for the depth range 100-250 m is less than 40% of that obtained in January, while in all the deeper depth ranges the densities are more than doubled compared to the previous survey. The density index on the deep water hake has in the same period increased somewhat in the 250-350 m and 550-650 m depth ranges, while the index has decreased in the depth ranges from 350 to 550 m.

Table 8 Central Region. Depth distribution of the two hake species. Mean densities in tonnes/nm² and mean catch rates kg/hour.

	100-250m	250-350m	350-450m	450-550m	550-650m
Cape hake					
Density	12.4	26.2	11.7	0.7	
Catch rate	370	780	350	20	
Deep w. hake					
Density		2.3	4.9	8.6	12.0
Catch rate		70	145	260	360
No. of hauls	24	19	11	7	4

The biomass estimate of Cape hake for the central region based on post stratification is 160 thousand tonnes (Table 9.) This represents a further reduction, 65 thousand tonnes or almost 30% since survey 1/94. The estimate on the deep water hake is 30 thousand tonnes, the same as in the previous survey. The 95% confidence limits on the estimates are ±15% on the Cape hake and ±18% on the deep water hake.

Table 9 Central Region. Estimates of total biomass by surveys, 1 000 tonnes.

Year/Survey	Cape hake	Deep water hake
90/1	180	4
90/3	219	6
91/1	150	6
91/2	302	13
92/1	261	15
92/2	542	15
93/1	280	12
93/2	280	20
94/1	225	30
94/2	160	30

Figure 8 shows the distribution of Cape hake over this region. This has the same main features as that of previous surveys, with high concentrations of fish forming bands 10-15 NM thick, but their depth position varying between surveys. In survey 1/93 the high concentrations were found from 20NM off Walvis Bay and in survey 2/93 and 1/94 it was about 30NM further offshore. In the present survey high concentrations were found at about the same distance from the coast, but they covered a smaller area. It is highly probable that the hydrographic conditions are forming a strong barrier for the fish distribution.

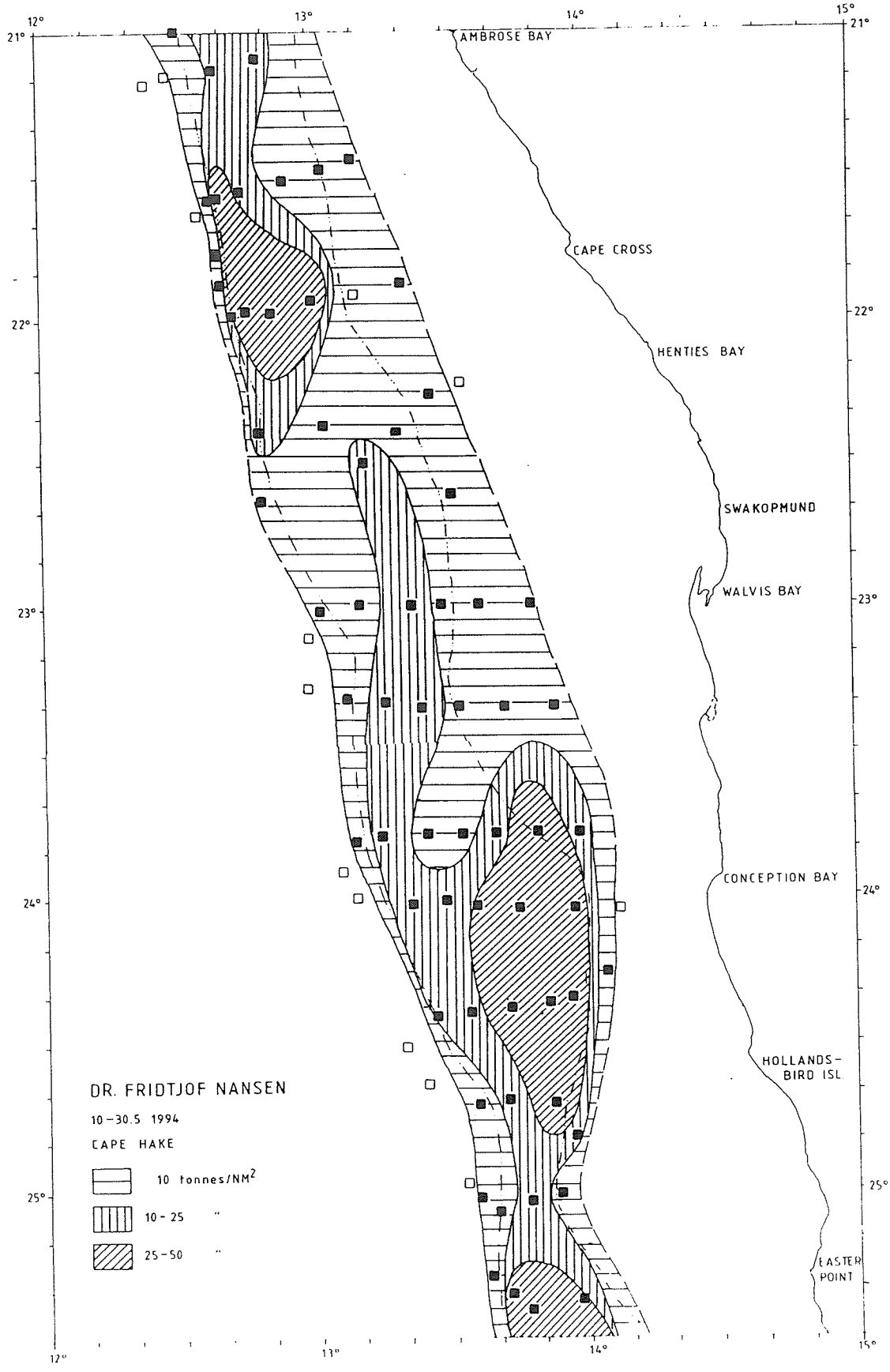

Figure 8 St. Francis Bay to Ambrose Bay. Distribution of Cape hake. Empty squares indicate stations where Cape hake was not caught.

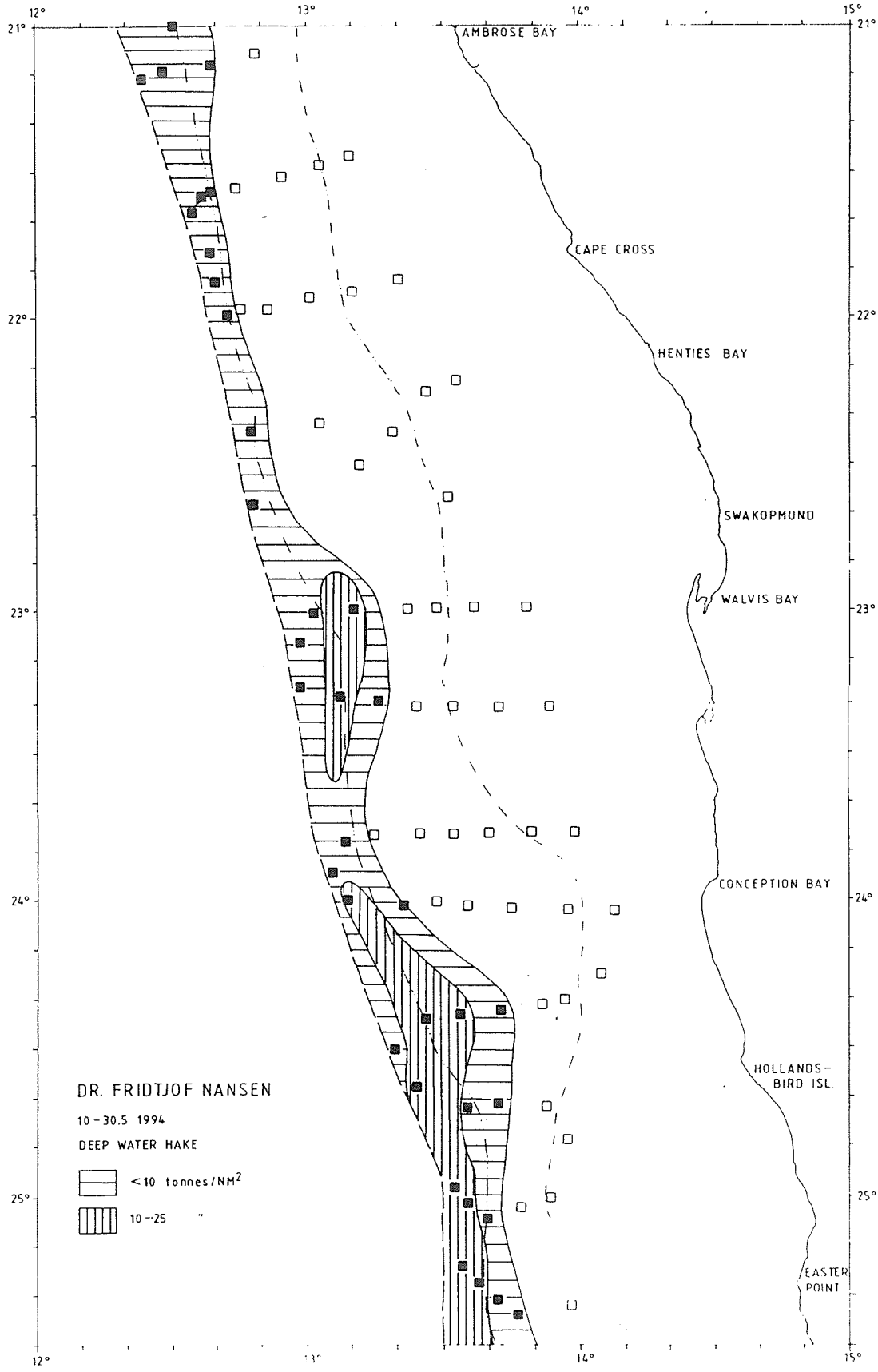

Figure 9 St. Francis Bay to Ambrose Bay. Distribution of deep water hake. Empty squares indicate stations where Cape hake was not caught.

The results from a cohort analysis on the length distribution are shown in Table 10.

Table 10 Central Region. Cape hake. Estimated age-cohorts from optimized length distributions.

Year class	Mean length	Sigma	Fraction of all fish	Population million N	Biomass 1 000 t
1992	24.1	2.6	0.83	830	77
1991	30.5	2.7	0.11	101	19
older			0.06	64	64

The 1992 yearclass dominates the fish population with 83% of the number of fish, followed by the 1991 yearclass with 11%. The fishable part of the population is 67 mill. fish and 65 000 tonnes, an increase of 15 000 tonnes compared to the previous survey. The non-fishable biomass is estimated to 927 mill. fish with a biomass of 95 000 tonnes, which is only half of what was estimated in January this year and brings the recruitment potential to the fishable biomass down towards half of the normal.

The more narrow distribution of deep water hake is presented in Fig. 9. Results from the length frequency analysis for the deep water hake is shown in Table 11. In this population the non-fishable biomass makes up 53% of the number of fish while the remaining 47% are fish of size bigger than 35 cm and are estimated to 36 mill. fish and 22 000 tonnes, 4 000 tonnes less than in the previous survey.

Table 11 Central Region. Deep water hake. Estimated age-cohorts from optimized length distributions.

Year class	Mean length	Sigma	Fraction of all fish	Population million N	Biomass 1 000 t
1992	28.5	2.0	0.317	24	4
1991	34.3	2.2	0.29	22	6
1990	41.0	3.5	0.2	16	7
1989	51.5	3.5	0.19	15	13
older			0.003	-	-

3.4 NORTHERN REGION, AMBROSE BAY TO CUNENE RIVER

Table 12 shows the catch rates by main groups for the shelf and slope separately. The mean rate for hakes has increased by approximately 25% in the shallower zone and in the deeper zone the rate is more than doubled compared to survey 1/94. The catch rates for monk in the slope is about 30% lower than in previous survey, but still much higher than in previous years.

Table 12 Northern Region. Catch rates by main groups in swept area bottom trawl hails, kg/hour.

SHELF 100-259m

ST.NO.	DEP.	Hakes	Monk	Dentex	Horse mck.	Squid	Other
299	160	30.9			1.9		
300	233	78.8					0.0
309	259	37.4		1.0	8.6		1.1
313	178	125.4		69.8	1728.0	31.5	19.4
314	237	456.2	11.7	1170.0	18.3		256.6
318	242	303.0		36.7	17.3		153.0
319	195	560.1	80.4	5910.0	2202.0		471.0
322	212	456.4	15.4	825.3	1143.5		363.5
326	228	2406.9		376.3	793.1		804.0
327	186	637.8		131.1	2990.2		476.5
332	117	447.6	17.4	594.6	575.4		257.1
344	240	234.8	2.4	1458.0	1414.8		64.8
345	165	310.1			1755.0		46.0
351	197	307.3	8.2	17.4	906.0		5.8
MEAN		456.6	9.7	756.4	968.1	2.3	208.5

SHELF 260-650m

ST.NO.	DEP.	Hakes	Monk	Dentex	Horse mck.	Squid	Other
301	345	928.7	168.3	9.6		15.3	831.4
302	442	147.8	16.2			21.1	1404.6
303	528	169.9	20.6		1.8	11.5	657.9
304	587	119.0	29.2		11.4	50.7	617.4
305	464	136.2	34.2			15.5	701.3
306	399	243.9	108.6			33.2	345.2
307	343	351.8	30.9	44.2	0.7	13.5	198.0
308	302	134.5	38.2		2.6	9.4	89.6
310	307	183.0	161.2	47.1	7.6	5.8	227.0
311	367	1017.3	121.4		15.1	4.9	280.1
312	453	337.6	22.7		0.4	8.6	418.7
315	330	3404.1	2.7	1325.6	10.7		1031.8
316	413	377.4	11.2				19.1
317	354	497.4	12.7				19.5
320	472	486.1	82.2			84.0	1846.0
321	588	422.8	33.1			0.6	1368.2
323	303	3097.6	20.8	532.4	145.2		1054.2
324	404	4705.9	126.1	26.7			1247.2
325	345	2735.5		463.3	218.2		1845.5
328	372	1728.0	8.4			98.8	2184.2
329	499	844.0	25.1				2188.9
330	524	396.8	129.8				718.1
331	498	514.0	45.4			50.8	2476.4
333	290	2632.2	22.3	327.6	179.8		1224.0
334	374	2756.5	47.0				1074.5
335	443	762.1	54.3			16.3	508.9
336	602	130.2	10.1				1199.1
337	501	222.5	95.8				781.7
338	593	182.8	74.7				617.5
339	499	1173.0	34.0			12.6	382.3
340	394	846.6	28.0			15.1	316.7
341	308	1235.7	35.7	15.7	41.7	3.3	789.4
342	285	466.1	27.6	148.5	312.0	7.1	308.9
343	289	256.3		182.5	109.4		35.9
346	479	64.8	38.2				755.4
347	393	409.7	23.6			18.4	336.8
348	304	500.0	15.0		59.2	28.0	126.6
349	294	380.6	0.7	3.5	84.0	22.9	16.8
350	269	500.9	2.2	206.4	49.4	7.2	66.7
352	303	463.6	47.5	63.4	56.4	16.0	91.9
353	325	886.8	29.0	2.0	29.1	25.8	161.1
354	349	450.9	27.6		42.9	59.8	270.3
355	429	771.4	65.8			4.9	496.5
356	501	119.3	50.2			28.6	843.9
MEAN		868.0	45.0	77.2	31.3	15.7	731.3

Figure 10 shows the distribution of Cape hake in the northern region by levels of density calculated from the catch rates and with corrections for fish in mid-water. The pattern of distribution is similar to that found previously in this region, with concentrations of high density in deeper waters extending northwards to the Cunene River.

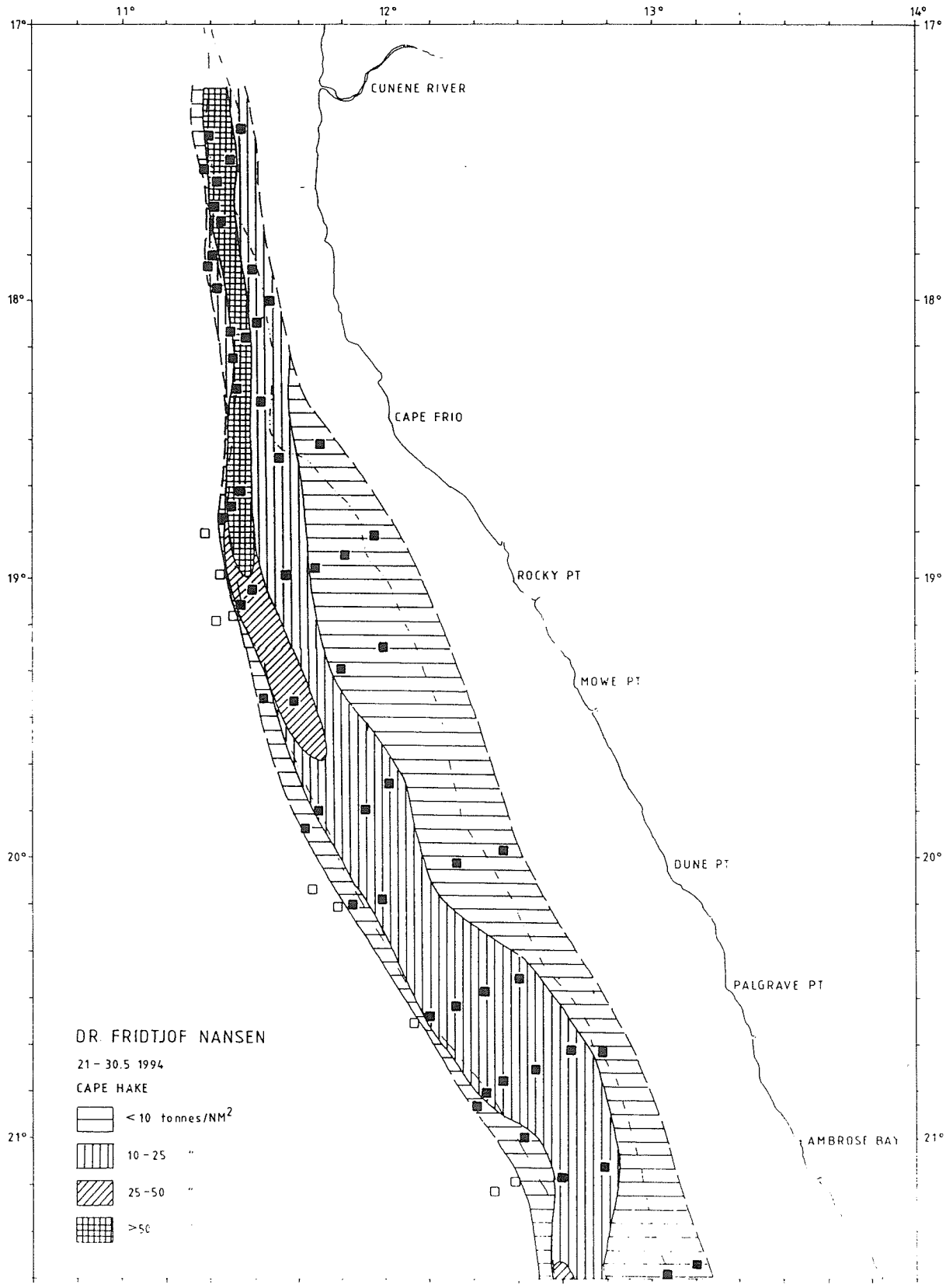

Figure 10 Ambrose Bay to Cunene River. Distribution of Cape hake. Empty squares indicate stations where deep water hake was not caught.

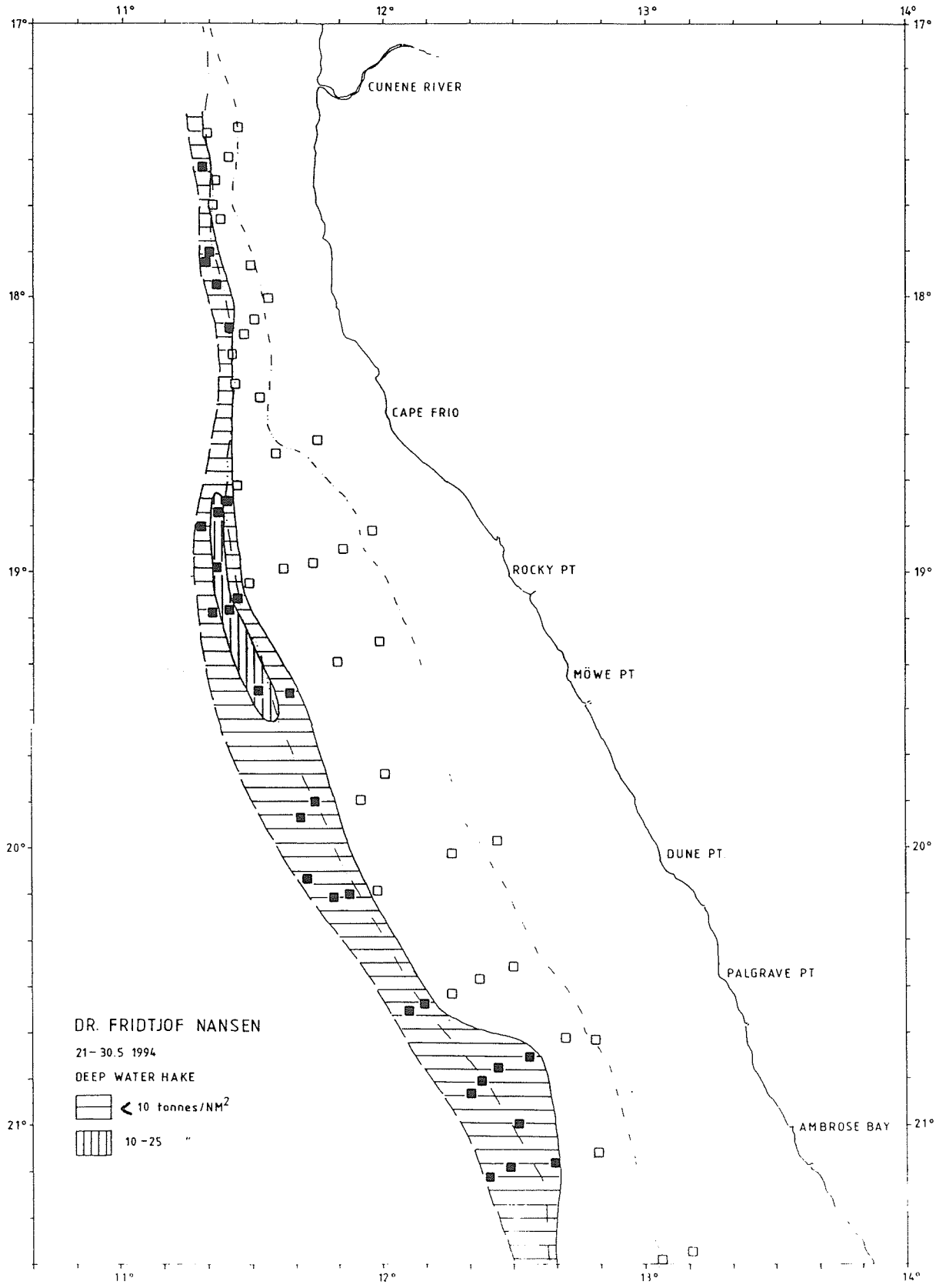

Figure 11 Ambrose Bay to Cunene River. Distribution of deep water hake. Empty squares indicate stations where deep water hake was not caught.

The depth distribution of the two hake species based on catch rates converted to densities are shown in Table 13. For Cape hake there was an increase in densities in all depth ranges compared to survey 94/1. The densities of deep water hake decreased somewhat in 350 - 450 m and 550 - 650 m but on the other hand increased in 450 - 550 m. This can be explained by small differences in distribution and area coverage between the two surveys.

Table 13 Northern Region. Depth distribution of the two hake species. Mean densities in tonnes/nm^2 and mean catch rates kg/hour.

	100-250m	250-350m	350-450m	450-550m	550-650m
Cape hake					
Density	14.7	33.1	35.4	3.9	1.3
Catch rate	440	990	1060	120	40
Deep w. hake					
Density		0.2	2.1	9.1	5.8
Catch rate		7	62	270	170
No. of hauls	13	18	12	11	4

Biomass estimates give a total of 130 000 tonnes of Cape hake and 14 000 tonnes of deep water hake (Table 14). For the Cape hake this represents an increase of 40 000 tonnes since the last survey in January 1994. The deep water hake on the other hand shows a decrease from 20 to 14 thousand tonnes, but the estimate is still more than the double of that obtained in April - May 1993. The 95% confidence limits on the estimates are ±12% on the Cape hake and ±47% on the deep water hake.

Table 14 Northern Region. Estimates of total biomass by surveys, 1 000 tonnes.

Year/Survey	Cape hake	Deep water hake
90/1	180	
90/3	105 *	
91/1	200	
91/2	140	2
92/1	185	4
92/2	190	8
93/1	150	4
93/2	110	6
94/1	90	20
94/2	130	14

* + hake in the mid-water.

The size compositions of the two hake species are shown in Annex I. The results of an analysis done on the pooled length frequency distribution on Cape hake in the northern region is shown in Table 15. The young part of the population with fish three years and younger makes up 69% of the number of fish, or 240 million fish with a biomass of 39 thousand tonnes. The so called 'fishable biomass', representing fish of 36 cm and larger, constitutes 135 mill. fish with a biomass of 102 000 tonnes.

Table 15 Northern Region. Cape hake. Estimated age-cohorts from optimized length distributions.

Year class	Mean length	Sigma	Fraction of all fish	Population million N	Biomass 1 000 t
1992	25.9	2.7	0.50	175	20
1991	35.0	3.5	0.19	65	19
1990	43.0	3.5	0.13	47	24
older			0.18	60	67

A similar analysis on deep water hake (Table 16), shows that only 29%, or 7 million fish with a biomass of 1 600 tonnes, is young fish of age 3 years or less. The fishable biomass is 13 000 tonnes.

Table 16 Northern Region. Deep water hake. Estimated age-cohorts from optimized length distributions.

Year class	Mean length	Sigma	Fraction of all fish	Population million N	Biomass 1 000 t
1992	28.1	2.0	0.11	3	0.4
1991	35.1	2.5	0.18	4	1.2
1990	42.0	3.2	0.38	10	4.8
1989	51.0	3.0	0.33	9	7.6