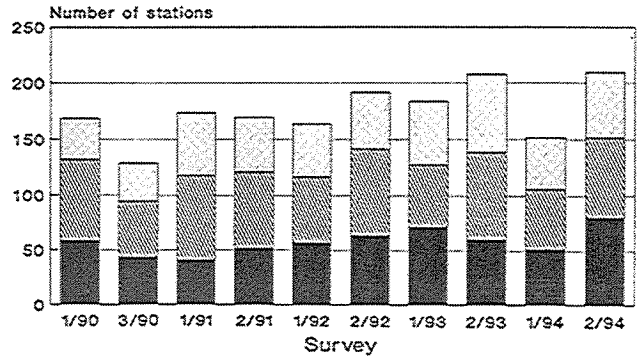
CHAPTER 4 CONSIDERATIONS ON THE SURVEY RESULTS

Survey effort

The present survey is the 10th in a series started in early 1990, covering the distribution of the hake stocks over the whole Namibian shelf. Figure 12 shows the effort spent in these investigations. The effort of the present survey is the highest both in number of trawl stations and of length samples.

a)



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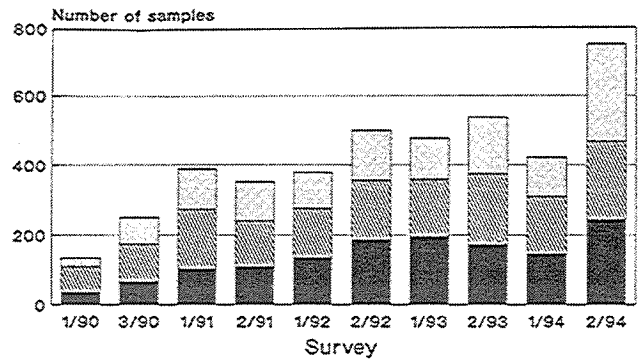

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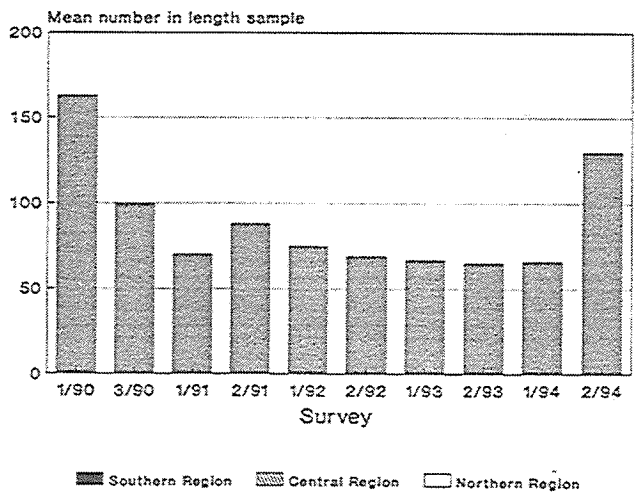


Figure 12 Hake survey effort 1990-94. a) Number of trawl stations by regions; b) Number of length frequency samples by regions; c) Mean number of fish in length sample.

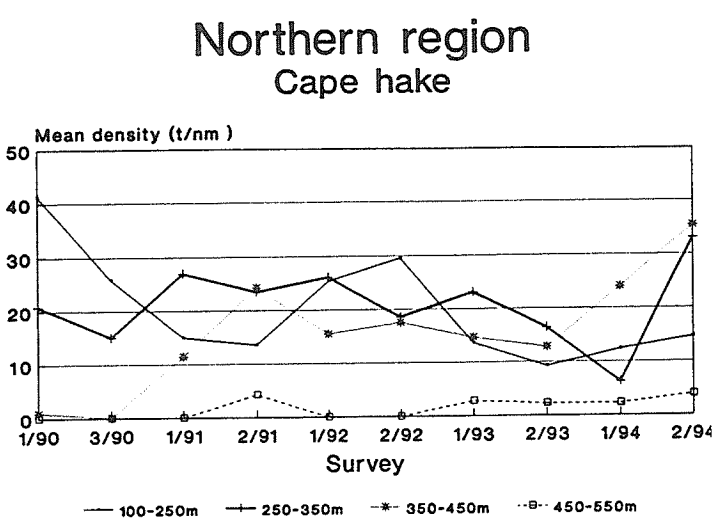
Mid-water behaviour of the hake can cause problems for the trawl survey methodology. However, improved acoustic technology has made it possible to establish a technique that can reduce the effect of this behaviour on the estimates. In the last four surveys (1993 to 1994) the pelagic behaviour may have caused some underestimate in the biomass, especially in the Northern Region.

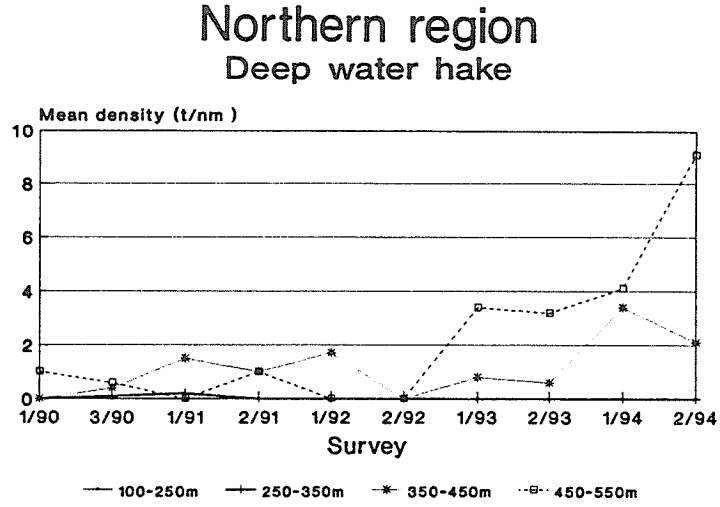
Catch per unit effort

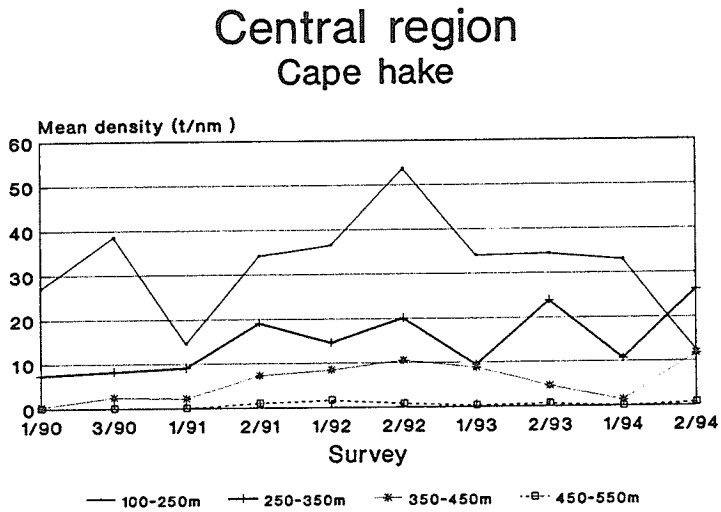
A summary of the estimates of the mean density of the hakes by depth strata is shown in Figure 13. For the Cape hake, the densities in the shallow range 100-250 m mainly reflect the strength of the young fish, 2-3 years of age, that inhabit this zone. Since the previous survey in February, the Southern Region shows a considerable decrease in the density of young fish from 11 to 6 tonnes/nm^2, the Central Region shows an alarming reduction from 33 to 12.4 t/nm^2, while the Northern Region had an insignificant increase from 12.4 to 14.7 t/nm^2. The drastic reduction in the Central Region will be further discussed below. The densities in the deeper zones mainly reflect the state of the fishable part of the hake stock. In the Southern Region these densities increased for both species, and most pronounced for deep water hake.

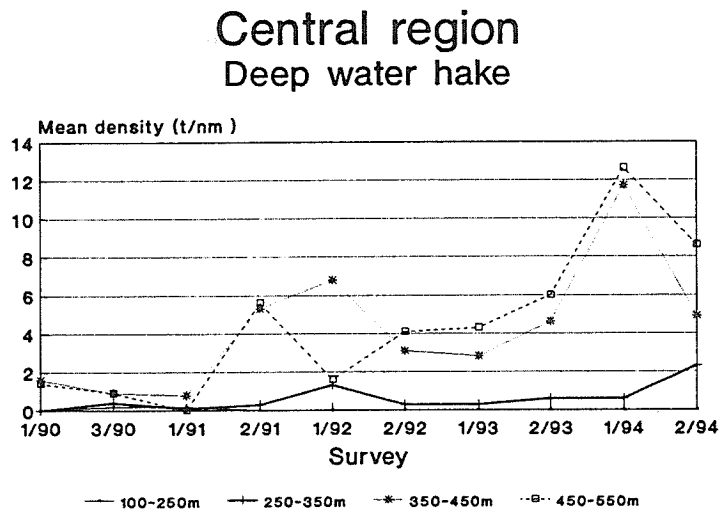
Biomass estimates

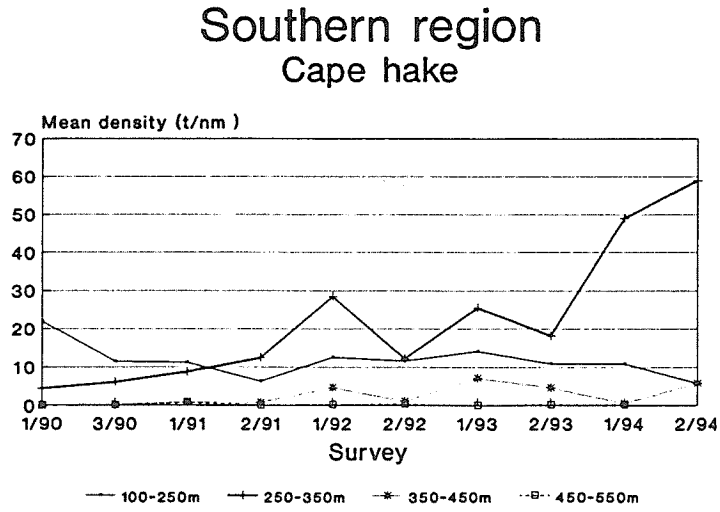
Table 19 shows a summary of the biomass estimates for the two hake stocks by regions and surveys. The estimated total biomass of hakes has increased slightly since May 1993 from 740 to 790 thousand tonnes. This increase results from higher estimates of both species in the Southern Region and of Cape hake in the Northern Region. In the Central Region the biomass of Cape hake has continued to decline and is now back to the level of 1990. The sudden drop in the biomass of Cape hake in the Central Region from 225 thousand tonnes to 160 thousand tonnes applies mainly to the young fish that will recruit to the fishery in the next 2-3 years. The cause for this reduction is not known, but the sudden character of the phenomenon indicates an environmental incidence causing mass mortalities, similar to what was observed in early 1993. The total country estimates on fishable biomass and recruits have also been summarized graphically in Figure 14. The dominant feature is the reduction in the fishable biomass of the Cape hake from 390 to 300 thousand tonnes during the last two years. This reduction has mainly taken place in the Central and partly the Northern Region (-105 and -40 thousand tonnes respectively), while in the Southern Region the biomass is 50 thousand tonnes higher than in survey 2/92 (Table 19).











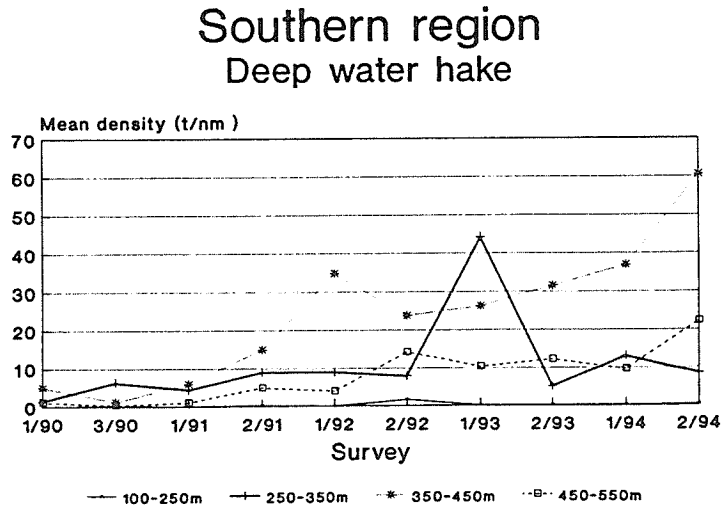


Figure 13 Estimated mean densities in depth strata by surveys. Mean densities in tonnes/nm^2.

Table 19 Summary of total, fishable and non-fishable biomass estimates for the two hake species by surveys and areas. 1 000 tonnes.

	Feb-Mar 1990	Sep-Oct 1990	Jan-Feb 1991	Oct-Nov 1991	Apr-May 1992	Oct-Nov 1992	Jan-Feb 1993	Apr-May 1993	Jan-Feb 1994	Apr-May 1994
TOTAL BIOMASS										
SOUTHERN REGION										
Cape hake	130	130	126	80	200	160	210	180	200	240
Deep water hake	22	25	31	83	145	125	150	115	160	215
CENTRAL REGION										
Cape hake	180	219	150	302	261	542	280	280	225	160
Deep water hake	4	6	6	13	15	15	12	20	30	30
NORTHERN REGION										
Cape hake	180	105*	200	140	185	190	150	110	92	130
Deep water hake				2	4	8	4	6	20	15
TOTAL NAMIBIA										
Cape hake	490	450	480	520	650	890	640	570	520	530
Deep water hake	25	35	40	100	160	150	170	140	210	260
Both	516	485*	513	620	810	1040	810	710	737	790
FISHABLE BIOMASS										
SOUTHERN REGION										
Cape hake				42	145	75	115	94	112	130
Deep water hake				42	113	80	123	95	114	164
CENTRAL REGION										
Cape hake				140	85	170	150	118	50	65
Deep water hake				(13)	15	15	9	16	26	22
NORTHERN REGION										
Cape hake				135	143	143	113	88	74	102
Deep water hake				-	-	-	-	-	19	13
Cape hake	200	270*	280	320	370	390	380	300	240	300
Deep water hake	20	20*	20	50	130	100	140	120	160	200
TOTAL FISHABLE	220	290*	300	370	503	490	520	420	400	500
NON-FISHABLE BIOMASS										
Cape hake	290	180	200	200	280	500	260	270	280	230
Deep water hake	5	15	20	50	130	50	30	20	50	60
TOTAL NON-FISHABLE	295	195	220	250	410	550	290	290	330	290

* Unadjusted underestimate due to fish off the bottom.

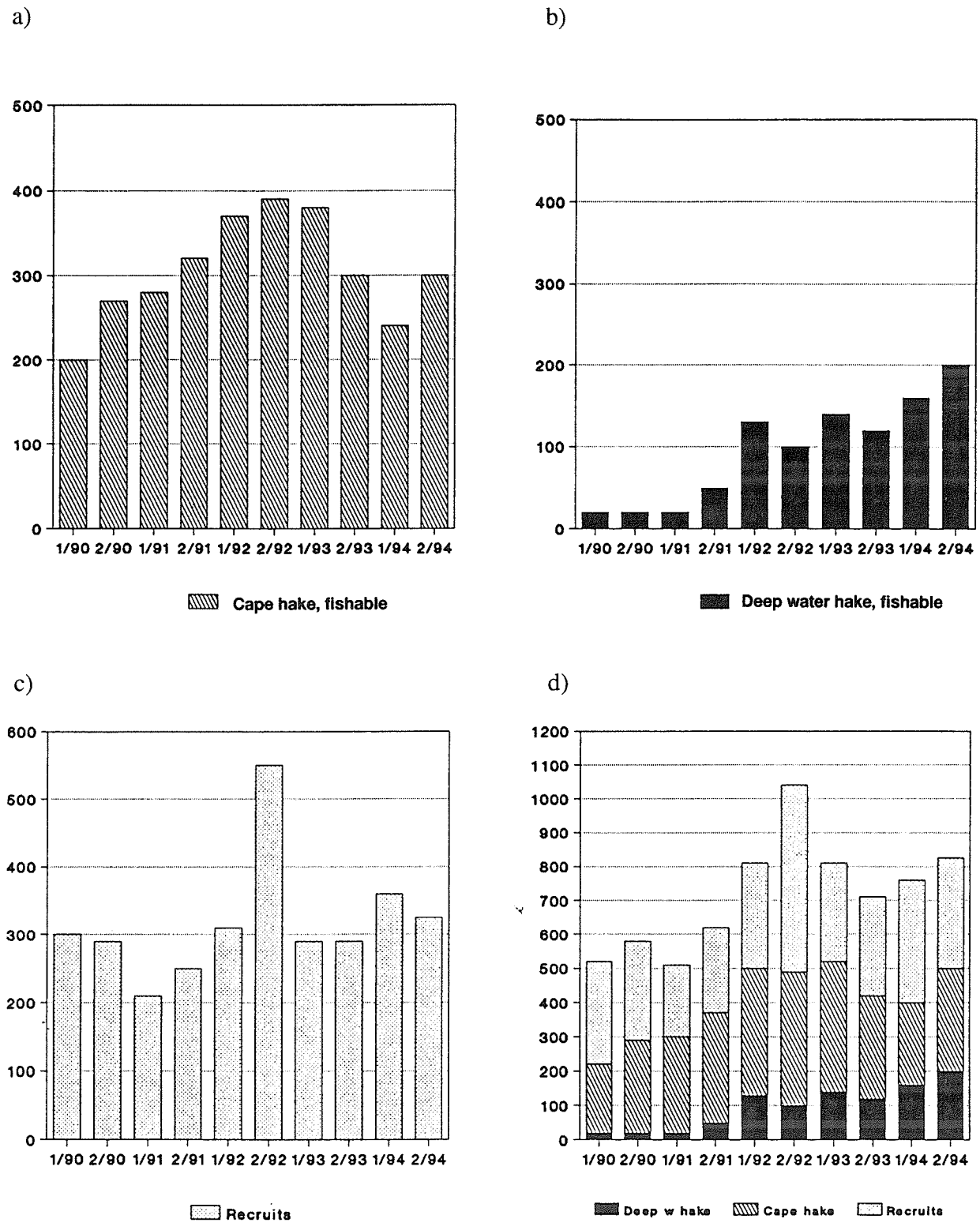


Figure 14 Trends in biomass estimates: a) Cape hake, 'fishable stock', b) deep water hake, 'fishable' stock, c) recruits ('non-fishable' biomass) and d) total hake in Namibia. Thousand tonnes.

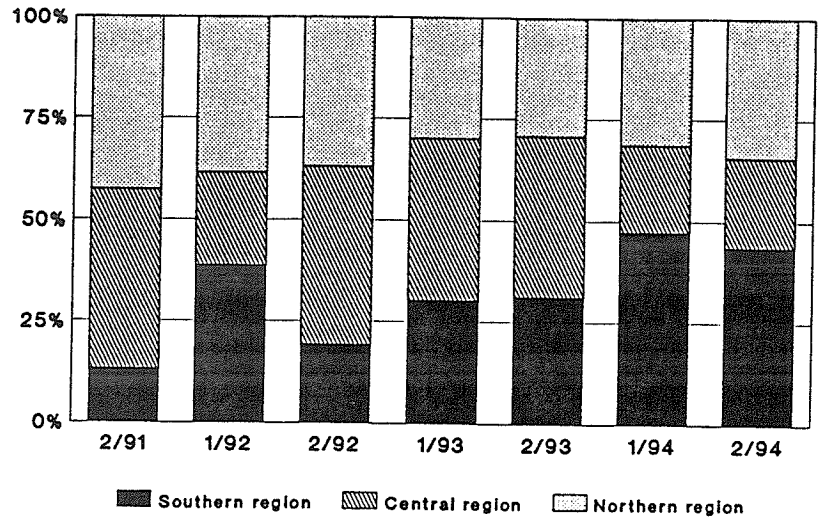


Figure 15 Relative regional share of fishable biomass of Cape hake 1991-94.

Geographic shift in the fishable biomass

Figure 13 shows the development of the relative share of the fishable biomass of Cape hake in the regions for the last three years. The figure demonstrates that the Southern Region, which in October 1991 only represented a 13% share of the biomass, in the last survey had increased to 44%. In the same period the biomass in the Central Region was reduced from 44 to 22% and in the north from 43 to 34%.

Recruitment potential

The recruitment to the stock of Cape hake can be estimated from the numerical abundance of the two year old fish. The estimates for the 1992 yearclass based on the current survey data are shown in Table 20 together with previous observations. A 'normal' recruitment level after two years seems to be around 2 billion fish ±200 million (Table 20). The 1992 yearclass fell within this range on the previous survey, but is now reduced to 1.25 billion, well below the average level. The reduction is mainly located in the Central Region, likely caused by environmental anomalies as discussed above. The further life history of the 1992 yearclass should be followed closely as it will be the main component determining the size of the fishable biomass in 1996.

Table 20 Estimates of strength of recent yearclasses of Cape hake. Cohort population numbers at about two years of age for the groups assumed to have been spawned in 1988, 1989, 1990, 1991 and 1992. Millions of fish.

Yearclass	1988	1989	1990	1990	1991	1991	1991	1992	1992
Southern region	980	100	160	300	990	670	390	250	230
Central region	1 320	170	1 710	1 620	3 500	1 230	1 370	1 880	830
Northern region	10	10	20	240	440	270	130	70	175
Total	2 310	280	1 890	2 160	4 930	2 170	1 890	2 200	1235
Survey/Year	1/90	1/91	2/91	1/92	2/92	1/93	2/93	1/94	2/94

Management considerations

A management practice that would ensure a more balanced harvest on the two hake species is strongly recommended. Administratively, the solution would perhaps be to direct the fisheries by regions. Estimates of the fishable hake biomass in this report are therefore presented by species and regions to allow for this management option, if chosen.

The rebuilding of the Namibian hake stocks since independence has followed a simple but effective strategy where after strict regulations on foreign fishing, part of the surplus production was set off to build up the standing stock of hake and the rest was mainly reserved to a growing national fishing industry. The rapid recovery of the hake stocks during the first years also allowed a gradual increase in the annual hake quotas as follows:

1991: 80 thousand tonnes
1992: 100 thousand tonnes
1993: 120 thousand tonnes
1994: 150 thousand tonnes

The first three years' quota were linked to an increasing harvestable biomass, while the most recent raise could seem more based on expectations that the stock should naturally and gradually increase towards its full potential. The findings in this report show that the most recent increase in the quota was not consistent with the trends observed through the survey investigations, that had already in the past year shown a stagnating or even declining stock biomass.

Historical catch records higher than 500 thousand tonnes indicate that the hake stocks have not yet reached their full potential in Namibian waters. *Why is then the fishable biomass*

levelling out and why are there signs of overfishing when the annual yields still are moderate? To understand this, one should keep in mind that most fish stocks in dynamic ecosystems do not grow gradually even if the conditions for expansion are favourable. Instead, the growth occurs often in uneven steps and leaps not seldom in orders of magnitude, dependent on the reproduction success of the stock. Table 20 has shown that the recruitment, measured at two years of age, has been fairly stable around 2 billion fish since independence, with one exception. The 1991 yearclass had a very promising level at 1.5 years of age, but was decimated drastically down to a 'normal' level during the following 3 months.

Attempts have been made to compare the recruitment indices from the Nansen surveys with similar data from the ICSEAF VPA studies for the yearclasses 1968-1985 and with recruitment indices from Spanish trawl surveys for the yearclasses 1981-86, (Appendix XX). To make the indices comparable several corrections had to be applied which make the results, compiled in Figure 16, indicative only.

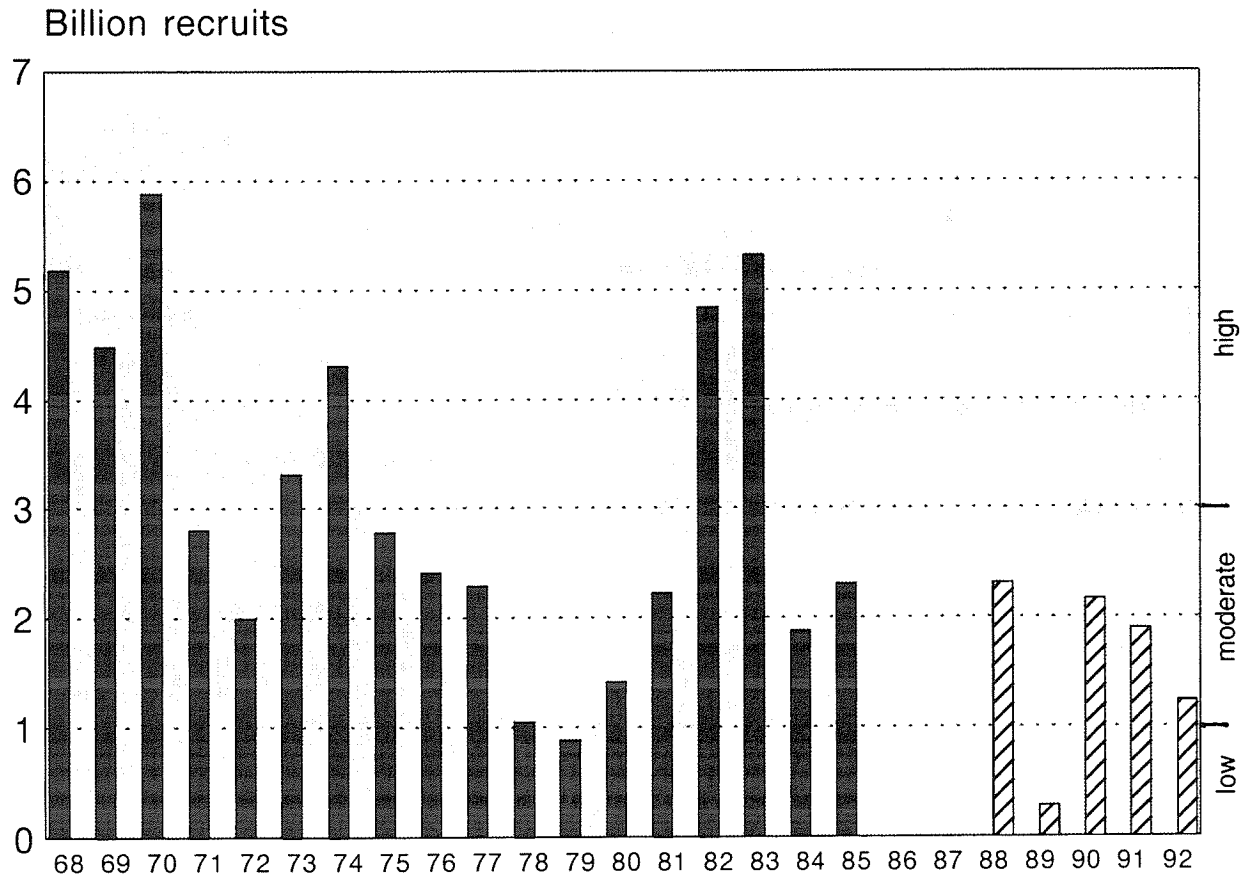


Figure 16 Recruitment indices on Cape hake yearclasses 1968-92. Compiled from ICSEAF VPA studies, Spanish trawl surveys and the Nansen surveys. See Appendix XX for details.

The figure indicates several important features:

- The recruitment process is extremely dynamic with yearclass strengths between 5.9 billion and 0.3 billion fish.
- The recruitment in the period since independence (yearclass 1988 and after) has been moderate with most groups around 2 billion fish.
- High recruitment, defined as more than 3 billion fish occurred in the periods 1968-70, 1973-74 and 1982-83 and these were the fundament for the following rich fishery.

The 1991 yearclass was estimated to 4.9 billion fish at the stage of 1.5 years, and thus set out to be a very strong yearclass. Unfortunately it was drastically reduced during the following months as already pointed out. With reference to the recent development of the fishable biomass, discussed above, one may therefore conclude that with the present recruitment level sustaining around 2 billion fish, the present effort in the fishery is in balance or perhaps even somewhat overexploiting the production capacity of the hake stocks. Further expansion of the fishery should probably await until at least one strong yearclass is recruited and firmly established at 2 years of age.

Other considerations

The management of the Namibian hake resources is at present based to a large degree on the results from the trawl surveys. The fishery data, stored in a UNIX data base, are not yet available for the urgent needed research. The main obstacle seems to be the transfer of the fish log forms into a user friendly database or statistical package. It is recommended that until the UNIX system is fully developed, to establish a simple PC based database. Past experience from several research institutions show that UNIX systems take a long time to develop, and the user threshold, before they are useful for the scientists, is usually high.