Seasonal Migration of Namibian Rock Lobster

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Namibian rock lobster (*Jasus lalandii*) migrates seasonally, depending on the oxygen level of the water off the Namibian coast. This migration affects rock lobster catches. Low oxygen levels result in retarded growth and could affect the survival of the rock lobster.

In 1993 researcher Bruce Tomalin investigated onshore-offshore migrations of rock lobster in relation to bottom dissolved oxygen levels, particularly over the lobster reefs to the north of Lüderitz. He found that there were three seasons in the distribution of dissolved oxygen, namely summer from January to April, winter from May to August and spring from September to December.

Summer in the Lüderitz area is characterised by long periods of strong southwesterly winds that cause cold, nutrient rich waters from deep offshore to be upwelled into the inshore coastal area. This upwelling is accompanied by turbulent conditions, resulting in generally low phytoplankton biomass despite the availability of nutrients. When the wind stops blowing, the temperature of the surface waters rises in response to summer warming and the water column becomes stratified.

Figure 1: Seasonal variations in wind, temperature and dissolved oxygen levels

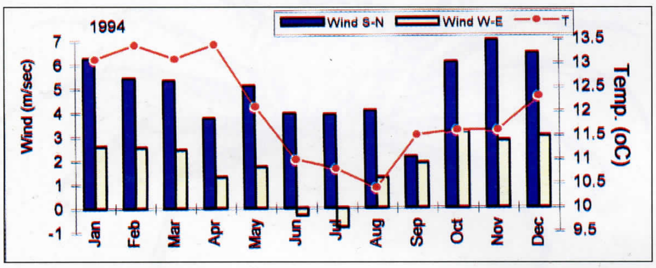


Figure 1a: **Monthly average wind direction and sea surface temperatures** *(SST) at Diaz Point*

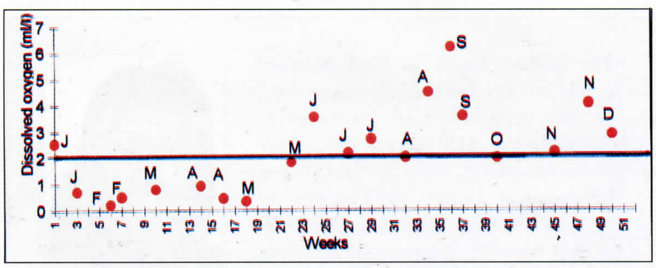


Figure 1b: **Bottom dissolved oxygen levels** *(ml/l) during 1994 at the Hottentot Point at 30 m*

During these short calm periods, conditions are ideal for phytoplankton growth, the nutrients are rapidly used and phytoplankton blooms develop. A red or orange pigmentation is characteristic of some phytoplankton species. When these occur in high densities they colour the surface waters. This is the red tide which, unlike commonly believed, is not always toxic.

The short-lived blooms soon begin to decay, organic particles sink to the seafloor and, in the process of bacterial decomposition, oxygen is consumed at the sea/sediment interface. As a result, bottom dissolved oxygen levels may drop suddenly during summer, with varying intensity and duration from year to year.

During winter, wind speeds decrease and bottom dissolved oxygen levels increase due to high winter swells, which mix oxygen into the water column. Strong southwesterly winds prevail during spring, causing intense upwelling which brings cold water with a high oxygen and nutrient content inshore from beyond the continental shelf. This results in high bottom oxygen levels on the lobster reefs throughout spring. This drops rapidly from late December to early January with the onset of summer.

Experiments conducted by researchers on *J. lalandii* showed that decreasing dissolved oxygen levels below 35% saturation (about 2 ml per litre at 13°C) resulted in decreased growth, feeding and survival and an increased intermoult period. On the Cape westcoast it was found that *J. lalandii* avoids water with less than 2 ml oxygen per litre. This could explain the mass migrations and walk-outs during the black tide along the Cape West Coast in March 1994. Divers observed similar inshore mass at the Hottentot Point reef, north of Lüderitz, during a phytoplankton bloom in March 1995.

The seasonal cycle, in environmental parameters as described above, in conjunction with biological processes such as moulting and releasing of eggs, causes lobster to migrate seasonally. Results from trapping and tagging surveys by Tomalin showed that lobster remained in shallow waters until May to June when they slowly moved offshore, possibly to seek shelter from winter swells, to feed and to release larvae in deeper water.

In winter, lobster occur offshore at depths of more than 100 m. Rapid inshore migrations, as observed in March 1995 at Hottentot Point, are correlated with a drop in bottom dissolved oxygen levels offshore in early summer. This seasonal pattern in lobster migration in correlation with

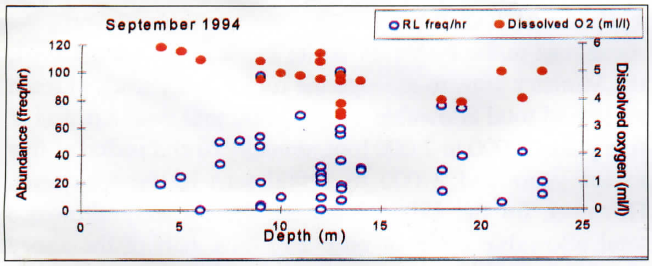


Figure 2a: **Rock lobster abundance and bottom dissolved oxygen levels** *in September 1994*

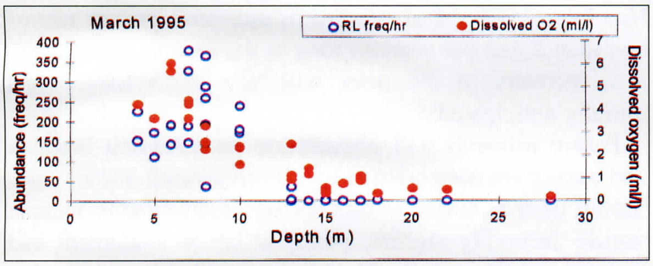


Figure 2b: **Rock lobster abundance** *in March 1995*

bottom dissolved oxygen levels, was confirmed during two consecutive diving surveys (Figure 1a and 1b).

In September 1994, there seemed to be no correlation between lobster abundance and bottom dissolved oxygen levels. Dissolved oxygen levels were high at above 3 ml/l and lobsters were present in varying densities throughout the depth range investigated by divers. In March 1995 a positive correlation was observed between lobster abundance and bottom dissolved oxygen levels. Lobsters were abundant at depths less than 10 m where bottom dissolved oxygen levels were high. At depths over 10 m bottom dissolved oxygen levels were below 1 ml/l and few lobsters were observed.

Implications for the lobster fishery

As offshore bottom dissolved oxygen levels drop during summer to levels below the physiological tolerance limit of the rock lobster, the lobster stock tends to migrate inshore to shallow depths where the water is aerated by wave action. This inshore migration coincides with the commercial lobster fishing season. The lobster is, therefore, fished at depths less than 20 m. Should bottom dissolved oxygen levels remain high during summer the lobster would not need to migrate inshore. As there would be less lobster in the deeper water, it would be out of reach of the traditional fishing traps and less lobster would be caught. It is thus important to continuously monitor bottom dissolved oxygen levels before and during the fishing season, in order to understand at least part of the mechanism behind short term changes in catch rates.

Present status of the resource

The distribution of the Namibian lobster resource is divided into four main areas, each consisting of various lobster grounds. The areas are named according to their geographic position in relation to Lüderitz. The total allowable catch (TAC) is allocated to include all four areas, depending on factors such as the availability of lobster in the fishing grounds, the average size distribution and the ratio of legal size lobster to total catch.

Dirk Heinrich

"Lobster boats" at Lüderitz.

Historic data show that catches were seldom limited through annual TACs since 1958, since limitation of catches was first applied. After the most recent environmentally induced decline in the stock between 1989 and 1991, the total allowable catch was reduced to such levels that for the first time in more than twenty years the quotas limited catches. This drastic reduction in TAC levels seems to have paid off. Since the record low catches of 1992, there has been a slow, but consistent increase in catch rates following the annual increases in the total allowable catch (See Figure 3).

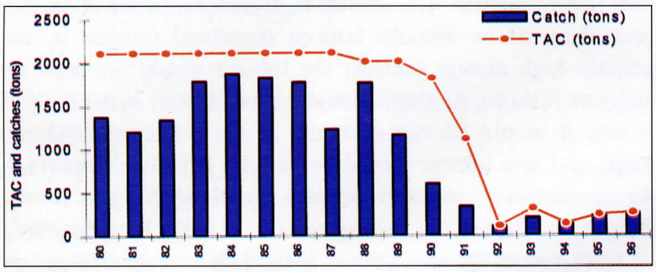


Figure 3: **Annual TAC and total catches of the rock lobster resource**
(Until 1991/92 fishing was regulated by limiting the number of vessels and traps)

Area-based catch rates varied considerably during the past few years. This seems to be related to various parameters such as environmental factors and variations in male migration. A comparison of the last three seasons, using the number of lobster of the legal size of more than 65 cm as a percentage of total unsorted catches, demonstrates the variation in availability of lobster in the different areas and fishing grounds (Table 1). The legal sized lobster was mainly male, probably because the female lobster tends to grow much slower than the male. Availability is very much influenced by male migration. Answers to various questions, such as where lobster migrate to, to what extent do they return, what causes the great variation in male population size structure within and between fishing seasons, still remain relatively unclear.

Future objectives

As set out in the Fisheries White Paper of December 1991, the Ministry aims to manage the rock lobster stock to reach an annual total allowable catch of 500 tons over a period of five years, 1 000 to 2 000 tons annually over a period of five to ten years and 2 000 to 3 000 tons in the long term. However, for the 1996/97 season, the Ministry allowed a total allowable catch of only 260 tons, half of the aimed short-term quota.

The growth rate of the South African *Jasus lalandii* is at present low and a similar trend has been observed in the Namibian stock. Most tag returns indicate a growth rate of less than 2 mm per year. As long as the growth rate remains low, recovery of the stock will take much longer than initially anticipated.

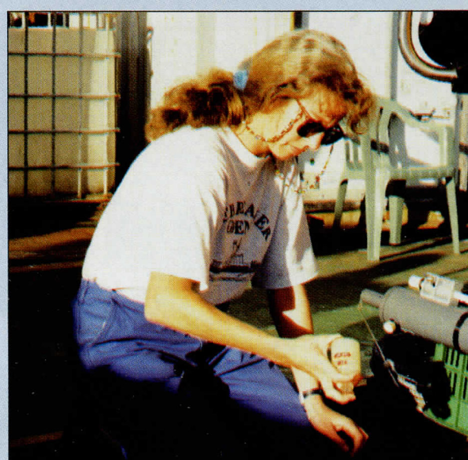
Future research will concentrate on assessing biomass and maximum sustainable yield levels overall and by area, setting up a recruitment monitoring programme to include female fecundity studies, puerulus larvae settlement and juvenile cohort analysis. The Ministry will also monitor various environmental parameters; study male migration patterns in relation to various biological and environmental factors; and intensify the annual tagging programme to determine growth rates along with cohort analysis.

% Lobster of landed catch (+> 65 mm)

Fishing grounds (area)	1993/94	1994/95	1995/96	1996/97
Kerbe Huk (south)	30	39	54	
SW Binder (central)	–	23	–	
Gallovidea (north)	41	23	29	
Hottentot Point (north)	14	12	49	
Black Rock (north)	40	9	36	
Saddle Hill (north)	38	24	28	
Average	32,6	21,7	39	

Table 1: Legal sized lobsters as a percentage of total catch

The authors: *Colette Grober was born and grew up in Namibia. She obtained a B Sc. degree with majors in Zoology and Botany in 1987, followed by a B Sc. (Hon) in Zoology in 1989. She has completed a thesis on adaptations of desert mammals in partial fulfilment of a M Sc. degree. She was appointed Marine Biologist with the Ministry of Fisheries and Marine Resources in 1992 and is involved in rock lobster research at the Lüderitz Seafisheries Research Station.*



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