

**UNDER-REPORTING OF CATCHES OF SOUTH COAST ROCK LOBSTER
PALINURUS GILCHRISTI, WITH IMPLICATIONS FOR THE ASSESSMENT
AND MANAGEMENT OF THE FISHERY**

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Under-reporting of fishery catches can severely affect the precision of stock assessment estimates, which require accurate information on catch and catch rate. Under-reporting of catches of South Coast rock lobster *Palinurus gilchristi* over the past decade was estimated from verified daily catch rates and the number of days spent at sea by the commercial fleet. The malpractice increased sharply between the 1997/98 and 2000/01 fishing seasons. The index of abundance for the resource (standardized catch per unit effort) increased by 2% for 1998/99, 12% for 1999/00 and 14% for 2000/01, after eliminating under-reported information from the input data. An age-structured production model, with the adjusted abundance index as an input, and including known and estimated over-catches between 1991/92 and 2000/01, increased the maximum sustainable yield estimate from 360 to 390 tons tail mass. The Total Allowable Catch (TAC) management regulation that was historically used in the fishery failed to address over-harvesting as a result of poor compliance. A combined TAC and Total Allowable Effort management strategy was introduced in 2000/01 to restrict fishing effort (days at sea) on the basis of quota size and vessel efficiency. Changes in management strategy, which include cancellation of the license of a fishing company responsible for systematic under-reporting and over-harvesting, decrease in fishing effort, reduction in over-capacity of vessels and other infrastructure and stabilization of trap catch rates have improved the outlook for the fishery.

Key words: fishery management, *Palinurus gilchristi*, South Africa, stock assessment, undeclared and under-reported catches

Management of fisheries by Total Allowable Catch (TAC) regulation can impose strong incentives on fishers to under-report landings, especially when regulatory agencies do not have sufficient resources to prevent illegal or over-quota landings (Masood 1997, Patterson 1998). Under-reporting has important implications, because official statistics are often used for stock assessment estimates, which require accurate catch and catch-at-age information (Hilborn and Walters 1992, Gavaris and Van Eeckhaute 1998, Patterson 1998). Under-reporting can take place in traditional or informal fisheries (Cockcroft *et al.* 2002), recreational fisheries (Sauer *et al.* 1997) and inshore or deep-sea commercial fisheries (Patterson 1998, Hutchings and Ferguson 2000).

Treatment of under-reported catches generally falls into four broad categories: (a) it is noted, but not immediately pursued further (e.g. Whitaker *et al.* 1998); (b) an attempt is made to recreate actual catches and effort (Sauer *et al.* 1997, Hutchings and Ferguson 2000, Watson and Pauly 2001); (c) independent survey information is used to correct trends (Cook 1997, Myers *et al.* 1997); (d) sensitivity of assessment models to different types of errors are tested (Restrepo *et al.* 1991, Gavaris and Van Eeckhaute 1998, Patterson 1998). The

latter three methods are often combined.

The South Coast rock lobster *Palinurus gilchristi* is endemic to the South African continental shelf, inhabiting rocky substrata in water between 50 and 200 m deep between Cape Point (18°20' E) and East London (28°E; Pollock *et al.* 2000). It is a long-lived, slow-growing species that inhabits a cold environment and has a complex life cycle (Groeneveld 1997, Groeneveld and Branch 2002). About 1 000 tons of the species (about 400 tons tail mass) are landed annually, supporting a US\$10 million export market. The longline trap-fishery is operated from large (30–60 m), steel-hulled, ocean-going vessels. Rock lobsters are either tailed, packed and frozen on board, or kept alive in recirculating seawater tanks. Vessels are at sea for between 180 and 300 days per fishing season, year-round from 1 October to 30 September.

Skippers are required to record accurate daily catch data, such as numbers of boxes of rock lobster tails or whole frozen rock lobsters or number of live lobsters, and fishing effort (number of traps set) on a prescribed form that must be submitted to fisheries authorities. The entire catch is weighed at the point of landing in the presence of a fishery control officer. Daily catch rates are determined by proportionally raising the skip-

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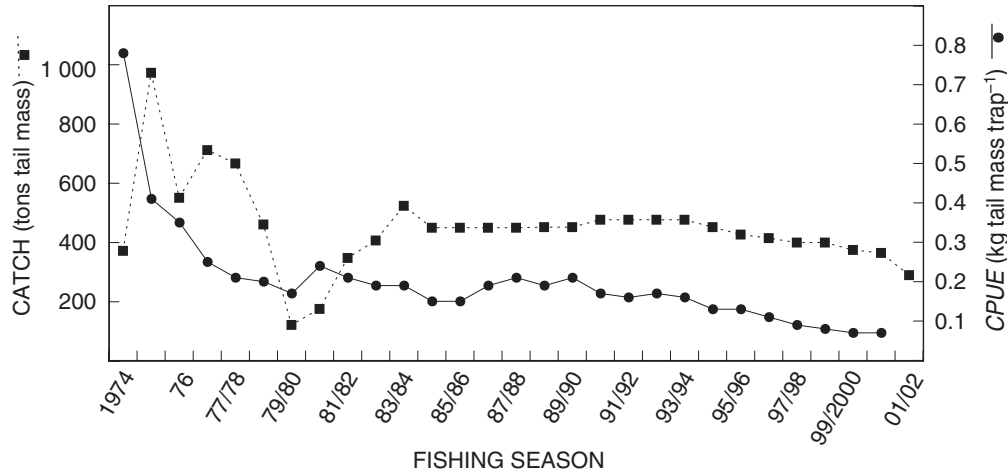


Fig. 1: Total reported catches and catch rates for the South Coast rock lobster fishery, 1974–2001/02. Catches reported after 1984/85 approximate the TAC

pers' estimates of catch per day by the actual weight. This detailed catch-and-effort information is available for all fishing trips from 1977 to date, and forms the basis for annual stock assessments of the status of the resource.

A General Linear Model (GLM) is used to standardize the daily catch per unit effort (*cpue*), by accounting for the influences of vessel characteristics, trap soak-times, month, year, location and depth (Glazer 1999). The relative abundance index is the most important input to the annual assessment of the stock, which is formally based on an age-structured production model (ASPM). The model projects the abundance of the rock lobster resource for management purposes (Johnston and Butterworth 2001).

Since 1984, the fishery has been managed by enforcement of a TAC and restricted entry to vessels of quota-holders (Pollock *et al.* 2000). Despite a steady reduction in the TAC from 477 tons tail mass (1 060 tons whole lobster mass; Groeneveld and Goosen 1996) in 1993/94 to 377 tons for the 1999/2000 fishing season, commercial catch rates have declined over 11 consecutive fishing seasons between 1989/90 and 1999/2000 (Fig. 1). This amounted to a cumulative 70% decline since 1988. To counteract poor compliance in controlling the TAC, a combined TAC and Total Allowable Effort (TAE) management strategy was introduced during the 2000/01 fishing season. This limited the number of sea-days allocated to the fishing fleet to catch the TAC.

Discrepancies in *cpue* were first identified when

trends in catch rates (tail mass day⁻¹) were compared among vessels and companies. A subsequent forensic investigation of a major fishing company (Company A) revealed that catches of rock lobster by that company were being under-reported for the 1999/2000 and 2000/01 fishing seasons. It was also alleged that this malpractice had continued since at least 1991.

This study investigates under-reporting of catches of South Coast rock lobster over a period of 12 years, and describes its implications regarding the resource and its sustainable management. The objectives of the study were to (a) quantify under-reporting and its impact on long-term data series (b) investigate the impact of under-reporting on recent stock assessments, (c) assess the current status of the resource and (d) discuss the changes made to the management strategy and compliance requirements to counteract over-harvesting.

MATERIAL AND METHODS

Actual catches made by Company A (as opposed to their under-reported catches) were estimated for the period 1991/92 to 2000/01 by multiplying the daily catch rates recorded for the fishing fleet (excluding Company A vessels) by the total number of days spent at sea in each fishing season by Company A's vessels. The number of days spent at sea was considered to be a more accurate reflection of effort than the effort statistics

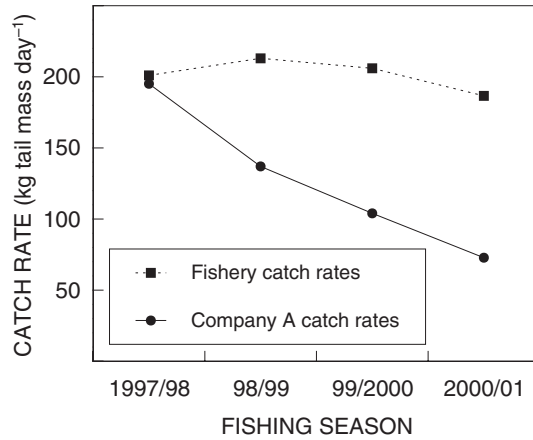


Fig. 2: Catch rates of South Coast rock lobsters estimated for Company A compared with those for the rest of the fishery

(numbers of traps set per day) provided by Company A, because it could be validated from independent sources, and could be compared among companies. These estimates were merged with forensic reports of catches for the 1999/2000 and 2000/01 fishing seasons.

The impact of under-reporting of rock lobster catches on the relative abundance index for the resource was investigated by comparing the index based on all available data with a recalculated version from which all the catch-and-effort data declared by Company A over the past four fishing seasons (1997/98–2000/01) were excluded (Glazer 2002).

The ASPM to assess the rock lobster resource is described in detail in Johnston and Butterworth (2002a, b). In brief, the reference case ASPM involved the

following choices: standard priors for P (harvest proportion), h (the “steepness” of the stock recruitment relationship), M (natural mortality), a_{50} and a_{95} (ages at 50 and 95% selectivity respectively); the GLM-standardized $cpue$, excluding Company A’s data for the past four years; catch-at-age data; a Beverton-Holt stock recruitment relationship; and deterministic recruitment. In addition to the reference case (RC), which included initial reported catches, a sensitivity analysis was run in which the estimated (1991/92–1998/99) and known (1999/2000–2000/01) over-catches were included (RC with over-catches).

RESULTS

Between 1997/98 and 2000/01, reported catch rates of Company A decreased more markedly than those of the rest of the fleet (Fig. 2). From virtual parity with the rest of the fleet in 1997/98, Company A’s reported catch rates decreased to 39% of the average of their competitors over four years, and to 37% of their own 1997/98 catch rate. Over the same period, fluctuations in the catch rates of the rest of the fleet were minimal.

Undeclared catches by Company A for the 1999/2000 and 2000/01 fishing seasons are shown in Table I. Their over-catch in 1999/2000 was 135 tons (189.6% greater than their quota) and in 2000/01 it was 58.4 tons (83.5% greater than their quota). These values are comparable with estimates calculated by multiplying the sea-days used by Company A with highest catch rates recorded for the rest of the fleet, i.e. 111.1 and 62.7 tons respectively. The smaller over-catch in 2000/01 compared with that of the previous year is because the company’s fleet was restricted to port after May 2001. The under-reported catch for 1998/99, when the quota was 80.1

Table I: TAC for the South Coast rock lobster fishery, the quota allocated to Company A and their confirmed and estimated undeclared catches for the period 1996/97–2001/02. Estimates were based on (a) maximum catch rates and (b) average catch rates of the fleet, excluding company A in both cases

Season	TAC and catch (tons tail mass)				
	TAC	Quota allocated to Company A	Confirmed undeclared catch for Company A	Estimated undeclared catch for Company A	
				(a)	(b)
1996/97	415	97.1	No data	27.7	9.8
1997/98	402	93	No data	14.3	2.7
1998/99	402	80.1	No data	114	69.1
1999/00	377	71.2	135	111.1	81.9
2000/01	365	69.9	58.4	62.7	35.5
2001/02	340	0	0	0	0

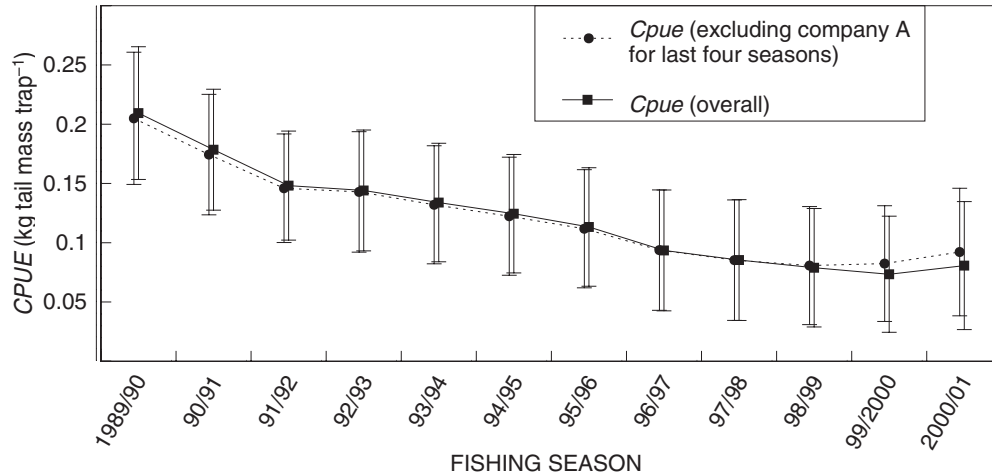


Fig. 3: Trends in standardized *cpue* (\pm standard error) for South Coast rock lobster for the period 1974–2001/02, including and excluding data reported by Company A for the past four fishing seasons

tons, was 114 tons (an over-catch by 142.3%).

Excluding the catch-and-effort data provided by Company A for the past four fishing seasons (1997/98–2000/01) resulted in an abundance index increase of 2% for 1998/99, 12% for 1999/2000 and 14% for 2000/01 (Fig. 3).

The 2002 RC assessment of the South Coast rock lobster resource estimated it to be at 23% of the carrying capacity for the exploitable portion of the stock and 27% for the spawning biomass. The assessment based on the “RC with over-catches” analysis were 25 and 29% respectively. The maximum sustainable yield (*MSY*) for the resource was estimated to be 360 tons for the RC model and 390 tons for the “RC with over-catches” model (Johnston and Butterworth 2002a, b).

DISCUSSION

Under-reporting of catches in the South Coast rock lobster fishery has allegedly taken place systematically throughout the 1990s and has increased sharply over recent years. Actual over-catches are known only for the 1999/2000 and 2000/01 fishing seasons, but estimates based on annual catch rates of the fleet (excluding Company A) and the numbers of days spent at sea are considered to be relatively accurate. Systematic under-reporting and over-quota catches in this fishery are most likely the result of poor compliance, a situation worsened by the lack of sufficient resources for com-

pliance purposes, such as funding and manpower.

Past management of the fishery relied almost exclusively on a *TAC* regulation and individual quotas, with little regard for limitation of fishing effort. As a result, new and larger fishing vessels moved into the fishery during the early 1990s, and the numbers of traps set increased dramatically during the second half of the 1990s (Groeneveld *et al.* 2003). This was despite declining catch rates and a decrease in *TAC*. The result was an over-capitalized infrastructure, with too many fishing vessels and few available lobsters. The surfeit of fishing vessels and gear undoubtedly contributed to over-harvesting, especially in the near absence of compliance.

The shift in management strategy during the 2000/01 fishing season, from a solely *TAC*-managed fishery to one based on a *TAC* and a *TAE*, effectively reduced the possibility of over-harvesting of rock lobster, by limiting the number of sea-days allocated to each company. Also, the closure of Company A resulted in a reduction in the number of fishing vessels from 12 to eight. However, in spite of this reduction, the *TAC* was easily caught in the 2001/02 fishing season. The combined *TAC* and *TAE* management strategy is now entrenched and strict guidelines have been set for the entry of new vessels into the fishery.

Issues such as under-reporting and over-harvesting, declines in trap catch rates, increasing qualitative and quantitative fishing effort (Groeneveld *et al.* 2003) and over-capitalization in vessels and gear, have been resolved to a large extent in the past two years. Under-

reported catch-and-effort data have been removed from assessments and over-catches have been estimated and incorporated into the stock assessment models. Use of a combined TAC and TAE strategy provides a more conservative approach towards improving the management of the fishery, but its recovery is expected to take several years.

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