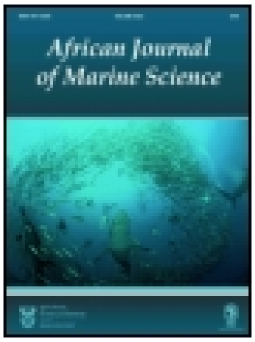

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THE IMPACT OF BEACH-SEINE NETTING ON THE BENTHIC FLORA AND FAUNA OF FALSE BAY, SOUTH AFRICA

S. J. LAMBERTH, B. A. BENNETT*, B. M. CLARK*, and P. M. JANSSENS**

A total of 31 invertebrate and 14 macrophyte species was recorded in the by-catch of 311 commercial beach-seine hauls made in False Bay between January 1991 and December 1992. *Ecklonia maxima* (22%), *Codium fragile capense* (16%) and *Gracilaria verrucosa* (9%) dominated the total macrophyte catch of 14,9 tons. The invertebrate by-catch was dominated by the ascidian *Pyura stolonifera* (18,3 tons) and 10 339 individuals of the brachyuran *Ovalipes trimaculatus*. Large macrophyte and invertebrate catches were infrequent, the bulk of the total catch being contributed by <10% of the hauls. Dive surveys found no significant differences in abundance or species composition between sites inside and outside the seine area. The beach-seine by-catch did not make a significant contribution to the composition or biomass of material deposited along the driftline. It is concluded that commercial beach-seine netting is not having a significant detrimental effect on the benthic flora and invertebrate fauna of False Bay.

Altesaam 31 ongewerwelde en 14 makrofietspesies is in die newevangs van 311 kommersiële strandseëntrekke wat in Valsbaai tussen Januarie 1991 en Desember 1992 uitgevoer is, aangeteken. *Ecklonia maxima* (22%), *Codium fragile capense* (16%) en *Gracilaria verrucosa* (9%) het die algehele makrofietvangs van 14,9 ton oorheers. Die newevangs van ongewerweldes is deur die askidiër *Pyura stolonifera* (18,3 ton) en 10 339 individue van die krap *Ovalipes trimaculatus* oorheers. Groot makrofiet- en ongewerwelde vangste het selde voorgekom en die oorwig van die totale vangs is deur <10% van die trekke opgelewer. Duikopnames het geen beduidende verskille in talrykheid of spesiesamestelling tussen plekke binne en buite die trekgebied aangetoon nie. Die newevangs van strandseëns het nie beduidend bygedra tot die samestelling en biomassa van materiaal wat langs die opdrifsellyn neergelê is nie. Daar word tot die gevolgtrekking geraak dat kommersiële strandnetvangs nie 'n beduidend nadelige uitwerking op die bentiese flora en ongewerwelde fauna van Valsbaai het nie.

Concern over fishing methods and their impact on benthic life is as old as their inception and has prompted numerous studies (e.g. Graham 1955, Caddy 1973, De Groot 1984, Hall *et al.* 1993). Most of these studies are centred on the effects of various trawl and dredging methods (see Messieh *et al.* 1991 for review). Few, if any, studies have investigated the effect of beach-seining on benthic life.

Graham (1955) found no difference in the numbers or species composition of benthic animals between areas inside or outside trawling grounds. Differences in the species composition and abundance of an infaunal community could not be attributed to the absence or presence of trawling activity, but the epifauna could be more vulnerable (Hall *et al.* 1993). By contrast, trawling has been shown in other studies to cause large mortalities to benthic invertebrates and to alter benthic habitats, resulting in an overall shift in abundance and species composition (Riesen and Reise 1982, De Groot 1984).

The effects of fishing on a benthic community will depend on the type of gear used, the nature of the substratum and the intrinsic vulnerability of the individual species concerned (De Groot 1984, Messieh *et al.* 1991). The possible direct effects of a net being dragged over the seafloor include mechanical damage to sedentary organisms or entrapment and removal of living organisms, drift algae or inanimate objects, such as rocks and shells (Graham 1955, Caddy 1973). Indirect effects are increased predation pressure attributable to the exposure of infaunal species, alteration of substratum texture and sediment resuspension with resultant clogging of gills, and smothering (De Groot 1979, Churchill 1989, Messieh *et al.* 1991).

As early as 1898, False Bay linefishermen expressed disquiet that beach-seine fishermen were netting large quantities of benthic organisms, namely the ascidian *Pyura stolonifera*, which they used as bait (Gilchrist 1899). In recent years, anglers and conservation groups have equated beach-seining to trawling (Haynes 1986). They claimed that the seine nets were not only scraping the sea bed of all forms of marine life, but depositing it on the shore and therefore polluting the beaches (Kirsch 1993, Petty 1993). In doing so, the nets were perceived to be removing a vital source of production from the surf-zone and to be

* Department of Zoology and Marine Biology Research Institute, University of Cape Town, Rondebosch 7700, South Africa
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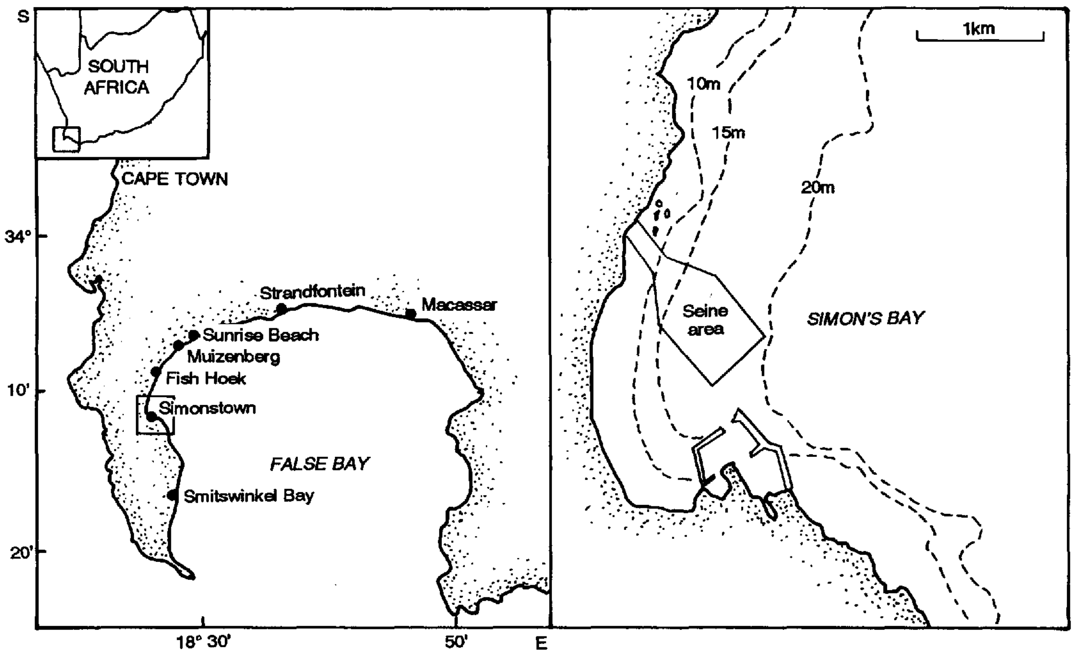

Fig. 1: Map of False Bay and Simon's Bay showing the study sites

altering the benthic habitat.

In this paper, the results of a survey aimed at estimating the abundance and the species composition of macrophytes and invertebrates captured in commercial beach-seine hauls are presented. The abundance and the species composition of benthic macrophytes and invertebrates, inside and outside areas swept by the nets, including the adjacent drift-line, are compared and discussed.

METHODS

Study sites and seining methods

The effects of beach-seining on the benthic flora and fauna were studied at two sites, the northern shore of False Bay and Simon's Bay on the western shore of False Bay (Fig. 1). These two areas were selected because they differ considerably in their physical parameters, as do the seining methods used at each site.

Seven commercial beach-seine teams operate from False Bay's northern and western shores (Fig. 1). The northern shore is exposed to the predominantly south-west swell entering the bay and has a beach-slope of roughly 1:50; seine areas seldom exceed 4 m in depth. The western shore is relatively sheltered and the beach-slope is approximately 1:10. Simon's Bay, on the western shore of False Bay, is a small bay of 3 km diameter with a maximum depth of 18 m.

Most nets conform to permit specifications of a length of 275 m, depth 5 m, minimum mesh size of 44 mm and hauling rope length of 600 m. These specifications are characteristic of seine nets used on the northern shore. Simon's Bay seine operators use a net that is "modified" to catch white steenbras *Lithognathus lithognathus*. This "Russman" net is weighted such that it is slightly negatively buoyant and rests lightly on the bottom when still. It has a mesh size of 90 mm, a length of 175 m, a depth of 3 m, and it is typically set 750–1 500 m from the shore. All the nets are set from boats rowed out through the surf-zone and are hauled shorewards at approximately 4 m per minute. Operators on the north shore are mobile and have access to approximately 7 km of beach. The Simon's Bay "Russman" operation is confined to approximately 100 m of beach and the net is set within a fixed area bounded by mooring buoys and a wreck.

Monitoring of catches

Commercial beach-seine operations in False Bay were monitored between January 1991 and December 1992. In each observed haul, all fish and the invertebrate and algal by-catch were quantified and identified as far as possible. Algal subsamples were taken and sorted, weighed and identified in the laboratory. Wind speeds were recorded at the time of each seine and for the week preceding each Simon's Bay haul.

Video recording

An underwater video camera was used to record the passage of the Russman net over the Simon's Bay sea floor. Filming started as the net was set and continued until the net was hauled up onto the beach. This was done to determine the extent to which the net scraped the sea floor.

Diving survey

During April 1991, a diving survey (using SCUBA) was conducted in Simon's Bay in order to compare the species composition and biomass of benthic invertebrates and macrophytes inside and outside the fixed seine area. In addition, the availability of benthic material to the seine nets could be determined. Four areas were sampled, two inside and two outside the seine area (Fig. 1). Two samples were taken at depths of 3, 8, 13 and 17 m within each of the four areas. Each sample was obtained by a diver swimming along a 25 m leadline and collecting whatever epibenthic material could be seen within one metre of one side of the line.

An additional dive survey was conducted in the surf-zone between Sunrise Beach and Strandfontein on the north shore in order to determine the biomass of macrophytes and invertebrates available to the nets in that area. This was done by swimming four 200 × 1 m transects perpendicular to the shore, collecting all macrophytic material and recording all invertebrates seen.

Drift composition

The algal composition of the Simon's Bay driftline was monitored daily during April and May 1991. The beach was divided into four 64 × 1 m transects along which all macrophyte material was recorded and subsampled. The rate of dispersal and the extent to which discarded seine material was resuspended and washed out to sea were noted.

Multivariate analyses were conducted according to the methodology of Field *et al.* (1982). Samples from the Simon's Bay seine catches, inside the seine area, outside the seine area and along the driftline were grouped using complementary classification and multidimensional scaling techniques applied to data on species composition and biomass (wet mass) with the Bray-Curtis measure of similarity. The Mann-Whitney *U*-test was used to compare total algal biomass inside and outside the seine area.

RESULTS

In all, 311 (30% of the overall total) commercial beach-seine hauls were monitored during the period January 1991 – December 1992. These included 26 hauls by the Russman net at Simonstown. The mean areas (±*SE*) swept by the net were 59 826 ± 1 298 m^2 and 28 774 ± 1 160 m^2 at Simon's Bay and the northern shore respectively. There was a significant positive correlation between the quantity of weed netted and the mean wind speed for the two days prior to each seining (Spearman Rank Coefficient 0,68, $p < 0{,}05$).

A total of 14 macrophytic species was identified in a total algal by-catch of 14,9 tons. The average catches of macrophytes amounted to 76,6 and 42,7 kg·haul^{-1} at Simon's Bay and the northern shore respectively. The catch was dominated by *Ecklonia maxima* (22%), *Codium fragile capense* (16%) and *Gracilaria verrucosa* (9%) — Tables I, II. The invertebrate by-catch was dominated by the redbait *Pyura stolonifera* (18,3 tons) and 10 339 individuals of the sand crab *Ovalipes trimaculatus* (Table I). Although large catches (> 50 kg) of macrophytes and *P. stolonifera* were infrequent, occurring in fewer than 10% of the hauls (Fig. 2), those hauls provided the bulk (> 80%) of the total catch. *O. trimaculatus* catches were relatively frequent, occurring 80% of the time, but few hauls captured more than 60 individuals (Fig. 2). Invertebrates < 1 cm long, e.g. amphipods, were not quantified and therefore do not appear on the list.

Video footage taken of the Russman net at Simon's Bay showed that it initially sank to the bottom, whereupon it rose to about 10 – 20 cm from the sea floor at the commencement of the haul. The net maintained this position throughout the haul and did not scrape the bottom, nor was it observed to disturb the burrows of infaunal species such as *Callianassa kraussi*, which occur in the bay. The only time that the net was

Table I: Summary of information on species composition, abundance and occurrence of all macrophytes and invertebrates caught in a total of 311 beach-seine hauls during the period January 1991 – December 1992. Algae and *Pyura stolonifera* are measured in kilogrammes

Taxon		Total	Number per haul	% Occurrence
	Macrophytes			
	All species	14 865	47,80	44,69
	Invertebrates			
Annelida				
Polychaeta	*Pectinaria capensis*	10	0,03	0,32
Ascidiacea				
	Pyura stolonifera	18 256	58,70	42,77
Bryozoa				
	Unidentified spp.	124	0,40	1,29
Crustacea				
Decapoda	*Carcinus maenas*	1	<0,01	0,32
	Jasus lalandii	2	0,01	0,64
	Dehaanius dentatus	162	0,52	1,93
	Ovalipes trimaculatus	10 339	33,24	81,03
	Planes minutus	12	0,04	1,29
	Macropetasma africana	40	0,13	0,64
	Unidentified sp.	8	0,03	2,25
Isopoda	*Paridotea reticulata*	300	0,96	0,64
Cnidaria				
Scyphozoa	*Chrysaora hysoscella*	572	1,84	32,48
	Rhizostoma sp.	2 859	9,19	39,87
	Unidentified spp.	1 000	3,22	30,23
Hydrozoa	*Physalia utriculus*	940	3,02	2,25
	Velella sp.	47	0,15	0,11
Echinodermata				
Asteroidea	*Marthasterias glacialis*	239	0,77	5,47
Holothuroidea	Unidentified sp.	1	<0,01	0,32
Ophiuroidea	Unidentified spp.	420	1,35	0,64
Mollusca				
Bivalvia	*Atrina squamifera*	63	0,20	2,57
	Choromytilus meridionalis	1 160	3,73	9,97
	Donax serra	26	0,08	1,29
	Mactra glabrata	5	0,02	0,32
	Scissodesma spengleri	917	2,95	14,15
Cephalopoda	*Loligo vulgaris reynaudii*	57	0,18	3,22
	Octopus vulgaris	23	0,07	3,86
	Sepia vermiculata	8	0,03	1,93
Gastropoda	*Aplysia oculifera*	131	0,42	2,89
	Glaucus atlanticus	2	0,01	0,32
	Janthina janthina	1	<0,01	0,32
Porifera				
	Unidentified spp.	1 014	3,26	9,32

observed scraping the bottom was as it approached to within approximately 20 m of the shore and the depth of the net exceeded that of the water column.

There were no significant differences in biomass of either macrophytes or invertebrates at equivalent depths inside and outside the Simon's Bay seine area (Mann-Whitney *U*-test, Table III). Multivariate analyses revealed no distinct groupings corresponding to depth or to position inside or outside the seine area. *E. maxima*, *C. fragile capense* and *G. verrucosa* constituted 85 and 82% respectively of the Simon's Bay seine and dive survey macrophyte samples (Table II). Seine catches (1,28 $g \cdot m^{-2} \cdot haul^{-1}$) amounted to 7,5% of the available macrophyte material (16,96 $g \cdot m^{-2}$) in Simon's Bay (Table II). Catches of *O. trimaculatus* represented 36% of those available in Simon's Bay

Table II: Species composition and biomass of beach-seine net catches, benthic organisms inside and outside seine areas and along the driftline in Simon's Bay and on the north shore of False Bay. Biomass inside and outside seine area and that available on the north shore was determined from dive surveys. Available biomass in Simon's Bay is the mean of that inside and outside seine areas. Macrophytes that originate from rocky substrata either adjacent to or farther away from the seine area are marked with an asterisk. Values given after ± indicate *SE*

Taxon	Biomass						
	Simon's Bay					North shore	
	Monitored hauls ($g \cdot m^{-2} \cdot haul^{-1}$)	Inside seine area ($g \cdot m^{-2}$)	Outside seine area ($g \cdot m^{-2}$)	Available ($g \cdot m^{-2}$)	Driftline ($g \cdot m^{-2}$)	Monitored hauls ($g \cdot m^{-2} \cdot haul^{-1}$)	Available ($g \cdot m^{-2}$)
			Macrophytes				
Chlorophyta							
*Caulerpa filliformus**	<0,01 ± 0,001	0,01 ± 0,003	0,11 ± 0,080	0,06		0,02 ± 0,007	0,63 ± 0,273
*Codium fragile capense**	0,34 ± 0,037	6,30 ± 3,281	5,82 ± 3,562	6,03	1,04 ± 0,288	0,13 ± 0,052	0,34 ± 0,172
*Codium papenfussii**						0,01 ± 0,006	
*Codium stephensiae**	0,15 ± 0,073	0,04 ± 0,025	0,06 ± 0,017	0,05	1,13 ± 0,239	0,13 ± 0,032	1,31 ± 0,728
Ulva spp.	0,02 ± 0,001	1,63 ± 0,530	2,70 ± 1,710	2,13	0,47 ± 0,089	0,03 ± 0,011	
Phaeophyta							
*Ecklonia maxima**	0,47 ± 0,018	6,81 ± 1,025	1,29 ± 1,130	4,20	468,75 ± 105,256	0,20 ± 0,046	8,51 ± 3,640
*Sargassum heterophyllum**	<0,01 ± 0,002					0,01 ± 0,003	
*Sargassum longifolium**					1,13 ± 0,201	0,01 ± 0,004	
*Splachnidium rugosum**					0,83 ± 0,119		
Rhodophyta							
*Gigartina radula**	<0,01 ± 0,002	0,24 ± 0,131		0,13	0,20 ± 0,045	0,06 ± 0,021	
Gracilaria verrucosa	0,28 ± 0,058	2,42 ± 1,192	4,74 ± 2,391	3,50	0,85 ± 0,312		
*Hypnea spicifera**	<0,01 ± 0,003	0,14 ± 0,130	0,02 ± 0,009	0,08	0,37 ± 0,063	0,07 ± 0,019	0,69 ± 0,370
*Nemastoma lanceolata**						0,68 ± 0,228	
*Plocamium corallorhiza**	<0,01 ± 0,001	0,19 ± 0,133	0,02 ± 0,012	0,11		0,11 ± 0,026	4,11 ± 1,770
*Pterosiphonia cloiophylla**					0,43 ± 0,112	0,06 ± 0,030	1,89 ± 0,657
*Trematocarpus flabellatus**					0,06 ± 0,014		
Other	0,01 ± 0,002	0,99 ± 0,401	0,29 ± 0,211	0,67	0,70 ± 0,149	0,12 ± 0,022	51,03 ± 10,260
All macrophytes	1,28 ± 0,119	18,77 ± 4,941	15,05 ± 6,072	16,96	475,96 ± 106,875	1,64 ± 0,284	68,51 ± 14,272
			Invertebrates				
Ascidiacea							
Pyura stolonifera	1,13 ± 0,129					0,04 ± 0,013	78,00 ± 25,760
Bryozoa							
Unidentified spp.						0,11 ± 0,045	23,49 ± 7,572
Cnidaria							
Scyphozoa spp.	0,01 ± 0,003	0,14 ± 0,036	0,05 ± 0,021	0,09		0,14 ± 0,036	18,00 ± 2,329
Crustacea							
Ovalipes trimaculatus	0,02 ± 0,001	0,09 ± 0,022		0,05		0,06 ± 0,007	172,08 ± 26,131
Echinodermata							
Marthasterias glacialis	0,015 ± 0,006	1,01 ± 0,235	0,93 ± 0,370	0,97		<0,01 ± 0,003	
Porifera							
Unidentified spp.	0,02 ± 0,003					0,09 ± 0,043	4,23 ± 1,657

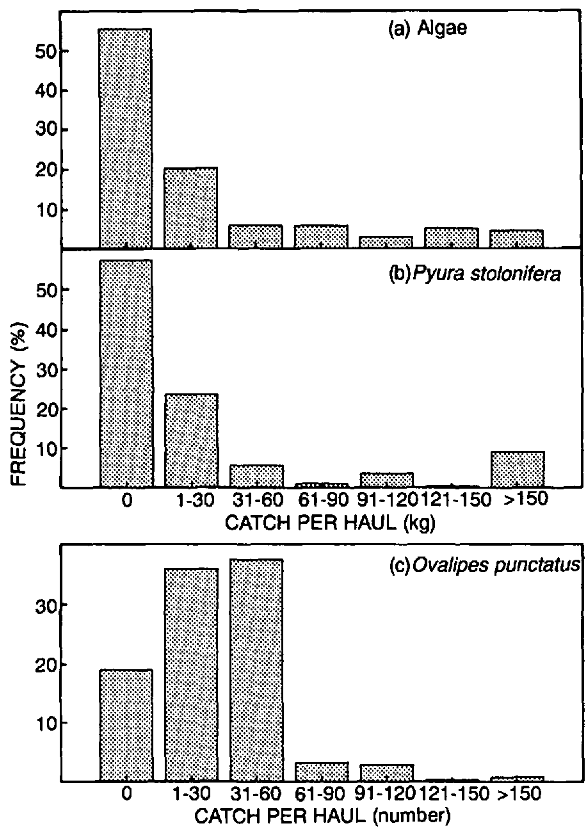

Fig. 2: Frequency distribution of catch size for macrophytes and the two most abundant invertebrate species in 311 commercial beach-seine hauls made in False Bay during the period January 1991 – December 1992

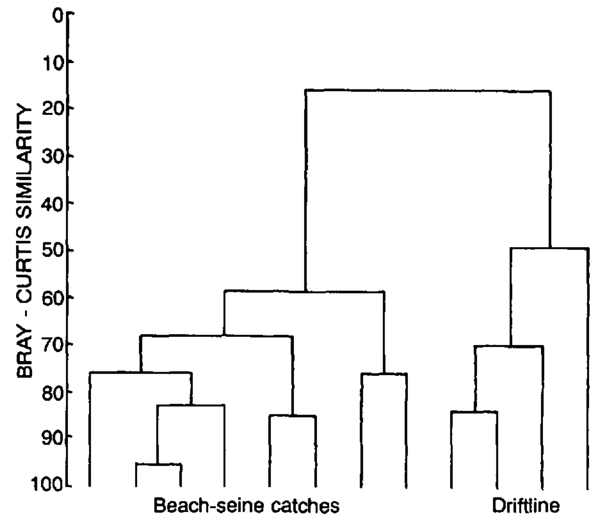

Fig. 3: Dendrogram showing similarities between catch compositions by beach-seine at Simon's Bay and by driftline

(Table II). Although caught in the seine, no *P. stolonifera* or poriferans were observed during the dive survey.

The dive survey on False Bay's northern shore indicated an available macrophyte biomass four times that of Simon's Bay (Table II). *G. verrucosa*, dominant in Simon's Bay catches, was recorded in neither seine catches nor dive surveys on the north shore. The proportion of the available macrophyte biomass (2,4%) removed by each haul was 30% of that of Simon's Bay (7,5% — Table II). The available invertebrate biomass on the northern shore was three orders of magnitude greater than at Simon's Bay (Table II). *O. trimaculatus* dominated at three individuals or 172,1 $g \cdot m^{-2}$. *P. stolonifera* followed at 78,0 $g \cdot m^{-2}$. The invertebrate biomass removed by each haul on the north shore amounted to 0,15% of that available within the area swept by the net.

Cluster analysis separated the composition of the seine catch and driftline at Simon's Bay into two distinct groups (Fig. 3). *E. maxima* (98%) dominated the drift biomass, which was one and three orders of magnitude greater than that available or that recorded in seine catches respectively (Table II). In turn, the Simon's Bay drift biomass (476 $g \cdot m^{-2}$) was double that of the northern shore (238 $g \cdot m^{-2}$) — Westridge Cleansing Depot (unpublished records).

Observations of macrophytic material discarded after each seine haul indicated that 78% of the catch was resuspended and carried out to sea within 24 h.

DISCUSSION

Beach-seine fishermen avoid netting at times and in areas where there are large quantities of suspended macrophyte and other material. Large macrophyte loads slow down the speed of the haul, cause the net to twist and roll and facilitate the escape of targeted fish (Pierce *et al.* 1990).

The presence and abundance of most macrophytes and invertebrates in the surf-zone is extremely patchy and variable in time and space (Robertson and Hansen 1982, Van der Merwe and McLachlan 1987). This is borne out by the observation that the bulk of the macrophytes and *P. stolonifera* caught during this study were captured in fewer than 10% of the hauls, even though similar or identical areas were being seined. In addition, excluding *G. verrucosa* and *Ulva* spp., all the macrophyte species in this study orig-

Table III: Summary of results of Mann-Whitney U-test testing for differences in biomass between samples from inside and outside the seine area. The test statistic and significance level are shown, the latter in italics

OUTSIDE SEINE AREA Depth (m)	INSIDE SEINE AREA Depth (m) 3	8	13	17
3	1,5	2,2	2,2	2,2
	0,1	*0,03*	*0,03*	*0,03*
8	1,6	0,4	0,4	0,7
	0,10	*0,70*	*0,70*	*0,50*
13	0,4	1,9	1,9	2,2
	0,66	*0,06*	*0,06*	*0,03*
17	1,6	1,6	0,7	0,7
	0,10	*0,10*	*0,50*	*0,50*

inate from rocky and mixed shores away from the seine area (Branch *et al.* 1994). All macrophytes observed in this study were unattached and therefore mobile.

The sessile invertebrate *P. stolonifera* is not a "resident" of the sandy-beach surf-zone, where it occurs in the form of uprooted pods washed from adjacent rocks or deeper waters. It was encountered in similar quantities and frequencies to the macrophytic material caught. This suggests that the presence and the abundance of *P. stolonifera* and detached macrophytes in the surf-zone are determined by the same factors, namely wind, wave action and current. The three-spot swimming crab *O. trimaculatus* was the only invertebrate species resident in the surf-zone to be caught frequently and in consistent quantities. The catch per haul of this species on the northern shore was 0,03% of its available biomass, which amounted to approximately 86 000 individuals over the area seined in a single haul. Few invertebrate species, including *O. trimaculatus*, were observed in the Simon's Bay benthic survey, which suggests that densities were lower or that they escaped observation through being buried. Infaunal species were not sampled during this study because prior observations and video footage indicated that the nets, "Russman" seine included, did not drag along, but rode approximately 10–20 cm above the sea floor. Burrows of organisms such as the sand prawn *Callianassa kraussi* were undisturbed by the net's passage and no individuals of this species were ever caught. Infaunal species, such as the bivalves *Donax serra* and *Scissodesma spengleri*, were abundant in the surf-zone, and they did appear in small numbers in seine-net catches. However, they were not counted in the visual surveys because they are normally buried beneath the sand surface.

Hall *et al.* (1993) point out that the problem with comparisons between areas which are fished and unfished is that the latter are not fished precisely because they differ in the habitat requirements that attract the fish in the first place. They suggest that the only viable way to undertake a net-fishery study of this sort is to find a protected area within the fishing ground. In this study beach-seine nets were excluded from the unfished areas by a wreck and mooring buoys, both anthropogenic in origin and therefore not natural features of the bay. There was no difference in biomass, species composition or abundance of macrophytes and invertebrates between areas in Simon's Bay which were or were not seined. The two "resident" macrophytes (*G. verrucosa* and *Ulva* spp.) were more abundant outside the seine area, but not significantly so. Beach-seine netting does not appear to have altered the benthic habitat or community structure in Simon's Bay.

Macrophyte material decays in the surf-zone with a half life of approximately eight days (Van der Merwe and McLachlan 1987). Assuming exponential decay and that all macrophytic material is imported, it follows that 28% of the standing or average macrophyte biomass is imported daily. Using a conversion ratio of 1 dry mass: 4,43 wet mass and 0,3 gC·g dry mass^{-1}, macrophyte imports to the surf-zone on the north shore amount to approximately 19,2 g wet mass·m^{-2}day^{-1} or 4,3 g dry mass·m^{-2}day^{-1} or 1,3 gC·m^{-2}·day^{-1} (Field *et al.* 1980, Levitt 1987). Detached macrophytes are still actively photosynthetic (Robertson and Hansen 1982). The production of these macrophytes is approximately 6,5 gC·g dry mass^{-1}·year^{-1} (Levitt 1993). On the north shore this amounts to 100,6 gC·m^{-2}·year^{-1}. Therefore, on the north shore, the import and *in situ* production of detached macrophytes is approximately 576,6 gC·m^{-2}·year^{-1}. Surf-zone phytoplankton production on the north shore is approximately 1 090 gC·m^{-2}·year^{-1} (estimated from Bate and Campbell 1990 and Clark *et al.* 1994). It follows that only in the extreme event of seine frequency increasing to the extent of removing all macrophyte material from the surf-zone is total production likely to be significantly affected. Another effect of removing all this macrophyte material could be the loss of the role it plays as a refuge and in attracting foraging species (Robertson and Lenanton 1984, Wright 1989).

There was a marked difference between seine catches and driftline composition of macrophyte material.

The biomass of "floating" macrophytes, namely *E. maxima*, was an order of magnitude greater along the driftline than in seine-catches or within the seine area.

In conclusion, macrophyte and invertebrate by-catches are infrequent by beach-seine fishermen, who make every attempt to avoid such catches, because they interfere with fishing operations. The removal of macrophyte material from the surf-zone by beach-seines is unlikely to effect production. Most seined macrophyte material is resuspended within a short period, does not contribute significantly to the driftline and therefore does not "pollute" the beaches. There is no difference in the species composition or biomass of benthic flora and fauna between fished and non-fished areas, and therefore no evidence to suggest that beach-seine netting is having a severely detrimental effect on the benthic flora and invertebrate fauna of False Bay.

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LITERATURE CITED

BATE, G. C. and E. D. CAMPBELL 1990 — *The Flora of the Sandy Beaches of Southern Africa. 2. The West Coast.* Report **25** of the Institute for Coastal Research, University of Port Elizabeth: 67 pp.

BRANCH, G. M., GRIFFITHS, C. L., BRANCH, M. L. and L. E. BECKLEY 1994 — *Two Oceans. A Guide to the Marine Life of Southern Africa.* Cape Town; David Philip: 360 pp.

CADDY, J. F. 1973 — Underwater observations on tracks of diedges and trawls and some effects of dredging on a scallop ground. *J. Fish. Res. Bd Can.* **30**: 173–180.

CHURCHILL, J. H. 1989 — The effect of commercial trawling on sediment resuspension and transport over the Middle Atlantic Bight continental shelf. *Continent. Shelf Res.* **9**(9): 841–864.

CLARK, B. M., BENNETT, B. A. and S. J. LAMBERTH 1994 — Assessment of the impact of commercial beach-seine netting on juvenile teleost populations in the surf zone of False Bay, South Africa. *S. Afr. J. mar. Sci.* **14**: 255–262.

DE GROOT, S. J. 1979 — An assessment of the potential environmental impact of large-scale sand-dredging for the building of artificial islands in the North Sea. *Ocean Mgmt* **5**: 211–232.

DE GROOT, S. J. 1984 — The impact of bottom trawling on the benthic fauna of the North Sea. *Ocean Mgmt* **9**: 177–190.

FIELD, J. G., CLARKE, K. R. and R. M. WARWICK 1982 — A practical strategy for analysing multispecies distribution patterns. *Mar. Ecol. Prog. Ser.* **8**(1): 37–52.

FIELD, J. G., GRIFFITHS, C. L., GRIFFITHS, R. J., JARMAN, N. [G.], ZOUTENDYK, P., VELIMIROV, B. and A. BOWES 1980 — Variation in structure and biomass of kelp communities along the south-west Cape coast. *Trans. R. Soc. Afr.* **44**(2): 145–203.

GILCHRIST, J. D. F. 1899 — *Report of the Marine Biologist, Department of Agriculture, Cape of Good Hope, for the year 1898.* Cape Town; Government Printer: 362 pp. + 21 Charts.

GRAHAM, M. 1955 — Effect of trawling on animals of the sea bed. *Deep-Sea Res.* **3**(Suppl.): 1–6.

HALL, S. J., ROBERTSON, M. R., BASFORD, D. J. and S. D. HEANEY 1993 — The possible effects of fishing disturbance in the northern North Sea: analysis of spatial patterns in community structure around a wreck. *Neth. J. Sea Res.* **31**(2): 201–208.

HAYNES, N. 1986 — Trekking does upset the environment. *Fish Hoek Echo*, 24 April 1986.

KIRSCH, B. 1993 — Trek netting is nothing less than wholesale slaughter. *Argus*, 8 December 1993.

LEVITT, G. J. 1987 — Studies on the seasonal primary production of Cape Peninsula littoral and sublittoral seaweeds. M.Sc. thesis, University of Cape Town: 196 pp.

LEVITT, G. J. 1993 — Primary production of Cape of Good Hope littoral and sublittoral seaweeds. *Trans. R. Soc. S. Afr.* **48**(2): 339–350.

MESSIEH, S. N., ROWELL, T. W., PEER, D. W. and P. J. CRANFORD 1991 — The effects of trawling, dredging and ocean dumping on the eastern Canadian continental shelf seabed. *Continent. Shelf Res.* **11**(8–10): 1237–1263.

PETTY, J. V. 1993 — Unfair trek netting bias. *Argus*, 5 August 1993.

PIERCE, C. L., RASMUSSEN, J. B. and W. C. LEGGETT 1990 — Sampling littoral fish with a seine: corrections for variable capture efficiency. *Can. J. Fish. aquat. Sci.* **47**: 1004–1010.

RIESEN, W. and K. REISE 1982 — Macrobenthos of the subtidal Wadden Sea: revisited after 55 years. *Helgoländer wiss. Meeresunters.* **35**: 409–423.

ROBERTSON, A. I. and J. A. HANSEN 1982 — Decomposing seaweed: a vital link in coastal food chains? *CSIRO mar. Labs Rep.* **1979–1981**: 75–83.

ROBERTSON, A. I. and R. C. J. LENANTON 1984 — Fish community structure and food chain dynamics in the surf-zone of sandy beaches: the role of detached macrophyte detritus. *J. expl mar. Biol. Ecol.* **84**(3): 265–283.

VAN DER MERWE, D. and A. McLACHLAN 1987 — Significance of free-floating macrophytes in the ecology of a sandy beach surf zone. *Mar. Ecol. Prog. Ser.* **38**: 53–63.

WRIGHT, J. M. 1989 — Detached chlorophytes as nursery areas for fish in Sulaibikhat Bay, Kuwait. *Estuar. coast. Shelf Sci.* **28**(2): 185–193.