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Role and efficacy of marine protected areas for the South African rock lobster, *Jasus lalandii*

Stephen Mayfield[A,C,D], *George M. Branch*[A] *and Andrew C. Cockcroft*[B]

[A]Zoology Department, University of Cape Town, Private Bag, Rondebosch, 7701, South Africa.

[B]Marine and Coastal Management, Private Bag X2, Rogge Bay, 8012, South Africa.

[C]Present address: SARDI Aquatic Sciences, PO Box 120, Henley Beach, SA 5022, Australia.

[D]Corresponding author. Email: mayfield.stephen@saugov.sa.gov.au

Abstract. Protected areas for the South African rock lobster, *Jasus lalandii*, were sampled by using divers, traps and ringnets at sites within and adjacent to four protected areas (St Helena Bay, Saldanha Bay and Table Bay rock lobster sanctuaries and the Betty's Bay marine reserve), over two years. Virtually no rock lobsters were found in St Helena Bay sanctuary, probably because of periodic harmful algal blooms. Abundance was greater in Saldanha Bay sanctuary than in adjacent fished areas, but only once in two years. Sizes were, however, larger in this sanctuary than the fished areas. By an order of magnitude, fewer and smaller rock lobsters were caught within the Table Bay sanctuary than in adjacent areas. Only at Betty's Bay were rock lobster sizes and abundance consistently greater inside than outside the reserve. Fecundity was similar among sites, with females in protected areas contributing no more to egg production than would be expected by the proportional area occupied by protected areas. Rock lobsters do benefit from protection in Betty's Bay reserve, but the west coast sanctuaries appear poorly located and seemingly contain large areas of unsuitable substrate. They clearly need relocation to be effective.

Appendix 1. Capture rates with traps: sampling method (gear), mean counts, standard error (s.e.), sample size (*n*), the percentage of the catch that was female (% female), the proportion of females larger than 60-mm carapace length (% repro f) and the proportion of the sample greater than 75-mm carapace length (% legal) for each sampling season and depth at each site using traps

Area	Site	Season	Depth	Gear	Mean count	s.e.	*n*	% female	% repro f	% legal
A	**St Helena Bay**	**Winter 1998**	**20–30m**	**S**	**0**	**–**	**42**	**–**	**–**	**–**
	Brittania Bay	**Winter 1998**	**20–30m**	**S**	**0**	**–**	**34**	**–**	**–**	**–**
B	**Jacob's Bay**	**Winter 1998**	**20–30m**	**S**	**12.70**	**2.01**	**40**	**41.5**	**23.7**	**1.4**
	Saldanha Bay	**Winter 1998**	**20–30m**	**S**	**13.70**	**2.65**	**27**	**50**	**32.3**	**9.2**
	Plankie's Bay	**Winter 1998**	**20–30m**	**S**	**6.30**	**1.14**	**30**	**50.3**	**35.2**	**2.2**
C	**Dassen Island**	**Winter 1998**	**60–70m**	**S**	**0**	**–**	**22**	**–**	**–**	**–**
	Table Bay	**Winter 1998**	**60–70m**	**S**	**1.11**	**0.43**	**42**	**0**	**0**	**100**
	Olifantsbos	Winter 1998	60–70m	S	0.78	0.48	42	14.8	75	11.1
	Dassen Island	Winter 1998	20–30m	S	88.20	13.00	46	18.7	81.6	16.8
	Robben Island	**Winter 1998**	**20–30m**	**S**	**31.60**	**3.74**	**71**	**43.2**	**42.6**	**0**
	Sea Point	**Winter 1998**	**20–30m**	**S**	**42.20**	**7.56**	**31**	**45.9**	**19.6**	**2.4**
	Camps Bay	**Winter 1998**	**20–30m**	**S**	**54.84**	**8.27**	**41**	**–**	**–**	**–**
	Llandudno	**Winter 1998**	**20–30m**	**S**	**9.80**	**1.68**	**34**	**43.1**	**85.7**	**19.2**
	Kommetjie	Winter 1998	20–30m	S	95.30	16.11	35	23.9	89.9	24.4
	Olifantsbos	Winter 1998	20–30m	S	94.9	13.7	48	20.27	88.8	25.7
	Dassen Island	Summer 1999	20–30m	L	32.73	5.92	38	33	97.3	60.4
	Robben Island	**Summer 1999**	**20–30m**	**L**	**3.74**	**2.19**	**38**	**35.6**	**58.8**	**0**
	Sea Point	**Summer 1999**	**20–30m**	**L**	**0.21**	**0.08**	**39**	**–**	**–**	**–**
	Llandudno	**Summer 1999**	**20–30m**	**L**	**1.15**	**0.45**	**39**	**39.1**	**61.1**	**28.3**
	Kommetjie	Summer 1999	20–30m	L	68.6	6.41	38	41.6	83.3	35.6
	Olifantsbos	Summer 1999	20–30m	L	78.9	5.28	40	43	76.9	27.4
	Dassen Island	Spring 1999	20–30m	L	65.15	10.7	32	56.7	92.1	4.9
	Robben Island	**Spring 1999**	**20–30m**	**L**	**1.28**	**0.63**	**36**	**44.4**	**80**	**11.1**
	Sea Point	**Spring 1999**	**20–30m**	**L**	**0.34**	**0.16**	**36**	**–**	**–**	**–**
	Llandudno	**Spring 1999**	**20–30m**	**L**	**2.25**	**1.11**	**20**	**51.1**	**100**	**64.4**
	Kommetjie	Spring 1999	20–30m	L	101.86	6.39	36	46.6	86.3	12.6
	Olifantsbos	Spring 1999	20–30m	L	78.43	6.13	32	33.5	85.5	37.3
D	Hangklip	Spring 1998	60–70m	S	70.6	5.84	10	53.8	72.4	7.2
	Mooihawens	Spring 1998	60–70m	S	45	6.43	10	51.1	76.1	4.8
	Betty's Bay	**Spring 1998**	**60–70m**	**S**	**24**	**9.29**	**10**	**55.1**	**62.3**	**0.5**
	Palmiet	Spring 1998	60–70m	S	1.3	0.36	10	–	–	–
	Betty's Bay	**Spring 1998**	**20–30m**	**S**	**147.95**	**11.12**	**40**	**87.6**	**95.1**	**7.6**
	Palmiet	Spring 1998	20–30m	S	140.60	10.63	40	73.5	67.5	6.6
	Hermanus	Spring 1998	20–30m	S	76.56	11.26	25	73.7	92.7	18.2

Gear S: small-mesh traps nested on long-lines, soak time = 12 h overnight; Gear L: commercial traps set individually, soak time = 0700–0900 hours). Bold lettering indicates sites in protected areas, plain lettering sites in adjacent fished areas.

Appendix 2. Capture rate with ringnets: mean counts per 15-min soak time, standard error (s.e.), sample size, the percentage of the catch that was female (% female), the proportion of females ≥ 60-mm carapace length (% repro f) and the proportion of the sample greater than 75-mm carapace length (% legal) for each sampling season and depth at each site

Area	Site	Season	Depth	Mean count	s.e.	*n*	% female	% repro f	% legal
A	**St Helena Bay**	**Summer 2000**	**< 10m**	**0**	**–**	**31**	–	–	–
	Brittania Bay	Summer 2000	< 10m	0	–	30	–	–	–
B	**Saldanha Bay**	**Summer 2000**	**< 10m**	**0.19**	**0.08**	**31**	**–**	**–**	**–**
	Jacob's Bay	Summer 2000	< 10m	0.13	0.06	30	–	–	–
C	Dassen Island	Summer 1999	< 10m	0.91	0.16	34	22.2	100	77.7
	Robben Island	**Summer 1999**	**< 10m**	**0.16**	**0.08**	**31**	**–**	**–**	**–**
	Sea Point	**Summer 1999**	**< 10m**	**0.69**	**0.23**	**33**	**–**	**–**	**–**
	Llandudno	**Summer 1999**	**< 10m**	**0.09**	**0.07**	**31**	**–**	**–**	**–**
	Kommetjie	Summer 1999	< 10m	1.26	0.26	34	50	85	22.5
	Dassen Island	Winter 1999	< 10m	3.6	0.61	30	38.7	100	74.8
	Robben Island	**Winter 1999**	**< 10m**	**0.02**	**0.02**	**35**	**–**	**–**	**–**
	Sea Point	**Winter 1999**	**< 10m**	**0.12**	**0.07**	**32**	**–**	**–**	**–**
	Llandudno	**Winter 1999**	**< 10m**	**0.03**	**0.03**	**29**	**–**	**–**	**–**
	Kommetjie	Winter 1999	< 10m	2.19	0.45	31	25.8	50	32.3
	Olifantsbos	Winter 1999	< 10m	4.77	0.87	31	49.3	57.6	14.9
	Dassen Island	Spring 1999	< 10m	3	0.8	33	51.6	100	79.6
	Robben Island	**Spring 1999**	**< 10m**	**0**	**–**	**35**	**–**	**–**	**–**
	Sea Point	**Spring 1999**	**< 10m**	**0.02**	**0.16**	**35**	**–**	**–**	**–**
	Llandudno	**Spring 1999**	**< 10m**	**1.09**	**0.31**	**31**	**–**	**–**	**–**
	Kommetjie	Spring 1999	< 10m	1.59	0.34	32	44.7	66.6	19.1
	Olifantsbos	Spring 1999	< 10m	3.51	0.51	31	52.3	81.1	21.8
	Dassen Island	Summer 2000	< 10m	5.1	0.88	32	49.3	100	44.7
	Robben Island	**Summer 2000**	**< 10m**	**0**	**–**	**32**	**–**	**–**	**–**
	Sea Point	**Summer 2000**	**< 10m**	**0**	**–**	**32**	**–**	**–**	**–**
	Llandudno	**Summer 2000**	**< 10m**	**0.3**	**0.12**	**30**	**–**	**–**	**–**
	Kommetjie	Summer 2000	< 10m	2.03	0.44	31	37.2	78.9	31.3
	Olifantsbos	Summer 2000	< 10m	3.43	0.51	32	52.6	56.1	12.6
D	Hangklip	Spring 1998	< 10m	3.8	0.57	41	31.4	93.33	30.3
	Mooihawens	Spring 1998	< 10m	7.03	1.1	32	48.5	98.79	43.7
	Betty's Bay	**Spring 1998**	**< 10m**	**8.73**	**1.22**	**30**	**32.9**	**93.38**	**53.2**
	Hangklip	Winter 1999	< 10m	4.09	0.71	31	26.7	100	24.1
	Mooihawens	Winter 1999	< 10m	5.12	0.56	31	19.8	96.6	52.9
	Betty's Bay	**Winter 1999**	**< 10m**	**6.15**	**0.72**	**33**	**18.7**	**100**	**58.3**
	Hermanus	Winter 1999	< 10m	1.32	0.34	31	14.3	–	48.6
	Hangklip	Summer 2000	< 10m	4.06	0.58	31	45.2	100	19.1
	Betty's Bay	**Summer 2000**	**< 10m**	**3.47**	**0.48**	**34**	**18.8**	**100**	**58.1**

Bold lettering indicates sites in protected areas, plain lettering sites in adjacent fished areas.

Appendix 3. Counts from diver transects: mean counts per 40 m^2, standard error (s.e.) and sample size (*n*) for each sampling season and depth at each site

Area	Site	Season	Depth	Mean count	s.e.	*n*
A	**St Helena Bay**	**Summer 2000**	**< 10m**	**0.13**	**0.07**	**32**
	Brittania Bay	Summer 2000	< 10m	0	–	32
B	**Saldanha Bay**	**Summer 2000**	**< 10m**	**14.6**	**4.71**	**32**
	Jacob's Bay	Summer 2000	< 10m	2.3	0.56	30
	Saldanha Bay	**Winter 1998**	**20–30m**	**26.30**	**7.90**	**26**
	Jacob's Bay	Winter 1998	20–30m	11.90	4.04	30
C	Dassen Island	Summer 1999	< 10m	48.9	11.6	30
	Robben Island	**Summer 1999**	**< 10m**	**3.09**	**0.84**	**32**
	Sea Point	**Summer 1999**	**< 10m**	**5.28**	**1.33**	**32**
	Llandudno	**Summer 1999**	**< 10m**	**3.41**	**0.66**	**29**
	Kommetjie	Summer 1999	< 10m	13	1.75	30
	Dassen Island	Winter 1999	< 10m	27.21	3.03	32
	Robben Island	**Winter 1999**	**< 10m**	**4.02**	**1.4**	**36**
	Sea Point	**Winter 1999**	**< 10m**	**7.18**	**1.31**	**32**
	Llandudno	**Winter 1999**	**< 10m**	**9.63**	**1.77**	**32**
	Kommetjie	Winter 1999	< 10m	12.21	1.65	30
	Olifantsbos	Winter 1999	< 10m	6.78	0.61	32
	Dassen Island	Spring 1999	< 10m	28.75	4.21	32
	Robben Island	**Spring 1999**	**< 10m**	**0.57**	**0.33**	**28**
	Sea Point	**Spring 1999**	**< 10m**	**1.68**	**0.39**	**32**
	Llandudno	**Spring 1999**	**< 10m**	**12.93**	**1.39**	**32**
	Kommetjie	Spring 1999	< 10m	3.84	0.69	32
	Olifantsbos	Spring 1999	< 10m	8.41	0.96	32
	Dassen Island	Summer 2000	< 10m	17.3	2.6	32
	Robben Island	**Summer 2000**	**< 10m**	**1**	**0.28**	**32**
	Sea Point	**Summer 2000**	**< 10m**	**2.88**	**1.4**	**32**
	Llandudno	**Summer 2000**	**< 10m**	**3.81**	**0.52**	**32**
	Kommetjie	Summer 2000	< 10m	7.56	1.21	32
	Olifantsbos	Summer 2000	< 10m	4.69	0.59	32
	Dassen Island	Winter 1998	20–30m	47.18	8.33	44
	Robben Island	**Winter 1998**	**20–30m**	**8.59**	**1.46**	**32**
	Sea Point	**Winter 1998**	**20–30m**	**6.80**	**2.18**	**26**
	Camps Bay	**Winter 1998**	**20–30m**	**20.71**	**3.89**	**32**
	Llandudno	**Winter 1998**	**20–30m**	**14.30**	**3.94**	**29**
	Kommetjie	Winter 1998	20–30m	15.20	1.52	44
	Olifantsbos	Winter 1998	20–30m	16.96	1.99	31
C	Dassen Island	Winter 1999	20–30m	22.06	3.41	32
	Robben Island	**Winter 1999**	**20–30m**	**1.81**	**0.56**	**32**
	Sea Point	**Winter 1999**	**20–30m**	**1.94**	**0.57**	**31**
	Llandudno	**Winter 1999**	**20–30m**	**10.59**	**2.42**	**32**
	Kommetjie	Winter 1999	20–30m	7.18	1.09	32
	Olifantsbos	Winter 1999	20–30m	10.03	0.93	30
	Dassen Island	Spring 1999	20–30m	24.78	3.94	32
	Robben Island	**Spring 1999**	**20–30m**	**5.3**	**1.52**	**30**
	Sea Point	**Spring 1999**	**20–30m**	**1**	**0.32**	**32**
	Llandudno	**Spring 1999**	**20–30m**	**7.31**	**2.01**	**32**
	Kommetjie	Spring 1999	20–30m	4.06	0.86	32

	Olifantsbos	Spring 1999	20–30m	6.78	0.69	32
	Dassen Island	Summer 2000	20–30m	73.8	10.6	31
	Robben Island	**Summer 2000**	**20–30m**	**3.03**	**0.64**	**32**
	Sea Point	**Summer 2000**	**20–30m**	**0.21**	**0.07**	**32**
	Llandudno	**Summer 2000**	**20–30m**	**3.75**	**1.04**	**32**
	Kommetjie	Summer 2000	20–30m	8.21	1.23	32
	Olifantsbos	Summer 2000	20–30m	5.41	0.8	32
D	Hangklip	Winter 1998	< 10m	8.14	1.29	27
	Betty's Bay	**Winter 1998**	**< 10m**	**5.77**	**0.76**	**31**
	Kleinmond	Winter 1998	< 10m	5.21	1.29	19
	Hangklip	Winter 1999	< 10m	14.59	1.91	32
	Mooihawens	Winter 1999	< 10m	18.28	2.41	32
	Betty's Bay	**Winter 1999**	**< 10m**	**30.46**	**4.67**	**32**
	Hermanus	Winter 1999	< 10m	11.84	1.16	32
	Hangklip	Summer 2000	< 10m	4.93	0.81	32
	Betty's Bay	**Summer 2000**	**< 10m**	**17.9**	**2.46**	**30**
	Hangklip	Winter 1999	20–30m	24.59	5.13	32
	Mooihawens	Winter 1999	20–30m	18.43	1.68	30
	Betty's Bay	**Winter 1999**	**20–30m**	**56.13**	**5.88**	**31**
	Hermanus	Winter 1999	20–30m	38.55	3.5	31
	Hangklip	Summer 2000	20–30m	15.1	1.31	30
	Betty's Bay	**Summer 2000**	**20–30m**	**22.8**	**2.24**	**30**

Bold lettering indicates sites in protected areas, plain lettering sites in adjacent fished areas.