Western Rock Lobster Ecology- The State of Knowledge

Addendum – January 2013

The purpose of this addendum is to provide updated information on western rock lobster catch rates, bycatch data, TEP species interactions, management changes and any other changes that have occurred since the original report was published in 2012. The section numbering in this addendum follows that of the Western Rock Lobster Ecology – The State of the Knowledge document which can be found at http://www.fish.wa.gov.au/Documents/research_reports/frr236.pdf

Section 1.0 Background to the Western Rock Lobster Managed Fishery

1.2 Management of the WCRLF

In 2010/11, management for the fishery continued to implement the process designed to secure its long-term sustainability following a significant decline in puerulus settlement over a period of several years. Measures undertaken in 2010/11 to initiate a transition to a full ITQ-based framework included maintaining the Total Allowable Commercial Catch (TACC) at 5500 t (roughly half the long-term average annual catch) and the introduction of a catch limit (or quota) on licences that varied in accordance with the number of units of entitlement on the licence and the zones to which the licence relates (de Lestang *et al.* 2012).

The change towards the TACC/ITQ framework required a great deal of adjustment and cooperation by both industry and the Department of Fisheries. The Department of Fisheries needed to design a new management and compliance strategy that was capable of accommodating the practicalities of quota monitoring in an industry where many fishes land their catch in remote locations (de Lestang *et al.* 2012). The new management arrangements have provided western rock lobster fishers with increased flexibility in their fishing operations, as well as the opportunity to maximise the prices they receive for their product by fishing during periods where the market price of lobsters is high (de Lestang *et al.* 2012).

For the 2011/13 season, a TACC of 6938 t was set for an extended licensing period of 14 months (i.e. 15 November 2012 to 14 January 2013). In the future, the season will open on 15 January and remain open all year. Several previous input controls have been removed (i.e. weekend closures 20fm line)and an Interactive Voice Response System for compliance and catch monitoring was introduced in 2011. During 2012, Department of Fisheries WA undertook a process to develop a new management plan to bring the fishery under formal quota management. The new plan will come into effect on 15 January 2013 and is available at:
http://www.slp.wa.gov.au/gazette/gazette.nsf/gazlist/798980909FF0A04648257A990042B081/$file/gg187.pdf

Section 2.0 Retained species

2.1 Lobster

Due to the new management changes (TACC) introduced in response to the very poor puerulus settlement in 2008/09 and subsequent years, the catch landed by the WCRLF for the 2010/11 season (5501 t) was less than in 2009/10 (5899 t; Figure 2.1). In 2010, the catches in A, B and C Zones were 950 t, 1875 t, and 2676 t, respectively, with A Zone 13. % lower, B Zone 10.5 % lower and C Zone 0.9 % lower than the previous season.

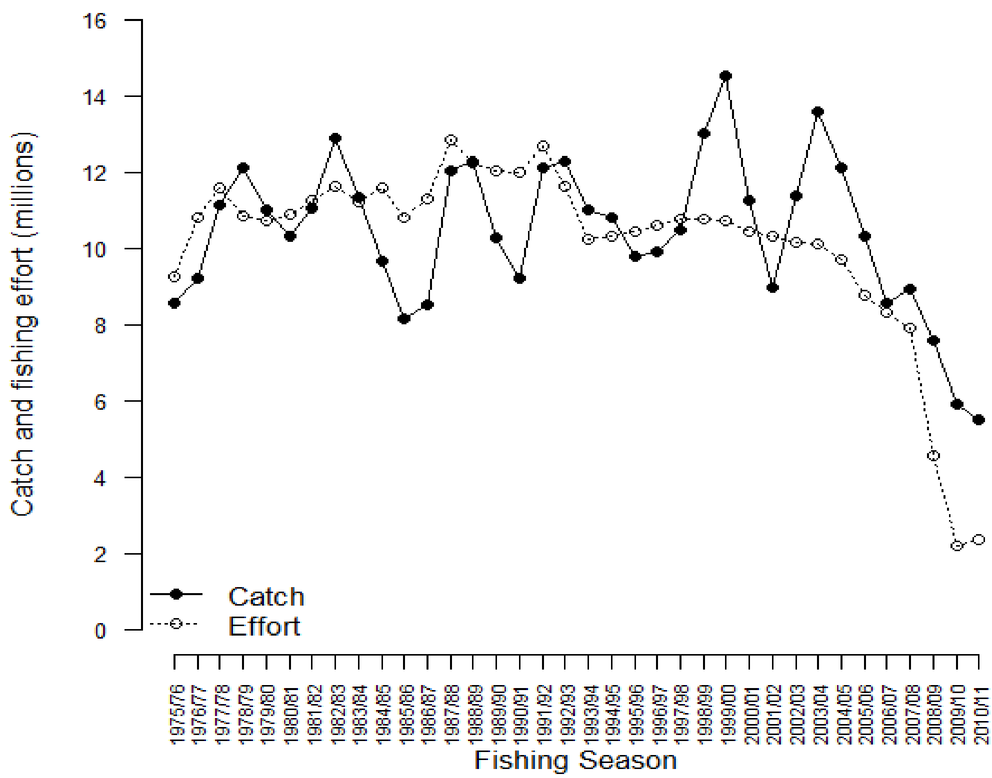


Figure 2.1 Annual catch (millions of kg) and nominal fishing effort (millions of potlifts) from fishers' compulsory monthly returns for the West Coast Rock Lobster Managed Fishery from 1975/76-2010/11 (Source: de Lestang *et al.* 2012).

2.2 Octopus

A catch rate of 0.02 octopus per pot lift was recorded in 2010/2011 from Catch and Disposal Records data. This was within the historical range (1985/86-2009/10) of 0.02-0.045 octopus per pot lift based on logbook data.

This catch rate translates to an estimated 45 263 octopus caught in all regions of the fishery during 2010/11. Estimated octopus catches for A, B and C Zones were 716, 29 095, and 15 460, respectively. The catch rate of octopus (incidental landings) is an indicator for the fishery, and at 0.02 octopus per pot lift, 2010/11 catch levels achieved the performance measure of being within 10 % of the historical range (0.02-0.043 octopus per pot lift; de Lestang *et al.* 2012).

The Department of Fisheries is currently two years into the three year study *Innovative development of the* Octopus *cf* tetricus *fishery in Western Australia.* The impetus for this study was a 260 % increase in catch rates in the octopus fishery in 2010, which lead to the developmental octopus fishery becoming the main source of octopus landings in the state. Prior to 2010, the majority of octopus landings in WA came as byproduct from the WCRLF (Figure 2.2).

Octopus landings in the WCRLF have been gradually declining from a peak of 140 t in 2002 to 35 t in 2011. During this period, CPUE of octopus in the WCRLF has not mirrored the decline in catches. It is believed the reduction of effort in the WCRLF has been the primary reason for decreased octopus landings in the fishery. To address this issue, a major objective of the aforementioned research project is to calculate the effects of fishing closures on octopus predation rates in the WCRLF. Initial analyses have revealed that octopus landings in the WCRLF are generally three times less than the reported evidence of octopus predation on lobsters. In other words, if the lobster traps were designed to catch octopus, then on average they would catch three times more octopus per annum (Figure 2.3).

The developmental octopus fishery is currently going through a period of exploration and expansion and is moving towards becoming a managed fishery. Expected octopus landings for the developmental octopus fishery in 2012 are approximately 150 t, with approximately 35 t anticipated to be landed in the WCRLF.

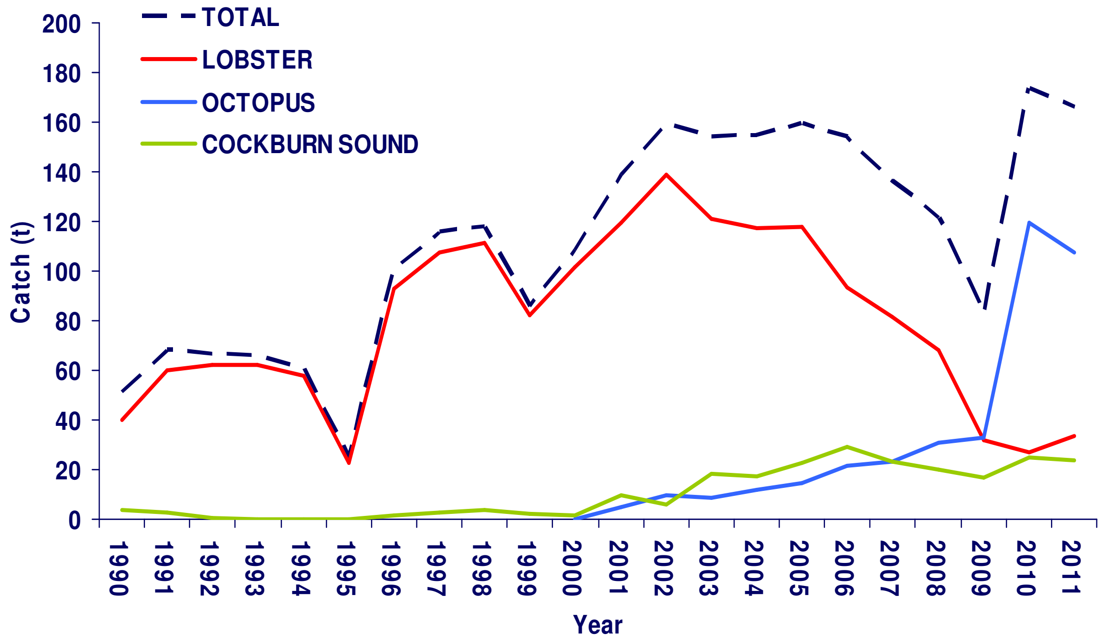


Figure 2.2. Octopus catch by fishery from 1990 to 2011.

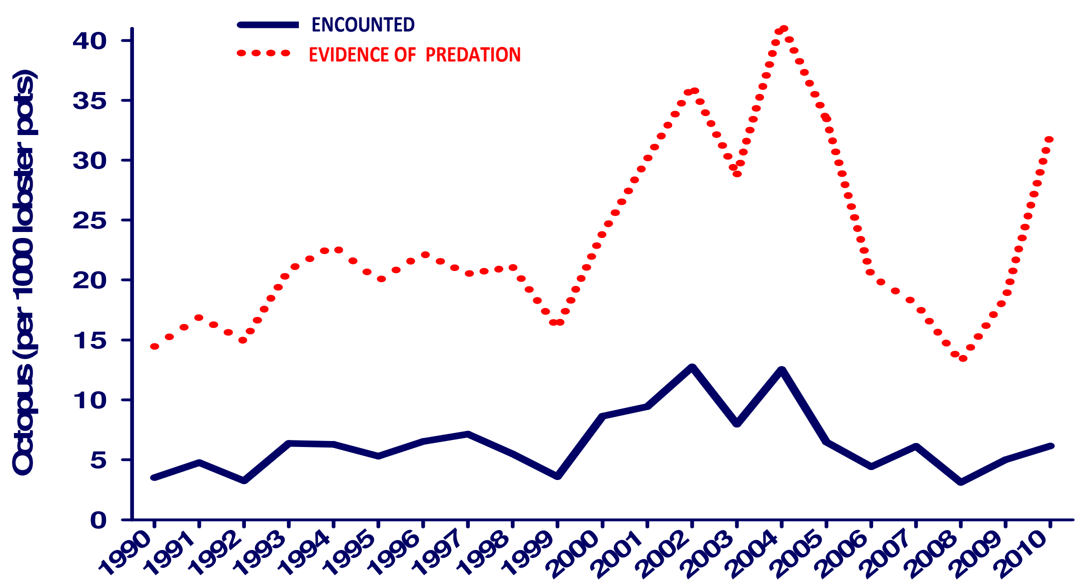


Figure 2.3. Reported evidence of lobster predation and actual octopus catch rates 1990-2010.

Section 3.0 Bycatch

3.1 Bycatch

The bycatch of finfish and other species landed during normal rock lobster fishing operations are now required to be recorded and provided to the Department of Fisheries as part of the fisher's statutory catch declaration. These data show that approximately 3.5 t of bycatch were landed during the 2010/11 fishing season (Table 3.1; de Lestang *et al.* 2012).

Table 3.1. Landings (kg) of bycatch in lobster pots recorded in compulsory Catch and Effort (CAES) monthly returns during 2010/11.

Bycatch species	Catch (kg)
Baldchin groper	1140.8
Pink snapper	636.3
Other fish varieties	375.0
Blue groper	267.4
Cuttlefish	225.3
Southern rock lobster	220.3
West Australian Dhufish	201.2
Breaksea cod	126.4
Bugs	121.8
Champagne crab	99.0
Leather jacket	56.0
Cod	33.5
Sweetlip emperor	29.5
Chinaman cod	28.7
Wobbegong shark	16.0
Spangled emperor	6.5
Parrot fish	6.0
Coral trout	4.0
Queen snapper	2.0
Trevally, (Skippy)	0.7
Total	**3596.4**

3.2 Bait

Western rock lobster fishing is conducted using baited pots. Most of the bait species used by the WCRLF come from managed fisheries, although the management status for a few species is unclear (Table 3.2). The most common bait for the 2010/2011 fishing season was Orange Roughy from New Zealand (610.02 t), which is a managed fishery. The amount of bait used has decreased in recent years, and in 2010/11 was 2737.9 t (Table 3.3).

Table 3.3. Effort, total catch and total amount of bait used by the Western Rock Lobster Fishery between the 2007/08 and 2010/11 fishing seasons including preliminary figures for 2011/13. The conversion rate indicates the amount of bait used (kg) to catch one kg of lobsters. Note: The 2011/13 season is an extended season of approximately 12 months fishing over 14 a month period.

Season	Pot lifts (million)	Catch (t)	Bait (t)	Conversion
2007/08	7.8	8926	10127	1.13
2008/09	4.8	7595	10904	1.44
2009/10	2.2	5899	4576	0.78
2010/11	2.3	5504	2737	0.50
2011/13	4.2	7473	3807*	0.51

*Bait information for 2011/13 season is not final (as of 27/03/2013).

Table 3.2a. Identity, origin and amount of bait supplied to the Western Rock Lobster Managed Fishery during the 2010/2011 fishing season.

Bait	Species	Tonnes	Usage	Origin	Managed	Source
Imported						
Hoki	*Macruronus novaezelandiae*	468.90	Heads	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=7&tk=153&sc=HOK
Alfonsino	*Beryx* spp	145.38	Heads/whole	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=7&tk=153&sc=BYX
Blue Mackerel	*Scomber australasicus*	0.16	Heads	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=7&tk=100&sc=EMA
Blue Mackerel	*Scomber australasicus*	574.48	Whole	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=7&tk=100&sc=EMA
Blue Mackerel	*Scomber australasicus*	0.71	Whole	Taiwan	unclear	http://www.worldfishing.net/features101/new-horizons/taiwan
Cardinal	*Epigonus telescopus*	11.40	Heads	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=7&tk=153&sc=CDL
Kahawai	*Arripis* spp	117.14	Whole	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=7&tk=153&sc=KAH
Kahawai	*Arripis* spp	1.10	Heads	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=7&tk=153&sc=KAH
Orange Roughy	*Hoplostethus atlanticus*	610.02	Heads	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=5&tk=1&fpid=15
Tuna	*Thunnus* spp.	84.52	Heads	Thailand	unclear	http://www.fao.org/fishery/countrysector/FI-CP_TH/en
Sanmar	*Cololabis saira ?*	7.23	Whole	Taiwan	unclear	http://www.worldfishing.net/features101/new-horizons/taiwan
NS Herring	*Clupea harengus*	47.04	Whole	Scotland	Yes	http://www.scotland.gov.uk/Topics/marine/marine-environment/species/fish/TAC/herring
NS Herring	*Clupea harengus*	26.87	Whole	Europe	Yes	http://ec.europa.eu/fisheries/marine_species/wild_species/herring/index_en.htm
Jack Mackerel	*Trachurus* spp	41.46	Heads/Whole	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=5&tk=1&fpid=50
Menhaden	*Brevoortia tyrannus*	31.66	Whole	USA	Yes	http://www.asmfc.org/
Blue warehou	*Seriolella brama*	1.06	Heads	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=8&tk=31&stock=WAR1
Barracouta	*Thyrsites atun*	5.14	Heads	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=7&tk=100&sc=BAR
Total imported		**2174.27**				
Australian						
Blue Mackerel	*Scomber australasicus*	99.76	Whole	SA/Aus	Yes	http://www.afma.gov.au/managing-our-fisheries/fisheries-a-to-z-index/small-pelagic-fishery/
Orange Roughy	*Hoplostethus atlanticus*	5.60	Heads	Tas	Yes	http://www.afma.gov.au/managing-our-fisheries/fisheries-a-to-z-index/southern-and-eastern-scalefish-and-shark-fishery/
Pork fat		114.05		WA	N/A	
Sardines	*Sardinops sagax*	6.01	Whole	WA	Yes	http://www.fish.wa.gov.au/docs/sof/2009/index.php?0706
A. Salmon	*Arripis truttaceus*	84.35	Heads	WA	Yes	http://www.fish.wa.gov.au/docs/sof/2009/index.php?0706
A. Salmon	*Arripis truttaceus*	227.28	Cutlets	WA	Yes	http://www.fish.wa.gov.au/docs/sof/2009/index.php?0706
A. Salmon	*Arripis truttaceus*	2.8	Whole	WA	Yes	http://www.fish.wa.gov.au/docs/sof/2009/index.php?0706
A. Salmon	*Arripis truttaceus*	3.88	Whole	Tas	Yes	http://www.dpiw.tas.gov.au/inter.nsf/WebPages/FSEN-8CC2V5?open
Kangaroo		6.68		WA	N/A	
A Herring	*Arripis georgianus*	14.92	Whole	WA	Yes	http://www.fish.wa.gov.au/docs/sof/2009/index.php?0706
Total local		**565.33**		WA		

Table 3.2b Preliminary identity, origin and amount of bait supplied to the Western Rock Lobster Managed Fishery during the 2011/2013 fishing season. Note: This table is not final, still waiting on figures from two processors (as of 27/03/2013).

Bait	Species	Tonnes	Usage	Origin	Managed	Source
Imported						
Hoki	*Macruronus novaezelandiae*	677.36	Heads	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=7&tk=153&sc=HOK
Alfonsino	*Beryx* spp	53.04	Heads/whole	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=7&tk=153&sc=BYX
Kahawai	*Arripis* spp	113.04	Whole	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=7&tk=153&sc=KAH
Orange Roughy	*Hoplostethus atlanticus*	455.30	Heads	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=5&tk=1&fpid=15
Blue Mackerel	*Scomber australasicus*	187.00	Heads	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=7&tk=100&sc=EMA
Jack Mackerel	*Trachurus* spp	136.84	Heads	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=5&tk=1&fpid=50
Jack Mackerel	*Trachurus* spp	15.66	Whole	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=5&tk=1&fpid=50
Sardines	*Sardina pilchardus?*	90.00	Whole	Morocco	unclear	
Blue Mackerel	*Scomber australasicus*	1468.72	Whole	New Zealand	Yes	http://fs.fish.govt.nz/Page.aspx?pk=7&tk=100&sc=EMA
NS Herring	*Clupea harengus*	18.12	Whole	USA	Yes	http://www.asmfc.org/
Menhaden	*Brevoortia tyrannus*	30.04	Whole	USA	Yes	http://www.asmfc.org/
Blue Mackerel	*Scomber* sp *(australasicus?)*	0.71	Whole	Korea	unclear	
Bonito	*Sarda orientalis*	74.00	Whole	Korea	unclear	
Total imported		**3319.83**				
Australian						
Blue Mackerel	*Scomber australasicus*	69.78	Whole	SA	Yes	http://www.afma.gov.au/managing-our-fisheries/fisheries-a-to-z-index/small-pelagic-fishery/
Pork fat		243.60		Aust	N/A	
Sardines	*Sardinops sagax*	16.00	Whole	WA	Yes	http://www.fish.wa.gov.au/docs/sof/2009/index.php?0706
A. Salmon	*Arripis truttaceus*	47.90	Heads	WA	Yes	http://www.fish.wa.gov.au/docs/sof/2009/index.php?0706
A. Salmon	*Arripis truttaceus*	62.61	Cutlets	WA	Yes	http://www.fish.wa.gov.au/docs/sof/2009/index.php?0706
Kangaroo		7.46		WA	N/A	
A Herring	*Arripis georgianus*	39.42	Whole	WA	Yes	http://www.fish.wa.gov.au/docs/sof/2009/index.php?0706
Total local		**486.77**		WA		

Section 4.0 Endangered/Threatened/Protected species

4.1 Bait band legislation

A state-wide ban on plastic bait bands on board all fishing boats operating in WA waters was implemented on 15 November 2011. This ban should reduce the risk of dusky whaler sharks becoming entangled in discarded plastic bands due to the rock lobster fishery (or any other commercial fishery in WA) to negligible.

4.2.1/4.2.2 SLEDs at the Abrolhos

The introduction of sea lion exclusion devices (SLEDs) in November 2006 for both commercial and recreational rock lobster pots in waters less than 20 m around the mid-west coast sea lion breeding colonies (north of Freshwater Point and south of Wedge Island) has reduced the ecological risk to sea lions (in particular sea lion pups) drowning in pots in this area to low. In addition, two new SLED zones within the Abrolhos Islands area (Pelsaert and Easter Group Islands) were implemented on 15 March 2011 to protect the sea lion pups in these breeding areas. Video trials have indicated that this device does stop sea lion pups form entering lobster pots and drowning (de Lestang *et al.* 2012). More information on the SLED management package is available at:
http://www.fish.wa.gov.au/Sustainability-and-Environment/Aquatic-Biodiversity/Pages/Protected-Species.aspx

The performance measure for the fishery is that no increase in the rate of capture of sea lions occurs. During the 2010/11 western rock lobster season, no sea lion captures were reported, whereas the historical level is just over three sea lions per season. The fishery has therefore met this performance measure (de Lestang *et al.* 2012).

4.3 Turtles

Turtle deaths as a direct result of interactions with the WCRLF are very rare. Of the six turtle species that occur in the waters of the WCRLF, very few are reported to interact with western rock lobster fishing gear each year. The small number of interactions was concluded to be above a negligible risk, although still rated as a low risk. Given the significant reductions in effort and hence pot ropes in the water since this assessment was completed, the current risk is probably even lower.

The performance measure for the fishery is that there is no increase in interactions with turtles. In 2010/11, no interactions with turtles were reported (de Lestang *et al.* 2012).

4.4 Cetaceans

The significant reduction in rock lobster fishing effort (pots in the water) that took place between 2008/09 and 2010/11 in response to a number of low puerulus settlement years, combined with the fishery's move towards quota management in 2009/10 and 2010/11, reduced the number of whale entanglements recorded in 2009 and 2010; however, there has been a significant increase in whale entanglements with all fishing gears on the WA coast in the past two years. The DEC's Cetacean Database reports four entanglements in 2010, nine in 2011 and 25 in 2012. Rock lobster fishing gear was identified responsible for eight of the entanglements in 2011 and 13 in 2012 (Figure 4.1).

The whale populations migrating along the west Australian coast have increased significantly since the moratorium on whaling in Australian waters in 1978 and internationally in 1986; however, the changes in fishing behaviour associated with extensions to the season in recent years appear to have had a significant impact on the number of entanglements.

Humpback whales are involved in the majority (> 90 %) of entanglements in WA due to their coastal migration pattern and overall morphology (Groom and Coughran *in press*). Interactions have been reported at locations throughout the fishery, and while interactions can occur in all depths, there are significantly more entanglements in deeper water (> 20 fathoms) on per pot in the water basis. Interactions with the WCRLF gear begin mainly in June and extend for the remainder of the year, with increasing interactions with increasing season length. With the extension of the fishing season in 2013/14 to year round, there is potential for an increase in entanglements during the later months of the year (October through November), when fishing has not previously occurred.

Most interactions occur with the float gear and ropes of the set pots, and without changes to fishing behaviour or gear, the number of interactions are likely to increase in following seasons. The western rock lobster fishing industry has developed a code of practice to minimise the interaction with whales in conjunction with DEC and SeaNet. The environmental management strategy adopted for the WCRLF requires monitoring of and attempts to minimise accidental interactions with these species wherever possible. The Department of Fisheries is currently consulting with the fishing industry to develop further mitigation measures to deal with this issue[1].

[1] A Department of Fisheries report on the issue is available at: http://www.environment.gov.au/coasts/fisheries/wa/rocklob/pubs/rock-lob-assessment-2012-appendix2.pdf

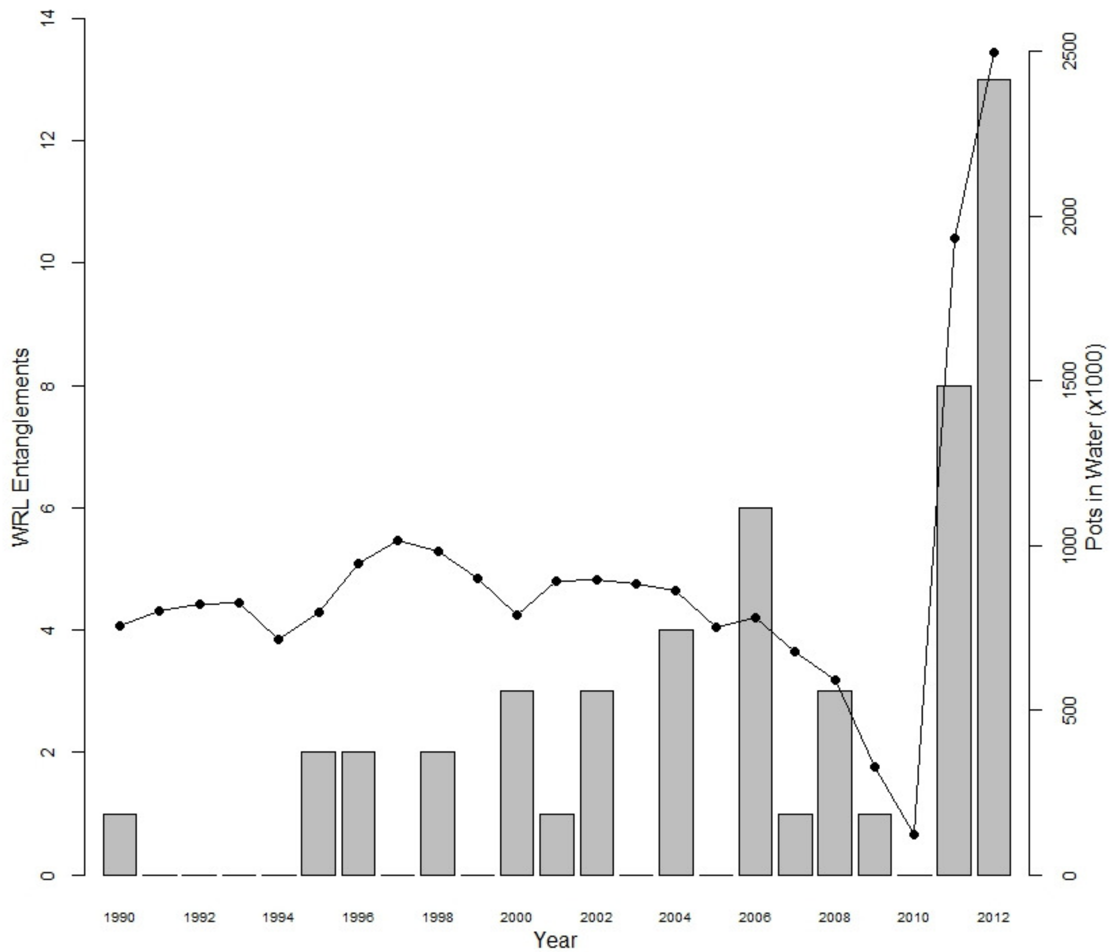


Figure 4.1. Entanglements in confirmed WCRLF gear (bars) and the number of pots being fished multiplied by the number of days in the water (points and line) during the winter months (May-October inclusive).

Section 5.0 Understanding habitat structure

5.3.1 The Abrolhos Islands shallow water habitats

A recent project by Department of Fisheries WA used remote sensing technologies to assess the ability to categorise and potentially monitor a large spatial area of shallow (< 20 m depth) marine benthic habitats at the Wallabi group of the Abrolhos Islands. Two satellite sensors (ALOS AVNIR-2 and Landsat 5 TM) were used to provide unsupervised classifications of the habitats, followed by extensive ground truthing in March and April 2010. Two habitat maps were produced, one with 21 habitat classes (Figure 5.1) and one with eight habitat classes (Figure 5.2). The eight class habitat map shows that the east-southeast or leeward side of the Wallabi group is dominated by coral habitat, while the northern and western sides are dominated by algae, seagrass and abiotic habitats (Figure 5.2). For full report see Evans et al. 2012 at http://www.fish.wa.gov.au/Documents/research_reports/frr237.pdf

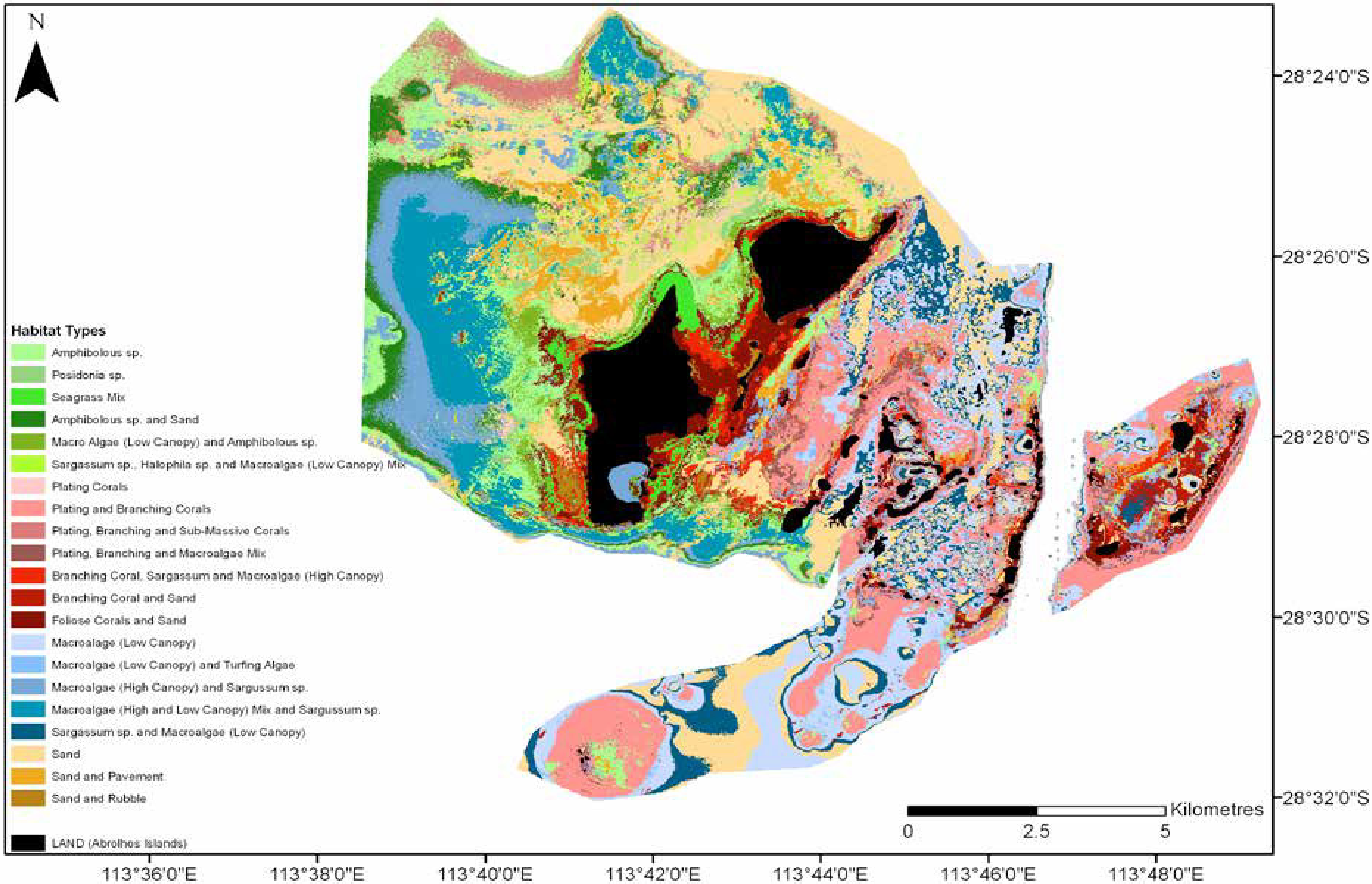


Figure 5.1. Twenty-one habitat class benthic habitat map for the Wallabi group of the Houtman Abrolhos Islands (Source: Evans *et al.* 2012)

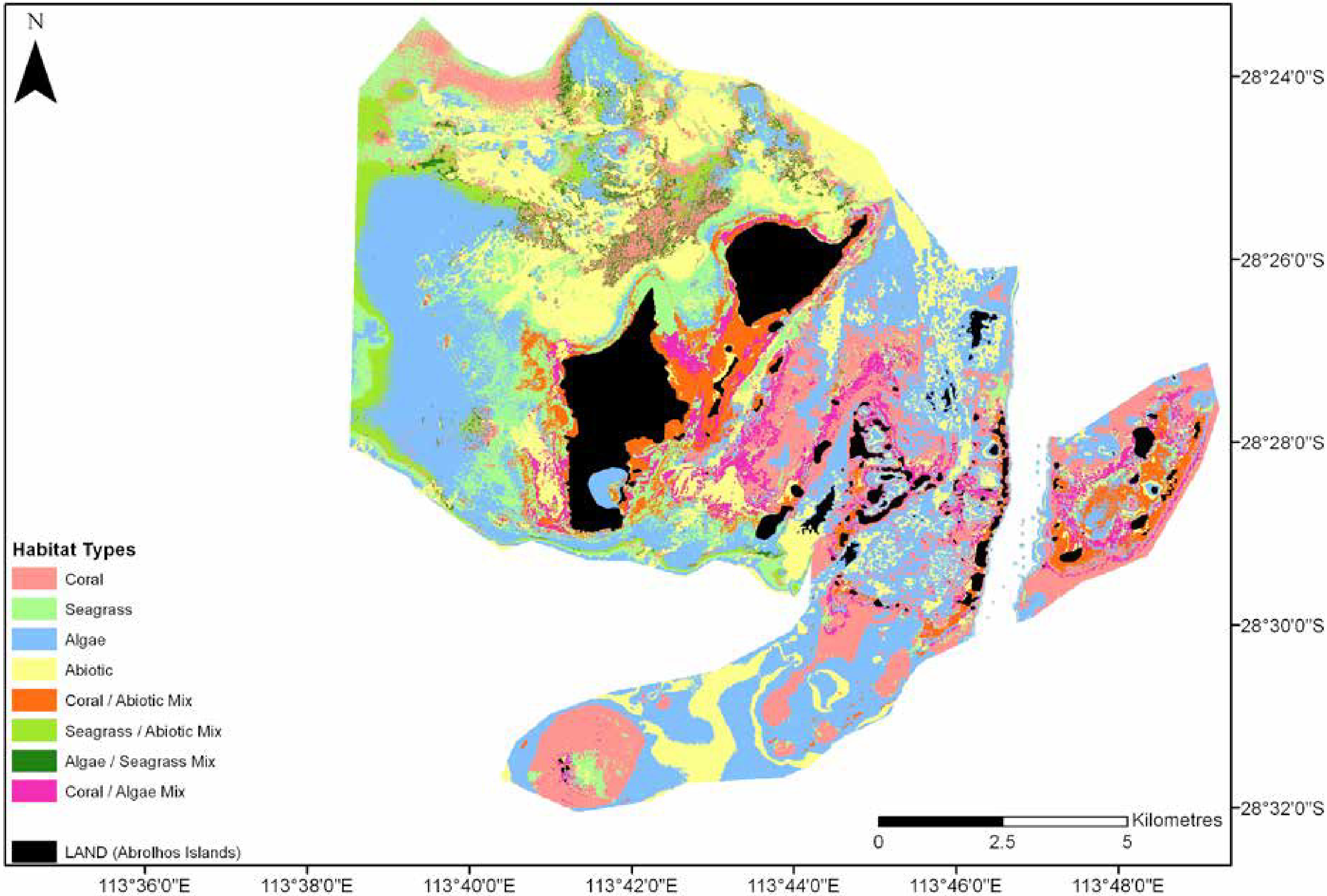


Figure 5.2. Eight habitat class benthic habitat map for the Wallabi group of the Houtman Abrolhos Islands (Source: Evans *et al.* 2012)

Section 7.0 Current and on-going research

7.1 Houtman Abrolhos Islands

7.1.1.1 Habitat Mapping

See Section 5.31 above

7.1.1.2 Determining potting effort on sensitive habitats

To determine the density of potting around the Houtman Abrolhos Islands (HAI) aerial surveys were conducted at the start of the commercial fishing season for western rock lobster in the 2006 (June) and 2011(April). The aerial surveys were conducted using a high winged Cessna 210, a flying at a height of approximately 152 m and speed of 60 knots along predetermined GPS gridlines spaced 1 minute of latitude (~1800m) apart. At each minute along the survey line, observers recorded the number of pot floats in the area. Potting density was recorded from both sides of the aircraft to a set distance of approximately 500m (1000m total distance viewed). The potting density data obtained from both surveys was analysed using ArcGIS software. Despite management changes between 2006 and 2011, potting effort (total number of pots) was similar between the two surveys (Table 7.1). However, the distribution of effort amongst the island groups has shifted with less effort in the southern Group during the 2011 surveys.

Table 7.1. Total number of pots counted during aerial surveys in 2006 and 2011

Island group	*Total Number of pots*	
	2006	2011
Southern group	614	366
Easter Group	552	618
North Island-Wallabi Group	881	924
Total	2047	1908

In 2006 potting effort was relatively evenly distributed within each island group, particularly in Easter and Wallabi Groups. However, in 2011 potting effort was focused on the outer reef edges of the island groups, particularly in Easter and Southern Groups (Figure 7.1). To assess if the shift in potting effort between 2006 and 2011 had the potential to impact different habitats, potting data was overlayed on digitised maps of geomphological units and their corresponding sensitivity (see Hatcher et al. 1998) (Figure 7.2a,b).

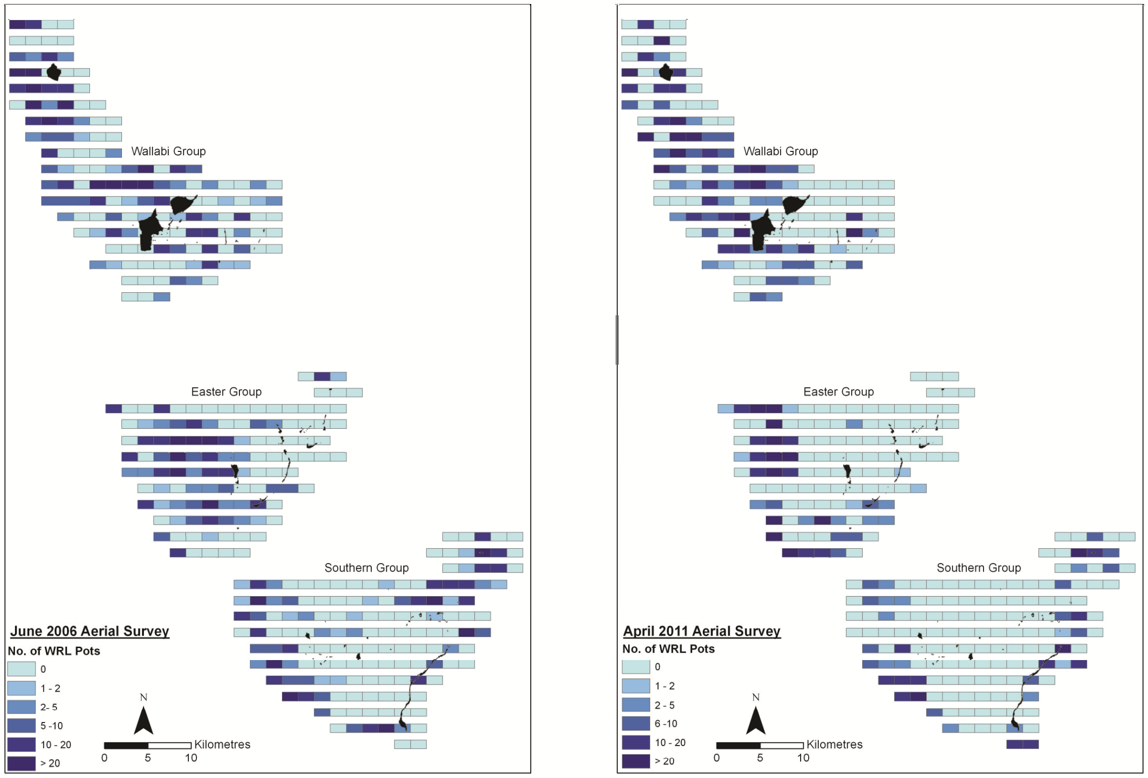


Figure 7.1: Distribution of potting effort in the western rock lobster fishery in; a) 2006 and b) 2011.

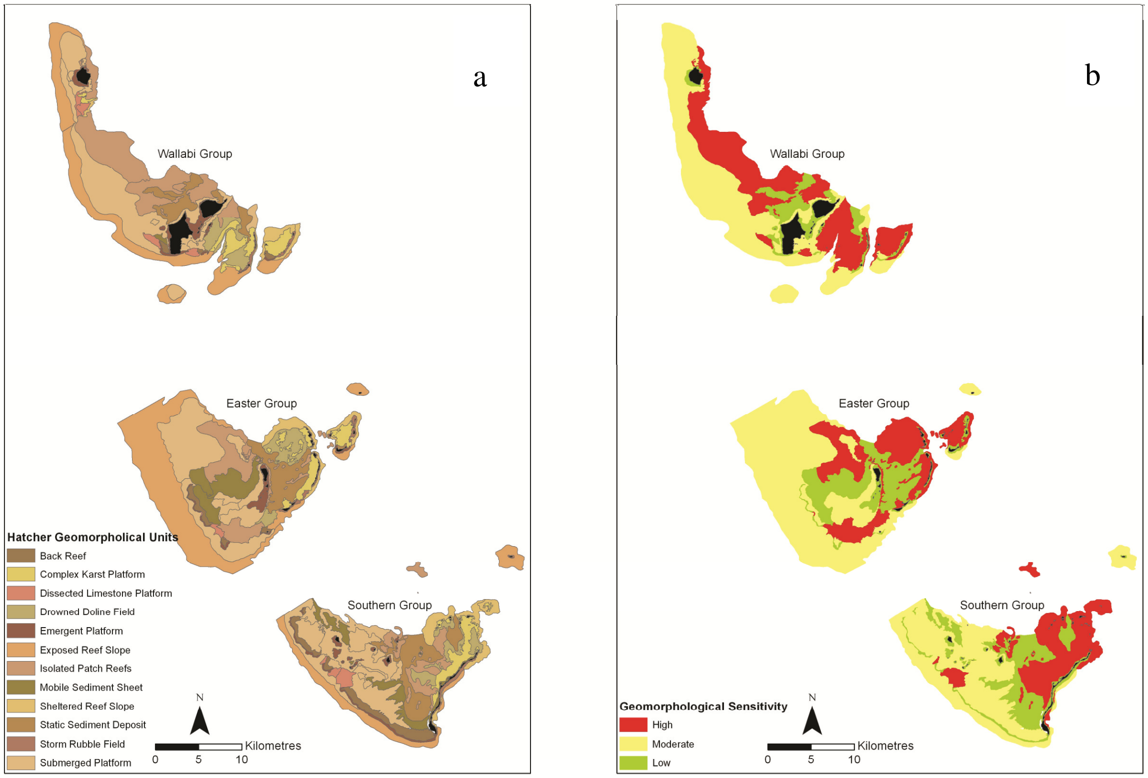
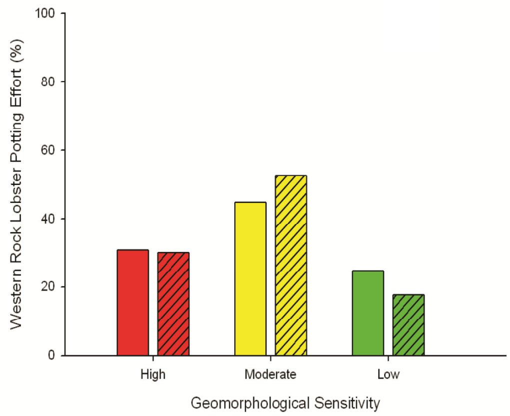


Figure 7.2: Geomorpological units and their sensitivity at the HAI a) geomorphological types and b) associated sensitivity from Hatcher et al. (1988)

In both years, areas of moderately sensitive habitats (i.e. back reefs) were subjected to the highest potting pressure (~50%) (Figure 7.3a), this may be because they are the preferred habitat of lobster and therefore are preferentially targeted by fishers. In contrasts, areas of low sensitivity habitats (i.e. mobile sediment sheets) receive the lowest potting effort (~20%), most likely due to lack of suitable lobster habitat. Between 2006 and 2011 the level of potting effort in highly sensitive habitats appears to have remained stable (~30%). In contrast, effort decreased in low sensitivity habitats while there was a corresponding increase in moderately sensitive habitats. The distribution of potting effort on habitats of different sensitivity did not change consistently between years and islands groups (Figure 7.3b). Effort was lower on areas of high and low sensitivity in Easter group in 2011 compared to 2006 but higher on areas of moderate sensitivity. While in Southern Group in 2011 effort was lower on areas of low sensitivity and higher on areas of high sensitivity.



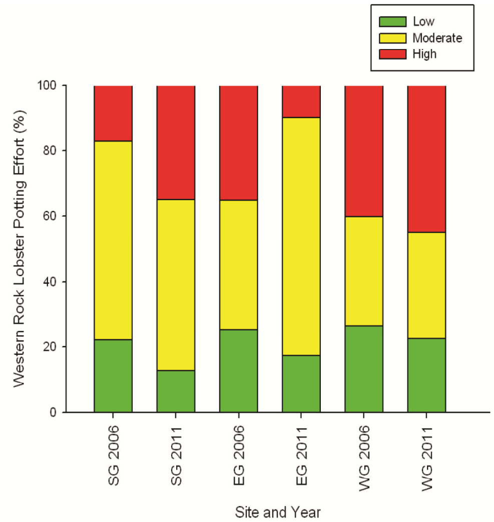


Figure 7.3: Percentage of pots on corresponding geomorphological sensitivity categories; a) for all island groups b) by island group. Note SG-Southern Group, EG-Easter Group, WG-Wallabi Group

Table 7.2: Percentage (%) of potting effort by geomorphological unit and island group.

Geomorphological Units	Sensitivity	EG 2006	EG 2011	SG 2006	SG 2011	WG 2006	WG 2011	Mean 2006	Mean 2011
Back Reef	Moderate	3	4	24	5	8	7	12	5
Complex Karst Platform	High	4	1	3	4	8	3	5	3
Dissected Limestone Platform	High	6	2	5	13	14	11	8	8
Drowned Doline Field	High	3	1	1	6	13	2	5	3
Emergent Platform	Low	4	1	8	3	2	3	5	2
Exposed Reef Slope	Moderate	10	24	21	24	12	6	14	18
Isolated Patch Reef	High	22	8	0	0	13	14	12	7
Mobile Sediment Sheet	Low	13	14	6	2	3	29	7	15
Sheltered Reef Slope	High	5	1	6	11	5	10	5	7
Static Sediment Deposit	Low	5	1	0	0	11	5	5	2
Storm Rubble Field	Low	10	6	21	28	4	1	12	12
Submerged Platform	Moderate	17	38	4	4	8	9	10	17

The data suggests that all habitats described by Hatcher et al. (1988) receive some level of potting effort (Table 7.2). On average higher efforts appears to be focused on back reefs, isolated patch reefs, exposed reef slopes, storm rubble fields and submerged platforms, with less effort focussed on complex karst platform and drowned doline fields, which are primarily moderate and highly sensitive habitats.

The aerial surveys have provided preliminary information on changes in the distribution of potting effort at the HAI. However, the data must be viewed with a number of caveats in mind. Firstly, the surveys were conducted in different months (June 2006, April 2011) and have not been repeated within the same fishing season. Therefore, the observed differences may be artefacts of localised weather conditions on the day surveyed rather shifts in effort and do not necessarily reflect the effort distribution for the entire season. In addition, there have been significant changes in the fishery between the survey periods. The introduction of a Total Allowable Commercial Catch (TACC) and temporal individual catch limits introduced in the 2010/11 season have undoubtedly altered the spatial and temporal distribution of effort at the HAI.

On-going analysis of potting data and fine scale habitat mapping (see Evans et al. 2012) will assist with clarifying the distribution of potting effort in relation to sensitive habitats at the Houtman Abrolhos Islands.

7.2 Deepwater Research

7.2.2.1 FRDC 2011/021 Development of an industry-based habitat mapping/monitoring system

This project is due to be completed by the end of 2013 below is a summary of the project thus far, a final report will be available in 2014. The objectives of the project were to:

1. Develop of a cost-effective system for obtaining geo-referenced environmental information
2. Conduct a trial implementation of system by industry to test concept
3. Undertake a cost-benefit analysis with conventional ground-truthing techniques

As of January 2013 three versions of POTBot have been trialled. Initial versions (I and II) ran on 5 volts and used a lower quality non-wide angle camera. These units proved problematic due mainly to the use of 5 volts. The cameras were especially unstable at this voltage due mainly to the large variation in voltage that can be obtained through rechargeable AA NiCad batteries (1.1 – 1.5 v). In January a complete re-build utilising 3 – 4 volt components designed to run of a 3.7 volt Lithium Polymer power source has initially proved very successful. These most recent systems are far more robust and consistent in their behaviour.

To date *ca*.300 individual deployments have been conducted throughout the WRL fishery in water depths from the coast out to 120 m (Figure 7.4). Of these deployments *ca.*150 (50%) have been 100% successful, recording geo-located habitat footage and water temperature data. Approximately 75 (25%) have recorded video without GPS and *ca*. 75 (25%) have recorded GPS without video. The majority of problems with the units have been malfunctioning video units, presumable due to power issues. There have been 15 defects with the water proof housings, 5 in depths of ~50 m and 10 in depths closer to 70 m. These have all occurred in the water proof torch housings, both through inappropriate seals and cracking of the lens. It is likely that the power modifications and newly developed housings with significantly improve the proportions of successful deployments.

Data from the successful trial versions of POTBot cameras highlight the usefulness to this system for the collection of accurate habitat data throughout the WRL fishery at minimal cost. They have also proven to provide spatial information on fish faunal composition, water temperature and depth. These data are extremely valuable for long-term monitoring of the ecosystem and identifying any climate induced changes over time.

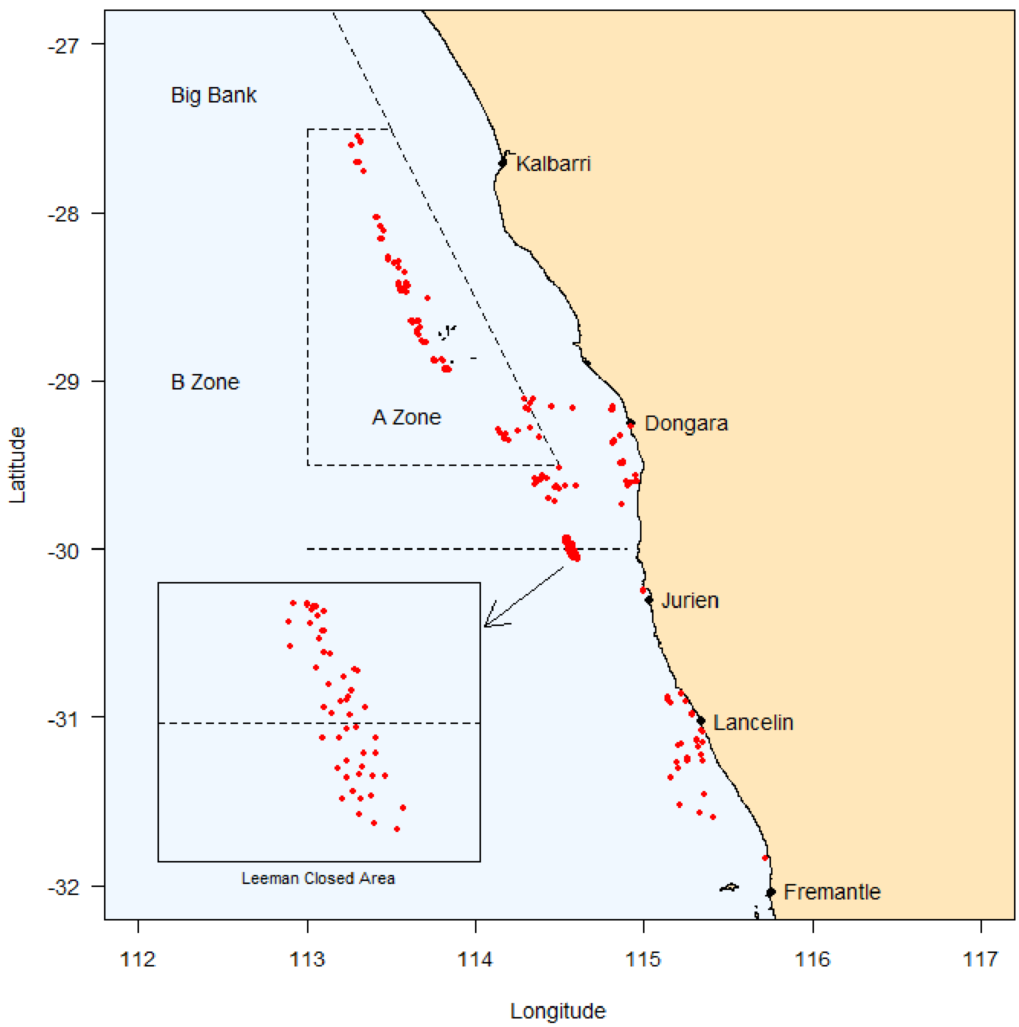


Figure 7.4. Distribution of POTBot deployments off the coast of Western Australia

Table 7.3. Summary of current and planned research on effects of fishing for western rock lobster on the ecosystem. Letters in column marked *Conceptual Model* correspond to bold type letters on the conceptual model (See Figure 1 of the Appendix).

Project Title	Lead Agency/ Publications	Funding Source	Study Location	Objectives / Project Description	Status	Conceptual Model
Assessing the ecological impact of the Western Rock Lobster fishery in fished and unfished areas (FRDC 2008/013)	DoF	FRDC	Jurien (30° line)	1. Identification and assessment of suitable unfished reference areas to exclude rock lobster fishing in deep-water 2. Development of a qualitative trophodynamic model that will provide a conceptual framework for determining sampling protocols, indictors and targets. 3. To provide cost effective methods to measure deep-water ecosystems in both fished and unfished reference areas	Draft report completed	A, B, C, E, F
Trophic interactions and ecological modelling for EBFM	DoF and ECU	WAMSI 4.3	Jurien (deep-water) and Metro region (shallow-water)	1. Improve understanding of the possible indirect impacts of fishing or other effects on trophic interactions (e.g. removal of keystone species) 2. To determine the main processes leading to changes in trophic interactions 3. To design experiments to examine the potential impact of fishing on benthic habitats, community structure or biodiversity	See draft report above	B, E, F
Indicative Development Plan, including baseline habitat and human use maps, to guide future development within the Houtman Abrolhos Islands	DoF	State NRM	Abrolhos Islands	Map the shallow-water benthic habitats of the Abrolhos Islands using remote sensing techniques and field based ground truthing. http://www.fish.wa.gov.au/Documents/research_reports/frr237.pdf	Completed	A

Table 7.3. Continued.

Project Title	Lead Agency/ Publications	Funding Source	Study Location	Objectives / Project Description	Status	Conceptual Model
Abrolhos Islands long term monitoring	DoF	Internal	Abrolhos Islands	Long-term monitoring of benthic habitats using a series of permanent transects. Transects are surveyed annually and the percentage cover of benthic habitats are recorded using diver operated stereo video	2006-ongoing	A, D
Assessing possible environmental causes behind the reduced colonisation of Western Rock Lobster puerulus collectors by a wide suite of species FRDC Report – Project 2008/085	DoF/UWA	FRDC	Various coastal locations	Monitoring community composition of marine flora and fauna colonizing puerulus collectors along the Western Australian coastline Determine the influence of environmental parameters on the floral and faunal communities colonizing puerulus collectors http://www.fish.wa.gov.au/Documents/research_reports/frr218.pdf	Completed	F
IMOS	National	National	WAIMOS (Jurien/ Abrolhos/ Rottnest)	Monitoring benthic habitats using AUV (Smale et al 2012 ICES Journal of Marine Science; doi:10.1093/icesjms/fss082)	Funded ongoing	A, D
Development of an industry-based habitat mapping/monitoring system	DoF	FRDC	Statewide	Development of a cost-effective digital monitoring system Comparison of functionality and effectiveness with conventional habitat mapping methods Trial use of system by industry and development of habitat maps	To be completed in 2012	A, D, F

Understanding processes that affect recruitment of western rock lobster to the fishery over a latitudinal gradient	DoF/UWA	FRDC	Statewide	Determine the relationship between benthic habitat composition and the abundance and distribution of different life stages of the western rock lobster Develop a low cost monitoring program for ongoing assessment of on benthic habitats and western rock lobster	Some components currently being conducted by DoF	A, D, F
Identifying factors affecting the low western rock lobster puerulus settlement in recent years (FRDC 2009/018)	DoF	FRDC	Statewide	To use a larval advection model and the rock lobster population dynamics model to assess the effect of spatial distribution of the breeding stock on the puerulus settlement To assess environmental factors (water temperature, current, wind, productivity, eddies) and breeding stock affecting puerulus settlement To examine climate change trends of key environmental parameters and their effect on the western rock lobster fishery	July 2009-June 2012	N/A
Development of a long-term program to monitor coastal communities within the Swan region	DoF (Bellchambers *et al.* 2009)	DoF	Rottnest Island	Provide a baseline of biological information for western rock lobster in the Swan Catchment Region Provide a cost-effective and efficient sampling protocol for the continued assessment and recording of these biological parameters into the future Produce a long-term time series as a robust indicator of relative "health" of the Swan Catchment into the future http://www.fish.wa.gov.au/Documents/research_reports/frr183.pdf	2008-ongoing	E, F
Management implications of climate change effect on fisheries in Western Australia (FRDC 2010/535)	DoF (Caputi *et al.* 2010b)	FRDC	Statewide	Assess future climate change effects on the Western Australia marine environments using a suite of IPCC model projections, downscaled to the key shelf regions and the spatial and temporal scales relevant	January 2011-December 2013	N/A

	for key fisheries Examine the modelled shelf climate change scenarios on fisheries and implications of historic and future climate change effects Review management arrangements to examine their robustness to possible effects of climate change

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