NIWA
Taihoro Nukurangi

Briefing Report: Possible impacts of phosphorite nodule mining on red rock lobsters around the Chatham Islands

Prepared for Merman Ltd

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Version 1

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Cover image: A large male red rock lobster, *Jasus edwardsii*, advances off a coastal reef over the sand flats. Photographer Alison MacDiarmid.

28 September 2012 8.51 a.m.

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Executive summary

Concern has been raised over the possible impact of proposed mining activities for phosphorite nodules on the crest of the Chatham Rise on the larval, post-larval puerulus, and benthic phases of red rock lobsters, *Jasus edwardsii*.

Due to the restriction of juvenile and adult phase red rock lobsters to depths less than 250 m it is unlikely there will be any direct impact of the proposed mining operations at ~400 m depth on rock lobster populations around the Chatham Islands.

Recent published research that modelled rock lobster larval sources and settlement localities strongly suggests that the Chatham Islands do not contribute significantly to the pool of lobster pueruli settling around mainland New Zealand. In contrast, the same study suggests that the Chatham Islands are heavily dependent on the east coast of mainland New Zealand as sources of lobster larvae, especially the area from Kaikoura to Cape Kidnappers.

The modelling of larval pathways suggests that for most of the long larval phase, lobster larvae that eventually settle around the Chatham Islands are entrained in eddy systems well to the north of the Chatham Rise. They are highly unlikely to spend time over the crest of the Chatham Rise in areas potentially affected by sediment plumes produced during mining activities.

1 Background

Chatham Rock Phosphate Ltd proposes to mine phosphorite nodules at depths of ~400m from the crest of the Chatham Rise within a licence area of 4,276 km^2 (Figure 1-1). There is the potential for these mining activities to form a downstream sediment plume that may affect the fauna and flora in the water column. Hadfield (2011) has modelled the possible trajectories of sediment particles released at three points within the proposed mining area. The size of the plume, the depths affected and the areas impacted are still uncertain as these are dependent on the size distribution of the particles released and whether these are released near the surface or near the seafloor.

Red rock lobsters, *Jasus edwardsii* (Decapoda, Family Palinuridae), are a vital part of the Chatham Islands economy with 357 tonnes fished from around the islands (CRA6 Fisheries Management Area) in the 2010/11 fishing year (Ministry for Primary Industries 2011). Rock lobsters have a complex life cycle with a free living, long-lived (12-24 months) and widely dispersed planktonic larval stage, a post-larval settlement stage called the puerulus that swims inshore to locate suitable settlement habitats, and benthic juvenile and adult phases. Concern has been raised over the possible impact of the proposed mining operations on the larval, post-larval, and benthic phases of rock lobsters. These concerns are addressed in this report by reference to the available published information.

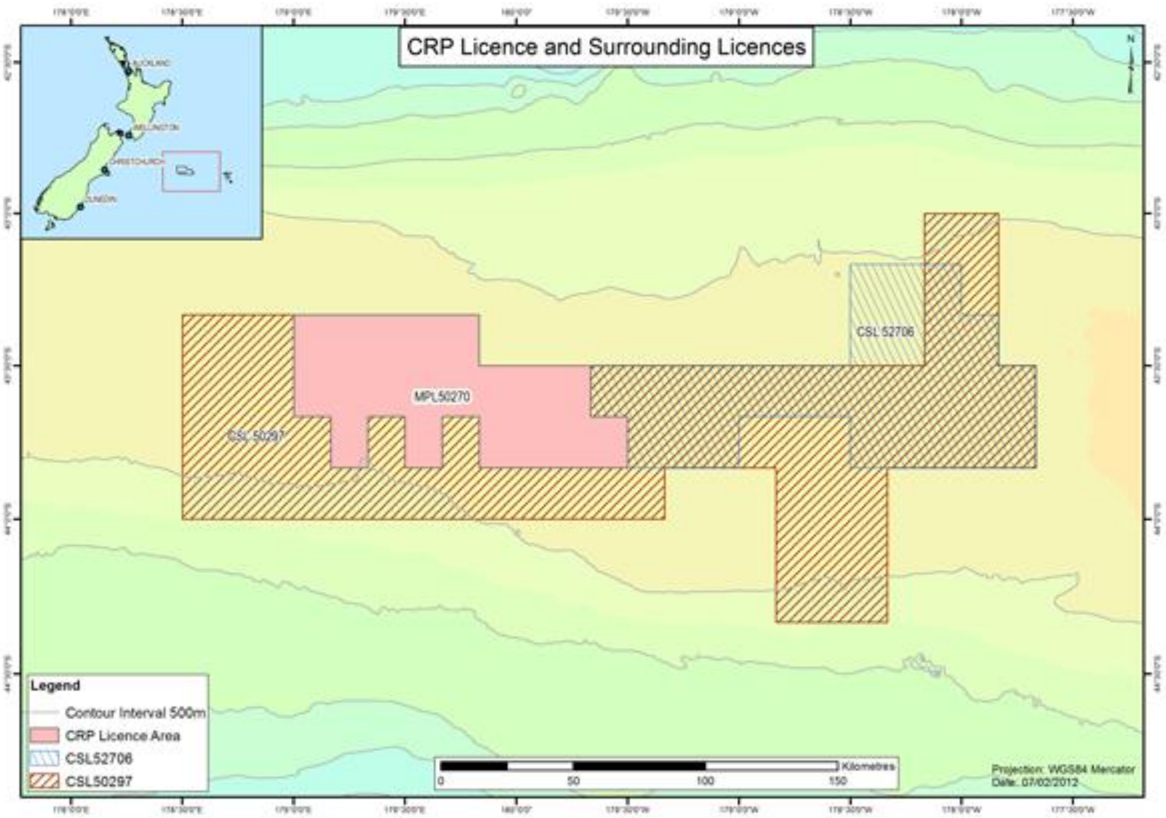


Figure 1-1: CRP licence area and surrounding licences on the Chatham Rise.

2 Rock lobster depth distribution

Booth et al. (1991) found that settlement of the puerulus stage of red rock lobsters near the shore takes place over a wide depth range. It occurs inter-tidally, and, as determined experimentally using crevice collectors, also takes place down to depths of at least 50 m. At sites along the east coast of the North Island of New Zealand, Booth et al. (1991) found that the depth of greatest settlement on collectors varied with locality and time, but was within the upper 11.5 m. Booth et al. (1991) concluded that settlement levels generally increased with depth to about 10-12 m, then decreased with increasing depth and distance from shore.

Juveniles are much more common in shallow reef areas (1 –10 m) than deeper reef areas, reflecting the depth of settlement. In the Cape Rodney to Okakari Point (CROP) Marine Reserve near Leigh in the outer Hauraki Gulf, MacDiarmid (1991) found that of the 1521 juveniles counted during routine monthly surveys 55% occurred at depths less than 10 m, 33% occurred between 10 -17 m and only 12% at depths greater than 17 m.

Adult red rock lobsters occur predominately on rocky reefs from the shallow subtidal to depths of about 50 m but in some areas they occur as deep as 250 m (Annala & Bycroft 1984). At particular times of the year they may also occur on open ground within 1-2 km the nearest reef to feed on shellfish, hatch their offspring or to migrate (Street 1969, McKoy & Leachman 1982, Kelly et al. 1999, Langlois et al. 2005). During this time they may be caught in bottom trawls (e.g. Anderton 1906).

Despite 50 years of research activity there is no record of adult rock lobsters occurring on the crest of the Chatham Rise in any of the phosphorite nodule mining licence areas.

3 Rock lobster larval dispersal to and from the Chatham Islands

Red rock lobsters have a long pelagic larval phase lasting 1-2 years (Booth 1994). Over this period, while in the water column, larvae may be carried considerable distances (100s – 1000s of km) away from the parental reefs. In some places large offshore eddies may maintain the larvae close to their source populations The degree of connectivity between populations of red rock lobsters around New Zealand has been explored by Chiswell & Booth (2008) who used satellite-measured ocean currents to numerically model tracks of individual larva originating from different locations. Chiswell & Booth built a statistical picture of both where larvae from a particular source settle (i.e. larval sinks), and conversely, where settlement at a particular location originated from (i.e. larval sources).

The study by Chiswell & Booth (2008) indicated that red rock lobster pueruli settling around the Chatham Islands mostly originate from populations along the east coast of mainland New Zealand - from Kaikoura to the Marlborough Sounds (CRA5) (51%) and from Wellington to Wairarapa coast (CRA4) (13%). Only 10% of lobsters settling around the Chatham Islands originate from the islands themselves.

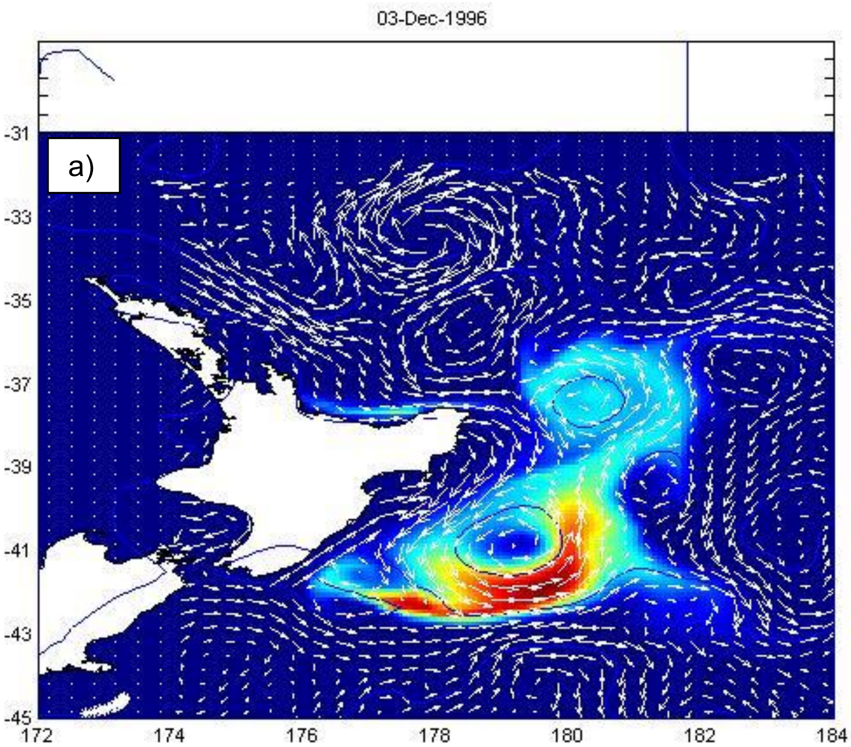
Chiswell and Booth’s (2008) results also indicate that rock lobsters around the Chatham Islands contribute very few larvae to mainland populations with only CRA3 from East Cape to south of Mahia Peninsula receiving any Chatham Islands derived pueruli. Importantly, these comprised only 1% of pueruli settling in the CRA3 area.

The numerical modelling undertaken by Chiswell and Booth (2008) indicates that almost all the larvae originating from mainland New Zealand that arrive in the Chatham Islands become entrained within the Wairarapa Eddy (Figure 3.1a).

The Wairarapa Eddy is a large anticyclonic eddy that on average sits north of the Chatham Rise centred near 41°S, 178.5°E, although at any given time, there can be a series of two or more eddies in the region. The Wairarapa Eddy system entrains almost all larvae hatched on the east coast of the North Island (including those that eventually settle in the Chatham Islands). These larvae become entrained within the eddy system within about two months after hatching, and generally remain in the eddy system throughout their larval duration. In the model larvae become competent to metamorphose into puerulus and ready to settle 15 months after hatching if they are located near the shelf edge

In the model, almost all larvae entrained in the Wairarapa Eddy system settle on the east coast of the North Island, but occasionally a patch of larvae-bearing water will break off from the main eddy system and propagate to the east (Figure 3-1d). In the model, it is these occasional events that bring larvae to the Chatham Islands.

It is important to note that the major concentrations of rock lobster larvae that contribute to the Chatham Islands stock occur in the eddy systems well to the to the north of the Chatham Rise for most of the duration of the larval period.



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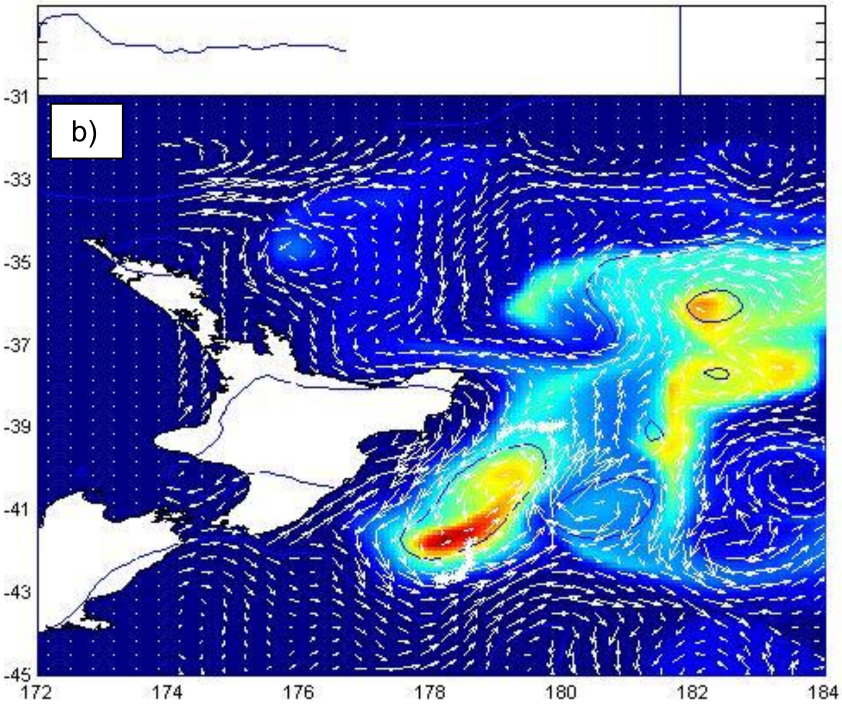

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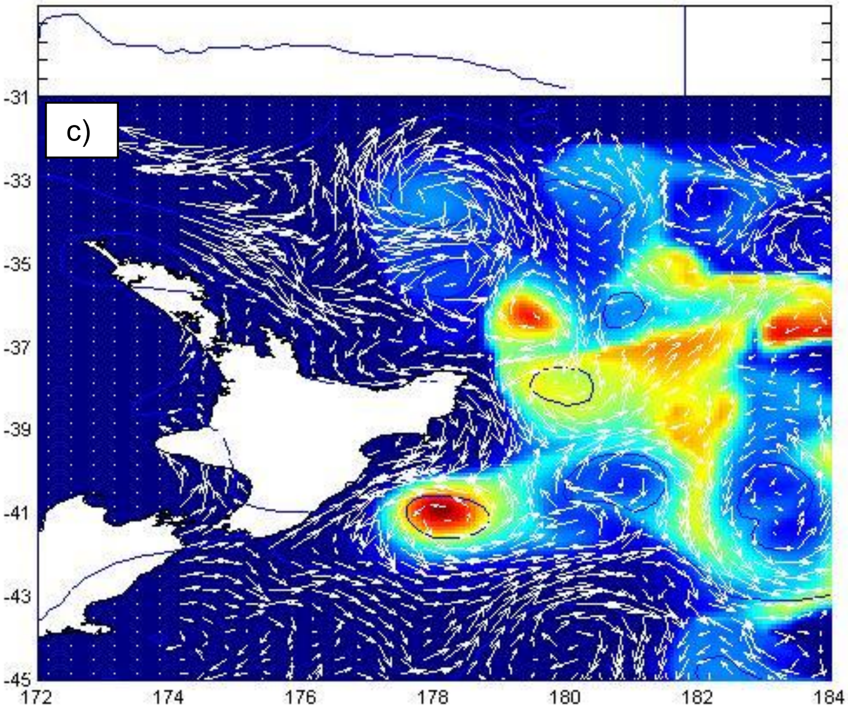

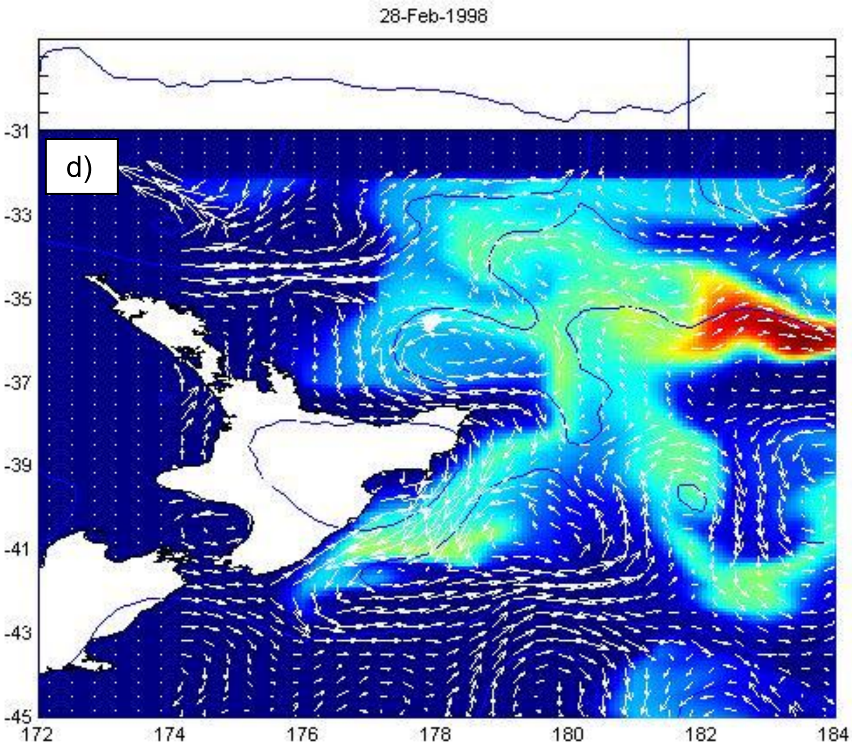

Figure 3-1: Tracer concentrations from the numerical simulations indicating rock lobster larval distribution and concentration at four periods after hatching. a) 2 months after hatching; b) 8 months after hatching; c) 13 months after hatching; d) 17 months after hatching. The simulations suggest that settlement at the Chatham Islands is from larvae that originally became entrained in the Wairarapa Eddy, but then exited the eddy system and were carried to the east, although most larvae that leave the eddy system are unlikely to survive to metamorphosis. The graph above each plot indicates the proportion of larvae occurring along the shelf edge. The vertical line indicates the timing of metamorphosis to the puerulus stage. Figures kindly supplied by S. Chiswell.

4 Discussion

Due to the restriction of juvenile and adult phase red rock lobsters to depths less than 250 m it is unlikely there will be any direct impact of the proposed mining operations at ~400 m depth on rock lobster populations around the Chatham Islands.

The modelling of larval sources and settlement localities by Chiswell & Booth (2008) strongly suggests that the Chatham Islands do not contribute significantly to the pool of lobster pueruli settling around the New Zealand. In contrast, the same study suggests that the Chatham Islands are heavily dependent on the east coast of mainland New Zealand as sources of lobster larvae, especially the area from Kaikoura to Cape Kidnappers.

The modelling of larval pathways by Chiswell & Booth (2008) suggests that for most of the long larval phase, lobster larvae that eventually settle around the Chatham Islands are entrained in eddy systems to the north of the Chatham Rise. Larvae that settle in the Chatham Islands are unlikely to spend time over the crest of the Chatham Rise in areas potentially affected by a sediment plume produced during mining activities.

5 Acknowledgements

I thank Steve Chiswell for reviewing the draft report.

6 References

Anderton, T. (1906). Observations on New Zealand Fishes, *Transactions and Proceedings of the New Zealand Institute*, 39: 477-496.

Annala , J.H; Bycroft, B.L. (1984). Exploratory fishing for rock lobsters in offshore areas near Gisborne. *Fisheries Research Division Occasional Publication* 45.

Booth, J.D. (1994). *Jasus edwardsii* larval recruitment off the east coast of New Zealand. *Crustaceana* 66:295–317.

Booth, J. D.; Carruthers, A.D; Bolt, C.D.; Stewart, R.A. (1991). Measuring depth of settlement in the red rock lobster, *Jasus edwardsii. New Zealand Journal of Marine and Freshwater Research* 25:123-132.

Chiswell, S.M.; Booth, J.D. (2008). Sources and sinks of larval settlement in *Jasus edwardsii* around New Zealand: Where do larvae come from and where do they go? *Marine Ecology Progress Series* 354: 201–217.

Hadfield, M. (2011). Ocean model simulations of sediment plume behaviour. NIWA Client Report: WLG2010-71, 23 p.

Kelly, S.; MacDiarmid, A.B.; & Babcock, R.C. (1999). Characteristics of spiny lobster, *Jasus edwardsii*, aggregations in exposed reef and sandy areas*. Marine and Freshwater Research* 50: 409-416.

Langlois, T. J.; Anderson, M.J.; Babcock, R.C. (2005). Reef-associated predators influence adjacent soft-sediment communities. *Ecology* 86: 1508-1519.

MacDiarmid, A.B. (1991). Seasonal changes in depth distribution, sex ratio and size frequency of spiny lobsters *Jasus edwardsii* (Decapoda, Palinuridae) on a coastal reef in northern New Zealand. *Marine Ecology Progress Series* 70: 129-141.

McKoy, J. L.; Leachman, A. (1982). Aggregations of ovigerous female rock lobsters, *Jasus edwardsii* (Decapoda : Palinuridae). *New Zealand Journal of Marine and Freshwater Research* 16, 141.6.

Ministry for Primary Industries (2012). Report from the Fisheries Assessment Plenary, May 2012: stock assessments and yield estimates. Compiled by the Fisheries Science Group, Ministry for Primary Industries, Wellington, New Zealand. 1194 p.

Street, R.J. (1969). The New Zealand crayfish, *Jasus edwardsii* (Hutton). *Fisheries Technical Report* New Zealand Marine Department 30: 1-24.