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Lobsters do well in sea-cages: Spiny lobster on-growing in New Zealand

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Abstract The spiny red rock lobster (*Jasus edwardsii*) is the third-biggest seafood export earner in New Zealand with exports from the wild fishery valued at just under ($NZ) 100 million in 2004. Consequently, there is significant interest in capturing wild *Jasus edwardsii* pueruli and on-growing them through to a marketable size.

Following several attempts to on-grow pueruli in land-based facilities the focus on lobster aquaculture research in New Zealand has switched from land to sea-based on-growing utilising specifically designed sea-cages.

Following experimental scale sea-cage on-growing, and in conjunction with commercial partners, NIWA have successfully run commercial scale sea-cage on-growing trials, rearing *Jasus edwardsii* pueruli from wild caught pueruli through to a marketable size of 200-250 g in 2-3 years. These trials culminated in the presentation of sea-cage on-grown lobsters to politicians and restaurateurs in December 2003. Following this commercial success NIWA has continued research into sea-cage design and the development of an artificial lobster diet to improve the economic viability of lobster on-growing in sea-cages.

This presentation describes sea-based lobster on-growing research in New Zealand and the relevance of this research to lobster aquaculture in other countries.

Key Words: spiny lobster, *Jasus edwardsii*, on-growing, sea-cages

The spiny red rock lobster (*Jasus edwardsii*) is the third-biggest seafood export earner in New Zealand with exports from the wild fishery valued at just under ($NZ) 100 million in 2004. Consequently, there is significant interest in capturing wild *Jasus edwardsii* pueruli and on-growing them through to a marketable size.

NIWA has undertaken an extensive research programme over the past 10 years to investigate the optimal conditions for on-growing wild caught pueruli. Initially the focus was on land-based holding systems and measured the efficacy of natural diets (James and Tong, 1997; James, 1998; James and Tong, 1998) and the effects of a number of environmental factors on lobster growth and mortality. The research showed that the optimal stocking density for captive lobsters is 50 lobsters m^2/internal surface area (James *et al*., 2002). Subsequent commercial scale land and sea-based trials have confirmed this research. The research also showed that the presence of shelters in a land-based holding system had no significant effect on lobster growth but lobsters that had shelters present had significantly better survival rates (James *et al*., 2002). Subsequent sea-cage trials have shown that it is possible to substitute shelters for a complex 3-dimensional structure that both significantly increases the internal surface area of the holding system and provides shelter for the animals (Unpublished data). A study of the effects of salinity on lobster growth and mortality found that both fluctuating (25‰-35‰) and low (25‰) salinity treatments had significantly lower growth and higher mortality than 30‰ and 35‰ treatments (Moss *et al*., 2000).

A series of experiments studying optimal tank design for on-growing lobsters showed that long shallow trays are not as suitable as medium or deep

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tanks and that it is possible to increase the density of lobsters held in deeper tanks by simply increasing the internal surface area available to the lobsters (James *et al*., 2003).

In 2001 an economic study was undertaken to establish the commercial viability of on-growing lobsters in a land-based facility. This study showed that economic land-based lobster on-growing would 'rely on greatly reducing the infrastructure and operating costs of land-based operations and lowering feed and labour costs' (Jeffs and Hooker, 2000) and that sea-based on-growing offered a more viable option for lobster on-growing. Subsequently, following several commercial attempts to on-grow pueruli in land-based facilities, the focus on lobster aquaculture research in New Zealand has shifted from land to sea-based on-growing.

A sea-cage on-growing experiment showed that animals held in sea-cages in the north of New Zealand, where ambient temperatures are significantly warmer, had significantly higher growth rates than lobsters held at sites further south where ambient seawater temperatures are cooler (Jeffs and James, 2001). However, the mortality of the lobsters held at warmer temperatures was significantly higher than those held at cooler temperatures. Following the success of this experiment, and in conjunction with commercial partners, NIWA undertook a commercial scale sea-cage on-growing trial, rearing wild caught pueruli through to a marketable size of 200-250 g. The trial involved 2 geographically separate sites. One site was in the Coromandel in northern New Zealand where water temperatures are significantly warmer than at the second site in the Marlborough Sounds further south. The results of this study again showed that lobsters had significantly greater growth in the northern, warmer site but that the mortalities were also higher in the warmer temperatures. Lobsters were held at two separate study locations at the southern site and the results showed significant differences in both growth and mortality between the two locations, despite there being no difference in ambient water temperatures. The trials also clearly showed that lobsters held in the commercial sea-cages had significantly better growth than any previous land-based on-growing trials and that it was possible to grow *Jasus edwardsii* to a commercial size in approximately 3 years (James and Jeffs, 2003; Jeffs and James, 2003). These trials culminated in the presentation of sea-cage on-grown lobsters to politicians, restaurateurs and lobster farmers in December 2003.

Following this commercial success, NIWA has continued research into both sea-cage design and the development of artificial lobster diets to improve the economic viability of lobster on-growing in sea-cages. During the commercial sea-cage trials there were a number of issues with cage design that were identified. These included problems with accessibility, ease of cleaning and feeding, and the requirement for heavy lifting gear to service the cages. The durability of the cages and the ability of the cages to retain early juvenile animals were also problematic. Consequently, NIWA has designed a new, open-topped design for on-growing lobsters in sea-cages. The design allows for easy feeding and access to the animals. Lobsters held in the cages in preliminary trials have shown very good growth rates and high survival compared to previous trials. Following this success of the sea-cage design in the preliminary trials NIWA has begun a commercial scale experiment to test the efficacy of the new cage design compared with the commercial cages that had been previously used. In addition, the efficacy of both natural, and artificial diets are being tested during the experiment using mussel, pellet and moist block diets. An additional treatment has been included to determine the effect on the growth of lobsters of the natural fouling that occurs on the cages.

The current sea-cage research at NIWA also aims to study the feeding behaviour of rock lobster juveniles in sea-cages. This will be monitored using remote video surveillance. The research will focus on the aggregation of lobsters at feed stations, aggression and formation of feeding hierarchies, frequency and periodicity of feeding. In addition, the consumption and digestion of the three diets will be measured in relation to the growth trials. The research will also focus on diet water stability, feed intake, feed-loss during manipulation, digestibility and gut retention time.

The research undertaken by NIWA has provided

critical information on optimal stocking densities, the effects of shelter and tank design and salinity. The research has shown that land-based on-growing is unlikely to be economic, but sea-cage lobster on-growing shows enormous potential. There are still a number of areas that require further research and these include sea-cage design, site selection and the availability of a suitable artificial diet.

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