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A comparison of roe enhancement of the sea urchin *Evechinus chloroticus* in sea-based and land-based cages

Philip J. James

National Institute of Water and Atmospheric Research, Wellington, New Zealand

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Abstract

A 12 week experiment was conducted to compare the efficacy of enhancing the roe of wild caught *Evechinus chloroticus* held in tanks on land and in sea-cages. The sea-cages were suspended from a mussel longline at depths of 3 and 6 m and identical cages were placed in land-based tanks supplied with flow-through seawater. Both land- and sea-based systems had high and low density treatments. The urchins were fed an artificial diet ad libitum throughout the experiment. An initial and a final census were conducted to measure urchin test diameter, wet weight, gonad index, and roe colour. The results showed that urchin roe quantity (GI) and quality (colour) can be enhanced in 12 weeks by feeding the NIWA artificial diet in land-based tanks or sea-cages, with high survival. There were no significant differences between the enhancement of roe quantity (GI) or quality (colour) in urchins held in land-based tanks or in sea-cages. There were also no differences between urchins held in sea-cages at 3 m and at 6 m, or between urchins held at low and high density.

Keywords: *Evechinus chloroticus*; Sea- and land-based; Cage culture; Gonad indices

1. Introduction

The sea urchin, *Evechinus chloroticus*, is commonly known in New Zealand by its Maori name 'kina'. The species has been commercially fished in New Zealand since 1986 and the urchin roe has been mainly sold on the domestic market. There have been a number of attempts to export urchin roe to overseas markets such as the Japan, but only a small amount has been exported due to the roe having a bitter taste (McShane et al., 1994), poor colour, and inconsistent or low yields (Herbert, pers comm.). Consequently, the fishery has not expanded in New Zealand to the same degree that has occurred in other countries (Andrew et al., 2002). Currently, fishing urchins in New Zealand is economically marginal and requires significant local knowledge and resources because of the variable quality and wide distribution of animals that have good quality roe (James, 2004).

Growing worldwide interest in the enhancement of sea urchin roe from wild caught animals has created intense interest in New Zealand. If it is possible to

E-mail address: p.james@niwa.co.nz.

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consistently improve the quality and quantity of roe from wild urchins, this would present the opportunity to export enhanced roe into lucrative international markets. However, markets such as Japan require roe of a suitable quality and reliable techniques for roe enhancement will be necessary to achieve this.

There has been extensive international research into the factors that effect sea urchin roe enhancement (Pearse and Cameron, 1991; Klinger et al., 1997; Robinson and Colborne, 1997; Walker and Lesser, 1997; Lesser and Walker, 1998; Lawrence et al., 2001). Key factors that have been identified are the availability of an effective artificial diet, the reproductive condition of the animals, and the availability of suitable holding systems. Most previous research has focused on land-based experimental scale trials, but more recently there has been increasing worldwide interest in sea-based urchin roe enhancement. In Canada, an experiment to test the feasibility and efficacy of enhancing the roe of *Strongylocentrotus droebachiensis* held in hanging sea-cages was successful (Robinson and Colborne, 1997). In Newfoundland, a roe enhancement ranching trial, holding the urchins in underwater corrals on the seafloor, was undertaken with some success (Bridger et al., 1998). In Scotland, a series of experiments investigating the potential for polyculture of the urchin *Psammechinus miliaris* with salmon cages (Kelly et al., 1998), showed that urchins held in lantern nets had greater roe production than those held in pearl nets because the salmon feed pellets were more available through the larger mesh of the lantern nets. An experiment holding *S. droebachiensis* in small sea-cages in Maine showed it was feasible to enhance the gonads of 'post-spawned' animals using a variety of natural algae as feed (Vadas et al., 1999). Growth trials of *Loxechinus albus* fed natural algae have also been carried out in lantern nets in Chile with some success (Mendes and Becarra, 2004). In Norway, sea-cage technology has been developed for roe enhancement of *S. droebachiensis*, with the animals held at stocking densities of 35 kg/m^2 in stacked baskets suspended beneath a supporting structure (Anon, 2000; Aas, 2004).

There have been a number of studies on the New Zealand sea urchin *E. chloroticus* testing the efficacy of natural diets and artificial diets on roe enhancement in land-based holding systems (Barker et al., 1998; Buisson, 2001; James et al., 2004). In addition, a study by Fell (2002) investigated the effects of holding kina in sea-cages and feeding a combination of artificial and natural diets, with promising results. Although both land- and sea-based holding systems showed some potential for increasing the roe production of kina, there have been no studies comparing land-based vs. sea-based holding systems for roe enhancement of urchins. In order to develop a viable kina roe enhancement industry in New Zealand, the most economic and effective holding systems must be established. The advantages of land-based systems include greater control of environmental parameters, such as light levels and photoperiod, and easy access to animals for cleaning and feeding: The disadvantages include the high set-up and running costs. Alternatively, sea-based systems offer relatively low set-up and maintenance costs, particularly when they can utilize existing mussel farm sites. The disadvantages of sea-based systems include difficult access to commonly remote farming sites, and issues related to marine compliance and exposure to environmental factors, such as storms and currents. A study into the economic feasibility of sea urchin gonad enhancement of *S. droebachiensis*, using both land-based and sea bottom corral culture in New Foundland, found significant enhancement potential with bottom culture appearing to be more viable, but higher risk, than land-based culture (Burke, 1997). Similarly, in New Zealand, sea-cage culture of lobsters has been shown to be more economically viable than land-based culture due to the significant reduction in infrastructure costs (Jeffs and Hooker, 2000). Urchin roe enhancement projects in New Zealand may be faced with a choice of land vs. sea-based holding systems and this study investigates whether there are any significant advantages in either system in terms of roe production and quality.

In previous sea urchin roe enhancement trials in New Zealand, the efficacy of the experimental treatments has been measured by the increase in the Gonad Index of the urchin and by the colour of the urchin roe at the conclusion of the trial (Barker et al., 1998). Gonad Index is relatively simple to measure but the colour of the roe is traditionally measured using some form of 'match-by-eye' technique. There are inherent difficulties with this subjective technique and a more accurate technique is to use a spectrophotometer to take measurements using the international standard