EXPERIMENTAL ENHANCEMENT OF BLACK-FOOT ABALONE, *HALIOTIS IRIS*, IN TORY CHANNEL, MARLBOROUGH, NEW ZEALAND.

Elizabeth F. Keys*
National Institute of Water and Atmospheric Research
Northland, 0151, New Zealand
e.keys@niwa.co.nz

Haliotis iris are marine gastropods endemic to New Zealand, inhabiting coastal sub-littoral environs on rocky shores. *H. iris* is a commercially important species which is facing stock decline due to overfishing. This has prompted research into stock enhancement by the commercial abalone community. Studies to date suggest that enhancement of *H. iris* in New Zealand can be achieved if due regard is given to environmental variation within the juvenile habitat and if successful, enhancement has the potential to significantly invigorate this dwindling fishery.

Haliotid species have been extensively researched, but knowledge of the effects of density on survival and growth has been restricted to a few studies. Due to the cryptic behavior of the shellfish, relocation of transplanted animals has impacted results. The objectives of this study were to investigate whether the seeding density and size of the abalone had an effect on growth and survival of juvenile abalone seeded into natural habitat.

Boulder reefs were constructed at sites throughout Tory Channel, New Zealand to mimic the sub-littoral habitat occupied by wild juvenile *Haliotis iris*. The reefs provided the ability to observe survival and growth while maintaining the seeded abalone in isolation, and enabled us to relocate animals. Hatchery raised juvenile *H. iris* were seeded onto the reefs for three months, after which destructive surveys were performed to measure the growth and survival of the abalone. Three experiments were conducted using these reefs. Two density experiments investigated the effect of a range of seeding densities on survival and growth of hatchery reared abalone and one experiment investigated the effect of initial seeding size on the survival and growth of juvenile *H. iris*.

Juvenile abalone were allocated onto the reefs in densities from 25 to 640 m^{-2} to evaluate the optimum stocking density for the Marlborough region. Survival for both experiments ranged from 6.6% in a low energy environment heavily silted from sediment to 70% at a site with moderate energy and clean boulder habitat without sand intrusion. Growth varied between sites and between seasons, ranging from 2.5 – 13.5 mm shell length. Results suggest abalone may be seeded at densities ranging from 35 – 300 m^{-2} in areas ranging from low to good habitat, without compromising survival or growth. Exposure to moderate wave energy, suitable boulder habitat, algal availability, and limited sediment will determine the density applied to the seeding site.

In spring 2004, four size classes of juvenile *H. iris* were allocated to six constructed boulder reefs to investigate the effect of seeding size on the survival and growth of juvenile hatchery raised abalone placed in natural habitat. Sizes ranged from 5, 10, 15 and 20^{+} mm shell length before seeding. Survival of juvenile *H. iris* increased with increasing seed size in 5, 10 and 15 mm size shell length classes ranging from 24% to 72% and showed a slight decline in 20^{+} mm shell length with survival of 60%. Growth was greatest in the 5 mm shell length size class (128%) which diminished with increasing size to the lowest value in the 20^{+} size class (60%).

Growth rate increased seasonally with increasing water temperature. Temperature and season may be used to optimise growth and physical condition of the seeded juveniles and will be considered in relation to the timing of seeding events and the size of seed used. This research supports a growing body of knowledge in *Haliotid* ecology and potential for enhancement in New Zealand based on the financial costs associated with purchasing juvenile seed. The results suggest that provided optimal habitat can be found, enhancement could be a viable method of restocking *Haliotis iris* populations in coastal waters of New Zealand.