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resulted in a higher catch per unit effort for this fishery with vessels capable of catching "150 dozen fish per day". Such high catch rates were unsustainable and ultimately led to the collapse of the fishery. This was reflected in consistently poor catch statistics in the 1970's and 1980's. Attempts to regenerate this fishery since 1991 have included a variety of measures such as restocking programmes, technical conservation measures, scallop stock assessments and the development of hydrodynamic and transport models to identify patterns of larval dispersal within the harbour and surrounding locations. However, each strategy, when implemented as a sole regeneration measure, has been ineffective. It has become increasingly clear that several, simultaneously implemented approaches may be necessary to regenerate this fishery. The current "ecosystem approach", by using local broodstock and "going with the flow" of the bay, will try to build a sustainable fishery based upon the carrying capacity of the harbour and in sympathy with other local stakeholders. It involves a collaborative research project between the Valentia Harbour Fishery Society, three national research centres; The Daithi O Murchu Marine Research Centre (DOMMRC), The Aquaculture and Fisheries Development Centre, NUI, Galway and Bord Iascaigh Mhara (BIM). The data generated will be used to modify and calibrate a hydrodynamic and transport model. This tool will inform management of the scallop fishery by allowing the cooperative members to quantify the restoration risks and to place the broodstock in a site that optimises larval retention and ultimately improves settlement on artificial collectors.

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11. COST BENEFIT ANALYSIS OF ALTERNATIVE TECHNIQUES FOR REHABILITATING ABALONE REEFS DEPLETED BY ABALONE VIRAL GANGLIONEURITIS.

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The newly described herpes-like virus, Abalone Viral Ganglioneuritis (AVG) was first observed in an ocean discharging hatchery in December 2005 at the centre of the western zone abalone fishery in Victoria, Australia. In May 2006 it began a pathological epidemic in the adjacent natural beds of the blacklip abalone (*Haliotis rubra*), moving eastwards through the zone with the prevailing inshore current. Clinical tests suggested that infection rates as low as a single viral particle produced 100% mortality in 2-3 days. The epidemic was observed to cut large swathes through the natural beds apparently causing total mortality in some parts but leaving other populations of abalone near unaffected and apparently un-infectious. At broader scales mortality rates were estimated at >95 – 45%. Following the epidemic, the Western Abalone Divers Association (WADA) initiated this study of the feasibility and relative merits of alternative methods for rehabilitating the most heavily impacted reefs. The Kilarney Reef in which a mortality rate of 85-95% had been observed and for which a quantitative stock assessment existed was selected as a case study for this cost-benefit analysis. The stock assessment suggested 100-20t of adult biomass had been lost due to the virus.
The local fishery assessment model was adapted to describe both population dynamics and the economics of reseeding, translocation and naturally rebuilding reef in the Western Zone of Victoria, Australia. The literature on abalone reseeding, translocation and natural mortality rates, were used along cost estimates provided by the abalone quota owners, hatcheries and processers to provide agreed 'best' parameter estimates for the model, which was used to analyze the likely costs and benefits of the alternative techniques of rehabilitating the Kilarney Reef code in western Victoria. Comparative economic performances were quantified as the impaired value of the Individual Transferable Quota for the area until the stock recovered to the level of maximum sustainable yield, as it was estimated to be prior to the AVG impact.

The literature shows that, at least, in Japan the augmentation of abalone stocks by reseeding juveniles, and the translocation of adults is technically feasible, although the literature from other parts of the world is more equivocal. It is not possible to determine from the literature whether the difference between the Japanese experience, and that of other countries, is due to lower predator levels in Japan, as claimed by some, or the inherent biases associated with the differing experimental designs employed outside Japan. The assumed mortality parameters for each rehabilitation strategy are critically important to the results of the analysis, as well as being notoriously difficult to estimate. Only in Japan have long term, large scale augmentation programs been attempted and fishery wide returns monitored until the augmented year classes have been fished out, producing truly reliable estimates of survival following reseeding and translocation. Outside Japan studies have been small scale, short-term experiments, so that recapture rates have been depressed by the cryptic nature of juvenile abalone, and movement out of research areas. Consequently the Japanese body of literature was used to substantially determine the range of mortality estimates used. For each of the parameters for which the analysis was found to be sensitive a range of values around the agreed best estimate were analysed. When the cost of capital was accounted for, none of the scenarios involving active intervention produced any cost benefit above that estimated to accrue from allowing an unfished natural recovery. Reseeding and the translocation of adults and were found to be similarly cost-effective. Across the scenarios modelled, translocation was estimated to always at least pay for direct costs, but did not always cover capital costs, while reseeding only covered direct costs if the price of abalone exceeded $40/kg and seed was cheap. In addition to the assumptions used about mortality rates and prices, these results and their general applicability are strongly conditioned by two further assumptions used in this model. Firstly, the standard form of the stock-recruitment relationship (SRR) widely applied in fisheries assessment, and used here, assumes that rates of recruitment per spawning biomass increases as density declines. In contrast, some abalone ecologists believe that abalone productivity declines disproportionately at very low densities (depensation), however, no data on this effect could be found in the literature and its potential effect was not analysed. The existence of a strong depensatory effect could completely negate this analysis. Secondly, the length of time taken by blacklip abalone in Victoria to grow through into the spawning stock is 7-10 years and this determines that both active rehabilitation techniques incur a high compounded cost of capital, which is not incurred in naturally rebuilding scenarios. Generally, it was the compounded cost of capital that mitigated against active rehabilitation being cost effective. Other abalone species grow more rapidly to maturity and if fast enough, the enhanced rate of rebuild might pay for, or profit over, capital costs of active rehabilitation. A final result concerns the timing of intervention. Given the form of the SRR curve used, rapidly rebuilding breeding stock levels immediately after catastrophic depletions, has the best prospect of being profitable. Later interventions, and interventions when stock levels are closer to carrying capacity are less cost-effective. This work appears to be the first time a fully specified quantitative population model has been used to analyse the biological and economic processes underlying the rehabilitation of abalone reefs.

Keynotes: Comprehensive case studies

12&13. STRATEGIC MIXING OF FISHERY MANAGEMENT, AQUACULTURE AND STOCK ENHANCEMENT: CASE OF THE CHESAPEAKE BLUE CRAB.

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Three main approaches are used in seafood production strategies: fishery management of wild stocks by regulating catch; aquaculture for directly consumable products; and stock enhancement or sea ranching that blends aquaculture with fishery management in open