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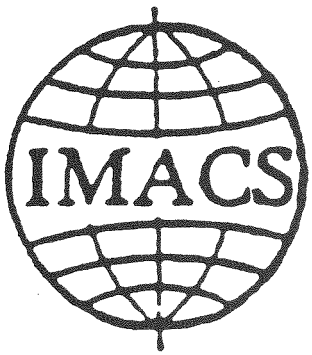

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THE FACILITATION OF LOCALIZED STOCK MANAGEMENT IN THE AUSTRALIAN ABALONE FISHERY THROUGH SIMULATION AND MODELLING: PEOPLE POWER IN THE AUSTRALIAN ABALONE INDUSTRY

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1. INTRODUCTION

Abalone (Haliotids) are marine molluscs which occur in high density aggregations on shallow coastal reefs (0-20m) in many parts of the world. Since pre-historic times abalone have been highly prized for their accessibility, large meaty foot muscle and bowl like shell. Today they are highly regarded as a delicacy by people of Chinese and Japanese decent for whom abalone symbolize prosperity. Abalone fisheries have proved prone to overfishing. The large fisheries of California and Mexico have experienced collapses. While landings from the large Japanese fishery have slowly declined over the last three decades. Global production peaked at 27 600 t in 1968 and has since declined to below 12 000 t per annum [1], [2]. Concurrently, the value of abalone as an international commodity has increased greatly since the 1960s partly due to declining supply but also as a result of the growing economic strength of the Asian economies.

Today Japan and Australia are the principle suppliers of abalone each supplying approximately 40% of global production. The landed value of abalone in Australian is approximately $AUD200 million per annum and approximately 200 divers are licenced to collect it. Entitlements to collect abalone are extremely valuable changing hands for $AUD1-3 million depending on the state for which the entitlement applies. State governments have been quick to realise the revenue potential of the industry and generally charge divers an annual licence fee of $30 000 - $40 000 [3].

2. MANAGEMENT HISTORY

The long term decline in global landings reflects limited success with managing the wild stocks and a failure to develop economically viable techniques for the large scale mariculture of abalone. Australia and Japan in particular have invested heavily in research and management and have apparently managed their wild stocks of abalone more successfully than most. In Japan strict management regimes have been enforced in many prefectures since last century. The history of management in Australia is shorter but modern commercial exploitation of abalone did not commence until the 1960s when the Asian market for abalone was first accessed. However the state authorities charged with management of the abalone resource began introducing management measures soon after exploitation began.

In Australia the resource is managed under the 'law of the commons' framework which allows a

large number of commercial operators to operate anywhere within a state or zone. Most states introduced minimum legal sizes in the early 1960s and limited the number of commercial abalone divers soon afterwards. During the 1980s divers were further restricted with the implementation of individually transferable quotas. However concern still exists about the long term sustainability of the industry.

Australian research has shown that abalone stocks are spatially intricate [4]. The dispersal of abalone is limited during their larval, juvenile and adult phases. Abalone beds or reefs occur on the scale of 100s of metres to kilometres. They are apparently self-recruiting and thus need to be self sustaining. Patterns of growth and maturity vary between nearby reefs. Which means that a size limit which preserves an optimum amount of spawning abalone on one reef may allow total over-exploitation on another nearby reef and no commercial harvest on a third. Thus quota levels and size limits, which are used to control exploitation rates, would optimally be established for each individual reef. This would require on-going monitoring and basic research for each abalone reef in an abalone fishery.

Optimal management of these valuable renewable resources requires management regimes to be developed and implemented on a reef by reef basis. The difficulty is that no modern 'small government' can afford to manage a resource this intensively. Modern governments maintain centralized fisheries agencies in which a few staff may be dedicated to abalone research and monitoring. Data collected in the field, together with compulsory returns from commercial fishermen are fed into large centralized data bases which are rarely analyzed thoroughly due to the shortage of resources. Legislation controlling size limits, quotas and access are necessarily applied over broad areas (often on a statewide basis) because centralized fisheries enforcement agencies are unable to enforce more effective legislation on the spatial scale required. These modern techniques of fisheries assessment and management have been proved effective for fisheries comprised of a few large units of stock, but their centralization, and the restricted availability and expense of fisheries expertise make them ill-equipped to manage spatially intricate renewable resources like abalone stocks.

A single reef of abalone less than a kilometre square may be capable of sustaining an annual catch worth $200 000 - $400 000 and commercial divers find it difficult to understand why monitoring and research commensurate with the value of these stocks is not forthcoming. They find it difficult to understand that the general public which votes governments into power demands that little of the resource rent the divers pay is actually returned to the research and management process. At the present time Australian governmental fisheries agencies operating under budgetary restraints are unable even to monitor long term trends in abalone abundance, let alone assess the optimal sustainable potential of the resource. Management of the resource continues, quotas for abalone are set annually, but the process is quantitatively blind relying entirely on qualitative anecdotal information provided by the divers.

The abalone resource is a valuable community asset. However much of its value is currently being expended in the highly disposable taxable incomes of individual divers. In an attempt to minimize personal levels of taxation divers tend to over-capitalize on the basic 5-10 m vessel and towing vehicle they require to operate. This in turn attracts community envy and encourages short sighted governments to tax the

industry more heavily without increasing levels of research and management. In one Australian state the annual licence fees levied on divers pays 130% of the running cost of the entire fisheries agencies charged with researching, managing and enforcing all fisheries resources.

Many commercial divers who wish to have security in the sustainability of their livelihoods know that some legal fishing practices are inappropriate for particular reefs. But there is no incentive to change diving practices because of the 'law of the commons' framework which promotes the thinking "if I don't do it the next person will." The resource is caught in the middle, inadequately monitored and managed, and on many reefs evidently declining.

3. INTEGRATED PERSONALIZED STOCK MANAGEMENT SOFTWARE

Specifically designed integrated and personalized stock management software for laptop computers may provide a way through this conundrum by empowering a large number of less technically trained personnel to monitor the abundance of abalone on individual reefs and conduct sophisticated stock assessments.

Specifically designed software could:

- Provide users with visual maps of their reefs showing topographical features and the structure of permanent abalone survey systems.

- Provide spreadsheets into which annual survey data collected by commercial divers could be easily entered, together with annual catch details.

- Analyse survey data to provide maps of stock abundance from which reliable indicators of stock abundance can be estimated.

-Analyse trends in indices of annual stock abundance together with catch trends to provide estimates over time of the relationship between brood stock left on individual reefs and future recruitment.

-Translate the results of complex stock assessment analyses into easily understood moving, colour simulations. This could provide relatively unskilled operators with 'flight simulators' of abalone stocks on individual reefs enabling commercial divers to establish their own reef by reef management regimes.

All of these features can be provided by existing software. The power of this concept is in the integration and combination with easily assimilated colour graphics. These factors have the potential to lift the complicated science of fisheries stock assessment out of the exclusive realm of population modellers and stock assessment experts and make them intuitive and easily understood by anyone with a modicum of

common sense and interest.

4. PROSPECTS FOR THE FUTURE

What are the prospects of this idea coming to fruition? Initial development and research suggests that computing power equivalent to a Unix or Sun is probably required to provided the integration of databases, analysis and graphics required. The nature of the industry is that until this sort of computing power is available in a laptop or small portable P.C. the idea will stay locked in the centralized facilities now charged with these roles. However the development of suitable hardware looks to be less intractable than the fundamental issue of resource security.

The system of self-management envisaged here requires individual divers or collaborative groups of commercial divers to have exclusive harvesting rights to particular areas of abalone stock. The management system envisaged will require an additional expenditure of labour and finance beyond that required now simply to collect abalone. Under the present 'law of the commons' system of resource management no individual or groups of individuals have the personalized incentive to invest in the long term future. The prevailing thinking remains 'if I invest someone else besides me will benefit from my investment.'

Industry may be expected to use this software to manage individual abalone reefs if they have exclusive harvest rights. An integrated software package could record and analyse annual reef surveys, and catch data. Colour simulations of population dynamics based on analysed trends could translate technical facets of population modelling and assessment. Opportunities could be created for a larger number of less highly qualified stock managers who might become analogous to the game-keepers of a bygone age.

Could this be the way to double the number of fisheries biologists employed in Australia?

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