EXTENSION OF ABALONE FISHERY RESEARCH TO INDUSTRY AND OTHERS BY USING INTERACTIVE EDUCATIONAL COMPUTER SOFTWARE

(FIRDC Project 89/8)

FINAL REPORT

to

FISHERIES RESEARCH AND DEVELOPMENT CORPORATION

by

SOUTH AUSTRALIAN DEPARTMENT OF FISHERIES

19 December 1991

FINAL REPORT - FIRDC Project 89/8

SECTION 1 - PROJECT TITLE

EXTENSION OF ABALONE FISHERY RESEARCH TO INDUSTRY AND OTHERS BY USING INTERACTIVE EDUCATIONAL COMPUTER SOFTWARE

SECTION 2 - OBJECTIVES

The objectives of the **originally proposed project** were:

. To make recent advances in abalone research accessible to the Australian abalone industry;

. To improve management of abalone fisheries through increased knowledge and understanding

. To develop new techniques of applying the results of fisheries research.

FIRDC granted only a small proportion of the funds originally applied for.

A year later, after viewing a prototype, it granted supplementary funding:

. To complete the software that now exists in prototype form;

. To edit and produce a user manual from the existing draft;

. To design an educational computer based training package;

. To present the model at the 1st World Fisheries Congress.

A proposed "workshop tour to transfer the results to industry" was not funded.

SECTION 3 - RESULTS

3.1 General

The project has resulted in the production and distribution of the **AbaSim** software package, two copies of which accompany this report.

Appendix A, copied from the user manual, lists acknowledgements, shows the contents of the manual and describes how to use the package. The benefits offered by the software package are listed on the order form (Appendix B).

Additionally, a prototype of an educational computer based training package called **AbManager** has been produced in collaboration with Dr Rob Day of Melbourne University, who will trial it in 1992.

The World Fisheries Congress was postponed for a year due to the Gulf War. However **AbaSim** has been widely shown to North American and European fisheries scientists (see below).

3.2 Distribution

The **AbaSim** package was released in September 1991.

Following consultation with the South Australian Abalone Divers Association, it was decided that an effective way of distributing the package to the Australian abalone industry was to deliver six copies of the package to the abalone industry associations in various states. This has been achieved via state fisheries departments, each of which was requested to maintain one copy in their library.

Additional copies have been distributed to other Australian fisheries departments and training institutions. These organisations were encouraged to obtain additional copies for use in staff training and to assist in further distribution.

In August 1991, FIRDC agreed that the South Australian Department of Fisheries sell **AbaSim** commercially. FIRDC will receive 10% of the sale price. The decision will be reviewed after three years.

As part of an overseas trip in September 1991, the project leader, Dr Philip Sluczanowski, demonstrated **AbaSim** at the annual conferences of the American Fisheries Society, the UK Marine Conservation Society and ICES. He also showed it to key officers at FAO (Rome), UNESCO (Paris) and RRAG (London). A number of sales have resulted and discussions are being held with potential overseas agents and distributors.

AbaSim was purchased and used as part of an FAO training project in Fiji in November 1991.

3.3 Feedback

The response of everyone who has seen or used the package confirms that it meets the original objectives of the project.

Commercial and recreational fishers, conservationists, fisheries managers, science communicators, research managers and senior scientists have been particularly enthusiastic about the benefits of the technology for providing new insights into the behaviour of fisheries systems that must be managed based on limited information (see Appendix C). Beverton, Pope, Shepherd, Holden, Megrey, Edwards, Garcia, Troost and Griffith praised the model.

They see the main uses of such models as communicating key and difficult fisheries management concepts to non-specialists (e.g. sustainable development, growth and recruitment overfishing, time lags, age sampling, cycles, rehabilitation). A user has remarked that "It's a great little minister convincer "

Some scientists suggest that **AbaSim** is not as useful as it could be because:

. the user cannot change the model parameters and thereby examine sensitivity;

(**AbaSim** was not intended to be a scientific tool.)

. the assumptions of the model are not clearly stated in the documentation;

(The documentation was aimed at non-specialists. "Small print" and references are provided for those who seek them.)

. **AbaSim** gives the false impression that fisheries management is simpler than it is in reality. In particular, the model does not take account of random variation or environmental effects and it is difficult to communicate uncertainty.

(The scope of the product had to be limited and a complicated model would have alienated many potential users. The ideal presenters of **AbaSim** are scientists who use it to communicate general principles and then qualify the model in relation to the real world.)

3.4 Future development

A list of possible improvements to the package has been compiled and is continually being updated in response to user feedback. The information would be incorporated into the specification of a future product, if feasible and justified.

During 1992, the SA Department of Fisheries will market **AbaSim**, seeking the best mixture of means of distribution (e.g. mail order, agents, distributors, publishers). The marketing project will be reviewed at the end of 1992 and decisions made regarding further distribution, future product development and the feasibility of the department commercialising such products.

A supplementary grant may be sought to support the trialing, refinement of the prototype and specification of the **AbManager** package.

APPENDICES

A Acknowledgements, Contents of manual, Use of package

Copied from the AbaSim user manual.

B AbaSim order form

C "Flying Fisheries"

Article for American Fisheries Society Computer Users Section newsletter.

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AbaSim: A Graphic Fishery
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John Tonkin, a computer artist, programmed the computer game.

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Abalone divers, their families and representatives
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Contents

Start here

About this manual

Usually when people buy a new computer game, they cannot wait to try it. But before you use **AbaSim**, please *Resist this temptation!*

Read the first three chapters of this manual first, and then play the games described in chapter 4. You will learn about abalone and fisheries management, and be entertained on the way.

The **AbaSim** program and manual were designed for a wide audience. We do not assume you know anything about abalone or about personal computers (PC's). But you will need to have access to a computer compatible with an **IBM-PC 286** with a **colour VGA screen**, preferably with a maths coprocessor.

AbaSim simulates what happens to a population of blacklip abalone, *Haliotis rubra*, on a reef when it is fished by abalone divers. The model uses information about the growth, reproduction, mortality and movement patterns of abalone and the behaviour of divers. It represents scientists' understanding of the dynamics of a fishery based on the abalone that live on a small reef off Tasmania. The fishery based on this stock was studied as part of a major research program carried out in Australia between 1984 and 1987, led by Dr Jeremy Prince.

Chapters 1, 2 and 3 introduce you to abalone biology, abalone divers and fisheries management. If you want more details about the models and their relationship to research results, consult "the small print" in Appendix B, the references (Appendix C) or write to the authors. Scientists are still investigating many of the issues discussed.

Chapter 4 **(Games)** is the most important in the manual. Use it to discover the dynamics of AbaSim Reef while "playing". Use this chapter to learn how to use the simulator. Don't cheat, or you'll miss some surprises. Chapter 5 discusses useful lessons about fisheries that arise from Chapter 4.

Chapter 6 tells you how to install the software and operate the program. It explains how information is shown on the computer screen. Use this chapter for reference.

When you use **AbaSim**, try to forget you are sitting in an office with a

computer. Instead, free your imagination; you are a god playing with the world! Well, not quite, but you are the manager of a fishery. And your computer is a terminal which reports what is happening in the world.

When using **AbaSim**, keep asking the question: "What happens if...?" and use the model to find out. Before making the model simulate a situation, try to predict what will happen and why. The gap between your expectation and what happens will stimulate you to think further and generate greater understanding and insight.

Good fisheries biologists learn about a fishery by applying scientific research techniques, studying the results and talking and working with fishers and other observers of the stocks. They then build a picture, or mental model, of how the fishery works. Most fishers do the same. Both use these mental models to help them understand and predict what will happen in the fishery: the fishers to help them catch fish effectively, and the biologists to manage the fishery better. A model is a purposeful representation of reality.

When you stop using the simulator, remind yourself that the **AbaSim** model is just a model and not an exact duplicate of the real world. It represents some of what we currently believe about abalone fisheries; it is not an actual abalone stock. It is limited by the extent and accuracy of research to date, our overall understanding and what is feasible to model. Models such as **AbaSim** are useful for developing understanding, but not necessarily for making accurate predictions about the real world. The purpose of this model is to gain insights and to find out where our understanding about the real world is weak and should be improved.

The successful management of fisheries is vital not only to the people whose livelihood depends on them, but also to a world of dwindling natural resources. Fisheries managers are at the forefront of learning how living resources can be developed in a sustainable way. **AbaSim** is designed to help managers understand how fisheries behave – and how managers' actions can affect them.

Enjoy using **AbaSim**. Please don't spoil the game for others by showing them what they should discover for themselves. Your suggestions for improvements are welcome.

Philip Sluczanowski, *Producer*

30 August 1991

APPENDIX B

AbaSim Order Form

AbaSim

FISH INSIGHT

"Faaaaantastic. The games are very easy to 'play', instructions are easy to learn and apply, options few and easy to get used to. The screen is brilliant."
Carol Moore
Senior Computer Systems Officer

This program comes closer than anything else I have seen to revealing how abalone populations behave. It is revolutionary and exciting."
Scoresby Shepherd, Biologist

A GRAPHIC FISHERY: Learning tool for fisheries management

The **AbaSim** computer program simulates a fishery based on a shellfish population that lives on AbaSim Reef.

Try being its manager. Your aim is to preserve the fish stock and develop it sustainably. While "playing" the easy-to-use computer program, you will learn important principles of fisheries management, and be entertained at the same time.

AbaSim simulates what happens to a population of abalone when it is fished by abalone divers. Each year, you can change the minimum size limit and adjust the fishing pressure. The catch and profitability of abalone divers harvesting the reef respond to your controls. You immediately see the effects as coloured dynamic graphics easily understood by non-specialists. You can also carry out research surveys. The model uses information about growth, reproduction, mortality, movement patterns and diver behaviour. It is based on real data.

The **AbaSim** program and manual were designed for a wide audience. To use it, you do not need computer experience or knowledge about fisheries or abalone.

The manual tells you about abalone biology, fisheries management, and the Australian fishery on which the model is based. An "easy-going" commentary leads you through scenarios, relates them to real world experiences, and leaves you to manage the fishery on your own. Later, it explains what happened and why, and draws lessons relevant to the real world.

The Australian Fishing Industry Research and Development Trust Fund (FIRDTF) supported the development of **AbaSim** and benefits from its distribution.

AbaSim should be considered a cost-effective and time saving method of improving the performance and understanding of participants in the fisheries management process.

FISHERIES MANAGERS

- The successful management of fisheries is vital not only to the people whose livelihood depends on them, but also to a world of dwindling natural resources. Fisheries managers are at the forefront of learning how living resources can be developed in a sustainable way. AbaSim is designed to help managers understand how fisheries behave - and how managers' actions can affect them.

FISHING INDUSTRY

- Continued and profitable harvesting of natural resources requires an understanding of the dynamics of the fish stock, a commercial fishery's core asset. This requires knowledge of biology and of population dynamics. **AbaSim** teaches these subjects simply.

CONSERVATIONISTS

- It is important that the public appreciates what is meant by sustainable management. Then they can respond when non-sustainable practices occur.

AbaSim can convey an understanding of the basic issues to a wide audience. The user can demonstrate alternative sustainable fishing policies and compare their benefits.

FISHERIES DEPARTMENTS

- Staff of a fisheries department appreciate the relevance of their work better if they understand the basics of fisheries management. **AbaSim** has been trialed as a training tool to achieve this. Managers, enforcement officers, administrators, communicators and scientists all found the experience instructional and satisfying.

A person training with AbaSim needs about 2-4 hours alone with a computer.

SCIENCE COMMUNICATORS

- The model illustrates types of behaviour often experienced by species other than abalone. **AbaSim** can be easily used to demonstrate some of these (e.g. sustainable development, overexploitation, time lags, eradication of a stock's spawning potential, age sampling, cycles, rehabilitation, etc.).

You can also use **AbaSim** to illustrate analogies in wildlife and other areas of natural resources management.

EDUCATORS AND STUDENTS

• **AbaSim** is an educational tool. The manual describes the latest knowledge about abalone biology and fisheries management. Key references are listed.

The model is suitable for university tutorial sessions, during which students can either follow the book's scenarios or be asked to experiment with the model and thereby gain insights based on their experiences. It has relevance in a wide range of subjects, e.g. biology, environmental studies and resource economics, mathematics, communications design and graphics design.

Schoolteachers can easily use the model to demonstrate some fundamental lessons about the behaviour of fisheries. 10-year olds can easily understand the screens and "play the game" after a few minutes' tuition.

SHERIES SCIENTISTS

• **AbaSim** offers a completely new view of the dynamics of an exploited fish stock. Dynamic visualisation and interactive graphics techniques reveal what is happening to the population structure when you manage the stock in different ways.

You use **AbaSim** like a flight simulator, gaining a feeling for the sensitivity of the dynamics and insights into the behaviour of the nonlinear system. The screen displays offer new visualisations of complex relationships previously only accessible through numbers and equations.

(Unfortunately, you cannot change the underlying model parameters.)

COMPUTER ARTISTS

• John Tonkin, who designed and programmed the screens, is an award winning Australian computer artist. **AbaSim** is an example of how artists can apply their unique communications skills.

"…u certainly learn a fair bit of how a fishery can collapse …nd how it can also saved. Sometimes a year is all it takes to save the fishery."
Angelo Tsolos
Senior Statistics Clerk

"I think that as a teaching aid for introducing students … the broader range of fisheries management issues the model is unsurpassed."
Don Mackie, past Enforcement Officer

Computer hardware required: • IBM-PC.286 compatible • colour VGA screen • maths coprocessor (optional, increases speed)

Developed by: FISH INSIGHT **Contact:** FISH INSIGHT, South Australian Department of Fisheries, GPO Box 1625, Adelaide, SA 5001, Australia

Customer Hotline: For details or a quotation on FISH INSIGHT services and products, please write to us. Or call our Customer Hotline in Australia Telephone 08) 226 0633 Int ...) 618) 226 0633 Facsimile 08) 226 0664 Int ...) 618) 226 0664

To order your copy of **AbaSim**, please complete and send or fax this order form to FISH INSIGHT

Dr, Mr, Ms,...
TITLE INITIALS OR CHRISTIAN NAMES SURNAME POSITION

ORGANISATION NAME OF SITE LICENCE (FOR SITE LICENCES ONLY)

ADDRESS

TELEPHONE FACSIMILE EMAIL

…aSim is HALF-PRICE to educational institutions and course attendees. Please enquire about special prices for Australian abalone divers.

☐ Yes, I would like to order a copy of **AbaSim**

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☐ **Single user licence:** US$195
1 program diskette
1 manual
single user licence

☐ **Site licence:** US$450
5 program diskettes
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Delivery: Allow 21 days. Customs duty: We'll make every effort to ensure your copies of **AbaSim** reach you quickly and take every care to protect you from customs duty. However, we cannot guarantee that your local customs authority will not charge import tax, and we regret we cannot accept liability for such charges.

US/1/91

APPENDIX C

Article for American Fisheries Society Computer Users Section Newsletter

FLYING FISHERIES

Pilots and fisheries managers both have to control complex dynamic systems in fluctuating environments. The better they understand the behaviour of the systems they are trying to manage (i.e. aeroplane or fishery), the more effective they are.

Scientists and engineers usually lead the development of understanding through research, experimentation and design. But is this level of understanding sufficient, and how best to communicate it ?

An aeroplane designer is familiar with the equations and performance levels describing a plane's behaviour and can explain the likely consequences of using different controls under various conditions. But can he (she) fly a plane ?

Certainly not, based on this "theoretical" level of understanding. To fly a plane, a pilot needs to experiment with the system to gain a "feeling" for its dynamics, sensitivity and responsiveness. The only way to do this is to interact with it through an effective user interface. This could be either a flight simulator or the aeroplane itself.

Interactive graphics models of fisheries offer similar advantages. You can combine the equations describing a fishery into a computer program which simulates certain aspects of a its behaviour. You can then outfit this model with a user interface that allows the user to easily interact with it and immediately see the consequences of different management actions. The user can "fly" the system and so learn about it.

FISH INSIGHT, a unit of the South Australian Department of Fisheries, specialises in providing a high quality user interface for models developed by others. The interactive graphics interface makes the models easily accessible, provides new insights into their complex dynamics and allows communication of this understanding to non-specialists.

AbaSim is one such program. It simulates what happens to a population of abalone when it is fished by divers. As the user, you act as the manager of the fishery. Each year, you can change the minimum size limit and adjust the fishing pressure. The catch and profitability of abalone divers harvesting the reef respond to your controls.

You immediately see the effects on the population as coloured dynamic graphics easily understood by non-specialists. The model is based on real data and uses information about growth, reproduction, mortality, movement patterns and diver behaviour.

Although **AbaSim** is based on an abalone population, it illustrates types of behaviour experienced by species other than shellfish. For example, it is easy to demonstrate "sustainable development", "growth overfishing", "recruitment overfishing", "the value of age sampling", "cyclic behaviour", "rehabilitation of a fish stock", etc.

SharkSim is another interactive graphics model. It is based on Australia's southern shark fishery. Commissioned as "an agent for change", it was used by scientists and managers in public meetings to convince industry and the public of the need for urgent and significant changes to management of the fishery. It did so by effectively communicating scientists' best understanding of the state of the stock and the likely consequences of alternative management actions.

Scientific visualisation and interactive games are rapidly growing areas of science made possible by recent advances in computer technology. They will change the ways in which we view data and analyse relationships.

Dr. Philip Sluczanowski

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