I. Project Title: ReefRanger Hawaii Phase II: A Multi-scale, Multi-level Version II of the ReefRanger 3D Coral Reef Game for Education, Training and Public Awareness

Principle Investigator: John W. McManus, PhD

Project Staff: Felimon C. Gayanilo (Senior Software Engineer)

Organization: National Center for Coral Reef Research (NCORE)
University of Miami

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II. Executive Summary

Coral reefs are vital to the culture and economics of many places in the world, including Hawaii. The average person reaping benefits from reefs has only a vague concept of their importance, a partial understanding of the complexity of the threats to these ecosystems and the complex process leading to a management decisions. The ReefRanger is an educational game designed specifically for teens (ages 13 and above) to give them a better understanding of the complexities involved in managing the coastal resources. This version (Save the Yellow Tangs) is focused on monitoring and managing the fish called yellow tangs. The yellow tang also formally called, Zebrasoma flavescens (Bennett, 1827) in the scientific community, is the most common aquarium fish in Hawaii.

The ReefRanger (Series 1: Save the Yellow Tangs) immerses the player in the complex world of coral reef management. The effects on coral reefs of human activities in the mountains all the way to the open ocean are simulated based on rules that can be modified and configured for specific audience. The game illustrates how one entity in the ecosystem can have a large effect on the health of another, and how not only inaction but also inadequate management actions can lead to ineffectiveness and ultimately degradation of resources like the yellow tang. The general objective is to select management options to ensure that the economically important fish industry of Hawaii is sustained and protected from human interventions.
The intelligence of the program is derived largely from constructed scenarios, stored in the game software. The rules may be modified for the target audience. This Phase 2 of a 2-phase project is a continuation of Phase 1: ReefRanger (A 3D Coral Reef Game for Education, Training and Public Awareness) designed to add more scenes and utilities to improve the performance of the game software. A redeveloped ReefRanger Authoring Tool gives users the capability to edit, add and submit new scenarios to ReefRanger and configure the game to reflect local conditions. It may also be edited to use a local language. Several preliminary BETA versions were published publicly in Phase 1 of this project to test the software. The first version of the software, updated user guides for the game and authoring tool, suggested lesson plans and short flyer are now available for download from the Project website (http://ncore.rsmas.miami.edu/reefranger/index.htm). The same materials may be ordered directly from HCRI and may be distributed on a CD. Updates will be released via the same website as they become available.

III. Purpose

[NOTE: The purpose and rationale of this project is similar to Phase I of this 2-phase project and summarized below.]

A. Detailed description of the resource management problem(s) to be addressed.

Hawaiian coral reefs are complex ecological systems, involving many interacting ecological components (e.g., Polovina 1984). As in many parts of the world, coral reefs are threatened by natural phenomena and human activities, that we are just beginning to understand their effects to the coral reef ecosystem. The management of coral reef ecosystems is complex and challenging. Natural resource managers must balance environmental, socio-cultural, political and economic issues. Managers combine these issues to evaluate potential impacts of a disturbance in the ecosystem or changes in regulations in one part of the ecosystem on other parts of the reef, and on the people to whom the reef is important.

Coral reef degradation often enhances impoverishment, and poverty often encourages people to increasingly ignore legal and social norms which would otherwise protect the reef. This process often leads to a loss of social consciousness, which can be enhanced by a perception of lack of involvement in decision-making, or by a loss of identification with the traditional social systems with which the protective social norms were associated. Corrective strategies that are effective often involve community-based activities aimed at reinstalling a sense of social responsibility. This can involve the revival of cultural traditions, the delegation of significant planning and enforcement responsibilities to the local communities, participatory research activities, and efforts to ensure that the primary beneficiaries of the coastal resources are the local populace (McManus 1996, Pollnac et al. 2000).
B. Detailed description of the question(s) asked to answer the resource management problem(s)

The average person reaping benefits from reefs has only a vague concept of their importance, and a partial understanding of the complexity of the threats to these ecosystems. Resource managers must deal with the interactions between human economic and social systems, and the ecosystem itself.

In the context of ecology, how well do users of the natural resource understand the broad range of factors involved in determining the abundances of the predominant benthic components on a reef? The many factors involved in determining the composition of these benthic groups are illustrated in Fig. 1. This synthesis is based largely on linkages that have been described in McManus et al. (2000) and McClanahan et al. (2002). The linkages are briefly described here, and supportive material and citations can be found in those references.

Figure 1: Schematic cause and effect diagram of some processes involved in the coral-algal balance on a coral reef. Solid lines represent strong effects and dashed lines are those that are often weak. Arrows indicate a positive impact or gain, circles represent a negative impact or loss. Disease affects all biotic components (unfilled ellipses). Filled ellipses are abiotic or anthropogenic factors. Direct impacts include diver or boat breakage, dredging, etc. (from McManus and Polsenberg, 2004)
Normally, when coral is dead, the resulting space (substrate after the removal of the colony and/or the surface of the dead coral) is filled within weeks by algae or other benthos (anthozoans, gorgonians, sponges, benthic foraminifera, etc.). Within months, a resilient community will exhibit settled planulae or asexual propagules. This settlement can be enhanced by “planulae-assisting” encrusting coralline algae. If the settlement or survival of these planulae is substantially inhibited because of fleshy frondose macroalgae, then a phase shift is the likely result. However, the reduction of reproductively active corals can be a contributory cause, particularly given that most coral planulae spend times in planktonic stages from a few hours to a few days (McManus & Meñez, 1997). The limited range of propagation by coral polyps (Sammarco, 1982) or broken portions of colonies (Highsmith, 1982) is such that these asexual reproductive methods are unlikely to compensate, at scales larger than a few hundred meters, for a reduction in sexually produced planulae. Thus, either a reduction in coral or an enhancement of frondose macroalgae can potentially facilitate or prolong a phase-shift.

Corals can be reduced by the boring away of substrate by sea urchins, and by breakage due to diver actions, boat groundings, dredging, use of fishing gear and other direct impacts. Bleaching and siltation are well-known causes of coral reduction. Although nutrients are necessary for coral growth, excessive levels can inhibit the success of coral settlement (Tomascik, 1991). Storms often break or damage corals, and very large storm waves can substantially reduce other components, including all forms of macroalgae, other benthos, and even herbivores and predators (not shown). However, the primary impact for the first months to years afterwards is normally a reduction in scleractinian corals. Runoff, upwelling and atmospheric deposition can all at least potentially increase nutrient levels (see Fig. 1).

The impact of eutrophication on coral reefs, often associated with human activities in the coast, can take many forms, some of which may not be immediately obvious. Initially, phytoplankton production will increase, which can reduce light penetration and increase direct detrital sediment deposition, effectively smothering the coral. Increased organic sedimentation encourages filter feeders which compete with corals for space. Increases in water column nutrients also promote the growth of macroalgae. Many reef systems have been shown to be quite sensitive to eutrophic conditions, and nutrient levels as low as 0.1-0.2 μM dissolved inorganic phosphorous and 1 μM dissolved inorganic nitrogen have been found to have adverse effects on reefs (Szmant, 2002). However, some nutrient addition studies have failed to reproduce such results, and it has been argued that coral reefs with complex, undisturbed food webs, or at least high levels of herbivory, can channel substantial increases in nutrients away from algal biomass into higher trophic levels (Littler and Littler 1984, McManus et al. 2000, Szmant 2002). Thus, a near-pristine reef would be expected to be less sensitive to nutrient additions than one in which more substantial fishing has occurred.
Nutrient loading within the reef system is directly impacted by and impacts the trophodynamics of the system. Predators can reduce herbivory, perhaps with an indirect negative impact on corals, but some predators (certain parrotfish, crown-of-thorns starfish, coralivorous snails, etc.) can also have negative impacts on corals. Fishing reduces many predators and herbivores, but may alleviate predation on some of each, such as the harvesting of piscivorous fish, potentially permitting herbivores to proliferate.

Managing these fragile ecosystems includes managing human activities to mitigate the negative anthropogenic effects, briefly explained above, to the ecosystem. This process is not well understood and can vary from one place to another or as conditions change to ensure compliance and acceptability by the stakeholders and general populace.

References:


C. Objectives to answer each question.

Educating the general public on the ecology and management of these resources is perhaps, the most effective strategy to conserve and protect the reefs. The project believes that the use of educational game software, configured to involve players, most specially teens, in a visually and mentally stimulating role-playing game about the decision-making process involved in the management of a coral reef and its associated watershed, major aspects of coral reef ecology, human-environment interaction, and management can be taught effectively.

The objective of this 2nd Phase of a 2-phase development project is to complete the development of the educational game software based on reports and comments submitted by users of the initial version releases, to enthral users, especially young teenagers, and instill in them a basic understanding of the complexities of human-environment interactions and ecological processes in the management of coral reefs and adjacent watersheds.
IV. Approach

The first phase of this project detailed architectural design of the software the program’s algorithm (see inset), utilizes a series of probability functions to draw the target area (upland, lowland, coastal and offshore areas). Depending on the target area, the algorithm then draws a scenario from the available scenario set for that area which the player will then face. Depending on the rank of the player (Junior Reef Ranger, Reef Ranger, Senior Reef Ranger and Park Manager), the player will have a pre-programmed time period to react to the scenario and a table of probabilities of success. The program will select the option, “No action required.”, if the player fails to react within the allocated time.

Depending on the action recommended, the player can be demoted or promoted to the next rank. The highest honor a player can have is to be promoted to the “Hall of Fame” which can only be reached from the rank of Park Manager. The game is halted (Game Over) if the biomass of the yellow tangs has reached the critical level that prevents it from recruiting back to its pristine condition (here, arbitrarily set to be 10% of the original biomass).

Parallel to the development of the program was the development of the 3-D scenes. This is the most tedious and time consuming part of this project. The scenes were constructed in 4 steps. Step 1 was the selection of the 2-D high-quality photos to use. Collections from the www.fishbase.org and the Jack Randall collection, which are available online from the Bishop Museum, were used. However, most of the published photos were readjusted for their: (i) orientation: the picture was sometimes taken at an angle and this had to be corrected, and (ii) light, color balance, hue and saturation: some photos were pre-processed in such a way that the photo no longer represented what is normally observed in the natural world.
The second step includes the creation of 3D objects. Some of these 3D objects can have as many as 1.8 million polygons. The rendered 3-D objects were created using the LightWave 3D Modeler software and textured using the corrected photos in the first step to be as realistic as possible. The 3D terrains were developed using Vue 5 software using the digital elevation map (DEM) of Oahu.

The last step is to put all of the 3D objects together and 3D motions are programmed for each object employing various algorithms functions (e.g., bone and bone weights and endo-morphing techniques) to facilitate the animation of the objects. The LightWave software was used to create the animated models.

Parallel with the programming of the software and the development of the 3-D scenes was the updating of scenarios. The initial sets of teaching points drafted by the project and the Scientific Advisory Team in Phase 1 of this project were not modified.

The sets of teaching points used in the authoring the rules were:

**Deforestation**
- Deforestation may profit industry, cities and the state, but it can lead to increased erosion which can reduce quality of life parameters and property values. Specifically, erosion often leads to increased sedimentation which can affect the quality of fish habitats and therefore the quantity of fish catches. Sustained sedimentation may also lead to the increased filling-in of river outlets which can affect boat access, destroy beaches and coastal waters. Also, sedimentation can cause coral mortality which may help lead to a coral-algal phase shift.
- If enough trees are removed, grasses may invade, inhibiting re-growth of the forest.
- Soil acidification and periodic erosion are expected. This can be even more pronounced in upland areas where clearing is done by burning.

**River Pollution**
- Lowland activities can pollute rivers leading to loss of river eco-services and damage to beaches, coastal waters and reefs.
- River pollution may persist because of burial of pollutants, especially where dredging activities persist to support river-based transports.

**Coastal Construction**
- Developing hotels and encouraging diving tourism may profit industry, city and state, but can deprive local fishers of livelihoods.
- Dredging sand for beaches to improve tourism and property values, but also have the potential to silt up reefs and damage reef ecoservices.
- Building a jetty to increase the size of your beach may deprive other beaches of sand, leading to a jetty-building domino effect and/or downstream erosion.
- Building on the fore-dunes may reduce sand build-up during winter, leading to net sand loss during summer.
- Natural shoreline and marsh vegetation are natural protection from coastal erosion and effects of storm winds and waves.
- Building a hotel along a reef may result (through runoff) in losing the reef.
- All coastal construction must be planned so as to include real public access where warranted.
- Permits to construct should always be augmented with continual review processes to ensure constant compliance with environmental standards concerning whatever has been constructed.
- Marinas may encourage ecoservice use and may profit industries, cities and states, but often lead to disrupted water circulation, disrupted coastal vegetation, pollution, and perhaps reduction of access and fishing rights.
- Beaches are ecosystems themselves.
- Beaches are made of sand that flows slowly in and away coming from various sources like rivers, corals and some species of macroalgae.

**Coastal Pollution**
- Golf courses along the coast may benefit industry, city and state but can cause pollution leading to eutrophication of water and reefs, and potentially add to HAB outbreaks.
- Golf courses with salt and low-nutrient adapted grass and recycling of water may reduce but can rarely eliminate nutrient runoff.
- Runoff from streets may pollute coastal waters
- Residential development may lead to organic pollution
- Oil drilling may lead to coastal pollution
- Discarded fishing gear can kill many Hawaiian fish and other marine species, and tangle around large coral heads to help them break away during storms.
- Discarded plastic bags, fishing line, and six-pack rings may tangle on fish, turtles and other marine life, leading to slow death.
- If the waters over a reef became constantly eutrophic or flooded with silt and mud, the beach generating capacity may be affected and beaches could be lost.
- HABs may affect human health
- Cholera may be tied to coastal pollution.

**Tourism / Recreation**
- Surfing often relies on subsurface fringing reef structures, but killing the coral may not alter this for decades.
- Muddy or sand-depleted beaches and muddy or green waters discourage surfing.
- Determining beach, ecosystem and general carrying capacities for people is extremely complex and filled with uncertainty.
- Shark nets may catch other species, and may endanger natural food webs, even when they effectively reduce shark attacks.
- Sea turtles need sand with minimal disturbance in order to breed.
Turning over stones on an inter-tidal area or underwater to find wildlife and not returning them, or doing so too frequently, may lead to the loss of that wildlife.

Touching, walking on, or sitting on corals too much may lead to coral lyses.

**Fishing/Collection**

- Artificial reefs in fishing situations usually act to increase fishing pressure.
- Subsidizing fisheries leads to increased overfishing.
- Setting aside no-fishing reserves reduces fishing grounds.
- No-fishing reserves may increase catch to adjacent fishing areas.
- No-fishing reserves may be important for supplying larvae to fished areas.
- Floating FADs may increase cannibalism, reducing target fish stocks.
- Floating FADs are only useful in reducing fishing pressure on a reef if the people who fish them are the ones who formerly fished on the reef – otherwise they often add to fishing pressure.
- Favoring sport fishing over artisanal fishing may profit city, state and industries, but may reduce local support for reef management and encourage poaching.
- Many fishers prefer to fish and lose money than to give up fishing for economic gain – and are often subsidized by family, governments, or low-interest and often non-collected loans.
- Dead shells in the ocean help support hermit crabs and marine life that would otherwise inhabit them.
- Seashell collecting is a form of fishing, with similar concerns.
- Sea turtles must migrate, and local populations may be reduced by fishing gear used elsewhere.
- Aquarium fish collecting is a form of fishing which may involve much less removal of fish biomass per unit economic return, but sometimes may focus on key species.
- Increasing fishing effort increases catches of a given species to a point, after which more fishing leads to less catch.
- Minor reductions in one species may have major impacts on other species, so basing reef fishing on single species criteria may not be wise.
- Many forms of fishing gear catch many non-target species, or do environmental damage leading to unsustainability of the fishery.
- Small-scale fishing is often more efficient in terms of distribution of profit, reduced loss to spoilage and damage, reduced environmental damage and improved social benefits than large-scale fishing, and the latter often reduces the former, even when conducted in deeper waters.
- Fishing herbivores may lead to coral-algal shifts.
- Fishing piscivores may remove population controls on herbivores, leading to fluctuations ending up in loss of herbivores and coral-algal shifts.
- One of the greatest demands of sport divers is to see large fish up close, and this directly impacts the value of the reef to tourism.
**Exotic Species**
- Species (mangroves, some seaweeds) that are beneficial and even profitable in some places can do substantial damage to coastal ecosystems elsewhere.

**Connections within and among ecosystems**
- Sea turtles are important components of reefs and seagrass beds.
- Many Hawaiian beaches are constructed from sand primarily made on reef flats and crests by calcareous algae, forams, corals and seashells.

**Bleaching / Climate Change**
- Coral bleaching may occur despite the best management actions, but a healthy reef with wise spatial management may increase the chances of reef recovery.

**Cross-Cutting**

**Stakeholder education and involvement**
- Generating coastal regulations without stakeholder involvement tends to reduce local support for reef management and encourage pouching.
- Environmentally educated stakeholders, and stakeholders with environmentally educated children, are essential in participatory management and in ensuring that local people and visitors are environmentally aware in their actions and that the government puts effective efforts into coastal protection.

**Local vs. visitors**
- In developing management strategies, it is important to take into account local access, perceptions of traditional ownership, the need for isolation and various considerations related to local vs. visitor use of resources.

**Open-access problems**
- Open-access to fisheries and other coastal industries is generally a problem, and must be reduced via zoning and access controls.

**Social disruption**
- Providing livelihoods for fishers in hotels and other industries may disrupt local social structures.

**Valuation**
- Tourist dollars must be accounted for not only as spent directly for enjoying the reef, beach, or other ecosystem, but must include indirect spending as in airports, restaurants, etc.

**Hawaiian traditions/values**
- Ancient Hawaiians practiced systems of coastal zoning and taboos which protected ecoservices.
Uncertainty

- Managers must deal with uncertainty in all decisions.
- Regulations must often be devised within a framework of periodic review and revision so as to make adaptive management feasible.
- Permanent construction may reduce the effectiveness of adaptive coastal management.

To facilitate the authoring of scenarios and importing these to the ReefRanger, a ReefRanger Authoring Tool was re-programmed. The software (ReefRanger and the Authoring Tool) was tested internally with students and volunteers.

V. Detailed description of the work performed for each objective from III(C), including (but not limited to):

A. List individuals and organizations actually performing the work

The project was coordinated and managed by the Principal Investigator (John W. McManus) in consultation with the Senior Software Engineer (Felimon Gayanilo) and the Advisory team. The Software Engineer has done most of the conceptual and development tasks but the NCORE staff and graduate students, and selected graduate students of the University of Hawaii, with support from HCRI, were very much a part of the project in advisory and editorial capacities. The graduate students of John McManus, Aletta Yñiguez whose dissertation work is in macroalgae, Marilyn Brandt who is working on coral diseases and Wade Cooper who is working on recruitment processes, have contributed to the creation of new scenarios and have assisted the authors in the completion of the documents which earned them co-authorship on the ReefRanger Authoring Tool manual.

The Advisory team consisted of:

- James Maragos, Hawaii Fish and Wildlife
- Richard Pyle, Bishop Museum
- Cindy Hunter, Waikiki Aquarium and University of Hawaii
- Dieter Mueller-Dombois, University of Hawaii
- Pat Chavez, US Geological Survey
- Ligia Collado, Florida International University

B. Material list

The project used University of Miami’s licensed copy of Microsoft .NET Studio, LighWave 8.2 and 9.0 and associated 3rd party software modules, to develop the software and the project website.

C. Construction instructions for anything used to accomplish the III(C) objectives

N/A
D. Deployment steps

The project developed and maintains a project website to announce new releases and links to the products of the project. The initial releases (BETA versions) and final version were deployed using the project website. The software and associated documents may be downloaded for free and are also available from HCRI-RP office. The project will maintain the project website beyond the life of the project and will update the software to correct programming defects as the need arises.

One of the major activities of this phase of the project is to re-develop the ReefRanger Authoring Tools to simplify the authoring of rules. The project recommends that if the game software is to be used for teaching purposes, the instructor should carefully review, edit or completely modify the set of rules to suite the target audience. The rules are password protected and may be obtained from HCRI-RP office.

E. Data collection procedures

3D Objects: Morphometrics and related information to create the 3D objects were largely taken from the FishBase website (www.fishbase.org), ReefBase website (www.reefbase.org), and other public documents.

3D Scenes: The various 3D scenes are simulated environments but are based on underwater photos available on the Internet and as observed in their natural environment by project staffs.

Rules: The rules are based on the list of teaching points (see above), discussion with the Scientific Advisory Team members, and researchers and scientists involved in HCRI-RP projects.

F. Data analysis techniques

N/A

G. Photos from research during each stage (construction, in situ, lab)

No photos were taken by this project.

H. Contact information for companies used to purchase items unique to your project (if applicable)

- For .NET software materials, see Microsoft website at www.microsoft.com
- For LightWave and Vue software packages, see www.newtek.com
VI. Results

A. Findings for each III(C) objective.

The number of active users of the published game software is insufficient to draw conclusions as to the effectiveness of the medium to educate individuals on the complex processes involved in managing resources. There is a need to design long-term activities specific to collect reactions/comments on the use of the medium for educational purposes, and to assess its impact to the conservation and protection of their natural resources.

B. Answers to III(B) each resource management question(s).

The numbers of the game software users of different educational levels, age groups, different localities and experiences in natural resource management so far may not be enough to draw conclusions to answer the question posted in the objective.

However, the wide spread of successes and failures of the initial set of players (made up of scientists, graduate students and resource managers) to keep the simulated yellow tang population from dying indicate the varied ways individuals look at what management should do. Players react to scenarios based on their experiences, levels of understanding of the ecology, and importantly, the socioeconomics and political structure of their local areas. Although still inconclusive, our findings indicate that a player’s tendency to understand things in too local a context is perhaps the main reason of their failures.

C. Site specific results for each location (Can place in an appendix as electronic file).

N/A

NOTE: If a progress report, describe results to date.
VII. Resource Management Implications

A. Given the results from VI, what are the implications for resource managers?

While it may still be inconclusive at this stage, initial results indicate the need for more activities to educate the public, not only on the need to conserve and protect the natural resources and on how human activities affect ecosystems, but also on the process and criteria (political, ecological, social and economic) used to derive management policies.

B. How do these implications and results help to address the resource management problem(s) identified in III(A)?

Community/stakeholders involvement in drafting management policies with the intent to conserve and protect the reefs will have the effect of educating the concerned individuals on the complexities involved in managing shared resources.

C. What recommendations for resource managers can be made based on the implications and results?

A participatory/community-based approach has been proven to work in many areas of the world. In the short-term, this approach makes the policies socially acceptable and provides a venue for unimpeded implementation of new management measures. In the long-term, instilling a sense of social responsibility will allow for a sustained implementation of these policies. However, there remains a need to continually educate the public on the processes involved in drafting new measures or modifying existing policies to suite the ever changing environmental conditions.

NOTE: If a progress report, skip this section.

VIII. Evaluation

For each III(C) objective:

A. Describe the extent to which the objective was attained, including:

1. Was the objective attained? How? If not, why?

Yes, the objective of the project to develop educational game software to educate/train people on the effects of management decision to the coral reef ecosystem has been achieved. Several BETA versions were released and modifications were made to the software as the need arises.

The software was tested with users of various educational levels and expertise in natural resource management. Although still inconclusive, initial results have shown that to be an effective manager, you will need a good understanding of both local and broadscale socioeconomics and political conditions, and ecology.
2. Were modifications made to objective? If so, explain.

   The objective to have an interactive interface to allow the user to explore the habitat was not implemented. This change was needed to allow users with simple computers to play the game. Adding such functions will require users to have powerful computers to play the game. Efforts were shifted to the re-rendering of the 3D scenes to incorporate more 3D objects that are common in Hawaii, and in the development of a new authoring tool to simply the authoring of rules.

3. If significant problems developed, resulting in less than satisfactory or negative results, discuss.

   None

4. Description of need, if any, for additional work.

   (1) Although the project is confident that major programming defects have already been addressed by the developers of the software, some defects may still be discovered as more people use the product. New versions of the software should be developed immediately that eliminate all observed product defects and notes issued to users indicating the changes made.

   (2) The project was able to produce enough 3D scenes to simulate the real world. However, additional 3D objects and 3D scenes are needed to capture other scenarios, e.g. invasive species issues.

   (3) Although efforts were made to draft a thorough Lesson Plan where the ReefRanger will be used, it also needs to be evaluated in an actual classroom setting. An updated or alternative “Lesson Plan” should be drafted and published based on the results of this experience.

B. What performance measures are used to evaluate how well the project met the stated objective?

   Performance of the project was measured, largely, by how well the project met the planned releases and reworks to the software as a result of reports from users, and the general reactions and comments of the users. As with many awareness-related projects, it is difficult make any conclusion on how well the project met the stated objectives this early as there are still very few users of the software.

NOTE: If a progress report, skip this section.
IX. Dissemination of Project results:

A. Explain, in detail, how the projects results have been, and will be, disseminated.

The project maintains a website (http://ncore.rsmas.miami.edu/reefranger/index.htm) where the project posts new releases and associated documentations. A direct link is also available from the HCRI-RP website. There is no need for interested individuals to register their copy. Updates and new releases will also be posted through this website.

A CD-image of the software is also available at the HCRI-RP office and may be requested by interested individuals who have problems in downloading the files from the project website.

Further dissemination of results of the project will be in the for of peer-reviewed research paper.

B. List of publications, workshops, and presentations

Publication(s):


Workshop(s):

None

Presentation(s):

None

C. Data or information products

The 2-CD version of the educational game software is available for download at the project website at no cost. Disk 1 image is about 606 MB and the second CD image is about 571MB. The CD version of the software is also available from HCRI-RP.
D. Partnerships established with agencies or organizations

The core partnerships established for the project are with scientists and researchers that are involved in HCRI-RP projects. This includes, among others, scientist from the Hawaii Department of Aquatic Resources (DAR), and scientists and researchers from various departments of the University of Hawaii at Manoa.