The Rufford Small Grants Foundation

Final Report

Congratulations on the completion of your project that was supported by The Rufford Small Grants Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole

Grants Director

Grant Recipient Details	
Your name	Yael Horoszowski
Project title	"GARDENING CORAL REEFS": TESTING THE APPLICABILITY OF USING NURSERY-GROWN CORAL TRANSPLANTATION FOR CORAL REEF RESTORATION
RSG reference	23.09.06
Reporting period	May 2007 – May 2008
Amount of grant	5000£
Your email address	yaelh@ocean.org.il
Date of this report	30/05/08

1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Test the applicability of the "Gardening coral reefs" concept for restoration of degraded reefs			+	This method was found applicable and generated promising results. New nursery-grown colonies can be used in order to restore large areas of degraded reefs.
Asses the survival and acclimation of the new transplants at their new environment			+	The mortality rates of the new transplants were very low (less than 10%), revealing a survivorship similar to the natural colonies monitored at the site, serving as controls.
Asses the engineering impacts of the nursery-grown colonies of creating new spatial and ecological niches for invertebrates and fish			+	The new transplants were quickly colonised by coral-obligatory invertebrates including *Trapezia* crabs, Alpheus shrimps, *Spirobranchus* worms and *Lithophaga* molluscs. Fish abundance increased on transplanted knolls as compared to control knolls monitored at the site.
Asses the transplant's ability to contribute to the coral reproduction at the restoration site			+	The new transplants were documented liberating planulae during the reproduction season.
Ameliorate transplantation techniques in order to develop farmed-corals restoration guidelines			+	We have gained a lot of knowledge and experience regarding the methodology. Still more work is needed, and this can be further refined, especially regarding the attachment of the colonies to the substrate at the nursery, and the transplantation of this substrate on a hard support at the reef.

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

The project had to be approved by the Israel Nature & National Parks Protection Authority and coordinated with them. The permit reception took longer than anticipated. Although the grant was awarded on December 06, the project only begun on May 07.
We were surprised that transplanted colonies of *Stylophora* and *Favia* were attacked by local fish (*i.e.* butterfly fish grazed on polyps, parrotfish broke branches or scrapped tissue) immediately following their attachment to the new sites. Those attacks led to tissue damage, loss of branches, and, in extreme cases, to the detachment of the colony from the substrate. We did not want to

intervene or replace the damaged colonies since those results were crucial for estimating the success of the method. While at first we worried about the fate of the damaged corals, we later discovered that the attacked colonies were able to quickly recover.

Some of those fish attacks and some diving activity at the site led to the detachment of colonies. This detachment should be minimized, and we are looking for new methods to attach the corals to the substrate on which they are cultivated at the nursery that will render the coral-substrate junction less fragile. A small group of colonies was raised on plastic anchors, a method that seams to reduce the detachment phenomenon. Some more experimentation is needed in order to be able to conclude that this reduces significantly the detachment.

3. Briefly describe the three most important outcomes of your project.

The most important outcome of this project is that the new concept of the Gardening coral reefs was found to be an applicable technique that can replace direct transplantation methods. Using this method changes the scale at which rehabilitation acts can be done because of the ability to generate a huge stock of new corals that can be used for this purpose and that without any harm to natural reefs. Using this method allows the use of whole colonies, instead of coral fragments, which substantially increases the corals' ability to acclimate in the damaged areas and has additional ecological impacts due to the spatial complexity of a colony as compared to fragments.

The second important outcome of this project is the fact that by using this method, not only the coral community is rehabilitated, but the whole carrying capacity of the habitat is increased due to the new ecological and spatial niches added to the site. This allows reef associated invertebrates and fish to colonize the new space, and thus, the number of fish and invertebrates living in the restored area increases. Consequently, by using the gardening method not only the coral community is reinforced, but the whole associated coral reef fauna.

A third important outcome of this project is that by synchronizing the transfer of the new nursery-grown colonies from the nursery to the degraded reef with the reproduction season, their contribution to the restoration of the coral community at the site can be doubled. The new transplants liberate planulae, sometimes in larger numbers than the natural colonies at the site due to the good physiological condition after growing in idyllic conditions at the nursery, and thus further enhance the coral community at the restoration area.

4. Briefly describe the involvement of local communities and how they have benefitted from the project (if relevant).

Although this project did not have any aim of involving local communities, while transferring the colonies and transplanting them at a site located in front of a diving centre, it has generated a lot of curiosity of people watching the activity. This has generated a lot of conversations in which we had the opportunity to increase the awareness of those divers and vacationers to the problem of reef degradation and the contribution of recreational activities such as diving and reef walking to the damage. Since then, a lot of people followed the project's progress and showed interest in our results. In addition, the diving centre started talking about the project and the degradation problem of the reefs during their diving courses, creating more aware divers that, hopefully, will make more effort to preserve and not harm the reefs when diving.

5. Are there any plans to continue this work?

Yes, this work will be continued. The transplanted colonies as well as the associated invertebrates will continue to be monitored during the next 2 years. The colonies will also be examined for reproduction during this period. We are planning additional transplantations with more species in order to continue to deepen our knowledge and to collect more information, allowing us to create a new technology and methodology available for costal managers and decision makers to use.

6. How do you plan to share the results of your work with others?

I plan to publish this work's results in scientific literature and present them in conferences and symposiums (the Coral Reef Symposium 2008 in Florida, for example).

7. Timescale: Over what period was the RSG used? How does this compare to the anticipated or actual length of the project?

The RSG was used over all the reported periods. This conforms to the planned period of the project that was supposed to be financed by the RSG.

8. Budget: Please provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Tank rental and filling	990£	962£	-28£	
Diving equipment maintenance and partial renewal	220£	238£	18£	
Diving insurance	120£	120£	0£	
Plastic slates and underwater paper for surveillance	75£	90£	15£	
Boat transport of the nursery-grown corals from nursery to the restoration site	430£	430£	0£	
Transport between laboratory and field, including bus and taxi fees	1300£	1280£	-20£	
Memory card for underwater camera	75£	75£	0£	
Plankton nets for larvae collection	120£	133£	13£	
Glue for underwater work	130£	147£	17£	
Dymo and dymo stripes for coral marking	70£	88£	18£	

Posters for explanation and awareness to hang at diving clubs	110£	110£	0£	
2 pneumatic drillers	90£	135£	45£	An additional driller was bought (total of 3 drillers)
2 first stages and hoses for pneumatic driller	250£	375£	125£	An additional first stage and hose was purchased (total of 3 sets)
Trays for coral transfer, plastic frames with nets as coral colonies holders	230£	242£	12£	
Plastic containers for coral transfer	85£	85£	0£	
Video camera and underwater housing rental	420£	420£	0£	
Plastic frames for settlement surveillance	60£	69£	9£	
Material for underwater work (such as plastic cups for larvae collection, cables, small buoys, plastic clips, plastic ware, glassware, etc)	225£	213£	-12£	
TOTAL	**5000£**	**5212£**	**212£**	The difference of budget was supported by the laboratory I belong to (B. Rinkevich, National Inst Oceanography, Haifa, Israel - IOLR)

9. Looking ahead, what do you feel are the important next steps?

Most of the reef restoration projects are short term studies. It is very important to continue monitoring this restoration experiment, done by our new gardening methodology, not only to continue assessing its success, but also to obtain long-term results and to better understand restoration impacts on coral reefs. This monitoring is also essential for our understanding whether our rehabilitation efforts are sustainable, and not only impact in the short run.

In addition, it is also important to continue following the new transplants reproduction in order to use this knowledge in future transplantations and benefit from its contribution. It is important to understand if the self seeding of an area, where colonies do not reproduce due to stress, can be restored by adding gravid colonies coming from nurseries.

Transplanting a larger number of nursery-grown colonies and incorporating additional coral species are also part of the future steps. It is important to demonstrate that this method is applicable to different species of stony corals and can be applies in large scale restoration acts.

In parallel, we have to continue refining the methodology and improve the attachment of the colonies to the rearing substrate in order to reduce detachment. We would like to extend the gardening concept and develop new transplantation techniques in order to make this method

suitable not only for hard substrate areas restoration but also for degraded areas containing send, rubble, etc (due to anthropogenic damage of the reef substrate from dynamite fishing for example).

10. Did you use the RSGF logo in any materials produced in relation to this project? Did the RSGF receive any publicity during the course of your work?

Yes, I have used the RSG logo in all my project presentations. The RSG received publicity at the international REEFRES 07 workshop Bolinao (Philippines) and at the Israel National Centre of Mariculture (NCM) seminar. I have also talked to peer students about the RSG support of the project and suggested them to apply.