

**Ripple Effects:
A study of the outcomes of taking university students to a local coral reef**

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**Publication information: Chapter in Filho, W.L. & Carpenter, D. (Eds.)
Sustainability in the Australasian University Context (2006). Frankfurt: Peter Lang.**

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By Carl Stepath and Hilary Whitehouse

“I reckon a day in the field is worth ten days in a lecture theatre” (JCU student)

It is generally accepted that outdoor, experiential education is an effective dimension of education for sustainability. Field visits and similar experiences of country are designed to enable greater understanding and increased awareness of special places and encourage future actions towards enhancing the sustainability of these valued places in the face of increasingly intense pressures on their biophysical and ecological integrity.

The coral reefs off the coast of northern Queensland are very special places. The Great Barrier Reef (GBR) is the name given to an extensive chain of diverse coral reef environments now designated as World Heritage and managed by a number of governmental agencies including the Great Barrier Reef Marine Park Authority and several Queensland state government departments. The Cairns campus of James Cook University is located close to numerous coral reefs, and Cairns is well known as an international destination for people wishing to visit the Great Barrier Reef and the World Heritage listed rainforests of the region. The Great Barrier Reef is estimated to be worth 1.2 billion AUD\$ annually to the Queensland economy.

Our story documents the ripple effects of taking university students enrolled in both environmental studies and education programs at James Cook University to an offshore reef in 2002 and 2003. The research was conducted as part of Carl Stepath’s doctoral studies in marine education in which tested the effectiveness of a number of educational strategies for what he calls ‘coral reef advocacy’ within formal education settings. In this paper, we report on research conducted with undergraduate tertiary students and the use of coral reef monitoring as a pedagogical device for enhancing reef learning. We present *in situ* qualitative data on tertiary students’ experiences and analyse the effectiveness of coral reef monitoring as a learning strategy. We then describe some unpredicted ripple effects of how this research project enabled education students to support changes in experiential educational practices at a Cairns primary school. This a positive story of individuals learning how to take up the challenge of education for sustainability in a community socially and economically dependent on the conservation of healthy coral reefs.

The use of coral reef monitoring as a pedagogical device

Transect line coral reef monitoring was devised by Dr Gregor Hodgson, Institute of the Environment, University of California Los Angeles, as a means for enabling community monitoring of the ecological health of different reef environments. Volunteer groups are active in coral reef monitoring in 82 countries and territories around the world (Reef Check 2005). This particular monitoring method is easy to teach and scientifically valid.

The technique involves laying a 50 meter transect line underwater along section of reef substrate and surveying the numerical presence of key marine organisms. Monitoring requires the use of snorkeling equipment and waterproof field guides. Recording is usually done using underwater pencils and plastic recording boards. These low technology demands enable many thousands of people to scientifically monitor their local reefs with data being submitted to and managed by Reef Check.

Carl became interested coral reef monitoring in Hawaii in the 1990s as part of his volunteer work in coastal environments. When he moved to Australia to undertake doctoral studies at James Cook University, Carl worked with the Cairns and Far North Queensland Environment Centre (CAFNEC) in 2001 to train volunteers from the Cairns community to monitor local reefs. On one of his CAFNEC trips, it occurred to Carl that this scientific technique could be applied as a formal teaching strategy. Observation and recording of species along a transect line focuses attention on the living organisms which form reefs. Particular attention is paid to the substrate of reefs such as the relative abundance of soft and hard corals, coralline and non-coralline algae and sponges; the presence of key invertebrates such as shrimps, clams, crabs and holothurians; and the presence of indicator fish such as parrotfish. The monitoring process enables people to comprehend and apprehend reef environments in a purposeful way. Reef monitoring can therefore serve a pedagogical purpose to be used as a structured and focused learning experience as part of a day reef trip.

The research process

To test the proposition that coral reef monitoring is useful as a pedagogical device, Carl approached two academic staff, Dr Elaine Harding, lecturer in GE2455 Natural Process, a second year environmental studies subject, and Dr Hilary Whitehouse, lecturer in ED3192 Science Education for Primary Schools, a third year education subject, and asked to conduct voluntary research with their students. In 2002 and 2003, Carl took a total of thirty JCU undergraduate students on four different trips to Fitzroy Island a 55-minute boat ride from the centre of Cairns (Stepath, 2006). 14 environmental studies students and 16 education students participated in this study. Numbers were limited as volunteers had to also pay for their own boat trip, about AUD\$25 return, and travel on a Saturday. On each trip, Carl taught the volunteers how to monitor the fringing reef on the northwest side of Fitzroy Island. The effectiveness of coral reef monitoring was researched by conducting pre-and post event surveys and recording structured interviews with undergraduate students *in situ* (on the island and the boat) on audio and videotape. One trip was marred by cold and blustery weather. A surprising number of these tertiary students (n = 11) had never been to a coral reef.

Coral reef monitoring is not part of the formal tertiary curriculum in either education or environmental studies at James Cook University, Cairns, so this was a new experience for all participating students and their lecturers. The sample size (n = 30) was too small for quantitative data to have significance so we have relied on the results of the qualitative research to focus on “the experiences of individuals and the meanings they make of their experiences” (Allison and Pomeroy 2000, p. 91).

Tertiary students describe coral reef monitoring

The value of reef monitoring was summed up by an education student who stated, “It is a good way of getting us to look at what is under the water”. Students were asked directed interview questions on their experiences of monitoring. Responses presented here indicate students saw meaning in being asked to look closely at reef organisms found along a transect line and record their observations. (Note: ED indicates an education student, ES indicates an environmental studies student)

It was really nice to ‘get out of the office’. It was beautiful and it was nice to spend time at one place and start to appreciate the patterns, to make a bit of sense of what is going on. I have never had a close look at one of these reef places and I had never looked at a reef systematically before, so that was pretty interesting. It’s a good idea to do something useful and slow people down so they are actually stopping and looking carefully and not just swimming through (ES male)

Because you are moving along a transect you really have to look closely at what is there (ED male)

It was meaningful to look at a defined area of reef. When you just go snorkeling, you snorkel on top of a large area, but I found it meaningful to have an enclosed sort of experience. I enjoyed the intensity of the experience, the closeness of getting right in there. (ED female)

I had never written anything underwater [before] and that was a plus except that there were two kayakers having a race right over the transect [line] and that scared the fish away. (ES male)

Systematic observation focuses attention on the relative abundance of living bodies, which compose coral reefs. It is difficult to count and record plants and animals unless you are also able to identify them. Learning to recognize a dozen or so common species made a difference to students’ willingness to feel more comfortable in what is otherwise, an alien environment. If one aim of sustainability education is to increase biological understanding, then reef monitoring does seem to have an effect on these tertiary students’ appreciation of the lives of corals and “the lifestyles” of fish.

I never knew corals were animals, I thought they were a kind of plant. I thought they just photosynthesized and they needed lots of nutrients. (ED male)

I’ve lived here all my life and I didn’t know that a coral is a little animal with a plant inside it and they depend on each other to live. (ED female)

The most interesting thing was all the coral. There was not as many fish as I thought there would be, but I was surprised at the amount of coral. (ES female)

I know what coral bleaching is now. I’ve seen it. (ED female)

I learned how to identify fish and corals and learned more about the lifestyles of fish. (ES female)

It is a lot different to learning from a book. When you are out there, it is like, “Oh, my goodness, I can pick out a butterfly fish”. You can read about it in a book, but when you actually [monitoring] it takes on a different meaning, like it is actually real. I discovered how to distinguish between hard and soft corals. I ran my hand past them to see. I didn’t really understand that before. (ES female)

I did like going out to the reef even though I was a bit apprehensive at first. The reef monitoring helped my awareness, though we had to allow time for the fish to come back. I learned a lot more about coral and the plant living inside the animal and to observe that relationship. I find that amazing. (ED female)

Now I can name the animals and that’s cool. I didn’t know what they were before, they were just pretty, but I know some names now. (ED female)

I saw one of those unicorn fish. It looked just like a rat with a point on its head. When we came up the beach I had no idea what it was and I had a look in the book and it matched the picture. (ED male)

Reef monitoring takes place in an energetic, liquid environment. One advantage of using a transect line is that snorkelers are confined to one area of ocean, which enhances water safety. Of concern on any reef trip is the weather, the height of the seas and the strength of the current. In fine weather, students were concerned about getting sunburned and in poor weather they suffered seasickness and found the water cold. A number of students were worried about their abilities to swim “strongly”, so Carl provided boogie boards for support. There were the usual problems using snorkeling equipment and some found it difficult to use the transect line.

I learned how to go along a transect line when you are floating in a current otherwise you can be carried away. (ES male)

It’s easier to go into a forest. You just lay down the transect line and walk around and what you are trying to record doesn’t move. (ES female)

Monitoring is fun but I don’t think I am a very good snorkeler (ES female)

I liked how our instructor [Carl] jollied us along even though we were sort of dying from hypothermia. (ES male)

I personally was really cold in the water and couldn’t write straight [on the record boards]. (ES male)

Everything is good, except tomorrow morning when I'm going to be peeling my skin. (ED male)

The snorkeling was exhilarating, even though I am not a strong swimmer and the current was taking me away from the transect line ... which kept flipping over in the current and I couldn't read the measuring marks. (ED female)

All students interviewed saw value in the reef monitoring exercise. As one student noted, "Just the experience is worth it". When asked the question how monitoring could be improved, most students said the monitoring was at least satisfactory and many said the experience was enjoyable and "fun". Transect line monitoring is not only a means for collecting scientific data, but can be effectively employed as a pedagogical device for encouraging active engagement with coral reefs.

I learned so freaking much my head is chock full. Seriously. I have had no previous experience with coral reefs, ocean wildlife or snorkeling, so I was absolutely blown away. I learned about different types of coral, their amazing colours and their destruction and die off. I learned about different types of substrate and what hides and lives in this ocean. The fish were amazing ... I saw a ray, a shark a turtle and had an absolutely amazing time. I have so much more appreciation and knowledge of coral reefs and this ocean ecological system. (ES male)

The value of reef experiences

There is value in providing tertiary students in north Queensland with proximal experiences of reef environments. A number of students when directly asked to describe their experiences, talked about the value of a "hands-on" approach in developing their understanding of coral reefs; in understanding the biological diversity to be found in coral reefs; and the importance of coral reefs to "quality of life".

This is better than learning in the classroom because you get a hands-on approach and you don't have to sit there in a boring classroom falling asleep. You actually get to go out and experience the elements. This is right on our doorstep and we should know about it. Every time I go [to a reef] I feel more connected to it. (ES female)

It's good to get outdoors and interact with the environment we live in. I think that every time you take a trip to the reef you feel more connected to it. You get more familiar with the place, more familiar with the environment, with diving around and seeing things (ED male)

I enjoyed being on the island, in the sun, on the reef and swimming around with fish. It was lovely. Coral reefs are incredible. They must be one of nature's best architects. Corals are building immense structures right along the Queensland coast and [in] other locations around the world and it is amazing, absolutely incredible. (ED male)

I don't think I would have got such a quality learning experience from a textbook. The hands-on experience of actually looking at coral is how you gain far greater understanding than looking at textbooks (ED female)

Human beings need to come and see the reef so that it makes them more passionate about diversity (ES female)

We need the reef, even though we kind of take it for granted. It was interesting to find out that, as a local, I know very little about the reef. This trip became meaningful because I realized what I didn't know and what I should know. (ED female)

This experience gives you a lot more power to say, "Well. I have been to a reef, it is a beautiful place. I saw these species of fish and coral and it is worth protecting". You do need to go see it. Like a lot of environmental things, reefs make our quality of life better and eventually, if the quality of life is so low, what is the point in living if you are living in dirty areas and you can't swim. We need reefs for our quality of life. (ES female)

I don't think humans need coral reefs for our survival but the world would be a much poorer place without them and aesthetically, it would be a very poor planet without them, just as if we didn't have literature or music. (ED male)

One declared aim of sustainability education is "a rediscovery of our connections to the natural world" (ISOS 2003). When people have learning experiences in (and of) marine environments, the concept of a coral reef is transformed from the abstract to the concrete. Personal experiences of coral reefs change what Probyn (2003) calls "relations of proximity". What becomes known as 'near' can no longer subjectively rendered as 'far', and even alien underwater environments can be subjectively experienced as intimate and 'connected to' those who dwell on land. By contrast, an unvisited reef can readily be "taken for granted" and disconnected from everyday concerns. Experiential education can enable connection with offshore coral reefs and can establish them as "aesthetically" (as well as ecologically) important places.

"Authentic learning" in coral reef environments

An important, though not predicted research outcome, was that the education students, as intending teachers, gained significant insights into how to run a field trip in a marine environment and how to include shallow water snorkeling as part of the day's experience.

Once you are aware of what is happening out here, you can start in schools. Education about reefs is really important. This is authentic learning. It's making a connection between theory and real life. We are valuing what we are learning by seeing the connections and this is what we need to be doing with children (ED female)

It does actually make me a bit more aware coming out here and experiencing the reef. You learn better with hands on, touching, snorkeling. I thought it would be good from my future [primary school] students as well. (ED female)

Coral reef monitoring helped me feel confident that I will be able to bring my class out here and undertake these activities. I was excited when I saw that just in shallow water there were so many types of corals and fish. I had no idea about the variety. (ED female)

This helps us to be more professional in terms of helping children understand what's going on with coral reefs. (ED male)

I got an overview of how to teach kids about reefs and break down the barrier of the fear thing about taking kids to the reef. (ED female)

Bennett and Heafner (2004, p.90) argue one of purposes of teacher education is to “provide experiences that prepare students who are competent and confident in contributing to environmental education in their schools”. Provision of reef experience could be significant in enhancing future possibilities for education. Voluntary participation in this small research study enabled a number of future teachers to overcome a fear of marine field experiences. Eight volunteers subsequently accompanied a class of nine and ten year olds on their school trip to Fitzroy Island.

Ripple effect: Year 4/5 at Whitfield State School go snorkeling

We took a composite Year 4/5 class from Whitfield to Fitzroy Island ... We had a group of eight to ten students each. Having done the coral reef monitoring we were much more prepared. We really wouldn't have known what to do before as we didn't know much about corals at all, even though Year 4/5 kids are up with that stuff. You took the pressure off us. It just seemed a bit more fun as if the anxiety and intensity had gone. You showed us this could be fun and educational at the same time and we did the same thing for our [primary] students, just made it a bit more fun. It's a day away and when you are having fun you are learning as well. When I have my own class I will actually encourage them to get out and about. (ED male)

In 2003, Ms Anna Holland and Ms Simone Calligaro were in charge of a combined year 4/5 class of 51 students at Whitfield State School, Cairns. Anna and Simone had taken their class to the Whitfield Range environmental park to explore rainforest and to the pioneer cemetery to examine Cairns' history as part of the class's Local Area Study. In reviewing her primary students' prior experiences, Anna discovered that over 85% of the class members had never been to a reef despite living so close to one of the world's most valued marine environments. She mentioned the fact to Hilary that she would like to take the class to study a reef as a “local area”. But Anna was hesitating due to the logistics and legalities involved in taking 51, nine and ten year olds into an offshore marine environment. Just thinking about the risks in order to address a risk minimization strategy

proved daunting. However, Hilary had recently accompanied Carl and a group of volunteer education students on an excellent research trip Fitzroy Island. An idea was hatched.

At first, Hilary asked Carl if he would lead the proposed trip to take the children to Fitzroy Island, but he refused on the grounds that Anna, Simone and Hilary were perfectly capable of doing this, despite their nervousness. Hilary sent out a request for assistance, and eight of the education students involved in the research committed to joining the class trip in October 2003. A series of rotational activities were planned for the day and the education students took the lead in planning the curriculum and gathering resources. The willing contribution of education students, their confidence buoyed from having experienced a reef monitoring trip, made all the difference in deciding that it was possible to take so many children to Fitzroy Island and have them all snorkel on the fringing reef.

The day of the trip was very hot (the surface temperature of the sand at midday sun was 41 degrees C). The seas, however, were calm. 50 out of 51 children went snorkeling in stinger suits and snorkeling gear hired from the island's dive shop. This is a highly unusual result.

Primary teachers in Cairns are understandably cautious about taking their students to local reefs. The brave souls that do go tend to restrict children to knee-deep water on the beach and use viewing boxes to glimpse the underwater environment. One effect of the research was to engender a state of confidence with intending primary teachers that they can and would take students to offshore islands and once there, would encourage them into the water.

It was quite easy really. All I said was, "Come on" and in they all came in. There was only one who refused to put his head in the water. But all the rest did. And then I couldn't get them out. They didn't want to leave. (ES female)

The result of this day was that 43, nine and ten year olds, who had never been to a reef before in their lives, got in the water and went snorkeling alongside their 7 more experienced classmates as part of their primary school Local Area Study. These children's experiences of being underwater on a coral reef at so formative an age may yet have ripple effects about which we can only dream..

Anna Holland is planning another trip to Fitzroy Island this year and the education students have now graduated and are working as teachers in primary schools in the Cairns area. Many report they are planning reef trips with (and for) their own students either this year or next.

To finish, we'd like to leave you with this well known poem by ee cummings whose work can reminds us that, in search of sustainability education, we do need to find ourselves in the sea.

maggie and milly and molly and may

*maggie and milly and molly and may
went down to the beach (to play one day)*

*and maggie discovered a shell that sang
so sweetly she couldn't remember her troubles, and*

*milly befriended a stranded star
whose rays five languid fingers were;*

*and molly was chased by a horrible thing
which raced sideways while blowing bubbles: and*

*may came home with a smooth round stone
as small as the world and as large as alone.*

*For whatever we lose (like a you or a me)
it's always ourselves we find in the sea.*

ee cummings

About the authors

Carl Stepath completed his PhD in experiential marine education with the School of Education and the School of Earth and Environment Science at James Cook University, Cairns, Queensland, Australia. He is currently a sustainability and marine education consultant for Save Our Seas. Email: cstepath@yahoo.com

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Acknowledgements

We would like to sincerely thank Dr Elaine Harding, School of Tropical Environmental Studies and Geography, James Cook University, Cairns; Ms Anna Holland, Ms Simone Calligaro and Mr Tony Constance (principal) from Whitfield State School, Cairns; and all the students from James Cook University, Cairns, who so willingly and graciously participated in this research.

Referencing this article

Stepath, C., and Whitehouse, H. (2006). Ripple Effects: A study of the learning outcomes of taking university students to a local coral reef, Chapter in Filho, W.L. & Carpenter, D. (Eds.) *Sustainability in the Australasian University Context*. Frankfurt: Peter Lang.

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