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This special issue is dedicated

to the memory of

Dr. Dioscoro S. Rabor

Preeminent Philippine Zoologist and Passionate Conservationist
Professor, Silliman University, 1947 – 1967
Honorary Doctor of Science, Silliman University, 1974
Fulbright and Guggenheim Fellow, Field Museum of Natural History
"Father of Philippine Conservation"

and to

Dr. Angel C. Alcala

Professor of Research and Director, Silliman University Angelo King Research Center for Research and Environmental Management
Former Secretary, Department of Environment and Natural Resources
1992 Ramon Magsaysay Awardee for Public Service
Former President, Silliman University
Former Dean, College of Arts and Sciences, Silliman University
Former Vice-president for Academic Affairs, and Vice president for Research, Extension, and Development.
Founder and first Director, Silliman University Environmental Center and Marine Laboratory

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NOTICE TO AUTHORS

The SILLIMAN JOURNAL welcomes contributions in all fields from both Philippine and foreign scholars, but papers should preferably have some relevance to the Philippines, Asia, or the Pacific. All submissions are refereed.

Articles should be products of research, taken in its broadest sense; a scientific paper should make an original contribution to its field. Authors are advised to keep in mind that SILLIMAN JOURNAL has a general and international readership, and to structure their papers accordingly.

SILLIMAN JOURNAL also welcomes the submission of "Notes," which generally are briefer and more tentative than full-length articles. Reports on work in progress, queries, updates, reports of impressions rather than research, responses to the works of others, even reminiscences are appropriate here. Book reviews and review articles will also be considered for publication.

Manuscripts should conform to the conventions of format and style exemplified in this issue. Whenever possible, citations should appear in the body of the paper, holding footnotes to a minimum. Documentation of sources should be discipline-based. Pictures or illustrations will be accepted only when absolutely necessary. All articles must be accompanied by an abstract and must use gender fair language. All authors must submit their manuscripts in duplicate, word-processed double-space on good quality paper. A diskette copy of the paper, formatted in MSWord 6.0 should accompany the submitted hard copy.

The Editorial Board will endeavor to acknowledge all submissions, consider them promptly, and notify authors of its decision as soon as possible. Each author of a full-length article is entitled to 20 off-print copies of his/her submitted paper. Additional copies are available by arrangement with the Editor or Circulation Manager before the issue goes to press.

editor's notes

The people who get on in this world are those who get up and look for the circumstances they want and, if they can't find them, make them.
George Bernard Shaw

What ever you can do or dream you can, begin it.
Boldness has genius, power, and magic in it. Begin it now.
Johann Wolfgang von Goethe

And the day came when the risk to remain tight inside the bud was more painful than the risk it took to blossom.
Anais Nin

In this issue. On September 1, 1954 the first issue of Silliman Journal was entered as a second-class mail matter at the Dumaguete Post Office. Published with grants from the James W. Chapman Research Foundation, this inaugural issue was edited by Pedro Dimaya and had for its managing editor, Edith L. Tiempo. Constituting its Board of Editors were Dioscoro S. Rabor representing the Biological Sciences, J. Elliott Fisher for the Social Sciences, Gerardo A. Imperial for the Physical Sciences, and Edilberto K. Tiempo for the Humanities. Lino Q. Arquiza served as the Business Manager. At that time, the annual subscription was P6.00 and individual copies sold for P1.50.

Envisioned as a quarterly academic publication for disseminating results of scholarly inquiry, Silliman Journal was intended principally as a means of communicating knowledge among scholars in the sciences, social sciences, and the humanities, and mediating the conversation among these disciplines long before the terms multidisciplinary and interdisciplinary have gained currency. The impetus behind its creation has been the recognition of the centrality of its place in promoting the development of academic research and high quality scholarship in particular and advancing the quality of education at Silliman University in general. With this inaugural issue, SJ joined a growing list of academic journals dedicated to establishing and maintaining critical and objective scholarship.

It has been 50 years since the first issue came out and the intervening years have seen a succession of preeminent members of the Silliman University faculty taking over the reins of Silliman Journal and producing admirable collections of articles contributed by equally renowned names in the sciences, social sciences, and the humanities. Much of what Silliman Journal has achieved in the span of 50 years owed largely to the works of several generations of editors and members of the editorial board who strove to produce publications of the highest academic and production standards in every issue and thus ensured the reputation of the journal as a scholarly publication. On this golden anniversary celebration, Silliman Journal recalls with gratitude the men and women who have been instrumental in its growth and progress. In dedicating these special issues to them, I harken back to the words of Alice Walker:

> To acknowledge our ancestors means we are aware that we did not make ourselves, that the line stretches all the way back, perhaps, to God; or to Gods. We remember them because it is an easy thing to forget: that we are not the first to suffer, rebel, fight, love and die. The grace with which we embrace life, in spite of the pain, the sorrows, is always a measure of what has gone before.[1]

In conjunction with this tribute, the special science edition honors two of Silliman Journal's most illustrious forebears whose dedication to excellence continues to animate the pages of Silliman Journal and whose life and works provide us with a model to emulate in guiding Silliman Journal's destiny towards its next golden anniversary:

> The late Dr. Dioscoro S. Rabor, eminent zoologist and conservationist, was a member of Silliman Journal's Editorial Board from its inception in 1954 to the time he left Silliman in 1967. Largely through his pioneering research work in the biological sciences, Silliman University has achieved what all universities aspire to - excellence in teaching and international recognition in research. Results of many of his wildlife studies research published in Silliman Journal have helped to secure for the journal its reputation as an international scholarly publication, thus attracting a continuing stream of high quality manuscripts from both local and overseas scholars;
>
> Dr. Angel C. Alcala, Professor of Research, former Silliman University Vice President for Research and Development, former President of Silliman University, and 1992 Ramon Magsaysay Awardee for Public Service followed in the footsteps of his mentor, Dr. Dioscoro S. Rabor, to continue the tradition of excellence in research and in teaching. Mainly through his efforts, Silliman University has experienced considerable growth in both capacity and research capabilities, which has enabled it to provide outstanding service to the country. As our records show, Dr. Alcala's association with Silliman Journal also spans nearly 50 years starting with the publication of his article in 1955. To date, holding the distinction of having the most number of articles in SJ among the entire faculty of Silliman, Dr. Alcala is the living witness of Silliman Journal's growth into an international publication.

It is a humbling experience to walk on the same path on which such distinguished predecessors have trod and to follow in their footsteps. I can only hope that as heirs of their legacy, my colleagues and I will prove worthy of this inheritance. It is said that, "the measure of any tribute is not how it commemorates a person, but in how it creates new ways of imagining the future once he or she is gone…in the best scenario, it is to witness the lighting of a symbolic candle and to take part in keeping it burning." This golden anniversary celebration is for us a reminder of this duty—the duty to continue the dissemination of results of scholarly inquiry, to hold sacred the unique exchange between authors and readers, to endeavor to create opportunities for Silliman faculty and other scholars to engage in writing and publication, and to strive to maintain excellence in academic research, scholarship, and publication.

Yet, keeping this duty has been for us—as much as it must have been for those who came before us—a constant challenge, familiar as we have all become with the vicissitudes of academic journal publication—heavy production costs, the waxing and waning of scholarly manuscripts, much editorial preparation, complex typography and artwork, low print runs due to their limited market, and very low financial returns—all of them combine to create irregular publication, late release, and uncertain continuity. That SJ has survived these vicissitudes through 50 years attests as much to the vision and courage of those who shaped its early years as to Silliman University's support for it and commitment to academic excellence.

For these reasons alone, there is much to be proud of this milestone and much to celebrate the changes that have taken place over the span of half a century. This golden jubilee gives us an occasion to review some of our accomplishments. For lack of space, I mention only three major accomplishments over the last six years: (1) the introduction of the peer-review process, (2) the inclusion of the Overseas Editorial Board, and (3) the use of information technology in journal production. The review of the editorial policies in 1998 and the consequent overhaul of the editorial board membership ushered in one of the most creative periods in the life of Silliman Journal. This was a time marked by many creative agitations that manifested themselves in both the content and format of the journal. One of the most significant changes introduced during this time has been the peer-review process. An important aspect of academic publications, the peer-review process is used to assess the quality of a manuscript submitted for publication and evaluate its importance. In providing a standard level of qualitative assurance, it allows for the selection of the best materials while influencing what enters the public domain. In this way, it helps to improve the quality of research and the papers that appear in print. From this period onwards, all manuscripts submitted to Silliman Journal for publication have followed standard academic peer review processes by specialists of respective disciplines both from here and abroad.

Hand-in-hand with the introduction of the peer-review process was the inclusion of international specialists in the Overseas Board of Editors. Coming from a variety of disciplinary backgrounds, these scholars and specialists review submissions and assist in locating other reviewers among their network of experts. The professional, functional, and geographical variety of their institutional affiliations reflects the diversity and interdisciplinary nature of Silliman Journal.

But perhaps our greatest achievement so far is in exploring the impact of technological change on the production of the journal. Because Silliman Journal had no headquarters to speak of, it helped that I was also the Chair of the Department of English and Literature when I became Editor and Chair of the Editorial Board in 1998. Consequently, the English Department has not only provided SJ a home for the last six years, but since that time, has also been generously lending its equipment for the production of the first of the subsequent issues using desktop publishing systems and special word-processing software. With this new technology, we have been able to produce the issues much more efficiently and prepare camera ready copies, thus providing a higher quality output, while reducing production cost and time.

About this time, too, the English Department had started subscribing to a private Internet Service Provider in the city and was among the first units in the university to have its own Internet connection long before the campus computer network was in operation. From this time on, the Internet connected SJ to the outside world facilitating call for papers, submissions, and peer-reviews in less than half the time it would have taken these communications to reach their destinations. Contact with prospective authors, reviewers, and potential subscribers around the world not only became possible but widened considerably at a speed undreamt of just a few years before. Needless to mention, the impact of the technology of the Internet on the processes of journal production, in enhancing the quality of the finished product both in terms of content and format, and in particular in creating for SJ a larger audience worldwide cannot be overstressed. By this time, SJ has become a fully peer-reviewed publication combining the highest standards of traditional scholarship and the possibilities and opportunities offered by information technology. While continually exploring new ways to improve both its quality and service, SJ commits itself to making available new research and facilitating effective communication between scholars, students, and the general public.

The making of the special anniversary editions provides yet another evidence of some of the wide-ranging possibilities offered by information technology particularly how it has radically altered the way we work at present and the space on which this work takes place. In 2002, I took a leave of absence from teaching and administration and moved to Germany, bringing with me Silliman Journal on what was envisioned to be an experiment in distance editing. Since then, four issues have successfully come out from my base in Germany. During these last two years, Cybertechnology has allowed me to breach the physical boundaries of space and remain connected with our production staff and the Editorial Board at Silliman as well as with authors and reviewers worldwide by Internet. In enabling me to carry out my editorial job and oversee the production of Silliman Journal from another part of the globe, information technology opens up yet another opportunity—allowing people to live in one place and work in another.

Nevertheless, in comparison to advancements made in the uses of information technology in teaching, learning, research, and publication in the developed world, which continue to challenge the traditional notion of a university as a teaching space, our experiment in distance editing seems light years behind. At this stage, our efforts are embryonic at best, but they signal the beginning of what is possible. Yet, just a few years back this was a completely impossible enterprise. Fifty years ago, our elders never guessed such a notion as the World Wide Web would come to pass or that most of the tools and information needed by authors, editors, and publishers could be Google-searched or retrieved through the Internet Explorer with a single click of the mouse. No other metaphor captures more aptly the kind of world we live in today in which an ubiquitous Internet connects information to an infinite and expanding web that is both accessible and more researchable than any collection of books or library, rendering knowledge available literally at one's fingertips.

This brings me to reflect on the future directions of SJ, but I will begin by mentioning some of the challenges facing SJ at present, which have implications for its growth in the coming years. One of the greatest challenges determining the fate of most academic journals is the escalating cost of production. Unless systematic funding arrangements are made whereby adequate funds are set aside specifically for research and publication, the continuity and regularity of appearance of issues will be difficult to ensure. Although SJ abides by the philosophy that the real value of scholarly publications does not lie in the revenues they generate but in their impact upon the scientific, socio-economic development of the society, there is an urgent need, in the face of fiscal constraints, to design new marketing or promotional strategies aimed at attracting more individual as well as institutional subscriptions. What may also help to mitigate high production costs is the availability of improved printing technology. This will mean, for instance, that SU Press need not farm out printing jobs such as color reproductions to commercial printers at exorbitant prices. Finally, the importance of providing SJ a permanent home and a full-time editorial staff who will no longer work on stolen moments or do balancing acts between teaching and administration and sundry professional and personal roles and responsibilities—and to be able to carry out the job in an especially-designated office accommodation with its own equipment—cannot be overstressed.

These problems notwithstanding, our experience working on SJ these last six years points to unsatisfactory local authorship as the root cause of long delay in the appearance of new issues. Unsatisfactory not so much in the level of quality as in the extremely limited number of submissions from members of the Silliman academic community. For the past several years, constituting an issue purely from Silliman University faculty submissions has been for us among the greatest challenges. If this issue is any indication, then the state of faculty publication on campus leaves little to be desired. Of the twelve full-length articles represented in this issue, only three are written by members of the faculty, representing roughly 1% of the entire faculty population. On the other hand, the number of international scholars sending submissions to SJ is steadily increasing, attesting to the respect and recognition the journal continues to receive in the international community of scholars and researchers. To date, in addition to the production and exchange of academic knowledge, Silliman Journal continues to aid the university's efforts in assessing research and scholarly work as well as appointments and promotion of its faculty. That this seems to have only minimal impact on faculty publication input perhaps requires some reexamination of the use of publication as performance indicator. Perhaps, too, there is a need to reassess the university's institutional investments to research and publication, and if necessary, design one which will provide better environment, resources, time, and encouragement for the faculty to publish.

In the years to come, I can see SJ remaining as a print-based publication, increasingly dependent for its production on technology such as more sophisticated desktop publishing systems, and on the Internet for information or electronic transmission. It will face the challenge presented by fiscal constraint, escalating cost of production, new technological developments, and an explosion of information while maintaining the values of peer review and protecting the copyright interests of its contributors. However, as the experience of our elders suggests, technology can only do so much. In the end, the future of SJ lies in the quality of institutional support, creative imagination, dynamic and inspired leadership, and committed vision of the people who will guide its destiny on to the next 50 years. It will be up to these people to make sure that SJ publications and manuscript submissions are of the highest quality, especially in light of new technological opportunities and challenges. They have to incorporate the best that technology has to offer, while revising and improving upon the best of its traditional methods, and redefining and maintaining standards of quality in publication.

The idea of an electronic journal is a prospect, but at this stage online or Cyberpublishing is still in its infancy even in the developed world. There is little doubt that electronic publication will eventually redefine the field of academic publishing, but I do not believe it will ever displace print journals. Nevertheless, for online publishing to become a reality at Silliman means that the university computing technology must become a properly integrated university activity and not just the sole property of one unit. Until

Silliman University develops strong technological infrastructure to be run by competent and highly creative IT specialists who know not only the latest in technology but also how best to use it to enhance teaching and learning and to develop new educational services and products, online publishing of the quality that can approximate the standard reached by the paper-print SJ publication, will not happen in the nearest future.

Although our continuing efforts at improving the quality of Silliman Journal have also increased work pressures, there is also much personal and professional satisfaction gained from association with an academic journal like SJ.

This volume resulted from an open call for submissions. As such, it does not claim to be representative or comprehensive. On the other hand, we have intended the collection to be broad in scope, yet thematically coherent; diverse in style and focus, yet consistent in quality and rigor, the measure of diversity making for a rich and lively conversation. But the articles do share one thing in common—they represent some of the writings by people who, at various times, have been connected with Silliman University as students and graduates, or are members of the faculty at present.

Leading this collection is Laurie J. Raymundo and Alan T. White's "50 years of scientific contributions of the Apo Island experience: a review." This paper reviews literature on Apo Island from the 1950s to the present in order to assess the contributions to marine science of studies that have examined the Apo experience in Community-Based Coastal Resource Management. According to Raymundo and White, research emphasis has been on the effects of management on the sustainability of reef fisheries; economic valuation and the benefits of tourism; and, anthropological and sociological studies of coastal fishing communities, particularly the role of women in fishing community dynamics and economics.

The next article on the "Long-term changes in coral reef benthic composition of Tubbataha Reefs: Response to bleaching in 1998 and protection" is authored by Aileen P. Maypa, Alan T. White, Sheryll C. Tesch, Anna Blesilda T. Meneses, and Evangeline White. This paper examines the benthic community of Tubbataha Reefs that have been severely impacted by the 1998 bleaching event and by lack of protection before 1992. According to the study, the bleaching episode caused major changes in community structure. This paper provides details of the changes of benthic composition of selected sites in Tubbataha Reefs from 1984 to 2004. A part of the Saving Philippine Reefs Project, whose long-term goal is to assist in Philippine coral reef management and conservation, the paper underlines the need for sustained management, protection, and regular monitoring of this reef system.

The next article by Aileen P. Maypa and Laurie J. Raymundo describes the result of a study which examined the effects of morphology and chemistry of four species of macroalgae on the early life history of the coral *Pocillopora damicornis* in laboratory aquaria. Entitled "Algae-coral interactions: mediation of coral settlement, early survival, and growth by macroalgae," the paper focuses on the impacts of abundant macroalgae on juvenile stages of coral and concludes that their effects on early life history stages of corals are complex and long-term, and vary between species.

The following article by Maria Rio A. Naguit, Jane Aquin, Francisco P. Tabiliran, and Laurie J. Raymundo entitled "Lead and Zinc Concentrations on the Venus clam, *Paphia textile* (Gmelin) in Soft-Bottom Communities of Katipunan and Roxas, Zamboanga del Norte: An Indicator of Heavy Metal Contamination," is based on a study assessing the possible health risk of heavy metal contamination from factory waste output on locally-consumed venus clam, *Paphia textile*. Analysis of samples for lead and zinc concentration levels from sampling sites revealed that the coastal waters of Katipunan and Roxas, Zamboanga del Norte are contaminated with both lead and zinc. According to the study, continued consumption of the clams will lead to biological magnification in human populations, thus posing an unquantified health risk to local coastal communities consuming these animals.

The next two articles focus on the rediscovery of Philippine Bare-backed Fruit Bat *Dobsonia chapmani* Rabor, the largest cave-roosting bat and also the first mammal declared extinct in the Philippines. The first of these, "The Philippine Bare-backed Fruit Bat *Dobsonia chapmani* Rabor, 1952: Rediscovery and Conservation Status on Cebu Island" by Lisa Marie Paguntalan, Marisol dg. Pedregosa, and Mery Jean G. Catacutan, reports the results of a preliminary survey conducted in Mabuli, Carmen, Cebu in late February 2001 which resulted in the unexpected mist-netting of several individuals of this species. The second article, "Rediscovery of the Philippine Bare-Backed Fruit Bat (*Dobsonia chapmani* Rabor) on southwestern Negros Island, the Philippines" by Ely L. Alcala, Renee B. Paalan, Leonardo T. Averia, and Angel C. Alcala, details the rediscovery of this species on southwestern Negros Island in 2003 and confirms its existence despite its disappearance in their former habitat on this island. Existing in very small populations at low density, these bats, according to the two papers, remain critically endangered for the following reasons: persistence of hunting and logging in their habitat, erosion of the little remaining topsoil by heavy rainfall, and frequent disturbance of the caves by hunters and guano miners.

Preceding these two articles is a short introduction by Lawrence R. Heaney providing the context for the two articles announcing the finding of living populations of *Dobsonia chapmani* on both Negros and Cebu Islands. According to Heaney, the rediscovery of this species is now a cause for hope, giving conservationists "a second chance to avert the most final and awful of biological events."

The next article by Apolinario B. Cariño, "Studies of Fruit Bats on Negros Island, Philippines," reports the findings of a study on fruit bats in some forests of Negros Island between March 1999 and March 2003. The study aimed to assess the current status of population of fruit bats in this area. The data gathered provide the basis for the development of a community-based conservation education program aimed at increasing awareness of the importance of bats in the ecosystem as well as encouraging local communities to initiate significant protective measures for the conservation of this species.

In the following article entitled "Threatened Wildlife of the Twin Lakes Balinsasayao and Danao Natual Park, Negros Oriental, Philippines," Cynthia N. Dolino, Apolinario B. Cariño, and Angelita M. Cadeliña" describe how habitat loss and degradation coupled with discrete hunting, collection and harvesting of aquatic and forest resources for subsistence, commercial, ornamental, pet or zoo trade are putting an increasing pressure on the threatened and non-threatened plant and animal species in the Twin Lakes area. The paper concludes with a call for long-term conservation efforts to protect keystone threatened plant and animal species which are essential for the preservation of the remaining forest and its wildlife.

In the next article, "A Study on the Birds of Small Islands off the Coast of Cebu Island, Philippines," Lisa Marie J. Paguntalan, Philip Godfrey C. Jakosalem, Marisol dG. Pedregosa, and Mery Jean G. Catacutan recorded a total of 67 species on the small islands of Carnaza, Camotes (Poro and San Francisco), Gato, Pescador, and Sumilon in Central Visayas in an attempt to assess the bird composition in these areas. Results of their study show that the island of Camotes, the largest of the five islands visited, had the highest number of species recorded followed by Carnaza, Sumilon, Pescador, and Gato Island. The paper also lists hunting of birds and large species of mammals mainly for the pet trade, food, and sports as well as the destruction of habitats as among the most serious threats to the survival of these species.

The final article still by Lisa Marie J. Paguntalan, Philip Godfrey C. Jakosalem, Marisol dG. Pedregosa, Mery Jean G. Catacutan, and Reginald Bueno on the "Conservation Status of Forest birds in Isolated Forest Patches in Masbate, Philippines" describes the result of bird surveys conducted on the island of Masbate in July 2001 and on March 20-25, 2002. The study mainly focused on identifying the remaining lowland forests and determining their condition, as well as ascertaining the conservation status of the endemic and threatened birds of Masbate. The most significant result of the study was the finding of a remnant population of the Visayan Tarictic Hornbill *Penelopides panini panini* among sightings of the seven Masbate endemic subspecies.

☙ ✧ ❧

The Notes section of this issue includes a report about the wildlife conservation concerns of Lake Balinsasayao Protected Area in response to moves by a government-sanctioned private enterprise to reduce the protected area size surrounding the Twin Lakes for mineral exploration. Entitled "Saving A Physically Challenged Ecosystem: Who Takes Charge of the Mt. Talinis-Twin Lakes Forest Reserve" by Angelita M. Cadeliña, Apolinario B. Cariño, and Cynthia N. Dolino, the paper provides reasons why the Forest Reserve should be protected and why efforts by private sectors to claim part of this area for economic reasons should be blocked.

The Book Review section includes a review by Angel C. Alcala of a Department of Agriculture-Bureau of Fisheries and Aquatic Resources publication entitled *In Turbulent Seas: The Status of Philippine Marine Fisheries.*

☙ ✧ ❧

The last section in this collection is a tribute to Dr. Walter C. Brown, the eminent American biologist credited for the advancement of our knowledge of herpetology -- the branch of biology that deals with amphibians and reptiles -- in the Philippines and the South Pacific by one of Dr. Brown's former students, Angel C. Alcala.

☙ ✧ ❧

The epigraphs that introduce this issue provide the plot lines for the story that gave life to Silliman Journal's golden anniversary projects as well as the inspiration that carried us through the difficult stages of realizing them. In the middle of last year, I began to discuss with Margie Udarbe, Chair of the Editorial Board's Special Projects Committee, the idea of celebrating SJ's golden anniversary with a number of projects: a special humanities issue, a special science issue, both showcasing the writings of Sillimanians, a volume of abstracts, a volume of indexes, and the construction of the SJ's website—altogether six projects.

My colleagues in the Editorial Board at Silliman University responded to these ideas with plenty of enthusiasm and so, by phone and email, we began working on the various tasks involved in getting the projects off the ground, plowed through ideas about the content of the issues or how the volumes might look, who would take charge of the monumental task of abstracting all articles published quarterly over a span of 50 years, which committee to handle the indexing project, or where the funding might come from. Margie was to take charge of abstracting all the humanities articles while Laurie Raymundo committed herself to doing the abstracts of all science articles. Meanwhile, I was to take charge of both special issues, while Philip van Peel, our production editor, was just the patient and experienced person we needed to supervise the completion of the projects. The indexing project fell expectedly on the hands of our library colleagues, Naty Sojor and Lorna Yso, while budget became the task of Norma Caluscusan. Ian Casocot was coopted to design the Journal's website. So that we have our sights trained on a particular goal, we set the University's Founders Day in August 2004 as a launching date. As yet, this was a most exciting time.

Little did we know at that time the difficulties and delays we would encounter in bringing these projects to life. Despite the excitement, there was also considerable frustration. Foremost, the projected budget needed for the six projects came to a million pesos—money we did not have! I decided to try raising funds and was directed to the United Board Alumni Program for help. Yet, even after dozens of emails, the University President's endorsement, and the United Board support, I had only minimal success in raising money for these projects. I decided to pour my energies into getting my issues together. By the summer of 2004, submissions were practically only trickling in and it was clear that unless we made a more aggressive call for papers, the issues will not materialize. In June, with deadline looming, Ian Casocot started forwarding several articles he solicited from writers he knew and finally the humanities issue was taking shape. Laurie took personal charge of soliciting the science articles and had plenty of success, except that by the time she was about to start on her abstracting project, she was also on her way out of Silliman to begin a tenure-track position at the University of Guam. Nevertheless, committed that she was to the project, she managed to get all her abstracts ready while also in the middle of a major relocation. Meanwhile, two deaths in Margie's family kept her away from her abstracting project for a time, but when she returned to it, it was with renewed vigor. Rechanneling grief into a frenzy of creative activity, she managed to turn out a monumental work, the quantity and quality of it a testimony to the transformative power of grief and the resiliency of the human spirit.

With the budget problem still looming large in our horizons, we got on with our respective tasks trusting that Silliman University will continue to support SJ as it has always done during the last 50 years. Peer-review of the manuscripts took longer than expected and their revision ate up even more time. As we feared, we missed our first launching deadline but managed to drum up some excitement for SJ's golden anniversary celebration with an exhibit of its 50-year history. A second deadline was set for the last week of November but that too proved too soon. In the end, we decided on simply getting the work done.

When I think how these projects were carried out under a variety of circumstances, sometimes tragic, oftentimes challenging, by people who have had to steal moments to do them while juggling time for many other duties at once, I cannot help but feel fortunate to be in an Editorial Board inhabited by stimulating, intelligent, and creative colleagues who believe as Erich Fromm did that, "creativity requires the courage to let go of certainties." A list is hardly adequate, but I cannot begin to say how much I owe, intellectually and personally, to Margie and Laurie, and to the rest of the colleagues in the Editorial Board for believing, when it mattered, that our golden anniversary projects would happen. I thank them for giving a face and a human form to George Bernard Shaw's words: "The people who get on in this world are those who get up and look for the circumstances they want and, if they can't find them, make them."

To Margie and Laurie especially, for their selfless commitment and the numerous hours they expended making a dream come true—thank you for the friendship.

When an endeavor takes a long time in the making, many people become implicated in, and part of, the continuing process.

A special word of thanks goes to our colleagues in the Overseas Editorial Board for their continued support, invaluable feedback, and especially for sharing their time and expertise with Silliman Journal. Starting with the golden anniversary issues, two new members are joining the board and it is my greatest pleasure as Chair of the Editorial Board to welcome them here: Dr. Lawrence R. Heaney, Curator and Head, Division of Mammals, The Field Museum in Chicago, and Dr. Thomas M. Brooks of the Conservation Synthesis Department, Center for Applied Biodiversity Science, Conservation International in Washington, D.C. Dr. Heaney brings to Silliman Journal his internationally-renowned expertise in Philippine Mammals while Dr. Brooks' passion for conservation and expertise on birds will surely animate the pages of our coming issues. I thank Dr. Heaney and Dr. Brooks for honoring Silliman Journal with their acceptance of this membership. I also wish to thank Dr. Marc L. Miller of the University of Washington and Dr. Rozzano C. Locsin of the Florida Atlantic University for sharing their time and expertise with Silliman Journal's Overseas Editorial Board for the last three years.

The authors in this collection deserve much credit and appreciation for their intellectual energy and receptivity to critical feedback, their diligent and inspired revisions, and their patience during the long months it has taken to bring this issue to press.

It gives me great pleasure to acknowledge the brilliance and keenness of insight of our reviewers who provided not only invaluable feedback but also enthusiastic support. Many thanks for giving the manuscripts an extraordinarily careful and thorough reading.

Several colleagues and friends have made the preparation of this enormously challenging project worth every frustrating moment. Much appreciation goes to colleagues at the Department of English and Literature, in particular the present Chair, Juliet Padernal, for continuing to host SJ, allowing Philip a space, both literal and professional, on which to work, and especially for the unlimited use of the office equipment; to Andrea Soluta for graciously consenting, at the nick of time, to provide Philip much-needed editorial assistance with copy editing and page proofing; to Ian Casocot for soliciting the submissions and designing SJ's website.

Nino de Veyra was my collaborator when I took over as editor of Silliman Journal in 1998. I haven't told him how much I have benefited from his creative mind—from him I learned much of what I now know about editing or publishing. I keep missing the times we used to work together till dawn to beat the deadline of a long-overdue SJ issue, the department's curricular revisions, or accreditation reports. But more than a great collaborator and colleague at the English Department, Nino remains a wonderful friend whose departure for UP-Mindanao in June of 2002 was for me a personal loss.

And even when she is not writing to me, I know that Naty Sojor is deep at work not only on the indexing project but especially on keeping us financially afloat. She does not know it but her serenity in the face of many difficulties keeps us focused on the work rather than on the problem.

As I mentioned earlier, I had but minimal success in my fundraising efforts for our projects but those I managed to touch responded generously and promptly, their donations going a long way to help finance our endeavors and their encouragement providing the much-needed prop when our steps were beginning to falter. In "The Story of Everest," W.H. Murray is unequivocal in his faith that "concerning all acts of initiative and creation, there is one elementary truth—the moment one definitely commits oneself, then Providence moves, too." I, too, am convinced that Providence saw the seriousness of our commitment and moved these friends to open their wallets and hearts to our call for support:

Prof. Frederick and Dr. Priscilla-Magdamo Abraham
Dr. Betty C. Abregana
Dr. Federico Agnir

Arnold and Shirlaine-Babol Castellino
Dr. Maren Gaulke
Dr. Efren and Julie Padilla
Bayani and Haydee Pioquinto

To them, and to Nan Hawkins of the United Board Alumni Program who facilitated these donations, my sincerest thanks and gratitude.

In my many other debts, more than there is space to repay, I wish particularly to acknowledge Dr. Agustin A. Pulido, Silliman University President, for his continuing support of all my endeavors whether it was in running the Department of English and Literature or editing Silliman Journal. Even at moments of quiet at his end, I know that he remains a steadfast presence. For so much confidence and support needed to carry out these projects and especially for believing in my ability to see these projects to completion, my profoundest thanks, Dr. Pulido, for being there.

From this end, Dr. Christian K. Schales is Silliman Journal's sole benefactor and biggest collaborator. Much appreciation to him for making our experiment in distance editing a great success with his contribution: a sunny working space, state-of-the art equipment, unlimited access to the Internet, generous donations of everything else that goes into the editorial process, and, especially, long hours on my own to work on these issues. For supporting my creative agitations and making these projects happen—many thanks beyond words.

From Maren Gaulke in Munich I received only endless encouragement—many thanks for providing the much-needed comic relief.

Finally, my deepest gratitude I reserve for many more individuals—colleagues, friends, and family—than there is space to mention their names who have contributed in a variety of ways to make Silliman Journal's golden anniversary projects a reality. As we always do, my colleagues and I have endeavored to give this issue the kind of close, intelligent, and creative attention we give all our other projects. I hope our readers and contributors will find in this issue a piece of work of the right proportion.

Ceres E. Pioquinto

[1]Alice Walker, "In These Dissenting Times", *Her Blue Body Everything We know: Earthling Poems 1965-1990.* Orlando, Florida: Harcourt Brace Jovanovich, Publishers, 1991.

foreword

I am pleased to provide this brief statement on the occasion of Silliman Journal's Golden Anniversary this year. The task of writing this paper has been rendered relatively lighter, firstly, by my having been part of the Silliman community since 1948, except for the 10 years of absence due to government service, allowing firsthand observation on the journal's development; secondly, by being an active participant in the making of this journal through my articles published over the years; and thirdly, by my four decades of writing and publishing in international refereed journals. I propose to trace the development of the *Silliman Journal* from the time the idea of a journal at Silliman was suggested, to its first publication in January 1954 and through the later years up to 2004, and to point to some directions for improvement in the future.

As an introduction to the research at Silliman University, let me recall that Silliman Institute became Silliman University in 1938. Since that year, Silliman has acquired a reputation as an excellent institution of higher learning. It has also been known for the research on ants by its missionary scientist, Dr. James W. Chapman, a famous authority on the ants of Asia (Carson 1965, pp. 339-340).

A brief historical sketch on how the *Silliman Journal* came to be published may be useful (Tiempo *et al.* 1977, **Silliman University 1901-1976**, p.60). According to Dr. Arthur L. Carson, the last American president who retired in 1953, the idea of a "Silliman Journal" was one of several ideas suggested by Silliman academic leaders while hiding from the Japanese invaders in the forest areas on Negros during the Second World War and planning what they should do when the University reopened. The establishment in 1950 of the James W. Chapman Research Foundation to encourage "research in the fields of knowledge of value to society, industry and government" (Tiempo *et al.* 1977, p.60) was the first step in the realization of the idea. The rationale for the publication of the *Silliman Journal* was the *need for an organ for the publication of the results of research* *undertaken in the different fields in Silliman University* (italics quoted from the title page of the first issue). The next step was the allocation by the Foundation of funds for the publication of the first issue of the *Silliman Journal* in 1954 and for several issues thereafter. The University provided small counterpart amounts and later fully assumed the responsibility for the publication costs.

There is confusion on the date when the *Silliman Journal* idea first became a reality. According to Dr. Arthur L. Carson (**Silliman University 1901-1959**, 1965, p. 341), the *Silliman Journal* first appeared in November 1953. What he reported on was probably only a draft because the first published issue (Volume 1, No.1) bears the date January 1954.

The election of Dr. Leopoldo T. Ruiz as the first Filipino president of Silliman University in April 1953 provided a sense of urgency to implement the *Silliman Journal* idea. During his presidency, faculty development, strong graduate school, use of the English language, and high quality education were emphasized and actively pursued. Research and publication were considered essential to maintain high academic standards, and a journal would be needed to help ensure the attainment of these goals. The need for research and the *Silliman Journal* was further justified by the results of the Fenn Survey conducted in November 1954 through May 1955 (Carson 1965, pp. 354-355), which recommended several improvements in the academic program. The Survey pointed out glaring deficiencies in research and publication of the Silliman faculty, as shown by a course syllabus being listed by a faculty member as a research output!

The *Silliman Journal* has undergone changes in external appearance, article formatting, design of external cover and title page, and frequency of publication from quarterly to semi-annually. But the more important change was in the editorial policy. Prior to 2000, the Editors and the Editorial Board had the sole responsibility of determining the acceptability and suitability of submitted articles. But at present a permanent Editorial Board and an Overseas Editorial Board pass judgment on the quality of manuscripts. Assisting these Boards is the Board of Reviewers for specific subject areas. The members of this Board of Reviewers act as referees to ensure that only high quality and scholarly papers are published in the *Silliman Journal*. This policy change is an attempt to elevate the publication standards of the journal to approximate those of leading international journals. This way authors who write good papers will be encouraged to publish in the *Silliman Journal*. The new policy may be showing some effects now as the number of foreign contributors increased in the 2000s. It would be interesting to find out if the authors' citation index for certain articles (example, science articles) published in the *Silliman Journal* also increased during the same period.

However, the *Journal* has not changed in one respect; it has kept its original multidisciplinary character by publishing results of studies in the humanities, the social sciences, and the natural sciences, as originally intended. The multidisciplinary journal has some merits, but it has also a disadvantage in that researchers may miss or ignore it because they generally prefer specialized journals as sources of published literature. The result is that authors publishing in general journals like the *Silliman Journal* may be less frequently cited in citation indices compared to those publishing in specialized ones.

More than 800 articles exclusive of book reviews have been published in the *Silliman Journal* from 1954 to 2004. The papers published in the journal covered a wide range of topics in the natural sciences with a strong bias for biology, the social sciences, education, and the humanities with the least number of papers, reflecting the academic strengths of the University. The impact of the studies reported in these articles is difficult to ascertain. But it may be assumed that at least they have contributed significantly to the education and professional development of the authors (such as promotion in academic rank) as well as the readers. This is certainly true for me. Writing for the *Silliman Journal* provided me an opportunity to learn to write in English, a skill that proved very useful in my work as a biological scientist. I am sure that many others at Silliman and other institutions have advanced in their chosen fields as a result of their writing experiences with the *Silliman Journal*. The impact of these 800 articles on social development is probably of more significance, but this would require research to establish.

The quality of the *Silliman Journal* articles varied during the four decades (1950s-1990s). While many papers of the Silliman faculty were well written, some fell short of the standards required of scholarly journal articles. Some of my own papers representing early attempts at writing and communicating scientific results to my colleagues and the general public belong to this group. This shortcoming I would attribute to poor writing and lack of a referee system. For example, I remember one editor who insisted in adding an unnecessary adjective to the title of my short paper on an exotic species of toad. The addition made no sense to me, it just lengthened the title.

Understandably, the majority of the authors of the papers in the *Silliman Journal* during the past 50 years were members of the Silliman faculty and their collaborators at other academic institutions here and abroad. Publications are required for promotion in academic rank. Only few non-Sillimanians were represented in the list of contributors. However, during the past four years, an increase in the number of contributors from other research and academic institutions has been noted. This could be a result of a more rigorous evaluation of submitted manuscripts following the adoption of a referee system.

As to directions for the future, the first steps have been made. The following suggestions are directed to the Editor and the Editorial Board. First, continue to implement strictly the referee system for submitted articles to maintain or improve the quality of papers. Second, promote symposia on the research areas of Silliman faculty members. They can serve as source of publishable papers for the *Journal* and also encourage inactive faculty members to engage in research. Third, access funds for publication through donations from foreign authors, sale of special issues, and similar schemes. Fourth, organize writing seminars for faculty to improve writing skills. Fifth, arrange for exchanges with more academic institutions in Asia and other parts of the world. I hope that more high quality papers will be submitted to and published in the *Silliman Journal* in the coming years, making the journal worthy of exchange with the best journals of the world.

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Silliman University

50 YEARS OF SCIENTIFIC CONTRIBUTIONS OF THE APO ISLAND EXPERIENCE: A REVIEW

Laurie J. Raymundo and Alan T. White

ABSTRACT

Apo Island, Negros Oriental, has been an informal "natural laboratory" for marine and social scientists for 50 years. It is important to assess the contributions to marine science of studies that have examined the Apo experience in Community-Based Coastal Resource Management. This paper reviews literature on Apo Island from the 1950s to the present. Research emphasis has been on the effects of management on the sustainability of reef fisheries; economic valuation and the benefits of tourism; and, anthropological and sociological studies of coastal fishing communities, particularly the role of women in fishing community dynamics and economics. Much of this research has been ground-breaking, applying novel approaches to issues facing coral reefs over the past three decades. Lessons learned from the Apo experience are discussed in light of current challenges facing reef managers.

Introduction

Apo Island is one of the most thoroughly documented marine reserves in the world. Through the years, this small island and its resident fishing community have provided biologists, social scientists, and students with an opportunity to study topics ranging from local amphibian fauna to tourism impacts to long-term effects of fishery management. It is an unofficial and unplanned "natural laboratory" that has become a globally-recognized example of successful Community-Based Coastal Resources Management (CB-CRM). In this day of scientists and managers eager for examples of community involvement in management and sustainable exploitation, the

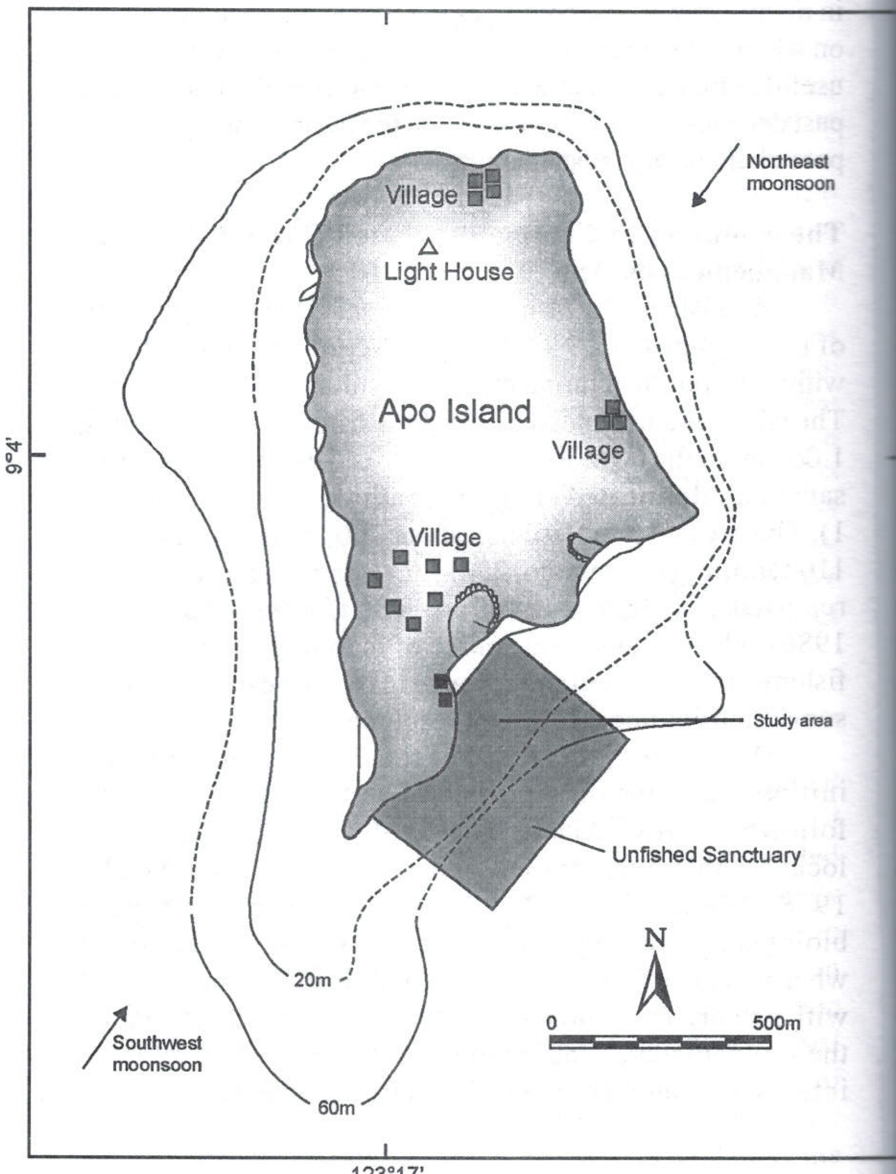
Apo Island experience stands out as a shining success story. Such examples are rare, particularly in overpopulated developing countries such as the Philippines where pressures on natural resources increase daily. The Apo situation is unique in many aspects, and continues to serve as an evolving model on which other management schemes are based. As such, it is useful to take a look at what has been accomplished over the past decades, as well as to examine the issues that continue to pose challenges to sustainability.

The evolution of Community-Based Coastal Resource Management on Apo

Apo Island is a 74-ha hilly, volcanic island 25 km south of Dumaguete City, 9 km from the Negros mainland. It lies within the political jurisdiction of the municipality of Dauin. The island is surrounded by a narrow fringing reef, covering 1.06 km^2 to the 60 m isobath, with a 0.45 km no-take marine sanctuary delineated along its southwest border (see Fig. 1). The present population is about 700, distributed among 110 families (Raymundo, 2001). This is 50% more than the reported population of 460 in 1986 (Savina and White, 1986). The predominant source of income continues to be fishing, although tourism revenue in recent years has helped some families boost financial resources.

D. S. Rabor, then head of the Biology Department, initiated studies on Apo Island as early as the 1950s, followed by A.C. Alcala. These collecting trips surveyed local amphibians, reptiles, and birds (Brown and Alcala, 1978, 1980; Alcala, 2001). At that time, Philippine biologists were simply attempting to find out "what lived where." These forays brought island residents into contact with researchers, and a rapport was developed that paved the way for later collaboration. By the mid-1970s, research interests broadened to include marine resources.

Figure 1. Map of Apo Island, Negros Oriental, Philippines.
Produced by J. Maypa



In the 1970s, establishing marine parks for reef management was gaining attention in the international scientific community, in recognition of increasing rates of reef and marine resource degradation worldwide. The "multiple use concept," applied to a marine park, held that combining scientific, aesthetic, and educational objectives in an area closed to harvesting would allow a reef to recover to a pre-harvested state (Cabanban and White, 1981; Alcala, 1998). This approach was implemented by scientists with little participation by local communities and unclear views of the impacts on fishers affected by closure of a portion of their fishing ground. Biologists from Silliman recognized that little could be accomplished without the support of fishing communities using the reef.

In 1976, researchers from the Silliman University Marine Laboratory (SUML) initiated talks on marine conservation with the Apo fishing community. At that time, destructive fishing was practiced, poverty was high, the island population was growing, and non-resident fishers frequented Apo's reefs. Boat anchors, blast fishing, and *muro-ami* were taking their toll on reef health (Savina and White, 1986). Interviews with fishers revealed their perceptions that reef quality had changed (Cabanban and White, 1981). An informal dialogue approach had already been tested on Sumilon Island fishers and local government officials, who endorsed the formation of a reserve after discussions regarding conservation (Cadeliña, 1976). SUML launched a similar campaign on Apo with the goals of promoting marine conservation and improving fish catch through better management. Slide presentations introduced families to preserving coral reefs as fish habitats, preventing damage to the reef, and avoiding over-fishing and destructive fishing. After four years of discussion and interactions with social workers and biologists, the community selected a 0.45

km stretch of the southwestern reef as a "no-take" sanctuary in 1982.

The sanctuary was legalized by Municipal Ordinance in 1986, through the assistance of the Marine Conservation and Development Program (MCDP; White and Savina, 1986; Torrequemada-Deguit, 1989; Alcala, 2001). The formation of the Marine Management Committee (MMC) followed, composed of elected Apo community members. Torrequemada-Deguit (1989) reports that the Apo community perceived that community-based management succeeded because of the commitment of the MMC. The Committee laid the groundwork for the widespread acceptance of the no-fishing sanctuary and the ban on destructive fishing. The MCDP was tasked with enhancing management capability and protecting reef resources (White and Savina, 1986; Cabanban and White, 1981; White, 1986a; White, 1989; White and Vogt, 2000). Through the MCDP, community organizers and biologists worked with Apo (and two other Central Visayas communities: Pamilacan and Balicasag, Bohol) to provide management advice and monitoring, and to formalize the process of community involvement in environmental management. Early success was noted in improvements in fish diversity and biomass (White and Savina, 1987a) and coral cover (White, 1986b) one to two years after sanctuary establishment.

In August 1994, the island was declared a Protected Landscape and Seascape by Presidential Proclamation No. 438, and placed under the National Integrated Protected Area System (NIPAS). Management, therefore, was turned over to the Protected Areas Management Board (PAMB; CRMP, 2004) of the national government, chaired by the Regional Executive Director of DENR Region 7. The PAMB created a system of fixed fees for visitors, strengthened enforcement capacity of the community, and funded development projects identified by the community. This move was initiated by A.C. Alcala (then Secretary of the

Department of Environment and Natural Resources), who felt that placing the island under national jurisdiction would strengthen management and enforcement capacity and limit land development (Alcala, 2001). The PAMB continues to manage the island's resources and revenue today, and elected community members comprise a portion of the Board, with other members coming from local government. The effectiveness of PAMB is currently under study, as a number of issues have been raised by community members: transparency and accountability; communication of decisions; involvement of residents in fund allocation based on felt needs; and management that includes all political factions (E. Oracion, pers. comm.; ongoing research).

The prevailing view during the 1970s and early 1980s was that management and conservation should be handled by scientists; lay people, however much affected by management decisions, were thought not qualified to participate. The combined approach that evolved with Apo Island management—stakeholder participation in decision-making, involvement of social scientists in coral reef issues, and linking coastal communities with support institutions—was innovative and untested. The success of this management tool has since been recognized and applied to coastal communities in developing countries worldwide, particularly in light of the failure of centralized attempts that involved little collaboration with local stakeholders. This approach, first applied experimentally to Apo and other Central Visayas communities in the 1970s, was considered key to the success of conservation efforts (White, 1986b) and has evolved into what is currently known as Integrated Coastal Management (ICM; Christie and White, 1997).

Conservation education of Apo fisherfolk was a learning experience for these ground-breaking marine biologists who had no formal training in social sciences. It was noted that non-formal community leaders were often most effective in convincing the community of a specific course of action. Without the support of such influential individuals, little progress was possible (Torrequemada-Deguit, 1989). In addition, perceptions and attitudes of people toward their environment could either hinder or help establish a conservation ethic. Most importantly, destruction caused by fishing practices was a touchy subject, one that must be handled objectively, and without blame (Cabanban and White, 1981). These lessons have since been formalized as a CB-CRM process (White *et al.*, 1994).

Several aspects are key to the practice of ICM in the Philippines. It begins with empowerment and building a core group of committed community members, requiring a community organizer to live in the community and build capacity. This is accompanied by environmental education – an awakening of the community's awareness of the consequences of various human actions on the environment, and instilling the knowledge that a course of action can be chosen which is conservation-oriented and beneficial. As experience has shown, it is a challenge to request an impoverished fishing community to refrain from harvesting a portion of an established fishing ground, particularly since benefits may not be visible short-term. Therefore, other activities must be identified such as enhancing livelihood options and mobilizing financial resources (White and Savina, 1987a; White *et al.*, 1994; White, 1996; Alcala, 1997, 1998). Health and reproductive issues have more recently been identified as key components to current CB-CRM thrusts (White and Deguit, 2000; White and Chua, 2003), such as the population control program at Apo currently supported by PATH Foundation and Dauin municipality (A.C. Alcala, pers. comm.). Finally, networks are built between communities and institutions, government departments, or non-government organizations (NGOs) to provide long-term support and technical advice.

Contributions to fisheries research

By far, the largest contribution of research on Apo has been an expanded knowledge of the effects of protection on coral reef fish communities. The Apo fishery has been studied since the early 1980s, prior to the creation of its marine reserve in 1982, and such long-term data sets are notoriously rare. Today, marine sanctuaries are frequently established to address the linked problems of reef degradation and over-fishing, but the concept was relatively untested when first applied in the 1970s. Though theoretically sound, little data supported the hypothesis that sanctuaries stimulated reef recovery and produced excess fish and/or larvae to be exported into adjacent fishing grounds, thereby increasing catch outside the reserve (the "spillover" and "recruitment" concepts; see Russ and Alcala, 1996a, 1996b; Russ *et al.*, 2003; Russ *et al.*, 2004). Long-term annual monitoring and short-term, intensive studies of the Apo fishery have created an extensive database. This database has provided some of the first empirical evidence of sustained fisheries enhancement effects of management, controlled exploitation, and small, no-take sanctuaries.

The first Apo fishery status assessment was conducted by Alcala and Luchavez (1981). The authors described catch composition (mainly reef fish), fishing gear (traditional, non-destructive methods), yield (a mean of 11.4 mt km^{-2} yr^{-1}), and average income (PhP5.83-PhP9.41), and concluded that fishery management and alternative livelihood options were needed, as the reef was over-fished. At this point, the marine sanctuary had not yet been delineated, though destructive fishing (*muro-ami* and blast fishing) had stopped. Alcala and Gomez (1985) and Alcala (1988) concluded that it was not reasonable to expect an effect of protection on fish catch at such an early management stage. By 1986, a second assessment was undertaken using a different method of evaluating catch, but results suggested a higher yield (31.8 mt km^{-2} yr^{-1}; White and Savina, 1987b). Again, catch composition reflected the fisher's preference for the more accessible reef fish; the pelagic fishery represented a small proportion of total catch. Reef quality was described as high, with little evidence of damage to coral, and yield was higher than was currently predicted with moderately heavy exploitation. It was concluded that the effects of eliminating destructive fishing and the presence of the sanctuary may have begun to influence the fishery. Though these two papers (Alcala and Luchavez, 1981; White and Savina, 1987b) came to different conclusions (low yield suggesting an over-fished state vs. higher yield than predicted with current exploitation levels), the data suggested that over a ten year period following the ban of destructive fishing methods (1976-1986), fish catch was sustained. During the same period, Russ (1985) compared yields from fishing grounds of three managed reserves, Sumilon I., Balicasag I., and Apo I., and showed that Sumilon, with the longest history of successful protection at that time (10 yr), had significantly higher fish yields than the other two. This type of study marked the first efforts to document the effects of protection on fishery resource recovery.

A number of recent publications report analyses of long-term data sets supporting the hypothesis that sustained, managed exploitation is possible without severe impacts to reef communities, and evidence of spillover is slowly accumulating. Such evidence is urgently needed: the MPA concept is often "sold" to fishers by convincing them that protection will eventually lead to greater catch—an approach that remains controversial due to the lack of hard evidence. Russ and Alcala (1996a) provided the first circumstantial evidence suggesting spillover from the Apo reserve into surrounding fishing grounds: significantly higher densities of target species were found closest to the reserve boundary, with decreasing densities farther from the reserve. This effect was seen only after several years of protection. A recent effort to examine long-term fishery trends in Apo was presented by Maypa *et al.* (2001). Compiling data for a twenty-year period, from 1980-81 to 2000-2001, the authors found that annual yield remained stable over this period, though fishing effort declined. These findings demonstrated a long-term effect of limiting fishing pressure, eliminating destructive fishing, and continually protecting the no-take sanctuary. The most compelling evidence for spillover is presented in Russ *et al.* (2003) for the surgeon fish *Naso vlamingii*. Over an 18-yr period, biomass of this species increased by a factor of 40 adjacent to the reserve boundary, but not at greater distances. Catch per unit effort was 45 times higher near the reserve boundary than for all other fishing grounds around the island. Russ *et al.* (2004) describe the effects of protection as having direct benefits for fishers in terms of reduced fishing effort, higher catch, and enhanced standard of living. However, Russ and Alcala (2004) emphasize that marine reserves require long-term protection (2-4 decades) before biomass of large target species is restored.

An alternative approach to analyzing the effects of management on fisheries was taken by Russ and Alcala (1996b, 1999, 2003a), who compared Apo I. and Sumilon I., two islands with contrasting management histories. Though the Apo Island reef system was protected later than that of nearby Sumilon I., protection and management of Sumilon has been inconsistent. This may be due to the lack of a resident community on Sumilon; the classic "tragedy of the commons" (Hardin, 1966). Visiting the island only to fish, fishers have not developed a sense of ownership/ stewardship, making enforcement difficult. In addition, political pressures from a corrupt local government resulted in periodic breakdown of enforcement regulations. Incidences of *muro-ami* fishing coincided with a major typhoon in the mid-1980s, leaving the reserve devastated (Russ and Alcala, 1996b; Russ and Alcala, 1999). The effects of sustained management (Apo) vs. the breakdown of protection (Sumilon) on predatory fish biomass suggested that fish communities respond to protection (or lack thereof) very quickly (Russ and Alcala, 1996b, 2003a). The authors found that with the opening of the reserve to fishing in Sumilon, density of large predatory fish immediately declined. Density increased within the Apo sanctuary over time, and several years of recovery time were necessary to regain lost biomass once protection in Sumilon was re-established.

In this day of increasing rates of worldwide environmental degradation, biologists are frequently asked to make management plans and decisions without sufficient information. Fisheries resources, upon which a significant portion of the world depends for protein and income, are under increasing threat. Often, it is the most marginalized and impoverished communities that are responsible for this threat—people least able to think about the future implications of their actions. Blending the urgent needs for both conservation and improved living standards of the Apo Island fishing community has resulted in what data suggest is a sustainable fishery; one which has not resulted in significant reef degradation and has resulted in improved living standards. It has been successful due to the insights of early marine biologists and social scientists of Silliman University and the commitment of Apo Island residents to try what surely must have been a risky venture when first presented to them. This story has provided the impetus for an unknown number of other such communities in developing countries worldwide. Shedd Aquarium in Chicago, U.S.A. recently adopted the Apo Island community as a model of fishery and biodiversity conservation, creating a substantial display that highlights local architecture, culture, handicrafts, and, most importantly, the rich diversity of its reefs.

Coral reef health assessments

The coral reefs of Apo Island have remained consistently healthy since their protection. Unlike many other reefs in the Philippines with portions delegated as reserves, Apo has not required a lengthy recovery period following a history of human-induced degradation. Table 1 summarizes data on coral health from a variety of studies over a 20-yr period, showing consistently high coral cover.

Table 1. Summary of data on coral reef health assessments, 1980-2003.

Live Hard Coral Cover	Site	Source
50-74% ("good" category)	5 sites around island	Gomez *et al.* (1981)
44.2% (reserve) 15.5% (non-reserve)	sanctuary & SW reef	MCDP (1985)
44% (reserve area) 28% (non-reserve) mean = 32%	sanctuary & SW reef whole island mean	Savina and White (1986)
41.3% (reserve) 35.2% (non-reserve)	sanctuary & SW reef	White & Calumpong (1992)
52% (reserve) and 7.25% (non-reserve)	reserve & SW reef 1995 data (2002)	Reboton & Divinagracia
increase from 34.7% (1982) to 56.6% (2002)	sites around island	White (2002)
decrease from 62% (1998) to 12% (2001), with subsequent increase to 56% (2003), post El Ni ño	sanctuary; permanent transects	Raymundo (2003)

Survey data at ten year intervals from 1982-2002 showed steady increases in coral cover, from 34.7% (1982) to 56.6% (2002; White, 2002). This period encompassed two El Niño events, 1982-83 and 1997-98, but the timing of surveys did not coincide with major bleaching. Raymundo (2003a) conducted annual surveys for Reef Check within the reserve beginning with the 1998 El Niño bleaching event. The reserve reef was badly affected by bleaching, due to the spatial dominance of a highly susceptible coral species, *Galaxea fascicularis*. Annual survey data noted a sharp post-bleaching decline in hard coral cover (Table 1), with a simultaneous increase in soft coral. Since that time, hard coral cover has increased to pre-bleaching levels and soft coral has declined. An in-depth examination of recovery two years post-bleaching revealed significant losses of tissue of *G. fascicularis* and recruitment of new colonies onto the bare skeleton provided by dead coral (Raymundo and Maypa, 2002, 2003a). Comparing data sets with differing sampling intervals and spatial scales can reveal long- and short-term trends. White's (2002) 20-yr data set revealed little long-term effects of two bleaching events, while the shorter-term, smaller scale data sets (Raymundo, 2003a) showed a large reduction in hard coral cover, followed by recovery lasting several years. These studies elucidated responses to El Niño events in a relatively unimpacted marine reserve, an area of current research interest, particularly since such events are predicted to increase in both frequency and severity (Hoegh-Guldberg, 1999).

Empirical studies have been limited, though the high quality of the Apo reef and its proximity to Silliman University makes it a prime site for research on reef ecology. Raymundo and Maypa (1997) examined recruitment patterns of scleractinian corals within the reserve, noting that competition by barnacles lowered recruitment. Raymundo (2001) reciprocally trans-planted coral fragments between two sites of differing health and water quality (Apo Reserve and Bais Bay), and found superior growth and survival in fragments growing in the more favorable Apo reserve site. Calumpong *et al.* (2000) attempted a giant clam restocking program within the Apo Reserve, but were only marginally successful due to high mortality of stocked clams. A recent survey of coral diseases revealed that Apo Island exhibited the lowest disease prevalence out of eight reefs surveyed in two regions in the country (Raymundo *et al.*, in review).

Economic valuation of natural resources: A new concept for scientists

Resource managers have come to the realization that placing a monetary value on a natural resource can be a powerful means of illustrating the effects of either protecting or losing that resource to overexploitation or conversion. Such a tool is particularly useful for non-scientists, government officials, and other decision-makers (Spurgeon, 1992). However, determining the economic value of a coral reef can be difficult, as attributes such as "educational value" and "biodiversity" are difficult to quantify. White and Cruz-Trinidad (1998) outlined the productivity of Philippine coastal ecosystems and discussed various ways of attaching monetary values to these ecosystems. An estimated US$1 billion is contributed to the Philippine economy annually from small-scale fishers (White *et al.*, 2000), but over- and destructive exploitation result in considerable monetary losses. The economic loss suffered as a consequence of ecosystem degradation and productivity reduction makes a compelling statement. In contrast, a recent report by Calumpong *et al.* (in press) cites that only 38% of tourism revenue is used for management of the Apo MPA, showing that a well-managed reserve can net a substantial income from user fees.

Tourism can alleviate such losses and lessen fishing pressure, but development of tourism enterprises must be managed. Oracion (2001) discusses the differences of mass tourism vs. ecotourism, stressing the importance of the behavior of individuals (resort owners, dive guides, etc.) in promoting a conservation approach. The author cites Apo's management history as the major reason for its success as an ecotourism destination, and Vogt (1997) discusses the Apo experience as a potential model from which other ecotourism enterprises could be developed. However, several economic analyses of tourism-derived benefits have stressed that few local residents derived direct income from tourism (Vogt, 1997; Cadiz and Calumpong, 2000; Oracion, 2001). Cadiz and Calumpong (2000) report that only 20% of tourism-supporting revenue (estimated at US$180,859/yr) went directly to Apo Island residents, but a later estimate calculated that 37% of user and entrance fees go directly to the community as livelihood assistance, subsidized electricity, and transportation (Calumpong *et al.,* in press). However, the same report cites that dive operators derived the most benefit from tourism-related activities on Apo. Similar figures were found by Bernardo (2001) for both tourism revenue (US$193,138-US$238,487/yr) and benefits actually received by the community (26-31%).

Under the NIPAS law, 75% of income from MPAs goes to the community managing the area, while 25% goes to the national government. However, bureaucratic delays have resulted in a lag time between the collection of fees and their availability to the community. This has caused a slight political upheaval within the Apo community. Two factions have developed that are at least partially defined by their "pro-" vs. "anti-" PAMB stance, as this situation is the direct result of management takeover by PAMB (E. Oracion, pers. comm.). Oracion (2001) cites the lack of funds for infrastructure projects and social services as the cause for the failure to democratize tourism benefits. This is particularly true in situations, such as in the Apo community, where many are not directly involved in tourism-related activities.

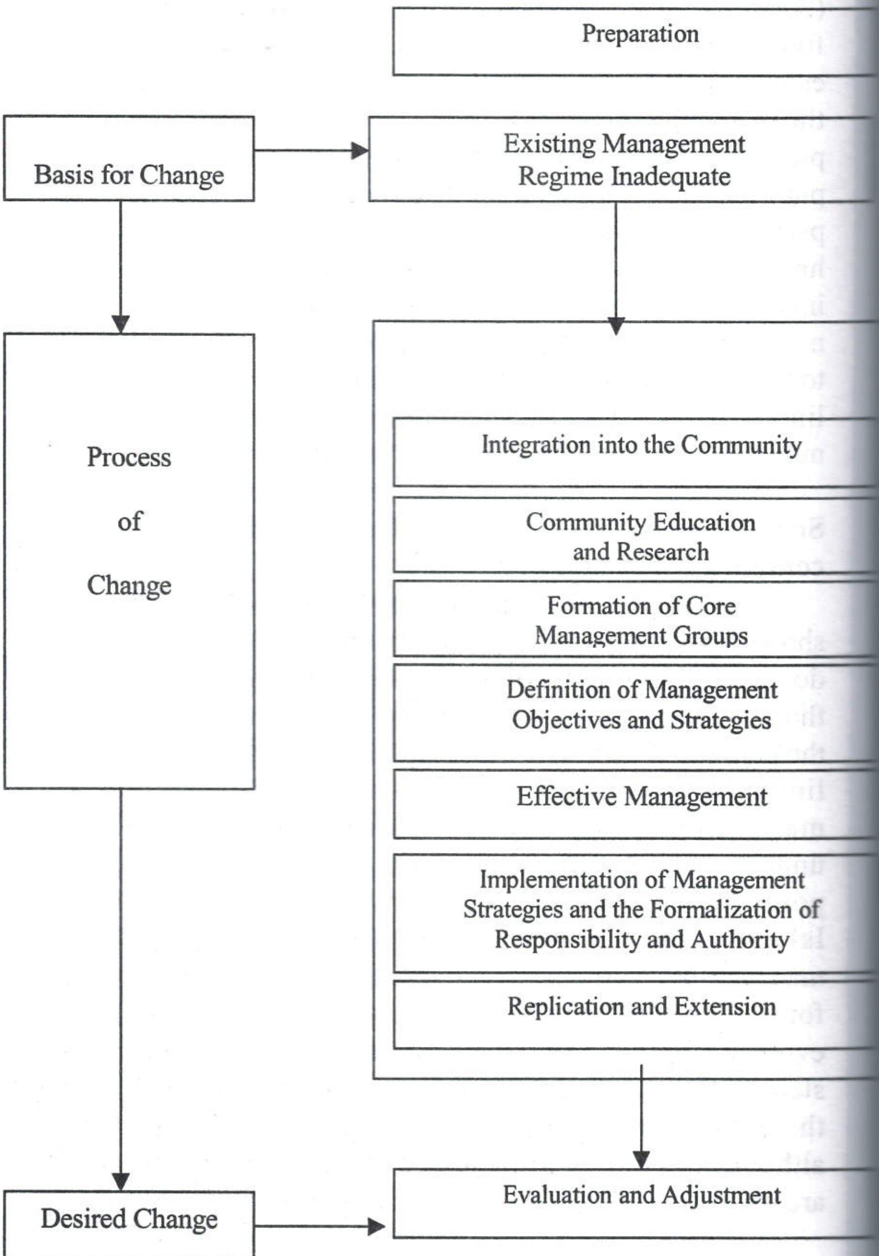
In addition, tourism has generated problems for residents; tourists and fishers often conflict, as tourists scare fish away and have reportedly destroyed a number of fish traps (Bernardo, 2001; Raymundo, 2002; Raymundo and Maypa, 2003b; M. Pascobello, pers. comm.). Oracion (pers. comm.;

ongoing research) states that some residents strongly support a diving ban within the sanctuary. Reboton and Calumpong (2000, 2003) report ongoing damage to the coral community from poorly trained tourist SCUBA divers, necessitating the enforcement of a "carrying capacity" limit for tourist divers on the reserve. Such studies highlight the necessity of careful planning of tourism ventures. Ecotourism is often touted as a panacea, a solution for both environmental and poverty problems. But panaceas do not exist; every potential solution has both positive and negative effects. The balancing act involves developing the positive effects while minimizing the negative ones. PAMB has been quick to act on the problem of tourist/diver damage by delineating fishing grounds as "off-limits" to tourist divers and setting a maximum limit of the number of divers allowed per day on the reserve.

Social science research: what a small island fishing community has taught us

Experience with the Apo Island community has shown, unequivocally, that small island communities can and do respond favorably to a conservation program that brings them immediate benefits. Because island ecosystems (both the human and environmental dimensions) are contained and limited, the impacts of degradation and/or results of management and conservation are measurable and understandable among the local population. Thus, the positive reinforcement of improved stewardship of Apo Island resources over the years has led to a stable management regime based on lessons learned. A framework for community-based marine resource management has evolved from the experience, summarized in Figure 2. The steps in the social change process have all been present in the evolution of Apo Island management. These steps, although not always sequential and sometimes repetitious, are indicative of CB-CRM in many parts of the world today.

Figure 2. Framework for Community-Based Marine Resources Managem...



The significance of the roles of women and children is rarely acknowledged in male-dominated societies. Yet in fishing villages in the Philippines, women are often the more important economic force, though their responsibilities are described as secondary to those of their husbands. An analysis of the division of labor among families relying on subsistence fishing revealed the contribution of fishers' wives; although fishing activities themselves were largely handled by men, their wives were responsible for preparations, fish processing, and selling/ trading (Oracion, 1998a). However, the importance of women as equal stakeholders and managers of scarce resources is largely unrecognized (Oracion, 1998a, 2000). On Apo, most women are involved in multi-tasking, taking on a variety of both domestic and income-generating activities simultaneously with little help from husbands. It has also been observed that the most productive involvement of housewives in income-generating tasks can only occur after their child-rearing responsibilities have lessened (Oracion, 1998b). Many of these women were among the first to actively protect the no-take zone; they describe the many hours spent sitting on the beach in the early 1980s, chasing fishers away from the sanctuary as they wove mats and baskets for sale and watched over their children (F. Candido, pers. comm.). Without this early informal "police force," it is doubtful that the sanctuary boundaries would have been respected. The participation of these women in management, decision-making, and conflict resolution has been documented by Torrequemada-Deguit (1989) and Oracion (2000), who highlight the importance of involving women in the CB-CRM process.

The issue of child labor in Negros Oriental fishing villages was reported by Abregana (1999). Child labor is a growing problem throughout Asia, the region with the greatest number of working children in the world. The author discussed the abusive nature of the deep-sea fishing industry, which recruits young boys for *muro-ami* fishing. Unlike boys from other fishing villages along the coast of Negros, however, those from Apo did not join the *muro-ami* boats. They had been warned by older relatives of the dangers inherent in this type of fishing, and the economic incentives were apparently inadequate to lure them away from fishing on Apo.

So, what has the Apo experience taught us?

It takes a long time and much effort to ensure that a management regime is truly sustainable. Given the status quo on the island, we can say with some certainty that the use of Apo's resources is within ecological limits. Indicators show that the coral reef is stable and healthy. The relatively positive returns from the coral reef fishery, and more recently tourism, have helped convince people and change attitudes in the community towards more sustainable use patterns. The commitment of the island community and its assisting institutions, such as Silliman University and the municipal government, has grown together with time. This has helped ensure a long-lasting protection of the resources that is not wavering. The small size and relative isolation of Apo Island and its close-knit community have made it easier to protect and manage the area in a holistic manner. Enforcement of the rules is internalized and no longer requires external policing. The recent development involving political factions surrounding management issues is more centered on the issues themselves; support for the sanctuary concept itself remains solid.

The mentoring of institutions from outside the island has been crucial to long term success. Silliman University continues to play a key role and the Department of Environment and Natural Resources is important in facilitating the management under PAMB. Involvement of Silliman University has been highly influential in sustaining the commitment and enthusiasm of Apo residents. As seen on Apo, a fully-integrated management approach is required, one that includes population control and reproductive health issues, alternative livelihood needs, health and nutrition, as well as interpersonal and political issues that often arise in small communities. Finally, a unique feature of community-managed or co-managed reserves is its intergenerational nature. By involving community members, children learn from their parents and grandparents, and grow up with the principles of conservation firmly embedded in their ethics. They, in turn, pass these on to their children, creating the essential element of sustainability.

A number of the studies cited above have attempted to use Apo as a model for other communities: for community-based management, for fisheries enhancement via the use of sanctuaries, for ecotourism. However, how applicable is the Apo experience to other communities? As stated above, Apo is a small island, with a tight-knit, cohesive community. It was relatively easy to impose a rule limiting fishing to Apo residents. Along an extensive coastline, such a delineation would be difficult and would necessitate an external policing force; poaching by 'outside' fishers is often cited as a major problem plaguing MPAs. The population of Apo is growing only slightly, partly because some people are emigrating to look for work elsewhere. Many families are aware of the value of having fewer children. In addition, the reef was in relatively good condition, and fishing pressure relatively low, when management was imposed; many community-managed MPAs are in areas with much higher fishing pressure and reefs that have been blasted, silted, or grossly over-fished (Aliño, 2003).

So, what can we take from the Apo experience and apply to other communities? Although the aspects listed above may prevent a direct transplantation of the Apo model to larger, less insular communities, Apo continues to serve as an inspiration to such communities. In 2003, a group of government workers, fishers, and educators from Vietnam visited Apo Island to see the effects of management first-hand. They came away inspired and determined to find ways to incorporate the management approach within a culturally-acceptable framework for Vietnamese fishing villages. People's organizations throughout the Philippines continue to visit and interact with Apo residents, brought by community organizers who recognize the power of hearing the words from fishers themselves. Though the Apo story is merely a "drop in the bucket" in the huge sea of coastal communities desperately needing workable management solutions, its successes have had a ripple effect, inspiring nearby Dauin municipality and other coastal communities to start their own programs. Several of these have become alternative dive sites for nearby resorts. Negros Oriental, alone, now boasts at least 28 marine reserves, though their size, enforcement effectivity, and budget commitment from local government differ widely. A total of 22 MPAs have been established within the Bohol Sea area, based on the Apo model (Alcala and Russ, 2003). In addition, it has had important impacts on national government policy and legislation. The lessons learned from the Apo marine reserve have implications for the open access nature of marine capture fisheries. This can be seen in the legislation of R.A. 7160, the Local Government Code, and R.A. 8550, the Fisheries Code of 1998. R.A. 8550 defined the jurisdiction of local government units (LGUs) for managing their coastal small-scale fisheries. Today in the Philippines, management of coastal areas is now in the hands of LGUs. It is important to keep these points in perspective—the key to Apo's success has always been the unfailing commitment of the community itself, supported by Silliman University, and local and national government. Community empowerment—the so-called "grassroots approach"—has proven its success where the traditional top-down, centralized approach has failed. This, perhaps, is the most important lesson, and one which can be transplanted and modified for other communities.

Nearly 30 years after the first marine parks were established, evidence is only now starting to accumulate to support the "spillover" concept. Obtaining proof is challenging as it involves multiple sources of data. One reason for the lack of evidence may be the time needed for fisheries to recover after heavy exploitation. Monitoring predatory fish biomass of Sumilon I. and Apo I. over a 17-yr period, Russ and Alcala (2004) concluded that time needed for full recovery to a pre-exploited state would take 15 yr and 40 yr for the two islands, respectively. This conclusion is based on current rates of biomass accumulation and life history aspects of the target species. Such an extended recovery period would translate into a slow spillover effect, and highlights the need for long-term commitment to management.

Without a fundamental shift in attitude among stakeholders toward conservation, commitment is short-term; protection does not last. Sustainability is a key factor (Alcala, 1997; White, 1986; Russ and Alcala, 2003b), and is often brought about most effectively using a long-term multi-sectoral approach: partnerships between stakeholders, local government, support institutions, or NGOs (White and Deguit, 2000), and involvement of women in decision making (Oracion, 2001). Environmental conservation requires more than just an awareness of destructive activities on the environment; most fishers know they are using a destructive fishing method, but may feel they have few other options. Population control, alternative livelihood options, health, and interpersonal/political issues must also be addressed. This is why it is called "Integrated Coastal Management."

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LONG-TERM CHANGES IN CORAL REEF BENTHIC COMPOSITION OF TUBBATAHA REEFS: RESPONSE TO BLEACHING IN 1998 AND PROTECTION

Aileen P. Maypa, Alan T. White, Sheryll C. Tesch, Anna Blesilda T. Meneses, and Evangeline White

ABSTRACT

The benthic community of Tubbataha Reefs is dominated by hard corals that were severely impacted by the 1998 bleaching event and by lack of protection before 1992. The bleaching episode caused major changes in community structure. In this paper we provide details of the changes of benthic composition of selected sites in Tubbataha Reefs from 1984 to 2004. Our results show that coral bleaching and the post-bleaching responses of reefs can vary spatially within a small reef system such as Tubbataha Reefs. Four post-bleaching responses were documented: (1) recovery in terms of increase in live hard coral cover; (2) no recovery or change in live hard coral cover; (3) phase shift in the living substrate composition from hard live coral to soft coral and vice versa; and (4) no significant change in live hard coral cover. It is also suggested that the responses of the benthic community after 1998 are affected by active reef protection, whereas in the period of 1984 to 1992, reef management had not yet been instituted. This may partly explain the decline in hard coral cover in these years. Consequently, the need for sustained management, protection, and regular monitoring of this reef system has been recommended. This study is part of the Saving Philippine Reefs Project, whose long-term goal is to assist in Philippine coral reef management and conservation.

Introduction

Long-term data sets documenting detailed changes in coral reef benthic community composition and fauna are rare. However, such information is needed for sustained coral reef management. In the Philippines, where 50% of animal protein is derived from marine fisheries and aquaculture (White and Cruz-Trinidad, 1998), support for coral reef conservation and management has been growing over time. But despite the growing number of measures to reduce anthropogenic threats to coral reefs, the impact of coral bleaching since the 1998 El Niño Southern Oscillation (ENSO) event remains a global concern.

The impact of coral bleaching varies from physiological changes in individual corals such as reduced growth and reproductive output and increased mortality (Marshall and Baird, 2000) to a spatially extensive reduction in coral cover and changes in fish composition (Fujiwara *et al.,* 2000). More seriously, it has been considered as a factor damaging the fragile economies of many developing countries and the livelihood of their people (Douglas, 2003).

Bleaching events are predicted to increase in frequency and severity (Hoegh-Guldberg, 1999). Bleaching is induced by a variety of stressors, of which thermal stress has been implicated in most large-scale bleaching events (Brown, 1997; Douglas, 2000). Elevated sea water temperature, often combined with increased solar irradiance, has been linked with long-term changes in global climate and compounded by ENSO events (Stone *et al.,* 1999). Factors affecting bleaching susceptibility and severity in corals include the molecular ecology of the zooxanthellae, the ecophysiology of corals (Douglas, 2003), and presence of bacteria which can cause bleaching (Kushmaro *et al.,* 1998; Ben-Haim *et al.,* 2003).

This study is part of the Saving Philippine Reefs Project, whose goal is to assist in Philippine coral reef management and conservation. In this report, we document the long-term changes in the benthic communities of Tubbataha Reefs and the differential post bleaching responses of various reef sites in the context of reef protection in the last ten years.

Methods

Study site

The Tubbataha reef system lies in the middle of the Sulu Sea. Its structure is that of a classic atoll with both fringing and atoll reefs facing the open sea outside the atoll lagoon (White *et al.,* 2003; Fig. 1, next page). Continuous reef platforms, 200-250 m wide, completely enclose sandy and coral substrate lagoons that range from 1 m - 24 m in depth. At extreme low tide, portions of the atolls' shallow reef platforms are exposed (NRMC, 1983). Tubbataha Reef was declared a National Marine Park in 1988 through a presidential decree, and as a UNESCO World Heritage site in December 1993 by the World Conservation Union (White *et al.,* 2003).

Data were gathered from six selected sites (Fig. 1) from 1984 to 2004, by scientists and trained volunteers of the "Saving Philippine Reefs (SPR) Earthwatch Expedition." These six sites are within the protected area of the Tubbataha Reef National Marine Park (TRNMP):

1. NR1 (North Reef): Amos Rock or Malayan Wreck (8°53.5 17' N, 119° 53.338' E)
2. NR2 (North reef): Ranger Station (8°55.5 22' N, 120° 0.327' E)
3. NR5 (North reef): Bird Islet (8°55.594' N, 120° 0.338' E)
4. SR1 (South Reef): Lighthouse (8°44.348' N, 119° 48.089' E)
5. SR3 (South Reef): Black Rock (8°47.842' N, 119° 50.352' E
6. SR4 (South Reef): Northwest corner of South Atoll (8°48.604' N, 119° 48.462' E)

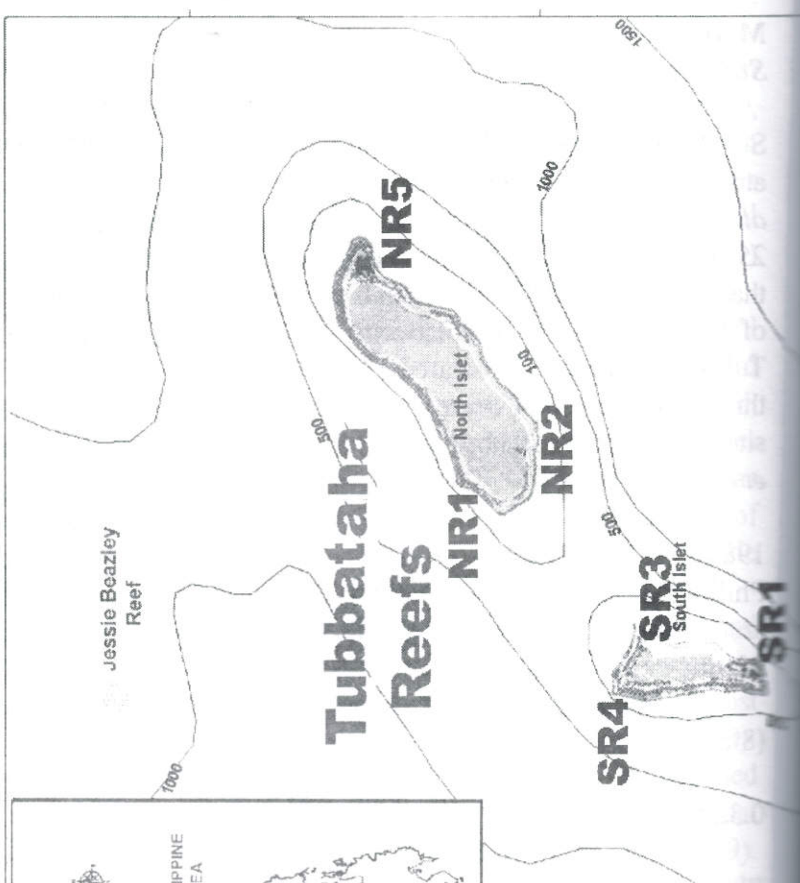

Figure 1. Study sites (NR1, NR2, NR5, SR1, SR3, SR4) on Tubbataha north and south atolls (modified from WWF Philippines).

Data collection

Scuba surveys were carried out at 7-9 m depth parallel to the reef crest using a systematic point-intercept method. Transects were laid on sections of a reef flat, reef crest, slope, or wall. Substrate was noted at 25 cm intervals along 50 m transects (no.= 1984=1; 1992=3-4; 1996=4-8; 2000 =11-22; 2004 =16-17). Distance between transects averaged 5-10 m. Survey sites were relocated yearly using GPS. Data gathered during SCUBA surveys were: (1) percent cover of living coral (hard and soft); (2) percent cover of non-living substrate (e.g., rock, rubble, sand, dead coral); (3) percent cover of living substrate (e.g., seagrass, algae, sponges); (4) numbers of indicator species (e.g., butterflyfish, giant clams, lobsters, Triton shells, Crown of Thorns starfish, and other invertebrates); (5) presence of large marine life (e.g., sharks, manta rays, Humphead wrasses, sea turtles, whales, dolphins, and others); (6) types of reef damage; and (7) fish species and densities. In this paper, we report only the substrate changes over time and the rest of the collected data were excluded but available in a separate report (White *et al.,* unpubl.).

Data analyses

Substrate categories were regrouped for comparison into total live hard coral, soft coral, rubble, dead coral (white dead standing coral, dead coral colonized by algae) and non-living substrate (rock and block, sand and silt), and presented graphically. Each category was compared within site between years using a One-Factor Analysis of Variance. Surveys from previous years with low replication ($n<3$) were excluded from statistical analyses, so T-tests were used to analyze sites with only two survey years available. All percentage data were log transformed. Normality was tested using Kolmogorov's Test for normality and Levene's Test for homogeneity of variances.

Results

The benthos of Tubbataha Reef was dominated by live hard coral (LHC) prior to the 1998 ENSO bleaching event (Figs. 2-5) with the exception of site SR3, which was primarily a soft coral reef (Fig. 1, 5). LHC fell within the "fair" to "good" categories (27.4 – 54.1%; as described in Gomez *et al.,* 1994) in all sites in 1984 and 1992 (Table 1). By 1996, LHC cover at site NR1 significantly increased (55.9±7.6%; Table 2). No significant changes were observed in other sites, though cover remained relatively high. By 2000, the immediate impacts of the 1998 ENSO were reflected in the significant ($p<0.05$) decline of LHC and/or soft coral (SC) cover in all sites except SR4 and SR1, where no significant change was detected (Table 2).

By 2004, distinct changes in the benthic composition of most sites were observed. NR2 LHC cover increased from 12.9±2 % in 2000 to 41.9±4.2% in 2004. Similarly, NR5 LHC cover also significantly increased from 18.5±2% in 2000 to 35.7±2.8% in 2004 (Table 1). The increase in LHC in both sites were coupled by decreases in non-living substrates (e.g., dead coral, sand/silt; Fig. 2), suggesting hard coral growth. In contrast, no recovery in LHC was observed in NR1; LHC cover in 2000 (23±3.4%) was not significantly different from 2004 (18±2.4%). Alternatively, SR1 and SR3 benthos exhibited phase shifts in dominant substrata (Fig. 4). In SR1, LHC still dominated in 2000 and 2004 over the rest of the substrate. Although changes in LHC between 2000 and 2004 were not significant, a decline in LHC corresponded to a significant increase in soft coral cover (Table 2, Fig 4). In SR3, the dominant soft coral substrate was replaced by LHC after the 1998 ENSO mass bleaching. No significant change in LHC was observed between years at the SR4 site, suggesting that LHC was not severely affected by the 1998 ENSO.

Data are summarized over time for all sites in Fig. 6. Percent change from 1984 to 1992 is +13.38% and from 2000 to 2004, is +37%. Although these changes are not significant (ANOVA) due to site variability, they indicate probable trends in the reef condition.

A decreasing trend in live hard coral reef is exhibited as indicated by a regression line (Fig.6).

Figure 2. Changes in benthic composition of NR2 and NR5 showing recovery of live hard coral cover after the ENSO bleaching event.

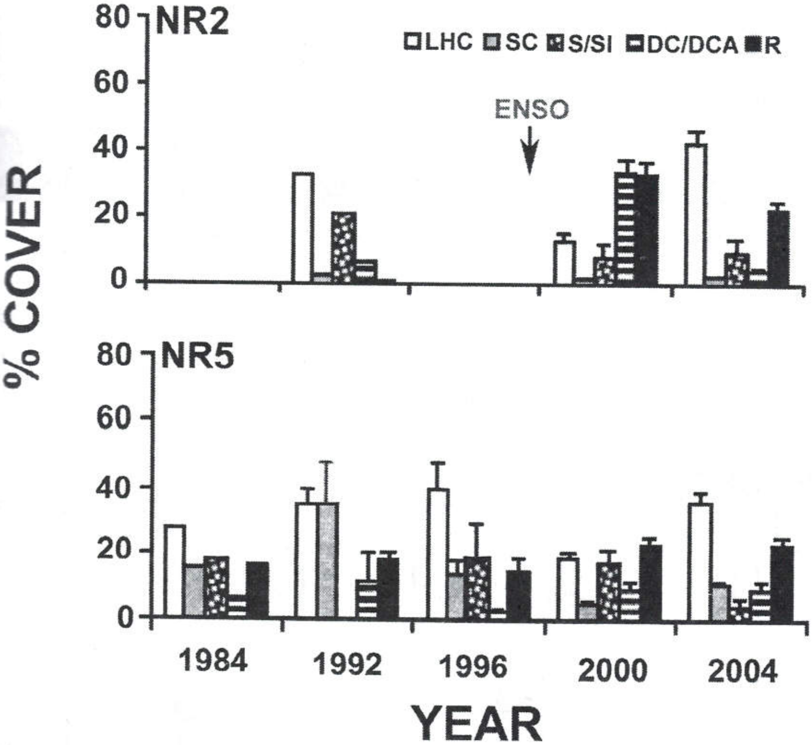

Figure 3. Changes in benthic composition of NR1 showing no recovery in live hard coral cover after the ENSO bleaching event.

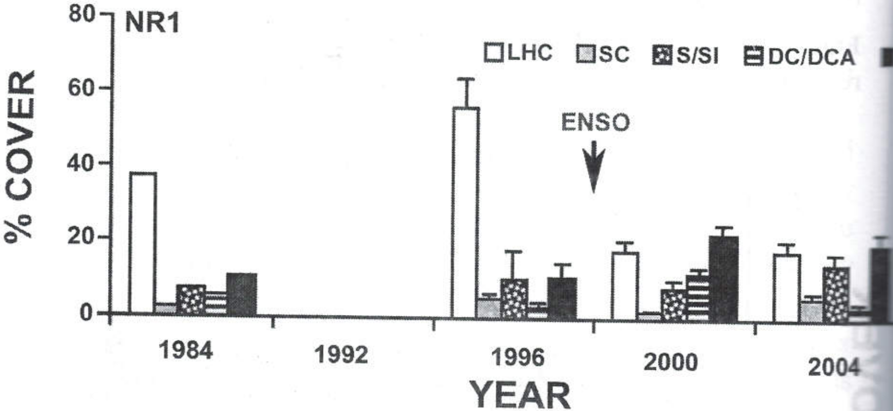

Figure 4. Changes in benthic composition of SR1 and SR3 showing phase shifts in the dominant substratum. SR1: continued decline in live hard coral cover and simultaneous increase in soft coral cover. SR3: replacement of previously soft coral-dominated reef to a hard coral reef.

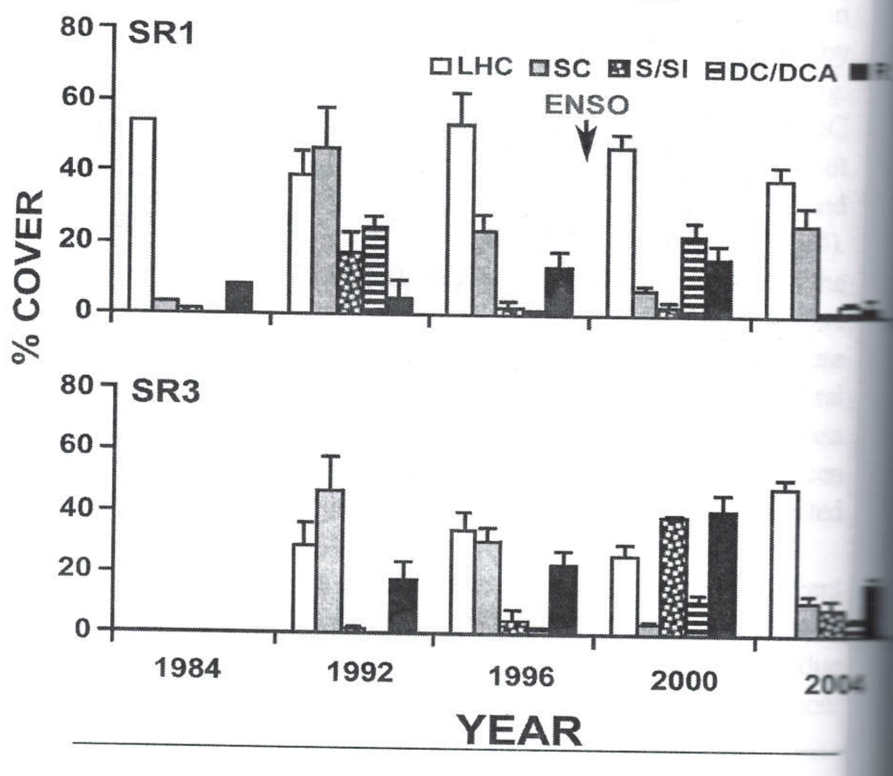

Figure 5. Changes in benthic composition of SR4 showing no significant change in live hard coral cover after the 1998 ENSO coral bleaching.

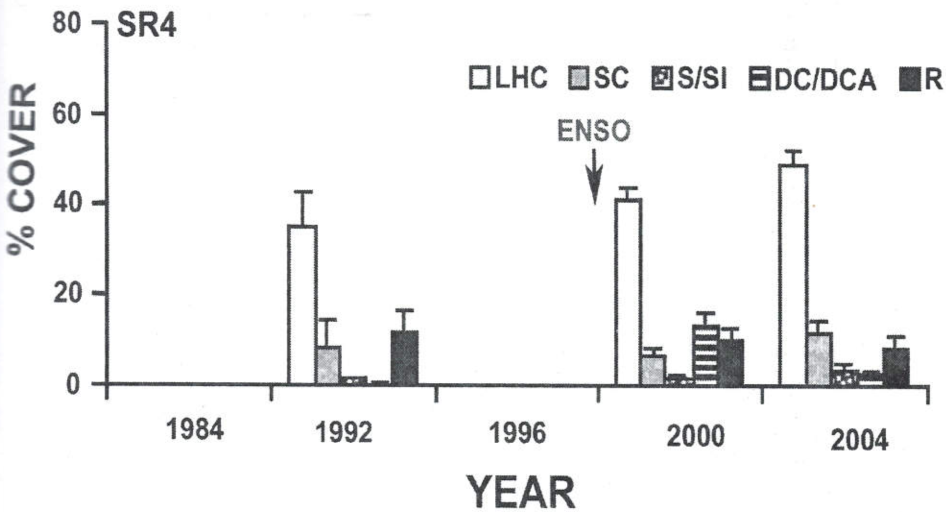

Figure 6. Changes in mean (± SE) overall live hard coral (LHC) cover of Tubbataha Reef showing a decreasing trend from 1984 to 2004. Straight line through graph indicates overall mean.

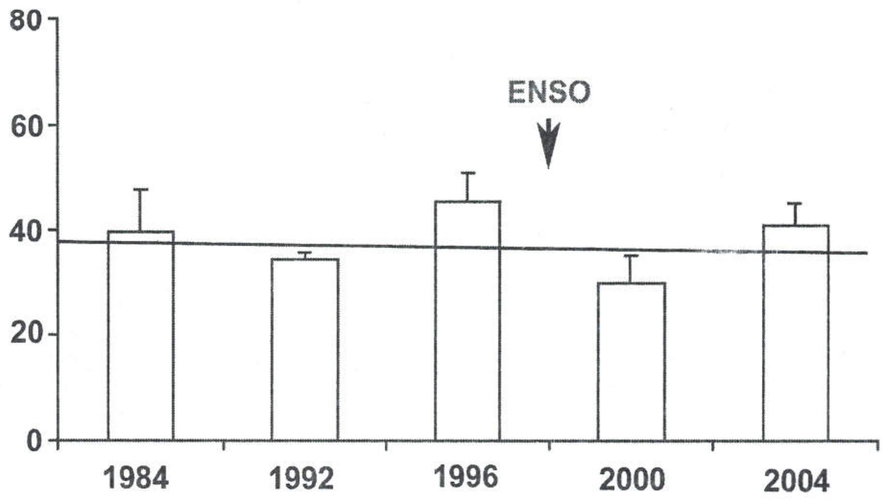

Table 1. Changes (% mean ± SE) in live hard coral cover (LHC) and soft coral cover (SC) from 1984 to 2004 in six selected sites at Tubbataha Reef.

Site/substrate	Year				
	1984	**1992**	**1996**	**2000**	**2004**
NR2					
LHC	no data	32.4	no data	12.9 ± 2.0	41.9 ± 4.2
SC	no data	1.8	no data	1.1 ± 0.4	1.7 ± 0.4
NR5					
LHC	27.4	34.9 ± 5	38.8 ± 8.7	18.4 ± 2.0	35.7 ± 2.8
SC	15.8	34.8 ± 13	13.9 ± 3.8	4.7 ± 1.0	10.1 ± 1.5
NR1					
LHC	37.3	no data	56.0 ± 7.6	23.0 ± 3.4	18.0 ± 2.4
SC	2.7	no data	5.3 ± 1	1.6 ± 0.5	5.5 ± 1.44
SR1					
LHC	54.1	38.9 ± 7.2	53.2 ± 9.2	47.2 ± 3.6	38.2 ± 3.8
SC	3.6	46.8 ± 11.6	23.4 ± 4.4	7.3 ± 1.4	25.4 ± 5.3
SR3					
LHC	no data	29.0 ± 7.2	33.7 ± 6.1	26.5 ± 3.2	47.9 ± 3.3
SC	no data	46.8 ± 11.6	30.7 ± 4.2	3.4 ± 0.9	11.4 ± 2.1
SR4					
LHC	no data	35.3 ± 6.9	no data	41.0 ± 2.7	49.0 ± 2.95
SC	no data	9.1 ± 5.2	no data	7.0 ± 1.8	11.7 ± 2.4
All sites					
LHC	39.6 ± 7.8	34.3 ± 1.4	45.4 ± 5.4	30.0 ± 5	41.1 ± 3.8
Overall LHC % change [(Year2/Year1)-1] x100		-13.38	+32.4	-33.9	+37

Table 2. Results of 1-Way ANOVA and **T**-test within substrate categories between years per site (á = 0.05). LHC = Live hard coral, SC = Soft coral, R = Rubble, NL = Non-living (sand and silt), DC = Dead coral.

North Reef

	NR1			NR2		NR5		
	1-ANOVA		Bonferroni post hoc	T-test		1-ANOVA		Bonferroni post hoc
Substrate	p	F		p	Ranking	p	F	
LHC	≤ 0.0001	20.7772	1996>2000=20004	≤ 0.0001	2004>2000	0.0004	7.497	1992=1996=2004>2000
SC	0.0003	4.4966	1996=2000>2004	NS		NS		
R	NS			0.016	2000>2004	0.0009	6.5659	2000>2004=1996
NL	0.047	3.3595	NS	NS		≤ 0.0001	17.046	2000>1992>1996>2004
DC	≤ 0.003	11.16	2000>1996=2004	≤ 0.0001	2004>2000	0.013	4.05	2000>1996

South Reef

	SR1			SR3			SR4		
	1-ANOVA		Bonferroni post hoc	1-ANOVA		Bonferroni post hoc	1-ANOVA		Bonferroni post hoc
Substrate	p	F		p	F		F	p	
LHC	NS			0.0018	6.163	2004>2000 1992=1996	NS		
SC	0.0167	4.1546	NS	0.8788	0.5236	>2000=2004	NS		
R	NS			0.0136	4.0981	2000>2004 1992>1996	NS		
NL	0.0051	5.8774	1992<2000=2004	0.0006	7.3274	=2000=2004	0.008	5.553	2004>1992=2000
DC	NS			NS			≤ 0.0001	13.41	2000>2004=1992

Discussion

Our surveys over a 20 year period indicated that the El Niño Southern Oscillation (ENSO) event contributed largely to the changes in Tubbataha coral reef substrate in 1988 and after. Although no visits were made to the reefs during 1998, our data suggest that the impact of the 1998 ENSO on Tubbataha reefs caused massive bleaching and death of the live hard corals (LHC) and soft corals (SC). This is reflected in the sharp declines of these substrata during the 2000 survey. Live hard coral cover was "fair" (25-49.9%) to "good" (50-74.9%). By 2000 and 2004 LHC declined to "poor" to "fair" (0 – 49.9%). In 2004, distinct differential responses were exhibited by various reefs in Tubbataha: (1) recovery in terms of increase in LHC: sites NR2 and NR5; (2) no change in LHC: SR1; (3) phase shift in the living substrate composition from soft coral to live hard coral or vice versa: NR1; (4) no significant change in LHC: SR4.

Coral reef recovery after bleaching was evident in two Tubbataha survey sites. NR2 and NR5 LHC declined by 20% in 2000, but significant increases in LHC were seen by 2004 in both sites. NR1, on the other hand, was apparently severely impacted by bleaching; LHC cover declined by 33% from 1996 to 2000. By 2004, NR1 showed the lowest LHC of all sites and no significant recovery was observed. These results indicate that coral recovery in NR1 is taking longer than other sites. Repeated bleaching episodes may result in the continued decline of coral cover at this site. It is interesting to note the spatial position of these three reefs (Fig. 1). Sites NR2 and NR5 are both on the eastern side of the atoll, while NR1 is on the western side. Possible difference in current patterns that drive the sea surface temperature (SST) differences between sites may have contributed to the differential responses to bleaching and subsequent recovery observed. Changes in community structure as a consequence of coral bleaching and death were seen in SR3 and SR1. A decline in soft coral and hard coral cover was observed in SR3 from 1996 to 2000. By 2004, a phase shift had occurred, and LHC cover increased by 81%. This replaced most of the soft coral population dominating the area prior to the bleaching episode. A similar change was seen in Apo Island Marine Reserve, Central Philippines, documented by Raymundo and Maypa (2002; 2003). Soft coral cover steadily increased, while LHC cover decreased, after ENSO from 1999 to 2001. By 2002, LHC cover started to increase with a simultaneous decrease in soft coral cover. In SR1, LHC was still the dominant substratum but data suggest a decreasing trend. When combined with the continuing increase in SC cover, this suggests that a community shift from LHC to SC may be occurring. Continued monitoring can quantify this shift over time, and would provide valuable information regarding responses to bleaching within a pristine reef system. This shows that bleaching disturbances may promote changes in species dominance and diversity which are not immediately apparent and which may take several years to complete (Marshall and Baird, 2000).

SR4 LHC cover remained unchanged from 1996 to 2004, and thus was apparently not affected by the 1998 bleaching event. Factors that may have contributed to the high survival of corals at this site during sea water temperature rise may include: (1) the depth at which the corals thrive; (2) species composition of the reef; and, (3) the exposure of the reef to strong local currents which may have acted as a temporary buffering system for temperature change. It is interesting to note that SR4 is on the opposite side of the atoll from SR1 and SR3, and on the same side as NR1 (Fig. 1). According to Skirving (2004), there are four different mechanisms that can vertically mix the water column, wind, low frequency currents (e.g., East Australian current, Gulf Stream), high frequency currents (e.g., tides), and swell waves. Winds are effectively absent during a mass bleaching event leaving swell waves and currents as the only mechanisms that can alter the spatial patterns of SST.

Our results show that the coral bleaching impact of the 1998 ENSO can vary spatially within a small reef system (10,000 ha) such as Tubbataha Reefs. These differential bleaching responses and changes in community structure may be a result of factors acting in synergism. Similarly, between-site differences in environmental conditions that trigger the bleaching (Glynn, 1993) due to thermal stress (Brown, 1997) and differential susceptibility and mortality among species (Hughes and Connell, 1999) are also major factors. Further, fragile species such as tabular and branching acroporids and pocilloporids are more susceptible to mechanical disturbances than massive faviids and poritids (Hughes and Connell, 1999).

Recovery from bleaching and changes in community structure of Tubbataha Reefs will likely be driven by the resiliency of the hard and soft coral species present, recruitment, soft coral competition (specifically in SR1 and SR4), corallivory, local current patterns, depth profiles, and frequency and severity of future bleaching episodes. But such recovery will only occur in the context of protection from other human related impacts. In earlier years, 1984 to 1992, Tubbataha was documented to have suffered from rampant illegal fishing (White and Palaganas, 1991). Evidence of declines in LHC is noted between 1984 and 1989 by White and Palaganas (1991) but because replication was inadequate, significance levels cannot be ascertained. Nevertheless, at the present time, it is essential to ensure the integrity of the reefs and the credibility of the monitoring data. Tubbataha is one of the few remaining reefs in the Philippines with outstanding biodiversity and relatively low susceptibility to human impacts (Arquiza and White, 2000). This reef system may play a major role in larvae supply and transport in the Sulu Sea and vicinity (Quibilan and Aliño, in rev.). The predominantly westward movement of ocean currents in the

Sulu Sea is believed to transport fish and decapod eggs and larvae to the eastern coast of Palawan (Dolar and Alcala, 1993). Thus, sustained reef management and protection from anthropogenic factors, combined with regular monitoring are essential for Tubbataha Reefs.

Acknowledgments

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ALGAE-CORAL INTERACTIONS: MEDIATION OF CORAL SETTLEMENT, EARLY SURVIVAL, AND GROWTH BY MACROALGAE

Aileen P. Maypa and Laurie J. Raymundo

ABSTRACT

Degraded coral reefs are often colonized by macroalgae, which can impede coral reestablishment. However, impacts of abundant macroalgae have not been well-established for juvenile stages of coral. This study examined the effects of morphology and chemistry of four species of macroalgae on the early life history of the coral *Pocillopora damicornis* in laboratory aquaria. Morphologies of *Sargassum polycystum* and *Laurencia papillosa* significantly inhibited larval settlement *(S. polycystum* and *L. papillosa*: <30% settlement, vs. algae-free control: 60% settlement), while their exudates enhanced settlement (*S. polycystum*: 67% $\pm$ 6%; *L. papillosa*: 71% $\pm$ 4%; control: 20% $\pm$ 4%). Neither morphology nor exudates of *Halimeda opuntia* and *Peyssonnelia rubra* significantly affected larval settlement. Juveniles survived less in aquaria containing *H. opuntia,* while survival was facilitated in aquaria with *P. rubra*. Growth was also affected differentially; colonies growing with *L. papillosa* (5 $\pm$ 0.8 polyps per colony) and *S. polycystum* (4 $\pm$ 0.1 polyps/colony) were significantly smaller at three months than those growing with *H. opuntia* (6 $\pm$ 0.9 polyps/colony) and *P. rubra* (6 $\pm$ 0.6 polyps/colony). These data suggest that the effects of macroalgae on early life history stages of corals are complex and long-term, and vary between species.

Introduction

Coral reefs are degrading worldwide (Wilkinson, 2002) and efforts to understand the processes affecting recovery are in their most initial stages (e.g., Connell *et al.,* 1997; Hughes *et al.*, 1999). Degraded reefs often undergo a phase shift from abundant corals to abundant macroalgae (Done, 1992; Hughes, 1994). Such shifts can result in lower fish biomass, coral biodiversity, and productivity, with a resulting loss of income for those dependent on reef resources. There is a widespread concern that this degradation is the result of human impact, though the relationship between anthropogenic stress and coral-to-algae phase shifts are poorly understood (McCook, 1999; Szmant, 2002).

Macroalgae and corals are competitors and increased abundance of macroalgae will lead to declines in coral populations (McCook, 1999). Brown fleshy algae colonize most of the hard substratum (dead corals and limestone) of previously dynamited reefs in the Central Philippines (Calumpong *et al.,* 1997a; 1997b), and a similar condition was observed in Kenyan lagoons (McClanahan *et al.,* 1996) and Jamaican reefs after a severe overfishing and mass mortality of the echinoid, *Diadema antillarum* (Hughes, 1994). Macroalgae are capable of overgrowing corals (Coyer *et al.,* 1993; Miller and Hay, 1996), which reduces coral cover, growth, and fecundity (Tanner, 1995). In addition, algae also cause abrasion and tentacle retraction, facilitating algal overgrowth and inhibiting feeding in corals (Coyer *et al.,* 1993; Miller and Hay, 1996). Experimental algal reduction in Kenyan lagoons increased coral cover by 5% within 6 months (McClanahan *et al.,* 1999).

Previous studies have reported that various algal species contain secondary metabolites which may function as anti-microbial and anti-fouling agents (Schmitt *et al.,* 1995; Hay,1996), herbivore deterrents, or as allelopathic agents to invertebrate larvae (Hay, 1996). Schmitt *et al.* (1995) exposed bryozoan larvae, *Bugula neritina,* to extracts of the brown alga *Dictyota menstrualis.* The alga was found to inhibit settlement and cause mortality and abnormal or reduced development in larvae settling near the thallus. Similarly, larvae of *B. neritina* and *Hydroides elegans,* a polychaete tube worm, either were immediately killed or failed to settle when exposed to waters conditioned with the algae *Dictyota sandvicensis* and *Laurencia cartaginea* (Walters *et al.,* 1996).

In contrast, some macroalgae have facilitative effects on invertebrate and coral larvae settlement. Aplysiid veligers showed high settlement and metamorphosis in the presence of certain algal species, suggesting that the algae release a metamorphosis cue for this species (Switzer-Dunlap and Hadfield, 1977; Otsuka *et al.*, 1981). Larval metamorphosis and settlement in polychaetes (Walters *et al.*, 1996), abalones (Morse and Morse, 1996; Jensen *et al.*, 1990), the crown-of-thorns starfish (Johnson *et al.*, 1991), and corals (Morse and Morse *et al.*, 1998; Heyward and Negri, 1999) were also found to be triggered by specific species of algae.

These data reveal a number of diverse functions of macroalgae on reefs; some deterrent and competitive to corals; others, beneficial. The application of such information to coral colonization and recovery after disturbance has only recently been considered in light of observations of competitive replacement of corals by macroalgae. One factor which may affect coral reestablishment is the ability of larvae to recognize highly specific physical and chemical cues (Morse and Morse, 1996; Babcock and Mundy, 1996). To date, very few species of algae are known to facilitate coral larval settlement. In degraded reefs where these settlement cues are absent, recolonization and recovery may be inhibited. A better understanding of the species that inhibit or facilitate coral settlement and/or early survival is therefore essential. Natural recovery via larval recruitment may be slow to non-existent, depending on the nature of the disturbance (Birkeland, 1977; Alcala and Gomez, 1985). Since data suggest that the mechanisms by which algae mediate coral recruitment on reefs are highly variable and species-specific, it is important to quantify these interactions in all stages of the coral life history. This is particularly important for species of algae with the potential to dominate in disturbed reef communities. In this study, we present experimental evidence on the facilitative and inhibitory effects of four common species of algae on the settlement, early survival, and growth of the coral *Pocillopora damicornis.* We hypothesize that an alga can affect settling larvae in two ways: either morphologically, due to possible shading, abrasion, or influences on water movement of the microhabitat; or chemically, through waterborne chemicals which may either deter or attract larvae.

Materials and Methods

Larvae collection

Pocillopora damicornis colonies were collected off Bantayan, Dumaguete City (9°19.800N, 123°18.693E), central Philippines prior to new moon. Larvae collection in the laboratory followed the protocol described in Raymundo *et al.* (1997). Colonies were placed in separate buckets supplied with running seawater each night. Bucket outlets drained into 125µ plankton mesh cups which collected the planulae as they were released. Since differences in settlement success in larvae from different parents have been documented from the Bantayan population (Raymundo and Maypa, 2004), larvae in these preliminary experiments were obtained from a single parent colony, rather than pooling larvae from different parents. Although this limited the interpretation of our results, it avoided the possibility that the results observed were due to behavioral differences in larvae from different parents, rather than responses to the algal treatments. Spent colonies were returned to the reef after spawning.

Effect of morphology on settlement and survival

Experimental set-up. Planulae used in this experiment were collected during two peak spawning days from a single colony. Five control aquaria were stocked with 90 planulae and contained 12 glass substrates, previously conditioned in salt water, roughened and fitted tightly at the bottom. This ensured maximum contact between algae and planulae by providing only upper glass surfaces for settlement. The planulae were allowed to settle for 48 h without aeration, after which settlement was censused on all plates. Aquaria were subsequently supplied with running seawater for eight hours during the day and aeration at night. All aquaria were cleaned weekly for the three-month duration of the study.

Halimeda opuntia, Laurencia papillosa, Sargassum polycystum and *Peyssonnelia rubra* were chosen for this study.

All algae were abundant on surveyed reefs in the central Philippines, and represented four distinct morphologies: *Halimeda opuntia* thalli are calcareous with articulated segments; *L. papillosa* is fleshy; *S. polycystum* has a bushy-frondose morphology; and *P. rubra* is coralline and foliose. All algae collected were allowed to acclimate in laboratory tanks supplied with running seawater for two to four days. Algal thalli were cleaned of epiphytes and only intact thalli were used in the experiments. Replicate aquaria (n=6 per alga) were set up as described above. To test for the effect of morphology on larval settlement, larvae (n=90 per aquarium) were provided with three possible choices for settlement: (1) four plates with a single thallus of the assigned alga in the center of the plate; (2) four with an artificial algal thallus made of plastic coated wire and nylon stocking, mimicking the morphology of the algae inside the aquarium but without chemical exudates and thallus movement; and (3) four empty plates. Stocking, settlement, and censusing were carried out as described above.

Settlement, survival and growth. Coral spat were counted after 48 h. The distance between each coral spat to the nearest living or artificial thallus was recorded, and position of each spat on the plates was mapped. Coral spat were monitored for survival, mortality, and growth weekly after settlement until colonies were three months old, the algae being maintained in the tanks for the duration of the study. Mortality was noted by the absence of mapped spat during the subsequent census. Growth was measured by the increase in polyp number.

Effect of waterborne chemicals on settlement

The method used in this study was modified from that of Walters *et al.* (1996). Algae collected from the field were cleaned of epiphytes and allowed to acclimate for two days in laboratory tanks supplied with running seawater. For each species, intact algae were chosen and rinsed with synthetic seawater (Coralife Salts®). Algae-to-water volume ratio was 1:10. Algae in buckets were left uncovered, unaerated, and unstirred for 24 h under natural light conditions. After 24 h, the algae-conditioned water was immediately poured into 1 L beakers (n=6 per alga) rinsed with synthetic seawater. A roughened, unconditioned glass substrate was also placed in each beaker tilted at an angle of 15° and 30 planulae were immediately added. Synthetic seawater and natural seawater controls were set up in an identical fashion. Planulae were left to settle for 48h. Half of the water in each beaker was changed every three days with either fresh algae-conditioned water or control water. Settlement and survival were monitored for 10 days.

Results

Effect of morphology on settlement, survival, and growth

All larvae in both control and treatment aquaria settled preferentially on the conditioned glass substrata, but settlement varied significantly among algal species (Table 1, Fig. 1; Kruskal-Wallis, $p = 0.0002$). Settlement was highest in aquaria with *P. rubra* (57 % $\pm$ 2.6) and *H. opuntia* (50.7% $\pm$ 1.6), but these were not significantly different from control aquaria. In *L. papillosa* and *S. polycystum* treatments, settlement was significantly lower (<30%). This suggests that the bushy frondose morphology of *S. polycystum* and the turf-forming *L. papillosa* are inhibitory to the settlement of *P. damicornis.* Settlement patterns, expressed as mean distance of spat to the nearest algal thallus, were similar in all algal treatments except in *H. opuntia* aquaria; mean settling distance of planulae was significantly closer to *H. opuntia* (20.5 $\pm$ 2.7; ANOVA, $p = 0.016$) than to *P. rubra, S. polycystum, and L. papillosa* (Table 2).

In general, highest mortality occurred during the first week, approximating Type III survivorship; succeeding weeks were significantly lower in all treatments and control aquaria (Table 1, Fig. 2; Friedman's test, $p < 0.05$). First week survival in *L. papillosa, S. polycystum* and *H. opuntia* aquaria was significantly lower than in *P. rubra* and control aquaria. At the end of the study period, similar survival patterns were seen between algal treatments though percent total survival differed between

Table 1. Summary of results of Kruskal-Wallis (KW) and ANOVA (AN) tests between algal treatments for the Morphology experiment and Waterborne chemical assay. C = Control; Pr = *Peysssonnelia rubra;* Ho = *Halimeda opuntia;* Lp = *Laurencia papillosa;* Sp = *Sargassum polycystum.*

Life history	p-value	*Post-hoc* test
Effect of morphology		
Settlement	0.0002 (KW)	C=Pr=Ho>Lp=Sp
Survival (12 weeks)	0.0001 (KW)	Pr>C>Ho>Lp>Sp
Growth (no. of polyps)	0.0067 (AN)	Pr>C>Ho>Lp=Sp
Effect of waterborne chemicals		
Settlement	0.0008 (KW)	Lp=Sp>Hp=Pr=C
Survival (10 days)	0.0005 (KW)	C=Lp=Pr=Ho>Sp

Figure 1. Maypa and Raymundo: Percent settlement (mean ± SE) of *Pocillopora damicornis* larvae in aquaria with living and artificial algal thalli. C = Control; Pr = *Peysssonnelia rubra;* Ho = *Halimeda opuntia;* Lp = *Laurencia papillosa;* Sp = *Sargassum polycystum.*

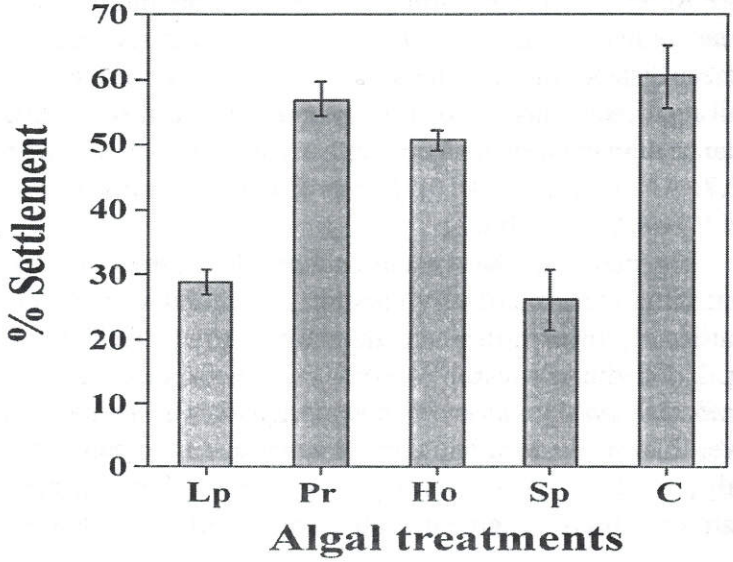


Table 2. Settlement distance of juvenile colonies to the nearest alga/fake alga and correlation between survival and distance to nearest alga/fake alga. r=Pearson Product Moment correlation coefficient. Only significant results ($p<0.05$) are presented.

Treatment	Settlement Distance (mm)	r
Halimeda opuntia	20.5 ± 2.7	0.54
Laurencia papillosa	31.4 ± 4.2	0.56
Sargassum polycystum	38.0 ± 3.3	0.65
Peyssonelia rubra	37.8 ± 5.0	0.16
artificial *S. polycystum*	41.1 ± 2.4	0.23

Figure 2. Maypa and Raymundo: Percent weekly survival (mean ± SE) of *Pocillopora damicornis* larvae in different algal treatment aquaria. N = 6 aquaria/treatment; N = 5 control aquaria.

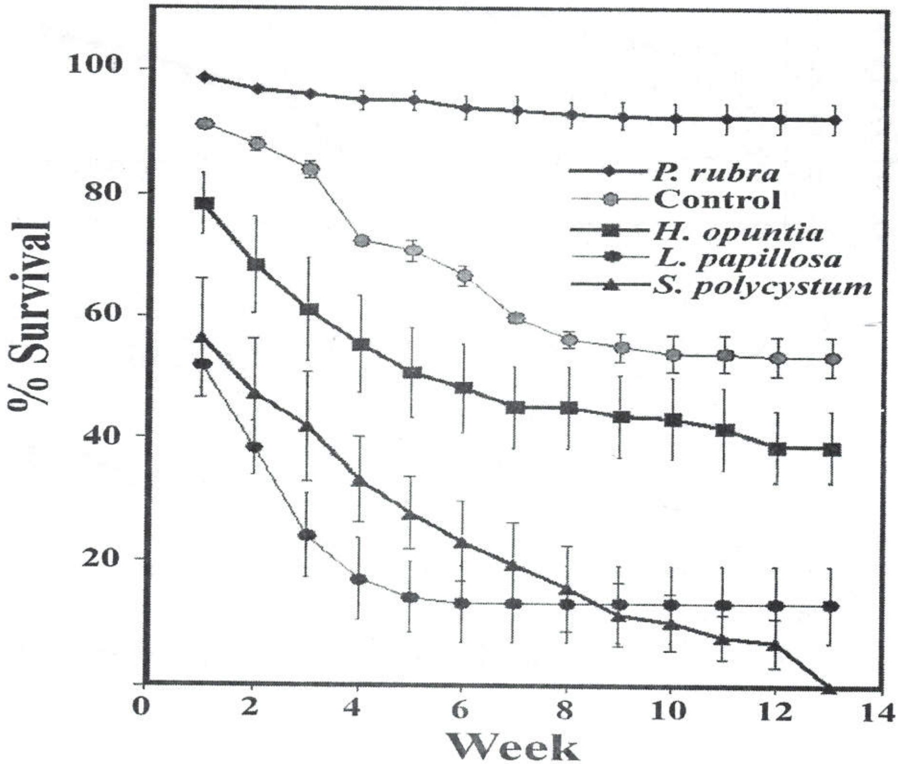
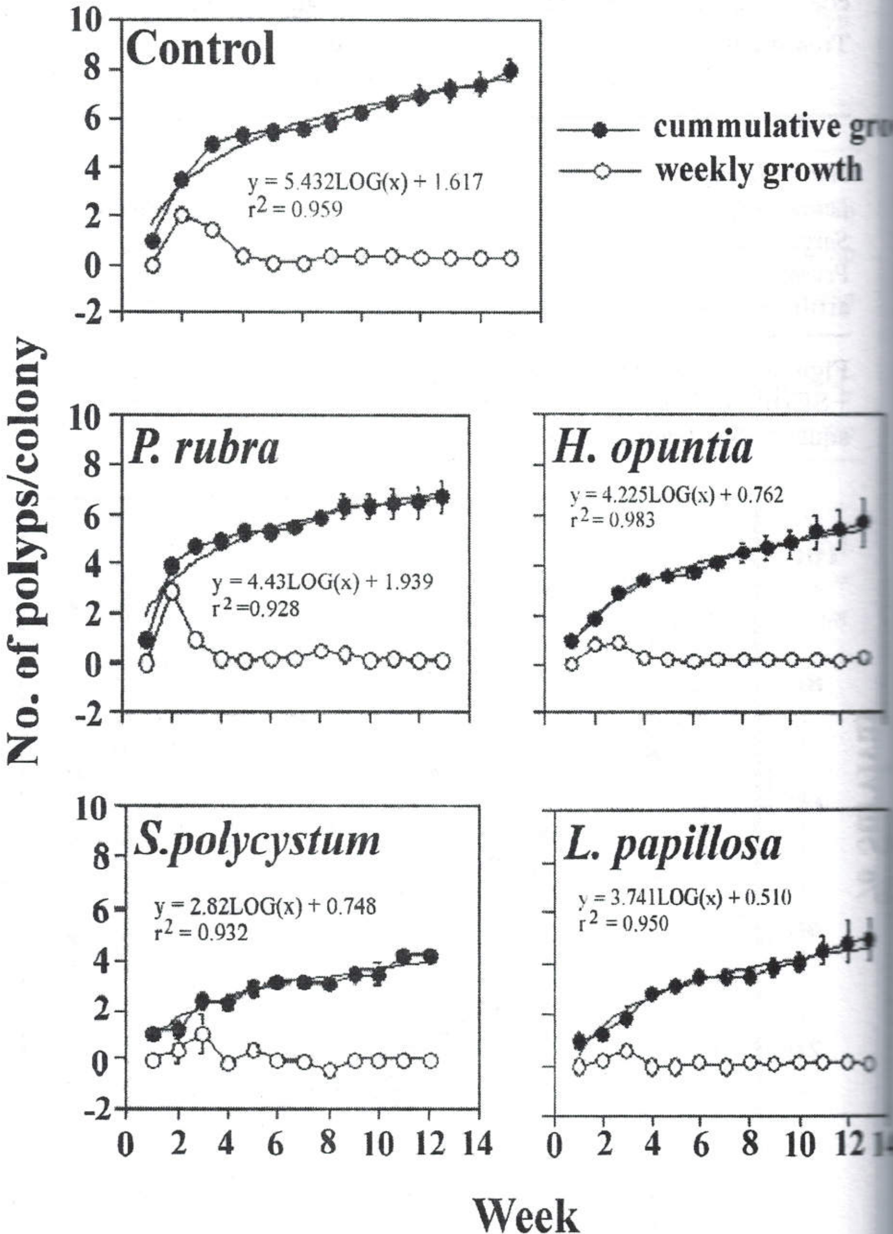


Figure 3. Maypa and Rymundo: Commulative and weekly growth rates to 13 weeks expressed as number of polyps per juvenile colony of *Pocillopora damicornis* in different algal treatments (mean ±



treatments. Total percent juvenile survival was highest in *P. rubra* (92.5% ± 2.4) and was significantly lower in *H. opuntia* (39% ± 5.8), *L. papillosa* (13.2% ± 6.2), and *S. polycystum* (0%; Kruskal-Wallis $p<0.05$).

Survival of *P. damicornis* juveniles was affected by their distance from the nearest alga or artificial alga inside the aquarium. Distance of juvenile colonies from *L. papillosa, H. opuntia, S. polycystum* and artificial *S. polycystum* were all significantly positively correlated with survival; the greater the distance between spat and algal thallus, the longer spat survived (Table 2; p =< 0.05). *Laurencia papillosa, H. opuntia, S. polycystum* and artificial *S. polycystum* thus had a negative influence on spat survival. No significant correlation was seen in *P. rubra* and all other artificial algae on juvenile survival. These results suggest that both morphologies of *S. polycystum* (bushy frondose) and *L. papillosa* (turf-forming) are inhibitory to both larval settlement and juvenile colony of *P. damicornis*. Although *H. opuntia* did not have any significant effect on larval settlement, it was inhibitory to juvenile survival.

Growth rates expressed as increase in polyp number per colony are shown in Figure 3. Colony growth was highest during the second and third weeks in all treatments and control aquaria, slowing and becoming fairly constant afterward. A significant difference was found in weekly growth rates between treatments (ANOVA, $F = 194.62$, $p = 0.0001$). At the end of the monitoring period, the total number of polyps per colony was significantly different between treatments (Table 1). The mean colony size in *H. opuntia* (6 ± 0.9 polyps per colony) and *P. rubra* (6 ± 0.6 polyps/colony) was not significantly different from those in the control (7 ± 0.5 polyps/colony) but was significantly higher than *L. papillosa* (5 ± 0.8 polyps/colony) and *S. polycystum* (4 ± 0.1 polyps/colony) aquaria. These findings are consistent with the settlement and survival results. The bushy frondose *S. polycystum* and turf-forming *L. papillosa* consistently inhibited the early stages of *P. damicornis* life history, while the effects of the calcareous and coralline algae, *H. opuntia* and *P. rubra,* varied.

Growth curves followed a logarithmic curve; colonies exhibited rapid initial growth, which then tapered off (Fig. 3). The lack of significant difference between slopes of growth regression lines in the different treatments indicates that growth rates showed similar trends over the three-month period (ANCOVA, $F = 1.27$, $p = 0.1242$).

Waterborne Chemical Assay

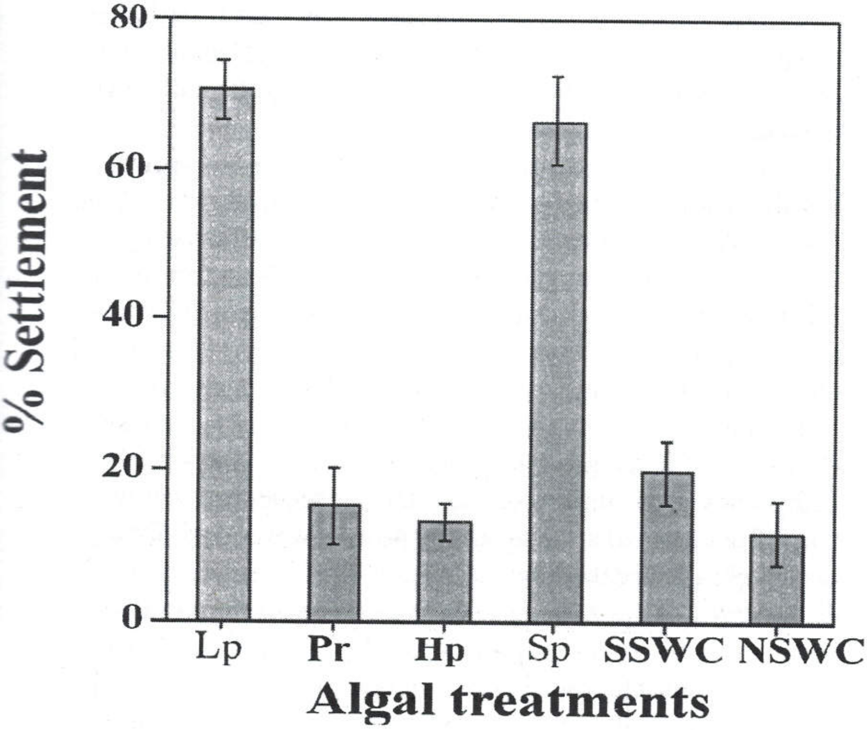
All planulae that settled by 24 hr settled on the bottom of the beakers in all algae conditioned water treatments and controls. No spat were found on the unconditioned glass plates. Settlement success of larvae varied significantly between treatments and controls. Settlement was significantly higher in *L. papillosa*- (70.7% $\pm$ 4) and *S. polycystum* (66.7 $\pm$ 6.1) conditioned water than in all others (Table 1, Fig. 4). Settlement in *H. opuntia*- and *P. rubra*- conditioned water and both controls was less than 21% and larvae that failed to settle during the first 24 h settlement period (approximately 80% per beaker) remained free-swimming during the subsequent 10-day observation period. In contrast, those that did not settle in *L. papillosa*- (29%) and *S. polycystum* – (33%) conditioned water died after 24 h.

Survival to 10 d of settled juvenile colonies was 100% in all control and algal treatments, except in *S. polycystum*. Survival in *S. polycystum*-conditioned water was significantly lower than controls and other treatments (Kruskal-Wallis, $p = 0.0005$). Spat mortality was observed daily, starting from the first day after settlement; none survived to the 10th day. This suggests that the exudates of *S. polycystum* were toxic to *P. damicornis* juvenile colonies but apparently not to larvae prior to 24 hr old.

Discussion

Settlement and metamorphosis in many marine invertebrate larvae are controlled by sensory recognition of, and responsiveness to, environmental stimuli and exogenous chemical cues provided by reef biota (reviewed in Pawlik, 1992; Morse and Morse, 1996). In this study, the variation in responses to morphology and exudates

Figure 4. Maypa and Raymundo: Percent settlement (mean ± SE) of *Pocillopora damicornis* larvae in different algae-conditioned water and controls. Pr = *Peysssonnelia rubra;* Ho = *Halimeda opuntia;* Lp = *Laurencia papillosa;* Sp = *Sargassum polycystum;* SSWC = Synthetic seawater control; NSWC = Natural sea water control; N = 6 aquaria/treatment; N = 5 control aquaria.



can be partially explained by shading. Adult *Pocillopora* spp. thrive best at high light levels as they are considered shade intolerant (Stimson, 1985). Coral planula larvae are photosensitive, responding to light as a cue for settlement, and shading—by algae or other corals—can negatively affect coral settlement, survival, and growth (Rogers, 1979; Stimson, 1985; Harrison and Wallace, 1990; Miller and Hay, 1996; Babcock and Mundy, 1996). Algal canopy consistently inhibited recruitment and growth of the coral, *Oculina arbuscula,* and shading and abrasion were suggested as the competitive mechanisms used by the algae (Miller and Hay, 1996). Miller (1995) found that the growth of *O. arbuscula* increased by 180-560% when grown in shallow areas where algae canopy was removed. Similarly, in our study, *S. polycystum* and *L. papillosa* and their artificial algae formed a canopy-like layer in each aquaria, thereby shading the substrata and reducing settlement. *H. opuntia* did not appear to affect larval settlement in aquaria, but in reef habitats, thalli tend to spread laterally close to the substrate and form dense mats. This may potentially shade coral larvae and juveniles on reefs.

Inhibition of *P. damicornis* juvenile survival and growth by the algal morphologies may also be attributed to abrasion. Spat survival of *P. damicornis* can be negatively affected by the presence of algae (Harrigan, 1972; Harriott, 1983), and an inverse relationship between densities of the coral *Balanophyllia elegans* and macroalgae has been reported (Coyer *et al.,* 1993). Algal abrasion facilitates algal overgrowth and exhausts energy reserves by reducing feeding time and requiring energy for surface cleaning (Potts, 1977; Fadlallah, 1983; Coyer *et al.,* 1993; Tanner, 1995). In this study, algal brushing did not influence settlement since water was left undisturbed in the aquaria for 48 h. However, algal abrasion negatively affected the survival and growth of juvenile colonies in *H. opuntia, L. papillosa* and *S. polycystum* aquaria. The continuous daily inflow of seawater in each aquarium caused enough water movement to result in slow whipping actions of algal thalli. It was observed that most juvenile colonies that died early or showed partial mortality were those settled close to an alga, i.e., within the "abrasion zone." In *H. opuntia* settlement distance of juveniles was significantly closer to the alga (0.05 mm – 3 mm), compared to other algal treatments and controls. Juveniles that settled close to the alga died early or showed partial mortality. These negative effects may be a compounded result of brushing and metabolic deficits from algal shading (Miller and Hay, 1996). Although water movement in the aquaria was minimal, water movement to a varying degree is always present in the natural habitat. When coral larvae settle near an alga, or the available settlement surfaces limit the choice of larvae to fleshy macroalgae vicinities, mortality is a possible consequence.

Macroalgae produce compounds that may affect survival and recruitment of benthic invertebrates and thus play a role in structuring marine communities (Hay and Fenical, 1988). The inhibitory and facilitative effects of algal compounds on invertebrate larvae have been documented (e.g., Morse *et al.,* 1984; Morse *et al.,* 1998; Schmitt *et al.,* 1995). In this study, the exudates of both *S. polycystum* and *L. papillosa* enhanced settlement. The lack of evidence of toxicity to larvae of *L. papillosa,* in spite of the presence of gland cells containing haloterpenoids (Young *et al.,* 1980), suggests that other water soluble compounds may be released by the alga that enhanced larval settlement. Alternatively, different species of invertebrate larvae might show differential responses to the same compound. Despite the proven toxicity of *Laurencia* terpenoids (Hay and Fenical, 1988), settlement and metamorphosis of *Aplysia* larvae were enhanced in the presence of *Laurencia* spp. (Switzer-Dunlap and Hadfield, 1979).

Unlike *Laurencia,* the secondary metabolites of brown algae, including *Sargassum,* are water- soluble and are released into the environment (Hay and Fenical, 1988). Pachidictyol-A from *D. menstrualis* (Schmitt *et al.,* 1995) caused death and abnormal development in the bryozoan *B. neritina* (Schmitt *et al.,* 1995) while exudates and boiled extracts of *Sargassum* spp. facilitated larval settlement and metamorphosis of the hydroid *Coryne uchidai* (Nishira, 1968). Similarly, larvae of *B. neritina* and the polychaete tube worm, *Hydroides elegans,* showed differential settlement responses to the same *Sargassum*-conditioned water (Walters *et al.,* 1996). Our results are consistent with previous studies. Settlement of *P. damicornis* larvae was enhanced in S. *polycystum*-conditioned water but juvenile survival was inhibited. This again suggests that invertebrate larval types respond differentially to the same algal exudates. Larval threshold differences and varying sensitiveness in different life stages in response to a particular compound or class of compounds may explain this (Walters *et al.,* 1996). Alternatively, differences in potency and release rates of metabolites in different species may also contribute to the observed responses of different larvae. Moreover, in the case of *S. polycystum,* although the exudates of the alga enhanced larval settlement, algal thalli inhibited settlement. This shows that the positive effects of the chemical exudates can be overridden by the negative effects of morphology. Continued exposure of *P. damicornis* larvae and juvenile colonies to *S. polycystum* exudates, compounded by shading and abrasion, may explain the high mortality observed in the aquaria. These effects may partially explain the consistent absence of scleractinians in most reefs colonized by beds of *Sargassum* in the Central Philippines.

Coralline crustose algae such as *Peyssonnelia* sp. and *Hydrolithon reinboldii,* facilitate settlement and metamorphosis of *Acropora spp.* larvae (Morse *et al.,* 1996). In this study, neither the morphology nor exudates of the red crustose alga, *P. rubra,* had any discernable facilitative or inhibiting effects on *P. damicornis* larvae. This contrast with the results of Heyward and Negri (1999); 50% of *Acropora millepora* larvae were induced to metamorphose in response to *Peyssonnelia* sp. methanol extracts. However, our results showed higher colony survival in aquaria with *P. rubra* than that of the control, suggesting a chemical influence. The absence of shading and algal abrasion in *P. rubra* aquaria may have contributed to this high survival, but the potential exists for fast growing crustose coralline algae to overgrow coral juveniles (Babcock and Mundy, 1996). *Lobophora,* a crustose-foliose brown alga, can occasionally overgrow corals (De Ruyter van Steveninck *et al.,* 1988).

Halimeda spp. produce diterpenoids that may only be released through mechanical damage of the alga (Paul and Fenical, 1984). In the natural habitat, where herbivores are present, mechanical damage of algal thalli is a regular occurrence and these metabolites may be frequently released. Production of metabolites in *Halimeda* spp. increases with increasing herbivory pressure (Paul and Van Alstyne, 1988), suggesting that heavily grazed areas may affect coral larval settlement and juvenile colony growth differently from areas with lesser pressure.

In hermatypic corals, calcification is dependent on light (Barnes and Taylor, 1973; Chalker, 1981) and coral morphology may be a function of light levels (Goreau, 1963). Reef flora that has the potential to alter substratum illumination, such as canopy-forming species, can affect the species distribution and composition of a reef. Shade-intolerant species may be selected against in such an environment. In degraded reefs already colonized by macrophytes, coral recolonization may be dependent on the species of algae present. It has been suggested in many studies that development of extensive coral growths in many shallow tropical environments may be dependent on the near elimination of macrophytes either by sea urchin and fish grazing (Hughes, 1994; Mumby, 2004) or human intervention by algal weeding or cropping (McClanahan *et al.,* 1999). In addition, coral reef degradation often involves a phase-shift from coral to macroalgae (Hughes, 1994; McCook, 1999). To prevent this phase-shift, there is an urgent need to protect herbivorous fish populations and minimize terrestrial run-off and nutrient inputs to the sea (McCook, 1999; Mumby, 2004). In reefs where long-term, severe damage has already occurred, selective algal cropping and weeding should be explored in conjunction with establishment of marine reserves, to protect herbivore populations as a management tool for rehabilitating degraded coral reefs.

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LEAD AND ZINC CONCENTRATIONS IN THE VENUS CLAM, *PAPHIA TEXTILE* (GMELIN) IN SOFT-BOTTOM COMMUNITIES OF KATIPUNAN AND ROXAS, ZAMBOANGA DEL NORTE: AN INDICATOR OF HEAVY METAL CONTAMINATION

Maria Rio A. Naguit, Jane Aquin, Francisco P. Tabiliran, and Laurie J. Raymundo

ABSTRACT

Infaunal bivalve communities are known to pose potential public health risks as they are bioaccumulators that may be regularly harvested for human consumption. To assess a possible health risk of heavy metal contamination from factory waste output, samples of the locally-consumed venus clam, *Paphia textile* were collected from nearshore soft-bottom communities of Katipunan and Roxas Zamboanga del Norte. They were analyzed for lead and zinc concentrations. The highest levels of lead (mean $\pm$ SD = 4.43 $\pm$ 1.23 mg/kg) and zinc (mean $\pm$ SD = 30.09 $\pm$ 9.40) were obtained from the Tuburan site, located nearest the Southern Island Oil Mill Port Area. The concentration levels from our sampling sites indicated that the coastal waters of Katipunan and Roxas, Zamboanga del Norte are contaminated with both lead and zinc. Continued consumption of the clams will lead to biological magnification in human populations, thus posing an unquantified health risk to local coastal communities consuming these animals.

Introduction

Metals are introduced naturally into the aquatic ecosystem as a result of weathering of rocks and volcanic eruption, or from anthropogenic sources such as municipal, industrial, and agricultural wastes, airborne particles emitted from combustion engines, and runoff from mining and highways. Point sources include metal processing plants, dye-making firms, and paper mills. Unlike organic pollutants, heavy metals are not broken down by bacteria. Consequently, they may persist in the water or bottom sediments for many years and eventually enter human food chains via marine animals or plants that consume or absorb them from the environment. This process, known as bioaccumulation, involves sequestering toxic compounds in body tissues by organisms which consume the toxins without detoxifying or excreting them. As these organisms are consumed by animals (such as humans) higher in the food chain, the effects of the toxins are magnified. One of the best-documented examples of the effects of bioaccumulation is Minamata Disease, the poisoning of a large segment of a Japanese coastal population by mercury from pollution effluent in the 1950s. The effects were devastating, affecting an as yet unquantified number of people (Ui, 1992).

Metals such as manganese, copper, iron, and zinc are micronutrients with essential roles in biological systems. Others, such as lead and mercury, are not required even in minute amounts by any organism. However, regardless of whether or not they are essential, metal accumulation can pollute marine ecosystems and can pose an often unquantified health risk. Zinc is a micronutrient associated with enzymes involved in DNA replication and protein synthesis. Hence, it is critical for growth and development. It can, however, reach pollution-level concentrations in water and sediment. Zinc is used in metallurgy, plutonium production for nuclear reactors, and manufacturing. Limited data show that it is processed from tissues relatively slowly by bivalves (Phillips, 1980). When ingested by humans in excess amounts, it may cause diarrhea, abdominal cramps, and vomiting within three to ten hours.

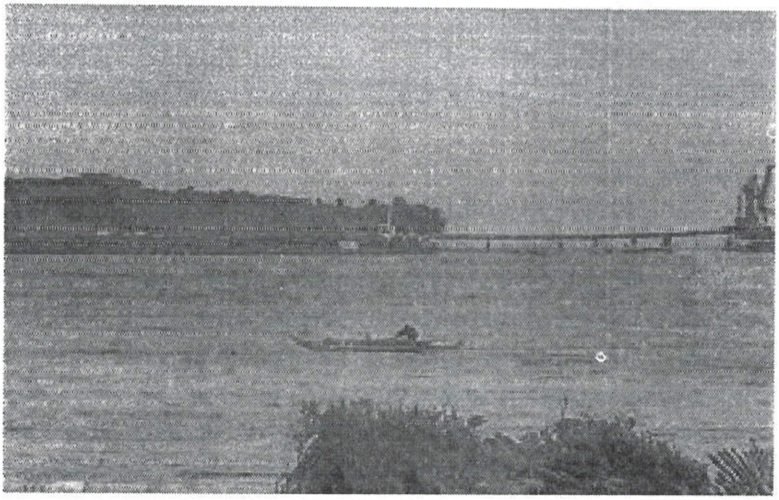
On the other hand, lead compounds are highly toxic, particularly to children (Barry, 1975, 1981; Baghurst *et al.*, 1987; Batuman *et al.*, 1981; Kaul *et al.*, 1999). The US Center for Disease Control considers lead poisoning a major environmental health threat to children (http://epa.gov/waterscience). Most problematic sources of lead are found in home products such as paint, but it is also found in petroleum products, which may end up in coastal waters from runoff or discharge. The human nervous system is particularly vulnerable to lead poisoning, which is why children, whose nervous systems are rapidly developing, are the most susceptible to encephalopathy with high levels of lead exposure (ATSDR, 1999; Fulton *et al.,* 1987; Hawk *et al.,* 1986). Exposure has also been linked with hypertension, reproductive toxicity (Alexander *et al.,* 1996), and developmental defects (Baghurst *et al.,* 1987). It inhibits enzymes critical to the synthesis of heme, causing a decrease in blood hemoglobin. Alexander *et al.* (1996) and Gennart *et al.* (1992) suggested that occupational exposure to lead decreases sperm count and motility, and increases abnormal sperm frequencies (Alexander *et al.,* 1996). Thus, sub-lethal long-term exposure can cause serious physiologic effects, but low levels of exposure have also been shown to have many subtle health effects in studied populations. Hence, it is important to identify and quantify all possible sources of lead contamination.

The Venus clam *Paphia textile* is a filter feeder of the family Veneridae. It has a solid, equivalve, inequilateral shell. Its color is externally beige to pale yellow with a characteristic zig-zag pattern in brown (Fig. 1). It commonly burrows on offshore shelf bottoms (Barash and Danin, 1992). *P. textile* has been harvested and consumed by residents of Katipunan and Roxas, Zamboanga del Norte for a decade. Pails of this clam are delivered and sold daily in the two municipalities, as well as in the public market of Dipolog City. Venus clams are collected 200 m from shore at a depth of 18 m (Fig. 2). Traditionally, the clams were harvested by hand from the soft-bottom, 10 cm deep. Currently, a device developed by local fishermen eliminates the necessity of free-diving. The device resembles a grab sampler which scoops up a volume of mud from which the clams can be removed on board a boat.

Like other benthic filter feeders, *P. textile* can be used as a biological indicator of metal pollution. Generally, clams readily accumulate metals by direct transport of water across their gills and from ingestion of suspended particles and bottom sediments and are, therefore, considered to be reliable indicators of heavy metal pollution (Phillip, 1980; Boisson *et al.,* 1998). They are

Figure 1. Photograph of *Paphia textile* clams harvested from the nearshore benthos of Zamboanga del Norte.

Figure 2. Photograph of a local fisher harvesting *P. textile* from the nearshore Tuburan station; the wharf is visible in the background



known to be tolerant to high trace metal concentrations; hence, their metal body burdens can reflect the contamination history of an environment. Data suggest high variation in the rate at which metals may be stored or eliminated both between species and between the metals themselves within species (see review in Denton *et al.*, 1999). As little is known regarding heavy metal toxicity as a health risk for coastal communities in the Philippines, and few Philippine bivalve species have been studied, people regularly consuming these clams are facing an unquantified health risk.

An uncharacteristic black coloration on the clam shells (Fig. 1) triggered this preliminary investigation to determine whether *P. textile* inhabiting the coastal substrates of Katipunan and Roxas, Zamboanga del Norte are contaminated with lead and/or zinc. The presence of both an oil mill and a wharf in the area from which clams are harvested represent possible point sources of pollution. Heavy metal bioaccumulation in the shellfish was suspected because the most probable sources of contaminants in the area (the mill and the wharf) produce or discharge byproducts containing lead (from gasoline) and zinc (from metallurgical operations). At this preliminary stage, water and sediments were not tested as the primary goal was an immediate quantification of a possible public health risk.

Methods

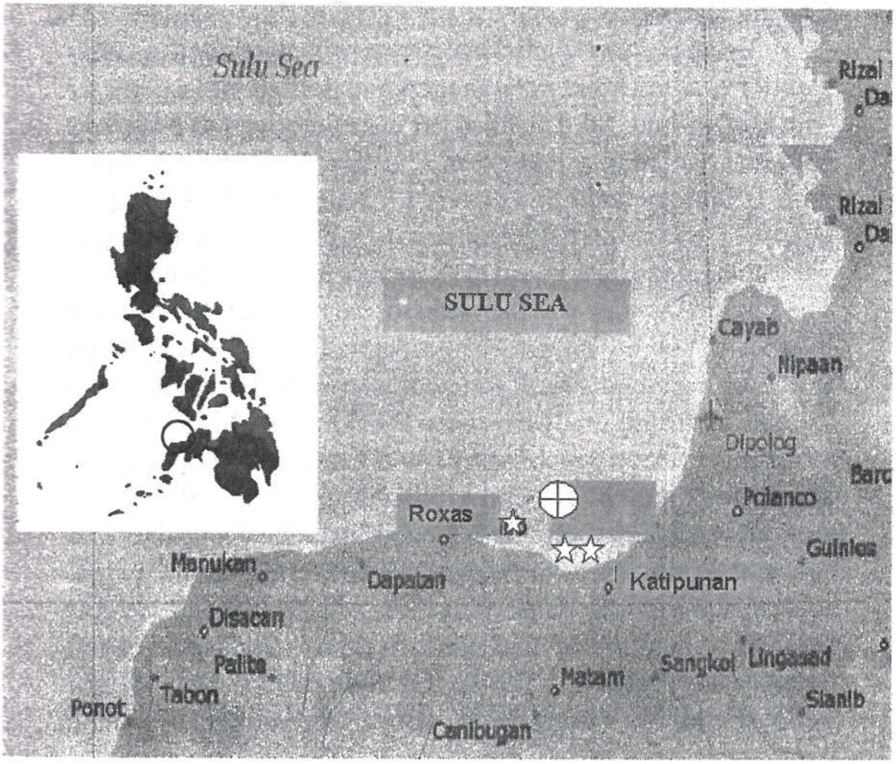
Sampling sites

Sampling was conducted in nearshore sandy/muddy substrates in three coastal barangays: Tambo and Tuburan of Katipunan (8° 30' N; 123° 17' E) and Irasan, Roxas (8° 31' N; 123° 13' E) in Zamboanga del Norte (Fig. 3).

Clam collection and preparation

Samples of *P. textile* were collected on January 30, 2004 from the three sampling sites, 200 m from shoreline at a depth of 9 fathoms in three replications per site, with nine clams per replication (a total of 27 clams per site). Samples were packed in

Figure 3. Map of the study area, showing the three sampling sites in relation to suspected point sources of pollutants.



plastic bags and immediately transported to the Jose Rizal Memorial State College-Katipunan National Agricultural School Chemistry Laboratory for tissue analysis preparation. The clams were thoroughly cleaned by brushing the shells with water and allowed to depurate for at least three hours to remove the silt and sediment from the tissue. The shells were carefully opened to remove the tissue. The tissues were packed in plastic bags and placed in a styropore box with ice, which was immediately shipped to Silliman University Chemistry Laboratory for spectrophotometry.

Chemical analysis

Tissue from each individual clam was homogenized in a glass blender to a paste-like consistency, and poured into a glass jar with a teflon-lined lid. The filled jars were then oven-dried for one hour and cooled in a dessicator. The dried tissue was digested with 10% nitric acid in a covered Erlenmeyer flask for 3 hr. Digestion was extended for another 3 hr, but this time the flasks were opened to allow liquid to evaporate and the residue to dry. The air-dried residue was then redissolved in a 3% nitric acid and filtered through Whatmann 42 filter paper. The filtrate was placed in a 25 ml volumetric flask and diluted to mark. It was subjected to lead and zinc analysis using Pye Unicam SP 9 Atomic Absorption Spectrophotometry (AAS), using the flame atomic absorption method. The above procedure was repeated for all replicates and all stations. As most published values of heavy metal concentrations refer to wet weight, we converted our dry weight concentrations to wet weight equivalents by subtracting dry weights from the original wet weights for each clam to determine a mean tissue water content of 80% for this species. Dry weight concentrations of Pb and Zn, therefore, represented 20% of the wet weight values in fresh tissue.

Results

The average concentrations of lead and zinc in *Paphia textile* are presented in Table 1.

Table 1. The range and mean concentrations (ìg/g dry wt) of Lead (Pb) and Zinc (Zn) in *Paphia textile* individuals collected from three sampling stations. Mean ± SD (upper values); Range (lower values); n=9 samples per site.

METAL	TAMBO	TUBURAN	IRASAN
Pb	4.18 ± 0.80 3.41 - 5.01	4.43 ± 1.23 3.01 - 5.15	3.92 ± 1.38 2.97 - 3.28
Zn	15.11 ± 5.0 9.49 - 19.08	30.09 ± 9.40 20.97 - 39.15	11.66 ± 2.50 8.78 - 13.25

As shown, samples collected from Tuburan (Station 2) registered the highest concentrations of lead and zinc. Samples taken from Irasan (Station 3) showed the lowest concentration for both metals. No significant difference was observed between stations for lead concentration (Fig. 4; ANOVA F (2,6) = 0.146, p=0.867). However, significant between-site differences were observed for the amount of zinc in tissues (Fig. 5, ANOVA F (2,6) = 7.221, p=0.025). Post-hoc comparisons indicated that zinc levels of Tuburan clams were significantly higher than those from Irasan; Tambo values were intermediate between the two, and the differences were not significant. It should be noted that Irasan is situated farthest from the oil mill and wharf area (Fig. 3).

Converting our values to wet weight concentrations allowed us to compare levels found in our study sites with other published concentrations of Zn and Pb in selected bivalve species. These values are presented in Table 2.

Figure 4. Concentration of Lead in *Paphia textile* samples collected from three stations in Katipunan and Roxas Zamboanga del Norte. Mean ± SD; n=9 clams per station.

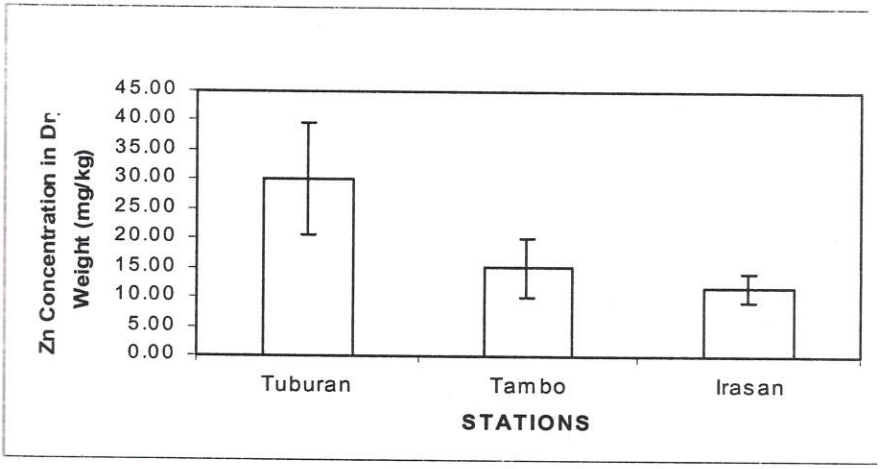
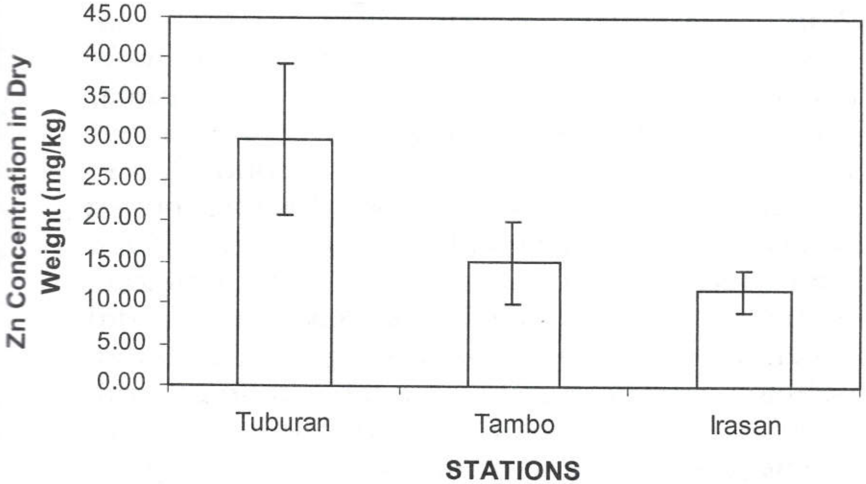


Table 2. Comparisons of the range of concentrations of lead and zinc in selected bivalve species (ìg/g wet wt).

Species	Metal	Location	Source	
	Pb	Zn		
Paphia textile	**0.99-1.03**	**1.76-7.83**	**Zamboanga del Norte**	**This study**
Chama iostoma	<0.9	41.0-164	Great Barrier Reef, Austr	Burdon-Jones & Denton 1984
Chama brassica	<0.3-2.0	79.4-387	Apra Harbor, Guam	Denton *et al.* 1999
Crassostrea gigas	0.3	80.5	Hong Kong	Phillips *et al.* 1982
Saccostrea amasa	<0.3-1.8	1163-2443	Australian coastal waters	Burdon-Jones *et al.* 1979
Saccostrea cucullata	<0.2-1.4	1012-2752	Australian coastal waters	Burdon-Jones et al. 1979
Saccostrea cucullata	<0.3-1.1	2262-4722	Apra Harbor, Guam	Denton *et al.* 1999
Spondylus ducalis	3.7-7.5	175-518	Great Barrier Reef, Austr.	Burdon-Jones & Denton 1984

Figure 5. Concentrations of Zinc in *Paphia textile* samples collected from three stations in Katipunan and Roxas, Zamboanga del Norte. Mean ± SD; n=9 clams per station.



Discussion

The highest concentrations of lead and zinc were obtained in Tuburan, which is located nearest the Southern Island Oil Mill Port Area (Fig. 2 & 3). In general, lead levels were not significantly different between sites, though zinc levels varied greatly. Zinc concentrations were significantly higher in Tuburan, and similar for Tambo and Irasan, though these two sites are not adjacent (Fig. 5). Undoubtedly, the large variation in zinc concentration between individual clams accounted for the lack of significance in concentrations between Tambo and Tuburan, even though the sites are close and both are within the proximity of the oil mill (Table 1, Fig. 3). Denton *et al.* (1999) notes considerable between-species variation in metal contents, with zinc being particularly variable.

In interpreting our data to identify a possible health risk, it is important to consider evidence from the literature. The selected studies presented in Table 2 indicate several points. First, heavy metal concentrations can vary greatly within a single species between different sites that have similar levels of pollution (see values for Zn concentrations in *Saccostrea cucullata*, Table 2). Second, closely related species can also vary considerably, and not necessarily in a predictable way; *Chama iostoma* contained much more lead, but much less zinc within the pristine Great Barrier Reef site than did specimens of *C. brassica* coming from the more polluted Apra Harbor, Guam (Table 2). In general, interpreting a lead contamination risk using bivalves can be problematic, as available evidence suggests that bivalves may not be particularly sensitive to lead concentrations in the environment (Denton *et al.,* 1999). However, in general, higher levels of lead in bivalve tissues indicate higher levels of organic lead in the environment. As inorganic lead is almost insoluble in water (Moore, 1991), it can be assumed that high lead concentrations in tissues are from particulate organic forms from industrial and mining activities settling into the substrate. Our values for lead concentration were higher than the upper range of values reported from known polluted waters (Apra Harbor and Hong Kong) but considerably lower than those reported from the Great Barrier Reef (Table 2). This could represent interspecific variation in lead uptake. Little is known regarding sensitivity of *Paphia textile,* and lead concentrations in the water column and substrate were not obtained, making a quantitative assessment of lead pollution difficult. However, considering that *P. textile* is regularly harvested and consumed as food, our data suggest that lead bioaccumulation in human populations consuming this clam is a possibility. Our evidence definitely suggests that a more in-depth study is needed.

Our zinc levels, on the other hand, were considerably lower than those found in other species (Table 2), though it is known that zinc levels fluctuate widely between species (Denton *et al.*, 1999). Oysters (*Saccostrea* spp.) are known to be very sensitive bioindicators of Zn and Cu pollution, but no information exists regarding *Paphia textile* sensitivity. However, our evidence suggests that Zn concentration levels probably do no constitute a health risk at this time.

Our data suggest that both the oil mill and the wharf could be possible sources of both lead and zinc contamination, as the site nearest these structures contained the highest levels of both metals. Unregulated fuel discharges of cargo vessels docked at the wharf could be a primary source of input. Such organic lead compounds are particularly toxic to most life forms (Denton and Burdon-Jones, 1986). In addition, little is known about the composition of the oil mill wastes and it is not known if any pollution control practices are in place. As shown in the map, Tambo and Tuburan are located inside a cove containing these possible point sources (Fig. 3), while Irasan is located on the outer coast. Local circulation patterns could contribute to the transport and deposition of pollutants; Irasan is better flushed and more exposed to open water. This may result in less exposure to heavy metal pollutants deposited from point sources. However, to establish the actual sources of these contaminants, a more focused and in-depth study is required.

This preliminary investigation suggests several lines of inquiry to determine the exact nature and extent of pollution in this area. A study of the surface water, sediments, and infauna would allow determination of correlations between the concentration levels and distance from suspected sources, as well as the extent of geographic contamination. Identifying general sources of pollution, such as municipal waste dumps, sewage outfalls, and the oil mill itself would elucidate sources of these heavy metals. Furthermore, our results suggest the possibility that there may be other metals and other species that should be considered. To assess public health risks, other harvested species (benthic invertebrates, coastal fish, macroalgae) should be surveyed with a broader assay of contaminants.

Acknowledgments

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A SECOND CHANCE TO AVERT EXTINCTION: GOOD NEWS FOR PHILIPPINE BIODIVERSITY

Lawrence R. Heaney

The documentation of the extinction of a species is a slow and, typically, an emotionally painful process. Especially in the tropical countries where biological diversity is very high, recognition that a species has disappeared comes only gradually, as fieldwork simply fails to document a species where it once lived. When there is little fieldwork on a given group of organisms, as is too often the case, the process of recognizing the occurrence of a potential extinction may take decades.

When I first conducted fieldwork in the Philippines in 1981, my colleagues at Silliman University and I documented the presence of many species of mammals, including one especially exciting bat that had not been formally described as a species (*Nyctimene rabori*, the Philippine tube-nosed bat). We noted the absence of *Dobsonia chapmani*, the Philippine bare-backed fruit bat, without much alarm at that point, for we were surveying only limited portions of southern Negros Island. Over the next ten years, as our field studies of mammals became more detailed and extensive, we noted with increasing concern the absence of *Dobsonia*. This led us to mention first the possibility of extinction and the need for further research, and gradually to increasing evidence that this was, indeed, the first mammal in the Philippines to become extinct. By 2000, the IUCN (keeper of the "Red Data Book" of threatened species) listed *Dobsonia chapmani* as extinct, seemingly extinguishing all hope.

This issue of the Silliman Journal contains two publications that make an extraordinary announcement: living populations of *Dobsonia chapmani* have been rediscovered on both Negros and Cebu islands. Rather than being a cause for regret, the rediscovery of this species is now a cause for hope, giving us a second chance to avert the most final and awful of biological events.

Several aspects of these discoveries are remarkable. First, the fact the bats have persisted in two different, widely separated locales gives us not just one but two places where we can focus our conservation efforts, greatly increasing the likelihood of success. Second, the discoveries carry the implication that there may be still more populations of the bats to be found, since there are some additional places with similar terrain and vegetation, as noted in both papers. And third, perhaps most importantly, both populations of *Dobsonia chapmani* have been found in habitat that most biologists would have likely passed by: badly degraded secondary forest over limestone and karst, where trees are small and the forest is sparse. This clearly demonstrates that the bats are more resistant to habitat destruction than we had dared to hope, and that any efforts we can make to protect and allow the recovery of this habitat will be rewarded with the recovery of critically endangered species. All of this is very good news indeed.

It remains clear, however, from both of these publications, that the bats are critically endangered—they exist in very small populations at low density, in locales where hunting persists, logging in their habitat continues, erosion under heavy rainfall continues to remove much of the little remaining topsoil, and the caves that form a crucial resource for the bats are frequently disturbed by hunters and guano miners. The future of the bats is by no means assured; we have a second chance, but not a full reprieve.

Both papers also make clear a final, crucial point: the well-being of the people of Cebu and Negros also will be strongly influenced by the recovery and health of these forests. Floods, droughts, erosion, damage to agricultural land, and siltation of riverbeds and coral reefs will all be held in check by protection of these watershed areas. By protecting the remnant forests where the bats live, the people of Negros and Cebu will be able to protect themselves and their children.

Field Museum of Natural History

THE PHILIPPINE BARE-BACKED FRUIT BAT *DOBSONIA CHAPMANI* RABOR, 1952: REDISCOVERY AND CONSERVATION STATUS ON CEBU ISLAND

Lisa Marie J. Paguntalan, Marisol dG. Pedregosa, and Mery Jean C. Gadiana

ABSTRACT

The Philippine bare-backed fruit bat *Dobsonia chapmani* is the largest cave-roosting bat in the Philippines. Known only from the islands of Cebu and Negros, it was also the first mammal declared extinct in the Philippines not having been recorded on either of these islands since the early 1970s, despite systemic searches by trained researchers (Heaney *et. al.*, 1998; Heaney & Regalado, 1998). However, a preliminary survey conducted in Mabuli, Carmen, Cebu in late February 2001 resulted in the unexpected mist-netting of several individuals of this species, all of which were released after being measured and photographed.

Along with the site of rediscovery of this species on Negros in 2003 (Alcala *et al.*, this volume), the forest in Carmen and Catmon constitutes one of the species' last and critically important strongholds. However, the only available habitat in this area is a series of small secondary growth, limestone forest fragments, all of which are highly disturbed. The largest remaining fragment, *circa* 60 ha, is also threatened by the cutting of trees for charcoal, agricultural development, and poaching. In addition, the site is not a protected area and was not included in the listing of 'Key Conservation Sites' on Cebu (Mallari *et. al*, 2001). Thus, it is important to identify and implement conservation measures in order to protect the surviving populations of this once believed extinct, but still critically endangered, endemic fruit bat.

Introduction

The Philippine bare-backed fruit bat is the only member of the genus *Dobsonia* occurring in the Philippines, where it was known only from low elevation forests in southern Negros and Cebu. It was described and named over 50 years ago (Rabor, 1952). About 35 specimens were collected in the late 1940s, 1950s and 1960s, with most of these originating from several different cave systems in southern Negros, parts of which were still quite well forested and sparsely populated at that time. By contrast, only three individuals collected from Naga are known from Cebu (two housed in Silliman University Natural History Museum and one in the Delaware Museum of Natural History).

Repeated searches for the species in previously known distribution sites over the last 40 years failed to secure any more recent records. At present, less than 4% of Negros Island is forested, with small patches of degraded forest in the Central and Southern portion of the island (Evans, 1993; Heaney and Regalado, 1998; Paguntalan, 2001; Paguntalan *et. al,* 2003). With the almost total deforestation in Cebu, it was assumed that the population was extinct.

Biological surveys conducted in Barangay Mabuli, Carmen Municipality, Cebu in February 2001 led to the unexpected rediscovery of the bare-backed fruit bat. This report therefore summarizes the present known distribution and conservation status of the bare-backed fruit bat, perhaps the most endangered of the world's megachiropterans.

Distribution status

The Philippine bare-backed fruit bat was formerly common in lowland forest from sea level up to about 800m elevation in southern Negros, roosting exclusively in caves (Heaney and Heideman, 1987; Rabor, 1986; Utzurrum, 1992). The species was recorded in four municipalities of southern Negros; namely, Amio, Sta. Catalina; Basay; Bais and Siaton. One was found in Cebu. The exact locality in Cebu was not specified, referring only to the municipality of Naga where the species was collected.

Taxonomic status

Our comparison with other species of *Dobsonia* (e.g. *D. viridis*) was based solely on descriptions provided by published literatures (Andersen, 1909; Rabor, 1952; Bergmans 1975a, b; Bergmans & Sarbini, 1985). Measurements and descriptions of the Philippine bare-backed fruit bat were based on published literatures and museum specimens in the University of the Philippines Los Baños (UPLB) and Silliman University. Because these museums do not have *D. viridis,* comparisons with this form were solely based on descriptions provided by publications. The species was considered to be conspecific with *Dobsonia exoleta* by Corbet and Hill (1992) but not by Koopman (1993).

Historical accounts

The Philippine bare-backed fruit bat was believed to be relatively common when it was last recorded in the 1960s. At the time of collection of the type series, there were approximately 300 bats inside the cavern, the largest cavern containing about thirty bats roosting very close to one another. Two females roosting in coconut palms on the banks of Amio River were also captured. Only one specimen taken outside of Negros was publicly announced. This was from Naga, Cebu Island, and is now housed at the Delaware Museum of Natural History. Another two specimens collected from Naga were deposited in Silliman University Natural History Museum. Surveys conducted in the 1970s to 1980s only resulted to recovering skeletal remains consisting of one mandible and a few leg bones, the only indication of the species' occurrence despite surveys in the last ten years of previously documented localities in Negros (Heaney and Utzurrum, 1991; Heaney & Heideman, 1987; Utzurrum, 1992).

Site Description

There are a few remnant patches of secondary forest on karst limestone, totaling approximately 60 ha, in Barangays Natimao-an and Caurasan, in Carmen, Cebu. The native and natural vegetation is limited to steep slopes and dominated by typical secondary forest tree species, including batino (*Alstonia macrophylla*), hindunganon (*Macaranga* sp.), tubug (*Ficus septica*) and matamban (*Mallotus* sp.), all with average canopy height of 4 meters.

The presence of well-maintained trails permeating the forest indicates continued use both for extraction of forest resources, access to households situated within the forest (there were at least three such households in February 2001), and passage to surrounding agricultural clearings planted with abacca (*Musa textilis*) and gabi (*Colocasia esculenta*), whilst coconuts were planted between cleared portions of the forest. The majority of the inhabitants in the surrounding local community live on subsistence farming or making charcoal (mostly from forest trees).

Methodology

Mist-nets measuring 6m by 4m with 34 -mm mesh size were set along ridge-top flyways and across ravines. Thirty six net-nights were spent in all sites. Opportunistic visits to known roost sites and crevices were also conducted. Search efforts for medium-sized species roosting inside crevices and limestone caves were made intensively.

Standard external measurements described by Ingle and Heaney (1992) were taken using a digital caliper. A 500g Pesola weighing scale was used in measuring the weight of the individuals caught.

Interviews with local people living within the periphery of the limestone forest were also conducted. Informants were asked about species frequently targeted for hunting, the location of reported roosting sites, and the frequency of hunting. The perception of the local people on the importance of forest and wildlife was also noted.

Results

Three females, two adults, and one sub-adult, were caught in Mabuli, Carmen. All three individuals were captured in the same location but on two separate nights. Identification was confirmed by L. R. Heaney from photographs and measurements.

DESCRIPTION

The individuals are larger than the musky fruit bat (*Ptenochirus jagori*) and a little smaller in size than the little golden-crowned flying fox (*Pteropus pumilus*). The ears, patagium, and naked dorsal skin are blackish brown. The fur on the top and sides of the head are generally olive green. The nape, upperside of shoulders, and furred upper part of the back had olive green hairs; a narrow line of these hairs runs along the spinal tract.

The inter-femoral membrane is somewhat reduced, forming narrow convoluted margins along the insides of their legs. Both the thumb and second digits of the upper limbs bore claws. The most distinguishing feature of this species, the naked membrane of the wings, extends to the midline of the back. There were two upper incisors, and two minute lower incisors.

Table 1. Morphological measurements of the three *D. chapmani* netted in Carmen, Cebu (February 2001). FA means forearm while HF means hind foot.

Individual	FA (cm)	Tail (cm)	HF (cm)	Ear (cm)	Weight (g)	Sex
1 (adult)	128	25	37	26. 3	143	Female
2 (adult)	128.4	24. 8	36.3	26. 8	138	Female
3 (sub-adult)	127	24	35.8	26. 4	125	Female
Ingle and Heaney (1992)	123-131	23-26	36-39	25-27	----	

N. B. Figures provided by Ingle and Heaney (1992, n=10) were taken from museum specimens.

The external measurements of the three individuals examined (Table 1), particularly the forearm, fall within the range of measurements provided by Ingle and Heaney (1992). Skull measurements, however, were not taken as no specimens were collected. All individuals caught were released back in the forest.

Discussion

The description of the specimens collected in Negros (Rabor, 1952) differs slightly in external coloration with the individuals caught in Cebu. From the descriptions, the Negros specimens were "colored mummy brown to umber on the top of the head, mantle, and face between the eyes . . . The fur along the forearm on wing membrane is golden tawny-olive." By comparison, the fur of the specimens caught on Cebu was generally olive-green in color.

All three individuals were caught in an agricultural clearing in a mist net set at least 6 meters above the ground, stretched between two coconut palms. The female specimens collected in Amio, Negros were also observed roosting in coconut fronds (Rabor, 1952). This indicates that the species is not restricted to lowland primary forest and to some extent are able to exploit degraded and highly disturbed habitats. It is remarkable that the species has not been previously recorded from the northern part of Cebu, though it may have been quite rare in this part of its range for a century or more, since deforestation occurred early in this area. From occasional contemporary reports received from local people in recent years, it seems likely that the species may also survive in other remnant forest patches on Cebu, though none of these reports have been confirmed.

OTHER BATS RECORDED

Several other species of fruit bats were also netted in the area. The most frequently captured bat was the common short-nosed fruit bat (*Cynopterus brachyotis*), followed by the musky fruit bat (*Ptenochirus jagori*), and the dagger-toothed flower bat (*Macroglossus minimus*) (Table 2). Except for the musky fruit bat, these bats are associated with disturbances in agricultural areas and are regarded as indicators of such degraded habitats (Utzurrum, 1992). However, the presence of these species also contributes to the natural regeneration of native trees in the area since they assist in natural seed dispersal as well as pollinating many agricultural plants (e.g. bananas).

Table 2. Species of bats caught in Mabuli, Carmen (February 2001).

Scientific name	Common Name	Status
Pteropus pumilus	Little Golden-crown Flying Fox	Vulnerable
Pteropus hypomelanus	Island Flying Fox	Common
Ptenochirus jagori	Musky Fruit Bat	Common
Cynopterus brachyotis	Common Short-nosed Fruit Bat	Common
Eonycteris spelea	Common Nectar bat	Common
Rousettus amplexicaudatus	Common Rousette	Common
Haplonycteris fischeri	Pygmy Fruit Bat	Vulnerable
Macroglossus minimus	Dagger-toothed Flower Bat	Common
Dobsonia chapmani	Negros Bare-backed Fruit Bat	Critically endangered

Threats and Conservation Status

Several individuals of Island Flying Fox (*Pteropus hypomelanus*) were found kept in cages in several households of Mabuli, Carmen. During the study, three groups of hunters, all using rifles, were observed hunting larger species of wildlife. From interviews conducted, hunters often visit caves and search crevices and known roosting trees to hunt for bats. This activity is obviously prejudicial to the continued survival of the bare-backed fruit bat.

A number of the local households surrounding the forest are dependent on the charcoal business. This creates a pressure on the remaining forest, as trees were cut and burned to make into charcoal, which is sold in neighboring towns or as far as metro Cebu. As there is very little forest left on Cebu, removing a single tree will have a large impact on the remaining forest.

Recommendations

Surveys in all likely habitats within Cebu, especially those linked with recent, convincing reports (descriptions) from local informants, should be intensified. The species were found in areas with limestone and at least secondary forest with caves. Focus should also be directed on the habitat preferences, feeding habits, and ecological requirements of the species. With this information, conservation action will be more directed towards assuring the survival of the species.

The presence of *D. chapmani* and its effect in regenerating second growth habitats demonstrates the species' tolerance to disturbed areas. The three individuals netted in Sitio Mabuli included a sub-adult, thereby indicating a breeding, if remnant, population. However, the very limited amount of forest (c. 60 ha) in this region is likely to be too small to sustain a viable population, especially given the continued, high degree of disturbance, attrition of habitat, and hunting pressure. This calls for immediate conservation action for the ensured survival of the species, especially the protection of roosting sites from intrusion by local people. A follow-up study, intended to help identify key sites and formulate protection measures (possibly including grid fencing of cave entrances, intensification of conservation awareness, and anti-hunting measures), is in the planning stages. The role and the possible practical contributions of local government units and the Department of Environment and Natural Resources (DENR), which are non-existent at present, will also be explored.

Acknowledgments

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REDISCOVERY OF THE PHILIPPINE BARE-BACKED FRUIT BAT (*DOBSONIA CHAPMANI* RABOR) ON SOUTHWESTERN NEGROS ISLAND, THE PHILIPPINES

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ABSTRACT

Since its last sighting in the late 1960s, the Philippine Bare-Backed Fruit Bat was presumed extinct. Its recent discovery on southwestern Negros Island confirms the existence of the species, despite the animal's disappearance in their former habitat on Negros Island. The discovery of five individuals in Calatong forest is a new capture record for the species. This paper also discusses the behavior of the individuals in captivity and their habitat characteristics. Netting success is also discussed together with the capture success of other bat species. This study was made possible through a grant provided by the ASEAN Regional Centre for Biodiversity Conservation (ARCBC).

Introduction

The Philippine Bare-Backed Fruit Bat (*Dobsonia chapmani*) (**Fig.1**), endemic to the Negros and Cebu Islands, the Philippines (Heaney, 1986; Heaney *et al.,* 1998), was described by D. S. Rabor in 1952. It has been reported to inhabit lowland tropical rain forest from sea level to 800 m above sea level, roosting in caves (Rabor, 1952 and 1986; Heaney and Heideman, 1987; Utzurrum, 1992; Heaney *et al.,* 1998). Fieldwork in limestone areas at and near the type locality in southwestern Negros Island from the late 1960s to 1998 failed to locate a single example of this species. This led Heaney and Heideman (1987), Utzurrum (1992), and Heaney *et al.* (1998) to suspect that the species has been extinct since the 1970s as a result of forest destruction, disturbances made by guano miners inside the bats' roosting caves, and hunting. Later, Heaney *et al.* (2002) labeled the species as "Extinct?". The rediscovery of this fruit bat in the Calatong Forest, Sipalay City in southwestern Negros in May 2003 shows that it is surviving on Negros Island, albeit in small number. This finding has also expanded its known distribution on Negros.

The present paper reports our observations on the rediscovered Bare-Backed Fruit Bat and its natural habitat in southwestern Negros Island. The fieldwork leading to the discovery of this fruit bat species is part of a larger study on the effects of tropical rainforest fragmentation on the herpetofaunal and mammalian species in several forest fragments in the municipalities of Hinobaan, Cauayan, and Sipalay (all in southwestern Negros) from August 2001 through May 30, 2003.

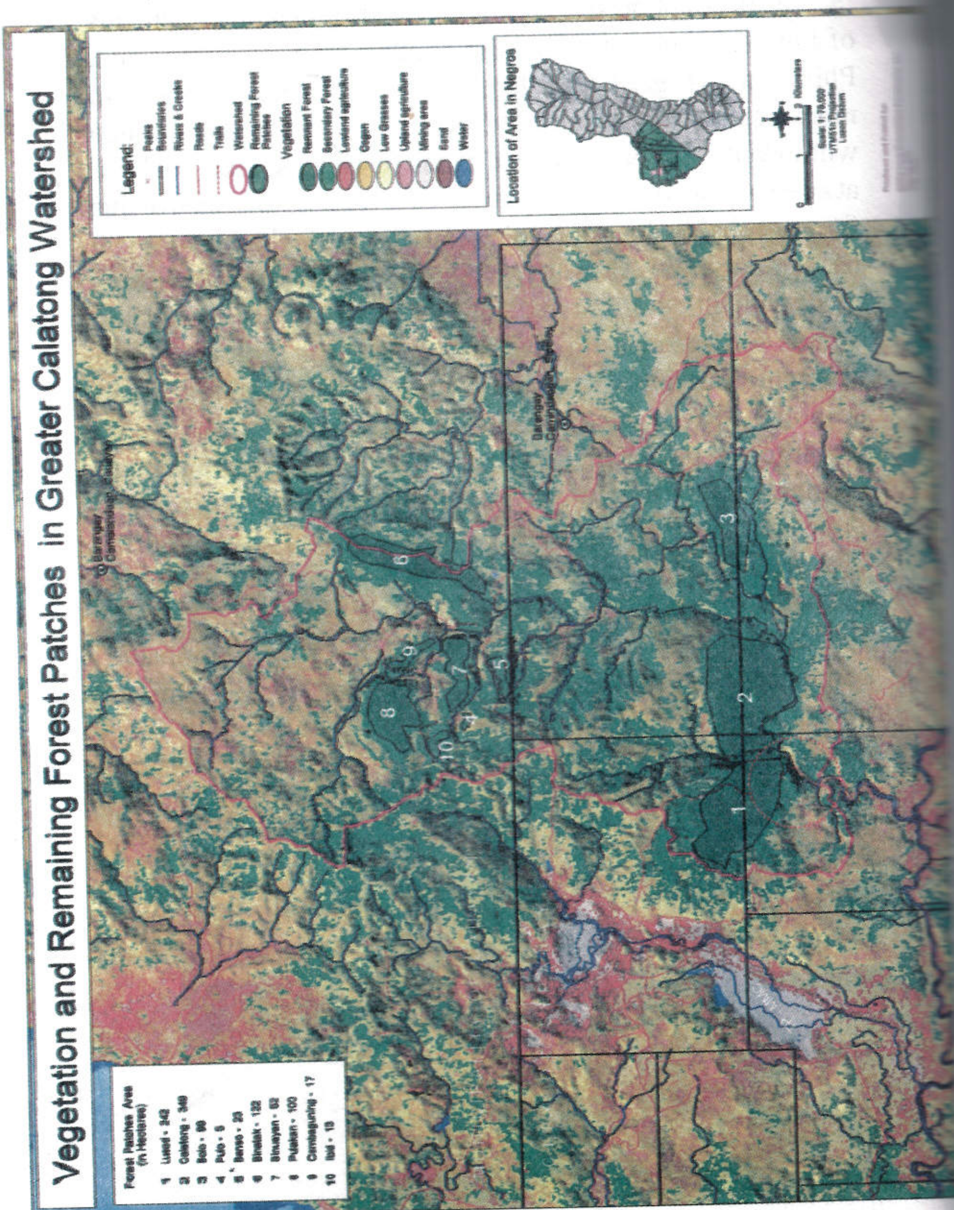
Fig. 1. Different views of *Dobsonia chapmani* showing back portion and different head perspectives.

Study Area

Calatong Forest is one of the several remaining fragments of lowland limestone forest in southwestern Negros Island, Philippines (**Fig. 2**). It is a logged-over dipterocarp forest with many patches of agricultural clearings. It is located in the area within 9° 46' 58" N, 122° 30'9" E and 9° 47' 6" N, 122° 30' 16" E at an elevation of 20-270 m above sea level. The total area of this forest probably does not exceed 1,000 ha, of which about 100 ha were surveyed. The site explored is predominantly limestone rocks with little soil as a result of erosion and may be considered a karst formation, with abundant caves. It is separated from adjacent grassland ("cogonal") areas by the Calatong River. Although heavily logged in the past, some large trees still exist including 8 species of dipterocarp trees, which are important elements that structure the rainforest. These are *Anisoptera thurifera*, *Dipterocarpus gracilis*, *Shorea astylosa*, *S. guiso*, *S. negrosensis*, *S. polysperma*, *Parashorea malaanonan*, and *Vatica mangachapoi*. The forest has a low canopy cover of <10% because of the loss of many emergent trees, which unfortunately continue to attract poachers. The netting site (elevation 190m and at coordinates 9°47'02" N and 122°30'14" E) for *Dobsonia* was a rocky portion of a clearing planted to corn and cassava near a logged-over dipterocarp forest. A wild fig tree about 24m in height and 1m in diameter at breast height about 50m away from the clearing was apparently a feeding tree of fruit bats. The ground area around this tree was littered with pulp, regurgitated fruit parts, and rotten fruits. An indigenous kiln for making charcoal was found near its base, indicating one use of forest trees in the site.

Materials and Methods

We surveyed Calatong Forest on May 21 - 30, 2003. Mist nets 12m x 6m with 60 mm mesh size were used to capture the fruit bats. They were set up on a hill in a rocky portion of a clearing in such a way that the nets were well above the canopy of a fruiting wild fig tree nearby. The nets remained in place from 6 o'clock in the afternoon of day 1 to 6 o'clock in the morning of the following


Vegetation and Remaining Forest Patches in Greater Calatong Watershed
Legend:
Vegetation
Location of Area in Negros

day, which was day 2 (= one net-night). The captured individuals were identified, measured for certain body parts, and marked with a water-based nail polish on one foot. For species determination, the taxonomic key of Heaney and Ingle (1991) was used. Two of these fruit bats (all males) were released on site. The other three were kept alive for observation.

Results and Discussion

Measurements of Captured Individuals

We caught 5 (4 adults and 1 juvenile) individuals of this rare species consisting of four males and one female at Sitio Narra, Barangay Manlucahoc, Sipalay City on May 26-28, 2003 (**Fig. 1**). Two distinct features are the animal's wings which meet at the mid-dorsal line, covering most of the back of the animal, and the yellow-greenish sheen of hair covering the neck. The measurements on the five individuals of the bare-back fruit bat are summarized in **Table 1**. Unfortunately, the three animals kept alive for observation died and were preserved as voucher specimens.

Table 1. Measurements of *Dobsonia chapmani* live specimens*

Indi.#	Sex	Age	TL	TV	EAR	FA	HF
C016	Male	Adult	218	22	27	133	30
C020	Male	Adult	175	24	28	121	29
ELA 30105	Female	Adult	240	20	28	130	28
ELA 30106	Male	Juvenile	220	22	24	119	30
ELA 30107	Male	Adult	256	26	26	133	32

TL=Total length ; TV=Tailvent; FA = Forearm; HF=hindfoot; units are in millimeter (mm)

Historical and Present Distribution on Negros and Cebu Islands

Dobsonia chapmani is endemic to the islands of Negros and Cebu, Philippines (Heaney *et al.,* 1998). Its historical geographic distribution is summarized here based on published literature, collectors' field notes, and skin specimens deposited at three natural history museums. On Negros Island, it had a wide range in the southern half of the island (**Fig. 3**). Rabor (1952) caught 18 males from Mambajo Cave, Paniabonan, Bais on May 13, 1949. Presently, Paniabonan belongs politically to the Municipality of Mabinay. Two female individuals were taken from coconut palms on the bank of the Amio River, Sta. Catalina on May 20-21, 1948 (Rabor 1952). The Delaware Museum of Natural History has two specimens from Kansan-an, Basay from ca 180-200m; one from Malindog, San Antonio from 800m, and one from Camp Lookout, Valencia. At the Royal Ontario Museum, there are 15 individuals taken from Labogon, Basay on June 4-9, 1964.

Of the 7 skin specimens at the Silliman University Natural History Museum, 2 were caught from Basay, southern Negros on February 10, 1968, and 2 from Bayawan (no specific locality) southern Negros on April 8 and 9, 1969. On Cebu Island, the fruit bat apparently was distributed in the northern half of the island (**Fig. 3**). D.S. Rabor collected a specimen (now at the Silliman Museum) from Naga, central-eastern Cebu in the late 1940s and another specimen in the same locality on December 20, 1964.

At the present time, the Bare-Backed Fruit Bat is found only in the Calatong Forest in Sipalay City, southwestern Negros, where it was rediscovered in May 2003, and in the Catmon area, northeastern Cebu, where it was rediscovered in February 2001 (L. Paguntalan, pers. comm.). Present fieldwork on both islands hopefully will extend its ranges on the two islands.

Abundance

Five individuals (4 adults, 1 juvenile) of *Dobsonia chapmani* were caught in 50 net-nights of total field effort, a 0.10 netting

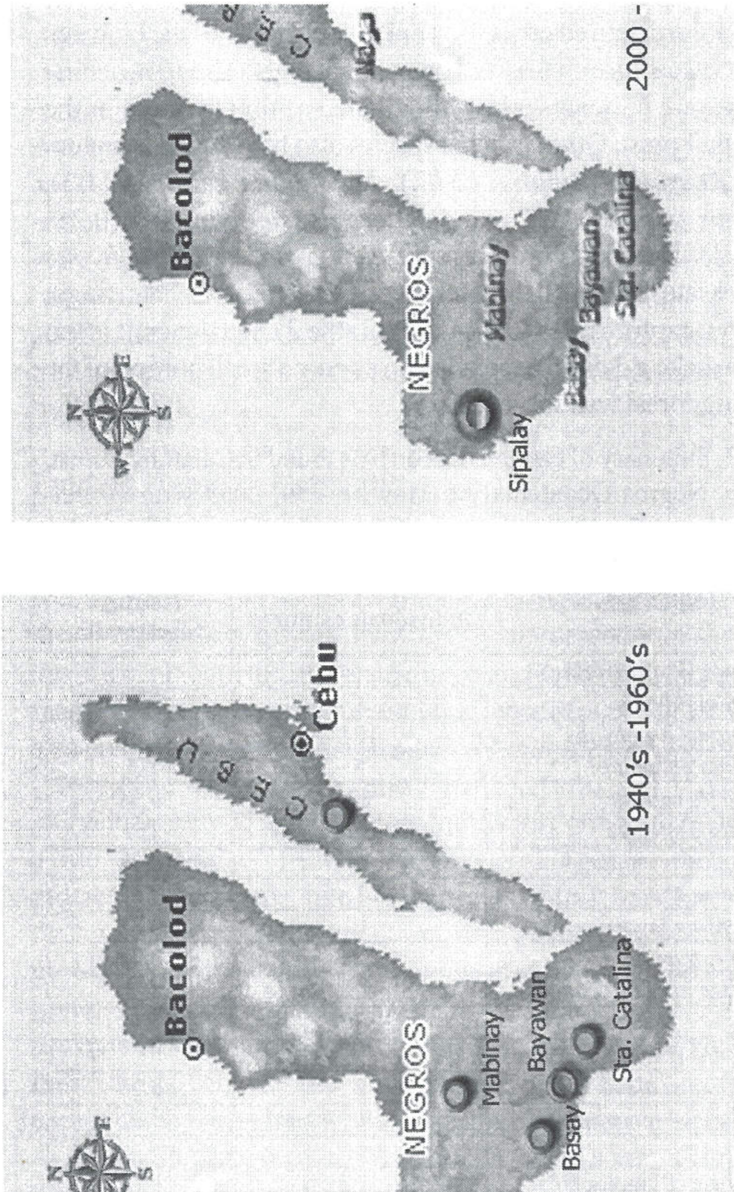


Fig. 3 Distributional range of *Dobsonia chapmani* on the islands of Negros and Cebu in 1940s-1960s and 2003.

success rate. Three males were caught on May 26 and two others, an adult male and a lactating female, were caught on May 28. The first capture occurred on the first operational night of the high net, the second capture on the third operational night. The 10% netting success rate indicates a low abundance of this fruit bat in the Calatong Forest. Other fruit bat species also have low net capture rates: *Acerodon jubatus* (0.02), *Nyctimene rabori* (0.02), *Pteropus pumilis* (0.22), and *Macroglossus minimus* (0.28) (Table 2). The most common species is *Cynopterus brachyotis* (capture rate, 2.08). All three species of insectivorous bats caught have low capture rates (0.02-0.04) (Table 2). However, it is too early to make a definitive conclusion as only a small portion of the Calatong forest was surveyed.

Table 2. Summary of capture data on bats found in Calatong Forest, Sipalay, Negros Occidental on May 21 - 30, 2003 with 50 net-nights of total field effort.

SPECIES	Number of individuals captured	Netting success rate
Fruit bats (Pteropodidae)		
Acerodon jubatus	1	0.02
Cynopterus brachyotis	104	2.08
Dobsonia chapmani	5	0.1
Eonycteirs robusta	27	0.54
Eonycteris spelaea	35	0.7
Macroglossus minimus	14	0.28
Nyctimene rabori	1	0.02
Ptenochirus jagori	41	0.82
Pteropus pumilus	11	0.22
Rousettus amplexicaudatus	25	0.5
Insect bats (Emballonuridae)		
Emballonura alecto	2	0.04
Saccolaimus saccolaimus	1	0.02
Insect bats (Rhinolophidae)		
Rhinolophus virgo	2	0.04
Total	**269**	**5.38**

Age and Reproductive Condition of Captured Individuals

Of the four male individuals captured, three were adults with large scrotal testes. One male (ELA 30107) showed characteristics of old age as its hairs on the head region were sparse and thin. The occlusal surface of the molars was worn out and irregular, and the canines were thin and less conical in appearance. The single juvenile had its testes in the abdominal region. The lone female was also observed to be very old as hairs were thinning and sparse in distribution and the teeth were worn out. It had large axillary mammae and was still lactating when caught. Regions around the nipples had several marks formed by the teeth of suckling infants. However, no infant was seen carried by this female.

Feeding Habits in Captivity

Captured individuals were fed with sweetened orange juice. However, not all of them ingested the juice with gusto. When feeding, the bats did not use their tongue in ingesting the juice, like the other fruit bats. Instead, they slightly submerged their snouts in the juice, placing the mouth in direct contact with the juice, and made chewing movements resembling those of pigs. The bats were also given ripe fruits of "mansanitas" *(Muntigia calabura),* mango (*Mangifera indica*), and yellow banana (*Musa sp.*). All four individuals refused to ingest these fruits. Only one adult male took a ripe "mansanitas" fruit. In the process of ingesting the fruit, it did not use its tongue, like other species of fruit bats, but bit the fruit with its front teeth (incisors), then pushed the fruit into its mouth. Chewing of this fruit occurred only when the bat was given the juice supplement while it was facing down. Feeding the bats in a hanging position was also tried, but none of the individuals took in the juice supplement. Fecal materials eliminated by these bats while inside the cloth bag were observed as fluid with some brownish residues and had a very strong bad (putrid) odor. These observations could indicate that the bat is also a meat eater.

Notes on General Behavior

The captured bats were generally docile and assumed a mild disposition when handled, readily clinging to the hand. They also appeared to be sensitive to light and closed their eyes when exposed to sunlight. They seldom made noise, unlike *Ptenochirus jagori* and *Cynnopterus brachyotis*. But when held tightly, the bat produced a sound similar to that of a piglet. This could be its distress call. Rabor (1949, unpublished field notes) noted the fruit bat's ability to hover in midair while maneuvering to enter a cave. This observation coincides with the description provided by local observers of a certain species of bat that has the ability to hover and swoop down in gliding motion. The wings of *Dobsonia chapmani* appear shaped for hovering and gliding. The wings are "mounted" dorsally and are relatively short, allowing greater lift and improved maneuverability, aerodynamic characteristics which conventional bats are less endowed with (Nowak, 1997). It appears that this ability to hover and glide gives the bats the advantage of maneuvering in tight and confined spaces (as in caves); it is likely that it also plays a vital role in flight and in foraging. However, this needs to be further investigated.

Associated Fruit Bat Species

Taken together with *Dobsonia* on May 26, 2003 were the following fruit bat species: *Pteropus pumilus, Rousettus amplixicaudatus, Eonycteris spelaea, and E. robusta*. The species caught with *Dobsonia* on May 28, 2003 were *Ptenochirus jagori, Rousettus amplixicaudatus, Pteropus pumilus, Eonycteris spelaea, and E. robusta*. In another net-night or date, *Acerodon jubatus* and *Nyctimene rabori* were also caught with the same net placed high over the forest canopy, but without the bare-backed fruit bat. All other bat species listed in Table 2 were taken by other nets.

Habitat of the Bare-Backed Fruit Bat

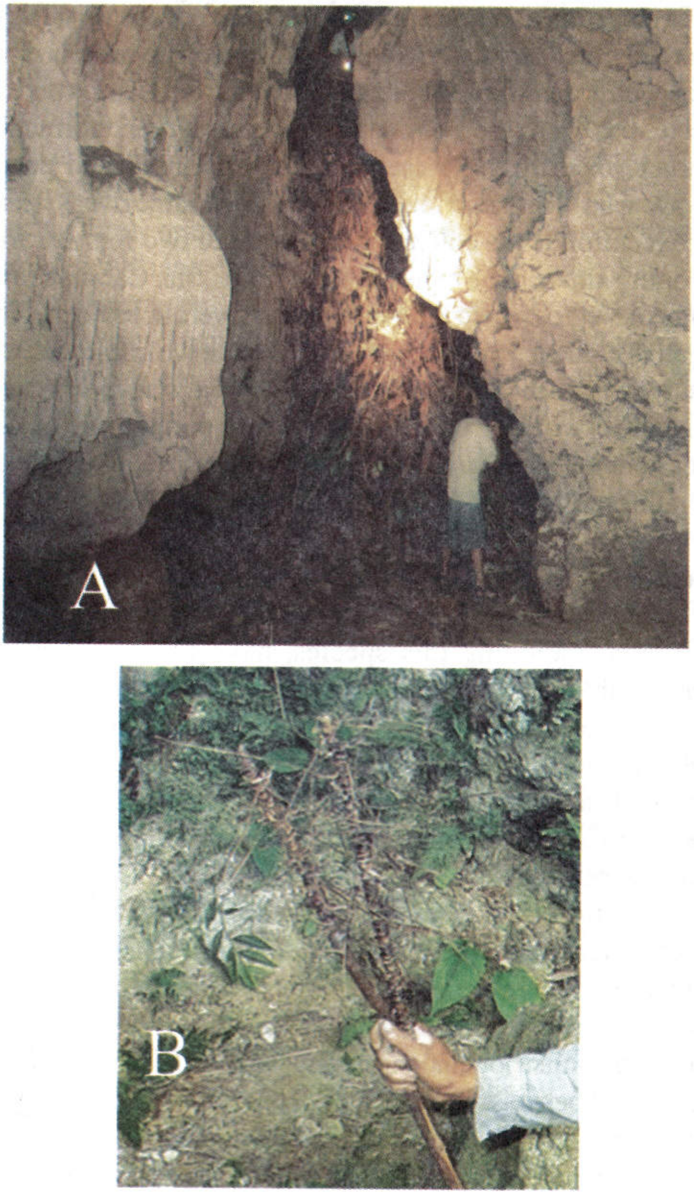
What are the major features that define the habitats of *Dobsonia chapmani*? Is it the presence of caves alone? Or is it caves plus something else? First, this bat has not been historically recorded from Cuernos de Negros, a volcanic area without caves. The localities in southern Negros and northern Cebu where the species has been recorded are limestone areas (karst formation) characterized by the presence of caves. Basay and part of Bayawan on Negros are limestone areas with large river systems. An exception is the collection by Rabor of two females from coconut palms on the bank of Amio River, Sta. Catalina town, southern Negros where limestone habitats were not evident. Thus negative evidence (absence of the fruit bat in volcanic area) and positive evidence (presence in limestone areas near river systems on Negros) would seem to point to the important role of karst (limestone) substratum in the vicinity of rivers in the structuring of the rainforest habitats of the Bare-Backed Fruit Bat.

Need to Conserve the Calatong Forest, Sipalay City

Interviews of eight hunters in the Calatong area indicate that fruit bats, including this species, have been hunted, and considerable numbers have been taken with the use of thorny vine attached to long poles to hook the animals while in midair. Elaborate entrapments set in cave openings have been observed in several caves visited during the study (**Fig. 4**). However, this report needs to be verified and the number of the Bare-Backed Fruit Bat caught by hunters determined.

The forest is surrounded by patches of cultivated area and uncultivated coarse grassland made up of cogon (*Imperata cylindrica*). There are about 819 households, 10 of which live inside the forest. Taking the average household number as 6, the estimated human population in the vicinity of the forest would be about 4,914 persons. The presence of this large number of people in and near the Calatong Forest poses a threat to the survival of wildlife, including bats. Another threat is the destruction of the forest itself, part of which is a mining claim. The immediate and

Fig. 4. A, a typical bat entrapment set at the mouth of the cave in Maanghit cave, Sipalay City. B, a thorny vine mounted on pole used to capture bats in midair.



stringent protection of this forest fragment is made urgent by the fact that it is a major watershed of Sipalay City.

Summary, Conclusion, and Recommendation

The Philippine Bare-Back Fruit Bat is still surviving on a small fragment of limestone tropical rainforest (ca 1,000 ha) in southwestern Negros. Field observations indicate the important role of caves and possibly freshwater bodies in the structuring of its habitat. The population size on Negros appears small and its habitat is threatened by forest poachers. The species should therefore be considered Endangered. Because so little is known about this species, no effort should be spared to study its population and field biology.

The preservation of the Calatong forest is the only way to save what is probably the last surviving population of this endemic fruit bat on the island of Negros. But this is only possible if the stakeholders—the Sipalay City government, the people living in the area, the hunters, and the forest poachers—can be persuaded to protect this unique fruit bat and its habitat. Sipalay City stands to benefit from the forest protection in terms of water generated by this forest for domestic use and for irrigation of agricultural farms.

Acknowledgments

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STUDIES OF FRUIT BATS ON NEGROS ISLAND, PHILIPPINES

Apolinario B. Cariño

ABSTRACT

The current status of population of fruit bats in some forests of Negros Island was assessed between March 1999 and March 2003. Bats were studied using mist nets and direct observations at their roost sites and in captivity at the A.Y. Reyes Zoological and Botanical Garden of Silliman University. A total of twelve species of fruit bats were recorded; namely, *Acerodon jubatus, Cynopterus brachyotis, Eonycteris spelaea, Haplonycteris fischeri, Harpyionycteris whiteheadi, Macroglossus minimus, Nyctimene rabori, Ptenochirus jagori, Pteropus hypomelanus, P. pumilus, P. vampyrus,* and *Rousettus amplexicaudatus.* A new island record of the Greater Bamboo Bat *Tylonycteris robustula* was first recorded in Canaway, Mantikil, Siaton, Negros Oriental. Species *A. jubatus, P. vampyrus,* and *P. hypomelanus* were observed roosting in thousands and in hundreds at Calinawan-Moratorium Area, Apo Island, Sta. Catalina, Vallehermoso, and San Jose in Negros Oriental and in Patag, Mambucal-Murcia, and Danjugan Island, in Negros Occidental.

The data gathered have been used to develop a community-based conservation education program aimed at increasing awareness of the importance of bats in the ecosystem. A local community and the Province of Negros Oriental have also initiated significant protective measures for the conservation of this species. On Negros Island, fruit bats are heavily hunted especially in their roosting and feeding sites.

Introduction

The Philippines is one of the world's major centers of biological diversity (WCSP, 1997; Kennedy *et al.*, 2000). Because of its high level of species endemism and the severity of threats to the survival of these species, the country is among the top ten of the world's biodiversity "hotspots" (Mittermeier, 1988). One of the highly diverse vertebrate faunal groups in the country with high endemicity are fruit bats (Heaney *et al.,* 1998). From the 25 total number of fruit bat species in the Philippines, 14 are found on Negros of which eight species are endemic. These include *Acerodon jubatus, Dobsonia chapmani, Eonycteris robusta, Haplonycteris fischeri, Harpyionycteris whiteheadi, Nyctimene rabori, Ptenochirus jagori,* and *Pteropus pumilus* (Heaney *et al.,* 1998; Ingle and Heaney, 1992).

In the Philippines and elsewhere, fruit bats play an important role in the pollination and seed dispersal of many tropical plants (Hutson *et al.,* 2001; Mickleburgh *et al.,* 1992; Fujita and Tuttle, 1991). However, bats face a number of threats that are pushing the natural populations to the brink of extinction (Utzurrum, 1992). These include habitat destruction by human disturbance at roost sites (e.g. hunting, guano extraction, and visits by people) and unregulated local or commercial hunting and trade (Mickleburgh *et al.,* 1990; Heaney and Regalado, 1998; Mildenstein *et al.,* paper in prep.).

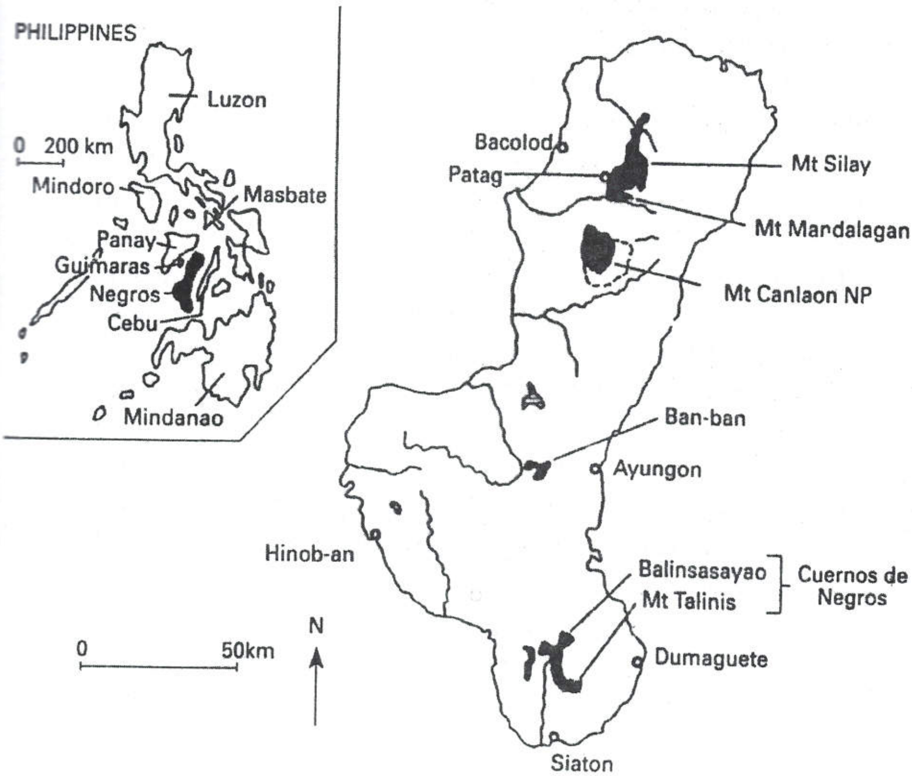
Thus, a concerted effort towards developing flexible and multidimensional programs to address problems of conservation for this species is imperative. This paper presents the current condition of the remaining population of fruit bats in the wild and the conservation activities being carried out through community-based initiatives.

Methodology

Description of Study Sites

Field surveys were conducted in selected forests of Negros Island, especially in Banban (Mabato-Candanaay Forests of Ayungon), Campuestohan (Mt. Mandalagan), Canaway and Landay (Mantikil, Siaton), Danjugan Island, Nasuji and Guinsayawan (Mt. Talinis Range), Twin Lakes and Calinawan (Sibulan), Maladjas-Talalak (Sta. Catalina), and caves in Candugay, Siaton and Guihulngan.

Figure 1. Map showing the island of Negros and the study sites (adapted from Brooks *et al.*, 1992).



Banban-Ayungon Forests

Between 26 March and 10 April 1999, a survey was conducted in the forests of Tihol-tiholan (9° 48' 68" N, 123° 0' 38" E), Katungaw-tungawan (9° 51'23" N, 123° 0' 29"E), and Manlawaan (9° 50' 35" N, 123° 0' 36" E) in Barangays Banban, Mabato, Candanaay, Maaslum, and Jandalamanon of Ayungon, Negros Oriental from elevations 750 to 896 m asl. These five barangays harbor a mature secondary lowland dipterocarp forest dominated by red and white laua-an and tangile trees (*Shorea negrosensis, Pentacme contorta,* and *S. polysperma*) with dbh that range from 20-260 cm and 8-30 m in height. Although the canopy was observed to have at least 40-70 percent opening in most parts of the forests, the undergrowth is dominated by saplings of dipterocarp species, shrubs, some herbs, ground orchids (*Spathoglottis* sp.), climbing pandan, and rattan (*Calamus* sp.). Orchids (*Vanda* sp.) and lipstick vines (*Aeschynanthus* sp.) were observed growing from the ground climbing to tree trunks that reached upper branches. Clinging to some of the branches in larger trees are epiphytes, such as hanging fern (*Platyerium coronarium),* bird's nest fern (*Asplenium nidus),* and many varieties of orchids including species of *Gramatophylum* and *Medinilla* spp. the latter, oftentimes seen growing on grounds in most parts of the forests. The forest ground is covered with humus and thick layer of decaying leaves (see detailed description of the site in CenTrop, 1998 unpubl. report, Brooks *et al.,* 1992 and Paguntalan *et al.,* 2001).

Campuestohan, Mt. Mandalagan Area

Mist-netting was conducted between 7 and 10 and 25 of May 1999 in a lightly disturbed old-growth forest, secondary forest, and abandoned clearings near Sitio Campuestohan, Mandalagan of the North Negros Forest Reserve 10° 39' N, 123° 08' E (see also Turner *et al.,* 2001 for the detailed description of the site).

Canaway, Mantikil, Siaton

From 28 to 31 March 2000, mist-netting was conducted along the Canaway River headwaters, ridge tops, and agricultural portions of the area (9° 12' 59" N, 123° 04' 12" E). The lowland forest (750-850 m asl) is a dipterocarp forest dominated by *Shorea* spp. and some species of *Lithorcarpus* and *Ficus* spp. clinging on boulders and rocks. Between 750 m asl to more than 1300 m asl, tree species *Agathis* and *Podocarpus* interspersed with "bolo" plants (*Schizostachium* sp.), oftentimes in dense population along steep ravines and between ridges, dominated the area. Epiphytes observed were composed of several species of orchids (*Vanda lamellata*), ferns (*Lycopodium* spp.), climbing vines, hoyas, lianas, bromeliads, *Medinilla* spp. and lipstick vines (*Aeschynanthus* sp.). In most of the forest clearings, agricultural crops were planted (*Cocos nucifera,* carrots, *Zea mays,* green onions, *Manihot esculenta, Coffea Arabica,* and *Ipomoea batatas).*

Danjugan Island

Occasional mist-netting was carried out on the Island from 25 to 28 April 2000. Danjugan Island is a small (approximately 43 ha), coral-fringed island covered with tropical limestone forest, 3 km west of Cauayan, Negros Occidental and 3 km off the coast of Barangay Bulata in the Sulu Sea (King *et al.,* 2002). In February 2000, the Island was designated as the Danjugan Island Marine Reserve and Sanctuaries (DIMRS) by the Municipal government of Cauayan and the provincial government of Negros Occidental (see King *et al.,* 2002; Harborne *et al.,* 1996; Turner *et al.,* 2002 for detailed description of the Island).

Landay, Mantikil, Siaton

Between 6 and 9 June 2000, mist-netting was conducted along a mature secondary forest and a mossy forest dominated by dipterocarp species (*Hopea, Pentacme,* and *Shorea* spp.), along river banks, and from 756 m asl up to 950 m asl on ridge tops in Landay, Mantikil, Siaton, Negros Oriental (9° 59' 39" N, 123° 00' 14" E) dominated by *Agathis* spp., *Podocarpus* spp., and many varieties of *Ficus* spp. Canopy is oftentimes closed and sometimes with 30 percent light penetration. Fallen logs were observed as fairly common and shrubs and tree ferns (*Cyathea* spp.) dominate most of the ridges and slopes. Species of pandans, Araceae, ground ferns, and *Calamus* spp. constitute ground cover. Climbing lianas, hoyas, drynarias, and lycopodiums were observed on tree trunks of most emergent trees in the area. Moss cover is common even on dead logs and along rocks and riverbanks, and tree buttresses. Common epiphytes observed were orchids, bromeliads, and lipstick vines (*Aeschynanthus* sp.), and *Medinilla* spp. (also observed on understorey and riverbanks).

Nasuji, Valencia

Mist-netting activities were conducted between 21-24 May 2001 in Nasuji, Puhagan, Valencia, Negros Oriental. The forest of Nasuji is part of the PNOC-EDC Project and is just a few kilometers away from the Palinpinon Geothermal Power Plant. The area is described as a mid-montane forest type dominated by almaciga (*Agathis* sp.; average dbh of 300-535 cm) and white and red laua-an trees (*P. contorta)* and (*S. negrosensis)* with average dbh of 35 and 50 cm. respectively). A few individuals of ulayan trees (*Lithocarpus* sp.), *Ficus* spp., and apitong (*Dipterocarpus grandiflorus)* were also observed in the area. Many tree ferns (*Cyathea contaminans)*, epiphytic plants (*Rhododendron* spp.), *Medinilla* spp., vines (*Aeschynanthus* sp.), and orchids were observed on river banks as well as on trunks and branches of taller trees, and these constitute the understorey of the forest. Several abaca plantations (*Musa textiles)* were observed on elevations 600 to 800 m asl.

Twin Lakes Balinsasayao and Danao

A survey was conducted on 27 - 28 June and 16 - 19 October 2001 in the Twin Lakes Balinsasayao area (9° 21' 10"N, 123° 10' 30" E). Steep slopes characterize Twin Lakes and their immediate surroundings. Some portions have low elevation and rolling terrain dominated by dipterocarp forest with some 181 tree species (RSA, 1994). Illegal cutting of trees and *kaingin* practice have mainly cleared the forest of many indigenous species. Years of advocacy finally resulted in the proclamation of the Twin Lakes on November 2000 as a natural park by virtue of Presidential Proclamation No. 414 and covers 8,016.5 ha (FPE-CenTrop, 2004; see also Antone, 1983; Utzurrum, 1995; Heaney *et al.*, 1989; Heideman and Heaney, 1989 for detailed description of the area).

Calinawan Community-based Sanctuary

Between 30 and 31 August and 22 - 26 October 2000 and 4 - 8 December 2001, a survey was conducted in the Calinawan community-based wildlife sanctuary of Enrique Villanueva, Sibulan, and Barangay Talalak of Sta. Catalina, Negros Oriental. The sanctuary is an old-growth dipterocarp forest of about 400 ha, with coordinates at 9° 20' 00" N and 123° 02' 00" E with an elevation of 500 to 1000 m asl, and characterized by low-lying hills with gentle slopes. The site contains old trees, with dbh of one to two meters, belonging to such premium species as *A. dammara, P. contorta, S. negrosensis,* and *S. polysperma* (also refer to Tiempo *et al.*, 2002; Cariño, 2002; CenTrop, 1998 unpubl. report).

Maladjas, Talalak, Sta. Catalina

The survey was conducted from 19 - 23 January 2002 in Maladjas, Talalak, Sta. Catalina, Negros Oriental (9° 19' 41.4" N, 123° 02' 19.4" E) from elevations 650 to 750 m asl, which is the highest part (in terms of elevation) of the sanctuary. Vegetation cover is very similar to the Calinawan Forest. It is part of the community-based sanctuary located in the Municipality of Sibulan.

Mt. Guinsayawan

Between 30 January and 4 February 2002, mist-netting activities were conducted from 650 to 800 m asl of Mt. Guinsayawan, Malaunay, Valencia, Negros Oriental, which is also part of the PNOC-EDC Project. Dominant tree species found are hindang (*Myrica javanica),* bakan (*Litsea philippinensis),* malatambis *(Syzygium hutchinsonii),* almaciga (*A. philippinensis),* and bunlas (*Tectona philippinensis)* with an average dbh of 45-141 cm and an average height of about 15-34 m. The area has been described by Heaney *et al.* (1989) and Heideman *et al.* (1987). The mountain has been heavily logged and cleared since their observations in 1987 and was observed to be in relatively similar condition during this survey. Many agricultural crops are now planted (cayote, *Collocasia esculenta, I. batatas, Musa* hybrids, and *M. textilis*) from elevations 500 to 700 m asl in valleys and ridges. Rattan (*Calamus* sp.), orchids (*Dendrobium, Vanda*), ferns (lycopodiums and tree ferns) were reported to be heavily harvested for human consumption and sold in local markets.

Siaton Candugay and Guihulngan Caves

Occasional visits to the Candugay Cave (9° 07' 04" N, 123° 02' 48" E) in Siaton on 11 March 2003 from an elevation of 145 m asl and to one of Guihulngan caves (10° 12' 29" N, 123° 16' 54" E) from 767 m asl were also made. The two limestone caves are both situated in agricultural areas planted with crops. Brush vegetations were observed around and near the caves' mouth.

Field Research

The field research was conducted between March 26, 1999 and March 15, 2003, with assistance provided by members of the People's Organizations surrounding the Twin Lakes area organized by CenTrop.

Bat capture by mist nets was carried out from 26 March 1999 to 15 March 2003. The mist nets were 6 m high, 6-12 m long when set, and with 36 mm mesh size. When possible, nets were placed end to end in a straight line, while other nets were separated by gaps ranging from 8-10 meters. The bottom edge of the lowest net panel was at least one meter above the ground. High nets were set following the methods used by Ingle (1993). Instead of using a pulley, the ropes were secured to a branch and made to hang on the canopy. An average of 25-30 nets per site were set up following methodologies described by Heideman and Heaney (1989) and Rickart *et. al.* (1993). Bats in caves were captured using scoop net and sometimes by flicking a 6m long mist net hand held by two assistants on both ends and blocking flight route of bats. Captured animals were released after these were sexed, weighed, photographed, and identified. Some threatened species, such as *Nyctimene rabori, Haplonycteris fischeri, Harpyionycteris whiteheadi, P. pumilus,* and *A. jubatus* were tagged with numbered necklace bands. Identification of bats was done using the *Key to the Bats of the Philippine Islands* by Ingle and Heaney (1992). In order to make a thorough study of the fruit bats in their natural roosts, direct observations were done at their roost sites using binoculars.

Results and Discusion

Field Research

In this study, six Philippine endemic species of fruit bats were recorded. About 50% of the total species recorded were endemic (Table 1). One out of 2 Negros-Panay Faunal Region endemic species was recorded in this survey on Ban-ban-Ayungon, Campuestohan-Mandalagan, Mantikil-Siaton, Twin Lakes, Calinawan-Sibulan, Talalak-Santa Catalina, Apo and Danjugan Islands, and Mt. Guinsayawan. The Greater Bamboo Bat *Tylonycteris robustula* was recorded for the first time in

Canaway, Mantikil, Siaton, Negros Oriental indicating that this species is a new record for the Island of Negros.

Species *Pteropus vampyrus* and *P. hypomelanus* were observed roosting individually or sometimes together on a tree in Mambukal, Minoyan, Murcia, Negros Occidental. *P. hypomelanus* individuals were also noted in 3 different roosting sites in Vallehermoso, one in Janay-janay, San Jose, and another in Apo Island, Negros Oriental and in Danjugan Island, Cauayan, Negros Occidental. *P. vampyrus* species were also recorded in Buenavista, Sta. Catalina, Negros Oriental.

Among the species of considerable conservation importance recorded in this survey are: the Philippine Tube-nosed Fruit Bat (*Nyctimene rabori*); the Golden-crowned Flying Fox (*Acerodon jubatus*); Harpy Fruit Bat (*Harpyionycteris whiteheadi*); Little Golden-mantled Flying Fox (*Pteropus pumilus*); and the Philippine Pygmy Fruit Bat (*Haplonycteris fischeri*). Most notably, the capture of the Greater Bamboo Bat (*Tylonycteris robustula*) in Canaway Forest of Mantikil, Siaton shows it to be a new record for Negros along with six other species of insect bats from the Families Megadermatidae, Rhinolophidae, and Vespertilionidae (Table 1), including the two Philippine endemics *Hipposideros pygmaeus* and *Rhinolophus virgo* species.

These species are fully accounted below in terms of their distribution, population size, behavior, and breeding activities.

Species Accounts

Acerodon jubatus (Eschscholtz, 1831)

Many observations of roosts and one capture were made of the Golden-crowned Flying Fox *Acerodon jubatus* (see Table 1), which is endemic to the Philippines and is classified as endangered by IUCN and CITES: Appendix II (Heaney *et al.*, 1998). On Negros, this flying fox was recorded by Cariño, 1998 (unpublished report) in Calinawan, Enrique Villanueva, Sibulan, Negros Oriental in an estimated 10,000 ha of lowland dipterocarp forest that also contains other species of wildlife. A single individual

Table 1. Bats netted in selected forests of Negros Island, Philippines between March 1999 and March 2003.

Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12
Family Pteropodidae												
*Acerodon jubatus**								1				
Cynopterus brachyotis	32	72	25	33	36	21	18	45	45	1		
Eonycteris spelaea	2		8	50	2	6	1	82	8			1
*Haplonycteris fischeri**	35	2	1		3	20	16	4	4	15		
*Harpyionycteriswhiteheadi**	1	1	1		4	8	1	4		1		
Macroglossus minimus	37	9	21		9	49	11	17	19	2		
*Nyctimene rabori***	9	3	2				1	4	2	2		
*Ptenochirus jagori**	44	16	85		146	34	86	57	42	34		
Pteropus hypomelanus				2								
P. pumilus	4		1	2	1			3	1			
P. vampyrus								1				
Rousettus amplexicaudatus	121				1		10	9	9			
Family Megadermatidae												
Megaderma spasma								1				
Family Rhinolophidae												
Hipposideros diadema			1									
*Hipposideros pygmaeus**	1		3								1	1
*Rhinolophus virgo**							1					
Family Vespertilionidae												
Miniopterus australis						1		1				
Scotophilus kuhlii								1				
Tylonycteris robustula			1									
Total Net nights	151	26	51	8	94	57	55	67	66	38	1	1

Legend:

Site 1: Banban-Ayungon Forest (26 March to 10 April 1999); Site 2: Campuestohan, Mt. Mandalagan (7-10 May & 25 May 1999); Site 3: Canaway, Mantikil, Siaton (28-31 Mar 2000); Site 4: Danjugan Island (25-28 Apr 2000); Site 5: Landay, Mantikil, Siaton (6-9 Jun 2000); Site 6: Nasuji, Valencia (21-24 May 2001); Site 7: Twin Lakes Balinsayao & Danao (27-28 Jun & 16-19 Oct 2001); Site 8: Calinawan Community-based Sanctuary (30-31 Aug and 22-26 Oct 2000 & 4-8 Dec 2001); Site 9: Maladjas, Talalak (19-23 Jan 2002); Site 10: Mt. Guinsayawan (30 Jan to 4 Feb 2002); Site 11: Siaton Candugay Cave (11 Mar 2003); and Site 12: Guihulngan Cave (15 Mar 2003)

* Philippine Endemic, ** Negros-Panay Endemic

Table 2. Breeding Records of some fruit bats in captivity at A.Y. Reyes Zoological Botanical Garden.

Species	Observations on Mating	Date of Births	Last Observed Suckling
Pteropus leucopterus	Oct - Nov, 1999 Oct - Nov, 1999 Oct - Nov, 2001	3 Apr 2000 5 Apr 2000 24 Apr 2002	24 August 2000 24 August 2000 6 September 2002
Pteropus hypomelanus	Aug - Sep, 1999 May - Jun, 2000	12 Jan 2000 10 Oct 2000	April 2000 11 February 2001
Acerodon jubatus	Nov. - Dec. 2000 Nov. 2002	4 Jun 2001 21 Apr 2003	7 October 2001 August 2003
Pteropus leucopterus	Dec. 2000 - Jan. 2001 Dec. 2000 - Jan. 2001	10 Mar 2001 26 Mar 2001	July 2001 July 2001
Pteropus pumilus	Dec. 2001 Dec. 2001	28 Mar 2002 30 Mar 2002	July 2002 July 2002

was captured using a high net placed above the canopy hoisted with a pole on both ends of the net on two white laua-an (*Shorea contorta*) trees in the area. Members of the People's Organization (PO), the Calinawan United Farmer's Association Inc. (CUFAI), first reported the roosting site in 1996. In Hinotongan area near Upper Tampa of Calinawan (09° 19' 32" N; 123° 09' 35" E, 1028 m ASL), the roosting site was moved to Anahawan, Enrique Villanueva (9° 20' N and 123° 02' E) area due to hunting pressures and habitat destructions.

During the April-May 1998 survey in Calinawan (unpublished report), a single adult female whose roosting site was disturbed by hunters, was observed carrying a young while on flight. Almost every week (especially during summer) hunters visit and shoot bats for fun and trade (sold for 20-30 PhP per individual) in this roosting site. Aside from *A. jubatus, P. vampyrus* species was also observed roosting in thousands. Although no counting was made to determine the species ratio of bats roosting in the area, an estimated 15,000 total number of individuals were counted visually in 1998 while bats were doing their exit flying at around 6:25 in the evening. However, Mildenstein *et al.* in 2002 (paper in prep.) recorded at least 10,576 total individuals of flying foxes in the same site of which 27% were *A. jubatus*. This shows that the four years of continuous hunting activities in the area has drastically reduced the population of both *A. jubatus* and *P. vampyrus* by an estimated 5,000 individuals. Other records for this species on the island were documented by Mildenstein *et al.* (paper in prep.) in Mt. Patag and Mambukal, Minoyan, Murcia, Negros Occidental.

Breeding records in captivity revealed that mating occurred from November to December 2000. Birth of *A. jubatus* was recorded on 4 June 2001 and weaning observations were noted starting 7 October 2001 (Table 2).

***Haplonycteris fischeri* (Lawrence, 1939)**

A total of 100 individuals of *Haplonycteris* fischeri were captured in these sites on Negros (Table 1). This endemic Philippine pygmy fruit bat is reported to be common in primary forest, rare in secondary forest, and absent in agricultural areas (Heaney *et al.,* 1998). Yet this species can still be found in some cleared forests that have been converted to agriculture, such as the Twin Lakes (with cleared areas planted to food crops), Calinawan, Enrique Villanueva, Sibulan (with corn and other vegetable plantation), Canaway, Mantikil, Siaton (planted to corn and other crops), and in Banban, Ayungon (agricultural areas within the forest). In Ayungon, two individuals were observed roosting on different plant types. One was found roosting under a *Rhododendron* leaf (Ericaceae) on the trunk of a large laua-an tree (approximately 3-4 m height) while the other one was observed roosting on a branch of a 2-3 m tall amalau tree (sapling). During this study, 4 pregnant females were observed on May 21-24, 2001 in Nasuji, Puhagan, Valencia. Records show that this species is the 6th most captured (Table 1) in terms of number of individuals.

***Harpyionycteris whiteheadi* (Thomas, 1896)**

During this study, the Harpy Fruit Bat was a rare capture. The only site having the most captures is in Nasuji with a total of eight (Table 1). This is probably because the Nasuji forest was still a moderately disturbed forest at the time of the survey. This species ranks number eight in the over all total number of captures in the study and is quite rare in the lowland areas of Ayungon, Canaway, and Twin Lakes. The species was observed feeding on the fruit of yagumyum (*Melastoma malabathricum)* which is abundant in thickets at medium-to-high altitudes in the areas surveyed. At least 1 female was recorded pregnant on 7 Jun 2000 in Landay, Mantikil, Siaton while two pregnant females were recorded on 21-24 May 2001 in Nasuji, Puhagan, Valencia, Negros Oriental.

Nyctimene rabori **(Heaney and Peterson, 1984)**

In this study, the most number of individuals of *N. rabori* was recorded in Ban-ban, Ayungon with a total capture of nine individuals. A total capture of three individuals was noted in Campuestohan, Mandalagan and Calinawan, Enrique Villanueva, Sibulan. Considered critically endangered (IUCN) and endemic, individuals of this species were twice captured (one individual each time) in Canaway-Mantikil, Siaton; Maladjas-Talalak, Sta. Catalina; Mt. Guinsayawan and only once captured at the Twin Lakes area. It is interesting to note that this species was also captured in secondary forests which are sometimes cleared for agriculture. As in the case of Banban-Ayungon, two individuals were captured in an agricultural area on a ridge top planted to cassava (*Manihot esculenta*), gabi (*Colocassia esculenta),* and camote (*I. batatas*), with forests on its slopes and ravine areas. In Campuestohan, the two individuals were netted on the ground at an abandoned *kaingin* (slash and burn) area where ferns were already growing. Another two individuals were captured on a moderately disturbed forest of Canaway, Mantikil (at the time of the survey) along the Canaway River. A single individual was netted in the Twin Lakes on October 17, 2001. This was recorded along a forest ridge on the slopes of Mt. Balinsasayao. In a semi disturbed primary lowland forest of Maladjas, Talalak, Sta. Catalina, only two individuals were recorded with one pregnant female observed on January 20, 2002. Two individuals were also recorded from a moderately disturbed primary forest of Mt. Guinsayawan. In Ayungon, two individuals were observed feeding on the fruits of *Medinilla magnifica* and were also identified through the fecal droppings inside the cloth bags.

Pteropus pumilus **(Miller, 1910)**

A total of 12 individuals of the Little Golden-mantled Flying Fox were captured in this study. This species is rare in degraded and cultivated areas exceeding 1 km from tracts of forest

(Utzurrum, 1992). This observation paralleled with the results recorded in Ayungon. Only four individuals were captured during the entire duration of the study. One was caught along a ground net set on a ridge top planted to agricultural crops such as cassava (*Manihot esculenta),* gabi (*Colocassia esculenta)*, and camote (*I. batatas*). The other individuals were caught inside the secondary forests of Banban-Ayungon. The other captures were recorded singly in Canaway-Mantikil, Landay-Mantikil, Maladjas-Talalak. Two captures were made in Calinawan-Sibulan and on plantations of *Rhizophora* species in Danjugan Island.

Breeding of this species in captivity is well noted by Seyjagat (1999). In captivity, couples were observed mating in dorsoventral position. Copulation lasts up to one minute and 15 seconds then resumes two or three times with an interval of five to six minutes in between in a day. The process includes following and flicking of wings by an interested male (or the dominant male) at a female. These activities are accompanied with great vocalization. The male displays grooming attempts at the female while positioning himself at her dorsal part. He will then clasp her with his wings and thumbs and grasp the thickened nape of her neck. Eventually, the male copulates with the female for about two minutes.

Similar actions have also been observed among species of *Pteropus hypomelanus* and *P. leucopterus* although *P. leucopterus* species mating lasts more or less two minutes a day. On the other hand, *A. jubatus* species are the noisiest breeders, their activity lasting also at least two minutes a day. Mating only occurs with dominant males in the colony or in a harem. Table 2 also shows breeding records of fruit bats in captivity at the A.Y. Reyes Zoological and Botanical Garden. At the Camp Look Out facility (now abandoned), three harems of *P. pumilus* species have been observed. During the observation, each harem was composed of five to eight adult females (most of them lactating and nursing pups), and at least three to five sub-adult males, three to four sub-adult females, and three to five adult males. Other adult males roosted singly or with a nursing adult female and juvenile offspring on the side.

Tylonycteris robustula **(Thomas, 1915)**

On Negros, this species was first recorded in Canaway, Mantikil on March 30, 2000. A single adult male was captured weighing 3.5 g, total length = 70 mm, tail vent = 26 mm, hind foot = 5 mm, ear = 9 mm, and forearm = 26.5 mm. This was caught on a ridge top at about 890 m asl. The site is characterized as a mature secondary type of forest and mossy at higher elevations (Hapon-haponon and Landay peaks) with clearings (slash and burn) on lower elevations near the Canaway River and steep slopes with elevations 800 – 885 m asl at the time of the survey. Reports from farmers revealed that 20 – 30 individuals roosted together inside one node of "bolo" (*Schizostachium* sp.), a smaller variety of bamboo found mostly in the ravines and upper slopes of the ridges in the area (850-1000 m asl). This species entered through a very small slit, crack, or crevice of the bamboo.

In the Philippines, it was first reported by Heaney and Alcala (1986) and has also been recorded in Luzon (in Rizal and Zambales provinces), in Calauit and Palawan (Heaney *et al.,* 1998). According to Heaney and Alcala (1986), this species is found in disturbed lowland areas with bamboo stands. Although widespread, its status in the Philippines is still unknown (Heaney *et al.,* 1998).

Conservation Monitoring Activities

As this study has shown, there is an urgent need to continuously monitor not only the known fruit bat colonies on Negros but also the bats that roost in caves (insect and fruit bats) and on trees (flying foxes). To protect these species, no less than the declaration of these sites as protected areas (locally or nationally) will be necessary and actions to this effect should be initiated as early as possible. Likewise, more ecological studies are recommended for bat species of ecological importance to areas such as Mantikil-Landay, Siaton; Talalak, Sta. Catalina; Calinawan, Sibulan; Banban, Ayungon; Mt. Kanlaon; Mt. Patag; Mt. Mandalagan and Mt. Talinis/Twin Lakes; and areas in the southern most part of Negros, Basay to Hinobaan, Sipalay, and Cauayan. Meanwhile, the discovery of the Greater Bamboo Bat in Canaway, Mantikil, Siaton indicates that although the microchiropteran community in this area is diverse, little is known of the species. Since microchiropterans are also sensitive to environmental threats such as the clearing of bamboo stands (mainly for building construction purposes), measures should be taken to protect this population. Consequently, conservation efforts for this group of small bats should be carried out as soon as possible.

Many caves on Negros, especially in Guihulngan, Mabinay, Basay, and Siaton are either constantly disturbed by spelunkers or ravaged by those who want to extract guano, hunt, and mine stalactites and stalagmites. Hence, a program for cave management and protection for the caves in these municipalities should also be initiated.

Community Education Programs for Fruit Bat Conservation

The community education program has been quite successful in increasing awareness for the environment, especially on the importance of conserving fruit bats, not only among the people living around the Mt. Talinis-Twin Lakes Area but also in the entire province of Negros Oriental. One of the program's activities, the summer theater workshop, has been particularly effective in attracting participation among the youth who benefited from enhanced learning experiences provided by speakers, facilitators, and trainors. Participants reported that the community theater affected their lives by instilling self-esteem and self-confidence through their performances before the local community, their parents, and a local resort center. Training provided by the workshop has enabled a good number of young participants to produce environmentally oriented presentations and perform them during fiesta celebrations in all target municipalities. This positive outcome has led to the planning of more theater workshops for out-of-school youth and members of the Sangguniang Kabataan (SK) of the Municipalities of Valencia, Dauin, Sibulan, and San Jose, and those living in the immediate vicinity of Mt. Talinis and Twin Lakes area. Among Filipinos given to watching plays in public rather than to listening to semi-formal lectures, community theater is proving to be an effective medium for disseminating environmental protection message to the public. It is hoped that the involvement of members of Sangguniang Kabataan, with funding from each local government unit, will further strengthen and help sustain the program.

Legislative and Public Support

Results of the wildlife conservation education caravan held since November 2002 (to the present) and participated in by nine municipalities reveal that many legislators in these municipalities support the program by formulating resolutions and declaring municipal protected areas to ensure the protection of this species. However, there is still an urgent need to attract more donors to support this effort, particularly in the production of educational materials such as posters, television, as well as radio programs aimed at increasing the awareness of the public not only in the municipalities of Valencia and Sibulan but the entire Province as well. The Province of Negros Occidental is another site of concern for wildlife conservation. A good captive breeding facility is initiating more education campaign for this province in collaboration with interested non-government organizations.

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THREATENED WILDLIFE OF THE TWIN LAKES BALINSASAYAO AND DANAO NATURAL PARK, NEGROS ORIENTAL, PHILIPPINES

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and Angelita M. Cadeliña

ABSTRACT

The Twin Lakes of Balinsasayao and Danao of southeastern Negros constitute an extensive tropical rainforest ecosystem and one of the centers of great biological diversity on Negros Island. They are a part of the 133,000 ha Philippine National Oil Company (PNOC) Geothermal Reserve. The lakes and forest ecosystems are refuges to the 180 species of dipterocarp and non-dipterocarp trees, 113 species of birds, 27 mammals, and 49 amphibians and reptiles. Currently, the Twin Lakes have been officially declared as a Natural Park with some of the unique mammals, birds, amphibians, and reptiles in threatened status. The vertebrate fauna having the most threatened species are the birds with 17 globally threatened species. The mammals have 11 threatened species that are under different levels of threat. The amphibians have 5 threatened species while the reptiles have two lizards and one snake that are threatened. Habitat loss and degradation coupled with discrete hunting, collection and harvesting of aquatic and forest resources for subsistence, commercial, ornamental, pet, or zoo trade are putting an increasing pressure on threatened and non-threatened plant and animal species in the Twin Lakes area. Long-term conservation program for keystone threatened plant and animal species is essential for the preservation of the remaining forest and its wildlife.

Introduction

The Philippine forests host one of the world's richest plant and animal species. They are estimated to harbor about 8,120 species of flowering plants of which about 3, 200 are endemic; 3,500 species of indigenous trees; 33 species of gymnosperms, and 640 species of mosses (The State of the Philippine Environment 1997). Philippine land vertebrate species number about a thousand (Alcala in Heaney and Regalado, 1998), approximately 105 amphibians, 278 reptiles, 556 birds (resident and migratory), and 174 mammals (Heaney and Regalado, 1998). Once overlooked as a center of biological diversity, this nation of islands has now vaulted to the top of the list of "megadiversity" countries. Unfortunately, with the discovery of the richness of Philippine biodiversity has come the realization that nearly half of the unique mammals, birds, as well as amphibians and reptiles are in threatened status. Acre – for – acre, the Philippines may have the most seriously threatened flora and fauna on earth (Heaney and Regalado, 1998).

Based on the composition of species on each island group in relation to land bridges formed during the Pleistocene period, the Philippines is divided into five major faunal regions: Greater Luzon, Greater Mindanao, Negros-Panay, Mindoro, and Palawan (Heaney, 1986). Among the five faunal regions, Negros, centrally situated in the Philippine Archipelago, is the third largest island with a total land area of 13,670 sq. km (Paalan, 1993). Two separate highlands are present on Negros: a main central range that runs nearly the length of the island, and a double cluster of uplands at the southern end. The southeastern part is dominated by Cuernos de Negros (PENRO-DENR, 1999), one of the most important but critically endangered ecosystems in the island. It is also popularly known as the 133,000 hectare Philippine National Oil Company (PNOC) geothermal reserve. Currently, the Twin Lakes of Balinsasayao and Danao, which are part of the reserve, have been declared as a Natural Park.

More studies on the systematics and ecology of the original and remnant flora as well as the vertebrate fauna on Negros have been carried out compared to those of any other larger islands in the Philippines. Since the mid-1950s to the present, scientists associated with Silliman University and their research collaborators have been conducting research on plants, mammals, birds, amphibians, and reptiles from which a number of scientific papers, monographs, articles, and books have been published, notably by D.S. Rabor, A.C. Alcala, A.Y. Reyes, W.C. Brown, L.R. Heaney, P. Heideman, and R.C.B. Utzurrum. However, these publications deal with generalized coverage of Philippine flora and fauna. Much of the data obtained from the fieldworks conducted in the remaining tropical rain forest of Cuernos de Negros and Twin Lakes (Balinsasayao and Danao) areas are incorporated in these publications.

This paper is written for three main purposes, namely: (1) to bring to the attention of the general public and to other scientists whose interests lie outside of conservation, our diverse but rare and poorly known plants and vertebrates present in the Twin Lakes area; (2) to present the conservation status of endemic threatened plants and vertebrates; (3) and to underscore the urgent need for protective measures for those plant and vertebrate species that are already listed under different levels of threatened category.

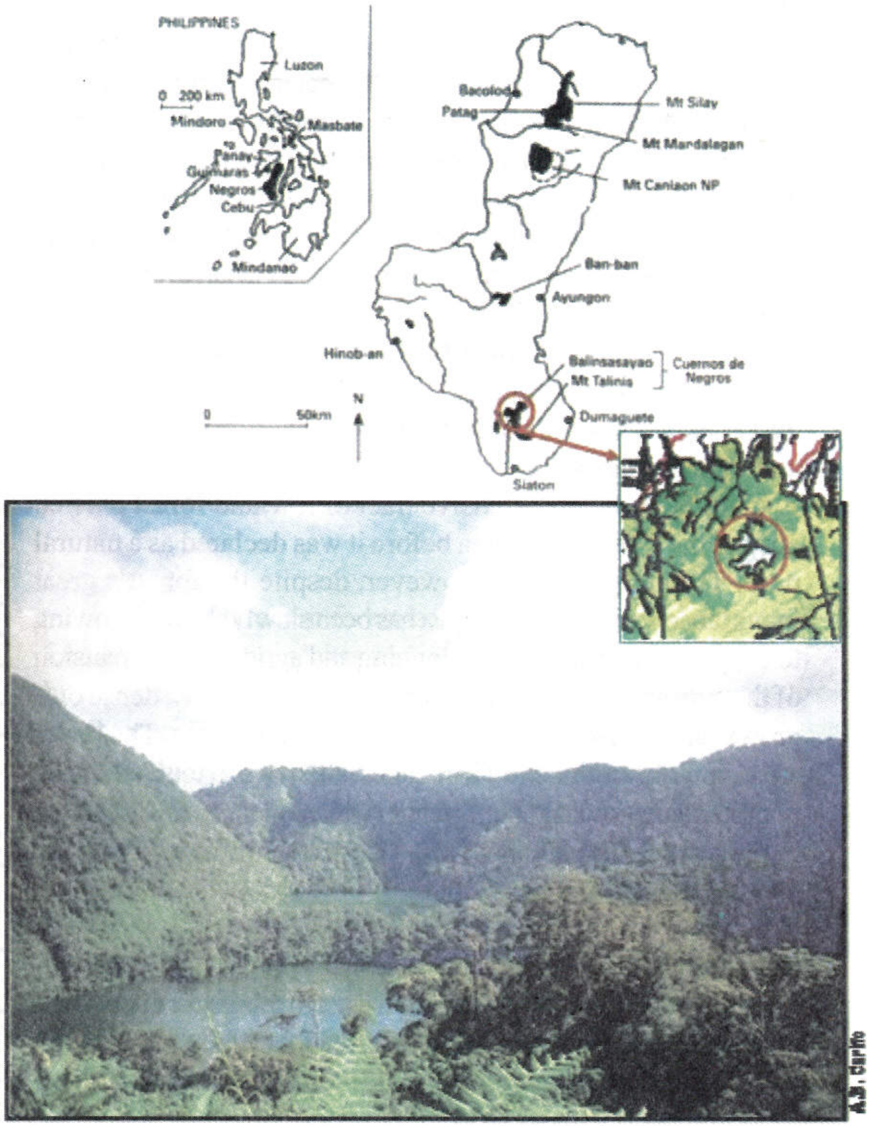

Figure 1. Inset is a map of the Philipines showing Negros Island with location (Brooks *et al*., 1992, DENR 2002) and photograph of the Twin Lakes Balinsasayao and Danao Natural Park in Southeastern Negros.

Methodology

Description of the Area

The southeastern mountain range of Negros Island is Cuernos de Negros that rises at 1,800 meters (6,600 feet) above sea level (ASL). To the north of Mt. Talinis are substantial areas of primary and secondary lowland dipterocarp forest around; the Twin Lakes at Balinsasayao and Danao Natural Park (Fig. 1), with some patches of secondary growth in recently cleared areas. These two small crater lakes are separated by a narrow mountain ridge, and situated in a hollow between four mountains, Mt. Mahungot to the south, Mt. Kalbasaan to the north, Mt. Balinsasayao to the east, and Mt. Guintabon to the west of the Twin Lakes. Lake Balinsasayao lies to the northwest of the ridge and Lake Danao to the southeast (Mallari *et al.*, 2001).

In the past, an extensive tract of lowland forest existed around the Twin Lakes area before it was declared as a natural park. Through the years, however, despite the forest's great importance, the Twin Lakes area has been slowly shrinking owing to the pressure of small-scale logging and agricultural expansion of the surrounding needy rural population. Currently, dense old-growth still surrounds the mountain peaks and lakes. The lower areas, mainly around the Twin Lakes, still have extensive stands of dipterocarp lowland rainforest as well as patches of Almaciga, the largest tree in the Philippines (which can grow up to 60 meters/ 197 feet in height) (Hicks, 2000).

Sources of Information

Literature. Much of the information used in this paper come from published surveys, researches, and Red Data documents along with unpublished manuscripts done in the mid-1950s, in the 1980s, early and late 1990s to 2003.

Biomonitoring Activities. Community validated outputs of surveys done by researchers in the academe and from planned wildlife monitoring activities learned by local people from the

Biomonitoring and Evaluation (BIOME) staff of CenTrop are also utilized in this paper.

Ethnobiological Interviews. Additional information on the presence or absence of plant and vertebrate species was gathered from residents (hunters and farmers) of nearby local communities adjacent to the Twin Lakes.

Internet and CD-ROMS. Websites and electronic database compilations of threatened plants and vertebrates have been cross-checked with previous and current Red Data Book listings.

Flora and Fauna of the Twin Lakes Natural Park

Flora

A total of 180 tree species (see ANNEX A) are recorded in the forest surrounding lakes Balinsasayao and Danao and are classified as dipterocarps and non-dipterocarps.

Dipterocarps

The dipterocarp forest is the principal tropical rainforest formation in the twin lakes and is characterized by several layers of vegetation and a multiplicity of tree species. These are mostly medium- to large size trees, unbranched to a considerable height, and usually attain a height of 40 to 65 meters in diameter at breast height (dbh) or a diameter above buttress (dab) of 60 to 150 centimeters. A few unusually large trees have been found to attain dbh or dab as large as 300 centimeters (de Guzman *et al.*, 1986). Of the 11 dipterocarp species recorded in the Twin Lakes area, the genus *Shorea* is well represented with seven species while the genera *Parashorea*, *Pentacme*, and *Hopea* have one species each (Annex A). From these seven species of *Shorea*, six species are under the Critically Endangered category while the lone species of *Agathis philippinensis* is Vulnerable (Table 1). They thrive on all types of topography but are usually well developed on wet valley bottoms and other well-watered and well-drained areas on the lower mountain slopes. Most of these species are found below an altitude of 700 meters ASL with very few species found above an altitude of 800 meters ASL (de Guzman *et al.*, 1986). They constitute the bulk of the country's log exports and wood for domestic building construction and infrastructure development. Hence, they are greatly in demand economically and, consequently, harvested illegally.

Table 1. List of globally threatened tree species recorded in Twin Lakes Balinsasayao and Danao Natural Park, Sibulan, Negros Oriental.

SPECIES NAME	LOCAL COMMON NAME	THREAT CATEGORY (IUCN 2000)
1. *Pentacme contorta* [1]	White Lauan	Critically endangered
2. *Shorea almon* [1]	Álmon	Critically endangered
3. *Shorea astylosa* [1]	Yakál	Critically endangered
4. *Shorea guiso* [1]	Guíjo	Critically endangered
5. *Shorea negrosensis* [1]	Red Lauan	Critically endangered
6. *Shorea polysperma* [1]	Tangíle	Critically endangered
7. *Agathis philippinensis* [1]	Almaciga	Vulnerable
8. *Aglaia rimosa* [1]	Balúbar	Lower risk/Not threatened
9. *Artocarpus blancoi* [1]	Antipólo	Vulnerable
10. *Cinnamomum mercadoi* [1]	Kalíngag	Vulnerable
11. *Elaeocarpus calomala* var. *postulatus* [1]	Hamíndang	Vulnerable
12. *Ficus ulmifolia* [1]	Is-ís	Vulnerable
13. *Macaranga bicolor* [1]	Kalomála	Vulnerable
14. *Mangifera monandra* [1]	Malapáho	Endangered
15. *Myristica philippensis* [1]	Dugúan	Vulnerable
16. *Palaquium luzoniense* [1]	Nató	Vulnerable
17. *Palaquium philippense* [1]	Malák-malák	Vulnerable
18. *Sandoricum vidalii* [1]	Malasántol	Vulnerable
19. *Tectona philippinensis* [1]	Philippine Teak	Endangered
20. *Terminalia nitens* [1]	Sakát	Vulnerable
21. *Terminalia pellucida* [1]	Dalínsi	Vulnerable
22. *Toona calantas* [1]	Kalántas	Data deficient
23. *Vitex parviflora* [1]	Moláve	Vulnerable

Reference:

[1] FPE - SUCENTROP RSA Report 1994

Non-Dipterocarps

The dipterocarps is not a pure stand of tree species but rather a mix forest consisting of non-dipterocarp species of various families. They comprise the other one hundred seventy trees or approximately 93% of the tree species recorded in the Twin Lakes area. Non-dipterocarp species are mostly broad-leafed trees which are associated with the dipterocarps as well as some exotic species introduced into the country for timber, food, fuel wood, ornamental, and other uses. In the uppermost stratum where the dipterocarps are dominant as well as portions of the lowest stratum, they exist as subsidiary species.

The 171 non-dipterocarp tree species in the Twin Lakes area are represented by 52 families and so many genera. The Euphorbiaceae is the most dominant among the families, represented by 15 species; Moraceae, 12 species; Meliaceae, 13 species; Lauraceae, 11 species; Rubiaceae, 9 species; Myristicaceae and Myrtaceae, each with 8 species. The other families are represented by 2-7 species each. However, it is mostly in these not well-represented families that many, at most a total of 23 species of plants are under threatened categories. Among them are *Mangifera monandra* of Anacardiaceae, *Tectona philippinensis* of Verbenaceae and *Agathis philippinensis* of Araucariaceae, categorized as Endangered while 13 other tree species of the rest of the families are considered Vulnerable, two are Data Deficient and one is at lower risk/not threatened (Table 1).

Vertebrate Fauna

A. Birds

The birds of Negros were extensively collected in the late nineteenth and early twentieth centuries as summarized in Dickinson *et al.* (1991). The inter-war period saw little ornithological fieldwork on the island, but studies were restarted there between 1947 and 1967 by D.S. Rabor, A.L. Rand, and S.D. Ripley. Their collections included Balinsasayao area

(Rand, 1951; Rand & Rabor, 1952). Once again in 1970, Rabor and company collected at Balinsasayao, and Alcala & Carumbana in 1975, and again in 1980 (Brooks *et al.*, 1992). Currently, a total of 278 resident and migrant birds have been recorded on Negros Island (Kennedy *et al.*, 2000; Dickinson *et al.*, 1991). However, most of the coastal and marine species have been removed from the list since they are not expected to occur in the Twin Lakes area. A few are retained in the list, particularly if they have been reported to go inland as far as the high elevation areas. Thus, the list has gone down from 278 to 209, with 113 species recorded in the Twin lakes Balinsasayao and Danao areas (see ANNEX B). Thirteen species of these are globally threatened (Table 2).

Threatened Birds

The bird of greatest concern is the Visayan Wrinkled Hornbill. It is known to be endemic in the central islands of the Philippines—Panay, Guimaras, and Negros, and believed to survive in small numbers only on the first and last islands (Collar *et al.*, 1999). Fewer than 50 pairs are estimated to remain on Negros (Y. de Soye verbally, 1997) but this may be an overestimation since fieldwork done in North Negros Forest Reserve resulted in two or three encounters of one or two individuals and none was seen during a week on Mt. Talinis (E. Curio *in litt.,* 1997). In the Twin Lakes, the average number of birds seen per month was 3.75 from January 1977 to July 1978 (Alcala & Carumbana, 1980). In 1991, only one group of four individuals—two females and two males—was recorded and seen twice at Balinsasayao over a total of 87 man-hours over four days spent in the field (Brooks *et al.*, 1992). Recently, local inhabitants residing around the Twin Lakes have reported sightings of only two individuals within this year, 2004 (pers. comm, Abancio). However, joint biomonitoring activities of the Center for Tropical Conservation Studies (CENTROP), POs (Peoples' Organization), and Department of Environment and Natural Resources (DENR) from 2002-2004

Table 2. List of globally threatened birds recorded in the Twin Lakes Balinsasayao and Danao Natural Park, Sibulan, Negros Oriental.

SPECIES NAME/COMMON NAME	HABITAT	THREAT CATEGORY (Birdlife International 2004)
HORNBILLS		
1. *Aceros waldeni* Visayan Wrinkled-billed Hornbill ** 1, 2, 3	Primary lowland forest	Critically Endangered
2. *Penelopides panini* Tarictic Hornbill * 2, 4, 5	Primary evergreen dipterocarp forest	Endangered
DOVES AND PIGEONS		
3. *Gallicolumba keayi* Negros Bleeding - heart Pigeon ** 1, 6	Mid-montane forest; Secondary forest	Critically Endangered
4. *Ducula poliocephala* Pink-bellied Imperial Pigeon 7	Primary lowland forest; Secondary forest	Near Threatened
HAWK-EAGLE		
5. *Spizaetus philippensis* Philippine Hawk Eagle 2, 3	Primary lowland forest	Vulnerable
HERON		
6. *Gorsachius goisagi* Japanese Night Heron^ 1	Shaded forest near bodies of water	Endangered
BABBLER		
7. *Stachyris (Dasycrotapha) speciosa* Flame-templed Babbler ** 1, 9, 10	Primary lowland forest; Secondary forest; forest edge; Secondary growth	Endangered
FLYCATCHERS		
8. *Rhinomyias albigularis* White-throated Jungle Flycatcher ** 8	Lowland montane forest	Endangered
SHRIKE		
9. *Coracina ostenta* White-winged Cuckoo Shrike ** 1	Lowland and montane forest	Vulnerable
KINGFISHER		
10. *Todiramphus winchelli* Rufous-lored Kingfisher * 1	Lowland forest streams	Vulnerable
FLOWERPECKER		
11. *Dicaeum haematostictum* Visayan Flowerpecker * 2	Lowland forest	Vulnerable
MONARCH		
12. *Hypothymis coelestis* Celestial Blue Monarch * 1	Forest edge or secondary forest	Vulnerable
COCKATOO		
13. *Cacatua haematuropygia* Philippine Cockatoo 11	Primary and lowland forest	Critically endangered

Legend: *Philippine endemic **Negros-Panay endemic ^ Migrant

References:
[1] Alcala & Carumbana 1980; [2] Brooks *et al*., 1992; [3] Evans *et al*. 1993; [4] C.R. Robson *in litt*., 1994; [5] F. Verbelen *in litt*., 1997; [6] Diesmos & Pedregosa 1995; [7] FPE-CENTROP RSA Report, 1994; [8] Collar *et al*., 1999; [9] Rand, 1951; [10] Erickson & Heideman 1983; [11] L. Tag-at verbally, 1995;

failed to observe this bird species in the Twin Lakes (pers. comm. Cariño). Habitat loss, along with hunting and collection for pet trade, continue to pose the greatest threat to this bird species. To compound all these difficulties, a chronic understaffing of the few protected areas in which this species occurs renders habitat protection and control of hunting difficult to enforce (E. Curio *in litt.*, 1997).

The Negros Bleeding-heart *Gallicolumba keayi* occurs only on Panay (where recently discovered) and Negros. On Negros, the species was considered "fairly common" by Eagle Clark (1900) although Hachisuka (1931-1935, 1936) called it "an extremely rare species". Half a century ago, it may still have been at least modestly represented on the island but recent sightings and reports confirm that it is now extremely rare and its numbers are very small (Collar *et al.*, 1999). In the Twin Lakes, biomonitoring activities by local inhabitants as well as members of the joint CENTROP-POs-DENR biomonitoring team failed to observe this bird from 2002-2004. Habitat degradation continues to pose a serious threat to the remaining fragments (Brooks *et al.*, 1992). Local trapping and hunting is a chronic problem that exacerbates the effects of deforestation (Collar *et al.*, 1999).

The Philippine Cockatoo *Cacatua haematuropygia* was common 50 years ago throughout the Philippines (Delacour & Mayr, 1946). However, Dickenson *et al.* (1991) considered it as rare and only confined to very few islands in the Philippines. It was reported on Negros by McGregor (1911) and particularly sighted in the Twin Lakes by L. Tag-at (verbally, 1995). Nevertheless, there are no recent records or local reports from Negros either from the 36-day fieldwork in 1991 (Collar *et al.*, 1999) or from the more recent joint biomonitoring activities of CENTROP-POs-DENR in the Twin Lakes. Habitat destruction and intensive trapping for the cagebird trade are the main threats (Boussekey, 1993; Lambert, 1994).

The Visayan Tarictic *Penelopides panini* is found only in the Philippines but it has now become rare or extinct on all the islands within its range (Collar *et al.,* 1999). On Negros, only two individuals were encountered at Mt. Talinis, Siaton, Lake Yagomyum, and Hinoba-an, with three in the Twin Lakes area (M. Ebreo & R. Paalan verbally, 1995) from 1992 to 1995. Currently, the hornbill is rarely seen in the Twin Lakes but according to Collar *et al.* (1999), it is less scarce than the Visayan Wrinkled hornbill. Forest destruction has been a major threat to this bird as well as hunting and trapping (Curio *et al.*, 1996).

The Japanese Night-heron *Gorsachius goisagi* is an uncommon winter visitor in the Philippines (Dickinson *et al.*, 1991) with the chief wintering area appearing to be the islands in the archipelago with Negros as one of them (Collar *et al.*, 1999). It was specifically recorded on the Twin Lakes during the period from January 1977 to July 1978 by Alcala and Carumbana (1980). However, its true status has not been and cannot be assessed with any confidence due to its cryptic and crepuscular habits in dense forest (Collar *et al.*, 1999). This bird species is presumably declining in numbers owing to destruction of its habitat and breeding grounds that are being converted to plantations (Collar & Andrew, 1988).

The White-throated Jungle-flycatcher *Rhinomyias albigularis* is known only on the islands of Negros, Guimaras, and Panay (Collar *et al.*, 1999). This bird was considered "extremely rare" (Bourns & Worcester, 1894; Worcester, 1898) and scarce by Whitehead (1899). On Negros, the outlook is very doubtful although in the six major forested areas surveyed in 1991, six individuals of this species were found only in Banban, Ayungon (Evans *et al.*, 1993). Also, during the floral and faunal survey in Banban, Ayungon, only one individual was recorded (Tiempo *et al.*, 1999). It was recorded in the Twin Lakes in May 1949 and December 1953 with two specimens in the Field Museum of Natural History (FMNH) (Collar *et al.*, 1999). Currently, there are no recent records of the species from the Twin Lakes inspite of the joint biomonitoring activities by CENTROP-POs-DENR from 2002-2004. The primary threat for this bird species is the continued habitat destruction for agriculture, charcoal production, and lumber extractions (Brooks *et al.*, 1992; Evans *et al.*, 1993).

The Flame-templed Babbler *Stachyris* (*Dasycrotapha*) *speciosa* is found only on Panay and Negros (Collar *et al.*, 1999). On Negros, Erickson and Heideman (1983) trapped them in the Twin Lakes but the bird went unrecorded in 1991 (Collar *et al.*, 1999). Continuing forest destruction is the major cause that "will lead to the extinction of *D. speciosa* in the near future" (Brooks *et al.*, 1992; Evans *et al.*, 1993).

The Celestial Monarch *Hypothymis coelestis* is found on most of the big islands in the Philippines. On Negros, it is found in the southern part including the Twin Lakes area (Alcala & Carumbana, 1980). However, the bird was not observed during a recent survey on Negros (Brooks *et al.*, 1992; Evans *et al.*, 1993) and it may be that it is now extinct on the island. Extensive and continuing habitat destruction within its range is a major threat to its survival (Collar *et al.*, 1999).

The Visayan Flowerpecker *Dicaeum* (*australe*) *haematostictum* is found only in the Philippines and occurs on three islands—Panay, Guimaras, and Negros (Collar *et al.*, 1999). On Negros, it was reported to be common in both the northern and southern parts of the island including the Twin Lakes area (Brooks *et al.*, 1992). Currently, the joint biomonitoring activities by CENTROP-POs-DENR from 2002-2004 in the Twin Lakes recorded only a few birds (pers. comm., Cariño). This species has been strongly affected by the removal of forest and scrub within its altitudinal range (Collar *et al.*, 1994).

The White-winged Cuckoo Shrike *Coracina ostenta* is known from the islands of Panay, Guimaras, and Negros with an unconfirmed occurrence in Bohol. On Negros it was found to be fairly common at all non-montane sites including the Twin Lakes area (Alcala & Carumbana, 1980; Brooks *et al.*, 1992; and Evans *et al.,* 1993). The joint bio-monitoring activities of CENTROP-POs-DENR from 2002-2004 in the Twin Lakes have recorded a number of individuals of this bird species. The major threat to the remaining population of this bird, which will lead to its extinction, is continuing forest destruction within its altitudinal range (Brooks *et al.*, 1992).

The Rufous-lored Kingfisher (*Todirhamphus winchelli)* is only found and widely distributed in the southern half of the Philippines, often on small islands. On Negros, it has been recorded mostly in the southern portion of the island that includes the Twin Lakes area (Alcala & Carumbana, 1980). At present, there are no recent records of the species from the Twin Lakes despite the joint biomonitoring activities of CENTROP-POs-DENR (pers. comm., Cariño). It is quite possible that the species is extinct on Negros (Brooks *et al.,* 1999). The continuing clearance of lowland forest poses a very significant threat and the problem is possibly greatly compounded by this species' need for freshwater habitats within this broader habitat type (T. H. Fisher verbally, 1997).

The Philippine Hawk Eagle *Spizaetus philippensis* is found in the Philippines where records exist for at least 12 islands (Collar *et al.*, 1999). On Negros, four individuals were recorded—one at the Twin Lakes area (Brooks *et al.,* 1992). The paucity of records compared to other raptors on Negros suggests that its status should be reviewed (Brooks *et al.,* 1999). This forest-dependent species is threatened by habitat destruction throughout its extensive but predominantly lowland range (Brooks *et al.*, 1992; Dutson *et al.*, 1992; Evans *et al.*, 1993; Collar *et al.*, 1994; Danielsen *et al.*, 1994; Poulsen, 1995). Habitat loss is exacerbated by considerable hunting and trapping pressure (Danielsen *et al.*, 1994).

Near-Threatened

The Pink-bellied Imperial Pigeon *Ducula poliocephala* is found on most of the major islands in the Philippines (Kennedy *et al.*, 2000). On Negros, it is recorded in the Twin Lakes area where it is still common. However, informal discussions with local inhabitants of the area showed that it has now gradually become rarer than it was 5 years ago. Habitat loss and trapping for pet trade are the primary threats for the continued survival of this bird species (pers. obs).

B. Mammals

Currently, a total of 54 mammals are recorded for Negros Island (ANNEX C), of which 23 are found in the Twin Lakes area. From this number, 11 species are under different levels of threatened categories (Table 3).

The Visayan Spotted Deer *Cervus alfredi* is found only in the Philippines and is recorded on Cebu, Guimaras, Masbate, Negros, and Panay islands (Oliver, 1994; Oliver *et al.*, 1992). It is geographically restricted and rare. Heavily hunted and severely endangered (Cox, 1987; Evans *et al.*, 1993; Oliver, 1994; Oliver *et al.*, 1992), it is now extinct on Cebu, Guimaras, and probably Masbate.

The Visayan Warty Pig *Sus cebifrons negrinus,* found originally in primary and secondary forests, is scarcely observed and rarely sighted. Heavily hunted, increasingly rare, and currently hybridizing with domestic pigs (Oliver 1992), it is believed now to be extinct on Cebu and Guimaras.

The Golden-crowned Flying Fox *Acerodon jubatus* is found only in the Philippines and is considered widespread in its distribution. From the late 1800s and early 1900s, it had been reported to number about 100,000 individuals in a colony but this figure contrasts with recent observations of maximum colony size of 5,000 and usually far fewer (Heaney & Heideman, 1987; Heaney & Utzurrum, 1991; Lawrence, 1939; Mickleburg *et al.*, 1992; Mudar & Allen, 1986; Rickart *et al.*, 1993; Taylor, 1984; Utzurrum, 1992).

The Philippine Naked-backed Fruit bat *Dobsonia chapmani* is one of the most threatened bats in the world. It is found only in the Philippines and endemic to Negros and Cebu islands. Heaney & Heideman (1987), Rabor (1986), and Utzurrum

Table 3. List of globally threatened mammals recorded in the Twin Lakes Balinsasayao and Danao Natural Park, Sibulan, Negros Oriental.

SPECIES NAME/COMMON NAME	HABITAT	THREAT CATEGORY
DEER		
1. *Cervus alfredi* Philippine Spotted Deer**[1]	Primary forest; Secondary growth	Endangered (US ESA: Endangered)
PIG		
2. *Sus cebifrons negrinus* Visayan Warty Pig**[1]	Primary and secondary forests; original or secondary growth, grassland	Critically endangered (IUCN 2000)
BATS		
3. *Acerodon jubatus* Golden-crowned Flying Fox*[1]	Primary and secondary lowland forests; Mangrove forest; Small islands	Endangered (IUCN 2000)
4. *Dobsonia chapmani* Negros Naked-backed Fruit Bat****[1]	Lowland forest (caves)	
5. *Eonycteris robusta* Philippine Nectar Bat*[1]	Primary forest; Mixed forest & clearings	Critically endangered #
6. *Nyctimene rabori* Tube-nosed Fruit Bat*[1]	Primary lowland and secondary forests	Data Deficient (locally rare)
7. *Haplonycteris fischeri* Fischer's Pygmy Fruit Bat*[1]	Primary lowland and montane forests	Critically endangered (IUCN 2000)
8. *Harpyionycteris whiteheadi** Harpy Fruit Bat*[1]	Primary and secondary forests	Vulnerable (IUCN 2000)
9. *Pteropus pumilus* Golden-mantled Flying Fox*[1]	Primary or lightly disturbed forest; lowland forest; montane forest	Vulnerable (IUCN 2000) Vulnerable (IUCN 2000) CITES: Appendix II
SHREW		
10. *Crocidura negrina* Negros Shrew***[1]	Primary and well-developed secondary lowland forest	Critically Endangered (IUCN 2000)
LEOPARD CAT		
11. *Prionailurus bengalensis rabori* Philippine Leopard Cat**[1]	Agricultural habitats and forest	Endangered (IUCN 2000)

Legend: *Philippine endemic **Negros-Panay endemic ***Negros endemic ****Negros and Cebu endemic

US ESA - Unites States Endangered Species Act

WCSP - Wildlife Conservation Society of the Philippines

CITES - Convention on the International Trade for Endangered Species

IUCN - International Union for Conservation of Nature

Mammal Specialist Group of WCSP

Reference:

[1] FPE=SUCENTROP RSA Report 1994

(1992) considered it to be formerly common in lowland forests in southern Negros Island, and roosting exclusively in caves (Heaney & Heideman, 1987; Rabor, 1986; Utzurrum, 1992). In the past years, however, it was believed to have become extinct when field surveys in these islands revealed negative find. However, this bat was rediscovered in forest patches of Carmen in Cebu by an expedition team from Cebu Biodiversity Conservation Foundation (CBCF) in early part of 2001 and in Manlucahoc of Sipalay City in Negros Occidental by a research team from Silliman University-Angelo King Center for Research and Environmental Management (SUAKCREM) in 2003 (see Paguntalan *et al.*, and Alcala *et al.*, this volume). Nevertheless, in the Twin Lakes area where it was reported to occur, continuous joint biomonitoring activities of CENTROP-POs-DENR have failed to observe this bat species (pers. comm., Cariño). Its population is severely declining as a result of forest destruction, disturbance by guano miners, and heavy hunting (Heaney *et al.*, 1998).

The Philippine Tube-nosed Fruit Bat *Nyctimene rabori* is recorded only on Cebu, Negros, and Sibuyan and is considered to be rare or uncommon at all sites (Heaney & Peterson *et al.*, 1984; Heaney *et al.*, 1989; Heideman & Heaney, 1989; Mickleburg *et al.*, 1992; Utzurrum, 1992). Populations have declined severely since 1950 as a result of habitat destruction and this species faces extinction on Negros Island, and possibly elsewhere, within 10 years if current trends continue (Mickleburg *et al.*, 1992; Utzurrum, 1992).

The Philippine Dawn Bat *Eonycteris robusta* is found throughout the Philippines but absent from Palawan Faunal Region and Batanes/Babuyan group of islands (Heaney *et al.*, 1998). Rarely captured in the 1980s and 1990s, it may now be quite rare (Heaney *et al.*, 1991; Mickleburg *et al.*, 1992; Utzurrum, 1992). Recent surveys have not observed or captured them around Negros Island and in the Twin Lakes area where they had been previously reported.

The Philippine Pygmy Fruit Bat *Haplonycteris fischeri* and the Harpy Fruit Bat *Harpyionycteris whiteheadi* are found only in the Philippines where they are widespread. They have stable populations in the wild but as a result of habitat destruction by logging, recent studies have shown that their numbers are declining (Heaney *et al.*, 1998).

The Little Golden Mantled Flying Fox *Pteropus pumilus* is found only in the Philippines but not in the Batanes/Babuyan and Palawan faunal regions (Heaney *et al.*, 1998). The species is most common on small islands and uncommon to rare on larger islands (Heaney, 1984; Heaney *et al.*, 1989; Heideman & Heaney, 1989; Lepiten, 1995, Rickart *et al.*, 1993; Utzurrum, 1992). The population is declining as a result of habitat destruction, but still fairly widespread and stable (Heaney *et al.*, 1998).

The Negros Shrew *Crocidura negrina* is recorded in the Philippines only and endemic to Negros Island. Specimens were obtained from primary lowland and montane forest in southern Negros (Rabor, 1986; Heaney & Utzurrum, 1991; Heaney & Ruedi, 1994), including the Twin Lakes area. It is rare because of restricted range and habitat destruction (Heaney & Utzurrum, 1991).

The Philippine Leopard Cat *Prionailurus bengalensis rabori* is uncommon but widespread in the Philippines. The subspecies *rabori* is recognized as distinct subspecies from the Negros-Panay Faunal Region (Groves cited by Heaney *et al.*, 1998). The population is declining due to heavy hunting (Heaney *et al.*, 1998).

C. Amphibians and Reptiles

A total of 86 species of amphibians and reptiles are recorded on Negros Island, with 49 listed in the Twin Lakes area (ANNEX D). Eight species are in threatened category, consisting of 5 frogs, 2 lizards, and a snake (Table 4).

Table 4. List of globally threatened amphibians and reptiles recorded in the Twin Lakes Balinsasayao and Danao Natural Park, Sibulan, Negros Oriental.

SPECIES NAME/COMMON NAME	HABITAT	THREAT CATEGORY
FROGS		
1. *Platymantis negrosensis* Negros Forest Frog** [1]	Lowland & lower montane forests	Endangered++
2. *Platymantis hazelae* Hazel's Forest Frog* [1]	Mossy and montane rainforests	Endangered++
3. *Limnonectes visayanus* Visayan Fanged Frog** [1]	Lower montane and lowland forests	Vulnerable++
4. *Rana everetti* Everett's Frog* [1]	Lower montane and lowland forests	Near Threatened++
5. *Platymantis dorsalis* Common Forest Frog* [1]	Lower montane and lowland forests	Near Threatened to Threatened++
LIZARDS		
6. *Hydrosaurus pustulatus* Sailfin Water Lizard [1]	Lowland forests; secondary forests; secondary growth	Vulnerable+
7. *Varanus salvator nuchalis* Rough-necked Water Monitor [1]	Wide variety of habitats including mangrove areas and rain forests	Near Threatened+
SNAKE		
8. *Python reticulatus* Reticulated Python [1]	Humid tropical rain forests	Near threatened+

Legend:
** Negros-Panay endemic
* Philippine endemic

++ IUCN/SSC CI/CABS Global Amphibian Biodiversity Assessment 2004
+IUCN - International Union for the Conservation of Nature 2000
CI - Conservation International
CABS – Center for Applied Biodiversity Science
SSC - Species Survival Commission

Reference:
[1] FPE-SUCENTROP RSA Report 1994

The most threatened frogs in the Twin Lakes area are the Negros Forest Frog *P. Negrosensis* and Hazel's Forest Frog *Platymantis hazelae.* They dwell on arboreal ferns, in leaf axils of screw pines and Araceae in lower montane and lowland forests of Negros. The common forest frog *P. dorsalis* is allied to undisturbed and disturbed lower montane and lowland forests. The aquatic Visayan fanged frog *Limnonectes visayanus* (formerly known as *Rana magna visayanus*) and Everett's frog *Rana everetti* are inhabitants of undisturbed and disturbed cool and clear unpolluted streams and rivers in lower montane and lowland forests.

The Reticulated Python Snake *Python reticulatus* and the Rough-necked Water Monitor *Varanus salvator nuchalis* are associated with humid tropical rainforests and observed on trees and on ground near streams, while the Sailfin Water Lizard *Hydrosaurus pustulatus* is at home equally in water or on trees and usually associated with unpolluted mountain streams in lowland forests (Alcala 1986).

Habitat for amphibians and reptiles is destroyed through various methods of harvesting timber which adversely interfere with many aspects of the biology of forest-restricted (and moisture-dependent) species of frogs, such as the Negros and the Hazel's forest frogs. Pesticides, high concentration of heavy metals washed into aquatic breeding sites, thermal pollution of streams and rivers from geothermal activity, and poisoning resulting from mining and logging operations may cause the decline (Pough *et al.*, 2001) of a few frogs such as the Philippine Woodland Frog *L. visayanus* and Everett's Frog *R. everetti*. The agamid Sailfin Water Lizard *H. pustulatus*, the varanid Rough-necked Water Monitor *V. salvator nuchalis,* and the colubrid Reticulated Python *P. reticulatus* are adversely affected primarily by increasing habitat loss and, and by collection for zoo, pet, and skin trades. Threatened by over collection for the pet trade, smaller specimens of Sailfin water Lizard are sold in large numbers at pet shops in Manila from P100 to P500 each. Rare in foreign zoos, it is sold in substantial numbers outside the country and prized by foreign collectors (Philippine Red Data Book, 1997).

Threats to the Wildlife of the Twin Lakes Balinsasayao and Danao Natural Park

The single most serious threat to wildlife is habitat modification and destruction. Tropical forests are some of the most species-rich habitats in the world and most vulnerable to human destruction (Pough *et al.*, 2001). The reason for so many species being threatened over the years has been summarized in Rabor (1958; 1961; 1966; 1979). For so many plants, birds, mammals, amphibians, and reptiles in the Twin Lakes area, habitat destruction and loss are by far the main hazard. Most of the threatened species are endemics associated with the rain forests (Dickinson *et al.*, 1991).

Rain forest destruction in the Twin Lakes area over the years is brought about by slash and burn forest farming, commercial and illegal logging, fuel wood gathering, charcoal production, and livestock raising, the first two posing the major threats to the forest. Fuel wood gathering, charcoal production, and livestock raising are gradually posing much damage on the local level. Therefore, remnants of the original forest are left in various sizes, shapes, and distances from other forest portions. Wildlife may or may not be able to disperse among isolated patches of habitat. Populations restricted to isolated habitat fragments are vulnerable to local extinction through chance environmental and demographic catastrophes and loss of genetic heterozygosity (Dickinson *et al.*, 1991). The tiny sizes of the populations are reason enough for concern because small populations are increasingly vulnerable to complete destruction by periodic storms, droughts, floods, disease, or other factors such as the occasional failure of a wild fruit crop in a small area of rain forest (Heaney & Regalado, 1998). A species common in its preferred habitat may in fact be threatened because its habitat is disappearing, or because its habitat is restricted, leaving the species vulnerable to random changes in the environment (Pough *et al.*, 2001). This holds true to all the threatened plant and animal species listed (and those not listed) within the Twin Lakes area.

Removal of trees due to small-scale logging and commercial harvesting opens the canopy, bringing aggressive and weedy species from outside the forest to occupy the open space (Heaney & Regalado, 1998) and threaten other groups of native non-dipterocarp species. Forest fragmentation deprives other plants of their optimum environment. The forest canopy buffers the microclimate of the forest floor, keeping the forest floor relatively cool, moist, and shaded during the day while reducing air movement and trapping heat during the night. When the forest is cleared, those effects are removed. As the forest floor is exposed to direct sunlight, the ground becomes much hotter during the day, and without the canopy to reduce heat and moisture loss, the forest floor is also much colder at night and generally less humid. Since species of plants are often precisely adapted to the temperature, humidity, and light levels, changes in these factors will eliminate many species from forest fragments (Primack, 1998).

The flowering epiphyte *Medinilla magnifica* (which is unique to the Philippines) is becoming exceedingly rare in its native habitat because of forest destruction which opens the canopy. Likewise, the epiphytic lipstick plant *Aeschynanthus* and other herbaceous plants in the understorey are especially susceptible to the removal of trees that shelter them from the bright sun. They are sometimes encountered in damp primary forests at low elevations but become more numerous in high mossy forests. Also, the removal of trees results in the loss of lianas in tropical rain forests which depend reciprocally on the trees for support. The number of species has drastically decreased because when trees are removed, aggressive and weedy species from outside the forest often move in and occupy the open space. Consequently, lianas have become one of the most threatened groups of plants in the Philippines (Heaney and Regalado, 1998).

The almaciga *Agathis philippinensis is* now listed as threatened species because of excessive tapping and destructive extracting methods (such as application of sulfuric acid to stimulate resin production) that have killed many trees (de Guzman *et al.*, 1986). The rattan *Calamus merrillii* is officially listed as threatened due to excessive harvesting. Since rattan is not cultivated, but only extracted from the wild, its collection as supplementary source of income for people living near the forest certainly puts pressure on the remaining populations. *Medinilla magnifica* is often sought out by garden enthusiasts and as a result more and more of this plant are gathered from the wild (Heaney and Regalado, 1998).

Another major threat is intensive and uncontrolled hunting which intensifies the effects of habitat loss and degradation. Hunting on Negros is for subsistence, trade, and sport (Diesmos & Pedregosa, 1995). The unsupervised and hence, uncontrolled, collections of threatened vertebrate species worsen the direct effects of habitat loss and degradation and unrestrained heavy hunting on the survival of these highly threatened species.

Summary

The tropical rainforest of the Twin Lakes Balinsasayao and Danao has been logged in the past and this practice has been continuing, though to a smaller extent today, in spite of the area being declared as a natural park. The illegal cutting of timber is believed to be reducing the inflow of water to the lakes and causing a fall in water levels especially during the dry season. The Twin Lakes are recognized as a major watershed supplying water to the lowland rural and urban communities. Hunting and collecting of faunal resources as well as gathering and collecting of floral resources are still going on clandestinely.

Currently, no known protection schemes have been given to threatened species, except for legislations and proclamations protecting wildlife in general and declaration of certain areas as national parks to protect habitats (Philippine Red Data Book, 1997). Over the next few years, the problem concerning priorities of human needs over forest preservation will become even more acute (Pough *et al.*, 2001). The preservation and protection of the existing forest biodiversity in the Twin Lakes must include social, political, and economic agenda. Willingness to preserve and protect would no longer be enough.

Recommendations

Conservation programs must be multifaceted and must involve: 1) field research in order to understand the animals especially those that are threatened; 2) education to provide information and increase the awareness of the public; 3) control of pet and zoo trades; and 4) legislations to protect threatened species and their habitat; and 5) habitat protection.

Field Research. One constraint on effective conservation is a lack of information on the basic biology of threatened species. We simply do not know enough about the basic requirements of most of the threatened species to be sure that we are protecting the right habitat, the right resources, or the right life history stages. Ideally, basic research should include examination of population size and structure, age-specific survivorship and sources of mortality, habitat preference, spatial requirements and activity patterns (including migrations to feeding and breeding sites), reproductive patterns and frequency of breeding activity, life history traits, social behavior, feeding ecology, and genetic variability (Pough *et al.*, 2001). We must be careful not to employ conservation solutions that are merely halfway technology—that is, interventions that are done after the problem has already occurred and which do not address the underlying causes of the problem (Frazer, 1992).

Information, Education and Communication. Education is urgently needed at all levels if we hope to maintain viable populations of threatened species. Conservation advocacy must be strengthened among local people who share the environment with threatened species, policymakers, managers, the media, and the general public. Training in basic areas of habitat protection, wildlife management, and conservation biology is needed. Educators and curriculum developers should be encouraged to produce materials for use in the schools to introduce children, who will be making policy decisions in the future, to conservation issues early in life. Naturally curious and enthusiastic, children are usually receptive to new ideas. A long-term benefit is a change in attitude in people toward nature (Pough *et al.*, 2001).

Regulation of Pet and Zoo Trades. Protected areas impose a total ban on wildlife hunting and collection for any purpose. If there is any collection for pet and zoo trade done outside of protected area, the legal framework of the region or province must prevail and must be used as a basis for the regulation and control of the same.

Habitat Protection. The most important action that can be taken for threatened plants and animals is to protect their habitat. If a reserve is to be established, decisions should include the location, size, and shape of the area to be protected. The degree of habitat fragmentation should be minimized in order to slow extinction rates (Pough *et al.*, 2001) specifically for highly-threatened forest-dependent species. Establishment of corridors to join patches of forest has been found to be effective in expanding the food range of threatened species.

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ANNEX A. Lists of forest tree species recorded in the Twin Lakes Balinsasayao and Danao Natural Park, Sibulan, Negros Oriental, Philippines.

Family/Species	Official Common Name
DIPTEROCARPS	
Family Dipterocarpaceae	
1. *Hopea acuminata* (1, 2, 3)	Manggachápui
2. *Pentacme contorta* (1, 2, 3)	White Lauan
3. *Shorea almon* (1, 2, 3)	Álmon
4. *Shorea astylosa* (1, 2, 3)	Yakál
5. *Shorea guiso* (1, 2, 3)	Guíjo
6. *Shorea negrosensis* (1, 2, 3)	Red Lauán
7. *Shorea polysperma* (1, 2, 3)	Tangíle
8. *Parashorea plicata* (1, 2, 3)	Bágtikan
NON-DIPTEROCARPS	
Family Actinidiaceae	
9. *Saurauia elegans* (1, 2, 3)	Uyók
Family Aceraceae	
10. *Acer laurinum* (1, 2, 3)	Baliág/Philippine Maple
Family Alangiaceae	
11. *Alangium meyeri* (1, 2, 3)	Putián
Family Amygdalaceae	
12. *Parinari corymbosa* (1, 2, 3)	Liúsin
13. *Pygeum vulgare* (1, 2, 3)	Lágo
Family Anacardiaceae	
14. *Buchanania arborescens* (1, 2, 3)	Balinghásai
15. *Buchanania nitida* (1, 2, 3)	Balitántan
16. *Buchanania* sp. (1, 2, 3)	
17. *Koordersiodendron pinnatum* (1, 2, 3)	Amúgis
18. *Mangifera monandra* (1, 2, 3)	Malapáho
19. *Pistacia chinensis* (1, 2, 3)	Sangílo
20. *Semecarpus* sp. (1, 2, 3)	
Family Annonaceae	
21. *Alphonsea arborea* (1, 2, 3)	Bolón
22. *Miliusa vidalii* (1, 2, 3)	Takúlau
23. *Papualthia lanceolata* (1, 2, 3)	Anólang
24. *Polyalthia flava* (1, 2, 3)	Lanútan-diláu

Family/Species	Official Common Name
Family Apocynaceae	
25. *Alstonia macrophylla* **(1, 2, 3)**	Batíno
26. *Alstonia scholaris* **(1, 2, 3)**	Ditá
Family Araliaceae	
27. *Polyscias nodosa* **(1, 2, 3)**	Malapapáya
Family Araucariaceae	
28. *Agathis dammara* **(1, 2, 3)**	
29. *Agathis philippinensis* **(1, 2, 3)**	Almaciga
Family Bignoniaceae	
30. *Radermachera pinnata* **(1, 2, 3)**	Banái-banái
Family Burseraceae	
31.*Canarium asperum* **(1, 2, 3)**	Pagsahíngin
32.*Canarium calophyllum* **(1, 2, 3)**	Pagsahíngin-bulóg
33.*Canarium odontophyllum* **(1, 2, 3)**	Salíng-salíng
Family Caesalpinaceae	
34. *Afzelia rhomboidea* **(1, 2, 3)**	Tindálo
Family Celastraceae	
35. *Euonymus javanicus* **(1, 2, 3)**	Malasángki
Family Combretaceae	
36. *Terminalia citrina* **(1, 2, 3)**	Binggás
37. *Terminalia foetidissima* **(1, 2, 3)**	Talísai-gúbat
38. *Terminalia nitens* **(1, 2, 3)**	Sakát
39. *Terminalia pellucida* **(1, 2, 3)**	Dalínsi
Family Cornaceae	
40. *Alangium* sp. 1 **(1)**	
Family Ebenaceae	
41. *Diospyrus philosanthera* **(1, 2, 3)**	Bolóng-éta
42. *Diospyrus pyrrhocarpa* **(1, 2, 3)**	Anáng
Family Elaeocarpaceae	
43. *Elaeocarpus monacera* **(1, 2, 3)**	Tabián
44. *Elaecarpus calomala* var. *postulatus* **(1, 2, 3)**	Kalomála
Family Ericaceae	Dusóng
44. *Vaccinium barandanum* **(1, 2, 3)**	

Family/Species	Official Common N...
Family Euphorbiaceae	
45. *Baccaurea tetrandra* (1, 2, 3)	Dílak
46. *Baccaurea philippinensis* (1, 2, 3)	Balóiboi
47. *Blumeodendron philippinense* (1, 2, 3)	Salngán
48. *Breynia acuminata* (1, 2, 3)	Karmái-búgkau
49. *Breynia rhamnoides* (1, 2, 3)	Tulog-tulog
50. *Bridelia minutiflora* (1, 2, 3)	Subiáng
51. *Drypetes maquilingensis* (1, 2, 3)	Tináang-pantái
52. *Glochidion album* (1, 2, 3)	Malabág-ang
53. *Macaranga bicolor* (1, 2, 3)	Hamíndang
54. *Mallotus philippensis* (1, 2, 3)	Banáto
55. *Mallotus ricinoides* (1, 2, 3)	Hinlaúmo
56. *Neotrewia cumingii* (1, 2, 3)	Apanáng
57. *Homalanthus populneus* (1, 2, 3)	Balánti
58. *Sapium luzonicum* (1, 2, 3)	Balákat-gúbat
59. *Trignostemon philippinense* (1, 2, 3)	Kátap
Family Fagaceae	
60. *Lithocarpus boholensis* (1, 2, 3)	Bohol oyágan
61. *Lithocarpus cyrtorhyncha* (1, 2, 3)	Layán
Family Guttiferae	
62. *Calophyllum blancoi* (1, 2, 3)	Bitánghol
63. *Calophyllum inophyllum* (1, 2, 3)	Bitáog/Pálo-maria
64. *Cratoxylum formosum* (1, 2, 3)	Salinggógon
65. *Garcinia venulosa* (1, 2, 3)	Gatósan
Family Icacinaceae	
66. *Gonocaryum calleryanum* (1, 2, 3)	Taingáng-bábui
67. *Stemonurus luzoniensis* (1, 2, 3)	Howard - Mabunót
Family Lauraceae	
68. *Beilschmiedia glomerata* (1, 2, 3)	Tirúkan
69. *Cinnamomum mercadoi* (1, 2, 3)	Kalíngag
70. *Cryptocarya ampla* (1, 2, 3)	Bagariláu
71. *Cryptocarya glauca* (1, 2, 3)	Baliktáran
72. *Dehaasia triandra* (1, 2, 3)	Margapáli
73. *Litsea glutinosa* (1, 2, 3)	Sablót
74. *Litsea perrottetii* (1, 2, 3)	Maráng
75. *Litsea philippinensis* (1, 2, 3)	Bakán

Family/Species	Official Common Name
76. *Litsea* sp. **(1)**	Púso-púso
77. *Neolitsea vidalii* **(1, 2, 3)**	Kabúro
78. *Phoebe sterculioides* **(1, 2, 3)**	
Family Lecythidaceae	
79. *Planchonia spectabilis* **(1, 2, 3)**	Lamóg
Family Loganiaceae	
80. *Fagraea obovata* **(1, 2, 3)**	Dólis
Family Magnoliaceae	
81. *Talauma villariana* **(1, 2, 3)**	Patángis
Family Melastomataceae	
82. *Astronia cumingiana* **(1, 2, 3)**	Badlíng
83. *Astronia negrosensis* **(1, 2, 3)**	Negros dungáu
84. *Astronia rolfei* **(1, 2, 3)**	Dungáu-pulá
85. *Astronia williamsii* **(1, 2, 3)**	Dungáu
86. *Melastoma* sp. **(1, 2, 3)**	Tungáu
Family Meliaceae	
87. *Aglaia diffusa* **(1, 2, 3)**	Malaságing
88. *Aglaia iloilo* **(1, 2, 3)**	Ílo-ílo
89. *Aglaia langlassei* **(1, 2, 3)**	Malaságing-pulá
90. *Aglaia llanosiana* **(1, 2, 3)**	Bayánti
91. *Aglaia rimosa* **(1, 2, 3)**	Balúbar
92. *Aphanamixis perrottetiana* **(1, 2, 3)**	Kangkó
93. *Cedrela odorata* **(1, 2, 3)**	Spanish cedar
94. *Chisocheton pentandrus* **(1, 2, 3)**	Katóng-matsín
95. *Dysoxylum arborescens* **(1, 2, 3)**	Kalimútain
96. *Dysoxylum decandrum* **(1, 2, 3)**	Ígyo
97. *Epicharis cumingiana* **(1, 2, 3)**	Tará-tará
98. *Sandoricum vidalii* **(1, 2, 3)**	Malasántol
99. *Toona calantas* **(1, 2, 3)**	Kalántas
Family Memcylaceae	
100. *Memecylon caeruleum* **(1, 2, 3)**	Javanese kulís
101. *Memecylon lanceolatum* **(1, 2, 3)**	Digég
Family Mimosaceae	
102. *Parkia roxburghii* **(1, 2, 3)**	Kupáng

Family/Species	Official Common N
Family Moraceae	
103. *Ficus balete* **(1, 2, 3)**	Baléte
104. *Ficus callosa* **(1, 2, 3)**	Kalúkoi
105. *Ficus gul* **(1, 2, 3)**	Butlí
106. *Ficus irisana* **(1, 2, 3)**	Aplás
107. *Ficus minahassae* **(1, 2, 3)**	Hagímit
108. *Ficus nota* **(1, 2, 3)**	Tibíg
109. *Ficus pubinervis* **(1, 2, 3)**	Dungó
110. *Ficus* sp. **(1, 2, 3)**	
111. *Ficus hauli* **(1, 2, 3)**	Lábnog
112. *Ficus ulmifolia* **(1, 2, 3)**	Is-ís
113. *Parartocarpus venenosus* **(1, 2, 3)**	Malanángka
114. *Artocarpus blancoi* **(1, 2, 3)**	Antipólo
Family Myristicaceae	
115. *Knema glomerata* **(1, 2, 3)**	Tambálau
116. *Myristica elliptica* var. *simiarum* **(1, 2, 3)**	Tanghás
117. *Myristica philippensis* **(1, 2, 3)**	Dugúan
118. *Myristica* sp. **(1, 2, 3)**	
Family Myrsinaceae	
119. *Ardisia loheri* **(1, 2, 3)**	Kandúlit
120. *Ardisia squamulosa* **(1, 2, 3)**	Tágpo
121. *Ardisia* sp. **(1, 2, 3)**	Lolúmboi
122. *Ardisia sibuyanensis* **(1, 2, 3)**	
Family Myrtaceae	
123. *Decaspermum* sp. **(1, 2, 3)**	
124. *Eugenia* sp. **(1)**	
125. *Rhodomyrtus* sp. **(1)**	
126. *Syzygium costulatum* **(1, 2, 3)**	Paítan
127. *Syzygium hutchinsonii* **(1, 2, 3)**	Malatámbis
128. *Syzygium nitidum* **(1, 2, 3)**	Makaásim
129. *Syzygium simile* **(1, 2, 3)**	Panglóngboien
130. *Syzygium zanthophyllum* **(1, 2, 3)**	Malatámpui
Family Naucleaceae	
131. *Nauclea coadunata* **(1, 2, 3)**	Bangkál

Family/Species	Official Common Name
Family Nyctaginaceae	
132. *Pisonia umbellifera* **(1, 2, 3)**	Anúling
Family Olacaceae	
133. *Strombosia philippinensis* **(1, 2, 3)**	Tamáyuan
Family Palmae	
134. *Arenga pinnata* **(1, 2, 3)**	Káong/sugar palm
135. *Caryota cumingii* **(1, 2, 3)**	Pugáhan/Fish-tailed Palm
Family Rhamnaceae	
136. *Ziziphus talanai* **(1, 2, 3)**	Balákat
Family Rubiaceae	
137. *Adina multifolia* **(1, 2, 3)**	Adina/Dunpílan
138. *Canthium ellipticum* **(1, 2, 3)**	Potót
139. *Ixora longistipula* **(1, 2, 3)**	Mayánman
140. *Neonauclea bartlingii* **(1, 2, 3)**	Lisák
141. *Neonauclea bernardoi* **(1, 2, 3)**	Ludék
142. *Neonauclea calycina* **(1, 2, 3)**	Kalamansánai
143. *Pavetta indica* **(1, 2, 3)**	Gusókan
144. *Psychotria* sp. **(1, 2, 3)**	
145. *Randia racemosa* **(1, 2, 3)**	Kapí-kapí
Family Rutaceae	
146. *Melicope triphylla* **(1, 2, 3)**	Matáng-árau
Family Sapindaceae	
147. *Euphoria didyma* **(1, 2, 3)**	Alupág
148. *Pometia pinnata* **(1, 2, 3)**	Malúgai
Family Sapotaceae	
149. *Chrysophyllum* sp. **(1)**	Mt. starapple
150. *Palaquium foxworthyi* **(1, 2, 3)**	Tagátoi
151. *Palaquium luzoniense* **(1, 2, 3)**	Nató
152. *Palaquium merrillii* **(1, 2, 3)**	Dulítan
153. *Palaquium philippense* **(1, 2, 3)**	Malák-malák
154. *Palaquium pinnatinervium* **(1, 2, 3)**	Tágkan
155. *Pouteria duclitan* **(1, 2, 3)**	Baehni-Duklítan
Family Simaroubaceae	
156. *Ailanthus integrifolia* **(1, 2, 3)**	Malasápsap
157. *Picrasma javanica* **(1, 2, 3)**	Nalís

Family/Species	Official Common Name
Family Sterculiaceae	
158. *Heritiera littoralis* **(1, 2, 3)**	Dungón-láte
159. *Kleinhovia hospita* **(1, 2, 3)**	Tan-ág
160. *Pterospermum diversifolium* **(1, 2, 3)**	Bayók
161. *Sterculia cuneata* **(1, 2, 3)**	Malabunót
162. *Sterculia montana* **(1, 2, 3)**	Tapínag-bundók
163. *Tarrietia sylvatica* **(1, 2, 3)**	Dungón
Family Stilaginaceae	
164. *Antidesma pentandrum* **(1, 2, 3)**	Bígnai-pógo
165. *Antidesma pleuricum* **(1, 2, 3)**	Bígnai-kalábau
Family Symplocaceae	
166. *Symplocos villarii* **(1, 2, 3)**	Agósip
Family Theaceae	
167. *Camellia lanceolata* **(1, 2, 3)**	Haíkan
168. *Ternstroemia megacarpa* **(1, 2, 3)**	Tapmís
Family Tiliaceae	
169. *Diplodiscus paniculatus* **(1, 2, 3)**	Balóbo
170. *Microcos stylocarpa* **(1, 2, 3)**	Kamúling
171. *Trichospermum discolor* **(1, 2, 3)**	Bonótan
Family Ulmaceae	
172. *Celtis luzonica* **(1, 2, 3)**	Magabúyo
173. *Trema orientalis* **(1, 2, 3)**	Anabióng
Family Urticaceae	
174. *Cypholopus muluccanus* **(1, 2, 3)**	Cypholopus
175. *Laportea meyeniana* **(1, 2, 3)**	Lipáng-kalábau
176. *Leucosyke capitellata* **(1, 2, 3)**	Alagási
Family Verbenaceae	
177. *Premna odorata* **(1, 2, 3)**	Alagáu
178. *Teijsmanniodendron ahernianum* **(1, 2, 3)**	Dangúla/Sasálit
179. *Vitex parviflora* **(1, 2, 3)**	Moláve
180. *Tectona philippinensis* **(1, 2, 3)**	Philippine Teak

Bold numbers in parentheses indicate references for species occurrence in the Twin Lakes Balinsasayao and Danao areas.

References:

[1]Foundation for Philippine Environment-Silliman University Center for Tropical Conservation Studies Rapid Site Assessment (FPE-SUCENTROP RSA) Updated Report 1995

[2] Panaguiton & Parco 1993

[3]Antone 1983

ANNEX B. List of birds (residents, migrants and endemics) recorded for Negros Island and in the Twin Lakes Balinsasayao and Danao Natural Park, Sibulan, Negros Oriental. All except a few of the coastal and marine bird species are excluded in the list.

Legend: R - resident M - migrant R/MP - resident/migrant population E - endemic
Species in **bold** are recorded in the Twin Lakes Balinsasayao and Danao areas. Numbers not in parentheses indicate reference(s) for species occurrence on Negros Island while bold numbers in parentheses indicate references for species occurrence in the Twin Lakes Balinsasayao and Danao areas.

NEGROS ISLAND

FAMILY/SPECIES/COMMON NAME

Family Podicipedidae (Grebes)

1. *Podiceps nigricollis* (Black-necked Grebe)[M 1, 2 (14)]

Family Ardeidae (Bitterns, Egrets, Herons)

2. *Bubulcus ibis* (Cattle Egret)[R/MP 1, 2, (17)]

3. *Butorides striatus* (Little Heron)[R/MP 1, 2, (9)]

4. *Gorsachius goisagi* (Japanese Night Heron)[M 1, 2, (3)]

5. *Nycticorax caledonicus* (Rufous Night Heron)[R 1, 2, (17)]

6. *Ixobrychus cinnamomeus* (Cinnamon Bittern)[R 1, 2]

7. *Dupetor flavicollis* (Black Bittern)[R 1, 2]

Family Anatidae (Ducks, Geese)

8.*Dendrocygna arcuata* (Wandering Whistling Duck)[R 1, 2]

9. *Anas luzonica* (Philippine Duck)[R 1, 2,]

Family Pandionidae (Osprey)

10. *Pandion haliaetus* (Osprey)[M 1, 2, (15)]

Family Accipitridae (Buzzards, Eagles, Harriers, Hawks, Kites)

11. *Pernis ptilorhynchus* (Oriental Honeybuzzard)[R/MP 1, 2]

12.*Pernis celebensis* (Barred Honeybuzzard)[R 1, 2]

13. *Haliastur indus* (Brahminy Kite)[R 1, 2, (9)]

14. *Spilornis cheela* (Crested Serpent-Eagle)[R 1, 2]

15. *Accipiter virgatus* (Besra)[R 1, 2, (9)]

16. *Accipiter trivirgatus* (Crested Goshawk)[R 1, 2, (9)]

17. *Butastur indicus* (Grey-faced Buzzard)[M 1, 2]

18. *Hieraaetus kienerii* (Rufous-bellied Sea Eagle)[R 1, 2]

19. *Spizaetus philippensis* (Philippine Hawk-Eagle)[E 1, 2, (4, 5)]

Family Falconidae (Falcons, Falconets)

20. *Microhierax erythrogenys* (Philippine Falconet)[E 1, 2]

Family Megapodidae (Megapodes, Scrubfowl)

21. *Megapodius cumingii* (Tabon Scrubfowl)[R 1, 2]

Family Phasianidae (Partridges, Pheasants, Quail)

22. *Coturnix chinensis* (Blue-breasted Quail)[R 1, 2]
23. ***Gallus gallus* (Jungle Redfowl)**[R 1, 2 (9)]

Family Turnicidae (Buttonquails)

24. *Turnix sylvatica* (Small Buttonquail)[R 1, 2]
25. *Turnix suscitator* (Barred Buttonquail)[R 1, 2]
26. *Turnix ocellata* (Spotted Buttonquail)[E 1, 2]

Family Rallidae (Coot, Crakes, Rails, Waterhens)

27. *Galliralus striatus* (Slaty-breasted Rail)[R 1, 2]
28. *Galliralus torquatus* (Barred Rail)[R 1, 2]
29. *Rallina eurizonoides* (Slaty-legged Crake)[R 1, 2]
30. *Porzana pusilla* (Baillon's Crake)[M 1, 2]
31. *Porzana fusca* (Ruddy-breasted Crake)[R 1, 2]
32. *Porzana cinerea* (White-browed Crake)[R 1, 2]
33. ***Amaurornis olivaceus* (Plain Bush-hen)**[E 1, 2 (17)]
34. *Amaurornis phoenicurus* (White-breasted Waterhen)[R 1, 2]
35. *Gallicrex cinerea* (Watercock)[R 1, 2]
36. *Gallinula chloropus* (Common Moorhen)[R/MP 1, 2]
37. *Fulica atra* (Eurasian Coot)[M 1, 2]

Family Columbidae (Doves, Pigeons)

38. ***Treron pompadora* (Pompador Green Pigeon)**[R 1, 2, (9)]
39. ***Treron vernans* (Pink-necked Green Pigeon)**[R 1, 2, (9)]
40. ***Phapitreron leucotis nigrorum* (White-eared Brown Dove)**[E 1, 2, (9)]
41. ***Phapitreron amethystina* (Amethyst Brown Dove)**[E 1, 2, (9)]
42. ***Ptilinopus occipitalis* (Yellow-breasted Fruit Dove)**[E 1, 2, (9)]
43. *Ptilinopus arcanus* (Negros Fruit Dove)[E 1, 2]
44. ***Ptilinopus lenlancheri* (Black-chinned Fruit Dove)**[R 1, 2, (9)]
45. ***Ducula poliocephala* (Pink-bellied Imperial Pigeon)**[E 1, 2, (9)]
46. *Ducula carola* (Spotted Imperial Pigeon)[E 1, 2]
47. *Ducula aenea* (Green Imperial Pigeon)[R 1, 2]
48. *Ducula bicolor* (Pied Imperial Pigeon)[R 1, 2]
49. ***Columba vitiensis* (Metallic Wood Pigeon)**[R 1, 2, (9)]

50. *Macrophygia tenuirostris* (Slender-billed Cuckoo Dove)R 1, 2, (9)
51. *Streptopelia bitorquata* (Island Collared Dove)E 1, 2
52. *Streptopelia chinensis* (Spotted Dove)R 1, 2, (9)
53. *Geopelia striata* (Zebra Dove)R 1, 2, (9)
54. *Chalcophaps indica* (Common Emerald Dove)R 1, 2, (9)
55. *Gallicolumba keayi* (Bleeding Heart Pigeon)E 1, 2, (3, 8)
56. *Caloenas nicobarica* (Nicobar Pigeon)R 1, 2

Family Psittacidae (Cockatoo, Lorikeets, Parrots. Racquet-tails)

57. *Cacatua haematuropygia* (Philippine Cockatoo)E 1, 2, (13)
58. *Prioniturus discurus* (Blue-crowned Racquet-tail)E 1, 2, (17)
59. *Tanygnathus lucionensis* (Blue-naped Parrot)R 1, 2
60. *Tanygnathus sumatranus* (Blue-backed Parrot)R 1, 2
61. *Loriculus philippensis* (Colasisi)E 1, 2, (9)

Family Cuculidae (Cuckoos, Malkohas, Coucals)

62. *Cuculus sparverioides* (Large Hawk-Cuckoo)M 1, 2
63. *Cuculus fugax* (Hodgson's Hawk Cuckoo)R 1, 2
64. *Cuculus micropterus* (Indian Cuckoo)M 1, 2
65. *Cuculus saturatus* (Oriental Cuckoo)M 1, 2
66. *Cacomantis sepulcralis* (Brush Cuckoo)R 1, 2, (9)
67. *Surniculus lugubris* (Drongo Cuckoo)R 1, 2, (9)
68. *Chrysococcyx russatus* (Gould's Bronze Cuckoo)R 1, 2
69. *Eudynamys scolopacea* (Common Koel)R 1, 2, (9)
70. *Centropus viridis* (Philippine Coucal)E 1, 2, (17)
71. *Centropus bengalensis* (Lesser Coucal)R 1, 2, (17)

Family Tytonidae (Bars and Grass Owls)

72. *Tyto capensis* (Grass Owl)R 1, 2, (17)

Family Strigidae (Owls)

73. *Otus megalotis* (Philippine Scops Owl)E 1, 2, (9)
74. *Ninox scutulata* (Brown Hawk Owl)E 1, 2
75. *Ninox philippensis* (Philippine Hawk Owl)E 1, 2, (9)

Family Podargidae (Frogmouths)

76. *Batracostomus septimus* (Philippine Frogmouth)E 1, 2, (9)

Family Caprimulgidae (Nightjars)

77. *Caprimulgus indicus* (Grey Nightjar)M 1, 2
78. *Caprimulgus manillensis* (Philippine Nightjar)R 1, 2
79. *Caprimulgus affinis* (Savannah Nightjar)R 1, 2

Family Hemiprocnidae (Treeswifts)

80. *Hemiprocne comata* (Lesser Tree Swift)[R 1, 2, (9)]

Family Apodidae (Swifts)

81. *Collocalia mearnsi* (Philippine Swiflet)[E 1, 2, (9)]

82. *Collocalia whiteheadi* (Whiteheads Swiflet)[E 1, 2]

83. *Collocalia esculenta* (Glossy Swiflet)[R 1, 2, (9)]

84. *Collocalia troglodytes* (Pygmy Swiflet)[E 1, 2, (9)]

85. *Mearnsia* (*Chaetura*) *picina* (Philippine Needletail)[E 1, 2, (9)]

86. *Hirundapus celebensis* (Purple Needletail)[R 1, 2, (9)]

87. *Apus pacificus* (Fork-tailed Swift)[R/MP 1, 2]

88. *Apus affinis* (House Swift)[R 1, 2]

89. *Cypsiurus balasiensis* (Asian Palm Swift)[R 1, 2]

Family Alcedinidae (Kingfishers)

90. *Alcedo atthis* (Common Kingfisher)[R 1, 2]

91. *Alcedo cyanopecta* (Indigo-banded Kingfisher)[E 1, 2]

92. Ce*yx lepidus* (Variable forest Kingfisher)[R 1, 2]

93. *Halcyon capensis* (Stork-billed Kingfisher)[R 1, 2]

94. *Halcyon coromanda* (Ruddy Kingfisher)[R/MP 1, 2]

95. *Halcyon smyrnensis* (White-throated Kingfisher)[R 1, 2, (17)]

96. *Halcyon* (*Todiramphus*) winchelli (Rufous-lored Kingfisher)[E 1, 2, (3)]

97. *Halcyon chloris* (White-collared Kingfisher)[R 1, 2, (17)]

98. *Actenoides lindsayi* (Spotted Wood Kingfisher)[E 1, 2, (9)]

Family Meropidae (Bee-Eaters)

99. *Merops viridis* (Blue-throated Bee-eater)[R 1, 2 (9)]

100. *Merops philippinus* (Blue-tailed Bee-eater)[R 1, 2]

Family Coraciidae (Rollers)

101. *Eurystomus orientalis* (Dollarbird/Broad-billed Roller)[R 1, 2, (9)]

Family Bucerotidae (Hornbills)

102. *Penelopides panini* (Tarictic Hornbill)[E 1, 2, (4, 6, 7)]

103. *Aceros waldeni* (Visayan Writhed-billed Hornbill)[E 1, 2, (3, 4, 5)]

Family Capitonidae (Barbets)

104. *Megalaima haemacephala* (Crimson-breasted Barbet)[R 1, 2, (9)]

Family Picidae (Woodpeckers)

105. *Drycopus javensis* (White-bellied Woodpecker)[R 1, 2, (9)]

106. *Dendrocopos maculatus* (Philippine Pygmy Woodpecker)[E 1, 2]

107. *Chrysocolaptes lucidus* (Greater Flameback)[R 1, 2, (9)]

Family Pittidae (Pittas)
108. *Pitta erythrogaster* (Red-bellied Pitta)[R 1, 2, (17)]
109. *Pitta sordida* (Hooded Pitta)[R 1, 2 (17)]
Family Alaudidae (Larks)
110. *Mirafra javanica* (Singing Bushlark)[R 1, 2]
111. *Alauda gulgula* (Oriental Skylark)[R 1, 2]
Family Hirundinidae (Swallows and Martins)
112. *Riparia paludicola* (Plain Martin)[R 2]
113. *Hirundo rustica* (Barn Swallow)[M 1, 2]
114. *Hirundo tahitica* (Pacific Swallow)[R 1, 2, (9)]
115. *Hirundo daurica* (Red-rumped Swallow)[R/MP 1, 2]
Family Campephagidae (Cuckoo-shrikes, Minivets, Trillers)
116. *Coracina striata* (Bar-bellied Cuckoo Shrike)[R 1, 2, (9)]
117. *Coracina ostenta* (White-winged Cuckoo Shrike)[E 1, 2, (9)]
118. *Lalage nigra* (Pied Triller)[R 1, 2 , (16)]
119. *Pericrocotus divaricatus* (Ashy Minivet)[M 1, 2]
120. *Pericrocotus flammeus* (Scarlet Minivet)[R 1, 2, (9)]
Family Pycnonotidae (Bulbuls)
121. *Pycnonotus urostictus* (Yellow-wattled Bulbul)[E 1, 2]
122. *Pycnonotus goaivier* (Yellow-vented Bulbul)[R 1, 2, (9)]
123. *Hypsipetes philippinus* (Philippine Bulbul)[E 1, 2, (9)]
Family Dicrudidae (Drongos)
124. *Dicrurus balicassius* (Balicassiao)[E 1, 2. (9)]
Family Oriolidae (Orioles, Fairy-bluebirds)
125. *Oriolus xanthonosus* (Dark-throated Oriole)[E 1, 2, (9)]
126. *Oriolus steerei* (Philippine Oriole)[E 1, 2, (9)]
127. *Oriolus chinensis* (Black-naped Oriole)[R 1, 2, (9)]
Family Corvidae (Crows)
128. *Corvus macrorynchus* (Large-billed Crow)[R 1, 2, (9)]
Family Paridae (Tits)
129. *Parus elegans* (Elegant Tit)[E 1, 2, (9)]
Family Sittidae (Nuthatches)
130. *Sitta frontalis* (Velvet-fronted Nuthatch)[R 1, 2, (9)]
Family Rhabdornithidae (Rhabdornis)
131. *Rhabdornis mysticalis* (Stripe-headed Creeper)[E 1, 2 (9)]
132. *Rhabdornis inornatus* (Stripe-breasted Rhabdornis)[E 1 (9)]

<u>Family Timaliidae (Babblers)</u>

133. ***Stachyris*** **(*Dasycrotapha*)** ***speciosa*** **(Flame-templed Babbler)**[E 1, 2, (11, 12)]

134. *Stachyris nigrorum* (Negros Striped Babbler)[E 1, 2]

<u>Family Turdidae (Robins, Shamas,Thrushes)</u>

135. ***Brachypteryx montana*** **(Blue Shortwing)**[R 1, 2, (9)]

136. *Luscinia calliope* (Siberian Rubythroat)[M 1, 2]

137. ***Copsychus saularis*** **(Oriental Magpie-Robin)**[R 1, 2, (9)]

138. *Copsychus luzoniensis* (White-browed Shama)[E 1, 2]

139. ***Saxicola caprata*** **(Pied Bushchat)**[R 1, 2, (9)]

140. *Monticola solitarius* (Blue Rock-Thrush)[M 1, 2]

141. ***Zoothera andromedae*** **(Sunda Ground Thrush)**[R 1, 2, (9, 12)]

142. *Turdus poliocephalus* (Island Thrush)[R 1, 2]

143. *Turdus obscurus* (Eye-browed Thrush)[M 1, 2]

<u>Family Sylviidae (Old World Warblers)</u>

144. *Gerygone sulphurea* (Golden-bellied Flyeater)[R 1, 2]

145. *Phylloscopus borealis* (Arctic Warbler)[M 1, 2]

146. *Phylloscopus olivaceous* (Philippine Leaf-Warbler)[E 1, 2]

147. ***Phylloscopus cebuensis*** **(Lemon-throated Leaf-Warbler)**[E 1, 2, (9)]

148. ***Phylloscopus trivirgatus*** **(Mountain Leaf-Warbler)**[R 1, 2, (9)]

149. *Acrocephalus orientalis* (Oriental Reed-Warbler)[M 1, 2]

150. *Acrocephalus sorghophilus* (Streaked Reed-Warbler)[M 1, 2]

151. *Locustella ochotensis* (Middendorff's Grasshopper Warbler)[M 1, 2]

152. ***Locustella fasciolata*** **(Gray's Grasshopper Warbler)**[M 1, 2, (9)]

153. ***Megalurus timoriensis*** **(Tawny Grassbird)** [R 1, 2 (9)]

154. *Megalurus palustris* (Striated Grassbird)[R 1, 2]

155. ***Orthotomus atrogularis*** **(Philippine Tailorbird)**[E 1, 2, (9)]

156. ***Cisticola exilis*** **(Bright-capped Cisticola)**[R 1, 2, (9)]

157. *Cisticola juncidis* (Zitting Cisticola)[R 1, 2]

<u>Family Muscicapidae (Flycatchers)</u>

158. ***Rhinomyias albigularis*** **(White-throated Jungle Flycatcher)**[E 1, 2, (]

159. *Muscicapa griseisticta* (Gray-spotted Flycatcher)[M 1, 2]

160. *Muscicapa randi* (Ashy-breasted Flycatcher)[E 1, 2]

161. ***Eumyias panayensis*** **(Mountain Verditer Flycatcher)**[R 1, 2, (9)]

162. *Ficedula narcissina* (Narcissus Flycatcher)[M 1, 2]

163. *Ficedula mugimaki* (Mugimaki Flycatcher)[M 1, 2]

164. ***Ficedula westermanni*** **(Little Pied Flycatcher)**[R 1, 2, (9)]

165. *Cyanoptila cyanomelana* (Blue-and-White Flycatcher)[M 1, 2]
166. *Cyornis rufigastra* (Mangrove Blue Flycatcher)[R 1, 2, (9)]
167. *Culicicapa helianthea* (Citrine Canary-Flycatcher)[R 1, 2, (9)]
168. *Rhipidura cyaniceps* (Blue-headed Fantail)[E 1, 2 (9)]
169. *Rhipidura javanica* (Pied Fantail)[R 1, 2 (9)]
170. *Rhipidura nigrocinnamomea* (Black-and-Cinnamon Fantail)[E 1, 2]
171. *Hypothymis coelestis* (Celestial Monarch)[E 1, 2 (3)]
172. *Hypothymis azurea* (Black-naped Monarch)[R 1, 2 (9)]
173. *Terpsiphone cinnamomea* (Rufous Paradise-Flycatcher)[E 1, 2]
Family Pachycephalidae (Whistlers)
174. *Pachycephala homeyeri* (White-vented Whistler)[E 1, 2 (9)]
Family Motacillidae (Wagtails, Pipits)
175. *Motacilla alba* (White Wagtail)[M 1, 2]
176. *Motacilla cinerea* (Grey Wagtail)[M 1, 2]
177. *Motacilla flava* (Yellow Wagtail)[M 1, 2 (9)]
178. *Dendronanthus indicus* (Forest Wagtail)[M 1, 2]
179. *Anthus hodgsoni* (Olive Tree Pipit)[M 1, 2]
180. *Anthus novaeseelandiae* (Richard's Pipit)[R 1, 2]
181. *Anthus gustavi* (Pechora Pipit)[M 1, 2]
Family Artamidae (Wood-Swallows)
182. *Artamus leucorynchus* (White-breasted Wood Swallow)[R 1, 2 (9)]
Family Laniidae (Shrikes)
183. *Lanius schach* (Long-tailed Shrike)[R 1, 2 (9)]
184. *Lanius cristatus* (Brown Shrike)[M 1, 2 (9)]
Family Sturnidae (Mynas, Starlings)
185. *Aplonis panayensis* (Asian Glossy Starling)[R 1, 2 (9)]
186. *Sturnus philippensis* (Chestnut-Cheeked Starling)[M 1, 2]
187. *Acridotheres cristatellus* (Crested Myna)[R 1, 2]
188. *Sarcops calvus* (Coleto)[E 1, 2 (9)]
Family Nectariniidae (Sunbirds)
189. *Anthreptes malacensis* (Plain-throated Sunbird)[R 1, 2]
190. *Nectarinia sperata* (Van Hasselt's Sunbird)[R 1, 2 (9)]
191. *Nectarinia jugularis* (Olive-backed Sunbird)[R 1, 2 (9)]
192. *Aethopyga flagrans* (Flaming Sunbird)[E 1, 2 (9)]
193. *Aethopyga shelleyi* (Lovely Sunbird)[E 1, 2]
194. *Aethopyga siparaja* (Yellow-backed Sunbird)[R 1, 2 (9)]

Family Dicaeidae (Flowerpeckers)

195. *Dicaeum aeruginosum* (Striped Flowerpecker)[E 1, 2]

196. *Dicaeum bicolor* (Bicolored Flowerpecker)[E 1, 2 (9)]

197. *Dicaeum haematosticum* (Visayan Flowerpecker)[E 1, 2 (9)]

198. *Dicaeum trigonostigma* (Orange-breasted Flowerpecker)[R 1, 2 (9)]

199. *Dicaeum pygmaeum* (Pygmy Flowerpecker)[E 1, 2 (9)]

200. *Dicaeum ignipectus* (Firebreasted Flowerpecker)[R 1, 2]

201. *Prionochilus olivaceous* (Olive-backed Flowerpecker)[E 9, 12]

Family Zosteropidae (White-eyes)

202. *Zosterops nigrorum* (Yellow White-eye)[E 1, 2 (9)]

203. *Zosterops montanus* (Mountain White-eye)[R 1, 2 (9)]

Family Ploceidae (Old World Sparrows, Weavers)

204. *Passer montanus* (Eurasian Tree Sparrow)[R 1, 2]

Family Estrildidae (Avadavat, Parrotfinches, Munias)

205. *Erythrura viridifacies* (Green-faced Parrotfinch)[E 1, 2]

206. *Padda oryzivora* (Java Sparrow)[R 1, 2]

207. *Lonchura leucogastra* (White-bellied Munia)[R 1, 2 (9)]

208. *Lonchura punctulata* (Scaly-breasted Munia)[R 1, 2]

209. *Lonchura mallaca* (Chestnut Manikin)[R 1, 2 (9)]

References:

[1] Kennedy *et al.* 2000; [2] Dickenson *et al.* 1991; [3] Alcala & Carumbana 1980; [4] Brooks *et al.* 1992; [5] Evans *et al.* 1993; [6] C.R. Robson *in litt.* 1994; [7] F. Verbelen *in litt.* 1997; [8] Diesmos & Pedregosa 1995; [9] FPE-CENTROP RSA Report 1994; [10] Collar *et al.* 1999; [11] Rand 1951; [12] Erickson & Heideman 1983; [13] L. Tag-at verbally 1995; [14] Rabor 1977; [15] PNOC Faunal Survey 2004; [16] pers. comm. Cariño; [17] pers. obs.

The Dark-throated Oriole *Oriolus xanthonotus* has only one previous record in Negros, specifically in the Twin Lakes Balinsasayao and Danao areas as recorded in the FPE-CENTROP RSA Report (1994). *O. xanthonotus* is restricted to the Palawan group of islands, namely, Culion, Calamianes and Palawan and not known in Negros (Kennedy *et al.* 2000; Dickenson *et. al.* 1991).

The Olive-backed Flowerpecker *Prionichilus olivaceous* was netted in a forest edge of Balinsasayao as claimed by Erickson and Heideman (1983) and is also recorded in the FPE-CENTROP RSA Report (1994). *P. olivaceous* is alsonot known in Negros, and, this may presumably be a misprint for the Philippine Leaf-warbler *Phylloscopus olivaceous* (Brooks *et. al.* 1992).

ANNEX C. List of mammals recorded on Negros Island and in the Twin Lakes Balinsasayao and Danao Natural Park, Sibulan, Negros Oriental.

Legend: * Philippine endemic ** Negros-Panay endemic
***Negros-Cebu endemic ****Negros endemic

Species in **bold** are recorded in the Twin Lakes Balinsasayao and Danao areas. Numbers not in parentheses indicate reference(s) for species occurrence on Negros Island while bold numbers in parentheses indicate references for species occurrence in the Twin Lakes Balinsasayao and Danao areas.

NEGROS
FAMILY/SPECIES/COMMON NAME
Family Cercopethicidae (Monkeys)
1. *Macaca fascicularis* (Long-tailed Macaque) [1, (2)]
Family Cervidae (Deers)
2. *Cervus alfredi* (Philippine Spotted Deer)** [1, (2)]
Family Suidae (Pigs)
3. *Sus cebifrons negrinus* (Visayan Warty Pig)** [1, (2, 3)]
Family Felidae (Cats)
4. *Prionailurus bengalensis rabori* (Philippine Leopard Cat)** [1, (2)]
Family Viveridae (Civets)
5. *Paradoxurus hermaphroditus* (Palm Civet Cat) [1, (2)]
6. *Viverra tangalunga* (Malay Civet Cat) [1, (2)]
MEGACHIROPTERA
Family Pteropodidae (Fruit bats)
7. *Acerodon jubatus* (Golden-crowned Flying Fox)* [1, (2, 3)]
8. *Cynopterus brachyotis* (Short-nosed Fruit Bat) [1, (2, 3)]
9. *Dobsonia chapmani* (Philippine Naked-backed Fruit Bat)*** [1]
10. *Eonycteris spelaea* (Philippine Nectar Bat) [1, (2, 3)]
11. *Eonycteris robusta* (Philippine Dawn Bat)** [1]
12. *Haplonycteris fischeri* (Fischer's Pygmy Fruit Bat)* [1, (2, 3)]
13. *Harpyionycteris whiteheadi* (Harpy Fruit Bat)* [1, (2, 3)]
14. *Macroglossus minimus* (Long-tailed Fruit Bat) [1, (2, 3)]
15. *Nyctimene rabori* (Tube-nosed Fruit Bat)** [1, (2, 3)]
16. *Ptenochirus jagori* (Dog-faced Bat)* [1, (2, 3)]
17. *Pteropus hypomelanus* (Island Flying Fox) [1, (2, 3)]
18. *Pteropus pumilus* (Golden-mantled Flying Fox)* [1, (2, 3)]
19. *Rousettus amplexicaudatus* (Common Rousette) [1, (2, 3)]
MICROCHIROPTERA (Insect bats)
Family Emballonuridae (Sheat-tailed bats)
20. *Emballonura alecto* (Philippine Sheat-tailed Bat) [1]
21. *Saccolaimus saccolaimus* (Pouched Bat) [1]
22. *Taphozous melanopogon* (Black-bearded Tomb Bat) [1]

Family Megadermatidae (False Vampire and Ghost Bats)
23. *Megaderma spasma* (Common Asian Ghost Bat) [1, (3)]
Family Rhinolophidae (Horsehoe and Roundleaf Bats)
24. *Hipposideros ater* (Dusky Roundleaf Bat) [1]
25. *Hipposideros diadema* (Diadem Roundleaf Bat) [1, (3)]
26. *Hipposideros obscurus* (Philippine Forest Roundleaf Bat)* [1]
27. *Hipposideros pygmaeus* (Philippine Pygmy Roundleaf Bat)* [1, (3)]
28. *Rhinolophus arcuatus* (Arcuate Horseshoe Bat) [1]
29. *Rhinolophus inops* (Philippine Forest Horseshoe Bat)* [1]
30. *Rhinolophus macrotis* (Big-eared Horseshoe Bat) [1]
31. *Rhinolophus philippinensis* (Enormous-eared Horsehoe Bat) [1]
32. *Rhinolophus virgo* (Yellow-faced Horseshoe Bat)* [1]
Family Vespertilionidae (Vesper and Evening Bats)
33.*Harpiocephalus harpia* (Hairy-winged Bat) [1]
34. *Miniopterus australis* (Little Bent-winged Bat) [1]
35. *Miniopterus schreibersi* (Common Bent-winged Bat) [1]
36. *Miniopterus tristis* (Greater Bent-winged Bat) [1]
37. *Myotis horsefieldii* (Common Asiatic Myotis) [1]
38. *Myotis macrotarsus* (Philippine Large-footed Myotis) [1]
39. *Myotis muricula* (Whiskered Myotis) [1]
40. *Myotis rufopictus* (Orange-fingered Myotis) [1]
41. *Philetor brachypterus* (Short-winged Pipistrelle) [1]
42. *Pipistrellus javanicus* (Javan Pipistrelle) [1]
43. *Pipistrellus tenuis* (Least Pipistrelle) [1]
44. *Scotophilus kuhlii* (Lesser Asian House Bat) [1]
45. *Tylonycteris robustula* (Greater Flat-headed Bat) [1]
Family Mollosidae (Free-tailed Bats)
46. *Chaerephon plicata* (Wrinkled-lip Bat) [1]
47. *Cheiromeles parvidens* (Lesser Naked Bat) [1]
Family Muridae (Rats and Mice)
48. *Apomys* sp. A (Western Visayas Forest Mouse) [1]
49. *Mus musculus* (House Mouse) [1]
50. *Rattus argentiventer* (Rice-field Mouse) [1]
51. *Rattus exulans* (Polynesian Rat) [1, (2, 3)]
52. *Rattus tanezumi* (Oriental House Rat) [1, (3)]
Family Soricidae (Shrews)
53. *Crocidura negrina* (Negros Shrew)**** [1, (2)]
54. *Suncus murinus* (Oriental House Shrew) [1, (2)]

References:

[1] Heaney *et al.* 1998

[2] FPE - SUCENTROP RSA Report 1994

[3] SUCENTROP - Peoples' Organization (PO) Biomonitoring System (BMS) Report 2004

ANNEX D. List of herpetofauna for Negros Island and in the Twin Lakes Balinsasayao and Danao Natural Park, Sibulan, Negros Oriental.

FAMILY/SCIENTIFIC NAME/COMMONNAME

AMPHIBIANS

Family Bufonidae (True Toads)

1. ***Bufo marinus* (Giant Marine Toad)** [2,3,(9)]

Family Ranidae (True Frogs)

2. *Fejervarya (Rana) cancrivora* (Asian Brackish Water Frog) [2,3]
3. ***Limnonectes (Rana) leytensis* (Swamp Frog)*** [2,3 (9)]
4. ***Limnonectes (Rana magna) visayanus* (Visayan Fanged Frog)**** [2,3 (9)]
5. ***Occidozyga (Ooeidozyga) laevis visayanus* (Small-headed Frog)*** [2,3,(9,11)]
6. ***Platymantis corrugatus* (Rough-backed Forest Frog)*** [2,3,(9)]
7. ***Platymantis dorsalis* (Common Forest Ground Frog)*** [2,3,4,(12)]
8. ***Platymantis hazelae* (Hazel's Forest Frog)*** [2,3,(9)]
9. ***Platymantis negrosensis* (Negros Forest Frog)**** [2,3,(11,12)]
10. *Platymantis spelaeus* (Negros Cave Frog)*** [3,7]
11. ***Rana erythraea* (Common Green Frog)** [2,3,(9)]
12. ***Rana everetti* (Everett's Frog)** [2,3,(9)]

Old World Tree Frogs

Family Rhacophoridae

13. ***Polypedates leucomystax quadrilineatus* (Common Tree Frog)**[2,3,(9)]
14. *Rhacophorus appendiculatus* (Rough-armed Tree Frog) [2,3]
15. ***Rhacophorus pardalis pardalis* (Gliding Tree Frog)** [2,3,8,(9)]

Narrow-mouthed Frogs

Family Microhylidae

16. ***Kaloula conjuncta negrosensis* (Truncate-toed Chorus Frog)**** [2,3,(9,12)]
17. *Kaloula kalingensis* (Smooth-fingered Narrow-mouthed Frog) [10]
18. ***Kaloula picta* (Slender-digit Chorus Frog)*** [1,2,3,(9)]

REPTILES

Lizards

Family Agamidae (Agamids)

19. ***Bronchocela cristatella (Calotes cristatellus)* (Indonesian Calotes)** [2]
20. *Bronchocela (Calotes) marmoratus* (Philippine Calotes) [2]
21. ***Draco spilopterus* (Common Flying Lizard)** [13]
22. ***Gonocephalus sophiae* (Dark-spotted Anglehead)** [2]
23. ***Hydrosaurus pustulatus* (Sailfin Water Lizard)** [2,(9,12)]

Family Dibamidae (Blind-earless Lizards)

24. *Dibamus argenteus* (Philippine Blind-earless Lizard) [2]
25. *Dibamus novaeguineae* (Blind-earless Lizard) [2]

Family Gekkonidae (Geckos)

26. *Cosymbotus platyurus* (Flat-bodied House Gecko) [2, 5, (9)]
27. *Cyrtodactylus annulatus* (Small Bent-toed Gecko)* [2, 5, (9)]
28. *Cyrtodactylus philippinicus* (Philippine Bent-toed Gecko)* [2, 5, (9)]
29. *Gehyra mutilata* (Tender-skinned House Gecko) [2, 5, (9)]
30. *Gekko gecko gecko* (Toko Narrow-disked Gecko) [2, 5, (9, 12)]
31. *Gekko mindorensis* (Mindoro Narrow-disked Gecko) [2, 5]
32. *Hemidactylus frenatus* (Common House Gecko) [2, 5]
33. *Hemidactylus garnoti* (Large Hemidactylid Gecko) [2, 5, (9)]
34. *Hemiphyllodactylus typus* (Small Smooth-scaled Gecko) [2, 5, (9)]
35. *Lepidodactylus christiani* (Negros Broad-tailed Smooth-scaled Gecko)*** [2, 5, (9)]
36. *Lepidodactylus herrei herrei* (White-lined Smooth-scaled Gecko) * [2, 5, (9)]
37. *Lepidodactylus lugubris* (Mangrove Smooth-scaled Gecko) [2, 5]
38. *Luperosaurus cumingi* (Cuming's Flap-legged Gecko)* [2, 5, (14)]
39. *Pseudogekko brevipes* (Orange-spotted Smooth-scaled Gecko)* [2, 5, (9)]

Family Scincidae (Skinks)

40. *Brachymeles boulengeri taylori* (Common Burrowing Skink) * [2, 6, (9)]
41. *Brachymeles talinis* (Large striped Burrowing Skink) * [2, 6, 9]
42. *Brachymeles tridactylus* (Negros Three-digit Worm Skink) * [2, 6]
43. *Lamprolepis smaragdina philippinica* (Spotted Green Tree Skink) [2, 6, (9, 12)]
44. *Emoia atrocostata* (Gray Swamp Skink) [2, 6]
45. *Lipinia auriculata* (Bronze slender Tree Skink) * [2, 6, 9]
46. *Lipinia pulchellum taylori* (Yellow-striped Slender Tree Skink)* [2, 6, 9]
47. *Lipinia rabori* (Black Slender Tree Skink) * [2, 6, 9]
48. *Lipinia quadrivittata* (Black-striped Slender Tree Skink)* [2, 6, 9]
49. *Mabuya indeprensa* (Mabouya)* [2, 6]
50. *Mabuya multicarinata borealis* (Two-striped Mabouya) [2, 6, (9)]
51. *Mabuya mullifasciata* (Common Mabouya) [2, 6, (9, 12)]
52. *Sphenomorphus arborens* (Negros Sphenomorphus)* [2, 6, (9, 12)]
53. *Sphenomorphus jagori grandis* (Jagor's Sphenomorphus)* [2, 6, (9, 12)]
54. *Sphenomorphus steerei* (Steere's Sphenomorphus)* [2, 6, (9, 12)]

Family Varanidae (Monitor Lizards)

55. *Varanus salvator nuchalis* (Rough-necked Water Monitor) [2, 6, (9 12)]

Snakes

Family Acrochordidae (Wart Snakes)

56. *Acrochordus granulatus* (Small Wart Snake) [2]

Family Colubridae (Colubrid Snakes)

57. *Ahaetulla prasina preocularis* (Elongate-headed Tree Snake)
58. *Boiga cynodon* (Philippine Blunt-headed Tree Snake)* [2]
59. *Calamaria gervaisi* (Gervais' Worm Snake)* [2 (9)]
60. *Cerberus (Hurria) rynchops* (Dog-faced Water Snake) [2]
61. *Chrysopelea paradisi* (Paradise Snake) [2, (9)]

62. *Dendrelaphis caudolineatus terrificus* (Lined Slender Arboreal Snake)* [2, 9]
63. *Dendrelaphis pictus pictus* (Common Bronze-backed Snake) [2]
64. *Dryophiops philippina* (Philippine Dryophiops) * [2, 9]
65. *Elaphe erythrura psephenoura* (Common Rat Snake)* [2, 9]
66. *Gonyosoma oxycephala* (Arboreal Rat Snake) * [2, 9]
67. *Lycodon aulicus capacinus* (Common Wolf Snake) [2, (9)]
68. *Oligodon modestum* (Spotted-bellied Short-headed Snake)* [2, (9)]
69. *Oxyrhabdium leporinum visayanum* (Banded Philippine Burrowing Snake)* [2, (9)]
70. *Oxyrhabdium modestum* (Non-banded Philippine Burrowing Snake) * [2, 9]
71. *Psammodynastes pulverulentus* (Dark-spotted Mock Viper) [2, (9, 15)]
72. *Pseudorabdion mcnamarae* (Mcnamara's Burrowing Snake) * [2]
73. *Pseudorabdion montanum* (Mountain Burrowing Snake)*** [2, 9]
74. *Pseudorabdion oxycephalum* (Negros Light-scaled Burrowing Snake)* [2, 9]
75. *Tropidonophis (Natrix dendrophiops) negrosensis* (Spotted Water Snake) [2, (9)]
76. *Zaocys luzonensis* (Smooth-scaled Mountain Rat Snake) * [2, (9)]

Family Elapidae (Coral Snakes and Cobras)

77. *Calliophis calligaster gemianulis* (Barred Coral Snake)** [2, 9]
78. *Ophiophagus hannah* (King Cobra) [2, 9]

Family Pythonidae (Pythons)

79. *Python reticulatus* (Reticulated Python) [2, (9)]

Family Typhlopidae (Blind Snakes)

80. *Rhamphotyphlops braminus* (Brahminy Blind Snake) [2, 9]
81. *Typhlops canlaonensis* (Canlaon Blind Snake)***2
82. *Typhlops cumingi* (Cuming's Blind Snake) [2, 9]
83. *Typhlops luzonensis* (Luzon blind Snake)*[2, 9]

Family Viperidae (Vipers)

84. *Tropidolaemus (Trimeresurus) wagleri* (Wagler's Pit Viper) [2, (9)]

Turtles

Family Bataguridae (Asian Hardshell Turtles)

85. *Cuora amboinensis amboinensis* (Malayan Freshwater Turtle) [2, (9)]

Crocodiles

Family Crocodylidae

86. *Crocodylus mindorensis* (Philippine Crocodile)*2

Legend:
*Philippine endemic
**Negros-Panay endemic
***Negros Island endemic

Species in **bold** are recorded in the Twin Lakes Balinsasayao and Danao areas. Numbers not in parentheses indicate reference(s) for species occurrence on Negros Island while bold numbers in parentheses indicate references for species occurrence in the Twin Lakes Balinsasayao and Danao areas.

References:

[1] Alcala 1956 ; [2]Alcala 1986; [3]Alcala & Brown 1998; [4] Brown & Inger 1964; [5]Brown & Alcala 1978; [6] Brown & Alcala 1980; [7] Brown & Alcala 1982; [8] Brown & Alcala 1994; [9] FPE-SUCENTROP RSA Report 1994; [10] pers. obs. Brown, Diesmos and Dolino; [11] pers. comm. Brown; [12] pers. obs; [13] McGuire & Alcala 2000; [14] pers. comm. Heaney & Hedeimann 1998; [15]pers. comm. Cariño

A STUDY ON THE BIRDS OF SMALL ISLANDS OFF THE COAST OF CEBU ISLAND, PHILIPPINES

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ABSTRACT

The bird composition of the small islands of Carnaza, Camotes (Poro and San Francisco), Gato, Pescador and Sumilon in Central Visayas was studied by deliberate search, mist-netting, and point counting. A total of 67 species of birds were recorded on all five islands. Forty-three species observed were breeding residents, 14 were migratory, and 2 were either residents or migrants; 8 species were Philippine endemics. The presence of Black-crowned Night-Heron *Nycticorax nycticorax* and the Caspian Tern *Hydroprogne caspia* provided new records for Gato Island. Glossy Starling *Aplonis panayensis* and the Pied Triller *Lalage nigra* were the most frequently netted birds. The island of Camotes, the largest of the five islands visited, had the highest number of species recorded followed by Carnaza, Sumilon, Pescador, and Gato Island. The study did not record any subspecies or species endemic to Cebu.

Hunting of birds and large species of mammals mainly for the pet trade, food, and sports is still practiced. Native species of tree and mangroves are illegally cut mainly for firewood, and household use. The conservation efforts on these islands are concentrated on marine resources with less attention to terrestrial wildlife.

Introduction

Located in the central region of the Philippines, Cebu is the third largest island in the West Visayas Faunal Region. It has more than a dozen satellite islets, most of which are inhabited. This includes the Camotes group of islands, Malapascua, Carnaza, Bantayan, and the smaller islets in the north, and Pescador, Badian, and Sumilon in the southwest portion. Among these islands, only the Camotes group of islands was not connected to Cebu or to the greater Pleistocene Islands more than ten thousand years ago. Thus Camotes is considered an oceanic island.

Not much information on the status of the biological diversity of the smaller islands of Cebu is currently available. Among the islands visited, only Carnaza Island has been visited for bird surveys in the past (Mapalo, 1991). Although there are no known Cebu endemic taxa on the small satellite islands, many regionally endemic species may have been present. However, very little is known about their remaining populations and it is even feared that many of these have already become extinct long before their population had been determined. Thus, this survey aimed to assess the status of biodiversity of the smaller islands surrounding Cebu.

Habitat Description of each Islands

Camotes Islands

The Camotes group is located between the islands of Cebu and the Leyte group of islands. Camotes is part of the province of Cebu and is made up of three islands with four municipalities (San Francisco, Poro, Pilar, and Tudela). The total land area is 17, 541 hectares.

The island's topography is hilly with the highest point at 386 m above sea level. Second growth vegetation of about five hectares is limited to portions near ravine, cliffs, and inaccessible areas. In Tambis, Monte Alegre, scrub and second growth areas are dominated by molave (*Vitex parviflora*). The average canopy height is about three meters. Coconuts and other agricultural products are planted at the edges of patches of natural vegetation. Humus cover is almost absent, and substrate is very dry and basically made up of limestone. Trails frequently used by locals in going from one farm to the other have been observed.

In Cansinggit, Cansabusab in Poro, second growth vegetation of about three hectares is limited on steep portions of riverbanks. *Ficus* species, molave (*Vitex parviflora*), bamboo (*Bambusa* sp.), and coconuts are among those identified in the area. The average canopy height is about four meters. A total of 6 days (February 2-7, 2002) were spent for bird surveys in Camotes.

Fig. 1. Map of Cebu showing the locations of the islands visited during the survey. Map was taken from the Geographic Atlas of Cebu (2000).

Carnaza Island

Carnaza Island has a total land area of 173.5 hectares (Mapalo, 1991) and is located between the islands of Masbate in the northeast, Cebu Island in the south, and Biliran Island in the east (11° 30' and 11° 32' North and 124° 4' and 124° 6' East). The highest point is 55 meters above sea level.

The area surveyed is located in the northwest of the island. The dominant vegetation is ipil-ipil (Leucaena leucocephala), which is utilized by the locals for fuelwood. Molave (Vitex parviflora), Ficus species, talisay (Terminalia sp.), and other mangrove-associated plants have also been observed. The average canopy height is about four meters. Some species of mangroves and Ficus trees were fruiting at the time of the survey. Trails criss-cross the island, often leading to isolated communities. People rely heavily on fishery resources as a source of livelihood. Trees are mainly harvested for fuelwood, charcoal, and for house or furniture building. The island was visited for 5 days (February 11- 15, 2002).

Pescador Island

Pescador lies in the Tañon Strait, located in between Negros and Cebu. The island is very small (1.3 ha) and is uninhabited. However, divers and fishermen visit the surrounding coral reefs for diving sport and fishing activities.

The dominant plant is ipil-ipil (Leucaena leucocephala), covering three-quarters of the island. Humus cover is almost absent and limited to portions with vegetation. Plants are stunted in growth while some species are low lying or creeping on limestone substrate. The average canopy height is four meters. Some beach species of plants were observed growing in the western cliff portion clinging to the rocky substrate. The island was only visited for a day (February 22, 2004).

Sumilon

Sumilon, a disc-shaped island with a bean-shaped lagoon, is located between the islands of Cebu in the north, Siquijor in the south, and Negros in the western portion. It has a total land area of about three hectares. Several structures in the northern part of the island were under construction at the time of the visit.

As in Pescador Island, the dominant vegetation is ipil-ipil (Leucaena leucocephala). In the eastern portion of the island, mangrove species (Sonneratia, Avicennia) were observed growing around the lagoon. Newly-planted coconuts were observed as well as some species of ornamental plants. Trails were observed leading to the construction site in the northeastern portion of the island, continuing to the western portion, where the sand bar and the docking area are located. The island was only visited for a day (February 23, 2002).

Gato Island

A conical-shaped island made up of limestone, Gato is located northwest of Cebu, northeast of Bantayan Island, and west of Malapascua Island. It is the smallest among the islands visited with a land area of only a hectare. It is a declared protected area due to the presence of sea snakes and other important marine species. A "safehouse" is located east of the island.

Very little vegetation was observed on the eastern side of the Island. Humus cover is absent, and dry, undecayed leaves are limited to areas with vegetation. In these portions, Ficus species were observed bearing fruits at the time of the survey. Most trees have massive buttresses but are stunted in growth. In larger species of trees, Flying foxes (Pteropus species) were observed roosting in colonies. Gato Island was only visited for a day (February 15, 2002)

Methods

Study sites were pre-selected and were biased towards areas with vegetation. Three days of field sampling was done in most of the study areas. Islets with land areas less than 1,000 sq m were sampled only for a day. In areas with very little vegetation, point counts and deliberate search for species were conducted. Established trails in vegetated areas were followed and bird species observed were recorded.

Because the rest of the islands were very small, mist netting was only conducted on the islands of Camotes and Carnaza. Mist-nets measuring 6 meters long by 4 meters wide were set along flyways and near feeding trees at least a meter above the ground and at the level of the canopy. These nets were checked regularly, at least every hour. Birds captured were identified and standard biometrical measurements were taken. A total of 45 mist-netting hours were spent for the two islands. Interviews with the community were also conducted to determine resource use, ascertain the attitudes and perceptions of the locals towards wildlife, as well as solicit historical information on the area.

Results and Discussion

Bird Species Composition

A total of 67 species of birds were observed on all six islands, 8 (12%) are endemic to the Philippines, 43 (64%) of which are breeding residents, 14 (21%) are migratory, and 2 (3%) are either residents or migrants. Subspecies endemic to Cebu were not observed on the islands. Of the six islands visited, Camotes Island recorded the highest number of species followed by Carnaza, Sumilon, Gato, and Pescador Island.

Table 1. Bird species composition of the six sampling sites. Number represents species observed, and — represents not observed.

Category	Carnaza	Camotes	Gato	Sumilon	Pescador
Philippine Endemic	3	8	1	2	1
Residents	24	38	6	19	9
Migratory	7	7	5	4	1
Resident/Migratory	---	1	---	1	---
Total species	34	54	12	26	11
Observation hours	16	16	4	4	4
Land area (ha.)	173.5	14, 509.5	1	3	1.3

On Carnaza a total of 34 species of birds were recorded, 3 of which are Philippine endemic (*Centropus viridis, Caprimulgus manillensis, and Collocalia troglodytes*). The Tabon Scrubfowl was only reported on Carnaza where locals reported collecting eggs for domestic consumption.

Camotes has the highest number of species observed. A total of 54 species were observed on Poro while a total of 51 species were recorded on San Francisco. Most of the species observed are resident species, including eight Philippine endemics (*Phapitreron leucotis, Centropus viridis, Caprimulgus manillensis, Collocalia mearnsi, Collocalia troglodytes, Hypsipetes philippinus, Sarcops calvus,* and *Dicaeum australe).*

The majority of the birds recorded on Gato Island were migratory species and bird associated with water. The birds observed included the Black-crowned Night-Heron *Nycticorax nycticorax*, and the Caspian Tern *Hydroprogne caspia,* new to the Cebu islands (Kennedy *et al.,* 2000). The former was observed in the rocky portion in the island, while the single Caspian Tern *Hydroprogne caspia,* with its huge size compared to other terns, and its red orange with black line near the tip of its bill, was observed on Gato Island (February 15, 2004). A total of 26 species were recorded on Sumilon and 11 on Pescador Island. *Collocalia troglodytes* was the only Philippine endemic species observed on these three islands.

Netting Results

Table 2. List of bird species netted during the survey. Numbers refer to individuals caught; — means the species was not netted.

Scientific Name	Common Name	Camotes	Carnaza
Caprimulgus manillensis	Philippine Nightjar	1	---
Halcyon chloris	White-collared Kingfisher	---	1
Oriolus chinensis	Black-naped Oriole	---	2
Lalage nigra	Pied Triller	---	4
Copsychus saularis	Magpie Robin	---	1
Lanius cristatus	Brown Shrike	---	2
Aplonis panayensis	Philippine Starling	---	5
Motacilla cinerea	Grey Wagtail	1	---
Hypothymis azurea	Black-naped Monarch	2	---
Nectarinia jugularis	Olive-backed Sunbird	2	1
Total number of individuals		4	16
Net hours		22.5	22.5

A total of ten bird species were mist-netted, species associated with agricultural habitats and disturbed areas (Dickinson *et. al.*, 1991; Kennedy *et. al.,* 2000). The Glossy Starling was the most frequently caught bird, followed by the Pied Triller *Lalage nigra*; the rest of the species were represented by one or two individuals.

It should be noted that the figures and species caught do not reflect the true nature of the bird composition of the island; rather, they present a supplementary information on the bird species identified during transects.

Threats and conservation

On all islands visited, hunting/targeting large species of doves, Coleto, Koel, and Orioles, appears to be a prevalent practice. A number of households were observed keeping these birds in cages, usually crowding a 2 x 2 meter square cage with up to 20 individuals of four to five species. These birds are sometimes sold to local tourists visiting the island.

Gathering of eggs of Tabon Scrubfowl for trade in nearby towns was rampant in Carnaza. This should be addressed to conserve the remaining population of Tabon Scrubfowl in the island.

Because much of the conservation efforts on the islands are geared towards marine and fishery products (thresher sharks, manta rays, marine mammals, coral reefs, and mangroves), little information has been disseminated on the importance and composition of land animals on the islands. On the other hand, the ecotourism projects only address natural cave formations and second growth vegetation. Given the dearth of crucial baseline information on the species composition, the information generated from this survey may help in the protection and conservation of terrestrial wildlife.

Conclusions

Among the islands visited, Camotes, the largest of the island, ranks first in terms of number of species observed. This is followed by Carnaza, the second largest island, and by Sumilon, and Gato Island. Pescador, the smallest island, recorded the lowest number of bird species.

The surveys conducted did not record species of birds that are of high conservation importance. The islands have poor avifauna and most of the bird species are shared with the nearby islands of Leyte and Cebu. The habitats on the island are also too small to support a larger population of birds. Thick vegetation could only be found on scrubland and vegetated areas in gullies and river banks. Even these areas are highly disturbed, with larger trees poached for timber and smaller trees either for fuelwood or charcoal production.

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APPENDIX A. Comparison of birds observed per island during the survey (February 2-15 and 22-23, 2002). Presence is indicated by **X;** Not observed is indicated as —. E means Philippine endemic; R means resident species; M means migratory.

Scientific name	Common name	Carnaza	Poro	San Fran	Gato	Sumilon	Pescador	Status
Egretta sacra	Eastern Reef-Egret	—	—	—	X	—	—	M
Egretta garzetta	Little Egret	X	X	X	—	—	—	M
Butorides striatus	Little Heron	—			—	—	—	RM
Bubulcus ibis	Cattle Egret	—	X	X	—	X	—	RM
Nycticorax nycticorax	Black-Crowned Night-Heron	—	—	—	X	—	—	M
Nycticorax caledonicus	Rufous Night-Heron	X	—	—	—	X	—	M
Ixobrychus cinnamomeus	Cinnamon Bittern	—	—	—	—	X	—	R
Dendrocygna arcuata	Wandering Whistling Duck	—	X	—	—	—	—	R
Haliastur indus	***Brahminy Kite***	—	*X*	*X*	—	—	—	***R***
Megapodius cumingii	***Tabon Scrubfowl***	*X*	—	—	—	—	—	***R***
Gallirallus torquatus	***Barred Rail***	*X*	*X*	*X*	—	—	*X*	***R***
Rallina eurizonoides	***Slaty-legged Crake***	*X*	*X*	*X*	—	—	—	***R***
Actitis hypoleucos	Common Sandpiper	X	X	X	—	—	—	M
Hydroprogne caspia	Caspian Tern	—	—	—	X	—	—	M
Gelochelidon nilotica	Gull-billed Tern	—	—	—	X	X	—	M
Sterna hirundo	Common Tern	X	—	—	X	X	—	M
Treron vernans	Pink-necked Green-Pigeon	X	X	X	—	—	—	R

Phapitreron leucotis	***White-eared Brown Dove***	—	*X*	*X*	—	—	—	***E***
Streptopelia bitorquata	***Spotted Turtle Dove***	*X*	*X*	*X*	—	—	—	***R***
Streptopelia chinensis	***Spotted Dove***	*X*	*X*	*X*	—	—	—	***R***
Geopelia striata	***Zebra Dove***	*X*	*X*	*X*	—	—	—	***R***
Chalcophaps indica	***Emerald Dove***	*X*	*X*	*X*	—	—	—	***R***
Cacomantis merulinus	***Plaintive Cuckoo***	—	*X*	*X*	—	—	—	***R***
Cacomantis variolosus	Brush cuckoo	—	X	X	—	—	—	R
Eudynamys scolopacea	Koel	X	X	X	—	—	—	R
Centropus viridis	Philippine Coucal	X	X	X	—	X	—	E
Caprimulgus manillensis	***Philippine Nightjar***	*X*	*X*	*X*	—	—	—	***E***
Collocalia vanikorensis	***Island Swiftlet***	—	*X*	*X*	*X*	*X*	*X*	***R***
Collocalia mearnsi	Philippine Swiftlet	—	X	X	—	—	—	E
Collocalia esculenta	***Glossy Swiftlet***	*X*	*X*	*X*	*X*	*X*	*X*	***R***
Collocalia troglodytes	***Pygmy Swiftlet***	*X*	*X*	*X*	*X*	*X*	*X*	***E***
Hirundapus celebensis	Purple Needletail	X	X	X	X	X	X	R
Halcyon smyrnensis	White-throated Kingfisher	—	X		—	—	—	R
Halcyon chloris	White-collared Kingfisher	X	X	X	—	X	—	R
Merops viridis	***Blue-throated Bee-eater***	—	*X*	*X*	—	—	—	***R***
Merops philippinus	***Blue-tailed Bee-eater***	—	*X*	*X*	—	—	—	***R***
Riparia riparia	***Sand Martin***	*X*	—	—	—	—	—	***M***
Hirundo rustica*	***Barn Swallow***	*X*	*X*	*X*	—	*X*	*X*	***M***
*Hirundo tahitica**	Pacific Swallow	X	X	X	—	X	X	R
Lalage nigra	Pied Triller	X	X	X	—	X	—	R
Pycnonotus goaivier	***Yellow-vented Bulbul***	*X*	*X*	*X*	—	*X*	—	***R***
Hypsipetes philippinus	***Philippine Bulbul***	—	*X*	*X*	—	—	—	***E***
Oriolus chinensis	Black-naped Oriole	X	X	X	—	X	—	R

Corvus macrorynchus	***Large-billed Crow***	*X*	*X*	—	—	—	—	***R***
Copsychus saularis	***Magpie Robin***	*X*	*X*	*X*	—	*X*	—	***R***
Saxicola caprata	Bushchat	—	X	X	—	X	—	R
Gerygone sulphurea	***Golden-bellied Flyeater***	*X*	—	—	*X*	*X*	*X*	***R***
Monticola solitarius	Blue Rock Thrush	—	X	—	X	—	—	R
Phylloscopus borealis*	***Arctic Warbler***	—	*X*	*X*	—	—	—	***M***
Megalurus palustris	Tawny Grassbird	—	X	X	—	—	—	R
Cyornis rufigastra	Mangrove Blue Flycatcher	—	—	X	—	—	—	R
Rhipidura javanica	Pied Fantail	X	X	X	—	X	X	R
Hypothymis azurea	Black-naped Monarch	—	X	—	—	—	—	R
Motacilla cinerea*	***Grey Wagtail***	—	*X*	*X*	—	—	—	***M***
*Motacilla flava**	Yellow Wagtail	—	X	X	—	—	—	M
Anthus novaeseelandiae	Richard's Pipit		X	X	—	—	—	R
Artamus leucorhynchus	***White-breasted Wood Swallow***	*X*	*X*	*X*	*X*	*X*	—	***R***
Lanius cristatus*	***Brown Shrike***	*X*	*X*	*X*	—	*X*	—	***M***
Lanius schach	Long-tailed Shrike	—	—	X	—	—	—	R
Aplonis panayensis	***Glossy Starling***	*X*	*X*	*X*	—	*X*	—	***R***
Sarcops calvus	Coleto	—	X	X	—	—	—	E
Anthreptis malaccensis	***Plain-throated Sunbird***	—	*X*	*X*	—	—	—	***R***
Nectarinia sperata	Purple-throated Sunbird	—	X	X	—	—	—	R
Nectarinia jugularis	***Olive-backed Sunbird***	*X*	*X*	*X*	—	*X*	*X*	***R***
Dicaeum australe	Red-keeled Flowerpecker	—	X	X	—	—	—	E
Passer montanus	***House Sparrow***	*X*	*X*	*X*	—	*X*	*X*	***R***
Lonchura malacca	Chestnut Munia	—	X	X	—	X	—	R
Total number of species	**34**	**54**	**51**	**12**	**25**	**11**		**67**

CONSERVATION STATUS OF FOREST BIRDS IN ISOLATED FOREST PATCHES IN MASBATE, PHILIPPINES

Lisa Marie J. Paguntalan, Philip Godfrey Jakosalem, Marisol dG. Pedregosa, Mery Jean G. Catacutan, and Reginaldo Bueno

ABSTRACT

Bird surveys were conducted on the island of Masbate in July 2001 and on March 20-25, 2002. The study mainly focused on identifying the remaining lowland forests and determining their condition, as well as ascertaining the conservation status of the endemic and threatened birds of Masbate. Using deliberate search, mist-netting, and informal interviews, a total of 55 species (58%) of the birds previously known from the island were observed. Four new species for Masbate were recorded during the survey. Nine (56%) of the 16 Western Visayas endemic subspecies of birds known from Masbate were not seen and most are now possibly extinct on the island. The most significant result of the study was the finding of a remnant population of the Visayan Tarictic Hornbill *Penelopides panini panini* among sightings of the seven Masbate endemic subspecies. Despite claims by locals that cockatoos ("white parrots") have been seen near the mangrove areas, the birds were not observed during the survey. Further study on other forest patches of Masbate Island may yet result in the discovery of significant populations of threatened and endemic species of birds.

Introduction

The Philippines is remarkably rich in terms of its high percentage of endemic wildlife. The complexity and diversity of its fauna is enhanced by the archipelagic nature of the islands where species are limited to only one island or group of islands. The West Visayas group of islands, composed of Negros, Panay, Masbate, Cebu, Guimaras, and Ticao, is one of the most important regions in the country both in terms of number of bird species under threatened conditions and the level of threats (Stattersfield *et al.,* 1998).

The Island of Masbate lies in the center of the Philippine archipelago, between Panay on the west and Burias and Ticao islands on the north and eastern portion, latitudes 11° 43' North and 21° 36' North, 123° 36' East and 124° 15' East. It has a land area of 404 km^2. The province of Masbate has three main islands: Burias, Ticao, and Masbate. The remaining forest resources of the province are found mainly on the rugged slopes of northeastern Masbate, particularly Mobo. Some forest is also found along the steep and rugged slopes and summits of the ranges of Manamoc.

Masbate holds a number of Philippine and West Visayan endemic species. This study aimed to identify the remaining lowland forest of the islands and determine the conservation status of the West Visayan endemic subspecies and its forest.

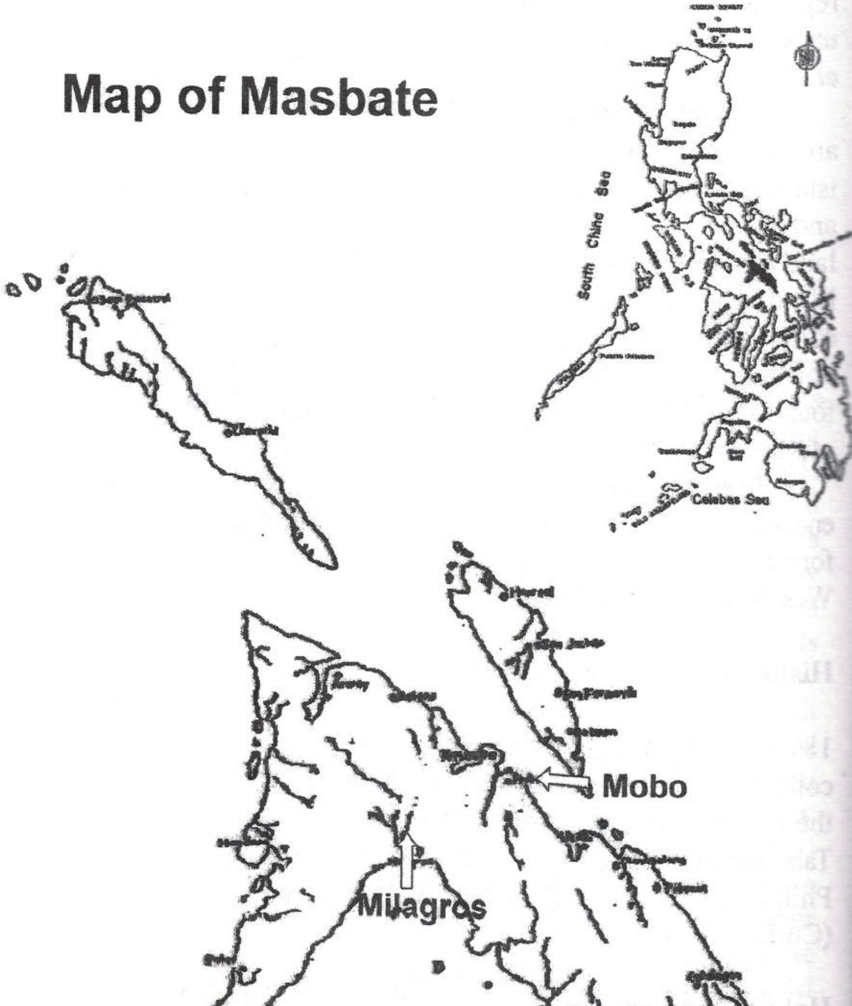
History of Ornithological Exploration

Steere conducted early collections in Masbate in 1888. In 1892 the Menage Expedition surveyed the island. McGregor collected in 1902 and Bartsch in 1908. Information provided by the collections was summarized in Dickinson *et al.* (1991). Tabaranza (1992) visited the island with particular interest in the Philippine Cockatoo. The island was revisited by Curio in 1992 (Curio, 1994).

Habitat Description

The plantation forest of Tugbo Watershed Forest Reserve in Masbate was visited on 15-19 July 2001. The site is a protected area managed by the Department of Environment and Natural Resources (DENR), and covers an area of 246.95 has. It is characterized by second growth and abandoned clearings replanted with Narra (*Pterocarpus indicus*), Raintree, *Gmelina arborea*, Mahogany (*Sweitenia macrophylla*), and *Acacia auricoliformis*

Map of Masbate



(PPDO-Masbate, 2000). The average tree height is 10 m (n=20; range= 6 – 15 m) with average diameter at breast height of 90 cm (n=20; range=40-160 cm). Vines are rare and epiphytes are limited to a few fern species. A thin layer of leaf litter covered the substrate. Coconuts have been planted in almost all of the portions of the watershed.

The forest in Milagros is located in the interior part of the town. The lowland secondary growth forest covers around 60 ha and is mostly dominated by *Ficus* spp. A number of *Ficus* species were fruiting at the time of the visit. Surrounding the forest are grassland and agricultural areas planted with mango and other agro-forestry products.

METHODS

The islands harbor patches of forest of less than 100 hectares. Point counts and deliberate search were conducted in both areas. All birds seen and heard were identified and recorded using *A Guide to the Birds of the Philippines* (Kennedy *et al.*, 2001).

Mist nets measuring 6m long by 4m wide were also used to capture birds. Nets were distributed along ridge tops, near fruiting trees, and in the forest understory to maximize the number and variety of birds caught. Nets were regularly checked (every 1-2 hrs) for captured birds. Biometrical data were obtained for each bird species captured before release.

Informal interviews were also conducted to ascertain the presence of significant patches of forest and to gather information on species readily obtained by direct observation. Information on land use, threats, and presence of key species was also collected.

RESULTS

A total of 55 resident species were recorded during the survey, including four species new to the island, which produce a combined Masbate total of 95 species along with the previous list provided by Dickinson *et al.* (1991). The most significant result was finding the Visayan Tarictic Hornbill *Penelopides panini panini* in an isolated forest patch in Milagros. A total of three individuals, two males and one female, were sighted on different occasions. The Philippine Hawk Owl form unique to Masbate (*Ninox philippensis proxima*) was also recorded (Table 1). Vocalizations were obtained and currently being compared with other subspecies of Philippine Hawk Owls.

Four new species for Masbate were recorded during the visit. These include the Spotted Dove (*Streptopelia chinensis*), Zebra Dove (*Geopelia striata*), Lovely Sunbird (*Nectarinia sperata*), and Chestnut Mannikin (*Lonchura leucogastra*). Both the Spotted Dove and Zebra Dove were introduced to the Philippines but have established residence in open country and cultivated areas. The range of these species is expanding and the record for Masbate Island adds up to its new distribution record.

Several species of doves were observed feeding on fruiting trees in Milagros. These included the Pompadour Pigeon, Pink-necked Fruit Dove, White-eared Brown Dove, Emerald Dove, and the Spotted Dove. The Pompadour Pigeon was the most abundant in the area. Although commonly encountered, the pigeons were heavily hunted for food and the pet trade.

Subspecies endemic to the island

Nine of the 16 endemic subspecies of birds in Masbate were confirmed during the survey. The Philippine Bulbul form (*Hypsipetes philippinus guimarensis*) was the most frequently encountered bird, followed by the Blue-headed Fantail (*Rhipidura cyaniceps albiventris*), White-browed Shama (*Copsychus luzoniensis superciliaris*), and Coppersmith Barbet (*Megalaima haemacephala homochroa*). The other species were represented by either one or two records. Majority of the larger species of forest birds (White-bellied Woodpecker, Philippine Oriole, Bar-bellied Cuckooshrike, and Greater Flameback) were not encountered during the survey. With very little forest left in Masbate and the absence of large, tall species of trees, it is unlikely that these species still survive in the 60 ha forest patch in Milagros and in the Tugbo watershed.

Table 1. Endemic subspecies of birds in West Visayas occurring in Masbate. Numbers in parenthesis represent individuals mist-netted; numbers outside parenthesis refer to individuals observed during sampling. Not sighted is indicated by —.

Endemic Subspecies	Common Name	Tugbo	Milagros
Ninox philippensis proxima	Philippine Hawk Owl	2	1
Penelopides panini panini	Visayan Tarictic Hornbill	—	3
Dryocopus javensis philippinensis	White-bellied Woodpecker	—	—
Picoides maculates maculatus	Pygmy Woodpecker	—	—
Chrysocolaptes lucidus xanthocephalus	Greater Flameback	—	—
Megalaima haemacephala homochroa	Coppersmith Barbet	—	4
Coracina striata panayensis	Bar-bellied Cuckooshrike	—	—
Hypsipetes philippinus guimarasensis	Philippine Bulbul	36 (3)	65
Oriolus steeri nigrostriatus	Philippine Oriole	—	—
Parus elegans albescens	Elegant Tit	—	—
Dicrurus balicassius mirabilis	Balicassiao	—	—
Copsychus luzoniensis superciliaris	White-browed Shama	9 (2)	4
Rhipidura cyaniceps albiventris	Blue-headed Fantail	22 (8)	30
Pachycephala homeyeri winchelli	White-vented Whistler	3 (1)	2
Dicaeum trigonostigma dorsale	Orange-bellied Flowerpecker	5 (1)	2
Zosterops nigrorum nigrorum	Golden-yellow White-eye	—	—
Total number of subspecies		**6**	**8**

Threatened Species

The Philippine Duck (*Anas luzonica*) was historically abundant in Milagros, Masbate (MacGregor, 1909) while Dickinson *et al.* (1991) reported the species to be still fairly common. Locals have reported the presence of ducks in several localities in Masbate (Milagros, Matipuron, and Aroroy). However, surveys are still needed to confirm the status of the Philippine Duck and ascertain whether the reported duck belongs to this particular species and not to the Wandering Duck. The Philippine Duck was not observed during the survey.

The Philippine Cockatoo (*Cacatua haematuropygia*) was found on Masbate (Dickinson *et al.,* 1991) and about 50-70 individuals were reported in 1992 by Tabaranza (Collar *et al.,* 1998). Several individuals were also reported at Matipuron at the 7-R ranch in 1992 by Curio (Collar *et al.,* 1998). The Cockatoo was not recorded in the watershed area during fieldwork. Although local officials have expressed awareness of the presence of "white parrots" on Matipuron, this information still needs further verification.

The Visayan Tarictic Hornbill was once very common in Masbate in 1880 and 1909 (F.S. Bourns and D.C. Worchester, 1894; MacGregor, 1909). The most recent record was made in 1992 (Curio, 1994). During the survey, a pair of Visayan Tarictic Hornbill was observed perched on a branch and moving from one forest patch to the nearest forest patch. On another separate occasion, a lone male was observed silently perching on a branch. Twice the hornbills were heard calling in mid-morning.

Two of the threatened species recorded on the island, Rufous-lored Kingfisher and Blue-naped parrot, were not encountered during the survey. With very little available habitat, it is very likely that these two species are now extinct on the island.

DISCUSSIONS

The watershed areas of Tugbo and Milagros still hold several species of birds unique to the West Visayas and may stand as the last refuge for these birds. Table 1 shows the current status of the 16 endemic subspecies of birds recorded on Masbate. A total of 9 species, most of which are dependent on deep forest were no longer observed and may now possibly be extinct on the island. This represents 50% of the total endemic taxa recorded on the island.

The deforestation of Masbate has therefore caused extinction of birds on the island. Those that remain are also under severe pressure of becoming extinct. With only three individuals of Visayan Tarictic Hornbill left in a very small patch, the chance of the species surviving in the next few years is remote. The remaining native forest patch is slowly being converted into an agricultural land and the rest of the surrounding areas have been converted into pastureland. There are very few tall trees left within the forest and even these are slowly being cut for timber.

Areas formerly classified as forests in Masbate are now almost devoid of forest cover. Trees in watershed areas are largely composed of replanted exotic species of trees. In most areas visited, either grassland/pastureland, or coconut plantation surrounds the forest. Where native vegetation can still be found, agricultural encroachment is slowly reducing the forest size. In Tugbo Watershed, forest guards have been assigned to maintain and protect the watershed from contamination through human activities, logging, and hunting of wildlife. Yet, despite such active protection, hunting activities targeting larger species of birds and bats have been observed in the area. Frogs were also reportedly captured for food.

In the lower portions of the watershed, small-scale mining and quarrying activities have been observed. These activities pose as a possible threat to the remaining habitat within the watershed. Attempts to mine and quarry inside the watershed have created pressure on local public officials as well as on the people living within the immediate boundaries.

CONCLUSIONS

Habitat loss caused by human intervention is the primary reason why endemic species of Masbate have become endangered and extinct. Only 44% of the endemic subspecies were observed (Philippine Hawk Owl, Philippine Bulbul, White-browed Shama, Blue-headed Fantail, White vented Whistler and the Orange-bellied Flowerpecker) surviving on remnant forest patches. The Visayan Tarictic Hornbill is very well near extinction, surviving only on a 60 hectare, isolated forest patch.

Although only very small isolated patches of degraded forest remain, these are still under severe pressure of being burned and cut down in favor of pastureland. Even in this state, hunting which targets larger species of vertebrates still continues.

RECOMMENDATIONS

1. Species Protection and Habitat Rehabilitation

There is very little forest left in Masbate and yet within these tiny patches of forest, the endemic species of birds in Masbate survive. It is only in these areas where one can hear the call of the Masbate form of Philippine Hawk Owl (*Ninox philippensis proxima*). Even to this date, little is known of the taxonomy and status of Hawk owls and with the fast disappearance of the forest, it may be too late before we have the chance to study this.

Replanting of trees, particularly in watershed areas in Mobo, should encourage endemic and native species of trees. Private land owners with significant forest patches should be mobilized to protect remaining forest patches and to replant native trees. On the other hand, the DENR should inventory the trees, monitor tree-planting projects, and initiate measures that ensure their protection. Rehabilitation through reforestation activities should continue using endemic species. Hunting should also be prohibited specially on larger species of birds.

2. Research

There is a need to survey other remnant second growth forest in Masbate. The limited record on the endemic subspecies of owl in Masbate and Ticao necessitates further survey on the local distribution of the species. With the current updating of the taxonomic status of Philippine Hawk Owl, an ecological study on the species is very much needed.

3. Conservation Awareness

There is a need to increase the level of awareness of the general public as well as the local and provincial policy makers in Masbate. The importance of the watershed area and the intricate relationship of its wildlife inhabitants should be instilled among the local stakeholders.

Conservation education may be carried out through the Dalaw-Turo program of DENR in collaboration with other related institutions. One way in which long-term conservation education action may be achieved is by incorporating conservation and environmental issues in the curricula and providing schoolteachers (preferably elementary and high school) the necessary skills and teaching strategies to enable them to introduce these issues into their classrooms.

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Appendix A. Bird species list of Masbate compiled from Dickinson *et al.* (1991) and compared with the data generated from the survey in July 2001 and March 2002. Species in bold are Philippine endemics. R means the species was reported in the area but was not observed in the sampling site. Numbers in parenthesis refer to number of individuals caught. C means common, UC means uncommon, and FC means fairly common.

SPECIES NAME	COMMON NAME	DKP	2001	2002
Dendrocygna arcuata	Whistling Duck	X	--	--
Anas luzonica	**Philippine Mallard**	X	R	R
Haliastur indus	Brahminy Kite	X	R	5
Haliaeetus leucogaster	White-bellied Sea Eagle	X	R	--
Pernis celebensis	Barred Honeybuzzard	X	--	--
Spilornis cheela holospilus	Crested Serpent Eagle	X	--	--
Butastur Indus	Grey-faced Buzzard	X	--	--
Circus melanoleucos	Pied Harrier	X	UC	8
Megapodius cumingii	Tabon Scrubfowl	X	--	--
Coturnix chinensis	Blue-breasted Quail	X	UC	1
Gallus gallus	Red Junglefowl	X	R	--
Gallirallus torquatus	Barred Rail	X	R	1
Amaurornis phoenicurus	White-breasted Waterhen	X	--	--
Gallicrex cinerea	Watercock	X	--	--
Treron vernans	Pink-necked Pigeon	X	--	7
Treron pompadora	Pompadour Pigeon	X	--	17
Phapitreron leucotis	**White-eared Brown Dove**	X	FC	11
Ducula aenea	Green Imperial Pigeon	X	--	--
Ducula bicolor	Pied Imperial Pigeon	X	--	--
Macropygia phasianella	Reddish Cuckoo-dove	X	--	--
Chalcophaps indica	Emerald Dove	X	(3) FC	7

SPECIES NAME	COMMON NAME	DKP	2001	2002
Streptopelia chinensis	Spotted Dove	--	--	12
Geopelia striata	Zebra Dove	--	--	6
Cacatua haematuropygia	**Philippine Cockatoo**	X	R	R
Prioniturus discurus	**Blue-crowned Racquet-tail**	X	--	--
Tanygnathus lucionensis	**Blue-naped Parrot**	X	--	--
Loriculus philippensis regulus	**Philippine Hanging Parakeet**	X	--	--
Ninox philippensis proxima	**Philippine Hawk Owl**	X	UC	1
Cacomantis merulinus	Plaintive Cuckoo	X	--	--
Eudynamys scolopacea	Koel	X	UC	11
Centropus viridis	**Philippine Coucal**	X	UC	10
Caprimulgus manillensis	**Philippine Nightjar**	X	UC	1
Hemiprocne comata	Lesser Treeswift	X	--	--
Collocalia esculenta	Glossy Swiftlet	X	C	20
Collocalia troglodytes	**Pygmy Swiftlet**	X	C	--
Alcedo atthis	Common Kingfisher	X	--	--
Alcedo cyanopectus	**Indigo-banded Kingfisher**	X	--	--
Halcyon capensis	Stork-billed Kingfisher	X	--	--
Halcyon smyrnensis	White-throated Kingfisher	X	--	1
Halcyon chloris	White-collared Kingfisher	X	(7) C	1
Merops viridis	Blue-throated Bee-eater	X	--	1
Merops philippinus	Blue-tailed Bee-eater	X	--	--
Eurystomus orientalis	Dollarbird	X	--	--
Penelopides panini	**Visayan Tarictic Hornbill**	X	--	3
Megalaima haemacephala homochroa	Crimson Barbet	X	--	4
Dryocopus javensis	White-bellied Woodpecker	X	--	--
Pitta sordida	Black Hooded Pitta	X	(1) FC	1

SPECIES NAME	COMMON NAME	DKP	2001	2002
Pitta erythrogaster	Red-bellied Pitta	X	(1) UC	1
Hirundo rustica	Barn Swallow	X	---	1
Hirundo tahitica	Pacific Swallow	X	X	1
Hirundo daurica	Red-rumped Swallow	X	---	---
Coracina striata	Bar-bellied Cuckoo-shrike	X	---	---
Pycnonotus goaivier	Yellow-vented Bulbul	X	C	23
Hypsipetes philippinus	**Philippine Bulbul**	X	(3) C	65
Oriolus chinensis	Black-naped Oriole	X	UC	29
Oriolus steeri nigrostriatus	**Philippine Oriole**	X	---	---
Corvus macrorynchus	Large-billed Crow	X	---	4
Parus elegans	**Elegant Tit**	X	---	---
Rhabdornis mystacalis	**Striped-headed Rhabdornis**	X	---	---
Lalage nigra	Pied Triller	X	---	8
Luscinia calliope	Siberian Rubythroat	X	---	---
Copsychus saularis	Oriental Magpie-Robin	X	UC	2
Copsychus luzoniensis	**White-browed Shama**	X	(2) FC	4
Monticola solitaria	Blue Rock-thrush	X	---	---
Saxicola caprata	Pied Bushchat	X	UC	---
Megalurus timoriensis	Tawny Grassbird	X	UC	7
Megalurus palustris	Striated Grassbird	X	UC	2
Orthotomus castaneiceps	**Philippine Tailorbird**	X	C	8
Phylloscopus borealis	Arctic Warbler	X	---	2
Cisticola exilis	Bright-capped Cisticola	X	UC	---
Cyornis rufigastra	Mangrove Blue Flycatcher	X	(1) FC	4
Muscicapa griseisticta	Grey-streaked Flycatcher	X	---	---
Rhipidura javanica	Pied Fantail	X	UC	4

SPECIES NAME	COMMON NAME	DKP	2001	2002
Rhipidura cyaniceps albiventris	**Blue-headed Fantail**	X	(8) C	30
Pachycephala homeyeri	**White-vented Whistler**	X	(1) UC	2
Hypothymis azurea	Black-naped Monarch	X	FC	4
Motacilla cinerea	Grey Wagtail	X	---	---
Motacilla flava	Yellow Wagtail	X	---	2
Anthus gustavi	Pechora Pipit	X	---	2
Anthus novaeseelandiae	Richard's Pipit	X	---	---
Artamus leucorhynchus	White-breasted Wood Swallow	X	FC	6
Lanius cristatus	Brown Shrike	X	---	6
Lanius schach	Long-tailed Shrike	X	---	---
Aplonis panayensis	Asian Glossy Starling	X	C	7
Sarcops calvus	**Coleto**	X	UC	3
Nectarinia jugularis	Olive-backed Sunbird	X	FC	14
Aethopyga shelleyi	Lovely Sunbird	X	---	---
Nectarinia sperata	Purple-throated Sunbird	---	---	1
Anthreptes malaccensis	Plain-throated Sunbird	X	UC	3
Dicaeum trigonostigma dorsale	Orange-bellied Flowerpecker	X	(1) UC	2
Dicaeum pygmaeum	**Pygmy Flowerpecker**	X	UC	2
Dicaeum australe	**Red-keeled Flowerpecker**	X	UC	3
Zosterops nigrorum	Golden-yellow White-eye	---	---	---
Lonchura leucogastra	White-bellied Munia	---	(1) UC	---
Lonchura malacca	Chestnut Munia	X	UC	17
Total species		**95**	**45**	**55**

SAVING A PHYSICALLY-CHALLENGED ECOSYSTEM: Who takes charge of the Mt. Talinis - Twin Lakes Forest Reserve?

Angelita M. Cadeliña, Apolinario B. Cariño, and Cynthia N. Dolino

ABSTRACT

This paper gives an overview of the wildlife conservation concerns of Lake Balinsasayao Protected Area, which form the basis for the objections by environmentalists to the efforts of influential politicians to reduce the Protected Area. Several major reasons have been advanced for the retention of the existing PA size. First, the area is a major watershed supplying water to municipalities of Southern Negros; reduction will mean conversion to other land uses that might impinge on its water-storing capacity. Second, the area is home to about 16 threatened species of mammals, amphibians, reptiles, and birds; and reduction of the area would also mean reduction of their roosting and feeding range. Third, the encroachment by other land users of the reduced buffer and protection zone will hasten the loss of biodiversity and resiliency after major perturbations like tornado or severe storms.

Introduction

Addressing the question about his environmental vision, Yitzhak Goren, Director General of the Ministry of Environment of Israel said, "I believe that the time has come to develop such tools as green accounting and green taxes which impose financial responsibility on those who generated pollution." Although the "polluter pays" principle is not a new thing, it will not be out of place to invoke it here if only to remind the Filipinos of their part in the continuing devastation of the environment. As it is now, the victims of pollution are the ones paying—the cancer victims, the deformed children, the barren, unproductive land, the silted rivers, the hungry people. It is still a struggle between those who want to protect the remaining natural heritage and those who want to advance their own economic agenda. Those belonging to the latter group never take into account the environmental concerns when carrying out their economic policy decisions.

It should be noted that the Philippines is called one of the ten biodiversity "hotspots" in the world and a priority for biodiversity conservation. In terms of biodiversity and endemism, it is probably the richest country in the world. Nearly one third of the country's 12,000 plant species are found nowhere else. Its waters have more than 500 of the world's 700 known species of corals. The country is recognized to have the highest endemism of plants and vertebrate animals per area in the world. It is for this reason that protecting the remaining treasures is of utmost urgency.

The Mt. Talinis-Twin Lakes (MTTL) Forest Reserve is one of the most important but critically endangered ecosystems in the Philippines. Known popularly as the Southern Negros Forest Reserve, it is within the jurisdiction of the 133,000-hectare Philippine National Oil Company (PNOC) geothermal reserve. The area is marked by several lakes, which were once the sites of volcano craters from which the name crater lakes comes. But the largest and the most beautiful of the lakes are the Twin Lakes of Balinsasayao and Danao (see Fig. 1 in Dolino, *et al.*, this volume). The lakes are about 850 m ASL (coordinates 9° 21' N, 123° 10' E) and the submontane forest surrounding it rises about 1,050 m. Although Mt. Talinis rises above 6,000 m ASL, these days the lake area can be reached by a motor vehicle such as a motorcycle or a non-4 wheel drive vehicle due to improved road system, 15 km northbound and to the west's all-weather roads 17 km off the highway. With a surface area of 76 ha, Lake Balinsasayao is three times bigger than its twin, Lake Danao, which has 28 ha. Maximum depth of Balinsasayao is 90 m and Danao 55 m. Variations in depth and hectarage coincide with rainfall intensities. The Twin Lakes are bordered by Mt. Kalbasaan on the north, Mt. Nahungot on the south, Mt.Balinsasayao on the west, and Mt. Guintabon on the east.

Economic and Environmental Dilemma: The Proposed Excision of the Twin Lakes Area Size

In the Philippines the environmental agenda has always been subordinate to the economic one and the government's environmental policy has never been one of prevention but treatment, except that the treatment always comes too late. This situation is very well reflected in the poverty alleviation agenda of the present government. It is clear that widespread poverty is a result of the decimation of our environmental resources by government-sanctioned economic activities which license the affluent few to carry out massive exhaustion of mineral and biological resources without the need to share profits equitably with those who are supposed to manage these resources – the rural dwellers.

And yet this country is not lacking in preventive laws meant to "conserve, check or deter environmental degradation." For example, RA 6147 declares the Philippine Eagle as a protected bird while the Natural Integrated Protected Areas System Act "sets up a system to protect and preserve natural areas for future generations by granting rights and prohibiting certain acts". Proclamation 2146 lists environmentally critical areas (ECA) and projects within the scope of the EIA system (1981). But in the same instance, LOI 1179 authorizes the President to exempt projects from the EIA system. This means that the President can allow the taking out of a portion of the previously proclaimed area (e.g. Proc. No. 414 series of 2000 declaring the 8000 ha Twin Lakes area as a Protected Area, now called Balinsasayao Twin Lakes Natural Park pursuant to RA 7586) so that a state-sponsored project such as mining or geothermal exploration may be carried out in this portion.

Historical Background

Data from surveys, researches, and technical working group (TWG) outputs carried out from the 1980s and from 1994 to the 2003 provide the historical basis for this paper. The management strategies implemented in the area by the communities have been drawn from the collaborative work between CenTrop-TMF staff and participants from People's Organization. Technical assistance to local managers is based on community-validated outputs of surveys done by researchers from the academe and from the biomonitoring activities learned by the local people from the Biomonitoring and Evaluation (BIOME) staff of CenTrop.

The Mt. Talinis-Twin Lakes Area Management Framework Plan and the PAMB Managed Balinsasayao Twin Lakes Natural Park

The Plan is a set of policies that lays the framework for the management of the 15,287 hectare Mt. Talinis-Twin Lakes Area situated within the 133,000 ha geothermal reserve. Facilitated by FPE-CENTROP-TMF partnership staff in December 2000, the Plan was formulated by the area stakeholders comprising of officers of Peoples Organization, Local Government Units, and officials of the Department of the Environment and Natural Resources. It is intended as a guide for all concerned agencies, institutions, and private groups which undertake conservation activities and intervention initiatives aimed at protecting the environmental integrity of Mount Talinis and Twin Lakes areas.

With the assistance of the technical working group, the stakeholders divided the area into various zones and laid down the permitted and allowable activities within each zone. The strict protection zone is similar to a "forest sanctuary." In July of 2002, the Protected Area Management Board (PAMB), whose members were appointed by DENR, was given the authority to manage the 8000 ha Balinsasayao Twin Lakes Natural Park, pursuant to the National Integrated Protected Area System (NIPAS) Act. The PAMB members then started the zoning of the Protected Area into: 1) strict protection zone; 2) buffer zone; 3) multiple use zone, and others. The rationale for zoning was similar in principle to that of the broader Area Management Framework Plan.

Then House Bill No. 1462 was introduced proposing the reduction of the Balinsasayao Twin Lakes Natural Park from 8749 ha to a mere 3,749 ha. This sparked a massive protest from all sectors of Dumaguete – students, environmentalists, researchers, and academics (CenTrop Files, Vol. 5, Issue No. 1, February 2004). Although Congress has quashed the bill in October 2004, there is some possibility that influential sectors might still lobby to revive the idea.

Why Protect the Mt. Talinis-Twin Lakes Area

The most urgent reason for protecting the Mt. Talinis-Twin Lakes area is that it is a major watershed. The two major watershed systems of Negros Oriental, the Mt. Talinis watershed and the Lake Balinsasayao watershed, supply water to most of southern Negros and vicinity. It has the largest contiguous forest in southern Negros Oriental (about 16,992 ha or 13% of timberland). It is home to many birds, plants (predominantly *Shorea polysperma, S. negrosensis, Syzygium nitidum*), and animals (high biodiversity) some of which are found only in the Philippines (high endemism) and even limited only to Negros and Panay area. It is reputed to be the habitat of the Visayan spotted deer, an endemic but endangered species. It is located within the area of the 133,000 ha geothermal energy reserve. It is known to be rich in mineral deposits. Its lower slopes are vast and fertile agricultural lands. Up to 87% of its 126,745 hectare timberlands have been deforested and converted to other land uses such as agriculture and settlement.

The area is forest habitat for globally threatened species of herps, birds, and mammals. The Twin Lakes area harbors 180 tree species, 49 herpetofaunal species, 126 bird species, and 27 mammalian species. The table below provides a list of the globally threatened species.

Species Name	IUCN status
1. Philippine Spotted Deer – *Cervus alfredi*[1]	Endangered[1]
2. Visayan Warty Pig – *Sus cebifrons*[1]	Critically Endangered[1]
3. The Philippine Tube-nosed Fruit Bat – *Nyctimene rabori*[1]	Critically Endangered[1]
4. The Golden-crowned Flying Fox – *Acerodon jubatus*[1]	Endangered[1]
5. Little Golden-mantled Flying Fox – *Pteropus pumilus*[1]	Vulnerable[1]
6. The Negros Shrew – *Crocidura negrina*[1]	Critically Endangered[1]
7. The Philippine Leopard Cat – *Prionailurus bengalensis*[1]	Endangered[1]
8. Negros Bleeding Heart – *Gallicolumba keayi*[2]	Critically Endangered[2]
9. Writhed-billed hornbill – *Aceros waldeni*[2]	Critically Endangered[2]
10. Visayan Hornbill – *Penelopides panini*[2]	Endangered[2]
11. Flame-templed Babbler – *Dasycrotapha speciosa*[2]	Endangered[2]
12. White-throated Jungle Flycatcher – *Rhinomyias albigularis*[2]	Endangered[2]
13. White-winged Cuckoo-shrike – *Coracina ostenta*[2]	Vulnerable[2]
14. Visayan Flowerpecker – *Dicaeum haematostictum*[2]	Vulnerable[2]
15. Celestial Blue Monarch – *Hypothymis coelestis*[2]	Vulnerable[2]
16. Negros Forest Frog – *Platymantis negrosensis*[3]	Endangered[3]
17. Hazel's Forest Frog – *P. hazelae*[3]	Endangered[3]
18. Common Forest Frog – *P. dorsalis*[3]	Near Threatened[3]
19. Visayan Fanged Frog – *Limnonectes visayanus*[3]	Near Threatened[3]
20. Everett's Frog – *Rana everetti*[3]	Near Threatened[3]
21. Sailfin Water Lizard – *Hydrosaurus pustulatus*[1]	Vulnerable[1]
22. Rough-necked Monitor Lizard – *Varanus salvator nuchalis*[1]	Near Threatened[1]
23. Reticulated Python – *Python reticulatus*[1]	Near Threatened[1]

Legend: [1]IUCN Red List of Threatened Species 2000; [2] Birdlife International 2004; [3]Global Amphibian Assessments 2004

The herpetofauna of Negros Island is the best-studied in terms of systematics and ecology compared to those of the larger islands of the Philippines. Scientists associated with Silliman University and their research collaborators have been conducting research on frogs, lizards, and snakes since the mid-1950s of which a number of scientific papers, monographs, and books have been published by W. C. Brown and A. C. Alcala (1950s to1998), R. M. Brown, W. C. Brown, A. C. Alcala, and A. C. Diesmos (early 2000s) and others. Much of the fieldwork has been conducted in the remaining tropical rain forest of Cuernos de Negros and Twin Lakes Balinsasayao area. These studies provide reliable data in making an annotated list of herpetofaunal species that are common, rare, or threatened with extinction.

Habitat alteration, hunting, and persistent pollutants (sulfur dioxide from the geothermal plant) are the common stress factors impacting on the avifauna of the Twin Lakes area. The outputs for birds and the result of anecdotal reports have been gathered from the 10 different barangays of the MTTL since 1994 and from actual visual censusing using transect walk done by the participants of the Biomonitoring and Evaluation (BIOME) in 2003. Bird hunters were also asked to identify the bird species and the place where the birds were caught or hunted. The birds reported in 1994 included those found in highly disturbed areas such as the brushland and grass meadows. The frequency of mention by respondents for all bird species in 1994 indicates that species diversity is high in the Calinawan area compared to other areas in the MTTL. There were 62 species of birds mentioned out of the total species, and these include the critically endangered bleeding heart pigeon (*Gallicolumba keayi*) and the hornbills (*Penelopides panini* and *Aceros waldeni*). Since the bird species are the most numerous in the 4 major areas monitored in the MTTL they constitute the bulk of species listed from the transect walk and cruise. (Please see Annex C in Dolino, *et al.*, this volume, for the complete listing).

Previous pioneering studies on the mammalian fauna of the Twin Lakes Balinsasayao and Danao include those of Rabor *et al.* (1970), Heaney *et al.* (1981), Heaney *et al.* (1989), Heaney and Utzurrum (1991), Heideman *et al.* (1987), Heideman and Heaney (1989), Utzurrum (1984), Utzurrum (1992), RSA (1994) and unpublished reports of the CenTrop-FPE biomonitoring project (2001-2003).

The lake waters do not harbor any native fish. The bigger lake is stocked with tilapia (*T. mosambica*), carp (*Lyprinus carpio* and haloan (*Opliscephalus stuatus*). Fishing in the lake is done purely for leisure if not for subsistence consumption.

Resource Users Against Constricting the PA in the Twin Lakes Area

The Twin Lakes area represents the only remaining forest patch in southern Negros. In the 70s the primary forest cover was still 30-40%. However, based on Swedish Space Satellite data of 1988, it has dwindled to a mere 4%. The 2 major factors for the decrease are illegal logging and *kaingin*. These two activities continue to this day in spite of the presence of POs and DENROs *bantay-lasang* (forest guards). The perpetrators of these illegal activities do not belong to any of the established people's organizations whose activities are facilitated by TMF and CenTrop. Neutralizing these illegal activities is indeed a big challenge to the POs. There is therefore a need for PAMB to double its efforts in managing the area and putting a stop to these illegal activities. To date, the zonation of the protected area is still going on. Reducing the area further would make this task more difficult.

It must be recalled that although a number of conservationists, and later CenTrop, through its FPE-partnership, started lobbying for the inclusion of MTTL as a NIPAS area since the mid and late 90s, it was only in November 2000 that Proclamation No. 414 was signed by the then President Joseph E. Estrada declaring the Balinsasayao Twin Lakes as Natural Park. The proclaimed area is just 8000 hectares and is under the management and jurisdiction of DENR-PAMB. Therefore, this area excludes the Mt. Talinis region. Considering that the entire forest is situated within the 133,000-hectare geothermal reserve, this 8000-hectare protected area is indeed very small. Reduction of the protected area would mean further constricting the PAMB's protective jurisdiction. During PAMB meetings, representatives from various barangays of Mt. Talinis-Twin Lakes have fully expressed their sentiments against the exploration work of INDOPHIL and the possible reduction of the protected area.

Summary of Reasons for the Retention of Protected Area Size and Recommendations

The management of extractive activities in the Philippines has still not improved. These activities have not in anyway enhanced the economic life and health of the community as reflected in the experience of Basay CDCP mining in 1979. The abandonment scheme was so poorly planned that the rehabilitation was a massive task. The MARCOPPER mining disaster, which caused serious health and environmental problems and placed the community of Marinduque at risk, is another classic example. Unless there is an improved mining exploration management, the Natural Park and the surrounding communities will be doomed to extinction along with the globally threatened species earlier mentioned.

As cited by Tiempo, *et al.* (2001), the sustained programs of habitat rehabilitation and protection in the MTTL area could develop forest corridors among the remaining forest fragments adjoining the bat sanctuary in Calinawan (partly of Sta. Catalina and Sibulan mainly) giving better chances of wildlife survival. A reduction of the area will definitely eliminate this chance.

Providing security of tenure (e.g. Community-Based Forest Management Agreement in a non-NIPAS Calinawan area) and environmentally friendly alternative livelihood programs has been found to be effective in the FPE CenTrop-

TMF project areas. There is no known PO member who is doing *kaingin* or illegal logging of trees in the area. The PO members are currently doing sustainable agriculture, organic fertilizer production, duck and vegetable raising. The only alternative livelihood that can be offered in mining activities are wage-work and unskilled labor and therefore short-term economic return. That such activities pose hazards to human and environmental health is well known.

A lot remains to be done for the protection of MTTL. Since it is supporting an electricity generating plant, it should be proclaimed as a critical watershed to prevent exploitative activities and settlement in the area. Yet, until 2003 it has not been listed as such. For the same reason, it should be considered an environmentally critical area and should belong to (ECA) network. This will ensure protection of this environmentally vulnerable area. In addition, the management of the area should be given to the indigenous inhabitants. This legal and enabling framework along with NIPAS and PAMB Management Framework will hopefully deter moves to counter the protective efforts done by those who have a high stake in the area.

Wildlife Biomonitoring Activities done by various POs are already in place under the aegis of the FPE-CenTrop BIOME project. Members of various people's organizations who took part in the BIOME training using the combined methods of transect cruise and walk, ocular survey using field diaries and photodocumentation, and focus group discussions have participated in wildlife biomonitoring activities. The participants carried out the ethnobiological survey and monitoring in the major mountain areas of MTTL. As a result of participation in the BIOME project, members of people's organizations have learned the value of wildlife protection. In this work, a wider range of protected area will give them more freedom of movement. Conversely, reducing the area will restrict their movement to the SPZ (Strict Protection Zone) to be declared by PAMB officially. Since the portion outside this area would no longer be under the jurisdiction of DENR, the wildlife protection and monitoring activities of the POs would be difficult to sustain.

PNOC's environmental responsibility of maintaining the forest vegetation has not met with success. "Bowl" forests, where the middle of the forest is cleared, have left great expanse of clearing planted to abaca or *cayote* in the middle of the MTTL. Clearings for recreation sites were also allowed in the reserve area. This is the order of the day for areas outside the current PA.

Acknowledgments

We wish to acknowledge the Foundation for the Philippine Environment (FPE) for almost a decade of support in the conservation of the Mt. Talinis and Twin Lakes. The same goes to the cooperating communities, especially the PO members who have always involved themselves in various conservation activities. Likewise, we are grateful to the Fauna and Flora International (FFI) through its Coordinator of the Philippine Programme, William Oliver, for supporting the captive breeding and research studies of endangered endemic species. Other partners in conservation that supported our research studies include: Bat Conservation International, Lubee Foundation, AZA Bat Taxon Advisory Group Small Grants Program, BP Conservation Programme, and Bristol Zoo. Our appreciation goes to the Ting Matiao Foundation for its biodiversity conservation efforts in Mt. Talinis and surrounding communities. We also thank in particular, the Biology Department through its chairperson, Mrs. Mirasol N. Magbanua, and the rest of the faculty and staff for their continuing logistical support and the much-needed encouragement. To the support staff and volunteers of CenTrop: S. Villegas, S. M. Villagante, G. Flores, Dr. G. Acuña, J. Diputado, A. Inocencio, L.J. Cerial, V. Futalan, L. Futalan, R. Vendiola, C.C. Catan, P. Lumhod, F. Catalbas and US Peace Corps Volunteers H. Fairbank, J. Hanna, M.L. Van Hoffman, M. Slavin, N. Sanchez, H.I. Roberts and J. Speicher go our heartfelt thanks for the various types of assistance to carry out the objectives of our conservation initiatives. To the Governor of the Province of Negros Oriental, Hon. George Arnaiz, and Vice Governor, Hon. Jose "Petit" Baldado, together with the Local Government Units of the municipalities of Valencia (Mayor Rodolfo Gonzales), Sibulan (Mayor Antonio Renacia), Dauin (Mayor Rodrigo Alanano), and San Jose (Nelson S. Ruiz) our gratitude for their support and assistance. Most importantly, we thank Prof. Felina A. Tiempo for her technical assistance, and Neil Aldrin D. Mallari and Dr. Angel C. Alcala for the initial review of the manuscript.

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In Turbulent Seas: The Satus of Philippine Marine Fisheries

by Department of Agriculture - Bureau of Fisheries and Aquatic Resources, Coastal Resource Management Project, Cebu City, Philippines. 378pp. (ICLARM Contrib. No. 1379).

May I begin with a historical note. Several decades ago, my favorite elementary school teacher taught me one important fact. She said that the Filipino people cannot live without rice and fish. Rice and fish since that day have been symbols of food for me. At that time, marine fish was so abundant and so cheap—a kilogram of Spanish mackerel, Grouper or Snapper, the three most highly desired species in the place I lived, cost only several centavos. In contrast, these fish species have become very costly nowadays, costing 100-140 Philippine pesos a kilogram, almost equal to an ordinary laborer's daily wage today! The reason is simple and is explained by the law of supply and demand: these fish are rare but too many people want to eat them.

Fish then was so abundant and marine habitats so pristine that nobody ever imagined that these resources were not inexhaustible. Hence, nobody (including government) ever entertained any idea of fishery management or environmental protection.

Marine fish as a major source of protein will probably be around for ages to come, unless fish in our waters should suddenly vanish like the Canadian cod in the early 1990s, despite the combined expertise and effort of fishery scientists and managers. On a hopeful note, though, Silvestre and Pauly (1997) believe the nature of the Asian tropical fisheries is such that this scenario will probably not occur. Let's hope so. As I understand it, one of the goals of fishery management is to prevent occurrences like the collapse of the cod fishery. What is true, however, is that there are examples, probably only undocumented, of local fishery collapse in the country in recent past decades. An example would be the chambered nautilus fishery in Tañon Strait between Negros and Cebu and in some areas of the Sulu Sea. Another one could be the dogfish fishery in many marine areas of the country. And still another is the sea cucumber fishery throughout the country.

The multi-authored book of 378 pages that we are concerned with here is organized into 5 sections, with an introduction and an overview at the beginning, and a conclusion and recommendations at the end; these make up 2 sections of the book proper. The 3 other main sections, consisting of 57 main papers, are (1) Status of Marine Fisheries and Habitats, (2) Fisheries Management, Policies and Tools, and (3) Case Studies in Fisheries Assessment and Management.

The book presents a comprehensive and up-to-date treatment of the various types of Philippine marine fisheries, including the larval and juvenile fishery and deep-water potential for fishery, topics which are usually not given much attention in fishery assessment books. At the same time, it also discusses the fisheries of various marine communities (sea-grass beds, mangroves, coral reefs, open sea), relatively small fishing areas (islands, bays), larger inland seas in the country, and a large eco-region (Sulu-Sulawesi) controlled by three countries, showing various scales of fishery and biodiversity management occurring in the country. The 57 main papers discuss practically all kinds of marine fishery resources, large and small, in the country and practically all aspects of Philippine marine fisheries including problems, management policies, management tools, economics, such issues as gender and poverty, and the needed management interventions in a language easily understood by laypersons.

However, missing in this collection are the results of management efforts on enhancement of fisheries yield in large marine areas. Many papers in this volume are well written and offer new information, but generally they are uneven in quality. Some reviews appear hurriedly done and offer no new information. Worth mentioning, a good feature of the book not usually seen in works of this type is the inclusion of an article on water quality, thus implying the need for an ecosystem approach to fisheries. Overall, this book is a useful volume for all marine scientists and all libraries, despite omissions and shortcomings discussed below.

With regard to water pollution, the book is silent on perhaps the major pollution that has a tremendous direct impact on seawater quality and the shallow-water fishery habitats as well as indirectly, on near-shore fisheries. This pollutant is the sediment carried by large volumes of flood and river waters emptying into the sea during the rainy season. The contribution of nutrients present in these freshwaters to marine primary production is nullified by the destructive effects of sedimentation such as the smothering of coral reefs, sea-grass beds, and mangroves. Sediment dumped by river systems to coastal areas is carried and circulated to offshore islands more than 20 kilometers away from shore, an urgent reminder that the definition of coastal resource management must encompass the barren uplands in an archipelago like the Philippines. This land-sea connectivity would have been a worthy subject for the book.

A couple of fishery resources of substantial value have been omitted from this book—the shell (mollusk) fishery and the sea cucumber fishery. Shell and sea cucumber species, like their finfish counterparts, have been over-fished. The great market demand has resulted in local extirpations of certain species, such as the chambered nautilus earlier mentioned and two species of giant clams. The demand has driven the highly-sought after and overly expensive cones and cowries to the brink of extinction. It is a common observation that Philippine coral reefs all over the country, except those with actual protection, have been "swept" clean of shells and sea cucumbers. The shells are now stored in large warehouses in Cebu City, and the dried sea cucumbers (*trepang*) are in restaurants.

The inclusion in the book of the classic 1997 paper of Silvestre and Pauly, "Management of Tropical Coastal Fisheries in Asia: An Overview of Key Challenges and Opportunities," is an attractive feature of this book as it sets the stage for the third section on the subject of fisheries management, in addition to linking Philippine fisheries to those of other countries in Asia.

The articles in the third section may be considered elaborations of the fishery problems and issues that Silvestre and Pauly had earlier pointed out or intimated way back in 1997.

Similarly, the reviews of the status of fisheries and fishery habitats in the first section of the book have pointed out essentially similar problems and issues discussed in the Silvestre and Pauly paper. For example, 13 of the 16 papers in the first section conclude that over-fishing, decline in fisheries production, overexploitation, potential for over-fishing, fishery reduction, and habitat degradation describe Philippine fisheries and fishery habitats. All of these issues have been confirmed by the authors of the last chapter. Needless to stress, the inclusion of an article summarizing the advances or gains in the management of marine capture fisheries between 1997 and 2003-4 in this collection would have been immensely useful in giving us a picture of where we were then, where we are now, and where we expect to be at some future time.

This brings me to Section 5, *Conclusion and Recommendations*. The authors of this section have summarized the key findings and key issues in Philippine fisheries in terms of 8 characteristics, namely depleted fishery resources, degraded environment and critical fisheries habitats, low fishery catches/incomes, physical losses and/or reduced values of catches, inequitable distribution of benefits, inter-sectoral and intra-sectoral conflicts, poverty of small-scale fishers, and inadequate systems and structures for fisheries management. The authors have proposed interventions and critical actions as well as opportunities to reverse the decline of marine fisheries. They recommend 6 critical actions in order to achieve sustainability of marine fisheries, all of which appear reasonable, but fail to go far enough to suggest who will implement these actions or how the results may be evaluated. Thus, the question of who will implement each of these actions and how the progress of the implementation of these recommendations be measured and evaluated remains a critical issue. The authors of this chapter themselves have explicitly stated the inadequacy of the Philippine government to manage fisheries. It would therefore be helpful if the implementers of these 6 actions were identified this early in order to pinpoint accountability.

Here I would take issue with the writers of this section on *Conclusion and Recommendations*. They have but ignored the most critical issue that requires urgent action: the reduction of population growth rate to stabilize the Philippine population within a period of time. Otherwise, all these proposed actions and interventions would have little or no chance to move fisheries forward. It is well known that the issue of population has always been a "hot potato" only those groups genuinely concerned with sustainable development would touch. The non-inclusion of the population issue in the book is a missed opportunity to effect changes in the present thinking of the national government with regard to fisheries and natural resources utilization and conservation.

Simply stated, the status of the marine fisheries may be described as one where there are too many fishers chasing a few fish. No one has ever expressed the role of population in fishery more succinctly than the fishers themselves who realize that their small catch owes to the fact that there are just too many of them and too few fish. In the words of one of them: "there are too many of us so my share is small, not like before." The painful reality then is that not only are fish depleted, there are also just too many people dependent on them. Unfortunately, this country's population is increasing in an exponential fashion at the rate of 2.5% annually, with a doubling time of 28 years, from a low figure of 0.8%, with a doubling time of 87 years in the first few years of the 20th century. (Incidentally, I am reminded that this is the present growth rate of Thailand after years of family planning, now with 60+ million people and a better economy than the Philippines.)

In making the recommendations on how to attain sustainable fisheries, authors in this collection put forward a number of assumptions. One of them is that over time marine habitats and water quality will recover to their previous states. However, the grim possibility that our fishery habitats and the marine environment will no longer recover their previous productive states within our lifetime continues to haunt us. We are seeing trends of how depleted fisheries in coastal areas can trigger certain ecological phase-shifts, for example, from autotrophic to heterotrophic communities, with negative implications for fishery production. The other assumption is that depleted stocks of fisheries will recover over time. But are there sufficient scientific bases for this assumption? Silvestre and Pauly (1997) have stated that one of the characteristics of tropical Asian fisheries is their rapid turnover rates, that is, most species are short-lived, r-strategists, and maximizing reproduction. This is shown by some species on the lower trophic levels. But this is apparently not true of the more valuable and highly desired piscivores and carnivores, as our own research findings indicate decadal recovery process from a depleted state. The natural processes, of which only little is known, will ultimately determine the course of fisheries, and our human interventions, we call management, will influence the direction to some extent. Let us hope that this influence will result in sustained marine fisheries in the future.

Let me quote from a paper presented last month at the National Academy of Science and Technology Annual Meeting by a well known Filipino marine biologist who is essentially looking at the marine fishery sector from the outside: "A survey of the trends in world fisheries production reveals that, as a whole, it has leveled off from the high positive growth in the middle of the 20th century. A closer examination indicates some negative trends among many fish stocks. The only sector that continues to show a consistent increase is aquaculture, with yet unknown ecological consequences. In the meantime, world population grows at an alarming rate. [These]...trends apply to the Philippines as well, with a negative slope characterizing the municipal fisheries sector, that is, the segment of our society where the largest number of fishers earning the lowest incomes fall, the epitome of rural poverty." He continues: "On the governance side, institutions are making too little effort too late to rescue marine resources from their downhill slide...In such a scenario we are losing our intergenerational equity, which bodes ill for ...our country unless there are profound changes in attitude [and] ...there is a quantum improvement in our governance system, which may not yet be on the horizon." This statement succinctly expresses the interrelations among fisheries, population growth rate, people's attitudes, and poverty in this country.

Ten years ago, former President Fidel V. Ramos said that the way to make the Philippines move forward is to reduce the number of fishermen and fisherwomen and to give them opportunities to develop value-added industries based on marine resources. At that time I did not understand what he was driving at. But now I get his point, that is, reducing the number of fishermen and engaging in value-added activities, such as developing marine aquaria for public exhibit, promoting local eco-tourism in order to generate jobs and incomes, among others, is one way to solve the poverty of coastal communities. But all of these possibilities are now, so to speak, "water under the bridge." As to our marine fishery resources and marine environment, what are the prospects of reversing the downhill trend and/or maintaining our marine fisheries now that we have the recommendations? Only time will tell.

Angel C. Alcala
Silliman University - Angelo King Center
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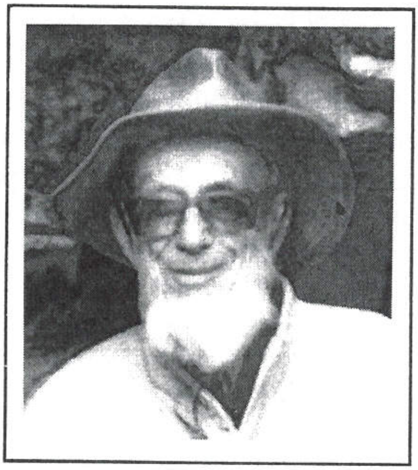
IN MEMORIAM

DR. WALTER CREIGHTON BROWN
1913 - 2002



Former Dean of Faculty, Menlo College, California, USA
Fellow, California Academy of Sciences, San Franciso, CA USA
Fulbright Visiting Professor, Silliman University, 1954-55

A LIFE OF SERVICE TO SCIENCE
A Tribute to Walter Creighton Brown
1913-2002

Angel C. Alcala

As a student and colleague of Dr. Walter Creighton Brown for 44 years, it is my great privilege to write this tribute to this humble and dedicated American scientist who contributed much to the advancement of our knowledge of herpetology, the branch of biology that deals with amphibians and reptiles, in the Philippines and the South Pacific.

Prior to his arrival at Silliman University, Dumaguete City to serve as Fulbright Visiting Professor in 1954-55, together with his wife and children, herpetological studies had been the domain of two American scientists, namely, Dr. Edward H. Taylor of the University of Kansas and Dr. Robert F. Inger, then at the Field Museum in Chicago. Taylor studied virtually all groups of amphibians and reptiles—frogs and toads, lizards, snakes, and turtles—between 1912 and 1925. He also brought together the known scientific information on Philippine mammals in his classic book on Philippine mammals. During the succeeding 29 years between 1925 and 1954, there was a hiatus in Philippine herpetological studies. These studies resumed in 1954, the year Inger's review of Philippine amphibians came off the press and also the year Walter and his family set foot at Silliman University.

Walter Brown's coming to the Philippines in 1954-55 marked the beginning of a comprehensive research program on amphibians and reptiles that was initially established at the Biology Department (now centered at SUAKCREM), Silliman University. This program has at this time spread to two well known Philippine universities, University of the Philippines in Los Baños, Laguna and De La Salle University in Manila. At Silliman, this program has produced some 80 scientific papers, monographs, and books on Philippine amphibians and reptiles mostly written by Brown and Alcala, but also by several scientists at the California Academy of Sciences (San Francisco, California), Smithsonian Institution (Washington, D.C.), and the Philippine National Museum over a period of 49 years (1955-2004).

For Silliman University and the Philippines, Brown's herpetological research in the Philippines, in the course of which he made four visits between 1954 and 1992, was significant for at least five reasons: (1) for the first time, a professional Filipino herpetologist (myself) took up the challenge of studying unpopular (compared to birds and mammals but nevertheless important) groups of Philippine vertebrates; (2) Silliman University became the center of herpetological studies in the Philippines; (3) research grants mainly from the United States National Science Foundation and graduate fellowships in science from private foundations became available to a Sillimanian for graduate studies in the U.S.A.; (4) many new species of frogs, lizards, and snakes were discovered and described in the scientific literature adding to the inventory of vertebrate biodiversity that has attracted the attention of the national and the world's scientific communities; and (5) vertebrate biology has become one of the course offerings at Silliman, one of the few Philippine institutions of higher learning offering such a course.

During his entire academic life and well into his retirement years, he maintained a strong interest in herpetological research. His Fulbright grant to spend a year at Silliman University to conduct research on Philippine amphibians and reptiles in 1954-55 was followed by several grants from the U.S. National Science Foundation and the American Philosophical Society during the next 15 years. We collaborated in all studies on the Philippine herpetofauna. He did the taxonomic studies while my field assistants and I did most of the fieldwork and the ecological data-gathering from several rainforest areas on the large islands of Palawan, Mindoro, Luzon, Mindanao, Bohol, Cebu, Negros, and several small islands in the Visayan and the Bohol Seas. This comprehensive herpetological survey laid the basis for the 80 publications on amphibians and reptiles mentioned above. Walter Brown himself has to his credit some 100 scientific papers on the systematics and ecology of amphibians and reptiles of the Philippines and the southwest Pacific. Some of his monographs like the taxonomic review of the skink genus *Emoia* required few years and several trips to museums in the U.S.A., Europe, and Australia to complete. His publication accomplishment done on top of his administrative and teaching duties is truly admirable.

Walter Creighton Brown died at his retirement home in Murphys, California on July 15, 2002 after a seven-year battle with bone cancer. He is survived by his wife, Dr. Jeanette S. Brown, daughter Pamela Lanigan of Redwood City, CA, son James of Lake Oswego, OR, daughter Julie Creighton of San Anselmo, CA, and four grandchildren. He was born in Butte, Montana on August 18, 1913, spent his first 10 years on a ranch, and attended a one-room school. After his family moved to Tacoma, WA, he finished high school and college education at the College (now University) of Puget Sound. There he taught biology at the Clover Park High School until the advent of World War II when he enlisted in the Army and served in the South Pacific and the Philippines. While in College, he developed an interest in herpetological research, which grew stronger when he was in the Army.

After the war, Walter Brown made good use of the GI Bill by attending Stanford University, Stanford, California and obtained a Ph.D. in Biological Sciences in 1950. His thesis was on frogs of the Solomon Islands, which was published in the *Bulletin of the Museum of Comparative Zoology* 107: 1-64. After a short teaching period at Northwestern University, he became Chairman of the Biology Department and later Dean of the Faculty at Menlo College in Atherton, California until retirement in 1978. He was for a time a Research Associate at the Division of Systematic Biology at Stanford University, where he taught a graduate course on systematics and evolution. He was elected Fellow of the California Academy of Sciences, San Francisco, where he maintained an office for many years. The Academy gave him support for his herpetological studies. The bulk of our herpetological collections from the Philippines have been housed in the Academy.

Walter Brown and his wife, Dr. Jeanette S. Brown, who once taught microbiology at Silliman in 1954-55, were friends of Filipinos. They actively promoted the Philippines at the Menlo College and Stanford University campuses through their social contacts. They were generous with ideas and had a genuine interest in furthering the academic advancement of Silliman faculty members. At least four Sillimanians received help by way of facilitating their graduate studies at Stanford University. Aside from me, they are Lino Arquiza, Ester Timbancaya, and Priscilla Lasmarias. While doing graduate studies at Stanford, I was treated as a member of the Brown family.

Walter was a family man. Despite his research and full time teaching and administrative duties at Menlo College, he had spare time for his growing children. In trips outside of their residence in Menlo Park, California, the Browns always brought their children with them.

Walter Brown made modest financial contributions to the Silliman biology program. But his lasting contribution to Silliman was the strengthening of the biology research program. In this regard, he is joined by another American scientist, Dr. Lawrence R. Heaney, of the Field Museum of Natural History, Chicago, who has trained several young Filipinos, some of them from Silliman, in mammal research.

I owe Walter Brown a debt of gratitude for introducing me to biological research and for assisting in many ways to enable me to embark on a professional career in science, first as a graduate student and later as an academic colleague. Our scientific collaboration is probably the longest one between an American and a Filipino, showing that a common love for science can transcend racial and cultural boundaries.

NOTES ON CONTRIBUTORS

Angel C. Alcala, Ph.D., is the Director and Research Professor of the Silliman University-Angelo King Center for Research and Environmental Management. In 1999, he was awarded the Pew Fellowship in Marine Conservation in recognition of his 26 years of research and practical community experience on the establishment of marine reserves managed by local communities and local government units.

Ely L. Alcala is a research associate of the Silliman University-Angelo King Center for Research and Environmental Management (SUAKREM) and member of the faculty of the Biology Department, Silliman University. As SUAKREM's research associate, he is in the forefront of research studies on the effects of forest fragmentation on mammalian and herpetological fauna on Negros Island and of conservation education activities.

Jane Aquin completed her chemistry degree from Silliman University. At present, she teaches at JRMSC-Katipunan National Agricultural School, Katipunan, Zamboanga del Norte

Leonardo V. Averia is an instructor at the Biology Department at Silliman University and researcher at the Silliman University-Angelo King Center for Research and Environmental Management (SUAKREM) where he participates in a number of biodiversity research projects and conservation education activities principally on Negros Island.

Reginaldo Bueno used to work for the Protected Areas and Wildlife Division of the Department of Environment and Natural Resources of Region 7 as a biologist, a position that gave him opportunities to participate in collaborative conservation efforts in Cebu and in Western Visayas. As of this writing, he should be in the last stages of studies, if he is not finished yet, for his Masters in Environment and Natural Resources Management at the University of the Philippines, Open University.

Angelita M. Cadeliña, Ph.D., is a specialist in forest resource management. She divides her time between teaching at the Biology Department of Silliman University and pursuing conservation education activities and research projects in connection with the Silliman University Center for Tropical Conservation Studies (CenTrop).

Apolinario B. Cariño is finishing his graduate studies at Silliman University. One of the busiest field researchers at Silliman, he has led a number of biodiversity studies on Negros Island, pioneering the Bat Counts 2002 project on most of the major islands of the country. He is presently the wildlife researcher and community education volunteer at the Silliman University Center for Tropical Conservation Studies (CenTrop).

Mery Jean G. Catacutan has been involved in a number of conservation work and biodiversity research projects in Cebu and West Visayas. A graduate of the Biology Department of Silliman University, she has worked as a junior researcher at the Center for Tropical Conservation Studies (CenTrop), an experience that prepared her well to take up an administrative position at the Crocolandia Foundation Inc. in Cebu.

Cynthia N. Dolino is one of the most experienced field biologists at Silliman University, having participated in a large number of biodiversity research projects in various capacities ranging from project leader to principal investigator to collaborator. Unfortunately, this passion has also successfully derailed her graduate studies. Already in the last stages of thesis writing, she is determined to finish so she could resume her wide-ranging interests in wildlife studies, including birds, mammalian, and herpetological fauna, among others.

Lawrence R. Heaney is presently the Curator and Head of the Division of Mammals in the Field Museum in Chicago. A Ph.D. in Systematics and Ecology from the University of Kansas, Dr. Heaney's current research program focuses on mammalian evolution and ecology / evolutionary biogeography / origin and maintenance of patterns of biological diversity / conservation biology / tropical biology. Internationally known for his groundbreaking research on mammals in Southeast Asia, the Philippines in particular, Dr. Heaney has been the Honorary Curator for the Department of Zoology of the Philippine National Museum since 1990 and the Science Advisor for the Center for Tropical Conservation Studies at Siliman University, Dumaguete City, Philippines, since 1992.

Philip Godfrey C. Jakosalem is connected with the Protected Areas and Wildlife Division, Department of Environment and Natural Resources Region 7 in Cebu City, Philippines as a biologist. As a volunteer/researcher, he regularly collaborates with biologists and wildlife specialists of the Cebu Biodiversity Conservation Foundation in biodiversity research projects in Cebu and in Western Visayas.

Aileen P. Maypa completed both her undergraduate and graduate degrees from Silliman University. Her specialization in coral reef ecology and marine reserves constantly takes her shuttling around the islands, gathering data as part of a participatory coastal resource assessment team for the Coastal Conservation and Education Foundation. At the same time, she has had to juggle her time between CCEF, Silliman University Marine Laboratory, and the Silliman University-Angelo King Center for Research and Environmental Management (SUAKREM) where she is one of the most experienced marine biologists.

Anna Blesilda T. Meneses is a graduate student in Environmental Science at the University of the Philippines, Los Baños. She is the Coordinator of the Marine Protected Areas-Pew Project of the Coastal Conservation and Education Foundation.

Maria Rio A. Naguit is a recent graduate of Chemistry from Silliman University. She is at the moment in the teaching staff of JRMSC-Katipunan National Agricultural School, Katipunan, Zamboanga del Norte, Philippines.

Renee B. Paalan teaches at the Biology Department of Silliman University, Dumaguete City, Philippines. In the little time that teaching and family life allows her, Renee actively pursues conservation education activities and research in the environs of Negros.

Lisa Marie J. Paguntalan finished her undergraduate and graduate degrees in Biology from Silliman University in Dumaguete City. A former recipient of the BP Conservation Bronze Award for her work on Negros threatened avifauna, Lisa is a regular participant of wildlife research studies and conservation education activities in both Negros and Cebu Islands. She is presently the Field Projects Officer of the Cebu Biodiversity Conservation Foundation, Inc., in Cebu City.

Marisol dG. Pedregosa is a wildlife biologist for the Cebu Biodiversity Conservation Foundation. A graduate of Zoology and Wildlife Studies degrees from the University of the Philippines in Los Baños, she was also a recipient of the BP Conservation Award in 2001 for her work on generating baseline information on small islands in the West Visayas.

Laurie J. Raymundo, Ph.D., is at present the Coral Reef Ecologist of the University of Guam Marine Laboratory, University of Guam Station in Mangilao, Guam. Until her move to UOG, Laurie was one of the most prolific marine biologists at the Silliman University Marine Laboratory at the forefront of coral reef ecology research. But Laurie is not only a consummate marine biologist; she is also a person of many talents. A fine stage actor, director, singer, martial arts enthusiast, and yoga practitioner, she left Silliman with a memorable swan song—the production of Eve Ensler's *Vagina Monologues*, which she directed. Certainly, her move to Guam is UOG's gain and Silliman's loss, but Silliman Journal is privileged to have her continuing participation as member of its Editorial Board.

Francisco P. Tabiliran finished his B.S. in Chemistry at Silliman University. Currently, he teaches at JRMSC-Katipunan National Agricultural School, Katipunan, Zamboanga del Norte.

Sheryll C. Tesch is a creative writer but is currently directing her energies on coastal resource management. She serves as the Information and Education Campaign Coordinator of Coastal Conservation and Education Foundation in Cebu.

Alan T. White, Ph.D., is a prominent figure in marine conservation and management for which he had received both local and international awards. Author of a number of publications on CRM, he is currently the Chief of Party of the Coastal Resource Management Project of the Department of Environment and Natural Resources, as well as the moving spirit behind the Coastal Conservation and Education Foundation in whose Board he sits as President.

Evangeline White has dedicated most of her life to coastal conservation, along with husband, Alan. She is presently the secretary of the Board of Coastal Conservation and Education Foundation.