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ASPECTS OF BIOLOGY AND CONSERVATION OF
THE PHILIPPINE COCKATOO *CACATUA*
HAEMATUROPYGLIA ON RASA ISLAND, PALAWAN,
PHILIPPINES

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ABSTRACT

The Philippine cockatoo, (*Cacatua haematuropygia*), is a highly endangered bird species. Since three years ago, the Philippine Cockatoo Conservation Program has been carrying out a project in southern Palawan to save this species from extinction. The project area comprises the small coral island of Rasa (8.3 km²) in the Sulu Sea, which belongs to the municipality of Narra in southern Palawan. The vegetation of the island consists of predominantly old growth mangrove and coastal forest, with a fair presence of suitable nesting and feeding trees.

One of the activities of this program is gathering information on the conservation status, population dynamics, feeding, and breeding biology of the species. As of 2000, the density of cockatoo breeding pairs was 1.6 breeding pairs per km². At the end of the breeding season in 2000 the minimum density was 6.7 individuals per km² which reflects the high proportion of non-breeding birds.

Following an ecosystematic, rather than a purely species conservation approach, with the cockatoo serving as flagship species, the project activities on Rasa consequently include all terrestrial and marine ecosystems of the island. Basic inventories of woody plants, fishes, reptiles, birds, and mammals have been conducted.

The project also follows a strongly community-based approach to management which involves all stakeholders in the design of the project from the beginning. Aside from the conservation work, other components of the project include information-education-communication campaigns, alternative livelihood and community organizing.

Introduction

The Philippine or Red-vented cockatoo (*Cacatua haematuropygia*) is endemic to the Philippines. Its former distribution comprises all major islands of the archipelago and

many of their satellite islands. Only the northern part of Luzon lacks records of the species in the past (Dickinson et al., 1991; Kennedy et al., 2000). Mainly due to habitat destruction and extensive predation by humans, cockatoo populations dwindled in the past forty years all over the Philippines. Today the strongholds of the species are Palawan and outlying islands, and the Sulu-Archipelago, particularly Tawi-Tawi, with an estimated overall population of 1,000 to 4,000 individuals (Lambert, 1994).

The remaining scattered pairs in southern Luzon, Patnanungan, Mindoro, Masbate, Bohol, Siquijor, Siargao, Dinagat, and Mindanao may no longer manifest viable populations (Collar et al., 1994; Collar et al., 1999).

Because of this drastic decline of bird population, the species was listed as 'Critically Endangered' by the International Union for Conservation of Nature (SSC/IUCN, 2000).

The Philippine Cockatoo Conservation Program (PCCP) aims to save the species from extinction by applying ex-situ as well as in-situ measures. Ex-situ conservation involves captive breeding through coordination of private breeders and zoos (Boussekey, 2000).

This paper describes only the in-situ component of the program which is focused on Rasa Island in Palawan. The procedure and the results of the blood and feather sampling of nestlings conducted within this program are described in more detail in Rebong et al. (this volume).

STUDY AREA

The project is implemented mainly on Rasa Island, a small coral island of 8.34 km² area situated in the Sulu Sea, just offshore of the municipality of Narra, Palawan, Philippines (Fig. 1). Coastal forest consisting mainly of mangrove covers about 1.75 km², while circa 5.6 km² are associated terrestrial herbaceous and shrubby beach vegetation. About 0.39 km² of the area is cultivated and

planted predominantly with coconut. The rest of the area (ca. 0.60 km²) is either barren or sparsely vegetated sand and coral outcrops.

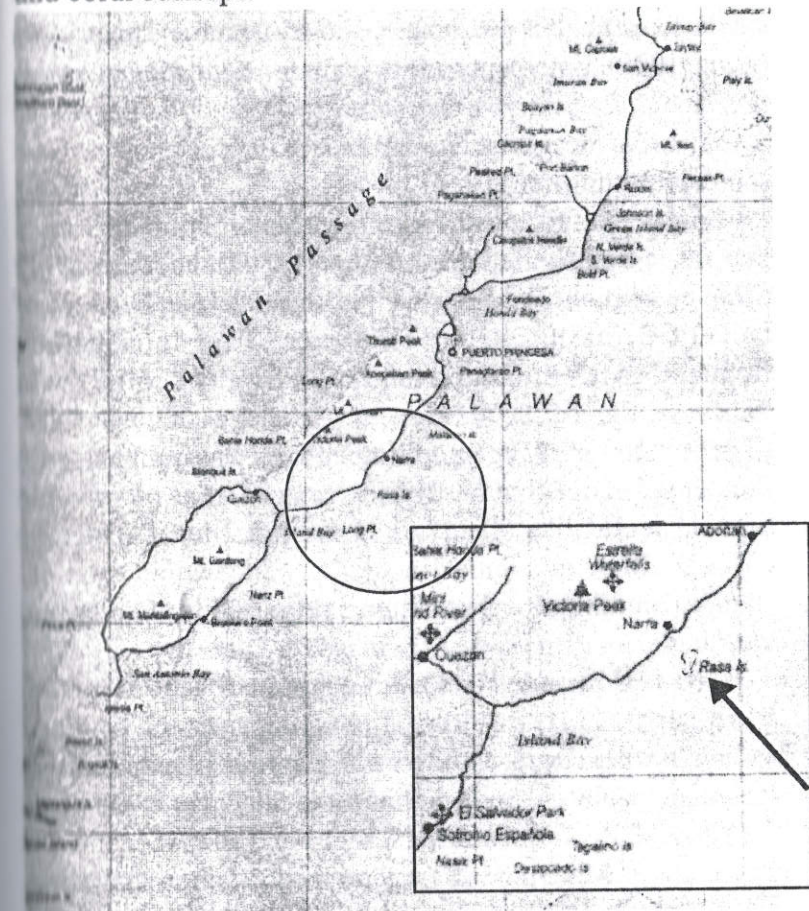


Fig. 1 Location of Rasa Island

The marine ecosystems of Rasa comprise sandy beaches, rocky shores, tidal flats, seagrass and algal beds, soft bottom areas, coral reefs, and open water. The tidal zone is dominated by dense stands of mangroves. Nine species of true mangroves of the genera *Rhizophora*, *Sonneratia*, *Avicennia*, *Bruguiera*, and *Ceriops* have been recorded. The beach vegetation typically consists of

herbs, like Goat-foot-vine (*Ipomoea pes-caprae*) and small patches of grass, shrubs, or trees like *Pemphis acidula*, *Erythrina orientalis*, *Pongamia pinnata*, and *Hibiscus tiliaceus*. The coastal forest holds approximately 120-150 shrub and tree species (Lang, 1999). Emergent species include *Melia dubia*, *Garuga floribunda*, *Pometia pinnata*, *Intsia bijuga* and *Pterocymbium taluto*. All of these are of importance to the cockatoos as food source or nesting trees.

Less than five percent of the area is claimed by local people and cultivated predominantly with coconut. Only three permanent households live on the island because of lack of drinking water. However, Tagbanua people frequently visit the island to harvest copra or collect wild honey, shells, sea cucumbers, crabs, and eggs of megapodes. In the last decade logging of timber trees was rampant, with the consequence that hardly any mature trees of valuable timber species, like *Intsia bijuga*, are left. Illegal mangrove cutting still occurs, but is in decline. The waters and tidal flats surrounding Rasa are intensively used for fishing and gleaning.

Rasa is included in a zoning system for the Man-and-Biosphere (MAB) Reserve which comprises the whole of Palawan. It is demarcated as a fish and bird sanctuary at the municipal level. Applications for inclusion in the National Integrated Protected Areas System (NIPAS) and for upgrading as MAB Zone 1 (strictest conservation) have been submitted.

BIOLOGY OF THE PHILIPPINE COCKATOO

Information on the feeding biology of the cockatoo was gathered by direct observation. On Rasa movements of the cockatoos were observed from a boat, from beaches, or coral outcrops. Feeding sources were then tracked down on foot. Movements of cockatoos on the mainland were observed from

higher vantage points.

Monitoring of the population trend on Rasa was done from a boat by counting individuals at a traditional roosting site situated in a mangrove area. Since July 1998, counts have been conducted before sunset once a month. Occasionally, counts were also conducted at dawn before birds left the roosting site. Whenever possible, counts were conducted under similar weather and light conditions.

A detailed map of vegetation formations of the island was prepared with the help of topographic maps, aerial pictures, and through ground-truthing with Geographic Positioning System (GPS) and transit.

Ten wardens who were guarding the island inspected the nesting trees starting end of September 2000. During the breeding season (February-July 2000), the nesting trees were under permanent watch. Trees were climbed and nest holes controlled once a week during that time. For safety reasons, dead or damaged trees were not climbed. Nesting trees were characterized by species identification, tree height, diameter at breast height (DBH), height of nesting hole, exposition of nesting hole, diameter of hole, diameter at base, and depth of cavity. The geographic location of each nesting tree was taken using a GPS and marked in a map.

The presence or absence of birds, eggs, nestlings, or nest predators were noted. Nestlings were ringed with aluminum rings bearing the inscription of the Department of Environment and Natural Resources (DENR), year, and number (e.g. DENR 00 0012)

Roosting. A traditional roosting site exists on Rasa where the cockatoos gather during dusk and spend the night. It is situated in the mangrove, close to the outer edge facing the sea. It is used year-round, except when storms approached from northern directions, thus directly affecting the roosting site.

During the period of study, the first birds arrived about twenty minutes before sunset, later in the evening when strong

winds prevailed. The birds moved between emergent Pagatpat (*Sonneratia alba*) before settling on a single one. The roosting site was also regularly frequented by Slender-billed crows (*Corvus enca*) and occasionally by Pied and Grey imperial pigeons (*Ducula bicolor*, *D. pickeringii*), and White-breasted wood-swallows (*Artamus leucorhynchus*).

The number of birds changed seasonally, with more birds outside the breeding season, and fewer in the breeding season. Absolute number of birds in the almost three-year observation period varied between 12 and 56 birds (Fig. 2).

Feeding. The Philippine cockatoo feeds on seeds and to a lesser extent on fruits, flowers, buds, and soft bark. The species is very adaptable and even forages on crops, particularly rice in dough (half-ripe) stage and corn. For this reason, cockatoos used to be regarded as pest. In the 1960s flocks of 300 to 400 birds reportedly swarmed rice fields in the municipality of Narra (Lascon, pers. comm., 1996). Up to now similar behavior can be observed during the end of the breeding season from July onwards but involves flocks not exceeding 20 birds. Raiding of fields by this species has been reported repeatedly from other places in the Philippines (e.g. Lambert, 1994; Tabaranza, 1992).

Most feeding observations included two or more birds inside as well outside of the breeding season. Feeding parties usually stayed long in a particular source tree if not disturbed. Observations ranged from six minutes to one hour or longer. In one incident it was observed that cockatoos carried the fruits of *Melia dubia* out of the source tree and consumed them on an adjacent tree about 30m away. In these rare occasions cockatoos could act as active seed dispersers by accidentally dropping fruits with intact seeds.

Sometimes cockatoos associate with Blue-naped parrots (*Tanygnathus lucionensis*), Grey imperial pigeons (*Ducula pickeringii*), Green imperial pigeons, (*Ducula aenea*), Slender-billed crows (*Corvus enca*), and Asian Glossy starlings (*Aplonis*

panayensis) while feeding.

Seventeen different plant taxa have been found to serve as food sources for cockatoos. Leguminosae were the most important, with five species belonging to this family. Seven species were widely cultivated in Palawan and elsewhere in the Philippines. An overview on food plant species recorded from Rasa and the nearby mainland is given in Table 1.

Breeding. In 2000 an attempt was made to clarify the complete sequence of reproduction of the Philippine cockatoo in the wild. It was observed that pair bonds started to get closer in October. Birds were traveling pair-wise and grooming of partners was observed more frequently at the roosting site. Nest holes were selected starting from end of December. However, since birds were not marked individually, it was not clear if the same pair occupied the same nesting holes in subsequent years.

Manipulation of nesting holes and in the direct nest vicinity included widening of cavities by chipping wood from the entrance and the interior of the holes, and cutting of twigs and leaves which hampered free access and visibility. The cut-off twigs on the ground on the bottom of trees indicated occupancy of nesting holes. Both sexes were involved in these preparatory nesting activities.

On Rasa, sixteen nesting trees have been reported comprising five tree species: Malugai (*Pometia pinnata*), Bogo (*Garuga floribunda*), Taluto (*Pterocymbium tinctorium*), Magtalisay (*Terminalia cf. foetidissima*) and Pagatpat (*Sonneratia alba*). One cavity in a dead Taluto was destroyed because of decay, so that only fifteen holes were recorded in 2000.

Almost all nesting trees were emerging above the canopy and ranged from ca. 15 to 48 m in height. The height of the nest holes varied between 12 to 35 m. No preference of a distinct exposition of the nest hole was observed.

Diameters of the nesting hole varied between 10 and 25 cm. The cavities were between 1.1 to 2.0 m deep and the diameter at the base ranged between 0.2 to 0.4 m.

Ten nesting trees were situated in coastal forest. Three out of five nesting trees in the mangrove had been occupied. The effective breeding population within the coastal forest therefore accounts for 5.7 pairs per km², and 0.53 pairs per km² in the mangroves.

Other tree-hole nesting bird species on Rasa are the Blue-headed racquet-tail (*Prioniturus platenae*), Mantanani scops owl (*Otus mantananensis*), Dollarbird (*Eurystomus orientalis*), Greater flameback (*Chrysocolaptes lucidus*) and Asian Glossy starling (*Aplonis panayensis*). The two larger woodpecker species of the Palawan archipelago, namely the Great slaty woodpecker (*Mulleripicus pulverulentus*) and the White-bellied woodpecker (*Dryocopus javensis*) were absent on Rasa.

Laying of eggs was recorded from the second February decade to the first April decade, but usually peaking between end of February and beginning of March. Full clutches contained two or three eggs. Noteworthy was the record of one clutch with four eggs, all of which survived. The exact duration of hatching can not be given because nests were not climbed daily for conservation reasons. First hatchlings were present in the second March decade. The nestling fledged in about eight weeks. In 2000, 18 chicks originating from eight pairs fledged successfully. Altogether five breeding attempts were unsuccessful. The outcome of two breeding efforts in the mangrove is unclear.

Two clutches only contained rotten eggs. One batch with three chicks showed massive infestation by mites and lice. Two chicks died in the nest. The last surviving chick of this batch jumped out of the nest cavity. It was recovered by the wardens and brought to the Community Environment and Natural Resources Office (CENRO) in Narra where it was repeatedly treated with insecticide soap normally used for fighting cocks. However, the chick died three days later. Two mummified chicks examined from a nest hole at the end of the 1998 breeding season also showed signs of ectoparasite infestation (dead lice, possible bites on the underwings and abdomen).

Another three chicks and three eggs fell victim to common monitor lizards *Varanus salvator*. Other incidents of nest predation could not be observed. Noteworthy is the fact that from all observed breeding attempts all hatchlings either fledged or were lost. After fledging, parents and offspring were observed near the nesting site for about one week.

Population dynamics. Population density and trends were estimated with the help of monthly counts at a traditional roosting site. The breeding population could be recorded directly by identifying nesting trees. It is quite likely that all nesting trees within the coastal forests had been found due to extensive search. However, large areas of the mangrove were inaccessible so that some additional nesting trees might occur there.

In 2000, 30 birds on Rasa formed the breeding population that accounted for a density of 1.8 pairs per km². Breeding pairs as well as unsuccessful pairs were observed to stay in the vicinity of the nesting trees during nighttime. Numbers of individuals counted at the roosting site during the breeding season ranged between 20 and 28 birds. These are assumed non-breeders since the breeding pairs tend to stay in the vicinity of the nest during night time. Eighteen hatchlings fledged during the breeding season.

The maximum count of birds at the roosting site was 56 birds in August at the end of the breeding season. These also included the fledglings and most likely the parent birds.

With 30 birds forming breeding pairs, 20 birds being non-breeders (the minimum number of birds observed at the roosting site during the breeding season), and 18 fledged in this year, the minimum population number in August 2000 was 68 birds.

After August numbers of birds decreased again due to dispersal to the mainland. From August to October cockatoos were recorded on the mainland in the vicinity of Rasa. Birds were observed in coconut plantations, coastal vegetation, and rice fields. Numbers ranged from 2 to 32 birds, with an average of 8.7 per flock. The cockatoos frequently fed on seeds of Horseradish trees,

Moringa oleifera. One snare with fruits of this tree as bait was confiscated and destroyed. One flock of ca. 15 birds feeding on half-ripe rice plants was reported by a farmer.

After October no records from the mainland near Rasa Island were made despite regular monitoring in December.

CONSERVATION OF THE PHILIPPINE COCKATOO AND RASA ISLAND

Potential natural habitat of the Philippine cockatoo. The density of Philippine cockatoos on Rasa Island is the highest known in the wild. Density of breeding pairs in the coastal forest is considerably higher in coastal forest than in the mangrove. This is likely due to the fact that the availability of suitable nesting tree is higher in the former habitat. Only *Sonneratia alba* is known as a nesting tree in the mangrove and at the same time the only source of food recorded in this ecosystem. Although the claim of Lambert (1994) that mangrove is crucial for survival might be true, our observations suggest that it may not represent the optimal habitat for the species.

Coastal forests, and possibly also swamp and riverine forests, are not well-defined vegetation formations in the Philippines. They have disappeared almost completely from the Sulu Sea floodplain of Palawan, mostly due to the conversion of land areas into ricefields or coconut plantations (Widmann, 1998). Aside from Rasa, remnants can be found in coastal areas of Narra and Aborlan, in Iwahig, in the Cabayugan area, and probably in some larger satellite islands of Palawan. These forest formations hold relatively high numbers of suitable nesting and feeding tree species.

These observations indicate that despite the fact that the cockatoo shows certain plasticity in habitat selection, particularly outside the breeding season, tall trees in the original lowland forest are crucial for its survival. The species is not specialized in the choice of food as it feeds on a wide variety of readily available

cultivated plants. It is therefore assumed that suitable nesting trees in an undisturbed surrounding are the limiting factor for the species. The high number of non-breeders, those birds counted on the roosting site, may also be a reflection of the scarcity of natural nest holes.

Lambert (1994) noted that lowland forest on steeper slopes seems to be avoided by the species. This is in line with observations of other authors (Collar et al., 1999) and also with the findings during the surveys on the Palawan mainland (Widmann, unpubl. data). The scarcity of cockatoos in forests of medium and high elevations cannot be explained by lack of nesting and feeding trees alone. However, potential competition of nesting holes in these forest ecosystems is higher with additional species like Blue-naped parrot (*Tanygnathus lucionensis*), Spotted wood owl (*Strix seloputo*), Palawan hornbill (*Anthracoseros marchei*) and Hill myna (*Gracula religiosa*) occurring in these forest habitats. On the other hand, observations on the cockatoo's aggressiveness from Rasa indicate that cockatoos are themselves quite competitive occupants of nest holes.

A limiting factor for the breeding distribution might be high rainfall during the breeding season. Losses of clutches have been observed on Rasa due to flooded nest holes. Cockatoos are not choosy in the selection of rainproof nesting situations. In one instance the nesting hole opens skywards which resulted in a loss of clutches in the 2000 and 2001 breeding season due to complete flooding during thunderstorms.

Precipitation increases markedly from the Sulu Sea over the alluvial plains to the high Victoria Range. The mountain ridges are frequently covered with clouds even during the dry season, whereas dry spells of four to six weeks often occur over the open sea and offshore islands. This precipitation pattern is very typical for landscapes with only narrow coastal plains and steeply rising mountain ranges (Walsh, 1996) which are prevalent in the Philippines.

Most cockatoo species occur in arid or semiarid conditions.

Rain during the breeding season is an unlikely event. Even species of the inner tropics seem to thrive best in conditions of pronounced dry seasons during the breeding season, like the Philippine cockatoo on Palawan or the Yellow-crested cockatoo, *Cacatua sulphurea* on the Lesser Sundas and Sulawesi (PHPA, LIPI, BirdLife International IP, 1998). Low precipitation may be a prerequisite for the successful nesting of most *Cacatua* species and may naturally exclude them from permanently wet forest habitats like montane forests in the Philippines.

Implementation of biological findings. Suitable nesting trees seem to be the limiting factor for the cockatoo population on Rasa. All suitable nesting holes were occupied during the breeding seasons in 1999 and 2000. It is therefore likely that the population could be further increased by providing nest boxes. The project has so far refrained from resorting to this measure because the island is still frequently visited by people collecting sea cucumbers or wild honey, and by claimants harvesting copra. For this reason, artificial nests were feared to be too conspicuous and could invite poaching. The same is true with the use of devices to protect nesting trees in the mangrove against predation by monitor lizards.

However, activities of people on the island are better known and can be better monitored in future breeding seasons due to improved communication. Presently, preparatory steps are taken to test nest boxes on Rasa and other well protected areas. This would include strict enforcement of the already existing regulation that only claimants are allowed to enter the island during the breeding season. Designs for nest boxes for different species of parrots are readily available and can be modified for the Philippine cockatoo based on the data gathered from the natural nest holes.

A long-term strategy for providing nesting and food trees is the enrichment planting of larger areas with suitable tree species, such as being undertaken by the program on Rasa. However, this measure will lead to results earliest in about twenty years for the

fastest growing species like Taluto (*Pterocymbium tinctorium*), and much longer for hardwood species, like e.g. Apitong, (*Dipterocarpus grandiflorus*).

People-related conservation activities. Given the major threats for the species such as poaching and habitat destruction, people-related conservation forms the main focus of conservation activities. The program follows a community-based approach in order to make management decisions transparent and facilitate the handing over of responsibility and knowledge in managing and protecting Rasa Island after the termination of the program. The most important components of this approach are briefly described in the following.

Sagip Katala Movement - Narra Chapter, Inc. and its activities

As an initial step of project planning, the Sagip Katala Movement-Narra Chapter, Inc. (SKM-NC, Inc.) was founded with 43 member-incorporators. These main stakeholders include claimants of coconut plantations on Rasa, former poachers, inhabitants of the neighboring barangay, and representatives of relevant agencies and local government units. During the planning workshop, the movement outlined three priority actions, namely; (1) increasing information dissemination and education campaigns; (2) enforcing laws and ordinances applicable to Rasa and its wildlife; and (3) initiating livelihood activities for its members.

The rationale behind the third priority action is to build confidence in the program and enhance active participation in it. Hog fattening was the priority livelihood project identified by the members and facilitated by the program. Wardens are also given incentives by the office for discoveries of new nesting trees of the Philippine cockatoo and other wildlife in Rasa, particularly other parrot species. Additional sources of income are derived from bird enthusiasts visiting Rasa Island, visiting foreign and local researchers, and labor services for the maintenance and operation

of the nursery.

Another confidence building measure is the mapping of coconut plantations on Rasa which provided occupants for the first time with proof of their claims. The positive effect of this measure was that the occupants realized that the program is not aiming to drive them out of the island. On the other hand, baseline data are now available to prove any illegal extension of coconut plantations.

Deputized wardens

PCCP has 10 volunteer wardens, most of them former poachers, whom the Department of Environment and Natural Resources has deputized. Charged with responsibilities as Special Deputy Environment and Natural Resources Officer (SDENRO), these wardens have been trained to perform observations in the field such as taking down notes and identifying wildlife. During the two years of project implementation, the wardens demonstrated their commitment to guard Rasa Island from illegal activities and performed their duties such as monitoring nesting sites of the cockatoo and other wildlife on and around Rasa Island with dedication. In cooperation with the CENRO and LGU, these wardens took action against common violations notably illegal cutting of mangroves and harvesting of forest products from the island. Part of their responsibility is the submission of monthly accomplishment reports to the DENR, the Municipal Mayor, and the Provincial Governor.

During breeding season (February-July), the wardens take a 24-hour duty at Rasa Island. Divided in three teams, they patrol around the island and particularly guard and monitor the eggs and hatchlings in nesting trees. In addition, they observe other wildlife encountered while on duty. Outside the breeding season, their concentration shift to patrolling the mainland coasts of the Barangays Panacan, Antipuluan, and Malinao in Narra where the cockatoos are frequently sighted in coconut plantations and in small forest patches on the mainland. Due to their knowledge of

the cockatoo and of the island which they acquired as former poachers, the wardens proved efficient in the task of monitoring wildlife. Consequently, poaching of birds was not observed during the breeding seasons of 1999 and 2000.

Narra Youth Organization For Environmental Conservation (NYOFEC)

The PCCP sees in the young people a potent force in strengthening its IEC component. Consequently, a seminar-workshop on environmental awareness was conducted involving high school student leaders and officers of youth groups in town. The objectives of the seminar-workshop were: (1) to equip the youth with knowledge on environmental issues and concerns, and (2) to develop in them the vigilance to help combat environmental threats and problems. The main purpose of organizing the youth in Narra was to develop the young people to become effective environmental educators and catalysts for change.

A major output of the group in 2000 was the publication of an activity book intended for elementary school pupils in Narra. Other activities during the youth encounter were field exposures, garbage collection and cleanliness campaign in Narra market, tree planting, and ecosystems assessment.

Lobbying for the legal protection of the Philippine cockatoo and Rasa Island

The program collects data which are relevant for the legal protection of Rasa and its biodiversity. Surveys therefore do not only focus on the cockatoo, but all other vertebrates, tree cover, and coral reef condition. The data are made available for local government units, DENR, and the Palawan Council for Sustainable Development.

Media coverage

A broad media coverage of the program is intended mainly to provide information to potential buyers of poached cockatoos

that it is illegal to possess poached birds and that the status of the species is critical.

Acknowledgments

We wish to thank the Loro Parque Fundación, Tenerife, Spain, particularly its President, Wolfgang Kiessling, and Director, Yves de Soye, for their generous support of our conservation efforts. We are grateful to Marc Boussekey who supports the program from Europe. He, Dr. Ceres E. Pioquinto, and Luca Borghesio thoroughly reviewed an earlier draft of this manuscript and improved the final version considerably, for which we are grateful. The German Embassy Manila funded the hog-fattening livelihood project for which we would like to express our gratitude.

The PCCP extends its appreciation to the Municipal Mayor of Narra, Hon. Lucena D. Demaala, and her very able Council. Likewise, we wish to acknowledge the interest and cooperation of the late Governor Salvador P. Socrates of Palawan, as well as the continued support of the incumbent Governor Joel T. Reyes. We are indebted to OIC CENRO of Narra, Fernando T. Tactay, for his unwavering support and guidance. For their continued cooperation, we would like to thank PAWB Director Reynaldo C. Bayabos, Carlo Custodio, and Josefina De Leon of PAWB Wildlife Section, PCSDS Executive Director Joselito Alisuag, and Adele Sandalo of PCSDS. Similarly, we would like to express our gratitude to Dr. Glenn Rebong for his technical support particularly in the conduct of the feather and blood sampling.

Hon. Serafin Esperancilla, Brgy. Captain of Brgy. Panacan, Narra and his council supported the program and cooperated with many of its endeavors. We would like to thank the residents of Brgys. Panacan, Malinao, and Narra, Palawan for their interest and help, and the claimants and members of the Sagip Katala Movement-Narra Chapter, Inc. for their

enthusiasm and assistance.

Finally, our deepest gratitude and appreciation we reserve to the volunteer wardens on Rasa: Doy C. Alisto, Dionisio B. Bantillo, Bernito L. Basio, Monico L. Beleg, Rogelio N. Coyao, Aguilaro D. Deig, Irineo A. Deig, Enrique S. Masbang, and Danilo P. Villaruz. Without their dedication, the program would not have been the same.

Table 1. Overview over food plants of the Philippine cockatoo

Species	Family	Common name	Part cons.
<i>Garuga floribunda</i>	Burseraceae	Bogo	seed
<i>Carica papaya</i>	Caricaceae	Papaya	seed, pulp
<i>Erythrina variegata</i>	Leguminosae	Dapdap	flower, nectar?
<i>Pithecellobium dulce</i>	Leguminosae	Kamachile	seed
<i>Leucaena leucocephala</i>	Leguminosae	Ipil-ipil	seed
<i>Gliricidia sepium</i>	Leguminosae	Kakawate	seed, bark
<i>Pterocarpus indicus</i>	Leguminosae	Narra	seed
<i>Melia dubia</i>	Meliaceae	Bagalunga	seed?
<i>Ficus sp.</i>	Moraceae	'Balet'	'fruit'
<i>Moringa oleifera</i>	Moringaceae	Malunggai	seed
<i>Pometia pinnata</i>	Sapindaceae	Malugai	fruit, seed
<i>Sonneratia alba</i>	Sonneratiaceae	Pedada	fruit
<i>Pterocymbium taluto</i>	Sterculiaceae	Taluto	flower, seed
<i>Trema orientalis</i>	Ulmaceae	Anabiong	fruit, seed
<i>Cocos nucifera</i>	Palmae	Coconut	flowers
<i>Oryza sativa</i>	Gramineae	Rice	unripe seed
<i>Zea mays</i>	Gramineae	Com	seed

Figure 2. Monthly counts of individual numbers of Philippine cockatoo on the traditional roosting site on Rasa Island. Numbers showed a slight increase in almost three years of recording. The numbers fluctuate seasonally and are lowest during, and highest after, the breeding season.

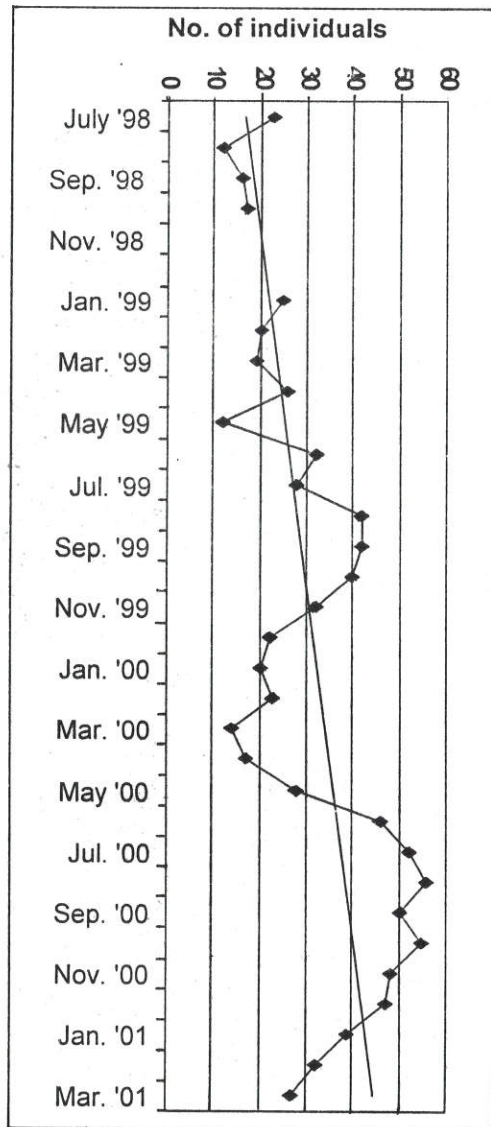


Figure 3: A clutch of Philippine cockatoos after ringing and feather sampling

