Giant Frugivorous Monitor Lizards in the Philippines

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PROJECT SUMMARY

We have developed a range of non-intrusive techniques to investigate the ecology and population biology of fruit-eating monitor lizards in the Philippines. We have investigated the status of the animals in various parts of Luzon and conclude that they no longer exist in many areas as a result of large-scale deforestation and are now restricted to fragmented forest in eastern Luzon. Small isolated populations also exist on Polillo and Alabat Islands in Quezon Province. A new form of fruit-eating monitor lizard was discovered in the Sierra Madre mountains whose taxonomic status is currently under study.

Work on Polillo Island has concentrated on identifying key resources for lizards in degraded forests, comparing population structure in habitats of different quality and examining the animals' role in the dispersal of *Pandanus* and *Canarium* seeds. Populations persist in moderately degraded forest if suitable shelter trees are present and key fruit resources available for at least part of the year, but these populations occur at higher densities and contain very few adult males. Where corridors of non cultivated land exist between patches they are utilised by the lizards. Evidence was collected suggesting the lizards are responsible for almost all uphill dispersal of *Pandanus* seeds and therefore play an important role in the maintenance of microhabitats that are essential to many endemic plants, animals and fungi. In May 2006 an Animal Planet documentary about the lizards and their plight on Polillo was released and shown world-wide.

Important Note: CLASSIFIED INFORMATION

Early in this study it became apparent that some discoveries about the distribution patterns of giant frugivorous monitor lizards had the potential to be misused and lead unscrupulous people to places where they would most easily be able to catch the animals. For this reason the specific identification of certain tree species have been withheld. I will supply the information on request to bona fide fieldworkers

PROJECT BACKGROUND

Giant frugivorous lizards (GFL) occur only in the Philippine Islands. They are an evolutionary and ecological oddity because they are obligate fruit eaters, extremely large (>9kg/180cm) and belong to a family of lizards whose other members are exclusively carnivorous. Despite their size they are extremely secretive animals. Only two species of GFL are known to science, one (*Varanus mabitang*) was discovered in 2001 and the other (*V.olivaceus*) was described in 1845 but had been the subject of a single study in the 1970s using destructive methodologies that are now considered unacceptable. Both are of high conservation concern because of their fragile niches and inability to survive outside their rapidly dwindling habitat of lowland dipterocarp forest. The only other giant lizard of equal conservation concern is the Komodo dragon, which has benefited from enormous publicity and conservation efforts. In comparison GFL have received virtually no attention at all. This report describes the development of non-destructive and non-intrusive methods to investigate baseline biology and population status of *V.olivaceus* on Polillo Island, Quezon Province and the application of these methods in other parts of the Philippines where unknown populations of GFL might still occur.

SURVEYS ACROSS THE PHILIPPINES

Summary

Investigations in central Luzon suggest that populations still occur in parts of Rizal Province and that a population in Laguna occurred up to at least the 1960s but is now almost certainly extinct. A very small population of *V.olivaceus* still exist on Alabat Island in Quezon Province and a GFL of undetermined taxonomic status was discovered in the Sierra Madre mountain range. The animal will be formally described following molecular analysis in cooperation with Rafe Brown at the University of Kansas. The known range of GFL suggests that many populations have been driven extinct without scientists ever having been aware of their presence. Almost all surviving populations are under extreme pressure because of increasing fragmentation and degradation of lowland dipterocarp fragments.

Background

A major aim of this study is to develop survey techniques for GFLs that do not disturb the animals and do not rely on the lizards' actual presence in the study area. Such an approach is important when looking for evidence of animals that show a highly clustered and, without knowledge of the local phenology of resources, unpredictable distribution. Surveys that rely on finding the animals require very high effort and a large element of luck in locating the current centres of activity. Inability to find lizards would mean the results were inconclusive or negative and require follow-up investigations. By surveying forest understorey for evidence of the animals' recent presence unpredictable factors that limit current occupancy (e.g. weather conditions, local resource availability, recent disturbance) can be disregarded. The core assumptions of these methods are that *Pandanus* is a staple part of the diet of all frugivorous monitor lizard populations and that no other vectors regularly disperse clumps of *Pandanus* seeds on hillsides and ridges. Early attempts to apply these methodologies outside Polillo are described in the Appendices and summarised below.

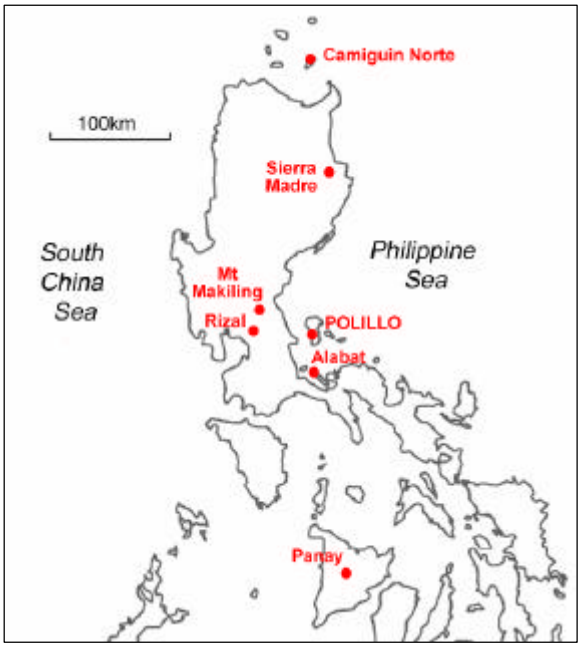

Figure 1. Study sites

Panay

The known range of *V.mabitang* is extremely small; it is known from forested areas in the northwest of Panay but has not been recorded elsewhere on the island. Following reports of a different type of large lizard in areas of central Panay, Marisol Pedrogosa visited Polillo to learn techniques in March 2005 and conducted a month long survey in central Panay in September 2005. No firm evidence that GFL exist in these areas was found and the lack of *Pandanus* in forested areas leads us to suspect that the lizards have not occurred in this region in the recent past. The full report is given as an appendix.

Camiguin Norte

Following reports (based on interviews with hunters and the supposed collection of feces containing large numbers of *Pandanus* seeds) of the occurrence of giant frugivorous lizards on the remote island of Camiguin Norte in the Babuyan group north of Luzon, a visit was made to the area in March 2005. *Pandanus* is absent from most forested areas and the *Pandanus* accumulations observed were attributed to the above-ground caching behaviour of rats (a behaviour that has not been observed on Polillo). There was no evidence of the presence of GFL at any of the sites we visited and if the lizards have existed there in recent times they must have had a very restricted distribution or been present at very low densities. The full report is included as an appendix.

Alabat

The small island of Alabat contains two patches of watershed forest that had been reported to still support a small population of *Varanus olivaceus*. In September 2005 Dr Rogelio Sisson (National Museum of the Philippines, Reptile and Amphibian Division) and Carl Oliveros conducted a survey for the species. *Pandanus* abundance is high within forested areas and although no feces were located it seems certain that small populations still persist within the watershed areas. Dr Sisson will return to the area before the end of 2006 in the hope of procuring a specimen for the National Museum. The full report is included as an appendix.

Mount Makiling, Luzon

To compare *Pandanus* abundance and distribution on Polillo with sites on Luzon a visit was made to Mount Makiling, Laguna. A day searching the area around Mudsprings found only a single *Pandanus* plant of unknown species. According to the late Blaz Hernandez some areas of Makiling do have high densities of *Pandanus* and he recalled that a large fruit-eating lizard was captured in forest behind the Animal Husbandry building of the University of the Philippines at Los Banos in the late 1950s or early 1960s. So although *V.olivaceus* may have occurred on Mount Makiling in the recent past, it can be stated with certainty that its distribution did not include the Mudsprings area.

Rizal Province, Luzon

Interviews with hunters by Matt Yuchek strongly suggest the presence of a population of GFL in forest east of Montelbarn in Rizal province. We hope to make preliminary field visits to the area in 2007.

Sierra Madre, Luzon

The northernmost populations of *V.olivaceus* known are those on Polillo Island and the adjacent part of Luzon (specifically the UP Land Grant site at Real) which is now entirely denuded. Auffenberg speculated that the species may occur northwards through the Sierra Madre mountain range but despite the presence of biologists in the area for several decades no evidence of the species had been found. In 2004 I saw pictures taken by Merlijn van Weerd of a large lizard that had been killed and chopped up by a hunter in Sierra Madre. The pattern of the animal was highly reminiscent of *V.salvator* but the feet and claws were large and powerful. The head appeared to be large and the nostril slit-shaped but the battered condition of the animal left some uncertainty. In March 2005 I visited the area with Merlijn and members of the Philippine Crocodile Team for a reconnaissance visit. The area was being heavily logged and in all areas we visited there was ample evidence of recent chainsaw activity. *Pandanus* distribution was clumped but many trees occurred on the top of the hills and local hunters spoke of a tasty lizard that ate *Pandanus.* Later that year Roldan Dugay joined the Polillo Butaan Team as a full time researcher and spent several months learning techniques on Polillo Island before

commencing a field study in Sierra Madre. Almost all the areas he has visited are experiencing disturbance and destruction from teams of chainsaw operators but a specimen was finally collected from a local hunter under permits issued by the office of the Protected Area Superintendent of the Northern Sierra Madre Natural Park and the lizard was deposited in the National Museum of the Philippines. Its taxonomic status is currently under investigation and full results are expected in 2007. The full report is included as an appendix. From photographic and other evidence we have eight confirmed localities for this form in Sierra Madre

Fig 2. New form of giant frugivorous lizard from Sierra Madre.

Extremely wet weather in 2005 had an adverse effect on field work in Sierra Madre and Panay.

RESEARCH ON POLILLO

The remainder of the report documents key developments in research methodologies and findings about the biology and conservation of GFLs, based on intensive research on Polillo Island

Study site

Polillo Island is situated in the Pacific Ocean east of Luzon Island in the northeastern Philippines (Map 1). The climate is complex but characterised by heavy rainfall through much of the year with peaks in August and November. The hottest and driest period is March-June, and the coolest months are December to February. The study site includes the protected Sibulan Watershed Reserve and adjacent forest fragments, with a total area of approximately 5km^2. The site is hilly (elevations 60-300m) with many streams and swamps in valley bottoms. Local vegetation profiles are described by Galley (2001) and Clements (2003) and range from apparently pristine (uncut) forest dominated by dipterocarps to heavily logged habitat with few large trees and virtually no dipterocarps. The area is bordered and interspersed by agricultural land (mainly rice fields and coconut groves) (Map 2).

Base camp for the project is the family house of Augusto Zafe who has been a principle member of the team since 1999. The camp is within ten minutes walk of the edge of the study site. Work is conducted by a core team (Daniel Bennett, Augusto Zafe, Mang Hil) accompanied by other forest wardens and visitors (primarily other biologists and veterinary students). Since March 2005 at least two field workers have been employed full time on the project to maintain camera traps and monitor study sites.

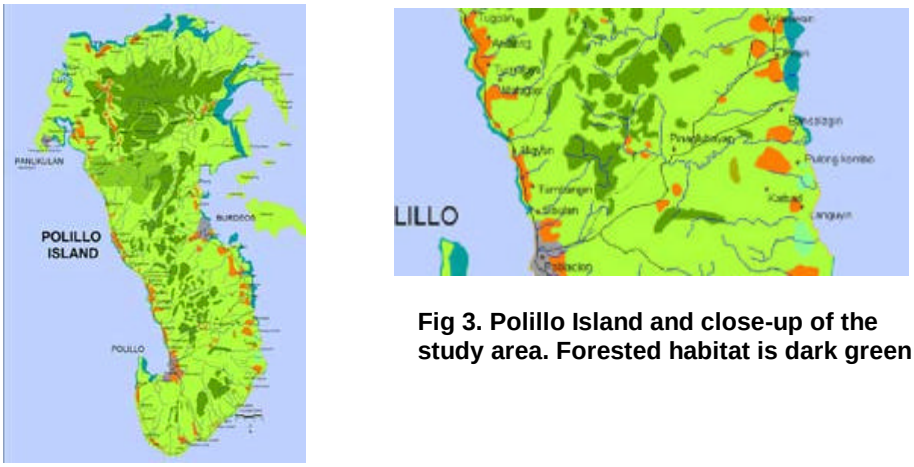

Fig 3. Polillo Island and close-up of the study area. Forested habitat is dark green

Study Techniques for GFLs

Summary

Giant frugivorous lizards are extremely shy animals. In some cases capture of individuals can lead to a cessation of all lizard activity in that area, probably as a result of chemosensory cues produced by captured animals. Captured individuals have never been observed to return to the point of capture, even after several years. For these reasons methodologies that do not rely on capturing animals are essential. They include fecal collection and analysis (to determine diet, identify activity areas and estimate overall activity levels and population structure) and use of infra-red triggered camera traps (to determine key tree resources, levels of intra and inter-specific competition, estimate population structure and investigate tree use by individuals). These methods reveal that on Polillo *V.olivaceus* feeds almost exclusively on three species of animals and 10 species of plants, forages for fruit in trees rather than on the ground and habitually return to certain trees whenever they are in fruit. The scattered distribution of rare fruiting trees leads to clustering of individuals for at least part of the year. The lizards are the main disperser of two important plant genera (*Canarium* and *Pandanus*) and seedling distribution of *Pandanus* can yield incontrovertible evidence of the animal's occurrence in an area even when the animals are seasonally absent. The methodologies developed pave the way for efficient surveys of other areas that may still contain populations of GFL and have identified key resources that are essential to the animals' continued survival.

Background

Varanus olivaceus is impossible to study using standard non-destructive methods employed for other *Varanus* lizards (e.g. Traeholt 1995, Sweet 1999, Bennett 2000, 2002) because they spend almost all their time high in the canopy, cannot be attracted to baits and are highly sensitive to disturbance. The only previous study of the species (Auffenberg 1988) relied on the use of dogs to capture individuals which resulted in very high mortality. The lack of acceptable methodology left little incentive for field researchers to follow up on Auffenberg's work and for almost 20 years the species attracted no interest. In 1999 and 2001 a study of *V.olivaceus* (known locally as butaan) was carried out as part of the Oxford University / University of the Philippines at Los Banos Polillo Islands Project to attempt to develop non-destructive and inexpensive methodologies that could be employed by local workers (Bennett 2001, Bennett and Hampson 2003).

Capture of Individuals

Varanus olivaceus cannot be attracted to baits effective for other *Varanus* species and the only way specimens could be caught was with dogs (Auffenberg 1988). We have developed several methods for the safe capture of the lizards (Bennett et al. 2001) and an efficient way of baiting the animals. However evidence from a variety of sources (see below) suggests that capturing individuals over 4kg causes long-term changes in their activity areas and can temporarily alter the behaviour of all sympatric individuals. As a result no animals have been purposely caught since 2002.

The Importance of Non-Intrusive Methodologies

One of the most striking aspects of the behaviour of *V.olivaceus* is its extraordinarily shyness and sensitivity to disturbance.

Spool and line data indicates that whilst animals under 2.5kg quickly recommence feeding behaviour close to (but rarely at) the point of capture larger individuals always leave the area, either immediately or after a 1-17 day period in a shelter tree at the release spot. They never return during the tracking period (maximum of approximately 35 days)) and there is no evidence from camera trap data that captured individuals ever return to the point of capture, although other individuals often make repeated visits to the same trees. It is suggested that the experience of capture causes individuals to avoid the capture area and that large individuals (presumably with good knowledge of alternative resources) prefer to omit the capture point from their activity areas.

When *V.olivaceus* are aware of the presence of people they hide themselves by moving to the opposite side of the tree trunk, flattening their bodies against the bark or taking cover in dense foliage. Animals over 1kg remain hidden for longer than team members have had the patience to watch them (up to five hours). Smaller animals sometimes descend the trunk, albeit cautiously, even when groups of people are standing at the base of the tree. They may make several forays up and down the trunk before eventually descending to a level where they can be noosed.

For population studies capture of any individuals is best avoided. If the interpretations given above are correct it can be surmised that capture causes temporary or permanent movement away from the point of capture and that disturbance of a single individual can

result in avoidance behaviour by the entire population for periods of days or weeks. In this case non-destructive methods are clearly intrusive and even non-intrusive methods have the potential to cause disturbance.

Feces

Summary

Feces are currently yielding valuable data on seed dispersal dynamics and ontogenetic, seasonal and annual differences in dietary composition. They also have the potential to allow entirely non-intrusive and highly accurate measurements of population size and structure, movements and feeding habits of individuals and levels of stress at both the individual and the population level using molecular markers for microsatellite DNA and corticosterone assays. Both would have important implications in the study of populations in highly fragmented and disturbed areas. Possibilities for employing these methodologies are currently being investigated.

Background

The vast majority of studies of diet in *Varanus* lizards have been conducted by dissections and, prior to this study, all that was known of the diet of *V.olivaceus* was based on the dissection of 112 individuals by Auffenberg (1988). Methods employed for other species include fecal recovery (Bennett 2000), direct observation (Auffenberg 1981, Traeholt 1994) and stomach flushing (Bennett 2004). Early in this study it became apparent that the feces of *Varanus olivaceus* were almost always easily distinguished by size and composition and could be detected with much less effort than it took to locate animals.

Methods

Searches for feces are carried out informally during the course of other activities or along flexible "Ariadne" transects (see below). Locations of feces are labelled with a ribbon tag for subsequent GPS mapping, age of the sample is estimated and the numbers and types of prey items present recorded. Seeds are counted individually whilst crab and snail fragments are always counted as 1 unless they clearly represent more than one individual.

In the case of flexible transects workers are fixed with a cocoon bobbin containing 320m of thread finish when the thread has expired. Width of these transects is taken as 2m to approximate the field of view of the searcher. Flexible transects have several important advantages over traditional straight line approaches which produce a random sampling area that includes trees and other obstacles and ignore differences in gradients. Searching for feces along straight line transects tends to yield very low results because they rarely intersect with paths taken by animals; most of the search is conducted in areas where, for various reasons, feces are unlikely to be encountered. Using a flexible transect allows sampling effort to be controlled whilst giving the worker the freedom to utilise knowledge of topography and animal paths to maximise yields. Other advantages of the method over random searches are that areas already surveyed by other workers can be easily avoided and disorientated workers can easily retrace their route to the start of the transect.

For dietary analysis the study area is divided into sites which consist of discreet fragments of forest or one or more hills within a larger block of habitat. Areas are visited at irregular intervals and care taken not to visit revisit sites that appear to be densely populated more than once every 14 days to avoid excessive disturbance.

Results

A total of over 1,100 fecal samples have been recorded from the Polillo study site, representing perhaps the largest dietary dataset for any single population of reptiles.

Seasonal and spatial variation: Distributions of feces suggest that populations are most scattered from November to March (when animals are feeding largely on fragrant, low-hanging fruit available in small quantities on scattered trees) and tend to cluster around rare, heavily fruiting trees from approximately April to October. Activity (or at least frugivory) may be reduced during the cooler months of December and January because few feces are found. Diet shows considerable variation between hillsides, seasonally and between years. For most fruit species utilisation appears highly correlated with availability. *Pinanga* is available throughout the year but only eaten during certain (irregular) periods suggesting that it is less preferred than other fruits.

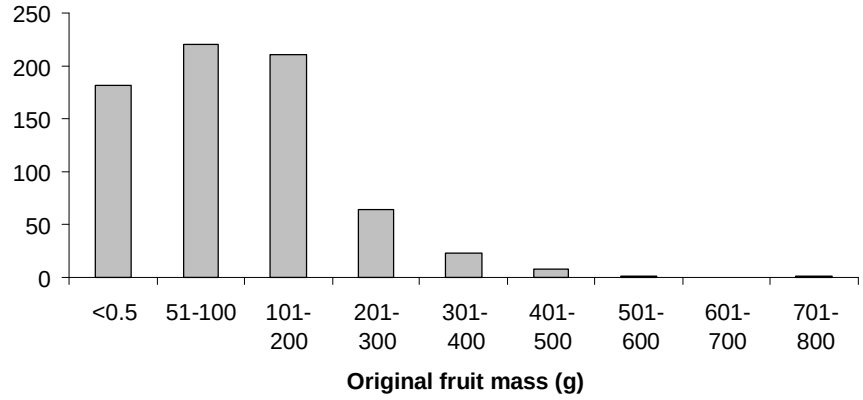

Fig 4. Size distribution of feces based on estimation of original fruit mass. Note large outliers.

Population structure: Estimates of population structure from feces agree well with estimates from camera trap data. A direct measure of population size is not possible from fecal data because many samples can come from the same individual. Smaller animals make more feeding forays than larger ones and probably defecate more regularly and over a smaller area. However the shape of size distributions can be used to infer population structure if it is assumed that larger feces are easier to find than smaller ones. A striking characteristic of fecal size distributions is the presence of a small but persistent number of unusually large outliers (Fig 6). Evidence from camera traps indicates that at least one exceptionally large (>10kg) individual is present in the study area.

Fig 5. An extremely large V.olivaceus captured on camera trap.

Comparison with mainland population: Overall plant diversity might be expected to be lower on Polillo because of its small size and distance from mainland Luzon, but there is no evidence that this is the case (Clements 2003). On Polillo plant species richness in the diet of *V.olivaceus* is similar to that reported by Auffenberg (1988) in Camaroan but the species composition shows important differences. The only plant important in the diet of the Caramoan sample that is not known to occur on Polillo is *Spondias pinnata*. Five species of *Aglaia* are known to occur at the Polillo study site but no fruit have been found in lizard feces. *Pinanga* an important item in the diet of lizards on Polillo is conspicuous in its absence from Auffenberg's study. Over 100 species occur throughout the Philippines and the genus is reported to be most diverse in limestone regions. It is very unlikely that they do not occur within his study area but none were

recorded in the diet nor is the genus mentioned in the text. If *Pinanga* is abundant in the Caramoan area the heavy dependence of the Polillo population on the fruits might be indicative of habitat that is poor in resources. That *Gnetum* was present ("common") in the Caramoan area but was absent from Auffenberg's dietary sample although it is common in the Polillo sample is more difficult to explain. Possibly preferred fruits exist in Camaroan or local *Gnetum* are somehow unpalatable to the lizards. Unfortunately the samples obtained by Auffenberg were not preserved (W. King, personal communication) and the possibility that some of his identifications are erroneous cannot be discounted.

Seed dispersal: Data suggests that *V.olivaceus* is the main disperser of *Pandanus* and *Canarium* seeds on Polillo. Although rats occasionally disperse *Pandanus* and *Canarium* by failing to destroy them (fig. 10) all seeds deposited by lizards germinate readily. *Canarium* seeds are also dispersed by a few species of birds on Polillo (hornbills and pigeons) but in very low numbers (according to estimates from hide observations and camera traps and from accounts in the literature).

In the absence of animal vectors *Pandanus* are dispersed by water and their usual habitats are swamps, waterway and coasts. On Polillo *Pandanus* is more abundant on hilltops than along streams and densities are extremely high. Dispersal of *Pandanus* is of particular importance because of increasing evidence that the plants act as essential microhabitats for many unique fauna and flora. They support a vast number of unique fungi, some insects, and in Madagascar are thought to be the only egg deposition sites of many species of amphibians (Lehtinen 2001). In this respect it is noteworthy that the two vertebrates endemic to Polillo are collected almost exclusively from *Pandanus* habitats. The gecko *Pseudogecko smaragdinus* is known as Butin na Pandan in Tagalog and strong empirical evidence exists of the relationship between *Pandanus* abundance and the occurrence of the frog *Platymantis poliloensis* (Hampson 2001). No studies of the invertebrate, floral or mycological communities of *Pandanus* have ever been undertaken on Polillo but such studies would unquestionably lead to the discovery of many new species.

Figure 6. *Pandanus* species from Polillo

Figure 7. *Varanus olivaceus* and *Rattus everetii* feeding on *Pandanus*

Many clumps of young plants are found growing uphill of any possible parent tree – strong evidence that the lizards are acting as their dispersal vectors. Visits to other areas inhabited by GFL confirm that *Pandanus* is a common element among hill top floral communities in Panay (around the type locality of *V.mabitang*) and in north-eastern

Sierra Madre (locality of a currently unclassified form of GFL - see below). This suggests that the lizards' feeding behaviour maintains high genetic diversity and density of *Pandanus* which in turn allows the persistence of unique faunal and floral elements by providing essential microhabitats. Over evolutionary time the effects on populations of adult *Pandanus* plants of the loss of animal dispersers would be a very slow process but the appearance of new clumps of *Pandanus* uphill of parent plants would cease immediately and it is that characteristic that makes the study of *Pandanus* distribution an extremely powerful tool in the identification of areas that still have, have recently lost, or have never been home to populations of GFLs. In the near future we hope to investigate the genetic diversity of *Pandanus* populations in areas where they are regularly dispersed by lizards or only rarely dispersed by rats using molecular techniques.

Camera and Video Camera Traps and Direct Observation

Background

Camera trapping has rarely been used to monitor reptile populations, however it has the potential to provide valuable information on resource use, levels of competition, changes in population structure through time and in individuals with age. With sufficient knowledge of the available resources it should also be possible to track individual's movement according to preferred fruit availability. Video camera trapping of low hanging fruit facilitates direct observation of foraging behaviour and estimation of individual fruit intakes. The discovery of trees with very high visitation rates suggested that direct observation from camouflaged hides might also be worth investigation. In particular it could be used to test the efficiency of camera traps, look for evidence of disturbance from camera flash or sound, investigate the potential for filming animals for a documentary and test the hypotheses that 1) mature individuals are often too big to forage on thin branches and 2) lizards prefer fruit on the ground to fruit on branches.

Equipment and Methodology

The units (Trailmaster 550 and Canon AE1 camera) cost almost $500 each and trials were conducted with various other models priced between $50 and $350. None were satisfactory, at least partly because the camera and sensor are combined units and there

are great advantages in being able to place the sensor closer to the tree than the camera. Furthermore pictures are best taken in portrait orientation to include as much of the tree trunk as possible. Other advantages of Trailmasters are long battery life (at least ten months from 4 X D cell batteries for the sensors, 3 months from 1 CR123A battery for the cameras), short camera delay (minimum 6 seconds), superior resistance to rain, precise control of sensitivity and on/off times. The primary disadvantage is that they are rather complicated to program and the manual is not easy for many co-workers to understand. The project currently owns 16 Trailmaster 550 camera traps purchased with the BP grant and has two 770V video traps on loan from Katie Hampson (Princeton University). We have lost two camera traps to theft. Within 14 months of purchase none of the Trailmaster units were functioning and are currently under repair in the US.

Traps are set at fruiting trees (occasionally at shelter trees) using the settings P=2 Pt=10 Cd = 0.1. The sensor is placed 2-3m from the trunk pointing slightly down to cover activity at a height of 0-2m depending on tree type. Colour print film is used rated at 100-1600 ASA. Cameras are usually set in portrait orientation and in "panoramic mode. This produces a narrower image but has the important advantage that the date/time information is on unexposed film and is therefore easy to read. Sometimes this information is obscured by bright backgrounds in standard mode. Because of low light levels in the forest and 24 hour operation flash was used on almost all films up to 2004. Experiments to test for differences in number of events obtained with and without flash have been inconclusive but direct observations from hides suggests that some lizards freeze when the flash is triggered and occasionally leave without feeding. Attempts to eliminate flash use using very high speed film (800 and 1600) were generally unsuccessful (see below). Because no lizards were ever recorded during the hours of darkness traps have operated only from 0615 to 1830 since 2004. Checking traps requires balance between ensuring cameras do not run out of film and minimising disturbance at the area. Logistical reasons also prevent regular checking during some periods and this, combined with failures due to wet weather and rodent damage means that monitoring periods are often incomplete.

Collected films are labelled in situ and developed when time permits. Prior to 2005 films were developed and printed at commercial establishments in Manila and electronic scans made of negatives that contained events. Attempts to save money by scanning negatives without a print guide were extremely time consuming because scans were made on a Minolta F-2800 machine that had to be manually loaded (36 exposures took 4-5 hours and required constant supervision). As a result consumable costs were considerable (approx $6.50 for film, processing and printing). The purchase of a Nikon Coolscan 5000 scanner and SA-30 bulk film loader in 2005 allows uncut rolls of negatives to be scanned automatically, greatly reducing the time involved and eventually saving money by eliminating printing costs. However the high cost of the equipment ($1500) means that cost savings are not expected until early 2007.

Images containing events are scanned at maximum resolution resulting in files of about 30MB from the Minolta and 67MB from the Nikon scanner. Images are examined to estimate the size of the individuals using a comparison image of the tree with a 10cm scale held against the trunk) and to determine identity. Two people independently attempt to identify individuals from pictures based on size, pattern and scars or injuries (unfortunately the tail notches given to captured individuals are too indistinct to be visible on camera trap pictures). Where their interpretations differed the series is re-examined and the most probable identifications agreed upon. The Polillo population of *V.olivaceus* is perhaps the least patterned of any of the races known. Except when they are very young most individuals have very indistinct markings. Identifications are further complicated by a loss of pattern as time since last skin shed increases, an increase in pattern when the lizards are wet and inconsistent exposure depending on time of day and position of the sun. Identification is therefore a lengthy process that often requires careful manipulation of image characteristics. Nevertheless positive identifications have been made for most events at three key trees that have been monitored during every fruiting period since 2003 and analysis of the entire dataset up to July 2006 is expected to be completed by the end of the year.

Results

Camera traps: 245 rolls of film that have been analysed taken at 41 trees have recorded 616 events (defined as a single visit to a tree) comprising of 336 images of lizards climbing trees and 475 of lizards descending. In addition images of skinks (<10g), rats, *Varanus salvator*, civet cats, monkeys, bats and birds have been obtained. Lizard activity was recorded at 29 trees and 106 films (43%) contained one or more event (mean 5.7, + 5.9, range 1-24). Trees that were visited received a mean of 0.82 visits per day (+ 0.7, range 0.04-3 visits per day). The least heavily utilised trees were shelter trees typically used for a few days by a single individual. The most heavily utilised trees were rare, dioecious, fruiting trees with a heavy crop and long fruiting season. These trees are probably visited by all members of the local population at least once. In several cases where such trees occur in degraded habitat they appear to be the only reason why the areas are visited by lizards. I hypothesize that removal of these trees would result in the final disappearance of *V.olivaceus* from the area. To date none of these trees within the study areas have been destroyed but two are likely to be lost through slash and burn clearing in the next couple of years.

Camera trapping supports findings from spool and line tracking that *V.olivaceus* pick fruit from branches rather than collect it on the ground. Mean time spent in fruiting trees was 20.5 minutes (N = 223). Some short visits (<5 minutes) are probably not feeding events but either freezing or fleeing behaviour associated with camera flash or lizards climbing a tree that is already occupied by another (always larger) individual and leaving prematurely. Sometimes lizards arrive at a tree separately and leave together and sometimes they arrive at the tree within minutes of each other. Lizards are more likely to meet conspecifics at fruiting trees than at shelter trees. Such encounters are rare for most of the year but peak sharply in July and August, which is believed to correspond to the mating season (Auffenberg 1988).

Figure 8. A pair of *V.olivaceus* captured on camera trap.

Small individuals tend to visit trees regularly (up to four times per week) whilst larger animals make fewer visits and the largest animals are the least frequent visitors. This may be because larger animals are able to consume many more fruit in a single visit and make fewer feeding forays as a result, or because larger individuals also forage at trees that are unknown to us. An alternative explanation is that young lizards return regularly to fruiting trees in order to reinforce their memory of its position

For more mobile frugivores information centre based scenarios have been proposed whereby individuals have the opportunity to learn the position of resources from others. Such behaviour is probably normal in birds, bats and primates that feed in groups. No such system has ever been proposed for a lizard but it seems probable that certain trees

act as information centres for *V.olivaceus* by carrying chemosensory details of recent visitors. In this scenario animals would search for trees used by conspecifics rather than trees containing fruit, and animals moving on resource trees have the option of leaving more or less clues of their visit. It is hoped to test some of these ideas using direct observation from hides in 2007.

Error Sources: Camera traps fail to record all visits to trees because some lizards take routes to the fruit source that evade the sensors; e.g. jumping to or from an adjacent tree, climbing vines or climbing the back of the trunk. This may be personal preference or in order to avoid noise and light from cameras. Anecdotal observations made from camouflaged hides of individuals foraging at trees with camera traps indicate that some individuals freeze for short periods when camera traps are triggered and one was observed to jump off the trunk and run away. Within the study areas many lizards are now well acquainted with camera traps and appear to ignore them entirely. A quantitative measurement of response to electronic camera flash and noise should be possible by observing the behaviour of naive animals of different sizes to camera trap operation using a (silent) video camera.

Video Traps: Most trees that have high visitation rates have canopies that are largely obscured from the ground making use of video camera impractical. Setting video on trunks yields very short sequences of animals ascending the tree but rarely captures the descent (because of the lengthy (3-5 second) start up time. Such videos are easy to obtain and show that lizards regularly tongue flick the bark as they climb. However video traps are most enlightening when the trigger and camera can be aimed directly at low-hanging fruit such as *Pandanus*. Attempts to capture feeding behaviour at *Pandanus* trees started in 2002 but because of their unpredictable fruiting patterns and the fact that most fruiting specimens are not visited by any lizards but all are visited by rats that like to chew cables no footage was obtained until 2004. The results were well worth the wait, because not only do they constitute the first moving images ever taken of a frugivorous monitor lizard in the wild they also shed light on why *V.olivaceus* is able to utilize a fruit that very few other animals consume. Removal of ripe *Pandanus* drupes often requires considerable

strength and the only “perching area” is a hard shiny trunk that few animals can grip. V.olivaceus removes *Pandanus* fruits by holding the trunk with the hind feet only and reaching out with the head and forelimbs to the syncarp. When a suitable drupe has been tongued and touched the lizard grasps it in the mouth and attempts to pull it from the syncarp by flexing the neck and back. Small individuals find it very difficult to remove *Pandanus* fruit and may spend 15 minutes removing a single drupe, falling out of the tree many times in the process. Some of the sequences obtained were highly entertaining, so much so that we were able to persuade a media company that it would be possible to produce a documentary about the lizard (see below). Video trapping also allows a precise count of how many fruits are eaten by individuals that has to be inferred from locally collected fecal data for still camera traps.

Camouflaged Hides: Ameristep camouflaged hides are set at least several days before first occupancy and observers equipped with binoculars and a video camera are in place by 7am and leave between 5 and 6 pm (depending on distance from base camp). Observers can drink but cannot eat or wear mosquito repellant. Conditions in the hide are most usually described in terms best summarized as “hostile”. Discomfort from heat and lack of ventilation are compounded by extremely high mosquito densities. However almost all observers have been rewarded with views of an animal that very few people have ever seen and some useful data has been generated. With the exception of *Grewia* no fruits have been observed to be eaten from the ground. Lizards sometimes eat one or two *Grewia* fruits from the ground before climbing the tree but even the largest animals can manipulate thin branches with apparent ease.

The considerable amount of data generated from camera traps is under analysis and a preliminary paper on the results is hoped for in 2007. Functioning camera traps from the project will be used throughout the Philippines with the aim of capturing images of endemic species that have never previously been photographed in the wild.

Education, Training and Development

The lack of any official enforcement of laws regarding logging and hunting in the Philippines is compounded by considerable population pressures and dire economic conditions. Thus although education efforts on Polillo have been extremely effective people appear to have little choice and no disincentive but to clear existing forest for agriculture and remove hardwood trees for timber. We believe that the activities of the Polillo Butaan team have almost entirely eliminated hunting of animals in this area and the destruction of habitat within the watershed zone. However connecting areas of forest are being destroyed at a very rapid rate. Key corridors between forest fragments have been identified and local landowners made aware of their importance. Over 100 trees that are of particular importance (to butaan or other vertebrates) have been identified in areas that are under immediate threat and are protected by people living locally.

A significant achievement has been to dissuade local people from taking dogs into the forest. Almost every household owns at least one dog and most lizards are caught following their discovery by dogs in the forest. Dogs on Polillo are adept at flushing out animals and attack even large pythons without fear. Polillo members of the project have worked tirelessly to persuade people to avoid taking dogs into forested areas because of the damage they cause. We have not seen a single dog in the watershed forest since 2005.

Despite the exceptionally high levels of endemism in the Philippines the country's wildlife is rarely portrayed in world-wide media. As far as I am aware the only documentary about Philippine fauna with world-wide distribution was a film about the Philippine eagle. A film crew from Steel Spyda (UK) visited Polillo to make a 60 minute documentary about *V.olivaceus* and the role of the Polillo Wardens in its conservation. The documentary ("Butaan – The Lost Dragon") was released in November 2005 by Animal Planet. Unfortunately the documentary contained multiple errors and failed to acknowledge any of the project's supporters. Animal Planet agreed to reedit the documentary and a much improved version was released in the USA in May 2006.

Students and researchers from eight institutions (UP Los Banos, UP Dilliman, Ataneo University, Philippine Crocodile Project, St Tomas University, Cebu Biodiversity Project, Katala Foundation, Mindoro Reptile Foundation) have visited Polillo to become acquainted with the techniques. Selected students on Polillo have also been trained.

To publicise methodologies presentations were made to students and staff of the University of the Philippines (Los Banos), University of the Philippines (Dilliman), Wildlife Conservation Society of the Philippines and the University of the Philippines Zoological Society. I also gave presentations at the Fourth International Symposium on Frugivores and Seed Dispersal (Brisbane), Chester Zoo education and curatorial staff, Herpetological Taxon Advisory Group Meeting of the AAZA (Houston), Third World Congress on Varanids (Bonn) and Conservation International Headquarters (in Washington D.C. - attended by two people!).

The Sibulan Watershed area contains the only pristine lowland dipterocarp forest on Polillo and is one of the last such fragments in southern Quezon. It contains all the known species of animals and plants that are endemic to the island. Despite the area's importance facilities for visiting scientists have been very rudimentary. We installed a generator at base camp that has been of great benefit to both local people and visitors.

CONCLUSIONS

V.olivaceus is an ideal flagship species for conservation in Philippine forests because direct action to ensure its continued occurrence would safeguard most other local fauna and flora. At present very little of the range of the species has been surveyed and available information suggests that the animals have disappeared from most lowland areas throughout their former range. Surveys of remaining forest patches should therefore be a priority. Inexpensive, low effort and reliable survey techniques that do not disturb the animals have been developed, most of the resources important to GFL can be identified and mapped, and patterns of use for many resources can be predicted. I anticipate that it will also be possible to determine areas previously or currently occupied by *V.olivaceus* based on the distribution of *Pandanus* trees within them (see above and below).

An ultimate aim of this study is to mitigate the effects of hunting and logging activities and to eventually facilitate the re-introduction of GFL into areas from which they have been extirpated. To this end considerable effort has been put into determining which resources are important to *V.olivaceus* and how the needs of the human population conflict with those of the lizard.

Effects of fragmentation and degradation

The implications of shrinking and increasingly fragmented habitat for a large immobile frugivore are intriguing. Most fragments in the study area are too small to support constant supplies of the required fruit resources and so animals move between patches, usually through corridors of dense ferns. Where such corridors do not exist the animals would be obliged to move through cultivated habitats where they are at high risk of detection by people or dogs. That they are sometimes forced to is illustrated by locals recollections of animals cornered in coconut trees, although such events are rare.

The situation on Polillo Island allows the processes through which lizards are driven locally extinct to be identified. The highly complex forest/ farm mosaic shows great

heterogeneity in terms of fragmentation, isolation and resource abundance. A number of areas that supported *V.olivaceus* in 1999 no longer do so, because they have been totally destroyed, have lost key resources, are subject to regular disturbance or have lost corridors and become completely isolated.

Forest patches on Polillo are small (maximum 4km^2), fragmented and virtually all degraded to some extent. As a very large and flightless animal with a narrow dietary breadth, *V.olivaceus* maybe more sensitive to habitat fragmentation than any other frugivore in the Philippines. Populations on Polillo have been subject to extreme pressure since the 1950s as a result of intensive and wide-scale logging and the surviving animals are restricted to very small patches of largely degraded habitat. Although habitat loss now occurs at a much lower rate it is ongoing in parts of the study area outside the Sibulan Watershed Reserve. At least several hectares per year of forest are cleared for coconuts through slash and burn and an unknown number of timber trees are extracted with chainsaws. Evidence suggests that most timber cut is used locally for construction. Based on the number of new houses built in the area and size of chainsaw stumps that I encounter, timber extraction is estimated at a minimum of 60 trees per year. These forest patches are privately owned and, in many cases trees are taken without the landowner's permission. Many landowners spend most of the year away from Polillo and rarely visit their forests.

Chainsaw operators preferentially remove the large emergent trees used for shelter by *V.olivaceus*. In general loggers prefer trees near the bottom of hills (for ease of extraction) whilst lizards prefer trees close to hill ridges (perhaps for thermoregulation). In the absence of these trees lizards shelter in the canopies of smaller trees which are invariably dense with vine thickets and other epiphytic vegetation. Preferential logging rarely destroys food resources (unless they are destroyed in the process of logging other trees) but it increases distance between shelter and food trees which makes detection by predators more likely. Some areas of forest contain no shelter trees of a suitable size for large individuals but are still visited because they contain important fruit resources.

Conversely there are few areas with abundant shelter trees that lack sufficient fruit resources (for at least part of the year) to support *V.olivaceus* populations.

V.olivaceus is in no way territorial and activity ranges regularly overlap. For about five months of the year populations are largely clustered around a few rare fruiting trees. These trees are considered a very important resource because they supply many members of the population with fruit throughout the reproductive season and may play a key role in social interactions at this time. Protection of key resource trees in marginal habitats and the maintenance of uncultivated corridors connecting them to other habitat fragments are key conservation priorities

Demand for timber directly affects lizard populations by removing trees suitable for sheltering adult individuals. As densities of these trees decreases encounters between people and lizards increase in frequency, especially on hills that also contain important fruit resources. Shelter trees on particular hillsides are therefore much more important than similar trees elsewhere and these sites need to be considered priority areas. On Polillo local landowners are receptive to the idea of setting aside specific hillsides that are important to local fauna and flora but claim that because most logging is done without their consent they have little control over which trees are taken. For Polillo at least, effective conservation strategies depend most on the goodwill of local people and least on legislative protection

Hunting

V.olivaceus is a highly esteemed food item for people throughout its range. Even people who do not know that the butaan is a lizard often know that it is delicious and it is by far the most commonly heard adjective when local people are talking about the animal. Using a well trained dog and a very experienced team of ex-hunters it took us an average of 20 hours in the field to catch a single specimen of *Varanus olivaceus*. Spool and line data indicates that the animals are on the ground for as little as 25 minutes per week and spend almost all of their time in large dipterocarp trees where they are impossible to spot. Catching an animal requires that it is surprised on the ground and caught before it can ascend a large tree. Thus population size, distance between resource trees and the density

of trees too large to be cut down with a machete are all important factors in determining how much effort is required to catch an animal. Hunting the animals with traditional techniques is very labour intensive and usually individuals are captured opportunistically. Most animals captured by people on Polillo are disturbed by dogs and take shelter in trees from which they can be recovered easily. Other individuals are caught in noose traps and although these have been largely eliminated from the study area because of the regular presence of Ecology Wardens it doubtless continues elsewhere. Auffenberg (1988) estimated that 240 individuals were captured per year throughout the entire range of the species, and although this is certainly an underestimate (because more animals than this reach Manila for the illicit animal trade) in good quality habitat the species is encountered too infrequently for hunting to make an important impact. In degraded areas the animals become much easier to capture, particularly if many individuals rely on the same resource because resultant clustering makes detection more likely and the lack of shelter trees means detected individuals are less likely to escape.

Future Work

Developing a Diet for Captive Animals

A highly relevant application of our knowledge of the feeding ecology of *V.olivaceus* would be in the development of suitable diets for captive populations of GFL. Most documented captive animals have been confiscations held by zoos although a few have been traded with CITES certificates in the USA and a small but thriving black market appears to exist in Asia, Europe and North America. However, only two captive breeding events have been reported, both producing a single hatchling and only one of which survived more than 48 hours (now 15 months old at the Avilon Zoo, Montelbarn). The vast majority of captive animals die within 12 months and the unanimous opinion of vets in the Philippines acquainted with captives is that they are very susceptible to gout-like afflictions that are attributed to a highly proteinaceus diet. Although captives have been known to accept sugary fruits such as grapes and figs, no suitable substitutes for the oil rich staples of their natural diets are available. In the absence of a suitable diet attempts to breed the animals in captivity look doomed to failure. However there is no doubt that captive breeding programs would be the only practical conservation strategy for some

extremely small and completely isolated populations of giant frugivorous lizards (e.g. the Alabat Island population, populations that may still exist on Calaguas, Lahoy, Rapu Rapu and other islands, as well as many surviving forest fragments in the provinces of Quezon, Laguna, Rizal and Montelbarn on Luzon. A captive breeding population of *V.mabitang* (known only from forested fragments in the northwest of Panay would certainly be highly desirable (the species is currently unlisted but amply satisfies IUCN criteria for EN listing).

The biggest obstacle to providing suitable fruit is that they are only accepted by the lizards when in a perfectly ripe state but remain in that state for very short periods, making transport of fruit even within Luzon problematic. In cooperation with zoo staff entrusted with holdings of *V.olivaceus* we are trying to develop extracts of fruit important in the diet of wild animals that have a longer shelf life and can be used to supplement artificial diets. Once the problem of feeding GFL has been overcome the prospect of being able to breed them in captivity will become a reality.

Molecular Studies of Feces

DNA of *Varanus olivaceus*, *Canarium* and *Pandanus* species can be extracted from feces collected on the forest floor and could be used to identify individual animals and plants, enabling precise monitoring of individual and populations and quantitative measurement of the lizards' efficiency as a seed disperser. We hope to investigate the potential for using microsatellite markers in the near future.

Corticosterone assays from feces have been used to measure stress levels in many animals and would be particularly pertinent to the study of GFL because many populations appear to survive only in marginal habitat. Recent work has demonstrated that fecal samples must be stored at low temperatures to yield accurate measurement of corticosterone levels. At present such facilities do not exist but the recent provision of an electricity supply means that refrigerated storage of samples may be possible in 2007.

On Polillo

Current work on Polillo is aimed at preserving corridors between fragments and assessing the role of *V.olivaceus* in the dispersal of the plants it feeds on.

In Sierra Madre

In the near future we hope to establish a new team to conduct research in the Sierra Madre Mountains and the remaining forests fragments of Aurora Province.

Elsewhere

A number of priority areas in central and northern Luzon, Samar, Panay and other islands in the Sibuyan Sea have been identified that should be surveyed for the presence of GFL as soon as possible. Subject to funding we will attempt to visit as many of these locations as possible in 2007.

Through vigorous publicity campaigns that include world-wide television and local publicity it is hoped to raise the profile of these poorly known animals and generate efficient community-based conservation strategies that are of benefit to both lizards and people

Team Members 2005-2006

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Financial Account

Item	Cost (US$)
12 camera traps	6800
Generator and fuel	935
Central Luzon Projects	300
Alabat Project	500
Camiguin Norte Project	3000
Sierra Madre Project	4450
Panay Project	2100
Wages for local workers-Polillo	4200
Honorariums for local researchers	2500
Food-Polillo	1677
2 flights Manchester-Manila return	2453
Medical, first aid, insurance-Polillo	1226
Camera film, processing, printing	916
Transportation	881
Communications	700
Misc. equipment	425
Total	**33063**

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Appendices

I - Notes on Sibalom Natural Park Survey, Antique, Panay. (Marisol Pedregosa)

II - Investigation into the Population Status of *Varanus olivaceus* in Alabat Island, Quezon Province. (Rogelio V. Sison)

III - Report on Study on the occurrence of fruit-eating monitor lizard in the Northern Sierra Madre Natural Park. (Roldan Dugay)

Notes on Sibalom Natural Park Survey, Antique, Panay

(September-October 2005)

Marisol Pedregosa

Introduction

Sibalom Natural Park (SNP) is located in the southern portion of Antique with an area of 5,511.47 hectares. It was established as a protected area on April 23, 2000. SNP has about 1,035 hectares of forest cover although the municipality of Sibalom has about 800 hectares not covered by the boundaries of the protected area. Habitat types such as old growth forest, lowland and mid-montane forests, mixed secondary forests, grassland and reforestation areas can be found within Sibalom Natural Park (SNP), province of Antique, Panay Island, Philippines.

Mabitang is recently described monitor lizard (Gaulke and Curio, 2001) is closely related to *Varanus olivaceus* from Southern Luzon, Catanduanes and Polillo islands. It has almost uniform black coloration, with slight indications of yellow on neck, anterior part of dorsum, and dorsal sides of extremities. The head shape is an elongate triangle from above with pointed and slightly domed snout, strongly bulging nasal and temporal region. It has slit-like narial openings and positioned closer to the tip of the snout than the eyes. The eyes are reddish brown, with pink tongue and dark grey claws. It has finer scales and higher scale counts in comparison to V. olivaceous, a triangular tail cross section, a well developed

double keeled scale row on its crest and a strongly keeled ventrals. According to Gaulke and Curio 2001, the holotype of *V.mabitang* is exclusively vegetarian in diet. It is essentially arboreal, and a secretive lowland forest species.

The main objective of this survey was to verify the presence of *Varanus mabitang* in Sibalom Natural Park, Antique as previously claimed by the locals of Sibalom

The survey was done from September – to October 2005.

Note: During the survey, Tropical depression "Labuyo" hit the country, this caused heavy rains and floods in the area

Ethno-biological interviews

- *Varanus salvator nuchalis* is locally known in Sibalom as "Halo" while *Varanus mabitang* is locally known as "Abitang"
- Several hunters have claimed the presence of *V.mabitang* in the area. At least 6 persons from different barangays (Brgy. Imparayan, Brgy. Cabanbanan and Cabladan) have claimed that Abitang is present in their area. These individuals have caught this species recently (1st week of July and 2nd week of August 2005) for food and "pulutan".
- Both species of *Varanus* were reported seen frequently when the sun comes out after a consecutive 3 to 4 days of rain.
- Use of dogs in locating both *Varanus* species is still prevalent in the area. This method used by the locals has been very advantageous to the hunter as it makes the animal searching time very short.
- Some hunters interviewed claimed that this Abitang when escapes from hunting dogs, would stay up in the tree or canopy for more than a week until it feels safe and move in search for food again.
- Hunters also claimed that this species eats some fruits (see below for the locally identified food plants) other than the known plants such as the *Pandanus* , *Canarium*, etc.
- Abitang was also reported to feed on small crustacean in the river and small streams within SNP.

Food Plants Locally Identified

1. BANAWAK – is a vine which was locally identified as food plant of the *Varanus mabitang*
2. BIRIBID which has a long and oblong shaped fruit
3. BARASAN with rounded fruit, most likely of the *Pandanus* cf. glauciferus species (needs to be verified)
4. BANGKAL is a tree which has a guava like fruit
5. TU-OG is a tree that bears black fruits, also eaten by bats and birds
6. TAPUYAY is a vine with round fruit like grapes, green when unripe and maroon red when ripe

7. ALOPIDAN vine is the host vine of Rafflesia which is locally known as “uroy”. It has green rounded fruits with dark brown spots when unripe, yellow fruit when ripe.

Known Food Plant / Tree Genera search

Search for *Pandanus* species was also conducted in SNP. There are three areas in SNP that have *Pandanus* species. One is in Lake Paco area, the second one is located outside the forest area of Barangay Imparayan and the third is located east of Ilihan with coordinates N 10.77178 E 122.11449 at 348 masl. Unfortunately, the *Pandanus* in Imparayan and Ilihan are not fruiting so it is very hard to identify the species.

In Lake Paco area the *Pandanus* are located in the southern ridge of the lake. Alopidan vines are also common in the area. The *Pandanus* species outside the forest of Imparayan were planted by the locals to make mats and bags, the *Pandanus* in Ilihan was later known to have also been planted for the same purpose.

Locals also claimed that “pili” or *Canarium* species are also present in the area. This has not been confirmed as no fruiting trees were available.

***Varanus mabitang* search**

The search for *V.mabitang* was done in SNP. Areas locally reported where the animal was frequently sighted such as rocky / limestone cliff-sides, trees and basking areas were visited.

On several occasions, *Varanus* salvator nuchalis were observed basking on cliff side rocks and trees. Other individuals were hand caught and released after identification. Some individuals were only photograph from a distance.

One individual of about 2.5 -3 ft in total length was seen and photographed in the ‘Igang’ rocks (rocks and boulders on creeks) in Cansilayan I near Labangan creek. The individual was not caught and was not identified to the species level as it has immediately escaped to the rocks as soon as it heard our footsteps.

On the course of searching the *Mabitang*, Bulo (bamboo) traps were seen set in locations were *Varanus* were frequently observed by the locals. This trap uses dead Bufo marinus and usually catches *Varanus* salvator nuchalis.

Varanus track marks and claw marks were seen on river beds and several trees. Some of these trees were observed for several hours from a considerable distance to check if any individual *Varanus* will go back to the tree but none were observed.

Some of the trees with claw marks have holes in the canopy level or on the middle portion of the tree.

Search for fecal material
The feces of civet cats were found (see below), although local guides strongly believed that some of those were the fecal material of Abitang. These scats below were seen along the tracks found in the river bank of Mau-it River.

In summary, there is a strong local knowledge on the Giant Frugivorous Monitor Lizard (GFML) in Sibalom, Antique. Although *Pandanus* and other known food plants of GFML in Polillo are present in the area, local knowledge of other species of food plants is very high. I believed that the GFML is present in Sibalom has a different diet from that of Polillo so the search of fecal material was not successful as I was looking for fecal material with *Pandanus* seeds.

These GFML are very secretive and elusive. The successful method of camera or video trapping used in Polillo on GFML would help verifying its presence in Sibalom.

List of the coordinates of some areas and important points:

Trail to SNP Peak	10.76830 N	122.12485 E	797 m a s l
Rafflesia Viewing Deck (near a tree with hole and scratch marks)	10.77745 N	122.12388 E	485 m a s l
Sitio Igmaru (way going to Lake Paco area)	10.78750 N	122.12276 E	276 m a s l
Lake Paco Bunk House	10.77591 N	122.13544 E	596 m a s l
SNP Pine Area	10.77586 N	122.115 21 E	372 m a s l
Tapuyay tree with claw marks and bulo trap	10.78607 N	122.11481 E	242 m a s l
SNP Watch Tower	10.77975 N	122.11204 E	346 m a s l
Ilihan point	10.77264 N	122.10970 E	369 m a s l
Rafflesia Site with claw marks near Lake Paco	10.77426	122.13297 E	639 m a s l
Barangay Imparayan	10.78753 N	122.10532 E	220 m a s l
SNP Nursery	10.78404 N	122.10783 E	182 m a s l

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Investigation into the Population Status of *Varanus olivaceus* in Alabat Island, Quezon Province.

Rogelio V. Sison, Senior Curator, National Museum of the Philippines, Zoology Division, Herpetology Section.

An investigation was conducted in August 2005 regarding the presence of the population of *Varanus olivaceus* on the island of Alabat, Quezon Province. It was confirmed by the Aeta natives that the animal still exists in the mountain forest of Mount Camagong in barangat Bacong, Alabat Municipality. The vegetation of the area consists of primary growth forest which is the typical habitat of *V.olivaceus*. This is the only remaining fragment of forest on the entire island.

According to natives who trap them the refuges of this population are holes amongst limestone walls. It is surrounded by rock boulders inside the forest where they are well secured from intruders. As reporter by an Aeta trapper (Laki). Their accessibility to their feeding areas could possibly be the reason why they prefer this sight since it is within the vicinity of their feeding trees (locally called Dau, Moling, mangga-mangga) which are allegedly abundant in the forest and even forest outskirts.

Lately an individual of 60cm in length was sighted among these rock walls within the boundary of Bgy. Villa Victoria and Bgy. Bacong within the forest 2km from the latter, by the natives. Attempts were made to capture or see some individuals but yielded negative results. They were instructed not to disturb the area to avoid its dispersal, and to report any sightings or capture. Efforts were also made to find some waste matter from these animals but yielded a negative result.

Last April 2005 an adult individual weighing an alleged 15kg was captured and slaughtered by a group of Aeta natives enroute to Sito Tumiis and Sitio Macalbang Villa Norte, Alabat Municipality. Skull and tail remnants were not found. Local officials and natives were instructed to immediately report sightings or capture in the future. If dead it should be preserved in 70% alcohol or 10% formalin and immediately reported for retrieval. Also to encourage the natives help in its population conservation.

In Perez Municipality no information was gathered regarding its present distribution, because it has not been seen in the area for at least four years. It seems that the only population is within 6the mountain range of Mount Camacong in the vicinity of Bacong Watershed, Alabat Municipality.

Some other large lizards that are commonly known to the natives are *Varanus salvator* and *Hydrosaurus pustulosus*. These are commonly caught usually in second growth vegetation.

Further investigations might still yield more information on the faunal population of the Island.

Report on the occurrence of fruit-eating monitor lizard in the Northern Sierra Madre National Park

Roldan Dugay

In 2005, the Mampam Conservation received grant from the BP Conservation Programme to allow local researchers trained for non-destructive research method and verify the occurrence of Gray's monitor and possibly new species of fruit eating monitor lizard in the country. One of the projects received from fund from it is the "Study on the occurrence of giant fruit eating monitor lizard in the Northern Sierra Madre Natural Park". Though it is known that the island of Luzon harbors the species of this reptile, there has been no previous research and study in some part of the main island to prove the evidence of the occurrence of this animal. Northern Sierra Madre Natural Park is one of these areas hence the Mampam Conservation in cooperation with the Cagayan Valley Programme on Environment and Development initiated a project to scrutinize the occurrence of fruit eating monitor within and outside the park.

The study focused in the Northern Sierra Madre Natural Park (NSMNP). The NSMNP is so far the largest protected area in the country. It covers a total area of more than 360,000 hectares of both marine and terrestrial ecosystems. The park is located in the eastern portion of Isabela province encompassing nine municipalities. It was proclaimed a protected area on 21 April 2003 through Republic Act 9125. Prior to congressional action, part of the area had been proclaimed as Palanan Wilderness Area in 1979 through Letter of Instruction 917-A due to its high diversity, ecosystem value and as a national heritage. The park is one of the ten priority protected area created under the National Integrated Protected Area System.

The study commences in June 2005 and the CVPED Office, EIC Building at the Isabela State University served as a base of the project. In 2003, a Dutch researcher, Merlijn van Weerd, took a photograph of a monitor lizard captured and killed by a local hunter in Ambabok forest in Northern Sierra Madre Natural Park. Prior to this, another picture of a live monitor lizard taken in 2001 in the same area by a Filipino researcher. This species shows similarity to *Varanus olivaceus* but has very unusual pattern and colouration thus require further study.

Working in a protected area like the NSMNP warrants prior permission from various authorities.
Months of June covered the preparation of necessary papers and needed documents for the application of working permit within and in the buffer zone of the park. Frequent coordination with different agency stakeholders had also been done until first part of the month of July. Papers and documents, which have been geared up, include the formulation of project/research proposal as a significant requirement for the issuance of Protected Area Management Board

(PAMB-NSMNP) and Gratuitous Permit. The NSMNP comprises nine (9) municipalities compose of four (4) on the eastern/coastal side and five (5) on the western slope. Of these municipalities, San Mariano, Mt. Ambabok and Mt. Dialogo in particular, were initially identified as sightings for this species. Concurrently, while preparing necessary documents, in the absence of a permit from the Protected Area Management Board (PAMB) using the permit issued by the Local Government Unit (LGU) of the municipality of San Mariano (dated 04 June 2005) interviews had been done as well on the months of June and July on the upland communities of the NSMNP and on the lowland communities of this municipality and its neighboring places for comparison. Hypothesis being tested was there is only one species of monitor lizard in Northeast Luzon. Employing a non-structured and semi structured questionnaire selected local residents, hunters and Aetas (Indigenous people) were asked and tested regarding their familiarity on monitor lizards. Results reveal that the locals on the lowland communities are acquainted with one species of monitor lizard whereas people near the buffer zone and within the park know two (2) species and can distinguish each distinct characteristic. Bitatawa, Batikaw or Batikaw, as the local residents distinguish, described further as a species of monitor lizard that feeds mainly on fruits of forest trees.

Based on interviews, site validation in Dungsog and Dibanuangan Forests was carried out where two of the local hunters mentioned that they have seen this kind of lizard in this site. Dungsog is a second growth dipterocarp forest where commercial logging took place in the area in the 70's. Though Philippine law stopped commercial logging in the early 90's, illegal logging is still rampant in the area during summer season. Enormous noises produce by a numerous number of power saws might be the cause why there were no evidences on the presence of this species of monitor lizard. The presence of Alas-as (Panadanus luzonensis), young and old were observed in this forest but have no evidence of the presence of monitor such as scratches and lizard faeces were found. *Pandanus* abundance on hillsides is much higher than along streams and clumps of plants were found growing uphill of any potential parent plant. Dracontomelon dao (Dao) and Calamus ornatus (Limuran) were also noticed which is, according to hunters, the monitor lizard is eating the fruits of these two plant species as well. Comparing Dungsog to Dibanuangan has a little bit different. Some portion of Dibanuangan is a limestone forest. I saw no disturbance in this site though my field assistant told me this area was subjected before in illegal logging activities. At present only the stumps of premium tree species were found and more or less those trees were cut two years ago. There were approximately ten (10) fully grown *Pandanus* with no fruits left were observed. Despite there were no evidences found I believe that this area still harbors the species of fruit eating monitor because the limestone is a very good retreat from an intruders. A species of this fruit eating monitor lizard was accidentally caught by a hunter (one of my interviewees) upstream of Dibanuangan forest. The hunter was asked to surrender the lizard with a corresponding reward. Locals name the area where the lizard was caught as Dibanti forest within Mt. Dialogo and is about one day trekking from Dunoy, the take off point.

A permit to transport wildlife was obtained from the office of the Protected Area Superintendent of the Northern Sierra Madre Natural Park as a requirement before the lizard is brought in the National Museum of the Philippines in Manila for donation. It is now being deposited in the said museum for further study.

On my interviews, there have been no hesitations regarding on answering questions on the part of the hunters. I observed their sincerity, especially those who have already caught a fruit eating monitor lizard that were not intentionally for them to hunt this animal. Traps were set in the forest and are intended for wild pig and deer. Local residents especially old men, claimed that previous decades sightings of this reptile was just nearby and much higher populations when the forest was still intact comparing now which are rare and seldom to see and are now on very far forest areas. Their disappearance in those nearby forest areas and possibly extinction is due mainly on habitat loss and not because of massive hunting.

The Protected Area Management Board (PAMB) is the policy-making and permitting body of the Northern Sierra Madre Natural Park (NSMNP). The Regional Executive Director of the Department of Environment and Natural Resources (DENR) as the chairman and the Local Chief Executives of the nine (9) municipalities covered the NSMNP composed the board. One of the basic requirements in order for obtaining a working permit within the park is the presentation of a project proposal in either Executive Committee or EnBanc meeting. In this case, the PAMB Executive Committee meeting was held on 02 August 2005 in Divilacan, Isabela one of the municipalities covered the NSMNP and is located on the eastern/coastal side of the park. Accessibility of the area is by means of plane and/or boat but the latter has no regular trip depending on weather and sea condition. The project entitled “Study on the occurrence of fruit eating monitor lizard in the Northern Sierra Madre Natural Park” was presented on the said meeting. DENR officials such as the Regional Executive Director, the Regional Technical Director and Division Chiefs for Protected Area Wildlife and Coastal Zone Management Service, Manager of the Conservation International-Sierra Madre Biodiversity Corridor Project and Municipal Mayors were present. The proposed project was unanimously approved after few questions raised subject to the compliance of the requirements as stipulated in the Department Administrative Order 55 (DAO 55) series of 2004. Two days were spent in this area to allocate time for some interviews with locals and Agta (Indigenous People) hunters.

In the month of August to first week of September, to gain much expertise on a non- destructive research method for Gray’s monitor lizard, a fieldwork on Polillo Island was done. Assisting in lizard faeces mapping in different forest within the project site was carried out. Checking of camera traps and lizard faeces collection are also a main activity on the duration of a one-month fieldwork.

Activities in Sierra Madre resume after the fieldwork on Polillo Island in September and October. The fieldwork took off on September 9 in San Mariano, Mt. Dialogo as the target site. One night was spent in Dunoy as my entry point and met Pedro Lorenzana, my field assistant and hunter caught the monitor lizard, and Larry Pitpit served as a porter and camp guard. A temporary camp was built, approximately one-hour hike to the site, made up of bamboo and sack-type roofing. Reconnaissance on nearby forest from the camp was carried out on the following day in order to familiarize the area (this will serve as the permanent camping site while camera trapping is on going on this site).

Assessment of *Pandanus* growth, fruiting trees and searches of lizard faeces were done. Panadanus are on fruiting season and expected to be ripened in one-month time however some of the *Pandanus* plants that were observed have no fruit yet or otherwise have just finished its fruits. Of the area monitored, there was only one Pili tree observed having ripe fruits near an open area but has no scratches on trunk.

There were three lizard faeces having four or five *Pandanus* seeds in each pile with a total of thirteen seeds have found on the other area. These were old faeces of about a week ago or have just washed with rains. There are no *Pandanus* trees neither fruiting or not nearby where the lizard faeces were found other than an unidentified tree which has lot of scratches extending to a hole on the upper portion of the trunk. In order to verify what is happening on this tree, a camera trap will be set on the next field trip. Problem encountered was the unfavorable weather condition. This situation halters the plan of setting camera traps to an identified tree resources. As an alternate activity, interviews to indigenous people community near the area were carried out. Indigenous peoples are more acquainted with the characteristics of the monitor lizard. During interviews, a public awareness campaign in collaboration with the Mabuwaya Foundations staff was done in the upland communities. A part of these is the contribution of articles in the CROC newsletter regarding the occurrence of giant fruit eating Gray's monitor lizard and its importance in the Northern Sierra Madre Natural Park and adjacent areas.

After few days we decided to go back in the forest while weather got better. The fieldwork in Sierra Madre took off on the 2nd day until 24th of October. Similar to previous trip, a field assistant and a camp guard were hired from the Sitio of Dunoy, which serve as my entry point, which are familiar of the Bitatawa (fruit-eating monitor). Dungsog forest was explored thoroughly for this time. The topography is moderately to strong terrain and in my assessment; Dungsog has the potential as a refuge site for the monitor in the near future. Beside that this site was totally disturbed during the summer season which large diameters of premium tree species were no longer observed, *Pandanus* plants have seen in ubiquitously within the area. Alas-as (*Pandanus*), locally known as Kadang in the locality, has two (2) "classes". Classes doesn't relate to a variety or species but on the sizes of these plants because most of these *Pandanus* that were

observed are young and yet they are now fruiting. Sizes are about standing One (1) meter from the ground and have small stem diameters. With these sizes and given the amount of *Pandanus* in this area, there was a difficulty in selecting and identifying in which resource tree for setting a camera traps. Bigger *Pandanus* plant shows no signs that the monitors are climbing it. Bidiw, commonly known as kalagimay is also present in the area. I have a total count of five stems but fruits were just finished. Fallen fruits were collected for comparison with the fruits of Kalagimay in Polillo. I did not see any signs either that the lizards are feeding on the fruit of Bidiw or Kalagimay for there were no scratches on trunks of this plant.

Only one old lizard faeces was observed, three *Pandanus* seed in pile which is starting to germinate. According to my field assistant this area was totally and rampantly disturbed last summer of the previous year when the road was still accessible by truck. In my opinion based on the old lizard faeces, the area was then visiting by monitors before the summer season. According to my guide they usually saw a lizard last year feeding on *Pandanus* fruit in the area. One of the camera traps was set on a selected tree that has lot of scratches extending to a hole on the trunk but it was decided to be removed because it was not safe to leave the camera on that time.

A nest of a Bitatawa was reported by a farmer in a nearby village of San Isidro (Interviews in this village had already done during the last fieldtrip). The said nest is a hole in the ground and along a kaingin (slashed and burned) area planted with corn. The opening of the hole has a diameter of about 40 centimeter and located in a sloping area. With the characteristics of arboreal and shy, I was not convinced that the lizard was a Bitatawa but the local confirmed it is a Bitatawa. With his explanation about the pattern and coloration I was convinced it is a Bitatawa. He explained further that the width of this lizard is about 30 centimeter. I learned from my field assistant that this farmer was a hunter and one of his companions before that is why he is so much familiar with the Bitatawa. According to him, in the month of July they usually saw this lizard entering into the hole and he tried once to set a trap on the opening but he was not successful to catch it. Since then they did not already see and has no evidence anymore that the animal is entering into the hole. Importance of the animal was explained to him and told him the animal is already protected by law.

One of my colleagues, Edmund, likewise reported a sighting of this fruit eating monitor lizard in the upland area of Cabagan (one of the municipalities covered by the Northern Sierra Madre Natural Park). A farmer shuts a monitor lizard on the top of a Taraw, *Pinanga* species. Edmund personally brought the tail of the lizard and based on the yellow band/stripe I was encouraged to visit the area. I talked with the farmer and he explained that he saw the lizard on the top of the Taraw. According to him this kind of lizard is very rare and seldom for them to see. The area is a secondary forest and there are no much *Pandanus* plants.

The area is being inhabited by the Ifugao people who are known for their slash and burn activities within the forest zones.

After a two months fieldwork in Sierra Madre, I went back on Polillo Island in November and December for two weeks each month fieldwork. Primarily conduct transecting to assess current fruiting tree resources for the lizard. Continuation for mapping of lizard faeces using a GPS was also carried out. Collection of lizard faeces was also simultaneously done while checking of camera traps for all the forest areas where activity of the lizard was identified. After a two weeks fieldwork on Polillo Island, the Sierra Madre Project with its initial report was presented in the en banc meeting of the Protected Area Management Board of the Northern Sierra Madre Natural Park. Presentation of results in the PAMB is one of the requirements agreed, before a project is approved, during the August presentation of project proposal in the coast of the Sierra Madre. Final report will be forwarded to the Office of the Protected Area Superintendent.

Since the lizard project in Sierra Madre started, local people in San Mariano made aware of the importance of the animal as seed disperser and not as a food item. Local people in lowland of the said municipality already know the existence of two species of monitor lizard in Sierra Madre. Furthermore, presentation made over local officials and responsible agency (DENR) through the Protected Area Management Board educated and informed the occurrence of this species in the park so an appropriate action will be taken up for the protection of the animal in their area of responsibility.

In general, the overall accomplishment of the project is the dissemination of information and the local stakeholders' awareness on the importance and occurrence of the giant fruit-eating Gray's monitor lizard in Northeast Luzon. However, necessary information should be generated for the on-site conservation of this threatened species in Northeast Luzon. In total, there were only 3 full months (July, September and October) fieldwork conducted in Sierra Madre excluding month of June which is more on preparation.

Acknowledgements
I would like to thank Mampam conservation thru Daniel Bennett for funding and providing technical support of the study in Sierra Madre. He made valuable support to make the study possible. The DENR in general and the Protected Area Management Board thru the Office Protected Area Superintendent in particular for providing permit of the study. The CROC team headed by Merlijn van Weerd and Jan van der Ploeg, CVPED Coordinator, for their assistance in public awareness campaign, suggestions, advises and supervision. And lastly, Dr. Andres Masipiquena, CVPED coordinators, for his support in obtaining permits. To all of you, my sincere gratitude!

Annexes: Permits

NORTHERN SIERRA MADRE NATURAL PARK
PROTECTED AREA MANAGEMENT BOARD

Excerpt from the Minutes of the Meeting of the Protected Area Management Board Executive Committee Meeting held at Divilacan, Isabela on August 02, 2005

RESOLUTION No. 06
Series of 2005

RESOLUTION APPROVING THE CONDUCT OF RESEARCH ON THE OCCURRENCE OF GIANT FRUIT-EATING MONITOR LIZARD

WHEREAS, NIPAS Law and Republic Act 9125 otherwise known as the Northern Sierra Madre Natural Park (NSMNP) Act of 2001, has mandated the Protected Area Management Board as the Policy-making and permitting body;

WHEREAS, RA 9125 provides the PAMB to approve proposals and guidelines for management of the protected area in accordance with the approved management plan;

WHEREAS, the approved management plan for NSMNP provides the need to update information on the biological resources of the park;

WHEREAS, RA 9125 provides authority for the PAMB to issue permit within the NSMNP;

NOW, THEREFORE, upon unanimous accord of the body, in the meeting duly assembled, it was;

RESOLVED, as it is hereby resolved, that the proposed project of the Cagayan Valley Programme for Environment and Development on the Occurrence of Giant Fruit-Eating Monitor Lizard be allowed subject to the compliance of the requirements as stipulated in the DAO 55 Series of 2004.

For the NSMNP Secretariat:

WILLIAM C. SAVELLA
CENRO-PASu

Attested by:

CLARENCE L. BAGUILAT
PAMB Chairman

Republic of the Philippines
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
Office of the Regional Executive Director
Region 02, Cagayan Valley
Regional Government Center, Carig Sur, Tuguegarao City, 3500
Tel. No.: (078) 844-8049 * Fax: (078) 846-5129
www.denr2.cagayanvalley.com * E-mail: r2@denr.gov.ph

RELEASED
DATE 05-08-05

ACKNOWLEDGMENT LETTER

August 23, 2005

Mr. ROLDAN R. DUGAY
Cagayan Valley Programme on Environment & Development
EIC Bldg., ISU at Cabagan,
Garita Heights, Cabagan, Isabela

Dear Mr. Dugay,

Your letter dated August 4, 2005 and received by this Office dated August 22, 2005 subject of which is *Re:* Request for Gratuitous Permit for the collection of one (1) specimen of giant fruit-eating monitor lizard in the municipality of San Mariano, Isabela, has been referred to:

Responsible Official	:	RTD for PAWCZMS
Office	:	Protected Areas, Wildlife & Coastal Zone Mgt. Service
Telephone No.	:	846-7544 & 844-8037
Date Referred	:	August 22, 2005

for his information and appropriate action.

To facilitate action on your request, you may follow it up directly with the official/office concerned.

You shall be duly informed of developments or results of action taken in due time.

Thank you and we look forward to be of service to you again.

Very truly yours,

CLARENCE L. BAGUILAT
Regional Executive Director

Let's Go Green !

Republic of the Philippines
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
OFFICE OF THE CENRO/PASu
Palanan, Isabela

PENRO : **Isabela** Region : **02**
Wildlife Transport Permit No.: **01-2005**
Permittee: ***ROLDAN R. DUGAY***
Address : ***San Pablo, Isabela***

SPECIAL PERMIT TO TRANSPORT WILDLIFE

Pursuant to the provisions of E.O. 192 dated June 10, 1987 Section 7 of Act 2590, as amended Act 55 as amended by Act 3767 dated October 23, 1991 and DENR A.O. No. 20 Series of 1988. **ROLDAN R. DUGAY,** researcher of Cagayan Valley Programme on Environment and Development (CVPED) is authorize to **TRANSPORT** rescued **Giant Fruit Eating Monitor Lizard with 14 lbs. and a total length of 160 centimeters** from **Cabagan,Isabela** to **National Museum at P. Burgos St. Metro Manila** via **Land Transportation** on ***July 20, 2005*** with a transport fees of ***P100.00*** under ***O.R. Number 1174467 C*** *and same subject to the terms and conditions herein specified following:*

1) *That the shipper shall transport the Giant Fruit Eating Monitor Lizard with weight of 14 lbs. and a total length of 160 centimeters for proper species identification in the Zoology Division of the National Museum of the Philippines at P. Burgos St. Metro Manila.*

2) That after proper identification of species, it shall be left to the museum for possibly donation.

WILLIAM C. SAVELLA
Community Environment and Natural Resources Officer/PASu
Northern Sierra Madre Natural Park

Republic of the Philippines
Province of Isabela
MUNICIPALITY OF SAN MARIANO

OFFICE OF THE MUNICIPAL MAYOR

PERMIT

TO WHOM IT MAY CONCERN:

PERMIT IS HEREBY GRANTED TO:

MR. ROLDAN DUGAY
Researcher, CVPED
Isabela State University
Cabagan, Isabela

To conduct research in the Municipality of San Mariano, Isabela and to collect specimen relative to his study entitled " **A Study on the Occurrence of a New Species of a Giant Fruit-eating Monitor lizard in the Northern Sierra Madre Natural Park** " from June 4, 2005 to December 31, 2005 .

It is also expected however the copy of his documentation /s made during the aforesaid activities shall be furnished to this Local Government Unit for record purposes and future references. Likewise, he is advised to have close contact with the Office of the Municipal Mayor to avoid problems especially in the field.

This permit is valid on the dates stated above only and subject to limitations imposed by law and Municipal ordinances and upon compliance thereof, due protection is hereby accorded to the bearer.

This 4th day of July, 2005.

EDGAR TALOSIG GO
Municipal Mayor

PONCIANA C. GUING