

The collaborative research between the University of the Philippines Los Baños, College of Veterinary Medicine, UPLB Museum of Natural History and The University of Tokyo for the last 3 years covered mainly zoonotic viral and bacterial pathogens found in bats. Preliminary results in some bat species showed positive antibodies for Gammaherpesviridae and Corona virus. The theory that the transmission of SARS corona virus to humans has a bat component is supported by these preliminary findings. Bats are also very useful biological monitors for environmental pollution. We sampled bats from two settings – rural setting represented by Caticlan, Aklan and urban setting represented by Diliman, Quezon City. Based on our findings the bats from Diliman, Quezon City were comparably clean when compared with those sampled from Caticlan, Aklan. The exact reason for this observation is not known but the team theorized that although Diliman, Quezon City which is urban in setting with plenty of cars emitting greenhouse gases the place is also well-planted with a lot of trees which could have possibly offset the bad effect of the pollution coming from the internal-combustion engine of cars.

The report now in this article is an attempt in our part to connect possible link of REBOV between monkeys and bats. The scientific field expedition to capture bats within the vicinities of monkey breeding centers was conducted from August 7-13, 2010. Two monkey breeding centers (MBC) were identified: MBC 1 and MBC located in Tanay, Rizal and Sto. Tomas, Batangas, respectively. Before the scientific field expedition was conducted all the necessary permits were obtained properly. The two monkey breeding centers are accredited by AAALAC (Association for the Assessment and Accreditation of Laboratory Animal Care, Inc.) and one of the strict requirements is a x-ray report

negative for pulmonary tuberculosis for every person who will establish close contact with the monkeys. All the members of the bat research team complied with this requirement. Everybody in the team is also familiar with the Animal Welfare law which requires that animals be handled gently and humanely.

In MBC 1 the veterinarian familiar with the terrain and pattern of wild animal behaviour was consulted as to where the mist nets will be set up to catch an optimum number of bats. Just like in the past scientific expeditions the setting up of mist net traps was done at the peak of bat activity. Being crepuscular to nocturnal animals the mist nets were set up just before dark (dusk) and just before sunrise (dawn) the following morning. To minimize injury to the bats and also damage to the mist nets the team saw to it that trapped bats are removed in the shortest possible time after being entangled in the mist net. Experience due to frequent bat collection honed most of the members of the team making safe, easy and fast recovery of captured bats. It was a general observation that there are fewer bats captured during dusk and more during dawn. Weather condition is also a big factor and most often a rainy night is not good for trapping bats. Insectivore bats are more difficult to catch using mist nets because of their keen ability to detect any obstruction along their flight path through echolocation. Fruit-eating bats on the other hand rely mainly on ocular vision and cannot detect the fine mist net especially after dark. Unintended animals were also caught like moths and birds. Just like in the past expedition the most common bird by-catch is the kingfisher. The non-target animals captured in the mist net were noted, photos taken and released unharmed. The team also observed one of the critical requirements of the Animal Welfare Law which states that animals should have freedom from hunger and thirst.

Before removing the bats from the mist net they were orally given 1-2 ml of 10 % sugar water solution (SWS). Fruit bats have fast metabolism and once they are captured they can easily consume the sugar in their body making them hypoglycaemic. If SWS is not available natural fruit juice will do. Once transferred to the cage they are given fruits available like guava which the bats munched with gusto.

In the laboratory the bats were anesthetized with a combination of readily made solution of zolazepam and tiletamine given intraperitoneally based on body weight. Blood was taken intracardially with tuberculin syringe. Needed organs were taken and the carcass was immersed in 10 % formalin and archived at the UPLB Museum of Natural History with the proper species and sex identification.

The total number of bats captured from the two MBCs is recorded in table form shown in this article. Note that it was only in MBC 1 that *Rousettus amplexicaudatus* was captured and none from MBC 2. Detailed laboratory analysis is now being done to elucidate the presence or absence of REBOV in this bat species. In our future field expedition we will do bat sampling from areas known to have big colonies of *Rousettus amplexicaudatus* like in Marinduque and Samal island in Davao.

In the Philippines there is only one species of monkey (*Macaca fascicularis*), the so-called crab-eating monkey, a.k.a. Southeast Asian macaque, long-tailed macaque and cynomolgus monkey. Before 1978 the rhesus monkey (*Macaca mulatta*) was the animal being used for biomedical research, in fact the first two letters of rhesus is the origin of the blood group of humans known as Rh factor. The main country exporting rhesus monkey for biomedical research was India. The religious group of India lobbied the government of India to stop exporting rhesus monkey for any use be it biomedical or

non-biomedical. The reason given by some religious cult was one of the Gods of Hinduism is Hannuman the monkey god. For these religious fanatics it is pure simple blasphemy if they will sell for export one of their gods to be used in biomedical research. The biomedical research community panicked and tried to look for other alternative monkey species and it was found out that the Southeast Asian long-tailed macaque (*Macaca fascicularis*) can equally match the desirable traits of the rhesus monkey as ideal animal model for biomedical research. Because of this demand “monkey business” became a big enterprising activity that brought in huge profits. Before 1983 the commercial trafficking of wild-caught monkeys was largely unregulated by the government. All the business man does is to get orders from abroad on how many monkeys are needed and the business man contacts illegal trappers. The monkey is bought from the trappers at a measly 30 pesos per head. In his yard, the animals are fed and housed in just a short time and when the deal is done the monkeys are sold to foreign buyers for U\$ 300 per head. You do not have to be a mathematician to figure out the huge profits of these enterprising people doing “monkey business”. Our government particularly the Department of Environment and Natural Resources through the Protected Areas and Wildlife Bureau (DENR-PAWB) is not complacent and was aware of this illegal practice. Now the unregulated practice of “monkey business” is no longer allowed. If a person or company likes to engage in such kind of business several rules and regulations will have to be followed before a license and permit will be issued. The biggest provision is that only captured-bred monkeys are allowed for export. Aside from PAWB regulations one also has to comply with CITES (Convention on

International Trade in Endangered Species) regulations and a regular inspection also by the Bureau of Animal Industry (BAI) for zoonotic diseases is strictly required.

Even with high-tech laboratory procedures monkeys are still preferred over tissue cultures for the manufacture and testing of infant vaccines like measles and polio. Monkeys are also needed following the WHO (World Health Organization) requirement that before a drug can be used for human clinical trials it has to undergo testing in three consecutive generations of rodents, non-rodents and primates. Monkeys in general are social animals and in macaques the group is called a troop or a gang of macaques. The troop is headed by the dominant alpha male and under his troop is his harem composed of several ready to breed female monkeys. As such the macaques are also good animal models for the study of animal behaviour (ethology). Before a monkey can be exported for biomedical use it has to undergo several tests like tuberculin skin test and fecal examination for parasites and Salmonella/Shigella bacteria. A very expensive monkey is also free from Simian Herpes B virus. The Philippines is very lucky because both MBC 1 and 2 are AAALAC accredited and in fact they are the first monkey breeding facility in Southeast Asia to be given such recognition elevating the status of biomedical research in the country. However, because of the big demand for monkeys other Southeast Asian countries like Vietnam is also now exporting captive-bred monkeys in huge numbers. China knew about this fact and also went into export of cynomolgus monkeys. Yes, if China will enter any business the price of the commodity can be sold cheaply including cynomolgus monkeys. Monkeys are not exempt from the saying "God created the world and everything else is MADE IN CHINA".

Table 1A. Bats captured in MBC 1 (Tanay, Rizal) 8-10, August 2010.

| Species | Common Name | Number of captures | | Total |
|----------------------------------|------------------------------|--------------------|--------|-------|
| | | Male | Female | |
| <i>Cynopterus brachyotis</i> | Common short-nosed fruit bat | 19 | 26 | 45 |
| <i>Ptenochirus jagori</i> | Musky fruit bat | 4 | 7 | 11 |
| <i>Rousettus amplexicaudatus</i> | Common rousette | | 1 | 1 |
| <i>Hipposideros diadema</i> | Diadem roundleaf bat | 2 | 1 | 3 |
| TOTAL | | | | 60 |

Table 1B. Bats captured in MBC 2 (Sto. Tomas, Batangas) 10-12, August 2010.

| Species | Common Name | Number of captures | | Total |
|------------------------------|------------------------------|--------------------|--------|-------|
| | | Male | Female | |
| <i>Cynopterus brachyotis</i> | Common short-nosed fruit bat | 11 | 17 | 28 |
| <i>Ptenochirus jagori</i> | Musky fruit bat | 6 | 15 | 21 |
| <i>Hipposideros diadema</i> | Diadem roundleaf bat | 1 | | 1 |
| TOTAL | | | | 50 |

PICTURES

August 7-13, 2010



The bat team is looking for straight thin bamboo for use as poles for the setting up of mist nets.



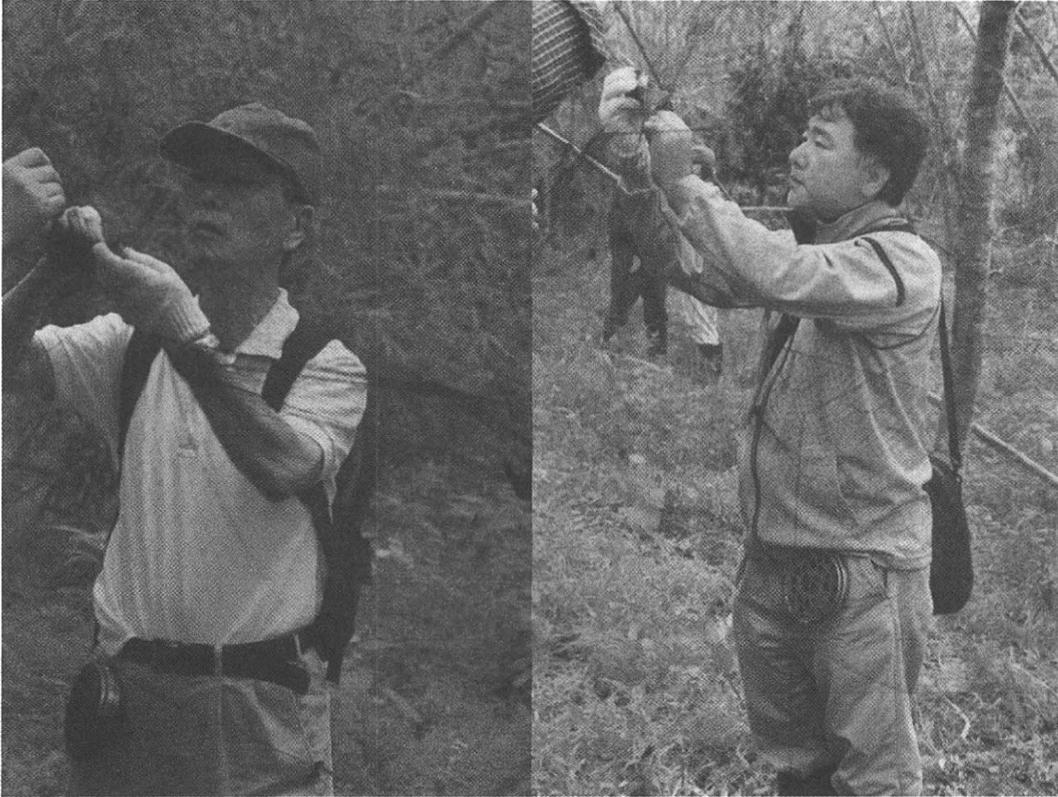
Dr. Yoshikawa, the leader of the bat team research carrying a bamboo pole. He is now a retired Emeritus Professor of the University of Tokyo. With his able leadership the bat team continues to conduct more research on bats with funds from INA research Japan and from Kitasato University where he now serves as a faculty of the College Of Veterinary Medicine.



The bat team is setting up a mist net near the monkey cage. To comply with the strict requirement of the monkey breeding center (MBC) all members of the team submitted x-ray readings negative for pulmonary tuberculosis. Monkeys are very susceptible to the human species of *Mycobacterium tuberculosis* which they can readily contract from people.



An entangled fruit bat. In spite of such condition no harm was done to the animal and the team saw to it that the trapped bats are removed from the net as soon as possible.



Dr. Akashi and Dr. Horimoto, both faculty members of the University of Tokyo removing captured bats from the net. Take note of the round perforated object hanging from their waist. The round perforated object contains a burning mosquito coil. In Japanese the mosquito coil is called "katorisenko" which roughly translates as "josh stick for removing mosquito". In the Philippines the term was bastardly shortened to just the first two syllables, hence we call it "katol".



Taniguchi and Ueda removing bats from the net. Taniguchi is assigned to do the research on REBOV while Ueda is still continuing his data collection on environmental pollution affecting animals like bats.



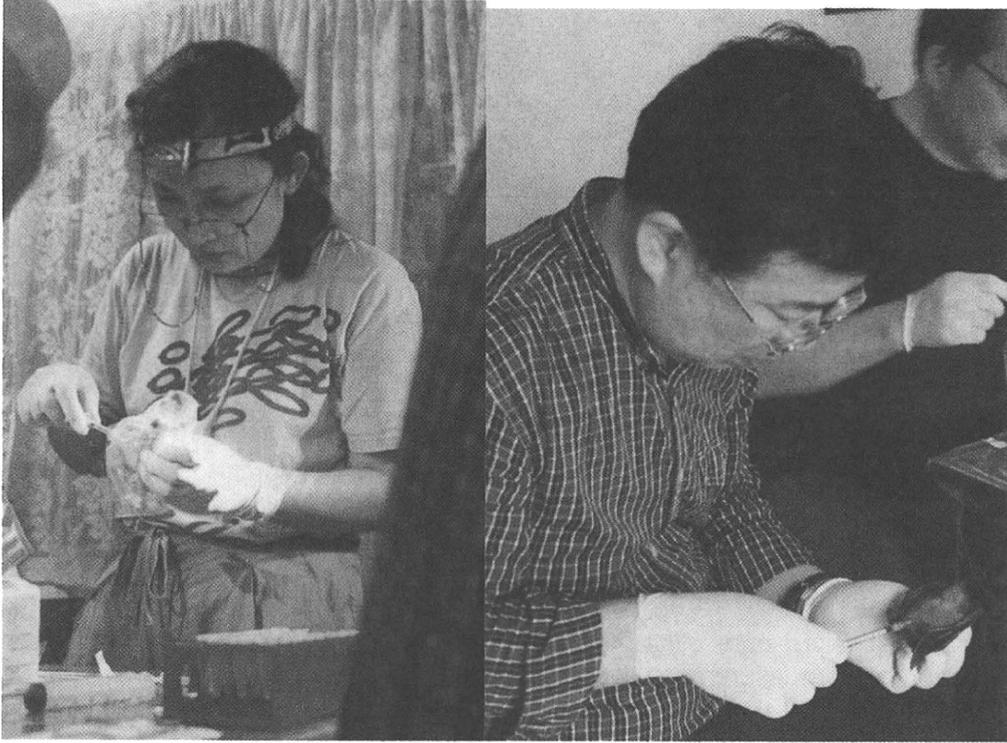
Dr. Une and Ueda (left picture), Lauren and Alisha (right picture) removing the bats from the net. Dr. Une is a faculty member of Azabu University, College of Veterinary Medicine. Lauren is now working in a small animal clinic in Cebu City. She came all the way from Cebu to participate in the bat collection expedition. Lauren also worked with bats for her undergraduate DVM thesis. Similarly Alisha also conducted her undergrad DVM thesis on bats and she is now presently working as research assistant in UPLB College of Veterinary Medicine.



Phillip, (left) our biologist takes note of the species identification of the captured bats after morphological data and body measurements were taken by Ed and Edison (right).



Kawaguchi and Iha (left) and Tsuda (right) dissecting the bats. Kawaguchi is now working in a big food manufacturing company in Japan in charge with environmental and food safety section. Iha is still continuing his PhD studies while Tsuda is a new member of our bat team who replaced Watanabe. Shumpei Watanabe is now working as a faculty member of a university in Kyushu.



Dr. Une (left) injects anesthetic agent intraperitoneally into the bat while Dr. Kyuwa (right) collects blood intracardially from the anesthetized bats.



Dr. Yoshikawa extracting blood intracardially from an anesthetized bat.



A common by-catch which is not the intended target species is the Kingsfisher. After carefully removing the bird from the mist net it was released back to the wild unharmed.



Dr. Une is shown administering 10% sugar water solution (SWS) orally to the bat while still attached to the net. Fruit bats have high metabolic rate that even such a short time of being caught in the net can consume its blood sugar making it hypoglycaemic. Timely oral administration of 10% SWS will help alleviate such problem.



Bats that are already placed inside the bird bag are also administered orally with 10% SWS prior to transport to avoid hypoglycaemia.



With strict compliance to the Animal Welfare law the captured bats are given fruit in season during transport in order for them not to become hungry. Guava is one of the favourite fruits of frugivore bats shown here munching the fruit with gusto.



The alpha male monkey mating with one of its females in the harem. *Cynomolgus* monkeys (*Macaca fascicularis*) also known as crab-eating monkeys are good animal models for many human diseases. The monkey breeding centers 1 and 2 strictly follow the Protected Areas and Wildlife Bureau's regulation of selling only captive-bred monkeys for research purposes only. The two facilities are also accredited by the Association for the Assessment and Accreditation of Laboratory Animal Care International (AAALAC) because of their strict compliance to local and international regulations and also with GLP (Good Laboratory Practice).



The bat team group together with some veterinarians of MBC 1



The bat team group together with the veterinarian of MBC 2

BATS in the GUINNESS WORLD RECORDS

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If you ask a Filipino what Davao is famous for, you will get two qualified answers: Durian and the Philippine Eagle. However, last year in February 1, 2010 Davao was again put in the map when the bat colony in the Monfort bat cave in the Island Garden City of Samal (IGaCoS) qualified for the Guinness World Records for having the largest colony of Geoffroy's Rousette Fruit Bats (*Rousettus amplexicaudatus*)—Guinness claim ID:266445; Guinness Membership No.234797; Date: February 1, 2010.

The geographic distribution of Geoffroy's Rousette bats includes the whole of Southeast Asia encompassing the countries of Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Vietnam, the island of Borneo, East Timor, Solomon Islands, Bismarck Archipelago and Papua New Guinea.

The majority of fruit bats navigate by sight but the Geoffroy's Rousette Fruit Bats use both sight and echolocation. On the other side are the insect-eating bats with very keen sense of hearing and mainly use sound navigation, technically called echolocation. This echolocation ability of bats became the basis for the invention of the radar which the Allied forces translated into early detection of enemy aircraft. Without the use of the radar the result of World War II would have been different and the Allied forces would have been defeated by the Axis forces. The bombing of London by the Luftwaffe Air Force of Germany was not successful because the bomber airplanes were detected early in their flight enabling the Royal Air Force to intercept the bombers and also forewarned the civilian population of coming air raid. Other animals like the whales and dolphins also have the ability to echolocate. If radar (RADIO Detection And Ranging) is to the airforce, sonar (SOUND NAVIGATION and Ranging) is to the navy which they use in submarines. *Rousettus amplexicaudatus* have good eyesight, keen sense of smell and hearing hence they can fly well and avoid obstacles in both daytime and night time. This

species can be distinguished from other fruit bats by their gray-brown to brown upperpart that is darker on top of their head with paler underpart. Even with short sparse fur these bats have long pale hairs on the chin and neck. Males can be distinguished from females by the presence of pale yellow tufts of hair on the side of the neck. Just like most mammals the males are significantly larger than females. Aside from audible clicks when calling the species is also easy to distinguish from other species because the wings are attached to the sides of the back and separated by a broad band of fur. Other distinguishing minute anatomical features are the dentition with the lower incisors being bifid and the canines have a longitudinal groove on the outer surface that is slightly medial to center while the first premolars are relatively smaller than the second premolars particularly on the upper jaw.

Bats are great contributors to the maintenance of the ecological balance. The insect-eating bats are responsible for controlling insect population. A good example of the role of bats in insect control is in Mexico and Texas by the Mexican free-tailed bats (*Tadarida brasiliensis*). The heart and soul of Mexico's agriculture is corn accounting for more than 60 percent of the country's total agricultural produce and 62 percent of its arable land. Close to 18 million people, roughly 17 percent of the population is dependent on corn for their livelihood. Without the bats the corn can easily be destroyed by the two most damaging pests: corn earworm (also known as cotton bollworm) moths (*Helicoverpa zea*) during summertime in northern Mexico, and fall armyworm moths (*Spodoptera frugiperda*) during winter months in the south.

In the south-central States, particularly in Texas, both moths are also major crop pests where the role of bats is appreciated by Texas cotton growers. With an estimated population of 100 million Mexican free-tailed bats they can easily consume roughly two-thirds of their body weight which translates to 1,000 tons of insects nightly. This pest-reduction service of Mexican free-tailed bats in south-central Texas is worth the equivalent of US\$ 740,000.00 a year to cotton farmers with an annual harvest value of approximately US\$ 6 million.

The bat cave in the Island Garden City of Samal (IGaCoS) is located in Barangay Tambo within the property of Ms. Norma Monfort. Actually there are also other caves in the island but most of them are now empty. Bats are sensitive to disturbances and once people go near the roosting places of bats they tend to go away. Another threat is illegal hunting because fruit bats are considered a delicacy by some people. Some exotic restaurants even include bats in their menus. Because of the popularity of bats as exotic food people abused them leading to over harvesting. This could be one of the reasons why the population of the Geoffroy's Rousette Fruit Bats in the Monfort cave increased from 1.8 million to the present conservative estimate of 2.5 million. A rough estimate of the density of the cave was tagged at 640 bats per square meter making it a very compact and dense population concentration. When threatened the bats will shy away from their normal roosting places and will look for more suitable and secure place which the Monfort cave provides, thanks to the effort of the owner in safeguarding and protecting the bats as well as the environment in general. Because of the nocturnal habit of bats they are always associated with bad characters like vampires. Fruit farmers also had the wrong belief that the fruit bats are pests because they tend to destroy and eat the fruits. Careful studies and observation proved that the fruit bats only eat the over ripe fruits which in effect contribute to quality control of the fruits by weeding out rotten fruits which can serve as breeding places for harmful insects like the fruit fly.

The Monfort cave is unique and is adapted very well to the natural contour and lay of the land. The cave is not a deep subterranean structure but a longitudinal fairly shallow cave with five openings. Another uniqueness of the cave is it monospecific population of bats. No other species of bats is found in the cave except the Geoffroy's Rousette Fruit Bats (*Rousettus amplexicaudatus*). I had been to other bat caves and most of them did not have a monospecific and homogeneous population but rather composed of different bat species occupying different parts of the cave. Because of the presence of these holes the observer does not need to enter the cave and disturb the bats. The first four holes are relatively large and bats can be observed not only in the