From the above observation it appears that the Whitebacked Munia prefers such an association with the ants, and that the nesting activities of the pair are tolerated by the ants, which can also differentiate the intruders, as whenever I ventured near the nest, the ants rushed towards me in hundreds, holding their abdomen skywards like anti-aircraft guns and within a very short time I found myself covered with ants all stinging, until I made a hurried retreat. A female Longtailed Mouse, *Vandeleuria oleracea* (Bennett), who built her nest in the same tree, was, however, unable to rear her young because of the ants.

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It appears that the munias were aware of the arms of protection provided by the ants, because there is no convincing alternative for the evaluation of such an association known at present.

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REFERENCES

ALI, S. & RIPLEY, S. D. (1971): Handbook of birds of India, Pakistan and Ceylon. *10*. Oxford University Press, Bombay.

BAKER, E. C. S. (1927): Fauna of British India including Ceylon and Burma. *6*. London.

CHISHOLM, A. H. (1952): Bird insect nesting association in Australia. *Ibis*. 94: 395-405.

HINDWOOD, K. A. (1955): Bird/Wasp nesting association. *Emu* 55: 263-274.

JACKSON, S. W. (1907): Catalogue and data of Jacksonian Oological collection: 72. Sydney.

MACLAREN, P. I. R. (1950): Bird-ant nesting associations. *Ibis* 92: 564-566.

NORTH, A. J. (1904): Nests and eggs of birds found breeding in Australia: 1-194. Sydney.

———— (1909): Notes on the Nesting-site of *Gerygone personata*, Gould. *Rec. Aust. Mus.* 7: 186-188.

17. BIRD PESTS TO RICE AT BUMBONG LIMA, PROVINCE WELLESLEY, WEST MALAYSIA

From April 1975 through March 1977, I conducted an investigation of bird pests to rice in northwestern peninsular Malaysia. The study came under the auspices of the United States Peace Corps/Smithsonian Institution Environmental Program, and was conducted in cooperation with the Malaysian Agricultural Research and Development Institute (MARDI). My study area consisted of 15 ha. of experimental rice fields at the MARDI Rice Research Center (RRC) at Bumbong Lima in Northern Province Wellesley. The RRC conducts research in the areas rice breeding and varietal improvement, rice plant physiology, agronomy, and crop protection, which includes such pests as rodents, insects, weeds, fungus and bacteria. Bumbong Lima is situated in one of Malaysia's most productive rice-

growing areas. Much of the agricultural land is irrigated so that two crops of rice are harvested annually.

Throughout Asia, numerous species of seed-eating birds cause extensive damage to cereal grain crops such as rice. In West Malaysia, the main bird pests are four species of munia in the genus *Lonchura* (Estrildidae), and the Baya Weaver, *Ploceus philippinus* (Ploceidae). Munias have long been popular with aviculturalists, and many cage studies of their behavior have been made, but relatively little research has been conducted under natural conditions. On the other hand, the Baya Weaver has been the subject of many field studies, particularly with regard to its nesting behavior, but as with the munias, its role as a crop pest has not received much attention. This study was designed to gather data on movements, food habits, and breeding seasonality of the bird pests to rice in the Bumbong Lima area.

At the RRC, the principal rice-eating species were the Sharp-tailed Munia, *Lonchura striata;* the Spotted Munia, *L. punctulata;* and the Baya Weaver. The Chestnut Munia, *L. malacca,* and the White-headed Munia, *L. maja,* occurred abundantly in fields within 15 km of the RRC, but only seldom did I observe them on the study area.

The results of my study are summarized below under three main headings. Additional data or details of the investigation are available from me upon request.

Movements

I instituted a ringing program early in the study to obtain data on the movements of the three target species. During 1975, numerous ringed birds were retrapped at the RRC, but reports of ringed birds being trapped out-station were non-existent. To spur interest among farmers, I advertised in the local newspapers and on the radio a reward of M$2.00 (US$0.80) for out-station recoveries of ringed birds. The response was very enthusiastic, and a total of 50 recoveries resulted.

The Sharp-tailed Munia (STM) was by far the most numerous of the three target species on the study area. Regular censuses showed that STMs were most abundant during the months of March and September, with lows occurring in May and November. This pattern of abundance corresponded with the pattern of rice availability at the RRC.

Overall, I ringed 1988 STMs, and recorded 250 on-station retraps. The high rate of retraps indicates that STMs in the Bumbong Lima area had rather localized movements and returned regularly to the RRC to feed. There were 11 out-station recoveries of STMs, all from within 10 km of the RRC, again indicating a localized pattern of movement.

At the RRC, field counts of Spotted Munias (SPM) tended to be low during the first eight months of the year and high during September-December, probably due to the addition of juvenile birds to the population. A total of 531 SPMs was ringed during the study, but only 14 on-station retraps were recorded. This suggests either that this species moves about more extensively than do STMs, or that SPMs are more successful in avoiding being recaptured. Two out-station recoveries of SPMs were reported, one from 16 km south of the RRC.

Numbers of Baya Weavers (BW) fluctuated quite drastically from month to month with no apparent pattern. Altogether, 863 BWs were ringed and 193 were retrapped on-station. Most of the retraps occurred within one month of the ringing date, and retraps over longer intervals were uncommon, indicating that once they left the study area, BWs seldom returned,

unlike STMs which regularly came back. There were 37 out-station recoveries of BWs. About half of these were from locations greater than 10 km from the RRC, suggesting that BWs ranged over a greater area than did the munias.

Food Habits

The food habits of the three target species were examined through field observations and crop analyses. In addition, cage studies were conducted on the munias.

In the field, STMs were observed eating rice almost 75% of the time. The only other food item recorded in the field was the filamentous green algae, *Spirogyra*. Rice was also the most common food item for SPMs in the field, but they were also frequently seen eating *Echinochloa*, a common weedy grass that was abundant at certain times of the year. SPMs also ate algae, but not as often as did the STMs. BWs were never seen eating algae. Rice comprised the bulk of their diet, according to the field observations, although they frequently were seen in tall grass and reed areas adjacent to the rice fields.

Crop analyses performed on a total of 231 birds largely confirmed the field observations. Very little other than rice and algae was found in the crops of STMs. SPMs ate rice more often than any other food item, but seeds of wild grasses as well as algae were recorded with appreciable frequency. No algae was found in BW crops, two-thirds of which contained rice. Seeds of the grass *Paspalum* sp. and various sedges (Cyperaceae) were frequently found. Insect matter was found in two BW crops.

In the cage experiments, munias, singly and in pairs, were given a choice of two food items on each of five days. In the first series, the food items were ripe rice and the grass *Echinochloa crusgalli*. In the second series, rice at various stages of ripening was used. The STMs tested usually showed a preference for rice over *Echinocloa* whereas the SPMs displayed no preference. This is very consistent with the field observations. In the second series, STMs tended to prefer younger, milky stage rice over rice that was at least two weeks older, although both were eaten. No distinction was made by the birds between rice that differed in age by just one week.

Breeding Seasonality

The breeding seasonality of the two munia species was examined in three ways: the presence of juvenile-plumaged birds in the population, the gonad size of autopsied birds, and field observations of nesting activity.

The juvenile plumages of both munia species persist until about three months of age. Among the STMs, birds in juvenile plumage were most common during the periods March-April and September-October. These periods were also the times of maximum rice abundance at the RRC. The peak time of juvenile-plumaged SPMs was September-December, although birds in juvenile plumage were present all year round.

Among the adult-plumaged STMs of both sexes, the greatest periods of reproductive activity, as indicated by enlarged gonads, were January-February and July-August, just prior to the periods of greatest juvenile abundance in the population. Thus, it appears that STMs at the RRC have two main periods of breeding activity annually.

Not enough SPMs were collected to determine their seasonal gonadal condition.

STM nesting activity was determined regularly at five locations outside of Bumbong Lima, and local (within 1 km) rice conditions were assessed at the same time. These obser-

vations showed that active or very active nesting occurred 12 times when rice was locally available and 6 times when it was not. On the other hand, only once was nesting *not* recorded when rice was available in local fields. The remaining 13 observations when no, or slight, nesting was recorded, there was no locally available rice. Thus, there was a definite association between STM nesting activity and nearby rice conditions.

It is hoped that the results of this study will lead to a better understanding of the relationships between certain bird species and the rice crop in Malaysia, and that these results will provide a basis for further studies.

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18. NOTES ON SEXING CROCODILIANS
(*With two plates*)

The need for sexing crocodilians for captive propagation or for release is self evident. Several authors have reported the effectiveness of the simple cloacal probe technique. The crocodile is held and turned on its back. The cloacal area is cleaned with water, finger (close-cropped nail advisable) is inserted to feel for the presence or absence of the penis.

Male crocodilians possess a single organ, rooted to the interior ventral wall of the cloaca immediately anterior to the anal vent. Normal rigidity of the organ permits contact when probed at a depth of 8 centimetres or less in an animal 3 to 4 metres in length. The absence of a rigid organ within the cloaca of the female reveals only a vacant chamber when probed. The small flaccid clitoris of the female cannot easily be confounded with the penis of the male if a minimum specimen size limitation of 75 cm is observed, particularly when dealing with individuals of the genus *Tomistoma* and *Gavialis* (Brazaitis 1968).

With smaller mugger (70-80 cm) it is often impossible to insert a finger. However the penis was extrudable by applying digital pressure on both sides of the cloaca while bending the animal's tail upwards (plate I).

Mugger (*C. palustris*) of under 80 cm are difficult to sex. The cloacal opening is small, the clitoris and penal tip are extrudable and look alike. As they grow larger the clitoris is no longer extrudable while the penis grows and continues to be extrudable manually. At 2.5 metres (near breeding size for the male) the penis will extrude approximately 10 cm and is about 3 cm in diameter.

Crocodylus porosus is similar in structure and development rate to the mugger. Animals of 90 cm can be reliably sexed using the fifth finger (small opening).

There is little in the literature on sexing *Gavialis gangeticus*. Our experience in examining 20 *Gavialis* from 1 m (2 years) to nearly 3 m (20 years) suggest that this animal has a slower rate of sexual development than the other two Indian crocodilians. In none of the gharial checked was the penis more than a few centimetres in length though the 2.7 m specimen was over 12 years of age (plates). Captivity (diet, metabolism, enclosure, disturbance)