Fig. 1. Fresh water habitat, Bang Phra Reservoir.

Fig. 2. Coastal marsh, mangroves at the mouth of the tapioca stream.

Fig. 1. Bamboo-lined stream, marshy tall grass, and banana grove with net in position to catch birds and bats.

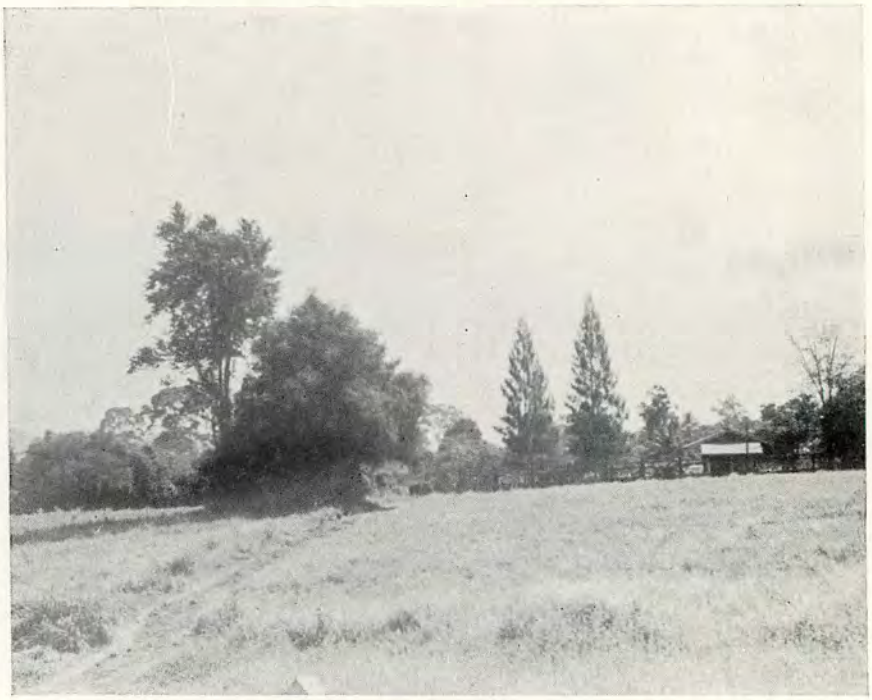

Fig. 2. Tall grass; trees in open.

Fig. 1. Tall grass field, just after the grass has been hand cut to feed the horses. Tree in open is also shown; this tree had a nest of the spotted-necked dove.

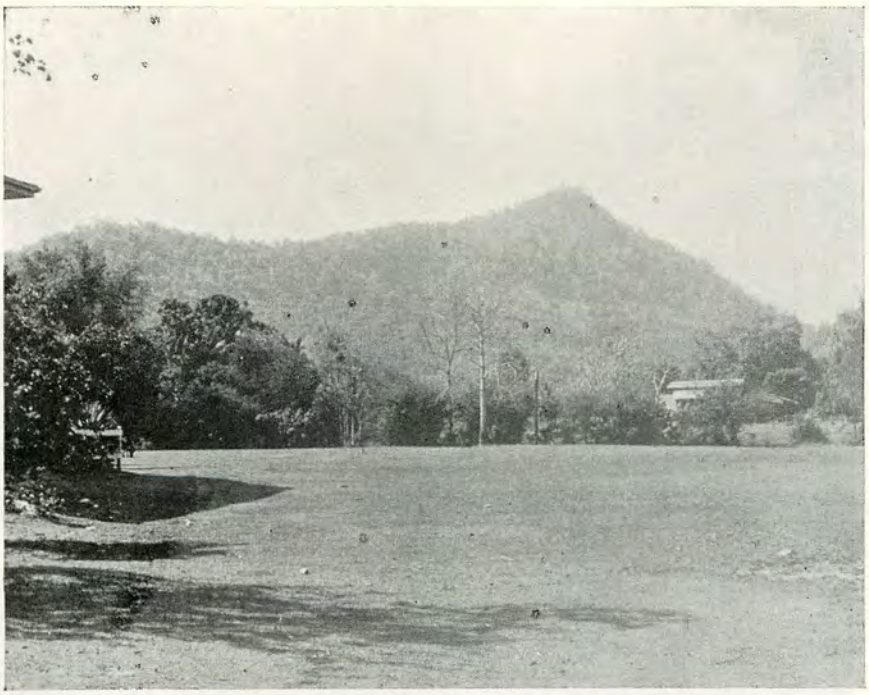

Fig. 2. Short grass field (wet), the habitat of migrating snipe; also ground near shady cover, the foraging site of magpie-robins.

Fig. 1. Brush thickets and "woods and shady trees." An example of "trees in the open" is the lone sugar palm on the right, in which bats roosted and palm swifts and weavers built their nests. A pair of Pegu sparrows also nested in this tree.

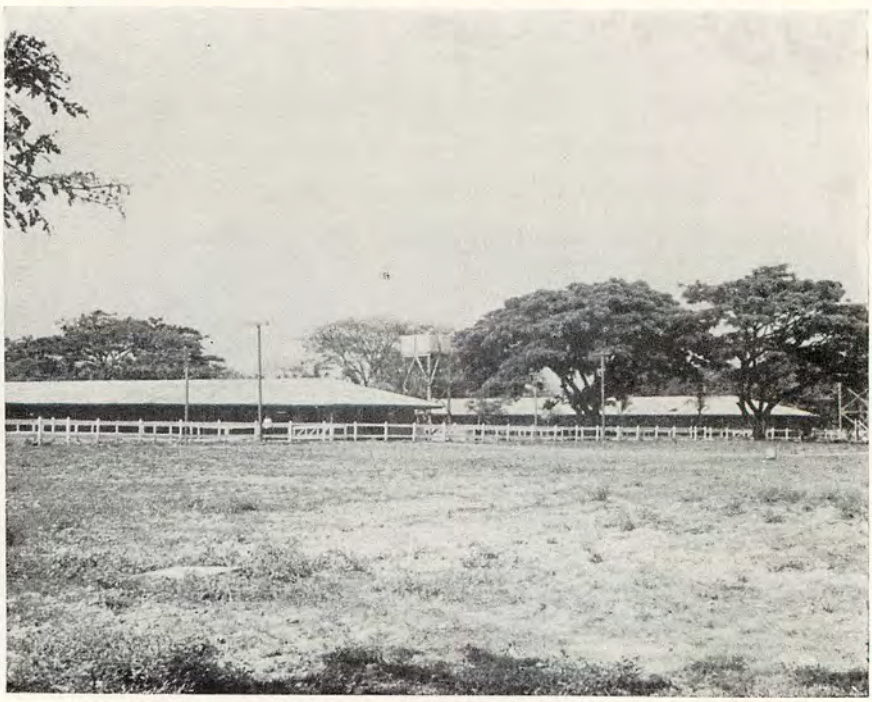

Fig. 2. Three habitats shown are "trees in open", "buildings," and "aerial"–the high power lines upon which many of the aerial feeding birds perched. The buildings are two of the horse stables.

VERTEBRATE ECOLOGY OF BANG PHRA

by

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INTRODUCTION

The attention of the Siam Society is invited to the following results of a two-year vertebrate ecology study which we believe to be quite unprecedented. It is unique first in covering an entire tropical vertebrate fauna, second in the great variety of wild species disclosed as residing on a small area heavily used by man, and third in revealing the large numbers of individuals–hundreds per 16 hectares–of some of these species. This is part of a study of arbovirus ecology by the USA Component of SEATO Medical Research Laboratory, pursued at the Red Cross Horse Farm, Bang Phra, Cholburi, in southeast Thailand.

DESCRIPTION OF THE AREA

The Red Cross Farm, operated by the Pasteur Institute to produce horse antivenin, is 75 km SE of Bangkok at 50 m altitude, 13°12′N by 100°57′E in Sriracha District, Cholburi Province. It lies on a plain used for agriculture between wooded hills fronting a reservoir to the east and mangroves and village along the gulf coast 1.5 km to the west. Most of the 16 hectares of the farm is in close-cropped pasture with scattered large rain trees and mangoes, the 130 horses use the pasture in the morning and the rest of the time are kept in large stables. Three large fields comprising 4 hectares are devoted to tall grass which is sprinkled and hand cut to feed the horses. A fence boundary is covered with bushes and vines. Another long boundary is formed by a small river, carrying effluent from a tapioca

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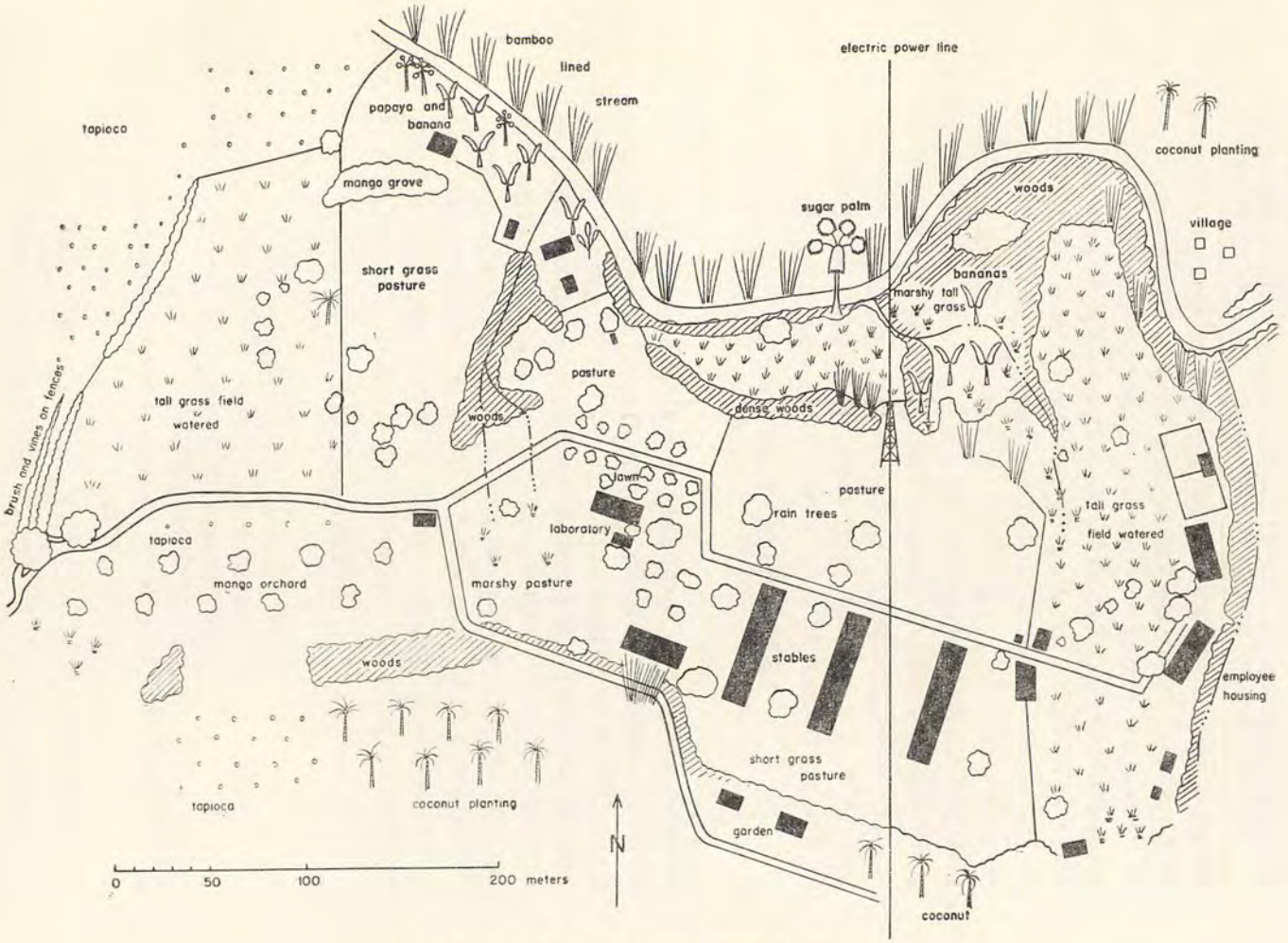
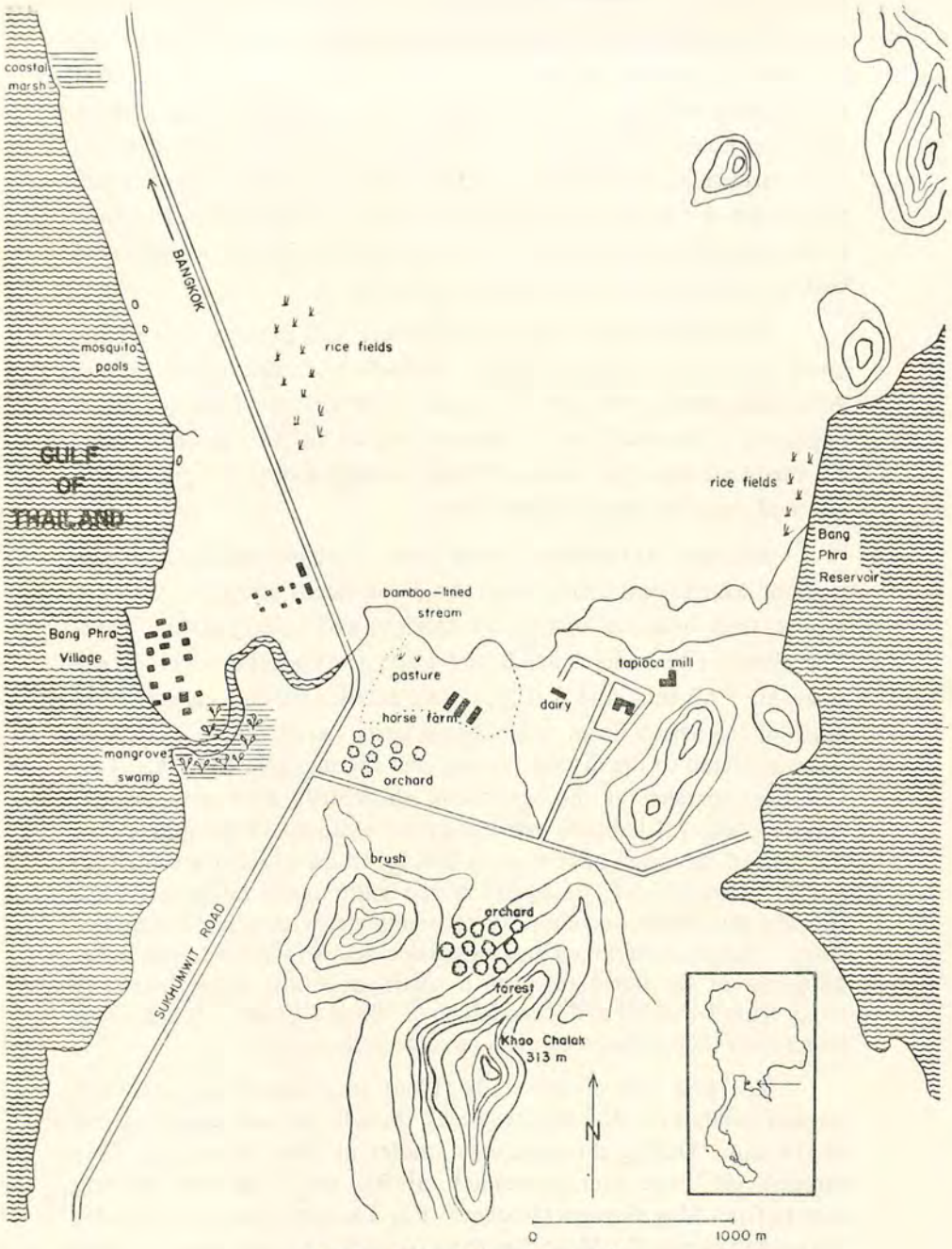


Map 1. Detail map of horse farm at Bang Phra.



Map 2. Map of Bang Phra region.

mill. It is lined with thickets of tall bamboo and the banks are covered with dense secondary woods. There are a spring and several small creeks running through thickets, tall grass and banana groves. Workers' housing, laboratory buildings, concrete drinking troughs, pens, residences, a high power line and shady mango groves complete the picture of a small area intensively used by man and beast (map. 1). It provides diversity of habitats to support a remarkably varied fauna both of mosquitoes and of small vertebrates.

As of February 1968 approximately 150 persons live at the horse farm, and there are 39 dogs, 205 chickens, 20 ducks, and 14 cats; doves and rabbits are kept in cages. The village of Bang Phra a kilometer to the west has 334 houses and about 2000 persons; there are the usual domestic and commensal animals except for pigs. We know of only one small piggery there.

Surrounding the Serum Farm (map. 2) are plowed tapioca fields some of which occasionally revert to dense weeds and grass, coconut groves, fruit orchards in a closed canopy, and a dairy of 450 head. The closest rice paddies are 2 and 4 km away at the edges of the reservoir. Mynahs and starlings were netted at a tapioca mill 7 km north of the Serum Farm, where these birds, hard to catch elsewhere, were attracted to the drying tapioca and the maggots therein. This was near marshes at the beach and shorebirds were also caught. Adjacent natural habitats are mangrove swamps on the gulf coast. Portions of the coast have a sandy beach behind which are some rain pools. Khao Chalak, rising 313 m just south of the horse farm, has considerable mixed deciduous forest remnants, with a bamboo understory. Original evergreen and mixed deciduous forest is found 10 km northeast of the horse farm on a small mountain range including Huay Kum waterfall and Khao Khieo of 798 m altitude. It has a rich fauna even though large animals have been hunted out.

The first year of the study (1966) experienced a greater than normal rainfall of 1567 mm, whereas the second was unusually dry at 814 mm. During the mosquito studies at Bang Phra from 1961 through 1967, the average annual rainfall was 1206 mm arriving mostly from May through October. For Thailand this is a rather dry "savannah climate". More than three times this amount is experienced in the rain forests of Trad Province, not far to the southeast.

VERTEBRATE ECOLOGY

A. Object.

The aim of the vertebrate effort was to provide the laboratory with large numbers of blood samples, taken serially as recaptures permitted, from accurately identified individuals of the abundant small vertebrates at the serum farm. Problems of identification necessitated preparing some museum specimens and embarking upon a taxonomic review of all the rats and mice of Thailand. Data on age, reproduction and home range accumulated through handling and recording the animals but a scientific population study was precluded by heavy use of the farm. Capture stations could not be set up in a regular pattern and had to be confined to thickets, banana patches and streamsides unfrequented by horses.

B. Method.

The various wild animals caught by hand, noosed, netted and live-trapped, were bled from the heart except that birds were bled from the right jugular vein and mice from the retro-orbital sinus after injecting 0.3 ml of saline into the body cavity of the mice. A few of the smallest birds died but most survived bleeding (table 1). The donor animal was identified, toe-clipped or supplied with an aluminum numbered band or ear tag, weighed, measured, sex determined, inspected to determine the reproductive condition and these data, along with date and specific location of capture were recorded on a punch card before the animal was released. The duration of the study was from February 1966 through February 1968.

In conducting the research described in this report, the investigators adhered to the "Guide for Laboratory Animal Facilities and Care", as promulgated by the Committee on the Guide for Laboratory Animal Facilities and Care of the Institute of Laboratory Animal Resources, National Academy of Sciences–National Research Council.

C. Results.

1. Habitats. The 151 species from which we took blood samples (totalling 5129) are arranged in table 2 according to the habitat in which they spend the major part of their foraging time.

Locations of these habitats are shown in maps 1 and 2. Number of captures including recaptures, relative abundance and seasonal status are included in table 2.

2. Populations. Of the common species of birds and mammals, a population many times in excess of what could be directly observed in the field was uncovered by netting and live trapping. Although most individuals were not captured again, the many that were recaptured over periods up to 2 years indicate a remarkably sedentary behaviour, an attraction to a home range or territory. In a given species there would be multiple recaptures of a few land-owning adults on areas up to 150 m across. A greater number, presumably mostly immatures, showed restriction also but to a wider area of about 400 m diameter. Some of them eventually settled down to a small area as they filled the ranks of the territorial hierarchy. Thus there is a large floating component and a smaller stationary component in each species population.

Of the 102 species of birds captured at or near the Serum Farm, 31 are migrants which breed in northeast Asia and spend their winter in Thailand. Most occupy fixed areas during their stay, as do the year round residents. Eight additional migrants merely pass through the horse farm in spring or fall between breeding stations to the north and wintering grounds farther south. The influx of passage and wintering migratory birds has swollen the bird population by a third or half in October. This is also the time, at the end of the rainy season, when the resident population is at its height from recent nesting.

3. Breeding season. A peak breeding season could not be discerned in records of 104 female fruit bats that were pregnant, lactating, or carrying a baby. Most of the pregnancies were in February and June. For rodents generally, pregnancies were scattered from July to March but concentrated in the cold months from November to February. Within these months the proportion of immature individuals increases to exceed the number of adults.

Breeding and molting season of birds is the same as in the north temperate zone except that it is spread over a longer time, involving more variation and less synchrony among individuals. Display and singing begin in January; nesting (judged from the incubation patch in adults and appearance of juveniles in the population) extends from February through July. After that the population is at least doubled by immatures. Exceptional birds are rice-feeding weavers and doves

whose utilization of human agriculture is doubtless correlated with a long breeding season from December through August. Lizards and particularly the geckos, which have vocalizations of apparent use in advertising territories, seem to have the same reproductive season as the birds.

Weaver-birds (Ploceidae: *Passer, Ploceus, Lonchura*) were permanently resident at the horse farm but could be netted little if at all from October through January. The explanation seems to be in daily sorties to ripening grain in rice paddies at that season. The closest are 2 and 4 km away. *Passer flaveolus*, at least, would return to the horse farm in flocks to roost in bamboos.

SYSTEMATIC LIST OF SPECIES

A. Amphibians (all mostly nocturnal; captured and sacrificed)

(Reference: Taylor, Edward H., The Amphibian Fauna of Thailand, Univ. Kansas Science Bulletin, Vol. XLIII, No. 8, 1962).

1. Frogs and Toads (Songs were identified and recorded on calibrated tapes unless otherwise stated).

a. Bufonidae, toads

(*1*) *Bufo melanostictus* (55 individuals captured, 5 preserved as museum specimens). This is the most abundant amphibian and the only one evenly distributed all over the horse farm, both on damp and dry ground, and in the open when it hops out to feed in the evening. Daytime is spent hiding in a hole. At about 0100 to 0200 they gather at permanent ponds to sing, which seems to go on all year. Mosquitoes feeding naturally on this toad at Bangkok, sometimes in numbers so as to cover the crown, are identified as *Ficalbia luzonensis*. One transferred to the human hand and fed, when the toad was picked up. Size large, up to 100 mm snout to vent. Eight weights average 33.5 g. and range from 3 to 70 grams.

b. Ranidae, frogs

(*2*) *Ooeidozyga lima* (8 individuals captured; 6 preserved as specimens). Common in flooded rice paddies at Bang Phra

reservoir; one singing in about every 5 square meters. Small, 3.0 cm snout-vent; seven weights average 1.8 g. and range from 0.5 grams to 3.5 grams.

(*3*) *Phrynoglossus martensii* (3 individuals captured and preserved as specimens). Equally numerous with the above in the same place. Also a dense colony in grass at edge of lake, and one heard at a spring on the horse farm. Size small, 2.5 cm snout-vent, 2 weights average 2 grams.

(*4*) *Rana tigerina* (36 individuals captured; 6 preserved as specimens). The largest amphibian of the study area (snout-vent 11.2 cm, weight up to 110 grams), common in the shallow water of rice paddies at the reservoir; one seen in a pond at horse farm.

(*5*) *Rana limnocharis* (52 individuals captured; 4 preserved as specimens). An abundant, medium-sized frog (snout-vent 4.5 cm), the one caught in greatest numbers. It was found on mud and grass borders of the reservoir and at the edge of a pond at the horse farm. Some were in amplexus and ready to lay eggs in August. The average of 21 weights is 4.4 grams (.5-10).

(*6*) *Rana erythraea* (22 individuals captured; 2 preserved as specimens). Common, somewhat larger than preceding (snout-vent 6.0 cm, three weights ranging from 10 to 16 grams), restricted to permanent deeper clear water with green aquatic vegetation. Eggs were present at least in August but the male sings all year. Found only at the reservoir.

(*7*) *Rana macrodactyla* (3 individuals captured and preserved as specimens). A smaller (2.5 grams) very slender relative of *R. erythraea* found in the same habitat but only 1/10th as numerous. Song, if any, not heard.

(*8*) *Rana nigrovittata* (2 individuals captured and preserved as specimens). Common medium-sized frog (5.2 cm snout-vent) restricted to clear shady streams. Taken in its characteristic natural habitat at Huay Kum waterfall and also noted at three small creeks on the horse farm. Sings in daytime as well as at night. The only amphibian seen active in daytime during this study. An August specimen was ready to lay eggs.

c. Microhylidae, narrow-mouthed toads

(*9*) *Microhyla ornata* (one individual captured and preserved as a specimen). A very small toad, usually common, found at muddy edge of reservoir and at shady spring on horse farm. Not otherwise noticed in 1967 because of scarce rains.

(*M. heymonsi*. Present at Serum Farm but not collected).

(*10*) *Microhyla butleri* (two individuals captured and preserved as specimens). Only three found singing at water line of reservoir in tall grass marsh. Size small.

(*11*) *Kaloula pulchra* (3 individuals captured and preserved as specimens). Medium sized, brightly-patterned toad noted for its resonant voice, like that of lowing cattle, uttered during heavy rains. Found under buildings and in wet grass under trees. Snout-vent 4.2 cm, weights 5 and 7.5 grams. Eggs in November.

(*12*) *Glyphoglossus molossus* (one preserved). A burrowing toad with peculiar shaped head apparently used like a bulldozer. One taken on ground at Mr. Burana's orchard. Voice not heard.

2. Caecilians

a. Caecilidae

(*13*) *Ichthyophis kohtaoensis* (one preserved). A large worm-like burrowing creature, one of which was found in soft mud bordering the reservoir.

B. Reptiles

1. Turtles (Reference : Wermuth, H. and Mertens, R., Schildkröten, Krokodile, Brückenechsen, Fischer, Jena, 1961).

a. Trionychidae, soft-shelled turtles

(*1*) *Trionyx cartilagineus* (one individual captured, marked, and released). Aquatic, taken at reservoir.

2. Lizards (large species were toe-clipped and released. Reference: Taylor, Edward H., The Lizards of Thailand, Univ. Kansas Science Bulletin, Vol. XLIV, No. 14, 1963).

a. Gekkonidae (All nocturnal and capable of vocalizing).

(*2*) *Phyllodactylus siamensis* (one preserved). Taken at the horse farm, habitat presumably on tree trunk, snout-vent length 5.0 cm.

(*3*) *Hemidactylus frenatus*, house-gecko (52 individuals captured; 9 preserved as specimens). The most abundant vertebrate at the horse farm, this species is found in and on all buildings and on branches of trees. It feeds at night upon small insects including mosquitoes. The average snout-vent length is 5.0 cm; thirty-two weights average a little over 2 grams and range from 0.5 to 4.5 grams. There are numerous small individuals, suggesting a rapid turnover of the population. Cats, snakes and owls feed upon these geckos, but their principal enemy in the stables is *Gekko gecko*.

As a suspect species for amplifying Japanese encephalitis virus, this lizard's intimate association with horses and mosquitoes at Bang Phra should be emphasized. The "chinchuck" reaches its maximum density in the long wooden enclosed stables, which provide ideal habitat, including crannies between the boards to receive the two eggs. Equipped with adhesive fringes on the digits, it runs with equal facility on screens, walls, and ceilings of the horse stalls, right where the mosquitoes which feed on the horses are apt to alight.

(*4*) *Platyurus platyurus* (9 individuals captured; 3 preserved as specimens). This domestic gecko outnumbers *Hemidactylus* in most places but at the horse farm it was in the minority. It was collected in buildings and on tree trunks. Habits and occurrence are the same as *Hemidactylus* but *Platyurus* is a trifle larger. The snout-vent length for a large adult is 6.9 cm; eight weights average 2.56 grams and range from 1.5 to 3.5 grams.

(*5*) *Gekko gecko* (13 individuals captured and released). Common in wooden buildings of the horse farm. There are probably at least a half dozen in each horse barn, where they feed on insects and the smaller domestic geckos (Taylor, *op. cit.*, p. 791). Vocalizing is at its height in February and March, suggestive of the onset of a definite breeding season, as in most of the birds. An adult individual of this large lizard measured 18.5 snout-vent. Eight weights average 90.6 grams and range from 27 to 180 grams.

b. Agamidae, diurnal lizards

(*6*) *Calotes versicolor* (237 individuals captured; 5 preserved as specimens). Common. This diurnal insectivorous lizard varies greatly in size (208 weights average 13.8 grams and range from 1 to 40 grams; snout-vent average is 8.0 cm), suggestive of a rapid turnover of the immatures of the population. The habitat of the fleet-footed, wide-ranging immatures is on and about bushes, grass, vines, and fences, whereas the relatively few mature individuals are stationed upon the shady trunks of trees. There they advertise their territory by striking changes of color. Each mango tree probably harbors a pair.

(*7*) *Calotes mystaceus* (22 individuals captured; 2 preserved as specimens). Frequent. This lizard is larger (15 weights average 30 grams and range from 9 to 68 grams) and less numerous than the above, although certain adults can be seen daily at their stations on mango trunks. Habits and occurrence are like the foregoing.

(Varanidae, monitors. *Varanus salvator.* Common along stream at Serum Farm but not captured).

c. Scincidae, skinks

(*8*) *Mabuya multifasciata* (6 individuals captured; 3 preserved). Uncommon. This large ground-dwelling skink forages over leaves or in short grass for insects. When surprised it runs to a hole or crevice in nearby rocks or a stream bank. Snout-vent length is about 11 cm; one weight, 30 grams.

(*9*) *Riopa bowringi* (one preserved). This rare small skink (snout-vent 4.6 cm) probably lives under leaf litter of the forest floor.

3. Snakes (Reference: Taylor, Edward H., The Serpents of Thailand and Adjacent Waters. Univ. Kansas Science Bulletin, Vol. XLV, No. 9, 1965).

a. Xenopeltidae

(*10*) *Xenopeltis unicolor* (2 captured; one preserved). Uncommon. One entered a mouse live-trap in the grass field, ate the adult mouse (*Mus cervicolor*), and was caught. A female of 114 cm total

length was about to lay 21 eggs in March. Notable for the irridescence and reflected colors of its mirror-like scales, this is called the sunbeam snake in Thai.

b. Colubridae

(*11*) *Oligodon cyclurus* (2 captured; one preserved). Uncommon. A vicious biter. By overlapping its flexible jaws it is able to bite even when held by the head.

(*12*) *O. quadrilineatus* (one preserved). Uncommon.

(*13*) *Dryophis nasutus* (6 individuals captured and released). Common. Lives in trees and hunts in the daytime. One caught and swallowed an adult sparrow (*Passer montanus*) near the top of a mango tree. Four weights average 33.5 grams and range from 8 to 46 grams.

(*14*) *Natirix flavipunctata* (one preserved). Uncommon. Aquatic.

(*15*) *Enhydris plumbea* (two preserved). Uncommon. Aquatic.

(*16*) *E. enhydris* (13 individuals captured and one specimen preserved). Abundant both at the reservoir and in mangrove swamp, where it enters holes of the mud-skipping gobi fish in order to catch them. Active in late afternoon and at dusk, this aquatic snake's numbers can be appreciated at low tide. Seven weights average 108.2 grams and range from 56 to 165 grams.

C. Birds (*signifies not previously reported from SE Thailand).

Abundance pertains to occurrence on the Serum Farm, not to the general prevalence in Southeast Thailand.

(*1*) *Ardeola ralloides* (5 individuals captured). A frequent visitor to the bamboo-lined stream at the horse farm, the pond heron is seen there only in the first-year plumage. It is recorded from Bang Phra between the months of June and February. The breeding area is to the north, in China (race *bacchus*) whence immatures migrate to Southeast Asia. The bulk of the local "wintering" population is at canals and mangrove swamps along the coast at Bang Phra, where it

is common. From there birds visit the horse farm almost daily, in groups of 5 to 10. Four weights average 293.1 grams and range from 243 to 348 grams. One was shot within 10 miles in September 1968, having been banded the previous February.

(*2*) *Ixobrychus cinnamomeus* (2 captured). The cinnamon bittern is a frequently seen resident. A pair performed nuptial flights in May and June, 1966, over the Serum Farm and may have nested near the stream. Weights are 150 and 162 grams.

(*3*) *Accipiter badius* (4 captured). At least one pair of the resident, bird-eating shikra goshawk lives in the vicinity of the horse farm. It hunts by pursuit inside tree growth. Four weights average 153.1 grams and range from 91 to 223 grams.

(*4*) **Turnix tanki* (1 captured). The yellow-legged buttonquail is a rare, or at least well-concealed, year around resident of tall grass in banana groves at the horse farm. The one immature captured weighed 25 grams.

(*5*) *Turnix suscitator* (11 individuals captured). The barred buttonquail is a frequently found year around resident of tall grass. One recapture 2½ months after yielding a 1 ml. blood sample, was 50 meters from the site of first capture. Ten weights average 50.5 grams and range from 35 to 77 grams.

(*6*) *Amaurornis phoenicurus* (one captured). The white-breasted waterhen, an uncommon resident, was caught once at the Serum Farm stream. It was an adult weighing 237 grams.

(*7*) *Rostratula benghalensis* (one captured). The painted snipe is an uncommon resident netted once at a marsh 7 km north of the Serum Farm. It was an immature weighing 124 grams.

(*8*) *Charadrius dominicus* (one captured, 100.5 g.). The golden plover is a common coastal winter visitor, netted once at the tapioca mill.

(*9*) *C. dubius* (one captured). The little ringed plover is a common coastal migrant (November). The one immature captured at the tapioca mill weighed 28.5 grams.

(*10*) **C. alexandrinus* (3 captured). The Kentish plover is a common coastal migrant (November), netted at the tapioca mill. The three weights range from 35.5 to 36.5 grams.

(*11*) *Tringa glareola* (one preserved as a museum skin). The wood sandpiper is a frequent winter visitor from northern Asia. A female netted at a tapioca mill on the coast weighed 50 grams.

(*12*) *Actitis hypoleucos* (5 captured). The common sandpiper is a winter visitor (seen October through January) to shores of streams and estuaries. One was netted at the Serum Farm stream, the others at pools beside the tapioca mill. The five weights average 39.8 grams (33-46).

(*13*) *Capella stenura* (3 captures including one preserved as a museum study skin). The pintail snipe is a common migrant in marshes and a wet pasture on the Serum Farm where flocks of about a dozen individuals were found in September and November. Three weights average 108 grams (93-178).

(*14*) **C gallinago* (one captured). The fantail snipe is an uncommon migrant (November); one netted in marsh near the shore weighed 84 grams.

(*15*) *Scolopax rusticola* (one captured and preserved as a museum study skin). The woodcock is an uncommon winter visitor (December) beside the Serum Farm stream. Weight 295 grams.

(*16*) *Calidris subminuta*, long-toed stint (17 captured including two preserved as museum skins). Abundant migrant (November) at the coastal swamp near tapioca mill Seventeen weights average 22.2 grams and range from 17.5 to 27 grams.

(*17*) **Streptopelia tranquebarica*, red turtle dove (two captured). At least a dozen individuals are resident at the Serum Farm. The two weights are 86 and 90 grams. This dove and those following, except for *Chalcophaps*, feed on the ground in the open and utilize tall trees and the power line for singing stations. Nests are in trees.

(*18*) *S. chinensis*, spotted-necked dove (2 captured). About 8 individuals reside on the Serum Farm, where a nest was being built in June. Others are captive pets at residences there. Two weights are 112 and 134 grams.

(*19*) **Geopelia striata*, zebra dove (7 captured). Another favorite cage bird in residences at the Serum Farm, this small dove

has been introduced from peninsular Thailand in the wild state. There are perhaps 10 wild pairs at the farm. Seven weights average 47.7 grams (44 to 52).

(*20*) *Chalcophaps indica,* emerald dove (one captured). A rare wanderer to the farm, one was netted in a dense orchard (weight 129.8 grams). The normal habitat is the forest floor where it is a common resident.

(*21*) *Cacomantis sonneratii,* banded bay cuckoo (three captured). Though resident in this part of Thailand, it was only an uncommon visitor from October to December at the Serum Farm and was not heard singing there. Three weights average 27 grams (26 to 28). These and the following cuckoos, except for *Centropus,* are exclusively arboreal, limited to dense foliage of trees.

(*22*) *C. merulinus,* brain fever bird (9 individuals caught). Although treated in the literature as a common resident of Thailand, this species was never heard singing at the Serum Farm where it evidently does not nest. Instead it was captured and seen there, as a winter visitor upon fixed territories, from September to January. Two individuals recaptured once and twice during a month were within 100 meters and 150 meters, respectively, of their first capture stations. Nine weights average 27.2 grams and range from 24 to 31 grams.

(*23*) *Phoenicophaeus tristis,* green-billed malcoha (one captured). Rare June wanderer to Serum Farm from nearby forests (where it is a common resident). One weight 101 grams.

(*24*) *Centropus sinensis,* greater coucal (one weighing 247 grams). This most common and conspicuous predator at the Serum Farm is a resident. It is capable of eating birds out of nets, supporting itself on spread wings so as not to get caught. Loud duets performed by each pair, all year around, indicate at least three pairs on the farm and several more at Burana orchard and surrounding wooded hills.

(*25*) **Centropus toulou,* lesser coucal (2 captured: 101, 108 grams). Common resident around the reservoir, but those netted at the Serum Farm in February appeared to belong to a wintering race which nests in southern China. However, they were released and the racial identification cannot be verified.

(*26*) *Otus scops*, common scops-owl (2 preserved as museum study skins). Uncommon winter visitor from NE Asia, caught in December and February beneath trees at the Serum Farm. The two specimens belong to the finely patterned migratory race, *stictonotus*, and weigh 73 and 86 grams. This and the following owls and the nightjar are strictly nocturnal.

(*27*) *Otus bakkamoena*, collared scops-owl (four captured, one of them preserved as a museum study skin). A frequently heard resident preferring trees at edge of clearings. There are probably three pairs on the Serum Farm and ten more in woods and orchards around the perimeter. A female was laying in February and another pair had young out in June. Four weights average 113 grams (98-123).

(*28*) *Athene brama*, spotted owlet (one captured). At least two pairs of these noisy small owls reside on the Serum Farm. They roost in hollow coconut trunks and buildings. One netted beside the stable weighed 107 grams.

(*29*) *Caprimulgus macrurus*, long-tailed nightjar (two preserved as museum study skins). Common resident at base of wooded hills all around the Serum Farm, to which one came and was caught in a banana grove (a juvenile weighing 71 grams). An adult female weighed 86 grams.

A smaller species, **C. asiaticus*, was commonly found in the pastures of the farm during the first year of the study but was not captured.

(*30*) **Apus affinis*, house swift (5 captured). Common resident, colonial. About 200 were nesting in June beneath beach houses at the Red Cross Hospital in Sriracha. Curious evening flights of 50 or so individuals twittering as they mill around in a compact flock have been seen in January, May, June and September, usually about 100 feet over the Serum Farm pastures. After a few minutes the birds suddenly become silent and dash off in all directions. Foraging upon aerial insects is usually high in the air, but the flock formerly hunted up and down the stream under the Bang Phra bridge, where they may also have nested, before it collapsed.

(*31*) *Cypsiurus parvus,* palm swift (six captured). Common resident. The single sugar palm on the Serum Farm was shared by bats, weavers and palm swifts. Generally 30 or more of the latter would circle around it, especially in the early morning and evening. At other times they spread out over the rest of the farm and adjacent hills to forage higher in the air. All those netted were caught near the base of the palm. They did not frequent coconut palms, which lack the skirt of dead fronds. Six weights average 10.5 grams and range from 9 to 15 grams.

(*32*) *Alcedo atthis,* common kingfisher (seven captured). Although a common resident of waterways and lagoons in the vicinity, the kingfisher was noted at the Serum Farm only as a frequent winter visitor from September 1967 to January 1968. It was captured in various net situations not all near the stream. There were no recaptures, indicating that our birds perhaps represented a post-breeding dispersal. Two were caught in the same net on the same day. Seven weights average 19.7 grams and range from 11 to 25 grams.

(*33*) *Halcyon smyrnensis,* white-throated kingfisher (18 captured). Common resident with at least two or three conspicuous pairs living on the farm and a dozen more individuals passing through during the two years. Of two recaptures, one was within 125 meters 11 months after the first capture. The second was 160 meters after 22 months. This kingfisher hunts from trees at edges of clearings and along streams. Seventeen weights average 70.2 grams and range from 54 to 83 grams.

(*34*) *Halcyon pileata,* black-capped kingfisher (8 individuals captured). Common winter visitor from China; present from October to February. This species is of similar size, habits and abundance as the resident *Halcyon smyrnensis,* and was caught in the same places. It differs mainly by being a winter visitor. At the Serum Farm, where of course it lacks any post-breeding dispersal, its recapture rate shows a population much more stationary than that of *smyrnensis* in which only the territorial pairs are stationary. Of the 8 individuals of *pileata* that were marked during the two years, two were recaptured in three days at the next net of the string and in the same net, respectively.

Two more were recaptured in three weeks at 85 meters and in the same net. Another bird was caught altogether five times in two successive winters, between which it had migrated to China and back, and all its captures fall within an area 375×115 meters along the winding streams. Eight weights average 87.5 grams and range from 76 to 95 grams.

(*35*) *Merops leschenaulti,* bay-headed bee-eater (17 individuals captured; one preserved as museum specimen). Common resident, hawking flying insects from exposed perches along streams. Incubation patch in March and April. The 39 captures pertain to only 17 individuals most of which were recaptured. Recaptures ranged up to 13 months in the same net or at distances up to 160 meters along the stream. It appears that the Serum Farm population, concentrated along 350 meters of a bend in the stream, included at least 9 individuals at any one time, and that these were replaced once during the two-year study. Sixteen weights average 25.6 grams and range from 22 to 29 grams.

(*36*) *Merops orientalis,* little green bee-eater (32 captured). Common resident, hawking insects in mid-air by rapid flights from a perch in the open. Not restricted to vicinity of the stream. Eight individuals were captured from 2 to 4 times with recaptures spanning periods of one week to 19 months from time of first capture. Capture points of 7 repeating individuals fall within areas of 110×50 meters or less. The 8th individual, caught 4 times during 19 months, covered an area of 325×140 meters. Thirty weights average 16.8 grams and range from 14 to 19 grams.

(*37*) *Merops viridis,* blue-throated bee-eater (8 captured). Rare resident. Aerial feeder, as are the foregoing. Eight weights average 33.0 grams and range from 23 to 38 grams.

(*38*) *Upupa epops,* hoopoe. Two distinct races were found. The first is **U. e. saturata* (3 captures), a rare winter visitor from northern Asia, identified by Mr. Somsak on the basis of subterminal marks of white upon the longer feathers of the crest. Three weights range from 61 to 71 grams. The resident race *U.e. longirostris* (6 individuals captured and one preserved as a museum study-skin) is rarely found at the Serum Farm. It was identified by the plain rufous crest

feathers tipped with black. Hoopoes appear to feed by hacking at the open ground with their bill. But the few sightings were of birds in flight across the farm. At dawn on 5 February 1968 four of them went into a net together beside the stream. Two of these were recaptures of 17 months at 40 meters, and one month at 65 meters distance from point of first capture. Six weights average 58.7 grams and range from 52 to 68 grams.

(*39*) *Megalaima haemacephala*, coppersmith barbet (one capture). Frequently seen resident, confined, for its feeding upon berries and its advertising singing, to the upper parts of trees, hence rarely netted. An immature weighed 33 grams.

(*40*) *Mirafra assamica*, rufous bush-lark (28 individuals captured, one preserved as museum study-skin). Common resident of both short and tall grass of open areas, where it feeds by picking up seeds and insects as it walks along the ground. Seven individuals were captured more than once: 6 were within areas of about 220×85 meters over periods from 8 days to 3 months (one was caught three times in the same net during 12 days); a 7th bird was caught 7 times in 3½ months at net stations covering 315×90 meters. This, plus its singing from fixed stations, shows that the bush lark is remarkably sedentary and territorial on the Serum Form. Twenty-seven weights average 25.3 grams and range from 15.5 to 30 grams.

(*41*) *Hirundo rustica* (33 individuals captured, including one at Sriracha and 12 at the tapioca mill). The house swallow is an abundant winter visitor from northern Asia. It feeds upon flying insects caught during continuous flight, often low to the ground. One individual, band no. 10571, was first captured at the Serum Farm on 1 February 1967. After its migration, presumably to eastern Russia, whence many bands have been returned from the birds banded at the Jawarad roost in Bangkok, it was recaptured on 18 December 1967 only 135 meters away. Another, no. 94340, banded at the tapioca mill on 9 November 1967, was taken at the Jawarad Street roost 12 days later by Kitti Thonglongya.

It is a well-known trait of swallows, as well as of bats, that individuals often visit other roosts to spend the night. The roost on

electric wires in downtown Bangkok was estimated by Marshall at 120,000 to 140,000 birds in the winter of 1964-65. Thirty-one weights average 13.6 grams and range from 10 to 16 grams.

(*42*) *Aegithina tiphia* (3 captured). The common iora is a frequently seen resident of tree foliage. An individual was recaptured, after a month, in a net only 40 meters from the site of first capture. Three weights range from 12 to 14 grams.

(*43*) *Pycnonotus atriceps* (4 individuals captured, one of which is preserved as museum study-skin). The blue-eyed bulbul was a rare visitor to the horse farm during one week in 1967. The four birds were caught in the same net within a banana grove, three of them on 25 May and one on 1 June. Four weights average 24.0 grams and range from 22 to 26 grams.

(*44*) *Pycnonotus aurigaster* (64 individuals captured). The red-vented bulbul is a common resident of the top parts of thickets and overgrown fence-rows, and taller trees. Recaptures of 15 individuals caught 2 to 6 times at distances up to 385 meters from the farthest point of previous capture, at times up to 17 months, show that they are wide-ranging in their daily movements. Some however, doubtless members of established or nesting paris, may be restricted: one was caught 3 times within 36 meters from September to October; another was caught 6 times within 90 meters during July. Sixty weights average 27.9 grams and range from 20 to 34 grams.

(*45*) *Pycnonotus finlaysoni* (3 captures). The streaked-throated bulbul rarely wanders to the thickest woods of the Serum Farm from the more natural habitat of the adjacent hills. The three records are from March, April, and May. Three weights range from 28 to 29 grams.

(*46*) *Pycnonotus goiavier*, yellow-vented bulbul (476 individuals captured). This bird, averaging 30 grams, is an abundant but inconspicuous permanent resident. An incubation patch on various adult females indicates nesting from March to June. The habitat is dense foliage of thickets, vines, bamboos and other trees. The birds remain well concealed there while foraging on insects and fruit. They take long flights quickly and low from one thicket to another. Early

in the year there are pairs, but by mid-year flocks up to a dozen are found. A flock of 10 of various ages and states of molt went together into a net one early morning in June. Smaller size and different plumage texture of the young show that they form half the population in May and that they increase to $\frac{3}{4}$ or more of captures by July through September. Ninety-eight individuals were captured 2 to 5 times (total of 173 recaptures) over periods ranging up to 2 years. This high repeat rate indicates restriction to a familiar area even though the range of most recaptured individuals extended from corner to corner of the horse farm, and probably went beyond it. Those few with 3 or 4 recaptures, thought to represent pairs established on territories, had recapture points within 90 to 360 meters, however. There must be a large unapparent population of several hundred regular vistitors that are drawn from a radius of perhaps a kilometer all around the farm. Two banding recoveries are of 030-38185 banded 2 March 1966 at the Serum Farm and recovered about 1.6 km to the northeast on 22 May 1966, and of 030-38295 banded 15 July 1966 at the farm and recovered at Sattaheeb,60 km to the south two years later (6 July). On 6 August 1969, adult 030–38144 was recaptured 115 m. away after $3\frac{1}{2}$ years. Weights of 385 birds range from 21 to 35 grams. From 30 grams in the cold season, November to March, the average drops two grams showing that immatures and juveniles form a large proportion of the population from April to October.

(*47*) *Pycnonotus blanfordi*, Blanford bulbul (405 individuals, one preserved as museum study-skin). This is the most abundant, most sedentary bird at the Serum Farm. It is a year around resident nesting from February to July so that the population is doubled or tripled by juveniles between April and September. The habitat is the interior of dense foliage of trees and bushes, where insects and fruits are fed upon. There are occasional short flights across openings to the next trees. The usual occurrence is as stationary pairs except that small floocks form in the rainy season. One hundred fifty-two individuals were captured from 2 to 19 times (total of 378 recaptures), at elapsed periods from a few days to 2 years. Those recaptured many times presumably established on territories, had capture points usually falling within much less than 150×140 meters. Others recaptured 1 to 6 times ranged up to 360 meters. These and many captured

only once presumably represent the floating population of dispersing young and others not yet restricted to the small area typical of established adults. It is likely that pairs of the Blanford bulbul are spaced more closely than any other territorial bird known in the world, although there is considerable overlapping. Weights of 141 adults average 30.6 grams; of 203 classified as immature or juvenile, 28.9 grams.

(*48*) *Dicrurus adsimilis* (32 individuals captured). The black drongo is an abundant winter visitor from the North, found at the Serum Farm from November to April. It is an aerial feeder, flying out from a perch in the open to catch insects. Three were recaptured one time each, 40 meters away, at intervals of one, one, and 8 days. The average of 27 weights is 39.2 grams (30 to 43 grams).

(*49*) *Dicrurus leucophaeus* (2 captures of which one, preserved as a museum skin, is the race *leucogenis*). The white-faced, soft gray race of the ashy drongo is a rare winter visitor from the North to the Serum Farm (October through February). It is an aerial feeder from a perch in the open. The two weights are 40 and 41 grams (the second, of an immatuare male).

(*50*) *Dicrurus paradiseus* (5 individuals captured). The greater racquet-tailed drongo is a frequently seen resident, staying in the foliage of taller trees within which its insect-capturing flights take place. One was recaptured 20 months later and 190 meters from the time and place of first capture. Five weights average 71.8 grams and range from 67 to 75 grams.

(*51*) *Crypsirina temia,* black racquet-tailed treepie (13 individuals captured, 1 museum skin). Frequently seen resident of the densest woods of the Serum Farm. Four recaptures pertaining to three individuals reveal a sedentary habit: 240 meters after 15 months, 80 meters after a week and again after 8 months, 24 meters after 2 months. Thirteen weights average 43.8 grams (38 to 57).

(*52*) *Macronous gularis,* striped tit-babbler (11 individuals captured). A common resident of the densest shady woods, where it gleans insects from the foliage, this babbler usually travels in small

flocks. Most of the individuals were captured during the first 8 days of netting; they were all recaptured from one to 8 times (20 recaptures total). In the remaining two years of the study only four new individuals were banded; they were never recaptured. This would suggest a longevity and low replacement rate quite out of proportion to the small size of the bird, whose average weight of 10 individuals is only 11.8 grams (10.5 to 13.0). Recaptures support the concept of the floating population versus the established territorial pairs as illustrated by two birds first captured at the same place on the same day. The first, a wanderer, was captured 5 times in 2 months along 530 meters of the stream and a tributary. The second was captured 9 times in 23 months all within an area of 115×50 meters.

(*53*) *Timalia pileata,* red-capped babbler (15 individuals caught). A frequently seen resident of dense brush thickets, this babbler like the preceding is so sedentary on small territories that a large proportion of captures were of previously banded individuals. Twenty-eight recaptures pertain to 7 individuals caught from 2 to 11 times at total periods (from first to last capture) of 6 days to 22 months. "Home ranges" encompassing the multiple capture points are 130×100 meters for a bird caught 7 times in 22 months, 125×45 meters for one caught 11 times in 15 months, and 218×80 for one caught 7 times in 2 months. Thirteen weights average 20.2 grams (17 to 25).

(*54*) *Erithacus calliope* (2 captured). The rubythroat was a rare winter visitor to the dense brush thickets on the Serum Farm. Two females preserved as museum study skins weighed 18.5 and 18 grams.

(*55*) *Erithacus svecicus* (one captured). An immature bluethroat taken in November weighed 14 grams. This species is also a rare winter visitor from northern Asia and inhabits dense brushy thickets.

(*56*) *Erithacus cyane* (2 captured, one preserved as museum study-skin). The Siberian blue robin was uncommonly netted in thickets. It is a winter visitor from northern Asia. The two females caught both weighed 14 grams. One of these was captured 3 times in 1½ months over a distance of 80 meters, indicating that like many thrushes, the birds have circumscribed winter territories.

(*57*) *Copsychus saularis*, magpie robin (133 captures, one preserved as study-skin). Abundant. This conspicuous ground-foraging territorial bird occurs in pairs or in family groups in summer. Fifty-three males average 37.2 grams and range from 32 to 43 grams. Forty-five females average 34.0 grams (27 to 40). A year round resident, its breeding season is from March to July. Juveniles doubled the population in May to September 1967. Fifty-one individuals were captured 2 to 9 times from a few days to 21 months. After the close of the study, on 25 July 1969, adult female 030-64186 was recaptured 250 m. away after 25 months. There is an inverse relationship between size of area and number of recaptures: 15 of 20 birds caught 3 to 8 times were within 160 meters, whereas more than half of those captured only 2 or 3 times had roamed more than 225 meters. This leads to an estimate of 15 breeding pairs on small overlapping forage areas and a more widely ranging floating population of about 50 non-established birds in the rainy season.

(*58*) *Copsychus malabaricus* (2 captured). The shama is a common resident of the dense woods of Khao Chalak and the shady Burana orchard at its base. At the latter locality it overlaps the magpie-robin and both species have used the same song perches, though at different times of day. Ground feeding is beneath dense cover. At the Serum Farm proper, the woodland is not extensive enough to permit a breeding population. Two apparent immatures were found there in the fall and winter of 1966, however. They weighed 25 and 26 grams and one of them was captured twice during 4½ months at 90 meters between net stations.

(*59*) *Saxicola torquata*, rufous-breasted stone-chat (1 study skin). A rare winter visitor to open areas from northern Asia. A male weighing 12.0 grams was netted on the pasture in October 1967.

(*60*) *Turdus obscurus*, white-browed thrush (4 captured). A rare winter visitor from northern Asia, this thrush occupied dense woods along the stream, probably as a small flock, during the winter of 1967-68. One was netted on 18 December and the other three on 8 January. Four immature weights average 60.8 grams and range from 51 to 69 grams.

Phylloscopus, leaf warblers. The following seven species of these small green warblers were winter visitors or migrants from

northern Asia to shady trees on the Serum Farm. They catch insects within dense foliage of the larger trees.

(*61*) **Phylloscopus fuscatus*, uncommon, winter (November to April), 7 individuals captured including 3 preserved as museum skins. Seven weights average 7.5 grams and range from 6.1 to 10.0 grams.

(*62*) *P. schwarzi*, rare, winter (October to March), 5 individuals. This bird feeds along the stream and closer to the ground than do the other species. Four weights average 10.0 grams (8 to 12).

(*63*) *P. inornatus*, frequent, winter (at least November to January). One individual was preserved as a museum study-skin, a male weighing 5.5 grams.

(*64*) *P. borealis*, frequent migrant (6 October to 7 November southbound; 10 to 23 May northbound), 13 individuals including two preserved as museum specimens for the difficult identification based upon rudimentary 10th primary, 8th longest, and 5th primary not emarginated on outer web as contrasted with *P. trochiloides*. Thirteen weights average 7.7 grams (5 to 10).

(*65*) *P. tenellipes*, uncommon, winter (October to February), 6 individuals including 4 preserved as museum skins. Six weights average 7.6 grams (7 to 9).

(*66*) **P. coronatus*, frequent migrant (October), one captured, weighing 7 grams.

(*67*) **P. reguloides*, rare migrant (March), one capture, a female preserved as museum study-skin, weight 8.6 grams.

(*68*) **Phragamaticola aedon*, thick-billed reed-warbler (37 individuals, two preserved as museum study-skins). Common winter resident from October to May, staying on small but not necessarily exclusive winter foraging territories in marshy tall grass or brush near water. Twelve individuals were captured more than once (23 recaptures), from 2 to 6 times over periods of 6 days to 2 years, ranging from the same net (after 6 days) to an area 315×95 meters (4 consecutive nettings in 12 days). Four individuals went back to northern Asia for nesting and returned a following winter to the same localized area on the Serum Farm as follows: band 020-39598

during three consecutive winters, covering 24 months, in a territory of 115×50 meters as outlined by 6 capture points; band 020-39602 in the first and third winters (avoiding capture in 1966-67) covering 20 months, at three net locations along a line of 150 meters; 020-39688 caught 4 times in two winters covering 13 months in an area 50×25 meters; and 020-39851 during two winters covering 7 months, caught three times at stations covering 130×40 meters. Twenty-nine weights average 23.1 grams and range from 19.5 to 33 grams.

(*69*) *Acrocephalus arundinaceus* (14 individuals captured including one from marshes at Sriracha and 2 museum study-skins preserved). A winter visitor from northeastern Asia, the great reed warbler inhabits marshy tall grass on the Serum Farm, where 5 were caught, and coastal marsh at the tapioca mill where 8 more were netted. In a long distance migrant such as this, it is a surprise that two of the latter birds when released at the Serum Farm (in November) stayed there instead of returning to the tapioca mill 7 km away. They were recaptured in 2½ and 3 months respectively after being released. This is explained perhaps by disinclination to migrate or navigate outside of the proper migratory season in September. Fourteen weights average 24.0 grams (19 to 27).

(*70*) **Acrocephalus agricola* (one museum specimen). This female immature paddy-field warbler was caught in a grass field on the Serum Farm on 9 October 1967, weighing 9 grams. It is distinguished from *concinens* by its relatively longer second primary (from the outside). A rare winter visitor from the north, this specimen is the second for Thailand.

(*71*) *Orthotomus sutorius*, long-tailed tailorbird (25 captured, including one study skin). A common resident of dense thickets, occurring in sedentary pairs. Six were captured from two to three times over periods ranging from two days to 18 months. Successive captures of individuals span distances from 30 to 170 meters; one was captured 3 times in a area of 100×50 meters during 3 months. Twenty-four weights average 6.8 grams and range from 5 to 9 grams.

(*72*) *Prinia hodgsonii* (3 captured including one preserved as a museum study-skin). A pair of gray-breasted prinias was perma-

nently resident of an area of brushy thickets near the stream, where a banded individual was seen often from June 1967 to March 1968. After their first capture the birds never again went into the nets, even when attracted by tape recordings of their territorial song. Three weights range from 4.5 to 6.0 grams.

(*73*) *Prinia rufescens* (1 museum skin). A common resident of foothill lalang grass, the rufescent prinia strayed only once to Bang Phra during our study. A vagrant individual was netted 3 July 1967 on the Serum Farm within the territory of the resident pair of *Prinia hodgsonii*. In non-breeding plumage the two species are distinguished from each other with great difficulty, although their voices are different. The specimen, Somsak number 352, is a female weighing 5 grams, distinguished from *hodgsonii* as follows: the gray of the chest is broadly interrupted by white in the midline; the tail is rufescent brown with pale brownish tip instead of plain brown with white tip. These criteria seemed useful in specimens examined in the British Museum, December 1968.

(*74*) **Prinia subflava*, plain prinia (1 capture). This was a rare vagrant to a tall grass area of the Serum Farm, doubtless a post-nesting wanderer from the resident population in marshes of the Bang Phra reservoir. Weight 10 grams.

(*75*) *Muscicapa zanthopygia* (9 captured, including 3 study skins). Tricolor flycatchers, all in immature plumage, were uncommon fall migrants from northeastern Asia. This and the following 4 species of flycatchers, subfamily Muscicapinae, all frequent tall woods and shady trees. Dates at the Serum Farm fall between 12 September and 26 October. Nine weights average 12.9 grams (11 to 15).

(*76*) *M. parva* (7 individuals captured; one study-skin). The red-breasted flycatcher is a frequent winter visitor, from 20 October to 9 March, to woods and shady trees. Arriving from northern Asia, each solitary individual can be expected in the same mango or rain tree day after day. One was recaptured after 2 months 90 meters from the point of first capture. Five weights average 10.4 grams (9 to 12).

(*77*) *M. mugimaki* (one study skin). A female Mugimaki flycatcher weighing 13.5 grams was captured on 1 December 1967.

(*78*) *Rhipidura javanica*, fan-tailed flycatcher (113 individuals captured). A common, small (thirty-six weights average 12.5 grams and range from 10 to 16 grams), arboreal, year round resident, travelling in pairs through shady trees and thickets. The food is small flying insects caught within and by flying out from foliage. Increased captures from April through July indicated a reproductive period in the hot season. Thirty-nine individuals were captured from two to six times up to 23 months. All were within small areas less than 140 meters long (including two which settled down after a long move) except 7 that ranged between 145 and 470 meters from the point of original capture. Recapture points showed that wandering pairs and the more stationary pairs criss-cross each other's paths.

(*79*) *Hypothymis azurea* (2 captured). The black-naped blue monarch is a rare winter vagrant to the Serum Farm from nearby forests where it is a common resident. Two weights are 10 and 11 grams.

(*80*) **Motacilla alba* (6 captured). The pied wagtail is a frequent winter visitor (October to February) from northeastern Asia, feeding on the bare ground at streamside and in pastures. Six weights average 20.4 grams (19 to 22).

(*81*) *M. caspica* (11 individuals captured, 2 prepared as museum skins). The gray wagtail, from northern Asia, is a common winter visitor (September to April) streamside. One was captured twice in the same net 3 months apart. Another was captured three times in two weeks at nets 185 meters apart. Fifteen weights average 14.4 grams and range from 12.2 to 16.1 grams.

(*82*) **M. flava* (17 individuals captured, 13 of them at estuary beside tapioca mill). The yellow wagtail is a common winter visitor from northeastern Asia. It was found in flocks at streamside, open pasture, and estuary between 7 September and 3 March. Two were recaptured within short distances at 4 days and 3 months (40 meters). Sixteen weights average 15.5 grams (12.5 to 18).

(*83*) *Dendronanthus indicus* (29 individuals caught). The forest wagtail, a common winter visitor from northern Asia, was netted at the stream between 20 October and 22 April. It also feeds on the

ground beneath shady woods and orchards. Individuals move widely, as evidenced by the scarcity of recaptures (only one, the next day, at 120 meters), and occur in small groups. Twenty-five weights average 16.6 grams (13 to 19).

(*84*) *Anthus hodgsoni* (2 captured). A winter visitor from the north, the tree pipit was netted only twice, the same day, 23 November 1966, near shady cover. Weights are 19 and 19.5 grams.

(*85*) *Anthus novae-seelandiae* (20 individuals captured, 9 of them at the tapioca mill estuary). There were 2 or 3 pairs of paddy-field pipits which were permanently resident on plowed tapioca fields and pastures, where they fed on the ground. Wintering flocks of a different, migratory race were abundant on the pastures by mid-September. They were netted there and at streamside. Twenty weights average 18.9 grams (18 to 23).

(*86*) *Artamus fuscus* (2 captured). The ashy swallow-shrike, an aerial feeder, is a common resident at the Serum Farm, where the flock of about 20 gathers on the high electric power line. Weights are 33 and 38 grams.

(*87*) *Lanius cristatus*, brown shrike (38 individuals including 1 museum skin). Common winter visitor from northeast Asia, arriving at Bang Phra on 8 September and 6 September of two years and last caught 11 April and 3 May. From a tree, bush or fence in the open this shrike flies to the ground to catch insect prey. The average of 36 weights is 28.4 grams (22 to 35). Individuals stay on small territories and return to them in subsequent winters. Thirteen were captured 2 to 5 times up to a duration of 22 months. Four were taken during their second winter residence at Bang Phra after migrating to nest in northeast Asia and returning; one was recaptured in its third winter at the farm, having avoided our nets during the 2nd winter. All capture locations of individuals netted more than once fell within 150 meters' diameter except for the one bird which was caught in its third winter; its locations spanned 230 meters.

(*88*) **L. collurioides*, chestnut-backed shrike (one collected as museum skin). Of uncertain status, possibly a local resident, this one female immature of 26 grams was taken on 4 November 1966.

(*89*) *L. nasutus,* black-headed shrike (21 individuals, including one museum skin and 5 caught at Sriracha or the tapioca mill). A frequently seen resident, occurring in pairs and foraging from trees in the open. The scarcity of recaptures suggests greater mobility than most residents of the Serum Farm. Three individuals were recaptured in from one to 3½ months at distances from 150 to 400 meters. Twenty weights average 42.2 grams (38 to 46).

(*90*) *Sturnus contra,* pied starling (93 individuals captured). Abundant resident, visiting streamside trees and bamboos at the Serum Farm in flocks. Of the total individuals, 39 were caught beside the stream at the Serum Farm, 4 at Sriracha, and 50 at the tapioca mill. Thirteen recaptures at intervals up to three months are of interest only in showing that the wide-ranging flocks come periodically to the same spots to feed or drink, and that three birds were netted first at the tapioca mill and again later at the Serum Farm. The average weight of 93 birds is 78.1 grams ranging from 64 to 88 grams.

Five species of starlings and mynas, of similar habits, were netted at the Serum Farm. They range widely, over perhaps 25 km judging from flights to roosts, and often mingle in large mixed flocks to feed. A roost of several thousands at Angsilla consisted of *A. cristatellus* and *S. sinensis* (winter only), the former travelling in groups over the mangroves to reach it. At Sriracha, 4 species gather each evening at a mangrove swamp to bathe and then to repair with others of their own species to roost separately in adjacent tall or dense trees. There *S. nigricollis* was the most abundant, *S. contra* and *A. tristis* next (the latter flying off high to a separate, distant roost), and *A. cristatellus* least numerous. A flock of about a dozen birds of 4 species was foraging along the mud margin of the Bang Phra reservoir on 3 August 1967. They ate objects scared up—apparently grasshoppers and small frogs. This seemed to be a coordinated herding action because they all walked in the same direction, spread out abreast. The species were *S. contra, S. nigricollis, S. burmannicus,* and *A. tristis.*

Because of the large "biomass" of starlings and mynas, making them of theoretically great importance as an arbovirus reservoir, a concerted effort was made to net and trap them, with varying results. In the first year practically none was caught at the Serum Farm, and

many nets placed at the Sriracha bathing and roosting area were unproductive. In the second year we moved the nets to the tapioca mill 7 km north of the Serum Farm with great success, as the birds came to feed on a peculiar kind of jumping maggot that flourishes in an ill-smelling product made from left-over tapioca trash. At about this time also, nets placed cross-wise of the stream at the farm began to take the birds in numbers, when they came to drink and to eat the same larvae in drying tapioca gleanings at streamside.

(*91*) *Sturnus nigricollis*, black-collared starling (47 individuals, all but 7 taken at Serum Farm; one recapture). Abundant resident, gathering in trees in the open and feeding on the ground. The 47 weights average 131.4 grams (108 to 149).

(*92*) *Sturnus burmannicus*, Jerdon's starling (4 captured, 2 of them at Serum Farm). Rare resident. Four weights range from 82 to 84.

(*93*) *Acridotheres tristis*, common myna (38 captured, 24 of them at Serum Farm, one recaptured two months later). Abundant resident. This species is more uniformly distributed and spread out in pairs than are the foregoing starlings. An individual (060-01423) netted at Mr. Burana's orchard was taken 6 months later at Sriracha, 6 km to the south, by Mr. Thirasakdi and reported to MAPS. Of 38 weights the average is 92.7 grams (70 to 114).

(*94*) *Acridotheres cristatellus*, crested myna (99 captured, 69 of them at Serum Farm). Abundant resident. Average of 98 weights is 88.3 grams (range from 63 to 108 grams).

(*95*) *Anthreptes singalensis*, ruby-cheeked sunbird (one captured). Rare resident, a small bird feeding among flowers of trees in the open.

(*96*) *Nectarinia jugularis*, yellow-breasted sunbird (5 captured). Resident, frequently seen and heard in flowering trees. Four weights average 6.8 grams (5 to 8). The three birds bled (.05 to .1 cc) were released in apparent good condition.

(*97*) *Dicaeum cruentatum*, scarlet-backed flowerpecker (19 caught, 2 of them prepared as study-skins). Common resident of

densest trees, especially the mangoes at the Serum Farm laboratory and large fruit trees at Mr. Burana's orchard. Thirteen weights average 5.6 grams—the smallest bird species at the Serum Farm. A male was captured three times in 17 months within an area 380 by 70 meters; long flights are taken. Solitary individuals or pairs are the rule.

(*98*) **Passer montanus*, tree sparrow (178 individuals captured). Abundant resident on and about houses. With pairs and small groups to be seen at all times of day on the laboratory roof and other buildings, one receives the impression of a very sedentary, small and insignificant bird. Netting, however, reveals an astonishing turnover and mobility of individuals as evidenced by 1) few recaptures (only 14 individuals taken twice, 2 of them 3 times, up to only 5½ months); 2) up to 220 meters distance between successive captures; 3) during the two years, 118 individuals caught in the same net, number 20, where they came to eat paddy in a chicken pen beside the workers' dormitory—10 of the recaptured individuals were caught twice in this same net; 4) although there were many about the lab, they were caught only between February and September; this means that like the other ploceids they were going off to ripening rice fields from October to January and eschewed the chicken pen. Nests were being built from December at least into June; brood patches of incubating females were recorded from March through August. Together these data indicate a long breeding season. Dr. Paul Smith cautions that communal roosts are lined with straw at any time of year, so that the carrying of sticks does not prove nesting.

A commotion in the top of a mango tree back of the laboratory called attention to a tree sparrow being swallowed, while still fluttering, by a vine snake (*Dryophis nasutus*). The bird had been banded (no. 020-39967) 5 months previously beside the adjacent horse stable 210 meters away. It was an adult male in breeding condition. This weaver, a small edition of the English sparrow, differs from that species in that both sexes are "cock-feathered". Therefore we could not distinguish the sexes and must combine the 49 weights of adults to average 18.7 grams (16-21).

(*99*) *Passer flaveolus*, Pegu sparrow (282 individuals captured). Common resident, seen in all months but netted at the Serum Farm mainly from February to October after which in common with the other weavers (Ploceidae) it is not feeding near any of the nets. Apparently it flies off to spend the day at rice paddies from 2 to 4 km away, there to feed upon the ripening grain. Weights average 19.4 grams for 56 adult males (ranging from 17 to 22 grams) and 19.3 grams for 34 adult females (ranging from 17 to 23 grams). Immatures average 18.1 grams (N = 129). A bird of pastoral habitats throughout Thailand south to the Isthmus of Kra, it prefers open areas where there are scattered trees, such as rice paddies with bordering sugar palms.

The reproductive season is undoubtedly longer than March to June, spanned by our records of brood patches and nests, because in June there are active nests at the same time that fully grown independent young are about. Similarity in color and texture of the juvenile and adult female plumages made it difficult to assess the age composition during the breeding season.

These sparrows feed on scattered grain on the ground but also spend much time crawling about within foliage of large trees. They gather insects on lawns during nesting. The nest is high in trees and in cavities and eves. These birds call loudly and gather in spreading trees and on roofs. After assembling in groups on the high power line they take long flights entirely off the area, high overhead. Some are around all day and many return to roost communally at the Serum Farm for the night, 15 to 25 feet up in the rain trees or bamboos.

Of 187 individuals banded up to 12 June 1967 (after which new captures were used in mosquito bait traps), 61 were captured 2 to 5 times up to 22 months at distances up to 415 meters.

(*100*) *Ploceus philippinus*, baya weaver (354 individuals captured, one museum specimen). Common summer resident from March to September. Though not truly migratory, the birds are away from the Serum Farm during the rest of the year; they are possibly traveling throughout the local rice paddies. Nets placed beside two compost areas for horse manure yielded 270 of the individuals

which fed there upon rice seed that passes through the horses' intestines. They gather between feeding sessions in the trees in the open. The gourd-shaped woven nests in the lone sugar palm were tended through June but definitely not being advertised in August. Sixty-four recaptured (89 total recaptured) were caught from 2 to 5 times at periods up to 16 months and distances averaging about 100 meters. This shows a localization commensurate with *Passer flaveolus*, considerably exceeding that of *P. montanus*. Average weight of 277 individuals at time of first capture is 22.0 grams.

Many of our banded *nokajawk* turned up in the Sunday Market at Bangkok (c.f. Migratory Animal Pathological Survey Annual Progress Report 1967).

(101) *Lonchura striata*, white-rumped munia (one captured). Rare resident, captured in April.

(102) *Lonchura punctulata*, spotted munia. Frequent. Weights of 113 of these high-flying small seed-eating weaverbirds average 11.9 grams and range from 9 to 15 grams. Pairs or small flocks roam several miles from one source of grass seed, including rice, to another. At any one time there are no more than a pair or two at the farm although 117 individuals were captured there during the two years, 78 of them in immature plumage. This plumage is carried well into the first year, however. There were only two recaptures, as expected from their far-flung foraging. Seen in every month, this manikin was netted at the serum farm mainly between June and October. A brood patch on females was noted in April, August, and September. Nest building was seen in June and August. The nest is in a tall tree, and is said to be used as a communal roost after the breeding season.

D. Mammals

1. Primates

a. Tupaiidae, tree shrews

(1) *Tupaia glis* (4 captured). The tree shrew is an uncommon resident, running among brush thickets and woods during the daytime. It was found at the Serum Farm (one captured) and on the brushy hillsides at Mr. Burana's orchard (3 captured). Three adult males average 167.6 grams (160-181).

2. Bats (Museum specimens, identified by J.E. Hill and Kitti Thonglongya, are all in the British Museum unless specified as being in the Thai National Reference Collection, ASRCT, Bangkhen).

a. Pteropidae, fruit bats

(*2*) *Rousettus leschenaulti* rousette (27 captured). Common; netted in banana groves at night. Weights of 12 males average 78.7 grams (47-106); of 11 females, 62.3 grams (43-84). [After the study, in July and August 1969, 10 were captured at Bang Phra for museum specimens (BM).

(*3*) *Pteropus lylei* (4 captured, preserved as museum study-skins and skulls: BM 1, ASRCT 3). A roost of thousands of flying foxes is protected at Wat Luang Prom Ma Vas, 41 km airline to the northeast of Bang Phra, also at Wat Pho, Bang Kla, Chachoengsao, 53 km airline to the northeast of Bang Phra, and mangroves at Ang Sila, 19 km north of Bang Phra. Those occasionally seen in the evening, feeding in fruiting trees at the Bang Phra reservoir and in flocks of hundreds flying over the mangrove swamps, where three specimens were taken, doubtless travel from these roosts. Though their numbers are prodigious, the ever shifting flights to fruiting trees make their occurrence at any one point, such as Bang Phra, decidedly uncommon. One was caught alive after it had crashed into a wire at the Serum Farm. Two males weighed 480 and 460 grams; 2 females, 460 and 390 grams.

(*4*) *Cynopterus sphinx angulatus*, dog-faced fruit bat (522 individuals captured; 1 study-skin with skull, BM). An abundant year round resident, this bat feeds at night in fruiting trees such as papaya, banana, custard fruit, ngaw, etc., and roosts during the day in the roof of the tapioca factory and under fronds of a sugar palm. It is so abundant that it gets into all nets placed near trees on the Serum Farm. One hundred and ninety-seven were caught once and banded, and 77 other banded individuals were captured 2 to 5 times from a day to 17 months' elapsed time (117 total recaptures). Plotting the recapture points shows that the individual covers the entire Serum Farm and doubtless more. One banded in April 1966 was recaptured

in August at the Serum Farm, then it was captured in Thonburi, 92 km to the northwest on 27 May 1968. Of the adults captured, we have attributed all those with forearm of 65 mm or more to this species. These are 183 males and 148 females, not showing sexual difference in size and with forearm ranging from 65 to 76 mm with average at 70 mm. Weights for adult females average 47.2 grams (33 to 67); for adult males, average 45.5 grams (33 to 58). Fifty-nine pregnant individuals, 4 carrying a baby, and 36 lactating females are so scattered in time that a definite breeding season is not discerned. Most of the pregnancies were in February and June. [After the study, 35 additional specimens (BM) with forearm greater than 65 mm were collected at Bang Phra, July-August 1969.]

(*5*) *Cynopterus brachyotis brachyotis*, lesser dog-faced fruit bat (10 captured; 2 study-skins with skulls, BM). Weights of 2 males average 38.5 grams (34-43); of 8 females, 31.6 grams (30-45). Average length of forearm of 10 individuals in 62.5 mm (61-64.5). Bang Phra lies in a narrow zone of overlap of two species of *Cynopterus*, a large northern and a small southern one. Our impression in netting the animals was that the small species, *brachyotis*, was of richer rusty color on the neck than the larger *sphinx*, which is grayer. Our 16 skins and skulls, now in the British Museum, from all over Thailand do not confirm such a color distinction nor do they show any qualitative difference in the skull, particularly in the relative length of the rostrum. [In July-August 1969 we took an additional 9 museum specimens (BM) at Bang Phra with forearm less than 65 mm.]

(*6*) *Eonycteris spelaea*, dawn bat (21 captured). Common at fruiting trees. Eight males average 61.6 grams (48 to 68); 10 females, 53.4 (37 to 64). [Six museum specimens (BM) captured at Bang Phra July-August 1969.]

b. Rhinolophidae, horseshoe bats

(*7*) *Rhinolophus acuminatus*, horseshoe bat (6 captured, 2 for study-skin and skull, BM; 1 in spirit, Senckenberg Natur Museum, Frankfurt). Common nocturnal aerial feeder upon flying insects. Five adults average 13 grams (12 to 15). Two other species of *Rhinolophus* were caught once each: *R. affinis?* (male of 14 grams), *R. rouxi* (a

female of 8 grams) preserved as a study-skin with skull (BM). [In July-August 1969 only *R. acuminatus* was found at the horse farm, when 9 additional museum specimens were collected (BM 2, ASRCT 7).]

c. Vespertilionidae, flittermice

(*8*) *Myotis mystacinus muricola*, mouse-eared bat (7 captured). Another common feeder upon aerial insects, averaging 5½ grams (6 individuals, ranging from 4 to 7 grams); forearm 33 to 36. [After the study, in July-August 1969, two museum specimens (BM, ASRCT) were secured at Bang Phra.]

(*9*) *Scotophilus kuhlii*, house bat (3 captured). This common nocturnal aerial feeder weighing about 29 grams, roosts during the day in buildings. Three were caught by hand in the roof of a house in Bang Phra. [One museum specimen (BM) was collected at Bang Phra, 30 July 1969.]

3. Rodents

a. Sciuridae, squirrels

(*10*) *Tamiops macclellandii* (one captured and preserved as a museum skin with skull). Frequently seen resident in shady orchard trees both at the Serum Farm and Mr. Burana's orchard. This small squirrel, weighing 48 grams, resembles a chipmunk, but it is strictly arboreal.

(*11*) *Menetes berdmorei* (44 captured). This striped ground squirrel is a common inhabitant of brushy thickets, along with the tree shrew. Both are diurnal. One *Menetes* was recaptured after two months in a trap 250 meters distant from the point of first capture—both places were beside the stream. Weights of 32 individuals average 178 grams (ranging from 119 to 222 grams).

b. Muridae, rats and mice

(*12*) *Bandicota indica*, greater bandicoot. Uncommon; locally common in colonies. This is a giant rat up to 773 grams living in burrows and given to unexpected seasonal movements. Thirty-five individuals were taken in tall grass near a creek at the southeast

corner of the horse farm. In rice paddies and weed fields off the study site, 78 others were caught of which two were made into study-skins. Pregnancies were noted in October, November, and January. Weights of adults are males: 561 grams, average of 20 ranging from 411 to 773 grams; and females: 472 grams average of 27, ranging from 340 to 694 grams. Most were autopsied, so there were no recaptures.

(*13*) *Mus cervicolor*, fawn-colored mouse (36 museum skins with skulls). An abundant mouse averaging 13 grams. Aside from some captured off the Serum Farm in weed fields and paddies along with *Bandicota indica*, all were taken in two grass fields on the horse farm totalling 3½ hectares. There they maintain a dense population irrespective of whether the grass is waist high or cut down by hand to make the area nearly bare, with stuble.

Mus cervicolor is a species practically unknown outside of Thailand. Specimens have been examined in the US National Museum, British Museum (type specimen) and American Museum of Natural History from all parts of Siam except the southwest and peninsula, from Vietnam and from Katmandu, Nepal.

Eleven were recaptured one to three times, after 3 days to 7 months, always within the same hectares area. Pregnancies occurred in October of both years. Immatures outnumbered adults in December 1967 to January 1968 and we may assume a heightened reproductive period in the cold season. The following are comparative numbers of individuals of the two species of mice caught:

	Mus cervicolor	Mus caroli
1966	73	9
1967	68	44
1968	11	19
Total individuals captured	152	72

(*14*) *Mus caroli*, Riukiu mouse (11 museum skins and skulls). A common mouse averaging 13 grams, in the same habitat as *cervicolor*. The only ecologic difference was in relative numbers, as seen on the above tabulation. Comparatively rare in 1966, *caroli* steadily built up

so that it predominated by late 1967. Pregnancies were in December 1967 to January 1968. As the population built up to exceed *cervicolor*, so did the proportion of immatures, resulting in more than twice as many immatures as adults from November 1967 to January 1968. Therefore it must breed in the cold season following rains. Eleven individuals were recaptured once or twice for periods of 12 to 42 days, within the same grass field.

Mus caroli is distinguished from *cervicolor* by the long tail, large dark hindfoot, white belly, dark brown incisors, short nasals, and shorter palatal foramina. It has a much wider distribution, even though its habitat is the same. In Thailand we have taken it from Huahin, Bang Phra, and Bangkok north to Nongkhai. It is definitely the same species as the type of *Mus caroli* in the British Museum and series there and in other museums from Okinawa (*caroli*); Taiwan (*formosanus*); Hainan, Yunnan, Fukien, Tonkin, Assam, Burma, and Vietnam (incorrectly labelled *kakhyenensis*); Java and Sumatra (*ouwensi*-see Sody, Treubia 18, 1941 : 287-288).

Laboratory colonies were established for the two species of Bang Phra mice, first, in order to test for viremia with Japanese encephalitis, and second, to attempt hybridization between them. No hybrid litters were obtained. The mixed pairs paid no attention to each other. On the other hand, members of pairs of the same species would box, squeal, and chase immediately upon being caged together, and many litters were raised.

Because of the scarcity of *Mus caroli* in the first year of our study, the two species were not recognized until the second year. Then most individuals were identified in retrospect from their measurements on the punch cards, which left only 14 individuals and 5 blood samples unidentified.

(*15*) *Rattus surifer* (5 captures, one skin and skull). This spiny rat is a common resident of ground near the shady cover of Mr. Burana's orchard and adjacent brushy hillsides and tapioca fields. The average of 5 weights is 138 grams (ranging from 102 to 173 grams).

(*16*) *Rattus norvegicus* (24 captures including two skins with skulls, the rest autopsied). The Norway rat was trapped uncommonly and only in store rooms of the Bang Phra market (January and February only). None was found at the Serum Farm, although one was dead in the highway between the farm and Mr. Burana's orchard, rather far from any buildings. The average weight of 8 adult females is 270 grams (ranging from 189 to 413 grams); four of them were pregnant. Eleven males averaging 236 grams ranged from 163 to 412 grams.

(*17*) *Rattus exulans* (87 captured, one museum skin and skull). The Polynesian rat is common in houses; thirty individuals were taken in and around the workers' housing and adjacent fields at the Serum Farm. They were ear-tagged and released, with only one recapture, 9 days later at 125 meters. The rest were taken at the Bang Phra market, Mr. Burana's home, and the Siriwatana Hotel which is built out over the ocean at Sriracha; they were autopsied. Of 14 pregnancies, 12 were in November and January. The average of 84 weights is 35½ grams (ranging from 14 to 55 grams).

(*18*) *Rattus rattus,* roof rat (650 individuals captured, 53 of them prepared as scientific study-skins with skulls). Abundant. This is a nocturnal rodent averaging 148 grams (82 adults range from 99 to 201 grams). It feeds on the ground and in houses but also climbs into bushes, trees and buildings. It prefers cover of buildings and bushes but forages out into grass fields also. Reproductive peaks, if any, were not consistent during the two years of study. But immatures comprised a third to half the population in most months. One hundred and thirty-five individuals were recaptured from 1 to 5 times at periods ranging from 1 day (many in the same trap as first capture) to 10 months. They showed wide individual variation in movements: many were caught successively in the same trap location (unlike birds except dependent juveniles and the ploceids coming to special food), some were caught for several months within 50 meters, while others roamed over 200 to 300 meters in successive weeks. The impression of the abundant population is that it is teeming with reproductive activity and with active travel criss-crossing each others'

home areas. The home range of adults seems to be 100 meters in diameter. The population is uniform in physical traits of 2+3 pairs of mammae, whitish underside, and moderately enlarged bullae.

(*19*) *Berylmys berdmorei*, least white-toothed rat (11 individuals captured, 2 study-skins with skulls). A rare resident of streamside vegetation, this rat averages 233 grams (7 individuals range from 128 to 314 grams). Six were taken at the Serum Farm, the rest at Mr. Burana's orchard. Two individuals were recaptured: ear-tag 1104, a male, was taken after $5\frac{1}{2}$ months at a distance of 190 meters; number 1105, a female, was caught 4 times during 11 months within an area of 160×50 meters along the bend of the stream.

4. Carnivores

a. Herpestidae, mongooses

(*20*) *Herpestes javanicus* (4 captured; one study-skin with skull). An uncommonly detected diurnal predator, found near shady cover where it runs over the ground in search of prey. The four examples average 860 grams, ranging from 520 to 1000 grams. Three were at the Serum Farm, the fourth at Mr. Burana's orchard.

ADDITIONAL BIRDS SEEN BUT NOT NETTED AT BANG PHRA

Podiceps ruficollis. Uncommon resident at the reservoir.

**Anhinga melanogaster.* Resident, seen once at the coast.

Butorides striatus. Common resident of mangrove swamps.

**Bubulcus ibis.* Common resident associated with buffaloes.

Egretta sacra. Frequently seen resident of the shoreline reefs.

**Egretta alba.* Uncommon resident of coastal marshes.

Egretta garzetta. Abundant resident of marshes.

**Elanus caeruleus.* A pair resides along the power line at the Serum Farm. These black-shouldered kites feed mainly on mice taken from the grass fields.

Milvus lineatus. Frequent winter visitor, soaring over open country.

Haliastur indus. Common resident along the coast and reservoir.

Butastur indicus. Rare winter visitor in flight over the Serum Farm (9 January 1968).

Haliaeetus leucogaster. This sea eagle is frequently seen in flight along the coast and hovering over the top of Khao Chalak.

**Gyps bengalensis.* A flock of 50 or so white-backed vultures lives near a slaughter house on the outskirts of Bang Saen, the next town north of Bang Phra.

Pandion haliaetus, osprey. Uncommon migrant, seen fishing at the reservior in November and February.

Francolinus pintadeanus. This large partridge was an abundant resident of the tapioca fields all around the Serum Farm. It was noted there up to September 1967 after which tractor plowing was commenced, causing the brushy and grassy field borders to disappear along with their inhabitants.

Gallinula chloropus. Resident, uncommon, at the reservior.

Charadrius squatarola. This plover was an uncommon winter visitor along the coast.

C. mongolus. Abundant winter visitor coastally.

C. leschenaultii. Common migrant along the coast.

Calidris temminckii. Abundant winter visitor to coastal marshes.

Larus brunnicephalus. This gull was common in winter at seaside Sriracha.

Chlidonias leucopterus. A wintering tern, rarely seen fishing at the reservoir.

**Tyto alba.* The barn owl is an uncommon resident seen one night beside the highway to Sriracha.

Ninox scutulata. Uncommon resident heard about the Serum Farm.

Caprimulgus asiaticus. This small Indian nightjar was commonly seen on the pasture during the first year of the study.

Chaetura cochinchinensis. A giant swift seen twice in winter over the Bang Phra temple and the summit of Khao Chalak.

Ceyx erithacus. A tiny resident kingfisher seen once at the Burana orchard.

Halcyon chloris. Common resident of the mangroves.

Coracias benghalensis. This roller was daily seen along the power line crossing the Serum Farm.

Megalaima zeylanica. A fruit-eating large barbet, which is a common resident of the Burana orchard and adjacent forested hills.

**Hirundo daurica.* Several of these swallows were seen in January and August over the reservoir.

Chloropsis aurifrons. This leafbird is a conspicuous but sporadic visitor to trees at the Serum Farm, noted in January and March.

Pycnonotus melanicterus. A fairly common resident of woods at the Burana orchard.

Dicrurus aeneus. Common resident of forested Khao Chalak.

Oriolus chinensis. Rare winter visitor to trees at the Serum Farm.

Corvus macrorhynchos. Abundant scavenger found in flocks. It associated with the vultures at Bang Saen and had a roost of hundreds in the coastal mangroves where we tried to catch them.

Pellorneum ruficeps. Uncommon resident at the Burana orchard where it feeds on the ground under dense cover.

Monticola solitarius. Common winter visitor, preferring roof-tops at Sriracha.

**Gerygone fusca.* Abundant resident of mangrove foliage.

**Cisticola exilis.* Common and conspicuous resident of tall grass fields at the Serum Farm.

Culicicapa ceylonensis. Like the previous two, a small insectivorous bird. This flycatcher is an abundant resident at the Burana orchard.

Sturnus sinensis. Abundant winter resident, seen by the hundreds roosting in tall trees at Angsilla.

Anthreptes malacensis. A sunbird, feeding in flowering trees, and a frequently seen resident at the Serum Farm.

Arachnothera longirostra. Common resident of dense trees at the Burana orchard.

CONCLUSIONS

The Serum Farm sustains enormous populations of many species because of its diversity of habitats and the persistence of natural sorts of vegetation around the edges of fields and along the watercourses. There is a general breeding season discerned for at least the resident birds from about January to August. Populations of resident species, ascertained by continual netting and trapping, are much denser than they appear from sight observations. They consist of these categories of individuals: 1) sedentary adult breeding individuals established upon small, rather exclusive territories; 2) immatures and non-established adults—the floating population, usually invisible—that are also sedentary but upon much larger foraging areas; and 3) dispersing juveniles moving outward from nesting areas, and merely leaving or crossing the study area. Persistent recaptures of a substantial proportion of marked individuals show that some very small species, such as the babbler, *Macronous*, have remarkable longevity and attachment to an area. Several species of long distance migrants which nest in northeastern Asia spend the winter at the Serum Farm. There they have individual foraging territories just like those of the residents. Furthermore, many of these migrants returned to their same restricted areas in their second and third winters.

ACKNOWLEDGMENTS

We were able to obtain the above data only through the absolutely impeccable cooperation of the local residents, who through the influence of Dr. Skon Rohitayodhin and his staff, never interfered with our animals. (Our earlier study at another place had failed through disturbance—the birds were eaten and the bands thrown away.) For this consideration we express our gratitude.

We also thank Dr. Skon for use of the Red Cross Serum Farm for a study area and for laboratory space there. Mr. Burana Burithep allowed us to trap in his orchard adjacent to the farm. Dr. Elliott McClure of the Migratory Animal Pathological Survey, US Army R & D Command, supplied us with nets and bands, and he developed the venipuncture method used on our birds. Dr. Thomas Yuill devised

the other techniques and records involving our processing of the vertebrate hosts from the time of capture to the weekly delivery of the serum samples on dry ice to the main virology laboratory at Bangkok. Captain George Manning and his assistants from the department of parasitology of the SEATO Laboratory collected most of the amphibians and reptiles reported here. Mr. Vandee Nongngork did the bulk of the field work by which trapping and netting were carried out during five days of almost every week during the two-year period.

Mrs. Elsie Marshall helped with the punch card records, working up the data, and typing.

Our collection of 62 specimens of 32 species of bats from all over Thailand was the basis for our field identifications. They are deposited in the British Museum (Natural History). We thank Mr. J.E. Hill for identifying them. Later, we were astonished to learn that Mr. Kitti Thonglongya had also properly identified the same specimens, without marking the labels. [Still later, from 25 July to 6 August 1969, Messrs, Vandee and Somsak Imlarp, together with the senior author, collected 72 additional scientific specimens of bats at the Serum Farm, in order to check the probabilities that the previous identifications of released individuals were correct. These have been sent to the British Museum.]

Table 1. Survival of small birds after yielding blood sample from right jugular vein.

Species	Approx. Weight	Amount of Blood Taken	Number of Blood Samples	Number of Individuals bled	Number Died	Number Released	Number Recaptured	Remarks
Dicaeum cruentatum	5-6 g	.05–.15 ml	5	5	3	2	1	Recaptured in good condition 9 months later
Orthotomus sutorius	7 g	.1 ml	15	12	1	10	2	Both caught after two bleedings each, in the previous 9 months and 3 months respectively.
Macronous gularis	11.8 g	.1–.2 ml	15	8	1	7	4	3 individuals recaptured after 1 bleeding 1 to 2 months previous. One individual recaptured after 4 bleedings during previous 15 months.
Rhipidura javanica	12 g	.1–.2 ml	113	80	3	77	28	19 recaptures after a previous single blood sample; 6 recaptures after previous 2 blood samples; 3 recaptures after previous 3 blood samples.

Compare these two individuals in the 30 gram class:
Pycnonotus blanfordi band # 040-06532 30-34 grams .3 ml Captured 19 times during 17 months and bled 11 of those times.
Pycnonotus goiavier band # 030-64028 29-32 grams .3 ml Caught and bled twice the same day by mistake; recaptured the following month.

Table 2. Habitats and wild vertebrates captured and bled at Bang Phra, 16 February 1966 through 21 February 1968.

Habitat & Species	Abundance[1]	Seasonal Status[2]	Total Number of Captures Including Recaptures
1. Fresh Water			
Ooeidozyga lima	c	R	8
Phrynoglossus martensii	c	R	3
Rana tigerina	c	R	36
Rana limnocharis	a	R	52
Rana erythraea	c	R	22
Rana macrodactyla	u	R	3
Rana nigrovittata	u	R	2
Trionyx cartilagineus	r	R	1
Natrix flavipunctata	u	R	1
Enhydris enhydris	a	R	13
Enhydris plumbea	u	R	2
2. Coastal Marsh			
Rostratula benghalensis	u	R	1
Charadrius dominicus	c	W	1
Charadrius dubius	c	M	1
Charadrius alexandrinus	c	M	3
Actitis hypoleucos	c	W	5
Calidris subminuta	a	M	17
3. Bamboo-lined Stream			
Ardeola ralloides bacchus	f	W	5
Ixobrychus cinnamomeus	f	R	2
Amaurornis phoenicurus	u	R	1
Scolopax rusticola	u	W	1
Alcedo atthis	f	R	7
Halcyon smyrnensis	c	R	20
Halcyon pileata	c	W	16
Motacilla alba	f	W	6
Motacilla caspica	c	W	18

Table 2. (*Continued*)

Habitat & Species	Abundance[1]	Seasonal Status[2]	Total Number of Captures Including Recaptures
Motacilla flava	c	W	19
Dendronanthus indicus	c	W	29
Rattus berdmorei	r	R	15
4. Marshy Tall Grass			
Phragamaticola aedon	c	W	58
Acrocephalus arundineceus	c	W	17
Acrocephalus agricola	r	W	1
Bandicota indica	u	R	113
5. Tall Grass			
Xenopeltis unicolor	u	R	2
Turnix tanki	r	R	1
Turnix suscitator	f	R	12
Lonchura punctulata	f	R	125
Mus cervicolor	a	R	174
Mus caroli	c	R	84
6. Short Grass			
Bufo melanostictus	a	R	55
Capella stenura	c	M	3
Capella gallinago	u	M	1
Streptopelia tranquebarica	c	R	2
Streptopelia chinensis	f	R	2
Mirafra assamica	c	R	45
Saxicola torquata	r	W	1
Anthus novae-seelandiae	c	R/W	20
7. Ground near Shade			
Kaloula pulchra	u	R	3
Glyphoglossus molossus	r	R	1
Mabuya multifasciata	u	R	6

Table 2. (*Continued*)

Habitat & Species	Abundance[1]	Seasonal Status[2]	Total Number of Captures Including Recaptures
Riopa bowringi	r	R	1
Oligodon quadrilineatus	u	R	1
Geopelia striata	u	R	7
Copsychus saularis	a	R	269
Copsychus malabaricus	c	R	3
Anthus hodgsoni	r	W	2
Rattus surifer	c	R	5
Herpestes javanicus	u	R	4
8. Banana Grove			
Rousettus leschenaulti ?	c	R	27
Cynopterus sphinx	a	R	639
Cynopterus brachyotis	f	R	10
Eonycteris spelaea	c	R	21
9. Brush Thickets			
Calotes versicolor	c	R	239
Calotes mystaceus	f	R	27
Centropus sinensis	c	R	1
Centropus toulou	u	W/R	2
Timalia pileata	f	R	43
Erithacus calliope	r	W	2
Erithacus svecicus	r	W	1
Erithacus cyane	u	W	4
Orthotomus sutorius	c	R	34
Prinia rufescens	r	V	1
Tupaia glis	u	R	4
Menetes berdmorei	c	R	45
Rattus rattus	a	R	829
10. Woods and Shady Trees			
Phyllodactylus siamensis	r	R	1
Dryophis nasutus	c	R	6
Accipiter badius	u	R	4
Chalcophaps indica	r	V	1
Cacomantis sonneratii	u	V	3

Table 2. (*Continued*)

Habitat & Species	Abundance[1]	Seasonal Status[2]	Total Number of Captures Including Recaptures
Cacomantis merulinus	f	W	12
Phoenicophaeus tristis	r	V	1
Otus scops	u	W	2
Otus bakkamoena	f	R	4
Megalaima haemacephala	f	R	1
Aegithina tiphia	f	R	4
Pycnonotus atriceps	r	V	4
Pycnonotus aurigaster	c	R	88
Pycnonotus finlaysoni	r	R	3
Pycnonotus goiavier	a	R	649
Pycnonotus blanfordi	a	R	783
Dicrurus paradiseus	f	R	6
Crypsirina temia	f	R	17
Macronous gularis	c	R	31
Turdus obscurus	r	W	4
Phylloscopus fuscatus	u	W	7
Phylloscopus reguloides	r	M	1
Phylloscopus schwarzi	r	W	5
Phylloscopus inornatus	f	W	1
Phylloscopus borealis	f	M	13
Phylloscopus tenellipes	u	W	6
Phylloscopus coronatus	f	M	1
Muscicapa zanthopygia	u	M	9
Muscicapa mugimaki	r	W	1
Muscicapa parva	f	W	8
Rhipidura javanica	c	R	179
Hypothymis azurea	r	R	2
Dicaeum cruentatum	c	R	21
Tamiops macclellandi	f	R	1
11. Trees in Open			
Athene brama	f	R	1
Caprimulgus macrurus	c	R	2
Upupa epops saturata	r	W	3
Upupa epops longirostris	r	R	8
Lanius cristatus	c	W	66

Table 2. *(Continued)*

Habitat & Species	Abundance[1]	Seasonal Status[2]	Total Number of Captures Including Recaptures
Lanius nasutus	f	R	25
Sturnus contra	a	R	106
Sturnus nigricollis	a	R	48
Sturnus burmannicus	r	R	4
Acridotheres tristis	a	R	40
Acridotheres cristatellus	a	R	100
Nectarinia jugularis	f	R	5
Ploceus philippinus	c	S	430
Passer flaveolus	a	R	376
Pteropus lylei	u	R	4
12. Buildings			
Hemidactylus frenatus	a	R	52
Platyurus platyurus	u	R	9
Gekko gecko	c	R	13
Passer montanus	a	R	193
Scotophilus kuhlii	c	R	3
Rattus norvegicus (market)	u	R	24
Rattus exulans	c	R	88
13. Aerial			
Cypsiurus parvus	c	R	6
Merops leschenaulti	c	R	39
Merops orientalis	c	R	46
Merops viridis	r	R	8
Hirundo rustica	a	W	33
Dicrurus adsimilis	a	W	32
Dicrurus leucophaeus	r	W	2
Artamus fuscus	c	R	2
Rhinolophus acuminatus	c	R	6
Myotis mystacinus	c	R	7

1) a = abundant, c = common, f = frequent, u = uncommon, r = rare
2) R = year round resident, M = passage migrant, W = winter resident, S = summer resident, V = vagrant.