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THE GORDON FRUIT BAT COLONY

SYDNEY

A REPORT FOR THE
NATIONAL PARKS AND WILDLIFE SERVICE
OF THE NEW SOUTH WALES GOVERNMENT

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1. COLONY COMPOSITION AND SIZE

i. History

It is generally understood that the Gordon 'camp-site' of Pteropus poliocephalus was first established in 1962 and has since been occupied every summer. The source of the hundred or so bats that were first observed in 1962, by the gardener of the Lady Gowrie Memorial Nursing Home (the grounds of which border the colony), appears to have been a colony in the valley behind the Seventh Day Adventists' Hospital at ~~St. Ives~~ Wahroonga. These fruit bats were forced to relocate after a fire destroyed their 'camp-site' in 1962 (David Costello and Helen George, personal communication).

However, it is likely that, prior to 1962, the Stoney Creek site and the adjoining Davidson State Recreation Area provided temporary roost sites. Thus, a resident of the Gordon area remembered seeing fruit bats in the Gordon camp over 30 years ago (Puddicombe, 1981) and in 1948 bats were seen to rise out of the Davidson State Recreation Area (Helen George, personal communication).

By 1972 the colony consisted of about 2,000 P.poliocephalus and was an important breeding site (Robinson, 1973).

There used to be a colony at La Perouse, another one in the Galston district (Martin Robinson, personal communication) and a temporary camp in the mangroves on the Georges River (Tony Rose, personal communication). With the demise of these colonies and the one at ~~St. Ives~~ Wahroonga, the Gordon camp is now the only regularly occupied site for a breeding colony of P.poliocephalus in the Sydney region.

ii. Species Composition

During this survey of the colony (10th to 13th January, 1984), the only species of fruit-bat present was the grey-headed fruit bat, P.poliocephalus.

However, the little red fruit bat, P.scapulatus, has been found in the Gordon colony during the summer and Puddicombe (1981) recorded a group of about 1,500 P.scapulatus present over five weeks between 27th December, 1980 and 4th February, 1981, some of which were observed to mate in late January. Thus, in good blossom years, the Gordon camp may be an important mating site for this species and my current studies on P.scapulatus indicate that temporary summer populations of many thousands may build up at Gordon.

iii. Colony Size

This survey

(a) Adults: Dusk counts were made of bats leaving the 'camp-site' at the narrowest points of the colony's two flight paths out of Stoney Creek, westwards at the Rosedale Bridge and at Maytone Avenue as they flew East and South (Sites used by Puddicombe, 1981). This was at a time when young remained in the camp at night.

A total of 12,120 bats were counted; allowing for a 25% underestimate of colony size due to the counting procedure:

Adult numbers were estimated as being between 12,000 and 15,000.

(b) Young: From a random sample of territories in the camp, there was a mean of 2-5 females per male territory, and the survey yielded few areas of solitary males. Therefore, in this maternity colony, a sex ratio of 2 females to 1 male appears realistic, and since 90% of sampled females carried young, there were an additional 7,000 to

9,000 young.

Total: Barring subsequent mortality of young (which may be high), the summer population of the Gordon Colony is estimated to peak between 19,000 and 24,000 P.poliocephalus.

Other Surveys

Prior to 1981, P.poliocephalus were only present in the Gordon camp, during the warmer months, between September and June. Thus, residents noticed a regular build up of numbers from October to a peak in January/February and a rapid decline in April.

However, during 1981, Puddicombe (1981) reports that, for the first time, a large proportion of the colony overwintered at Gordon. He recorded about 13,000 bats in June and a decline in August from approximately 8,500 to 6,000 animals. By the middle of September, 1981, the numbers of P.poliocephalus in the camp had risen to 7,500. Puddicombe (1981) also noted that a large proportion of juveniles remained and that most of the adults that made up this unusual winter camp were males. From this we can infer that it was mainly the females that left the colony in that year. Indeed, even in mid-September of 1981, there were still very few females in the camp (Puddicombe, 1981). By mid-summer of that year the colony held up to 20,000 bats, a figure which coincides with the present projection.

The large winter colony present in Gordon during 1981, was attributed to mild weather conditions in that year and an unusually abundant food supply (Puddicombe, 1981). However, it is possible that the size of the present colony has resulted in a slight change in wintering habits with the formation of a winter nucleus of juveniles and males.

Clearly, regular surveys are now required to assess whether the site at Gordon is more or less permanently occupied now.

iv. Population Structure

Although rain prevented detailed sampling of the colony during the survey period, it is clear that Gordon is a very important maternity site for P.poliocephalus. The random sample of territories containing females yielded a mean of 2.5 females per male, a value which is shared with the larger maternity colonies studied by the author in the Northern Rivers region. Further, 90% of the females carried young which is a high reproductive success rate.

These facts, together with the relatively few territories containing solitary males and no obvious groups of non-territorial males or yearling animals, implies that many of the 'non-reproductive' animals are roosting elsewhere. From my current research in the north of the state, camps of the more mobile non-breeding bats are found in peripheral, often higher altitude, areas where lower nocturnal temperatures may prohibit the formation of maternity colonies. Thus, there should be equivalent smaller temporary roost sites in remoter areas of the Blue Mountains region and National Parks/State Forests adjacent to the Sydney area.

Puddicombe (1981) also documents the importance of the Gordon camp as a mating site for P.poliocephalus, and observed mating in territories between 22nd February and 19th August, 1981, with a peak between March and May.

During the author's survey, there was no particular structure to the colony as male territories containing females and their young were distributed uniformly throughout the camp and were well represented on the periphery. However, in February and March, when territorial activity is becoming pronounced and much of the roost space is occupied by territorial animals, Puddicombe (1981) recorded some structuring of the colony. Thus, on the northern boundary of the colony, along the creek edge, there were marked concentrations of juveniles and the outer trees of the rest of the camp were irregularly occupied by adult males. In addition, he noted that juveniles were commonly found in nocturnal creches on the northern boundary of the colony during November and December, after their mother had left to feed. However, by early January, during the present survey, young were commonly left in their diurnal territories even when these were on the periphery of the camp.

In effect, during a normal annual cycle the Gordon site is used as a centre for the birth and rearing of young during late spring and summer followed by a role as a mating centre in late summer and autumn. In addition, with a tenfold increase in the colony size from approximately 2,000 bats in 1973 (Robinson, 1973) to its present maximum of around 20,000 bats, juvenile and male elements of the population may overwinter here in some years.

2. ROOST DAMAGE AND CONTROL MEASURES

i. Vegetation Composition

The following description is largely derived from Puddicombe (1981) and observations by D. Costello (Kuringai Council).

The upper slopes of the valley (including the subject land) are dominated by large native trees of Angophora costata, A.floribunda, Eucalyptus pilularis, E.saligna, E.gummifera, Syncarpia glomulifera. There are also large amounts of introduced privet, Ligustrum lucidum and L.sinense as well as a few introduced camphor laurels, Cinnamomum camphora, and coral trees, Erythrina indica. The predominant native understorey species on the valley slopes are from the genera Hakea, Grevillea, Leptospermum and Banksia. However, there is also a large amount of introduced Lantana camara and the ground cover is mainly the introduced weed, Tradescantia albiflora.

The creek edge is dominated by the native trees Elaeocarpus reticulatus and Ceratopetalum apetalum, as well as abundant introduced privet. Ground cover is again mainly T.albiflora with some Crofton weed, Eupatorium adenophorum and ginger, Hedychium gardnerianum.

ii. Damage

Although a quantitative assessment of damage to the vegetation within the colony area was not possible in the time available, deleterious effects from a variety of causes were apparent.

(a) Fruit Bats

There is no doubt that the heavy roosting pressure on the vegetation caused by the confinement of the colony to a relatively small area has resulted in significant damage to particular trees. This can be best illustrated with a few examples. The upper canopy of an *Angophora* was heavily settled by bats and as a consequence of their territory establishment it had lost almost all leaf cover, compared to its intact lower canopy which lacked roosting fruit bats. The branches of a stringy bark that were used as perches were almost completely devoid of leaves, whereas adjacent branches without bats were unaffected. Similarly, a densely occupied privet had lost about 30% of its leaf cover compared to an unoccupied and intact neighbour.

Although the majority of trees are not so heavily colonised as to cause permanent damage, recovering in winter and spring when the camp is generally vacated, it is likely that some favoured and densely colonised trees will eventually die from inadequate photosynthesis through loss of leaves. With normal regeneration and replacement taking place this is probably unimportant. However, additional factors, considered below, may be impeding natural regeneration and require counter measures.

(b) Drainage

There are already a number of dead trees concentrated on the lower slopes of the valley occupied by the bats. D. Costello of Kuringai Council (personal comment) attributes most of the current dieback to waterlogging of the soil caused by inadequate and reduced drainage. Thus, Stoney Creek is used as a stormwater channel for water drainage from the surrounding street catchments. This considerably increased water load must exacerbate waterlogging in these sandy clay loam soils.

(c) Weeds

A vegetative factor that may prolong periods of waterlogging is the dense ground cover of the introduced week, Tradescantia albiflora, that must directly inhibit soil moisture evaporation and the drying out of soil. In addition, the stranglehold that privet and lantana are gaining in the understorey vegetation will further prevent water loss through the highly humid environment below their dense upgrowth.

However, undoubtedly the most severe problem caused by the invasion of the introduced 'weed' species (T.albiflora, L.camara and the two privets, L.lucidum and L.sinense) is their inhibition of natural regeneration among the native trees. Apart from probably encouraging soil-waterlogging and thereby reducing effective seedling establishment for less water tolerant natives; the highly efficient colonisation of natural vegetation gaps and rapid growth of these weeds enables them to outcompete the slower growing and less efficiently dispersed natives. The weeds severely retard the rate of natural regeneration of the Eucalypt dominated open forest..

In effect, any increased rate of gap formation caused by the defoliating activities of the fruit bats will probably favour the rapidly colonising weeds at the expense of the native species, unless preventive action is taken.

iii. Control

Given that it is impractical to control where bats roost in the colony, effort needs to be directed at increasing the capacity of the native flora to recuperate.

(a) Drainage.

It is proposed that an evaluation of the drainage requirements of the valley and its burden of stormwater conduits be undertaken. This could be conveniently done under the auspices of Kuringai Council and the Department of Environment and Planning, which are responsible for Stoney Creek. If drainage is inadequate and waterlogging is taking place, appropriate steps should be taken to alleviate this problem.

(b) Weeds

The long term viability of the colony is probably closely associated with the maintenance of the taller canopy trees that provide warm roost sites by giving bats access to direct sunlight during the early morning and late afternoon.

To encourage natural regeneration at the colony, it is proposed that a program of weed control is started in the valley which should also involve (at least initially) the planting of native canopy trees in light gaps. Weed control should be particularly directed against the two privet species, Lantana and the ground covering week, Tradescantia albiflora.

I believe that such work is already being undertaken in the area by the Kuringai Bushland and Environmental Society and that the President of this group, Janet Fairlie-Cuninghame would be sympathetic to the initiation of a program at the Gordon colony. It is further suggested that, in order to reduce disturbance to the colony of bats, the bulk of this work be carried out in winter when the camp is generally vacated, or at least harbours fewer animals.

In conclusion, although there is ongoing damage to particularly heavily colonised trees in the roost, this should not jeopardise the long term viability of the colony if natural regeneration is encouraged through weed control and/or improved drainage.

3. CONSEQUENCES TO THE COLONY OF THE PROPOSED SITE DEVELOPMENT

i. Current use of the Subject Land

Although the colony area will expand further during March and April (when mating takes place and young are fully weaned), in January its borders infringed on the subject land by generally ten metres or less (Fig. 1). A total of 440 fruit bats were found to occupy 21 trees on or directly bordering the subject land. Thus, only some 2% of the total summer population would be directly affected by the proposed subdivision. However, indirectly, the site development would have a more marked effect than is at first apparent.

ii. Complicating Factors

(a) Aspect: It is shown in Fig. 1 that the colony is essentially restricted to the southern side of the valley. In addition, the site that it occupies is the largest area available with a north-easterly aspect. This north-easterly aspect of the settled southern slopes is very important to the colony since its maximum exposure to the sun ensures a comparatively warm environment, particularly in the early morning when diurnal temperatures are lowest and in the colder months of the year.

Therefore, there is a relatively small area of the valley that provides optimal roost sites and a substantial portion of this area is directly below the subject land.

(b) Buffer Zone: Currently, the semi-cleared lower levels of the subject land provide a valuable buffer zone for the colony at its easiest point of access from the surrounding suburbs, via Edward Street. The existence of this buffer zone has been due to the policy of the present owners to restrict access to the valley via their land. Thus, the undisturbed nature of the subject land has enabled the colony to occupy the maximum available area of the north-east aspect slope. This has resulted in the overlapping of the colony boundary with the lower reaches of the site to be developed.

If the lower reaches of the plots 2 and 3 (A in Fig. 1) were cleared and developed, even for residential use, this would push the colony at least a further 20 metres down the slope to allow for the establishment of a new buffer zone. Should this occur, it can be readily appreciated from Fig. 1. that the optimum area available to the fruit bats would be significantly reduced on this critical north-east aspect slope. Thus, a 20 metre buffer zone below the present property would reduce the January colony area on the southern side of the valley by about 20%.

As a consequence of a probable 20% loss in favourable roosting area, there would be a proportional increase in roosting pressure on the remaining space. This would result in increased damage to trees and ultimately an equivalent decline in the carrying capacity of the site.

4. RECOMMENDED BUFFER ZONES TO PROTECT THE COLONY

i. Subject Land

In order to safeguard the colony of fruit bats against future development, it is recommended that the lower portion of the subject land (A in Fig. 1) is retained as an undeveloped buffer zone.

It is understood that the present owner of the subject land released the 1.5 hectares below this site, on which the fruit bat colony presently resides, to the Department of Environment and Planning. Consequently, it seems appropriate that this portion of land required as a buffer zone (A, Fig. 1) should be purchased by the aforementioned department and assimilated as 'County Open Space' with the rest of the colony area.

However, it is considered that residential development of the upper portions of plots 2 and 3 (B in Fig. 1) would offer no threat to the viability of the colony since an adequate buffer zone would be provided by area A (Fig. 1). Area B, taken as an irregular lot (about 1250 m^2) complies with the minimum allowable area, width of access corridor and the width or depth of the allotment under Kuringai Council's subdivision code. Therefore, it is recommended that the owner be permitted to offer this subdivision for sale.

Similarly, since plot 1 is already developed as a residence for the owner and there is only marginal use of its north-west corner by the bats, there should be no further conservation restriction placed on its sale.

ii. Remainder of the Southern Slopes

The other area of the colony under most threat from disturbance and potential development is its south-east corner, where bats are roosting in the side gully that runs due north down into Stoney Creek (readily identifiable by contours on the 1:4000 orthophotomap, Pymble U0960-S).

This area, because of its less favourable aspect, is not currently so heavily settled as that below the subject land but provides an important reserve of roost space that needs to be maintained. Thus, in order to ensure the long term integrity of the colony it is recommended that no further clearing of this gully vegetation should take place. An appropriate buffer zone on the eastern corner of the colony, where its border crosses Stoney Creek, would be created by an additional eastward band of 50 metres along the creek.

The western tongue of the colony in front of the Lady Gowrie Memorial Nursing Home again occupies 'County Open Space' down to the creek, and this narrow area should be retained in its entirity for use by the colony. A convenient western boundary line for this designated buffer zone is the stormwater drainage channel that runs from the north-western corner of the Lady Gowrie Memorial Nursing Home's gardens down to Stoney Creek (x-x, Fig. 1).

iii. The Northern Side of the Valley

An ample buffer zone for the colony on the northern side of the valley would be a band of forest about 50m from the creek side. Although P.scapulatus are also reported to roost on this side (Puddicombe, 1981), it is not heavily colonised by P.poliocephalus because of its unfavourable aspect. Such a buffer zone would protect the colony from any future developments on this valley side.

5. RELOCATION OF THE COLONY

There is no known, practical method of relocating colonies of fruit bats; the logistical problems are unsurmountable.

Even assuming that a relocation could be effected, the population of these animals is so mobile and their annual re-occupation of camp sites so traditional that the colony would return.

6. LIFE OF THE COLONY

It should be first cautioned that there is no base-line data on the relationship between colony life and vegetation structure/damage; neither do we know the total longevity of any one site. However, there are flying-fox colonies that have occupied degraded sites for many decades (within living memory). Thus, Nelson (1962) reported that there were camps that "have been occupied seasonally for 80 years", and some of these would have been inhabited for a century by now.

Compared to the severe degradation (mainly due to logging and weed/ vine invasion) in many camps on the North Coast, the current level of damage at Gordon (derived from inadequate drainage, weed and vine competition and defoliation by bats) would not seriously detract from the life of the site. However, there seems no doubt that the carrying capacity of the Gordon site will be gradually reduced unless natural regeneration is encouraged through a program of weed control (and improved drainage). If the recommended buffer zones were adopted and a vegetation regeneration program implemented, there is no a priori reason to place any limit on the life of the colony.

In conclusion, given proper management to encourage natural regeneration of the native dominants, there are no in situ factors to prevent the establishment of a permanent colony at Gordon. However, it needs to be stressed that the principal determinant for the prolonged maintenance of a colony in a particular locality is adequate availability of food.

7. LITERATURE REVIEW

Zoogeography

The precarious status and inadequate biological knowledge on which to base conservation and management policies for members of the important fruit-bat genus Pteropus is regrettably a poor reflection of its wide distribution and species richness. Restricted to the Old World this genus has sixty-five species, including the world's largest bats, distributed through the islands of the Indian Ocean from Madagascar to India and across South East Asia through the South Pacific to Australia. Many of the species have very restricted island distributions and are greatly endangered by habitat depredation, indiscriminate shooting and uncontrolled harvesting for human consumption (Perez, 1973; Wodzicki and Felten, 1975; Gould, 1977; Wheeler, 1979; Racey, 1980).

Australia has four resident species of Pteropus, of which P.poliocephalus and P.scapulatus are endemic and P.alecto together with P.conspiculatus are also found in New Guinea. Hall (1981) and references therein provides a synopsis of current distributions. In New South Wales there are present three of the four species; including permanent colonies of P.poliocephalus and P.alecto (only in the very far North Coast) and P.scapulatus is an important migrant in inland as well as coastal areas.

Natural History

The pioneering work on Australian flying-foxes was carried out by Ratcliffe (1931 and 1932) in the late 1920's. His study was essentially confined to the coastal districts of Queensland and New South Wales. During his investigations he obtained information on the distribution, reproduction, social behaviour, dietary preferences and migratory tendencies of all four species. The aim behind Ratcliffe's work was to collect data relating to the predation of cultivated fruits by flying-foxes: "with a view to determining whether it would be possible to suggest effective control measures or promising lines of further investigation to such an end." After extensive investigations he concluded that: flying-foxes were mainly blossom feeders, were not a serious menace to the fruit industry and there was no practical form of control (Ratcliffe, 1931).

Some thirty years later, Nelson (1964, 1965a, 1965b) carried out more detailed work, mainly in South-east Queensland, on the reproduction, social behaviour and seasonal movements of P.poliocephalus, P.alecto and P.scapulatus. From his investigations Nelson concluded that P.poliocephalus and P.alecto form large camps in the summer for the purposes of parturition, rearing of young and mating. During the winter he proposed that most adults leave the summer camps and remain dispersed, whereas the young form winter camps that are generally separate from their summer locations. P.scapulatus was found to form large camps in the summer and Nelson (1964) hypothesised that young were born while the species was dispersed in the autumn. However, the present author has recorded large autumn camps of P.scapulatus and recently, Prociv (1983) has located a large maternity colony of P.scapulatus in Queensland during the winter.

Puddicombe (1981) carried out a valuable and detailed behavioural study of P.poliocephalus at the Gordon colony, which concentrated on thermoregulatory and social behaviour at the roost site.

The major gap in these studies has been the lack of a comprehensive investigation of the relationship between seasonal movements, annual reproductive/social cycles and the availability of food. The author is currently completing such a study, based for two years in the Northern Rivers region of New South Wales. Particular attention has been paid to:

(i) the status and distribution of Pteropus spp.

(ii) their role as pollinating agents and seed dispersers of native plants.

(iii) the relationship between flying-fox social structure and foraging behaviour.

The results of this work will lead to some modification and considerable refinement of our past ecological knowledge of these valuable native mammals.

However, there is still an urgent need for coordinated studies on the distribution, food and habitat requirement of flying-foxes throughout their range - both within New South Wales and in Australia as a whole. This applies particularly to the highly migratory P.scapulatus, for which detailed ecological information is sparse.

Physiology

The relationship between ambient temperature and body temperature, oxygen consumption and heart rate have been investigated for P.poliocephalus and P.scapulatus by Bartholomew et al (1964). Studies on the flight metabolism of P.alecto (P.gouldii) and P.poliocephalus have been undertaken by Thomas (1975,1981) and Carpenter (1975) respectively.

Additional Subject Matter

Wheeler (1979) has provided a comprehensive bibliography of the genus Pteropus which covers regions outside Australia and topics peripheral to this report.

8. THE GORDON COLONY IN PERSPECTIVE

The Gordon colony is the largest and most important maternity colony of the grey headed fruit bat known in the southern half of New South Wales. As such, it is probably crucial to the future survival of this species in the southern half of the State.

There are only three colonies of P.poliocephalus known to exist south of Sydney. These are a small summer colony of unknown provenance at Yatteyatah (220 km south, near Milton) and an unsurveyed camp at Jamberoo (120 km south, near Kiama). Mallacoota in Victoria is the site of the most southerly colony known in Australia. North of Sydney, the nearest colony known to be annually re-occupied as a site for parturition and mating is at Wingham (350 km north, near Taree).

This very sparse present-day distribution is a severe indictment of the past and contemporary categorisation of fruit bats solely as pests of orchard fruits, with no emphasis being placed on their importance as pollinators and seed-dispersors of native plants. Thus, on account of their unprotected status in New South Wales, the few colonies remaining in the State have been and are still regarded as legitimate targets for reprisals by orchardists or for sport by shooters.

Even in the late 1920's when Ratcliffe (1931) found seven colonies of fruit bats in the Hunter River District alone and estimated colonies to occur at least every 40 miles along the New South Wales Coast he reported:

"There has undoubtedly been a marked decrease in the numbers of the animals, due to the settlement of the coastal areas. This has naturally been greatist in the south, and has thus chiefly affected the Grey-headed fox, P.poliocephalus. There is plenty of evidence of this diminution in numbers. .....".

Today, in the whole of New South Wales there are perhaps only 10 known colonies of similar importance as maternity sites for P.poliocephalus to that of Gordon (all of which are in the northern half of the State). This is not surprising, considering previous levels of distruction; a record provided by Ratcliffe (1931), albeit from Queensland, detailed the slaughter of 300,000 flying-foxes in the first three years alone of a Pests Destruction Board.

Clearly, in order to halt the continuing loss of colonies that threatens the long-term survival of these native mammals in New South Wales, extant colonies need protection. Therefore, it is recommended that all fruit bats and their remaining colony roost sites should be protected, as a matter of urgency. However, in those years when natural food shortages result in serious predation at commercial fruit orchards by fruit bats, humane deterrent action on these orchards could be licensed.

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