A FIJI PEREGRINE (Falco peregrinus) IN AN URBAN - MARINE ENVIRONMENT

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ABSTRACT

The daily routine and hunting methods of a female Peregrine *(Falco peregrinus)* resident in Suva, Viti Levu island, Fiji, are described, and her food examined. The falcon was capable of hunting in very poor light conditions, and specialised in birds weighing roughly 100 - 300 g., although larger and smaller prey were available. Food consisted mainly of pigeons, waders and sea-birds, unlike that of rainforest-dwelling Peregrines at a nearby eyrie, which fed on flying fox bats. The Suva falcon showed a tendency to kill birds which were unusual or uncommon on her hunting range, including two species of rail previously thought to be extinct or near extinct on Viti Levu.

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INTRODUCTION

Until recently the presence of the Peregrine as a breeding species in Fiji was doubted (Brown & Amadon 1968: 852). In 1971 it was proved that the Peregrine does nest in Fiji, and the diet of a pair at Joske's Thumb in southern Viti Levu, which fed largely on the flying fox or giant fruit bat *(Pteropus tonabus)* was described (Clunie 1972; 1973: 9-11). Peregrines have since been seen in several parts of Viti Levu, in central Vanua Levu, and on Ovalau, and I have learnt of their presence on Vatuvara island in the Lau Group (D. McCarthy, pers. comm.). It appears that the Peregrine is widespread in Fiji and not so rare as was thought. Fiji Peregrines are probably of the Melanesian race, *F. p. nesiotes* (see Brown & Amadon 1968: 852).

From February 1972 to time of writing in April 1975 a female Peregrine was present in Suva, and its hunting and food were studied. The results are presented here.

HABITAT

The Fiji Islands lie in the south-west Pacific, scattered across the 180° meridian between latitudes 15-22°S. Suva, the capital city (pop. 70,000) covers a peninsula projecting from the south coast of rugged and mountainous Viti Levu (10,429 km²), the largest island of the Fiji archipelago.

The waters of Suva Harbour to the west of the peninsula, and those of Laucala Bay to the east, are protected from the open sea by a barrier reef, broad tracts of which are exposed at low tide. From the west coast one looks across the harbour at ranges of low but rugged rainforest-clad mountains, which rise from the north shore of Suva Harbour, and include the Peregrine nesting cliffs at Joske's Thumb, 14 km to the northwest. Immediately north of the low hills of the peninsula, which rarely exceed 60 m above sea-level, the ground rises sharply to over 100 m to the suburbs of Samabula and Tamavua, while across Laucala Bay lie the broad mangrove swamps of the Rewa delta.

Almost all of Suva peninsula is built on, but the large trees and shrubs of suburban gardens give a rather well-wooded appearance to all but the central-western and north-western sections, the commercial and industrial hearts of the city.

Land reclamation has removed the foreshore along the northern half of Suva's west coast, but at low tide muddy sand flats, from 100 m to several hundreds metres wide, extend from the south and east coast, and from the north shore of the harbour. These support a large population of migratory shorebirds from early September to late April. Quite large numbers over-winter, and can be seen there throughout the year. These shorebirds are mainly the Golden Plover *(Pluvialis dominica)*, Wandering Tattler *(Tringa incana)*, Bar-tailed Godwit *(Limosa lapponica)* and Ruddy Turnstone *(Arenaria interpres)*. The Reef Heron *(Egretta sacra)* is present along the waterfront and reef. Patches of mangroves occur on the southeast coast, larger concentrations clustering about creek mouths in the extreme northwest of the peninsula and in the east, with the Mangrove Heron *(Butorides striatus)* present. The common sea-bird of Suva Harbour is the Crested Tern *(Sterna bergii)*, while occasionally the Red-footed Booby *(Sula sula)*, Lesser Frigate Bird *(Fregata ariel)*, Black-naped Tern *(Sterna sumatrana)* and Black Noddy *(Anous minutus)* straggle in, especially in stormy weather.

Ashore introduced birds predominate. The Feral Pigeon *(Columba livia)*, Malay Spotted Dove *(Streptopelia chinensis)*, Jungle Mynah *(Acridotheres fuscus)*, Indian Mynah *(Acridotheres tristis)* and Red-vented Bulbul *(Pycnonotus cafer)* are present in thousands, with the Java Rice Sparrow *(Padda oryzivora)* and Strawberry Finch *(Estrilda amandava)* also numerous. A variety of native birds is present, most conspicuously the Fiji Goshawk *(Accipiter rufitorques)* which invades the city after its breeding season, the Swamp Harrier

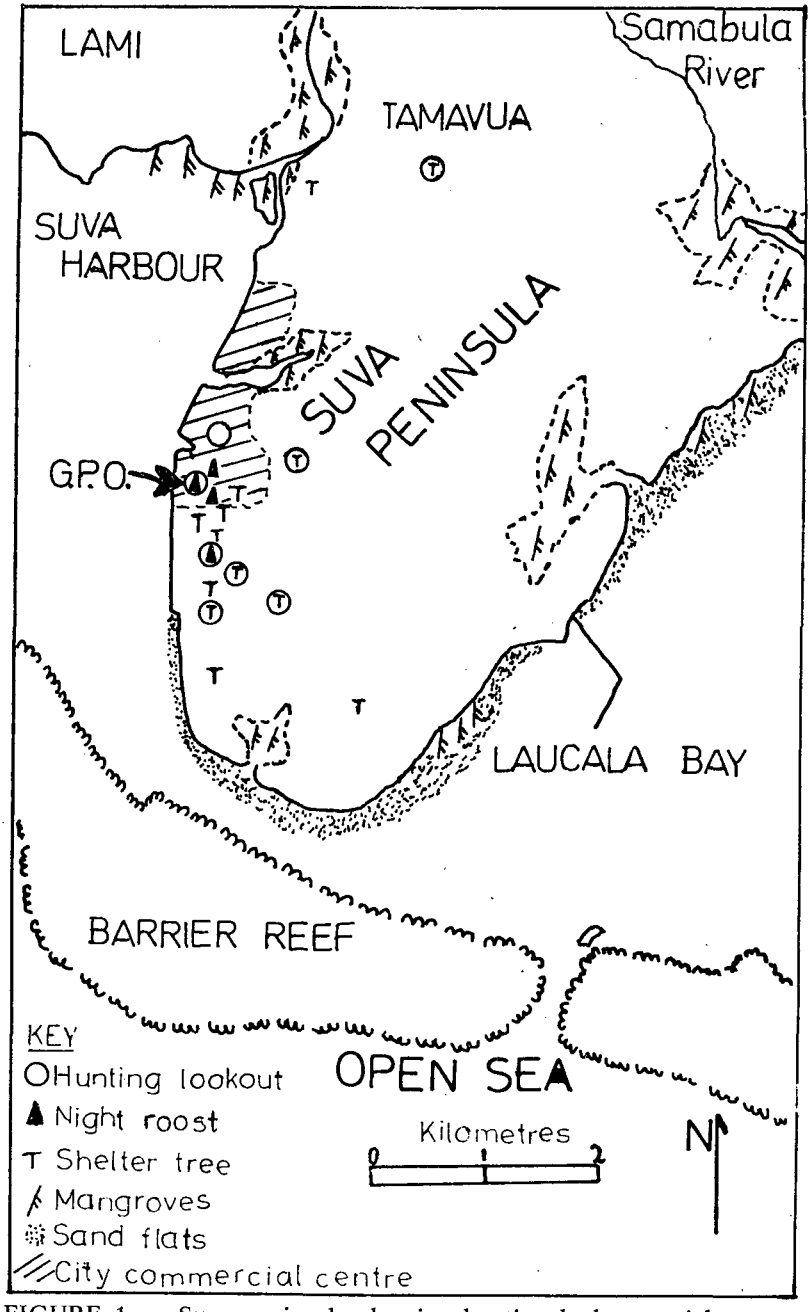

FIGURE 1 — Suva peninsula showing hunting lookouts, night roosts and shelter trees of the resident Peregrine.

(Circus (aeruginosus) approximans), Collared Lory *(Phigys solitarius)*, Many-coloured Fruit Dove *(Ptilinopus perousii)*, White-rumped Swiftlet *(Collocalia spodiopygia)*, the Wattled and Orange-breasted Honeyeaters *(Foulehaio carunculata & Myzomela jugularis)*, and the Red-headed Parrot Finch *(Erythrura cyanovirens)*. Several other native bird species are either present in smaller numbers or restricted to a few localities.

The flying fox also commonly enters the city at dusk.

Suva's climate is very wet, with an average annual rainfall of about 3,000 mm.

OCCUPATION PERIOD

Early in February 1972 I received a report of two Peregrines from a Suva suburb, one of which ate a Feral Pigeon on top of a concrete lamp-post (M. G. MacKenzie, pers. comm.). On 16 February I saw the falcon, which became resident in the city perched in the dead top branches of a tall tree in the Suva Botanical Gardens, being mobbed by Wattled Honeyeaters and a mixed group of mynahs and bulbuls. There may have been another Peregrine in the area as the falcon called several times, something she never did when alone as future observations were to show.

The streaked plumage of the underparts and the very large size of the falcon established her as a yearling female early in the moult to the barred breast and belly of an adult, which she acquired over the next few months. She was recognised as the same bird throughout the study period by her established habits, roosts, lookouts and feeding posts.

This falcon stayed on the Suva peninsula throughout 1972 and through early 1973, disappearing at the end of June and only reappearing occasionally until late September, when she again took up residence until mid-May 1974 after which, apart from an occasional visit she was missing until early September when she became resident, still being present at time of writing (April 1975). The disappearances of 1973 and 1974 coincide with the known Peregrine nesting season for Fiji, which extends from at least as early as June to September (Clunie 1972: 311-313) and longer in cases of successful breeding. It is likely that the falcon left town for breeding cliffs on these occasions, although irregular appearances of several days duration, and her lone and early return, suggest she did not, in fact, nest.

DAILY ROUTINE

Shortly after arriving in Suva the falcon established a basic daily routine which was followed through the study period. She roosted overnight on high window ledges and fire-escapes, or on exposed church towers or tall radio-telephone masts, these last often being occupied even in very bad weather. In the early morning she usually hunted; resting in the heat of the day in the middle of tall shady trees and remaining quiet there until the late afternoon, although

she did sometimes hunt under the midday sun. She generally hunted again, or at least occupied a hunting lookout, through the late afternoon and evening, before returning to her night roost.

In dull weather she often remained quite openly on a prominent hunting lookout for most of the day, making no attempt to fly to more protected roosts, even in conditions of heavy rain. Indeed, she could generally be said to have sheltered more from the sun than rain.

The most regular night roosts seen were an exposed ledge near the top of the north tower of the Roman Catholic cathedral in the commercial heart of the city, and the radio-telephone mast on the roof of Suva's General Post Office (referred to henceforth as the GPO mast) only 200 m away. She usually roosted on the grid of the maintenance platform near the top of the GPO mast, the very tip of which was also her favourite hunting lookout. The ledge on the cathedral tower was so narrow that she had to face inwards when roosting there, as Peregrines roosting on narrow cliff ledges do elsewhere in the world (Herbert & Herbert 1965: 74). These two roosts, which were in the heart of her favourite hunting area, were often used alternately, one for several hours, then the other. She often slept there in the rain with sheltered window ledges available within 100 m.

A common daily routine was for the falcon to wake on the cathedral tower and fly direct to the top of the GPO mast in the early morning, hunt from there for a couple of hours, then return to shelter on the shady west side of the cathedral tower until the sun came overhead, when she flew into a tall African Tulip *(Spathodea campanulata)* tree 200m away to rest until late afternoon. Then she returned to the GPO mast and hunted from there until dark, finally roosting on the cathedral tower. She also commonly roosted overnight on a window ledge of the fifth floor of the Government Building, and on other large buildings in the city, usually occupying one particular roost for several consecutive nights. Daytime shading places were in African Tulip, Weeping Fig *(Fiscus benjamina)*, Breadfruit *(Atocarpus altilis)* and Rain Trees *(Samanea saman)*, all of which provide good shade.

During the long periods of inactivity on day perches, she dozed fitfully; watched passing birds, paying particular attention to Feral Pigeons (her favourite food), and to Reef Herons (which she never attacked); and scratched, stretched and preened frequently. Between heavy showers of rain she spread her wings and fanned her tail as if to dry them. One early morning, after a wet night, she definitely sunbathed on the GPO mast platform, standing facing the sun, bending her body forward parallel to the floor, her tail sticking out behind her, level with her back, and her wings opened out and drooping down. After several minutes she turned to face west, adopted the same stance, and exposed her back to the sun for 10 minutes or so.

VISITS BY MALE PEREGRINES

Several times in 1972 adult Peregrines, which from their much smaller size must have been males, were seen in company with the resident female, who had just assumed adult plumage, and did not leave the city that nesting season.

On 16 July 1972 a male perched quietly with the female on tope of the GPO mast (M. M. Brown, pers. comm.), and I saw a male perched alone there on 3 August. A pair were also there in early October (A. Blackburn, pers. comm.). These sightings all fall roughly within the nesting season.

From 21 to 25 November 1972 a male was present in the city and associated with the resident female on the first two days, before being attacked by her. I became aware of him in the late afternoon of 21 November when I heard the female repeatedly give a high-pitched and repeated " ee-chip ee-chip ee-chip " call, similar or identical to calls made by nesting birds and sounding like the creaking of a rusty and heavily loaded metal pulley. She flew from the GPO mast with a fluttering flight quite unlike the normal strong Peregrine flight, and hovered low over the top floor scaffolding of the partially completed YWCA building about 150 m away, where a male peregrine was perched, then fluttered back to circle the GPO mast and returned to land on the penthouse roof of the YWCA building, directly above the male, looking down at him and giving the " ee-chip " call for several seconds. The male ignored her and a few minutes later flew to a window ledge on a building only 50 m away, sending incubating Feral Pigeons out in panic, while the female called after him. Here he ate pigeons' eggs from at least two nests. Minutes later the female flew past him with the curious fluttering flight, dangling her legs as she passed his ledge, then flew on again, circled the GPO mast, and returned to perch on the YWCA scaffolding, giving a series of strident " ee-chip " calls. I have seen a female falcon at Joske's Thumb entice her mate from a feeding ledge and into the nearby eyrie by this very movement, although in that case she dangled a kill which she bit at twice, and not just her empty feet.

A minute later the female again fluttered past him and landed on the GPO mast platform, where she gave loud " ee-chip " calls for several seconds, before falling silent. Both birds roosted quietly in these positions until dark.

It seems probable that the female was trying to attract the male to her favourite roost, hunting lookout and feeding platform. She may possibly, however, have been attempting to lure him into the open where he could more easily be attacked.

Early next morning both birds were high on the same scaffolding as before, the male perched fluffed up with a full crop, while the female was perched, very nervous, on the scaffolding 5 m above and 2 m to his right. She showed intense interest in him, leaning forward and gazing down at him constantly, while he occasionally glanced up

at her. This went on for 20 minutes, when the female gave several " ee-chip " calls but was ignored by the male. She grew progressivly more agitated over the next half hour, shuffling about and making head-bobbing movements. Suddenly she walked along the scaffolding until directly above him and without warning dived and struck him hard in the back with her feet, knocking him off the scaffolding. After falling about 3 m he regained control and with a high-pitched scream fled at speed, while the female flung up 10 m above him and stooped, kicking out at his back as he dodged violently aside, screaming as if in terror. She flung up and stooped again, and he turned over in flight and seized her slashing feet in his own, screaming. Once more she flung up and stooped, the male rolling over screaming and lashing at her with his feet as she struck at him. She rose and dived, and he dodged aside with a scream, then landed on the penthouse of a building some 400 m from his starting point. She came at him in a shallow stoop from 100 m, hitting him in the back and sending him tumbling down the roof, dashed on, turned, and came in again very fast, striking him in the back as he regained the roof top, rolling him down the pitch of the roof. She then broke off the fight and flew direct to her roost on the Roman Catholic cathedral, to perch facing the wall. A few minutes later the male emerged, perched huddled up on the balcony surrounding the roof down which he had tumbled. The female did not even look over her shoulder at him from her perch 500 m away.

Despite this vicious attack the male hunted Feral Pigeons in the area on 24 November, feeding on one on a window ledge only 150 m from the GPO mast, and was photographed next day roosting on the scaffolding from which he had been knocked.

The only other sighting of a male Peregrine in Suva was on 7 December 1972, when a male and female were seen on the GPO mast, one on the very top and the other on the platform (M. M. Brown, pers. comm.).

INTERACTIONS WITH OTHER RAPTORS

The Suva falcon was seen to clash with both the Fiji Goshawk and Swamp Harrier, the only other diurnal raptors in Fiji.

Fiji Goshawks often hunted the commercial area while the falcon was on her GPO mast lookout, although I only saw one approach closer than 150 m, and it was attacked. These hawks caused a far greater reaction among the mynahs, bulbuls and even the Feral Pigeons than ever the Peregrine did. The falcon generally appeared to ignore the hawks, but she did once attack a Fiji Goshawk as it rose from the roof of a building only 150 m from the GPO mast. The falcon, in direct pursuit of Feral Pigeons, suddenly dived at the goshawk, stooping at it as it dived into the streets below, narrowly missing it. The hawk fled only a metre or two above the road, and the falcon did not pursue. This attack was made without sound or warning and was perhaps a hunting rather than a territorial clash, the falcon

stooping at the hawk as it rose vulnerably off the building in front of her, possibly even mistaking it for a pigeon.

On another occasion the falcon and an immature Fiji Goshawk appeared to deliberately avoid each other. The hawk flew straight for the tree in which the falcon was resting. As it approached, the falcon rose from the tree and flew northeast to another tree several hundred metres away, while the hawk immediately altered course to the southwest.

The territorial attachment of urban Peregrines to certain buildings in New York has already been pointed out by the Herberts (1965: 66) and two direct territorial clashes between the Suva falcon and other raptors in defense of the GPO mast were seen. In one of these an immature Fiji Goshawk chased a flock of Feral Pigeons to within 100 m of the GPO mast, and was herself attacked by the falcon, which had retired to its night roost on the Roman Catholic cathedral. The falcon flew straight at the hawk and struck at it with her right foot as she passed over its back, the hawk dodging the blow successfully. The falcon swung round in a wide arc and came at the hawk again, striking at it with one foot as it passed over its back, the goshawk dodging the blow and turning and flying rapidly back the way it had come as the falcon swung round to renew the attack. She did not pursue the hawk but instead chased some pigeons swirling about in the vicinity, making two unsuccessful attacks then returning to her cathedral roost. The duel was carried out in silence and the falcon flew more slowly and with more apparent caution while attacking the goshawk than she did when hunting prey, and generally seemed reluctant to press the attack seriously.

In the second territorial clash two Swamp Harriers flew low over the city, one straying within 100 m of the GPO mast, on which the falcon was perched. As it approached she spread her wings and commenced the harsh "airk airk airk airk airk" battle cry used when defending eyries against intruders. The harrier flew steadily on and the falcon flew slowly out at it, following it for about 100 m as it passed. The angle of the harrier's approach brought it no closer than 80 m from the GPO mast. The falcon did not return to the mast but flew to an African Tulip tree several hundred metres away, and perched there for 15 minutes before resuming her hunting.

HUNTING METHODS AND PREY

The entire Suva peninsula and Suva Harbour were hunted over by the Peregrine, while prey remains suggest hunting was often carried out to sea. The area most hunted over for Feral Pigeons was the commercial heart and market area of the city, most hunting flights being launched from the GPO mast.

The falcon's basic hunting method was to perch on a prominent lookout and from there make flights against flocks of birds. If the first attack of a hunting flight failed, she often made several more

on other targets before returning to her lookout to rest. Should a series of hunting flights from the one lookout fail, as was commonly the case, she abandoned it and flew to another more than a kilometre away, to hunt a fresh area from there. Alternatively, she rose to great height and circled widely as if prospecting for new and less alert prey. After a series of fruitless hunts over the fresh area, she returned to her original lookout, first making a low level surprise attack before perching and launching another series of hunting flights from there. Such surprise approaches were made well below roof or tree top level, and in the commercial area were usually made along Nabukalou Creek, which flows through the heart of the city. The falcon would follow the course of the creek, keeping just above the water, and when she reached its mouth suddenly turn off to attack the unsuspecting pigeons in the wharf and market area.

By far the most regular of the falcon's hunting lookouts was the GPO mast. She perched there on most mornings or evenings and often throughout dull days and overnight. The GPO mast commands a wide view of Suva's commercial heart and Suva Harbour and barrier reef. It is only 300 m from the wharf, market and bus stand area, whose population of Feral Pigeons runs into thousands. The falcon usually returned to the mast with her kills, plucking and eating them on the grid of the maintenance platform near the top of the mast, although she did sometimes feed on top of other buildings when hunting this area successfully. Kills which dropped from the mast platform to the GPO roof were retrieved by the falcon and eaten on the balcony surrounding it or on the roof of the lift penthouse. Several other hunting lookouts were also discovered on the tops of tall buildings or trees, particularly tall casuarina *(Casuarina equisetifolia)* trees. All these lookouts commanded a fine view of Suva and its harbour. The falcon did not necessarily favour the highest building top in an area as a hunting lookout; in fact she showed the same strong preference for her habitual lookout on the GPO mast even when new high-rise buildings rose up and dwarfed it in 1973-1974. Indeed, apart from commanding fine views, all of the hunting lookouts gave the falcon unobstructed vision in all directions. The falcon may have chosen these lookouts with a partially defensive motive, as she was seen being stoned by humans on several occasions, and may have learnt to choose lookouts without a blind side.

A favourite casuarina tree lookout 1.4 km from the GPO mast was definitely used as an alternative lookout to it, as was another 3 km away on Tamavua heights, the falcon regularly flying to them after a series of unsuccessful hunts from the GPO mast.

Most hunting took place in the early morning, from dawn until three hours after sunrise, or in the late afternoon and evening. The Peregrine rarely hunted in the heat of a sunny day, although she frequently hunted throughout the day in dull weather.

Several species of falcon are capable of hunting under poor light conditions late in the evening and the Peregrine is one of them.

Crepuscular bat hunting by Peregrines has been summarised recently by Porter & White (1973: 30); while Beebe (1960: 171) was convinced two Peregrines he saw late one evening over cliffs on a British Columbian island were waiting to hunt outgoing sea-birds. It was so dark that the falcons kept disappearing then re-appearing in flight but he thought they would attack the prey as it was silhouetted against the sea. In support of this he cited cases of crepuscular bat hunting, and stated that trained Peregrines were easily able to take a lure flung against the sky when it was far too dark to see it against the ground, and would even come in to lures illuminated by car headlights at night.

Careful observation of the Suva Peregrine confirms that this species is indeed capable of hunting under surprisingly dark conditions, and does so with a high success rate. In this its behaviour was reminiscent of that of Eleanora's Falcon *(Falco eleanorae)* which often hunts at dusk and dawn, surprising migratory birds over the sea (Brown & Amadon 1960: 820) in a similar manner.

She was seen to hunt successfully in the early dawn, with stars still in the sky and her underparts eerily lit up by the street lamps as she passed overhead. In the evenings hunting flights were made under even darker conditions, the falcon waiting until after sunset before hunting, often perching on the GPO mast for several hours beforehand, dozing and preening through the late afternoon and only hunting as the light faded from the day. This hunting under poor light conditions only became common after she had been in Suva for several months, but from then on became so prevalent that she would specialise in it for weeks on end.

Evening hunting was of short duration, the lack of a twilight period in the tropics leaving only a limited amount of time between sunset and dark. The falcon regularly launched successful hunting flights when it was so dark that I, with good night vision, could barely distinguish her with the naked eye from 100 m away, when she was perched in silhouette against the eastern sky. With the aid of 8 x 30 binoculars the fading light reflecting off the calm harbour waters made it possible, however, for me to clearly see flocks of waders passing low over the water, and the falcon could perhaps discern them as easily. It is thus probably significant that most of the late evening flights were over the harbour. The success rate of this crepuscular hunting appeared to be high, and it is likely that she achieved complete surprise at this time, when a predator would be unexpected and hard to see. Light conditions were so bad that I could see only the beginning and end of these flights, losing the falcon immediately after she passed over the shore street lamps. On several occasions I left her hunting under these conditions, further observation being impossible, only to return an hour before first light to find dew-covered but freshly plucked feathers with congealing blood on them beneath the GPO mast.

Sea-birds, shorebirds, and the light coloured male of the Many-coloured Fruit Dove *(Ptilinopus perousii)*, which appears very pale in flight, were the commonest kills at early dawn or late evening. It is possible that the Collared Lory *(Phigys solitarius)* which can often be heard passing overhead up to two hours after dark, was also susceptible to predation at this time.

Hunting flights, whether crepuscular or in broad daylight, always began in a similar manner. The falcon, perched on her lookout, would watch birds very closely, occasionally bobbing her head slightly. Suddenly she would brace herself, very deliberately spread her wings to their full extent, hesitate a moment, then fly out at her target. Targets appeared to be selected with some care, the falcon often spreading her wings, hesitating, then folding them again, sometimes recovering her balance with difficulty.

Her commonest method of attack was to approach a flock of say pigeons at great speed and from slightly above, alternating a series of rapid wing strokes with a sudden surge of speed when she folded her wings against the body, followed by another rapid series of wing strokes, only to shoot forward when she again folded her wings. Such an attack flight would sometimes be made from more than a kilometre from the prey. Nearing the flock she would dive through it at a shallow angle, making rapid jinks and passes and slashing at the scattering birds. If unsuccessful she would approach another flock in the same manner, and attack again and again. She would attempt to seize a bird directly beneath her or fly alongside and roll over sideways, kicking out at its side with her foot. Another very common hunting method was to approach in the same manner until directly above a flock of pigeons, glide for a moment on out-stretched wings as if selecting a target ,then suddenly fold her wings and stoop at an almost vertical angle down through the scattering birds, attacking one and following it almost to earth as it dived away. Such stoops were usually made only from 5 m to perhaps 15 m above a flock, the classic grand stoop of the Peregrine over longer distances only being seen on two occasions, and then from not more than 100 m above the target.

A quite common method of attack was to approach at a shallow angle with the usual rapid wing strokes alternating with a short surge of speed with folded wings, then dive beneath a flock and suddenly shoot up through it at great speed, slashing at her target as she passed over it. Direct pursuit of fleeing stragglers was also practised, the falcon easily overhauling them if they were not too far ahead, and kicking at their backs or rolling on her side and kicking at them. The manoeuvrability of the Feral Pigeons served them well here, and many hairbreadth escapes were seen. The falcon was also once seen attempting to take pigeons head on, making a fast horizontal approach straight into a group of them, closing at tremendous speed, the pigeons scattering at the last instant, and the falcon slashing vainly at one and dashing on. It was common for two or three varying attack

methods to be used in quick succession in a single hunting flight.

When attacking pigeons feeding in open fields or on the wharf the falcon dived down at great speed when 200 m or more away, then shot along less than ½ m up, grass-clipping, forcing the birds to rise as she approached then swinging up through them and stooping straight down on one, only pulling out of her headlong dive when it seemed she must smash into the ground. In one of the few hunting flights seen over water at close range in good light she used similar tactics, skimming low over the waves, but the two shorebirds she was pursuing kept low and out-manoeuvred her, she seeming reluctant to press the attack too recklessly when less than a metre above the sea.

Attacks were made with apparent recklessness over the city, the falcon pursuing pigeons up Suva's main streets at only 5 m up, twisting in and out between buildings and up side streets, or shooting along the wharf in direct pursuit of pigeons, only a metre up and paying scant regard to wharf workers and tractors, only to shoot through the rigging of a ship, turn, and make another attack run, Most attacks took place low down, rarely above 50 m and usually lower, although attacks on high flying pigeons and shorebirds were sometimes made at much greater altitudes. Attacks were pressed repeatedly at high speeds. After a series of vigorous pursuits the falcon returned slowly to her lookout, gliding up at it from slightly below, to perch bill agape and clearly panting, apparently winded. After a few minutes rest another hunting flight would be launched.

By far the greatest numbers of attacks seen were against Feral Pigeons, a favourite prey of the Peregrine through much of its range, falcons having followed them into many cities outside the breeding season (Hickey 1969: 9). In Suva, the alert nature and agility of the Feral Pigeon made it a difficult bird to kill, and although it was by far the commonest prey species in the Suva area, and the falcon devoted far more time to hunting it than any other species, it is only by a relatively slight margin the most common bird on the prey list. The kill rates against Feral Pigeons was low. Brown & Amadon (1968: 853) have noted that wild Peregrines often make 10 - 12 unsuccessful attacks for every successful one, and the Suva Peregrine, when hunting Feral Pigeons, certainly had a difficult time. In 74 definite hunting flights seen against this species I saw 130 actual pressed attacks. In the majority of these cases I only saw part of the flight, the falcon being hidden by buildings for much of each flight, and more attacks were surely pressed home. Of these 74 hunting flights, I did not see the end of 12, the falcon not returning to its original lookout, but of the remaining 62 flights only 6 resulted in successful kills. In 2 other cases pigeons were hit and dropped but not retrieved, the falcon in one instance flying about screaming with a fistful of pigeon flight feathers, examining them as she flew then casting them away. There was thus a success rate of about 1 in 10 hunting flights, and only about 1 kill to every 20 pressed attacks. Against other prey species, especially at dusk and dawn,

the falcon seemed to have greater success, but I do not have enough data to give a reliable judgement.

The three actual kills I saw were made on Feral Pigeons. Death was immediate in one case, when the falcon seized a pigeon at great speed just as it was rising up off a roof in alarm. Each of the other two times the falcon seized the pigeon in her feet, then bent forward in flight, swung her legs forward, and bit the wildly struggling bird in the neck or head, killing it instantly. Examination of the more complete prey specimens recovered suggests that the falcon almost invariably seized its prey live in this manner, then despatched it by biting through the neck, or more rarely, the skull. Uneaten prey I recovered had been bitten through the neck, the vertebrae being severed and massive internal bleeding having occurred, but they were otherwise unmarked apart from tiny skin punctures where the falcon had gripped them.

Only one flight, which is not listed among the hunting flights, appeared definitely to be in play, the falcon, with its crop still swollen, terrifying a passing pigeon but not pressing the attack close. She did, however, certainly kill when not immediately hungry, as she was several times seen to cache fresh kills untouched on the GPO platform, returning to feed on them later, sometimes not until next morning. Partially eaten kills of the previous day were also commonly eaten if hunting proved unsuccessful, and she sometimes ate from quite stale kills. A successful evening hunt did not necessarily preclude hunting in the morning, although it usually began later than usual, and if the falcon killed in the morning she would often hunt again in the late evening. This could perhaps account for kills being cached untouched on the platform overnight.

Beebe (1960: 172) reported that *F. p. pealei* often kills in excess of its needs, and records that 5 or more untouched kills are often found near eyries. The Suva Peregrine certainly killed in excess of her needs on at least three occasions, and like the Peale's Peregrines did not behead her prey. One morning she killed an adult and an immature Sooty Tern *(Sterna fuscata)*, eating only the neck flesh of the adult; while on another morning she killed two Collared Petrels *(Pterodroma leucoptera brevipes)* and one Fan-tailed Cuckoo *(Cacomantis pyrrhophanus)*, and only ate one of the petrels. The day before she had eaten only the neck and breast meat of an Audubon's Shearwater *(Puffinus lherminieri)*. On the third occasion she killed two Sooty Terns and left them to rot on the GPO mast maintenance platform. It is perhaps not coincidental that the three instances mentioned above took place in mid-April 1972, early May 1973, and early April 1975, all of which are either in or very close to the onset of the known Peregrine breeding season in Fiji. On many other

occasions birds were only partially eaten and left to rot on the GPO mast platform or on the GPO roof.

The falcon fed on Feral Pigeon nestlings on at least two occasions at night roosts, while a male Peregrine ate pigeon eggs, as noted earlier. Peregrines have been recorded feeding on sea-bird nestlings elsewhere (e.g. Brown & Amadon 1968: 854). I did not see any real indication of systematic hunting of window ledges and other niches for pigeon chicks or eggs by Peregrines, although a Fiji Goshawk was once seen deliberately searching a building for them.

The remains of 425 birds of 19 species were collected and identified from falcon feeding posts, all but two coming from the GPO roof. As the falcon fed on the grille-work maintenance platform of the GPO mast, the dismembered heads, wings, legs, etc., fell through the grille to the flat roof of the building, from where they were collected periodically for identification. This roof was often littered with heads, wings, legs and partially devoured corpses, Jungle Mynahs sometimes gathering to feed on dermestid beetle larvae present in the rotting remains, while once a Malay Turtle Dove fed on rice and maize from the burst crop of a Feral Pigeon the falcon had killed that morning.

Care was taken to clear the roof of all remains at each visit, to avoid duplicating evidence. The total number of birds given here for the various species is the minimum possible for each. For example, if a pair of legs, a left wing and a head of a Collared Petrel were recovered on the same visit, they were taken as belonging to the one bird. As many of the remains found were fragmentary, only a foot or mandible being present to indicate a kill in extreme cases, this was considered the safest method, although it must have inevitably led to some underestimation. Often most of the remains of a particular kill would be blown clear of the roof, or other remains would be washed away in torrential downpours, so the number of kills recovered from the GPO is by no means a complete record of the birds eaten there by the Peregrine. A few of the kill remains from the GPO roof could have been left there by the visiting male Peregrine(s), but they could only have accounted for a few of them, and no change in the type or size of bird taken was noted during the periods they were present.

Several castings or food pellets were recovered from the GPO roof, one containing the remains of the only Peale's Pigeon *(Ducula latrans)* known to have been eaten by the Suva falcon. This pigeon does not normally occur in Suva and was probably taken on an excursion into the rainforest, or along the forest fringe. All other prey evidence is from kills.

PREY SPECIES IN ORDER OF FREQUENCY WERE:

Species	*No.*	*% of kills* (approx.)
Feral Pigeon *(Columba livia)*	101	24%
Collared Petrel *(Pterodroma leucoptera brevipes)*	81	19%
Wandering Tattler *(Tringa incana)*	76	18%
Golden Plover *(Pluvialis dominica)*	55	13%
Sooty Tern *(Sterna fuscata)*	45	11%
Many-coloured Fruit Dove *(Ptilinopus perousii)*	22	5%
Audubon's Shearwater *(Puffinus lherminieri)*	7	2%
White Tern *(Gygis alba)*	7	2%
Collared Lory *(Phigys solitarius)*	7	2%
White-collared Kingfisher *(Halcyon chloris)*	5	1%
White-browed Rail *(Poliolimnas cinereus)*	4	1%
Bar-tailed Godwit *(Limosa lapponica)*	3	<1%
Black Noddy *(Anous minutus)*	3	<1%
Banded Rail *(Rallus philippensis)*	2	<1%
Fan-tailed Cuckoo *(Cacomantis pyrrophanus)*	2	<1%
Jungle Mynah *(Acridotheres fuscus)*	2	<1%
Crested Tern *(Sterna bergii)*	1	<1%
Peale's Pigeon *(Ducula latrans)*	1	<1%
White-breasted Woodswallow *(Artamus leucorhynchus*	1	<1%
	425	

The kills collected clearly show that the Suva Peregrine depended on medium sized birds for its food, mainly pigeons, shorebirds and sea-birds. This is a typical diet for a Peregrine in an urban-marine environment practically anywhere in its range (Brown & Amadon 1968: 854), but it differs markedly from that of rainforest-dwelling Peregrines at Joske's Thumb (see Table 1) only about 14 km from, and in plain view of the GPO mast lookout (Clunie 1972: 315-322; 1973: 10-11). Here the staple diet of the falcons was the flying fox *(Pteropus tonabus)*, which is also killed by Peregrines at Vatuvara Island in Lau (D. McCarthy, pers. comm.). In contrast the Suva Peregrine did not kill a single flying fox.

In my earlier papers (Clunie 1972: 319; 1973: 10-11) I suggested that the rather unusual dietary habits of the Joske's Thumb Peregrines was perhaps a necessity forced on them by the dense rainforest cover, which effectively shields many potential prey species from attack. The Suva falcon, with an adequate supply of suitable prey birds in the form of pigeons, shore and sea-birds certainly had ample opportunity to add fruit bats to its diet as these big clumsy mammals were commonly active in Suva well within her hunting times. Indeed, following a hurricane in October 1972, starving flying foxes streamed

TABLE 1

COMPARISON OF THE PREY OF RAINFOREST-DWELLING PEREGRINES AT JOSKE'S THUMB WITH THAT OF THE URBAN-MARINE PEREGRINE IN SUVA.

PREY SPECIES.	JOSKE'S THUMB.	SUVA
Collared Petrel (Pterodroma leucoptera brevipes)	*	*S
Audubon's Shearwater (Puffinus l'herminieri)		*
Banded Rail (Rallus philippensis)		*
White-browed Rail (Poliolimnas cinereus)		*
Golden Plover (Pluvialis dominica)		*S
Wandering Tattler (Tringa incana)		*S
Bar-tailed Godwit (Limosa lapponica)		*
Black Noddy (Anous minutus)		*
White Tern (Gygis alba)		*
Booty Tern (Sterna fuscata)		*S
Crested Tern (Sterna bergii)		*
Feral Pigeon (Columba livia)		*S
Many-coloured Fruit Dove (Ptilinopus perousii)	*	*
Golden Dove (Ptilinopus luteovirens)	*	
Peale's Pigeon (Ducula latrans)	*	*
Red-throated Lorikeet (Charmosyma amabilis)	*	
Collared Lory (Phigys solitarius)	*	*
Fan-tailed Cuckoo (Cacomantis pyrrhophanus)		*
White-rumped Swiftlet (Collocalia spodiopygia)	*	
White-collared Kingfisher (Halcyon chloris)	*	*
Polynesian Triller (Lalage maculosa)	*	
Vanikoro Broadbill (Myiagra vanikorensis)	*	
Golden Whistler (Pachycephala pectoralis)	*	
White-breasted Woodswallow (Artamus leucorhynchus)		*
Jungle Mynah (Acridotheres fuscus)	*	*
Orange-breasted Honeyeater (Myzomela jugularis)	*	
Wattled Honeyeater (Foulehaio carunculata)	*	
Red-headed Parrot Finch (Erythrura cyanovirens)	*	
Flying Fox (Pteropus tonabus)	*S	
Unidentified rat species	*	

KEY : * = prey item.

S = staple prey item, 10% or more of diet.

into Suva by the thousand, and were present at all hours of day for several months. On numerous occasions I watched the falcon actively and vainly pursue Feral Pigeons when the surrounding sky teemed with clumsy flying foxes, which she completely ignored. The whole question of Peregrines killing and eating these big bats is one which will have to await further investigation in other Fiji habitats and elsewhere in Melanesia. Certainly the dispersal of a large flying fox colony in the hills near Joske's Thumb following the October 1972 hurricane, denuded the area of the bats which once swarmed there every evening, and coincided with the abandonment of Joske's Thumb as a Peregrine nesting and roosting cliff in 1973 and 1974.

It is possible that the Suva Peregrine, with a wide variety of bird prey available, was put off by the size and strength of the flying

fox, which weighs 700 g and more. While there is little doubt that a falcon the size of the Fiji Peregrine can kill and carry prey of this size if taken and bound to in flight (Clayton M. White, pers. comm.), the Suva Peregrine appeared to deliberately specialise in prey weighing between 100 - 200 g, or up to 300 g if it occurred near its feeding post. The ready availability of prey this size possibly deterred it from attacking larger and stronger animals, such as the flying fox, something it is quite physically capable of doing under less favourable conditions.

The Joske's Thumb Peregrines also took a wide range of birds, including tiny Orange-breasted Honeyeaters (*Myzomela jugularis* — 10 g) and Red-headed Parrot Finches (*Erythrura cyanovirens* — 13 g), but the Suva Peregrine never touched anything much smaller than a mynah.

Apart from two Jungle Mynah kills early in its stay in Suva, the falcon made no known attempt to attack any of the thousands of mynahs and bulbuls which were exposed to it daily, concentrating generally on birds weighing 100 g or more. The smallest birds taken with any frequency were the Collared Lory and Many-coloured Fruit Dove, both of which are fleshy, brightly coloured, and weigh 60 - 120 g. The two mynahs fall within this weight range, weighing 80 - 90 g. The Peregrine did, however, show a definite tendency towards attacking birds of this size or slightly smaller if they were relatively uncommon or unusual on her hunting range. Thus we have thousands of conspicuous mynahs and bulbuls ignored, but 5 White-collared Kingfishers, 2 Fan-tailed Cuckoos, one White-breasted Woodswallow and 4 White-browed Rails being taken within the study period. Of these the woodswallow may have been taken in anger, as they often harrassed the falcon and she was once seen to pursue and nearly catch one of three which were repeatedly diving at her, apparently in annoyance as she did not hunt that afternoon. Of the other birds, the kingfisher, while not rare in the Suva peninsula is not common, nor is it normally as exposed to Peregrine hunting methods as a mynah, while the drably coloured Fan-tailed Cuckoo is only ever present in small numbers, and very inconspicuous. Most surprising of all is the presence of no less than 4 White-browed Rails among the falcon's kills, this secretive little ground-dwelling bird never having been seen by human observers in the area most hunted by the Peregrine. The presence of Banded Rail kills could also well be attributed to this apparent attraction toward the odd and unusual, although it falls within a heavier weight range.

When the falcon first arrived in Suva she sparked off the same violent reaction among small birds as does the Fiji Goshawk, their most feared and constant avian predator. However, they soon seemed to learn that the falcon was not a danger to them, and bulbuls in particular paid no heed to her, often perching only a metre or so away from her on the GPO mast and making no attempt to mob her. Mynahs also soon abandoned their usual reaction to a hawk, which

is to gather in large groups on prominent lookouts, and swirl up en masse when it nears them. Within a few months both mynah species would give alarm calls as the falcon flew out at the target, but they made no attempt to occupy high lookouts, bunch, or take evasive action.

It is interesting to note too that the very common Malay Turtle Dove was never molested, while the much scarcer Many-coloured Fruit Dove was killed quite often. One might argue that the bright coloured plumage of this dove, the Collared Lory and kingfisher attracted the falcon to them, but this does not explain the rail and cuckoo kills, these birds being well camouflaged and normally very inconspicuous. Nor can the defensive flocking of mynahs really be seen as a deterrent factor of any importance in this regard — the Suva falcon proved herself capable of killing this species, which was also killed at Joske's Thumb, and she never hesitated to attack massed flocks of Feral Pigeons.

The large number of sea-birds killed, constituting about 34% of the prey taken, means that the falcon must commonly have hunted outside the barrier reef, and have had to carry her kills intact at least 3 km to the GPO mast to feed. To my knowledge, Audubon's Shearwaters, Collared Petrels, Sooty Terns and White Terns never venture within Suva Harbour, at least during daylight hours. The larger Crested Tern, weighing 250 - 350 g, was always easily available in the harbour, but only one was ever taken and that early in the falcon's occupation period. I never saw her pay any attention to this species. A very young male Collared Petrel recovered intact from the GPO roof weighed 119 g, and the other sea-bird prey species all fall roughly within the 100 - 250 g weight range, as do the Wandering Tattler and Golden Plover, the most common shorebird prey. The prey list reveals clearly that the falcon concentrated on birds of this size, although she would take Feral Pigeons weighing up to 300 g over the land and relatively close to the GPO mast. The Crested Terns within this weight range look much larger than Feral Pigeons, and this may have deterred the falcon from taking them even quite close inshore, with smaller prey available. With shorebirds too, the very few big Bar-tailed Godwits taken may reflect this apparent preference for smaller prey where available.

Peregrines have often been recorded hunting far out to sea; Beebe (1960: 175) mentioning that Canadian west coast fishermen see them up to 160 km from land. There are also numerous records of Peregrines joining and hunting from ships far out at sea in the annual report of the Royal Naval Bird Watching Society, the *Sea Swallow* (e.g. Tuck 1967a: 44; 1967b: 49; RNBWS 1971a: 12; 1971b: 33; Tuck 1973: 28; Casement 1974: 64). Perhaps more relevantly the island Peregrines Beebe studied commonly hunted offshore, as did the Aleutian Peregrines watched by White, Emison & Williamson (1971: 625) one of which was seen hunting 8 km offshore. There

would therefore appear to be nothing unusual in the Suva Peregrine hunting 3 km and more offshore.

Collared Petrels seem to be common in the waters off southern Viti Levu, as do Sooty Terns, both of which were killed in all months of the year, there being no seasonal peak. A Peregrine kill from Joske's Thumb misidentified earlier as *Pterodroma hypoleuca* (Clunie 1972: 315) was a Collared Petrel, and more were later discovered there. Collared Petrels were the only sea-birds known to have been captured by the Joske's Thumb falcons; and seeing one at least was probably captured over the sea, certainly being killed in the middle of the day as its blood was not fully coagulated when collected then; it seems that the Joske's Thumb Peregrines may have ventured out over the reef on occasion, returning some 9 km with their kills. The presence of the introduced mongoose *(Herpestes auropunctatus)* throughout the hills about Joske's Thumb may possibly preclude the possibility of this petrel breeding there, but this is by no means certain.

Shorebirds are common about Suva coasts and the high incidence of tattler and plover kills reflects this, by far the greater number being taken in the shorebird season, as would be expected. An interesting point is that Ruddy Turnstones, which are also quite common in the area and of suitable size, were never taken.

The presence of rails among the Suva Peregrine's kills is of great interest, as these are commonly believed to be extinct or virtually extinct on Viti Levu, thanks to the depredations of the mongoose. (Mayr 1945: 128; Mercer 1966: 4-5). Rails by all accounts are at least rare in the area, and being ground-dwelling and rarely flying are not birds which one would normally expect to be taken by a Peregrine. This particular falcon's apparent attraction to the uncommon and unusual may have had something to do with the rail kills, as was suggested earlier.

The remains of two Banded Rails were collected from the GPO roof in December 1972 and February 1974 respectively. Banded Rails are common on Nukulau and Makaluva islets in the barrier reef, over 10 km from the GPO mast and on the other side of Suva peninsula. Banded Rails in Fiji usually weigh 190 - 250 g, and while Nukulau and Makaluva could well have been within the Suva Peregrine's hunting range it is difficult to envisage the falcon carrying these weights 10 km to the GPO mast, when she could land and eat them after a considerably shorter flight to the far side of the peninsula, or could eat them on the islands. This is especially so as she would have to pass other of her hunting and feeding posts to get to the GPO mast from there. The remains of one of the Banded Rails were substantial, suggesting that it was carried whole. It is, therefore, likely that this rail species may occur reasonably close to Suva city, at least on occasion, and may possibly be taken in flight over the harbour waters from one point to another. In areas where Banded

Rails are common in Fiji they are also killed by the Fiji Goshawk and Swamp Harrier, the former being quite capable of killing birds as large as itself.

The presence of four White-browed Rail kills, collected in December 1972 and December 1974, was even more unexpected, this little rail generally being considered very rare in Fiji (Mayr 1945: 163), and on Viti Levu only being known to have survived in a single swampy area at Koronivia (Mercer 1965: 5; Morgan 1965: 163) 14 km from the GPO mast. It appears from these falcon kills that White-browed Rails survive somewhere closer to the city, possibly in the coastal mangrove swamps, which they favour in Australia (MacDonald 1973: 139). Their presence as falcon kills in Suva suggests that they may not be as rare in Fiji as previously thought.

The prey of the Suva Peregrine is of value in providing rare birds or at least birds rarely seen by human observers as skeletal or even skin specimens. It suggests that falcon feeding posts and eyries in Fiji and westward into Melanesia should be investigated wherever possible by fieldworkers. In an area where fieldworkers are so few substantial potential information would appear to be being collected by the Peregrine, particularly where hunting a marine environment, and efforts should be made to collect the evidence provided by them.

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APPENDIX I

COLLARED PETREL MEASUREMENTS

The large number of Collared Petrels *(Pterodroma leucoptera brevipes)* taken by the Suva Peregrine allowed a series of measurements of this species to be taken. These petrels range quite considerably in size, older birds certainly having considerably longer measurements and being much more heavily built, especially in regard to the feet, head and bill than those only a few months old.

Culmen: av. 24.3 mm (22.1 mm - 26.9 mm). 28 specimens.
Tarsus: av. 26.9 mm (24.1 mm - 30.6 mm). 30 specimens.
Wing: av. 212 mm (201 mm - 222 mm). 16 specimens.
Tail: 97 mm. 2 specimens,
Weight: 119 g. The weight is of a very young, lightly built male bird. Adults would certainly weigh considerably more.

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