Chapter 3

The Nesting Sites and Bee Behaviour

Physical Aspects

All the cliffs in Kaski District identified by the honey hunters in preliminary talks as sites of bee colonies were included in the survey: a total of 26 cliffs. The survey showed 20 of these to have existing or recently vacated nests, and 6 remnants of nests that had not been occupied for a considerable time. During later stages of the survey and project a few additional cliffs were identified that had, or had previously had, bee colonies, but these were not included in the formal survey and will be studied in more detail at a later date. Some cliffs at higher altitude were also omitted from the survey because of the difficulty of gaining access to them. Cliff occupation is a 'living system', as conditions change bees migrate on a longer term basis to new sites, or return to old ones, so that the number of occupied cliffs changes over time.

The details of the 26 sites in the survey are summarised in Table 3.1, including the location, altitude, cliff aspect, distance from water, distance from the ground, number of nests per cliff, cliff ownership, and surrounding vegetation. The sites were surveyed at various times from September 2000 to August 2001.

Most of the nests were located on steep inaccessible cliffs that were almost devoid of vegetation. This might be because these sites are the best places to avoid the depredations of predators such as pine martens, black bears, and monkeys. There may also be an advantage in terms of having more exposure to direct sunlight.

All of the cliffs with nesting sites were located close to rivers. Most of the cliff nesting sites lay less than 200m from a major water source; only two were located more than 500m from water. A similar pattern was observed in informal observations in Bhutan. Informal observations in Kaski indicated that similar cliffs did exist away from water, but were never inhabited by bees. The study team observed bees licking water from glacier meltwater streams, and also saw worker bees frequently visiting hot water springs close to the Dalang nesting site near Khaderjung village. These and other observations indicate that *Apis laboriosa* has a strong need for water.

Eighteen of the 26 bee cliffs faced between southeast and southwest, 5 faced east and 2 west; only one site had a slightly northern (NW) aspect, and this one had no nests at the time the study was done. The generally southerly aspect of the cliff sites suggests a need for sunshine. There are various likely reasons for this, the warmth itself could be useful for the nests and may facilitate flying and reduce energy consumption. At the same time, a southeast or southwest aspect prolongs the photoperiod and thus the length of day for foraging.

The bees appeared not to be particularly disturbed by noise. The Lamakhet nesting site (site 14) is located right next to a busy footpath. Similarly there are well-known bee nesting sites at Kodari next to the busy China-Nepal highway, and along Bhutan's main highway.

The general vegetation type surrounding each of the sites is summarised in Table 3.1. The mountain areas where the bee is found are covered with a variety of vegetation including rhododendron dominated mixed forest, pockets of pristine dense forest, riverine forest, and newly planted alder dominated forests. The common factor is that they provide sufficient forage to enable the bees to survive in an essentially highly competitive environment, where survival of the fittest is the law governing ecosystem function. The presence of *Apis laboriosa* is itself an indicator of environmental health as the bee requires enormous supplies of nectar, water, and pollen to survive (Ahmad and Roy 2000).

The sites in the survey were all at around 2000m, except for those used for winter migration some of which were at altitudes as low as 1100m. This is considerably lower than the nesting site altitude of 2500 to 3100 masl for the Himalayas overall reported by Roubik et al. (1985) and Valli and Summers (1988) .

Similarly positioned cliffs were observed that had no indication of bee nests. It seems likely that the composition of the rock also plays a role in the selection of nesting sites but this was not investigated in this survey. One honey hunter, for example, indicated that aggregation of salts on a cliff face had changed the colour and also made the cliffs inhospitable for the bees. These types of indications will be followed up in later studies.

Seasonal Migration

General observations made during the survey indicated that the bees followed two distinctly different migration cycles depending on the valley in which they were located. One migration pattern was to nest during the winter on cliffs at lower altitude, and then migrate in the summer to different cliff nesting sites at higher altitude. Other bees remained at high altitude throughout the year, but left the cliff nesting site in winter for more protected areas at the base of the cliff, under fallen logs, at the base of overhanging trees, or similar. This appeared to be the preferred option when there was no appropriate nesting site further down the same valley and had various advantages compared to remaining high on the cliff face including, for example, that the bees use less energy to fly to water and are closer to any plants that are still producing forage – although these are rare (Table 1.3). In general, it seemed that bee colonies were very unwilling to cross a ridge divide to another valley. The details of these patterns are still unclear and will be studied in more detail in follow-up studies. Table 3.2 summarises some of the observed seasonal movements of bees within different valleys.

Table 3.1: The *Apis laboriosa* nesting sites in Kaski district

SN	Cliff name	Longitude/ latitude	Approx. altitude[1] (masl)	Cliff aspect	Distance above ground	Distance from water	No. of nests[2]	Ownership of cliff	Nearest settlement	Vegetation type and bee flora
1	Sodque Bhir	84°04'.359E 28°20'.161N	2000	SE	200m	200m	37 (o) 10 (e)	Owned collectively by ward 6 of Parche VDC	Malakuna village	Common plants *Colebrookea oppositifolia, Alnus nepalensis, Plectranthes mollis, Kapium insigne, Bauhinia spp, Maesa chisia, Coriaria nepalensis, Lyonia ovalifolia, Cedrela toona, Buddleia spp,* and *Schima wallichi*; rich ground vegetation dominated by *Eulaliopsis binata, Eupatorium,* and *Saccharum spp*. Sparse distribution of *Zizyphus spp, Rubus spp, Berberis spp, Woodfordia fruticosa,* and *Artemisia spp*, area of riverine forest dominated by *Bombax malbaricum* about 500m from the cliff
2	Kamro Bhir	84°06'.912E 28°22'.776N	2000	SE	150m	200m	27 (o) 11 (e)	Owned collectively by ward 7 of Parche VDC	Sikles village	Rhododendron dominated dense forest composed of *Rhododendron arboreum, Arundinaria falcata, Cedrela toona, Ficus spp, Alnus nepalensis, Maesa chisia,* and *Lyonia ovalifolia*; ground vegetation dominated by many different grass species in association with *Fagopyrum spp, Primula spp,* and *Cyathea spinulosa*
3a	Chadque Keugha, Sini Khersai Bhir (adjacent to 3b)	84°06'.928E 28°23'.227N	2000	SW	150m	300m	13 (o) 3 (e)	Owned collectively by ward 6 of Parche VDC	Sikles village	Dense virgin forest (little disturbed by humans) with *Elaegnus spp, Leucoceptrum spp, Colebrokia spp, Rhododendron spp., Cedrela toona, Ficus spp, Alnus nepalensis, Prunus cerrasoides,* and siasi (local name); ground vegetation dominated by daree ghas grasses, *Urtica dioica, Girardinia diversifolia,* and *Cyathea spinulosa*
3b	Chadque Keugha, Sini Khersai Bhir (adjacent to 3a)	84°06'.928E 28°23'.227N	2000	SW	150m	300m	4 (o) 2 (e)	Owned collectively by ward 6 of Parche VDC	Sikles village	Directly adjacent to 3a
4	Biura Pro, Biura Pro Keira	84°06'.687E 28°23'.927N	2000	E	90m	150m	17 (o) 1 (e)	Owned collectively by ward 7 of Parche VDC	Sikles village	*Alnus* dominated forest with a few *Aesculus indica, Ficus spp, Leucoceptrum sp, Colebrokia spp, Buddleia* spp and *Rubus spp*; marshy ground vegetation dominated by *Fagopyrum spp* and *Polygonum hydropiper*
5	Thama Thera	84°07'.102E 28°24'.462N	2000	SW	70m	650m	2 (o) 6 (e)	Owned collectively by ward 5 of Parche VDC	Sikles village	*Alnus* dominated forest with a few trees of *Ficus spp, Maesia chisia, Buddleia spp,* and *Rubus spp*
6	Dhoya Quincha	84°07'.102E 28°24'.462N	2000	SW	60m	100m	4 (o) 3 (e)	Owned collectively by ward 5 of Parche VDC	Sikles village	*Alnus* dominated forest with a few trees of *Ficus spp, Maesia chisia, Buddleia spp,* and *Rubus spp*
7	Ligha Quira[4]	84°07'.258E 28°25'.656N	2000	SE	30m	60m	6 (e)	Owned collectively by ward 8 of Parche VDC	Sikles village	Mixed forest transitional between *Alnus* forest in the river valley and *Cedrus deodara* at the top of the hill; dominated by *Rhododendron spp* and *Aesculus indica*
8	Pli Quira	84°08'.251E 28°25'.800N	2000	E	60m	120m	8 (o) 32 (e)	Owned collectively by ward 6 of Parche VDC	Sikles village	Mixed (virgin) forest dominated by *Rhododendron spp* and *Aesculus indica* in association with *Alnus nepalensis, Ficus spp, Rubus spp., and Berberis spp*
9	Karshidhu[4]	84°08'.082E 28°25'.880N	2000	NE	30m	200m	5 (e)	Owned collectively by ward 6 of Parche VDC	Sikles village	Mixed (virgin) forest dominated by *Rhododendron spp, Aesculus indica, and Quercus spp* in association with *Alnus nepalensis, Ficus spp, and Rubus spp*
10	Pli Quira[4]	84°08'.082E 28°25'.880N	2000	S	60m	120m	11 (e)	Owned collectively by ward 6 of Parche VDC	Sikles village	Mixed (virgin) forest dominated by *Rhododendron spp* and *Aesculus indica* in association with *Alnus nepalensis, Ficus spp, Rubus spp, and Berberis spp*
11	Kaula Shoi Koira[3]	84°08'.087E 28°25'.877N	2000	E	200m	500m	10 (e)	Owned collectively by Ward 5 of Parche VDC	Sikles village	Mixed forest dominated by *Rhododendron spp* and *Arundinaria falcata* in association with *Aesculus indica, Acer spp, Cinnamomum spp,* and *Berberis spp*; ground vegetation rich in *Ranunculaceae (mainly Anemone), Fragaria spp, Primula spp,* and *Skimia fragrans*
12	Pla-ra Koira[3]	84°05'.699E 28°25'.280N	2000	E	50m	500m	nr	Owned collectively by Ward 6 of Parche VDC	Sikles village	Mixed forest dominated by *Rhododendron spp* and mountain bamboo (*Arundinaria falcata*) on the top of the cliff and by *Alnus nepalensis* and *Ficus spp* on the riverbank
13	Ghaya na Koira	84°06'.787E 28°23'.985N	2000	E	50m	1000m	1 (o) 6 (e)	Owned collectively by Ward 7 of Parche VDC	Sikles village	Mixed forest with *Rhododendron spp, Arundinaria falcata, Magnolia champaca, Michelia kisopa,* and *Cinnamomum spp*
14	Kangro Bhir, Taprang Bhir	84°05'.371E 28°17'.134N	1100	SE	10m	200m	8 (o) 6 (e)	Owned by Taprang village (kinship group)	Lamakhet	Moist and mossy hanging vegetation on the cliff; *Bombax spp, Woodfordia spp, Kapium insigne, Butea monosperma, Rhus succedanea, Rubus spp, Berberis spp* around the cliff; rice, maize, and wheat nearby

Table 3.1: **The *Apis laboriosa* nesting sites in Kaski district (cont'd)**

SN	Cliff name	Longitude/ latitude	Approx. altitude (masl)	Cliff aspect	Distance above ground	Distance from water	No. of nests	Ownership of cliff	Nearest settlement	Vegetation type and bee flora
15	Maha Bhir[1]	83°41'.477E 28°18'.948N	1900	NW	30m	500m	nr	Owned by Tomejung village of Lumle VDC	Tomejung	*Juglans regia, Ficus spp, Pyrus pashia, Rubus spp, Berberis spp, Pyracantha crenulata* and other fruit trees
16	Sobrok[2]	83°49'.879E 28°25'.433N	1900	SW	30m	30 m	nr	Owned by ward 9 of Ghandruk VDC	Dauło and Teļje	*Michelia kisopa* dominated forest with *Cinnamomum spp, Machilus spp, Quercus spp, Rhododendron spp, Arundinaria falcata, Maesa chisia, Rubus spp, Mahonia nepalensis, Erythrina stricta, Ficus auriculata, and Polygonum hydropiper*
17	Obio[3]	83°49'.879E 28°25'.433N	2200	SE	200m	200m	nr	Owned by ward 9 of Ghandruk VDC	Chhomrong	*Michelia kisopa* dominated forest with *Cinnamomum spp, Machilus spp, Quercus spp, Rhododendron spp, Arundinaria falcata, Maesa chisia, Rubus spp, Mahonia nepalensis, Erythrina stricta, Ficus auriculata, and Polygonum hydropiper*
18	Kuti Bhir[3]	83°49'.721E 28°25'.207N	2200	SE	30m	30m	16 (e)	Owned by Dauło villagers, Chhomrong	Dauło and Teļje	*Michelia kisopa* dominated forest with *Cinnamomum spp, Machilus spp, Quercus spp, Rhododendron spp, Arundinaria falcata, Maesa chisia, Rubus spp, Mahonia nepalensis, Erythrina stricta, tusaro, Ficus auriculata, and Polygonum hydropiper*
19	Silasi Bhir, Chhomrong Bhir	83°49'.513E 28°25'.155N	2200	SW	50m	120m	8 (o) 2 (e)	Owned by Chhomrong village	Chhomrong	*Cinnamomum* and *Machilus spp* dominated forest with *Michelia spp, Juglans spp, Quercus spp, Rhododendron spp, Buddleia spp, Plectranthes spp, Elaegnus spp,* and *Arundinaria spp*
20	Chakrevra, Chanedhar[3]	83°48'.684E 28°25'.300N	2200	SE	50m	200m	nr	Owned by Chhomrong village	Chhomrong	*Cinnamomum* and *Machilus spp* dominated forest with *Michelia spp, Juglans spp, Quercus spp, Rhododendron spp, Buddleia spp, Plectranthes spp, Elaegnus spp,* and *Arundinaria spp*
21	Khuldi Bhir[3]	83°50'.780E 28°26'.681N	2200	SE	30m	300m	nr	Owned by ward 5 of Ghandruk VDC	Chhomrong	*Rhododendron* dominated temperate forest with *Machilus spp, Acer spp, Colebrookia spp, Quercus spp, Rhododendron spp, Plectranthes spp, Elaegnus spp,* and *Arundinaria spp*
22	Ruhinabei	83°49'.771E 28°26'.209N	1600	W	25m	150m	3 (o) 1 (e)	Owned by Landruk village	Chhomrong	*Quercus* dominated forest with *Elaegnus spp, Michelia spp, Cinnamomum spp, Rhododendron spp, Juglans spp, Buddleia spp, Alnus nepalensis, Arundinaria spp* and *Machilus spp*
23	Kroja Bhir	83°49'.221E 28°22'.405N	1600	W	20m	20m	20 (o)	Owned by forest user's group, Landruk village	Landruk	Settlement area on one side with *Citrus spp, Musa paradisica, Pyrus spp, Prunus spp, Rubus spp, Berberis spp,* and *Artimisia spp*; mixed forest on the other side of the river with *Alnus spp, Plectranthes spp, Ficus spp, Quercus spp, Prunus cerasoides, Maesa chisia, Lyonia ovalifolia,* and *Michelia kisopa*
24	Tamu Khark	83°44'.026E 28°20'.362N	1500	S	30m	30m	12 (o)	Owned by forest user's group, Jiltbarang	Jiltbarang	*Prunus cerrasoides, Rubus spp, Berberis spp,* and *Pyracantha crenulata*
25	Chimro Bhir	84°00'.160E 28°20'.648N	1100	SW	25m	150m	7 (o) 2 (e)	Owned by honey hunting group, Khaderjung village	Bhurjung khola	Dense broadleaf forest disturbed by tree cutting; *Quercus spp, Machilus spp, Acer spp, Elaegnus spp, Ficus spp, Rubus spp* and *Berberis spp*; ground vegetation marshy with *Marchelia conica, Chilanthes grise,* and other ferns and mushrooms
26	Dalang	83°58'.801E 28°20'.729N	1100	SW	150m	200m	5 (o)	Owned by honey hunting group, Khaderjung village	Khaderjung	Dense forest of medium-sized trees and shrubs; *Quercus spp, Machilus spp, Acer spp, Elaegnus spp, Rubus spp, Berberis spp*; rice, maize and vegetables nearby; fodder trees such as *Ficus spp* along field edges

[1] Approximate altitude calculated from the altitude recorded in the MASIF mapping system and the GPS location

[2] o = occupied; e = recently empty (migrated bees); nr = only old nest remnants

[3] Bees have left the site; active or very recently empty nests (migrated bees) not found at the time of study (shaded)

[4] No nests with bees at the time of study, seasonal migration likely

Table 3.2: Arrival, Departure and Honey Hunting Time of *Apis laboriosa* Colonies in Kaski					
Nesting area	**Approximate altitude**	**Cliff list number[1]**	**Approximate arrival time**	**Approximate departure time**	**Honey hunting time**
Seti Valley					
Ghachowk[2,3]	1150m	None	September	January	December
Madi Valley					
Sikles and Parche	1980m	1, 2	February	June	May
Hoku	2000m	3a, 3b, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,	April	October	September
Lamakhet	1100m	14	February and October	May and December	April and November (twice in a year)
Modi Valley					
Ghandruk	1940m	15, 16,	February/ March	September/ October	September
Chhomrong	2170m	17, 18, 19, 20, 21,	February/ March	September/ October	September
Landruk	1565m	22, 23,	February/ March	September/ October	September
Sardi Valley					
Khaderjung[3]	1100m	25, 26	September	January	December

[1]Site 24 not included as an isolated nesting site
[2]This winter nesting site was identified after the formal survey had been carried out and is not included in Table 3.1
[3]The summer nesting sites for these colonies have not yet been located

Predation

According to the honey hunters, and also the team's observations during the survey, the bees' main predators appear to be hornets, birds, bears, monkeys, squirrels, lizards – and human beings. Hornet nests were observed at *Apis laboriosa* nesting sites and on adjoining cliffs. The hornets were seen to attack *Apis laboriosa* both while they were in flight and while they were foraging. The *Apis laboriosa* bees were observed to spend much less continuous time feeding on a flower than other honeybee species – it was, for example, extremely difficult to photograph them feeding as their alighting time was so short. This suggests that they may be wary about being attacked.

A particular type of bird that we could not fully identify was seen to heavily predate *Apis laboriosa*. The bees' speed and manoeuvrability could not save them from these birds. This bird ate flying bees and also attacked nests. The bees reacted by raising their abdomens in concert in a group to create a series of 'bee waves', in a similar manner to the waves created by football crowds. The continuity and beauty of this bee wave was recognisable whenever bee nests were attacked. The study team also saw monkeys feeding on brood combs and abandoned honeycombs. Fallen bees and their brood are eaten by squirrels and lizards, and are taken away by ants. Bears are only able to predate relatively accessible *Apis laboriosa* nests.

Declining Nest Numbers

Although it is difficult to obtain accurate information, there are clear indications that the number of colonies of *Apis laboriosa*, and presumably the total population, is on the decline. In 1986 Benjamin Underwood published a list of *Apis laboriosa* cliffs that he had identified in Kaski. During and after the 2001 survey we revisited the eight cliffs he had identified and looked for indications of bee nests. Four of the eight sites had no nests at all, one had only two colonies, compared with 76 in 1986, one had 16 sites where there had been 26, but all were empty, and only two had similar numbers of nests to those recorded earlier. The honey hunters identified three other cliffs that had contained large number of colonies earlier and were now devoid of nests, and a further four that only had abandoned nest remnants. These observations are summarised in Table 3.3. Similar observations were reported by local people and honey hunters in all the areas of Nepal investigated during the preliminary survey.

General observations around the cliffs that were now devoid of colonies indicated certain features that provide some clues about the reasons for the decline.

In some areas land degradation and soil erosion (intensified by land use change and the stripping away of forest and ground cover) had impacted heavily on the shape of cliffs. One cliff at Lamakhet had been partially destroyed as a result of faulty construction of a tourist trail. Deforestation also appeared to have affected water flows in some parts. Previously dry cliffs were exposed to storm water flows where forest cover had been removed and there was increased runoff. Bees never feel secure enough to nest on cliffs over which storm water flows occur.

Table 3.3: Declining populations of *Apis laboriosa* on some cliff sites in Kaski

Location of the cliff	Cliff list number	Cliff face	Altitude (masl)	Distance from the ground (m)	Number of Colonies	
					1986[1]	2001[2]
Tomejung, Lumle VDC 2	15	NW	1616[3]	30	11	nc
Landruk, Lumle VDC 9	23	SW	1250[3]	20-30	17	20 (o)
Kuli Chhomrong, Ghandruk VDC 9	18	S	1708[3]	30	26	16 (e)
Obio Chhomrong, Ghandruk VDC 9	17	S	1647[3]	60	14	nr/nc
Khuldi Chhomrong, Ghandruk VDC 5	21	SE	2226[3]	20	10	nr/nc
Silasi Bhir Ghandruk VDC	19	SE	1860[3]	150	15	8 (o) 2 (e)
Ghachowk Machhapuchre VDC[4]	-	E	1220[3]	15-60	76	2 (o)
Ghachowk Machhapuchre VDC[4]	-	SW	1400[3]	15-30	13	nr/nc
Sobrok, Pache-9, Daulu village	16	SW	1900[5]	30	NA	nr/nc
Pla-ra Koira, Parche-6	12	S	2000[5]	50	NA	nr/nc
Chaknevra/Chanedhar, Chhomrong	20	SE	2200[5]	50	NA	nr/nc
Ligha Quira, Parche-8	7	SE	2000[5]	30	NA	6 (e)
Karshidhu, Parche-6	9	NE	2000[5]	30	NA	5 (e)
Pil Quira, Parche – 6	10	S	2000[5]	60	NA	11 (e)
Kaula Shoi Koira, Parche-5	11	E	2000[5]	200	NA	10 (e)

[1] cited from Underwood (1986)
[2] nr/nc - no indication of active colonies, in most cases old nest remnants visible; o – occupied nests; e - recently empty nests
[3] altitude as cited in Underwood (1986)
[4] nesting sites identified after the formal survey had been carried out, not included in Table 3.1
[5] calculated approximate altitude

Mass of bees on the nest surface

Predators and prey: hornet nest (green oval) adjacent to Apis laboriosa nests (red oval)

A more dramatic problem appeared to be an overall loss of forage opportunities. There were two main reasons for this. The first was that in many areas there had been marked changes in land use, with conversion of previously pristine areas to farmland, mainly for cultivation of rice and maize. It appeared that wherever possible people tried to transform every piece of pristine land they owned into rice fields. This inevitably results in a reduction in the supply of nectar and pollen. The second was the slow change in forest composition following the introduction of easily cultivable species like *Alnus* and *Ficus*. One example was seen at a cliff belonging to Ghachowk village, which according to the honey hunters had hosted as many as 120 colonies six years before and now had none (not included in Table 3.3). The area around this cliff used to be covered in mixed broadleaf forest with many *Ziziphus* plants and bushes which provided a major source of nectar and pollen for the bees. The forest has been completely cleared and the area is now planted with rice. The same trend was evident at Tomejung (site 15), and in other areas like Taprang where fewer nests were found. A number of honey hunters and other local people reported that there had been a decrease in the productivity of the major nesting sites, which might be explained at least partially by the loss of forage. It seems that although *Apis laboriosa* has a larger foraging radius than many insects, this is not sufficient to compensate for the massive loss of foraging opportunities.

These and other possibilities are discussed further in Chapter 6.

Infrastructure vs. Bees

Lamakhet cliff used to be a major attraction for those who liked to hunt honey and who enjoyed watching bees. Recently a tourist track was constructed and the cliff site was partially destroyed; the number of bee colonies decreased significantly as a result. Our observations suggest that it would have been possible to construct the track without physically disturbing the cliff site, but the local construction managers were not aware of the appropriate techniques, or of the damage they would cause and the broader implications. Now tourists find it easier to walk up and down the Annapurna circuit, but at what environmental cost?